Student Projects Catalogue 2018-19
Polytech Orléans

Polytech Orléans

Ecole Polytechnique de l'université d'Orléans

Direction management des formations, prospective et innovation pédagogique

☎ : 02 38 49 43 56

🖷 : 02 38 41 73 83

✉ : directrice.formations@univ-orleans.fr

Site Léonard de Vinci
8 rue Léonard de Vinci
45072 ORLEANS cedex 02

Site Galilée
12 rue de Blois, BP 6744
45067 ORLEANS cedex 02

Site du Pôle Universitaire d'Eure et Loir
21 rue de Loigny-la-Bataille
28000 CHARTRES

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Message from the Director

One essential element of the activites 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

For further information:
Direction des Relations Entreprises, Stages, Innovation, Formation continue
12 rue de Blois, BP 6744
45067 Orléans cedex 2

+33 2 38 49 48 48

relations.entreprises.polytech@univ-orleans.fr

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 under the direction of Jean-Jacques Yvernault. 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.

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.

For a list of all participants in the Final Year Projects Forum of 2018-19, please see page 179.

Civil Engineering

Application of probabilistic methods in the study of the design and behaviour of underground constructions

Civil engineering


G. GARON


T. SEGRETAIN

Géraud GARON / Thomas SEGRETAIN
Academic supervisor: D.P. DO

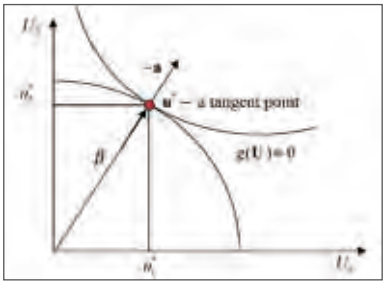
Institution: LaMé Laboratory

Objective/motivation

The behaviour of underground constructions such as deep tunnels depends on data such as mechanical properties of geomaterials or liner thickness. However, obtaining accurate knowledge of these parameters is difficult due to the heterogeneity of the geomaterials. Nowadays, the probabilistic approach brings additional precision by supporting awareness of the uncertainty in the structure design process. The work will consist of implementing the method in simple programming language (Matlab®, Mathematica). To summarize the problem: during the design process of a tunnel, there are criteria that need to be respected to avoid security problems. Therefore, multiple options are implemented until a satisfactory result is obtained. As this is a long and costly method, the point of the project is to reverse the process: to create a program that aims for a collapse probability and gives the minimum parameters to achieve this.

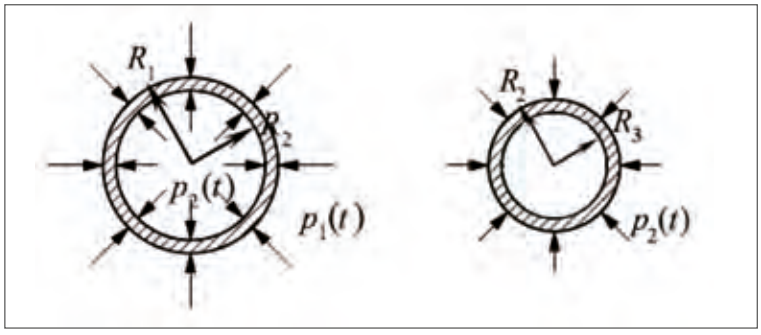
Results

First, we started by reading the bibliography to decide what the method used to carry out the project would be. We then decided to use a function already existing on Matlab®, FMINCOM, working with the Most Probable Point (MPP) method. In theory, this one fits perfectly our problem, but in reality, its operation is much more complicated than we expected. That is the reason why we spent a lot of time understanding, with simple examples and equations, how it works. We then applied our solution and our program to the initial tunnel problem. A doctoral student of the laboratory helped us as he had already written all of the long equations in Matlab®. However, dealing with a program built by someone else means getting the logic of how it works. With our program, the user can get the dimensions of the tunnel by simply indicating the probability of failure at a time t.

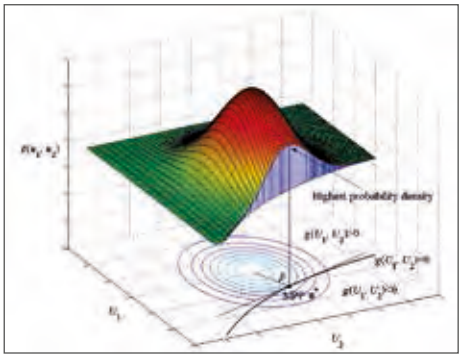


The MPP is a tangent point

Keywords: tunnel, probabilistic methods, Matlab®, programming



Sequential excavation of tunnel and installation of two liners



Highest probability density at the MPP

Contact: geraud.garon@etu.univ-orleans.fr ; thomas.segretain@etu.univ-orleans.fr

BIM in civil engineering: application to an innovative eco-district

Civil engineering


A. BOUTELET


P. LANAVE


L. PICARD

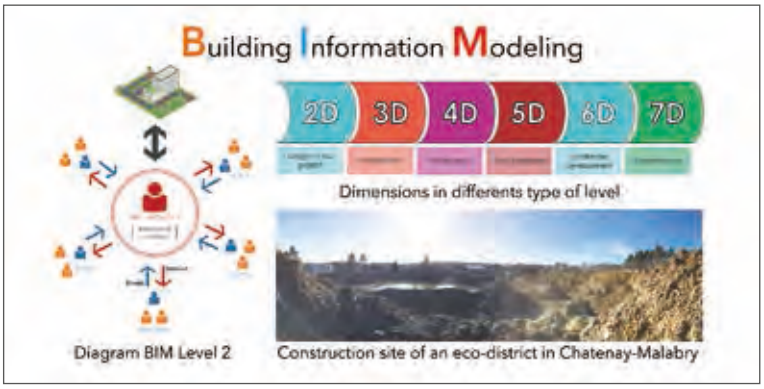
Anaëlle BOUTELET / Pauline LANAVE / Louis PICARD
Academic supervisors: T. EGGEN, M. SLAIMIA
Industrial supervisor: T. JASAROSKI

Company: Eiffage Route IDF Centre Ouest

Objective/motivation
The point of our project is to work on the BIM process. BIM means Building Information Modeling or Management. It is a process of collaborative work and an innovative approach in the construction field. Thanks to software and BIM-qualified managers, all the participants in the construction project are able to work on shared information. Usually, it takes the form of a 3D modeling of the entire project, which contains all the separate parts from each co-worker and all the information about the designed objects. First, our study starts with a short bibliographical summary about the BIM process. Then we have to list the tasks of the approach taking into account the BIM Manager requirements, and to define an internal procedure to check the data shared. At the end, our goal is to offer possible solutions when recurring problems are detected.

Results
After studying the specifications of the public works part of the innovative eco-district construction situated in Châtenay-Malabry, we visited the construction site. Unfortunately, the first phases run late, and consequently the phase about the setting up of the BIM process does not start. Given the fact that we were supposed to assist the BIM manager of the construction project, our industrial supervisor had us write two summaries, a detailed one and a less detailed one, of the technical specifications of the public work part. Then, to complete the study, our academic supervisor had us create a poster for the specialty civil engineering of Polytech Orleans explaining the BIM process. Finally, given the circumstances, we were not able to meet the first objectives, but we carried out an in-depth bibliographic study about the BIM, the approach and its operators.

Keywords: BIM (Building Information Modeling), public works, shared information, process, eco-district



Contact: anaelle.boutelet@etu.univ-orleans.fr ; pauline.lanave@etu.univ-orleans.fr ; louis.picard@etu.univ-orleans.fr

Call for tenders follow-up software

Civil engineering

A. BLANCHIER

E. MERIMEE

Annabelle BLANCHIER / Emmanuelle MERIMEE
Academic supervisor: L. JOSSERAND
Industrial supervisor: J. MILBERT

Company: Colas Ile-de-France Normandie

Objective/motivation

The industrial project we carried out was proposed by Colas Gennevilliers Paris Ouest, a Colas Ile-de-France Normandie group agency. This agency needed a software program that will be used to follow-up the calls for tenders. Indeed, the company agency has to submit trade statistics quarterly and annually to the headquarters. Therefore, Colas Gennevilliers needs a tool to achieve this task. The current software program in Excel® is heavy and slow. Our role is to find the best solution to develop a new version of this software program. It has to enable the user to manage a database of calls for tender and to generate several schedules and statistics.

Results

We first explored the existing software in order to understand how to improve it. We noticed many ergonomic problems and several bugs. Therefore, we chose with the company to redevelop the software totally with a most convenient aesthetics and programming. We started with a VBA self-study, the language used by Excel®, so we had all the tools needed to create a simple and efficient software. Programming required a lot of rigor, concentration and subtlety. We created three databases, manageable through Excel® user forms, that lead to the required statistics. By the end of the project, we achieved our objectives and the company approved the software program.

Flow-through ratio tab

Keywords: software program, calls for tenders, statistics

Example of programming in VBA

Userform for adding a call for tenders in the database

Contact: annabelle.blanchier@etu.univ-orleans.fr ; emmanuelle.merimee@etu.univ-orleans.fr

Characterization of thermal, hydro and mechanical behavior of a material

Civil engineering

C. FEDERICE SILVA

D. OUMAROU GANDA

Camila FEDERICE SILVA / Djibrilla OUMAROU GANDA
Academic supervisors: K. BECK, N. BELAYACHI
Industrial supervisor: H. DESSAPT

Company: Vega Group

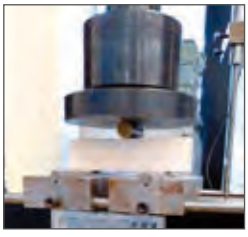
Objective/motivation

This project focuses on the study of the mechanical, thermal, acoustic, hygrometric and adhesion properties of three types of mortars that have been developed by the Vega group, a company specialized in manufacturing plaster and rehabilitation mortars. The first mortar is Cal Therm, a lime-based mortar of laying which is designed for joining the body of plaster and the final coating. The second mortar is Cal Therm Finition, which, like Cal Therm, is a lime-based mortar to be used as a finishing plaster. The last mortar is a mortar for plaster body named Isolteco, which is a lightened mortar with expanded polystyrene balls that play a very important role in the characterization of this mortar, which is usually used for indoor or outdoor thermo-acoustic insulation and for waterproofing walls.

Results

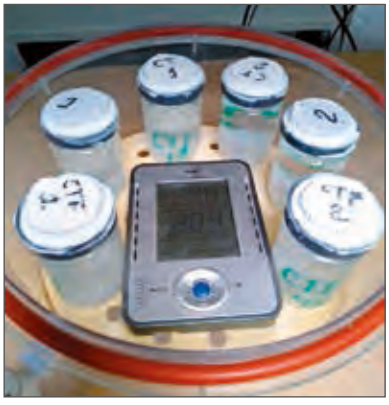
In terms of results, at the end of this project, we can say that the expanded polystyrene has a great impact on the performances of the materials. We observed that it is very useful not only because it helps to lighten the mortars but also because it brings interesting characteristics to thermo-acoustic insulation and permeability to water vapor. At the same time, it highly decreases the mechanical characteristics. We also saw that Cal Therm was the mortar that has the most interesting mechanical behavior which is logical because it is an adhesive mortar used to paste the different mortars together. Cal Therm Finition is a finishing mortar characterized by its high porosity which enables it to evacuate water by evaporation in case of capillary rise of water or moisture on the walls.

Keywords: mortars, coating, lime, isolation



Mold preparation

Flexion test



Permeability test

Contact: camila.federice@etu.univ-orleans.fr ; djibrilla.ganda@etu.univ-orleans.fr

Concrete: its composition, properties and evolution

Civil engineering


C. DUFOUR


J. EL ASLANI

Claire DUFOUR / Jalal EL ASLANI
Academic supervisors: K. BECK, N. BELAYACHI
Industrial supervisor: O. MORAND

Institution: Centre Sciences

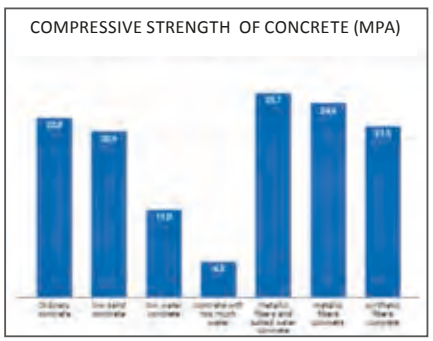
Objective/motivation

Concrete is the most commonly used material in the building and public work sector at national and international levels. This material is constantly evolving for structural and aesthetic uses. The purpose of the project is to prepare a collection of concrete samples with different formulations and various criteria of use. They are intended for the general public and students during the "Centre Sciences" exhibitions. Each sample has its own description on mechanical and thermal characteristics. In addition, posters are included. Our project has several parts. First, there is a research section. The bibliographic study on the types of concrete provides ideas for posters. In the meantime, samples are created according to the selection of "Centre Sciences". Then, tests for the identification of properties at 28 days are carried out. Finally, there is the graphic design part for posters and stand proposals.

Results

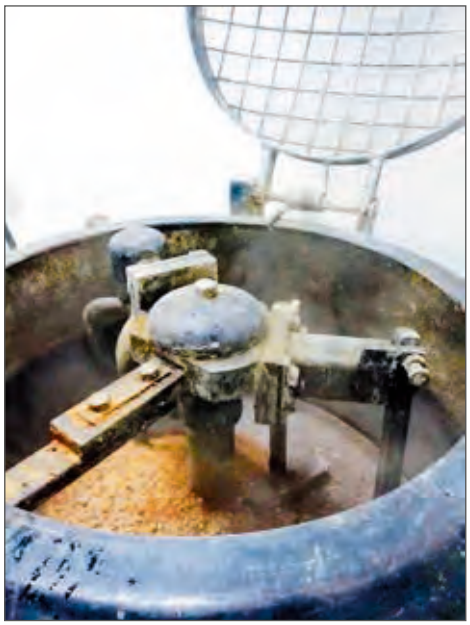
According to the selection made, 82 concrete samples have been created and more than twenty posters have been designed. We have planned six stands for the exhibition. The concrete formulas that we have chosen are the following: classic concrete; three bad formulas (too much water/ not enough water/not enough sand); concrete with steel fibers; concrete with steel fibers in salted water; concrete with synthetic fibers; concrete with wet recycled rocks and sand; sample with dry recycled rocks and sand; light concrete; and concrete with vegetal fibers. In order to know the difference between those samples, we calculated the compressive strength of each sample as you can see in the chart below and have done a thermal analysis as well.

Keywords: exhibition, concrete samples, activities, discovery



Graph from the resistance test


Compression test of a concrete sample to determine its strength


Production of concrete specimens by using the mixer

Contact: claire.dufour1@etu.univ-orleans.fr ; jalal.el-aslani@etu.univ-orleans.fr

Configuration of the non-linear finite elements model of the EPR

Civil engineering


K. BAIDAOUI


L. LEGRAND


J. MORELLI GIRONDO

Kaoutar BAIDAOUI / Ludovic LEGRAND / Julia MORELLI GIRONDO
Academic supervisors: T. EGGEN, D. HOXHA
Industrial supervisor: M. HUGUET

egis industries
Company: EGIS

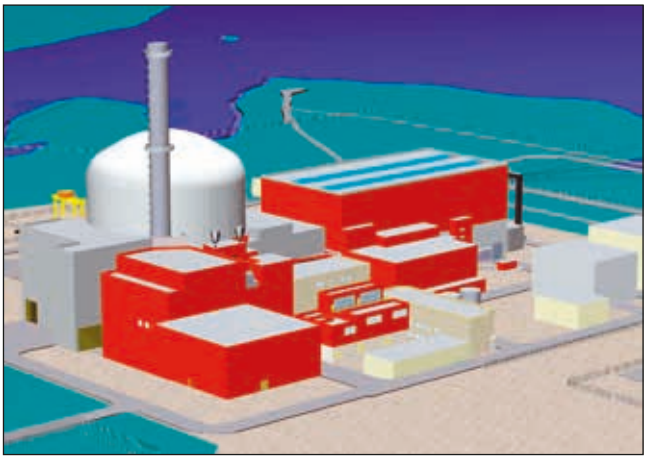
Objective/motivation

The costs of projects of nuclear buildings are really high, and one of the reasons is the method that is used to calculate the reinforcement of the structural elements. Considering this, EGIS proposed this study to develop a different method to calculate the armature of walls and floors of the Evolutionary Power Reactor (EPR) based on the theory of nonlinear finite elements. The goal is to optimize the armature of the reinforced concrete used to build the EPR, using less steel and being more economical and realistic without interfering with the security of the structure. The work consists in creating a program to automatize the calculus of the real armature that will be used in the structure with the Python™ code, based on a Scilab code already given by EGIS.

Results

After working two months on the project, the group developed a new routine with the Python™ code that was able to accelerate and automate the calculation of all the parameters that were described in finite elements nets. As a result, the program created was able to read the information that would be used as input data in different sources, such as Excel® files and text files. After extracting the input data, the program is used to calculate the parameters of every finite element, like the diameter of the bars used in the reinforcement, the frame section, the coating of the elements and some other parameters. The formulas for the calculus used in Python™ were the same as EGIS used with the Scilab code.

Keywords: Python™, non-linear behavior, Scilab, finite elements


Model of the EPR

Contact: kaoutar.baidaoui@gmail.com ; julia.girondo@gmail.com ; ludovic.legrand@etu.univ-orleans.fr

Create a new version of the third-year practicals

Civil engineering


V. LALOUM


J-P. LE

Valentine LALOUM / Jean-Pierre LE
Academic supervisors: D. BADREDDINE, X. BRUNETAUD

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Objective/motivation

The project studied is based on the observation and analysis of the current third-year practicals and their improvement in terms of equipment and execution procedure. They are programmed in the Materials and Material Resistance module. Sometimes the damaged equipment makes the practicals too long and the students don't have the time to do them properly, so the educational goal is not reached. The aim of this project, suggested by the school, is to fix the equipment such as the samples, the scales or the loads, and clarify the wording in order to update and improve the practicals. It consists of the analysis of existing practicals to highlight the limitations and problems encountered. The practicals requiring attention due to difficulties with implementation or comprehension are those concerning pure traction, deflected bending, effusivity and conductivity, and microstructure.

Results

To better understand the difficulties, a questionnaire has been sent to the teachers supervising the practicals. Concerning the equipment, our school has the resources to fix the damaged samples in its laboratory. The wording is improved to make the practicals more efficient. Students must be able to understand and solve any problems encountered during the execution of the practical. These improvements are made for effusivity and conductivity, and microstructure practicals. The last part of the project consists in creating a poster for better understanding. The latter is optional, although creating at least one poster will encourage future project groups to do it for other practicals. In the end, the goal is to have a poster for each practical subject.


First practical's installation. The type of sample to fix is placed in the middle.

Keywords: practicals, update, improving, educational, wording


Analysis of the efficiency of the samples and creation of new wording

Contact: valentine.laloum@etu.univ-orleans.fr ; jean-pierre.le@etu.univ-orleans.fr

Creation of a new version of acoustic practical work and updating of a concrete practical work

Civil engineering


A. FISCHER


T. GLANDAIS

Adrien FISCHER / Thomas GLANDAIS
Academic supervisors: K. BECK, M. SLAIMIA

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

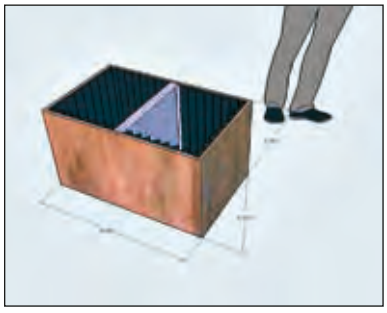
Institution: Polytech Orléans

Objective/motivation

Our project consisted in improving the current civil engineering practical works for the 4th year students. In order to achieve this goal, first of all, it was necessary to gather the current French standards concerning civil engineering. Thus, it was possible to verify the conformity of the standards used in the current practical works and, then, to update the obsolete standards so that the practical works teach something useful. After that, we had to analyze the course of the current practical works adopting quality engineer responsibilities and to propose solutions to improve them. Finally, we had to create a new acoustic practical work in its entirety to complete the existing one and adapt it to the building option of the civil engineering specialty.

Results

We actualized the standards used in the practical works and they are now updated. We attended practical works sessions and wrote down all the problems and obstacles to their smooth running. Then, we looked for and proposed solutions to solve them. We gave examples to solve the problems and the costs of the material that would be necessary. Our tutors will decide what solutions will be set up for next year. We created supports such as explanatory sheets, pictures and a video helping the students to understand the practical works and improving the security. We suggested different acoustic practical works and we explained the detailed ways to set them up. We made a first approach to the new sonometers and created instructions to help future students and teachers to use them.


3D model of the box that we conceived and built for the new acoustic practical work

Keywords: practical work, acoustic, concrete, improvement


Noise level measurement with a sonometer


Students during practical works sessions

Contact: adrien.fischer@etu.univ-orleans.fr ; thomas.glandais@etu.univ-orleans.fr

Creation of a new version of geotechnical practical work

Civil engineering

O. BENHADDI

F. LEGIOT

Oussama BENHADDI / François LEGIOT
Academic supervisors: D. BADREDDINE, K. BECK

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Objective/motivation

The aim of this project is to update the current geotechnical practical work that third-year students have to do by the end of this semester. The AFNOR database was at our disposal and we could therefore consult all the geotechnical standards and edit a new duplicate of the geotechnical practical work. However, this was not our only work to do during the project. The real objective was to do everything we could to improve the conditions and the period during which third-year students execute the geotechnical test. Thus, we did several things to help the students to understand and to execute the practical work better. Afterward, we created the new version of the geotechnical practical work and designed some posters which will be exhibited in the Polytech laboratory, explaining the test with all the dangers to which students are exposed.

Californian Bearing Ratio (C.B.R) test

Results

At the request of our supervisor, we also created a big database grouping all the geotechnical standards that exist in France and in the European Union. We can consult and see the changes to which geotechnical standards have been subjected. Moreover, future students now have a version of the updated geotechnical practical work. In addition to placing about fifteen posters, we audited the Darcy Hall laboratory to note the good points and the problems related to the tests. The laboratory is ready to be inspected and then certified. It was really interesting to work on this project. The work we produced was very satisfactory because it was about some previous lessons and we did all what was possible to improve the geotechnical part of the third-year. We are also glad to help our university and our teacher, and to create better conditions for the next students.

LOS ANGELES machine

Methylene blue test

Keywords:
geotechnics, practical work, laboratory

Shear test, Casagrande box

MicroDeval test

Contact: oussama.benhaddi@etu.univ-orleans.fr ; francois.legiot@etu.univ-orleans.fr

Creation of Excel® tools to prepare highway renovations applied to the A71

Civil engineering

D. COURIVAUD

L. NEVEU

Damien COURIVAUD / Lucas NEVEU
Academic supervisor: L. JOSSERAND
Industrial supervisors: S. GOURDEAU, A. LOUAFI

Company: Colas Direction des Grands Projets

Objective/motivation

The aim of the project is to make preparation and following of highway construction sites easier for civil engineers. Colas oversees the renovation of 13 kilometres of a highway this year. The next part between Olivet and Vierzon will start from mid-March. Our tools will be created depending on this construction site but they should be used for other work sites. We must create two distinct tools, one dedicated to budget and the other to scheduling the rotations of trucks. The goal is to make the preparation work as easy as possible for the Colas personnel. This construction site is a typical one. The task consists of renewing the pavement with a new material while disrupting traffic as little as possible. Many such construction sites exist.

Results

First, we began reading and understanding all the documents in the market. Then we worked on imagining the construction work and how it would take place: how the trucks will enter construction site, where they will do a U-turn, etc. Once we understood the tasks and how they would be done, we started working on the budget. We listed every material or personal equipment needed during the renovation. Listing all the estimated expenses gives the projected budget, which is more than one million euros excluding VAT. We have already created an Excel® file that can estimate the time travel of every truck. It calculates the number of trucks needed and the timetables of each, the time drivers need to go to the concrete plant to be loaded, etc.

Construction site similar to this project

Asphalt plant

Keywords: preparation, renovation, pavement, highway, A71, Colas, Bouygues

Application of hot asphalt

Compactors rolling the hot asphalt

New highway

Contact: damien.courivaud@etu.univ-orleans.fr ; lucas.neveu@etu.univ-orleans.fr

Design of a concrete and wood footbridge

Civil engineering

L. BURGEMEISTER

Y. SFEIR

Lucas BURGEMEISTER / Yael SFEIR
Academic supervisors: X. BRUNETAUD, D. HOXHA
Industrial supervisor: C. DIOUX

Institution: University of Orléans

Selected participant
13th Annual Final Year Projects Forum

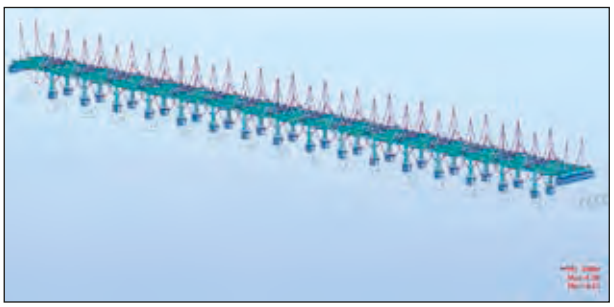
Objective/motivation

During this final project, we are working for the University of Orleans designing a new footbridge in order to replace an older one, located on the campus, not far from the cafeteria Le Lac. The original footbridge is currently unusable. A study made two years ago concluded that it is too hazardous to cross, and that is why we were appointed to think of a new one. For this we have the following constraints: the bridge has to be accessible to disabled people (level and wide), and has to be made of wood and concrete. If we want our project to be achieved, we have to suggest a less expensive, improved bridge. We wanted to have an architectural model, which looks like some real bridges like the Pont-Passerelle of the Mont-Saint-Michel, and a concrete and wood bridge in Quebec.

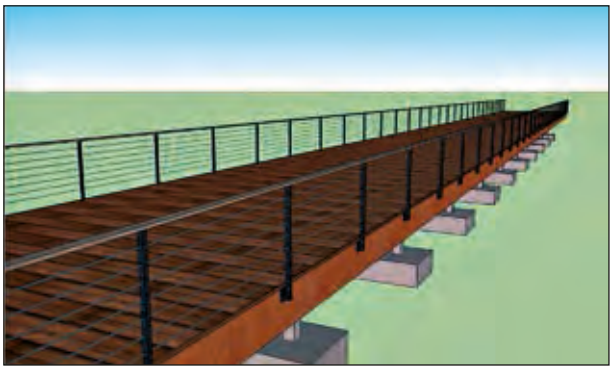
Results

We set to work on a software programme in order to calculate different efforts. This footbridge has to be sized for unusual cases such as when it is fully crowded or when someone heavy is jumping, etc. A new challenge appeared a few weeks after the start of the project: the footbridge structure has to support a vehicle. So we got a numerical model of our bridge, with its strengths and weaknesses. The conclusion we made is that the footbridge would not collapse. Considering the vehicle on the bridge, the cost had widely exceeded the previous one. We have therefore decided to design two bridges, at two different costs, the first one considering a pedestrian footbridge, and the second one sized for a car. The client will have the opportunity to choose the one he prefers.

Keywords: footbridge, architectural design, structural design, wood, concrete



Footbridge model on the software which calculates structural efforts.
Purple lines represent the impact of the car on each component of the bridge.



Architectural view of our bridge, with the constraints our client told us to respect

Contact: lucas.burgemeister@gmail.com ; yael.sfeir@live.fr

Designing a solution to assemble metal plates onto the monorail to propel a ground effect train

Civil engineering


P. BRILLET


L. LEGALL

Pierre BRILLET / Loic LEGALL
Academic supervisor: T. EGGEN
Industrial supervisor: N. SAID

Company: Spacetrain

Objective/motivation

Spacetrain, based in Orléans, is renting a structure called a monorail that was built in 1968 in order to connect Paris to Orléans by train in under 20 minutes. Only a portion of the rail was built, which is about 40 kilometers long. It is planned to attach steel and aluminum plates on each side of the rail to propel the train to turn the old rail into an induction monorail. Our job is to determine how to attach those metal plates to the rail. We also have to study how the materials will behave depending on the temperature. Moreover, we have to figure out solutions for every environmental problem that the rail could encounter (heat, rain, snow). To do so, we are using a finite element analysis program, Abaqus, that none of us has ever used before.

Results

We have determined several attachment solutions that respect all the company requirements. We have designed them on AutoCAD, calculated the temperature shift and then calculated different thermal dilations. We have also determined the materials we need to use to protect the plates from water infiltration. Using Abaqus, we have established a model of the system, including interactions between materials, thermal dilation, and internal strength that can act on the attachment solution. Our model should simulate many environmental conditions that we can observe and use to dimension the pieces. According to this, we can work out a solution cut to fit the old infrastructure. Following our work, Spacetrain will be able to add some more aspects they want to work on and set up the all-new monorail and its specific features.

Keywords: monorail, ground effect train, linear induction, air cushion


The 1968 aerotrain


Spacetrain shuttle


Technology of the shuttle

Contact: pierre.brillet@etu.univ-orleans.fr ; loic.legall@etu.univ-orleans.fr

Feasibility study for the security of a crossroad

Civil engineering

M. BUSSO

X. XIE

Mégane BUSSO / Xinyi XIE
Academic supervisors: T. EGGEN, L. JOSSERAND, M. SLAIMIA
Industrial supervisor: J. LUCY

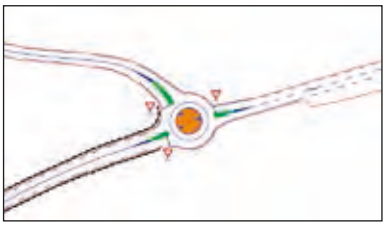
Company: Iris Conseil

Objective/motivation

The project was given by Iris Conseil, which is an independent engineering firm specializing in town planning, transportation infrastructure, displacement and environmental issues. This project consists in feasibility studies to secure an existing junction between two roads, the RD54 and RD54e, as they are judged accident-prone in Saint-Aubin-sur-Scie, Normandy. The departmental council of Seine-Maritime would like to secure this crossroad by providing facilities that would be appropriate to reduce speed and improve visibility. The project lasts nine weeks and consists of various tasks as the analysis of the current situation, the topography and compliance with standards of road marking and road sign. Then, three 2D layouts that could replace the current one and make the road safer have to be suggested. Finally, a multicriteria table is made to compare all the layouts from which only one will be selected.

Results

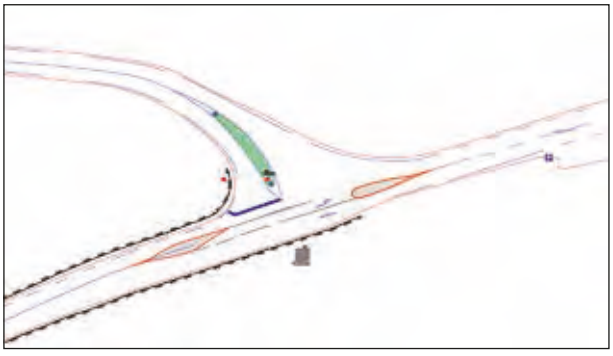
After having studied how the crossroads works and the conformity of the road sign and road marking with the Inter-ministerial Instruction of Road Sign, it emerged that road signaling is not implicated in the dangerousness of the crossroads. Speeding is very likely to be the main cause of the accidents occurring there. Four layouts were chosen to replace and secure the crossroads: transverse rumble strips, traffic lights, a roundabout and turn lane. These layouts were sized according to standards like the Layouts Intercity Crossroads, and then drawn in 2D using AutoCAD. They will be compared with one another on different criteria like the cost, the complexity of the work to be done, the hazardous nature and the impact on the natural habitat. All the results obtained will be summarized in an explanatory report which will be given to IRIS Conseil.



Plan view of the roundabout

Keywords: crossroad, safety, layouts, feasibility, environment

Picture of the current crossroad



Plan view of the turn lane

Contact: megane.busso@etu.univ-orleans.fr ; xinyi.xie@etu.univ-orleans.fr

Geochemical study of the sediments of the Brenne ponds

Environmental engineering


W. LI


M. LUCAS

Wei LI / Maxime LUCAS
Academic supervisors: C. DEFARGE, M. MOTELICA

Institution: The Institute of Earth Sciences in Orléans (ISTO)

Objective/motivation

The aim of the project is to study the sediment of Brenne's ponds in Indre (36). This study is a part of a bigger project named DynEtang, which is financed by the Région Centre-Val de Loire. It requires the understanding of the hydrological, water sedimentary, geochemical, biological dynamics and human interactions with the environment. With initial sediment sampling, treatment of pond results using geostatistics and physicochemical analysis in a laboratory, we defined the depth profile of one of the Brenne's ponds and its sedimentary composition and other physical and geochemical parameters. We also determined limnic regions using geochemical data interpolation based on a surface sediment survey. Then, we drew an Arcgis map with the kriging method. Thus, we could predict the sediment condition of all the Brenne's ponds, and better understand the functioning of the ponds and the influence of the nutrient load in the composition of the sediments.

Results

Firstly, the methodology to analyze the sedimentary carrot was divided into multiple experiments. We first analyzed the color of the sediment, its granulometry, its water content, its density, its pH and conductivity. Moreover, we had to prepare some samples for the geochemical analyses, in which we used a pyrolizer flash (total C and N concentration) and Rock-Eval (organic carbon concentration and organic matter indexes). Thanks to all these experiments, we obtained information on the components of the sediment and the process of its creation. Secondly, for the kriging study, we modeled each pond with the known points by searching the most suitable statistical model. The known points contained information about the components of sediment which they had been obtained by coring. Thanks to them, the model estimated the proportion of components on the total area of the pond.

Contact: wei.li@etu.univ-orleans.fr ; maxime.lucas1@etu.univ-orleans.fr

How to make a typical building file concerning dikes with the new flooding risk decree

Environmental engineering


C. ROTA


N. VANEGUE

Cécile ROTA / Nicolas VANEGUE
Academic supervisor: L. LE FORESTIER
Industrial supervisor: P. PHILIPPE

Institution: Etablissement Public Loire

Objective/motivation

Our fifth-year project is about how to do a typical building file that respects the new law concerning flooding risk (GEMAPI context) and the new 2015 decree, which changed the previous 2007 decree. These decrees are specific to the rules applicable to purpose-built dikes against flooding risks. Basically, GEMAPI is for everything that concerns water (sea, river, etc.) and dikes or seawalls in France. This is new because before the decree of 2007, only the government took care of state-owned dikes in the country. However since 2018, the "EPCIs" (the public institutions which regroup several municipalities to exercise their skills in common) are in charge of all the dikes in France. In addition, the state may help the EPCIs to take care of state-owned dikes until 2024. So now every EPCI needs to get ready for it because it will need more work (supervision, maintenance, reparation on a small or large scale) and a higher cost for those towns and cities.

Results

Our goal was to develop a typical building file which will help the dike administrator to better know his building. That includes the history of the dike, the protected area, the level of protection, its weakness, etc. We managed to meet stakeholders in the domain of dike management. Thanks to their advice, we were able to realize the organization of the building file. For two days, we have been near Angers in order to visit a dike at Saint-Georges-Sur-Loire and to find local archives. This way, we start doing a real building file on the containment system of Saint-Georges-Sur-Loire. Later, this file will be taken over by the "Établissement Public Loire" staff in order to program new studies (for instance, technical visits) or to store more archives.

Keywords: dike, GEMAPI, building file


Dike located in Saint-Georges-Sur-Loire near Angers

Contact: cecile.rota25@gmail.com ; nicolasvanegue@gmail.com

Hydro-geochemical study of the Brenne ponds

Environmental engineering


E. FENDARD


J.D. NDENDET

Etienne FENDARD / Jean Davy NDENDET
Academic supervisors: C. DEFARGE, M. MOTELICA

Institution: The Institute of Earth Sciences in Orléans (ISTO)

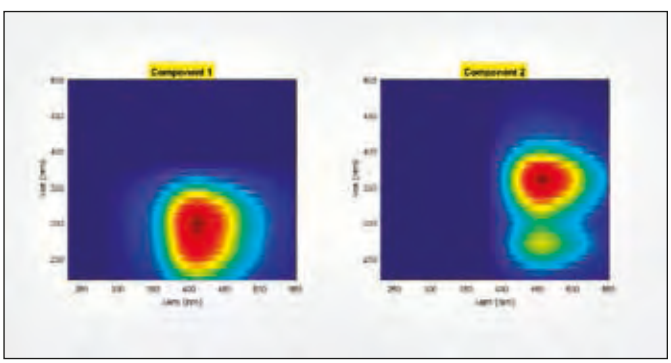
Objective/motivation

Many hydrosystems are studied nowadays but the study of ponds has been particularly neglected by scientists. That is why the Centre-Val de Loire region has financed a thorough study of the ponds of Brenne, called “the country with a thousand ponds”. The DynEtang project aims at preserving the natural heritage of the region by managing these water bodies. We are participating in this project in collaboration with ISTO and CETRAHE to understand the hydrogeochemical dynamics of these ponds and the interactions between humans and the environment. The main objective is to take stock of the situation of ponds over two years of water sampling and to study the influence of deoxygenation on the biogeochemical functioning of ponds in the context of climate change and impact of human activities. We will identify a hydrogeochemical trend to optimize the management of these waters.

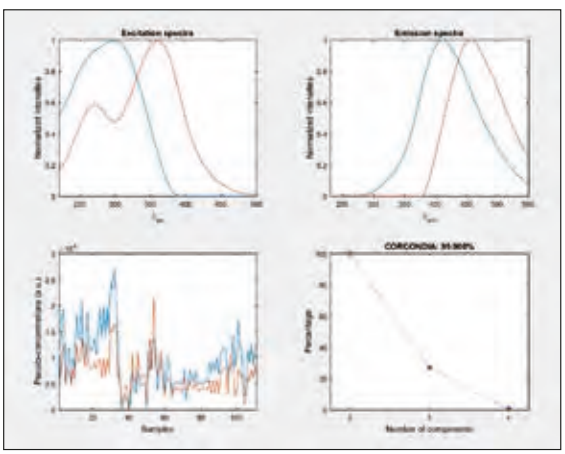
Results

During the first month of the project, we carried out all the bibliography concerning the ponds of the Brenne and studied the context of the studied zone. We also collected water samples from three different ponds and we analyzed them thanks to a spectrofluorometer to determine the fluorescent compounds of including natural organic matter the water of these ponds. During the first two weeks of February, we managed to start the interpretation of the data we got from the spectrofluorometer and from an ion chromatography analyzer. We also analyzed the data processed by statistical analysis via PARAFAC. On the basis of these data, we finally explained how the pounds are fed, with which kind of water, and the presence of certain natural compounds.

Keywords: Brenne, ponds, hydrogeochemical study, water analysis, spectrofluorimetry, organic matter



Spectra of the two components


Graphs of the spectra of the components

Contact: etienne.fendard@etu.univ-orleans.fr ; jean-davy.ndendet@etu.univ-orleans.fr

Investigation of vineyard soil composition and its effects on vines

Environmental engineering

L. BALON

P. PINGEOT

Loan BALON / Pauline PINGEOT
Academic supervisor: M. MOTELICA

Institution: The Institute of Earth Sciences in Orléans (ISTO)

Objective/motivation

The purpose of the project is the study of vineyard soil composition which affects beneficially or badly vine production and wine quality. Today, phytosanitary products are used in order to handle vine diseases and to increase vine productivity. However, these products are potentially harmful for soil ecosystems and may contaminate water bodies. Therefore, winegrowers have to use new methods and new treatments, like drones, sensors or environmentally friendly products, as alternatives in order to preserve the environment. Our project is part of a larger one called Vinodrone which is able to detect vine diseases easily and follow vine healthcare. For eight weeks, we studied different soils for their composition and analyzed them. To do this, we sampled different surface soils on three plots of vines in Chinon. We then analyzes these three soils by several methods.

Soil preparation for pH study

Results

Our project is composed of two main parts: bibliographic research and laboratory testing. We wrote several reviews about the life cycle of vine, agricultural soil amendments and vine treatments, grapevine diseases and microbial population in soil. This part allowed us to better understand our project and to interview Guillaume Delanque, a winegrower in Chinon. The second part of this project focuses on experiments and soil composition analysis. In order to know the soil properties of these three vine plots, we made several experiments such as physical, microbiological and chemical surveys. This report presents pH, conductivity, structural analysis, carbon and sulphur content and two detailed experiments: “Rock Eval” and “Pyrolyse Flash” of our samples. Thanks to all the results of these experiments, we could compare these three soils and we identified the effects of treatment or biocontrol on soil.

Keywords: Vinodrone, soil composition, soil studies, vine, experiments

Vineyard of Chinon where we carried out some tests

Sample preparation for chemical analyses

Contact: loan.balon@etu.univ-orleans.fr ; pauline.pingeot@etu.univ-orleans.fr

Logistics improvement on the construction site of the Saint-Denis Pleyel station

Civil engineering


L. SEGALA

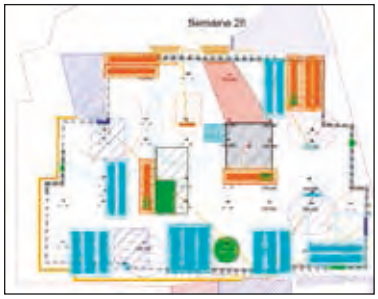

N. SIMONNET

Léa SEGALA / Nicolas SIMONNET
Academic supervisor: N. BELAYACHI
Industrial supervisor: T. AUBIN

Company: Eiffage

Objective/motivation

The main objective of our project is to simplify and optimize the storage areas and the vehicle runways during each phase of the construction of the foundations. In fact, this construction is complex, and the available space is limited as the site is in an urban environment. Moreover, two companies are building the foundations this year, so it is necessary to synchronize the workshops to avoid interference. Each company is building two foundations during one week, so three different workshops are necessary: drilling, cutting and concreting. Thus, six teams using large areas are working simultaneously. It is also important to manage storage areas, so that it does not change from week to week to reduce displacements of the equipment and the use of the cranes.


Extract of our plans on Autocad

Results

In a first phase we analyzed the construction site and all the constraints we must take into account. As our goal is to optimize logistics on the site, we drew up three sets of plans with different sequencing for the foundations. For each plan, which represents a week of work, we represented the locations of the engines, the storage areas and the runways. The first set was done with the initial sequencing established by the foundation companies and the two others were done to avoid superposition and with the deadlines given by Eiffage to speed up the foundations work. Our second set enabled the project to finish earlier and has almost no issues with the locations of the engines. This sequencing has been adopted by Eiffage and will be presented to the foundations team.

Keywords: Grand Paris Express, underground station, organization, logistics, foundations


Space organization on the board


The construction site with cranes and foundation engines

Contact: lea.segala@etu.univ-orleans.fr ; nicolas.simonnet@etu.univ-orleans.fr

Modeling of the phreatic table of the Ain river

Environmental engineering

M. ALLEAUME

A. BLANC

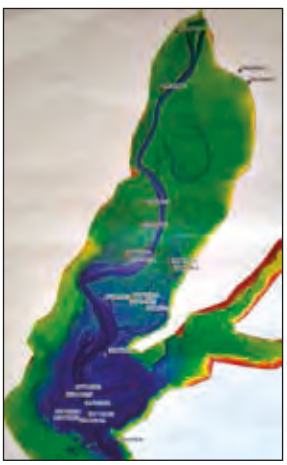
Margaux ALLEAUME / Arnaud BLANC
Academic supervisors: S. BINET, C. DEFARGE
Industrial supervisor: T-P. HANS

Institution: Jura Department Council

Selected participant
13th Annual Final Year Projects Forum

Objective/motivation

Our project deals with the modelling of the accompanying phreatic table of the river Ain in collaboration with the Jura Department Council. This project responds to a major environmental issue. In fact, since the 18th century, several human interventions on the Ain river bed have deeply modified its route and its flow. Therefore, the level of the accompanying groundwater table of the river Ain is decreasing and the risk in the future is for the wells to be above the phreatic table level during droughts. There is also a threat to biodiversity because of the decline of the average river level, which is drying up wetlands. Our duty is to demonstrate that works can prompt a gain in water level and then exhibit the benefits as regards drinking water provision and biodiversity.

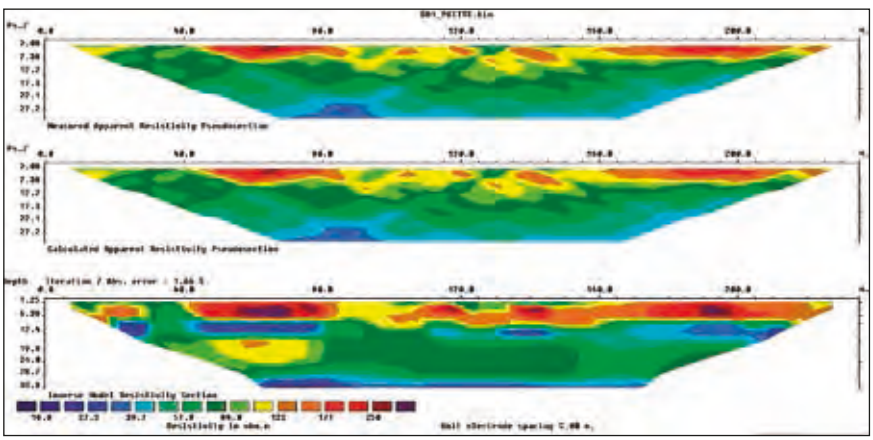


Modeling and estimation of water volume

Results

After a bibliographic research about the river and a field trip to Jura to collect some samples and tests, we made the analysis of all these data. In parallel, we made a Geographical Information System model of the subsoil of the study area with the top and the bottom of the aquifer to compute the winnable water volume with a certain increase of the level thanks to works in the river bed. We have also summed up all the hydro chemical data concerning the phreatic table and the river to understand the scheme of the exchanges between surface waters and groundwater. With the GIS model and the hydro chemical research, we have been able to calculate the winnable water volume and so to prove that works can prompt a gain in water level. This project is a preamble to pursue the civil works and the redevelopment of the Ain river.

Keywords: modeling, environment, water supply, hydrochemistry



Data processing

Contact: margaux.alleaume@etu.univ-orleans.fr ; arnaud.blanc@etu.univ-orleans.fr

New stone masonry footbridge

Civil engineering

K. DIABY

D. MAMBOU KAYEP

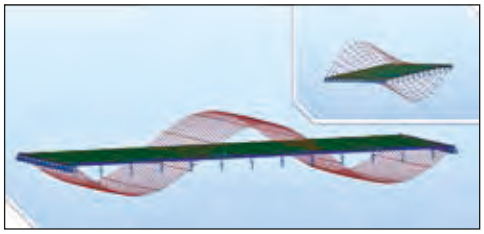
Karamoko DIABY / Desmond MAMBOU KAYEP
Academic supervisors: X. BRUNETAUD, D. HOXHA
Industrial supervisor: C. DIOUX

Institution: University of Orléans

Second Place
13th Annual Final Year Projects Forum

Objective/motivation

The aim of this project is to replace a bridge located on the campus of the university of Orleans. Therefore, we are required to study the renovation of the run-down footbridge of the campus, which is currently not in use. It will then be a question of suggesting a new structure to replace the existing pedestrian walkway made of timber by one made of stone masonry. Stone masonry is mandatory for the framework but not for the superstructure. Therefore, that will enable us to mix the materials for this footbridge by using timber for the deck, and timber or maybe glass for the railing. Therefore, various types of structures can be suggested.



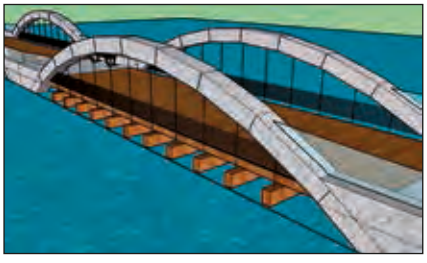
Dynamic calculations

Results

First, we succeeded in architecturally modeling four types of footbridges by using SketchUp and, through a survey that we carried out at Polytech, we were able to choose one of them. We then did the mechanical and dynamic calculations by using different kinds of software such as Robot structural analysis, RMD7 and Pybar. Before, we had never learnt how to size an arch footbridge at school and that was challenging, but our motivation to reach our goal pushed us to do more research on the internet and to browse books at the library, and we finally managed to meet our needs. After sizing the footbridge, we dealt with the foundations and we put a cost on our pedestrian walkway. Finally, we tried to optimize the cost of our structure by minimizing the amount of raw material that will be used. That was possible due to the kind of arch we proposed, considering the fact that the efforts on the arch diminish from the keystone to the base, so we can use an arch called “elephant legs”.

Side view

Keywords: arch footbridge, mechanical calculation, dynamic calculation, pedestrian walkway, Robot Structural Analysis software



Structure of the footbridge

End view

Cross section

Contact: karamoko.diaby@etu.univ-orleans.fr ; desmond.mambou-kayep@etu.univ-orleans.fr

Optimization of resources

Environmental engineering

H. BELKACEM

S. MAKHOUL

Hasni BELKACEM / Sami MAKHOUL
Academic supervisor: C. PROUST
Industrial supervisor: Y. PUCHAULT

Company: SOGEA Centre

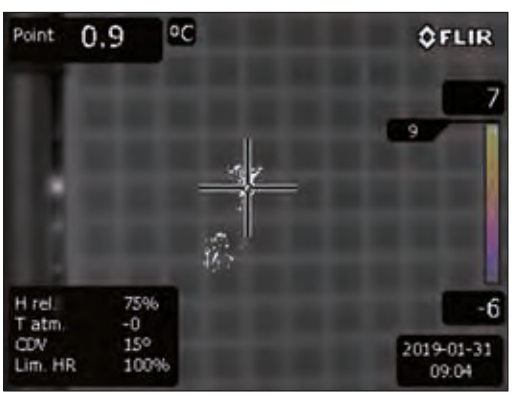
Objective/motivation

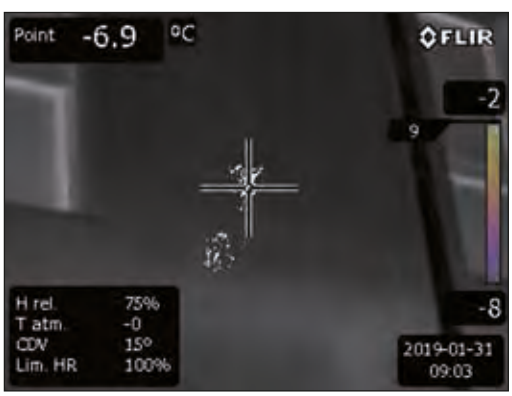
The main task of this project is to reduce by around ten percent the quantity of CO_2 for two agencies of the company SOGEA located in Orleans and Tours. The company is aiming to construct a new agency in the coming years and one of their objectives is to avoid CO_2 problems. The first step of this project consists in collecting the documents which will help us to create a Carbon report. With an Excel® file, we had to calculate the consumption of the company for one year: water, electricity, transportation and all other contributions which might impact the emission of CO_2 (papers, cardboard boxes, etc.). To collaborate with the company, we interacted with quality security environment correspondents. During this project, they helped us to obtain all the necessary documents. We started our work for the company of Orleans and continued with the company in Tours.

Results

The first results show that transportation constitutes the main proportion of their consumption. The results show that fuel consumption represents around 75% of the CO_2 produced by the company. One of the solutions is to propose an urban mobility plan but this would mean that the employees should start work at the same time. On the other hand, the company buys a huge quantity of paper, cardboard boxes, more than three tons of paper per year. This also represents around ten percent of the CO_2 produced by the company. This is not the crucial leverage to reach our goal. One of the solutions is to buy recycled papers, which consume less CO_2.

Keywords: CO_2 emission, carbon report, resources





Contact: hasni.belkacem@etu.univ-orleans.fr ; sami.makhoul@etu.univ-orleans.fr

Planning a three-way intersection in Greges

Civil engineering

O. BROSSARD

M.B. DIAGNE

Ophélie BROSSARD / Mame Bineta DIAGNE
Academic supervisors: T. EGGEN, L. JOSSERAND
Industrial supervisor: J. LUCY

Company: Iris Conseil

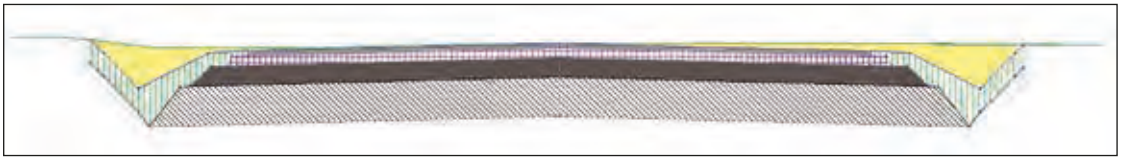
Objective/motivation
Our study is about planning a three-way intersection in Greges in order to secure the zone and reduce the accident frequency rate. In fact, the intersection is not perpendicular, causing a lack of security in the corners. We received a folder containing topographic plans, traffic and security studies, buried network plans and mails relating to the project. Our project consists of a complete site analysis, 3D modelling of the intersection with Mensura and AutoCAD software. We also determined the sanitation according to the rainfall of the area and the existing one. After that, we calculated the estimated cost of the project: earthwork, road construction, and workforce. We will also do its planning. All of these steps will be written on a report and sent to the company and to our pedagogic tutors.

Results
A big part of the existing road will be re-used, so that this variant is more economic for the client. To model the intersection and get the volumes, we did several platforms in order to separate the existing road and the new one. Our three-way intersection is now more secure because, at the crossroads, the road's axis is perpendicular. Part of the project was to analyze the radius of gyration of the trucks in order to check if they will not touch curbs surrounding the traffic islands. After the modelling part, we did the cost estimate by calculating the different volumes of materials and determining the needed heavy equipment and workforce. Then, we did the planning with the determination of the duration of tasks.

Keywords: three way intersection, 3D modelling, project costing, road, planning

Current intersection that needs securing

3D view of the new secured intersection



Cross profile of the road

Contact: ophelie.brossard@etu.univ-orleans.fr ; mame-bineta.diagne@etu.univ-orleans.fr

Preparation for building project management

Civil engineering

Aubin DESOEUVRES / Elodie GAUTIER / Lucie GUETARD
Academic supervisors: T. EGGEN, M. SLAIMIA
Industrial supervisor: K. SIVGIN


A. DESOEUVRES


E. GAUTIER


L. GUETARD

Company: Obatem

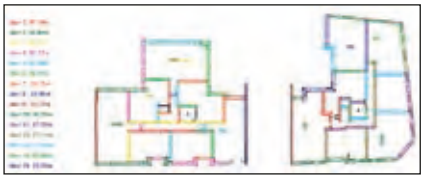
Objective/motivation

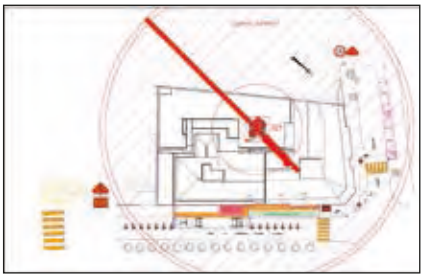
The project concerns the construction of a 69-flat housing complex built on two basement levels. The objective of this project was to carry out the preparatory work that a works engineer would do for the smooth running of the project once it has started. This work should be beneficial for the company. Indeed, the work we have done should give another point of view about the preparatory work compared to the one already done by Obatem. Each of us wants to work as a site manager, like our company tutor. This project was a good experience for us because we will do the same work once we have graduated. Consequently, we got basic knowledge on building project management.

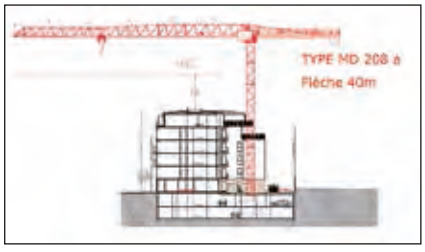
Results

Overall, we produced different documents useful to make sure the construction runs smoothly. We carried out a site plan in which we indicated the position of the crane, the offices and sanitary facilities, among other things. The crane was chosen in accordance with the site constraints. We established a schedule for the implementation of the structural work and a schedule of quantities. We also analyzed the special technical specifications. Besides, we showed the rotation of the formwork walls by drawing on a plan the different walls we will build each day. Finally, we wrote operating procedures, which are mandatory documents for any construction site, so the workers can work safely.

Keywords: building, site constraints, preparatory work, construction site, management


Rotation of formwork walls


Plan of site intallation - Infrastructure stage



Plan of site installation - Crane


Project View

Contact: aubin.desoeuvres@etu.univ-orleans.fr ; elodie.gautier2@etu.univ-orleans.fr ; lucie.guetard@etu.univ-orleans.fr

Site preparation: construction of a building of 18 collective housing units, commercial premises and car park

Civil engineering


M. COLLET


V. IMBEAU

Maxime COLLET / Vivien IMBEAU
Academic supervisor: T. EGGEN
Industrial supervisor: K. SIVGIN

Company: Obatem

Objective/motivation

The objective of the project is to prepare the construction site for a building of 18 collective housing units, a shopping area and a car park in the basement. The work to be done by OBATEM must be organized on the space and time levels. To begin with, a summary of the technical specifications of the site must be written, from which metrics and a schedule of works will be established. A site installation plan will be created according to the progress of the site. From these plans, various elements such as the crane, the waste sorting bins and the site accommodation will be placed. All these elements must be chosen beforehand according to the regulations and the needs of the site. The last task to be carried out will be the drafting of a safety plan to address all risks.


Site accomodation

Results

After taking control of the project thanks to the analysis of the technical documents, we synthesized the work to be done by detailing the characteristics of the products to use. The metrics were compared with those made by OBATEM and permitted the scheduling of the structural work over a little more than eight months. After taking into account the many space constraints that affect construction sites in urban areas, we established a site installation plan. At the same time, an operating diagram of the installation of wall formworks was created to optimize the working time of the workers and thus save time on the site. This very formative project allowed us to be confronted with a crucial stage of a construction site: preparation.

Keywords: scheduling, metrics, site installation, technical documents


Site plan


Final rendering of the building

Contact: maxime.collet1@etu.univ-orleans.fr ; vivien.imbeau@etu.univ-orleans.fr

Sproove creates and builds custom equipment for cars

Civil engineering


G. PALLOTTA

Gabriel PALLOTTA
Academic supervisors: N. BELAYACHI, M. MARIN

Company: Sproove

Objective/motivation

I have been a student-businessman at the university since October 2018. I have been working on my project for three years. My start-up, Sproove, creates and builds custom equipment for cars. Currently, I am working on custom car mounts for smartphones. These innovative products have a new system to hang in the vehicle, are more "design" and are more reliable thanks to their clever position in the vehicle. Of course, custom equipment means one product for one car model. If you want more information you can visit my Facebook page where you will find a few pictures of my products: https://www.facebook.com/Sproove/ and my website https://sproove.com/. My goal for these last two months was to launch three new products for the Peugeot 208 / 2008, 308 and 3008II / 5008 II and work on my communication plan.

Results

For the production, I made three moulds to produce the series of three new products. This step was very quick because I am beginning to have some savoir-faire in the making of silicon moulds. Currently, I am beginning to produce for the launch on March 14. Indeed, I already have 50 orders to prepare for this date. As far as communication is concerned, I have been improving my presence on social networks. Now it is possible to subscribe to my start-up on Facebook, Instagram, LinkedIn and YouTube. Now, every day, there is one new publication on my Facebook about the project to attract the community. I have also been working on my physical communication. Indeed, I want to have a physical space to display my products. I therefore made an appeal to many potential partners. Today, I can count on one of them, a businessman who has two Peugeot dealerships in Orleans.


Car mount with smartphone

Contact: gabrielpallotta0@gmail.com

Study of the installation of a slide simulator

Civil engineering


H. DJAMMAL


O. LEFRIYEKH

Haajar DJAMMAL / Oumaima LEFRIYEKH
Academic supervisors: T. EGGEN, C. MALLET
Industrial supervisor: P. DE BAUDUS

Company: Bouygues Construction

Objective/motivation

Our first objective is to carry out a study on the slide simulator that will be put in place at the aquatic center of Orleans. For this, a thorough research on existing suppliers and simulators was essential in order to optimize the choice of the subcontractor. In order to carry out this work, it was necessary to compare the offers of the various suppliers chosen by the company, based on the technical, aesthetic, and economic aspects of the slide simulator, and its maintenance and operation, as well as the price study, which remains a decisive task for the final choice. At the same time, a similar study was carried out on the Pentagliss (water slide) in order to optimize the choice of its supplier.

Results

Regarding the study carried out, we provide a synthesis which included a comparison table of suppliers' offers containing the technical and aesthetic characteristics of the simulator, its maintenance and method of execution with a table covering all the opinions and feedback of users and aquatic centers and a price study containing the details of the estimates of each supplier. This synthesis allowed us to compare the offers of the main suppliers chosen by the company in order to facilitate the choice of the latter from the Bouygues construction team. Concerning the Pentagliss (water slide), we have also provided the same study as the sliding simulator.

Keywords: sliding simulator, water slide, suppliers, estimate

Contact: haajar.djammal@etu.univ-orleans.fr ; oumaima.lefriyekh@etu.univ-orleans.fr

Study of the vertical elements of the Orléans cathedral

Civil engineering

A. DUPRE

J. VUILLEQUEZ

Antoine DUPRE / Julia VUILLEQUEZ
Academic supervisors: X. BRUNETAUD, L. JOSSERAND

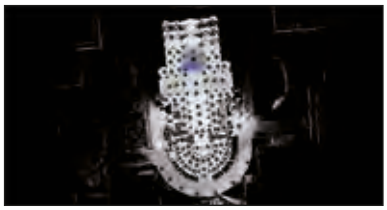
Institution: Fédération Archéologique du Loiret

Objective/motivation

This project aims to study the stresses and deformations of the vertical elements of the Orléans cathedral such as the pillars and vaults. As we do not have any architectural plans of the different modifications that were done over the years, the goal is also to gain as much information as possible on the cathedral to understand how it was built several centuries ago. To achieve that, we first need to create a 3D model of the interior of the cathedral using a laser scanner that produces point clouds. By taking several scans and assembling them in an application called ReCap, we can have a complete scan of the cathedral. With this model, we observe the elements precisely, enabling us to link the stresses to the deformations by analyzing them on AutoCad and Cloud Compare.

Results

We spent two days doing scans which provided us with 150 point clouds. With this model, we were able to have different horizontal and vertical cross-sections of the whole cathedral. The analysis was mainly about studying cross-sections on AutoCad. For example, the superposition of different horizontal cross-sections at different heights gave us a lot of information about the pillars. We were also able to estimate the verticality of elements on Cloud Compare by checking the coordinates corresponding to the plane formed by this element. At the end of our study of the different vertical elements of the cathedral, we were able to identify several areas which had significant deformations, like the center of the transept.



Top view representing the final 3D model

Keywords: Orléans cathedral, laser scanner, structure deformation

Scan of the Orléans cathedral interior

View of the Orléans cathedral interior

Contact: antoine.dupre@etu.univ-orleans.fr ; julia.vuillequez@etu.univ-orleans.fr

Sublimation of industrial building facade

Civil engineering


G. STANGANELLI VIEIRA


J. TOUBLANT

Giovana STANGANELLI VIEIRA / Jeanne TOUBLANT
Academic supervisors: D.P. DO, C. MALLET
Industrial supervisor: Y. COTTARD

Company: Alytor

Objective/motivation

Altyor Group, a company specialized in connected objects, wishes to modernize the facades of their building situated in Saint-Cyr-en-Val. The focus of this project is to present different solutions for facade paneling to improve the aesthetic aspect of their main office. There is a limited budget of 50€/m² for the solutions. In order to define the necessary materials, we started with bibliographic research looking for different existing types of facades in order to find the most adapted solution for the company. Another part of this project consists in analyzing the feasibility and the cost of the various possible solutions, but also in contacting the suppliers for a first quotation. We also considered the way to go about the installation in order to find a nondestructive method and preserve the structural integrity of the building.

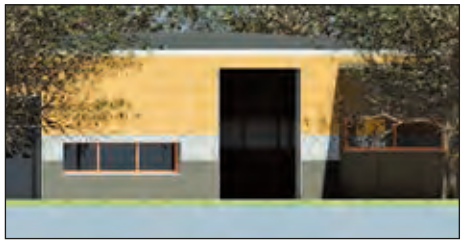
Results

After measuring the facade with a laser rangefinder, we used REVIT software to modelize the building structure. In this way, we got various facade design by changing used materials. We also adopted different points of view and different sun orientations to have an idea of the visual view at different moments of the day. We made a providers/makers list for each selected material (wood, PVC, etc.), the prices of these materials and a list of companies specialized in cladding installation. All our work will be grouped in a single document which will be provided to Altyor. It will enable them to have all the necessary information about the different facade types, but also the REVIT results we obtained and all the company contacts we had during the project, which will be useful to the realization of their future building façade.

Keywords: modeling, Revit, facade, design, budget, supplier contact


Actual building


Possible anchorage points


Solution 2


Solution 13

Contact: giovana.stanganelli-vieira@univ-orleans.fr ; jeanne.toublant@laposte.net

Technical and operational synthesis of IG 93008

Civil engineering

M.A. CHAABIHI

A. PIETERS

Mohamed Amine CHAABIHI / Alexandre PIETERS
Academic supervisors: X. BRUNETAUD, M. SLAIMIA
Industrial supervisor: S. CARITTE

Company: ETF

Objective/motivation

The purpose of our project is to synthesize the new SNCF IG 93008 standard, which was proposed by ETF, a subsidiary of EUROVIA, itself a subsidiary of VINCI. ETF is one of the most important French companies in railway works. The new standard has been applied for six months. It actually concerns replacing or repairing fittings in built-in track apparatuses in welded long rail and nearby on conventional lines and high-speed lines. By studying IG 93008, Excel worksheets were developed to help ETF workers in the choice of the right control sheet for a specific task. The worksheets contain useful information as well as steps that comply with SNCF regulations. The main objective consists in optimizing team efficiency and productivity. This work will train the ETF teams to deal with the latest technical and operational changes introduced by SNCF.

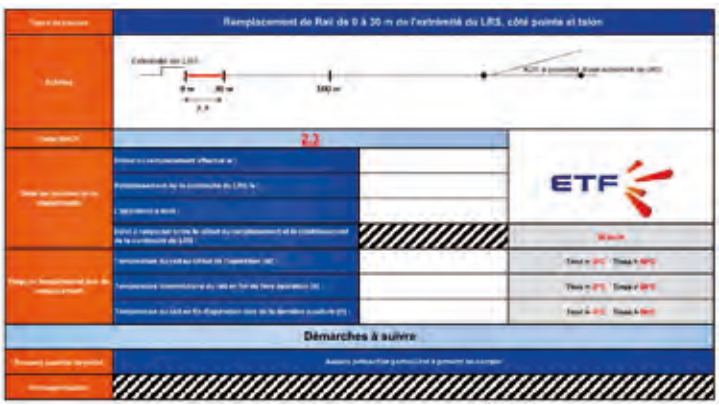
A built-in track apparatus

Results

At first, a full reading of the IG 93008 standard was made to collect the relevant information. Then, we developed Excel® worksheets which will be printed and completed by the site managers. The challenge was to define standard sheets that facilitate the understanding of workers on site. Several versions were prepared until the final version was obtained. The sheets had to be helpful, user-friendly and easy-to-understand. All types of operations present in the standard were treated. Through a menu with a list of choices, the users can easily find the required square and then the appropriate worksheet. They fill in the blanks and must follow the instructions so as to respect important elements one by one, such as deadlines, temperature ranges, working steps, etc. In brief, this work allows time savings and an optimal maintenance trace for the company.

Keywords: built-in track apparatuses, fittings, railway, regulation, track maintenance

File home page



Extract of the Excel® worksheet

Contact: aminechaabihi1@gmail.com ; alexandre.pieters@gmail.com

Technical survey of the university campus' footbridge

Civil engineering


J. DEPONT


T. KONATE

Jérémy DEPONT / Thioro KONATE
Academic supervisor: D. HOXHA
Industrial supervisor: C. DIOUX

Institution: University of Orléans

Selected participant
13th Annual Final Year Projects Forum

Objective/motivation

The purpose of the project is to perform a detailed analysis of the current state of the University of Orléans' wooden footbridge for its replacement. The main tasks of our project are as follows:

- In situ observation and diagnosis of the ageing of the superstructure and the substructure
- Proposal of a test plan to characterize the degradation state of the bridge
- Carrying out the tests of characterization of the state of the elements of the bridge
- Critical study of the bridge design and verification of compliance with Eurocodes
- Proposal of a renovation technique for the bridge

The tests and measurements will give the impact of ageing on the mechanical properties of the wooden elements. The results of this project will allow the clients to know whether they will renovate the bridge or if they will destroy it to build another one.


Manipulation in lab

Results

The verification of the footbridge design focused on the state of the decking, the assemblies and the structure's static study. The results of this verification show that the footbridge does not comply with current standards. Indeed, the decking contains several non-compliances, for example the thickness of the piles is insufficient and the assemblies are poorly done. As for the state of the materials, it shows a heterogeneous reduction in the rigidity of the structural elements. Indeed, the most damaged parts of the elements are those where the ventilation of the wood is not ensured. It is observed that about four centimeters of the thickness of the joists is very damaged. However, the residual strength of these elements is sufficient for supporting dead and traffic loads. We can conclude that while a full revision of the structure is necessary, partially reusing the materials is possible.

Keywords: footbridge, wood, decking, assembly, resistance


State of the decking


Lab tests


Samples taken


In-situ tests

Contact: jeremy.depont@etu.univ-orleans.fr ; thioro.konate@etu.univ-orleans.fr

Unpublished projects in Civil Engineering

The details of the projects completed by these students in Civil Engineering have not been authorized for publication by the company/institution.

Baptiste BORDE
baptiste.borde@etu.univ-orleans.fr

Maryam CHEDDAD
cheddadmaryam@gmail.com

Florent GEORGES
florent.georges@etu.univ-orleans.fr

Alioune NIANG
alioune-alexandre.niang@etu.univ-orleans.fr

Emmanuel OLIVRIE
emmanuel.olivrie@etu.univ-orleans.fr

Engineering Physics and Embedded Systems

3D Scanner

Electrical engineering

V. DUBOIS-PIVOT

Valentin DUBOIS-PIVOT
Academic supervisor: S. TREUILLET
Industrial supervisor: C. NOVELLO

Institution: Fablab Académique de Polytech

Fifth Place and Innovation Award
13th Annual Final Year Projects Forum

Objective/motivation

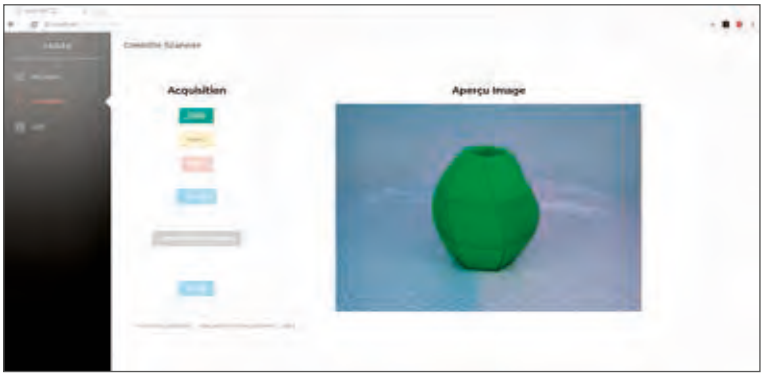
Currently, with the rise of 3D printers and 3D simulation in our daily lives, it is necessary to find more 3D scanning methods to reproduce all types of objects as simply and accurately as possible. Using the results of our project, an uninitiated user will be able to reproduce any object he or she wants. The system consists of a photo box with a plain background, and LED lighting to avoid any shadows in order to obtain the best possible uniformity. At its center is a turntable that allows the SLR to take a picture from all angles of the current object. All the control parts will be done on a web interface managed by a Raspberry Pi.

Results

We currently have a complete scanner which is ready to be used by an uninitiated user. The interface is really simple and refined. A user's manual is present in case the user does not find what he or she wants. To make a complete and detailed scan, all photos are taken in RAW format to get as much detail as possible in order to facilitate the processing of the software later. It takes about 20 photos, all of which are compressed in a zip folder at the end of the process which makes the management of the photos easier for our user. You can enter any object up to a maximum size of 30cm by 30cm. Any object with holes can be managed and some small changes can be made later in the photo editing software.

Keywords: scanner, modeling, web interface, user friendly

Complete acquisition system, with photo box and SLR camera



Web interface to control the scanner

Contact: valentin.dubois-pivot@etu.univ-orleans.fr

Ambient data collector: Cub'O by Revame

Electrical engineering

F. THAUVIN

Florian THAUVIN
Academic supervisor: R. CANALS
Industrial supervisor: S. JUILLOT

Company: Revame

Fourth Place
13th Annual Final Year Projects Forum

Objective/motivation

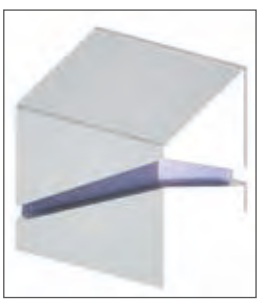
REVAME is a private company of building management system which produces practical solutions to control comfort and uses for its customers. To provide a supplementary service, REVAME plans to supply a novel product: a connected object that will measure and qualify the customer's ambient comfort. The ultimate goal is to raise awareness about their uses' impact on their comfort. The finished design will be a little box, portable, autonomous and customizable. The user will be allowed to change the color signalization, for example, or the sound control. Several accurate data typically have to be precisely measured: effective temperature, humidity, and observed luminosity, etc. Finally, all these data have to be displayed in an Android application, with curves or graphics to assist the user to visualize them and see his uses' impacts.

User interface

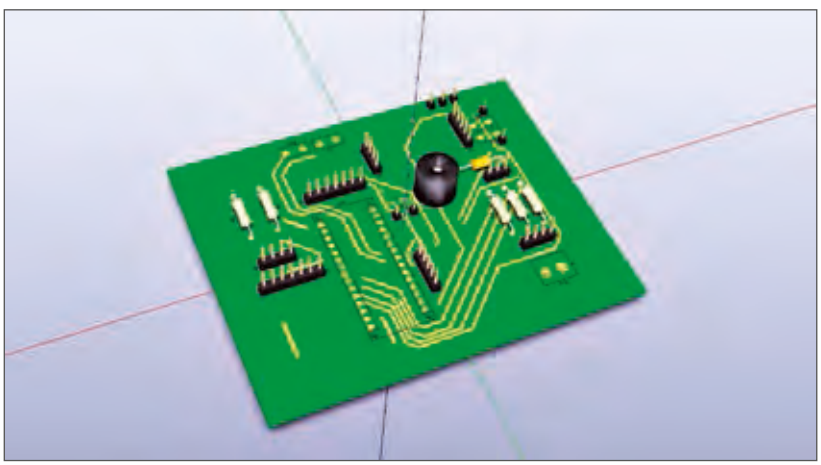
Results

The results of this specific project are a mobile Android application and an associated object. They are working in parallel with each other. The object is acquiring empirical data each minute, with sleep mode between two measures to save power. To command it, the smartphone delivers an operational command (like "get the data"), which will voluntarily suspend the process and execute the following order. Once the desired action is properly ended, it will continue at the previous step. Diverse orders are properly implemented: erase all the information in the wearable device, produce a light or sound signal, obtain the data, get and set the object's time. The data is displayed in distinctive graphs, where you can visualize them in various graduated scales and specific colors.

Keywords: comfort, ambient, connected, autonomous, portable



Model of the box



Electronic card

Contact: florian.thauvin@orange.fr

Design of a micro pressure sensor

Semiconductors engineering

R. BEAUBATON

Rémi BEAUBATON
Academic supervisor: A. STOLZ
Industrial supervisor: R. DUSSART

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Innovation Award
13th Annual Final Year Projects Forum

Objective/motivation

This project is a continuation of global research efforts on capacitive structures (measuring the deformation of a membrane). It consists in producing a capacitive type micro-sensor for the purpose of measuring pressure. The goal is to develop a reliable manufacturing process using micro-machining technologies. The purpose of such a miniature sensor is its high sensitivity and high temperature resistance. It allows a relatively accurate measurement in difficult environments. In the field of pressure measurement, some sectors such as aeronautics or petroleum research require sensors with great precision which operate at temperatures above 200 °C.

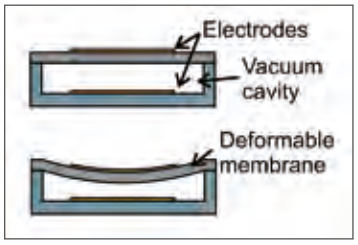
Miniaturization of sensors

Results

The manufacturing of a micrometric suspended membrane is the most complicated part of the project. This is a technological challenge. After multiple bibliographical searches, a fabrication process has been developed to create this membrane. Five masks have been designed for this process. They are essential for etching, photolithography and the deposit of thin layers in order to manufacture the micro sensors. Three sizes of micro sensors have been made (1 cm, 5 mm and 1 mm) and have been characterized.

Keywords: microsystem, sensor, capacitive, pressure, microelectronic

Reproduce touch



Schema of a capacitive sensor

Mask for lithography

Contact: remi.beaubaton@laposte.net

Improvement of face detection and classification

Image processing

C. FRUCTUOSO

Charles FRUCTUOSO
Academic supervisor: A. CHETOUANI
Industrial supervisor: G. AUDIBERT

Company: Winter Mushroom

Selected participant
13th Annual Final Year Projects Forum

Objective/motivation

The company has created a digital advertising kiosk that targets prospects like an internet site, but without suffering from "ad blockers" or spam robots, and without intruding on the user's privacy. The customer (shopping centers, stores, etc.) buys the opportunity to post the right message to the right customer at the right time. Thanks to classification algorithms that detect the gender and age of passers-by based on their appearance, the kiosk adapts its display in a fraction of a second to the profile of the passer, choosing the most suitable ad in the inventory. The performance of the algorithms are limited by several factors such as light or backlighting. The proposed project aims to analyze these limitations and propose corrective solutions by the image processing upstream.

Results

The goal is to enhance facial detection in term of range (how far the person is from the kiosk) and lighting condition (obscurity, backlighting). The second objective is to increase the precision of the age classification. Thanks to the analyses of different face detection classifiers and different image filters, the result is positive. The image processing allowed for an increase in performance of more than 20%. Walkers in the dark are now seen in every frame and the uniformity of the results has also been upgraded. A filter working like an eye retina allows the system to adapt to its environment and prevent problems due to lighting conditions.

Keywords:
face detection, image processing, OpenCV, adaptability, evolutive

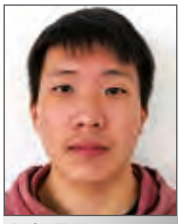
Example of a result obtained by the algorithm

Advertising kiosk with a CMO sensor

Contact: fructuoso.charles@gmail.com

Locating and tracking of a mobile device via magnetic field measurement

Electrical engineering



E. HO WEE JIN

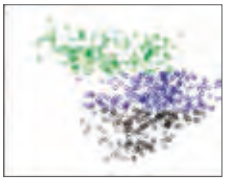
Edward HO WEE JIN / Boyao SONG
Academic supervisor: K. ABED-MERAIM
Industrial supervisor: A. BOCQUEHO

B. SONG

Company: Géonomie

Objective/motivation

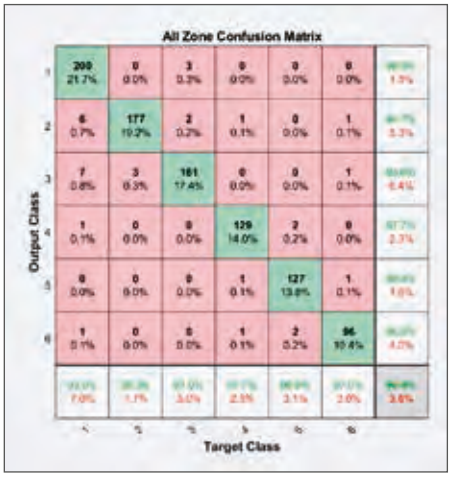
Our missions are: to analyze and sort out measurement data of magnetic fields retrieved by the company's robot and a smartphone; to classify measurement data with Fuzzy C-Means method without training; to classify measurement data with the Support Vector Machine (SVM) method with training; and to propose solutions and classification models in Matlab® and perform correlation studies between measurement data from a smartphone and those given by the robot.



C-means

Results

For this project, we started our work from scratch. With the help of Mr. Abed-Meraim, we have learnt the principle of classification algorithms such as C-Means and SVM. We tested the algorithms in different software (Matlab® & Python™) to compare the classification quality. Once the algorithm is ready, we will then proceed to classify the real measurement data. We used Confusion Matrix to evaluate our model and determine the common failure occurred during classification process. Thus, we can have a thorough understanding of the parameters affecting the classification accuracy in order to improve it. With fuzzy C-Means, we used the calculation of Barycenter in geometry to predict and locate the point where the measurement was taken. We have built a Hierarchy Classification structure to improve the precision. Finally, we came up with a solution and proposed several models by combining SVM and C-Means for better classification.



Confusion matrix

Project

Keywords:
indoor mapping, classification, machine learning, C-Means, SVM

Contact: edward.ho-wee-jin@etu.univ-orleans.fr ; boyao.song@etu.univ-orleans.fr

Luggage classification system

Electrical engineering


J. BAJON


J. DAMBRAINE


A. TAYEB

Julien BAJON / Jerome DAMBRAINE / Achraf TAYEB
Academic supervisors: A. CHETOUANI, E. COURTIAL
Industrial supervisor: J-M. DEDISSE

Company: Alstef

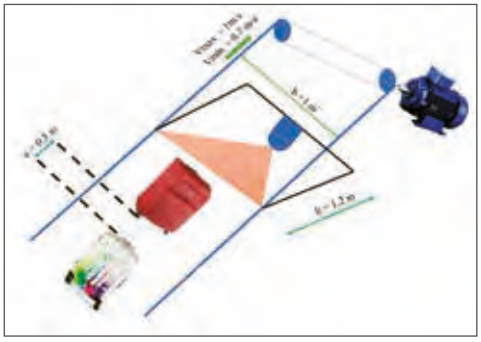
Objective/motivation

ALSTEF is specialized in automatic conveyor equipment used for the most part in airport luggage transport. A new problematic appears in this type of system due to the "All automatic" aspect. Indeed, the goal is to have an autonomic system with minimal human intervention. In our case, the main problem is that some objects which are put on the conveyor can get stuck and cause interruption of the automatic system leading to financial consequences. The objective is to build a system to classify the luggage in order to exclude all problematic objects to a manual treatment.

Results

The actual system uses a LIDAR sensor linked to a software interface. This gives some characteristics of objects transported on the conveyor system. These characteristics are used in different image processing algorithms which can assess whether or not the analyzed luggage is problematic. This classification system can be improved with a second one that uses a camera and a deep learning algorithm in order to have better performance and viability.

Keywords: luggage, software, image processing, classification


System illustration


Workshop test bench of the system


Example of object classification

LIDAR LMS4000

Contact: julien.bajon@etu.univ-orleans.fr ; jerome.dambraine@etu.univ-orleans.fr ; achraf.tayeb@etu.univ-orleans.fr

Micro energy harvester for connected object

Energy harvesting


M. CADIER


P. JAUNET


N. VENIGER

Maxime CADIER / Paolo JAUNET / Nicolas VENIGER
Academic supervisors: R. CANALS, C. HESPEL
Industrial supervisor: A. DELEU

Company: DSA Technologies

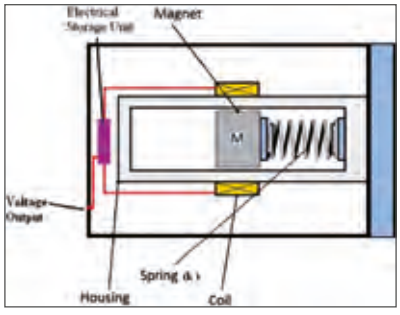
Objective/motivation

Nowadays, sensors are used everywhere in our daily lives. One of the main objectives for the coming decades is to increase the lifetime of these sensors and thus limiting the number of recharges. Our project is led by DSA Technologies, a company that designs sensors for several fields and appliances. We are particularly focussing on three sensors that are used to detect a presence in a room. One is placed on a window, another on a door and the third on the ceiling. The main objective is to develop a prototype of a micro-energy harvester adapted to the presence sensors given by the company. The current sensors work with lithium batteries. The prototype aims to expand their lifetime. The main challenge for us is to use the energy loss in the sensor's environment to supply it.

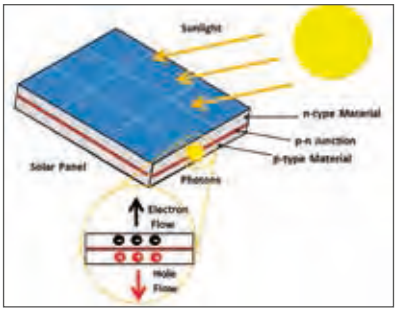
Results

After gathering information about every possible energy harvester, three technologies have been selected to be adapted to the sensors: electromagnetic, photovoltaic and a radio frequency (RF) harvester. Our challenge is to design these technologies to provide a 2 mW-supply to the sensors. The electromagnetic system is used to harvest the mechanical movement of the door. The photovoltaic technology is more adapted to work near windows opening to the outside. As they are in an isolated area, the ceiling sensors are the most difficult to deal with. Indeed, few energy sources are available there. Therefore, the Radio frequency harvester is a good solution for this problem. After sizing those systems, prototypes are designed and tested. During this development it is important to keep in mind the cost of the products (10% of the sensors' price) and its size.

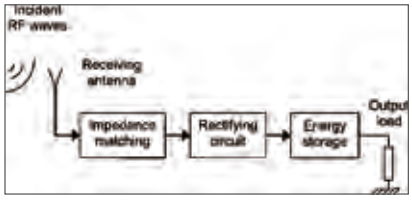
Keywords: energy harvesting, presence sensor, IoT



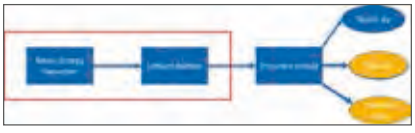
Electromagnetic harvester



Photovoltaic panel



RF Harvester diagram


System diagram

Contact: maxime.cadier@etu.univ-orleans.fr ; paolo.jaunet@etu.univ-orleans.fr ; nicolas.veniger@etu.univ-orleans.fr

Monitoring of caterpillars

Environmental engineering


P. FELICIANO


J-B. GREE


L. SIVAGOUMAR

Paul FELICIANO / Jean-Baptiste GREE / Ludovic SIVAGOUMAR
Academic supervisors: J. FANTINI, S. TREUILLET
Industrial supervisors: F. MOAL , J. ROUSSELET

Company: INRA

Selected participant
13th Annual Final Year Projects Forum

Objective/motivation

Global warming has led to a lot of significant changes in ecosystems. For instance, habitat areas and processions periods of pine processionary caterpillars have evolved during the past few years. This species settles more and more to the north, and the procession period might happen between September and June instead of February and April as before. These caterpillars represent a health risk for the population because of their stinging hairs, which is why it is important to prevent population when the risk of procession is high. A forest research laboratory wants to create a predictive mathematical model of caterpillar's processions. Our objective in this project is the creation of an embedded system to collect data about the period of processions and meteorological information. This system must be autonomous and integrated in a trap already used.

Results

Our system is composed of a concentrator connected to different collectors. Collectors will be settled directly in pines, with a trap named ecopiege. The detection of caterpillars' processions is made thanks to sensors and Arduino technology. There are many possibilities in order to detect the caterpillars' processions, but we chose laser detection as the final solution. Moreover, the temperature will be recorded every hour. A large capacity battery coupled with a solar panel ensure autonomy, and the collectors can be use for three months without human intervention. Communications between collectors and the concentrator are done with the LoraWan network. The maximum distance allowed is 600 meters. Data will be stored and viewable on a public server (Cayenne). Everybody with an access will be able to see the meteorological and processions information on graphics.

Keywords: ecology, monitoring, caterpillar, prediction, data


Caterpillar


Ecotrap

Contact: paul.feliciano@etu.univ-orleans.fr ; jean-baptiste.gree@etu.univ-orleans.fr ; ludovic.sivagoumar@etu.univ-orleans.fr

Redesigning a website for a cat association

Web development


W. FARGUES

William FARGUES
Academic supervisor: T. KAOUTHER
Industrial supervisor: G. JAILLET

Company: Les Amis Des Chats Du Loiret

Objective/motivation

The main goal of this project is to help the association become more visible. My mission is divided into two steps. The first is to redesign their website, which needs to be more attractive and some functions need to be rethought. The second is to help organize a raffle. My main mission concerning that point is to integrate a page regarding the raffle into the website so people can buy tickets.


Design software used

Results

I had to use WordPress because it is more user-friendly for the staff. I then used Divi (a WordPress module) to help me do the website faster. Of course, I used a lot of CSS to do what I wanted to do because tools like WordPress are quite limited.

Keywords: web, WordPress, engineering

Original website

New website

Contact: william.fargues@etu.univ-orleans.fr

Reflectance Transformation Imaging

Electrical engineering

A. D'ARMAND DE CHATEAUVIEUX

Alexis D'ARMAND DE CHATEAUVIEUX
Academic supervisor: T. GIBERT
Industrial supervisor: S. TREUILLET

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Objective/motivation

The purpose of this project consists in creating an RTI prototype. RTI is a computational photography technique that enables a user to control and combine several lighting sources in different points to capture the surface shape and color of the artefact by interactively changing the lighting effect. More precisely, this project will focus on the creation of image acquisition, an LED lighting dome and its control with a direct visualization of images on a computer to analyze an artefact. LEDs are set at different positions on a dome to provide different light directions causing the light to bounce off the artefact surfaces. Owing to the reflectance, the camera will capture this light. Thanks to the RTI software, the user will be able to analyze the artefact. The RTI technique has been used for the virtual examination and study of Cultural Heritage artefacts.

Model RTI system

Results

The result is an RTI prototype that includes different tasks such as:

- Creating a dome and integrating three different types of LEDs (white, UV, IR) then cabling them
- Developing a software LED lighting control and image acquisition using a specific electronic card called Arduino
- Developing a human-machine interface where the user can easily change the lighting configuration and directly see the changes on his/her computer, then save it as a computer file
- Having the possibility to add a memorized cycle to automatically get an acquisition from a lighting configuration that has already been decided, set up and programmed

To conclude, the prototype includes a dome with LEDs set at different positions connected to an Arduino and a driver to control 32 groups of 3 LEDs. The user will then be able to control these LEDs from a computer thanks to a software program which allows for the saving of images and analyzes them thanks to another software program.

RTI application before/after: Egyptian scriptures

RTI application before/after: Egyptian shelf

Keywords: Reflectance Transformation Imaging (RTI), computational photography, light, surface analysis

Contact: alexis.darmand-de-chateauvieux@etu.univ-orleans.fr

Support system for using a regulator

Smart buildings


S. BAUDIER

Stephen BAUDIER
Academic supervisor: J-Y. CADOREL
Industrial supervisor: S. JUILLOT

Company: Revame

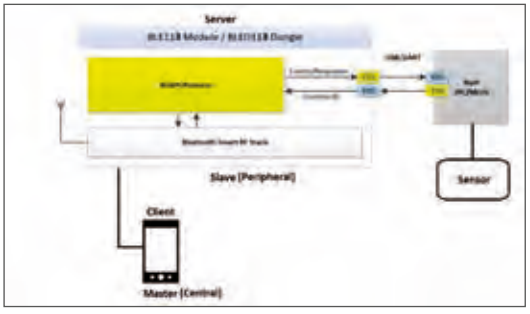
Objective/motivation

My objective is to respond to the Revame project request. This company provides services for convenience in the office, and today they want to provide a system which is able to help users to diagnose or control the material which is furnished to the client. This system can do multiple tasks such as giving a setpoint temperature, detecting a problem, opening a shutter or locating the regulator. In addition, restricted access gives possibilities to different people to do different things. Efficiency and ergonomy are keywords for this project. The targeted customers are people who aren't experts in the field.

Results

The results were obtained by researching various technical documents and from advice concerning industrial solutions. The regulator was simulated via a Bluetooth Low Energy (BLE) dongle which simulates the different parameters via the creation of specific characteristics with a particular tree structure that can be read or modified using a smartphone application which broadcasts in both iOS and Android environments via the use of tools such as Ionic Framework. This provided an embedded solution which can be used by everyone.

Keywords: regulator, BLE, smartphone, smart buildings



Architecture of the simulation

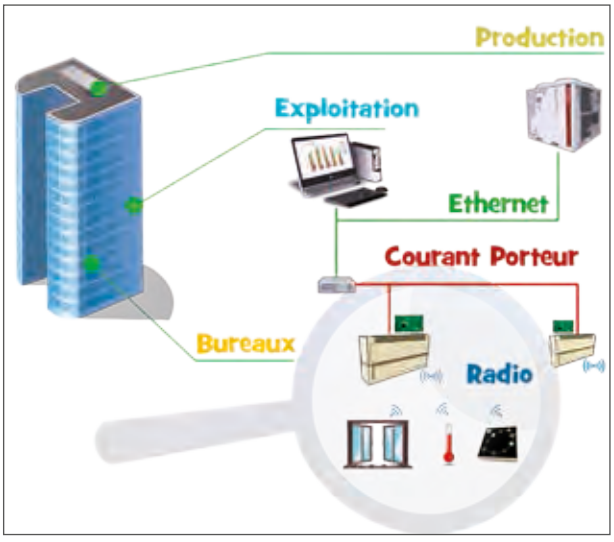


Diagram of the system

Contact: stephen.baudier@etu.univ-orleans.fr

Unpublished projects in Engineering Physics and Embedded Systems

The details of the projects completed by these students in Engineering Physics and Embedded Systems have not been authorized for publication by the company/institution.

Adrien LALIERE
adrien.laliere.pro@gmail.com

Yuan LI
yuan.li1@etu.univ-orleans.fr

Industrial Engineering applied to Cosmetics, Pharmacy and Food Processing

Automatization and optimization of worker distribution on production lines

Production engineering


J. NACHIT


M. NEAU


A. RANDRIANAIVO

Jihane NACHIT / Maurane NEAU / Anaëlle RANDRIANAIVO
Academic supervisor: G. HIVET

Company: undisclosed (confidential)

Objective/motivation

A factory we worked with is specialized in injectable products for animal health. In this factory, the production lines require specific abilities and the distribution of workers on the lines is done manually. The weekly process of distribution could be very long (from 1 to 4 hours) because employees are not versatile, and the demand is usually higher than the capacity. The first goal of our project is to find a way to reduce the planning process time, using an Excel® VBA program. The other goal is the identification of the correct parameters to open the most priority lines with competent people working on them.

Results

First, an arborescence tree was written to link, with some programs, all the parameters needed. Then, a data bank was created, built on the tree, so it can be used to test the program's parts done step by step. All the way of thinking of the program is written, and some parts have been coded and tested on witness cases. In the next months, the program will be finished and linked to the final data base. Finally, it will be tested on real cases.

Keywords: automatization, production, scheduling, optimization, Excel® VBA


Vaccines on the production line

Contact: jihane.nachit@etu.univ-orleans.fr ; maurane.neau@etu.univ-orleans.fr ; anaelle.randrianaivo@etu.univ-orleans.fr

Calcium carbonate's extraction by seawater electro-decarbonation

Production engineering

A. GUILBAUD

Sarah BECHICHE / Aurore GUILBAUD / Léa RICARD
Academic supervisor: G. HIVET
Industrial supervisor: D. VILLESSOT

Company: Mascara

Objective/motivation

Mascara-NT offers solar-powered water desalination solutions for island and/or isolated populations. To make the water drinkable after desalination, it is necessary to inject a neutralizing agent that corrects the pH and remineralizes the water. The company wanted to propose completely autonomous drinking water production solutions and thought to integrate an existing technology for the neutralisation stage: electro-decarbonation. This electrolysis process extracts calcium carbonate (or limestone) from water, which can be used as a neutralizing agent for osmosed water. This technology is currently used for surface waters and the project group had to study the feasibility of an electro-decarbonation on seawater.

Results

Through chemical and electrochemical studies, two chemical reaction scenarios were found and three electrolytic scenarios were highlighted (depending on the size of the reactor and the chemical reaction involved). Tests on a pilot unit should be carried out to confirm the reaction involved and to fine-tune the most suitable electrolytic parameters, allowing for production of enough limestone, avoiding at the same time the formation of other unwanted chemical species. The energy conditions of this process remain to be studied (operating time and conditions, and energy consumption) before integration into a solar-powered global system.

Drinking water produced from seawater

Keywords: drinking water, desalination, renewable energy, autonomous installation

Contact: sarah.bechiche@etu.univ-orleans.fr ; aurore.guilbaud@etu.univ-orleans.fr ; lea.ricard@etu.univ-orleans.fr

Changeover time decreasing

Industrial engineering


E. RADICE

Elise RADICE
Academic supervisor: A. HIVET
Industrial supervisor: H. LEGER

Company: PUIG

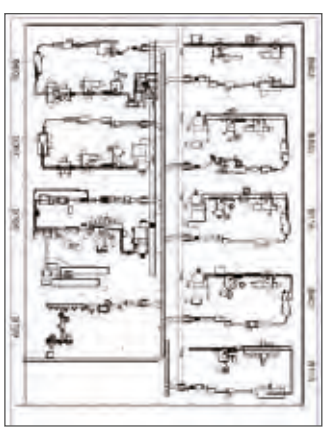
Objective/motivation

PUIG is a growing cosmetic company which mainly sells fragrances. In terms of volume and capacity, the biggest plant of the group is located in Chartres. Looking at customers' needs, more and more products have to be manufactured. That is leading to improvement in the production capacities of each plant. The main mechanism to do so is to decrease the changeover times. There is one group goal: any changeover time should be less than two hours. One pilot line has been chosen to assess the changeover times, to reduce them and to standardize them before the deployment of the solutions on the other lines of the plant.

Results

At this step, the identified solutions are established on the pilot line. These solutions are based on the work organization during the changeover. In the pilot line, 80% of changeover times are less than 2 hours, previously at 50%. A guidance for the change is realized by all the project team's members. The next step is the deployment of the identified solutions on the other packaging lines. The visual management is applied to ease the use of the solutions by the operators.

Keywords: production, improvement, SMED, DMAIC, change management


8 automated lines and 1 manual line in the packaging area

Visual management to anticipate which line will be in changeover during the next team

DMAIC method

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

Cleaning validation

Industrial engineering

O. ABEIDA

Oumaima ABEIDA
Academic supervisor: J-M. AUFRERE
Industrial supervisor: C. DELAUNAY

Company: Septodont

Objective/motivation

Septodont is a pharmaceutical company dedicated exclusively to the dental profession. For over 85 years, Septodont has developed, manufactured and distributed a wide range of dental drugs and medical devices. Dentists around the world know that they can rely on the consistent quality of Septodont's products (more than 500 million dental injections around the world are made using Septodont's anesthetics). It is understood that the product's quality must be irreproachable because it concerns public health. Therefore, it is essential to ensure that the processing equipment is suitable for pharmaceutical manufacturing. As part of the validation department, the purpose of my project is to work on the optimization of equipment cleaning processes to reduce the risk of drug product contamination. Then, build and execute the cleaning validation program to prove the reliability of the process.

Cleaning validation swab

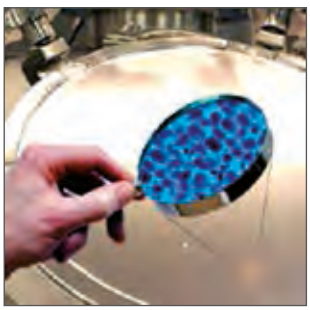
Results

As this is an ongoing project, it is far from being completed in March 2019. However, the strategy of the cleaning validation was established. A matrix approach and criticality analysis were adopted to prioritize the processing equipment that have to be validated. As is known, potential contaminants include residues of pharmaceutical ingredients (actives and excipients) or residues from the cleaning process such as detergents or solvents. Therefore, for each equipment, a worst-case product and its chemical plotter was identified. Shortly, we will develop specific analytical methods for the substances being assayed to detect contaminants at the acceptable residue levels for an appropriate level of cleanliness. At the same time, we start writing the validation protocols and determine the required testing based on GMP's guidelines. We will then review the validation data and testing results to draw-up the cleaning validation report.

Surface swab sampling

Keywords: validation, cleaning process, reliability, contamination, regulatory requirements, analytical methods

The plant of Saint-Maur-des-Fossés



Microbiological control

Contact: oumaima.abeida@etu.univ-orleans.fr

Continuous improvement in logistics

Industrial engineering


M.L. DE ASSIS MARCOLAN

Maria Luiza DE ASSIS MARCOLAN
Academic supervisors: S. BRUNEL, C. MERCIER
Industrial supervisor: J-B. VIDAL

Company: Pierre Fabre Dermo-Cosmetics

Objective/motivation

Pierre Fabre Dermo Cosmetics, a pioneer in its field, creates innovative skin care and hair care solutions following a sacrosanct principle: beauty rooted in ethics. Our Logistics and Supply Chain departments aim to ensure the availability of our products to our distribution centers and subsidiaries around the world as part of our objectives of cost, quality, service rate, customer satisfaction and lead time. Mastering our supply chain processes requires a whole vision of the company, especially from an industrial and commercial point of view. As an apprentice in continuous improvement in logistics, I develop and execute projects leading to the continuous improvement of our work. The goal of these projects is to assure the procurement of all the necessary resources to reassure our production schedule.

Results

I am currently working on one major project, which is the mastery of suppliers. Our goal is to develop a simple reporting tool using KPIs concerning our suppliers. The objective is to create internal reports for our department, to do a follow-up of the KPI evolution, to do global monthly reports for some of the key departments of Soual's industrial site, and an analysis scheme to simplify the KPI analysis. This would facilitate our exchanges with our strategic suppliers and improve our partnership and communication with them. I am also participating in other projects, such as changing our procedure to manage regulated article codes, the follow-up of double sourcing orders, DDMRP implementation and the differentiated management of industrial securities.

Keywords: logistics, supply chain, continuous improvement, dermo cosmetics, cosmetics


Soual's industrial site

Contact: mlamarcolan@gmail.com

Continuous improvement in the maintenance department

Industrial engineering

S. OUARAB

Saad OUARAB
Academic supervisor: G. HIVET
Industrial supervisor: C. ROUSSEAU

Company: Novo Nordisk

Objective/motivation

Novo Nordisk is a Danish multinational pharmaceutical company which manufactures and markets drugs all over the world. I am carrying out my apprenticeship at Novo Nordisk in the Chartres plant within the maintenance department. My role is to develop continuous improvement tools which will help the service and encourage technicians using Lean tools to perform in their field. One of my assignments was to create a new performance board to manage the maintenance team. The maintenance service is mainly composed of technicians working in 5-shift rhythm, so in this context, communication can be complicated between the different teams. As they work on the production lines, all information about corrective and preventive maintenance has to be precise and the board is here to give an overview of what has been done in the previous shifts.

Results

The new board was implemented in the service. It is composed of two parts, one dedicated to daily transmissions orders between the different technicians' teams and the other more focused on performance indicators to help the maintenance manager piloting the entire team. On the new board, we find more visual management which helps lead to efficient action and then to production lines with a lower downtime. We also find magnets with priorities degrees that can help technicians to coordinate their actions in their daily job. The entire team finds the new board clear and practical, so we will continue to use it until there is a new optimization.

Keywords: pharmaceutical industry, maintenance, continuous Improvement, 5-shift rhythm, KPI

Performance board 1

Performance board 2

Contact: saad.ouarab@etu.univ-orleans.fr

Continuous improvement project

Production engineering


B. DUBOIS

Benjamin DUBOIS
Academic supervisor: G. HIVET

Company: undisclosed (confidential)

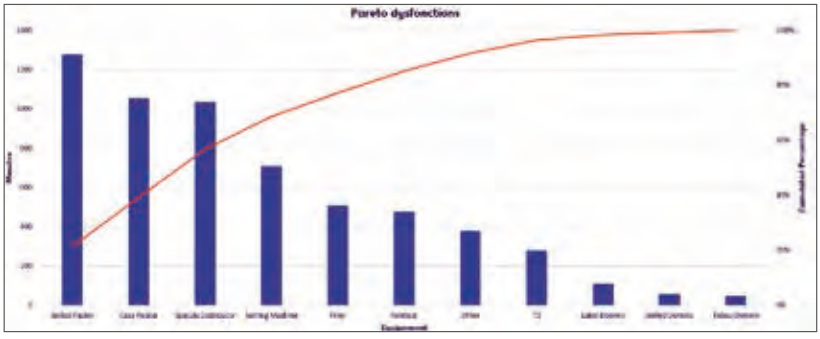
Objective/motivation

One of the power brands of a company is produced at their site in Chartres. As these products respond to a high seasonality, it is necessary to give the means to avoid breaks during the high season and thus to achieve the objective service rate of the site. Working primarily on two lines dedicated to the production of depilatory cream, the goal of my project is to increase the capability of these lines. The technical part is important, but the managerial part is also very present in order to involve the partners as much as possible in this project.

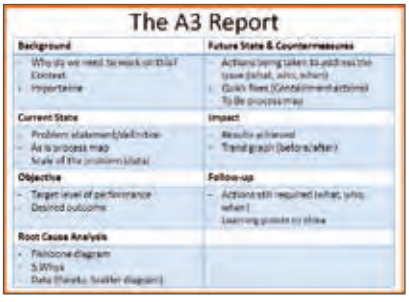
Results

As it is an ongoing project, there is currently no final result. Using the A3 resolution method, the observation and analysis part took a lot of time but allowed all of the actors of this project to understand completely what the root problems were and not just the visible consequences. Indeed, at first, we decided to focus on reducing the time of malfunction of theses lines. At present, we are currently implementing the action that we have identified with the project team, and we look forward to improvements soon.

Keywords: continuous improvement, production, OEE, Cream



Pareto chart



Project template

Contact: benjamin.dubois3@etu.univ-orleans.fr

Creating and implementing a process for the development and launch of giftsets

Production engineering


P. LECOMTE

Pauline LECOMTE
Academic supervisor: L. DELPLANQUE
Industrial supervisor: J. RAULIN

L'ORÉAL

Company: L'Oréal

Objective/motivation

The goal of this project is to create a process to help marketing, supply, development and financial service's teams to work better and more easily together in order to launch new giftsets into the French market. Those giftsets are key for L'Oréal to keep their leadership in the worldwide beauty market. A clear process is needed in order to help different departments work and communicate better. Timelines and deadlines must be respected because the priority is to serve the client on time. The main goal is to make sure that the customer service's rate is achieved in order to make the business grow.

Results

The process has been written and communicated to all the departments involved. It needs to be applied by all and will require time and patience to change people's habits. Launching a new giftset on the market takes one year so the process needs to be followed meticulously to obtain long-term good results. By following this process and the road map, the different departments will understand better the stakes and needs of other departments. It will facilitate working smarter and more easily.

Keywords: supply chain, process, development

Contact: pauline.lecomte.18@gmail.com

Creation of new supports for staff training in the Sanofi packaging department

Industrial engineering


V. DOMEON

Virginie DOMEON
Academic supervisor: G. HIVET
Industrial supervisor: S. PAIN

Company: Sanofi

Objective/motivation

The project focuses on the improvement of staff training in the packaging department of Sanofi Winthrop. This subject is essential within the department because there is a high turnover of staff linked to the recent increase in the company's activity. The stakes are to enable operators to acquire basic knowledge in order to perform their work effectively and quickly. To do this, it is necessary to standardize drivers and pilot's training by creating training modules for the department. Modules have to be created for two types of packaging lines, the blisters line and bottle line, and for two types of training, empowerment and rehabilitation. The supports are driver and pilot apprenticeship books that highlight all of the themes related to the different concepts of these trades.

Results

To answer the needs of the company, four books have been created. The first book brings together the concepts of the profession of line driver on blister packaging lines, and the the next talks about the job of line pilot on blister packaging lines. Another is about the job of line driver on the bottle packaging line. The last one speaks about skills improvement for drivers in blister packaging line. After the books have been tested, operator surveys were carried out and opinions were very positive regarding the ease of use and efficiency of these books. To finish, books were integrated into the company database to be used regularly by new employees. The project's prospects are to create another training book for pilots on the packaging line bottles. Training for skills improvement of the drivers of blister lines will also be organized.

Keywords: production, drivers, pilots, training, skills

Contact: virginie.domeon@etu.univ-orleans.fr

Defining equipment requalification frequency through a risk analysis

Industrial engineering


P. OBIOHA

Promise OBIOHA
Academic supervisor: J. ROUSSEL
Industrial supervisor: M. KESSELER

Company: Innothera Chouzy

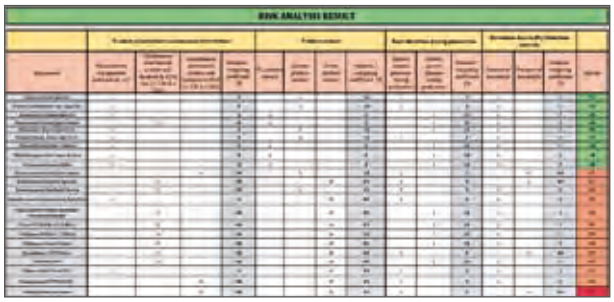
Objective/motivation

The aim of this project is to reevaluate production equipment requalification. The first part of this project is to review production equipment requalification frequency. Manufacturing and Packaging equipment requalification has been carried out every three years without a risk analysis. It was then decided to conduct a risk analysis that will help to determine equipment criticality in order to define their requalification frequencies. The second part of this project is equally to reevaluate the content of the tests carried out during the requalification exercise: whether installation qualification (IQ), operational qualification (OQ) or performance qualification (PQ) has to be done.

Results

I was able to realize the first part of the project during my short apprenticeship period. I created a risk analysis version 0 with the help of a risk analysis team. This first version result helped to identify each production equipment requalification frequencies (category 1: No requalification needed; category 2: requalification every 3 years, and category 3: requalification every 5years). Thanks to the result, equipment requalification planning for the year 2019 was scheduled. The second part of the project will start at the long apprenticeship period.

Keywords: risk analysis, qualification, requalification, production, equipment


Risk-analysis result V0


Thermoformer Partena: most critical equipment

Contact: promise.obioha@gmail.com

Direct purchase department business continuity and securing of strategic pharma products

Industrial engineering


T. BLANCHARD

Thomas BLANCHARD
Academic supervisor: A. HIVET
Industrial supervisor: V. CHAMPAGNE

Company: Ceva Animal Health

Objective/motivation

The program aims to work on the business continuity of some of Ceva's key pharma products and ensure components such as active pharmaceutical ingredients, excipients and packaging Items. The main stakes are the securing of some Ceva strategic suppliers, the identification of market opportunities and corporate alignment with the proposed solutions. The program is transversal and involves supply chain, corporate quality, ranges marketing, production, industrial, legal, R&D and regulatory. Reported to academic tools and knowledge, the program mainly requires: MRP, DDMRP, SAP, statistical analysis, pharmaceutical and galenic knowledge, ISO & GMP standards knowledge.

Results

Depending on the different problematics, suppliers, strategic impacts, products, purchasing families, and involved plants, different elements have been implemented to answer the needs. The program's major outputs being: corporate purchasing strategies review (APIs, excipients, packaging items), corporate purchasing strategy implementation (packaging items), implementation of a tool to follow the strategic suppliers' partnership evolution (suppliers' evaluation, scorecard), a steering committee implementation to follow business continuity with suppliers for top products (planning, KPIs & ST design) and market opportunities reports. These different elements were not all implemented during the apprenticeship period but on different or longer time-scales to support the group sustainability.

Keywords: supply, purchasing strategies, industrial direction

Ceva top product example (Vectra)


Ceva Animal Health Headquarters

Ceva top product example (Feliway)

Contact: thomas.blanchard@etu.univ-orleans.fr

Evolution of operator training

Industrial engineering

V. BERGON

Valentine BERGON
Academic supervisor: E. COURTIAL
Industrial supervisor: N. DA SILVA

Company: Sanofi

Objective/motivation

Sanofi is a French multinational pharmaceutical company engaged in research and development, manufacturing and marketing of pharmaceutical products. The factory I am working in is a chemical plant, specialized in the production of active pharmaceutical ingredients. My project has been classified as a priority for the year 2018/2019. In a risky and technical environment, the import of this project is to facilitate the appropriation of knowledge and allow operators to drive facilities safely while respecting production's constraints. To achieve that, the goals are to improve both the current system of operator training and the ergonomic design of the manufacturing files and to introduce new technologies.

A production area

Results

A multidisciplinary team is working on this project, including technicians, operators and engineers. The current organization of operator training and ways of working have been analyzed to identify the potential improvements in terms of training, mentoring, procedures, work authorization, etc. This has led to a new organization concerning operator training and to a new standard document for manufacturing files. The next step will consist of the creation of training modules by collecting technical information from the production area. New technologies such as tablet computers will also be added to help operators in their work.

Keywords: performance, training, mentoring, digital transformation

The plant of Aramon

An operator working in the production area

Contact: valentine.bergon@etu.univ-orleans.fr

Implementation of a data integrity program

Production engineering


D. EL AOUAM

Doha EL AOUAM
Academic supervisor: J-P. BLONDEAU
Industrial supervisor: A. HAMMADOU

Company: GSK (GlaxoSmithKline)

Objective/motivation

During my fifth year in Industrial Engineering applied to cosmetics, pharmacy and food processing, I am carrying out my apprenticeship at GSK within the Quality Assurance department. GSK's ambition is to reduce risk to data integrity by the end of 2020. The program deals with the implementation of a data integrity program. The main objectives are to reduce data integrity risk across paper, electronic and hybrid systems, develop a data integrity mindset throughout the site and ensure compliance with regulatory requirements to deliver vaccines which are safe and effective to patients.

Results

The data integrity program is composed of many projects related to electronic data generated by equipment and handwritten data through batch records. My role within the data integrity team is to ensure that each project is completed on time, with the necessary resources, and to bring up any sticking points so that they can be discussed by the entire data integrity team. To this end, I took the lead in creating KPIs to track projects and audits in parallel. Moreover, I have the role of facilitator to accompany people in their work, answer their questions and find solutions together to develop their mindset and include the concept of data integrity in their routine.

Keywords: data integrity, assessment, mindset, compliance, deviation


Data integrity planning describing main actions

The ALCOA+ system of data integrity

Contact: doha.el-aouam@etu.univ-orleans.fr

Implementation of an integrated management system

Industrial engineering

M. CHADLI

Meryem CHADLI
Academic supervisor: J-M. AUFRERE
Industrial supervisor: S. DELAUNAY

Company: Cofatech

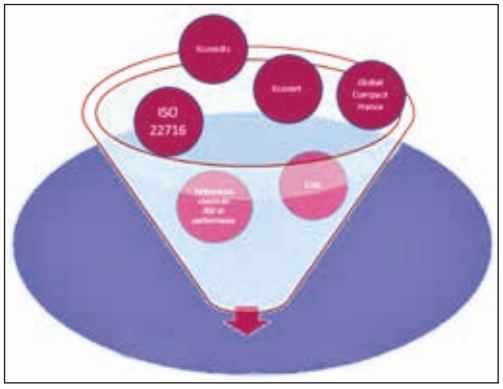
Objective/motivation

My apprenticeship took place at a cosmetic company called Cofatech. I worked on the project for the implementation of an integrated management system. It is a simplified management system that allows primarily clarifying the organization and optimizes it, to implement a solid "base" to effectively link all approaches, and to improve the operation of the processes. It also allows mastering of all types of "risks" (risk approach), to value the services of the company and the stakeholders (contribution), but also measure and improve the overall performance (concept "continuous improvement").

Results

The implementation of an integrated management system is a structured and coherent approach to deploy and pilot several complementary approaches. The expected result of this project is to improve the global management of the company, to optimize the overall operation and reduce the risks of non-quality, to improve overall performance, to set a solid framework in the aim to improve continuously, and finally to control the regulations/standards/labels applicable.

Keywords: management system, processes, risks, contribution, operation



Integrated management system

Contact: meryem.chadli@etu.univ-orleans.fr

Implementation of serialization in a pharmaceutical plant

Production engineering


L. AYAS


A. GRANDPIERRE

Layan AYAS / Alice GRANDPIERRE
Academic supervisor: B. LE ROUX

Company: undisclosed (confidential)

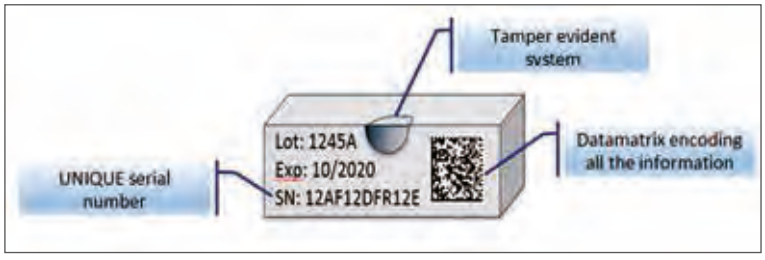
Objective/motivation

We are working for a subcontracting company, manufacturing products for pharmaceutical laboratories. The site in which we work is specialized in the production of dry, liquid and pasty forms. In 2011, the Falsified Medicines Directive released the EU/2011/62 directive to fight counterfeiting. This directive applies to any pharmaceutical plant in Europe as of February 9, 2019. This directive translates into serialization. Serialization involves assigning a unique serial number to each product, allowing the product to be traced from a European database. The aim of the project is to ensure its deployment on the site, aiming to be in compliance with the client's needs and specifications regarding this new legislation. The implementation of this system will have consequences on all departments, the entire supply chain of the company and the practices of the operators.

Results

A multidisciplinary team has been created for this project, including engineers, production members, quality assurance team and the IT department internally, as well as suppliers of the serialization module externally. Serialization equipment has already been installed on all 15 lines impacted by this change. This involved a study of the line to be modified, a shutdown of production on the line, the installation and the connection of new equipment to the line and its qualification (Installation Qualification/Operational Qualification/Performance Qualification). As of February 9, 2019, the involvement of operators through training has been one of the many steps to be taken in order to facilitate their acceptance of change.

Keywords: Falsified Medicines Directive, serialization, reluctance to change



Example of serialized packaging

Contact: layan.ayas@etu.univ-orleans.fr ; alice.grandpierre@etu.univ-orleans.fr

Improvement of quality management system

Production engineering

J. OUMERTOU

Jaafar OUMERTOU
Academic supervisor: G. HIVET

Company: undisclosed (confidential)

Objective/motivation

This project is for a company which wants to be a pioneer in cosmetic innovation to offer its customers high quality products that respect the environment. In this regard, my task is to ensure that product quality is as good as possible in order to ensure high customer satisfaction. At first, I set up control standards on finished products and components. The purpose of these standards is to optimize controls so that non-compliant products are not put on the market. After this, audits will be carried out with suppliers. The objective of these audits will be to support the suppliers by making them more reliable in order to have high-quality product and to decrease the number of non-compliant products.

Results

The results are not yet measurable because the process is not yet complete. However, the checks carried out show a decrease in non-compliant products. Regarding the quality department, a dashboard has been set up to manage all daily tasks and feedback to ensure that they are positive. Fewer and fewer tasks are forgotten or delayed by assigning a deadline to each task. The next step is to put another dashboard in order to measure and track customer complaints due to non-compliant products. The object is to know the number and type of customer complaints and thus work to reduce them.

Keywords: quality management system, quality assurance, continuous improvement

Quality dashboard

Contact: Jaafar.oumertou@gmail.com

Improvement of spare parts management

Materials


B. LE METTE

Bastien LE METTE
Academic supervisor: G. HIVET
Industrial supervisor: T. DUHAMEL

Company: Novo Nordisk

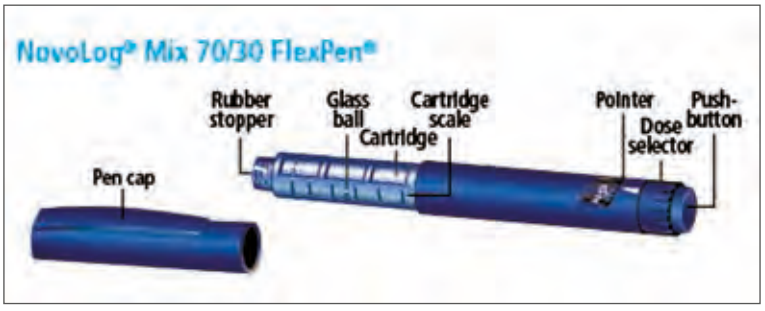
Objective/motivation

Novo Nordisk is a Danish pharmaceutical company, world leader in the treatment of diabetes with insulin production. The study project assigned to me during my fifth year consists of improving the management of spare parts common to several production processes in order to secure their stock level, to ensure the sustainability of production and thus to satisfy the growing demand of patients. As part of this project, I will work in collaboration with all of the site's maintenance departments to establish the process for forecasting the consumption of common spare parts. Once established, this forecast will enable the Asset Management team to anticipate consumption peaks and guarantee an appropriate level of stock. It will also allow the Purchasing Department to renegotiate delivery times and prices with the main suppliers.

Results

The project is currently ongoing. The results expected at the end of this project are financial through limiting the risk of production downtime due to a lack of spare parts and by adjusting the quantities of spare parts available, according to the consumption forecast and random potential and through the renegotiation of their purchase price. The expected results are also methodologically based on the construction of a forecast based on process maintenance plans, by the coordination and anticipation of spare parts needs and by the optimization of orders so that they are received in time for technical intervention via updated delivery times.

Keywords: maintenance, material management, improvement, stock optimisation, cost reduction



Conception of a Flexpen®

Contact: bastien.le-mette@etu.univ-orleans.fr

Improvement of the quality assurance system

Industrial engineering


A-M. UNG

Anne-Marie UNG
Academic supervisor: J. DOUSSOT
Industrial supervisor: R. DE ROECK

Company: Servier Laboratories

Objective/motivation

During this last year, my wish was to discover the supply chain world of the pharmaceutical industry. The objective of the project is to ensure the conformity of all processes with a potential impact on patients. Indeed, quality assurance is a support for supply chain operations teams as well as Servier subsidiaries around the world, and their distribution partners. To do this, two types of compliance must be distinguished: product conformity and distribution network compliance, in order to focus the actions to be taken.

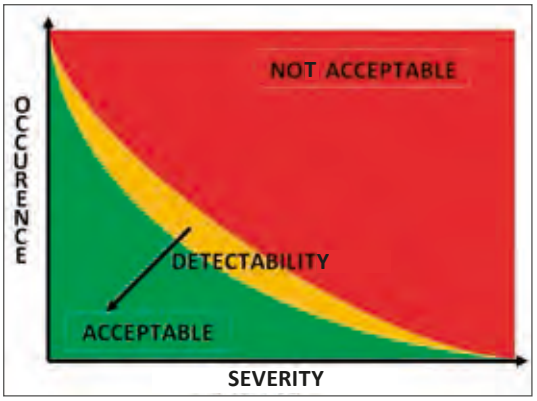
Results

The evaluation of the performance of quality assurance processes is necessary to adapt practices and keep activities under control. Audits of critical processes are part of the continuous improvement and monitoring of the product quality via complaint management, which is also a daily activity. Quality assurance acts as a control tower for the Servier distribution network relating all quality aspects. The company acquires new products integrated into the oncology portfolio, and the process is updated to coordinate the management and integration of these new drugs with the distribution network. The participation in the development of training for the subsidiaries is planned for February 2019 on the management of quality complaints.

Keywords: supply chain, GDP, GMP, quality complaints, audits

Good distribution practices for distribution network

KPI complaints in 2018



Quality risk management during an audit

Contact: anne-marie.ung@etu.univ-orleans.fr

Increasing the volume of operational production units

Industrial engineering

Hugo PALLET
Academic supervisor: E. COURTIAL
Industrial supervisor: S. ALLAIS

Company: Sanofi

Objective/motivation

The SANOFI manufacturing factory where I am working is based in Aramon. It is dedicated to pharmaceutical active principles production. This plant has the specificity to use three different production technologies: plant extraction, organic synthesis and biotechnology. The SANOFI group is constantly committed to a continuous improvement process. During this project I am working in the department of plant extraction. My goal is to improve the operational unit. In fact, most of the time, the size of the reactors involved in the product manufacturing are not fully exploited. Faced with a production increase, the size of the batches must be augmented and consequently numerous parameters should be verified. The parameters in question can be classified into different categories: quality, safety and the respect of the limits of the equipment.

Results

The project can be divided into two parts. The first, done at the beginning of my internship, concerned the inventory of the current use of reactors and the creation of documentation relating to production equipment. At the end of this first part, we were able to choose three relevant products for our project. The choice of these products was based on the potential product quantity gained by optimizing the reactors, the production frequency of the product as well as the ratio between quantity of active ingredient produced and processing time. The second part is based on the impact that such an increase would have on the chemical reaction. In it will be calculated various parameters. Many of these factors are critical and can avoid any increase.

Keywords: optimization, equipment, production, quality, safety

Pipe that allows products from outside the circuit to be loaded into the reactor

Stainless steel reactor from workshop 08

Contact: hugo.pallet@etu.univ-orleans.fr

Installation of a monitoring system for critical parameters in a pharmaceutical laboratory

Electrical engineering


V. LEROUX

Vincent LEROUX
Academic supervisor: C. RIGAUT
Industrial supervisor: F. BOURGAULT

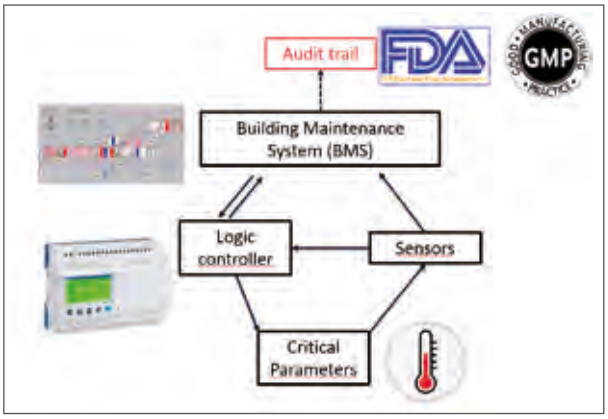
Company: FAMAR L'Aigle

Objective/motivation

FAMAR L'Aigle is a pharmaceutical laboratory and is continuously producing millions of high quality tablets and capsules. Those drugs can be sensitive to environmental parameters such as temperature, relative humidity, differential pressure, pH and so on. To ensure the stability of the products and their safety, those critical parameters have to be controlled which include regulation and monitoring. This project concerns monitoring. Every critical parameter registered on the site was already linked to a Building Maintenance System and all data was saved and displayed as a graph, which was then part of the audit trail. However, the monitoring system was not compliant with the latest standard GxP 21CFR part 11. In addition, the monitoring, the way of generating graph and report, were time-consuming and not user-friendly. A new system that would comply with GxP 21 CFR part 11, be user-friendly and evolve with our needs had to be set instead.

Results

The first step was to clearly define the specifications and requirements of the project and get the approval of everyone concerned. A provider then had to be selected. The system had to be compliant and fit the specifications previously defined, plus the technical solution had to be compatible with our technical constraints. Delay and support services were also decision criteria. Every step of the installation, which included hardware installation and software installation on the server and the setting, had to be properly defined in order to schedule what every member of the project had to do. Thus, a GANTT was made and a few meetings were held in order to coordinate the whole project team. To date, the software installation has gone well but the hardware installation experienced a few unforeseen events that are being overcome, one after another. In fact, the planning has been adjusted but the project is still running on time and will carry on.



Existing system

Keywords: monitoring system, data safety, FDA, BPF, GxP

Contact: vincent.leroux@etu.univ-orleans.fr

Lean Office

Production engineering

A. PIPONIOT-LAROCHE

H. TAYQ

M. VIGOUROUX

Anouk PIPONIOT-LAROCHE / Hajar TAYQ / Marine VIGOUROUX
Academic supervisor: A. HIVET

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Objective/motivation

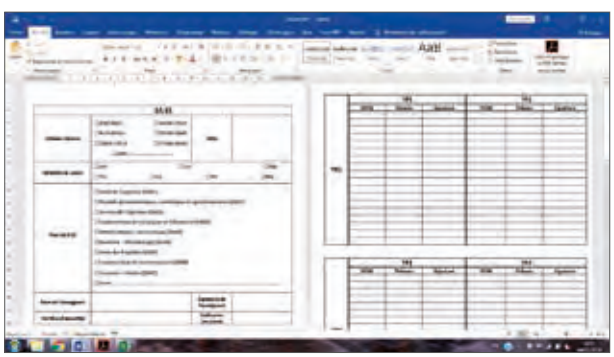
Lean is a participatory process that aims to develop a deep transformation through the learning of collective work and the change of mindsets. This project was initiated by the industrial engineering's administrative team to stop being overworked. This project started in June 2018 and was taken over by us in September for the purpose of improving the functioning of the Industrial Engineering department. As the Toyota Production System House shows, the customer is always at the heart of the business. We identified two main customers for the Industrial Engineering department: students and industrials that hire the students after their graduation, the product of this business being the degree offered by the university. Therefore, throughout this 6-month project, our objective was to increase the quality of the university's "product" (the degree) through the students' eyes.

Results

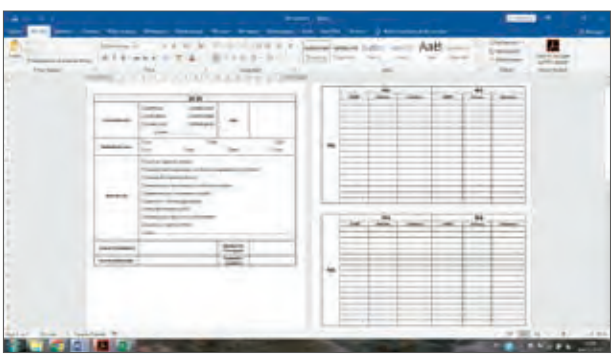
In order to satisfy the customer, it is important to increase the perceived quality and reduce the customer's effort. To do so, we focused on several things. First of all, we worked on the attendance sheets. Previously, there was one attendance sheet for each type of class for each course, making more difficult the job of the secretary and the student responsible for this sheet. We made one attendance sheet for each semester facilitating the visual aspect and the processing work behind it. Our second job was implementing an "idea board" where everyone who is confronted with the Industrial Engineering department (students, teachers, etc.) can write problems or suggestions they have with a section where solutions can be suggested. Among other things, we also created, with an illustrator's help, a comic strip to inform the students of the specific procedures in place in Chartres.

Keywords: lean office, Toyota production system, visual management, movement

One of 46 sheets previously used



Front page of the new single attendance sheet for third-year students



Back page of the new single attendance sheet for third-year students

Contact: anouk.piponiot@gmail.com ; hajartayq88@mail.com ; marine.vigouroux@orange.fr

Métamorph'Ose project: extension and continuous improvement of the manufacturing unit

Industrial engineering

N. BOUCHTITA

Nesrine BOUCHTITA
Academic supervisor: S. LEROUX
Industrial supervisor: M. JOURNEE

Company: Shiseido

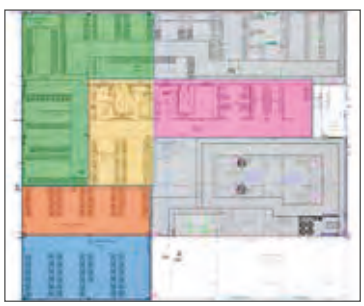
Objective/motivation

Shiseido Group is the fifth largest cosmetics company in the world. In addition to the Japanese founding label, the company owns numerous brands in the beauty industry, including skin care, haircare, makeup and perfumes. As part of the strategic plan VISION 2020 implemented by the group, several projects are currently underway in order to rebuild the foundation and accelerate group growth. At the Shiseido Val de Loire plant where I work, this transformation is reflected in particular by the extension of the manufacturing unit project. This expansion project is currently underway in order to increase the production capacity of this area and improve the overall performance of the industrial site. This project, Métamorph'Ose, will respond to the increase in activity. The goal of my project is to adapt the new premises to our needs by studying the flows, to increase the capacity and improve the performance of the manufacturing unit. Furthermore, I am also working on the continuous improvement of this unit.

VISION 2020

Results

Currently, all of my projects are in progress. The extension will increase the current storage capacity of raw materials and manufactured bulks, increase the capacity of the weighing unit and centralize the cleaning activity. We are working on the organization of the warehouse in order to adapt it to our needs. I will also be in charge of defining the raw material supply rules in the weighing area (creation of the weighing schedule, SAP modifications, and visual management). In the weighing area, I am working on a transfer pump project in order to improve the ergonomics and the productivity of these workstations. Moreover, I participate in the updating of cGMP standards. As part of the continuous improvement of the manufacturing unit, I am in charge of several projects to provide ergonomic solutions, improve safety and increase productivity.



The cosmetic manufacturing extension

Keywords: manufacturing, performance, continuous improvement, value stream mapping, cGMP

The Shiseido Val de Loire plant

Cosmetics manufacture

Contact: nesrine.bouchtita2@gmail.com

Modeling of a packaging line, flow simulation and virtual reality using the software FLEXSIM

Production engineering

Thomas ASPA / Sylvain MARIN-MENDEZ / Alexis SAJOUS
Academic supervisor: A. ROUSSEL
Industrial supervisor: A. HIVET

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans


T. ASPA


S. MARIN-MENDEZ


A. SAJOUS

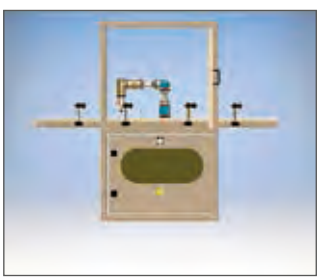
Objective/motivation

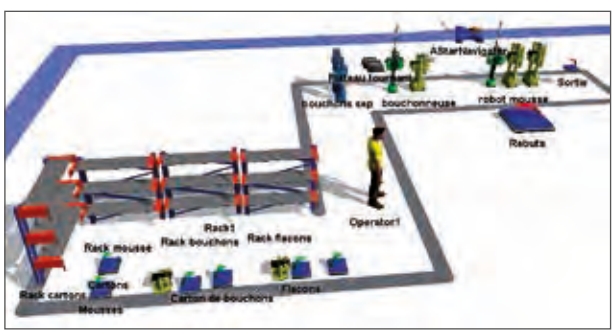
The objective of this project is to use the software FLEXSIM to simulate flows on the production line at the Chartres Polytech facility and then to use virtual reality to enhance immersion and understanding of the process. The simulation can serve different purposes. At first it can be used to create different scenarios virtually and then decide real applications on the actual production line after testing them with the software. Then it can be used for training purposes. For example, new operators could have their first experience of the line with the software, to have a global view of the flows and to get familiar with the equipment used. For an immersive virtual reality experience, 3D models with a visual close to the actual equipment are needed but not necessary.

Results

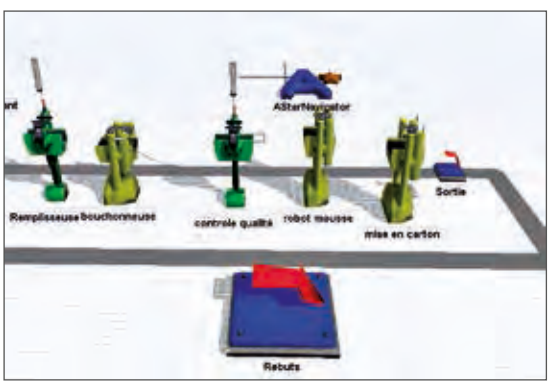
Different scenarios have been tried and simulated on the production line. The different flows occuring on the line and the different steps were simulated. However, some parameters went unnoticed and then needed some necessary adjustments. In addition, another simulation was created for the sole purpose of the virtual reality experience. Many 3D models were created to enhance the virtual reality experience and a more realistic line in terms of visual was also created. This simulation sought to provide a more visual view of the process but not yet a realistic one and we use the HTC Vive goggles for the virtual reality immersion. The user can then see the flows on the production line with the actual items going through and the machines used. It can be used as a first introduction to the equipment of the process.

Keywords: virtual reality, flow simulation


3D model created for the line



Scenario 1 : One operator on the production line



Successive steps followed by the product

Contact: thomas.aspa@etu.univ-orleans.fr ; alexis.sajous@etu.univ-orleans.fr ; sylvain.marinmendez@gmail.com

Optimization of a production line

Industrial engineering


S. CHAHBI

Sahar CHAHBI
Academic supervisor: A. HIVET
Industrial supervisors: M. MURE, E. TRI

Company: Novo Nordisk

Objective/motivation

Novo Nordisk is a global healthcare company created in 1931 and engaged in the discovery, development, manufacturing and marketing of pharmaceutical products. It mainly operates through three business segments which are diabetes, obesity care, and biopharmaceuticals products. The company has a production site in Chartres, France, since 1961 in which insulin cartridges are produced and insulin pens are assembled and packaged. The department I am working on is in charge of filling insulin into cartridges with two filling lines in a controlled atmosphere. Those two production lines don't have exactly the same equipment. One of them has an overly complex system that generates higher costs due to time without production caused by shutdowns and breakdowns of the equipment. The goal of my with an entire project team is to replace the complex system by the same system present on the other production line, to qualify the new equipment and to provide the necessary training to operators for the use of this equipment.

Results

The project is currently underway. However, once the new equipment is implanted, we will compare the operation of both production lines and we will analyze the data of the line where the new equipment has been installed, notably the machine downtime, which will then enable us to evaluate the costs and the gains made thanks to the new equipment.

Keywords: process, optimization, pharmaceutical industry, aseptic production

Novo Nordisk around the world


Insulin cartridges


Project goal: increase performance

Contact: sahar.chahbi@etu.univ-orleans.fr

Performance improvement of packaging lines

Industrial engineering


H. BEN FADDOUL

Halima BEN FADDOUL
Academic supervisor: G. HIVET
Industrial supervisor: C. FRITZ

Company: Novo Nordisk

Objective/motivation

Novo Nordisk manufactures and packages several products to fight against diabetes, including the Flexpen, which is a pen that allows patients to inject insulin to regulate their blood sugar level. Today, there are more than 382 million patients worldwide with diabetes and approximately 2 people diagnosed every 10 seconds. The company must therefore cope with this increase in the number of patients by increasing its production. In fact, in 2019, the goal is to produce 16% more Flexpens than in 2018. To cope with this increase, two axes were considered: increase of the production staff and increase of the productivity of the lines. As a result, my project is part of a process of continuous improvement and consists of improving the performance within the production department which has two packaging lines.

Results

To carry out this project, the DMAIC method is used by first defining the perimeter of the project. Then, in the Measurement phase, an OEE study on the year 2018 made it possible to highlight, thanks to a Pareto diagram, the three main axes significantly influencing the performance, including equipment shutdowns. As a result, a study of the history of stops requiring the intervention of maintenance is carried out as well as implementation of an Excel® file on line, so that the operators can inform the nature of the stops during production. The goal is to have a history of equipment outages, to highlight the redundant issues currently impacting the OEE. Subsequently, an Ishikawa diagram will be created on the main source of variability, to find the root cause. Finally, control charts on the stops will be carried out by equipment, to follow the evolution of the stops and to evaluate the effectiveness of the actions put in place.

Keywords: DMAIC, continuous improvement, performance, OEE, maintenance


Flexpen

DMAIC method

Contact: halima.benfaddoul@etu.univ-orleans.fr

Project's change management and communication

Production engineering


L. ANDREUX

Loris ANDREUX
Academic supervisor: J. DOUSSOT
Industrial supervisor: P. NOURIGAT

Company: Sanofi

Objective/motivation

During this project, my main tasks are oriented toward improving effectiveness and communication in the sterile manufacturing department, and to improve productivity and links between all the services and workforce. I can rely on Sanofi's Lean Policy which is a group standard template to manage and create new communication tools and upgrade old ones. I also work with people from different hierarchic levels to create useful and ergonomic tools for everyone. For example, I work on two different communication procedures, one at the beginning of a team turn and the other at the end of their shift. My task on these two procedures is to improve communication between the team and the manager and to diversify the subjects being discussed. I also created a tool for addressing and treating the different irritants and improvement propositions in the production area.

Results

The procedure at the beginning of each shift is already launched. This procedure presents and opportunity to speak about subjects like security or quality. For the other procedure, I have finished the observation step and started WorkShop with the different Team Managers, to see the strengths and weaknesses of the current practice to find solutions to these weaknesses and reach the objectives. Ideally, this practice needs to transfer information between the operational level and the managerial level. Finally, I launched the irritant tool. It is also in a pilot step and needs to be adjusted and upgraded. This tool is currently efficient and permitted to address many irritants from the different teams in the production area. It improves the follow-up of the actions and it is explicit with the state of each irritant.

Keywords: communication, management, LEAN, improvement

Contact: loris.andreux@etu.univ-orleans.fr

Redesigning a workshop to change product range

Production engineering

Paul RAYNIERE
Academic supervisor: C. RIGAUT

Company: undisclosed (confidential)

Objective/motivation

2019 is the year chosen by one of the greatest French poultry companies to make a shift in its organization. Among its different production plants, several species of birds were transformed into numerous items, each one belonging to a product range. The strategic enhancement planned by the chairman of the group is to dedicate a plant to both a specie and a range to ensure that each factory will perform in its domain. The object of this study is the cut-up workshop of a plant located in western France, which was planned to turn its production from standard to certified chicken quality. This switching involves many more process changes than item ones, due to the break between standard and certified production flows. Bottlenecks appear, input variability throws item pace off balance, and labor finally suffers from stress.

Results

The first step of this strategic repositioning occurred in March. The different factories concerned have done their shift, and the total amount of poultry that represents the whole input of raw material that supplies the group is now fully set according to the schedule selected. After a long modelling process of the previous layout of the factory, especially its cut-up workshop, the performance of each processor has been calculated to check their compliance with the new production plan. Even if the new arrangement of this workshop keeps most of the previous equipment, some new machines have been bought to absorb the overflow induced. Moreover, new sequences of the production schedule have been implemented to prevent the excess of variability inside the process giving a better way to use equipment. This new production way has then moved to a continuous improvement phase.

Keywords: production, food process, item flow, management, scheduling

Contact: raynierepaul@gmail.com

Reducing batch changeover time within the aseptic filling department

Production engineering

O. HAIDA

Oumaima HAIDA
Academic supervisor: A. HIVET
Industrial supervisor: S. MOTTES

Company: Novo Nordisk

Objective/motivation

As a part of my fifth year at Polytech Orléans within the specialty Industrial Engineering applied to cosmetics, pharmacy and food processing, I did an apprenticeship in Novo Nordisk, which is a Danish multinational company that manufactures and markets pharmaceutical products and services. In order to increase the production capacity of its aseptic filling lines, the filling department aims to reduce batch changeover time. By reducing this time, we can have more productive time for running production, which will allow us to improve machines and resources utilization. It can also reduce finished products inventory size and the lead time which is the time between receiving raw materials from suppliers and the delivery of goods to customers.

Results

The project is in progress now and the strategy that was pursued to achieve its objective is to study initially the current situation by analyzing information and data that the company already has and to try to find root causes of the problems. The next step is to organize workshops with operators, team leaders and engineers in order to brainstorm about potential improvements and create standardized work instructions and update rolls cards for operators. Finally, all the suggested improvements and solutions will be implemented and applied on the production lines.

Keywords: batch change over, production lines, performance, optimization, workshops

Insulin cartridges produced within the filling department

Production site of Novo Nordisk

Contact: oumaima.haida97@gmail.com

Reducing changeover time with SMED

Industrial engineering

M. MAGAT

Marie MAGAT
Academic supervisor: J-B. VIDAL

Company: undisclosed (confidential)

Objective/motivation

During my last year studying Industrial Engineering applied to cosmetics, pharmacy and food processing, I was asked to work on a SMED project for a production line of a cosmetics and pharmacy company in order to reduce changeover times of a packaging line. For this specific packaging line, many different production batches can be packaged in a week. It is a key challenge to produce smaller and different products on a same packaging line.

Results

Currently, this SMED project is in its early stage. I will be able to measure its benefits in the next three months. Therefore, to carry out a SMED project, it is necessary to evaluate project issues and requirements specifications, and to implement performance indicators. It is also important to create a project team composed of packaging line employees and maintenance technicians for their technical knowledge and involvement. It is necessary to follow four steps to lead a SMED project: 1) Identify internal and external tasks during a changeover time; 2) Divide these two types of tasks; 3) Convert as many changeover steps as possible to external tasks; and 4) Simplify and streamline the remaining steps. SMED projects are the best way to standardize changeover processes and lower manufacturing costs.

Keywords: continuous improvement, SMED, dermo-cosmetics

Tube production line

Contact: marie.magat@etu.univ-orleans.fr

Reducing juice losses

Production engineering


L. LARRIEU

Laura LARRIEU
Academic supervisor: D. TRIHAN
Industrial supervisor: J-P. BIER

L'ORÉAL

Company: L'Oréal

Objective/motivation

L'Oréal Group is the world leader in beauty including make-up, haircare, perfume and skincare. The factory I work in specializes in shampoo, conditioner and shower gel. There are two main issues in my project. On the one hand, it has an economic aspect because plant losses must be in line with budgeted amounts. On the other hand, it deals with L'Oréal's commitment to a sustainable performance "Sharing Beauty With All". Indeed, the plant must reduce the generation of its waste by 60% compared to 2005. As juice is the biggest part of waste, the plant decided to work on this at the end of 2017 with a DMAIC approach. Even if the target was not achieved by 2018, the plant obtained good results in the second semester of 2018. Therefore, the goal of my project is to stay on course by setting standards "wedge" avoiding a new drift and to find new levers that will reduce juice losses.

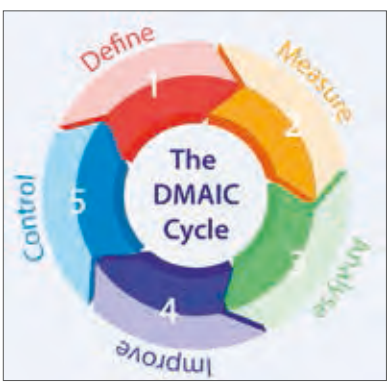

A shampoo production line

Results

There has been a real improvement with cash saving since July 2018 compared to a loss target decided in the budget. But past projects have not enabled us to set up a wedge to ensure the sustainability of the results. The group therefore attaches importance to this point. The project is in progress and we finished a road map for the TPM juice losses group in 2019 that will allow us to give direction to the group and to follow the project progress. For example, we planned to involve production people more by raising awareness among operators with visual management and daily monitoring by team leaders. We also want to look deeper into innovative solutions: automatic captors for purges, heated covers and electropolishing for storage tanks, as well as a steam flash solution for manufacturing tanks.

Keywords: lean, six-sigma, DMAIC, juice losses


The Rambouillet manufacturing site



DMAIC approach

Contact: laura.larrieu@etu.univ-orleans.fr

Reducing material losses

Industrial engineering

D-C. DE BUSSCHERE

Diane-Clélie DE BUSSCHERE
Academic supervisor: E. BEURUAY
Industrial supervisor: D VERHAEGUE

Company: Danone

Objective/motivation

Danone Produit Frais de France is one of the four divisions of the multinational Danone, which produces all the yoghurt for the Danone brand. My plant, Danone Pays de Bray, located in Normandie, is specialized in fruit yoghurt production. Because of the changeover and the reduction of serial time, the loss of raw material had increased. Fruit loss represents around 3% per month. My part on loss reduction is to identify, measure and reduce fruit loss in the conditioning area.

Results

With this project, we have analyzed and measured the sources of fruit loss, such as residual fruit in the container or lost during the start of production. With the data, it is possible to quantify the loss of fruit per lines. On each line, I have calculated the average and the confidence interval of fruit residuals lost. Therefore, we can be focused on production where losses are greatest, such as the production of organic yoghurts, and find solutions to avoid them.

Keywords: reduction losses, food processing industry, raw material

Conditioning lines

Danone factory

Contact: diane-clelie.de-busschere@etu.univ-orleans.fr

Robotic Process Automation (RPA) for batch record review

Industrial engineering

M. BENDIB

Meriem BENDIB
Academic supervisor: A. HIVET
Industrial supervisors: N. RENAULT, S. ROUZET

Company: Novo Nordisk

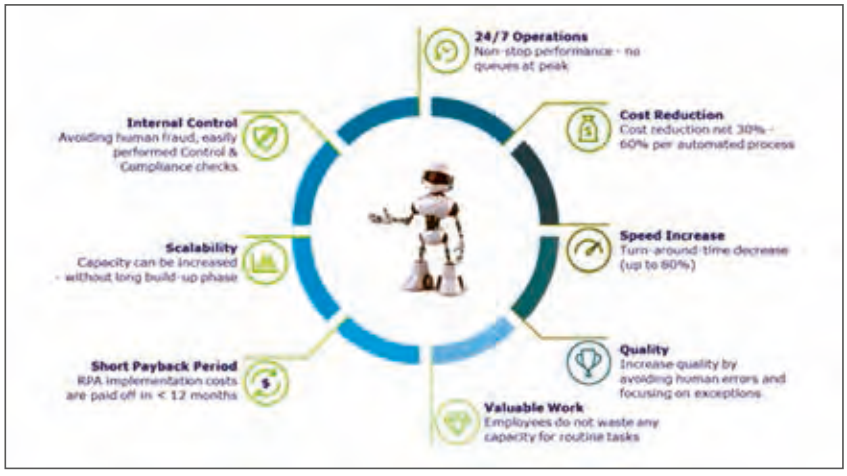
Objective/motivation

Novo Nordisk is a global pharmaceutical company which treats diabetes, among other diseases. In fact, diabetes is a health challenge: it is estimated that 736 million people will have diabetes by 2045. To meet this increasing demand, Novo Nordisk has to ensure an aligned production while being compliant with regulations in order to ensure patients' safety. To guarantee compliance, meet the demand and minimize errors, some processes can benefit from new technologies such as automation by robot. This project takes place in the quality assurance (QA) department. Indeed, in order to release insulin batches, a certain amount of controls and checks must be performed. Those controls are done by production and quality assurance. This process of batch record review and release in the market could be automated by Robotic Process Automation (RPA). It will ensure data integrity with elimination of human errors regarding data controls and quality.

Results

Robotic Process Automation is a software application that replicates the actions of a human being interacting with the user interface of one or more IT systems. It is a way to automate repetitive and rules-based tasks and can help streamline, standardise and optimise processes and significantly reduce costs depending on the characteristics of the process. RPA technology is quite new in pharma regulated industries and will enable further increases in productivity in the QA department and thus reduce, for instance, transactional tasks performed by academics and free up resources to do more value-adding work. As a result, the batch record process review and release will be done automatically by the robot according to the requirements, and pharmacists will handle only exceptions since human judgment will be still needed. This technology supports simplicity, improves quality and is more accurate.

Keywords: process digitalization, technology, efficiency, automation, productivity



Benefits of RPA

Contact: meriem.bendib@etu.univ-orleans.fr

Supply and storage of Vichy, La Roche-Posay and St Gervais waters

Production engineering


J. JOUGON

Joffrey JOUGON
Academic supervisor: L. DELPLANQUE
Industrial supervisor: P. DURANT

Company: L'Oréal

Objective/motivation

Nowadays, customers care more about cosmetics with immediate results and the benefits they provide to health. That is why L'Oréal is working to launch many products in the next years from its Cosmetic Active division. Consequently, the PIQ EMEA, which is involved in the launch of new products, needs to use the Cosmetic Active waters (Vichy, La Roche-Posay and St Gervais) to adjust the formulas for new products and to transmit them to the different plants. However, these waters are very pure and fragile and need proper storage conditions. The project deals with the establishment of these conditions based on the current warehouse in the PIQ EMEA and the deployment of new supply methods.

Results

This project is at the heart of the problem of plants using these waters. In some cases, sterilized plastic bags are used, but this does not work for all waters. The plant that uses the most water for its products has a continuous filtration system that allows optimal water use by avoiding conservation problems based mainly on the validity date. Is it profitable to invest in a filtration system? Are there other less restrictive methods? In the spring of 2019, these issues will have to be resolved.

Keywords: water, supply, storage conditions, logistic

Contact: joffrey.jougon@gmail.com

Visual management project in the industrial supplies department

Industrial engineering

F. MAHE

François MAHE
Academic supervisor: J. ROUSSEL
Industrial supervisor: N.TOURNIER

Company: Sanofi

Objective/motivation

The main goal of this project is to find a way to measure and improve the performance of the industrial supplies department, which is in charge of buying and receiving spare parts from external suppliers. I worked with the employees of the whole department to find which KPI (Key Performance Indicator) would be the most appropriate to follow. The objective was to create a short daily procedure (10 minutes) which would allow us to track actions and analyze abnormal situations. This procedure would happen in front of a visual board in order to make it very simple to follow and easy to understand. The goal behind this tool is for employees to think differently about the way they work and to involve them in the process of improving their performance and solving their problems.

Fermentation production line

Results

The first version of the tool was launched in January 2019. This is a standard on site and the vast majority of the departments use it. A standard should be dynamic and change as time goes by. Employees in the industrial supplies warehouse started to suggest new improvement ideas and better KPIs to follow. Five kinds of KPIs exist: EHS (Environment, Health & Safety), Quality, Delay, Cost and Involvement. My role in this project and in my job in general is to find with people what working better means in their own context. As the tool is used more and more frequently in the future, I will follow the implementation of the tool, suggest improvements and find with the employees how we can continuously improve this standard.

Keywords: lean manufacturing, continuous improvement, pharmaceutical industry, visual management, processes

Saint Aubin les Elbeuf site

Contact: mahefrancois@live.fr

Innovations in design and materials

Creation of an energy management law of a multi-source generator

Energetics


G. CASTELLI


M-A. MBETIBANGA


F. VAUDECRANNE

Greg CASTELLI / Michel-Ange MBETIBANGA / Florian VAUDECRANNE
Academic supervisors: C. BOURILLON, G. COLIN
Industrial supervisor: F. BEN AMMAR

Company: Spacetrain

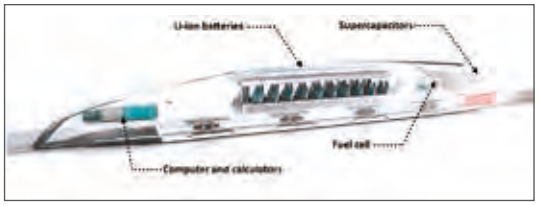
Selected participant
13th Annual Final Year Projects Forum

Objective/motivation

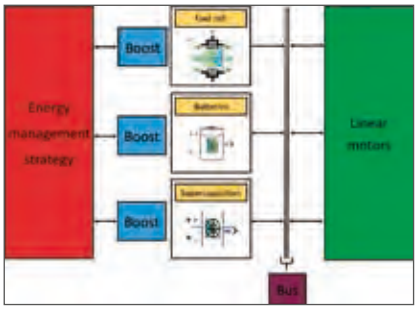
The projects aimed to help with a part of the development of a Spacetrain shuttle. Simply speaking, a Spacetrain shuttle is a train moving on an air bearing in order to reduce dramatically the resistive friction forces. The Spacetrain can move thanks to three types of power sources (a fuel cell, Li-ion batteries and supercapacitors) which we had to control smartly in order to respect the requirements (be able to perform a 500km cycle with a cruise speed of 500kmph). Thus, we had to size the three power sources. Our industrial supervisor wanted us to provide a Simulink file with the three-power sources model and the energy management law. Of course, we also had to write a user's manual.

Results

The first step was to size and model the three power sources. The sizing was done thanks to Microsoft Excel® by identification of the energy needs (during acceleration, deceleration and constant speed phases). The modeling was done thanks to pre-implemented Simulink models. We chose to use an energy control method named Auto-Adaptive Filtering Based Energy Management Strategy. Thanks to this method, it is possible to manage the power sources by taking into account their specific power, specific energy and the response time. We have managed to finish the implementation. Moreover, we added an algorithm which has to compensate internal and external conditions such as the ageing of the battery.



Keywords: energy management strategy, train, supercapacitor, fuel cell, Li-ion battery



Operating diagram


Model of the Spacetrain

Contact: greg.castelli@etu.univ-orleans.fr ; florian.vaudecranne@etu.univ-orleans.fr ; michel-ange.mbetibanga@etu.univ-orleans.fr

Design of a photomask for optical inspection

Production engineering


J. BION


G. NOUYOUX

Julie BION / Gwendal NOUYOUX
Academic supervisor: J. GILLIBERT
Industrial supervisor: S. EMONIN

TOPPAN
TOPPAN PHOTOMASKS, INC.

Company: Toppan Photomasks France SAS

Objective/motivation

The goal of this project is to develop a process to spread polystyrene spheres on a photomask. A photomask is a plate made of glass and chromium commonly used in photolithography, a process to pattern integrated circuits. The industrial supervisor had the wish to find a way to calibrate their optical inspection tools called QCOptics. The students have to drop and fix 800 polystyrene spheres of four different diameters on the photomask surface. Production operators will use the photomask as a daily monitoring to ensure the specification of the tools. At the end of the project, the students will have to provide four monitorings to the company.

Results

The first part of the project was to determine a method to drop and fix spheres on the photomask surface. Students studied existing scientific articles and theses and worked in pairs with a professor from the GREMI laboratory. The second part was to prepare the photomasks in a clean room to avoid any kind of contamination by using the method previously defined. During the whole project, the students and Ms. Emonin worked in tight collaboration to be certain to achieve the company request.

Keywords: photomask, inspection tool, calibration, laboratory work, white room


The clean room

Contact: julie.bion@etu.univ-orleans.fr ; gwendal.nouyoux@etu.univ-orleans.fr

Design of a semi-automatic polishing system for stainless steel tanks

Mechanical engineering


R. CADUE


J. JOUANOLLE


M. LEKHEL

Rémi CADUE / Justine JOUANOLLE / Manal LEKHEL
Academic supervisor: B. LE ROUX
Industrial supervisor: M. CORBIER

Company: 3C France

Objective/motivation

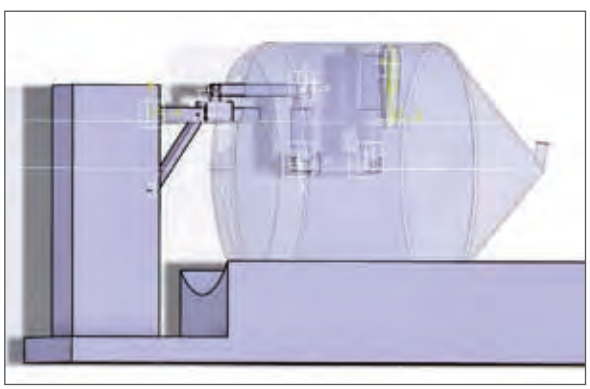
3C France is a French company in charge of the design and manufacture of stainless steel tanks for companies in the medical, pharmaceutical and cosmetic fields. These fields require many precautions in terms of cleanliness of their equipment, so the welds made during the manufacturing process need to be polished. This way, no pharmaceutical, medical or cosmetic substance that will be put inside the tank for hours will be stuck in the welds and generate bacteria. The polishing process currently used is manual and very tiring for the operative. The objective of this project is to design a semi-automatic system that will handle the polishing process instead of the operative who will only be guiding the machine. Our mission comes up with a major technical constraint, which is that the machine has access to the steel tanks to polish it through a hole that is only 35 centimeters large.

Results

The result of this project is a full study that includes the choice of the technical solution that fits best according to the constraints and requirements that we and the company have imposed to satisfy the need. In this study we design, present, and explain the chosen technical solution with all its components (engines, sensors, parts) and its automatic and manual control modes. We decided what technical solution we are going to work on. Then we started sizing all the components depending on the efforts they will have to handle. Also, we defined the cinematic chain of our system. What we have left to do is define and choose all the elements of the automatic aspect and the way we are going to control the mechanical arm which is the solution we decided to develop.

Keywords: polishing, semi-automatic, tanks, welding, abrasive


These tools will be attached to the mechanical arm and used to polish the tanks


3D model of the mechanical arm


An example of the tanks 3C France produces and needs to polish

Contact: remi.cadue@etu.univ-orleans.fr ; justine.jouanolle@etu.univ-orleans.fr ; manal.lekhel@etu.niv-orleans.fr

Development of a practical work for characterizing the thermal conductivity of materials

Materials


F. AZOUGAGH


V. GIRAUD


V. REYNAUD

Fouad AZOUGAGH / Valentin GIRAUD / Vinciane REYNAUD
Academic supervisors: L. DEL CAMPO, M. MALKI

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

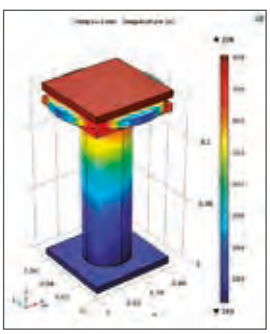
Objective/motivation

This final year project consists of the development of a practical work to study the thermal conductivity of solid materials. This academic project is in the continuity of previous works since 2014. Our objective is to set up a practical work in the premises of the Vinci site of Polytech Orléans, for the fourth-year students of the ICM specialty. To do this, numerical simulations by modeling the setup and instruments on COMSOL Multiphysics® software for each material sample (steels, PMMA and ceramics) will be done. Experimental measurements to compare numerical and experimental values will also be performed. Indeed, we want to study the validity of the unidirectional Fourier's conduction law in our configuration as a function of the sample's thermal conductivity and geometry to confirm the hypothesis and the results obtained in the practical work.

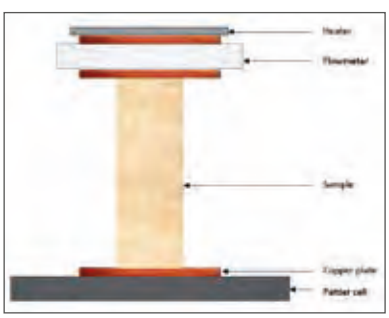
Results

First, we conducted the manipulations and measurements to ensure the proper functioning of the instruments and to test the man-machine interface that had already been set up in previous projects. After verifying that the equipment used to impose a temperature difference, the acquisition instruments and the software worked properly, we compared the experimentally obtained thermal conductivity values to values obtained via simulations, as well as to theoretical values. The performed numerical simulations were also used to confirm the need to correct the heat flux rate measured on the flowmeter by a surface ratio (flowmeter/sample). Transient studies were also carried out and the time required to reach the steady state for each sample was estimated.

Keywords: practical work, characterization, thermal conductivity, heat flux, simulation


Temperature schema


Practical work set-up


Cross-section of the materials

Contact: fouad.azougagh@hotmail.fr ; valentin.giraud@etu.univ-orleans.fr ; vinciane.reynaud@etu.univ-orleans.fr

Electrical linear motor simulation of the Spacetrain project

Electrical engineering

A. EL OUALI

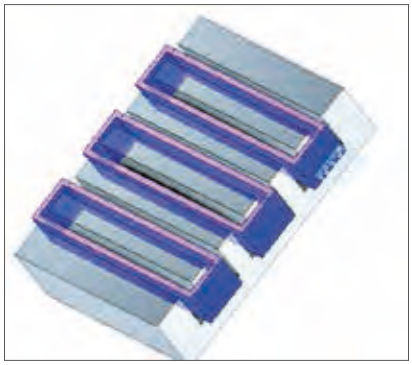
Ayoub EL OUALI / Arnaud MAIRE
Academic supervisor: E. BEURUAY
Industrial supervisor: F. BENAMMAR

A. MAIRE

Company: Spacetrain

Objective/motivation

The company Spacetrain works to revive an old train project: the elevated monorail. This one began in 1970 and just stopped four years after. Spacetrain created a partnership with Polytech to create the monorail and to develop a sustainable partnership with future engineers. Our project consists in designing and simulating a model of the electrical motors. These motors will move the train forward. The train will have to reach a very high speed up to 500 km/h and will levitate on an air cushion. We will realize the design of our motor with the ANSYS software because this will also allow us to simulate the magnetic behavior. The second part of our project is to write a user's guide of the ANSYS software to train the employees of the company.

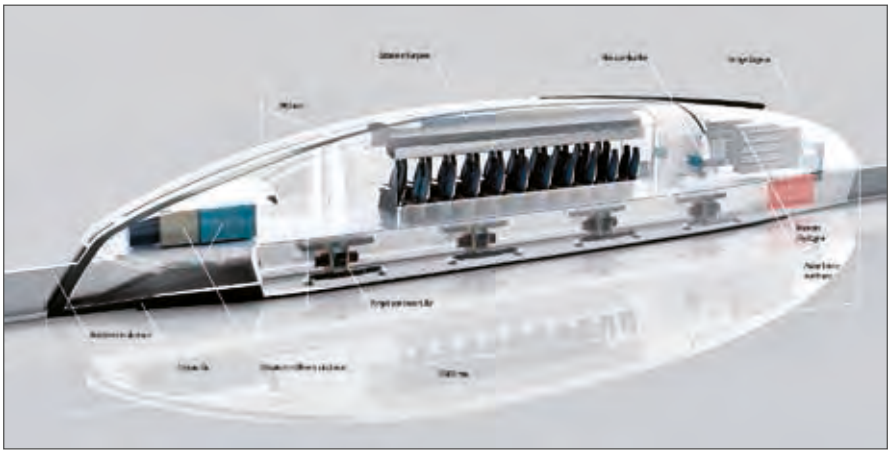


First part of the linear motor

Results

We met Spacetrain in their company facilities at Orleans to define the objective of this project. This realization is a two-month project, and, at the end, we will give the results and a detailed report of our research. The main objective is to simulate the motor magnetic field. At the beginning, we did some research to know how this type of linear electrical motor works. Then, we tried to launch first simulations on simple motors with the ANSYS new software, which has never before been used. The second step was to develop a precise and adaptable model that Spacetrain could use in the future. We have succeeded in launching the first simulation despite many problems that prevented us from having results. At the same time, we were designing the final electrical motor and writing the training document.

Keywords: magnetic field, linear electrical motor, ANSYS, sustentation



The Spacetrain project

Contact: ayoub.el-ouali@etu.univ-orleans.fr ; arnaud.maire@etu.univ-orleans.fr

Finite Element Simulation of thermal shock by solar flux and laser flux

Mechanical engineering

M.F.F. BIN FADZIL

L. WAN

Mohamad Fareez Fahmy BIN FADZIL / Lili WAN
Academic supervisors: D. ANDRE, M. HUGER, G. OUM, T. SAYET

Institutions: IRCER Limoges, LaMé Laboratory

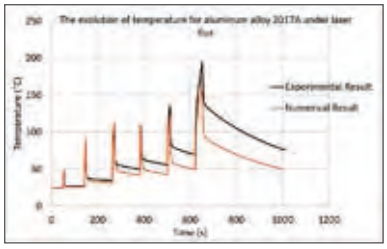
Objective/motivation

The project is divided into two phases. The first one is related to the numerical simulation of the central solar tower receiver. The principal of the simulation consists in giving a periodic solar flux to a steel sample and observing the thermomechanical consequences on the sample. Our objective in the first phase is to compute the temperature on the front surface of the sample and to compare the results to those obtained by another Finite Element Analysis (FEA) model created by using Code Aster. The second phase consists in replacing the solar flux by a laser flux and the chosen material is aluminum 2017A. Our goal for the second phase is to verify the evolution of the temperature under a period of time which contains six different discontinuous laser impacts with the experimental results given by the experimental tests made in the IRCer laboratory in Limoges.

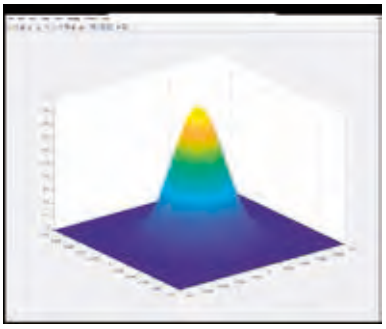
Results

For the first phase of the project, after doing some bibliographic research to find the temperature dependent properties of material Inconel-625, we conclude that the evolution of the temperature on the center point of our model in Abaqus is exactly the same with the result from Code Aster and slightly different with the experimental result. This is because we considered the coefficient of convection is constant, but in reality, the coefficient changes based on the temperature and the meteorology condition (ex: wind speed). For the second phase, we have studied the influence of the specific heat, thermal conductivity, emissivity and coefficient of convection on our final result.

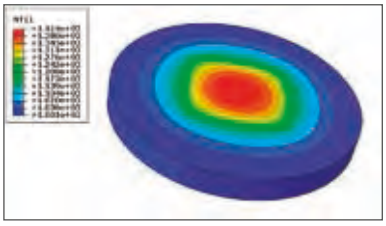
Keywords: numerical simulation, thermal choc, thermomechanical analysis, aluminium alloy



Numerical result of aluminium alloy 2017A



Gaussian distribution of laser flux TEM00 on Matlab®



First result of solar flux for Inconel-625

Contact: mohamad.bin-fadzil@etu.univ-orleans.fr ; lili.wan@etu.univ-orleans.fr

InMoov Project : conception of four InMoov humanoid robots

Mechatronics


V. BOUBAULT


A. DIJOUX


F. THOMAZO-MASSIGNAC

Valentin BOUBAULT / Alexandre DIJOUX / François THOMAZO-MASSIGNAC
Academic supervisor: A. FONTE
Industrial supervisor: J-P. ANCHISI

Company: AD Prod

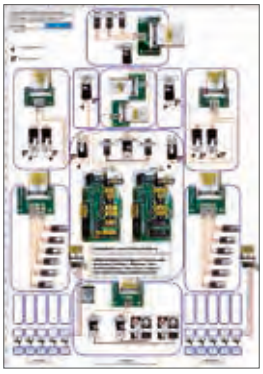
Objective/motivation

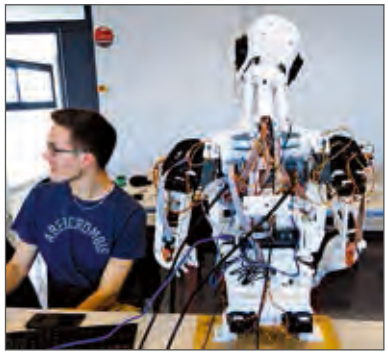
Léonard da VINCI is one of the most brilliant inventors of history. As a part of the "Léonard et les Robots" show which takes place in Orléans from March 2 to April 7, 2019, the company AD PROD contacted Polytech Orléans and asked its students to create four open source humanoid robots from the InMoov Project. Our purpose will be to manage the resources on this project, which began in September, and to be a part of the mounting team to finish those robots in time. To achieve this goal, we will receive the help of the FABLAB laboratory in electronics components and equipment. This project regroups four technical disciplines that make up the mechatronic domain: materials, electronics, mechanics and computing. This show also regroups two of the best-known creations of Léonard da Vinci: "La vis" and "LORNITOTTERO".

Results

After two intense months of preparation and creation, we have been able to put all four of the robots in place at the exposition. More than just the robots, we have implemented programs that permit them to interact with their environment nearby and, more important, with humans. Many problems arose and slowed us down but we were able to adapt to deliver what needed to be done. Managing the team project was our biggest task as well as the mechanics and electronics parts and their interactions. The robots are controlled with a small computer and software called "MyRobotLab" that permits us to talk with it and to test its operations. The last test was a game of rock/paper/scissors between the robot and us.

Keywords: humanoid robot, A.I., interaction, open source, 3D printing


Map of connections


Final robot test


Robot installed

Contact: valentin.boubault@etu.univ-orleans.fr ; alexandre.dijoux@etu.univ-orleans.fr ; francois.thomazo-massignac@etu.univ-orleans.fr

Instrumented needling demonstrator for non-woven carbon fabrics

Mechanical engineering, Materials


A. LIOUKIN


A. MESNIL


J. PARMANUM


Q. ROCHER

Aleh LIOUKIN / Amaury MESNIL
Jayendra PARMANUM / Quentin ROCHER
Academic supervisor: J. GILLIBERT
Industrial supervisors: G. HIVET, A. SHANWAN

Institution: LaMé Laboratory

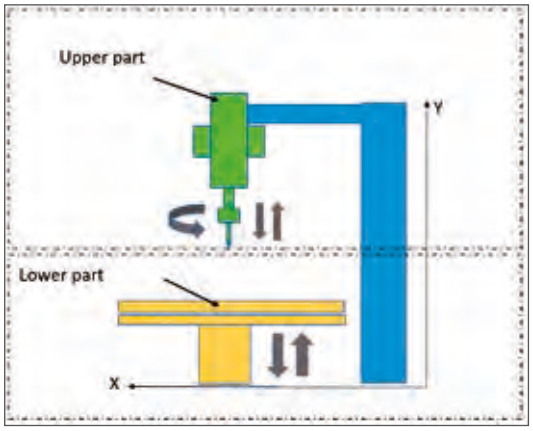
Objective/motivation

This project is led in collaboration with the laboratory LaMé. The aim is to design an innovative instrumented device dedicated to improving the knowledge and tackling the modeling of needling of non-woven carbon fabrics. Thus, a needle is used to penetrate several stacked layers of non-woven fabric. The penetration of layers by the needle creates local deformations inside the fibrous reinforcements, which might substitute the use of yarns used for linking the stacked layers together. During this project, we contacted several suppliers to order the necessary parts for the device. All of these parts should then be mounted together to make the required device.

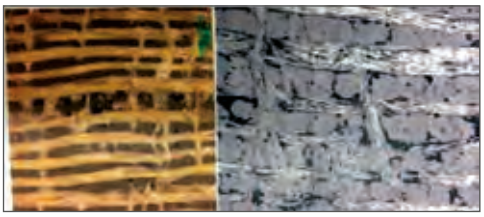
Results

Based on the specifications established by the industrial supervisor, we reviewed some technological solutions and compared their advantages and disadvantages. We divided the machine into two parts: the lower one and the upper one. The main work is to integrate the chosen solutions together with intermediate parts that we have to design. To create the technical drawing and the 3D model, we will use the CAD software 3DEXPERIENCE®.

Keywords: needling, reinforcement, composite, structure, carbon fiber



Two parts of the device


Picture of vertical stresses in composite

Contact: aleh.lioukin@etu.univ-orleans.fr ; amaury.mesnil@etu.univ-orleans.fr ; jayendra.parmanum@etu.univ-orleans.fr ; quentin.rocher@etu.univ-orleans.fr

Luggage classification system

Electrical engineering


J. BAJON


J. DAMBRAINE


A. TAYEB

Julien BAJON / Jerome DAMBRAINE / Achraf TAYEB
Academic supervisors: A. CHETOUANI, E. COURTIAL
Industrial supervisor: J-M. DEDISSE

Company: Alstef

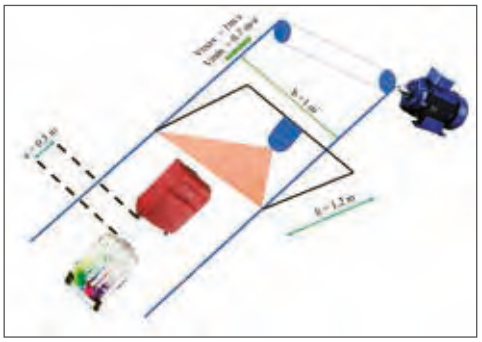
Objective/motivation

ALSTEF is specialized in automatic conveyor equipment used for the most part in airport luggage transport. A new problematic appears in this type of system due to the "All automatic" aspect. Indeed, the goal is to have an autonomic system with minimal human intervention. In our case, the main problem is that some objects which are put on the conveyor can get stuck and cause interruption of the automatic system leading to financial consequences. The objective is to build a system to classify the luggage in order to exclude all problematic objects to a manual treatment.

Results

The actual system uses a LIDAR sensor linked to a software interface. This gives some characteristics of objects transported on the conveyor system. These characteristics are used in different image processing algorithms which can assess whether or not the analyzed luggage is problematic. This classification system can be improved with a second one that uses a camera and a deep learning algorithm in order to have better performance and viability.

Keywords: luggage, software, image processing, classification


System illustration


Workshop test bench of the system


Example of object classification

LIDAR LMS4000

Contact: julien.bajon@etu.univ-orleans.fr ; jerome.dambraine@etu.univ-orleans.fr ; achraf.tayeb@etu.univ-orleans.fr

Modelling of sports surfaces for interaction with shoes

Mechanical engineering


V. CALLEWAERT


G. DONKENG NGUEFACK


C. TURBIN

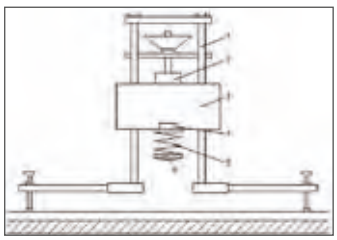
Vincent CALLEWAERT / Gidel DONKENG NGUEFACK / Clément TURBIN
Academic supervisor: T. SAYET
Industrial supervisor: L. BOUTEN

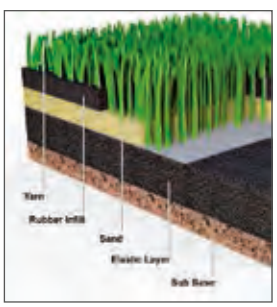
Company: Décathlon

Objective/motivation
In the design of sports shoes, the company Decathlon has to characterize and model for the interaction between the ground and the sole. The aim of this project is to determine the representation of the ground in a numerical model, which would represent the interaction between the ground and the sole. The ground can be a track or a football turf. To make this numerical model, we have to identify the behaviour law of the grounds cited above and identify the types of modelling that we are going to use. To carry out this project, we used the software of finite element analysis, Abaqus.

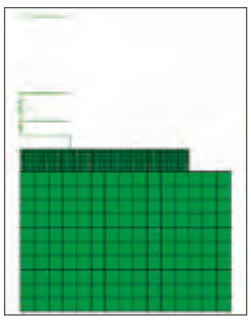
Results
To achieve this project, we needed to collect some information about the behaviour of the surfaces above in order to model the impact of shoes on it. Thanks to existing literature, some research exists on both behaviour laws of athletic tracks and turf. With regard to the latter, different laws exist to predict the behaviour such as hyper-elastic, viscoelastic or microfoam models. For athletic tracks, the best behavior law is a hyperelastic model called Mooney-Rivlin. Before creating a modeling between shoes and ground, we made a numerical model of Advanced Artificial Athlete (AAA test) in order to validate our ground modeling. This AAA test allows calculating the Force Reduction (FR).

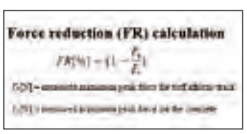
Keywords: modeling, interaction, shoes, track, turf


Advanced Artificial Athlete test apparatus



Artificial turf


Numerical model of Advanced Artificial Athlete test on Abaqus



Force reduction formula calculation

Contact: vincent.callewaert@etu.univ-orleans.fr ; gidel.donkeng@etu.univ-orleans.fr ; clement.turbin@etu.univ-orleans.fr

Monitoring of caterpillars

Environmental engineering


P. FELICIANO


J-B. GREE


L. SIVAGOUMAR

Paul FELICIANO / Jean-Baptiste GREE / Ludovic SIVAGOUMAR
Academic supervisors: J. FANTINI, S. TREUILLET
Industrial supervisors: F. MOAL, J. ROUSSELET

Company: INRA

Selected participant
13th Annual Final Year Projects Forum

Objective/motivation

Global warming has led to a lot of significant changes in ecosystems. For instance, habitat areas and processions periods of pine processionary caterpillars have evolved during the past few years. This species settles more and more to the north, and the procession period might happen between September and June instead of February and April as before. These caterpillars represent a health risk for the population because of their stinging hairs, which is why it is important to prevent population when the risk of procession is high. A forest research laboratory wants to create a predictive mathematical model of caterpillar's processions. Our objective in this project is the creation of an embedded system to collect data about the period of processions and meteorological information. This system must be autonomous and integrated in a trap already used.

Results

Our system is composed of a concentrator connected to different collectors. Collectors will be settled directly in pines, with a trap named ecopiege. The detection of caterpillars' processions is made thanks to sensors and Arduino technology. There are many possibilities in order to detect the caterpillars' processions, but we chose laser detection as the final solution. Moreover, the temperature will be recorded every hour. A large capacity battery coupled with a solar panel ensure autonomy, and the collectors can be use for three months without human intervention. Communications between collectors and the concentrator are done with the LoraWan network. The maximum distance allowed is 600 meters. Data will be stored and viewable on a public server (Cayenne). Everybody with an access will be able to see the meteorological and processions information on graphics.

Keywords: ecology, monitoring, caterpillar, prediction, data


Caterpillar


Ecotrap

Contact: paul.feliciano@etu.univ-orleans.fr ; jean-baptiste.gree@etu.univ-orleans.fr ; ludovic.sivagoumar@etu.univ-orleans.fr

Numerical simulation under Abaqus for the deformation of a reinforced fiber on pure bending

Mechanical engineering


S. BI


S. SUN


T. WEI

Shuran BI / Shiwei SUN / Tianming WEI
Academic supervisor: J-L. DANIEL
Industrial supervisor: A. HIVET

Institution: LaMé laboratory

Objective/motivation

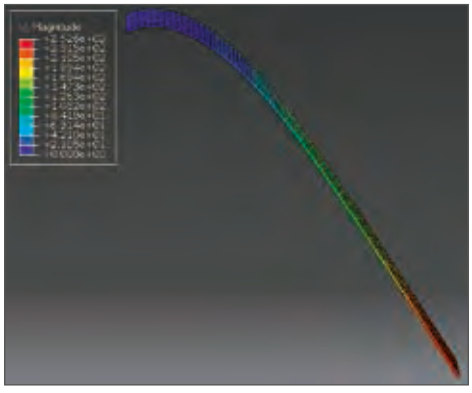
Our task consists in reproducing the bending behavior of different fibers, characterizing the heterogeneity of the bending stiffness for carbon fibers, and performing simulations with different stiffness distributions for reproducing experimentally observed dispersion. More precisely, our missions include building a numerical model for the carbon fibers under Abaqus, applying the properties and obtaining the curves by the output of our model. Once we got the curves, we could compare them with the real curves obtained by experiments. If they were not in accordance, we should change the shear modulus G13 we applied in Abaqus and figure out a solution to make the numerical curves and experimental curves correspond.

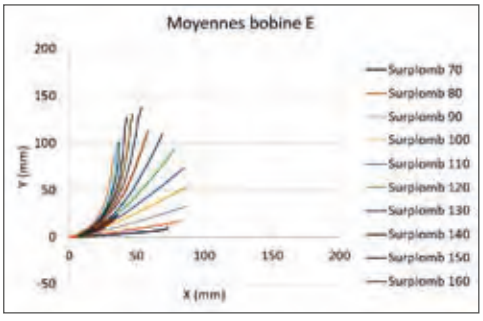
Results

The thickness of the carbon fiber has a massive influence on the characterization of bending stiffness. Different stiffness distributions of the carbon fiber represent the characteristics of the heterogeneity in bending. After applying a correct value of thickness, we found exact shear modules along the length of the model. Based on the bending stiffness distributions that we have found, the simulation results are in accordance with curves obtained by experiments.

Keywords: numerical simulation; Abaqus; reinforced fiber; shear modulus; pure bending


Modeling operation on Abaqus


Displacement of 200mm carbon fiber in X-Z plan



Experimental curves

Contact: shuran.bi@etu.univ-orleans.fr ; shi-wei.sun@etu.univ-orleans.fr ; tianming.wei@etu.univ-orleans.fr

Phased array ultrasonic inspection of weld joints

Materials engineering


S. BIN SIMON


C. DELPECH


M. MUSSELIN

Suhaimi BIN SIMON / Clémence DELPECH / Mathias MUSSELIN
Academic supervisors: M-L. BOUCHETOU, L. DEL CAMPO

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Objective/motivation

The aim of the project is to create a practical work for the 4th year students of Polytech Orléans in the specialty ICM (Innovations en Conception et Matériaux). The students will use the phased array ultrasonic equipment called PRISMA from the company Sofranel in order to find the defects in a weld. For the students, the goal of the topic is to learn how to use an advanced non-destructive method to inspect a component (a pipe or a plate, for example). We chose this project because we would also like to learn this method and discover this new equipment.

Results

We started the project by researching the theory of ultrasonic detection and, more precisely, phased array inspection. Then we learnt how to use the device to be able to explain it to future students. At the same time, we wrote the topic of the practical work with clear instructions, step-by-step using schematics. The topic starts with an explanation of the purpose, the theory of the phased array ultrasonic inspection and how the device works. After reading this part, the students will have to calibrate the probes before using the equipment on a specific weld of a steel plate. This weld was made with particular defects by Sofranel (their position is known) and the students will have to find them. Then, they will have to find other different defects in other plates.

Keywords: ultrasound, non destructive inspection, phased array, defects, weld


Schematic of the operating principle


Ultrasonic inspection using the conventional probe


Ultrasonic inspection using the phased array probe

Contact: suhaimi.bin-simon@etu.univ-orleans.fr ; clemence.delpech@etu.univ-orleans.fr ; mathias.musselin@etu.univ-orleans.fr

Practical work on dilatometry

Materials


A. BEAUNEVEU


O. ELYADINI


Q. VARENNE

Arthur BEAUNEVEU / Ossama ELYADINI / Quentin VARENNE
Academic supervisor: M-L. BOUCHETOU

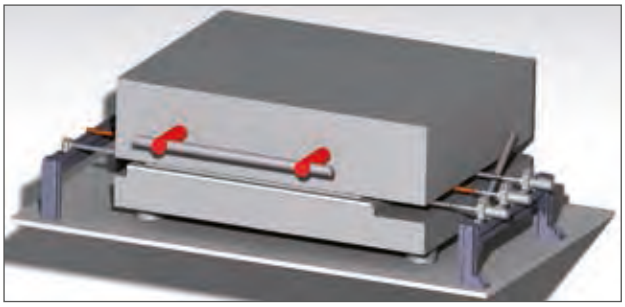
POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Objective/motivation
Our project consists in creating a practical work about dilatometry. This branch of material science studies the effect of heat on a part. Thermal expansion can be an easy concept to understand. Indeed, when particles are heated, their interaction is enhanced. Boiling water is an example of thermal expansion: the molecules are agitated and the water volume gets bigger. However, this phenomenon is quite hard to control, which makes it a frequent problem encountered in the industry. Rail buckling is a result of stresses from unanticipated thermal expansion on long continuous rail tracks. Therefore, our goal is to set up two experiments in order to demonstrate that metal expands when heat is applied. This practical work is designed for second year students at Polytech. It falls within their general courses which give them solid scientific bases.

Results
During the first experiment, three tubes of different compositions will be heated by running steam through them. The expansion of the tubes is then measured visually using a special ruler. This experiment is just an introduction that will familiarize the students with the subject. The second experiment requires a longer preparation. It involves three metallic rods that are heated in an oven. Once the rods have reached the desired temperature, displacement sensors will measure the expansion as a voltage value that student can have access to using a voltmeter. The metric value of rods expansion can be found by a simple transformation. Students will determine the linear coefficient of thermal expansion, given the length alteration previously found. With this practical work, they should be able to understand and analyze the impact of thermal expansion on different materials.

Keywords: dilatation, thermal expansion, experiment, measurement


Oven


Thermal expansion of rails

Contact: arthur.beauneveu@etu.univ-orleans.fr ; ossama.elyadini@etu.univ-orleans.fr ; quentin.varenne@etu.univ-orleans.fr

Realization and modeling of composite bridge for SAMPE contest

Mechanical engineering, Materials

Raphaël BONDO / Jane WITAS / Shaofeng XU / Kanwen ZHENG
Academic supervisors: B. CAM, A. GASSER


R. BONDO


J. WITAS


S. XU


K. ZHENG

SAMPE Contest (Society for the Advancement of Material and Process Engineering)

Objective/motivation

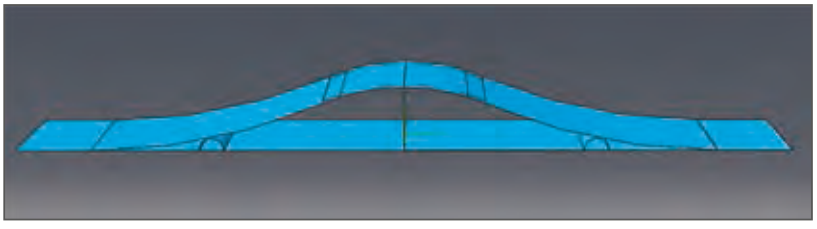
The aim of this project is to manufacture and model a composite bridge as part of the competition organised by SAMPE (Society for the Advancement of Material and Process Engineering). Currently, the main challenge is testing bridges in four-point bending and trying to reach the higher resistance (strength/weight ratio) using only materials provided by SAMPE. By manufacturing composite specimens and performing mechanical tests as shear load, results can be compared to those obtained by finite element simulation on Abaqus software. According to previous results obtained last semester, we decided to choose an existing bridge geometry and to focus on gluing because it was the reason for failure most of the time.

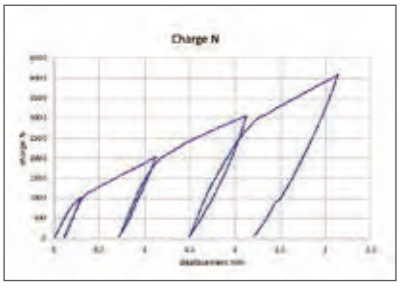
Results

The process of specimen fabrication is long and tedious. Thus, we had to make several attempts before successfully obtaining usable specimens. In order to simplify the work of future students on the project, we wrote a detailed procedure of fabrication of these specimens. Indeed, the quality of the bridge manufacturing will influence its strength tremendously. We have also improved the geometry by adding reinforcements, by focusing on the interface interaction. Experimentations showed that the behavior of the gluing depends on the kind of surface (smooth or rough). The next step in this project will be to build the bridge in full scale and to model it on Abaqus.

Keywords: composite, modeling, strength of materials, shear, behavior law


Composite bridge prototype


Abaqus simulation of composite bridge



Shear discharge graph

Contact: raphael.bondo@etu.univ-orleans.fr ; jane.witas@etu.univ-orleans.fr ;
shaofeng.xu@etu.univ-orleans.fr ; kanwen.zheng@etu.univ-orleans.fr

Solar Cup

Mechanical engineering

J. DELAGE

I. IBBA

L. RENAUDON

Julien DELAGE / Insaf IBBA / Logan RENAUDON
Academic supervisor: E. BEURUAY

Event: Solar Cup annual race

Objective/motivation

This project is about creating an autonomous solar vehicle so as to participate in this year's race at the end of June. We have been working on this project for two semesters. The mechanical study is completed, and all the components have been chosen, we have also found the suppliers to provide us with all that we need. The new chassis has been designed and the CAD drawings of the workpieces are finished as well as the energy study. This project will allow the ICM specialty to open up to the eco-design of electric vehicles, to designing a functional prototype and optimizing the prototype for the following years.

Results

Because of an incident last year during the race, we have decided to create a new chassis with a new material. We currently have the new design, the mechanical and electric components and the steering system. Regarding the main components such as the solar panels and the battery used to power the vehicle, we kept the same used last year. This project will be taken over by fourth-year students. They will have to finish up ordering all the auxiliaries to ensure all the links in the power chain and the items needed to carry out the assembly of the vehicle, the preparation of the pilots and the participation in the race.

Keywords: solar panel, motor controller, solar vehicle, prototype, Chartres Solar Cup

Contact: julien.delage@etu.univ-orleans.fr ; insaf.ibba@etu.univ-orleans.fr ; logan.renaudon@etu.univ-orleans.fr

Thermomechanical modeling of a heat exchanger

Mechanical engineering

Marion GAUDET / Michaël GAUTREAU / Jérôme ROBICHON
Academic supervisors: A. GASSER, J. GILLIBERT, T. SAYET
Industrial supervisors: N. GALLIENNE, N. RICHET

Company: Air Liquide

Selected participant
13th Annual Final Year Projects Forum

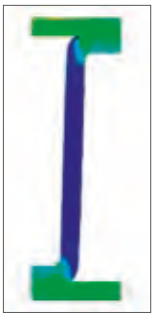
Objective/motivation

In order to save energy and money, Air Liquide wants to run their production during special hours instead of the current 24 hours-per-day production. The choice of the company is to reduce working time but they do not know if the machines are designed for this cycling production. The main machine is called the Brazed Aluminium Heat eXchanger (BAHX). Air Liquide uses BAHX to cool air down to nearly liquefaction temperature and to increase the pressure of the filtered air. Our goal is to verify, by the finite element method (on Abaqus software), if the aluminium waves, located in a BAHX, withstand the pressure involved. The aim of the waves is to increase the load losses to get a good heat transfer.

Results

This project began a few years ago. A homogenization method was used to determine the parameters of a material that has a behaviour equivalent to that of the structure with waves and plates (sheets). Its goal is to simplify calculations and simulations of complex structures. The present work is to use submodeling in order to simplify post treatment. Indeed, it is possible to focus on a particular area of the global model from the results of a simulation made by a homogenized approach to the overall model. Strains and displacements in this sub-structure can be obtained without examining the entire model. This method is often used in the case of complex structures in order to save money and time. In parallel to this numerical approach, some tensile tests were performed on aluminium tensile specimens. A protocol was created to determine the mechanical characteristics of the material such as Young's modulus and damage. The results were compared to those obtained by digital image correlation.

Keywords: heat exchanger, submodeling, homogenization, finite element method, tensile test

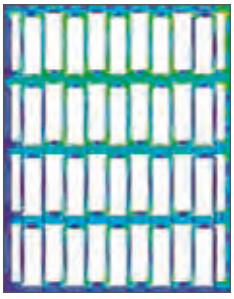


Submodel of half wave

Brazed Aluminium Heat eXchanger (BAHX)

Stack of aluminium leaflets

Folded sheet metal in waveform



Heterogeneous global model

Contact: marion.gaudet1@etu.univ-orleans.fr ; michael.gautreau@etu.univ-orleans.fr ; jerome.robichon@etu.univ-orleans.fr

Virtual reality conception

Mechanical engineering


C. DESENCLOS


A. GILBERT


L. LU

Cindy DESENCLOS / Arno GILBERT / Linfeng LU
Academic supervisor: J. GILLIBERT

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Selected participant
13th Annual Final Year Projects Forum

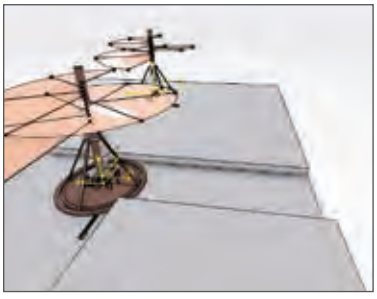
Objective/motivation

The immersive reality design highlights the shortcomings and flaws of CAD designs by allowing the designer to highlight future problems, such as design error or repetitive strain injury for the future user, using modern tools such as augmented reality or virtual reality. However, these technologies require a phase of configuration and debugging. A 3D digital model is created with all the equipment installation and configuration as well as a debug tutorial. We are going to explore 3DExperience software usage as well as the understanding of how immersive virtual reality works, having the awareness of the possibilities of the benefits and limits of immersive reality in the field of industrial design application.

Results

We created a virtual space for the Polytech Orléans Open House 2019 as well as a configuration of both software and hardware. More specifically, potential users who want to experience our VR equipment will be able to move around in the virtual space with two controllers in hand, catch objects with gravity applied, and have simple teleportation and achieve collisions between them, etc. A simulation will be done with a mechanism called 'La Vis', which was first imagined by Leonardo da Vinci and is a vertical-propeller aircraft interpreted by some as a forerunner of the modern helicopter. The objective is to manipulate the mechanism with two controllers and visualize the movement in the helmet. At the same time, we need to write a complete tutorial of both software and hardware configuration and user's guidance.

Keywords: virtual reality, design, HTC VIVE, 3DExperience, interaction


Interactive experience 'La Vis' with HTC Vive


User experience with HTC VIVE


Exploded view of 'La Vis' in the virtual reality space

Contact: cindy.desenclos@etu.univ-orleans.fr ; arno.gilbert@etu.univ-orleans.fr ; linfeng.lu@etu.univ-orleans.fr

Production Management

Becoming self-sufficient in water

Environmental engineering


R. POUILLY

Regis POUILLY
Academic supervisor: J-B. VIDAL
Industrial supervisor: G. LARDIER

Company: undisclosed (confidential)

Objective/motivation

Sugar beets are made up of 20% sugar, 75% water and 5% pulp. The process of sugar extraction creates sugar, pulp, and water. We use water in different steps of the process, including in the boiler, in washing, or to make a dilution. We have two boilers that produce 115 tons of steam each hour. To produce this amount of steam, we need a specific quality of water. If the water quality is too bad, we risk breaking our boilers. We can make sugar without additional water if we use only the water extracted from the sugar beet. When the factory is functioning, it is autonomous. However, to start it we need a large quantity of water, which is why we want to stock an additional quantity of water to use during the next production period.

Results

Our solution to store water was to create a tank. A few years ago, our boiler worked with fuel oil, which is why we explored a solution to convert the old fuel oil tank in the water cistern. With this new functioning, we needed to change our water circulation system. In collaboration with sugar manufacturing workers, we developed a specific function to circulate the water in the cistern. The tank needs a specific coating in order to maintain the water quality. Now we are waiting for the budget for this project (around 100,000€). Action to convert the tank is planned to take place in a few years. This modification will allow us to be 100% self-sufficient in water and we have also added some new functionality to have an easier driving process for water.

Contact: regis.pouilly@hotmail.fr

Control of leak maintenance in a power plant

Production engineering


T. TOURNEUR

Tristan TOURNEUR
Academic supervisor: J-M. AUFRERE
Industrial supervisor: A. BARRAUD

Company: undisclosed (confidential)

Objective/motivation

A power plant is a much-regulated facility. In this context, we have to manage the quantity of active leaks to respect norms and laws. Furthermore, the Chief Executive Officer of the power plant has his own demands. When we combine both, our goal is to reduce the number of leaks from 230 to 150. A power plant has a strict maintenance schedule which requires us to respect a few milestones. The most important is to reach 150 active leaks before the end of unit outages because after each restart, a self-sufficient agency checks that the power plant is able to produce energy. If the number of leaks is above 150, outages can be postponed.

Results

After several months working on this project, my team and I can claim two main good results. First of all, to complete this assignment, we had to make an automated file which makes an inventory of all leaks on the facility. This file is a real success because no leaks are going to be forgotten anymore. Then, thanks to this file which helped us to locate leaks, we reached the objective of 150 leaks on the facility, one month before the deadline. A few months after this achievement, the level of leaks is consistently under 150. Through this task, our power plant is one of the best French power facilities regarding leaks.

Keywords: maintenance, project management, planning, management

Contact: tristantourneur@hotmail.com

Conveyor extension to optimize logistic labor

Mechanical engineering

P. LE ROUX

Pierre LE ROUX
Academic supervisor: C. DUROS
Industrial supervisor: J. COURAT

Company: undisclosed (confidential)

Objective/motivation

With the recent acquisition of a new project, the 3V5 project concerning painted products, a company must transport welded products from welding machines to painting machines. Thus, we want to develop a blueprint the same way we have done for an assembly unit, especially by bringing new machines to fulfil the customer's needs. We carried out an analysis in order to select the best method according to our needs and constraints: we compared all the possible solutions to our problematic, whether financial or safety, thanks to a flow study. This project allowed me to work within a team that involved each department and made me improve both my technical and management skills.

Results

Thanks to the analysis we carried out, the choice was clear that by extending the painting conveyor, we have the best result. Furthermore, budget monitoring also showed the effort at reducing project costs by 10%, which was actually a second objective we managed to achieve by reducing the total costs by 15%. By extending the conveyor, we will be able to drastically reduce the number of operators while satisfying the customer because we reduced logistic labor, which doesn't have added value. Consequently, the manufacturing costs decreased so that the plant increases its margin of profit as well as increasing safety by splitting up the flows, making the plant more competitive within its group.

Keywords: flow management, project management, design

Example of an aerial conveyor

Contact: pierre.le_roux@hotmail.fr / pierre.le-roux@etu.univ-orleans.fr

Creation of an inspection tool

Production engineering

Paul MONTOYA
Academic supervisor: J. FANTINI
Industrial supervisor: F. MARANJON

Company: Essity

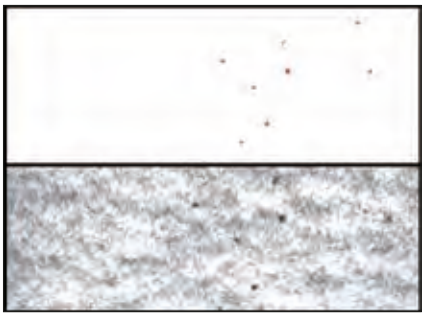
Objective/motivation

In order to improve our client satisfaction, focus has been turned to a recurrent quality problem. The analysis showed that tracking of the problem was lacking. I was tasked with finding a way to improve the reliability and accuracy of quality control.

Results

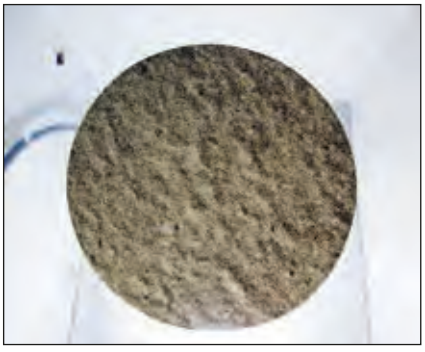
Through the many possibilities, it was decided to implement a new tool based on an industrial vision system. This new tool allowed us to improve the check allowing us to get reliable and accurate data, gain additional information for the defect tracking, and reduce the time spent controlling.

Keywords: industrial vision, quality



Highlighting defects – Counted and measured automatically

New system – automated inspection tool



Old system - visual inspection using a light and a glass plate

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

Definition and implementation of a preventive maintenance plan

Production engineering


C. RAHON

Camille RAHON
Academic supervisor: C. DUROS
Industrial supervisor: G. PELLAT

Company: SKF

Objective/motivation

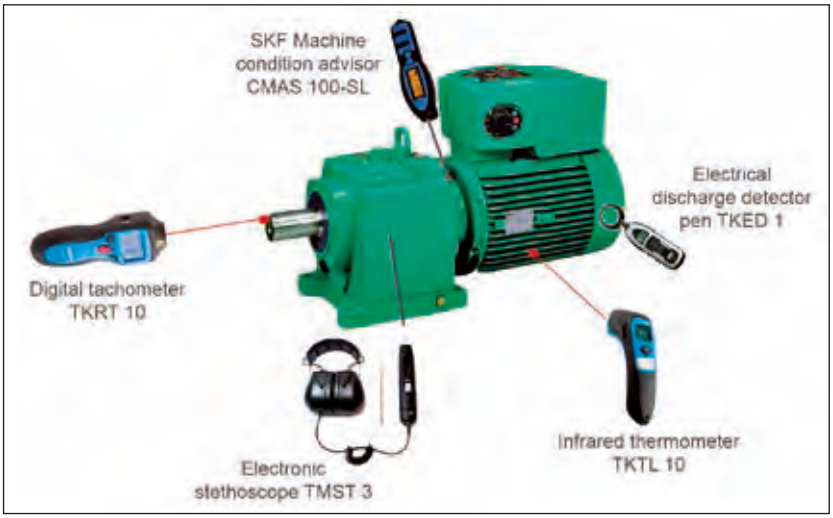
SKF is a part of the worldwide leaders in the domains of bearings, seals, mechatronics, lubrication systems and services. The St. Cyr/Loire site, where I perform my traineeship, is divided into several factories with in particular the manufacturing of deep-groove ball bearings. My main project consists in defining and implementing a maintenance plan on the critical machines of a pilot production line. It stems from the Maintenance Excellence program which is decided at a strategic level and aims to reach goals such as improving the reliability and the availability of the machines. Accordingly, being in the maintenance domain, my overall job consisted in defining the way to perform the right maintenance, on the right equipment, at the right time, with the right people and for the right reasons.


Grinding machine, type of critical machine

Results

To ensure the improvements by means of the actions of the Maintenance Excellence projects, and in particular with my project, our improvement maintenance team follows some KPI up (Key Performance Indicators). Among them, for each critical machine we follow up the MTBF (Mean Time Between Failure), D-Time (unavailability time) or else a strategic ratio (unplanned maintenance time compared with planned maintenance time). Following the implementation of the Maintenance Excellence program and maintenance plan on critical machines, the trend is positive with a D-Time diminution of approximately 50% and a dominant planned maintenance time. In addition, an important reduction of maintenance costs has been noticed.

Keywords: preventive maintenance, maintenance plan, breakdown elimination, CMMS, FMEA



Example of preventive tasks of a maintenance plan

Contact: camille.rahon@etu.univ-orleans.fr

Generate profit from scrap melting

Production engineering

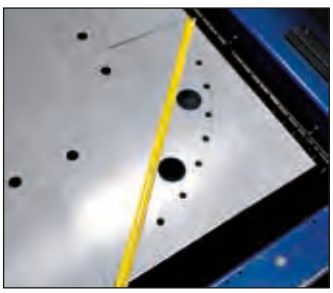

G. BATUT

Gabin BATUT
Academic supervisor: H. LAILHEUGUE
Industrial supervisor: G. RIPAUD

Company: Nidec Leroy-Somer

Objective/motivation

The Leroy-Somer factory in Orleans produces high-power alternators for the sector of energy production such as water, wind, gas turbine and diesel powered applications. At the beginning of the manufacturing process, several sheet metalwork operations are done for a part by stamping and laser cutting. These processes generate on average 50% scrap, today sold to a metal merchant. The goal of the project is to sell this scrap to the melting plant of Leroy-Somer Angoulême. I am in charge of the management of this project: installing the equipment on the stamping processes, accompanying operators and modifying their habits on the laser cutting, investigating and solving issues for the full completion of the project, communicating with melting plant on the metal quality validation, leading meetings for decisions, validating actions plan and, finally, contacting suppliers.


Test on laser cutting

Results

The new process has to be put in place for the end of July 2019 and the planning is divided for each means of production involved. The result is conditioned by the metal specifications validation on the stamping scrap which is more uncertain than the laser cutting scrap. Equipment needed and changes are also different on these two means. Laser cutting is more concerned with human change than the stamping process, which is more about equipment change. The return on investment at the launch of the project is at 50k€ in two years for each equipment calculated, with total scrap volume produced for a month on the equipment and the profit generated by a higher selling price for Orléans and a lower raw material price for Angoulême. In terms of quality, the Orléans scrap has to be used in the melting process of a specific casting range, respecting the bill of supply specifications.


Samples of stamping scrap

Keywords: change management, laser cutting, stamping process


Reflection and observation on the unloading operation

Contact: batut.gabin@gmail.com

"Good at first time" adjustment

Production engineering

Y. YAHYIOUI

Yosra YAHYIOUI
Academic supervisor: E. COURTIAL
Industrial supervisor: R. LAFON

Company: Mechachrome

Objective/motivation

The Right First Time project adjustment of X (piece that we machine at Mecachrome) was launched to control variability. It has been found that the X generates approximately 2119 hours of loss (three months). Three objectives were defined:

- Quality: Introduction of new standards to reduce variability of execution
- Cost: Cost of the project must not exceed 5000 euros
- Deadlines: Respect deadlines that were scheduled
- Performance : Reduce by at least 90% touch-ups requested by the control department

Results

The implementation of actions is still in progress today, but we can already confirm the following improvements:

- Introduction of three new standards that replaced old documents
- Standardization of work
- Touch-ups were reduced by 40%

In the coming years, we will set up a video training to support execution. This will not only facilitate the integration of new people but also will secure single standard and a single way of working and therefore control the variability of the process. This approach is part of the "Zero defects" and "Digitalization" projects undertaken at corporate level.

Keywords: adjustment, quality control, X (piece that we machine at Mecachrome)

DMAIC schematic

Contact: yosra.yahyioui@ent.univ-orleans.fr

Implementation of fabrication orders in the ERP

Production engineering


D. HAMON

Damien HAMON
Academic supervisor: A. FONTE
Industrial supervisor: D. BARDET

Company: undisclosed (confidential)

Objective/motivation

As markets grow, there is a need to improve labor and equipment management in order to honor orders on time. In this context, my mission was to raise the rate of service of the preparation sector of a company. The load on the stations being difficult to achieve on the posts upstream, this resulted in overloads and therefore delays in order picking. Due to delays in preparation, the picking service was late and therefore the delay was noticeable to customers. We had a service rate that was not in line with objectives. The target of the manufacturing order (OF) put in place is to better distribute the workload on various positions. This improved distribution will limit delays and thus increase the rate of customer service.

Results

After several months of work on this project, my team and I can claim two good results. First, to complete this mission, we had implemented manufacturing orders in the Enterprise Resource Planning (ERP). This implementation allows us to manage the workload of all workstations and to adapt it to their capabilities and available workforce. In addition, we changed the deployment of schedules on workstations. This deployment is now done dynamically with a daily update. The dynamics makes it possible to better manage the new OFs and especially to prioritize in order to produce on time. A few months after this achievement, the first results are an increase in the service rate of the order picking sector. We still do not have enough feedback to see improvements in customer service. Through this mission, we went from a pushed system to a pulled system.

Keywords: optimization, production, supply chain, project management, flow management

Contact: damien-hamon@hotmail.fr

Implementation of preventive maintenance

Production engineering


K. ROUX

Kevin ROUX
Academic supervisor: G. HIVET
Industrial supervisor: S. BARRE

Company: Pro-Finish

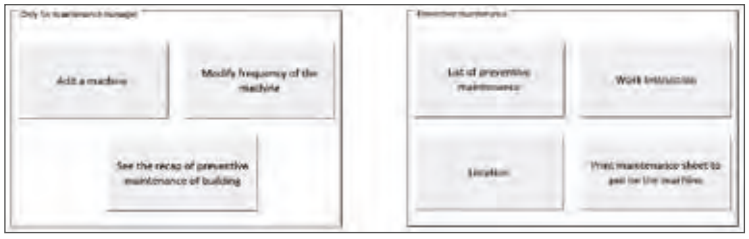
Objective/motivation

To validate my degree, I had to do an internship abroad. I did my project with PRO-FINISH and two other companies which work with PRO-FINISH, a Thai company near Bangkok which makes bracelets for luxury watches. In this company, there was no maintenance management. My objective therefore was to introduce and to implement preventive maintenance into three companies. As there were almost 800 production machines and 300 building machines involved, a lot of time was required to do it.

Results

I have now applied preventive maintenance for building machines in the three companies, using Excel. I hired three people to do it. I contacted the suppliers of the machines to know what kind of maintenance the machines need and how often. Through my project, all the machines have received preventive maintenance. Thus the building machines have fewer breakdowns. I am now planning with the boss of the group to go to work in the company when I get my degree to continue this work, to implement the preventive maintenance of production machines and to improve production.

Keywords: optimization, production, maintenance, project management



Man-machine dialog

Contact: kevin-roux@hotmail.fr

Improve reliability of buses fleet

Production engineering


C. HYOLLE

Corélien HYOLLE
Academic supervisor: B. ROUSSEAU
Industrial supervisor: L. REIBELL

Company: KEOLIS Orleans Val de Loire

Objective/motivation

The objective of this project was to improve the reliability of 150 buses. We had to find out which parts were too old and should be replaced, plan preventive actions and create standard control sheets for preventive maintenance. We had many reliability issues because the bus fleet is a bit old and the technicians did not have the same work methods. When I started this project, an average bus had approximately 3.1 breakdowns every 10,000 km (the fleet buses cover approximately 8,000,000 km/year). The budget allocated on this project is around 150K€ for new parts and I had one year to renew all the defective parts of the bus park.

Results

After studies, we found out that ten parts caused most of the issues (water pump, brakes, external doors, alternator, suspension, starter, transmission, injectors and engine beam). All these parts accounted for around 60% of breakdowns. We decided to start with the parts which were causing the most important breakdowns like doors, alternator, water pump and engine beam. After one year, the reliability had improved by 3% (3 breakdowns per 10,000km). We continue to plan preventive operations on the other parts. This project is not finished and must to be updated and followed monthly.

Keywords: reliability, buses, apprentice, Orléans

Contact: corelien.hyolle@etu.univ-orleans.fr

Improve working conditions and productivity rate

Production engineering


F. LECLERC

Fabien LECLERC
Academic supervisor: B. LE ROUX
Industrial supervisor: F. VERNA

Company: Alstef

Objective/motivation

To develop my knowledge inside the company, I replaced my colleague as a workshop coordinator. My job was to create a work team to assess the situation in a context of business development and renewal of teams. I first prioritized tasks, supervised the process and checked the quality of conveyors before shipment to client sites. I developed many skills such as independence, assurance and responsibility. After this period, I had sufficient knowledge to identify the problems and the goal which was to develop production capacity: flow improvement, work area organization and practice standardization with tools such as 5S or Lean Manufacturing. Meanwhile, the goal was also to reduce hard working conditions and improve the ergonomics of workstations. To meet the deadlines, we divided the project into different steps like analyses, workflow and process standardization.

Results

We first analyzed the production process of roller conveyors in the logistic field to identify production problems and prioritize the actions to solve them. To decrease wasted time and reduce difficult working conditions, we moved the assembly area just next to the cutting machine. We then installed racks to increase storage capacity and organized the place of each part to allow quick retrieval. Third, we placed four workstations inside the assembly area and all of the parts for the assembly of the roller and chain conveyors. Above the work plan, instructions indicate the assembly method to facilitate the training period. Finally, we defined safety instructions to improve communication about safety rules. At the end of this project, working conditions improved, the operators were surprised by the improvements, and they were able to assemble one extra conveyor per day.

Keywords: working condition, Lean Manufacturing, process, production flow, standardization


Storage before shipping


Assembly workstations

Contact: fabien.leclerc1@etu.univ-orleans.fr

Improvement of performance of packing lines

Production engineering

Charlene BEN NSEKE
Academic supervisor: B. ROUSSEAU
Industrial supervisor: E. SAUVAGE

Company: Shiseido

Objective/motivation

In the luxury domain, companies need to be competitive. To achieve this goal, their firms need to be performant. In order to measure the performances of the packing lines, Shiseido uses the OEE (Overall Equipment Effectiveness) method. The aim of my project is to improve the OEE of packing line 21. This line produces the Dolce&Gabbana perfumes at a cadence of 45 products per minute. Nowadays, the OEE is around 46% and the aim is to reach 64%. To achieve this goal, we will first analyze the OEE in order to know why it is so low. Then we will create a work group composed of people who have the skills that could help us in this project. Finally, to know more about the root causes of the different failures, we will use the 5*why method.

Results

The aim of the project was the improvement of the performances of the packing line 21. Thanks to the 5*why method, we have determined the root causes of the different failures. It helps us to improve the OEE of packing line 21. We reached 60% thanks to the different actions we did on the line. We also improved the storage space of some equipment.

Keywords: OEE, packing lines, implementation, failures, equipment

Contact: charlene.ben-nseke@etu.univ-orleans.fr

Improvement of preventive maintenance

Production engineering

M. POUPAT

Martin POUPAT
Academic supervisor: A. FONTE
Industrial supervisor: A. BAUDIN

Company: Wilo Intec

Objective/motivation

Today, we maintain our production equipment periodically: each preventive action is planned weekly, monthly, or semi-annually but not according to the usage of each production tool. However, we spend a lot of time doing this preventive maintenance even though it may not always be necessary. To reduce this time, we decided to implement a new system: Preventive Maintenance in Number of Cycles (PMNC). A cycle represents a unit of usage of a production tool. The purpose of this new system is to count the cycles of each and to trigger preventive actions according to a frequency in number of cycles. Due to the complexity of the project, it has been split into two scopes. The first is the implementation of a temporary system on three tools with short-term available resources.

Results

We designed a software program on Excel® that shows the different meters of each tool. Every day, maintenance technicians click on a button to update the data. If the number of cycles for a maintenance standard of a tool reaches the trigger level, the color of the visual indicator will change so the technicians are easily warned. They can go to the place where the tools are stored. If the tool in question is absent, they put its related card on a special spot, so an operator will call them when the tool is back from the production area. When the operation is completed, they can validate it on the software program and it will be recorded. This temporary system allows us to try this new way of working and to identify potential issues for the final system.

Keywords: preventive maintenance, continuous improvement, project management, Intec 4.0

A technician performing preventive maintenance on a production tool with the software program in the background

Contact: martin.poupat@etu.univ-orleans.fr

Improvement of the organization of the modification department

Production engineering


M. BOUCLET

Maximilien BOUCLET
Academic supervisor: P. GRILLOT
Industrial supervisor: J. ALCANTARA

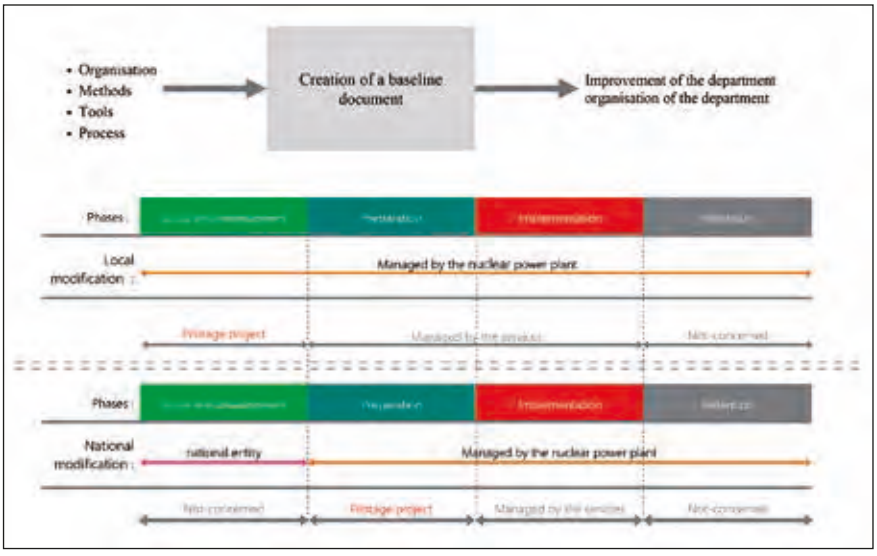
Company: EDF — Nuclear Power plant of Dampierre-en-Burly

Objective/motivation

Involved in combating climate change, EDF wishes to reduce its carbon dioxide footprint which is a factor of greenhouse gases. Also committed to reducing the share of fossil energy use, EDF has decided to build solar panel parks as well as wind turbine parks. Pending the construction of renewable solutions, EDF plans to continue to exploit nuclear and hydraulic energy, which do not release carbon dioxide. However, plenty of these nuclear power plants are going to reach their production time originally planned for 40 years. Therefore, EDF announced a program named "grand carénage" which consists of restoring nuclear power plants in order to improve safety. Taking note of the workload increase, my project is to improve the organization at the automatism and test service level allowing the group to integrate all projects.

Results

Our project is divided into several parts. First, we have to define the current situation: course of action, due date and all the actors present inside the integration process. Thanks to a SysML architecture, we have determined the structure of the project (use case, bloc diagram, requirements). Then we have to identify the internal and external dysfunctions in terms of automatism and test service. Through many meetings, we have to deal with the people involved in the process and set up an improvement strategy. To this end, we created a baseline document which includes all the methods and the use of computing tools. This document is accessible for a new recruit and allows them to standardize practices. In order to evaluate the relevance of this project, a presentation took place for management of the site. Finally, this project has been adopted by all actors of the process.



Keywords: reduce, nuclear power plant, program, safety, organization

Contact: Maximilien.bouclet@gmail.com

Information flow optimization

Production engineering


M. GUEDJ

Manon GUEDJ
Academic supervisor: A. FONTE
Industrial supervisor: T. SANTIN

Company: Latécoère

Objective/motivation

The project was to create a new database. The goal was to optimise information flow through capitalisation and centralisation of all information. The project concerns seven different types of departments in five countries. The purpose of this implementation was to save time in processing and have only one easy, collaborative and efficient communication channel. All the departments can communicate in the tool. We brainstormed to determine all the information needed in the base when someone wants to create a new alert. This project concerns all the events which block or possibly block production.

Results

Now we have a new interface use for each department and country concerned by the transmitted data. The base is translated in French and English. We therefore have traceability of all events and all departments found a quicker solution to reduce the impact to production. Because of this new communication flow, all collaborators use this tool to communicate and have the event history in one single server. Some services created a new workstation with someone who works only on all the alerts created in the interface. We also have some Key Performance Indicators through the database. After the implementation of this new database and assessment by all collaborators, we presented the project to the direction. Because of that, now we have a budget to digitize all the departments in the workstations and offices.

Keywords: collaboration, information flow, database, international, communication

Implantation of Latécoère around the world

Contact: manon.guedj@etu.univ-orleans.fr

Modification of maintenance walkway for TER Centre Val de Loire

Production engineering


J. MALLOL

Jules MALLOL
Academic supervisor: B. LE ROUX
Industrial supervisor: Y. AMIRAULT

Company: SNCF

Objective/motivation

The TER trains of region Centre Val de Loire are maintained at the maintenance facility of Saint-Pierre-des-Corps. This site has the capacity to keep up electrical and thermal trains. A part of the electrical fleet is reaching the end of its life cycle and it will be replaced by a new generation of trains. However, the maintenance walkway is adapted to the structure of the old one. The main difference between those two generations is, for the new one, the location of the systems which are placed on the roof of the train. Therefore, the project is to modify this maintenance facility and make it able to receive the new generation. Moreover, it must abide by the new labour code and safety rules for work on the roofs of trains.

Results

At the moment (September 2018), the functional specifications have been sent to companies able to do this kind of work. Four of them answered a proposition for the modification of the maintenance walkway. We have analysed the answers and we will choose one in December 2018. The modification of the facility will be achieved before May 2019 and the maintenance walkway will be operational in June. The replacement of the old generation will begin in September. Therefore, the project must be concluded before this date.

Keywords: project management, maintenance facilities, train

Contact: jules.mallol@etu.univ-orleans.fr ; mallol.jules@live.com

Optimization of tooling process and safety material

Production engineering

Mohamed BAHASSAN
Academic supervisor: P. GRILLOT
Industrial supervisor: S. JAMIN

Company: undisclosed (confidential)

Objective/motivation

Nuclear power is the main means of energy production in France and is a solution to meet the energy needs of an industrial country. While ensuring the safety of power plants and their personnel, a permanent effort is maintained to obtain quality production at a lower cost. To do this, it is necessary to improve the logistic performance of the activities and to carry out maintenance operations on the nuclear units. It is in this perspective that my industrial project is fitting. The main motivations that pushed us to implement this project are customer dissatisfaction, negative feedback and waiting hours. My main goal was to put an action plan in place to improve the quality of the tooling process and reach a waiting time of less than ten minutes, in order to ensure the distribution of tools and RP equipment in good condition, quickly and at the right time.

Results

In order to improve the tooling process, I used the DMAIC method. It was therefore necessary beforehand to constitute the project team. During the various workshops I was able to lead, we were able to make an exhaustive inventory of dysfunctions and thus identify corrective actions formalized in an action plan. An overhaul of the computer database allowed us to adjust our computer and physical stock and thus make our computer database more reliable. The overhaul of the maintenance process allowed us to reinforce the availability of tools and equipment. In addition, important work has been carried out in our tooling stores, which allowed us to streamline flows and better organize tool storage. All of these actions have helped us to achieve the goals we had set, such as reducing the waiting time at counters (<10 minutes) and improving customer satisfaction.

Keywords: logistics, management, tools, maintenance, 6Sigma

Development of the action plan

Contact: mohamed.bahassan@etu.univ-orleans.fr

Production line improvement

Production engineering


F. FAURE

Félix FAURE
Academic supervisor: J-M. AUFRERE
Industrial supervisor: C. WIESNER

Company: undisclosed (confidential)

Objective/motivation

To deal with order increases all around the world and be able to keep its leader position in the market and invest more money in research and development, a company has to improve its production line to reduce production time and cost. To improve the production process, some points need to be improved such as planning, stock optimization, quality, 5S and ergonomics.

Results

Working on production time paired with ergonomics allowed us to reduce production time by 1.5. Seeking to lighten the workplace, we reduced the component stocks on the line by three and the tools stock by two. Fixing some other points highlighted some quality problems. In fact, some frames were out of dimensional tolerance, so we corrected the mechanical plan and alerted the supplier. These actions allowed the company to change the storage on some stations, reduce the stocks on the line, identify some quality mistakes, fix them and also correct the production time to plan more each week. This also had a positive economic effect because reducing stocks and planning more increased earnings and reduced spending. In the end, all this work allows the company to improve its turnover by 10%.

Keywords: leader position, improve its turnover, optimization

Contact: felix.faure@etu.univ-orleans.fr

Reducing energy consumption

Energetics

K. VINCENT

Kévin VINCENT
Academic supervisor: E. COURTIAL
Industrial supervisor: N. DUDEL

Company: Faurecia

Objective/motivation

The objective of my project is to reduce energy consumption in the company, saving 16.5% of the total consumption of the plant from 2017 to 2019. My mission is to analyze the current situation and identify the energy deposit, which will allow me to find some solutions and plan them. Currently, the analysis is over and the search for solutions is in progress. For this step, I am working with an energy expert in energy consumption and the maintenance department because they know the different machines and technologies.

Results

The energy expert has identified some solutions. At the same time, actions are implemented by different departments such as human resources for the removal of the night team in the painting building, or the maintenance department regarding some machines. To conclude, many actions are in progress concerning several subjects, but it will be mainly during the last year (in 2019) that the majority of actions will be carried out to satisfy the objective set by the plant manager.

Keywords: energy, consumption

Contact: kevin.vincent1@etu.univ-orleans.fr

Reduction of production costs related to micro-drilling

Production engineering

S. GRISEL

Sylvain GRISEL
Academic supervisor: C. DUROS
Industrial supervisor: L. JARNAUD

Company: Delphi Technologies

Objective/motivation

I did my trainee period at Delphi Technologies located in Blois. Delphi is one of the biggest suppliers to car manufacturers in the world. In Blois, we design and produce injection systems for diesel vehicles. An injector is composed of several parts including the nozzle. The nozzle is composed of a body and a needle. For my second year of engineering school, I was assigned to the project of reducing the cost of micro-drilling of injection holes. Indeed, we spent about 1000€ each day to buy electrodes. At the beginning of the project, we identified four issues that had to be dealt with: loss, forgetting and breaking of electrodes, incomplete wear of electrodes, purchasing cost of electrodes, and strict follow-up of electrode consumption.

Results

To avoid too much loss when operators take electrodes to put them into the machine, we designed a system which allows operators to easily get electrodes out of the tube. The second modification is to improve the descent of electrodes to consume more of them. We found a solution allowing the electrode to go down until a length of 50mm. In addition, the purchase department found a new supplier that offers cheaper electrodes. We also put in place an automated distributor to provide production parts to the operators in order to regulate the output. Indeed, the purchase cost allows us to save about 34,000€ per year, the descent of the electrode, 50,000€ per year, and other savings are estimated at about 8,000€ per year. The entire project allows the company to save about 100,000€ per year, which represents about 25% of profit.

Keywords: method, continuous improvement, conception, cost reduction, production

Micro-drilling machine

Photo of an electrode (above coin). Actual diameter of coin is 2cm.

Contact: sylvain.grisel@etu.univ-orleans.fr

Reliability of a heat stress process on electromechanical instruments

Production engineering


B. BIOUDI

Benjamin BIOUDI
Academic supervisor: G. HIVET
Industrial supervisor: I. PERCHAT

THALES

Company: Thales

Objective/motivation

The company manufactures on-board and cockpit equipment for aircrafts. Thus, the products are submitted to extreme temperature conditions and fluctuations. The customers in their requirements specify these conditions. We found non-compliance on the heat stress process, which allows us to provide the customer the effective operation of the products, according to their needs. Indeed, during this process, we apply temperature cycles to products to eliminate their initial defects (break-in-period). In order to carry out this process, the company uses climatic chambers. The aim of this project is to make the heat stress process on our products reliable by characterizing and improving the performances of our production means. In addition, these non-compliances had a negative impact on our First Pass Yield indicator, resulting in a level under the goal set by the direction of the company.

Results

After analyzing and characterizing the climatic chamber performances with tests and by tracking temperature cycles, the conclusion that I reached was the inability of our production means to grant us the performance level that we need. The characterization phase allowed me to model our different requirements using SysML language, with the purpose of acquiring new climatic chambers. In addition, continuous tracking by a supervisor of the heat stress process had been set up to be able to diagnose its compliance in real time. These two solutions allowed us to enhance the First Pass Yield, i.e. our quality level, and go beyond the goal set by the direction of the company.

Keywords: automatic, climatic chambers, heat stress process, tracking, quality

Contact: bioudi.benjamin@gmail.com

Reorganization of a production space

Production engineering

A. BALVAY

Alizée BALVAY
Academic supervisor: S. GROSSELIN
Industrial supervisor: E. SANTOS

Company: undisclosed (confidential)

Objective/motivation

The redevelopment project of the company has emerged in an economic context in which we experienced a strong growth of demand. As a result, the organization of the workspace had to be redesigned mainly at the level of flow management. The goals were to clearly define the flows necessary to obtain a finished product, to optimize handling, and to banish as much as possible any movement that doesn't bring added value for the customer and thereby to outline a new organization of the machine park. We also found that there was no forklift traffic zone and no defined work area. This represented a very high pedestrian risk that we sought to master during this project. Finally, we wanted to eliminate sources of waste throughout the manufacturing process.

Results

Thanks to the realization of a flow mapping, we were able to identify the redundant flows and the most frequent crossings. From this analysis, we were able to define the position of each machine in order to handle products as little as possible. We then organized the work, after getting agreement from all the services constituting the company. It was very important for me to involve as many people as possible in this project because in this way, everyone felt useful and valued in the organization of production. It has been a collaborative project. The balance of this project was very positive because the investment made to achieve this new implementation quickly improved productivity and therefore resulted in a better turnover.

Keywords: Flow mapping, Improvement, Organization, Process, Workspace

The new implementation

Contact: alizee.balvay@etu.univ-orleans.fr

Reorganization of work area

Production engineering

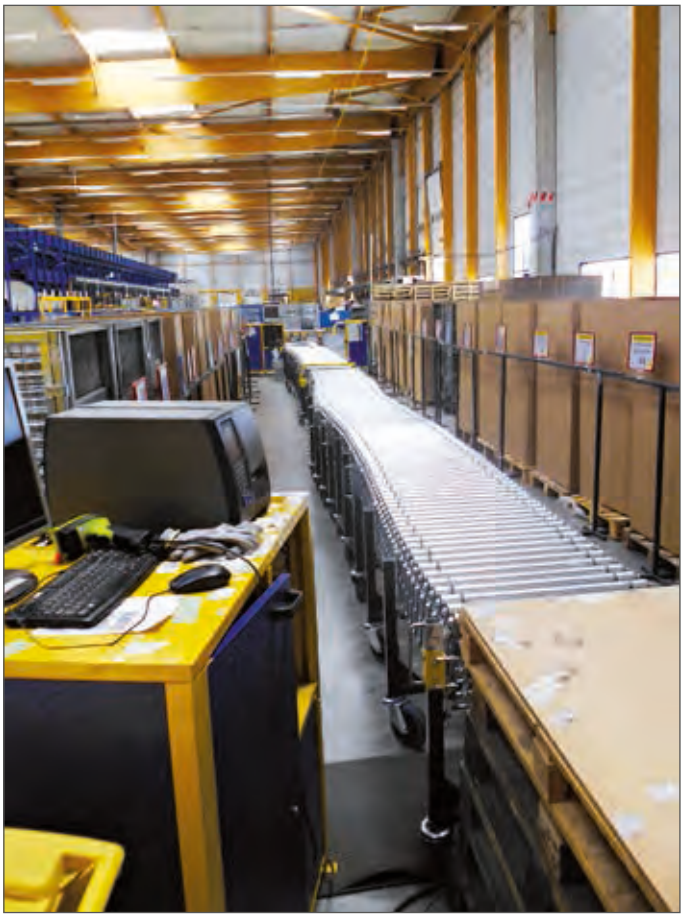

J. FONTAINE

Jonathan FONTAINE
Academic supervisor: S. TOUTAIN
Industrial supervisor: R. BRISSET

Company: Colissimo

Objective/motivation

In order to support its unstable traffic and absorb an activity surplus during the week, the Colissimo sorting center of Mer, in addition to using a sorting machine, sorts parcels manually in a special area equipped for this. However, the equipment used today does not permit efficient and fast deployment for manual sorting. The work area is made from recovery equipment, so it is impossible to achieve optimal manual sorting. The center wants to improve its manual parcel sorting in order to be more efficient.



Results

After various studies, I decided to propose several placements of the zone. Operators were able to choose the best placement for the job. I installed computers and printers to computerize the process. Thanks to the new placement and equipment, I installed a second manual sorting area identical to the first. These modifications reduced the number of actions made by operators and improved the operators' quality of life. This project was a success for the sorting center in several respects. During a comparable period, the number of parcels sorted manually rose per day, and the center was able to ensure the total sorting of parcels over the week. That is why Mer's platform can accept more unsorted parcels on time at the national level, such as those coming from high-traffic areas like the sorting center of Paris.

Keywords: improvement, ergonomics, work area, parcel

Contact: jonathan.fontaine@etu.univ-orleans.fr

Set up a pull-flow on a repair activity

Production engineering


M. PAPILLON

Mégane PAPILLON
Academic supervisor: A. FONTE
Industrial supervisor: C. MARTIN

THALES

Company: Thales

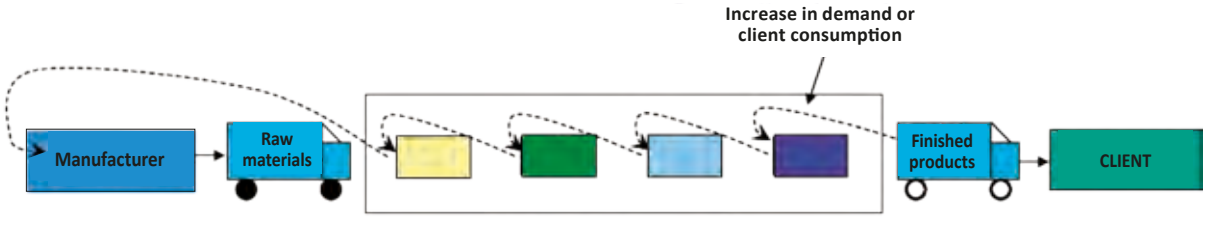
Objective/motivation

The aim was to improve productivity by setting up a pull-flow on our repair activity. The number of products we have to repair in the area we treat increases by at least 10% each year and we still have the same human and machine resources to handle it. We have to improve the way we repair so that we don't waste time and we use our resources in the best way. The pull-flow helps to achieve these goals. It is also a way to highlight the problems and improve the involvement of technicians, supervisors, support teams and even the director, to solve them.

Results

The flow is now pulled in a whole workshop and in logistic areas. We improved the problem solving and the way we work together. It also had an impact on our punctuality and quality of repair. Soon, we will develop the pull-flow on the site so we can offer our customers new and better services. The project led to faster repairs and gave the opportunity to develop technicians' competencies as they now know how to apply lean manufacturing in their everyday work but they also have time to develop their repair skills on other products or in our fablab.

Keywords: production, pull-flow, repair service, flow management



PRODUCTION CHAIN

Contact: megane.papillon@etu.univ-orleans.fr

Setting up the potential of productivity of a plant

Production engineering

Alexandre ROUX
Academic supervisor: E. COURTIAL
Industrial supervisor: L. ROBIN

Company: Faurecia

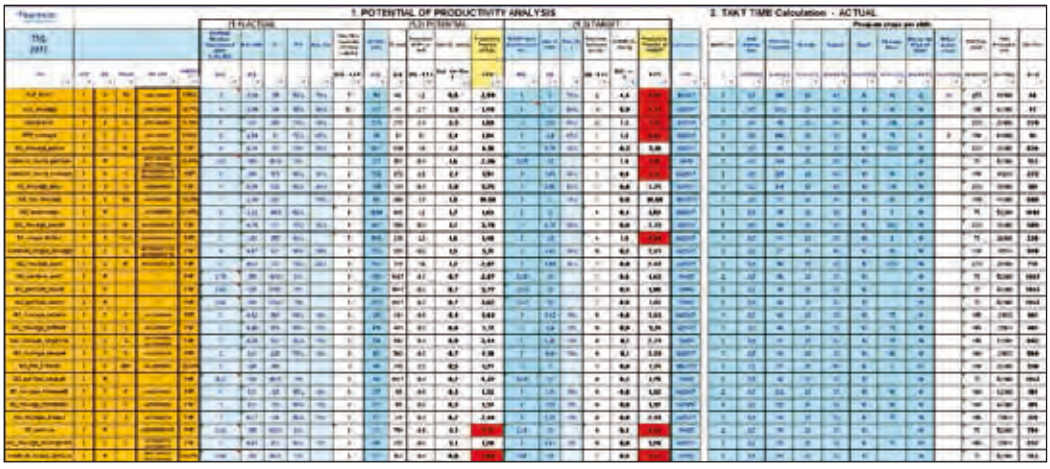
Objective/motivation

The aim was to build a tracking file of the potential of productivity on each production line of the site. The potential of productivity is calculated with the difference of the actual statistics like the DLE (Direct Labour Efficiency) indicator and the theoretical statistics we can expect on the production line. This file permits us to identify the lines with the highest potential and set up workshops to achieve the target. The final aim is to increase profitability of the targeted production lines and the efficiency of the plant by mastering the set up and the rhythm of production for each line.

Results

This file is now working and is updated every month and after each improvement workshop. We now know the productivity reached on each production line and the potential we can achieve. By using this file, we have set up workshops on the two highest potential on the site and reached the target we aimed. Those two lines are now more efficient than before. The final result was a gain of productivity up to 19% above standards for the first high runner of the site and a gain of productivity up to 14% above standards for the second high runner. This gain permits a savings of €70,000 per year for these two parts.

Keywords: productivity, lean manufacturing, continuous improvement



Potential of productivity analysis

Contact: alexandre.roux@etu.univ-orleans.fr

Test equipment retrofit

Mechanical engineering


S. TURCHINI

Sylvain TURCHINI
Academic supervisor: J-M. AUFRERE
Industrial supervisor: C. ROUSSEAU

Company: ASCO

Objective/motivation

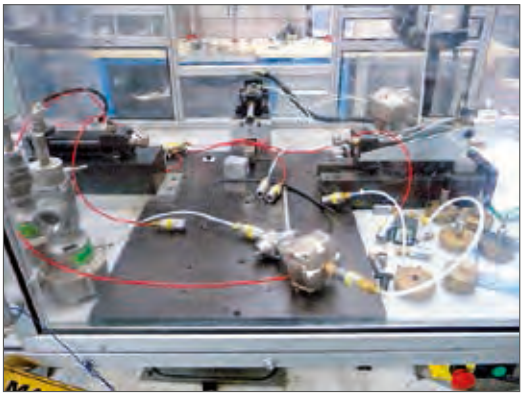
The concerned automated test equipment integrates the company valves sector, which represent 10% sales of the site. A retrofit consists of refurbishing worn-out equipment. The machine in question could not work fully because of specific tool sealing problems which were time-consuming. The company decided to carry out valve tests on a temporary manual post. Workforce cost had risen because of the operators' mobilization, which caused extra work and had to be stopped. The test control is conditioned by operators, so it is necessary to put the automated equipment back and change the technologies which were causing problems. Demand rises according to the forecast, thus it is necessary to honor orders and warranty product quality level. It is an opportunity to replace tests on the line. This will evacuate any handling error risk.

Results

A project team was created involving various departments such as methods, quality or maintenance. A project management was set up which I followed. It consisted of weekly meetings to follow up project progress and integrate new project requirements into the schedule. The mechanics, automation and pneumatic system of the automated machine were modified. I was in charge of the pneumatic and automation modification and the maintenance department carried out physical modifications. The pneumatic test technology was changed, including less mechanics, which were a source of the sealing problem. Pneumatic circuits and the GRAFCET machine program were modified to permit the new test process. The rehabilitation of the machine allows the original flux of the line to be retained. The manual test was removed from the line, and the time of product transport was removed.

Keywords:
retrofit, flow, test


Original state machine


Finished machine

Contact: sylvain.turchini@etu.univ-orleans.fr

Unpublished project in Production Management

The details of the project completed by this student in Production Management have not been authorized for publication by the company/institution.

Antoine HIGELIN
antoine.higelin@etu.univ-orleans.fr

Smart Building

Establishment of a real estate master plan

Smart building

Y. STERVINOU

Yann STERVINOU
Academic supervisor: S. RAGER
Industrial supervisor: R. CHAPUY

Company: Châteauroux Métropole

Objective/motivation

As an engineer apprentice for Châteauroux Métropole, I am working in the building department. I was asked to set up a real estate plan to improve the management of real estate from the city of Châteauroux and the urban community « Châteauroux Métropole ». We wanted to hire a consulting firm to help us create this real estate plan. I started by benchmarking other cities and the urban community to complete and retrieve information on similar projects in order to create the public contract. After this stage, the first objective is to make an inventory of real estate in the community. The project management assistant must then help us to establish a heritage management strategy. Then he or she must suggest a real estate master plan to follow for the next years.

Results

We have retained a program manager to carry out this mission. We are working on upgrading our building databases. Next, we will develop strategies to improve real estate management. The duration of the mission is one year. We hope that this real estate plan will enable us to reduce our heritage and will make it possible to prioritize the investments to be made to keep our buildings in good condition.

Keywords: building, management, public contract, property strategy

Contact: stervinouyann@gmail.com

Evaluation of the criticality of buildings

Smart building

T. BOIZARD

Tristan BOIZARD
Academic supervisor: S. TREUILLET
Industrial supervisor: P. ORTIZ

Company: Safran Seats

Objective/motivation

As an engineer apprentice for Zodiac Seats France, I am working in maintenance service. The company's facilities are getting old and I was asked to determine the percentage of acceptable loads on the metal frame of the main building. The objective is to know the maximum weight that can be supported by the frame. To do this, I needed to do a load descent capability of the weight of each kind of cables and systems (ventilation, sprinklers ...) and give an estimated value of the acceptable weight on the metal frame.

Results

The result of this evaluation is an Excel® table that can be used by any maintenance employee in order to know beforehand if the new or the future system that will be installed is too heavy for the metal frame. This table is linked to another one that updates the remaining acceptable weight on the frame.

Keywords: building, criticality, evaluate, optimization

Zodiac Seats France

Contact: tboizard36@gmail.com

Heating and cooling regulation optimization using outdoor temperature forecast

Smart building

M. IMBEAUD

Marie IMBEAUD
Academic supervisor: G. LAMARQUE
Industrial supervisor: S. JUILLOT

Company: Revame

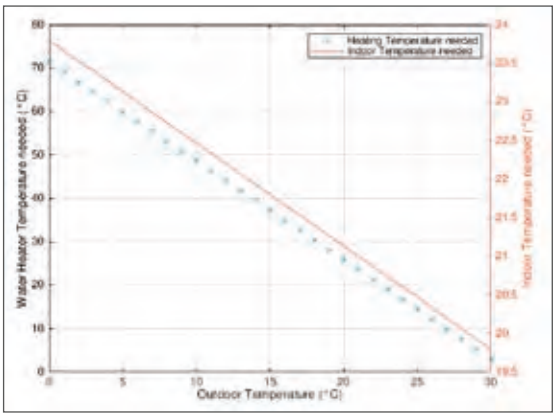
Objective/motivation

As part of my last year of apprenticeship for Revame, a building management system company, I suggested that heating and cooling temperatures could be regulated according to outdoor temperature forecasts and building characteristics (insulation, glazing types, …). Now, real-time temperature is used, and the production temperature is calculated following a linear equation identical for several areas. Using both outdoor temperature forecast and building characteristics, occupant comfort is ensured while the energy consumption decreases and corresponds to what is really needed. In fact, today's solution implies a higher consumption than what is needed, especially during mid-season. In the current environment, this project could help a main contractor to get higher certification levels such as LEED or BREAM, which are the main ones requested by the contracting authority.

Results

After expressing the heat and cool needs in the building based on a setpoint temperature, the production temperature needed for the heating and cooling devices is calculated. These calculations are done according to what our customer requested. In order to facilitate its deployment into our customers' buildings, we are developing a website allowing them to provide us with their contact details and the building characteristics. This way, the customer will receive an email every day with the production temperature needed to ensure occupants comfort in the building despite the outdoor temperature. Then, they only need to modify the heating and cooling device setpoint temperature in their building management system to reduce their energy bills and ensure the occupants' comfort.

Keywords: building, optimization, building management system, comfort, HVAC



Water heater and indoor temperatures needed depending on outdoor temperature for a setpoint temperature of 21°C

Contact: imbeaud.marie@gmail.com / marie.imbeaud@etu.univ-orleans.fr

Individualization of heating cost in collective houses

Smart building


H. PANCHKAWREE

Hillarie PANCHKAWREE
Academic supervisor: J-M. ROUSSEL
Industrial supervisor: D. LAVILLONNIERE

Company: OPAC36

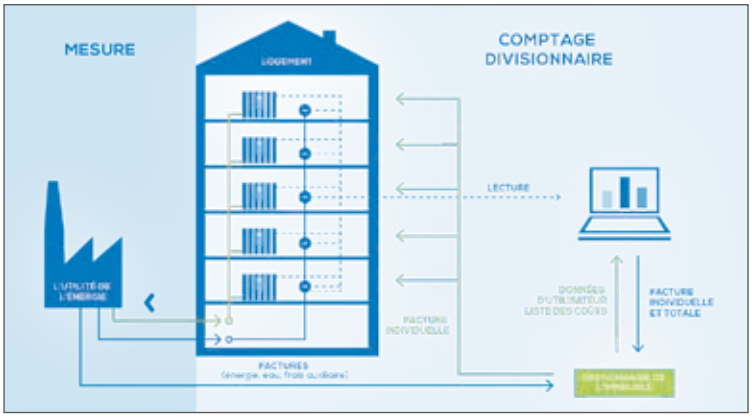
Objective/motivation

As an apprentice engineer in Smart Building for OPAC36, I am working in the Control of Energy Unit. The project is the individualization of heating costs in collective houses and the goal is to apply different technologies which estimate the real cost of heat production in a flat. With these components, users pay for their actual heating consumption. OPAC36 is a lessor and the main contractor in this project. To launch this project, I have many assignments such as sizing the real estate, evaluating the total budget, modelling the impact on the renter's bill in different buildings and focusing on the building where we have to install HCA. Yet, it is currently technically impossible. Moreover, the heating costs have been individualized to make users more responsible.

Results

At the beginning of the project, I started a benchmarking on the individualization of heating cost application by the different lessors in the district. I then collected a lot of information on the process application on the renter's bill. We had a first meeting with the contractor to discuss the deployment of Heart Cost Allocator on the real estate and the configuration of these technologies. The configuration point is how OPAC36 will count the calories that depend on the location of the flat in the building. In February, we will change some heaters in five buildings because the HCA does not respond to this type of heaters.

Keywords: heaters, cost, Heat Cost Allocator, individualization, building



Contact: hillariepanchkawree@gmail.com

Management of the electrical department

Electrical engineering


L. SIMON

Louis SIMON
Academic supervisor: P-O. LOMBARTEIX
Industrial supervisor: O. VIGNAU

Company: Express Mécanique

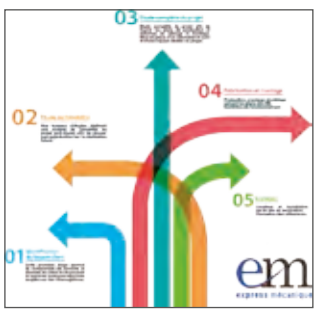
Objective/motivation

This industrial project consists in managing the electrical department in a company that creates industrial machines. The electrical department is composed of 10 persons: 1 assistant, 2 schematic technicians, 2 automation engineers and 5 electricians. My job consists in managing all the persons in the department and doing electrical studies and quotes for clients before we obtain the contract. I also control the work done before we send it to clients. I must communicate with all persons involved in the project: client, workers and all the departments in the company. This is really interesting.

Results

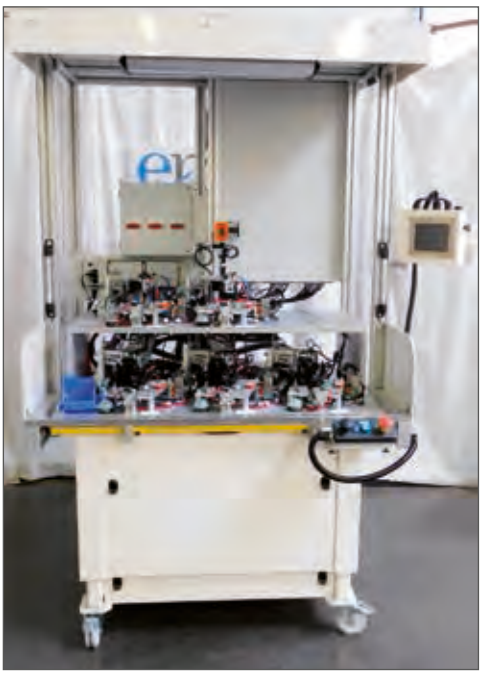
At the end of the project, we could see really good results. The first aspect is better communication between electricians because, before this project, there was a bad communication between them and it was difficult to do associations of persons. The communication with the other departments such as the mechanic department and the sales department was also better because I created an organization which never existed before. For the technical aspect, I did good studies for packing machines and we signed the contracts with the client. We did the machines with organization and the client was proud of this work. This was really a good project.

Keywords: management, electric department, electrical studies



Steps of a project


Skills of the research department


Example of an assembly machine

Contact: louis.simon1@etu.univ-orleans.fr

Manhattan Loft Gardens project

Smart building


A. ABRAHAM

Augustin ABRAHAM
Academic supervisor: R. CANALS
Industrial supervisor: P. ROUET

Company: Engie Ineo UK

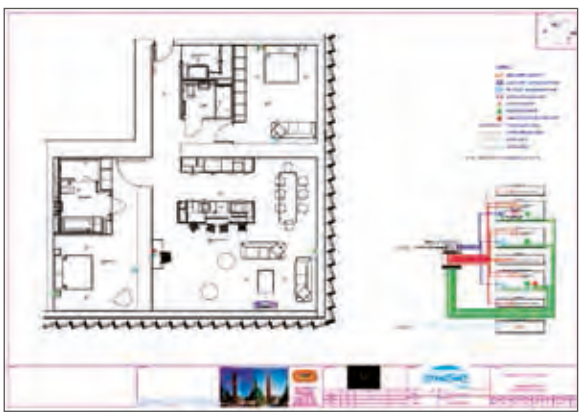
Objective/motivation

As part of my studies, I had to do a 12-week internship abroad. I did my internship in ENGIE INEO UK in London. The company works in the field of electrical installation and integrated lighting management in offices and housing in London and its suburbs. My role was to manage a team of 12 people. The job was to supervise the installation of the low-current equipment made by the subcontractor, to give instructions according to the progress of the work, and to define the team's work plan for the day. In case of some difficulty, I had to contact the company concerned to solve the problem. Finally, I had to check the proper execution of the work requested and transmit the status of the site to my superiors every day.

Results

During this project, I succeeded in implementing a routine between ENGIE and the subcontractor so that the execution of the equipment installation could be done more quickly. This routine was negotiated with the site management, on the one hand to have faster access to the site and the subcontractor, on the other hand to have more staff and therefore faster rates. The work has been very enriching for my professional experience in both the technical and human fields. Working with the site managers, the various electricians and site workers at the same time allowed me to have a detailed vision of a site implementation.

Keywords: ENGIE INEO UK, Apprentice Construction Manager, smart building, Manhattan Loft Gardens London



Contact: augustin.abraham@orange.fr

Reduction of energy consumption in an industrial building

Energy efficiency

Y-G. GOUBERT

Yann-Gaël GOUBERT
Academic supervisor: J-M. FAVIE

Company: undisclosed (confidential)

Objective/motivation

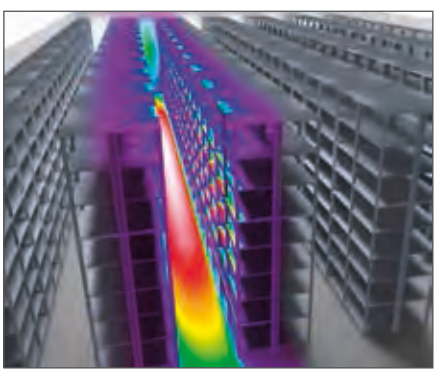
For several years, energy savings have been one of the major challenges. Following that aim, my project was to reduce the energy consumption of a company working in the automotive field with significant energy consumption. Another important point to consider is the fact that, in the private sector, there is a constraint about turnover, which is approximately 3 to 4 years. Furthermore, that aim cannot be achieved without following energy consumption, so another point was to set up software for the monitoring of energy consumption.

Results

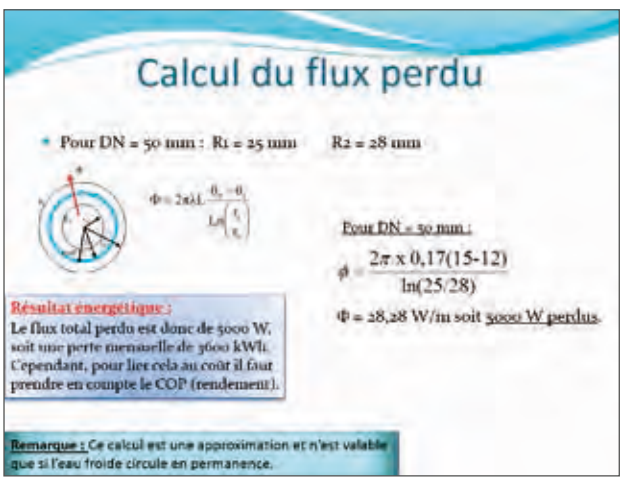
The software has been quickly set up to follow and select the items consuming a lot and on which it was possible to obtain significant energy gain. Moreover, alerts have been set up on the software to get overconsumption notifications by e-mail. My first year was oriented toward the compressors that supply the production lines, as the air networks had leaks which we detected with an ultrasonic detector. Another point concerned heat loss and condensation on cold water pipes inside the production area of the building. I had to calculate the heat loss through thermal formulas and determine how to avoid that condensation. The pipes were insulated and the savings is going to be verified during the following year. The last part of my internship was centered on the energy consumption of the logistic platform with the replacement of LED lights and optimization of the extraction from production, and, finally, the addition of renewable energy.

Alerts

Keywords:
energy gain, heat loss, air leakage, LED lights, monitoring of energy consumption



Dialux simulation



Heat losses

Contact: yann-gael.goubert@etu.univ-orleans.fr

Studies, realization, installation and commissioning of a power supply

Electrical engineering


V. BIARD

Vincent BIARD
Academic supervisor: P. REBEIX
Industrial supervisor: N. ROUGE

Company: Eiffage Energie Ferroviaire

Objective/motivation

Since the creation of electric engines, transport technologies have not stopped evolving. It is in this perspective that I wanted to join the Eiffage group and more particularly its electromechanical rail branch in order to extend my electrical engineering skills in this sector. During my last three years as an apprentice engineer in charge of business, I took part in a 3-year project for the design of a railway power supply (metro) for the RATP maintenance and storage site (as part of the extension of line 14 on the Parisian metro) by exploring two specific dimensions: the technical, by taking part in the design of the different electrical equipment (CAD and dimensioning calculation for power cells, control panels, cables) and their implementation on the site, and a "Project Manager" part more focused on the financial and human aspect (completion of consultations, costing, and team management).

Results

Currently carrying out the installation of electrical equipment at the maintenance site, one of the most important stages is in progress: unwinding cables and connecting different equipment. Upstream, panels have been controlled in the workshop to test all the primary functions. A new testing phase will be carried out before the commissioning, under the future operating conditions.

Keywords: electrical engineering, engines, power electronic, RATP, ligne 14


Electrical cabinet interior


Work site exterior


Work site interior

Contact: vincent.biard@etu.univ-orleans.fr

Technologies for Energy, Aerospace and Engines

Aerodynamic characterization of the ESA HUYGENS probe and its appendages

Aerospace engineering


A. BERAUD


S. COUCHE


C. DE TIENDA

Armand BERAUD / Simon COUCHE / César DE TIENDA
Academic supervisors: P. DEVINANT, A. LEROY
Industrial supervisor: J-P. LEBRETON

Institutions: PRISME Laboratory, LPC2E, European Space Agency

First Place
13th Annual Final Year Projects Forum

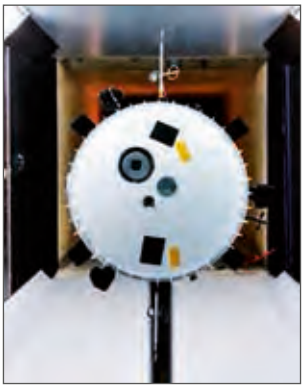
Objective/motivation

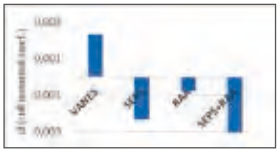
Huygens is a space probe that landed on Titan, one of the several natural satellites of Saturn, on January 14, 2005. The goal of the mission was to study the properties and physics of the atmosphere and surface of Titan. In this context, the probe was equipped with many external instruments and needed to rotate during its descent under parachute thanks to vanes designed for this purpose. Despite an almost complete success of the mission, the experienced spin during the descent was different from the predicted one. This project investigates the possible causes of this unexpected spin by testing a 1/3 mock-up of the probe and its appendages in the Lucien Malavard subsonic wind-tunnel located at Polytech Orléans and operated by the PRISME Laboratory.

Results

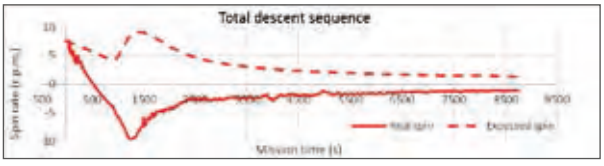
The roll moment was measured and analyzed during the tests according to different configurations of the mock-up. Indeed, different appendages were set up on the mock-up, separately or in combination to observe their influence on the spin. In fact, it has been highlighted that the vanes induce a roll moment in the predicted rotation direction but the different appendages around the mock-up induce a reverse spin. Therefore, the presence of the appendages seems to be the reason why the Huygens probe rotated in the wrong spin direction. The appendages which have the highest influence on the reverse roll moment are the SEPS (Heat Shield Separation Subsystems) and the RAA (Radar Altimeter Antennae). Moreover, there might be some aerodynamic interaction between them which could increase the amplitude of the reverse roll moment.

Keywords: Huygens, wind-tunnel, aerodynamic characterization, space probe


Picture of the probe in wind tunnel vane



Roll moment coefficient for appendages



Total descent sequence under parachute

Contact: armand.beraud@etu.univ-orleans.fr ; simon.couche@etu.univ-orleans.fr ; cesar.de-tienda@etu.univ-orléans.fr

Analyses of turbulence level for different types of combustion chambers in a natural gas engine

Mechanical engineering


Y. CHEN


X. LIU

Yitian CHEN / Xiao LIU
Academic supervisors: P. BREQUIGNY, C. ROUSSELLE
Industrial supervisor: O. POUSSIN

Company: Renault Trucks

Objective/motivation

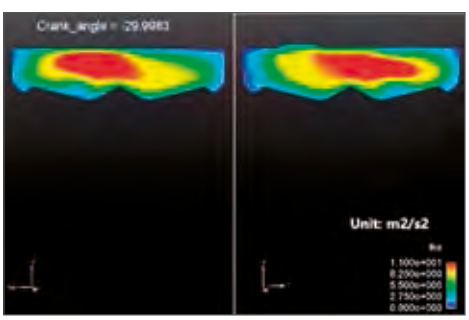
Emission regulations are becoming more and more strict nowadays. The goal of this project is to suggest new type of combustion chamber geometry in order to use natural gas as fuel in place of diesel fuel. Compared with diesel and gasoline, natural gas generates less pollution in the environment, especially if particle matter is considered. However, because of different chemical properties, especially the reactivity of natural gas, the combustion could be incomplete, which in turn could generate unburnt and CO pollutants. Therefore, in order to optimize the combustion of natural gas, the geometry of combustion chambers has to be adapted to generate adequate levels of turbulence to help flame propagation. A bibliography study about natural gas engines will be needed for this project as well as the analysis of the results from this study. In addition, some suggestions about optimal geometry of the combustion chamber will be proposed based on our study.

Results

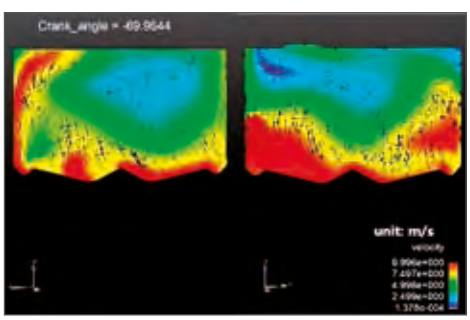
At the start of the project, we did a bibliographic study on the influence of combustion chamber geometries on generation of turbulence for a natural gas engine. Several papers indicated that re-entrant combustion chambers could generate more turbulence compared with other types. We therefore designed a few re-entrant chambers with different geometries in order to run the simulation for further study. We also analyzed the turbulence during the process of compression from the simulation done with Converge CFD, generated for three cases of chambers named 'Ellipse, G3 and R1'. For each case, the evolution of the 2D flow fields and Turbulent Kinetic Energy results was recorded as a function of the crank angle degrees. G3 generates the highest turbulence level. The TKE contour and velocity streamline showed a favorable evaluation of mixture flow in the cylinder.


Model in CONVERGE CFD

Keywords: natural gas engine, turbulence, combustion chamber



TKE



Velocity

Contact: yitian.chen@etu.univ-orleans.fr ; xiao.liu1@etu.univ-orleans.fr

Analysis of a generic injection in a ramjet engine

Mechanical engineering


Q. BEZELGA


L. DAVIS

Quentin BEZELGA / Luc DAVIS
Academic supervisor: I. FEDIOUN

Company: undisclosed (confidential)

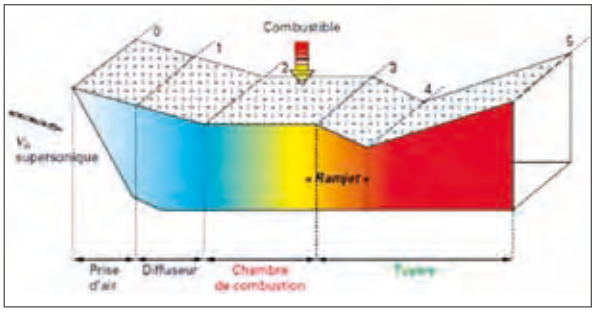
Objective/motivation

Fuel injection in a propulsion system is decisive for maximizing the performance of an engine. The study of ramjets or scramjets is not an easy task because it requires a correct understanding of turbulence and combustion and especially the interactions between both phenomena. The final purpose of this project is the simulation of these phenomena in a scramjet combustion chamber. To reach this goal, a first part of the study will analyse the fuel jet penetration in the chamber with various parameters and the atomization of this fuel jet by the transverse inlet air stream. At the same time, the combustion of the fuel will be studied. Mastering both phenomena will allow us to simulate the combustion of an atomized jet fuel correctly. Our simulations on ANSYS®, a multi-physics software, will be compared with experimental results of reference publications for different flow speeds in subsonic and supersonic conditions.

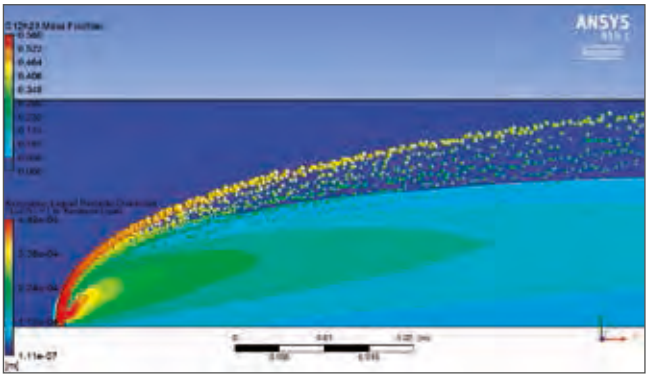
Results

First, we performed our simulations in a subsonic flow to enrich and improve the maps previously established and to compare them with empirical correlations. This enabled us to observe, for different settings, the behaviour of the jet penetration in the cross-flow as well as the size and the distribution of the resulting droplets. A simplified simulation of kerosene combustion was carried out and compared to experimental values, of temperature and mean mixture fraction. We were able to observe the development, the structure of the flame and the different chemical species resulting from combustion. We also set the injection in the supersonic case, generating shocks waves. After these simulations, we added the combustion to the simulation parameters to evaluate the efficiency of the combustion chamber.

Keywords: aerospace propulsion, atomization, cfd (computational fluids dynamics), combustion, ramjet, subsonic/supersonic injection



Description of a ramjet engine



Kerosene injection in a cross-flow stream

Contact: quentin.bezelga@etu.univ-orleans.fr ; luc.davis@etu.univ-orleans.fr

Characterization of a separated flow on a ramp and its control

Mechanical engineering


B. LEGROS


J. LIU


Y. TENG


H. YANG

Brian LEGROS / Jie LIU / Yongxiao TENG / Hao YANG
Academic supervisor: A. KOURTA

Institution: GDR 2502

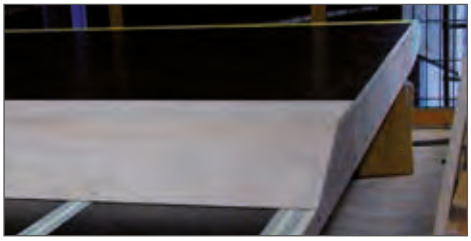
Objective/motivation

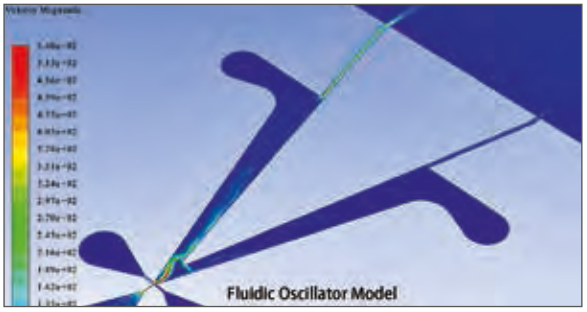
When the fluid flow passes a ramp, a phenomenon of boundary layer separation happens because the fluid momentum is too low to overcome the adverse pressure gradient. This phenomenon will produce a vortex between the surface and mean flow, lead to pressure decrease, energy loss and even serious accidents in some situations, for example the wing stall of an airplane. Our work is based on an active flow control method established by using a fluidic oscillator that was designed. The main objective of this work is to optimize the choice of position and characteristics of the fluidic oscillator, to achieve a better control of boundary layer separation, so as to improve the aerodynamic performance of the ramp and thus reduce consumption and pollution.

Results

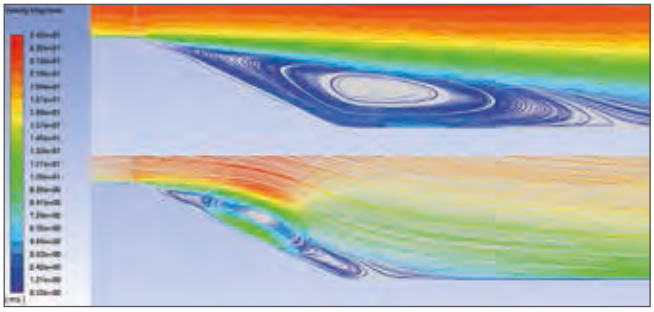
Using numerical simulations, the characteristics of separation flow and oscillator were calculated. And we obtained the boundary layer separation characteristic parameter Lr/h≈5 in the initial condition, the working frequency of the oscillator f=400Hz, these figures are very close to the result of the experiment. After that, we combined the oscillator and ramp in a 3D model, using the UDF to make the model as simple as possible. The simulation result showed that the boundary layer separation can be controlled effectively by the oscillator. More research showed that aerodynamic performance of the ramp can be improved further by obliquing the oscillator jet.

Keywords: active flow control, ramp flow, fluidic oscillator, CFD


Ramp



Oscillator


Separation flow

Contact: brian.legros@etu.univ-orleans.fr ; jie.liu@etu.univ-orleans.fr ; yongxiao.teng@etu.univ-orleans.fr ; hao.yang@etu.univ-orleans.fr

Combined air storage-gas turbine for EREV

Energetics engineering


P. KEMPSKI


M. THUILLIER

Paul KEMPSKI / Martin THUILLIER
Academic supervisor: P. HIGELIN
Industrial supervisor: W. BOU NADER

Company: PSA Group

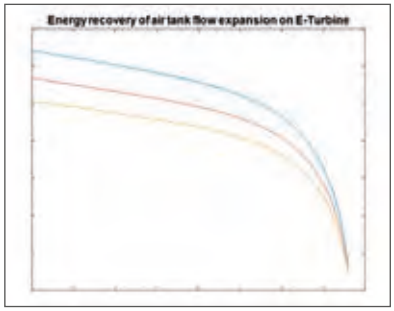
Objective/motivation

In today's context of global warming, the reduction of fuel consumption and pollutant emissions are the main goals of engine and car manufacturers. Aiming at improving the efficiency of an internal combustion engine (ICE) by reducing heat loss, hybridization has become a reliable way. In our project, we are working on a hybrid series which means that the car is powered by a motor and the electrical energy is provided by an auxiliary power unit which is usually an ICE linked to a generator. Our project is to model a hybrid series where the ICE is replaced by a combined air storage-gas turbine. The goal is to develop an operational model and test it in a normative driving cycle such as the Worldwide harmonized Light vehicles Test Cycles (WLTC). At the end, we will see if there is significant improvement in terms of efficiency and fuel consumption compared to an ICE as an auxiliary power unit model.

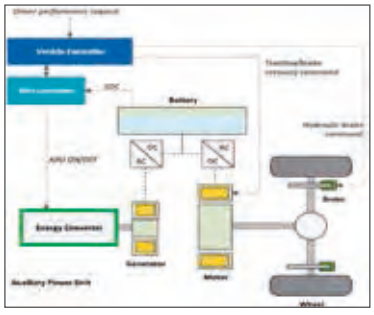
Results

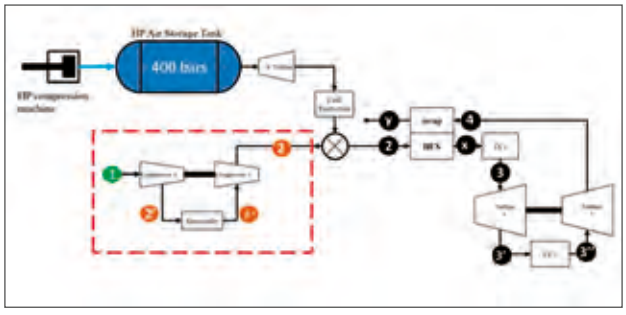
As the project is not yet finished, we cannot provide definitive results. At this stage in the project, we have already determined the autonomy of the vehicle depending on the mass of air stored in its dedicated tank. We have also calculated how much power is needed to compress the air from ambient pressure to 400 bars using a multi-stage compressor. The back-up system, as circled in the schematic diagram below, is complete as the study on the efficiency depending on temperature using a genetic algorithm is done. Overall, we have also determined the energy recovery on the e-turbine depending on pressure into the air tank. Then, we are implementing those results into a Matlab® model in order to size the other components (turbines, combustion chamber). The last task will be to run the model on the WLTP cycle in order to analyze and discuss the results.

Keywords: energy, efficiency, hybrid series, air-storage, turbine



Energy recovery behavior on the E-Turbine


Global schema of a hybrid series vehicle



Schema of the energy converter

Contact: paul.kempski@etu.univ-orleans.fr ; martin.thuillier@etu.univ-orleans.fr

Creation of an energy management law of a multi-source generator

Energetics


G. CASTELLI


M-A. MBETIBANGA


F. VAUDECRANNE

Greg CASTELLI / Michel-Ange MBETIBANGA / Florian VAUDECRANNE
Academic supervisors: C. BOURILLON, G. COLIN
Industrial supervisor: F. BEN AMMAR

Company: Spacetrain

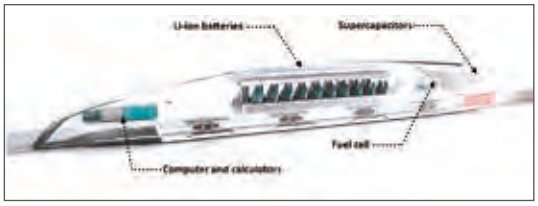
Selected participant
13th Annual Final Year Projects Forum

Objective/motivation

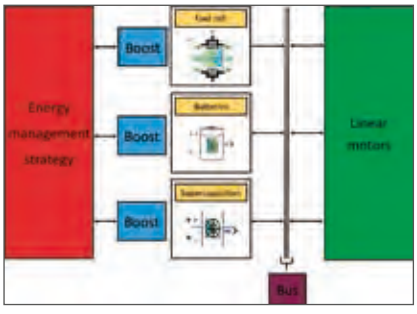
The projects aimed to help with a part of the development of a Spacetrain shuttle. Simply speaking, a Spacetrain shuttle is a train moving on an air bearing in order to reduce dramatically the resistive friction forces. The Spacetrain can move thanks to three types of power sources (a fuel cell, Li-ion batteries and supercapacitors) which we had to control smartly in order to respect the requirements (be able to perform a 500km cycle with a cruise speed of 500kmph). Thus, we had to size the three power sources. Our industrial supervisor wanted us to provide a Simulink file with the three-power sources model and the energy management law. Of course, we also had to write a user's manual.

Results

The first step was to size and model the three power sources. The sizing was done thanks to Microsoft Excel® by identification of the energy needs (during acceleration, deceleration and constant speed phases). The modeling was done thanks to pre-implemented Simulink models. We chose to use an energy control method named Auto-Adaptive Filtering Based Energy Management Strategy. Thanks to this method, it is possible to manage the power sources by taking into account their specific power, specific energy and the response time. We have managed to finish the implementation. Moreover, we added an algorithm which has to compensate internal and external conditions such as the ageing of the battery.



Keywords: energy management strategy, train, supercapacitor, fuel cell, Li-ion battery



Operating diagram


Model of the Spacetrain

Contact: greg.castelli@etu.univ-orleans.fr ; florian.vaudecranne@etu.univ-orleans.fr ; michel-ange.mbetibanga@etu.univ-orleans.fr

Design of a pressure sensors calibration bench

Mechanical engineering


A. COUR


A. FRANKOWSKI

Adrien COUR / Alexis FRANKOWSKI
Academic supervisor: P-Y. PASSAGGIA

Institution: PRISME Laboratory

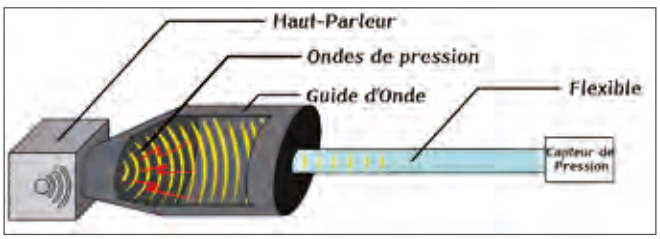
Objective/motivation

Pressure sensors are commonly used in unsteady aerodynamic studies, for instance, to measure aerodynamic forces and determine unsteady near-wall phenomena. For feasibility reasons, flexible tubes, also known as capillaries, are used to link pressure taps with sensors. The presence of these capillaries has an effect on pressure measurements and the goal of this project is to understand how these tubes act on pressure signals and which of their parameters have the greatest influence on the signals. These parameters were identified as the length, radius, curvature and material properties. Experiments are conducted to test our theoretical models and approve their capability to correct the pressure signal acquired from measurements in experiments. Our contribution aims at calibrating our sensors depending on the configuration of the capillaries using our calibration bench. This work could also be useful to reanalyze previous experimental results given that we know the capillaries setup used at that time.

Results

A transfer function is to be determined to highlight the capillaries influence on the pressure measurements. Using this transfer function, we can transform from the altered pressure signal measured by our sensors to the real pressure signal without acoustic perturbations induced by the flexible tubes. The acoustic perturbations are dependent on the amplitude, frequency and the flexible geometry (diameter, curvature). Using experiments, we study the influence of each parameter and post-treat the pressure measurements to compare the transfer function obtained with theory. With knowledge of the capillaries influence, we develop a pressure sensor calibration bench which enables anticipation of the modification induced by capillaries during wind tunnel experiments. This work also provides knowledge about non-destructive pressure sensor calibration procedures and the validation of a new low-cost pressure sensor for the PRISME laboratory.

Keywords: acoustic, pressure, sensor, aerodynamics, wind tunnel



Contact: adrien.cour@etu.univ-orleans.fr ; alexis.frankowski@etu.univ-orleans.fr

Design of a rocket igniter test bench

Mechanical engineering

Benjamin BARBIER / Valentin BLANCHE / Alexandre FAUCON
Jaouad HAJJAJI / Clément VANDOME
Academic supervisors: P. BREQUIGNY, C. ROUSSELLE
Industrial supervisor: A. GUY


B. BARBIER


V. BLANCHE


A. FAUCON


J. HAJJAJI


C. VANDOME

Company: CNES (PERSEUS)

Third Place and High Schoolers' Choice Award
13th Annual Final Year Projects Forum

Objective/motivation

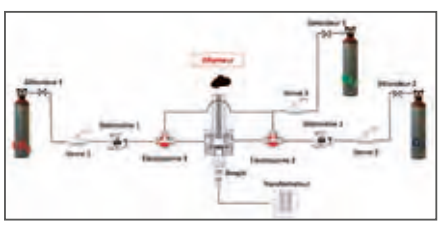
The PERSEUS programme (European University and Scientific Space Research Student Project) launched by CNES aims to offer students targeted space-related activities to support innovation. The study of reuse based on liquid oxygen/methane propulsion will modify the architecture of future launchers and give them attractive cost compared to the actual liquid oxygen/hydrogen design. In Europe, CNES and ArianeGroup are developing a rocket engine using this new mixture, called PROMETHEUS. Within the PERSEUS framework, the technical objectives related to reuse are defined through the DREAM ON challenge (Disruptive Reusable Experimental Advanced Methane Oxygen Nanolauncher) with the aim of developing a reusable rocket demonstrator capable of reaching an altitude of 5 km based on a LOX/CH4 engine, whose igniter bench and igniter are developed within Polytech Orléans. Another aspect of the PERSEUS project will be to look at the Pintle injection in anticipation of the landing.

Results

After spending some time on the literature, we focused on the NASA torch igniter system. We were then able to understand and study the most important parameters like the temperature and power of the igniter. The aim was to adapt this study into our specific case: a fuel-rich mixture. To do so, we had to design our own torch igniter. To simulate the flow and the combustion inside the igniter, a numerical simulation was performed using ANSYS Fluent®. In practice, we had to think about all the test bench components that will allow us to experiment our igniter. Afterwards, we can design all the installation in a Computer Aided Design drawing to visualise the space organisation. In conjunction, we also worked on the pressurisation of the rocket engine where we adapted a Blow Down system into a Dynamic Pressure Regulator one.


Torch igniter

Keywords: torch igniter, LOX/CH4, test bench, combustion, reusable rocket


Synoptic drawing of our test bench


Example of firing

Contact: b.barbier26@gmail.com ; valentinAPB@hotmail.fr ; alexandrefaucon4@gmail.com ; jaouad.hajjaji@gmail.com ; clement.vandome@hotmail.fr

Development of a dynamic simulation tool for the study of the ESA HUYGENS probe descent on Titan

Aerospace engineering


R. JOCHMANS


L. KOVACS

Rémy JOCHMANS / Léo KOVACS
Academic supervisors: P. DEVINANT, A. LEROY
Industrial supervisor: J-P. LEBRETON

Institutions: PRISME Laboratory, LPC2E, European Space Agency

First Place
13th Annual Final Year Projects Forum

Objective/motivation

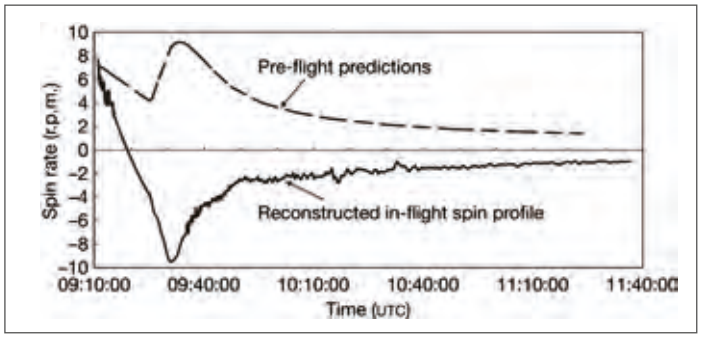
On January 14, 2005, after a 2-hour atmospheric descent, the Huygens probe landed on the surface of Titan, one of Saturn's moons. The Cassini-Huygens mission was introduced to study the region of Saturn and the physical properties of Titan's atmosphere. During the descent, the Huygens probe was meant to spin about its central axis in an anti-clockwise motion, but it unexpectedly spun in the opposite direction. Fourteen years after the landing, this unexpected behavior is still not completely explained. In order to understand the 2018 and 2019 wind tunnel test campaigns' results, a numerical study has been ordered to the Huygens Aerodynamic Investigation project. The final goal is to try to figure out what caused the rotational direction to reverse during the final descent under the parachute. The results could potentially be used for future atmospheric re-entry missions, thanks to a better understanding of what can happen during a re-entry.


Probe model reworked in Solidworks®

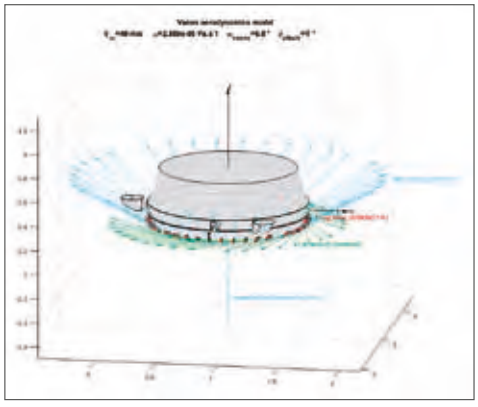
Results

The final descent is modelized through the Fundamental Principle of Dynamics and will be simulated on Matlab® (a programming platform). A simulation tool with an interface was created to have full control over which parameters are considered to run the simulation. This tool will allow the model to be adaptable to a different configuration. Different forces such as aerodynamics, weight, and drag induced by the probe's complex and asymmetrical geometry are taken into account. These forces will help in making a more realistic simulation of the probe's dynamics during the descent. Due to its appendices and random factors such as atmospheric winds, it is difficult to draw a conclusion about the probe's unexpected behaviour.

Keywords: space, probe, descent, trajectory, simulation



Spin profile (prediction & real) during the descent


Visualisation of aerodynamic forces on the probe

Contact: remy.jochmans@etu.univ-orleans.fr ; leo.kovacs@etu.univ-orleans.fr

Energy diagnosis and fluid for building

Smart buildings

Q. LI

O. MANGLAVITI

Qinglan LI/ Olivier MANGLAVITI
Academic supervisor: J-M. FAVIE
Industrial supervisor: L. PRUD'HOMME

Company: Lacen

Objective/motivation

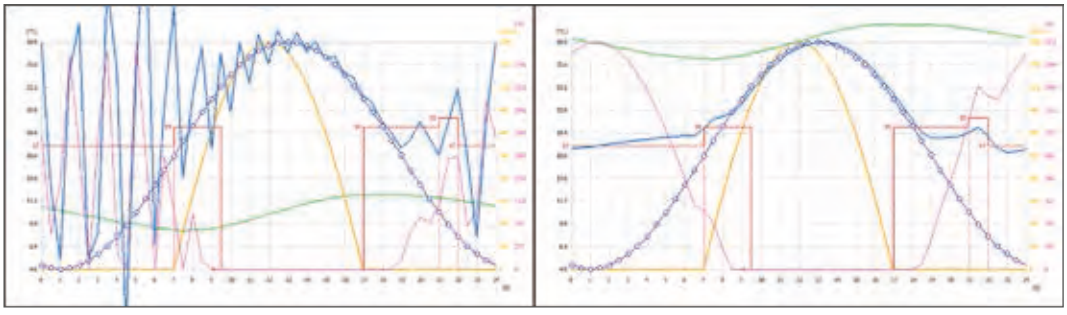
Our project deals with the energy efficiency of a building. The objective is to design the ventilation system for the building in order to assess the body comfort as well as energy performance. Ventilation is necessary to deliver fresh air and extract stale air which influences well-being in a habitation due to variations of temperature, humidity and pressure. Moreover, it is not just a matter of thermal comfort. For a new dwelling, French legislation and sustainable development issues require energetic efficiency systems. Thus, thermal insulation, the production of heat and ventilation should be scaled according to construction regulations. Our target is to accomplish a program to calculate temperature, humidity and air flow rate which takes surrounding conditions and building characteristics into consideration. This program should also be suitable for different buildings (houses and apartments) and help to scale the ventilation system.

Results

The program developed is able to read a data file with different information: simple geometrics of the building, connection between different living rooms and physical parameters (volume, surface, thermal diffusivity, convection, etc.). Thus, we have just finished developing the thermal equation and the method to calculate the humidity. Indeed, we made improvements to the program to follow real time energy consumption with the unconditionally stable scheme and auto discretization by time. The program calculates and plots the temporal evolution of the temperatures of different locations in a building and the humidity in the air. Next, we would like the program to include human occupation and the coefficient of solar radiation. Concerning thermal physical parameters, the program has to learn automatically with the instruments. Regulation by ventilation and the heuristic model to obtain the optimum are still works in progress.

Energy diagnosis for building

Keywords:
energy efficiency, ventilation system, programming, thermal comfort



Comparison of unstable and stable simulations

Contact: qinglan.li@etu.univ-orleans.fr ; olivier.manglaviti@etu.univ-orleans.fr

Feasibility study of a flex fuel engine: diesel/syngas, and its sizing

Energetics

M. DOUSSOT

A. MERCIER

Maxime DOUSSOT / Adrien MERCIER
Academic supervisors: P. BREQUIGNY, C. ROUSSELLE
Industrial supervisor: R. MARTIN

Company: Naoden

Selected participant
13th Annual Final Year Projects Forum

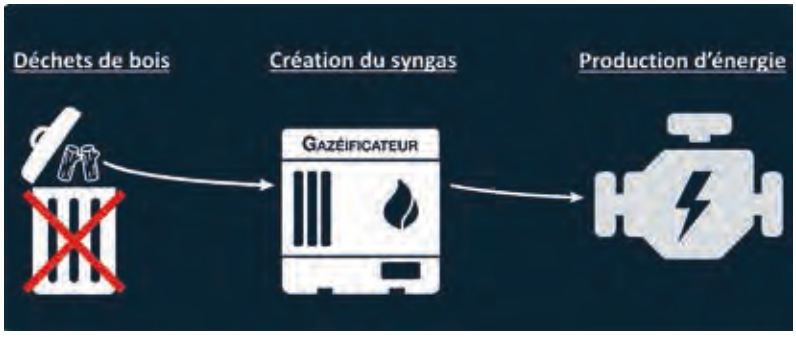
Objective/motivation

To embrace energy transition, Naoden, a company based in Nantes and created in 2015, expanded by recovering wood wastes in order to produce energy. This company designs, manufactures and installs compact, small power plants to produce energy from biogas, also called syngas. To produce its syngas, NAODEN uses biomass matter, especially wood waste derived from several forms, such as wooden pallets, wood chips, sawdust, and shells. Henceforth, Naoden wants to diversify its offer by implementing Flex Fuel cogeneration plants, running with syngas or classical diesel fuel as a function of supply issues. Moreover, the availability of diesel fuel in the plant allows it162 to be used in the ignition of Syngas, and this combustion mode is commonly called Dual Fuel. From that, NAODEN asked Polytech Orléans to study the feasibility of a 'Flex Fuel/Dual Fuel' syngas/diesel engine and to size it.

Steps in the gasification process

Results

A detailed bibliographic review of the existing dual fuel helped us to better understand how a dual fuel engine works, especially in the case of syngas. We were then able to simultaneously simulate the combustion process of the syngas and diesel mixture via CHEMKIN software. The aim is to use the high reactivity of the diesel fuel to ignite the syngas although the combustion process is somehow difficult due to the very low reactivity of the syngas. Thus, we obtained the evolution of the combustion parameters depending on both mixing parameters (as syngas amount and global equivalence ratio) and volumetric ratio (to represent different engine configurations). After knowing the minimal quantity of diesel fuel needed to ignite syngas and the optimal volumetric ratio, we could size the engine according to Naoden's requirements and suggest a suitable engine.



Naoden gasification schematic

Keywords: cogeneration, powerplant, dual fuel, flex fuel, syngas, Naoden

Contact: maxime.doussot@etu.univ-orleans.fr ; adrien.mercier@etu.univ-orleans.fr

Homogeneous mixture of air and emission-reducing gas in the diesel engine of a ship

Mechanical engineering

O. AKCA

S. OUDIN

Oguzhan AKCA / Simon OUDIN
Academic supervisor: P. HIGELIN

Company: undisclosed (confidential)

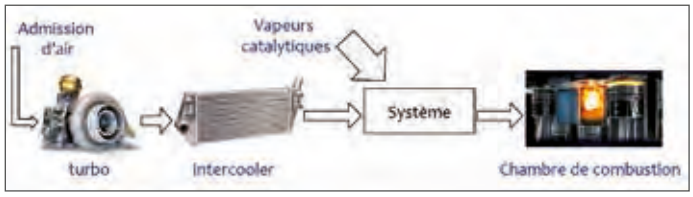
Objective/motivation

The aim of the project is to homogenize an emission-reducing gas and the air coming from the turbo and going to the engine's combustion chamber. We need to try different injection solutions, do the simulation on different programs such as ANSYS Fluent® and GT Power® in order to present the results to our supervisors and choose the best solution. In the previous study done by the industrial supervisor, the gas was injected in the air before passing through the turbocharger. The mixture was homogeneous but we discovered that the mixture was less effective. Therefore, our second objective is to see if our results are going to be more or less effective than the industrial supervisor's results.

Results

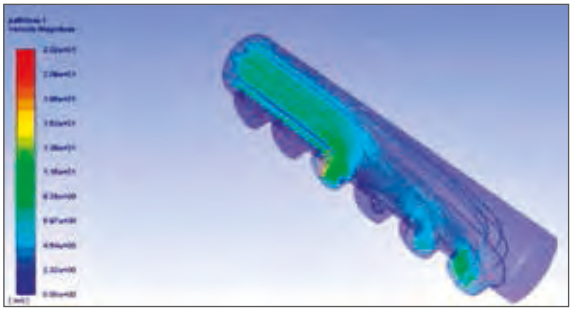
The first step of our project was to analyze the documentation of the industry. We tried to understand the 2D and 3D plans in order to design the engine and begin trying different solutions. Once the computer aided design was done, we started to look at injection types. We found four different possibilities and started to draw them, do some calculations and design them. The next step was to design them according to our engine numerical plans so we can test their feasibility. After that, we started simulating each solution in different conditions. The next step is to meet our industrial advisor and discuss the solutions, simulations and results in order to choose one and focus on this solution.

Keywords: diesel engine, turbo, commercial ships, NOx emissions



System diagram

2D simulation



Simulation in Fluent®

Contact: oguzhan.akca@etu.univ-orleans.fr ; simon.oudin@etu.univ-orleans.

Micro energy harvester for connected object

Energy harvesting


M. CADIER


P. JAUNET


N. VENIGER

Maxime CADIER / Paolo JAUNET / Nicolas VENIGER
Academic supervisors: R. CANALS, C. HESPEL
Industrial supervisor: A. DELEU

Company: DSA Technologies

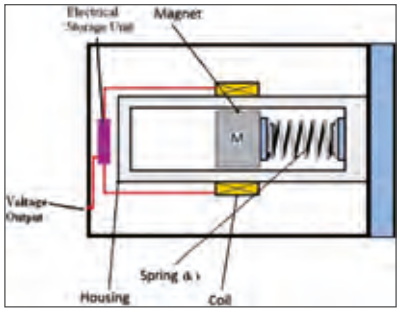
Objective/motivation

Nowadays, sensors are used everywhere in our daily lives. One of the main objectives for the coming decades is to increase the lifetime of these sensors and thus limiting the number of recharges. Our project is led by DSA Technologies, a company that designs sensors for several fields and appliances. We are particularly focussing on three sensors that are used to detect a presence in a room. One is placed on a window, another on a door and the third on the ceiling. The main objective is to develop a prototype of a micro-energy harvester adapted to the presence sensors given by the company. The current sensors work with lithium batteries. The prototype aims to expand their lifetime. The main challenge for us is to use the energy loss in the sensor's environment to supply it.

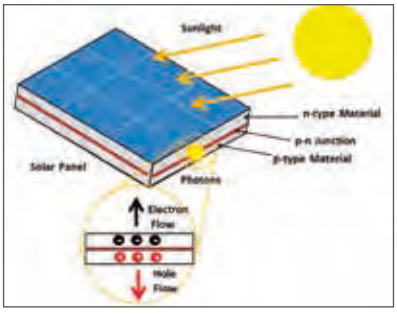
Results

After gathering information about every possible energy harvester, three technologies have been selected to be adapted to the sensors: electromagnetic, photovoltaic and a radio frequency (RF) harvester. Our challenge is to design these technologies to provide a 2 mW-supply to the sensors. The electromagnetic system is used to harvest the mechanical movement of the door. The photovoltaic technology is more adapted to work near windows opening to the outside. As they are in an isolated area, the ceiling sensors are the most difficult to deal with. Indeed, few energy sources are available there. Therefore, the Radio frequency harvester is a good solution for this problem. After sizing those systems, prototypes are designed and tested. During this development it is important to keep in mind the cost of the products (10% of the sensors' price) and its size.

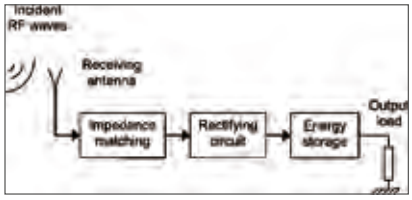
Keywords: energy harvesting, presence sensor, IoT



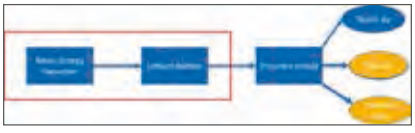
Electromagnetic harvester



Photovoltaic panel



RF Harvester diagram


System diagram

Contact: maxime.cadier@etu.univ-orleans.fr ; paolo.jaunet@etu.univ-orleans.fr ; nicolas.veniger@etu.univ-orleans.fr

Modeling of LNG carrier power consumption

Energetics

M. CORDONNIER

B. ENGELEN

Margaux CORDONNIER / Benjamin ENGELEN
Academic supervisor: C. CAILLOL
Industrial supervisor: N. BORDET

Company: OSE Engineering

Objective/motivation

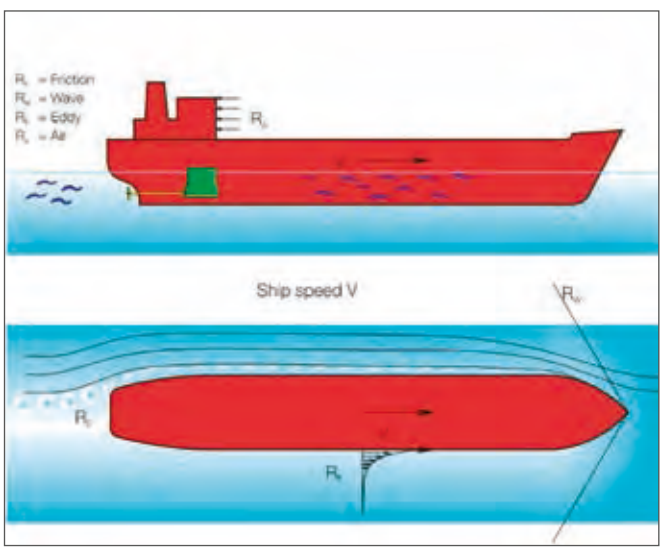
The maritime sector today faces new legislation in terms of environmental impact. It is now necessary to manage ships' energy consumption. The main objective of this project is to create a predictive model of energy consumption for container ships. The model inputs are forecasted meteorological data (wind speed, wind direction, etc.) and sea data (current speed, etc.) on the ship route. The first objective is to define a simplified yet accurate physical model. The second objective is to transform this physical model into an algorithm on Matlab® Simulink®. The calibration and validation of this algorithm will be done with the data of all the routes a specific ship travelled in one year (data provided by the client). The last objective is to optimize this model and build a roadmap of other future possible optimizations.

Results

The physical approach and the equations chosen to create the model were validated with some test cases. The algorithm was tested on different routes, with different meteorological and sea conditions. The algorithm successfully predicted the consumption for those journeys with a margin error of 10%. The road map created offers different ideas on three main points of optimization. First, the physical representation of the problem, second, the data collection and last, the determination of unknown parameters.

Keywords: marine propulsion, consumption, predictive model

Container vessel CMA CGM Chopin (MarineTraffic.com)



Total ship towing resistance (MAN diesel & turbo, basic principles of ship propulsion)

Contact: margaux.cordonnier@etu.univ-orleans.fr ; benjamin.engelen@etu.univ-orleans.fr

Numerical study of a grain silo ventilation

Mechanical engineering

D. PAYRAUDEAU

Déborah PAYRAUDEAU
Academic supervisor: N. MAZELLIER
Industrial supervisor: O. CHATRIOT

Company: Axeréal

Objective/motivation

The temperature and moisture regulation of grain during storage is really important for several reasons. The first reason is to keep the grain in a sufficient state in order not to damage its properties and to keep it safe for consumption or for its future use (cattle feeding, food making, etc.). This project pertains to a study aiming to improve storage conditions of grain with a double ultimate goal: (i) energy consumption saving and (ii) reduction of use of pesticides. This particular study aims at characterizing ventilation and air flow into the silo, to understand the process on how grains are cooled during storage. The final aim is to have a sufficiently realistic characterization to derive equations to explain this process and finally being able to adapt it regarding weather conditions.

Results

The simulation of the silo has been divided into two different parts: (i) modeling the grain and (ii) modeling the ventilation. Grains are modeled as a porous medium. The ventilation model has been completed to enable accurate results. In this way, the distribution of the flow through the outlet has been identified. These data allow the other part of the simulation to be closer to real-life operating conditions. The model of a porous medium (to model the grain) allows us to get the pressure drop induced by this medium and the way the temperature varies in the medium. Different parameters have been studied to observe the impact on the heat.

Keywords: ventilation, silo, grain, cooling

Contact: deborah.payraudeau@etu.univ-orleans.fr

Optimization of dynamic air intakes for the Spacetrain shuttle

Mechanical engineering

Y. DABBAB

L. ROUGÉ

Yassine DABBAB / Lucas ROUGÉ
Academic supervisor: N. MAZELLIER
Industrial supervisor: N. SAID

Company: Spacetrain

Objective/motivation

The Spacetrain project is ambitious and aims to create a viable solution for air-cushioned train transportation. The advantage of such a technology is to reduce the friction between the train and the rail, but like all vehicles, the Spacetrain needs studies on aerodynamics. Our part in this project is to reduce the drag that the front of the shuttle experiences. The nose of the shuttle is shaped in such a way that a lot of pressure drag is created. By adding air intakes, we might be able to evacuate the air and reduce the drag. This study is about the optimization of air intakes and their effect on the overall drag and flow.

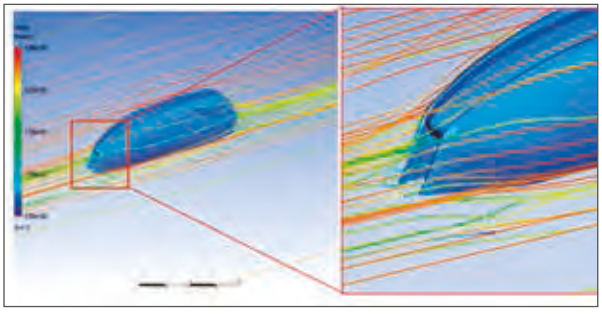
Results

The project is divided into three parts: the study of the train without the air intakes, the optimization of the air intakes alone and the simulation of the optimization with both the train and the air intakes simulated. All of these studies are conducted with CFD simulation and verified by analytical calculation. The first parts allowed us to determine the working pressure around the shuttle and with those results we simulated the air intakes with the right conditions. The air intakes geometry has been optimized with the adjoint method and then added to the train. The final phase aims to verify the effect of our solution and again correct the air intakes geometry if necessary.

Keywords: aerodynamics, train, drag, air intakes

Drawing of the shuttle without air intakes as seen from above

Pressure coefficient distribution on the front of the shuttle



Flow simuation on the shuttle

Contact: dabbabyassine@gmail.com ; lucas.rouge@hotmail.com

Optimization of engine performance of the Exergie association

Mechanical engineering

E. BLIN

Q. MOURIER

Eddy BLIN / Quentin MOURIER
Academic supervisor: P. BREQUIGNY
Industrial supervisor: Exergie Association

Institution: Exergie Student Association

Objective/motivation

In a context of growing energy consumption, sustainable development is a sector of innovation where everyone can contribute in their own way within different means. The Shell Eco Marathon is an automobile competition based on the criteria of energy performance with the purpose of creating the most innovative and environmentally friendly vehicles. The Exergie association aims to participate in this competition every year. Our will enable us to achieve the competition objectives to create a fuel-efficient vehicle. Our goal is to build a dynamic rolling test bench from the previous inertia bench and then create two engine mappings to enable robust and stable engine operation. These maps will be carried out on the new rolling test bench to meet the needs of the Shell Eco Marathon competition.

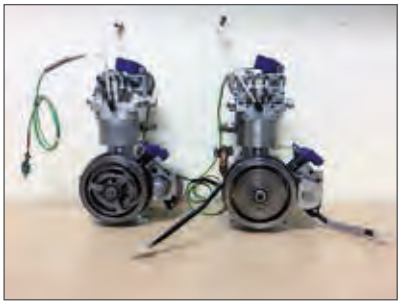
Results

The first thing to do was to test the injector to determine the best duration for the injection at the stoichiometry. We obtained around 3000 µs, which will allow the engine to run better and avoid clogging. It was then necessary to size the electrical architecture with an electric motor and a frequency converter. For that, we used a 1.5 kW three-phased electric motor with a 1.5 kW mono/three-phased frequency converter to enable the association to use the dynamic rolling test bench everywhere. After that, the bench architecture was achieved with iron bars, soldering, sanding and painting. An inventory of necessary and available material and a manual on how to build the engine were also accomplished. Finally, some tests were done on the dynamic test bench to improve performance of the engine for the Shell Eco Marathon.

Keywords: engine tuning, calibration, test bench, Shell Eco Marathon

Dynamic rolling test bench on SolidWorks®

Prototype of Exergie association



4-stroke engines of Exergie Association

Contact: eddy.blin@etu.univ-orleans.fr ; quentin.mourier@etu.univ-orleans.fr

Potential for reduction of consumption of a thermal recovery system based on a tri-thermal machine for automotive application

Energetics

W. COTTIN

M. MOREIRA

Willy COTTIN / Mickaël MOREIRA
Academic supervisor: A. CHARLET
Industrial supervisor: W. BOU NADER

Company: PSA Group

Selected participant
13th Annual Final Year Projects Forum

Objective/motivation

Nowadays, in the automotive industry, consumption minimization is an essential point. Despite the restrictions, the need for driver comfort has been increasing over time. Our project aims to put a tri-thermal machine, which has three heat sources (a hot source, a cold source and the environment) on a hybrid car. These machines are commonly used in heat pumps. These engines are based on the Rankine cycle. Hybrid cars have a lot of advantages, but they also have some drawbacks. When you are driving in full electric mode, the engine is not working so there is no fuel consumption, but there is no thermal production used for thermal comfort. Thus, electricity is used to ensure comfort but it has a cost. Moreover, it reduces the battery's autonomy. Our ambitious project aims to reduce these losses by recovering electricity from the engine's thermal loss when it is working.

Results

An organic Rankine Cycle will be used in order to convert the thermal loss into electricity. First, we wanted to see the influence of each parameter of the cycle. From our simulations, we can analyze the influence of the two pressures of the cycle against its subcooling and overheating temperatures because we aim to optimize the parameters regarding their influence versus the cost and the practicability of the optimization. We saw that the pressures are more influent than the temperatures of the cycle and precisely the lower pressure of our cycle (see Figure 2). We optimized the parameters of our ORC and we discovered that we can ensure the electric cost of the heating and the cooling system of the vehicle and we can also add 901 Watts to the battery, which increases the engine efficiency by 2%.

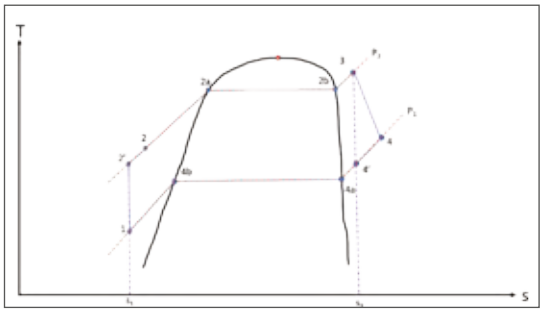


Figure 2

Keywords:
organic Rankine Cycle, automotive Industry

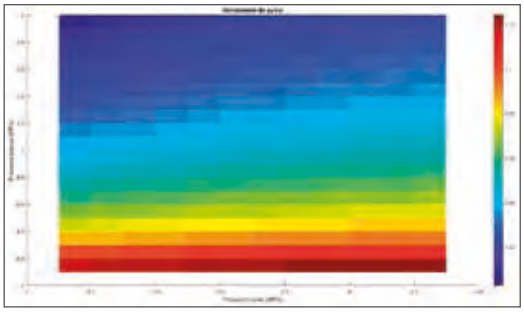


Figure 1

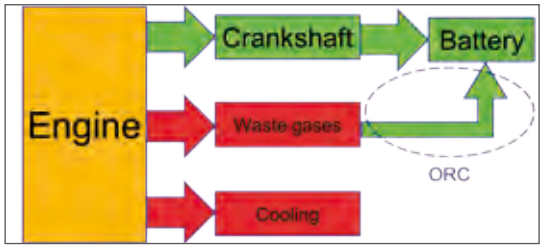


Figure 3

Contact: willy.cottin@etu.univ-orleans.fr ; mickael.moreira1@etu.univ-orleans.fr

Size calculations of renewable energy production means

Energetics


H. AHRAZEM


O. AVRAM

Hamza AHRAZEM / Octavian AVRAM
Academic supervisor: J-M. FAVIE
Industrial supervisor: L. PRUD'HOMME

Company: Lacen

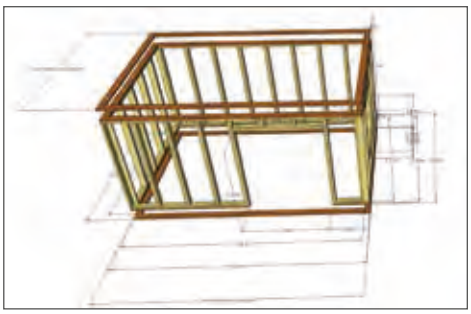
Objective/motivation

As part of a global energetic transition, the objective of our project is to reach an energy self-sufficiency for buildings. Using renewable energies to produce your personal energy not only enables you to decrease costs, but also to reduce your carbon footprint and even become totally autonomous. Our project deals with the sizing of different clean energy production means (photovoltaic panels, solar thermal panels, wind turbines, heat exchanger, etc.) for a prototype building (approx. 18 m²) that is located at Lacen, a company owned by Laurent Prud'Homme. These energy means are classified according to their use: electricity production, heating, storage.

Results

The project was divided into three parts. The first step was to study the energy needs for the building we were working on. We later had to identify the most adequate renewable energy systems that would meet our requirements. The second part consisted in getting in touch with several suppliers to request a cost estimate for the system we needed. Furthermore, we proceeded with a precise selection of the suppliers based on their product and our needs in order to send the final offers to M. Prud'homme. The third part involved ordering the systems from the suppliers and then setting them up. The final step dealt with coding the systems using an optimization program called "Processing".

Keywords: renewable energy, self-sufficiency, production, sizing



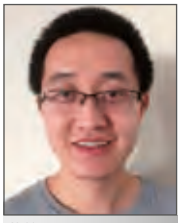
Hybrid kit

Contact: hamza.ahrazem@hotmail.com ; octavian.avram@etu.univ-orleans.fr

Study of a powertrain with a fuel cell

Mechanical engineering


J. DU


X. LI


J. ZHANG

Jing DU / Xiang LI / Jie ZHANG
Academic supervisor: A. LIBEAU
Industrial supervisor: A. CHARLET

TRANSITION-ONE

Company: Transition-One

Selected participant
13th Annual Final Year Projects Forum

Objective/motivation

In order to solve the problems of energy shortage and environmental pollution, the goal of the project is to convert a thermal vehicle (BMW X5) into a fuel cell vehicle. The simulation results should keep the same driving experience. We need to study regulatory restrictions related to the use of fuel cells and the storage and transportation of hydrogen, and details of the fuel cell vehicle approval process. After that, we need to choose the proper motor and the hydrogen fuel cell to simulate the vehicle. At the end of project, we will optimize the results.

Results

First, we did bibliographic studies. Then we calculated the performance requirements of the fuel cell, motor, and battery, and found suppliers that meet the requirements. Based on the parameters provided by the supplier, we simulated the car through AMESim™. Then we decided on the energy distribution strategy. We verified the performance feasibility of converting X5 into a fuel cell vehicle. In addition, we also calculated the volume of all parts to ensure that the X5 can provide enough space to accommodate these parts. Finally, the modified car can reach a maximum speed of 170km/h, with acceleration from 0 to 100 km/h in 11 seconds. The car can have 500 km endurance.

Keywords: fuel cell vehicle, hydrogen, battery emissions


Fuel cell

Contact: jing.du@etu.univ-orleans.fr; xiang.li@etu.univ-orleans.fr ; jie.zhang2@etu.univ-orleans.fr

Supersonic ejector configuration analysis

Mechanical engineering

Q. LAINE

A. TURPAULT

Quentin LAINE / Alex TURPAULT
Academic supervisor: I. FEDIOUN
Industrial supervisor: T. BEQUET

Company: MBDA

Objective/motivation

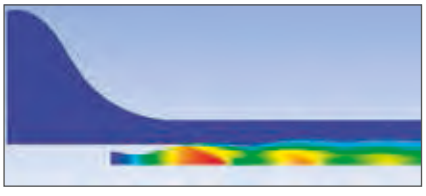
In aerospace and defense fields, supersonic ejectors are usually employed to increase the thrust of a turbojet or to simulate high atmospheric pressure conditions. The key strength rests on its simplicity, as it has no moving parts. The operating principle is to speed up a low-pressure flow thanks to a high-pressure driver flow, which is expanding in a channel. Existing data are essentially theoretical and based on a simplifying hypothesis. Therefore, the main objective of the project was to build a 2D model in ANSYS Fluent®, which is closer to reality, in order to test various geometries and then quantify the impact on specifications of supersonic ejectors. Another objective was to simulate an annular configuration reversing the primary and the secondary flow.

Results

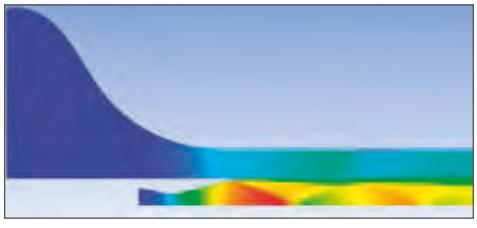
First, we coded a program to reproduce theoretical performance curves of a supersonic ejector based on the calculation developed by J. Délery. The objective was to compare our results to the theory in order to validate our models and then study the effect of different geometries. The main part of the job was to conduct 2D CFD simulations with the software ANSYS Fluent®. We tested different boundary conditions and geometries. The results match quite well with the theory. Several problems of convergence occurred as the flow was both supersonic and subsonic in different regions. We managed to obtain all the regimes that define the operation of supersonic ejectors, that is to say the supersonic, the saturated supersonic and the mixed regimes.

Keywords: CFD (computational fluid dynamics), numerical simulation, supersonic ejector, modeling, fluid mechanics

Contour of Mach number for the supersonic regime



Contour of Mach number for the mixed regime



Contour of Mach number for the saturated-supersonic regime

Contact: quentin.laine@etu.univ-orleans.fr ; alex.turpault@etu.univ-orleans.fr

Transition-One: transforming your thermal vehicle to an electric one

Mechanical engineering

H. DANTHU

G. SAIMOEN

Hugo DANTHU / Gérémy SAIMOEN
Academic supervisor: A. CHARLET
Industrial supervisor: A. LIBEAU

Company: Transition-One

Selected participant
13th Annual Final Year Projects Forum

Objective/motivation

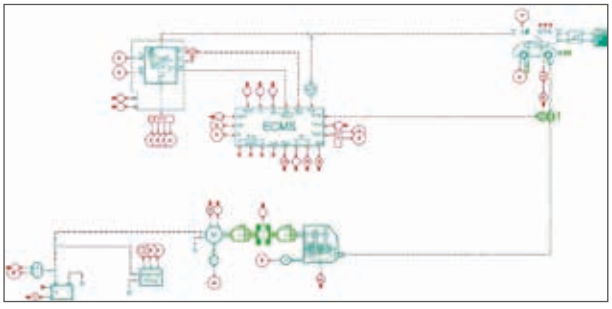
Currently, we are in a world that has become increasingly involved in ecology and the reduction of polluting emissions. That is the reason why, during the COP 21 in 2017, the former French minister of ecology, Nicolas Hulot, vowed to abolish the sale of petrol and diesel cars by 2040. Furthermore, Aymeric Libeau chose to get involved in a new project called Transition-One. The goal of this project is to transform an internal combustion car into an electric car. In order to comply, we have to replace the engine with an electric motor in just three hours and with only 5000 €. The purpose of the project is to optimize the electric motor of a prototype (built in 2018) in order to make it functional and compatible with its original gearbox. However, we have to respect the following conditions: retain an average distance of 100 km and a maximum speed of 110 km/h.

Results

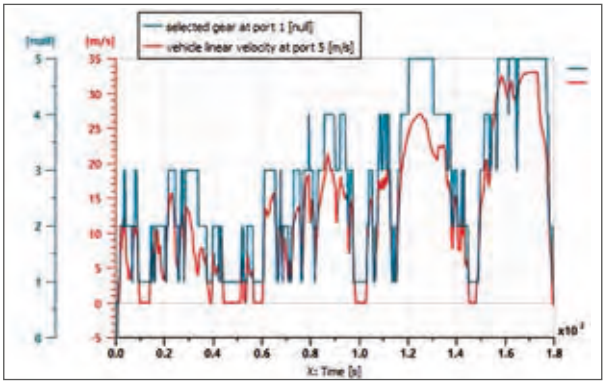
In 2018, Aymeric Libeau built an electric Twingo 2, the first Transition-One car, by following the pre-studies carried out at Polytech Orleans in 2017-2018. This year, the project has been renewed in order to optimize the choice of the electric components. This study should facilitate the use of the original gearbox within the car. Accordingly, using AMESim™ software, we have developed a numerical model of the prototype to approve and compare it to the real performances of the Transition-One vehicle. Thanks to this simulation, we have established a range of values for the power and the torque of the electric motor which is required to allow the use of the gearbox as in an internal combustion car. Then, thanks to our research and contact with European electric motor companies, we have found an electric motor which appears to be suitable for the project.

Project objective

Keywords: electric motor, controller, gearbox, ecological transition, optimization



Numerical model use for simulation



Speed vs gear ratio function of time

Contact: hugo.danthu@etu.univ-orleans.fr ; geremy.saimoen@etu.univ-orleans.fr

Transonic-supersonic rocket components design

Energetics


M. RAHBANI


K-S. TING

Mikael RAHBANI / Kee-Sheng TING
Academic supervisors: N. MAZELLIER, P-Y. PASSAGGIA

Company: SpaceTech

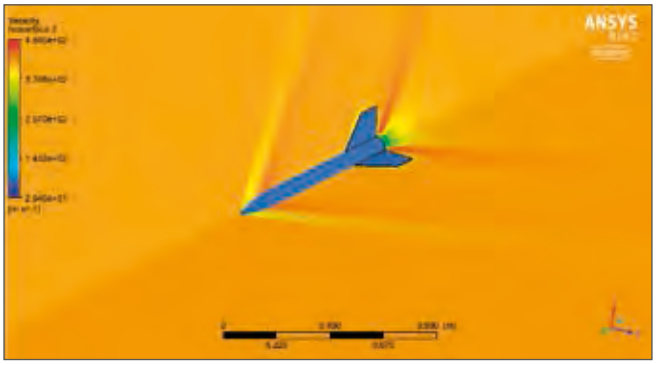
Objective/motivation

SpaceTech is a student association that builds experimental rockets to participate in the national rocket launch campaign, also known as C'space. This project has been integrated as part of an academic research at Polytech to propose an optimized design for the nosecone and fins intended for a supersonic flight. To do so, a thorough preliminary study must be carried out on the existing nosecone and fins designs. To understand other phenomena linked to supersonic rocket flight, a series of numerical simulations using a CFD (computational fluid dynamic) software such as ANSYS Fluent® is carried out. This study helps define the best design of the nosecone and fins based on the main optimization criteria: the drag force. After getting the desired geometry, the dimensions of the components will be drafted and be sent for manufacturing. This will be the prototyping phase of the rocket.

Results

We have retained the best solution based on aerodynamic performance, mechanical strength as well as the feasibility criteria. The solution to our nosecone geometry is a design proposal known as "HAACK VON KARMAN". The design is typically used in missiles. The geometry yields a decent aerodynamic performance, with a reasonable drag force reduction of 13% compared to the basic conical nosecone. This solution seems to be the best as it is feasible through 3d printing and mechanically robust to withstand aerodynamic forces during launch. As for the fins, four identical trapezoidal fins will be fixed at the base of the fuselage. The fins are essential to the rocket as it provides stability during flight. The design of the fins is concluded mainly based on the lift generated and the static margin yielded in respect to the flight stability criteria.

Keywords: rocket, nosecone, fin, cfd, supersonic



Contact: mikael.rahbani@etu.univ-orleans.fr ; kee-sheng.ting@etu.univ-orleans.fr

Vehicle's aerodynamic performance improvement

Mechanical engineering

S. JEANJEAN

M. MOREAU

Samuel JEANJEAN / Martin MOREAU
Academic supervisor: A. KOURTA

Institutions: GdR 2502, PRISME Laboratory

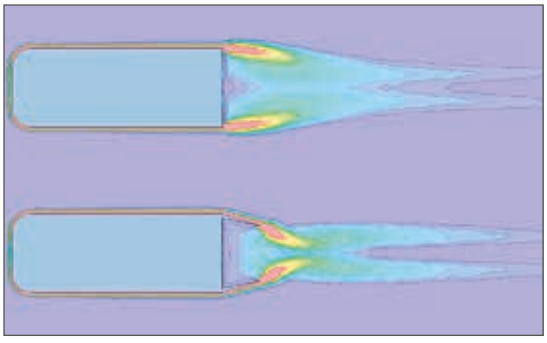
Objective/motivation

CNRS French Research group 2502 called "Separation control", which includes the PRISME laboratory and PSA industry, ordered this study. The aim of this project is to reduce vehicles' aerodynamic drag using vertical rear deflectors to modify the near wake. Reducing this resistive force will increase the vehicle's efficiency and so decrease fuel consumption and greenhouse gas emissions. Rather than study a specific vehicle geometry, the Ahmed body is used. The flow around this body captures the main flow characteristics around any type of car. The effect of vertical deflectors is studied using a CFD approach with ANSYS Fluent® software. Several deflector configurations are imagined and tested to find an optimal shape. The height, length and closing angle are the major parameters studied, first in 2D and then in a 3D approach.

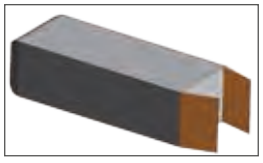
Results

Using vertical deflectors in 2D decreases the drag coefficient, Cd, by up to 56%. This improvement is not realistic as the flow above and under the body is not considered, but it enables the study of flow separation. In 3D, the optimal angle is different from 2D as it is a compromise between wake narrowing and pressure behind the deflectors. This study shows that the longer the deflector the better the results. Therefore, it was fixed at a half body width to remain realistic. Moreover, in a range from 20m/s to 40m/s, the optimal deflector geometry seems to be the same. Finally, the optimal geometry in 3D provides a decrease of Cd up to 13% for an angle around 10° and a deflector all along the body height. To improve these results even further, horizontal deflectors are added to get a Cd decrease of up to 50%.

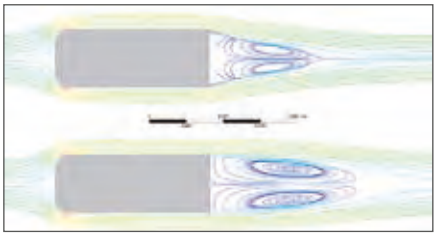
Keywords: Ahmed body, aerodynamics, vertical deflector, drag



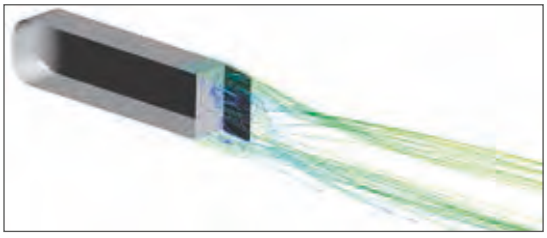
Horizontal sectional view of vorticity contours around 3D Ahmed body with deflectors



Ahmed body with deflectors



2D streamlines around the Ahmed body with and without vertical deflectors (top view)



3D streamlines around a half Ahmed body with vertical deflectors

Contact: sam.jeanjean@gmail.com ; martin.moreau12@gmail.com

Which powertrain for a small hybrid vehicle?

Mechanical engineering

B. DUPONT

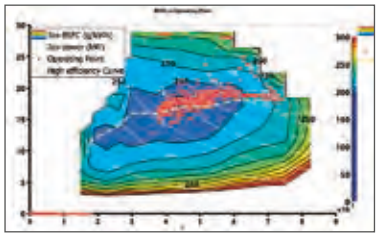
Benjamin DUPONT / Yinghao HUANG
Academic supervisor: A. CHARLET, G. COLIN
Industrial supervisor: Student Challenge SIA

Y. HUANG

Company: SIA (Société des Ingénieurs de l'Automobile)

Objective/motivation

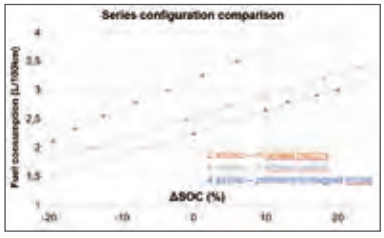
The aim of the project is to determine a powertrain for an ultra-light vehicle. There are many areas that can be improved, including internal combustion engine efficiency, downsizing, electrification, energy sources, etc. In our case, the vehicle will be a hybrid car. For future urban vehicles, the biggest challenge we met is to produce the most suitable and most satisfactory powertrain system. The trend of urban vehicles is to be small and be recharged at the end of your daily ride. Our research goal is to study and to identify the best combination of the technological bricks of the market, to meet the specifications, in compliance with standards and regulations. The results will be extracted from simulations on AMESim with a vehicle modeling created from real component data.



Specific fuel consumption engine mapping (torque vs rpm) with operating points

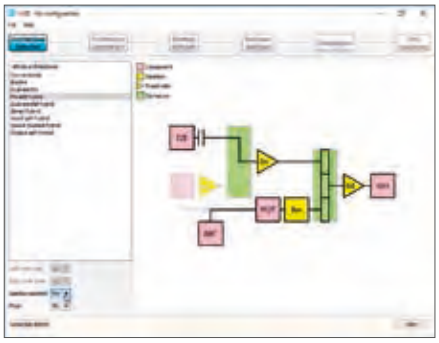
Results

We selected different engines: two-stroke & four-stroke ; transmissions: Manual & CVT; battery types: Lithium-ion & Solid state electrolyte; motors/generators: "in-wheel" & classic induction. We then focused on the component assemblies and optimal operating points for the Serie & Parallel Hybrid. Our main results concern fuel consumption compared to the difference of the battery state of charge (SOC) between its initial and final value. We simulate the two different architectures controlled with an automated controller (ECMS) and then with our own control strategy. Our control strategy succeeded in meeting the ECMS controller results with less than 2 L/100 km fuel consumption for a complete drive cycle in Series or Parallel architecture.



Engine/motor configuration comparison for a same drive cycle (each point, one simulation, one complete drive cycle)

Keywords: modelization, hybrid vehicle, control, challenge, innovations



Hybrid optimization tool for a vehicle modeling

In-wheel motor technology (Protean Drive™)

Contact: benjamin_dupont@outlook.com; yinghao.huang@etu.univ-orleans.fr

Unpublished projects in Technologies for Energy, Aerospace and Engines

The details of the projects completed by these students in Technologies for Energy, Aerospace and Engines have not been authorized for publication by the company/institution.

Yann DESQUIENS
yann.desquiens@etu.univ-orleans.fr

Antoine LE FUR
antoine.le-fur@etu.univ-orleans.fr

Gabriel ESSAMI
gabriel.essami@gmail.com

Florent RENEAUD
florent.reneaud@etu.univ-orleans.fr

Zhiyuan HUANG
zhiyuan.huang@etu.univ-orleans.fr

Shujian YU
shujian.yu@etu.univ-orleans.fr

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.

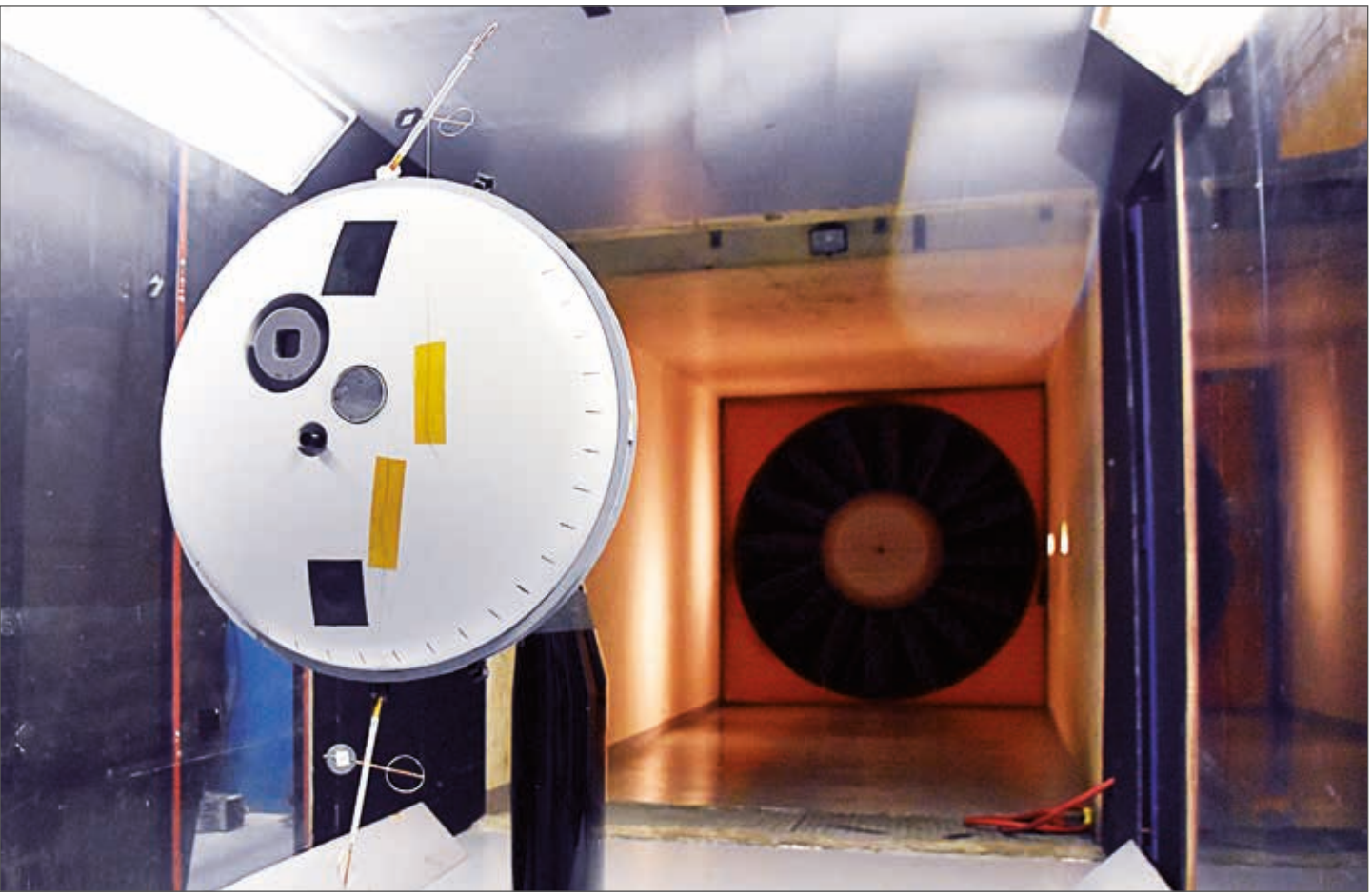
Clean Room
A class 10,000 clean room of 100m^2 is in service at the GREMI laboratory of Polytech Orléans. Students working in the Engineering Physics and Embedded Systems specialty carry out their practical work study projects in micro/nano-technologies and plasma processes in this facility.

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

Participants in the Final Year Projects Forum

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

Index of participating companies and institutions