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Student Projects Catalogue 2020-21

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Polytech Orléans

Polytech Orléans

Ecole Polytechnique de l'université d'Orléans

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Message from the Director

One essential element of the activities of any engineering school is the maintenance of partnerships with businesses and institutions in the local community and beyond. Thanks to its close ties to such organizations, Polytech Orléans can guarantee the employability of its graduates (of which 90% find a first job within three months of receiving their degree), accurately adapt its programmes to respond to the changing needs of the business and scientific community, and acquire the most up-to-date equipment, materials and software.

Our partners also benefit from these exchanges by receiving high-level scientific expertise as they welcome hundreds of our students in internships each year and avail themselves of the educational facilities and equipment we can provide.

To prepare for their entry into the professional world, fifth-year students at Polytech Orléans are required to prepare and complete a project according to the specifications established by an engineer working in the field. For Polytech, these projects validate the body of technical and managerial competencies acquired by students during their years in our programme. For our industrial partners, the students' projects permit them to test systems, confirm new ideas, and create prototypes, among other valuable research outcomes.

Publishing a yearbook that brings together in one volume the overviews of all fifth-year industrial projects is a concrete way of presenting the entirety of the fields of activity in which graduate engineers of Polytech Orléans will work. It is also a way for our business partners to evaluate the assistance which Polytech can bring to them. Our ambition is to highlight the achievements realized in collaboration with businesses and institutions and to encourage development of new industrial partnerships.

Christophe Léger
Director, Polytech Orléans

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Civil Engineering

3D mapping of the accuracy of a laser survey, applied to the cathedral of Orleans

Civil engineering

F. SILOTIA

G.TUNIS

Florent SILOTIA / Guillaume TUNIS
Academic supervisor: L. JOSSERAND, X. BRUNETAUD

Institution: Fédération Archéologique du Loiret

Selected Participant
15th Annual Final Year Projects Forum

Objective/motivation

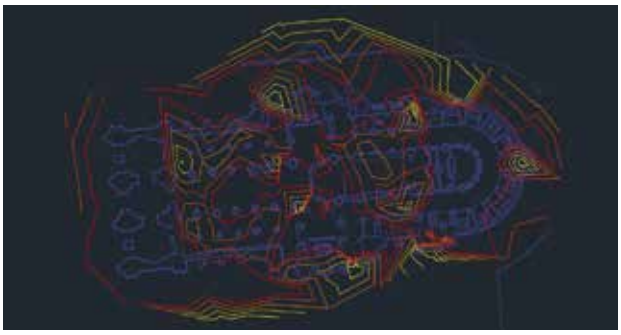
The objective of this project is to study the accuracy of a 3D laser survey of the cathedral of Orleans. After several scanning campaigns, it has been noted that some areas were inaccurate. This project consists of the creation of a 3D map showing the variation of precision around the cathedral. This 3D map will allow us to identify inaccurate areas. It will also help to define the positioning of future scanning campaigns. The positioning of the laser stations has a decisive effect on the accuracy of a scan. Once this work is completed, it can be used by architects to draw more precise plans. The final objective of the project is to help architects to define their future renovations plans. This 3D map may also be used to investigate the accuracy of other 3D laser surveys.

Results

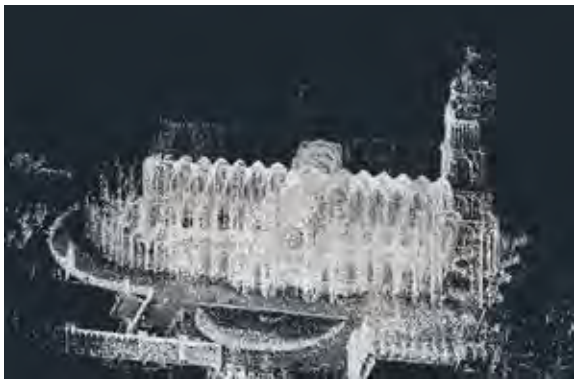
At first, we went to the Cathedral to complete the 3D laser survey. We used a laser scanner. After assembling all the scans on the Recap software, we retrieved all the precision data from the stations. The work carried out was developed on the basis of two hypotheses. To begin with, we assumed that the accuracy of a station was at its center. By studying the basic precision indicators given by Recap, we were able to draw a 3D map. To do this, we constructed a numerical field model and then level lines to identify areas of inaccuracy. The use of both raw and standardized data allowed us to refine these maps. Later, we started studying an effect called quilting. It is the study of the positioning difference of the points of two juxtaposed scans.

cathedral plan

Keywords: 3D mapping, cathedral, accuracy



Laser survey of the cathedral of Orleans



3D map of the accuracy

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3D modeling of the Cathedral of Orléans, for structural analysis of old buildings

Civil engineering

A. RANWANGONNAGE

A. WÉRY

Amandine RANWANGONNAGE / Anaëlle WÉRY
Academic supervisor: L. JOSSERAND, D. HOXHA

Institution: Fédération Archéologique du Loiret

Objective/motivation

The goal of the main project is to digitise the whole building in order to remember its original shape if any problem would appear and to model the whole cathedral as an object that can be analyse by a structural software.

Having this 3D-model allow us to analyse further the structure, its behaviour and deformations… and to simulate many situations (like fires) in order to establish evacuation plans for example.

We chose this project because we wanted to have a better understanding of the behaviour of old constructions before the beginning of our internships in building renovation, a field we are really interested in.

Flying buttress considered

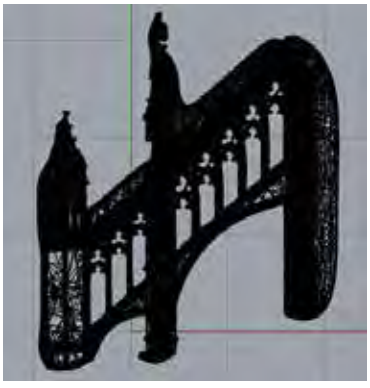
Results

We were able to model the 3D structure that allow us to analyse the deformations of the flying buttress. The project was only achievable with software and numerical tools. This is one of the reasons why we chose this project. Unfortunately, due to quarantine and problems with computer access, only a flying buttress was analysed.

So we started by cleaning the data got from the laser scans (removing isolated points, reducing the amount of points by square centimetre…). Then we meshed the obtained point cloud few times in order to finally get an object. When it is created, we can apply loads and see the distribution, which is the goal of the project. But this procedure needs a lot of manual manipulations, so we were trying to automatise the process in order to apply it to the whole cathedral.

Keywords: 3D-modeling, cathedral of Orleans, structural analysis, French heritage

Flying buttress as a point cloud, view from above



Flying buttress meshed on Rhino

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Application of digital tools to the analysis of the stability and optimization of the design of concrete structures

Civil engineering

M. GHIZLAN

G. TSIGAIN TCHOUMTCHOUA

Mohamad GHIZLAN / Georges TSIGAIN TCHOUMTCHOUA
Academic supervisor: D.P. DO

Institution: LaMé Laboratory

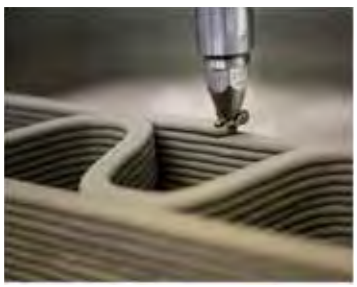
Objective/motivation

stability of a construction element in printing 3D concrete.
Modeling of a structural element using CAO software.
Mesh of this structural element using CAO software.
Importing the mesh of the structural element into analysis software.
Analysis of element stability during printing and commissioning.

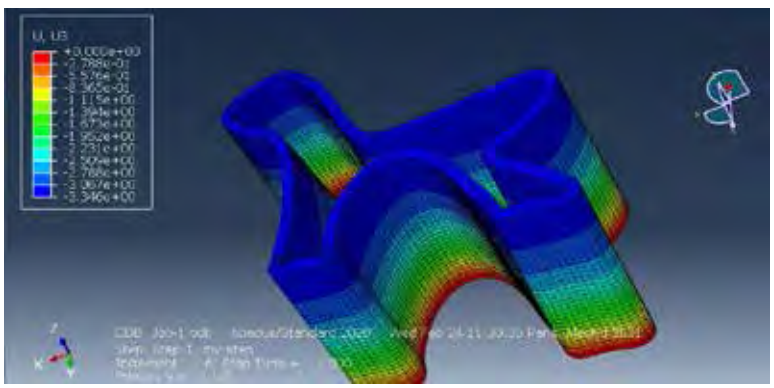
Results

The modeling of the structural element of our project is quite simple, however given the complexity of the models generated by the Rhino CAD software we must verify during the modeling that all the poly surfaces created form a solid. closed that can be defined as a volume.
Once the model is created, we are unable to transfer its mesh to the Rhino software to launch the analysis. This is why we are going to export only the solid model and perform a mesh of this model again in the ABAQUS software before performing its analysis.

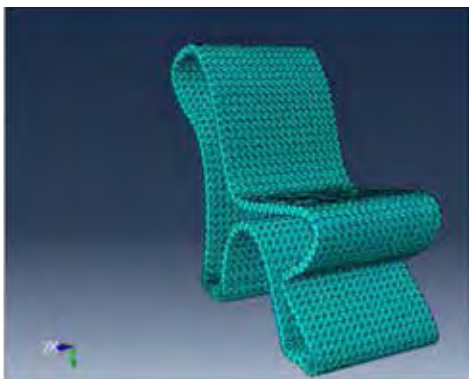
Keywords: Stability of a construction element in printing 3D concrete



Extrusion



Numerical simulation



Mesh

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Automated Quality Assessment of Prefabricated Culverts

Civil engineering

Manideep Reddy KANCHERLA
Academic supervisor: S. REMOND
Industrial supervisor: S. BOIVIN

Company: LafargeHolcim Innovation Center

Objective/motivation

The primary objective of this project is to verify the theoretical advantages automated quality assessment could have over manual inspection through practical applications. Therefore, the project revolves around finding the most cost effective software and hardware options without any compromise on quality and operational efficiency using a practical application: Prefabricated Culvert. We will make use of data sources available on the market like LiDAR (3D Laser Scanners) , Photogrammetry, and Laser Trackers, etc. to generate a 3D point cloud. Later on, we will explore different solutions for automation like a 3D scanner attached to AI enabled mobile robots. Furthermore, the data collected through these multiple sources require efficient software to integrate it with the CAD model of the as-designed culvert for tolerance analysis. Therefore, we are partnering with Alteia, a software platform provider for visual intelligence using AI.

Keywords: LiDAR, photogrammetry, tolerance analysis

Culvert on site for experiments

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Calculation tool for building thermal consumption considering the active system

Civil engineering

F. BERTON

V. SCHOTTEY

Fabien BERTON / Victor SCHOTTEY
Academic supervisor: N. BELAYACHI

Institution: Academic, Polytech Orleans

Selected Participant
15th Annual Final Year Projects Forum

Objective/motivation

The aim of the project is the improvement of an excel calculation sheet for house consumption. We have to make it efficient and easy-to-use for someone who doesn't have any knowledge in the field of construction. This excel sheet must be in line with the French thermal building regulation (RT 2012) and will be used for both new building and renovation. Once this will be done, we will use it to test the efficiency of different insulation materials including eco-materials (Sheep Wool, straw, expanded cork...). The last step is to find a compromise between price, choice of materials, consumption, and comfort for renovation of old houses.

Results

We created the Excel sheet as expected, the user fills out 5 sheets and there is a last sheet with a summary and a rating of the building according to the thermal regulation. We made a user manual to explain the functionalities and the details. The calculation takes into consideration:

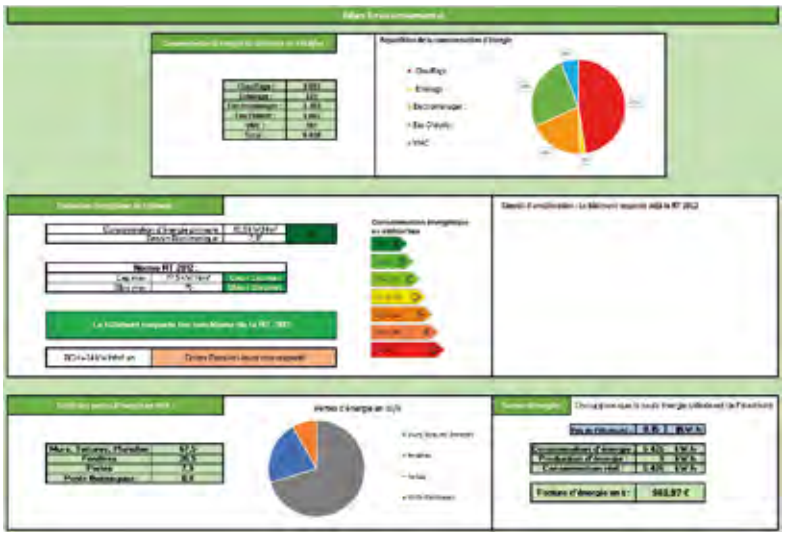
- Thermal losses through the walls, the roof, the floor, the windows, and the door
- Thermal bridges
- Passive solar gains and internal heat gains
- Ventilation, heating and domestic hot water

The result sheet gives some information: an estimation of the total energy consumption, some advice to reduce this consumption and the annual price in energy.

Thermal regulations 2012

Keywords: Eco- materials, excel, energy consumption, thermal regulation

Bio-based Materials



Results

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Characterization and modeling of the concrete cone failure of a headed stud during a pull-out test

Civil engineering


V. TIAGO BRONZATTO


Z. ZHOU

Vítor TIAGO BRONZATTO / Zhengjie ZHOU
Academic supervisor: D. HOXHA
Industrial supervisor: M. N. ROBSON

Institution: Centre Scientifique et Technique du Bâtiment

Selected Participant
15th Annual Final Year Projects Forum

Objective/motivation

For anchoring external loads to concrete structures, use of headed studs is one of the common technics as it allows to transfer high loading level. The resistance of a headed stud relies on the mechanical interlock between its head and the surrounding concrete. When subjected to tensile loading, the two most frequent failure modes are steel failure and concrete cone failure. This latter consists of the extraction of a cone shaped concrete portion due to circumferential stresses emanating from the anchor head. This project aims at contributing to the comprehension of this failure mode by analyzing the typical failure cones obtained after pull-out tests.

Results

A full set of pull-out tests on single-headed studs embedded priorly to the concreting were performed following a DoE program. During these, the displacements and pull-out forces were recorded as well as a visual monitoring. After each test, the resulting cone was recovered. Using a set of photos, taken following photogrammetry rules, it is possible to obtain a detailed 3D numerical model of the cone. This model was used to study various characteristics of the failure surface such as its shape, rugosity and curving during failure process. For the simplest case, when the failure surface is described as a circular conical surface, it was found that upper and lower bounds of inclination angles are situated between 22,2° and 32,8°. The future work consists in connecting the design factors and the failure features.

Keywords: concrete cone resistance, chemical fixation, pull-out test, surface equation, photogrammetry


Concrete rupture cone obtained from a pull-out test


3D model of a concrete rupture cone obtained using photogrammetry


Autocad model of a concrete rupture cone


Pull-out test with the hydraulic jack at the CSTB


Displacement measuring during a pull-out test


Resulting concrete slab after removal of cones

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Contribution to the method for the constitution of a prefectoral decree for the protection of sites of geological interest

Environment engineering


F.BELLOEUVRE


C. LY

Fanny BELLOEUVRE / Camillia LY
Academic supervisor: C. DEFARGE
Industrial supervisor: S. LEGAL

Institution: Luberon regional nature park

Objective/motivation

Our project is in collaboration with the Luberon regional geological park. We interact with Stephane Legal the person in charge of the project.

This project was found by the student Fanny Belloeuvre as she was looking for a caesura project. That is why we do not interact with a Polytech's teacher.

We are two students working on this: Fanny Belloeuvre and Camillia Ly.

The project started in September and will end in March. We have two weeks projects every month.

We have been asked to create a selection list and to establish the method of site selection for this list, in order to present a list of parks eligible for a prefectoral decree for the protection of geotops

Plus, after making this list, we have now to draw up scientific data sheets of the selected sites. Then, we started writing down all the information regarding the chosen sites, which are the scientific sheet. We are now rewriting these sheets in order to present an official document, that will be used when they will ask some juridic protection around those sites.


Triclavel Viens quarry

Results

To classify them and obtain the list of choosen sites, we decided to class them according to the marks they get in various categories, which are:

- The number of stars, which goes from 0 to 3, and 3 means that there is no juridic protection on the site
- Patrimonial interest which is a kind of average over 48
- The effective protection, which goes also from 0 to 3, with 0 which means that there is strong protection around the site and 3 that means that there is a lack of protection around the site
- And the need of protection


Crocodile skull

For the second part of our work, we have to draw up scientific sheets. The important information that we may found in the notes that we wrote are about:

- The identification
- The localization
- The general description
- The collections that we can found on the site
- The accessibility
- The geologic description
- The interest
- The effective protection
- The needed of protection/ the vulnerability
- And the final evaluation of the site, which are grade on:
  - o The patrimonial interest, which is a grade over 48
  - o And the needed of protection, which is grade over 12

Keywords: protection, geotopes, prefectoral, scientific, data

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Development of an excel sheet that calculates the maximum capacity of tensioned angles attached by a single leg

Civil engineering

Mathilde LEFEBVRE
Academic supervisor: N. BELAYACHI
Industrial supervisor: F.-L. MARIN

Company: Baudin-Châteauneuf

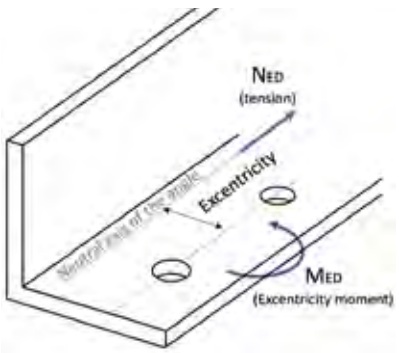
Objective/motivation

During my year of completing a professionalization contract in the calculation pole of the departement of metallic buildings and special structures of the company Baudin Châteauneuf, I had the opportunity to work on the revision of the Excel calculation sheet used to determine the maximum capacity of a tensioned round-edge equal leg angle attached by a leg. These elements are frequently used in bracing systems such as St. Andrew's crosses for example. The transverse forces due to the eccentricity moment caused by the asymmetry of the connection were not taken into account in the Excel sheet, so the purpose was to improve it to make the calculations more accurate.

Results

A method had to be found to integrate these calculated forces with the verifications required by the Eurocodes, but another part of the work was to simplify the use of the sheet and to improve its graphic presentation. The sheet now takes into account all the forces, but also allows us to make the same verifications for round-edge inequal leg angles, which was not the case before. The user now simply has to select the angle he wants to use from a catalog, from which angles can be added, and to enter the arrangement and the number of bolts he wants to use for his connection. A VBA code was used to display the right number of bolts on the Excel sheet, according to the user's choice.

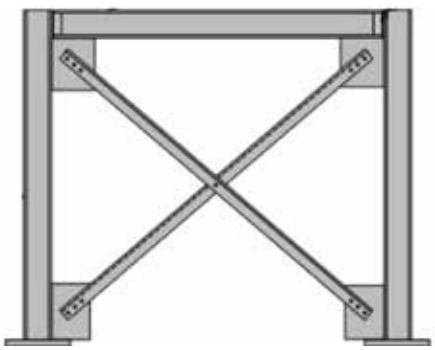
The development of this sheet enabled the creation of a compilation of so-called standard connections for equal and inequal leg angles, to have the most optimal bolt arrangements for the most common angles rapidly, according to the tensile force acting on the connection



Shear and moment representation

Keywords: Calculs, excel, equal and inequal angle, VBA

Drawing of the connection with angle calculated by the Excel sheet



Example of the use of angles attached by a leg on St. Andrew's cross bracing

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Diagnostic and development of the hamlet of Villiers-le-Bois

Civil engineering

Y. HENINI

C. NGOUAKA

Youssef HENINI / Christ NGOUAKA
Academic supervisor: X. BRUNETAUD
Industrial supervisor: M. ROTAT

Selected Participant
15th Annual Final Year Projects Forum

Company: Sologne Ingénierie

Objective/motivation

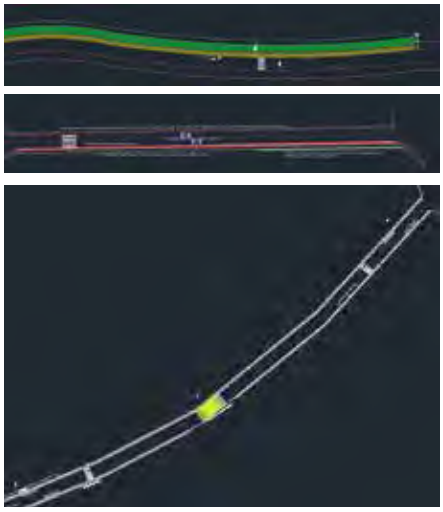
Our objective for this work is to submit a suggestion for the development of three axes of Nogent-le-Phaye. The city wants safer streets (pedestrian crossings, installation of devices to reduce vehicle speed), wants to redevelop sidewalks and parking spaces or create new ones. It will also be necessary to work on the aesthetics of the city and create a bicycle path.

This type of project makes it possible to restore dynamism to a city and gives a certain freedom to its inhabitants when it comes to choosing their means of transport by allowing them to move around safely on foot or by bicycle. It is therefore important to us to understand the real problems of these roads and find the best possible solutions in order to help the city in their renewal project.

Results

After several meetings with our supervisors, we succeeded in making development suggestions for all these streets. First, we had to go on site several times to take the necessary measures for our work. We also had a few meetings during our trips to Nogent le Phaye, which gave us the opportunity to talk with the inhabitants of their feelings about their streets. Their opinions obviously had an influence on our choices.

We therefore worked on the enlargement of the sidewalks in certain places of the city, and also on the increase of parking spaces, the marking on the ground, the devices allowing to slow down the vehicles and a secure cycle path running through several streets.



Development proposal for a street

Keywords: Redevelopment of the streets of Nogent le Phaye.

Extract from the IGN map of the study area

Current state of the streets of the town

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Energy Rehabilitation study: case of an experimental building

Civil engineering


R. LARIBI


W. PRUD'HON

Rayane LARIBI / William PRUD'HON
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Institution: LaMé Laboratory

Objective/motivation

The project concerns the in-situ study of the thermal and hygrothermal performances of biosourced materials for the external insulation of buildings. A biosourced material is a material which comes from animal and vegetable biomass (wood, straw, cellulose wadding, cork...). For our project, we follow the behavior of different insulation materials developed in the LaMé laboratory in reletion with the research work of Ms. Belayachi and used in the insulation of a demonstrator building carried out under the research project PEPITE. These materials are composed of cereal straw, lime and different types of natural additives. The aim is to test the hygrothermal performances of the materials by carrying out measurements of heat flow, temperature and humidity with sensors installed inside and outside the experimental building which is located next to Polytech Vinci. The goal is to compare the laboratory characteristics with the real characteristics of each insulation after its implementation to analyze the effect of the process and the conditions of use on its behavior. Our first motivation is to understand and learn how scientists work to improve building performance.


insulating material

Results

Even though we had many problems such as faulty sensors, software issues, and containment due to Covid 19 which delayed the start of our sensor recording, the project goal was achieved on a portion of data. Thanks to the data collected on the demonstrator, we were able to understand the behavior of the insulators at the wall level and to compare the different materials to determine the most efficient in terms of thermal insulation. Moreover, thanks to the WUFI software, we were able to simulate the behavior of the multi-layer wall and compare the humidity and the heat flow to compare the numerical and experimental results. This comparison allows us to use an inverse analysis to determine the in-situ parameters of the insulators (thermal conductivity and specific heat) and to analyze the impact of the manufacturing process and the environmental conditions on the properties of these materials.

Keywords: Insulation, humidity, temperature, thermal flow, hygrothermal


Demonstrator


Sensors

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Evolution of the thermal properties of concretes undergoing cooling after a fire:
impact on the resistance and stability of fixing structures

Civil engineering

A. GRANDEMANGE

N. RAAFAT EL METWALLY EL KAZZAZ

Alexandre GRANDEMANGE / Nora RAAFAT EL METWALLY EL KAZZAZ
Academic supervisor: D. HOXHA

Institution: Centre Scientifique et Technique du Bâtiment

Objective/motivation

We know that Eurocodes 2 fix the different thermal properties to consider for concrete structures facing a fire (during and after fire). Our project is to take back the results of experimental temperatures given by CSTB : These temperatures are achieved by placing sensors positioned while respecting given intervals in a concrete veil and defining boundaries of intervention. The results that CSTB has given us relate to experimental temperatures after the fire. Our job is to carry out a reverse procedure that will allow us to go back from the results (temperatures) to the thermal properties of concrete.

In order to achieve this, we will use the Matlab software and existing programs that we will have to adapt and modify.

In addition, the theoretical part of the project will be based on many existing works already in this area of civil engineering.

Results

We obtained the following zones with equations that best corresponded to the behavior of the experimental curves of temperature: (D is the thermal diffusivity)

Zone 1: between 0 and 400 degrees Celsius; the following equation is obtained: D=A - 1/(BX2-C) with A, B and C which are parameters to be determined using the inversion program created on Matlab.

Zone 2: between 400 and 550 degrees Celsius; the shape of the equation in this zone corresponds to a Gaussian: D=A0-exp (-A1 (x-475)2).

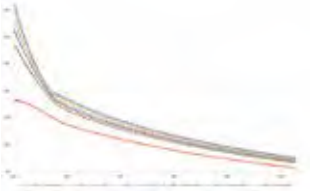
Zone 3: between 550 and 573 degrees Celsius: in this zone the spreadivity is constant D=E

Zone 4: between 573 and 750 degrees Celsius: it is a Gaussian form D=B0-exp (-B1 (x-573)2) with a peak (to be determined).

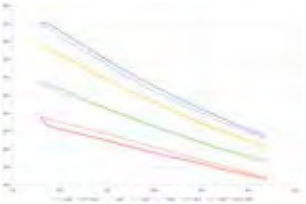
After this work, we were able to confirm the accuracy regarding the different parameters with a confidence interval of 95%. Subsequently, we drew the calculated temperature curves and compared them with the experimental temperature curves while calculating the relative deviations corresponding to each profile and the average relative difference.

Moreover, we drew the diffusivity curve.

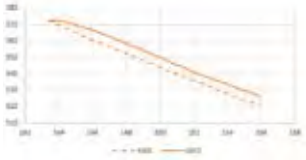
Keywords: concrete, thermal properties, cooling, structure



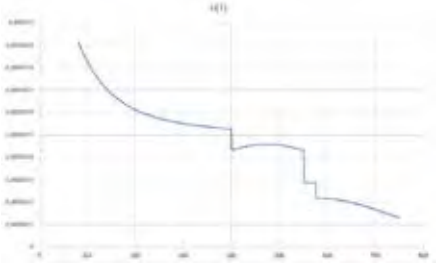
Zone 1 Matlab inversion results : experimental curves in dotted lines and calculated curves in solid lines for six thermal sensors between 80 and 400°C



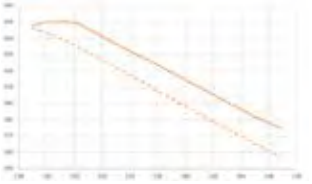
Zone 2 Matlab inversion results : experimental curves in dotted lines and calculated curves in solid lines for four thermal sensors between 400°C and 550°C



Zone 3 Matlab inversion results : experimental curves in dotted lines and calculated curves in solid lines for 1 thermal sensor between 550°C and 573°C



Diffusivity curve Curve constructed for the corresponding functions for each zone and fixed by Matlab software



Zone 4 Matlab inversion results : experimental curves in dotted lines and calculated curves in solid lines for 1 thermal sensor between 573°C and 750°C

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My first steps as works supervisor

Civil engineering

Wenceslas MARTIN
Academic supervisor: S. REMOND
Industrial supervisor: N. RICHARD

Company: Eiffage Infrastructure

Objective/motivation

When I was student in my 4th year in Polytech Orléans I decided to learn my job not only in school but also in a real company. To say the truth, I was a little bored on the benches of amphitheatres. That's why, I contacted my ex-internship tutor, Nicolas RICHARD, to be hired by EIFFAGE Infrastructure as an alternating student.

For sure, in school, teachers share with us very useful theoretical pieces of knowledge. But, according to me, it's not sufficient to become a good engineer. We must complete these academic skills with practical experiences. Indeed, be aware of the field's reality it's fundamental, especially in the public works domain. Finally, I wanted to discover people from different horizons and keep in touch with persons that I will command in a near future. It's important to try to understand the living conditions they must face.

Results

After several months all my objectives are reached.

First, for three months I was included in a team of 5 persons managed by a charismatic field leader named Eric POCHON. Thanks to him and my colleagues I could develop my technical skills. Nowadays, I have a better appreciation of the field. Also, thanks to time spent with workers, my entourage is made up of several social categories of people. That's very important for my open minding. As a future engineer, I don't want to be focus only on my community.

Then, I evolved, and I followed my way with the management teams. I could learn new engineering, management, accounting methods that make me a better engineer.

Finally, my last studying year was a success because I was surrounded by excellent professionals. I wish for all Polytech Orléans students to meet tutors like mine.

EIFFAGE Infrastructure, Oudalle Agency

Keywords: road works, management, technical skills, human relationships, open minding

Construction of a sewerage network

Realization of a bituminous base layer

Installation of a rainwater drainage drain

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From work supervisor to market researcher

Civil engineering

Steeve PERRIN
Academic supervisor: K. BECK
Industrial supervisor: L. SEBIANE

Company: Dagari

Objective/motivation
I wanted to join a human-size company because it was only my second work experience in the building field. First, I was scared about my skills because I know that in the building field the theorical approach is quite far from the practical one.

Results
After a short period of adaptation, I realized that I could manage a team of several types of workers. The size of the company allows me to run two or three sites on the same time and that's something I wouldn't have done if I was in a big company. Moreover, I had the chance to be more and more universal because now I can also handle researches on future work sites and their feasibility.

Keywords: work, rigor, patience

Pannels of cladding

Coating on insulations

Putting up insulations

Painting on insulations

Painting on balconies floor

Casing of bay windows

Contact: perrin.steeve@gmail.com

Multimodal urban mobility and reduction of environmental impacts

Environment engineering

S. CHAIBI

N. HANNI

Sabry CHAIBI / Nicolas HANNI
Academic supervisor: C.PROUST

POLYTECH ORLÉANS
The Engineering School of the University of Orleans

Institution: Academic, Polytech Orleans

Objective/motivation

The project that we are studying out aims at studying the environmental impacts of several modes of transport during their use phase and adding the infrastructure construction phase. To carry out this project we have several resources at our disposal, such as scientific articles, theses and analytical software that simulates the emissions of vehicles during their life cycle (cradle to grave)

In addition, thanks to these comparisons we will be able to establish the multimodal alternatives that citizens can take to travel in these cities, so that their journey is as short as possible, but as clean as possible. The final idea would be to find a solution that makes the best compromise practicality, saving time and limiting the ecological impact. By making this last criterion a main issue.

Results

The main results are presented in two points:

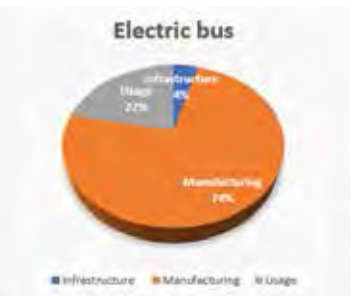
i) The environmental impacts depend mainly on the mode of transport used and the travel speed of (motorized) vehicles. Moreover, the most environmentally friendly means of transport (electric vehicles) have higher emissions than the others during the manufacturing phase. It should also be considered that the number of passengers transported in buses and trams reduces the average emission.

ii) Multimodal solutions are also under consideration as they allow for the best transport alternative for each person (for example tram and bicycle) depending on the trips made. As far as the GREET analytical tool is concerned, it only has common transport modes (cars, buses...) and a study on emerging transport modes (electric scooters and bicycles...) is hardly feasible given the lack of current data on these types of transport.

Keywords: Environmental impacts, modes of transport, GWP indicator, road infrastructures, life cycle assessment

Share of each phase in the life cycle of diesel cars in terms of CO2 emissions

Share of each phase in the life cycle of electric cars in terms of CO2 emissions



Share of each phase in the life cycle of electric buses in terms of CO2 emissions

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Optimization of work monitoring processes on rehabilitation operations in occupied areas

Civil engineering

Almamy Kelle SYLLA
Academic supervisor: K. BECK
Industrial supervisor: A. DURMORD

Company: Eiffage construction-Amélioration de l'habitat

Objective/motivation

OPR (Operation prior to acceptance) with zero (0) reservation.
EIFFAGE Construction, the general contractor for the project, is subcontracting all the works to specialized companies.
Today, with the increasing requirements concerning quality, it is important to be able to control the quality of the implementation of the work, component by component, before the OPR (operations prior to acceptance). This avoids having reservations (taking back non-conforming work) after the overall control of the work, thus saving considerable time.
Indeed, my project's main objective is to achieve OPR with zero (0) reservation. To achieve this goal, I will write below the methods and resources that I used:

- The daily follow-up of the works in phase of execution with the digitalized tool FINALCAD that allows control
- The filling of sheets of self-checking provided to each trade body, thus to each subcontractor.

These controls allow us to check that the works are conforms at each step of the progress, thus reducing the risk intervening again. In case of non-conformity of the work, I make the concerned companies intervene to correct the non-conforming work.

Results

Currently, I have started to undertake the OPR of the housing regarding the phase 1 of our project. Thanks to the work monitoring tools at my disposal, I was successful in achieving the objectives that were set for me. The pie chart below describes the OPR performed on the first 35 housing nowadays:
The main objective of zero reservation is not achieved yet as it is the beginning of the project. I have a strong belief that it will be reached soon.

Project pie chart: Social rehabilitation project in occupied areas of 288 housing units (13M€) Deadline 24 months.

Keywords: Tenants, works, monitoring, opr (operation prior to acceptance), reservation


Scaffolding for cleaning the facade


Attic and basement insulation


Repair of all the wet rooms


Coworking space

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Performance Assessment of a Bio-Sourced Insulation Material from an Inverse Analysis of Measurements on a Demonstrator Building

Civil engineering

Kilian MAGNIEN / Bastien PÉDEMARIE
Academic supervisor: D. HOXHA


K. MAGNIEN


B. PÉDEMARIE

Institution: LaMé Laboratory

Objective/motivation

The Profeel project consists of the analysis of different biosourced insulation materials used in industrial buildings with metal envelopes. To carry out this study, a demonstrator building was constructed in the city of Haironville. This building has 7 biosourced insulators contained in a metal envelope. During the visits on site, sensors were installed to measure three types of data: heat flows, humidity, temperatures. They enable the properties of the insulators to be determined and compared with each other. Several visits on site were necessary to install the sensors because of the time it took to order them. In the meantime, Excel files were created to record various installation pieces of information, such as the location of the sensors and the type of insulation they were fitted with. After several months, enough data was collected, and the evaluation of the results could begin.


Tested building without metal cladding

Results

First, an Excel file was created for each station, to group together the flow, humidity and temperature data recorded during the different months. The Excel table also contains graphs allowing the evolution of these different parameters to be plotted.
In a second step, it was necessary to compile the results of the different sensors located on each wall of the demonstrator building and to distinguish the sensors located on an area with a vapour barrier or not. These graphs make it possible to compare different insulations subject to the same conditions. These results give an initial trend on the efficiency of certain kinds of insulations, but it is necessary to go through the heat equations to determine the properties of each of these insulations coupled with the metal envelope.


Tested building in its final shape

Keywords: Insulation efficiency, industrial building, hygrothermal behavior, heat flow, bio composite


Hygrothermal device (displayed: temperature/relative humidity/ number of measures logged)


heatflow sensor placed on insulating material


Hygrothermal device and dataloggers for heatflow sensors (for the roof in this case)


Engineer in action monitoring the devices

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Preliminary design of a parking and car-sharing platform (Moulin d'Ecalles)

Civil engineering


H. HADDAT


A. LEGROSSE


M. VERHELST

Hamza HADDAT / Adrien LEGROSSE / Maxim VERHELST
Academic supervisor: L. JOSSERAND, E. REMOND
Industrial supervisor: J. LUCY

Company: Iris Conseil

Objective/motivation

This project consists in the proposal of a preliminary design solution for a car-sharing platform, near a small town named La-Rue-Saint-Pierre and located in the Seine-Maritime department (20 kilometres North from Rouen). In fact, due to the daily and consistent saturation of the existing parking infrastructure, the creation of a new one seemed to be the most convenient option. The operation had to follow two major phases, the first one including the conception of 25 parking spaces (equivalent to half of its capacity). The second stage considers a possible long-term extension to 50 spots, ensuring that both steps of the operation are independent and without any further demolition. All of this while respecting the environmental specificities of the site. Our common interest for urban design and the desire of discovering more technical skills made us choose this project at first

Results

In the beginning, our principal missions were to thoroughly examine the environmental sensibility of the site, using multiple documents provided by our industrial supervisor, and to design our proper variant on a computer software (AutoCad). Therefore, each member of the group elaborated his own alternative, the most appropriate being chosen by means of a multi-criteria analysis. The next steps were to dimension the rainwater capture systems (essentially the stormwater drains and retention basin) and do our project's numerical modelling on another software (Mensura), leading to our final plans and profiles. In addition, we had to consider how to optimise the cost of implementation, the balance between the amount of cut and fill material. Finally, we estimated for both phases the budget and schedule, by assessing the needs for skilled labour, the tasks durations, and the general quantities of required materials.


Site before project

Keywords: Car-sharing, parking, modelling, optimisation, budget

2D modelling of our project


3D modelling of our variant

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Recovery of concrete residues

Civil engineering

A. AWAD

T. Xue

Awad AWAD / Tong XUE
Academic supervisor: S. REMOND, M. BOUARROUDJ
Industrial supervisor: P. BROILLIARD

Company: CEMEX

Objective/motivation

The construction sector in France generates 260 million tons of waste per year, which is five times more than household waste, which makes it the largest producer of waste in France, this sector is also the largest consumer of natural raw materials with more than 440 million tons of aggregates extracted. The purpose of this project is therefore to help CEMEX, one of the leaders in the construction materials industry, to recycle these concrete residues. The first objective is to suggest modifications to existing concrete plants so that they can integrate the reuse of these materials. The second objective is to study the properties of the study materials, to formulate concretes from these materials and to determine the characteristics of the concretes formulated in the fresh and hardened states.

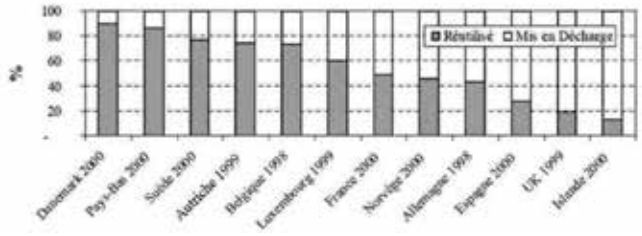
Results

Our project focuses on the recovery of dried concrete residues resulting from the washing of mixer trucks. It includes three main chapters:

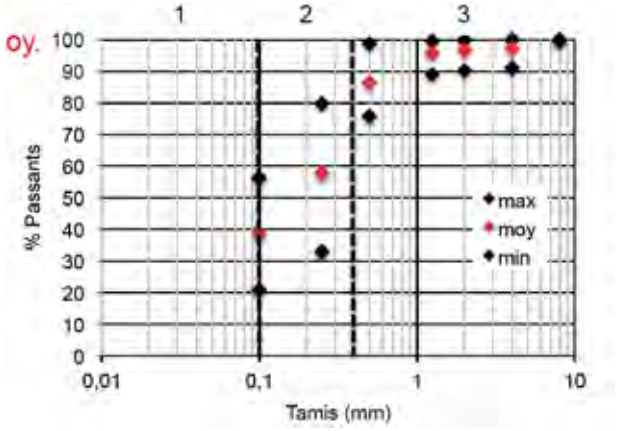
- The first part is dedicated to the bibliographic study of the project and to the study of the various projects and valuation techniques.
- The second part suggests a way to make modifications to the concrete factory and its equipment in order to change them or modify them to suit the proposed problem (recycling concrete residues).
- The third part presents the experimental program for the characterization of study materials, the formulation of concretes based on these materials and the characterization of their properties in the fresh state and in the hardened states.

Concrete mixer truck

Keywords: concrete residues, recycle, formulation



Management of construction and demolition waste in EU



Average, maximum and minimum grain size curves of the laitance

Contact: awad.o.awad96@gmail.com ; tong.xue@etu.univ-orleans.fr

Restructuring of a technical college

Civil engineering

V. BELLET

J. CHAMOIS

Victor BELLET / Jean CHAMOIS
Academic supervisor: E. REMOND
Industrial supervisor: S. GAY

Institution: Région Centre Val de Loire

Objective/motivation

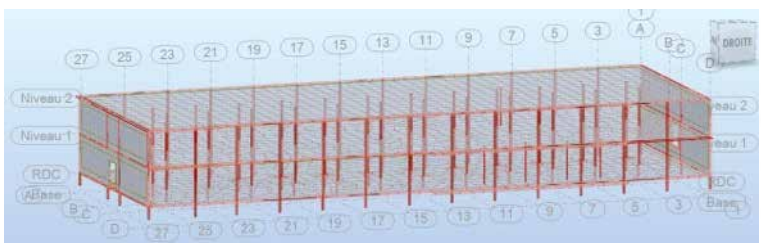
The main goal of this project was to renovate the high school Gustave Eiffel in Tours (which was built in the 60s when the use of asbestos was still permitted) from a thermal point of view. Indeed, this high school has thermal insulation problems in some rooms: we acknowledge that these are overheated due to the sun during the summer (window insulation) and bad insulation also at wall level. It was therefore necessary to find a solution to face those problems. To do this we used models on different software: Revit and Robot (we had to create the model by ourselves) to modify the structure of this building. We chose this project because we wanted a project on an existing building to improve our skills on the software but also to study the different techniques that can be used to carry out such a renovation.

Results

To succeed in this project, we, therefore, determined different solutions that can be used to reduce the overheating and we have retained two of them: sun blockers and building caps. Then, we modeled the building with these solutions using the Revit software and we imported this model under the Robot software to check if the descent of loads due to the addition of these elements is acceptable. Then, we had to determine how to better isolate the walls and increase fire resistance. To do this, we studied various techniques and we finally chose the flocking because it combined the two results with an affordable price and a simple implementation. We, therefore, determined which materials would be the best to obtain optimum insulation at a lower cost. Finally, we set up a schedule to organize all of this work and to place the lifebase on the site.

Lycée Gustave Eiffel

Keywords: High school, renovation, BIM



Structure robot

Structure revit

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Studies on wastes generated by economic activities of ASTEE members

Civil engineering


B. MAURER


D. MITANCHEY

Basile MAURER / Damien MITANCHEY
Academic supervisor: L. LEFORESTIER, C. DEFARGE
Industrial supervisor: B. NYETE-DIEBE, F. LACOMBE

Association: ASTEE

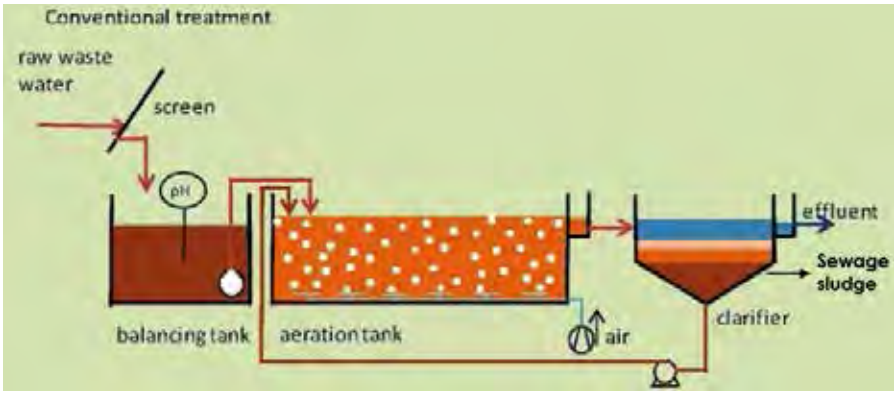
Objective/motivation

The economic activities of industry, services and agriculture produce significant amounts of waste. This waste then ends up in processing units such as sorting and storage centres, incineration facilities or treatment plants among others. ASTEE, an association committed to professionals in water and waste management in France, seeks to better understand what is done in these treatment units. The methods used are based on a collection of data from an online survey and telephone calls to the various unit managers. The data are used to identify, characterize, and quantify waste. This allows to know what types of waste are produced, their recoveries and the constraints which members may be exposed to. The final objective is to allow ASTEE to consider recommendations and actions to be implemented in order to limit the production of waste and to manage them efficiently.

Results

During this project, more than 150 emails were sent. Out of these, only 2 people responded to the survey. To relaunch the poll, 70 telephone calls were made for a return of 6 concrete results. Finally, this low return does not allow to provide enough consistent data for ASTEE. The reasons for this low response rate can be explained by several factors. First, at the level of email addresses, about 20% could not be sent because they were obsolete. Second, the length of the questionnaire may also be a reason. It may also be simply a lack of desire from the respondents. In terms of calls, people often mentioned that they were not the right person to contact. As a result, they had few or no relevant information to provide, or they did not simply want to provide their data.

Keywords: Waste, economic activities, water, recycling, processing



Production of sewage sludge on wastewater treatment plant

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Study of the establishment of the O-ZNS site

Environment engineering

T. MALBURET

B. LAHEURTE

Théo MALBURET / Benjamin LAHEURTE
Academic supervisor: C. MALLET
Industrial supervisor: C. MALLET, G. LAURENT

Institution: ISTO

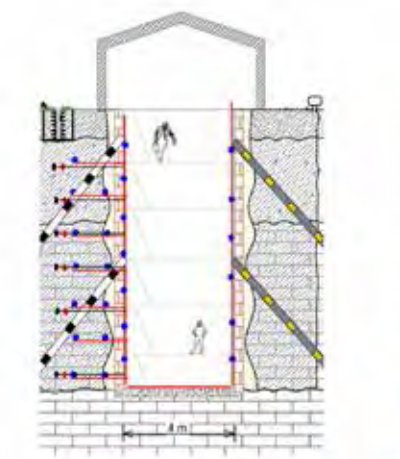
Objective/motivation

The objective of this project is to prepare and monitor the digging of O-ZNS well nearby Villamblain. O-ZNS project consists in studying the effects of soil pollution directly by observing it into the soil, between the surface and the water table. We had to study soil samples and log imagery to find what elements of those were remarkable. Another objective was to create a photographic setup to image the well lithology during the digging. Moreover, we had to prepare the digging by studying the soil on site. We also had to follow the digging operations of the well and to keep an updated report for the research team.

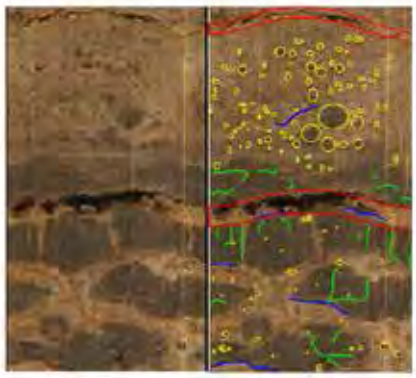
Results

We created an excel sheet to characterize all the heterogeneities we could find in the soil between the surface and the water table which was approximately 20 meters below. We differentiated cracks, pores, changes in lithology and karsts. We also managed to quantify the size of every crack and pore in the soil. We also studied to understand and choose which camera to use for the well lithology imagery. It has been done depending on our heterogeneity characterization and possible camera characteristics (focal distance, resolution, distance from the subject, exposure time, which camera lens to use)

Keywords: Geology, photogrammetry, geophysics, worksite supervision, environment



First look at the well/observatory



Cracks & pores in a sample of soil

Photogrammetry by Gautier Laurent (ISTO)

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Study of the rolling loads effects on Joigny bridge

Civil engineering

M. K. ATTIGUI

H. BOUKHARI

Hafida BOUKHARI / Mohamed Khalil ATTIGUI
Academic supervisor: E. REMOND, S. REMOND

POLYTECH ORLÉANS
The Engineering School of the University of Orleans

Institution: Academic, Polytech Orleans

Objective/motivation

Our goal is to do a mechanical study of the rolling load on the Joigny Bridge. This structure is the first bridge built with high-performance concrete in France. This project will be an example of the use of high-performance prestressed concrete structures and beam bridges.

Our first steps was the design. We started modeling the structure on CAO software Revit in order to get the 3D shape of the bridge to get a global vision of our structure. We set up a lot of hypotheses on the bridge geometry. Our final objective was to prove those hypotheses.

Secondly, once the 3D model is done, we export it to other CAO software (Robot) where we can give the structure all the mechanical aspects, starting by linking different parts of the bridge, then the support effort, and finally apply all the loads on it.

Our first objective was to have a good model so that, next year, students could use it to start simulation. They have all the basics to start comparing different combinations of rolling loads.

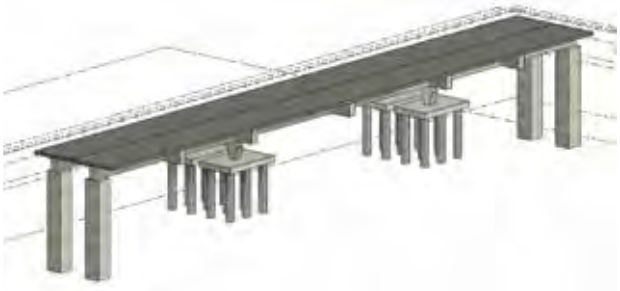
Results

In addition to the fact that our project allowed us to broaden our spectrum of competence in civil engineering, we are now able to manipulate a set of software that could be useful to us in our careers.

On the first place, we had to design all the elements of the structure on CAO software called REVIT. We encountered difficulties during this operation, however we still had the support of our project supervisors who offered several alternatives and solutions. Secondly, we exported the model to other software, ROBOT, which allowed us to apply the loads that we calculated manually on different locations on the bridge deck. For lack of time, unfortunately, we did not carry out checks on the calculations. This project will be offered to next year's 5A students, who will continue the work we started.

Joigny bridge

Keywords: Modeling and mechanical structure of Joigny bridge.



Joigny's bridge revit

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Urban soil quality study as part of the "Zero Phyto Project"

Environment engineering

L. Bourneix

P. LE BOULAIRE

Ludo BOURNEIX / Pauline LE BOULAIRE
Academic supervisor: M. MOTELICA
Industrial supervisor: M. MOTELICA

Institution: STO

Objective/motivation

The aim of our project is to characterize urban soils (Blois, France) and their quality to better understand the benefits of abandoning phytosanitary products. This project is carried out within the framework of "Objective Zero Pesticide" approach and the preservation and enhancement of urban biodiversity.

Our soil samples have been taken from the city and the agglomeration of Blois because Blois stopped using phytosanitary products in 2012 for green spaces and in 2019 for private gardens. Indeed, these products are potentially harmful to soil ecosystems.

Our project is part of a larger project called BIENSUR which is a multidisciplinary project to study the microbial and plant biodiversity of urban soils.

We have studied the composition and physico-chemical properties of different soils and analyzed them. To do so, we used samples from urban soil slots with 5 different management levels, level 1 being a low management level and level 5 an intensive one.

All 135 soil samples

Results

Our project contains two main parts: bibliographical research and laboratory tests.

We have therefore conducted research on soil biogeochemical properties and soil biological functions. This part allowed us to better understand the stakes of our project.

The second part of this project focuses on experiments and analysis of soil main properties. In order to know the soil properties, we conducted several experiments such as physical and chemical studies. This report presents results for soil pH, conductivity, texture, and porosity. Thanks to all results, we were able to assess the impact of both soil origin in the city and management.

Keywords: Urban soils, soil type, quality and management, soil microbiodiversity, laboratory experiments

Soil preparation for conductivity measurement

Soil preparation for texture

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Water exchanges between ground-water and the Loiret basins

Environment engineering


D. CHARLEMAGNE


L. LOBELLE

David CHARLEMAGNE / Léa LOBELLE
Academic supervisor: S. BINET, C. DEFARGE
Industrial supervisor: C. AUTERIVES

Institution: BRGM

Selected Participant
15th Annual Final Year Projects Forum

Objective/motivation

The project aims to identify the places where water exchanges occur between the ground-waters and the Loiret basins, for Orléans Metropole and the BRGM. The project consists in doing chemical measurements in the Loiret river and using them to get data related to the water mixing and make maps on a GIS (geographical information system) dedicated software named Qgis. This is part of a bigger project led by BRGM to identify the groundwaters network around the Orléans city. Indeed, this will allow scientists to improve risk management, concerning collapses or floods and drought mitigation. It can also be used to show the population the places where groundwaters feed the Loiret Basin, as the map created on Qgis, is a good way to visualize information.

Results

First, scientists from the BRGM did measurements in river in the of mid-September to collect data. They used probes to measure parameters like pH, temperature, conductivity of the water, etc. Our data treatment was to have a first sorting of data to delete all the minor measurement mistakes and incoherencies for each parameter. We used Excel and its features to create graphs and trend lines to be sure of the coherence of the data. Finally, we used that data in the Qgis software to map all the information collected. Our final goal on this project was to show how the water in the Loiret river can be chemically different at some specific points. This way, we can determine if there is an upsurge in the surface water groundwater. That way, scientists can focus on some of these specific points and be more accurate on their research.


Field trip on the Loiret to collect data on the water (photograph from the BRGM)

Keywords: hydrogeology, exchanges, groundwaters, river, GIS


Le Bouillon, a source of water in the parc Floral (photograph from the parc floral)

Karstic system of the Val d'Orléans

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Engineering Physics and Embedded Systems

Benchmark of sensor networks

Aerospace engineering

Marwane AIT BRAHIM
Academic supervisor: J-Y. CADOREL
Industrial supervisor: R. GUILLERM

Company: Ariane Group

Objective/motivation

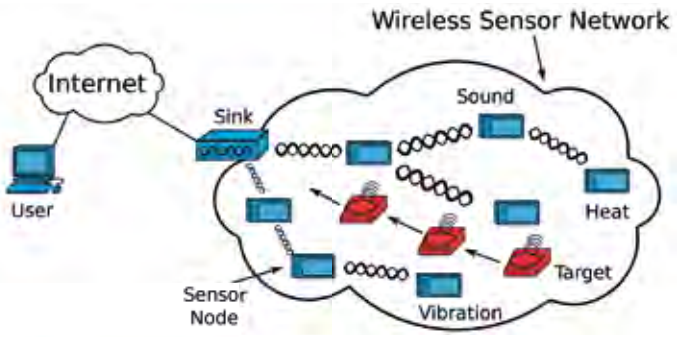
In the frame of the development of future civil launchers, a very well-known European aerospace company that works on space rockets and other defense and security businesses, is evaluating new technologies in order to improve and optimize its products.
In particular, following the important development of IoT and wireless networks during the past decades, this project intends to benchmark various possibilities so as to implement such technologies on space applications, with high environmental and reliability constraints. The objective of the project is to identify available sensors technologies, then, imagine different solutions, and finally, highlight the most feasible configuration for such applications.

Results

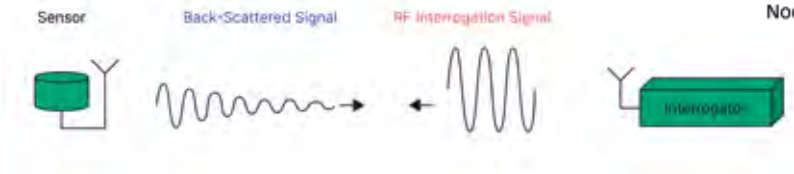
Two sensor network setup possibilities have been considered:
The first one is based on mesh network topology. This setup is made from units called “Nodes”, each node is connected to sensors for measurements. All nodes are interconnected, and they channel their data to one main unit called “the sink”. The advantage of this setup is the reliability of measurements.
The second solution is the use of fully wireless sensors based on the Surface Acoustic Wave technology. These sensors consist of two elements, the sensor and the reader. The wireless data transmission is done via antennas. SAW sensors have important advantages, such as high sensitivity, low cost, and ease of fabrication.
However, even if these solutions become increasingly used in industries, they can’t be easily implemented in the harsh environment of our application. Therefore, these solutions are yet to be improved.

Ariane 6 (source esa)

Keywords: smart sensors, wireless, rugged, network, space engine



Wireless Sensor Network (open source wikimedia)



SAW sensor (source www.teansense.com)

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Combination of Different Illuminations in a Computational Imaging System to Highlight the Defects of The Parts to Be Inspected

Electrical engineering

W. BI

Z. LYU

Wenjuan BI / Zihao LYU
Academic supervisor: C. CACHONCINLLE
Industrial supervisor: Y. CHENE

Company: Scortex

Selected Participant
15th Annual Final Year Projects Forum

Objective/motivation

From a specific industrial request, we are looking for a new acquisition design technology, specifically computational imaging. Within computational imaging setups, multiple images acquired with different acquisition settings (e.g. exposure, light sequence, etc.) are combined to create new contrast, in order to improve the visibility of defects and increase the accuracy of inspection. During this project, we are expecting to assemble an acquisition system with multiple lightings and define a computational acquisition sequence for a given sample. Designing an image processing algorithm is also required. The algorithm will merge all the acquired images into one optimized image.

Results

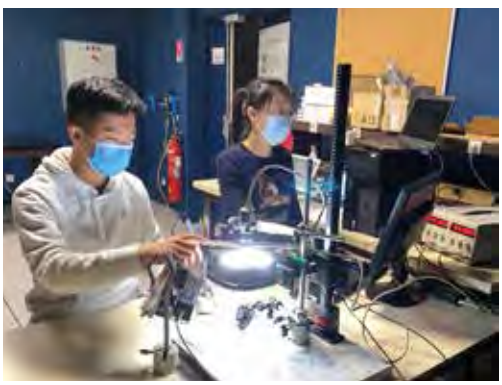
A prototype consists of a single camera and multiple lights (ring light, bar light) have been assembled and it runs perfectly. By manipulating the lights with its incident angle, intensity and its on-off state, many images of a given sample have been taken and will be processed in the next stage.

After the processing of the algorithms, some rarely observed defects, even some invisible ones to the naked eye, are apparent. This advantage has been unmatched by conventional photography in the past, which greatly helps to inspect defects on samples and ultimately improves efficiency and control of quality.

Keywords: Computational imaging, multiple illumination, algorithm, image processing

Overview of the system assembled for the project

Acquisition system
(Hardware - camera, lights, sample holder)



Working together on the project

Contact: wenjuan.bi@etu.univ-orleans.fr ; zihao.lyu@etu.univ-orleans.fr

Connected Tear Gas Sprayer

Electrical engineering

J. GUARDIOLA

L. VALIER-BRASIER

Jérémy GUARDIOLA / Laura VALIER-BRASIER
Academic supervisor: R. CANALS
Industrial supervisor: S. Djendoubi

Company: Shield Ans Connect

Fourth Place and Innovation Award
15th Annual Final Year Projects Forum

Objective/motivation

These days more and more people feel safe wearing objects to protect themselves. The most common one is a tear gas sprayer which hasn't evolved in the past thirty years. The shield Ans Connect project idea is to create the first collaborative defence object by connecting the tear gas sprayer via Bluetooth, which will allow the transmission of critical information such as the location or the recording of the aggression to a smartphone. Thus, these specifications will enable the prevention of future attacks thanks to the information gathered on the application.
The project aims are to create the manufacturing file, test the components selected, work on the signal processing and test to send critical information through bluetooth to a smartphone.

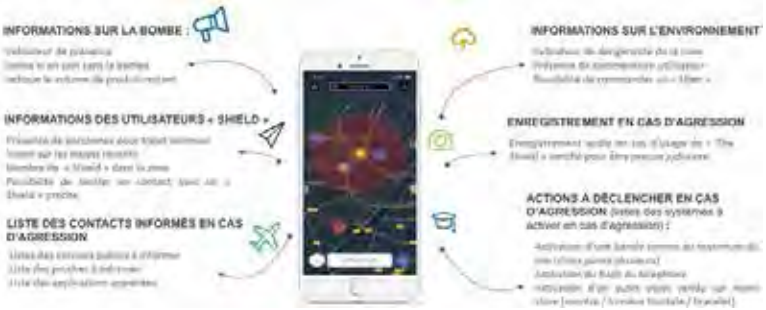
Results

After much research and a precise choice of components according to the various parameters, we found that the feasibility of the project is conclusive. In fact, the choice of all the components, including the manufacturer of the product designed, does not exceed €100. In addition, the product is not too big and can contain all the components in addition to the electronic card. We therefore obtain a manufacturing file including an electronic diagram as well as the PCB of the product. In addition, the microphone tests were conclusive. The processing allows the voice to be isolated from the recording in a scrambling environment and to detect the triggering of the bomb. Finally, audio data is transferred from an ESP32 to a Raspberry via Bluetooth.

Keywords: Protection, help, tear gas sprayer, IoT, application

The connected functionalities

The connected tear gas sprayer



The collaborative application

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Create an industrial vision system to realize a Go/No control of cosmetics defects on optical surfaces

Industrial engineering

Clément GAMBLIN
Academic supervisor: S. RAGER
Industrial supervisor: J. DESSOMMES

Company: Cilas

Objective/motivation

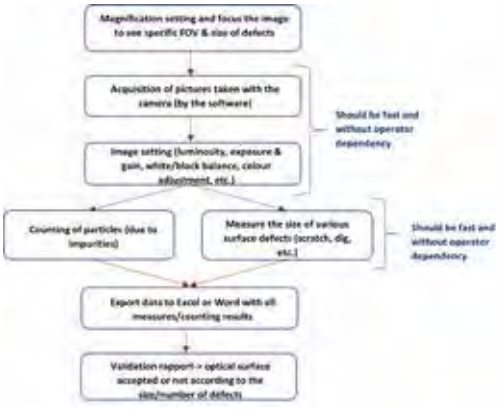
In the industrial field, the productivity and the quality of the production are essential to cut costs, to increase reliable of an operation (by less human dependency), to avoid endlessly long or too uncomfortable tasks for workers and to make more reliable and available products. This system was designed to replace human vision control by a quick, repeatable, and reliable control. This project is in collaboration with CILAS which is an industrial company where the quality of optical surfaces is prominent for military applications which use high energy laser sources which can create irreversible damage on defective optics. Therefore, optics requires defects control. In this industrial project, a computer vision system should be assembled with various systems bought alongside manufacturers to perform an industrial Go/No (or validity) control of optical surfaces.

Results

As a result, for this project, a computer vision system was created for Go/No controls of surface cosmetic defects (equivalent to visual defect) especially on Lithium Niobate crystal or Nd:Yag rods which are critical optical component. This vision system is composed of several parts: 20 MP Industrial camera running on software, an optical imaging system (optical stereoscopic microscope) and a computer. The real difficult of this study was to find systems which conform to all the functional specifications: detected smallest defects of 5 µm, have a field of view on the optical surface of a few mm and a sufficient distance between the surface and imaging system (>90 mm). This work requires lots of communication with manufacturers and tutors to have a machine vision system as better as possible.

Keywords: optical components, Go/No go control, camera vision, cosmetic defects

Scheme of the computer vision system



Steps of the quality control

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Defect counting and localization algorithm

Industrial engineering

Nikola JOVANOVIC
Academic supervisor: S. TREUILLET
Industrial supervisor: Y. CHENE

Company: Scortex

Objective/motivation

In many industries, detecting defects is a big challenge. This project takes part in the initiative of automatizing the process of quality control by developing defect detection algorithms to replace detection by humans. In detecting defects on an object, many parts can be important to look at in order to find them, one of them is the logo area. The first objective of the project is to detect and localize the logo on an object in order to focus on that part for defect detection. Then, after using a detection algorithm that runs with AI, defects around the logo area are found. Finally, the goal is to keep track of those defects throughout a sequence of images in order to localize them one at a time on the object.

Results

The result of the project consists of an entire algorithm pipeline that can be implemented in an existing detection algorithm program. The algorithms developed during this project can detect the logo of a specific object using template matching, it also gives access to percentages of detection as well as the location on the images of the logo. They also provide information on the best image to see the logo in a sequence where the object is moving, and the logo is not visible at all times. Finally, it can localize defects and compare their location to other defects detected in other images in order to count the number of defects and give positional information to the object manufacturer.

Keywords: algorithm, image processing, detection, localization

Contact: nikola.jovanovic.etu@gmail.com

Design of a connected rodent trap

Environment engineering


M. FOURMY


C. GORMAND


A. GUILLET

Mathilde FOURMY / Colin GORMAND / Axel GUILLET
Academic supervisor: R. CANALS, M. MEKHILEF
Industrial supervisor: L. BELLOUT

Company: Dame2Pic

Selected Participant
15th Annual Final Year Projects Forum

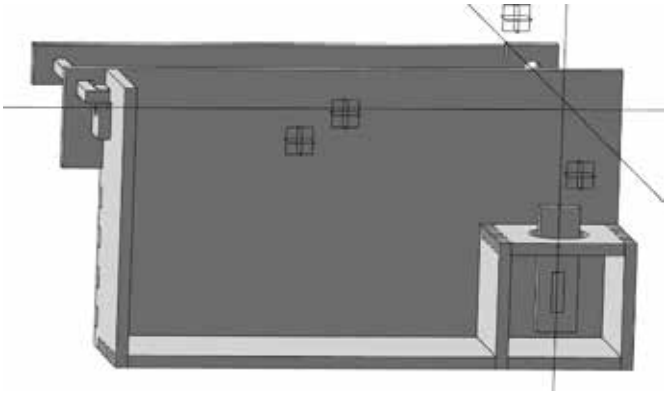
Objective/motivation

The goal of our project is to limit the use of biocide, as these products are harmful for biodiversity. Through this project, we were looking for a more ecological way to deal with pest control. Rodents always lives in colony and tend to warn others of danger. On long term, they get used to usual products such as rodenticide. The trap should be able to transform itself into a station bait. Thanks to the connected part, Dame2Pic will know exactly when a rat is captured and therefore abide by the law (stating that you must clean traps within 12 hours) and the client can have more autonomy (make appointments, be aware of an invasion...).

Results

All our mechanisms have been designed using 3D Experience, a computer-aided design software. The final design has been chosen from a wide panel of solutions, and the client chose the one that was best fitting their needs. The actual mechanism uses the movement the rat is creating by picking the food to libertate a rotating door. This movement liberates expansive resin, which then traps the rat inside the box. The trap is made with ABS, and the material's characteristics were checked thanks to the software Grante Edupack. All parts can be cut thanks to a laser cutting machine, so that broken parts can be replaced easily. For the connected part, the result consists of an Arduino card with a SigFox module to send the data and the hall effect sensor to detect the opening of the door as well as a web interface to access to the data.

Keywords: Rodent, trap, connect, multicapture, design


Front face of the prototype trap by CAD design


Front face of the prototype trap


Back face of the prototype trap

Contact: polypiege@gmail.com

Design of a High-Performance Device for Taking Pictures of an Object Flying at 300 m/s

Industrial Engineering

Paul MARSAN
Academic supervisor: R. LECONGE
Industrial supervisor: P. LATCHOUMAYA

Company: undisclosed (confidential)

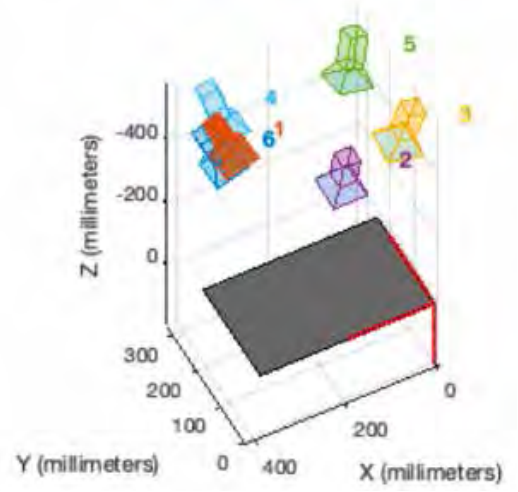
Objective/motivation

The aim of the project is to identify the position of the projectile in relation to a reference frame. The projectile will be in a zone between 0.5 m and 3 m when the photo is taken, its maximum speed is 300 m/s, i.e. a little over 1000 km/h. It is therefore a question of designing a device that takes a photo at the right time with a shutter speed high enough to avoid blurred movement, which would make the photo unusable.

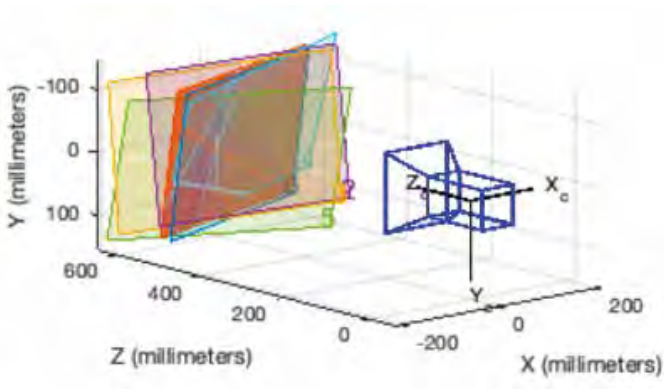
Results

At the end of this project, I was able to identify the need and its technical characteristics to refine my search for a high-speed camera. Indeed, there are a lot of different types of cameras with different characteristics and, above all, they are expensive. I was able to identify 2 cameras that could meet the need. One is perfectly adapted but its price is relatively high, while the other, cheaper, can also work but it will be necessary to be more precise with the shot because the field of view is reduced. It was also decided to use an image processing method under MATLAB to determine the position of the ammunition; a "calibrator camera".

Keywords: High speed camera, detection in space, projectile



Pattern-centric



Camera centric

Contact: paul.marsan45@gmail.com

Design, realization and characterization of a low-pressure DC discharge plasma reactor

Physical engineering

B. BRETON

V. DELLAC

Benjamin BRETON / Vincent DELLAC
Academic supervisor: R. DUSSART, C. PICHARD
Industrial supervisor: R. DUSSART, C. PICHARD

Institution: GREMI Laboratory

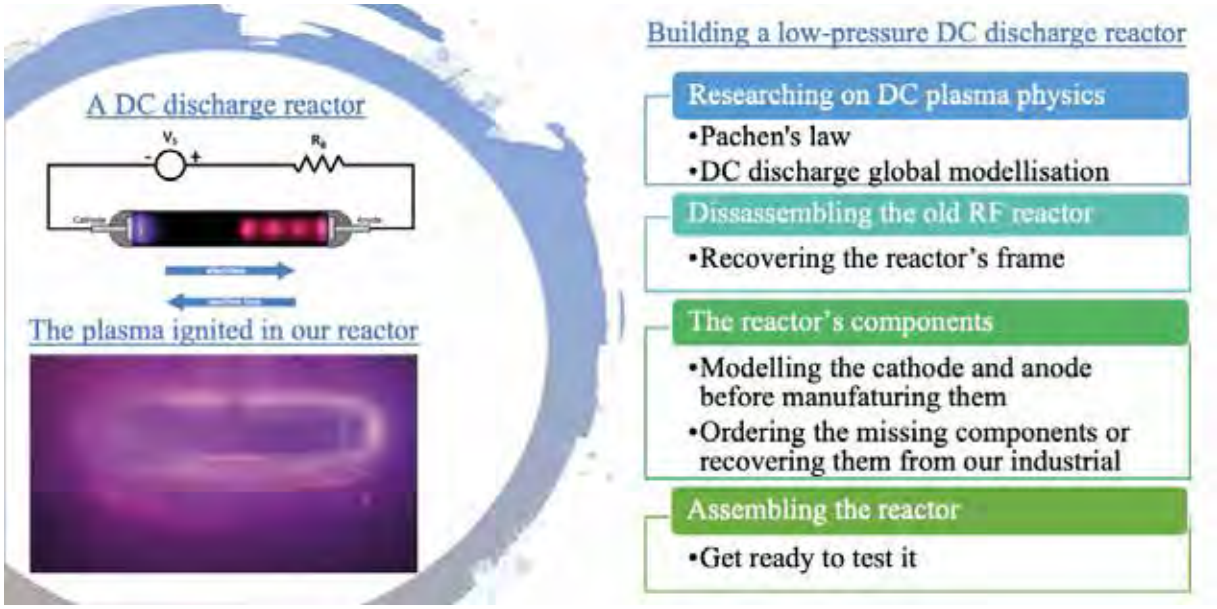
Objective/motivation

The aim of this project is to build a low-pressure DC discharge plasma reactor reusing an old RF plasma reactor. This reactor will be used by Polytech's students (especially GP) for practical works in order to characterize a DC discharge. The first step is to build it then to be able to characterise the discharge. We will focus on the first step.

Results

At the beginning, we dismantled an old RF plasma reactor to make room for our elements and we kept the parts that could be reused like the reactor's chamber. Then we design some piece that needed to be custom-made and we order the missing parts when our industrial tutor couldn't provide it to us. In the end, we managed to build the reactor in time and we ignited a plasma with it. So we achieved our main goal. However, there is still some improvements that can be made in order to have a stable discharge inside the chamber before we can characterize the plasma.

Keywords: Plasma, low-pressure, DC, reactor



Project schematic

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FPGA and ARM Implementation of spectral analysis tool for scientific space applications

Aerospace engineering


A. LOUYOT


L. MARCHAND

Armand LOUYOT / Loïc MARCHAND
Academic supervisor: R. WEBER
Industrial supervisor: F. COLIN, O. LE DUFF, A-L. MILLET

Company: LPC2E

Objective/motivation

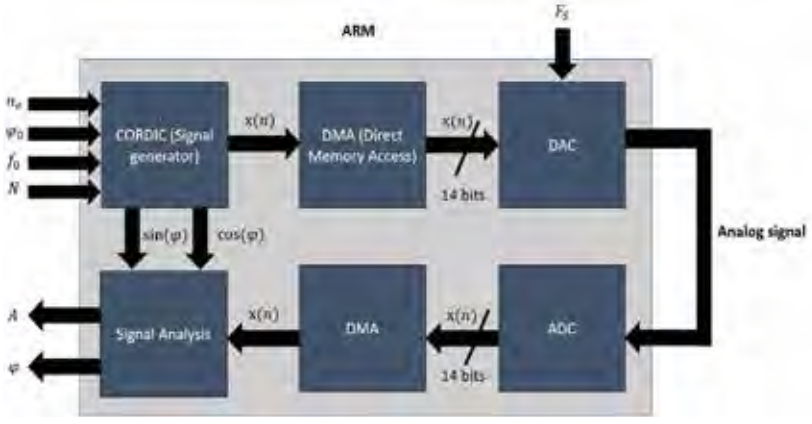
LPC2E builds satellite-mounted scientific experiments for the analysis of space plasma. In this context, our project is to study the feasibility of implementing a plasma frequency analysis algorithm on an FPGA. This algorithm will be implemented in two different ways: on the one hand directly from a VHDL description and on the other hand in an ARM target integrated in the FPGA. An evaluation board with a Xilinx Zynq 7000 will be used as a test medium for this implementation. The spectral analysis is based on either a CORDIC or a DDS (Direct Digital Synthesizer).
Armand : (Takes care of the ARM part) It's exciting to discover the results of the plasma signals' composition with the new specific electronic card for the signal processing.
Loïc : (Implement inVHDL) For my part, learn VHDL could be a good thing to me to develop my skills in my future professional project : work in the aerospace.

Results

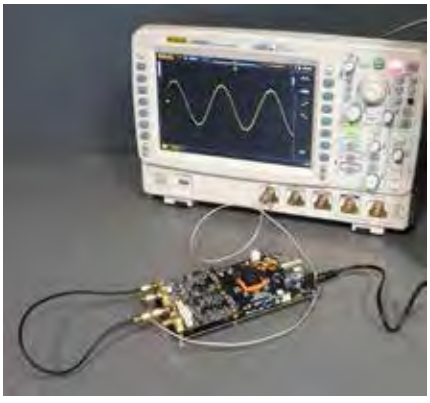
FPGA results : The main gaol of the project was to learn VHDL / FPGA approaches. and to understand the algorithms.
ARM results : In the ARM part, the main goal was to simulation of the algorithm in python, implementation of the analog-to-digital and digital-to-analog conversion + implementation of the CORDIC which allows to generate a sinusoid of a given frequency.


Eclypse Z7 Zynq 7000 card

Keywords: Space, FPGA, ARM, signal analysis



Implementation of project


Measure the generated signal_with Eclypse Z7 Zynq 7000 card

Contact: armand.louyot@etu.univ-orleans.fr ; loic.marchand1@etu.univ-orleans.fr

Hands Free Kit: Assistance in deploying a drone

Electrical engineering

Virgil GUYARD
Academic supervisor: F. DAUBIGNARD
Industrial supervisor: H. MINOT

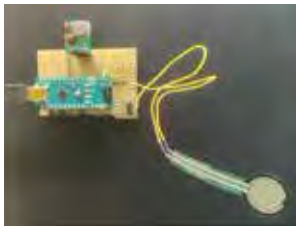
Company: Base Aérienne 123 Orléans-Bricy

Selected Participant
15th Annual Final Year Projects Forum

Objective/motivation
The objective of this project is to create a hands-free kit to replace the push to talk system, while using the equipment already in use. Currently to communicate, it is necessary to press a button to allow the transmission of sound from the microphone to the radio. However, this is not practical when the user deploys an 8 kg drone and therefore has his hands busy. The goal is therefore to replace this push to talk with a hands-free kit. For this project, the chosen solution is to use a touch sensor, requiring the use of a finger only. This sensor positioned on a glove must send the information to a card that replaces the push to talk, using a transceiver

Results
The results of this feasibility study are conclusive. The tactile sensor placed on a glove allows the use of only one finger and does not hinder the user in his movements at all because the prototype is not bulky. The transmission between the card collecting information from the sensor and the card replacing the push to talk system is carried out without loss of information using a transceiver. With the help of the received information, the sound transmission from the microphone to the radio via the Arduino board is carried out or not, depending on the data received.

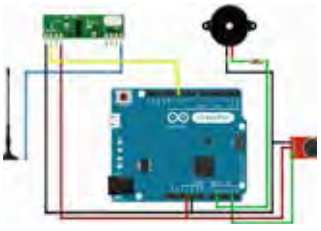
Keywords: Hands free kit drone



Prototype emitter card

Fritzing emitter card

Prototype receiver card



Fritzing receiver card

Prototype communication system

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Hangar Aircraft Entry/Exit Video Surveillance System

Electrical engineering

Yannick CORDIER
Academic supervisor: R. JENNANE
Industrial supervisor: E. MERCIER

Company: ESTA

Objective/motivation

My project is in collaboration with the Bricy air force base. It consists in avoiding the endangerment of maintenance engineers. Indeed, they must go to the top of the aircraft, using a lifeline, in order to check its upper state. These checks cannot be performed from the ground due to the limited visibility.
Therefore, the purpose of this project is to suggest various solutions to meet the requirement of maintenance engineers.

Results

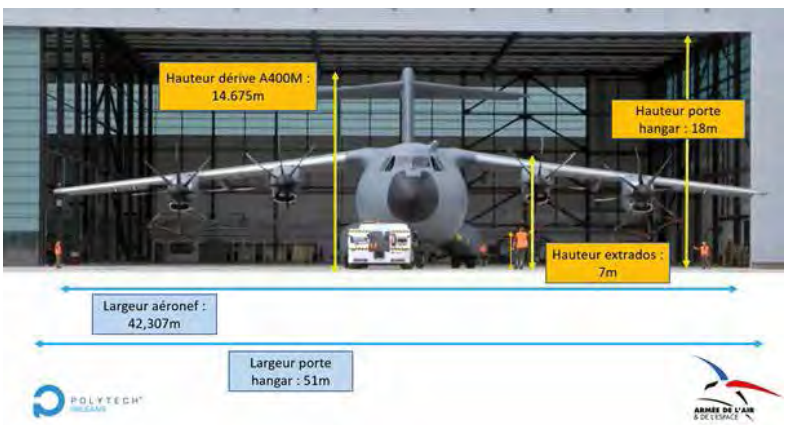
The exchanges with our interlocutors on the military base enabled us to choose two solutions:

- Solution 1: Fixed ceiling cameras
- Solution 2: Fixed cameras on Hangar deck

The first solution would involve the installation of multiple cameras (18) to cover the entire surface of the aircraft.
The second solution will require fewer cameras (7) but will involve the automation of the movement of the hangar deck or the assistance of a technician to perform the acquisitions.
The entire system will be wired to a PC to allow remote control and image recovery.

Keywords: Army, aircraft, camera, process

Possible design for inspection application



Dimension of the aircraft compared to the hangar

Interior view of the hangar with the aircraft

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Implementation of SBSFU Security Solutions on Processors

Electrical engineering

Haoliang QIN
Academic supervisor: C. ALAYRAC
Industrial supervisor: S. ROUXEL

Company: CRESITT Industries

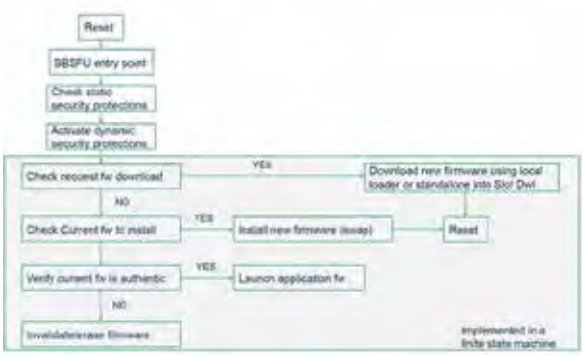
Objective/motivation

For a microcontroller, most data are stored directly in its own memory (flash memory, registers, SRAM, DRAM, etc.) and includes a lot of sensitive information, such as encryption and decryption keys, user privacy data, etc. Hackers can inject their code, force memory overflow or use detectors to steal user code and data in MCU devices. In addition, unprotected microcontrollers can easily be reverse-engineered. In the context of the rapid development of the Internet of Things and smart devices, the protection of microcontrollers has become more and more important. In this project, we will analyze the impact of new security technologies on system performance from the four perspectives of flash memory occupation, power consumption, initialization time and code execution speed.

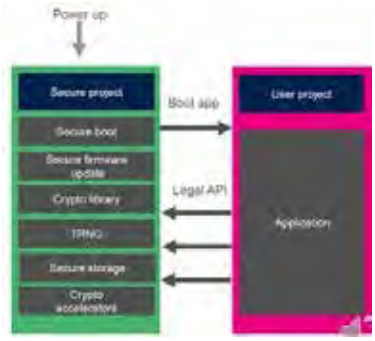
Results

By comparing with the control group, we understand the impact of using SBSFU technology and TrustZone technology on the performance of the microcontroller. Developers can decide whether to use these new security technologies according to their actual needs. At the same time, we have also established some corresponding templates which developers can directly use for their project

Keywords: SBSFU, TrustZone, STM32, Security



SBSFU concept



TrustZone concept

Screenshot of oscilloscope

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Integration of Photonic Structure

Physical engineering

Lucie LARAIGNOU
Academic supervisor: A. Stolz

Institution: Academic, Polytech Orleans

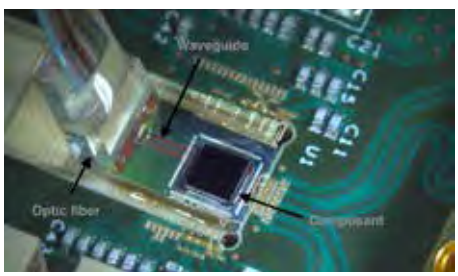
Selected Participant
15th Annual Final Year Projects Forum

Objective/motivation

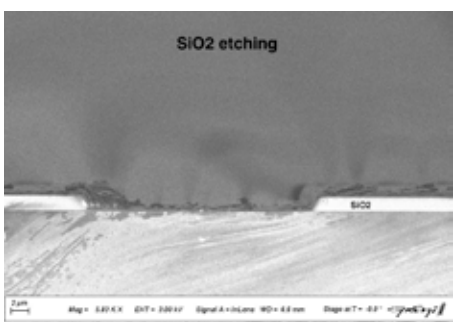
In microelectronics, the information transmitted from an optical fiber to the components of a chip is generally scattered throughout the chip. There is therefore a loss of signals in numbers and power. For this reason, light guides have been manufactured: to guide the signals to the components and minimize these losses. These guides are made of silicon because this material allows the transmission of non-visible rays (rays transmitted by optical fibers). In some applications, such as Lab-on-Chip, it is desired to be able to guide signals in the visible range. Thus, this project consists of creating optical guides for blue LEDs. This work consists of 2 parts: the manufacture of the LEDs and the optimization of the process for creating the guides.

Results

To optimize the process for creating the guides, 24 tests were carried out. It is advisable to find a good shape and thickness of etching to obtain the best possible guide. We wanted 2 µm for the thickness and a rectangular shape. Some of the tests were not conclusive because the resist has melted and this being the case, it is impossible to conclude on several results. However, the other processes allowed us to achieve an optimal process. These samples allowed us to observe a relationship between the varying parameters and the thickness of the etching guide. The LEDs were manufactured but could not be finished. Indeed, the equipment that allows the waveguide to be etched is no longer functional.

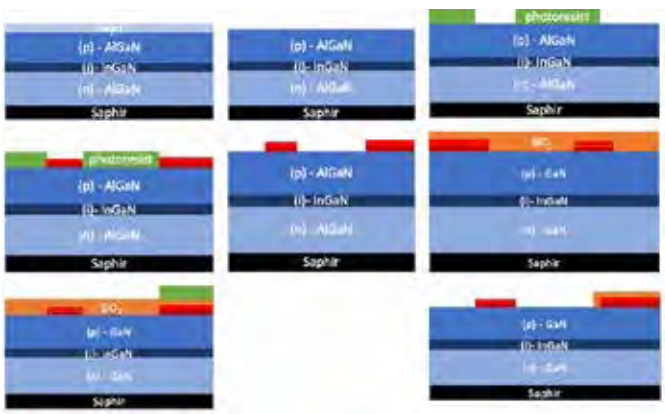


Optical guide



SiO2 etching

Keywords: plasma, cleanroom, photonic, waveguide, LED



Microfab process

Contact: lucie.laraignou@etu.univ-orleans.fr

Lighting in degraded light conditions

Energetics

Aurélie NIEL
Academic supervisor: C. CACHONCINLLE
Industrial supervisor: L. CALDAIROU

Company: Base Aérienne 123 Orléans-Bricy

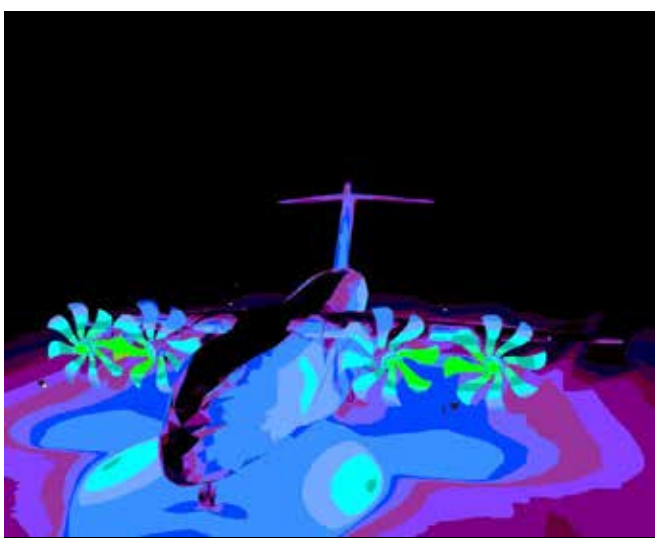
Objective/motivation

The project was given by the Bricy airbase near Orléans, it is a real need because for the moment, when they need to repair or control an aircraft by night, they just use a flash light. For a 45-meter-long and 15-meter-high aircraft, it is not secure. So, the aim of the project is to create a system able to light the entire aircraft to help the mechanic to repair with low visibility in case of bad weather or at night. The system can be used on the airplane park or can be deployed in other countries to check of the aircraft before the flight. So it must be simple to use, relatively light, powerful, adaptive and compact.

Results

Four models were imagined and simulated on Dialux Evo with different lights. Some criteria must be taken into account such as the autonomy of the lighting system, visibility (it may be necessary not to be spotted in risk areas), weight and height (due to the wind). The dimensions of the aircraft complicate the different simulations because of the different shadows and the power required to illuminate the entire aircraft. Moreover, the installation time of the systems must be kept to a minimum to ensure the use of the equipment. If it's too long, the mechanic won't want to install it in order to save time.

Keywords: airbase, A400M, lighting simulation



Simu dialux

A400M

Simu dialux

Contact: aurelie.niel@etu.univ-orleans.fr

Maintenance of optical components and birefringence

Physical engineering

Mélodie HERNANDEZ
Academic supervisor: T. GIBERT
Industrial supervisor: A. MONSTERLET

Company: Cilas

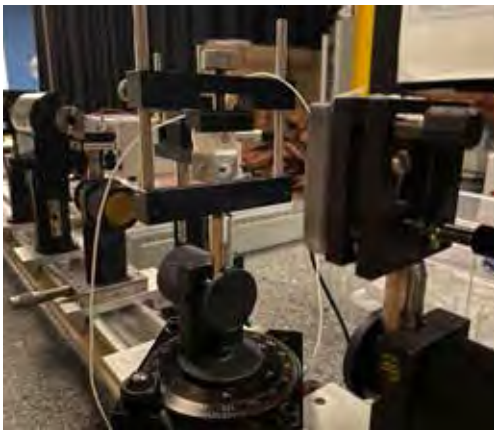
Objective/motivation

Laser are composed of several elements, such as polarizers, diodes or electro-optical components. The objective of this project is to characterize the Pockels cell which acts as an optical switch allowing or not the light transmission. The birefringence of this element is studied in function of voltage, axial misalignment and homogeneity. Thus, the aim of this project is to determine the role of the Pockels cell in the malfunctioning of Lasers due to depolarization.

Results

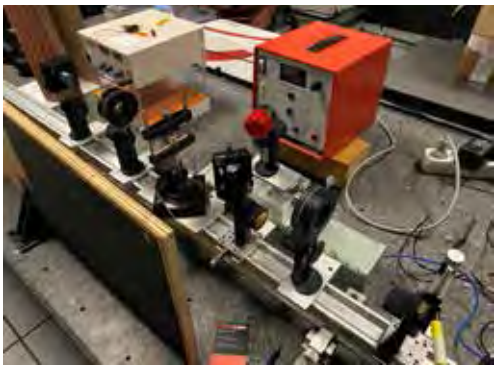
After studying the Pockels cell from the angles mentioned above, it is possible to conclude that this component could be one of the problems of the laser malfunction. Indeed, if the voltage applied to this electro-optical component is not perfectly stable, the induced birefringence will unwanted laser switch. Moreover, it is essential that the axis of the Pockels cell is parallel to the optical axis because a difference, even of 2°, causes an unwanted and different birefringence.

Keywords: Laser, physics, optical instrumentation



The Pockels cell

Optical assembly



Optical assembly

Contact: melodie.hernandez@etu.univ-orleans.fr

Segmentation by deep-learning and registration of multimodal images in Android

Electrical engineering

Min WANG
Academic supervisor: S. TREUILLET
Industrial supervisor: S. TREUILLET

Company: PRISME Laboratory

Objective/motivation

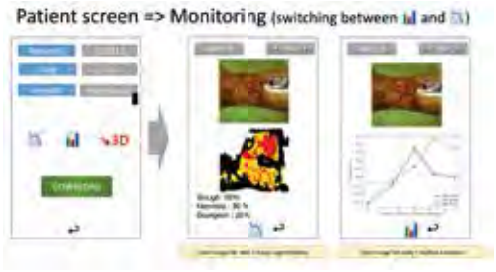
As the longevity of the population increases, the incidence of diabetes-related complications also increases. Among the complications of diabetes are foot problems, the most common cause of non-traumatic limb amputation. The feet of people with diabetes can be affected by neuropathy, peripheral arterial disease, foot deformity, infections, ulcers and gangrene. The objective of the project is to develop a mobile application on Android smartphone to help hospital staff or the patient himself monitor ulcer wounds with a tablet/smartphone equipped with a FlirOne Pro thermal camera. The application should make it possible to monitor healing indicators from the processing of color and thermal images and a relief map.

Results

After about two months of work programming on Android Studio and with regular meetings with my academic supervisor, This app now implements some basic functions:

- Store and manage patient information in a database
- Process the picture and segment the wound
- Call the ToF camera configured on the phone to scan the wound and then produce a 3D model
- Download the existing wound 3D model and display it in the app

Keywords: smartphone application; Android, deep-learnin, Image segmentation, 3D modle



Show wound information

Monitoring wound information

3D display wound model

Image processing in the app

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SUSPECT project ,interface for interception of transmissions

Industrial engineering

Maxime CAUDRON
Academic supervisor: R. WEBER
Industrial supervisor: L. PONCIN

Company: Armée de l'Air et de l'Espace

Objective/motivation

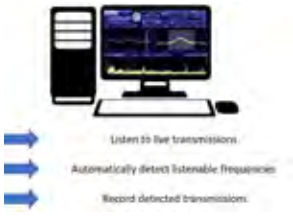
The Ground Electronics Squadron is an Air Force unit specializing in the interception of telecommunications and more particularly Hertzian transmissions. The unit is regularly required to deploy around the world to gather pieces of information about crisis situations.
The SUSPECT project consists in automating the search and optimising the characterisation activity. The aim is to develop an electromagnetic spectrum scanner in the HF, VHF and UHF ranges (up to 3GHz) in order to detect the different transmissions.
The general idea is to reduce the resources (material and human) dedicated to these two activities in order to increase production capacity.

Results

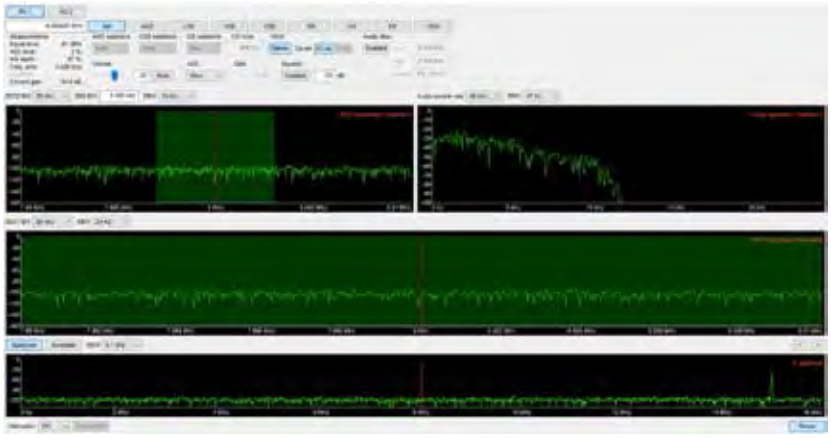
This project has led to the completion of an interface that allows the realization of different functions.
It is possible to listen a transmission directly by selecting a listenable frequency. It is also possible to visualize the spectrum of the frequencies to be detected. Finally, it is possible to scan the spectrum in order to quickly identify the frequencies of the listenable transmissions.

Keywords: human-machine interface, transmission detection

Project functioning



Software functionality



Software interface

Contact: max-caudron@hotmail.fr

Takeover and Finalization of the OPERA 2.0 Application

Electrical engineering

Qi ZHAO
Academic supervisor: P. RAVIER
Industrial supervisor: C. JOUBERT

Company: La Fabrique Opéra Val de Loire

Objective/motivation

Create an Android application for La Fabrique Opéra Val de Loire to provide information about the Theatre of Orléans and let people know and enjoy the magic of opera in an immersive way. Provide a tool enabling La Fabrique Opéra Val de Loire to manage the mobile application content efficiently.

Results

For the client, this application provides a brief but comprehensive introduction to the Theatre of Orléans. At the same time, customers can obtain theatre information inside the application, such as the timetable, ticket price, and actors. Some QR codes are provided that customers can scan to get the information quickly. In addition to this, to attract younger customers, the application comprises a mini game about theatre knowledge and a funny augmented reality camera with 3D face masques.

For the server, WordPress is installed on the server, and some WordPress pages containing the corresponding contents of the mobile application have been created. La Fabrique Opéra Val de Loire's manager can use the Divi editor inside WordPress to manage texts, images, and videos of the application. The mobile application can update the contents in real-time.

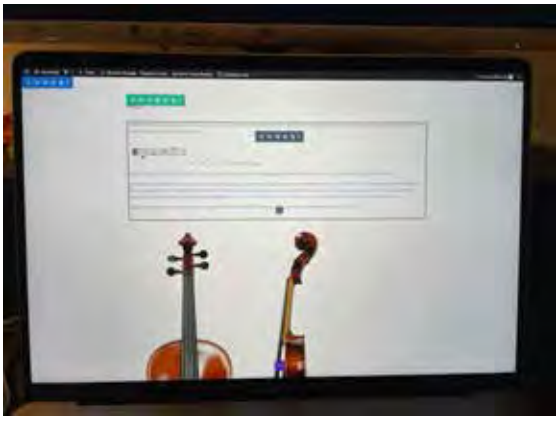
Keywords: Android development, augmented reality, SQLite, WordPress, Opera theatre

Orchestre

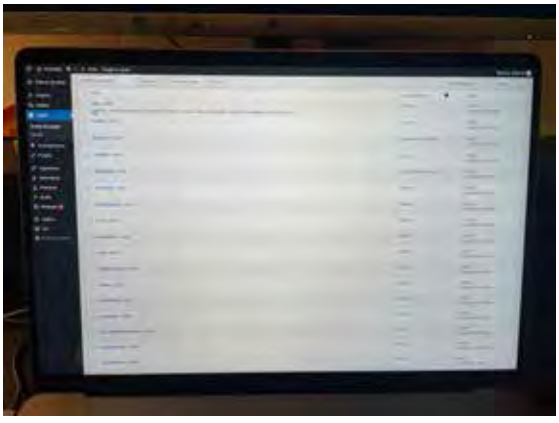
Theatre Presentation

Orchestre

Mini Game



Content editor



Content Management

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Thermal Image Processing of the Arch of the Foot by Deep Learning. Android Implementation

Electrical engineering

Baojie WANG
Academic supervisor: R. HARBA
Industrial supervisor: R. HARBA

Company: PRISME Laboratory

Objective/motivation

Among the complications of diabetes, foot problems are the most common cause of non-traumatic limb amputation. According to research, the lifetime incidence of foot ulcers in diabetic patients is about 15%, and may even be as high as 25%. It is helpful for treatment to detect the diabetic foot early. The goal of this project first is to use convolutional neural network (CNN) for semantic segmentation in order to extract the arches of the feet in the images. Then, we imported the results of deep learning into Android. The smartphone combined with Thermal camera to take the thermal images. The gray value of the thermal image corresponds to the temperature. The image after semantic segmentation is used to calculate the temperature difference between the two arches of the feet. The area greater than 2.2°C is at greater risk of ulcers.

Results

The dataset used in this project has a total of 828 single-foot arch images, 700 of which are used for training and 100 for testing. Tensorflow is an open-source Python deep learning framework. In this framework, the Deeplab v3+ model for image semantic segmentation is used. The output is binary images of the marked arch region. Then use the results of the automatic segmentation and the manually labeled ground truth, divide their intersection by the union to get the IoU (intersection over union). In order to obtain better results, the input images used in deep learning are preprocessed. We extracted the channels of thermal images and color images, and generate new images as input images for training. Through the comparison of IoU, the best input image channels settings and the best results can be obtained.

Keywords: Deep Learning, convolutional neural networks, semantic segmentation, android

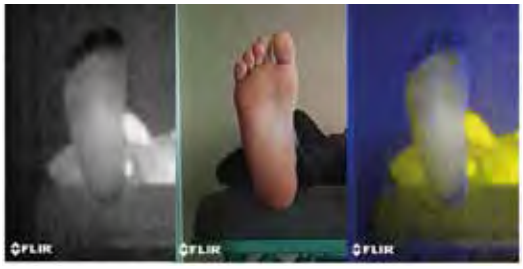
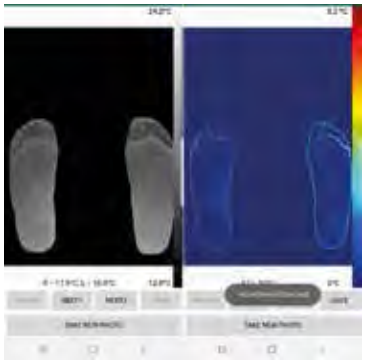


Image preprocessing



Temperature difference calculation

Segmentation results in the app

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Treatment of workpieces from additive manufacturing using a plasma technique

Physical engineering

Amélie AUDEBERT
Academic supervisor: R. DUSSART
Industrial supervisor: A. MAUDUIT

Company: Cetim Centre Val de Loire

Selected Participant
15th Annual Final Year Projects Forum

Objective/motivation

Additive manufacturing is a new technology. It consists in using a high-power laser to melt metal powders. These powders can be made of different materials such as steel, titanium, aluminum or chromium, making it possible to produce an infinite number of components. This manufacturing technique has many advantages, it allows the production of lightweight and complex workpieces, thus enabling an industrialist to reduce the number of parts used by manufacturing a single customized part. However, powder residues can be found on the surface of the parts which can be troublesome in certain applications (in case of liquid passage for example). This research project is investigating if plasma treatment of aluminium parts can remove micrometric powder from the surface.

Results

The tests performed with argon plasma did not show any efficiency in the cleaning of the parts. Chlorine plasma, a species used to etch aluminum, influenced the parts only with high bias voltage. However, a treatment with chlorine plasma allowed the metal powders to be etched on the upper surface but not to be removed. Moreover, this plasma treatment also degraded the surface of the parts by making them porous and new particles with a diameter of about 30 micrometers appeared.

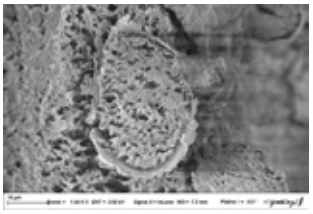
Keywords: Plasma, research, etching, additive fabrication

The new plasma reactor

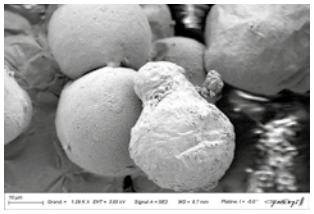
The new plasma reactor

Plasma treatment with ICP Corial reactor

Etched metals powders



Surface after plasma chlorine treatment



Powders

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Virtual Reality Application for Simulating Risky Situation

Electrical engineering

Kadi JIN
Academic supervisor: R. JENNANE
Industrial supervisor: A. BOISSONNET

Company: SDIS 45

Selected Participant
15th Annual Final Year Projects Forum

Objective/motivation

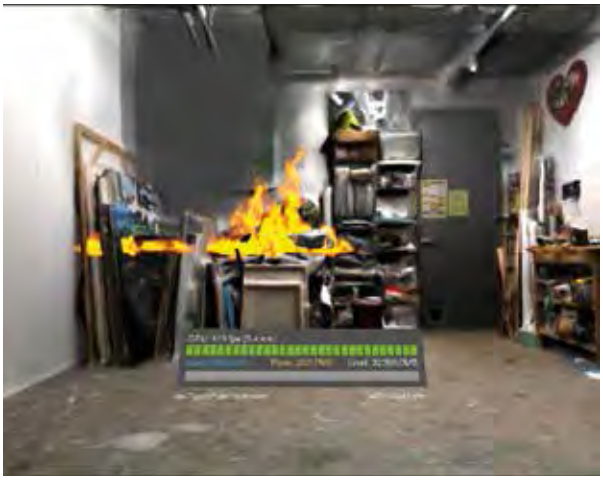
According to research, more than 250,000 domestic fires occur each year in France. This impressive figure means that a fire breaks out on average every two minutes, and that one in three French people is at risk of being affected by a fire. Most fatalities in a fire are not caused by the flames but by the toxic fumes. So, SDIS-45 is searching for a solution to raise public awareness of the risks associated with apartment or house fires. The objective of the project is to create a VR application which can put users in a virtual smoky enclosed space. The users can observe the evolution and propagation of smoke during the experience.

Results

After two months of programming on Unity/Visual Studio, our proposed virtual reality application already has basic functions. Using smart glasses, users can travel in a virtual room and observe the evolution and propagation of smoke. It was really a challenge to learn a new coding language (C#), along with the Mixed Reality Toolkit, Unity and VR development. With this new VR application, people can learn more about house fire security.

Keywords: VR application, House fire, HoloLens 2

User with HoloLens



Application Picture

Development Tools

Contact: jinkadi0603@gmail.com

Web Epsilon
Wireless boat equipment monitoring

Electrical engineering

A. MURALEESWARAN

S. RONGIONE

Aswaddaman MURALEESWARAN / Sylvain RONGIONE
Academic supervisor: F. DAUBIGNARD
Industrial supervisor: F. DAUBIGNARD

Company: APPEP

Selected Participant
15th Annual Final Year Projects Forum

Objective/motivation

The Epsilon application is a PLC-based system developed by APPEP that connects onboard equipment and devices of a leisure boat, monitors and controls them via a dedicated dashboard.
Our project is to determine the best communicating architecture and the most suitable solution for the 2.0 version of Epsilon called "Web Epsilon". We have to design an interface that will overcome the dashboard constraint, the goal being to create a more extensible application allowing multiple users to directly use their smartphones or tablets to control the boat.

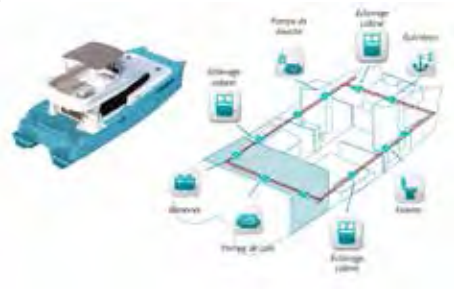
Results

The objective of the project was to study the feasibility of a communicating web gateway in a local security network for boats. First of all, we worked on the front-end part dealing with the graphic design of the web interface, the display of the boat plans, the various elements on board, the control buttons. For this, we decided to use Angular which is a suitable framework from Google to develop beautiful and interactive HMI. Then we worked on the backend part. We implemented the Flask API from Python into our Linux microcontroller to create our web server to process the receipt of client orders and send serial SCI (UART TTL) messages to the powerline network for boat equipment control. The gateway had to ensure bidirectional communication allowing the interface to display in real-time measurements of the boat sensors. For safety reasons, we ensured that all the operations and the boat as well as the condition of the boat are continuously recorded in a dedicated database. This study concluded with a delivery of our work to the company APPEP from Smarves in order to prove the feasibility of the project.

Keywords: web interface, programming, embedded, electronics, boats

Frameworks used

Linux microcontroller OposSom



Boat PLC network

Web-epsilon-interface

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Industrial Engineering applied to Cosmetics, Pharmacy and Food Processing

Alternance Planning assistant

Industrial engineering

Ana Caroline DE SIQUEIRA DANIEL
Academic supervisor: G. HIVET
Industrial supervisor: P. RUCH

Company: Firmenich

Objective/motivation
Firmenich is the largest privately-owned perfume and taste business in its industry. The global company is on the market more than 125 years with sustainability at the core of our strategy. Within the company, there are 3 divisions: flavors, fragrances and ingredients. Firmenich Grasse is classified in the last category as an affiliate dedicated to the production of natural ingredients. These ingredients are mainly used for fragrances but also for flavors. Working within the planning service the objective of my work as a planning assistant is to assist the Firmenich Grasse planning team. The projects that I have been entrusted with aim to improve the planning department in a continuous improvement process. The main project being the redefinition of the standard packaging for products sold between the affiliates.

Results
Each project has a specific expected result, employing tools and solutions, providing better management of time, materials, and economic gains that will improve not only service planning, but the company's entire supply chain. For the main project until in development is expected the definition of a maximum of 3 standard packaging per product generating at the end effectiveness for planners in the process of choosing the conditioning of products and an inventory reduction and consequently cost reduction.

Keywords: Planning, supply chain management, chemical industry, natural ingredients, perfumery, continuous improvement

Firmenich site Grasse

Firmenich Grasse

Planning room

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Collaborative Robot UR3

Industrial engineering

Q. QI

X. SHEN

Qi QI / Xinyi SHEN
Academic supervisor: J. ROUSSEL / C. CAPDESSUS

Institution: Academic, Polytech Orleans

Objective/motivation

To limit the interventions on a production line, one possible solution is to use robots. These robots are aware of their environment through various sensors, which allow them on the one hand to perform "intelligent" actions and on the other hand to react according to events. We can therefore entrust them with missions involving collaboration with a human. They can also be programmed to be safe for objects and humans in their environment. The goal is to program a "collaborative" application. It is no longer a question of programming the robot to take an object at a given position, but for example to retrieve it in the hand of a partner operator with the help of an industrial vision system, and this without any risks of injury.

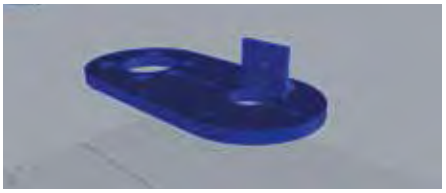
Results

First of all, we have mastered how to use the robot and vision system and inserted a collaborative program into the UR3 robot program so that we can use camera imaging to control the robot to find objects. Secondly, we actually measured the size of vision system and robot in the school factory. We 3D modeled the pallet used to connect the camera, lighting and robot and 3D printed it. Finally, in Flexsim software, we customized the appearance of the UR3 robot, and simulated our production line in the school factory, which involved filling, capping, tightening, testing and packaging. Among them, the robot needs to send the tightened products to the testing place and classify the products after testing.

Keywords: Collaborative robot, industrial vision system, 3D modeling, 3D printing, Flexsim simulation

PiCOBOT

KEYENCE-Vision System



3D modeling

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Continuous improvement in manufacturing in the pharmaceutical sector

Industrial engineering

Pauline LEMOINE
Academic supervisor: J-P. BLONDEAU
Industrial supervisor: A. MARTIN

Company: Sanofi Winthrop Industrie

Objective/motivation

The aim of this project is to establish standards, rules in a manufacturing cell. To achieve this goal, I deployed the 5S method. Today, in the current cell a lot of different processes are used to manufacture medications. Because of this, the work area is quickly messy. The 5S method will help to reduce tasks, movements with no added cost. The workplace will be safety and organized. This is a participatory management method making it possible to empower staff in improving the organization of their workspace. The method takes place in 5 steps: sort (remove the unnecessary), set in order (a place for each thing), shine (avoid sources of dirt), standardize (apply tidiness and cleanliness) and sustain (join and respect together the established rules).

Results

Today only the first S (sort) has been fully deployed. The second S (set in order) is underway on the equipment and some work has been started. Today, there are therefore no quantified results. However, the first S made it possible to remove a large number of elements from the cell which were never used by operators during production. The work area already seems tidier. Employees are highly motivated, have a lot of ideas for improving things and are starting to have a way of thinking and working that is close to the dynamics expected for a continuous improvement process. The next step is the validation of the second S and then the implementation of the following S.

Keywords: 5S method, manufacture, continuous improvement

The 1st S

The manufacturing cell

Communication board

Contact: pauline.lemoine@etu.univ-orleans.fr

Continuous improvement of Sanofi Pasteur Val de Reuil's laundry documentation system

Industrial engineering

Khady BA
Academic supervisor: J. ROUSSEL
Industrial supervisor: K. BENAMAR

Company: undisclosed (confidential)

Objective/motivation

I am in my last year of engineering studies and I am doing a work-study program in my company. It is a challenge to learn and work at the same time. The goal is to carry out my tasks and make them a success by the end of the year. It is an opportunity to develop my skills and gain experience and I can count on my colleagues and tutors to achieve these goals.

This will allow me to work in the sectors of quality and production in the pharmaceutic environment thanks to the experience that I will have acquired.

The realization of my tasks will make it possible to set up changes that will be controlled in the respect of the quality, to comply with the good manufacturing practices (GMP) by correcting deviations, and to set up means to facilitate these actions to the laundry workshop team.

Results

I carry out my duties in the Vaccine and Formulation Department, which is itself composed of the Formulation workshop and the Washing and Material Preparation workshop. I work in this last workshop whose main mission is to provide the formulation department with the clean material it needs for the formulation of vaccines. The main issue of my project is a quality gap. It consists in implementing changes, correcting the deviations that have occurred and preventing their recurrence. The final challenge is to deliver compliant products in accordance with regulatory requirements and procedures. My tasks consist of: the implementation of CAPA (Corrective Action/ Preventive Action), the integration of CAPA, changes and corrections in the quality documents and the creation of new quality documents, the treatment of CCR (Change Control Request), the update of the documentary mapping, the standardization of the reprocessing of the material in the laundry workshop.

Keywords: Quality system, documentation, corrective action, preventive action

Contact: khady.ba@etu.univ-orleans.fr

Continuous performance improvement in production

Industrial engineering

Anaïs GIRAUD
Academic supervisor: G. HIVET
Industrial supervisor: D. VIGNAU

Company: Sanofi Winthrop Industrie

Objective/motivation

Sanofi is considered as one of the most famous French pharmaceutical company around the world. The production site located in Ambarès-et-Lagrave is specializing in both dry and injectable medecine. As far as i am concerned, I am working in the injectable department of this production site and more precisely in the visual inspection/packaging area. My role is to improve both the performance and the quality of this department through different missions which have been entrusted to me. One of my main missions was to participate and analyse of trends in data concerning rejected pharmaceutical ampoules on visual inspection lines. Once this project finished, i participated to other projects such as continuous improvement ones. These projects allowed me to interact with different hierarchical levels and different departments to improve the performance of the department. It was also an occasion for me to improve my knowledge in these fields.

Results

The analyse of trends in data concerning rejected pharmaceutical ampoules on visual inspection lines made it possible to improve data concerning lot folders in mirage process. This data must be updated each year to improve the visual inspection process and this task will continue in the next few years. This study was the occasion for me to put in place a tool to see in real time the visual inspection process. This tool can be used to see in a brief way if a deregulation is appearing and immediately react when it's appearing.

Keywords: Electronic mirage, pharmaceutical industry, production, continuous improvement performance

Sanofi

Mireuse Electronique

Ampoule Pharmaceutique

Contact: anais.giraud@univ-orleans.fr

Creation of training modules for operator accreditation

Industrial engineering

Manon ACHARD-TORTUL
Academic supervisor: J. ROUSSEL
Industrial supervisor: C. SUSMAN

Company: Sanofi Winthrop Industrie

Objective/motivation

My project is to create training modules for habilitation. The objective is to reduce process deviations due to mistakes caused by the operator.
This training course is divided into two stages: firstly, the theoretical part, where the operator must validate the notions seen in the training module by answering a multiple-choice test, and then there is a practical part. This practical part will allow the trainee to carry out tasks in pairs with a tutor before being able to carry out the task alone.

Keywords: Pharmaceutical industry, training, production

Remplissage

Contact: manon.achard-tortul@etu.univ-orleans.fr

Digital project in packaging area

Industrial engineering

Justine SAINT-GERAND
Academic supervisor: J-P. BLONDEAU
Industrial supervisor: L. IMOBERSTEG

Company: Sanofi Winthrop Industrie

Objective/motivation

The goal of this project is to follow the performance of the factory using digital tools. In the packaging area, the production was traced by OEE paper reports and the objective is to replace it by a computerized OEE to collect the data about the stop machine, the quantity produced and the OEE. My task is to finish to deploy this software for all the packaging lines: it means dealing with suppliers, manage the installation, configure the software, train the production team to use it and fix the problem we can find.
The objective is also to analyse the way of how we use those data to improve our way to work: daily, weekly, and monthly meetings with the production teams, reports, action plans... and improve the OEE.

Results

Today, the software is in place on every line. All the stop machine, the time for changeover, the quantity produced and the OEE for the different products are collecting by this system. We use the data on daily meeting with the production team to follow the production and deal with the production issues in order to find solution and avoid it the next time. I created a graph to analyze the 5 big failures of the week for the entire manufacturing shop to set up action plan to fix it quickly.
The OEE is progressively used in the factory and my role is to continue to develop its use in the factory during the daily meetings with the operators and weekly and monthly meetings.

Keywords: Digital, lean management, performance

Packaging workshop

Software visual interface

Operator using the digital OEE

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Distance Courses (Lean – COVID)

Industrial engineering


L. JOSSE


L. PATRIS


S. SADIGZADEH


G. SHI

Lætitia JOSSE / Loïse PATRIS / Sevim SADIGZADEH / Guannan SHI
Academic supervisor: A. HIVET
Industrial supervisor: G. HIVET

Institution: Academic, Polytech Orleans

Objective/motivation

The current health crisis (Covid-19) has led to a complete review of teaching methods and organization of online courses. All the processes that were done previously in conventional and face-to-face teaching had to be modified in order to adapt to the new circumstances. During the first lockdown from March to May 2020, different actions and procedures were tested but without preliminary preparation. Indeed, the situation was unprecedented, and no organization or procedures existed: everything was done "on-the-job" and at the last moment.

That is where our project step in to find solutions for switching to distance learning.

The objective of this project is therefore to put in place a strategy and processes with different procedures for the implementation of distance learning. The purpose of these procedures is to guide people that are concerned by remote work: students, teachers and administrative staff.

Results

To best match the situation and be as effective as possible, the study was first based on teachers, students and administrative staff's feedback analyses, regarding the first and second lockdown. We listed the different processes that needed to be created or improved. The attendance process has been the priority since it's a legal requirement and a tool (for the industrial engineering's administration) to check whether the real schedule matches the programmed or theoretical schedule.

Furthermore, several indicators were created to ensure that the necessary conditions for transiting to distance learning are satisfied and that the industrial engineering department is well prepared. In addition, a Teams platform manual for distance learning has been proposed and continuously improved based on users' feedbacks and suggestions.

The project is still in progress and in the "plan" phase of the PDCA method. Once the different processes are implemented and tested, we will be able to see the results and measure their effectiveness.

Keywords: Lean, distance learning, organization

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Ergonomics project on an aerosol production line

Industrial engineering

Cécile PROAL
Academic supervisor: L. DELPLANQUE
Industrial supervisor: R. JULLIOT

Company: Soprocos – L'Oreal

Objective/motivation

Ergonomics is the scientific study of working conditions and the relationship between human beings and machines. The ergonomic project on a production line in the factory consists in organizing the workstation according to the limits of the human factor. We decided to begin this project on the production line that produces largest sizes of containers: 300/500 mL. Indeed, large containers mean heavy loads = ergonomic impact. The aim is to improve the well-being of employees at their workstations, by informing them about the right positions to adopt and by analyzing risky situations. By listing the ergonomic risks on the studied line, by quantifying the implementation of the solutions and by setting up the most relevant solutions, the objective will be to reduce the displacements covered by the operator, and the carrying of loads.

Results

With this project, we want to reduce the operator's movements on the production line, and the loads he carries. Concerning the carrying of loads, we noted 4 situations where the operator must handle relatively heavy loads, with a so-called "extreme" posture (See picture: "Carrying loads"). At the end of the project, the goal will be to have no more extreme postures. To reduce the load bearing and the displacements of the operator on his production line, we have brainstormed 24 actions to be implemented: organizational; dimensional; load carrying; efforts; technical actions. We are now at 7 completed actions.

Keywords: Safety culture, ergonomics, workplace well-being, cosmetics, aerosols, organization

Carrying loads

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Golden Rules of Quality: strengthening the culture of quality and product safety

Industrial engineering

Anaïs DETOUR
Academic supervisor: S. CHAKER
Industrial supervisor: O. COPIN

Company: Tereos Sucre France

Objective/motivation

As a leader in the sugar, alcohol and starch markets, Tereos develops a quality food offer that enhances the value of agricultural raw materials. The Connantre site ensures year-round seasonal sugar production and industrial sugar packaging. Tereos Connantre offers a complete and international BtoB (Business to Business) offer and works with major groups throughout the world. These customers, who are among the largest bottlers and food industries, have requirements in terms of sugar quality.
Tereos is therefore committed to providing its customers with safe products that comply with regulations and product quality and safety standards. In order to strengthen the culture of quality and safety of our products, we have set up a Golden Rules project. This project consists of the formalization of quality golden rules. We want to make our employees aware of their roles and responsibilities in terms of sugar quality and safety. To do this, we intend to deploy and implement these golden rules on the site. The idea is to share best practices in a continuous improvement process.

Results

The main challenge of this deployment of the golden rules at the Connantre site (pilot site) is to strengthen the product quality and safety culture. The aim is to guarantee the protection of sugar and thus ensure customer satisfaction and the protection of the end consumer. As it is an ongoing project, there is currently no final result.
For the moment we have started to deploy these golden rules via visual communications: every week a message concerning a golden rule is presented to the operators during the performance meetings. Regarding the deployment of these rules: displays on these golden rules are set up at strategic points of the plant. Meetings on the actions to be taken to protect the integrity of the finished product are held with the operators. Thanks to their ideas for improvement, we have developed an action plan and prioritized these actions according to the available budget and the impact that these actions will have on the field. We are currently waiting for quotes; the work will start soon.

Keywords: Quality, food hygiene, food safety, golden rules

Sucrerie de Connantre

Réception de betteraves

Campagne betteraviere

Contact: anais.detour@etu.univ-orleans.fr ; anais.detour@gmail.com

Implementation and management of data tools

Industrial engineering

Guillaume GAULLIER
Academic supervisor: A. HIVET
Industrial supervisor: O. POUILLIER

Company: Novo Nordisk

Objective/motivation

I am working on a new project in Chartres, FlexTouch project, it contains a new assembly line and a new packaging line. The purpose of this project is to respond a higher international demand from the market of insulin pens. My mission is to implement the data monitoring for the beginning of production. The tools must warn and notify maintenance technicians directly on the line of deviations and trend in scrap rates. This will allow us to be able to analyze precisely where the drift is coming from and therefore set up effective and proactive maintenance. Tasks for using data tools: Implemented all prerequisite (Ipad, counter validation...), trained all shifts, performance reports, follow data quality.

Results

Multiple data tools are implemented to help the production and maintenance department. I am responsible of the good utilization and comprehension of these tools. For example, we have implemented "RTFD", short of Real Time Failure Diagnostic", which uses Statistical Process Control (SPC), to help technicians to identify problems on the line with higher precision. It displays the behaviour of the line in details (in % of scraps or stops) for the last samples. Benefits: faster reaction to problem-solving and data driven mindset.

Keywords: Data, industry 4.0, lean, improvement

RTFD

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Implementation of 15 technical cameras on an aseptic line in a pharmaceutical company

Production engineering

Julien LEFEBVRE
Academic supervisor: A. HIVET
Industrial supervisor: E. TRI

Company: Novo Nordisk

Objective/motivation

The site of Novo Nordisk Chartres produces ever year millions of insulin-based products. The quality and the security of the patients are the center of all attention. In order to reduce the number of non-conformities on their aseptic filling line, Novo Nordisk wants to reduce at maximum the number of human interventions in controlled area class A.

For that, Novo Nordisk chooses to develop a new monitoring system based on the use of technical cameras directly inside of the line. During this year of internship, I worked on this project from the risk study through the cameras and support choice to the final implementation in August 2021. As a process engineer, I led this project through the numerous challenges that come with the production of pharmaceutical product.

Results

The project is on track with 15 cameras and supports ready to be installed. The final step will take place at the technical shutdown of summer where the aseptic line will be accessible for maintenance work. I am still currently working on the organization of the installation with the help of the maintenance, utilities, and IT services. Once theses cameras set up, the maintenance team will be able to overwatch every station of the filling line without the need of getting inside of the controlled area. The cameras records will be used for maintenance investigations as well as for technical analyses. This will lead to a decrease of both human interventions on the line and maintenance investigation time.

Keywords: Cameras, aseptic, line filler, pharmaceutical

Prototype de support caméra fait en impression 3D

Caméra Axis F1025 par SIEMENS

Capture de la vision d'une des caméra sur ligne

Prototypes de cameras sur ligne Danois

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Implementation of the production planning of an active principle within a multi-product workshop

Industrial engineering

Karima BARAKA
Academic supervisor: E. COURTIAL
Industrial supervisor: R. VHEL

Company: Sanofi Winthrop Industrie

Objective/motivation

I work within a production line in a pharmaceutical company belonging to the Sanofi Group. The production operations concern chemical synthesis of active ingredients. I work on improving the production of one of these active ingredients.
The aim of the project is to facilitate production management for managers and operators.
The project consists in setting up the production planning of a pharmaceutical active ingredient within a multi-product workshop.

Results

GANTT's planning of the process has been completed and will be displayed in the control room shortly.
I first defined the sequence of all the steps from the raw material to the finished product, then I associated durations to these steps with the help of a rigorous study.
A control table containing a set of information will be displayed in the workshop to facilitate the work of the production operators and make the control of the active ingredient more fluid.

Keywords: Pharmaceutical, active principle, process planning

Use of my GANTT for an operator workshop

Overview of the control GANTT installed in the control room

Zoom on the piloting GANTT

Contact: karima.baraka@etu.univ-orleans.fr

Lean Customer Satisfaction

Industrial engineering


K. BOULGHOUDAN


A. DINDAR


F. KCHABA


R. KONE

Khaoula BOULGHOUDAN / Aleyna DINDAR / Fatma KCHABA / Rokia KONE
Academic supervisor: A. HIVET, G. HIVET
Industrial supervisor: A. HIVET, G. HIVET

Institution: Academic, Polytech Orleans

Objective/motivation

Our motivation is the lack of monitoring of customer satisfaction in the specialty Industrial engineering. We define students and professors as customers of the specialty. By setting up this project we want to avoid : non traceability of customer satisfaction, lack of monitoring of customer satisfaction and the impossibility to implement improvement actions because of lack of information.

The goal of our project is to put in place indicators that will make it possible to monitor the satisfaction of the clients of industrial engineering specialty. To monitor these indicators, an effective process will be described to make updates easily and regularly. Our indicators will also be visual, precise and if possible timeless or otherwise adaptable to the changes that could arise in the organization of the specialty.

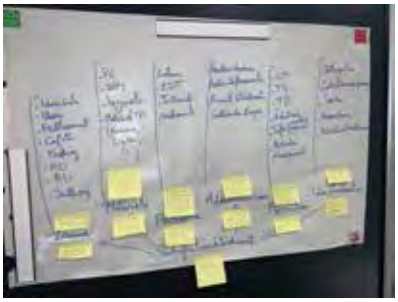
Results

As a result, we defined indicators for the clients of industrial engineering specialty. We have defined mainly 6 groups of satisfaction criterias for clients which are: Locals, Resources, Administration, Training, Student life and Corporate social responsibility. For each criterias, we defined indicators which will permit us to measure the satisfaction. We sorted those indicators by the way they will be measured and by the satisfaction criterias we defined.

Finally, we put in place a process in which we can collect and measure defined indicators. We suggested doing Gemba Walks for some of them, which means going to the front line to spot the problems and think about improvement. We also suggested satisfaction forms to be filled by clients when the indicators can not be measured in any other way.

Keywords: Lean management, client satisfaction, continuous improvement


Indicators which permit to follow-up our project progression


Indicators for the client "Student"


Indicators for the client "Professor"

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LEAN Organisation

Industrial engineering


K. BENAZZOUZ


M. CUENOT


J. GUENARD-PION


A. NAIT EL HADJ

Kenza BENAZZOUZ / Marie CUENOT / Jeremy GUENARD-PION / Abir NAIT EL HADJ
Academic supervisor: A. HIVET, G. HIVET

POLYTECH ORLÉANS

Institution: Academic, Polytech Orleans

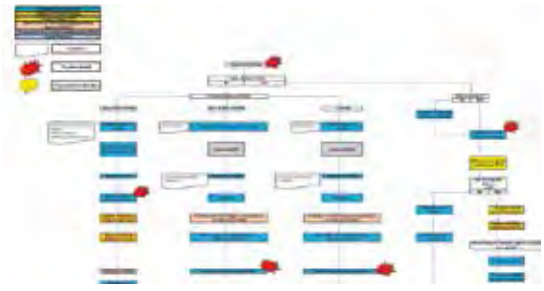
Objective/motivation

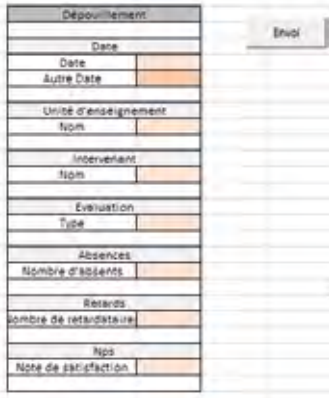
A major operational problem is noted by the staff inside the secretariat of “Génie Industriel” speciality based in Chartres. Indeed, customer and personnel dissatisfactions begin to arise. The staff believe that a lack of organization is the reason of these dysfunctions that generates feelings of get lost. In fact, the personnel are subjected to this situation. Their objective is to regain control and be in “pilot mode”. Our work is to adopt a LEAN approach to diagnose problems and their root causes, and to work on their resolutions. We want to avoid customer and personnel dissatisfactions and improve the service quality. Thus, we are particularly interested in the "Budget and Orders" and "Organization of Tasks" parts as well as the creation of a tool for data monitoring.

Results

To enable the data written on the students signing sheets to be entered and to emerge statistics, we created a tool via Excel. These data is allow better monitoring of delays and absences in relation to learning of the various stakeholders and EU as well as the associated satisfaction.
For the of budget orders, we created a flowchart to summarizing all steps needed to manage orders to define all the tasks of the budget orders process, specifying the place and the actor of each task.
We made a document to process teaching evaluations data to give a student satisfaction rating and be able to use it in different indicators and to detect problems.

Keywords: Lean, organisation, polytech, GI


Flowchart order



Excel Tool - Input


Excel Tool - Dashboard


Students Satisfaction

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Modeling and implementing a security system that protect operators from mooving parts on aseptic linefiller

Industrial engineering

Ayoub KHELIFI
Academic supervisor: G. HIVET
Industrial supervisor: M. MURE

Company: Novo Nordisk

Objective/motivation

As part of my last year at Polytech Orléans, I had the opportunity to join the aseptic filling production team at novo Nordisk.
Novo Nordisk Chartres, produces Penfills, assembles and packages insulin Flexpens. In the filling service we have two filling lines in a controlled atmosphere area.
In the general filling procedure, there is a step of performing a microbiological particulate control using an electronic device that analyze the air inside the Linefiller.
The company wants to perform this test and bring the equipment into the line without stopping it to meet its planned performance. In addition, employee safety is the priority of Novo Nordisk which seeks to eliminate any risks or risky situations that may affect the employee or the patient.

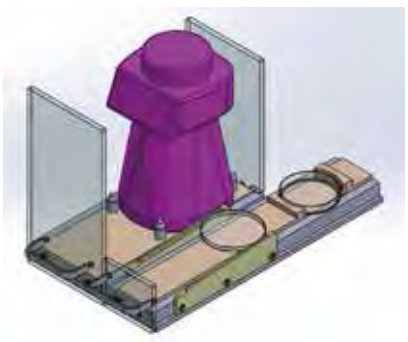
Results

As a result of a risk assessment study on the two filling lines, several positions were assessed as potential risks. In fact, when introducing electronic equipment inside the line through a hatch without stopping the machine, the operator can access to the moving parts on the machine which represent a danger.
I took an approach to come up with two systems that I modeled to meet all the constraints of the aseptic area, machine safety regulations and the circulation of laminar flow inside the lineFiller.
The two systems are different because of the dedicated space for sampling and the size of the lineFiller.
I have manufactured prototypes for each sampling point which will be tested during the technical shut-down of the company to validate the non-impact of a new element in the lineFiller on the quality of the product.

Keywords: ZAC, Machine safety regulations, quality of the product

Novo Nordisk chartres

Actual situation



New system to input the device

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Optimization of drying times (fresh or frozen fruits) in 24 hours

Industrial engineering

Gaëtan KANICKI
Academic supervisor: S. CHAKER
Industrial supervisor: R. BIGONNEAU

Company: Fruitofood

Objective/motivation

The objective is to find the parameters to achieve drying times in 24 hours with the best adjustment parameters to increase drying capacity. The company approves fresh or frozen fruits, these fruits put on several trays. After these trays will put in dryer. The fruits are heated between 50°C and 75°C to evaporate water for 48 hours currently to reach a moisture content between 0,4-3%. The adjustment parameters must allow to reduce the variability of the process to obtain fruits with the same moisture content (homogeneous) and organoleptic aspect and to optimize energy consumption (gas, electricity, and water consumption).

Results

I am currently working on the project optimization of drying times. In the first step, we studied the unit drying step. Subsequently in a second step, I am working with an engineering firm to integrate new equipment by writing the specifications (automatism, electricity, hydraulic, chilled water systems). In the third step, I am going finding providers to realize work at production site. The next step is the monitoring of work on sites. And the last step will feature to valid the works with minutes to ensure start-up equipment.

Keywords: Fruits, moisture, drying times, dryer process

Loading of lemons on trays

Dry products at the end of drying 1

Dry products at the end of drying 2

Dried apricot powder

Loading of lemons on trays 2

Contact: gaetan.kanicki@etu.univ-orleans.fr

Optimization of the 1400L Bins Flow within the site and trimestral allocation of the bins in line with the production's demand

Industrial engineering

Roshan KARKI
Academic supervisor: G. HIVET
Industrial supervisor: E. ROBINET

Company: undisclosed (confidential)

Objective/motivation

The pandemic has been a fierce teacher by changing consumer behavior and demand. The sales of antibiotics have slumped post Covid Crisis due to increased awareness in personal hygiene, social distancing, among others. This has forced my company, leader in antibiotics production, to be resilient by searching new business strategies like reducing operating expenses. The Site uses around 220 bins to stock and transport raw materials and intermediate products and costs around 170K euros for their annual maintenance and repairing. The objective of this project is to optimize the flow of the bins and find out the optimum number of bins needed to ensure the production.

Results

First, we proceeded by calculating the individual use rate of the total bins in the year 2020 and compared the trimestral use rate of the bins with the trimestral production volume over the year. The average trimestral use rate of the bins was 41%,38%,39% and 32% for Q1,Q2 Q3 and Q4 2020 respectively. Next, we did the process mapping to find out any bottlenecks in different processes where the bins could be retained for longer times than usual. All this helped us to reduce the number of bins and determine a panel of 100 bins to ensure the quarterly production planned for the year 2021.

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Quality Assurance Engineer

Industrial engineering

Élise CORDONNIER
Academic supervisor: M. BLONDEAU
Industrial supervisor: M. ROGEZ

Company: ADM-SIO

Objective/motivation

At ADM-SIO, our Mission is to offer to the Health and Nutrition industry our expertise and our mastery of plant-based ingredients manufactured according to the most demanding quality standards. Our products are used in pharmaceutical, cosmetics, feed and food industries and Quality is our TOP priority. During this period in the Quality Assurance department, I was in charge of following the implementation of preventive and corrective actions plans further to customer audits and regulatory inspection, further to internal audits specially for the purified pharmaceutical oils. Another project I managed the increase of the Quality level of one of our excipients to anticipate the future request from customers.

Results

At the time of publication, it is too early to report results for all the different activities.

Keywords: Quality, pharmaceutical, vegetable oils

Contact: elise.cordonnier@etu.univ-orleans.fr

Risk Management Education Program Project

Industrial engineering

Myriam BEN RABAH
Academic supervisor: J-P. BLONDEAU
Industrial supervisor: B. PRAL

Company: undisclosed (confidential)

Objective/motivation

Several issues have been identified by global functions and sites regarding weaknesses in the risk management training process. In order to strengthen the education and knowledge of personnel regarding Risk Management, we launched the "Risk Management Education Program" project in 2020.
This project, which is part of Sanofi Pasteur's Quality Plan, will harmonize the educational components that exist within Sanofi Pasteur for Risk Management by creating a Training Matrix that uses the Competency Based Learning (CBL) approach. As such, this Training Matrix will provide direction to sites regarding the Risk Management Curricula they will need to implement locally.

Results

In order to improve the training process, this project was set up to achieve the following objectives:

- Harmonize the education and increase the onboarding delay.
- Provide direction to the Sites regarding the Risk Management Curricula that they need to implement locally.
- And provide training ranging from awareness to expertise bast on needs of the sites.

Keywords: Quality risk management, training, education, program

Contact: myriam.ben-rabah@outlook.fr

Robotino Project

Industrial engineering


K. DUBAR


M. LIANG


P. ISSARD

Kévin DUBAR/ Minnan LIANG / Paul ISSARD
Academic supervisor: C. CAPDESSUS, J. ROUSSEL

Institution: Academic, Polytech Orleans

Objective/motivation

Our project consists in connecting the LIDAR sensor to the Robotino to make these trips autonomous on the site of the school factory. We will be able to make demonstrations during the practicals, during the open days and the science festival.

In the context of our project, the problem is the following: how the Robotino can use this sensor so that it can move autonomously to the various strategic points of the school factory without following a line drawn on the floor.

Results

The main results of our projects are as follows:

1. We have created a program and a protocol for the demonstrations of the Robotino.
2. We have successfully read the data transmitted by the LiDAR sensor
3. We researched different types of algorithm and prepared different types of tests to test them
4. We have prepared protocols and done research to allow the next groups working on our project to save time in their research.
5. We could not achieve the final goal of programming the robot to make it autonomous because it broke down.

Keywords: Festo, Robotino, LiDAR, Ubuntu, ROS


Production line


Robotino in storage


Robotino put down a pallet


Robotino movement


Robotino movement

Contact: kevin.dubar@etu.univ-orleans.fr ; minnan.liang@etu.univ-orleans.fr ; paul.issard@etu.univ-orleans.fr

Smart Monitoring

Industrial engineering


J. LANGLET


A. MINIER


E. PETIT


J. XIA

Jeanne LANGLET / Agathe MINIER / Emma PETIT / Jianing XIA
Academic supervisor: C. CAPDESSUS, J. ROUSSEL

Company: Novo Nordisk

Objective/motivation

Today, Smart Industry has only just begun. We worked on predictive maintenance which is one of its topics.

In the perspective of building a smart factory in our institute, the purpose is to contribute to the development of a demonstrator of a real time monitoring system that allows to check the screwing of caps in a SOLUJET via a communication between a sensor and a Raspberry. This may enable the development of monitoring systems for local companies with associated constraints and requirements on a larger scale in the future.

NovoNordisk, an industry manufacturing under aseptic conditions, is dedicated to finding solutions for remote monitoring instead of requiring human labour directly on site. Therefore, they are interested in implementing predictive maintenance to reduce costs and improve the accuracy of interventions. The aim is to understand their needs and to implement predictive maintenance in three parts of the production line: camshafts, parts in translation and chips and cracks.

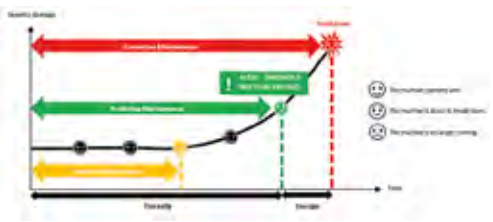
Results

For Novo Nordisk, our aim is to provide three reports detailing the problem observed in the production chain, the existing measures and the expected plans for improvements with detailed solutions (implementation, costs, deadlines, etc.) to the specific problems they raised.

For the Ravoux machine monitoring simulator, we have made a functional prototype which includes: a Node-Red program dedicated to monitoring the production process in real time, a user interface website and a database which records the data of each production. Users will be able to have access to previous data and thus have a long-term tracking of the production with this interface.

Keywords: Smart factory, predictive maintenance, sensor


Screwdriver of the SOLUJET


Explanatory diagram of the various types of maintenance

Project shematic : Monitoring 4.0

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emma.petit@etu.univ-orleans.fr ; jianing.xia@etu.univ-orleans.fr

Virtual Reality Project based on Flexsim

Industrial engineering

C. LI

F. LIU

Chan LI / Fangfei LIU
Academic supervisor: J. ROUSSEL, C. CAPDESSUS

Institution: Academic, Polytech Orleans

Objective/motivation

Controlling the contamination of human interventions has always been one of the keys for the pharmaceutical manufacture. The technology of Virtual Reality combined with digital twin can be useful to limit this kind of contamination. Our project aims to apply this technology in Solujet, a machine of bottling liquid medication in GI university factory. On the basis of a digital twin of Solujet made by the students of GI 4A 2019-2020, we try to make improvements in this digital twin to make it more and more like the real machine, and also to simulate human interventions in this virtual model. At the same time, we hope to find more possibilities of VR technology application in pharmaceutical industry by communicating with the professionals as well as the general public.

Results

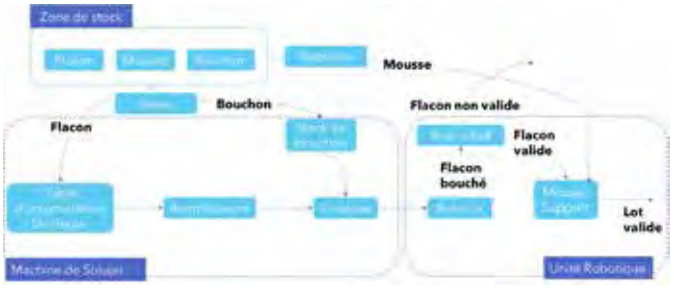
Firstly, we participated in the 2020 Science Festival of Chartres by showing to the public the virtual reality model of the production line of Solujet machine, which was developed by the students of GI 5A 2019-2020. And then we organized a meeting in order to exchange with the engineers of Novo Nordisk (Site Chartres) and discuss the needs of the pharmaceutical industry in terms of application of the VR technology. Besides, we accomplished a virtual dashboard in the FlexSim model of the Solujet machine, which now makes it possible to control the working of the model via the interface of FlexSim software. In the future, we hope to do a 100% realist modeling so that the model could be applied for training students at a distance to understand the working process of the Solujet machine.

Digital Twin of Solujet with a virtual dashboard

Real dashboard on the real Solujet machine

Keywords: Virtual reality, simulation, Flexsim, modeling, solujet machine

Poster in the 2020 Science Festival of Chartres



Schematic diagram of the production line of Solujet machine

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Innovations in Design and Materials

Anticollision system between airplane and lifting platform

Industrial engineering

Q. PAPILLON

J. PLUMEAU

Quentin PAPILLON / Julien PLUMEAU
Academic supervisor: E. BEURUAY
Industrial supervisor: L. CALDAIROU

Company: Base Aérienne 123 Orléans-Bricy

Objective/motivation

As part of our last year as engineering students at Polytech Orléans, we have to work on an industrial project. Ours is a plan development of an anticollision device between aircraft and platforms at the military air base 123 Orléans-Bricy. Our academic tutor is Mr.BEURUAY, teacher in electronics at Polytech and our tutor at the military base is Lieutenant CALDAIROU. These platforms have been used by technicians in order to carry out maintenance mission on particular aircrafts as A400M. Nowadays, such a system does not exist but using sensors seem to be the best solution to detect obstacles without any contact and with different warning zones detection. That is why, while respecting the rules in air security, we will have to meet the specifications in contemplation of performance improvement to reduce risks concerning collision with aircraft by March 12th, 2021.

Results

We were able to see the two different types of lifting platforms used for the maintenance of the A400M. We have seen that the two nacelles have very different dimensions, and our system has to adapt to this. One of the two types of platforms is rented, so it cannot undergo any modification, our system must be able to be autonomous and detachable like "Plug and Play" style. In addition, since maintenance is carried out 24/7, our system must be able to be installed in a maximum of two hours to minimize the loss of time for the requisition of the aircraft. We also noticed the narrow positions that the platform had to have, since the mechanic must approach the order of a centimeter to perform his operation. We therefore conducted our research for a contactless ultrasonic sensor.

Keywords: Airplane, platform, anticollision, military

The two types of lifting platforms on which we must adapt

The Airbus A400M, which we have to adapt to its materials and shape

Principle of operation of an ultrasonic sensor

The fixing system for our sensors without modifying the structure of the platforms

The Human-Machine interface that we developed under Labview

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Centering and motion system design for -inside- pipe refection

Mechanical engineering

G. BERTRAND

E. FONROQUES

Guillaume BERTRAND / Élodie FONROQUES
Academic supervisor: B. LE ROUX
Industrial supervisor: Y. PIALAT

Company: Kemica Coatings

Objective/motivation

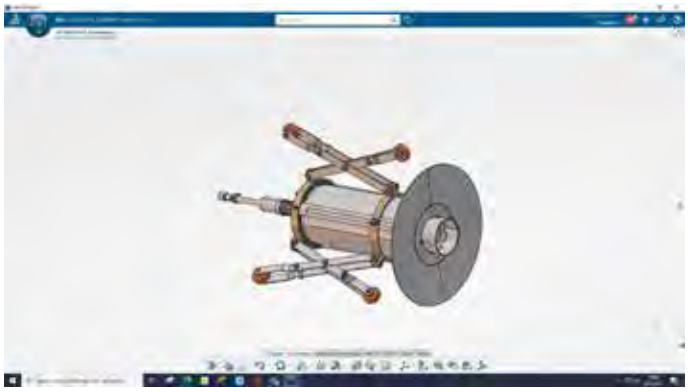
The purpose of this system is to rehabilitate existing buried pipelines rather than replacing them. To do this, the company Kemica Coatings uses a special resin that is projected on the pipe walls to seal them and to avoid their corrosion. Our job is to design a system to center and guide the spray head, and a system to drive and wind the cables. Kemica Coatings has developed a specific system for spraying resin in pipes. Therefore, our part consists in joining their work in order to bring the mobility aspect to their system in the pipes. We worked on a 3-branch centering star with casters to allow the passage of elbows for different-size pipes. The system mobility is assured by traction with a winch and a specific strand will be winded with a reel.

Results

We started with the centering part, we did a study on the existing systems which maintain the spraying head position at the center of the pipe. We found a three-branch star, this system permits a good stability and an adaptation to the different pipe sizes. Then we design the centering system on software, and created plans and simulation to make sure it would fit in bends. Finally we asked to make a prototype of this system.

Concerning the motion part, the main point was to know the force needed to drive the spraying head and all the cables and hoses. The difficulty was to find a solution for driving the head and cables but also wind them and feed continuously the spraying head during the use. Once, we knew all the data about the motion system, we worked with different suppliers to find a solution for this system.

Keywords: Pipe rehabilitation, pulverization head, centering system, movement system



Modele CAO

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Characterization and simulation of a seal during continuous casting

Materials engineering

Valentin DUPREY
Academic supervisor: J. GILLIBERT
Industrial supervisor: E. BLOND

Institution: LaMé Laboratory

Objective/motivation

The continuous casting process is a process that consists in making large metal parts by solidifying the molten metal. To innovate in this process, we need to find a new material stronger, more heat resistant, less expensive and more environmentally friendly. Therefore, LaMé laboratory is interested in a new solution of structural material, using a specific seal (mortar) between two refractory bricks. To find the right material, we need to test two different materials (bauxite and chamotte). To this end, samples were realized and tested during compression tests at heat temperature to look at their evolution until failure. Thereafter, we collected all the results to format them (graph, table, properties relation) and analyzed them to find maximum stress and strain. Finally, we were able to say if a solution was good or not and realized a final report for the laboratory.

Results

First, to start the preparation of all the samples, we drew their plans on the refractory bricks (9 samples with a 45° angle, 9 with a 55° angle, and 9 with a 65° angle) in order to cut them with a saw. Then we realized some compression tests at different temperature (room temperature, 600 degree and 1200 degree). To have good results, we needed to realize the same tests for three identical samples for all different angles. In addition, we did DIC (digital image correlation) tests with matlab. As a matter of fact, comparing our previous results from the machine test with these new ones helped us to have better stress and strain results. Lastly, we analyzed rupture facies of the samples. All the results allowed us to characterize the different materials as well as to meet the laboratory's needs.

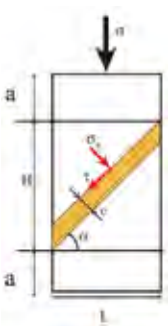
Rupture facies of samples

Keywords: Refractory bricks, heat temperature, compression test, dic

Compression test at heat temperature

Compression test at room temperature

X displacement of a sample by DIC



Slant shear test specimen

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Characterization of a steel from 3D printing

Materials engineering


C. GAUJEAN


M. MARTIN-MOYON


O. SALVAUDON

Charlotte GAUJEAN / Mathieu MARTIN-MOYON / Ophélie SALVAUDON
Academic supervisor: M-L BOUCHETOU, J. GILLIBERT
Industrial supervisor: A. MAUDUIT

Company: Cetim Centre Val de Loire

Objective/motivation

The main goal of the project is to characterize Maraging 300 steel from additive manufacturing : laser powder bed fusion (LPBF). Initiated for the FAMAD project (Additive Metallic Manufacturing for Aeronautics and Defense), the aim is to answer questions from Centre Val de Loire industrialists concerning the limits and benefits of additive metallic manufacturing processes. In order to provide CETIM with a database of maraging steel, crude and heat-treated (6 hours at 490°), we need to :

- Quantify the porosity ratio thanks to microscopically analysed sections and compare these data with the literature,
- Determine the mechanical properties of the specimens: first without and then post-heat treatment. Printed in two different orientations to check the anisotropy,
- Study the microstructure,
- Determine the roughness of our material.

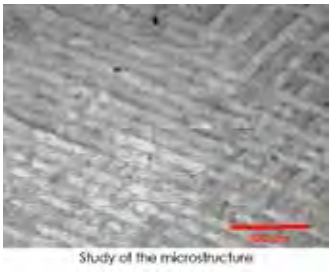
Results

Our samples have been printed by the UIMM of Orleans. We contacted them to learn more about 3D printing of metals and to have the samples printed for our tests. The printing was often interrupted by printing defects, so the tests were delayed. At this moment in time, we have only received a few of our specimens and due to time constraints; we have prioritized testing non-heat treated specimens in order to provide a complete database on one type of sample. Tensile tests have been performed on crude specimens. The study of the microstructure made it possible to link the orientation and size of the cords to the heat treatment. Tensile tests in the XY orientation were carried out. From the results obtained, various mechanical parameters such as Young's modulus were determined. Optical microscopic observations have made it possible to study the microstructure. They revealed the presence of pores within the metal measured by the vacuum impregnation method and immersion in water.

Keywords: Maraging, metal additive manufacturing, traction, porosity, microstructure


Visit of the UIMM (La Chapelle-Saint-Mesmin)

Visit


Study of the microstructure

Microstructure

Contact: charlotte.gaujean@etu.univ-orleans.fr ; mathieu.martin-moyon@etu.univ-orleans.fr
ophelie.salvaudon@etu.univ-orleans.fr

Characterization of the cohesion of fibrous structure to optimize the manufacturing of composite materials.

Materials engineering

Mathieu DEVOS
Academic supervisor: A. SHANWAN

Institution: Academic, Polytech Orleans

Objective/motivation

The manufacturing processes of composite materials depend on the behavior of fibrous structures that go into the manufacture of these materials. The cohesion of fibrous media is an important criterion which depends on the mechanical properties of these materials. The objective of this project is to characterize the cohesion of the fibrous structures in an experiment approach to define the influence of the shaping defects of the fibrous reinforcement.

I personally chose this project, because I am doing a course focusing on these materials, and this is what has fascinated me since the beginning of my academic course. It has enabled me to work on an experimental project in the laboratory, something new for me.

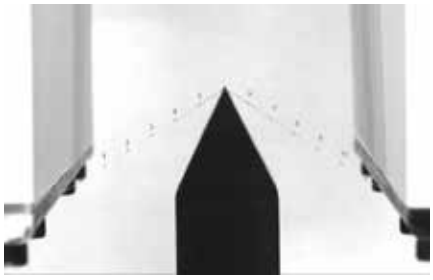
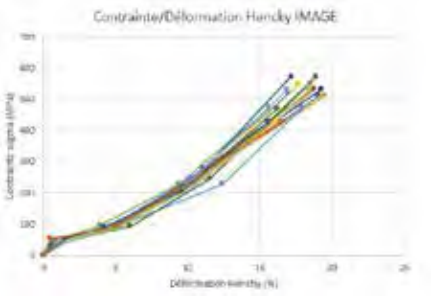


Photo from camera

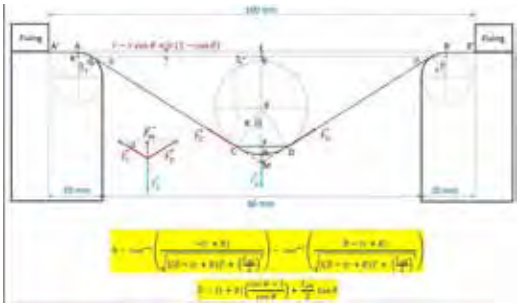
Results

After preparing samples for testing and carrying out nearly a hundred monotonic tensile tests and needling tests, the machines gave us a lot of analytical values, which we processed. The various tests were also filmed using a camera, so we also had to do some image processing. After the analysis, we were able to study the reproducibility of the tests and the associated dispersion thanks to Weibull's law. But above all, we obtained many tensile curves, which enable us to characterize the behavior of the tested material in traction. This project is an experimental one, so my conclusions on this project will mainly be the presentation of experimental data. This project was accompanied by scientific research work through a specific thesis on the microstructural behaviors of PA66.

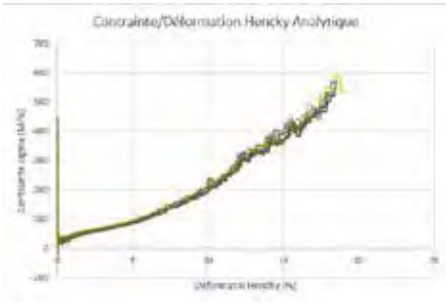


Graph Stress_Deformation image

Keywords: Characterization of the cohesion of fibrous media



Experimental scheme



Graph Stress_Deformation Analytical

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Design of a connected rodent trap

Environment engineering


M. FOURMY


C. GORMAND


A. GUILLET

Mathilde FOURMY / Colin GORMAND / Axel GUILLET
Academic supervisor: R. CANALS, M. MEKHILEF
Industrial supervisor: L. BELLOUT

Company: Dame2Pic

Selected Participant
15th Annual Final Year Projects Forum

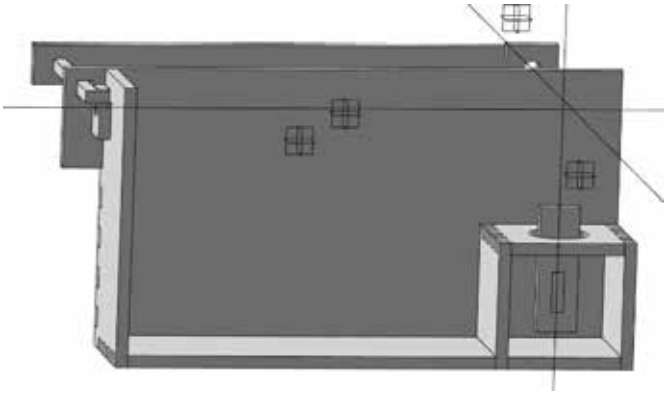
Objective/motivation

The goal of our project is to limit the use of biocide, as these products are harmful for biodiversity. Through this project, we were looking for a more ecological way to deal with pest control. Rodents always lives in colony and tend to warn others of danger. On long term, they get used to usual products such as rodenticide. The trap should be able to transform itself into a station bait. Thanks to the connected part, Dame2Pic will know exactly when a rat is captured and therefore abide by the law (stating that you must clean traps within 12 hours) and the client can have more autonomy (make appointments, be aware of an invasion...).

Results

All our mechanisms have been designed using 3D Experience, a computer-aided design software. The final design has been chosen from a wide panel of solutions, and the client chose the one that was best fitting their needs. The actual mechanism uses the movement the rat is creating by picking the food to libertate a rotating door. This movement liberates expansive resin, which then traps the rat inside the box. The trap is made with ABS, and the material's characteristics were checked thanks to the software Grante Edupack. All parts can be cut thanks to a laser cutting machine, so that broken parts can be replaced easily. For the connected part, the result consists of an Arduino card with a SigFox module to send the data and the hall effect sensor to detect the opening of the door as well as a web interface to access to the data.

Keywords: Rodent, trap, connect, multicapture, design


Front face of the prototype trap by CAD design


Front face of the prototype trap


Back face of the prototype trap

Contact: polypiege@gmail.com

Design of a hip protector for people with osteoporosis

Biomechanical engineering


R. DUQUENNOY


B. WARREN

Rémy DUQUENNOY / Benjamin WARREN
Academic supervisor: R. HAMBLI
Industrial supervisor: R. HAMBLI

Institution: LaMé Laboratory

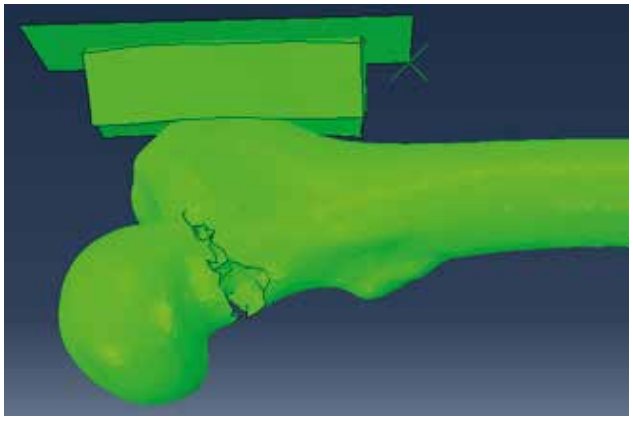
Objective/motivation

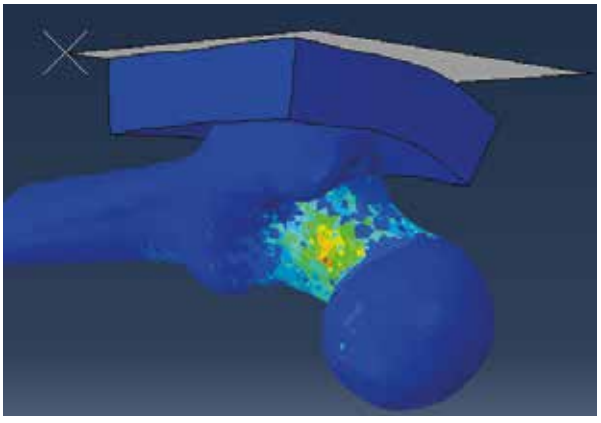
In everyday life, the human body can be subjected to shocks which can lead to bone fractures. Our subject of study is the protection of a particular part of the body which is the hip (Joint between the femur and the hip bone). Nowadays hip fractures are very common and, in some cases, may require surgery to place a prosthesis. Our project is to design a personalized hip protector for the elderly with osteoporosis to prevent hip fracture following a fall. To do this, we must carry out simulations on the femur models provided to us, the goal being to know the ideal dimensions of a hip protector of which we must define the material allowing sufficient shock absorption for different morphology (height and weight).

Results

All our work is based on simulations that we had to create on the Abaqus software. We had to simulate the fall of a person on his femur to see the influence that the morphology of each person can have on the stress that the bone will undergo due to the impact. We have first determined that the material used for our hip protector will be the EVA (Ethylene Vinyl Acetate) which is the most suitable for what we want to do. After understanding the influence of the body's morphology, we had to create a tool to size a hip protector capable of absorbing at least twenty percent of the impact to reduce the stress within the femur.

Keywords: Biomechanical, osteoporosis, simulation, health, hip


Simulation of a femoral fracture


Stresses on the femur during a fall

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Designing a biodegradable material for funeral urns

Environment engineering


A. BENCTEUX


M. GABAY

Alexis BENCTEUX / Marion GABAY
Academic supervisor: M-L. BOUCHETOU

Institution: Academic, Polytech Orleans

Objective/motivation

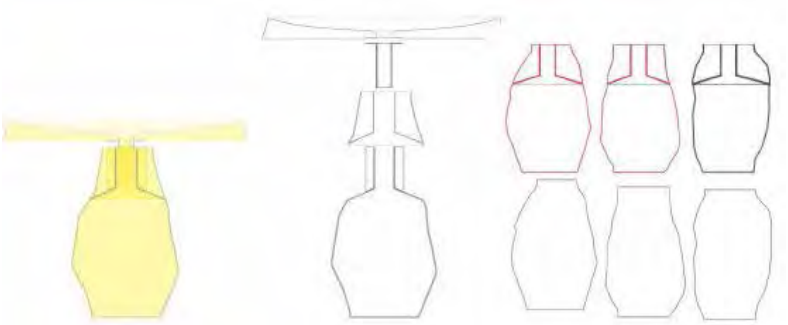
The final objective is to design a new material, an environmentally friendly one, which should be bio-based and biodegradable to make a funeral urn with a 3D printer. This urn will be placed around an "oya" which is an irrigation technique that always allows the ground around it to be fully watered and humidified in a homogeneous way. The most important is to bond ecology, death, and functionality: this urn should decompose in a few weeks to mix the ashes with the soil and provide the plants nearby with all the nutrients that can help them grow. The tree growth should bring a haven of peace to places that are mostly gloomy, and it permits the people that would use it to make a difference, environmentally speaking, even after they pass.

Results

The aim of our project was to find out more about ashes, the "oya" system, the 3D-printing technology and thus, complete the very basic knowledge that we had on these fields. The amount of ashes able to be mixed with the soil is also very important, to facilitate plant growth and not poison them. This project requires us to find a material that must match two priorities: it has to be bio-based (sustainable, recyclable, from renewable resources and cannot harm the environment in which it will be put) and 3D-printable (lots of techniques and different forms). So far, we have already picked several materials that could fit all the parameters: PLA (polylactic acid) which is made from corn starch and easily printable with the FDM method, a hybrid of PLA and wood fiber which has the same characteristics as PLA but the wood fibers enable it to have better surface conditions.

Keywords: Biodegradable, Material, Funeral Urn, 3d Printing, Environment


Project overview


The system design phases


The oya and its urn

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FANUC Industrial Robotics Competition

Industrial engineering


S. BENKIRANE


Y. HAMDANI


Y. MALKI


O. SOULAMI

Saad BENKIRANE / Younes HAMDANI / Youcef MALKI / Omar SOULAMI
Academic supervisor: A. FONTE

Company/Institution: Fanuc France

Objective/motivation

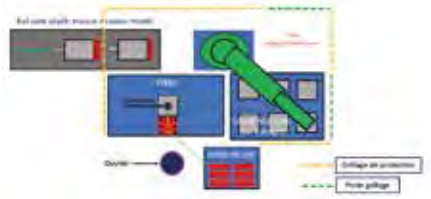
This project is a part of the annual Olympiads, organized by the company FANUC, our mission is to carry out a preliminary project linked to the industrial world. The objective of this project is to demonstrate the feasibility of automating an initially hand-operated production chain. So, we need to propose a technical alternative while considering the specifications. We need to automate a process that consists in assembling encoders on digital control motors. Consequently, we must design a new layout for the production line, to determine the combination of tasks between the robot and the operator. Then, we must choose the tools, and the robot to meet the criteria for our new line, from a catalogue provided by FANUC. Finally, we should also analyze the security aspects of the proposed facility.

Results

This project is divided into two parts: The submission of the preliminary draft, and the practical part of the competition.

So far, we have finished the first part in which we have sent a technical document explaining our choices, and our solutions, accompanied by a simulation on the ROBOGUIDE software, on which we have represented all the work done in terms of chosen materials, the organization of the line, as well as the programming of all robot movements.

Keywords: Robotics, production, operator, engine, automatic


New line


Chosen Robot


New line ROBOGUIDE


Program


Program end

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youcef.malki@etu.univ-orleans.fr ; omar.soulami@etu.univ-orleans.fr

Gain in mass, volume and performance by additive manufacturing

Materials

J-B. Aubéry

M-A. BIN-SUHAIMI

Jean-Baptiste AUBÉRY / Muhammad-Adeeb BIN-SUHAIMI
Academic supervisor: Ridha HAMBLI
Industrial supervisor: M-E. NAVE, L. MARCON, P. BECERRIL

Company/Institution: undisclosed (confidential)

Objective/motivation

Currently majoring an engineer graduation in innovation, material, conception Adeeb and I thoroughly looked for an industrial application that mixes innovation process and additive manufacturing in order to extend our knowledge in an emerging technology : 3D printing. After having received technical courses and modelled some applications, the industrial project was the opportunity to develop and use our knowledge. We also wanted to discuss with an industrial client and be confronted with their needs. The CILAS project proposed that mix. The point of this project was to design different kind of boxes to protect electric devices against multiple threats (chocs, oxidation...).

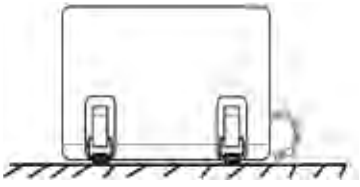
Results

The goal of our project was to design boxes by using couples of 3D printing processes (FDM, SLA, SLS) and materials (aluminum, ABS...) in order to minimize the mass and meet as much as possible the specifications (resist against the chocs, the corrosion, the vibrations...). After having done researches on technics and processes, we proposed four complete models to cover case of use. Our model are a combination of shape, material and process. Among our four models, one is especially for a low weight, one is made to minimize the volume, one is able to resist to the chocks and one is made especially to be opened easily (in case of regular maintenance). The next step is the building of the models with the 3D software in order to simulate them.

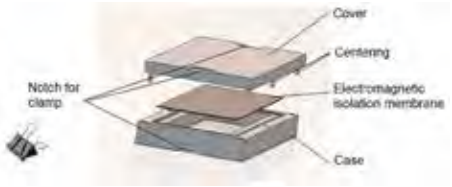
Keywords: Additive manufacturing, box, innovation, mass optimization, electromagnetic shielding

Existing protective case

Not dismountable protective case



Protective case removable without being disassembled



Protective case 2

Protective case 2 with 6 clips

Contact: jean-baptiste.ay@outlook.com ; muhammad-adeeb.bin-suhaimi@etu.univ-orleans.fr

Impact resistance of a screw

Mechanical engineering

M. AMÉRICO DE ALMEIDA

G. FOOS

Mateus AMÉRICO DE ALMEIDA / Guillaume FOOS
Academic supervisor: T. SAYET
Industrial supervisor: E. LEROY

Company/Institution: undisclosed (confidential)

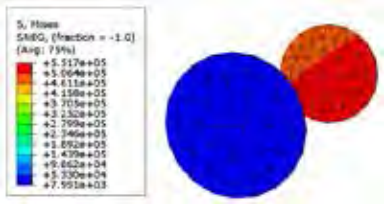
Objective/motivation

Screws are the most significant parts in most of fixation systems and are subject to massive mechanical loads. It is necessary to consider the impacts and fatigue resistance of these parts during the product design to guarantee the reliability of the equipment and the safety of its users during operations.
The objective of our project is to carry out a study of the mechanical resistance of screws to mechanical shock impacts by a simulation on the Abaqus software. Next, we will conduct a study of the fatigue of the fastening system of embedded equipment. The purpose of this study is to determine the lifetime of the system under operational conditions.

Results

The modeling of mechanical shocks on screwed assemblies is an old problem for which there are many solutions. However, it is important to guarantee the reliability of these models for manufacturers. The method used is a modeling of a screw connection using functionalities in Abaqus, which allows to calculate the acceleration and the resulting forces in the screw. The screw is modeled using a cylindrical connection between the two plates to which it is screwed. This technique allows a simplification and a saving of calculation time for the simulation, without having to model the screw in the model. The result of the simulation makes it possible to obtain the maximum stresses in the screw. With these different results, we can determine if the screw will withstand the shocks that it could undergo during its use.

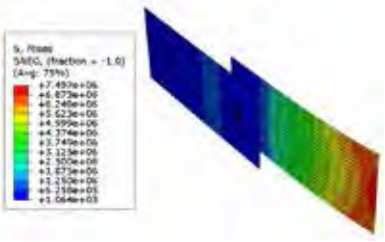
Keywords: Mechanical Shock, Screw, Mechanical Behavior, Modeling And Simulation, Abaqus



Von Mises stresses in the regions that represent the screw

Model assembly

Application of the fastener tool to represent the screw



Von Mises stresses on the plates

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Infrared emitter modelling

Industrial engineering


L. Cormier


Q. Giraud

Léo CORMIER / Quentin GIRAUD
Academic supervisor: M. MALKI
Industrial supervisor: M. MALKI

Institution: Academic, Polytech Orleans

Objective/motivation

This project called: "Infrared emitter modelling" is a study about finding the emitter's best positions to heat up a tile homogeneously. It is the continuation of a semester nine course unit called: "Glass and high temperature simulation." So, we will use some of the main models previously created to begin with this project. Our main steps are: 1. Theoretical study, 2. Modelling infrared emitter, 3. Comparison between the models and the real emitter from Polytech Orléans laboratories, 4. Study of enclosed radiations. Our goal, beyond having good models and simulations, is also to give new strategies about heating up a tile homogeneously.

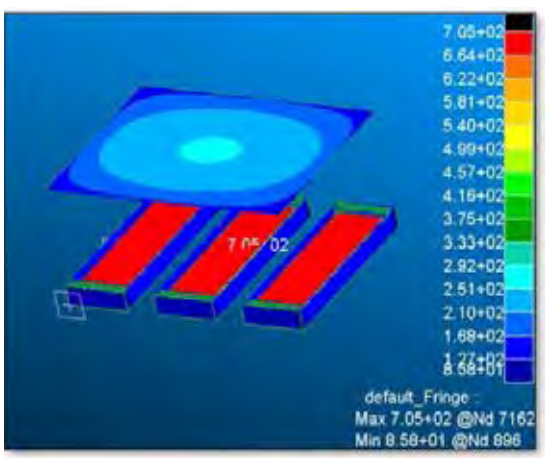
Results

With our project, we must simulate an emitter on Patran/Nastran software which will compute numerically and gives us the heat fluxes, temperature gradients and the temperatures of the emitter. In order to check our simulations, we must experiment on the real system in Polytech laboratories, thanks to a thermocouple. Then, we can compare the measured temperatures with the simulations. With the real system, we got 680°C at the center of the emitter, whereas Nastran calculated 705°C. Hence, we have a 3% error which is an excellent figure because it means that our 3D model is accurate. Therefore, we can correctly estimate temperature measures thanks to the simulation. Thus, we can use it to determine the emitter's best positions.

Keywords: Infrared emitter modelling heating up tile


Temperature measurement by thermal camera


Temperature measurement by thermocouple



Infrared emitter modeling

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LabVIEW Project to control the Carbon Caracterisation Machine

Electrical engineering

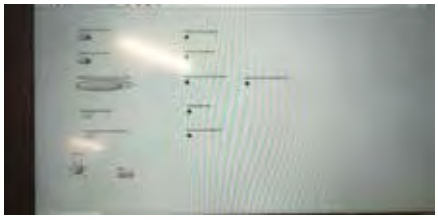
Lucas CHAZOTTES
Academic supervisor: J. GILLIBERT
Industrial supervisor: A. SHANWAN

Institution: LaMé Laboratory

Objective/motivation

The LaMé laboratory has developed a machine to analyse fibrous structures. This has to be controlled thanks to a National Instruments Card and a LabVIEW program. This project consists in creating a LabVIEW program in order to generate a Pulse Width Modulation (PWM) signal to control a machine. This signal will be transferred through a speed variator as shown on the illustration. This project is about to be included in the development of a global solution for Carbon fiber analysis, indeed the machine will be able to record the necessary strength and the position at specified intervals.

The main application of this program is in the Laboratory. The program developed in LabVIEW must be as simple as possible so as to be used easily by the technician.



Front panel of the LabVIEW code

Results

I have developed the hardware part for the project. It is now integrated in the entire system. Even if I had some issues with this development, they are now fixed. The engine is well moving in the two ways. I need now to develop the software part to launch the command of this machine. Moreover I will fix the problem regarding the communication between the machine and the computer.

Mitsubishi servo motor

Keywords: LabVIEW, electronics, carbon, control command

Complete electrical cabinet

Terminal block of the electrical cabinet

Manufactured electronic circuit

Ordering machine

Contact: lucas.chazottes@etu.univ-orleans.fr

Metallographic Atlas: Training tool for micrographic study of duplex steel

Industrial engineering


B. CORRE


J. MAISON


A. PERALDI

Baptiste CORRE / Julien MAISON / Alexandre PERALDI
Academic supervisor: M-L BOUCHETOU

Institution: Academic, Polytech Orleans

Objective/motivation

In certain temperatures conditions the microstructure of duplex stainless-steel changes thereby altering its properties. Pipes that are used in a maritime environment such as oil platform or offshore wind turbine must be corrosion resistant. This is an important issue to take into account so as to avoid serious accidents.

The goal of our project is to create a tool for a junior technician of a pipe manufacturing company or a Polytech student. In this way, they can have an experience in microstructure observation of duplex stainless-steel and they can specifically recognize the presence of deleterious phases (for example sigma phases). Another objective is to create a reproductible protocol which gives all information about the conditions and process to make sigma phases appear and reveal them with different etching.

Results

In order to observe the sigma deleterious phase, the first stage was to create it by applying theoretical conditions given by Norms. After the heat treatment, the second stage was to prepare the sample for the microscopic observation: the surface of the sample had to be polished and chemically etched. The different chemical or electrolytic etching had to be chose and tested to determine which one gave the best results for the visualization of the microstructure and the deleterious phases.

The major difficulty of the project was to be able to visualize the deleterious phases because they are quite scarce and fade into the microstructure making harder to distinguish and quantify them. The other challenges of the project are to write the protocols, to establish a database of the microstructures and to find a way to preserve the surface state of the polished samples.

Keywords: Duplex steel, sigma phase, polishing, electrolytic etching, microstructure


Example of a heat treated sample microstructure


Materials for electrolytic etching


Polishing machine


Measures before samples cutting


Example of one sample during molding

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alexandre.peraldi@etu.univ-orleans.fr

Modelling of a catalytic reactor

Industrial engineering


L. MACARRO


M. MANSON


M. PIFFETEAU-PAGNOTTA

Luis MACARRO / Marie MANSON / Maxime PIFFETEAU-PAGNOTTA
Academic supervisors: N. BETTAIEB , C. HESPEL
Industrial supervisor: V. HUYGHE

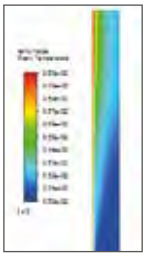
Company: TMFCT

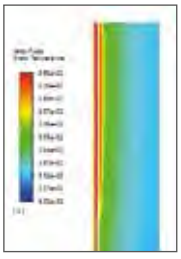
Objective/motivation

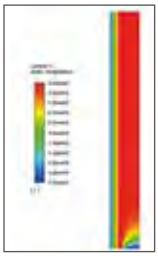
This project takes place in a chemical environment in a laboratory that wishes to carry out a catalytic treatment of alcohol vapours. These vapours are surrounded by a heat transfer fluid that must keep them at a temperature of 350°C. Therefore, the objective was to suggest a double-skin column design that respects thermal, geometric and mechanical constraints. With the help of documentation and bibliographical research, the first step was to establish a simple but effective model, thanks to several hypotheses and simplifications. Then, thermal theoretical calculation was carried out, followed by 2D modelling and simulations of thermal exchanges on Ansys Fluent®. Moreover, 3D models and simulations of mechanical stresses were achieved on Abaqus. Finally, with satisfying first results, the geometry was improved and the simplifications progressively removed to obtain a better and more realistic design of the column.

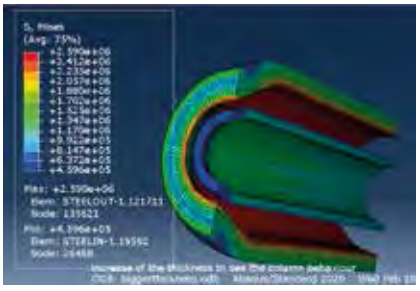
Results

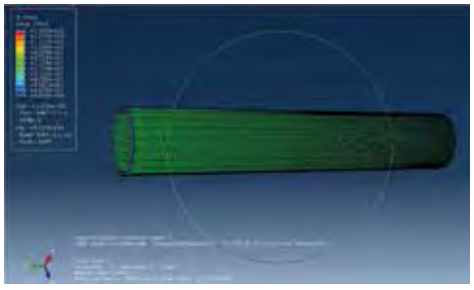
Thanks to the different characteristics of the fluids, materials and geometry of the chosen model, flow parameters and global heat exchange coefficients were calculated. Thus, heat production and losses were estimated as well as thicknesses and mechanical stresses. Studies were made in steady and unsteady states, then checked with 2D simulation to see if the column could handle the constraints while respecting specifications. Therefore, a numerical solution with correct parameters was found, enabling a temperature of 350°C maintained along the column. The results obtained from thermal simulation were: inlet and outlet boundary temperatures, temperature along the column, and heat exchange between fluids, materials, catalyzer and exterior. For the mechanical simulation, Von Mises stresses and strains in the column were computed and were below the material elastic limit. Eventually, the model will be optimized, and results will be helpful for the industrial boiler making study.


Reactor's fluids temperature in steady simulation on Fluent®


Zoom on fluids temperature in steady simulation on Fluent®


Final temperature in the column in unsteady simulation on Fluent®


3D mechanical simulation with deformation scale on Abaqus


Axisymmetric mechanical simulation on Abaqus

Keywords: Design, simulation, heat transfer, mechanics

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Numerical simulations of the dynamic fracture of human ribs

Mechanical engineering

Y. ABADA

A. MAKOWIECKI

Yassine ABADA / Augustin MAKOWIECKI
Academic supervisor: R. HAMBLI
Industrial supervisor: R. HAMBLI

Company/Institution: LaMé Laboratory

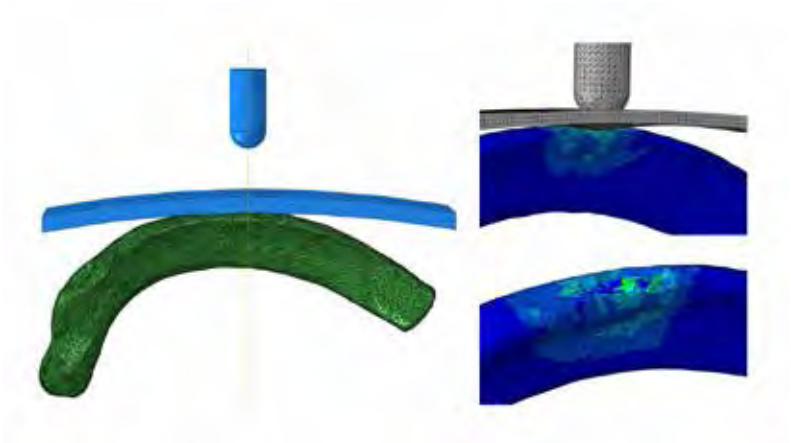
Objective/motivation

This last year project aims to simulate the mechanical behavior of thorax bones under different types of impact. The study focuses on a ballistic impact and a seat belt impact after a crash. We used the finite element method and Abaqus software to perform the analysis. The project can be split into two parts. The first one is the analysis of the elastic deformation following the impact until breaking. The second one is the post-fracture behavior study to determine the risks for vital organs inside the thorax. For practical reasons, we used a pork rib scan. As mechanical properties of pork bones are similar to human ones, the results have not been impacted.

Results

The first step was to develop the simulation model. We used the software Simpleware to convert the scan of the rib into a finite element part. We imported it on Abaqus, and we settled the study parameters such as the impactor's shape, velocity, and boundary conditions. Material properties of the rib are determined by Simpleware. We also added the quasi-brittle behavior found by Mr Slim DJEBIEN during a similar project in 2017. We obtained an adaptable simulation model. We computed many simulations of impacts on this base and developed some protection systems, especially for bullet impact. The picture below presents the deterioration of the rib's surface due to insufficient protection.

Keywords: Rib, fracture, biomechanical modeling, finite element



RibFracture schematic

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Realization of an exoskeleton to give physiological help to rescuers of the SDIS45

Mechanical engineering


T. GALICIER


J. MONETTI

Thomas GALICIER / Jérémy MONETTI
Academic supervisor: A. FONTE
Industrial supervisor: A. BOISSONNET

Company/Institution: SDIS 45

First Place and Innovation Award
15th Annual Final Year Projects Forum

Objective/motivation

Often, rescuers help 160Kg's victims in cramped spaces. Therefore, they extract on their own, the victim in unappropriated position that could lead to musculoskeletal disorder.SDIS45 asked Polytech Orleans to design an exoskeleton that could help them in these interventions. It must be resilient enough to support the victim, not cumbersome, easy to put on and light.

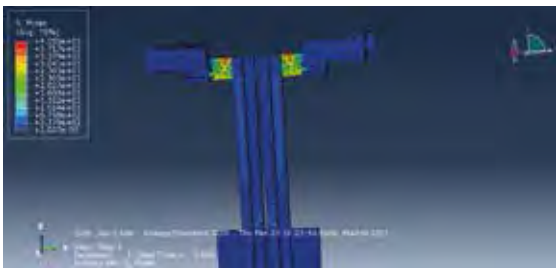
Results

To achieve this goal, we used 3Dexperience and Abaqus. 3Dexperience allowed us to create the exoskeleton and Abaqus to simulate the influence of the victim's weight on the structure. The method is to create a first exoskeleton on 3D experience, test it on Abaqus, then go back to 3Dexperience and improve the component's resistance by working on materials and dimensions of each parts of the structure.
In the end, according to our simulation. The Exoskeleton will easily support every stress and will stay flat. Consequently, the Exoskeleton is ready to become a real prototype.

Keywords: Exoskeleton, musculoskeletal disorder, conception, physiological help

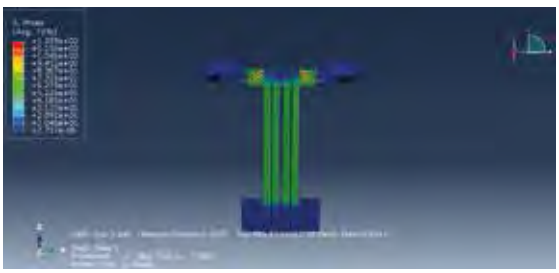

Exoskeleton compact form front


Exoskeleton compact form


Stress repartition Before on Abaqus


Exoskeleton compact form front


Exoskeleton setting elbow


Stress repartition After on Abaqus

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Specimen realization by using machine Form Up 350

Materials

A. J. HARATONO

S. WU

Abdul Jabbar HARATONO / Siying WU
Academic supervisor: S. THOMAS
Industrial supervisor: A. MAUDUIT

Company/Institution: UIMM, Cetim Centre Val de Loire

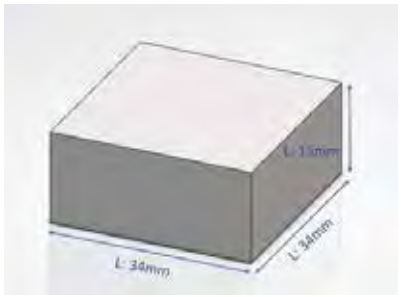
Objective/motivation

The objective of this project is to analyze the influence of different manufacturing strategies on the residual stress of the specimens manufactured by using a 3D printing machine called Form Up 350 which is located at UIMM. The different manufacturing strategy is including the presence of thermal treatment, the orientation of the specimens and the displacement of the laser. The material used to produce our specimens is maraging steel 300 which is provided by UIMM.

Results

We designed our specimens by using 3D Experience software and manufactured them by using a 3D printing machine called Form Up 350. Unfortunately, we were unable to obtain the specimens as the Form Up 350 machine broke down.

Keywords: Additive manufacturing, residual stress, maraging steel 300, experiment



Design of specimens

Additive manufacturing

Machine Form up 350

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Stress homogenization in a bondline during Lap-shear test

Mechanical engineering

A. GUIBERT

A. MIGUET

Alexandre GUIBERT / Anthony MIGUET
Academic supervisor: A. GASSER / T. SAYET
Industrial supervisor: K. AARON

Institution: NASA Jet Propulsion Laboratory

Selected Participant
15th Annual Final Year Projects Forum

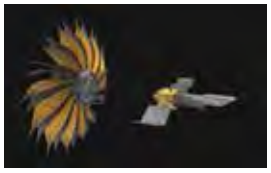
Objective/motivation

Bonded assemblies are found in a wide range of fields such as the aerospace industry. Indeed, adhesive bonding is a cheap, fast, and robust joining technique. However, high localized stress concentrations are commonly observed in the adhesive layer. These stress concentrations imply that only a relatively small part of the adhesive is carrying most of the load. The goal of the project is to explore modified bonded lap shear joints with tailored stiffness across the bonded region to allow more of the bonded area to carry useful load. The tailoring being considered is well suited to metallic additive manufacturing. The project uses Finite Element Analysis (FEA) to explore the different concepts. Some geometries are 3D printed to be tested and the numerical results from the FEA are validated experimentally using lap shear tests.

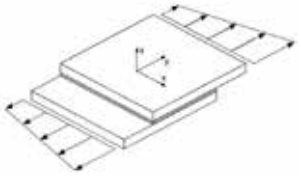
Results

As a first milestone, we created a finite element model to simulate a single lap-shear test. We made several assumptions regarding the geometry and the contact between the adherends and the adhesive for this first analysis. We compared the results with two theoretical models present in the literature. The finite element model of the single lap-shear test has been used as a baseline throughout the study. Then, we suggested and explored innovative single lap-shear geometries. We studied and optimized the different promising geometries and concluded on their added values. Two concepts were selected to be 3D printed and to be tested to compare the experiments with the numerical simulations. Finally, we discussed the results and made recommendations for future studies.

Keywords: Lap-shear, stress distribution, finite element analysis, additive manufacturing



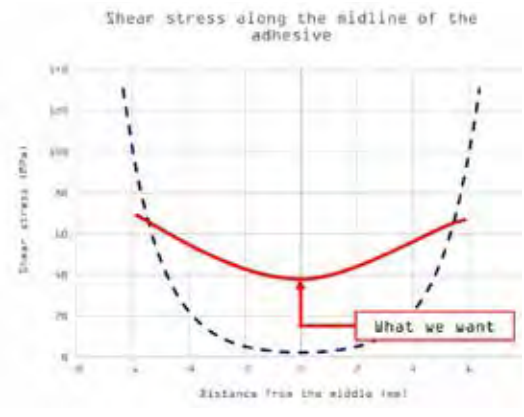
Artist's concept of the Starshade



Schematic of a single-lap shear test

3D printed lap-shear specimens

Numerical simulation of a modified lap-shear test



Graph of the shear stress distribution in the adhesive

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Study of materials for the fabrication of a no-license car frame

Materials

A. FOOS

O. COULIBALY

Alexandre FOOS / Oumou COULIBALY
Academic supervisor: B. LEROUX
Industrial supervisor: F-X. RODET

Company: Foxonrock SAS

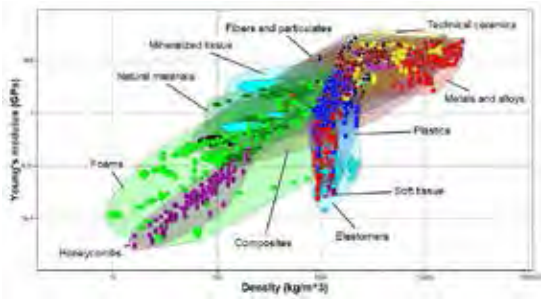
Objective/motivation

The main purpose of this project is to fabric an electric no-license car. Our missions were to study the possibilities of materials to use for the conception of a frame for a no-license car. Then we studied for a medium size production and a unit production, the manufacturing processes existing for each material retained. And we dealt with the advantages and disadvantages in depth for each solution found.

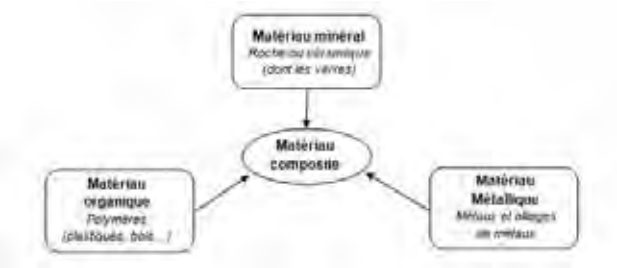
Results

At the end of the project, the company is able to make the most appropriate choice for the material of their car frame, depending on economic criteria (investment costs and unit price), the mechanical interaction, the weight and the recyclability of it. They will receive a chart filled with characteristics of the chosen materials and the name of subcontractors associated with the manufacture process.

Keywords: Automotive, materials, innovation, industrialization, recyclable



GRANTA Edupack software to select the best materials



Different type of materials

Exemple of a rival frame car

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Study of scalmalloy instabilities

Materials

P. GRENERY

L. RETTEL

Pierre GRENERY / Lisa RETTEL
Academic supervisor: J. GILLIBERT, M-L BOUCHETOU
Industrial supervisor: A. MAUDUIT

Company/Institution: Cetim Centre Val de Loire

Selected Participant
15th Annual Final Year Projects Forum

Objective/motivation

The objective of the project is to characterize the instability of plastic deformation on an aluminium alloy. This alloy is called Scalmalloy, it contains aluminium, magnesium and scandium. This material is innovative and from additive manufacturing: laser powder bed fusion (LPBF). When it is subjective to traction Scalmalloy generates some instabilities in plastic field. We must identify these instabilities, there are two types, Lûders bands and Portevin le Chatelier instability. The project goal is to know which parameters influence the appearance of the instabilities: for example, the speed of tensile tests, the geometry of the specimens, ...

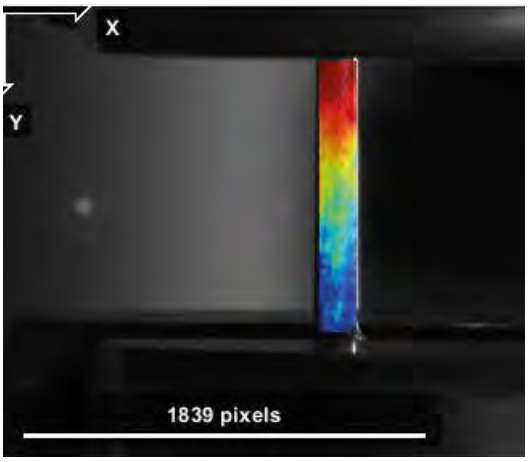
Results

At first, we have realized some tensile tests on aluminium specimens to verify the experimental protocols. When these tests were done, the final tests with Scalmalloy were able to be carried out. The tensile test allowed us to observe the characterization of the different instabilities such as their amplitude and frequency of appearance. Therefore, we were able to determine the type of instabilities for each specimen. In addition, we realized that the speed of tensile test had an important role on the frequency of instabilities and that the heat treatment greatly reduced the presence of instabilities. Image correlation was also performed to observe the movement of the Luders' bands.

Keywords: Scalmalloy, instability, aluminum, alloy, tensile test

Microscopique observation

Tensile test



Observation displacement

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Thermal study of a pseudo-extruder

Mechanical engineering

J. GRIVALLIERS

T. JEANNEROT

Jondalar GRIVALLIERS / Thomas JEANNEROT
Academic supervisor: T. SAYET
Industrial supervisor: P. LIGEARD

Company: WeGreenCity

Objective/motivation

Wegreencity proposes us to carry out a thermal study of their extruder to better understand its behaviour and thus better control it. The purpose of this study is to clarify the following points:

- Positioning of the fusion front. This is where the plastic begins to melt and mix with the rubble. Today its position in the extruder is unknown and uncontrolled.
- The formation of stoppers

When the material cools during the process, it clumps around the axis and stops the translation movement into the extruder. As soon as this appears, a plug forms and slows down the manufacturing process.

Results

Many problems of communication between us and the industrialist have meant that the conclusions we have been able to draw only concern the tools we have used :

- Abaqus software has limitations for modelling matter
- The size of our model makes it difficult to use software using a method of discrete elements like GranOO
- Fluid flow software seems more suitable for dealing with this kind of problem (Fluent Ansys for example)

Keywords: Thermal simulation, abaqus

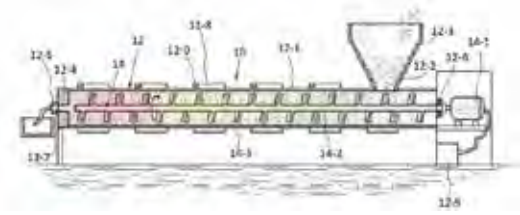
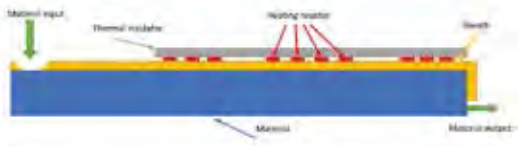
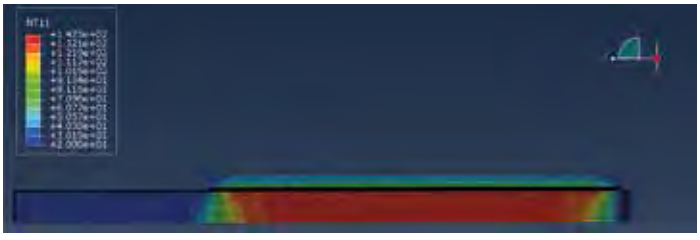


Illustration of the WeGreenCity extruder



Representation of a part of our system



Visualization of the temperature fields in the extruder

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Weight saving using composite materials

Materials

A. CACHOT

A. PERES

Arthur CACHOT / Antonin PERES
Academic supervisor: R. HAMBLI

Company/Institution: undisclosed (confidential)

Objective/motivation

The main issue with military-grade on-board equipment is the weight of the device. Lower the weight is, the more vital materials such as ammunition or rations a soldier or a vehicle can transport, and that is why this characteristic is very important. It is possible to lightened devices by changing their geometry or their dimensions, but in our case, this will be done by changing the type of material (composites instead of aluminum alloys) used for the different components of the device. To do so, we carried out extensive research about composite materials, their characteristics, and their applications in the military field.
Also, still in a weight loss approach, we had to focus on the heat sink properties of some specific materials (composites or not) for heat dissipation applications.

Results

The main result of our project is a consequent bibliographic synthesis of composite materials and materials with great heat sink properties. The purpose of this document is to provide a wide knowledge of some composites that the company could use in their product. It includes references of the composites, their characteristics, their applications, their production methods, etc.
It also includes a few summaries about the different types of composites (OMC, CMC, and MMC), their global architectures, and their behavior laws to predict their characteristics.

Keywords: Composite materials, optronics, weight saving, military, heat dissipation

Aramid fibers (left), carbon fibers (upper), glass fibers (right)

LASER designation military device

Some LASER designation military product

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Internet of Things

3D pose estimation of an endoscopic probe by deep learning

Electrical engineering

Maxence LAME
Academic supervisor: S. TREUILLET
Industrial supervisor: S. TREUILLET

Institution: PRISME Laboratory

Objective/motivation

The goal of the EMMIE research project is to perform optical tissue characterization in the stomach during endoscopic examination, in a less invasive way than traditional incisional biopsies and histological analysis. In order to make this technique usable by a physician, a fiberscope is inserted through the instrument channel of a commercial endoscope and connected to a hyperspectral camera. My job in this project is to deduce the relative pose (the position and orientation in the 3D space) of the optical probe observed in the endoscopic view in order to locate the optical biopsy onto the stomach wall. I am using computer vision methods and deep neural networks to achieve this.

Results

As a first step, I validated the fact that a deep learning regression neural network makes it possible to estimate the 3D pose from the segmentation mask of the endoscopic probe as an input. I implemented classic image processing to extract a few lower order moments of the silhouette of the probe to feed a three-layer neural network with more compact feature vectors than the overall image. An important part of my project was the generation of the database for training and testing the network, and the qualification of my results in comparison with a previous analytic approach. In the end, the proposed approach is supposed to be included in an end-to-end pipeline to perform the segmentation and the pose estimation from the color endoscopic image as an input.

Keywords: endoscopic examination, computer vision, image processing, deep learning, pose estimation

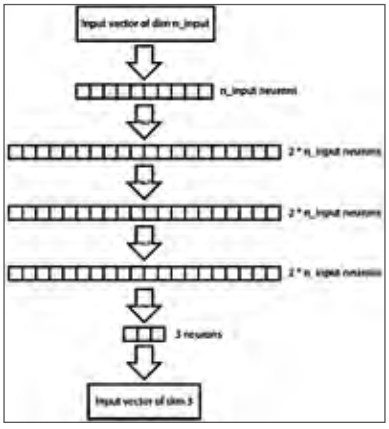

Diagram of the DNN

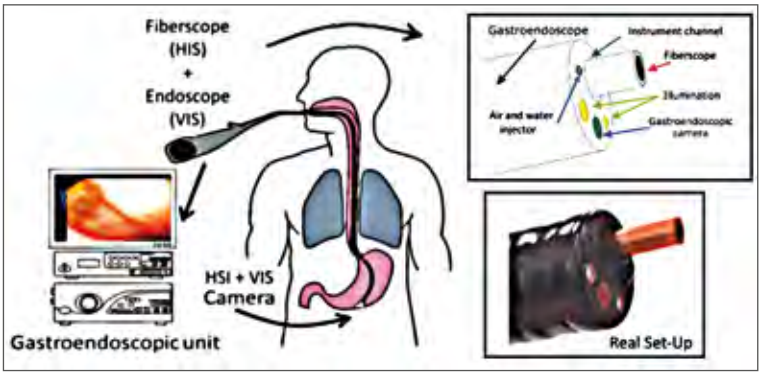

Diagram of the gastroendoscopic probe

Real binary mask example

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3D reconstruction

Electrical engineering

Alexane DANTEN
Academic supervisor: R. CANALS
Industrial supervisor: R. CANALS

Company/Institution: undisclosed (confidential)

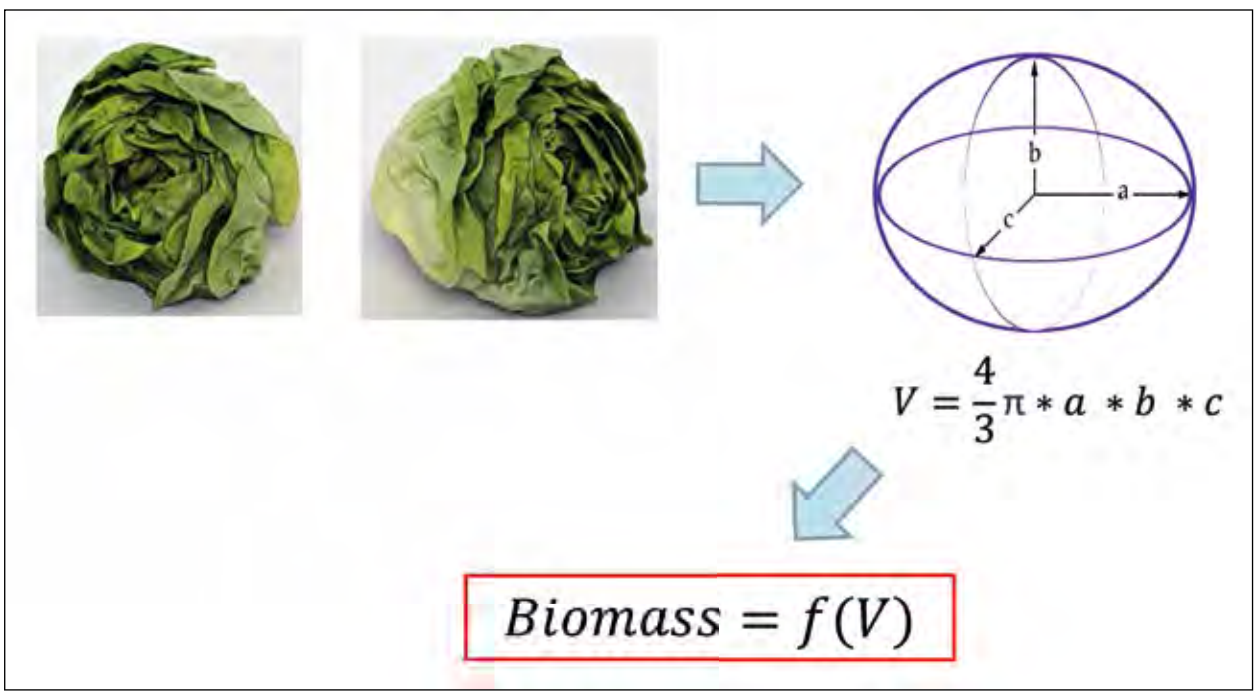
Objective/motivation

The main goal of this project is to approximate the biomass of vegetables using only images. The program will determine the volume of a 2D shape. Then, with a function depending on the volume, it will approximate the biomass of the vegetable.

Results

The expected result for this project is a program which is able to determine the volume of an ovoid or hemisphere with only a picture taken above the scene with a calibration object. The calibration object is the table on which the ovoid or hemisphere is set.

Keywords: computer vision, image, 3D, volume



3D reconstruction

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Battery Management System

Electrical engineering

Hugues TURMEL
Academic supervisor: G. LAMARQUE
Industrial supervisor: M. DOS SANTOS

Company: MSL Circuits

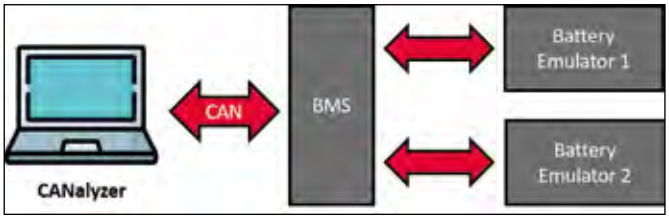
Objective/motivation

The objective of this project is to have all the necessary information to realize a Battery Management System test bench which will be carried out during the internship. The project was divided into two parts: a technological watch about the technology used in the Battery Management System and a prototype to learn how to use a Battery Management System with battery emulators.

Results

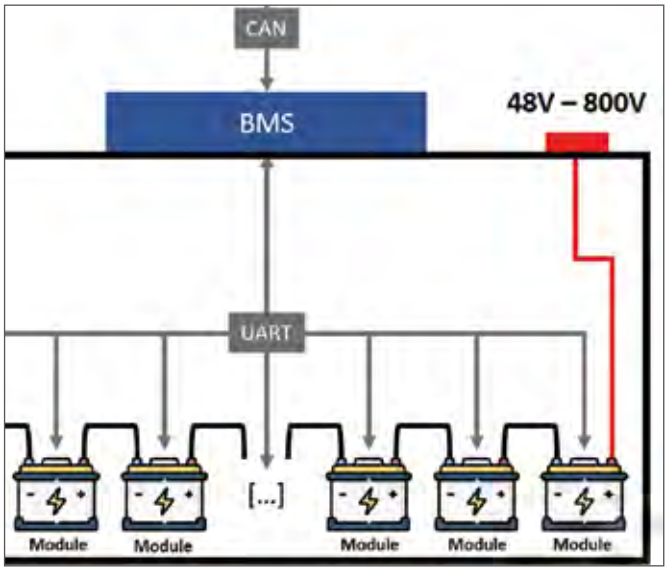
Battery Management Systems are used to protect all the devices which are currently using Li-ion batteries. From the smartphone to the electrical car, each of these device contains a Battery Management System to avoid overcurrent, overvoltage or overtemperature. There are a lot of different technologies used in Battery Management Systems to realize cell balancing; depending on the price or the efficiency, the manufacturer will choose a passive or active cell balancing.

Keywords: automotive, electronic, simulation, technological watch



Prototype diagram

Simulation of the three cells charging by a passive Battery Management System



Example of Battery Management System on a Li-ion battery

Contact: hugues.turmel@etu.univ-orleans.fr

Development of a pedagogic kit based on Huawei IoT cards

Electrical engineering

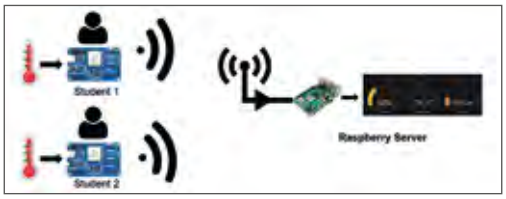
Pacôme LECOINTE
Academic supervisor: R. CANALS
Industrial supervisor: R. CANALS

POLYTECH ORLÉANS

Institution: Academic, Polytech Orleans

Objective/motivation

With the strong evolution of Internet of Things (IoT) devices, this project aims to develop a pedagogic kit based on Huawei IoT cards in order to study this phenomenon. These cards, named BearPi, are very user-friendly because they are based on modules that simply require being plugged in. The idea of this project is to create a document (tutorial) which allows you to use these cards and deploy a Raspberry server to connect them. From a pedagogical point of view, this will easily represent the IoT chain (from sensors to the database) to the students. Moreover, they will be able to focus on specific aspects of this chain such as communication protocols.



Project diagram

Results

As a result, for this project I made a document with two parts. One will allow use of the Huawei IoT cards: BearPi, with its technical characteristics, its use (driver, software, connection) and explanation of programs. The other will deploy the Raspberry server with an explanation of each of its services and features.

Keywords: IoT, telecommunication, network, Huawei, server

Huawei IoT card: BearPi

Graphical interface of the server

Raspberry server

Contact: pacome.lecointe@gmail.com

Drill core images texture analyses: a digital tool for geometallurgical processing prediction

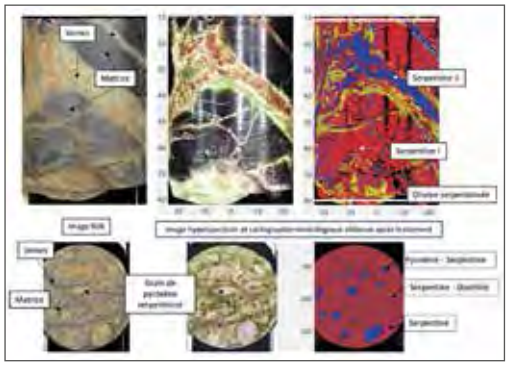
Materials

Cyril DUPONT
Academic supervisor: R. HARBA
Industrial supervisor: S. DELCHINI

Company/Institution: French Geological Survey, BRGM

Objective/motivation

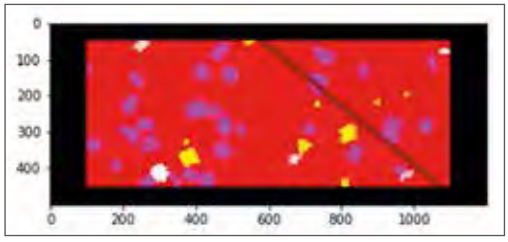
The identification of the nature of rocks and, more precisely, of their mineral texture is important data for the mining industry. This mineral texture is classically identified by mine geologists with visual assessments of the samples (drill cores) which can result in a subjective interpretation that is difficult to correlate with the performance of geometallurgical treatment. The automation of this step based on image analyses of the drill cores acquired with a drill core scanner is an important challenge. In this context, the objective of this project is to automatically extract mineral texture parameters such as the shape and size of grains as well as their spatial distribution. To proceed with the image analyses, a deep learning approach was chosen involving the creation of a training base of image synthesis designed to represent the ground truth established by the geologist.



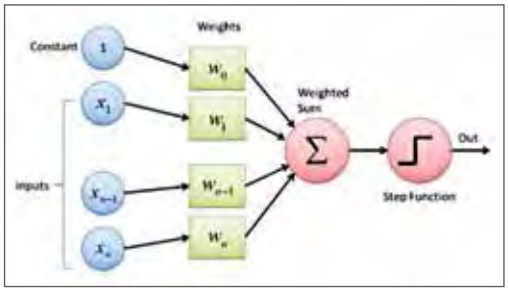
Core drill RGB image, hyperspectral image and ground truth image

Results

Results obtained can be separated into two parts. The first concerns the accuracy of synthesized ground truth images (supposed to be similar to measured ground truth images). The second concerns the customization of the program (e.g., image number, image parameters) to take into account geologists' needs. Python language has been used for the program (high-level language to avoid syntax problems). This work is realized in collaboration with a geologist who brings the expertise to correctly describe the mineral textures from measured images and to validate the results (synthesized ground truth images). Currently, the program as developed can compute 10,000 images in one day, but by optimizing the program, the computation of one million images could be expected. Computed images are in .png file format but this can be changed if the customer needs a higher resolution (e.g., .tiff). Images are saved in a folder named “result”. From a general point of view, requirements are satisfied despite some differences between the ground truth model (synthesized) and the measured ground truth.



Example of image synthesis obtained representing the ground truth and composed of 3 minerals (classes) in yellow, purple and white included in a red matrix, intersected by a brown vein



Model of a neuron

Keywords: mining drill core, mineral texture, geometallurgy, deep learning (convolutional neural network), image synthesis

Contact: cyril.dupont1@etu.univ-orleans.fr

Geolocation and guidance system for fire detectors

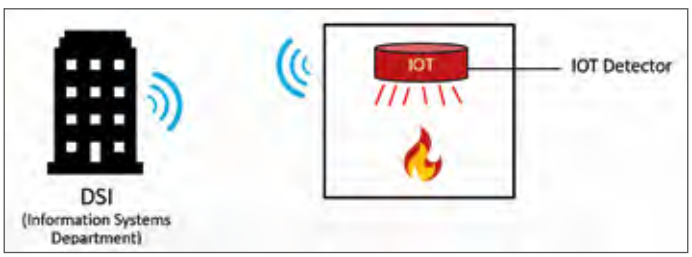
Industrial engineering

Alexandre LANQUAR
Academic supervisor: J-Y. CADOREL
Industrial supervisor: T. DESCHAMPS

Company/Institution: undisclosed (confidential)

Objective/motivation

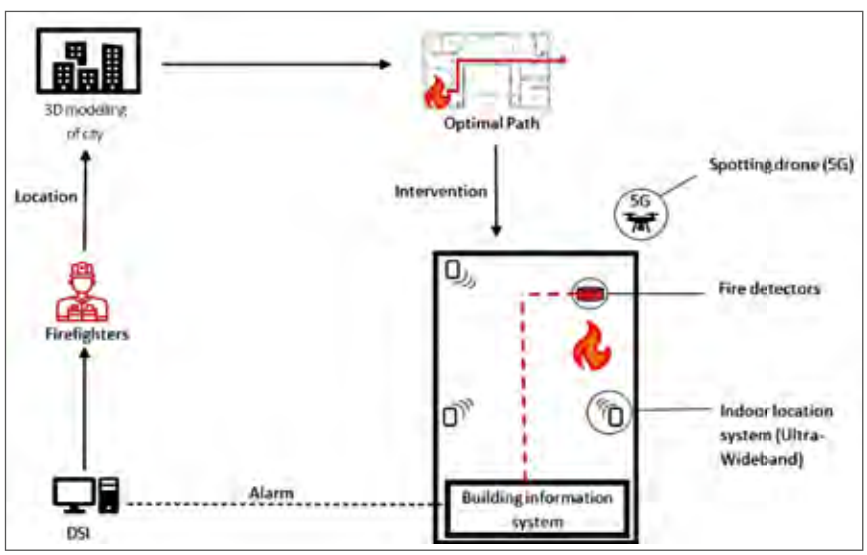
Our client company is looking for a way to intervene more quickly when a fire is declared. One of the solutions to this problem would be to know the precise geolocation of the smoke detector which is at the origin of the alarm as well as the best way to access the interior of the building concerned. If firefighters can be guided towards a fire by a reliable and precise system, they will be able to intervene quickly and thus avoid excessive and costly damage. The aim is to be able to guide a firefighter to a smoke detector in real time via an optimal path by means of 3D modelling of the building and the location of the detector that triggered the alarm.



Expected result

Results

The aim of the project is to make a feasible solution with maximum detail to accomplish the mission of locating the fire detectors. The difficulty of the search for results in this project is mainly defined by the possibility of installing the system on all types of fire alarms in the city. This solution should be only a theoretical one because if it is accepted, it will subsequently be the subject of a POC (Proof of Concept) in the client company. The stakes of this project are high because the aim is to have a new standard adopted for the dwellings of an entire city.



Project diagram

Keywords: geolocation

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Human-Machine Interface

Electrical engineering

Achille GOHIN
Academic supervisor: R. JENNANE
Industrial supervisor: J-F. GIBRAT

Company: Arcys

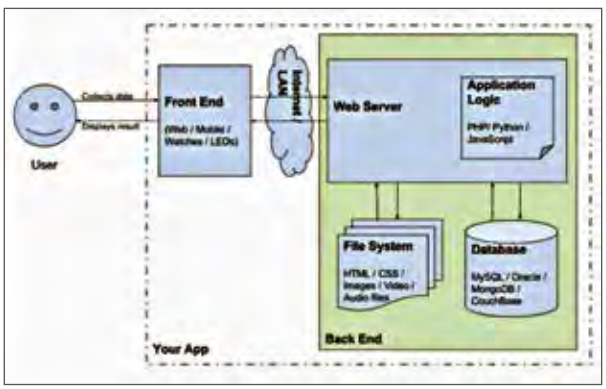
Objective/motivation

The objective of this project is to create a Human-Machine Interface (HMI) for the company Arcys to store all of their wireless components and their configuration files. The project was divided into two parts: the first is the frontend development that represents the HMI and the second is the backend development that represents the management of the database.

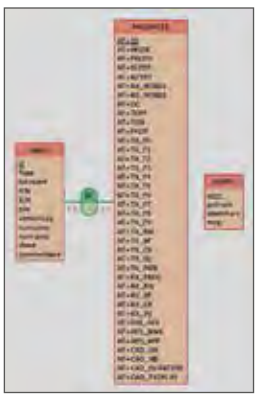
Results

The HMI and the database can communicate thanks to the backend. Engineers can store a product and its configuration file in the database. A user can find the product and download the configuration file from the website. The monitoring of the data from the frontend to the storage is respected.

Keywords: interface, web, server, storage



Example of a project structure with frontend and backend



Structure of the databases and all tables

Display of the home page with products

Contact: achille.gohin@etu.univ-orleans.fr

Instrumentation and monitoring of a collective composter with tracking software

Environmental engineering


K. BEDU

Laura BEDU / Corentin HURE
Academic supervisors: M. EXBRAYAT, R. WEBER
Industrial supervisors: M. COCHON, V. GOREL


C. HURE

Company: O'compost

Objective/motivation

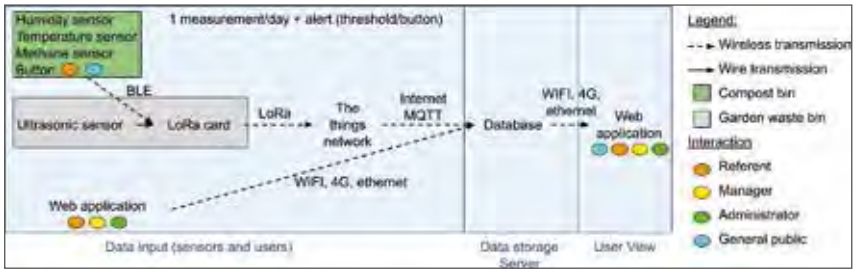
This project concerns the development of a connected composter for municipal communities or buildings. The main target is people who do not have a garden to make a compost pile. This project also allows us to reduce the climatic impact of bio-waste with a reduction of CO_2 and provide quality soil for nearby gardens. The product has been conceived to reduce user constraints via instrumentation to prevent foul-smelling composts and optimize bio-waste decomposition. A second part of the project is to allow the client and different users to access a website with composter information such as displaying the location of the composter and to give specific users the possibility to access composter values and be alerted if an incident occurs (like foul odors). This website allows for the management of composter parks in France.

Home page of the website

Results

The prototype is based on a previous composting instrumentation project. The main point of improvement is lower energy consumption. At the end of this project, we should have a prototype which monitors compost bins, and sensors which communicate in LoRa. The system measures temperature, humidity, methane and the filling rate of the bins. The software allows us to display, modify, input data and locate the composting site. The website is adapted to a smartphone view.

Keywords: compost, Internet of Things, software, prototype, wireless



Global scheme of the project

Contact: laura.bedu@etu.univ-orleans.fr ; corentin.hure@etu.univ-orleans.fr

Setting up a sensor network

Electrical engineering

Nathan AUTRIVE
Academic supervisor: R. CANALS
Industrial supervisor: J-Y. CADOREL

3ZA ENGINEERING

Company: 3ZA Intech

Objective/motivation

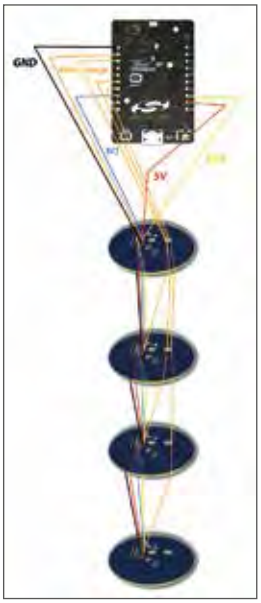
The main goal of this project is to create a sensor network to oversee data in different spots in an experimental greenhouse. It will help the client to optimize its parameter and the growth of the vegetable and plants in the greenhouse. I have chosen this project because it encompasses all the different aspects of the IoT school that I am really interested in. It also gives me the possibility to work on all the different states of a complete industrial project.

Results

The architecture of the network has been made and some tests conducted of the feasibility of the project. Some components were ordered. The project is going to be pursued during an internship after the end of this industrial project.

Keywords: IoT, sensor, network

3D view of the final result



Electrical schematic of the final device

Main architecture of the project

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Wi-Fi expansion board for home automation modules

Electrical engineering

Robin BRUNEAU
Academic supervisor: F. ROS
Industrial supervisor: D. LEBRUN

Companies: Altyor, NodOn

Objective/motivation

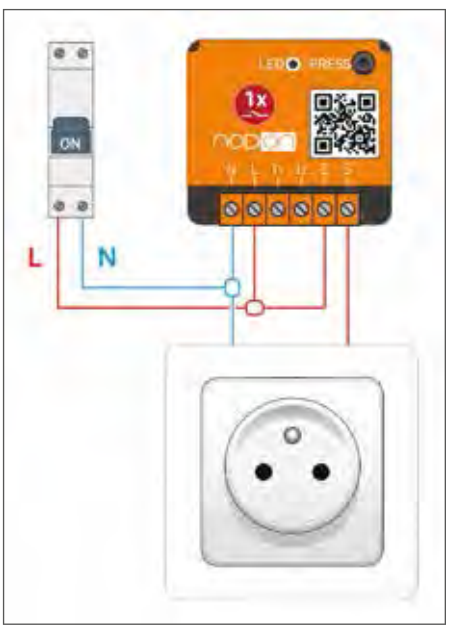
NodOn, a company of the Altyor group, is specialized in smart home and smart building. With the help of Altyor's design office, they develop home automation products in order to "make homes and buildings more comfortable and energy efficient", according to their official website. Alongside battery-less wall switches, smart plugs and various type of sensors, NodOn developed home automation modules, called SIN modules. There are different types of SIN modules that allow the user to control heaters, roller shutters, awnings, lights, or electrical appliances remotely thanks to a radio protocol called EnOcean. The objective of the project is to develop a new version of the SIN module that uses Wi-Fi, allowing it to stream power consumption data while in use.

SIN home automation module

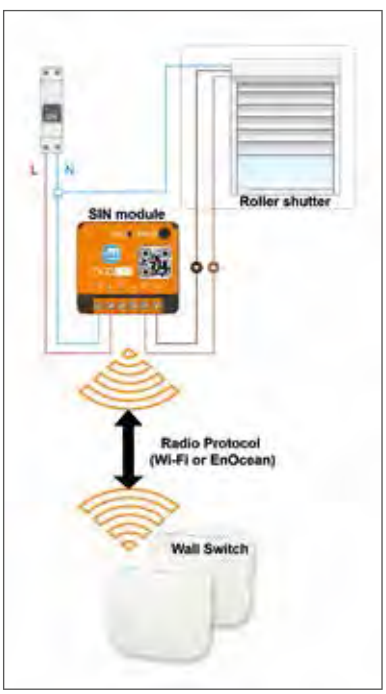
Results

The technical objective of this project was to conduct a feasibility study of the Wi-Fi version of the SIN module. Since NodOn wanted the new version to keep the same electrical and mechanical architecture, I had to make sure we could fit a Wi-Fi chip and its associated electrical circuit inside the casing of the module. After choosing an adequate Wi-Fi microcontroller and estimating the power consumption of the device, I started designing a new power supply circuit capable of handling the Wi-Fi current peaks, while considering the power dissipation problematics. To make sure the product would work for a future user, my co-workers and I also worked on a Proof of Concept of the device firmware. Using the official coding tools of the Wi-Fi chip we chose, we made a first working version of the device, which gives a first green light to a potential industrial designing.

Keywords: home automation, Wi-Fi, electronics



SIN connected wall plug configuration



SIN roller shutter wall switch configuration

Contact: robin.bruneau@etu.univ-orleans.fr

Production Management

Automation of end of line to increase productivity

Production engineering

Julie EIGNER
Academic supervisor: S. LEROUX
Industrial supervisor: A. BOUTET

Company: SKF

Objective/motivation

The project presented began when the group's strategy was to recover market shares in the historic range of the Vehicle Parts (VP) unit. .

The project I led responded to the desire to increase the productivity of the lines. This would make it possible to increase the capacity of the lines to absorb the additional volume due to the market recovery. The first priority has been to concentrate on the line most affected by the new production volumes. The first version of the proposed project then consisted in automating the packaging of kit boxes on this line using a cobot.

Then, this project was extended to 2 other lines to integrate palletizing as well as the transfer of pallets from the end of the lines to the strapping machine. A project team carried out this large-scale project.

Results

To carry out this project the next steps were followed: an analysis of the needs; the scheduling of tasks; the analysis of references related to the project such as the different formats of boxes, containers and pallets; the analysis of the layout of the lines; the drafting of specifications; a call for tenders from 8 suppliers. Today, the group has changed its strategy and the project is no longer in the priorities, so it was stopped. However, end-of-line automation would increase productivity by 18% and improve the ergonomics of end-of-line stations. In addition, specifications were drawn up and are now used for other automation projects, such as a cobot or an autonomous smart vehicle, which would save time for the implementation of these projects.

FR SKF box

Workshop

End of line

Pallet

Palletization

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Capitalisation of skills for the realisation of nuclear activity files

Production engineering

Rodolphe RENIER
Academic supervisor: E. BEURUAY
Industrial supervisor: A. BARBELLION

Company: Électricité de France

Objective/motivation

To carry out maintenance in a nuclear power plant we have to prepare maintenance files. These files are drawn up by project managers using an ERP specific to the nuclear industry.
In this file we will find several pieces of information such as component disassembly aid (physical file) and permit applications (computer file).
With the arrival of new software, it is necessary to capitalise on all the information from each system. The jobs in the nuclear industry are very varied, I concentrate on the mechanical part.
The files will be more or less consequent according to the system to be treated, repairing a turbine will be less consequent than repairing a small valve.
My project was to capitalise on everyone's knowledge to create a common method of data capitalisation. For this it was necessary to analyse the situation of each trade and to define the need they had, while showing tact and understanding.

Results

The results are not really quantifiable, in fact they are mainly "managerial" projects and capitalisation of skills.
Nevertheless, a common software programme has been developed and allows each project manager to capitalise on the information needed to insert them in the file.
Problems still persist in the capitalisation of files, which leads to loss of time in the preparation of maintenance files when there are technical stoppages.
It is important to know that this does not only concern the maintenance files but also the reactor control files (which I did not manage).
We are on the right track to have all the nuclear power station maintenance files will be capitalised by the end of 2021.

Keywords: Management, capitalization, project management

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Continuous improvement of warehouse and inventory reliability

Production engineering

Maxime GOSSET
Academic supervisor: E. COURTIAL
Industrial supervisor: L. DUCHENE

Company: Shiseido International France

Objective/motivation

Although very old, the Shiseido company came to a decisive turning point for it a few years ago. That is why, with the arrival of the new Chief Executive Officer in Japan, a new era is emerging for the company. Uotani's "Vision2020" is oriented in such a way that the company will be present for at least a century. The Gien plant is part of the group's improvement drive. The "Transformation 2020" project is the local version of the group's vision.

This is mainly about increasing the plant's production capacity and bringing innovations while managing our resources better. It is in this context that my mission was to make improvements in the inventory management of the warehouse. This involved deploying new IT and technology tools as well as helping to optimize storage space.

Results

The main objectives of this project are to reduce the time of an inventory, and the number of people necessary for its realization. This allows operators to devote more time to tasks with higher added value. Our objective was also to reduce external storage in order to reduce its cost. For this, I implemented a new tool based on Excel that lists palettes stored without movement for several weeks. So, we can free up locations or check the need to avoid unnecessary stocks. To complete this tool, we invested in an inventory drone. This tool allows an operator to control and inventory 250 locations in about one hour without using a nacelle. It therefore saves time, human resources and is more safe for the operators. Combined with an extension of our internal storage capacity, this has reduced our external storage by hundreds of pallets and improved the reliability of our stock.

Keywords: Logistics, Cosmetic, Drone, Warehouse

Drone

Contact: gosset.max@free.fr

Create and deploy an exchange interface for data linked to traceability in order to implement an ERP.

Production engineering

Arthur AUDIBERT
Academic supervisor: P. VRIGNAT
Industrial supervisor: S. RORTEAU

Company: MBDA France

Objective/motivation

In aeronautics, a lot of parts have key characteristics which have to be controlled and saved in the company's ERP (Enterprise Resource Planning) for traceability. This work is done by the quality controller and it is a repetitive task, time consuming and which generates mistakes. The aim of my project was to develop and deploy, with our suppliers, an interface with which the latter can send us the traceability data we need and with which our quality controller can also automatically implement our ERP. The different data concerned depend on the key characteristics: they could be either qualitative or quantitative and could also be either letters or numbers. It depends on the parts and on the supplier concerned. That's why the interface had to be easy to use, flexible and allow the users to have an overview.

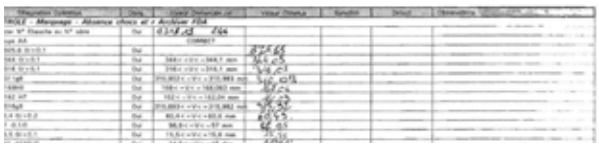
Results

To meet this need I created an excel file which was selected among two other tools already developed because it was more synthetic and easier to use than the two others. Then I deployed this tool with several suppliers and now they use it to send us the key characteristics measured. In the input, you need data extracted from the ERP and after completion by the supplier, the quality controller automatically transfers the data from the interface to the ERP. Thanks to this project, when, before, it could take a week to implement our ERP with all the data, the quality controller can now do the same in a few minutes. It also reduces the number of errors and improves our relationship with our suppliers. This project was also a POC (proof of concept) of a bigger project for the GIFAS.

Keywords: Traceability, aeronautic, sap, data, dematerialized

Stake of traceability

Process of the solution developed: IMEDIS



Before my project the data was written by hand

From now, the data are dematerialized

Contact: ar.audibert@outlook.fr

Creation of a new production process

Production engineering

Paul COLY
Academic supervisor: A. FONTE
Industrial supervisor: M. TINCHON

Company: Rosinox

Objective/motivation

My project was carried out during my 4th year in Production management at Polytech and my second year at Rosinox. The aim of this project was to create a new production process in collaboration with the new production and supply chain manager. He wanted to have a vision of our load of work according to our capacity and for this we implemented a tool allowing us to see if we were in overcapacity or under capacity in terms of resources (machine and men). This project was carried out during the health crisis, so we faced some budget constraint to recruit staff that is why we needed to control our capacity.
My project also includes a logistics part in which we worked on articles having a double or a triple location due to a management system based on production islands. This update allowed us to relocate 150 articles.

Results

In terms of results, during the last year, we had no temporary recruitment and thanks to the tool we implemented, there has been no delayed order since the beginning of the summer 2020. The project is not over, and I will continue it during my 5th year. The continuity of the project will go through the implementation of a new production schedule that will allow us to reduce our Lead time and more over to improve our capacity or work.
For the part about the tool that we call “load/capacity”. This tool allowed us to see that some of our sectors didn’t have enough capacity for all the work we needed to do and some of our sector had more capacity than work to do. We added versatility by moving people from their sectors to others sectors which needed help. This people didn’t need training on their new assignment because they already had it before in their career. We also do some production smoothing thanks to this tool because it allowed us to do more product than before by removing the bottleneck sectors

Keywords: Process, production, capacity, logistics

Contact: paul.coly@etu.univ-orleans.fr

Creation of a quality training for operators

Production engineering

Baptiste NICOLAS
Academic supervisor: S. TOUTAIN
Industrial supervisor: C. ETIENNE

Company: undisclosed (confidential)

Objective/motivation

We studied the causes of the many rejects we had on the production lines and we discovered that 20% of those rejects were caused by human mistakes. Many operators misunderstood the standard instructions for the quality control of the parts and some of non-compliant parts were sent to the value stream production lines. So, we had to teach the good practices to the operators. The aim is to put in place a certification for operators after the training to ensure that they will apply what they have learned in their work. The quality training has 2 modules: the theoretical training, where operators will attend a presentation on the good practices and will answer a quiz at the end to check that they understood the presentation, and a practical training where they will practice what they learnt in a real simulation.

Results

The training aims to give the operators an important first step in the versatility table and to ensure that they will have a better understanding of the standard instructions and won't do the same mistakes again. So, audits will be led to ensure that the operators continue to practice what they learnt in the training. If operators don't succeed in the tests during the training or during the audits, they will have to attend a synthetic presentation where they will learn again what they have to do during their work. The goal is to eliminate all the rejects caused by human mistakes, that is, 20% of the total of rejects on our production lines. This training will also become required for every new employee who will work on the production lines in our workshop.

Keywords: Quality, training, standards, improvement

5A - BN 3

5A - BN 1

5A - BN 2

Contact: baptiste.nicolas@live.fr

Deployment of an automated vision based measurement system

Production engineering

Romain TCHISSAMBO
Academic supervisor: R. WEBER
Industrial supervisor: T. MENANTEAU

Company: Lisi Automotive

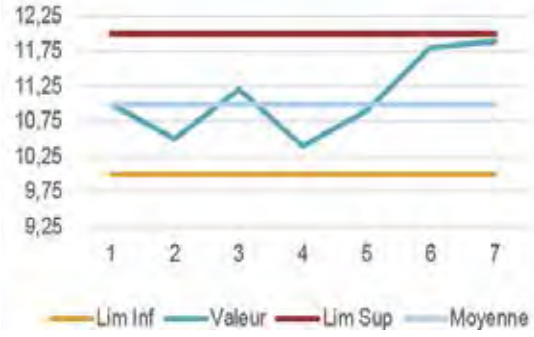
Objective/motivation

Lisi automotive manufactures complex threaded fastener and safety components for the automotive industry. Our quality standards meet the needs of many automotive and industrial vehicle applications. The parts manufactured by Lisi become more and more complex with technological advancements. To remain at the edge of quality control, Lisi had the need to use more sophisticated measurement systems. Such systems are vital for the company to be able to accept new safety components, as safety regulations become stricter every year. My mission was to program and deploy a vision-based measurement system capable of handling the future needs of Lisi automotive in quality control. Considering the high production output, the measurement systems also had to be fast enough not to bottleneck the production line.

Results

The systems proved to be more repeatable and reproducible than the previous methods. This is an important aspect of quality control as it allows for measuring tighter tolerances. The systems are slightly slower to complete a given control compared to the previous methods. However, the control requires no human intervention, which allows for the control to be done concurrently with the production. Digitalisation of the data is also something that we took advantage of, with automated export to statistical process control software. Lisi automotive is moving toward industry 4.0 with data management and these systems are a part of it. Ultimately, the project and the installation of the new measurement systems allowed the company to accept contracts for multiple, more complex safety components and are one of the tools that proves that Lisi automotive is one of the most innovative suppliers.

Measurement system



SPC

Example of part

Contact: romain.tchissambo@gmail.com

Development and improvement of a production area

Production engineering

Loïc VIAULT
Academic supervisor: M. BEURUAY
Industrial supervisor: M. VAILLANT

Company: Brandt

Objective/motivation

The factory I am in is a household appliance factory. We manufacture induction hobs and ovens. For my part my mission focuses on the oven part. Indeed, the manufacture of an oven is carried out in 3 stages. The first is the fabrication of the structure with stamping and welding. The second is the enamelling and washing part of the sheet metal parts. My mission focuses on this part because we have to do the decorating parts. These parts are made in an area called stainless steel island.
I will therefore have to develop and reorganize the island. The third step is the assembly. So I will also work with floor one because the stainless steel island is the customer and with the assembly which is our customer. Therefore I will work in collaboration with them.

Results

To meet the objectives, we decided to organize ourselves in stages. Indeed, I do not know the island at all. I started off with a period of discovery and learning to pilot. I then took a lot of notes and analyzed the good or bad functioning of the island.
Following this I analyzed the work of the posts. So I took post by post. I performed workstation measurements and analyzed ergonomics. I also measure the number of steps. Following all these calculation analyzes, I started to make modifications such as making a door between the island and the storage area so that operators took fewer steps. Thanks to this, an operator travels 150 km less per year.

Keywords: flow management, development, production, management

Contact: loic.viault@etu.univ-orleans.fr

Implementation of a logistics train in an automotive equipment manufacturer

Production engineering

Léa CHOTARD
Academic supervisor: M.BEAUVALLET
Industrial supervisor: M. BUGAJ

Company: undisclosed (confidential)

Objective/motivation

The plant in which I work is composed of many buildings and all the transport of parts, semi-finished or finished, was made by forklift. The forklift drivers made a lot of round trips between the production workshop and the storage warehouse and their workload was very variable. The company manufactures composite parts for cars or trucks. Some parts are just molded and drilled, and some other parts are painted after perforating. For example, we manufacture spare wheel supports, roofs of goods vehicles, engine protection covers and truck radiator grilles.
The issues were to reduce costs, have a better organization and increase the safety in the plant, within a budget of €25,000.
The objectives of my project were to reduce the risk of accidents with forklifts, to optimize the part flow and to reorganize the forklift operators' working time to improve the work distribution and spread the workload.

Results

To meet the objectives, we decided to implement a logistics train with several trolleys to transport containers. Due to the complexity of the plant, an operator drives the train. It allows to reorganize the collect of parts in production and to implement cyclic work with a logical and optimized flow. The train is used for parts manufactured regularly and with a high production rate. The logistics train can transport until 6 trolleys which correspond to 6 box parts, opposite to the forklift with 2 box parts. It allows to reduce round trips and increase the efficiency of the transport. The trolleys had to be adapted to different sizes of containers and to be resilient because full containers weigh up to 400kg.
The project respects the imposed budget and allows to save around €30,000 by reducing the number of forklifts rented and by not replacing a forklift driver when they retire.

Keywords: flow management, logistics train, standardization

Logistics train

wagon1

wagon2

Contact: lea.chotard@etu.univ-orleans.fr

Implementation of color control of the cap before assembly

Production engineering

Albert BRAULT
Academic supervisor: B. ROUSSEAU
Industrial supervisor: B. ROBERT

Company: TI Fluid Systems

Objective/motivation

At TI FLUID SYSTEM we manufacture brake tubes for the automotive industry. To protect the tube during transport, we cap them. The manufacturer uses the caps as a deception device to avoid attaching a tube upside down to the car. However, we have more than 5 colors of caps in reference and the operator is the only person who controls that the color of the cap corresponds to the bill of materials of the article to produce.

Our customer will not admit to having the wrong color cap on the tube. He asks us and we sell him the color control of the caps. Our objective is to certify that the cap color matches the requested color. However, we have several production lines that cap the tubes. Internally, the technical objective is to use an identical control system for all production machines

Results

The installation and set-up of SensoPart color sensors is a new technology in the company using intelligent color sensors. We can control up to seven colors. We programmed the PLC to control the colors according to the tube references. On all three production machines we used the same program, which simplifies the rework. The project is validated by the quality department. It is also the quality department that takes responsibility for justifying the feasibility of the control to the customer. We provide them with the necessary proof.

We add the new sensor reference in maintenance. To ensure the correct operation over time, we train a maintenance technician on the programming of the sensor and on the use of the software linked to the sensor. A maintenance procedure is set up.

Keywords: quality, control, standardization

New sensor installed

Initial situation

Final situation

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Improvement of a production area

Production engineering

Thomas VIBERT
Academic supervisor: P. DEPOIX
Industrial supervisor: A. HIVET

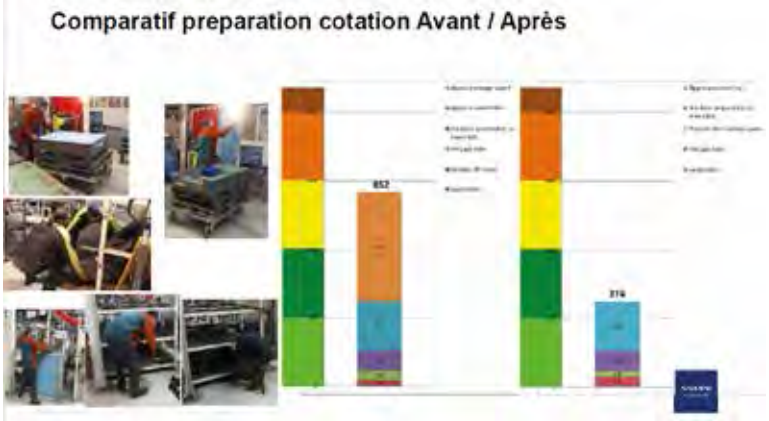
Company: undisclosed (confidential)

Objective/motivation

My project was about the improvement of an entire production area. This area is used to manufacture gantries for trucks. This project was initiated after an accident during the production of the gantries. The objective of the implementation of this project is the transformation of this area qualified until now from a prototype into a production area. This transformation results in the elimination of current safety risks and consequently of all ergonomic risks as well. My role is to coordinate a team composed of technicians and producers while following the general guidelines of the production manager. Therefore, I had to organize meetings as a facilitator to outline the different objectives. We completely reorganized the area and changed some production media to create a logical flow for everyone.

Results

Following the completion of this improvement in the production area, 90% of the security risks initially found have been eliminated. An ergonomic rating was carried out before and after the site to prove a clear improvement in working conditions. The area that was previously not dedicated only to production is so now. A general 5S was done to identify all the locations and allow the flow to continue over time. Job descriptions have been created to make life easier for producers and newcomers. All the problems have not yet been solved, which is why we must keep this site alive with new objectives that continue to evolve. The remainder to be done concerns especially the ergonomic risks which are not all eliminated whereas the policy of the company is the well-being of its employees.



Site

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Improvement of an automatic controlling machine

Production engineering

Florent DUC
Academic supervisor: N. ROUSSEAU
Industrial supervisor: O. SANDRON

Company: undisclosed (confidential)

Objective/motivation

The main objective of my project was to improve an automatic sorting machine which the plant received in October 2018. I have been involved in this project in October 2019 as a design office engineer, responsible for the communication between the sorting process and the production line, as well as continuous improvement. Actually, the machine used to reject a lot of parts as scraps because it saw them out of the tolerances, dimensionally and aspect-wise. Moreover, most of these parts were qualified good by the quality department. The reliability for the customers was as they expected but internally we had a scrap rate, first go, at more than 25%. It has been decided that the scraps will be controlled twice as much to converge to the real scrap rate after all. I approached my mission with a problem resolution method that I created.

Results

First, I created the Key Performance Indicators: First Time Quality, Last Time Quality and the difference between them, Waste. The aim was to enlighten the main objective: reduce the Waste to be able to have only one go for the parts in the machine. Secondly, I decided to work with a Pareto diagram to see where most scraps were produced and concentrate the efforts on the most significant problems. Then, thanks to the 5 why and a PDCA, I was able to find the root causes and solve them. All of this based on visual management and the involvement of the operators, managers, and even people from diverse departments. As a result, we reduced by 40% the Waste. In spite of the Covid-19 context and its consequences, I expect to reduce by 55 more percent (95% total) the Waste within 2 months so that we can do only one go and ensure the best quality, delay for the customers and saving waste.

Keywords: Continuous improvement, KPI, Team work, Project management, Innovation

Visual management on the line

InkedThe vision automatic controlling machine LI

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Maintenance in operational conditions

Production engineering

Maxence JOLLY
Academic supervisor: C. DUROS
Industrial supervisor: S. ROUZEAU

Company: Thales Avionics Vendôme

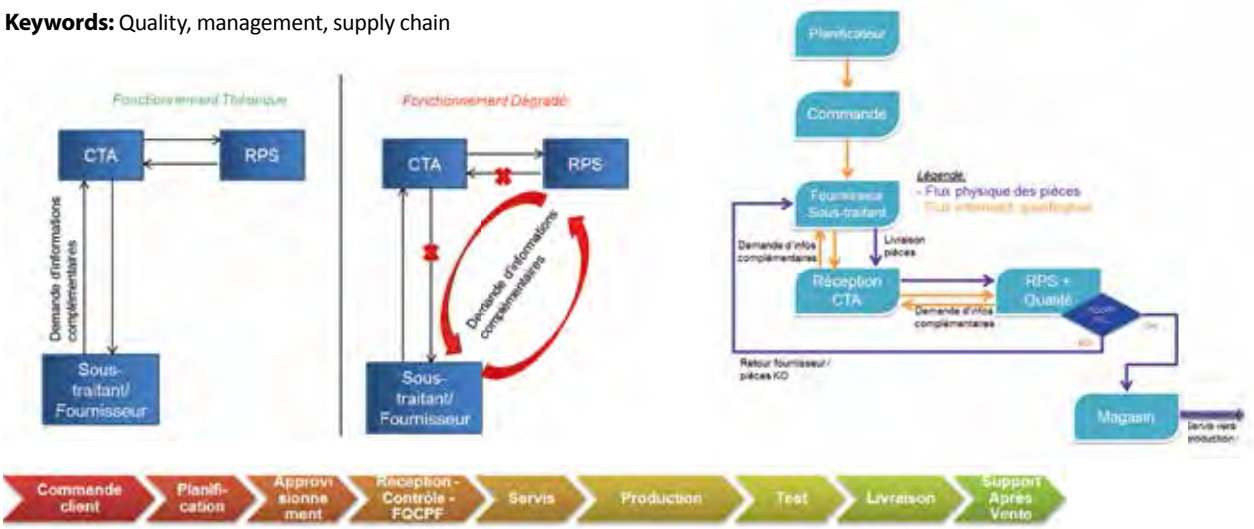
Objective/motivation

I am in charge of managing the definition of products that are brought onto the line. This activity is a quality-related one, which ensures a high-quality product to our customers. The related activities can vary quite a lot: the control can be either administrative or it can also be a heavy technical analysis of the part. I have been able to develop new skills and to enrich my knowledge in some fields. Indeed, I was able to learn how to prioritize topics related to production emergencies. I also learnt to establish a regular follow-up in order to have a global vision on my progress. Finally, I discovered the exchange between customers and suppliers by being in direct contact with them.

Results

While setting up my project, we defined objectives for each mission in order to follow a clear process. The performance indicator is a weekly report about the evolution of the number of folders in progress. We have seen that since my arrival the number of folders has decreased significantly. This freed up workload for the various engineers in my department. As a result, other subjects could be unblocked. With the reduction of files, the engineers were able to take the subjects.
With some hindsight, I was able to suggest ways of improvement on the different themes of this year. These may create a new mission for me in order to, perhaps, implement my suggestions.

Keywords: Quality, management, supply chain



product qualification

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The migration problem of needle bearings on MRA2 steering column following the endurance test

Production engineering

Maxence DESSAY
Academic supervisor: S. TOUTAIN
Industrial supervisor: M. HASSE

BOSCH
Invented for life

Company: Bosch Automotive Steering Vendôme SAS

Objective/motivation

My apprenticeship at Bosch Automotive Steering SAS, located in Vendôme, took place in the U-joint area where steering columns are produced. Focused on setting standards, my initial priorities were modified following the problem that we encountered in the MRA2 project. In escalation with the final customer, this project deals with the migration problem of needle bearings following the MRA2 endurance test. Observed after 2.5 vehicle lifetime, this migration can cause a watertightness problem of the u-joint bearings and a potential steering column blockage. Given the criticality of the subject with the customer, I was included to work on this topic in order to avoid a level III escalation, requiring the customer's presence on site at all times.

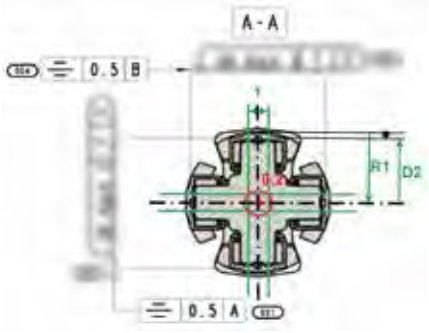
Results

We worked closely with all the departments of Bosch Vendôme and the Schwäbisch Gmünd site, our intermediate customer. My main activity was organized thanks to the 6M5P and the PDCA tool where the deadlines were noted. Demanding a rigorous expertise, we sought to control the presence of this space. Within this large and complex project, my main mission focused on the problem of free space between the needle bearings and the yoke crimping. The main objective was to increase our efficiency and guarantee customer satisfaction. This subject allowed to reduce the waste cost, to decrease the customer's claims and to increase the productivity of production lines. Recording a significant decline in business and a heavy loss of sales amplified by the COVID-19 crisis, we are also positioning ourselves for the acquisition of new projects in order to distinguish ourselves from the competition.

MRA2 endurance test

Keywords: Quality, automotive, claim, machine setting, production

Product-process interaction



Quotation chain of MRA2 product

Carrying out the tests

Adjustment wheels for press-fitting and crimping parameters

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Performance indicators enhancement and burning-in

Industrial engineering

Joran BEN ABID
Academic supervisor: P. GRILLOT
Industrial supervisor: O. BLANCHETON

Company: Les Laboratoires Servier Industrie

Objective/motivation

The purpose of the project is to redefine and enhance some of the indicators that are in use within a production unit. Industrial performance is a key parameter today in a sector that is becoming more and more competitive. As such, the indicators like the Overall Equipment Efficiency or the Losses are the ones on which the project focuses. The other part of the project is to help the performance department manager with training some of our operators to the use of our computer tools that are directly linked to our indicators. At last, other punctual missions come with this project, such as the definition of a SMED-like standard or the creation of simple user's guides and helping computer tools for specific SAP transactions.

Results

One of the tools we use to gather data for our Overall Equipment Efficiency is called Total Productive Maintenance. The number of mistakes made by operators while filling in the associated document has been reduced. All our operators working with the tools linked to indicators have been trained. Losses data are now fully accurate, helping the performance department to find root causes. The time spent on changeovers on specific equipment has been halved. The time spent on our performance-linked SAP transactions was comprised between 20 and 30 minutes. With the help of the user's guide and the guided computer tool created, no more than 5 minutes are required today.

Keywords: Pharmaceutics, Performance, Indicators, Standards, Production

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Production schedule

Production engineering

Guillaume BRETON
Academic supervisor: J-M. AUFRERE
Industrial supervisor: I. ROMANIN

Company: Les Laboratoires Servier Industrie

Objective/motivation

The subject of my mission concerned a container break in production flow. This lack of container had a direct impact on our production. The goal was therefore to anticipate these breaks in production to remedy the problem before encountering it. I worked with the site production scheduling department. The major concern was the lack of information when scheduling production batches. Indeed, the necessary information is the availability of industrial equipment, available human resources, raw materials and other items. We then needed to know the availability of specific containers for each batch of products. Once this information is obtained, we will be able to know what to act on. As a reminder, the fact of running out of container generates disorganization at the operational and planning level. The equipment, raw materials and human resources available could be on hold and especially our patients, which is unthinkable. This mission was created to prevent this risk

Results

First of all, I had to set up a working group, with which I managed to collect all the information I needed (manufacturing process, type of containers, production flow, reading of the production schedule). With the Visual Basic tool (programming in Excel) I was able to create a macro to read the site scheduling planning, each product and each batch in order to quantify the number of containers to use (by category). We simply have to enter the number of containers available before running the macro. Obviously, the schedule updates the available container stock according to the production planning and the packaging planning, because at the packaging step the containers become immediately available again. Other ideas have emerged to make programming information more reliable. The study of the flow made it possible to observe that the containers all passed in a precise place, the cleaning phase takes place. This phase has become a point of verification. When the containers go through, an inventory can be made so that we really know the available containers and clean the containers which are currently unusable.

Keywords: Production, production schedule

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Qualification of a semi-automatic assembly line and audit

Industrial engineering

Guillaume ROQUES
Academic supervisor: G. HIVET
Industrial supervisor: S. TINTILIER

Company: APTIV

Objective/motivation

For two months, I got the opportunity to work in the Hungarian plant of my company APTIV. I went to Hungary to support a project leader engineer. My aim for these two months was to help him launch a line in production. The objective was to obtain positive results for this line for any potential audit.
We started with nothing because when I arrived, the line wasn't set up in the company. Yet, since I left, this process is able to run only with trained operators and technicians. In order to reach this result, a lot of engineers worked together. We had only seven weeks to improve this line and change the cycle time from 300 seconds to 150 seconds. During these two months, I discovered different aspects of the job I want to do in the future.

Results

During these weeks, we had three audits of the line, the second and the third occured because the previous ones didn't reach the expected result. Audits are the main thrust of a project because they allow to see if the specification at the begining of the project have been followed by the company. The last week of this internship abroad was special for me because, for the first time, I had a lot of responsibilities and I had to manage the line on my own. It means that in this last week, I had to keep track of the process in order to assemble all the products needed by the customers, I had to train a few engineers to manage the line in August and finally I had to manage the process during the last audit. It was a success.

Keywords: Engineering, production, industrialization, audit

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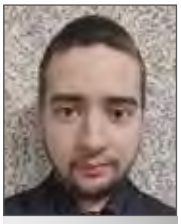
Reduction of production stoppages

Production engineering



Alexandre HERMANT
Academic supervisor: A.FONTE
Industrial supervisor: C. DIMARTINO

Company: Borgwarner.

Objective/motivation

Since the increase of the customer demand for the Westport sector, the latter has been experiencing various problems, including several production stoppages. In order to strengthen the company's position in the market for diesel injectors for heavy goods vehicles and to compensate for the decrease in sales of diesel injectors for private individuals following Diesel gate, I carried out a project whose main aims are the reduction of production stoppages and the anticipation of increased customer demand. The objective was to understand the origin of these stoppages, analysing the current situation and determining the root causes. This would then enable the development of a solution that would put an end to them, while increasing the production load to 500 parts per week instead of 250, allowing the Westport workshop to move from prototyping to mass production.

Results

After analysing the current situation, we concluded that the production stoppages were due to a lack and misuse of production trays (containers in which our parts are kept throughout the process). To make up for this lack, we assembled 45 new trays, with recovered materials, for uses other than production. We also carried out an awareness campaign for operators. In all, we reintegrated 68 trays into the production flow, i.e., 70% of the trays used incorrectly. In addition, we have developed a tool that allows us to know the quantity of trays needed for a given load. Finally, the health crisis resulted in slowing down our production, so the reduction in stoppages was not measured. Nevertheless, the proper use of the trays limits the risk of mixing parts and breaking in the flow.

Keywords: Production stoppages, improvement, tray, production flow

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Reliability of a weighing process in package handling

Production engineering

Théotime NIERADZIK-KOZIC
Academic supervisor: B. LE ROUX
Industrial supervisor: H. DEGUYENNE

Company: Groupe La Poste

Objective/motivation

For this project I worked with DPD, in Switzerland. DPD receives parcels to be sorted and dispatched from customers, who indicate a parcel weight, on which the dispatch tariff depends. On its sorting lines, DPD weighs the parcel to check the weight indicated by the customer, and to charge an additional fee if the checked weight causes the parcel to move to a higher tariff band. However, some weighed parcels come out with a zero weight, making it impossible for us to check the weight indicated by the customer, and therefore the rate applied. This problem of weight measurement can be observed in our eleven Swiss depots. My project consists in analyzing, first of all on the two largest depots the origin of these measurement problems, and then in making the necessary modifications (equipment, process, operators' work space, etc.) in order to solve this problem.

Results

In our two largest depots, an average of 7.09 and 8.66% of the parcels came out with zero weight per day. However, the median values over the same periods were 5.70 and 7.59%, suggesting the presence of a few aberrant days, which were real but not representative of the normal and usual depot activity. In the nine other smaller depots, this proportion ranged from 0 to 1% per day. The objective given to me was to lower the proportion to 1% or bellow, per day per depot. After finding correlations between the characteristics of the depots and the proportion of weight errors, targeting different factors that could affect the quality of the weighing and modifying the sorting lines, the proportion of errors was greatly reduced. The two largest depots went down to 0.8 and 1.0% on average after a few weeks, and the other, smaller depots were down to zero.

Modified manual weighing station

Keywords: Process improvement, quality

Modified weighing station

New weighing station

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Setting up performance and steering indicators in the departments concerned at the Industrial Competence Centre

Production engineering

Paul MERCURY
Academic supervisor: E. COURTIAL
Industrial supervisor: C. ALMER

Company: undisclosed (confidential)

Objective/motivation

Key performance indicators help to evaluate the performance of one or more departments. They allow managers to know where they are in terms of achieving their objectives, where they are succeeding and where they are having difficulties. As an apprentice production engineer, I work on the indicators attached to the Industrial Competence Centre. The indicators must be adapted to the needs of the LAS site and THALES. The aim is to have robust dashboards and total autonomy for each manager to update the indicators. This means having a defined process that is quick and easy to use. These indicators are essential for managers because without them they will not be able to know the efficiency of the company and effective decision support. Key performance indicators are one of the pillars of the company's success.

Results

The project on the deployment of key performance indicators is not finished, indeed it is a long-term project. Progress report: There are about 30 indicators spread across the CCI departments, which are: production, incoming inspection, maintenance, methods, industrialisation, production quality, planning, supplier performance, finance and procurement. Recently, the company in La Ferté Saint Aubin went through a period of transformation at the database level: transfer of data from the ERP to SAP. For this, an Excel file was set up to create the specifications to meet the objectives that had been set. The specifications consisted of the existing indicator (its remains), its needs and its form, all in computer coding in order to automate and make it simple to use for the people concerned (objective to be achieved).

Keywords: KIP, Objective, strategy, responsibility

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Standardisation of format changes

Production engineering

Pierre GROB
Academic supervisor: J-M. AUFRERE
Industrial supervisor: P. GAUBERT

Company: Les Laboratoires Servier Industrie

Objective/motivation

With more than 50 medicine produced on the site of Gidy, the needs to trace which mechanical part goes with medicine is required. In addition, each medicine can be in different packagings, depending on the dimensions of the pill or of the box. The equipment/product portfolio of Les Laboratoires Servier is in constant evolution, the quantity of mechanical parts, called: “format parts”, will increase. At the moment, there are more than 2000 parts on the site. For this purpose, an inventory had to be made to precisely know what parts we have but also where the latter are. In addition, a man-machine interface must be built in order to know the format parts necessary for the production of a product.

Results

With the part referencing phase, the company now has a database that allows it to know exactly the different format parts for the packaging lines. These format parts have engraved references that make it possible to distinguish between them. Moreover, each part can be found individually. Finally, with the integration of 3D part plans, new operators or technicians can easily find the part they need among several.

The tool also allows a person to be on a mission in a different environment from the one in which they are most experienced in order to carry out a format changeover. They will need to enter various data from the Production Order in order to have a list of parts to be changed and to know where to find them. The outgoing format will also have a better chance of being stored in a defined place if everyone uses the tool.

Keywords: Format change, SMED, database, production line

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Training and assessment modules for operators

Production engineering

Jean-Baptiste ALLEAU
Academic supervisor: C. DUROS
Industrial supervisor: S. HENRION

Company: undisclosed (confidential)

Objective/motivation

As part of the development of operators' skills on the Descartes site, the company wants to set up skills assessments and create a digital E-Learning system so that staff can train themselves. This initiative dates back to 2012 when the management observed that it was difficult to recruit staff, especially trained staff. To overcome this problem, the management decided to set up a system of self-training for production operators so that staff can train themselves to acquire new skills but also to deepen their knowledge of other skills. The aim is to enable the personnel to be more autonomous on the machine, to increase their level of first-level maintenance, but also to give them maximum responsibility and make them more versatile in order to better anticipate future personnel movements.

Results

The work carried out during this year has enabled me to draw up a schedule, establish the main lines of the project as well as create evaluations that allow us to measure the level of the operators and to know their training needs. Yet, as this is a project spread over several years, we will see the results in a few months' time. Now we will be able to get down to the concrete realization of the project by creating the design and layout of the training modules on the one hand, and on the other hand by completing the various modules that exist today and by writing the various non-existing modules. For my part, in the coming year, I will have to work with our English counterparts to set up the E-Learning system on the Descartes site.

Keywords: Training, Lean manufacturing, Production Standards

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Value Stream Mapping through Lean principles

Production engineering

Valentin FAGGION
Academic supervisor: B. LE ROUX
Industrial supervisor: S. ROMEDER

Company: Borgwarner

Objective/motivation

At BorgWarner Stonehouse, England, the CEO has put forward actions concerning Lean Value Stream Mapping. Those actions will allow huge money savings in terms of part stock (finished and Work-In Progress stocks) and raw materials. It will also smooth the production line, thus avoiding overproduction, and enlighten some Lean issues that may occur on the production lines, such as waste (8 muda). Visual management is also an important point to put in place on the line, as there is not any of it. It is in this context that I joined the APU1 of the Stonehouse plant in England, to work on a project aiming to apply Value Stream Mapping on a production line, from the analysis of the line to the implementation of actions, with the training of the different shifts of operators.

Results

After the analysis of the line and the creation of the current-state map, I designed the future-state map of the line, with a lot of improvements all over it, such as supermarket and FIFO transitions, a process sequencing wheel, a new Kanban scheduling system with 3D printed signal solutions, and several other upgrades. Working conditions have also been improved overall, with a new designed rack for raw materials, and some visual management for instance. Thanks to all the improvements, the lead time of the line has been reduced as a projection of 82%, from 17 days to 3 days. Moreover, the parts stocked all over the line have dropped from 35,000 parts to 10,000 parts, which represents a global value reduction of 70%, from £205,000 to £62,000 (considering the raw material only, without any added value).

Keywords: Value stream mapping, lean, production

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Working conditions' improvement during hygiene activities

Industrial engineering

Lilian BARRET
Academic supervisor: S. GROSSELIN
Industrial supervisor: M. DURAN

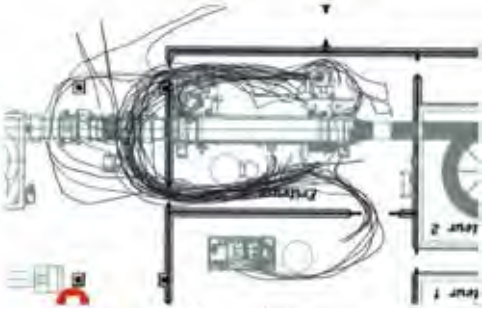
Company: Cargill Foods France

Objective/motivation

A hygiene plan is a weekly 6-hour shutdown, included in the production plan, which allows the cleaning and complete disinfection of the equipment. In the food industry, we must ensure the quality and safety of products in order to eliminate any risks of bacteriological contamination. Currently, these are tiring activities for operators and it is difficult to carry out all the hygiene steps in 6 hours. Indeed, these activities very often lead to delays in restarting, which results in production losses. Consequently, my job consists in improving the working conditions, reducing the existing safety risks and learning to know how to manage them in the time frame foreseen by the production plan. The two main goals are safety improvement and process control in order to reduce hygiene activities by one hour per week.

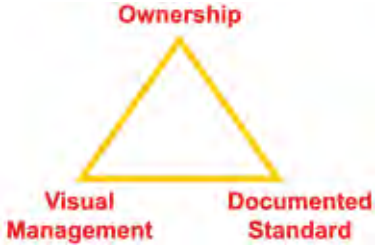
Results

Our production floor is a large area, so I decided to create an island of excellence in order to focus our efforts on a small part. I used the WPI method allowing to reduce every loss in a work process in order to achieve the objectives set. A WPI project represents an infinity of 5 steps loops but my assignment concerns only the first. Indeed, the latter aims to make operators from other areas want to continue the approach. As a result, the hygiene of the two complete production lines will be improved gradually throughout the loops thanks a snowball effect. For now, the working group has noted that very few steps have added value and the rest needs to be optimized. The distribution of the workload between the operators is not balanced due to a lack of organization. Therefore, the rest of the project will focus on improving what exists in order to meet the set objectives.

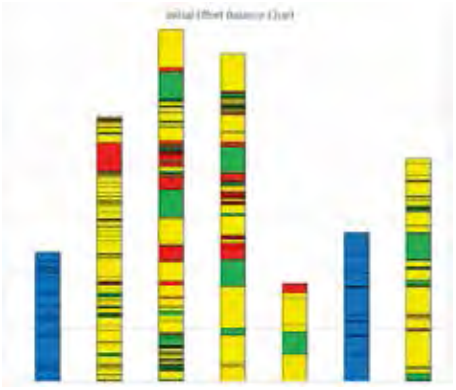


Motion analysis

Keywords: Work process improvement method, island of excellence, gain expertise, processes knowledge, working conditions



Golden triangle



Unbalanced workload

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x

Smart Building

Agronutris

Civil engineering

Jeffrey SERRES
Academic supervisor: R. WEBER ROZENBAUM
Industrial supervisor: A. FOULOUH

Company: Pingat Agroalimentaire & Industrie

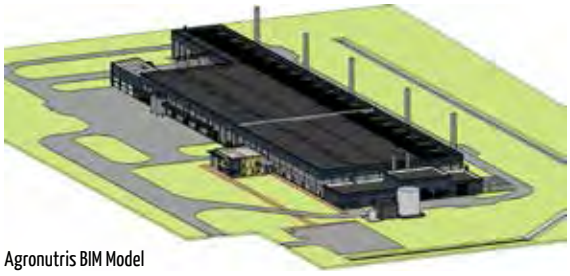
Objective/motivation

During my studies at Polytech Orleans, I studied in the Smart Building specialty in apprenticeship and worked in a company on the project management called Pingat Agroalimentaire & Industrie. I used to work on one project: Agronutris, which is the design and construction of a plant for producing some substrates produced by the Black Soldier Fly, a non-invasive fly of equatorial origin and noninvasive, which is an excellent variant for the co-products of agribusiness. The plant would be approximately twenty thousand square meters and twelve meters high. The challenge was huge, dozens of millions of euros have been invested for a start-up with just 10 persons working in it. We had to design the utilities, cold water, hot water, steam production and later we had to manage all the standards of a factory in collaboration with Chinese and Swiss companies.

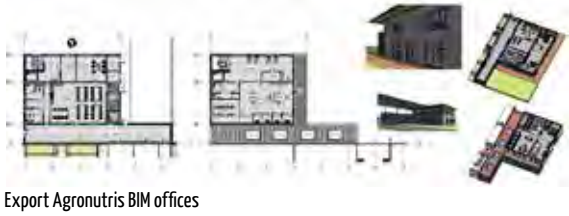
Results

First, for twenty months, we made a feasibility study and a preliminary draft with blueprints and costs to present to Agronutris and an ecological label. After that, we filled in the building permit which we submitted to the city hall of Rethel (08). It was accepted rapidly, probably because the Agronutris project is considered in the French Ardennes as one of the most exciting and bright projects. The last point I worked in is the tender document. We described the construction of the project and cost it in detail, sometimes with the assistance of partner companies. So, today, we are choosing each company for the construction site and the first step of the construction should be started during March 2021. The collaboration between Agronutris and Pingat makes it certain the commissioning of the plan for mid-2022, and 100% of the production for the end of 2022.

Keywords: Civil engineering, agro-food, project management, fly larvae



Agronutris BIM Model



Export Agronutris BIM offices

Land insertion of Agronutris factory

Contact:

Automatization of logistic building

Electrical engineering

Guillaume DELPLANQUE
Academic supervisor: Mr.CADOREL
Industrial supervisor: Mr.ROUET

Company: Engie solution

Objective/motivation

The objective of my project was to create a network communication in a logistics building to control and read the different values of the different sensors inside this building. The objective is to control any rainwater pump, lighting, heating, water consumption. But in this project, I also had to control the different alarms like the fire alarm. To control this network communication, I had to create a supervision, supervision is a representation of the various alarms in the building. This supervision consists of all the operating states of each control point and allows the building to operate in automatic mode. With the help of this supervision, we add communicating meters which allow us to generate consumption returns in order to then be able to create graphs to be able to analyze building consumption. To be able to retrieve the various building information, we use communication modules (which will make it possible to make the link between the supervision and the various sensors of the building). These modules are wired either in RS485 or in Ethernet.

Results

The result of this project was the commissioning of the building with the help of supervision by managing the different parts of the building as the customer wanted and by integrating schedules.
After installing the building supervision on site, we carried out training with the client and the various managers of the future building to allow them to individually control all their orders.
We made them discover the interface of the supervision to better understand and to be able to interact simply with it.

Keywords: Supervision, Smart Building, sensors, network communication

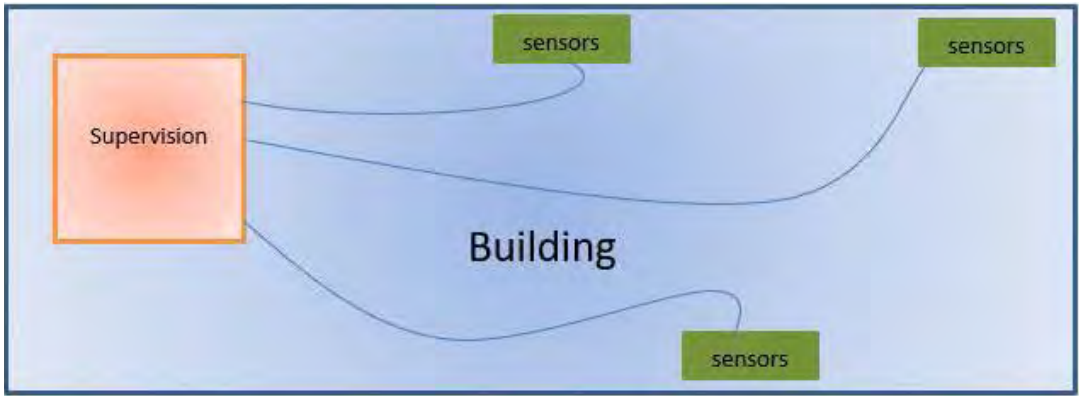


Schéma projet

Contact: guillaume.delplanque@etu.univ-orleans.fr

BMS Project Management Engineer

Smart building

Agathe BAFCOP
Academic supervisor: E. BEURUAY
Industrial supervisor: O. KOZMIN

Company: Schneider Electric (Grenoble)

Objective/motivation

After two years of apprenticeship at Schneider Electric company in Grenoble, I had the chance to continue my training by integrating the Smart Building specialty in apprenticeship at Polytech Orléans. During my three years of engineering school, I continued to evolve within Schneider Electric with the aim of continuing to learn more and more about the technical management of buildings. Indeed, having a technical training in the field of automation and electricity, I wanted to continue my studies in order to expand my knowledge and gain skills. During my apprenticeship, I had the opportunity to work on various projects related to the building management system of the site I'm working on, in particular on Schneider Electric software, used to control lighting, heating, cooling and many other systems. The final objective of constantly optimizing this software allows us to control our consumption and therefore the impact of our buildings on our environment.

Results

During these three years of engineering studies, I mainly worked on Schneider Electric's SBO software. First, I had to do a complete study of the software in order to understand how it worked. The main interest was to be able to continuously optimize our consumption based on our presence and our use of this workspace. Secondly, I worked on the project to rehabilitate the technical equipment of all the old buildings on the site in order to have only one BMS at the end. Indeed, our site being composed of different buildings, we previously had several technical management systems. This second project allowed us to simplify, optimize and connect our buildings. Our main wish is to have total control on all the technical installations of our site. Among other things, we have obtained Leed Platinum certification for our building.

Technopole grenoble

Keywords: Building management system; software; electrical

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Characterization and development of an autonomous connected solution about natural zenithal illumination

Smart building

Pierre CONSTANT--BERAUD
Academic supervisor: G. LAMARQUE
Industrial supervisor: V. CHANTEPIE

Company: Bluetek

Objective/motivation

This was my second year in Smart Building, an engineering apprenticeship course in Polytech Orléans. I made my apprenticeship in BLUETEK, an ADEXSI group company, which advocates roof lighting development with natural illumination and other well-being solutions such as natural ventilation. There were two purposes in this project, firstly to develop an autonomous skylight thanks to a solar panel, using the Sun's energy. Secondly, to build a connected platform where our autonomous skylight's data could be transferred. The lake of electricity is covered using the autonomy provided by the organic photovoltaic panel (OPV), the main purpose was to integrate it. The connected platform development for monitoring was a main part of the subject too. For making new autonomous smart buildings a place of welfare, this project gathers different actors to use renewables energies and to develop new opportunities about energy management.

Results

The first step of the project was to equip a skylight with an organic photovoltaic panel. With these OPV the skylight became autonomous and could ensure ventilation and shading cycles using a renewable source of energy. Natural ventilation and shading are very important solutions for building well-being. In the second place, the autonomous skylight was equipped with a connected platform which provides the real-time monitoring of the installation gathering information about the weather, battery status or number of ventilation cycles. The final goal is to provide to any manager of the installation will have a complete access to an internet page where they could find graphics and indicators to understand the setup's positive impact on the building, considering the reduction of electricity consumption and a better air quality.

Keywords: Natural ventilation, natural illumination, autonomous, opv, connected

Connected monitoring plateform

Organic photovoltaic panel

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Conception of a complete HVAC solution for a pharmaceutical group

Smart building

Jules KAPRAL
Academic supervisor: E. BEURUAY
Industrial supervisor: Y. SALLÉ

SIEMENS

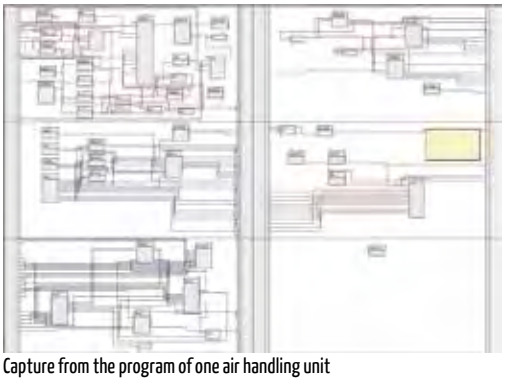
Company: Siemens

Objective/motivation

A major group in the pharmaceutical industry wants to build a new infrastructure for the making of new products. When a company works in this kind of activities (food-processing or pharmaceutical laboratory), a lot of normalization must be respected. Our client is looking for a complete solution with the automation of the air conditioning (temperature, humidity and pressure) through Building Management Station (BMS) with the same requirement as Environmental Monitoring System (EMS). This is done in order to make some energy efficiency while respecting the Foods & Drugs Administration (FDA) and Gamp5 recommendations. That's why Siemens was asked to do all the qualifications from the redaction of documents to the realization of the test on the different installations. Finally, the monitoring of all these data must appear on our supervisor.

Results

Firstly, I had to do the whole documentary system. All the deadlines, roles and tasks to do for each person in the project is detailed in the Engineering Specification which is globally for the project. Then we had to write down our functional specification for validation for each installation. While the Hardware Design Specification precise elements such as firmware, type of logic controller or even complementary module, the Software Design Specification details all the different characteristics and parameters of the program. In harmony with how the system works, we prepare the test documentations that our client will oversee during the implementation of the air handling unit. These documents are a checklist of all the different scenarios that can occur on the system. Finally, we create the user interface for the monitoring of the building on the supervisor.



Capture from the program of one air handling unit

Keywords: Automation, energy efficiency, infrastructure, management of project

Loading program into a PLC

Siemens Desigo CC – The supervisor

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Construction site supervision

Civil engineering

Léoric CHAUVEAU
Academic supervisor: R. CANALS
Industrial supervisor:N. CHAUDUN

Company: Engie solution

Objective/motivation

By starting a work-study program, I hoped to learn more about the world of work in order to gain experience when I graduated, because the knowledge I had of the world of work was probably wrong. I also wanted to learn more about the jobs I was discovering, because I knew nothing about the complexity and demands that could be imposed. I also wanted to discover environments that were totally unknown to me.

Results

After 3 years of work experience I have learned a lot about the world of work. Especially about how it works and how things don't always go in the right direction or don't always go well. After a first year in a small company where I didn't have the same vision as them about taking an apprentice, I had to look for a new company to finish my training. After finding a new one, I understood a lot about the difference between big and small companies.

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Manage the deployment of an innovative offer on the smoke detector (DAAF) market

Smart building

Alexis LEREBOURG
Academic supervisor: K. ABED-MERAIM
Industrial supervisor: J. BEAUCHAMP

Company: Ecometering – Engie Solution

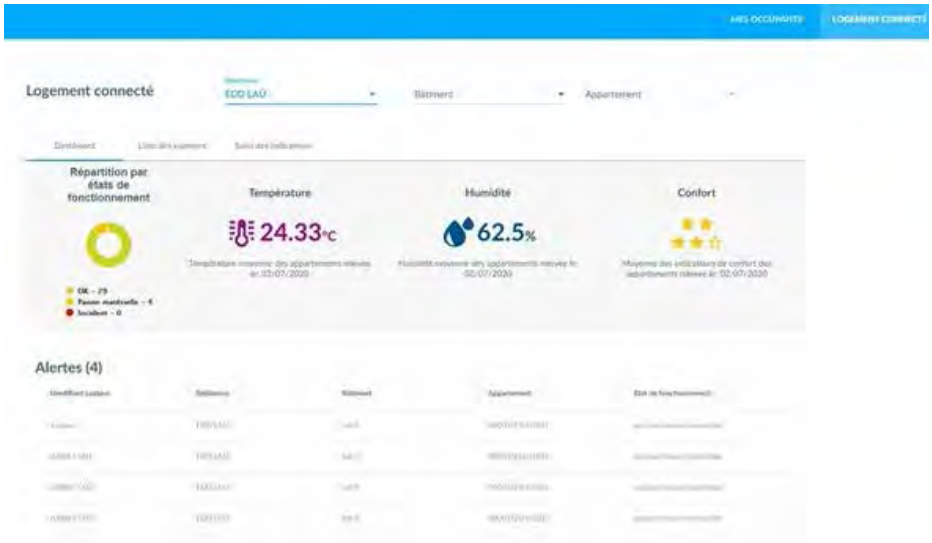
Objective/motivation

Ecometering wanted to develop its field of activity and assigned me a part of this project. Its objective is to deploy an innovative offer on the connected housing market. This offer is deployed on two residences (which represent a total of 90 housing units spread over 10 buildings). These residences will be equipped with autonomous smoke alarms/detectors in each housing. This equipment has various technologies that will allow us to provide customers with different data related to housing on their customer portal. The occupants of each housing and the manager of the residence will have access to the customer portal where they will find the data related to the installed equipment. In our case, the smoke detector has three sensors that can analyze temperature, humidity and smoke. With its data, it will provide a comfort index and an index of indoor air quality of housing.

Results

The development of this new project, was carried out in several phases which are the test phase, the carrying out of the methods and processes, the deployment of the solution, the integration of the data in our systems then, to finish, the delivery of the portal client to clients. The first two phases have given us a perfect understanding of the equipment we are installing. It will also allow our partners who are going to perform the installation to carry it out correctly. During deployment we did not manage to have perfect reception for each installed device. To remedy to this problem, we had to equip one of the buildings with a micro wireless communications station in order to have better network coverage.

Keywords: building, connected device, data collect, supervision, project management



User interface of the residence manager

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Project Manager, a stakeholder in the development of new buildings

Smart building

Auguste HERISSE
Academic supervisor: J-M. FAVIE
Industrial supervisor: N. DA SILVA

Company: Cofaco

Objective/motivation

Engineering schools give basic theoretical knowledge about various subjects chosen at the beginning of the school cycle. Moreover, without any doubt the most important thing, engineering schools teach students how to think through courses, which represents a third of the school schedule. However, the acquisition of technical knowledge is only possible in companies through projects. The purpose of the mentioned project concerns the improvement of efficient energy use of the buildings. Many buildings were built just after World War 2. The energy consumption of those buildings is too consequential for today's world. Furthermore, the environmental aspect in the construction and refurbishment is not developed enough in comparison to other countries and public demands. So, the objective of the project is the development of a renovation method using green materials with the aim of reducing the building energy use.

Results

At the end of the engineering school cycle, an engineer must be able to create and manage a project. The project must fulfill its purpose (SCOPE), be completed within the budget (COST), and come in on schedule (TIME). Here, the project provides a new tool, which is the deliverable of the project, for the company. Through a method of refurbishment of building envelopes with an external insulation using green materials, it is possible to help the project managers make fast estimations during a meeting with a potential client. The tool allows given realistic numbers for a client about the cost of its project, the thermal aspect of the building after renovation and the saving in the short term and in the medium term. This tool helps the project managers into becoming stakeholders in the development of more efficient energy use buildings.

Keywords: Efficient energy use, refurbish, green materials

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Realization of indoor and outdoor lighting studies

Smart building

Chaimaa AMIMI
Academic supervisor: C. CACHONCINLLE
Industrial supervisor: D. CHAFAUX

Company: Signify (Ex Philips Lighting)

Objective/motivation

During my Smart Building training as an engineer at Polytech Orléans, I had the privilege of doing my apprenticeship at Signify. I spent my 3 years, working in the design office support position, working for the Paris-Ile-de-France/centre distribution team. My mission is to carry out lighting studies using simulation and calculation software, and to support the sales representatives by transforming their functional specifications into technical specifications. So, for each project, I have to submit a technical report highlighting the results obtained with different lighting solutions. The objective is to meet customer expectations in terms of technical solution, cost and deadline, and to comply with the standards in force. During these years of apprenticeship, I worked on different aspects and managed several times different projects simultaneously (indoor and outdoor). Now, I feel able to guide customers towards the best solution and to anticipate the results according to the installations.

Results

These 3 years of training have been very rich in teaching, from a technical but also human point of view. I arrived at Signify with little knowledge in the lighting field. I found a motivating work atmosphere with the service team that has supported me throughout these years. This apprenticeship allowed me to discover a whole other range of equipment as I also learned the functionality of Philips products. This way, I was able to optimize my way of working since project organization and meeting deadlines are necessary in the lighting field. Finally, I am satisfied to have chosen this apprenticeship training path, I was able to continue my studies while having a foothold in the professional world and having a full employee status. The experience I gained will undoubtedly be beneficial to me in my future work and career.

Keywords: Lighting, lighting studies, software, standards, Technical specifications

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Response to a call to a tender in Electrical field on the rebuilding of Eiffel Offices in Créteil

Electrical engineering

Alice BOUDIER
Academic supervisor: E. BEURUAY
Industrial supervisor: B. BONVIN, N.MAILLOT

Company: Spie France – Industrie et Tertiaire – division Tertiaire

Objective/motivation

I signed my apprenticeship contract with SPIE Industrie et Tertiaire – division tertiaire in 2018. I first signed with St-Jean-de-Braye (45) office and then made an amendment with Migné-Auxances (86) office. I was a total beginner in the construction field and had a lot to make up for, but these last three years have made me curious about a new sector, as much as it brought me sound knowledge in the electrical field. Until now, I have worked both on work sites and design offices and I am about to switch on the business part of the job. Through each experiment, I was able to see different atmospheres and team organizations which helped me to find a balance between my professional and personal life. For now, I'd like to keep having various experiences, gather knowledge and pursue in sustainable development.

Results

My work consisted in responding to a call to tender for Eiffel Offices in Créteil for the destruction and total rebuilding of the 21,000 m² area of offices and 9,000 m² car park for a public tender. We worked on strong current, weak current, fire safety and building management system lots. It implied drawing up blueprints, making light studies, quantifying the equipment costing, drafting cost estimation, dimensioning wires and, most of all, keeping modifying our plans in order to suit the contracting authority. The call for bids lasted 7 months for the electrical lot and 3 phases of Preliminary Design Report. In the end, we didn't win the tender but it was a constructive skill in project monitoring.

Keywords: Electrical field , tertiary buildings, design office, construction site, project monitoring

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Restructuring of the accommodation and day school

Civil engineering

Swann MORENO
Academic supervisor: J-Y. CADOREL
Industrial supervisor: S. GAY

Company: Conseil Régional Centre Val de Loire

Objective/motivation

As an apprentice at the Centre-Val de Loire Regional Council, and the person in charge of operations, I lead missions concerning high schools in the department of Loiret (37): construction, renovation, fire security systems, etc. For all of my missions, I represent the contracting authority. Therefore, I represent the final client. I had the opportunity to assume the responsibility of project manager in connection with the actors of the building (MOE, companies, CT, CSPS...) and the internal services of the regional council according to the situations and the files. Organising coordination meetings and drawing up schedules. Carrying out the technical and financial preparation of an operation. To monitor operations technically and administratively from the launch of studies to acceptance, as well as the programming phase and the guarantee of perfect completion. One of my projects this year is the restructuring of the accommodation and day school of a high school located in Tours. This project has many objectives: to allow the school to have additional rooms for teaching, to centralise the school life, infirmary and entrance/exit area of the school, to facilitate access for people with reduced mobility. As the person responsible, the challenge of my mission is to properly steer the operation, thus enabling us to coordinate each phase by involving the various players

Results

The planned works for the operation will be completed in summer 2022. It is an occupied site operation which receives the public. Today we are in the study phase of the project, more specifically in the diagnostic phase because we are doing restructuring. The programming phase was delivered on time. This is the result of good organization and collaborative work with the various trades, regional council internal services and users involved in this operation. To carry out the operation, I carry out operational planning, detailing each key phase of the project, which allows me to set milestones and plan meetings with all the construction actors involved in the project and assess it progress. This allows me to maintain efficiency in the management of the project and to ensure that I meet the needs of the users

Keywords: Construction, building, school, contracting authority, management

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Restructuring of the electrical installation at THELEM Checy site

Electrical engineering

Timoté FOULON
Academic supervisor: S. TREUILLET
Industrial supervisor: A. BERTIN

Company: Eiffage Énergie Systèmes

Objective/motivation

The project is located on the THELEM Insurance site in Chécy. This project consists of the restructuring of the electrical installation, making it possible to supply the various buildings and servers. The site is made up of a double EDF inlet which provides emergency assistance if an inlet ever stops. The problem given at the base of the project is that these two inlets are not separate and therefore work together, which can be problematic in case of a hitch. This is why the customer asked us to create two separate power supplies so that we actually have two power sources in an uncommon way. To be able to achieve this, we had to think about several possibilities in order to create two tracks (A and B) at the end, these two tracks are supplied by EDF but both are rescued by a generator for each.

Results

Each week, a meeting is scheduled at the site with the managers of the various departments, the architect and the project manager, making it possible to follow everyone's progress and to communicate on this subject if any problems. Several changes have taken place on the site, in particular on the transformer as well as the integration of a cabinet containing an automatic inverter. Two main low-voltage boards were installed, supported by two generators of 1000KVA and 300KVA as well as two m Modulys inverters. Thelem Insurance is composed of two data centers containing the servers which are powered with PDU for communication. It is therefore unthinkable that a power cut should occur in these rooms, which is why I carried out the identification and the updating of these markings in order to be able to connect the new installation without disconnection problem.

Keywords: Building, management, generators, inverters, main low-voltage boards, data centers,PDU= Power Distribution Units

Generator 300KVA

Data Center

Power Distribution Unit

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Routing of a customer file

Building engineering

Rayan ZERIGUI
Academic supervisor: T. GIBERT
Industrial supervisor: R. GAUTHIER

Company: Triangle Élevage

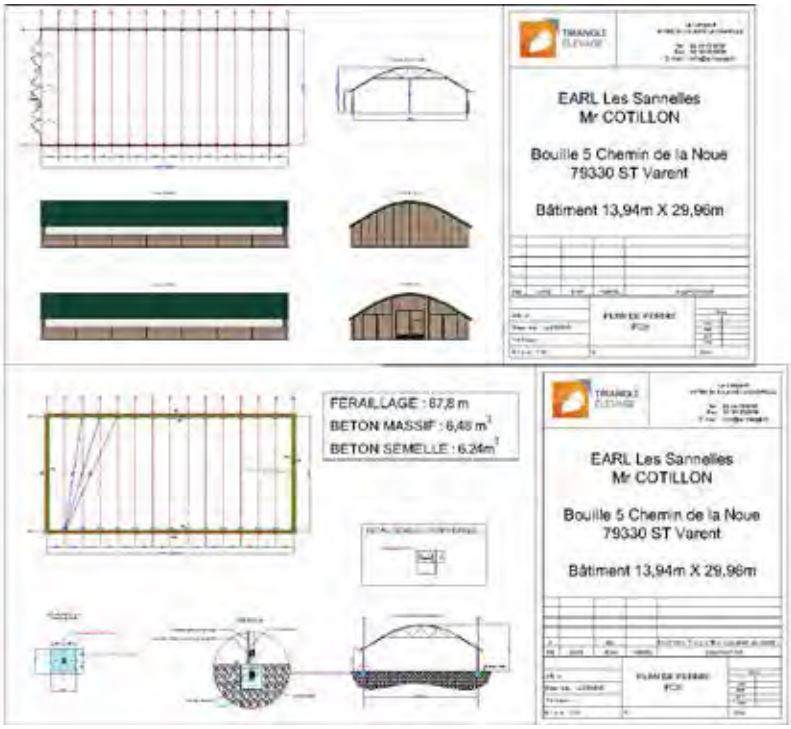
Objective/motivation

Before signing my apprenticeship contract with Triangle Elevage, located in Vendôme, in 2018, I had first tried my luck to be part of the Smart Building training but I had not found a company capable of training me during these three years. That is how I came into contact with Triangle Elevage, first as draughtsman in their design office. Through this trial, I discovered a world that was totally unknow to me, that of the livestock building. After signing my contract, I was oriented towards the different tasks necessary for the creation and follow-up of a customer file. Thanks to this experience, I was able to improve in a multitude of tasks and, above all, I learned how important communication within a company is. Each experience within the company has strengthened me both professionally and personally.

Results

One of my projects was to produce a complete file for a client who wanted a 420 m² barn. First of all, I worked on the building permit plans in accordance the salesman's specifications signed by the client.

Despite everything, it is always necessary to discuss with the sales representative in order to point out details to ensure a plan in accordance with the client's request but also company standards if the client wishes to comply with the standards of his LABEL. It is also necessary to make a layout plan for the masons. After validation and payment, I was able to carry out, under the technical file which will be sent to production in order to manufacture the building in our workshops. The technical file includes the entire building to the smallest screw. Finally, the monitoring of the building during assembly is carried out with the assembly manager in order to be responsive to any problem.



Keywords: Building industry, livestock, building, design office, construction site, project monitoring

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Technologies for Energy, Aerospace and Engine

A400M take-off performance and trajectory optimization

Aerospace engineering


N. LECLERC


M. RINALDO


R. ROSSIGNOL

Nicolas LECLERC / Miguel RINALDO / Romain ROSSIGNOL
Academic supervisors: A. CHARLET, P-Y. PASSAGGIA
Industrial supervisor: Captain M. EMONOT

Institution: Base Aérienne 123 Orléans-Bricy

Objective/motivation

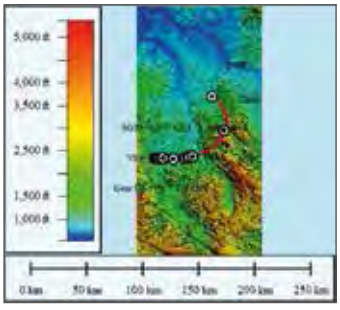
The main objective of this project is the porting of an existing Python software, used to identify obstacles that could conflict with an A400M take-off, to another programming language. The software uses data from various sources: an artificial obstacle database, digital elevation models for terrain-based obstacles, and outputs from a trajectory computation software. To be conservative, said trajectories are computed with one engine inoperative. It delivers an analysis of the obstacles along each trajectory, as well as a visualization of the safe zone that said obstacles must not infringe. Moreover, we also optimize the program by adding the support of another obstacle database format, overhauling the graphic interface, improving structuration and lowering its runtime. The new software could end up being used by most European military partners of the A400M program.

Results

We chose to use C++ for the new software, as it is suitable for both national and international certification. As of this writing, the porting is almost complete, missing only the safe zone visualization. The reason for this is the geospatial data reader libraries used to produce safe zones and the numerous functions used to compute them. Having carried out a runtime evaluation of the number of functions call and their execution time, we discovered that only two functions were occupying the bulk of the computational runtime, and thus were responsible for the poor computational efficiency of the original software. Furthermore, we succeeded in adding a new database format in the program. Regarding runtime improvement, we tested different calculation strategies, vectorization, and parallelization using our IDE provided by Visual Studio and our compiler. Finally, we added a new graphic interface.

Graphic interface

Keywords: A400M, C++ programming, software, transposition, optimization


Global mapper view


A400M

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Aerodynamics and aerothermal study of an engine nacelle of a blended-wing body aircraft

Aerospace engineering


A. ELBASSIOUNY


C. ROLS


L. WALTER

Asser ELBASSIOUNY / Clément ROLS / Lucas WALTER
Academic supervisors: N. BETTAIEB, N. MAZELLIER
Industrial supervisor: C. DE TIENDA

Company: Eenuee

Second Place
15th Annual Final Year Projects Forum

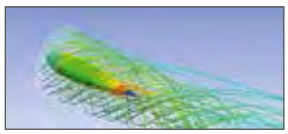
Objective/motivation

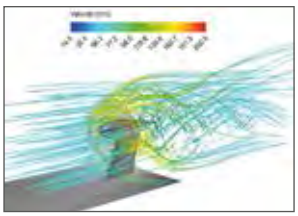
The present project takes part in the design phase of a new hybrid-electric blended wing body Aircraft (BWB) that will be presented by EENUEE in 2025. With the new BWB aircraft, EENUEE aims to offer customers a comfortable, cheap and point-to-point journey. Specifically, travel time in the days of the BWB will be greatly shortened with the door-to-door journey concept. With amphibious capabilities, the new aircraft model will no longer require traditional runways for take off and landing. Moreover, BWB will provide a sustainable mobility solution since it is estimated to consume half as much energy per person compared to an electrical Tesla car. The design of the engine nacelle is a key point in achieving high aerodynamic performance. This issue is at the core of this project, which carries out a shape optimization in order to reduce the drag load induced by the nacelle. Based on Computational Fluid Dynamics (CFD) tools, a low drag nacelle geometry will be designed with respect to the dimensions of the internal engine. In addition to that, a design of the cooling system of the engine and the air intake system will be performed.

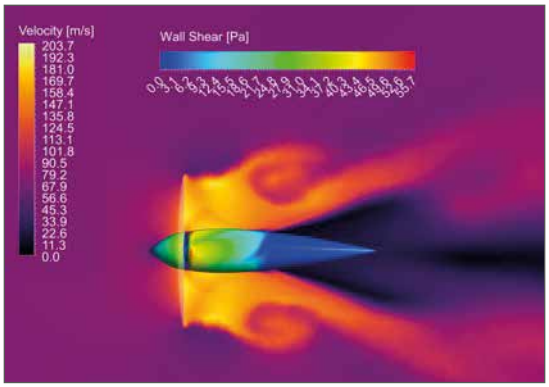
Results

The academic licence of Ansys Fluent® was used to conduct the numerical study of our project. Since this version is restricted in terms of mesh elements, simulations in 2D axisymmetric were first performed and then extended to 3D. In a first stage, the flow around the original geometry of the nacelle was investigated and analyzed to calculate the drag force. The geometry of the nacelle was then optimized by decreasing a target function, which is the drag force. The optimized geometry resulted in a drag reduction up to 82%. Despite the limitation of the solver, we managed to conduct 3D simulations, which were more realistic. The 3D study of the problem enabled the integration of the rotating propeller effect on the nacelle and the drag force. Based on the obtained results, a wide panel of solutions was provided to EENUEE. A thermodynamic analysis was also conducted to estimate the required air mass flow rate to evacuate the heat generated by the engine, and a first design of an air intake based on the estimated air mass flow rate was proposed.

Keywords: aerodynamics, hermodynamics, optimization, drag, cfd, nacelle


Flow path of velocity (nacelle only)


Flow path of velocity (nacelle/mast)



Interaction of the nacelle with the propeller flow

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Autonomous washing of aircraft

Aerospace engineering

C. MORCHAIS

L. SULPICE

Camille MORCHAIS / Lucas SULPICE
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Industrial supervisor: A. GASSELIN

Institution: Armée de l'Air et de l'Espace

Objective/motivation

The main objective of this project was to search for autonomous systems designed to wash planes in a fast and efficient way. Currently, this washing is performed manually and is quite long. Moreover, because it is slow, the plane must remain on the base for days and cannot be used for other purposes, which is costly. Washing is important because dirt might hide technical issues on some parts of the aircraft. It also reduces corrosion and therefore increases plane lifetime. To achieve this objective, we had to take into consideration many parameters, such as plane dimensions, but also respect some restrictions of pressure and distance. The specifications were different regarding the plane's geometry: indeed, distance and pressure should vary on "specific", the most fragile, and "no specific" zones, for instance.

Results

Regarding the dimensions and specifications, two different solutions were designed: one moveable and the other stationary. The moveable one is a robot: thanks to programming, this engine could move along the plane in a linear way and move its arm in an up and down motion. It could use pressurized water, then a brush with a cleaning solution, and air for the drying phase. The other solution is a gantry all around the plane which will clean it with some spray nozzles: some of them will contain pure water, and the others cleaning solution (with a specific pH). This second solution is much more costly; however, it is also much faster. The final solution will probably be a mix of these two options, with a noticeable gain of time and ease of use.

Keywords: A400M, washing, autonomous

The moveable option: the robot

The steady option: the gantry

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Battery cooling of an electric vehicle by a pulsatile flow

Aerospace engineering


G. ANDRIANO


N. DESCHATRE


M. POIRON

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Academic supervisors: C. CAILLOL, P-Y. PASSAGGIA
Industrial supervisor: M. SIMONETTI

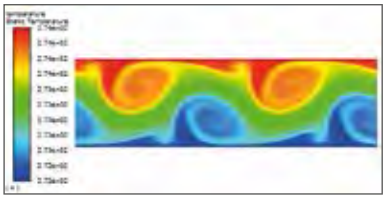
Company, Institution: PSA, PRISME Laboratory

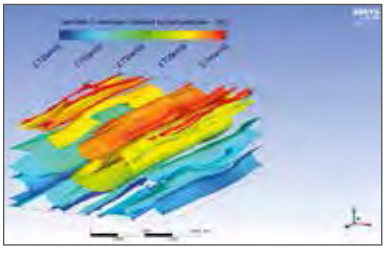
Objective/motivation

The energy transition and the decarbonisation of the automotive sector will require the development of electric vehicles (hybrid or fully electric) where propulsion is no longer linked to the combustion of a fossil fuel but to the production of electricity via a Lithium-ion battery. For the development of future electric vehicles, the design of the battery system and in particular the control of its temperature is a major challenge to have a reliable and efficient battery. In order to maintain the battery within its acceptable operating temperature range, and to respect an electrical safety performance compromise, a liquid cooling system is commonly integrated into a battery pack. The primary objective is to achieve high energy density battery pack architectures through a compact and efficient cooling system design. Batteries need to be cooled more and more due to the high electric charge and discharge. To do so, new flow configuration needs to be investigated, particularly pulsatile flow.

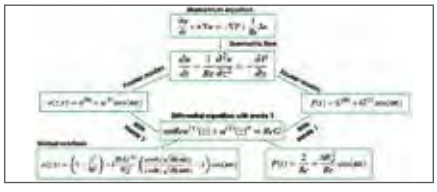
Results

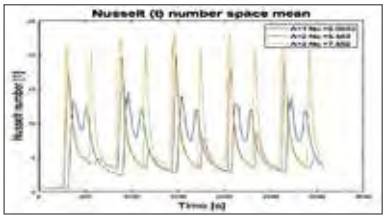
Different dimensionless numbers such as Reynolds number (ratio inertial force to viscosity), Womerlsey number (ratio viscous thickness to the frequency of the pulsatile component), Nusselt number (ratio convection and conduction flux at the wall) and Prandtl number (ratio momentum and thermal diffusivity) are used to characterize the kind of flow. To study the influence of a pulsatile flow, we made calculation with different Wo, Re and amplitude. We have brought to light that pulsatile flow creates instabilities at the end of the deceleration phases, for a Womersley number lower than 12, and there is a maximum for Wo = 7. Our results match with the study of Linear and nonlinear dynamics of pulsatile channel flow - Benoît Pier & Peter J. Schmid, J. Fluid Mech. (2017). This instability allows the increase of the Nusselt number by a factor of 5 and thus improves the exchange of energy.


Creation of instabilities with the static temperature in the channel

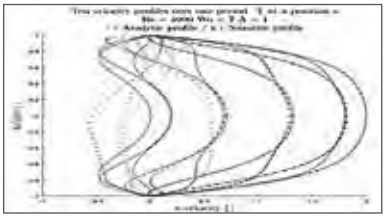

Lambda 2 criterium colored by temperature (K)

Keywords: thermal, pulsatile flow, channel flow, cfd, vehicle batteries


Fundamental equations to create a pulsed flow



Nusselt (t) number space mean


Ten velocity profiles over one period T at a position x

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Characterization of a detachment on a ramp (or flap) and its control with a sweeping jet

Energetics


A. HUBERT


A. ROUILLARD


M. TOCQUER

Antonin HUBERT / Amaury ROUILLARD / Mathieu TOCQUER
Academic supervisor: A. KOURTA

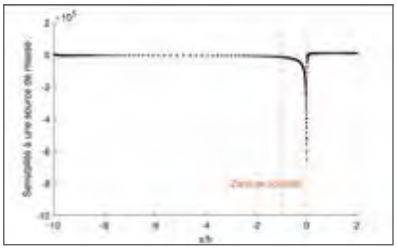
Company/Institution: PRISME Laboratory, GDR 2502, Dassault

Objective/motivation

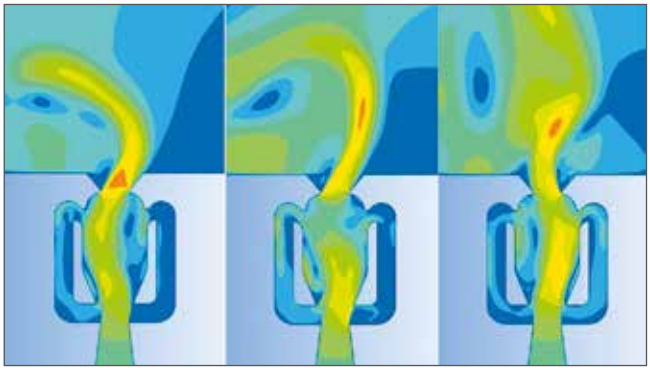
The GDR 2502 is a research group dedicated to aerodynamics, mainly focusing on flow separation, with the aim to improve performance, safety and the energy consumption of aerodynamic vehicles. The PRISME laboratory and the industrial partner Dassault are both involved in this project. Our work analyzes the flow over a ramp when it is disrupted by a sweeping jet actuator. This fluidic actuator offers several advantages, such as a constant inlet pressure and the absence of moving parts. This project involves two different studies: the study of the actuator itself and its geometry, and the analysis of the flow over a backward-facing ramp, more precisely the reduction of the recirculation bubble with respect to the position and the inclination of the actuator.

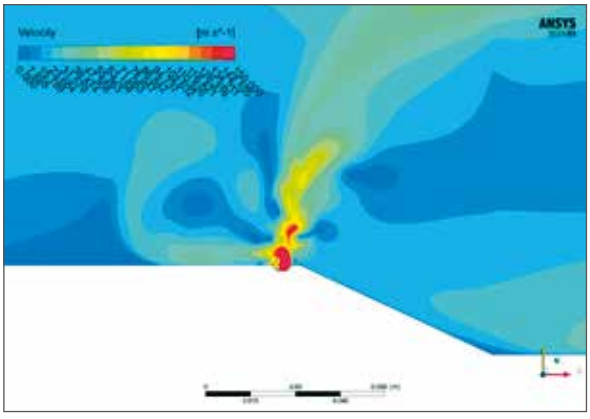
Results

As mentioned above, this project focuses on two different parts: studying the actuator and analyzing the flow. We used the student version of the software Fluent® in order to perform two different simulations, one at the scale actuator and one at the scale of the ramp. The results given by the actuator simulations, which are carried out with different inlet pressures, are used in the flow simulations as the actuator outlet for the ramp. We determine the optimal angle and position for the actuator using an adjoint-based optimization method with the objective of minimizing the size of the recirculation zone. To verify these results, a mapping of the angle was peformed. Finally, transient simulations are done with and without the actuator and results are analyzed and criticized.


Sensitivity to a mass source

Keywords: flow control, sweeping jet, optimization


Actuator



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Comparing different measurement methods of a two-phase flow phenomenon

Electrical engineering

S. KADI

F-X. LECOMTE

Souad KADI / François-Xavier LECOMTE
Academic supervisor: N. MAZELLIER
Industrial supervisor: E. TOPENOT

Company: MBDA France

Objective/motivation

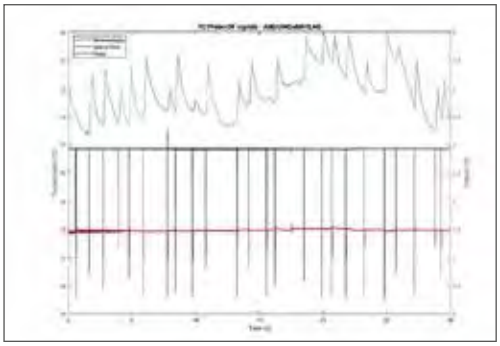
The combustion chamber of a ramjet is cooled with kerosene, which will be injected into the combustion chamber once it becomes gas. MBDA France wants to figure out where and when the fuel turns into gas, to optimize the cooling system. Several constraints must be considered: the dimensions of the mechanical structure, which are small, and secondly, the use of kerosene in lab facilities. The main purpose of our project is to compare different measurement methods which detect a phase change, not specifically a vaporization. A thermocouple (K type) and a homemade probe are used. The first experiment is made to detect a water droplet and the second experiment is made to detect air bubbles in a fluid (water or glycerin). The main goal is to compare the two measurement methods (thermocouple K and homemade probe). Other instruments such as a camera or an optical fork could be used to have more precision during tests.

Results

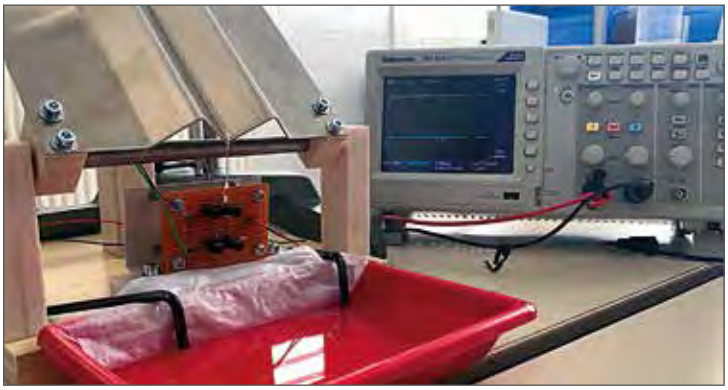
A whole acquisition chain had to be settled. Different ways to acquire probe/thermocouple/optical fork signals were tried, the best of which seems to be a combination of Arduino & MATLAB®. Indeed, that acquisition chain has an interesting acquisition frequency. Regarding the first experiment, the results are satisfying. The probe has the most effective signal, and the signal processing is rather easy to deal with. In addition, in order support these results, an image processing was applied. However, for the second experiment which aims to detect an air bubble in a fluid (water or glycerin), things are a little more complicated. Indeed, we have not yet had any results. The probe and the thermocouple seem to be unresponsive when they are submerged in a fluid. A solution including a heat source is being developed.

Mechanical structure

Keywords: signal acquisition, sensors, signal processing, two-phase flow, experimentation



Probe, thermocouple and optical fork signals



Experiment 1: detecting a water droplet

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Construction of demonstration models for renewable energies

Energetics

B. MENANT

L. ROUMIER

Benjamin MENANT / Loïc ROUMIER
Academic supervisor: J-M. FAVIE
Industrial supervisor: J-M. FAVIE

Institution: Academic, Polytech Orleans

Objective/motivation

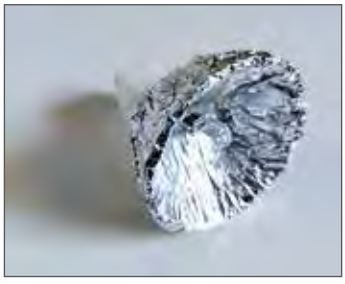
This project deals with the construction of a demonstration model for renewable energies. This project is under the supervision of Mr. Favié, a professor of Polytech Orleans. The idea is to create models to illustrate the energy transition during the next Open House Days and various forums. Thus, we must make them pedagogical and easy to use for the public. The main demos will be a wind turbine and solar thermal panels. Then, we aim to do others, for example geothermal energy with a Canadian well and a hydrogen fuel cell. Models must illustrate real uses, with energy storage solutions (in the case of the solar thermal panels, one model could be the illustration of the use of solar panels to heat the sanitary hot water stock in a water tank). Models must be small enough to be easily transportable and users must be able to control the models to make them more interactive.

Results

The model illustrating the use of solar thermal panels to heat sanitary hot water is well underway and should be in operation soon. First, the user can connect to an interface through a webpage to see the temperature evolution inside the water circuit and can control the model (control the water pump, the cooling device, and the halogen bulb). Regarding the thermal part, we made the calculation to define the size of the house and make our model realistic thanks to the Reynolds number (predict flow patterns as laminar or turbulent flow) and the Nusselt number (ratio of convective to conductive heat transfer at a boundary in a fluid) similitude between the water circuit in a real house and the model. The wind turbine model progress is slower, at the moment a little further than the middle of the project since the CAD design of the wind turbine is almost finished.

CAD model of the windturbine

Keywords: renewable energy, thermal, CAD design, programming



Convergent covered with aluminium foil to concentrate the light rays

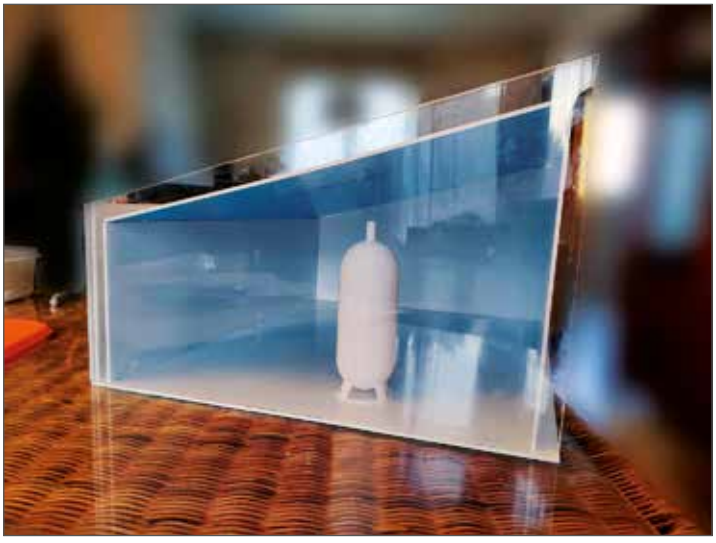


Photo of the solar thermal model

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Construction of reduced chemical models for combustion

Aerospace engineering


A. COUDRAY


W. HAO

Alexandre COUDRAY / Weichen HAO
Academic supervisor: C. ROUSSELLE
Industrial supervisors: B. CUENOT, T. NAESS, E. RIBER

Institution: Cerfacs

Objective/motivation

Within the framework of Large Eddy Simulation of turbulent reacting flows in complex geometries, using detailed chemical mechanisms which take into account hundreds of species and thousands of reactions to model fuel oxidation chemistry is still out of reach. The objective of this project is to test a methodology proposed by Cerfacs (the European centre of basic and applied research specialized in modelling and numerical simulation) to improve global mechanisms that account for few reactions and species. This is performed through the modification of the NASA polynomials and the pre-exponential factor of the Arrhenius law. The target quantities are the adiabatic flame temperature and the laminar flame speed. All of the calculations are performed with the opensource kinetic solver CANTERA. The methodology is first applied to the oxy-combustion of methane used in rocket engines and second to the combustion of kerosene in air for aircraft engine simulation purpose.

Results

The modification of NASA polynomials has proven to be effective while matching the adiabatic flame temperature for the global mechanism used for methane/oxygen combustion. The modification of the pre-exponential factor allows matching of the laminar flame speed. The methodology could not be applied for the global mechanism used for kerosene combustion in air because of calculation problems, yet a three-step mechanism is proposed and should recover the target flame properties once optimized.

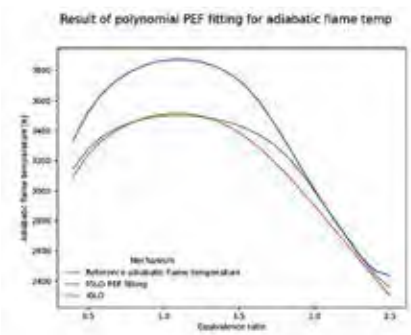
Keywords: large eddy simulation, combustion, cfd, numerical simulation, transport

$$CH_4 + \frac{1}{2}O_2 \rightarrow CO + 2H_2 \ (R1)$$
$$CO + \frac{1}{2}O_2 \leftrightarrow CO_2 \ (R2)$$
$$H_2 + \frac{1}{2}O_2 \leftrightarrow H_2O \ (R3)$$
$$CO + H_2O \leftrightarrow CO_2 + H_2 \ (R4)$$

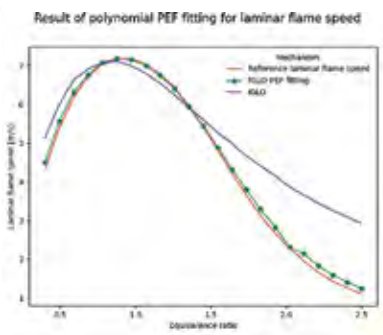
Methane/oxygen 4 steps global mechanism

$$KERO + 10\,O_2 \rightarrow 10\,CO + 10\,H_2O$$
$$H_2 + 0{,}5\,O_2 \leftrightarrow H_2O$$
$$CO + 0{,}5\,O_2 \rightarrow CO_2$$

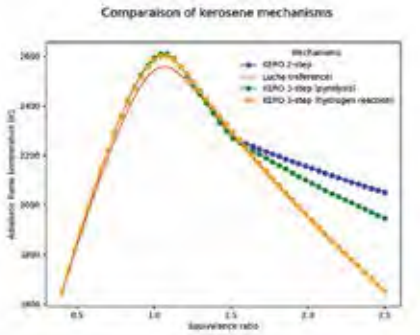
Kerosene/air 3 steps global mechanism



Methane/oxygen combustion, before (iGLO) and after (fGLO) optimization



Methane/oxygen combustion, before (iGLO) and after (fGLO) optimization



Kerosene/air : comparison of global mechanisms with the reference one

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Control of a rocket's trajectory with a thrust vector control (TVC)

Aerospace engineering


Y. BOUZOUBA


P. FAN


C. HAGE

Yassine BOUZOUBA / Penghui FAN / Charbel HAGE
Academic supervisor: G. COLIN
Industrial supervisor: A. UNGURAN

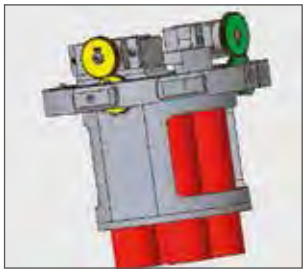
Company: SpaceTech

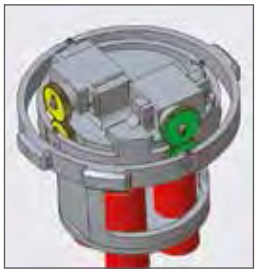
Objective/motivation

This project is proposed by the SpaceTech association which aims to create an adaptable TVC system that will be able to accommodate several engines from category A to D which can stabilize the trajectory during the ascending phase of a mini rocket. Moreover, our project is divided into several parts: developing a model of the rocket trajectory using the thrust curves of the engines, working on a PID control system using MATLAB®/Simulink® to control the trajectory of the rocket, designing a CAD model of the TVC system and finally assembling the model on Arduino. We should then succeed in a launch test at the end of the project. The launch system is represented by the ascending and the landing phase. The landing phase will be performed using a parachute system when the engines of the first phase cut off.

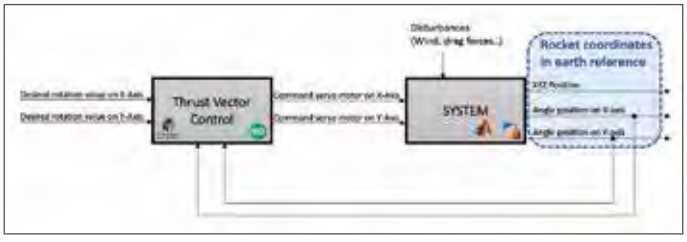
Results

The project is divided into two parts: 1) Developing a simulation of the rocket trajectory and rotation (on Simulink® and MATLAB® software) in order to extract the PID controller and use it on the Arduino board. The latter represents the motherboard of the thrust vector controller. It manipulates three servo motors (two for the TVC system and a third for the parachute system) in the function of our constraints and PID controller. 2) Crafting the thrust vector control. Firstly, the design was done on CREO after many redesigns to obtain the best and most accurate design that corresponds to our demand. Secondly, the printing and assembling of parts underwent the same process of optimization. Finally, several static tests were carried out before the launching test. Still, some rigorous improvements need to be made, such as measuring the mechanical time response, implementing the parachute system, and small details that will pave the way for accomplishing a successful launch.

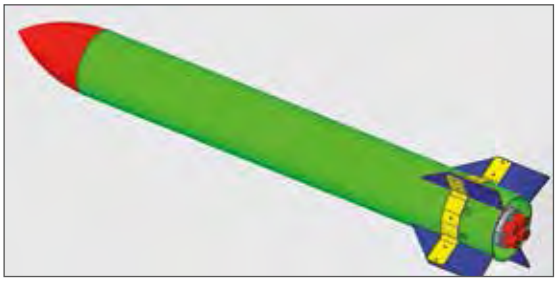

Profile image of TVC


3D image of TVC

Keywords: thrust vector control, 3D design, aerodynamics, electronics, automatics ,mechanics, rocket



Project schematic


3D image of rocket

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Demonstrator of an eco-driving's analytical solution

Energetics

C. HONORE

M. NICOLAS

Cindy HONORE / Morgane NICOLAS
Academic supervisor: K. GILLET

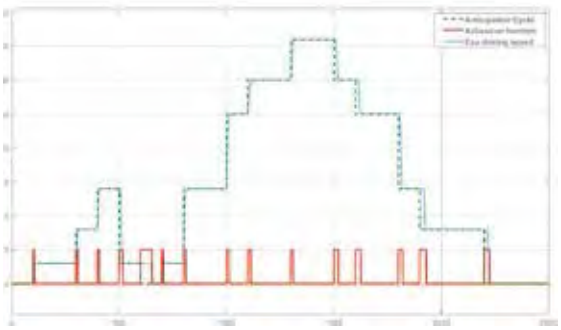
Institutions: PRISME Laboratory, Academic Polytech Orléans

Objective/motivation

The main objective of our project is to demonstrate the adaptability of an analytical algorithm to reality. This algorithm is used to compute an eco-driving trajectory based on a known cycle subject to time and distance constraints. Eco-driving is an efficient way of driving that minimizes consumption and pollutant emissions. This project takes place in a context of energetic transition in the automotive sector. In our case, we created a demonstrator allowing us to observe the data's evolution in real time. This demonstrator is able to compute different types of cycles, types of driving, and perturbations on the road. Thanks to a straightforward interface, it is accessible to any user. At the end, the objective will be to verify the versatility of the algorithm by comparing the results. In the long-term, this demonstrator could also be used to optimize the algorithm.

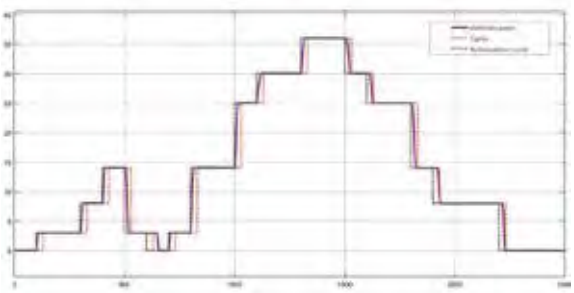
Results

Our first task was to do a literature review of previous studies conducted on this topic. With this scientific basis, we were able to approach the algorithm of the eco-driving analytical solution in order to adapt it in a real-time demonstrator. We started by working on the electrical model and succeeded in running the algorithm in real time. We then did the same for the ICE vehicle and implemented a driver and vehicle model for both types of vehicle. These models allow us to have an energy consumption at the end of the cycle (delta SOC or fuel consumption). Our other objective is to study the parameters of the algorithm, influenced by the anticipation distance. Finally, our demonstrator is consistent with real life vehicles' consumption and behaviour and could be used in the automotive industry.

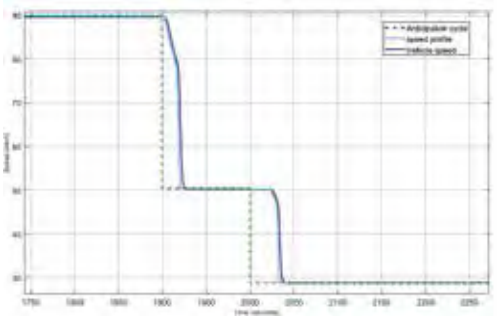


Activation of the eco-driving algorithm for the electrical vehicle

Keywords:
automotive, eco-driving, numerical simulation, real time, optimization



Eco-driving solution for the electrical vehicle



Driver behavior during the deceleration for the ICE vehicle

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Design of a light aircraft electric powered tug

Mechanical engineering


T. MAUCHAMP


A. NASRI


F. ROSSANI

Thomas MAUCHAMP / Andy NASRI / Florent ROSSANI
Academic supervisor: N. BETTAIEB
Industrial supervisor: J-M. BAUCHIRE

Company: Aéroclub d'Orléans-Loiret

Objective/motivation

The present project consists in designing a Light Aircraft Electric Powered Tug (LAEPT) for the Orleans-Loiret Flying Club. The LAEPT design has been proposed in the frame of assisting the club members to safely maneuver aircrafts in and out of their hangars. Precisely, this project aims to replace the currently used manual tug in order to facilitate the maneuvers that can be difficult for some of the members due to the weight of the planes (around 1000 kg) and their sizes. The current LAEPT would be designed for a specific plane that is the Robin DR400. Besides facilitating the plane maneuvers, the new design will also increase the manageability of the plane. To achieve an efficient performance, the LAEPT is estimated to have a full day autonomy and be easily charged overnight.

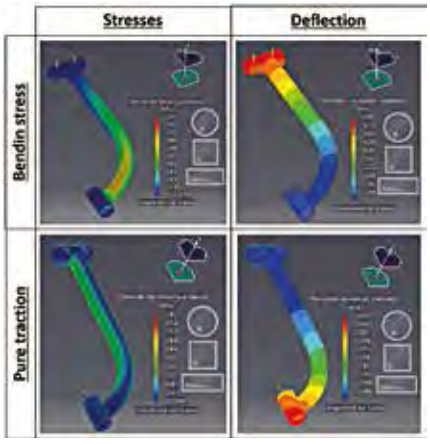
Results

Long periods of brainstorming in front of the whiteboard resulted in the realization of a complete CAD model of the electric powered tug. Every element has been carefully sized and designed, considering the manufacturing process of each part. Starting from the initial needs, we were able to define the global tug's structure first. In a second stage, the mechanical power chain was sized so we could focus on the system control. The main result of this work is a detailed report with solid explanations about the design process and the choice of parts. Documentation and models are part of the expected deliverables. During the last weeks, one of the main parts of the tug has been prototyped and 3D printed.

Keywords: tug, aircraft, mechanical design, DR400

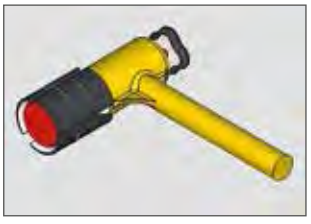

Articulated arm CAD model


Power chain CAD model



Stresses and deflection analysis results


Tug CAD model


Expandable shaft CAD model


Robin DR400

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Design of a sweeping jet fluidic actuator to enhance aerodynamic efficiency of vehicles

Mechanical engineering


J. CABOCHETTE


P. DESPLANCHES


M. DIOP

Julien CABOCHETTE / Pierre DESPLANCHES / Mohamed DIOP
Academic supervisor: A. KOURTA
Industrial supervisor: A. KOURTA

Institutions: GDR 2502, PRISME Laboratory

Objective/motivation

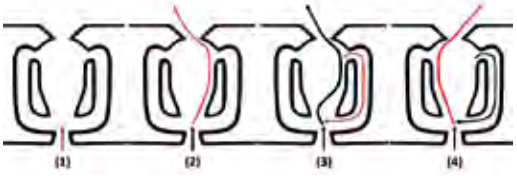
Due to global warming and new energy consumption rules, industries from all around the world and from every sector are looking to reduce their energy consumption by different means. One of these is to use active flow control to increase the aerodynamic performance of all kinds of vehicles (cars, planes, trucks, etc.). The goal of this project is to have an impact on the turbulent boundary layer of the free stream flow to reduce the recirculation zone behind an abrupt change of profile. To achieve this, the designed actuators oscillate at a certain frequency which must be as large as possible to affect the small vortices of the turbulent flow. These actuators must be energetically efficient and have a large spreading angle to affect a wide zone.

Results

The results of the CFD (Computational Fluids Dynamics) study showed the influence of geometrical parameters on the actuator efficiency (frequency, spreading angle, power losses, etc.). Between two different geometries, the one with rounded feedback channels gives much better efficiency than the one with rectangular feedback channels (+300 Hz). In the second case, the best feedback channels diameters seem to be 2.5 mm at the entrance (+100 Hz) and 2 mm at the exit. Concerning the exit divergent, it results that the longer the length and the smaller the angle, the more important the power losses (7.5 % to 14.5 % of power losses). On the contrary, smaller aperture angles on the exit divergent seem to allow a wider jet spreading angle (80°) due to Coanda effect along the divergent wall.

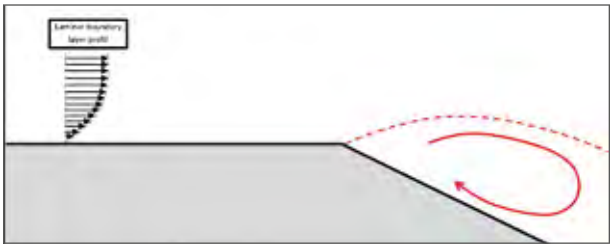

"Rounded" geometry actuator

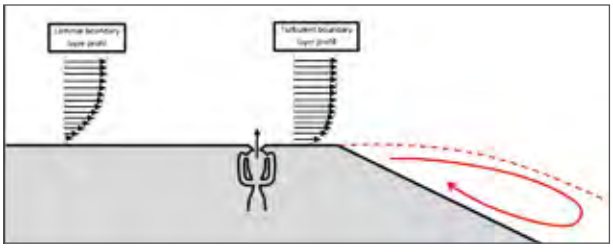

"Rectangular" geometry actuator



Schematic functioning of the actuator

Keywords: active flow control, sweeping jet actuator, fluid dynamics, experimental, computational fluid dynamics


Streamflow along the wall without actuator


Influence of the actuator on the free stream

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Design of an electric vehicle test bench

Mechanical engineering


A. EISENBERG


B. FOURMEAUX


Q. HUMBERT

Adrien EISENBERG / Brice FOURMEAUX / Quentin HUMBERT
Academic supervisor: A. CHARLET
Industrial supervisor: F. FRANCO

TRANSITION-ONE

Company: Transition One

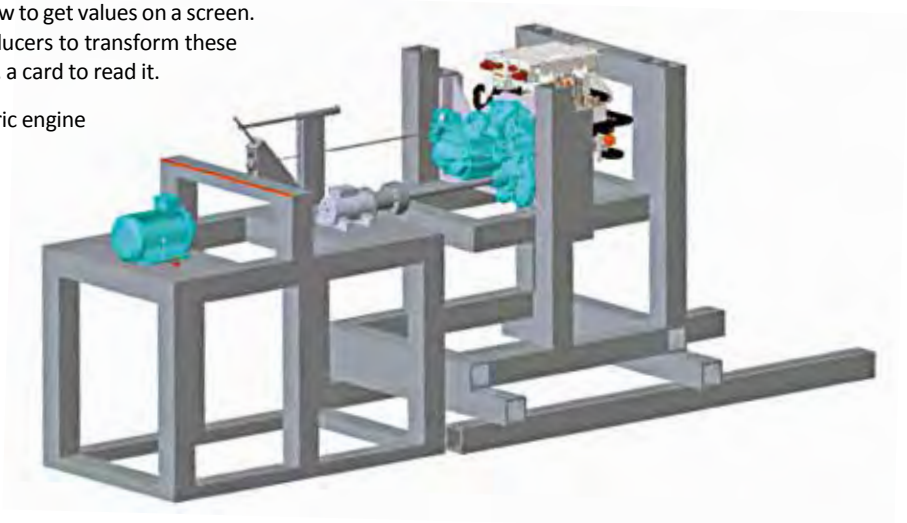
Objective/motivation

The project was suggested by Transition One which converts internal combustion vehicles into electric ones. The project consists in designing a bench allowing tests of the standardized electric engine they install in each vehicle. The test bench would carry out some tests on the gearbox and clutch lifetime. The test bench is composed of two parts, the first with the electric engine and the gearbox we have to test and the second with a reducer and an electric receptor. One of the specifications is about the first part: it must be removable. The project deals with a mechanical aspect by making CAD parts, torque and force calculation of the system and frame installation. The second main task is automation processing; once the test bench is built, the engines must be controlled and some sensors must be implemented in order to acquire data and, finally, to analyze it.

Results

The mechanical part dealt with different elements of the test bench and frame designing. The reducer chosen to reduce torque is a second car gearbox. By using Creo software, we designed the whole test bench and the scanned gearbox will be added. The frame is composed of a fixed part with the receptor engine and a mobile one which consists of the tested gearbox, the tested clutch and the electric engine installed in the cars retrofitted by Transition One. The second part deals with the values we need to acquire. A list of data and sensors we need has been written. We're currently working on the way to install this sensor on the bench and how to get values on a screen.
It means that we need sensors, transducers to transform these values into electric signals, and, finally, a card to read it.

Keywords: retrofit, test bench, electric engine


Test bench CAD with both engines, the reductor and an automatic clutch system

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Design of an energy management system for a small electric vehicle

Energetics


F. LASCOSTE


B. LI


S. SOULEY

Fabien LASCOSTE / Boyuan LI / Saratou SOULEY
Academic supervisors: C. BOURILLON, A. CHARLET, G. COLIN
Industrial supervisor: F-X. RODET

Company: SAS Foxonrock

Fifth Place
15th Annual Final Year Projects Forum

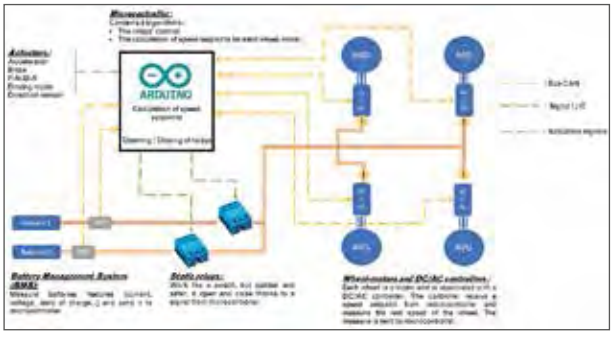
Objective/motivation

Electric vehicles are gradually taking their place on the automotive market in a world in full energy transition. Secure and innovative electric mobility is at the heart of the miniMax project. In this project, an energy management strategy was defined for a small 4kW electric vehicle called "miniMax" accessible from the age of 14 years old designed to compete with two small electric vehicles in the market : the Citroën AMI and the Renault TWIZY. The energy management strategy includes an intelligent management of discharge of removable batteries according to different driving modes: eco, standard and sport. It also includes an intelligent battery recharge management via a 220V consumer charger, a solar panel, a regenerative braking system and supercapacitor.

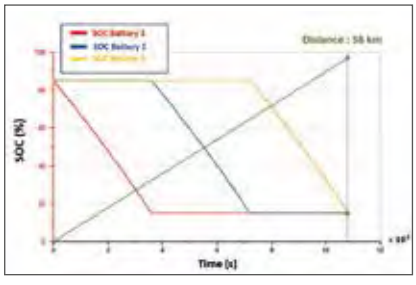
Results

The strategy chosen for the different driving modes is to discharge the batteries one by one in eco mode, to discharge them at the same time in sport mode and to mix the two for the standard mode. The results obtained show, for four batteries on board the vehicle, a range of approximately 77 km in eco mode and 62 km in standard and sport modes. In terms of performance, the vehicle can accelerate from 0 to 45 km/h in 6 seconds at best. The study of the solar recharging option enables us to conclude that it would be possible to recharge 2.5 batteries in the summer season. The addition of supercapacitor shows us that with few batteries in the vehicle, the power deficit is compensated and the acceleration time in standard mode is the same as in sport mode.

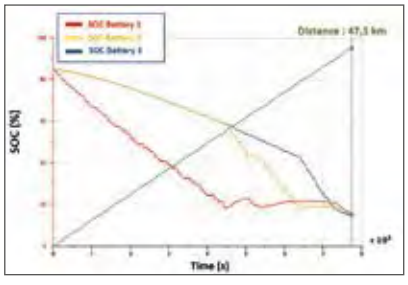
Keywords: electric vehicle, energy management system, battery, driving modes



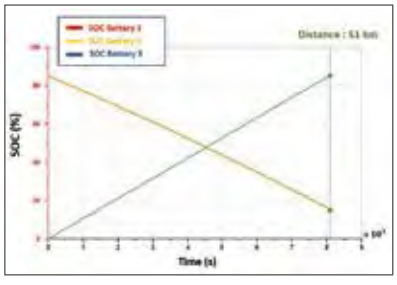
Controller interaction with vehicle components



Evolution of SOC as a function of time in eco mode



Evolution of SOC as a function of time in standard mode



Evolution of SOC as a function of time in sport mode

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Dynamic modelling of a mini-turbojet

Aerospace engineering

A. AIT HADDOU

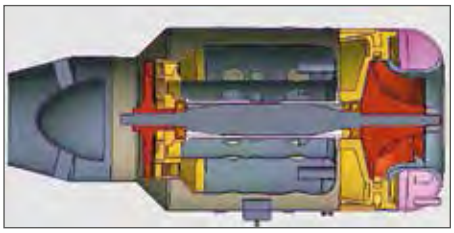
A. OUERDANE

Amyne AIT HADDOU / Amélie OUERDANE
Academic supervisor: P. BREQUIGNY
Industrial supervisors: T. BEQUET, M. BOUCHEZ, A. LE FOL

Company: MBDA France

Objective/motivation

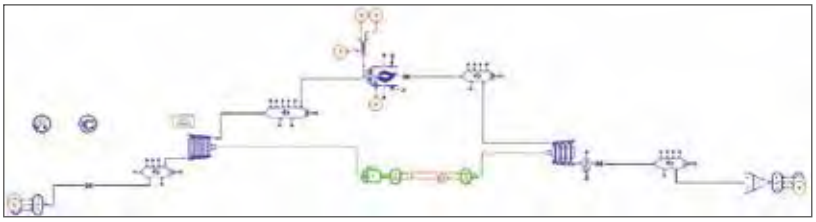
Polytech Orleans recently acquired a mini-turbojet test bench for the training of students as part of their practical work. It will also enable the realization of research projects. These propulsion systems, sometimes called micro-turbines, are usually capable of producing several hundred Newtons of thrust while being compact enough to be held with one hand. They find their application mainly in the modeling world, but they are also very popular with research laboratories that can study turbojets at a lower cost. The european missile manufacturer MBDA is interested in this type of propulsion for future systems. The objective of this project is to build the turbojet model on the software AMESim® and simulate its control through co-simulations with Simulink®. In parallel, based on a bibliographical study, modifications of the experimental device can be proposed.



Cut view of the CAD model

Results

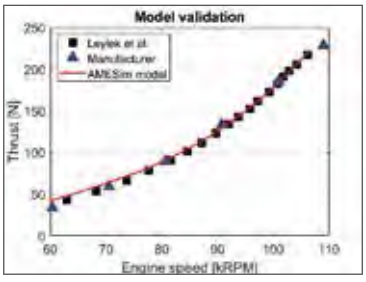
Based on a bibliographical study, a model of the small single spool, single stage turbojet has been made. To validate the model, simulation results were compared with manufacturer data and experimental data found in scientific reports. The evolution of thrust, rotation speed, and air flow rate as a function of the fuel mass flow rate are consistent with the available data. The control of the engine is managed thanks to a co-simulation with Simulink®. A PI regulator has been embedded to adapt the engine speed to the throttle command by actuating the fuel mass flow rate. A flight plan has been created to test the model for different environment situations. A CAD model of this particular engine has also been made to study possible modification of the test bench.



AMESim® model

Keywords: mini-turbojet, propulsion system, dynamic modelling, simulation

Turbojet test bench



Thrust comparison for validation

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Electrification of a blended wing body type airplane

Mechanical engineering


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A. NICOLAS


B. TEDIKA

Chaïmaa FOUNOUNE / Arthur NICOLAS / Boris TEDIKA
Rémi DEMYTTENAERE / Nathan RENE-CORAIL
Academic supervisors: C. BOURILLON, A. CHARLET, G. COLIN
Industrial supervisor: C. DE TIENDA

Company: Eenuee

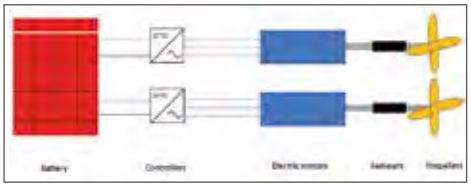
Objective/motivation

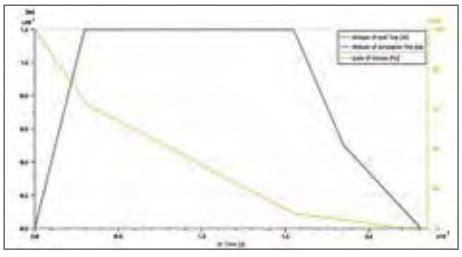
The airplane is a means of transport that currently accounts for a large share of global pollutant emissions. One of the challenges of our generation, therefore, is to limit its impact on our environment as much as possible. It is within this context that the EENUEE start-up project is taking place. The company aims to create airplanes that operate entirely using an electric energy chain and with a particular geometry, the blended wing body. The purpose of these airplanes will be to fly regional type routes (less than 1000 km) with 19 passengers on board and to be able to land on any type of surface thanks to a revolutionary system. To do this, students will have to size all the components of an electric chain (engines, batteries, controllers and propellers) respecting the specifications concerning weight (4500 kg for the plane including 1500 kg for the electric chain), size and power. The start-up would also like to explore the possibility of a hybrid aircraft, where electric motors would be coupled with a thermal generator.

Results

To start the project, the students searched for an update on state-of-the-art electric airplanes. They were able to see that some projects competing with the start-up already existed or were in the development phase. The second step was a pre-dimensioning of the different components using the energy and power requirements of the aircraft at each moment of the flight cycle. At this point of the project, the students found existing components that could meet the specifications and mainly the mass of the energy chain criterion, but also the pre-dimensioning calculations. To verify the various calculations previously made, the students modelled the system representing the aircraft in both full electric and hybrid versions. These models were made using AMESim® software. The final part of the project was the energy management of different models, by doing a cosimulation between AMESim® and another MATLAB® Simulink® software.


P2-T40 blended wing airplane


Electric chain of the project


Graph of altitude/time for simulated trip

Keywords: aircraft, electric, hybrid, modelling

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From effluent to valorization in combustion systems

Environmental engineering, Energetics


S. DIALLO


S. EL KACEMI


B-T. PHAM

Souleymane DIALLO / Salma EL KACEMI / Ba-Tuan PHAM
Academic supervisor: C. ROUSSELLE
Industrial supervisor: G. NOURRIT

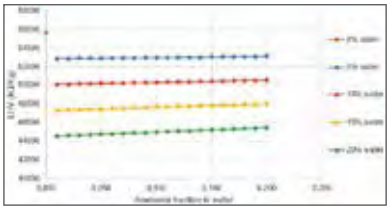
Company: Nereus

Objective/motivation

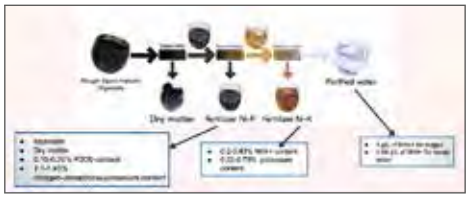
We have been working in collaboration with NEREUS, a company that designs, develops, and builds industrial equipment for low-energy water extraction. The company extracts and recycles water from difficult waste-water resources. During this process, a quantity of ammonia, too great to be easily separated, can be dissolved in the aqueous solution obtained after filtration. The objective was to evaluate whether this intermediate product can be valorized in energy systems as an auxiliary power unit (APU) and, on the other hand, whether ammonia water can be injected in APU to reduce NOx emissions during combustion and whether, as a function of the ammonia content in the aqueous solution, there is an effect on efficiency.

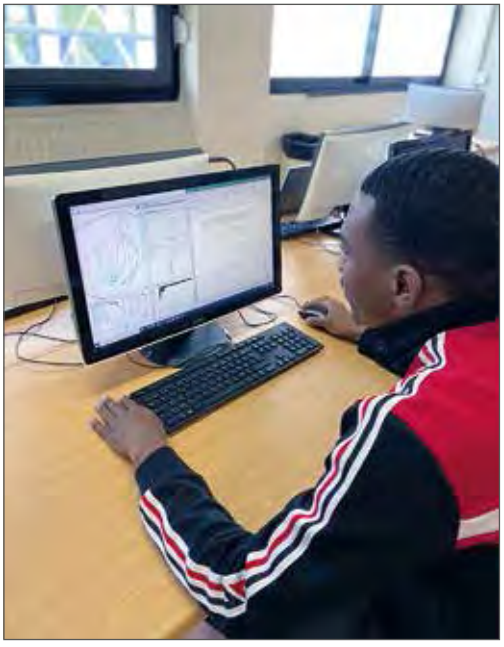
Results

The literature search showed us that there is no system that operates solely with ammonia as a fuel. Because of its low combustion rate, most existing combustion engines that use ammonia as a fuel generally require a combustion promoter. In a second step, we used the CHEMKIN PRO software to perform a numerical simulation of methane combustion with an aqueous solution whose ammonia concentration we varied. The addition of water has a considerable impact on NOx emissions. In fact, it reduces the combustion temperature, and this is what leads to a reduction in thermal NOx, which is formed mainly at high temperatures. When the ammonia content in the water is increased, the lower heating value (LHV) and thus the energy released during combustion is reduced. However, due to a chemical reaction, ammonia still reduces NOx emissions, which corresponds to the observation made by other studies.


Energy study of ammonia solution

Keywords: energy, ammonia water injection, internal combustion engine


Water treatment process


Simulation using CHEMKIN PRO

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Gas injection optimization of an industrial burner

Energetics


L. HARDOUIN


L. NGONGANG


A. YANG

Loïc HARDOUIN / Laëlien NGONGANG / An YANG
Academic supervisors: P. BREQUIGNY, I. FEDIOUN
Industrial supervisor: R. MARTIN

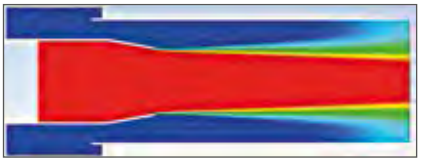
NAÕDEN
Company: Naoden

Objective/motivation

NAODEN, a French company based in Nantes, develops energy-efficient solutions to recycle biomass waste into green gas using modular systems. Its raison d'être is to reduce the carbon footprints of companies and boost the local economy by converting their waste into energy directly on site. Our project consists of carrying out a CFD study for the gas injection optimization of an industrial burner. The objective of the company is to be able to optimize a burner to be used with synthesis gas (also called syngas), a product of the gasification process of biomass. To do so, our role was to model and optimize the geometry of the flare as well as that of the industrial burner. We had to make sure that we had a homogeneous mixture burned in the flare. Moreover, we had to come up with a solution to optimize the injection of syngas in the burner in a way that allowed the burner to be used either with syngas, natural gas, or both at the same time, depending on the energy needs of the client.

Results

Initially, a CFD study was done to improve the geometry of the flare to obtain a homogeneous mixture at the outlet of the flare, so that the combustion takes place in optimal conditions. Obviously, the goal was also to reduce greenhouse gases as well as NOx emissions while still maintaining a good enough combustion. In addition, the combustion of the syngas was also simulated. After that first study, a CFD study of the industrial burner was done in order to determine an optimized geometry of the injectors that allows the result of our work to comply with the specifications.


CFD simulation of the flare before optimization

Bioenergy plant Nobilis (burner mode)

Bioenergy plant Imperium (cogeneration mode)

Keywords: cogeneration, energy efficient, burner, syngas, CFD

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Heating a greenhouse by diffusion of heat from a swimming pool

Energetics

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Academic supervisor: J-M. FAVIE
Industrial supervisor: L. PRUD'HOMME

Company: LaCen


A. COTELLE


A. FERNANDEZ-MARQUES

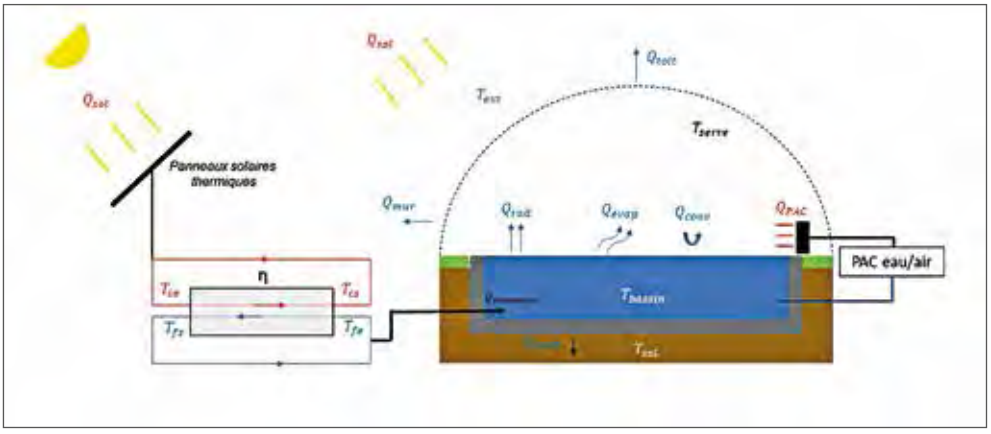

C. LEGER


W. SUN

Objective/motivation
In addition to being a recreational facility, the swimming pool is also a good energy storage device. Taking advantage of the large specific heat capacity of water, we hope to be able to use a swimming pool to keep the room temperature of a greenhouse constant. The heat source of the swimming pool is the solar energy absorbed by solar panels, which is more environmentally friendly than traditional heating methods. We hope to analyze the energy dissipation of each part of the entire greenhouse and verify the feasibility of the plan through heat balance.

Results
According to the different weather conditions of the year, we calculated the solar energy that solar panels can receive. Obviously, there are many factors affecting this part of energy. Based on different outdoor temperatures, we also calculated the energy required for the greenhouse and the energy loss of the swimming pool. Their simulation results with PLEIADES software also showed good agreement. We also calculated the heat exchanger and pipes to predict the choice of heat exchanger in the actual solution. Next, we will add a temperature sensor to the greenhouse to verify whether the actual heat loss is consistent with our calculation results.

Keywords: energy, greenhouse heating, solar panels, heat balance, PLEIADES



Project diagram

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Micro eco-neighborhood, sharing and photovoltaic resilience

Energetics


F. COSSARD


M. MA


P. SARDA

Florian COSSARD / Mengjiao MA / Paul SARDA
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Industrial supervisor: L. PRUD'HOMME

Company: LaCen

Objective/motivation

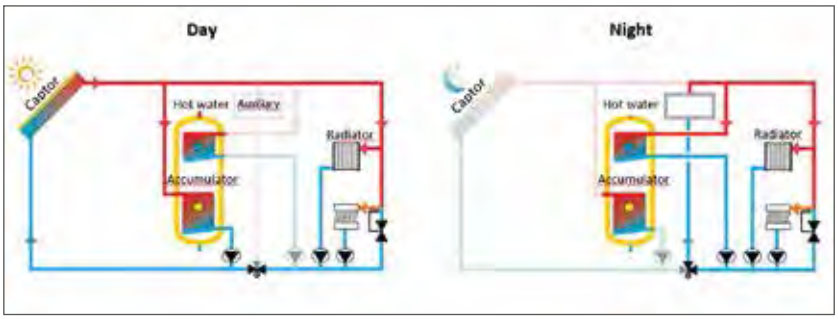
Lacen is an Orleans start-up created in 2016 by Laurent Prud'Homme. The vocation of this company is to improve the resilience of our territories, in view of the changes that global warming implies. That is why Lacen asks us to work on the implementation of innovative solutions for a micro-district located in Combleux. It comprises an old house and two habitable modules. One is an office, the other a studio. The main goal is to make the two modular buildings self-sustaining with different ways of production and storage of energy. The second target is to create a micro-grid by connecting the different buildings and the house to manage energy and use it when and where it is necessary. Thanks to this, we hope to sensitize inhabitants to reduce their energy consumption. Each member of this project is interested in saving energy and in optimizing consumption.

Results

Once the energy audit was done with the estimates of heating and hot sanitary water needs and power consumption, solar panels were sized and several scenarios were established. Moreover, different energy solutions concerning the energy production were contrived, to leave the choice of the most suitable one up to the customer. These scenarii have been measured according to price, carbon footprint, coverage of energy consumption, and adaptability to the structures. Finally, for each scenario, we selected a solution that is both economic and ecologic. Combining photovoltaic panels, thermic panels and a gas boiler or other equipment, the scenarios can not only meet the energy needs of the three structures but can also save money and emit less CO_2 than the original solution.


Implementation plan of the micro eco-neighborhood


Office to be equipped



Descriptive diagram of solar heating

Keywords: resilience, energetics, audit, sharing, ecology

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Modelling and control of hydrogen fuel cell

Energetics

R. GUEYE

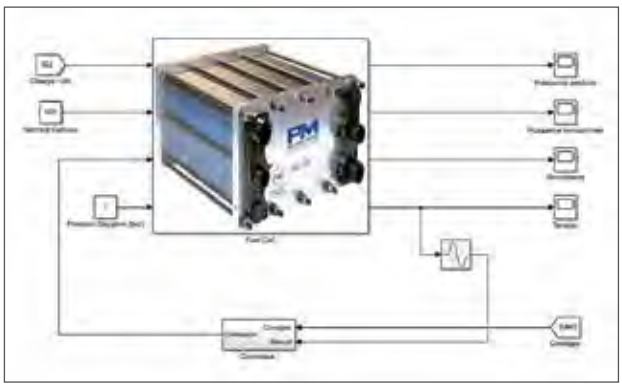
Raky GUEYE / Hugo NEVREUX
Academic supervisor: M. HAMMOUDI

H. NEVREUX

Institution: Academic, Polytech Orleans

Objective/motivation

The question of which energy carrier will replace oil once it has disappeared, or at least become truly inaccessible, is increasingly on the agenda. Solar energy or wind turbines are not satisfactory at the moment. From an environmental point of view, the H2 fuel cell has the advantage that it only discharges water and does not pollute too much. This perspective suggests that the H2 fuel cell has a future ahead of it. The TEAM speciality is planning to equip itself with an H2 fuel cell TP in order to develop its practical training offer. The aim of this activity is to raise students' awareness of current and future energy issues. As the use of hydrogen energy is set to develop, knowledge of how an H2 fuel cell works will enable them to develop their critical thinking and judgement.



A model of the fuel cell

Results

In the course of this project, we have achieved the following results: a rich bibliographical synthesis in order to facilitate the understanding of the subject to the students in charge of the TP, quotes from various suppliers and/or manufacturers of dihydrogen fuel cells, and modeling of a dihydrogen fuel cell to facilitate control for the team that will carry out the practical work.

The fuel cell

Keywords: energetics, automatic

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Modelling of a catalytic reactor

Industrial engineering


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M. MANSON


M. PIFFETEAU--PAGNOTTA

Luis MACARRO / Marie MANSON / Maxime PIFFETEAU--PAGNOTTA
Academic supervisors: N. BETTAIEB , C. HESPEL
Industrial supervisor: V. HUYGHE

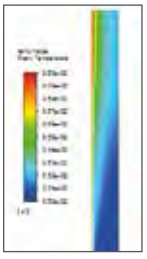
Company: TMFCT

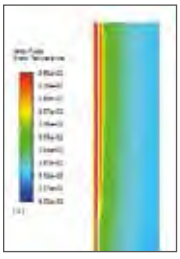
Objective/motivation

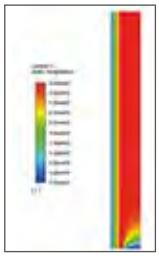
This project takes place in a chemical environment in a laboratory that wishes to carry out a catalytic treatment of alcohol vapours. These vapours are surrounded by a heat transfer fluid that must keep them at a temperature of 350°C. Therefore, the objective was to suggest a double-skin column design that respects thermal, geometric and mechanical constraints. With the help of documentation and bibliographical research, the first step was to establish a simple but effective model, thanks to several hypotheses and simplifications. Then, thermal theoretical calculation was carried out, followed by 2D modelling and simulations of thermal exchanges on Ansys Fluent®. Moreover, 3D models and simulations of mechanical stresses were achieved on Abaqus. Finally, with satisfying first results, the geometry was improved and the simplifications progressively removed to obtain a better and more realistic design of the column.

Results

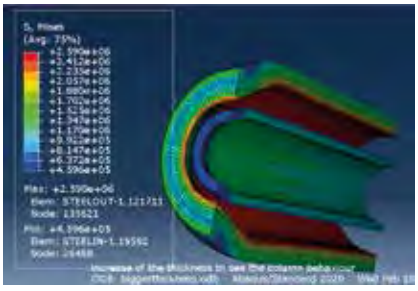
Thanks to the different characteristics of the fluids, materials and geometry of the chosen model, flow parameters and global heat exchange coefficients were calculated. Thus, heat production and losses were estimated as well as thicknesses and mechanical stresses. Studies were made in steady and unsteady states, then checked with 2D simulation to see if the column could handle the constraints while respecting specifications. Therefore, a numerical solution with correct parameters was found, enabling a temperature of 350°C maintained along the column. The results obtained from thermal simulation were: inlet and outlet boundary temperatures, temperature along the column, and heat exchange between fluids, materials, catalyzer and exterior. For the mechanical simulation, Von Mises stresses and strains in the column were computed and were below the material elastic limit. Eventually, the model will be optimized, and results will be helpful for the industrial boiler making study.

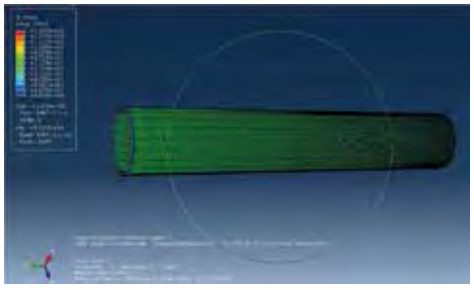

Reactor's fluids temperature in steady simulation on Fluent®


Zoom on fluids temperature in steady simulation on Fluent®


Final temperature in the column in unsteady simulation on Fluent®

Keywords: design, simulation, heat transfer, mechanics


3D mechanical simulation with deformation scale on Abaqus


Axisymmetric mechanical simulation on Abaqus

Contact: luis.macarro-de-la-cruz@etu.univ-orleans.fr ; marie.manson@etu.univ-orleans.fr ; maxime.piffeteau-pagnotta@etu.univ-orleans.fr

Optimisation of an internal combustion engine

Motorisation

F. HURAULT

Florian HURAULT / Junchen MA
Academic supervisor: P. HIGELIN
Industrial supervisor: F. HURAULT

J. MA

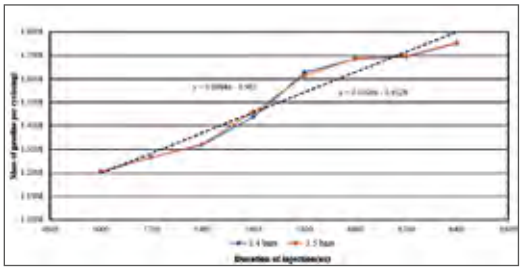
Company: Exergie

Objective/motivation

Our work deals with the fuel efficiency of one internal combustion engine of the association EXERGIE. Its purpose is to develop a super fuel-efficient prototype to run in the Shell Eco Marathon. The main objective of our project was to create the tools to be able to tune the association engine and finally create a basic tuning that will allow the association to run its engine. To do so, we instrumented the rolling test bench of the association in order to get the power information of the engine and to be able to control the engine speed. We also made a modification to the engine so that one can implement a pressure sensor and angular encoder. The aim was to create a complete instrumentalization of the engine in order to monitor the latter during various tests.

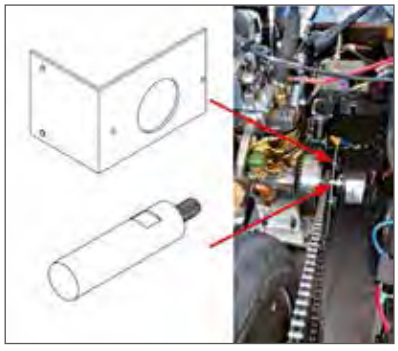
Results

To complete this project, we decided to split it into two parts: the first for tuning the equivalence ratio of the engine and the second for tuning the spark timing. To reach the end of the first part, we solved the rolling bench problem in order to control it as we wanted. Second, because the injector was a brand new one, we characterized it. Finally, we implemented a lambda probe in the exhaust pipe to control the gas mixture. For the second part, we modified the head cylinder in order to implement a pressure sensor to know the works inside the combustion chamber. We then instrumentalized the entire rolling bench thanks to sensors, hardware and software. At last, to do more realistic tests, we improved the rolling test bench so that we can simulate different rolling conditions. Unfortunately, we did not have time to do a basic tuning of the engine because of a problem we encountered.

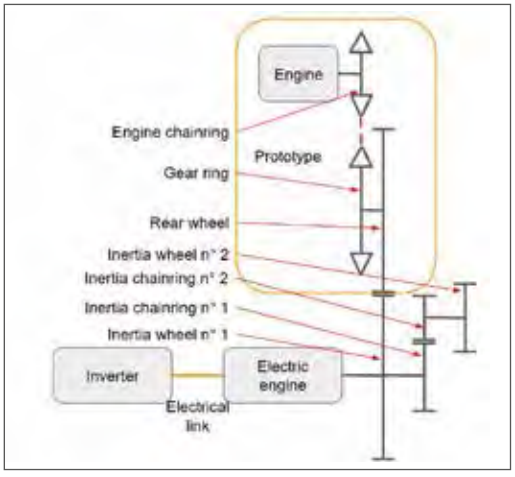


Injection law

Keywords: optimisation, engine, spark ignition, rolling test bench, equivalence ratio



Creation and implementation of the support and the crankshaft extension



Schematic representation of the rolling bench

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Optimisation of travel time of an electric vehicle with consideration of recharging terminals

Industrial engineering

L. LAISNE

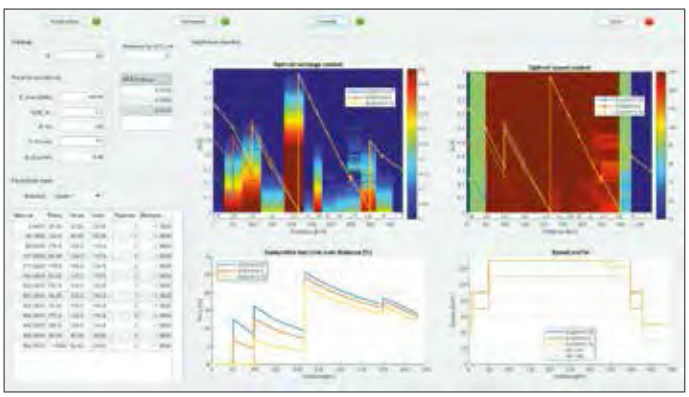
D. VERNAY

Lucas LAISNE / Dimitri VERNAY
Academic supervisor: K. GILLET
Industrial supervisor: G. COLIN

Company: PSA

Objective/motivation

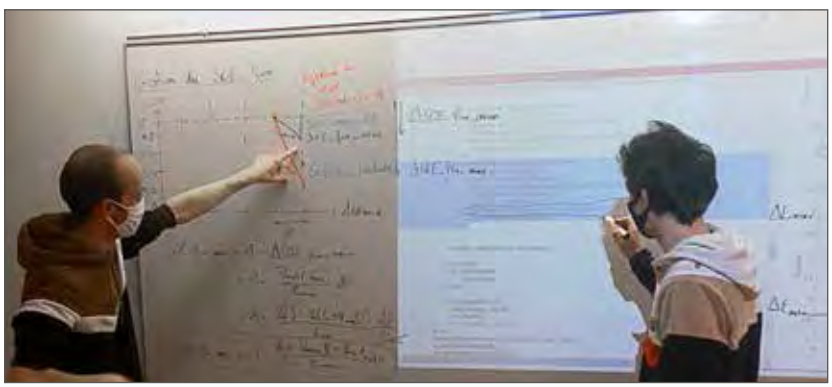
The main purpose of this project is to find the shortest travel time from one point to another under a final state of energy constraint. A previous algorithm was developed on MATLAB® using dynamics programming. The program commands the speed and the recharge percentage under constraint of state of charge in order to optimise travel time. Our main goal is to improve this program and to develop an interface for an industrial demonstrator. However, the algorithm divides travel into continuous cuts and only two charging stations are modeled. We therefore have to adapt the algorithm to more realistic cases and create an application to make the programme easier to use. In addition, we must study the robustness of our model to propose a range of validity for the application.



MATLAB® application

Results

Firstly, we studied the repartition of charging stations on the French territory on specific travel to extract the distance between cuts and charging power and considering a defective rate. We then added new types of stations (22, 43, 175, 350kW) and adapted the new charging profiles. Secondly, we study the repartition of stations on real travel routes like Paris-Lyon or Lille-Toulouse and we changed the display of results to accept discontinuous cuts. Then, we programmed a man-machine interface on MATLAB® using AppDesigner. Users can change the vehicle, trip and mesh parameters and the results are quickly displayed depending on the mesh. Today, we are working on the problem of the final state of charge by putting an additional cost to calculate the optimal route. By doing that, we constrain more or less the final state of energy, but the route is less optimal for travel time.



Working on the final SOE

Keywords: travel time, optimisation, dynamics programing, algorithms

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PERSEUS Project: design of a rocket igniter and its test bench

Aerospace engineering


S. DULAC


M. FIASCONARO


N. TAWDI

Stéphane DULAC / Matteo FIASCONARO / Nihal TAWDI
Academic supervisor: P. BREQUIGNY
Industrial supervisor: D. TCHOU-KIEN

Institution:
CNES (National Center of Space Research)

Third Place
15th Annual Final Year Projects Forum

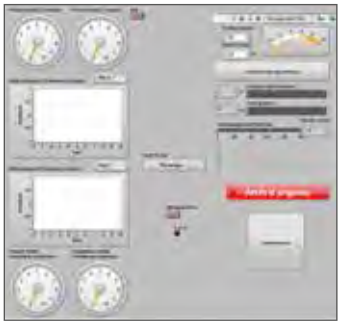
Objective/motivation

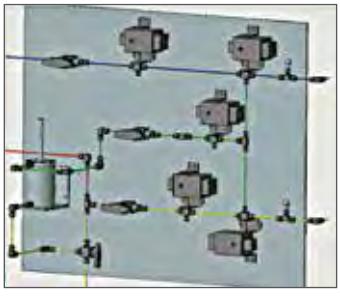
The objective of this project is to design a rocket igniter and to build the test bench. Working as a torch, its function is to initialize the ignition in the combustion chamber of the rocket. The igniter is already designed. We then must build the test bench and test it in order to verify that it delivers enough power at the outlet. This igniter is allowed to work with two different pairs of propellants: CH4/LOx and E75/LOx. To assure the switch between two pairs, sonic throats are used, which would control the flow rate at the inlet of the igniter. The nozzle also can be switched at the outlet, depending on the pair of propellants. Those solutions need to be easily removable for the user.

Results

The test bench of the igniter needs a support to use it, where all the tests will be done. The test bench is also composed of a hydraulic panel that will supply propellants to our igniter. Finally, we have to design a numeric control panel that will allow us to control the test bench, but also to start the ignition tests and to collect data. All those tasks need a budget, provided by the industrial. This project is bequeathed since 2019 by different groups working on it, so every step must be imagined as a part of a whole and not separately. In addition, our igniter needs to be put together with the pintle of the rocket, developed by a group of the school Art et Métiers at Lille.

Keywords: rocket, igniter, test bench, aerospace, PERSEUS


Man-machine interface


Hydraulic panel


Igniter mounted on the test bench

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Study of cooling models for hot gases thanks to an evaporating spray

Aerospace engineering

A. EL OUACHANI

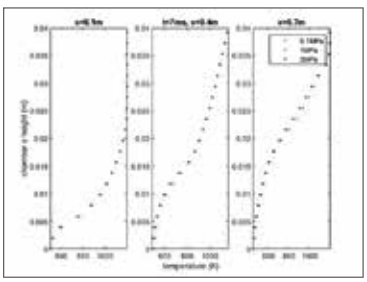
A. SIMON

Adil EL OUACHANI / Alexan SIMON
Academic supervisor: C. HESPEL
Industrial supervisor: A. CARRATALA

Company: Naval Group

Objective/motivation

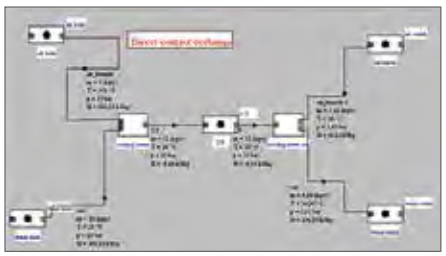
Our work deals with the physical models involved in the cooling of hot gases with an evaporating spray of water. This is a common issue in engineering applications where hot fluids are generated because of combustion either for propellants, energetical transformations or other industrial applications. The concrete application for this project was not communicated by Naval Group for confidentiality reasons. The aim here is to review the different evaporation models and highlight the ones which are compatible with our case of study (high pressure/temperature in a chamber). The latter are then coded and compared on MATLAB®. In the meantime, a CFD simulation is carried out, paving the way for a pressure-based parametric study. Finally, a heat exchanger is also modeled on Thermoptim to quantify heat and mass exchanges. Once again, it is another tool of comparison.



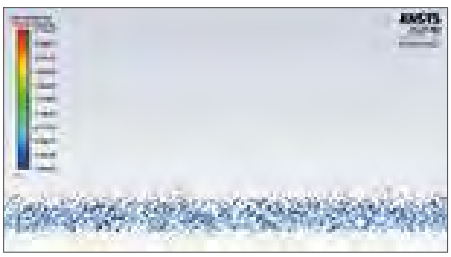
Radial distribution of temperature in the chamber for several pressures, 1200K

Results

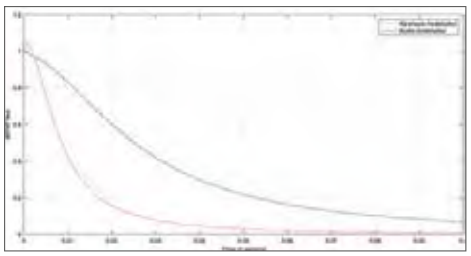
The bibliographic review shows the relevance of infinite conductivity models for droplets. Coding the latter implies a Lagrangian approach reduced to one droplet and then expanded to the spray with a statistical distribution. Diameter's decrease, temperature evolution and velocity are then obtained. More specific phenomena such as condensation at the beginning of the process, which punctually raises the diameter of the droplet, are also observed. The CFD simulation highlights a large and fast drop in temperature along the propagation of the spray. Raising the ambient pressure in the chamber slightly reduces the evaporation rate. These changes do not have any significant impact either for the temperature decrease nor for the droplet's distribution among the spray.



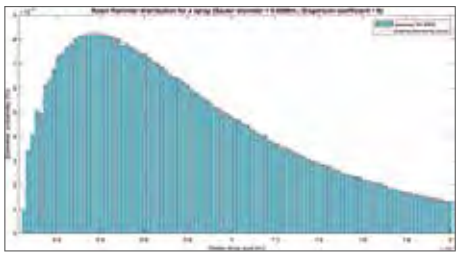
Modelization on Thermoptim



Atomization of droplets in the spray, Ansys Fluent©



Squared droplet's diameter decreased compared with Guella and Abramzon models



Rosin Rammler statistic distribution for droplet's diameters in the spray

Keywords: spray, droplet, heating, evaporation, simulation

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Trawler 2030: choice of an optimal propulsion architecture for a fishing vessel

Industrial engineering


J. FAVRESSE


L. MONTEIL


T. VEYRAT

Julien FAVRESSE / Lucas MONTEIL / Thomas VEYRAT
Academic supervisor: C. CAILLOL
Industrial supervisor: N. BORDET

Company: OSE Engineering

Selected Participant
15th Annual Final Year Projects Forum

Objective/motivation

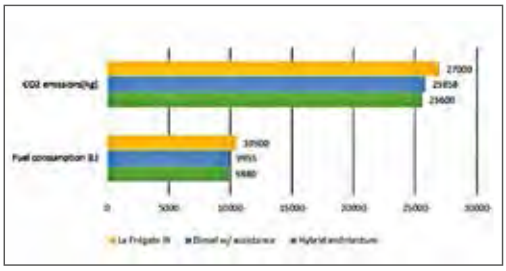
The introduction of environmental regulations for maritime transport, in particular related to CO_2 emissions, constrains ship owners and operators to report the quantities of CO_2 emitted by their entire fleet. These are the first signs that more stringent standards will appear soon. Fishing ships are preparing for this type of constraint with, in perspective, operating costs that generate a need to optimise the energy generation systems on board. Many systems for transforming primary energy (carbon chain in liquid or gas form) into final energy (mechanical and/or electrical) exist and make it possible to meet specific needs related to the use of ships: mechanical diesel, "diesel on demand", hybrid with or without assistance with or without storage system, dual fuel, etc. The current project aims to study different architectures of the propulsion system and to select the most efficient in terms of fuel consumption and pollutant emissions.

Results

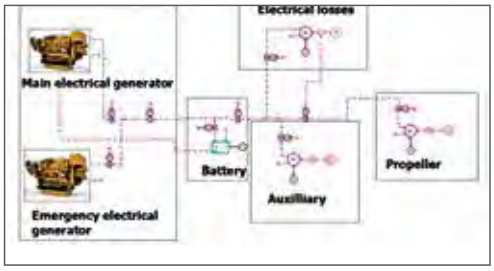
Based on a five-day operational profile characteristic of a conventional fishing campaign and representative of the power demand of the different energy consumption machines, two novel power architectures were modeled and compared to the current. The current architecture modeling shows that the ship consumes 10.500 L of fuel for a five-day run and emits 27 tons of CO_2. These values set the reference for the designed and modeled architectures. Based on an electric production and storage, these two other architectures give better results in terms of fuel consumption and CO_2 emissions. The adopted strategy consists of using the electric generators at their best operating point, storing the excess amount of electricity in batteries and eventually helping the propulsion with an additional internal combustion engine, thereby saving 6% of fuel which corresponds to saving 600 L with a decrease in CO_2 emissions of 1.4 tons.

La Frégate III

Keywords: trawler, propulsion, engine, power, architecture



Fuel consumption and CO_2 emissions over a 5-day run



Hybrid architecture

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Trawler 2050: transition to alternative decarbonised fuels for propulsion fishing vessels

Mechanical engineering, Energetics


Z. CHARLES


L. ROUSSELOT

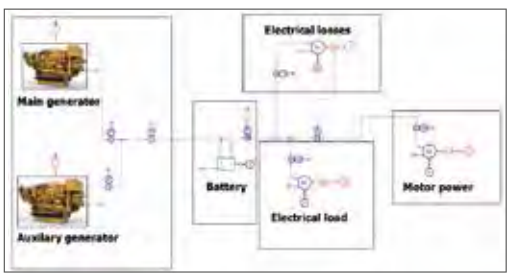
Zacharie CHARLES / Léandre ROUSSELOT
Academic supervisor: M. CAILLOL
Industrial supervisor: M. BORDET

Company: OSE Engineering

Selected Participant
15th Annual Final Year Projects Forum

Objective/motivation

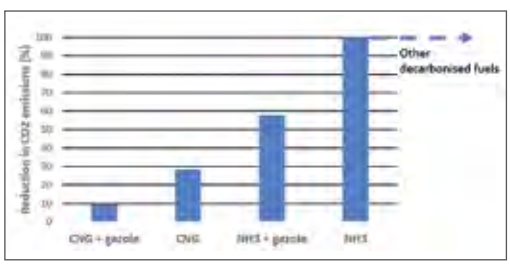
In 2018, the International Maritime Organisation set ambitious greenhouse gas reduction targets for the maritime transport sector. The carbon intensity had to be reduced by 70% compared to 2008. The use of decarbonised fuel can help to meet this target. Without carbon in the fuel, the combustion process does not emit any CO_2 resulting in a "cleaner" combustion for the environment. But the task is not easy, little research has been conducted, and ships using alternative fuels are very recent or are in the development phase. OSE Engineering has been tasked to improve fishing vessel propulsion. La Frégate III is an electrically propelled fishing vessel using a diesel generator to produce electricity. In this project, we have tested different fuels, using AMESim® software, to evaluate the carbon impact reduction of each and the corresponding fuel operating costs.



AMESim® model used for comparing the consumption of alternative fuels

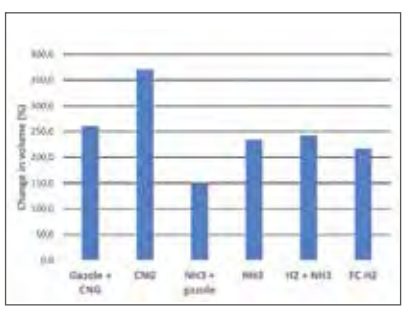
Results

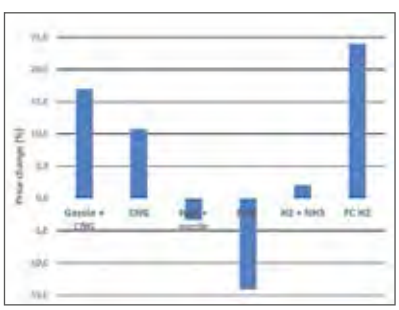
Different possible fuels have been investigated in a state-of-the-art review. The most suitable ones are natural gas and ammonia in a blend or pure with diesel and hydrogen in an engine and hydrogen in a fuel cell. A first study of estimated consumption and prices has been established, helping us validate our model results. In terms of pollutant emissions and fuel costs, the most promising result is pure ammonia, with no CO_2 emissions and a cost reduction of around 10% depending on the engine type. Still, there could be some problems with this fuel such as the storage of ammonia on the ship: the quantity increases significantly in comparison to diesel, between 2.2 and 2.5 times the volume. The results of the ammonia blends with hydrogen are encouraging, but the storage issue still exists, and hydrogen prices are still high.



Reduction in CO_2 emissions compared to diesel on a trip

Keywords:
alternative fuel, decarbonised, polutant emissions, distant horizon


Change in volume required compared to diesel on a trip


Change in fuel prices compared to diesel on a trip

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Unsteady modelling of a two-phase heat exchanger for the active cooling of a ramjet

Aerospace engineering


E. BEAUGENDRE


A. BEAULIER


I. TEBBA

Erwan BEAUGENDRE / Alex BEAULIER / Inès TEBBA
Academic supervisor: I. FEDIOUN
Industrial supervisor: S. POEUF

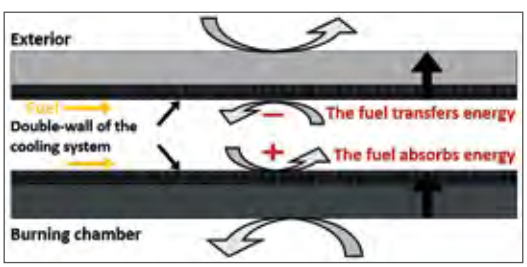
Company/Institution: undisclosed (confidential)

Objective/motivation

Ramjets travel between Mach 3 and 5 (approximately between 3600 km/h and 6000 km/h). Such a high speed leads to the heating of the wall of the missile. This can cause a structural damage, which could be the cause of a major dysfunction. The main purpose of this project is to study the active cooling of high-speed vehicles by using the fuel itself in the heat exchange in order to avoid deformations. We must modelize the double-wall in which the fuel flows. The picture attached represents this double-wall. Initially, the project was carried out in one dimension, considering an incompressible flow. Our general task is therefore to improve the model and its representation by turning it into a two-dimensional and compressible model, thus by taking into account more parameters (external flow, gas/liquid flow).

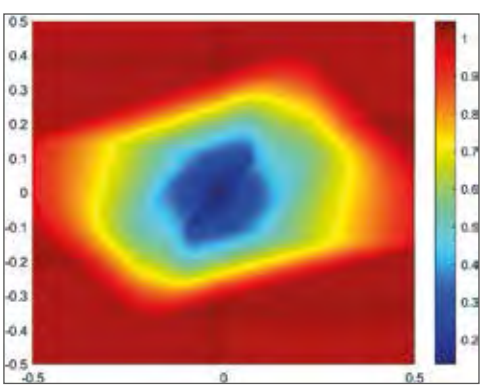
Results

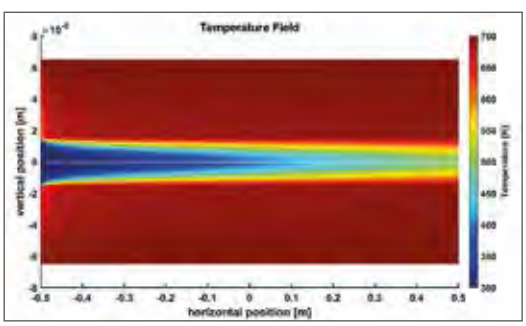
Our research led us to code a two-dimensional Euler solver by considering, initially, only an inviscid ideal gas with a Lax-Friedrichs numerical scheme. After validating this first step, we were able to use a more powerful scheme: the Courant-Isaacson-Rees. Finally, we introduced the viscosity of the fluid by considering the Navier-Stokes system. All these calculations were carried out with FORTRAN 90 and MATLAB®. At the same time, a CFD study was performed using the commercial Ansys Fluent® software. The aim was to start with simple and comprehensive test-cases and increase the complexity step-by-step in order to validate the in-house FORTRAN code. Results show that taking into account compressibility effects leads to only minor differences in the head-losses, compared to the incompressible flow assumption.



Representation of the double-wall in the ramjet

Keywords: ramjet, cooling, euler solver, two-phase


Pressure contour of Liska-Wendroff test case no.6 for a 2D shock tube



Fluent® (overhead)/MATLAB® (underneath) comparison, incompressible flow with Q=0.4 kg/s in a channel

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The Final Year Projects Forum

Each year, students who are completing their final year of studies at Polytech Orléans compete to participate in the Final Year Projects Forum. Students may present their projects individually or in groups, after which a selection is made by each department head of those projects which will compete before a jury of knowledgeable professionals from businesses and institutions in the wider community. During the Forum, each student or group of students presents their project over the course of an entire day, beginning with a general assembly during which a brief oral description and PowerPoint® presentation is made. This is followed by in-depth discussions with each jury member at individual stands constructed by the students, where they are able to give a more detailed explanation of their work. The jury selects and makes an award to each of the five best projects of the Forum, and also presents the Innovation Award and the High Schoolers' Choice Award (not awarded in 2021 because of social distancing requirements related to Covid19).

The Final Year Projects Forum promotes the relationship between the school, its students and the business community, and allows students to make direct contact with those companies who might wish to recruit graduates in their field.

Our remarkable equipment

Wind Tunnel
The Lucien Malavard wind tunnel of the PRISME laboratory is used by Polytech Orléans students for aerodynamic systems studies typical of the automobile, aeronautics and environmental industries. Those who specialise in these fields have the opportunity to do their practical work and projects in this exceptional environment.

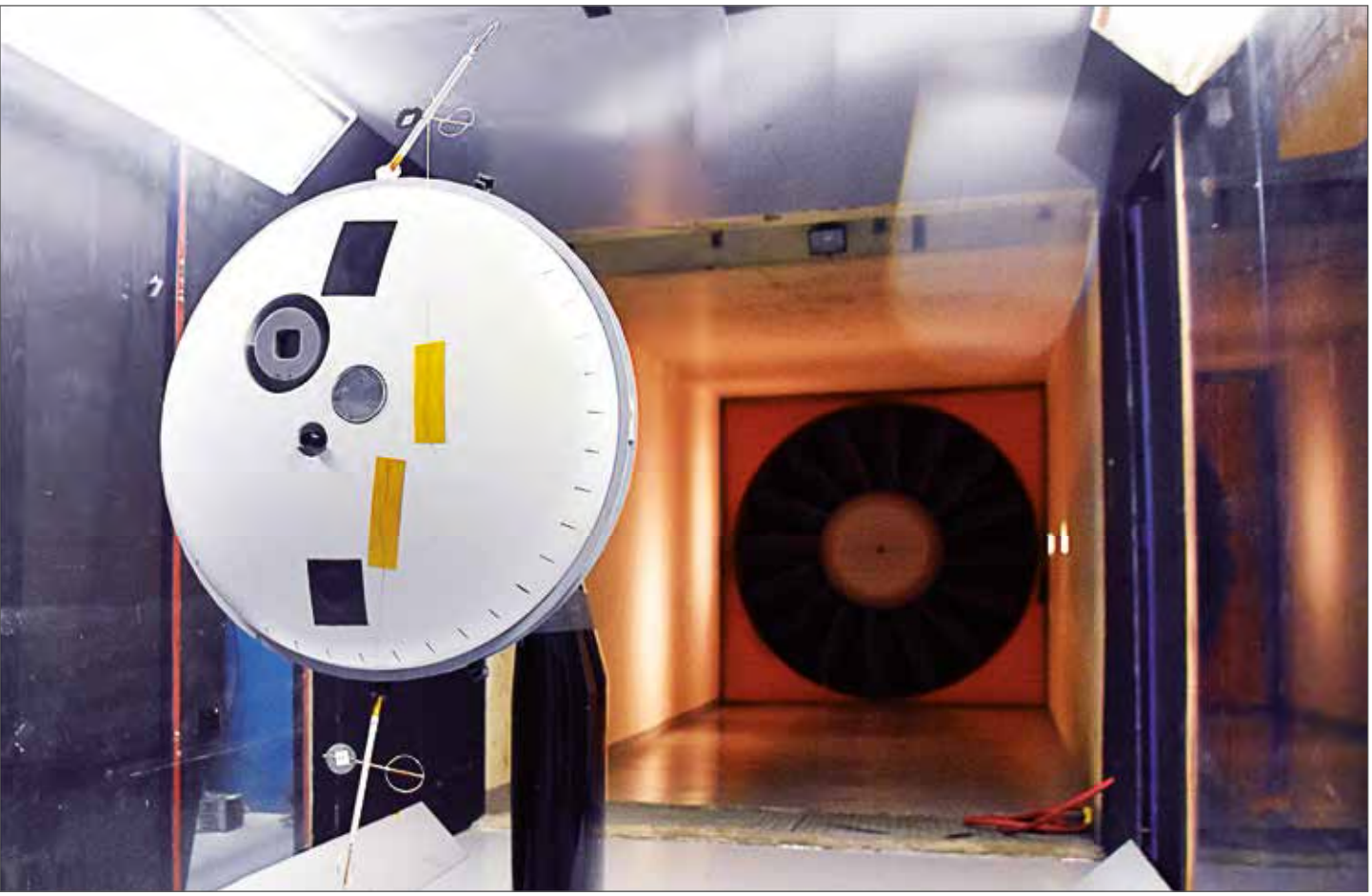
Clean Room
A class 10,000 clean room of 100m^2 is in service at the GREMI laboratory of Polytech Orléans. Students working in the Engineering Physics and Embedded Systems specialty carry out their practical work study projects in micro/nano-technologies and plasma processes in this facility.

Engine Test Benches
The engine test benches of the PRISME laboratory are used by Polytech engineering students and by students of the international Master's degree "Automotive Engineering for Sustainable Mobility" for projects and practical work in the fields of combustion, energy efficiency, pollutant formation and engine control.

Computer science labs and WIFI network
Polytech Orléans provides twelve self-service computer science labs with 300 computers and all necessary software for the use of its engineering students for lessons, projects, and personal work. WIFI access points are available in Polytech facilities and on campus for internet connection using laptop or tablet computers and smartphones.

Robots
Polytech Orléans has both industrial and domestic robots for use as part of the robotics coursework.

Material Mechanics Hall
Experimental devices in the Material Mechanics Hall of the PRISME laboratory are used by our engineering students during their projects to determine the mechanical behavior of innovative materials. This equipment may also be used to test materials such as woven composite reinforcements for aerospace and medical applications (biaxial tensile benches, benches to test shear, bending, wear and shaping) and materials in extreme conditions, such as ceramics for high temperatures with applications in new energies (mechanical test furnace for traction, compression, bending, and creep, under controlled atmospheres (nitrogen, argon, air) from ambiant temperature up to 1600°C).



Index of students

Final Year Projects Forum Awards

- 1st place
- 2nd place
- 3rd place
- 4th place
- 5th place
- Innovation
- High Schooler's Choice
- Participant

Index of participating companies and institutions

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