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ORLÉANS
School of Engineering of the University of Orléans

Student Projects Catalogue 2019-20

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Polytech Orléans

Polytech Orléans

Ecole Polytechnique de l'université d'Orléans

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Message from the Director

One essential element of the 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

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Civil Engineering

3D modelling and structural calculation methods based on a laser survey, applied to the cathedral of Orléans

Civil engineering


R. BOUGAREL


B. GIRAUD

Rémi BOUGAREL / Benjamin GIRAUD
Academic supervisors: L. AUBRY, L. JOSSERAND
Industrial supervisor: S. PRODHON

Institution: Citeres-Lat (University of Tours)

Objective/motivation

By choosing this project, we expect to improve our knowledge on 3D modeling and to learn how to use software commonly used in this domain. The first objective was to find a way to model the cathedral of Tours, and to use this model to calculate the efforts in the links between the wood/iron chains and the stone columns. Another objective is to find the easiest and fastest way to model the structure in order to maximize the efficiency of the process. The complexity of the structure can allow us to learn about cathedral structural components and to deeply understand the full process of 3D modeling, from reality capture to the design of a mesh and a solid, to finally calculate efforts. We expect this project to be a real asset to be efficient for a future professional use of this method.

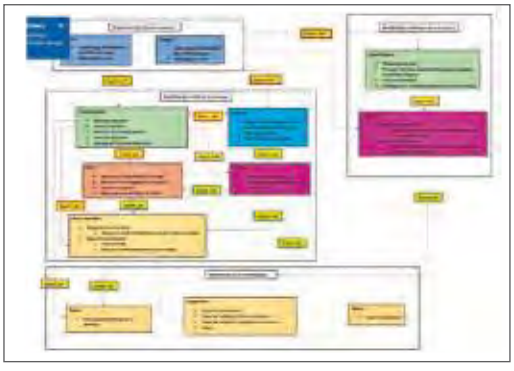

Structure mesh

Results

So far, we have been able to find steps to calculate deformations in a part of the cathedral of Orléans (four columns and a vault). We expected to apply this method to answer the Citeres-Lat laboratory problematic, but we could not because of a late receipt of data during the 7th week. During the project, we kept the problematic in mind. Even though we did not directly answer the problematic, we developed a tool and a written report that will help future students and/or the laboratory itself to answer the problem, following the steps. The report can help in the understanding of how to put together several scatter plots obtained from a laser survey, and how to decimate it. It then helps to create a 3D mesh and a solid, to finally perform mechanical tests.


3D mesh of a part of the cathedral of Orléans


Structure form


Software use

Keywords: 3D modeling, cathedral, structural analysis

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3D printing of the spiral double helix staircase and the "Tour Lanterne" of the chateau of Chambord

Civil engineering

Auriane NION / Juliette TERRIER
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POLYTECH ORLÉANS
School of Engineering of the University of Orléans

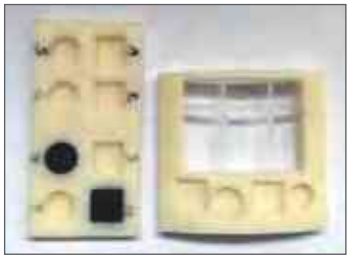
Institution: Polytech Orléans


A. NION


J. TERRIER

Objective/motivation

The objective of our project is to create a 3D model on a 1.85% scale of the double-revolution staircase and the "Tour Lanterne" of the chateau of Chambord. This model will be created from a numerical clone of the chateau. This project follows another one about the printing of the double helix staircase. Once finished, this model will be put in place at the chateau itself. This model will be printed using a 3D printer from the Fablab in Orléans. To ensure a realistic rendering, we have chosen to make pieces to represent the black slates and stained glass window on the "Tour Lanterne". These pieces will be created thanks to the laser cutting machine. Moreover, we also had to make technical changes, such as the sections per floor on the 3D model used for the impression.


Materials for the model (slates and stained glass)


3D modelling of the double helix staircase and the "Tour Lanterne"

Results

We went to the chateau of Chambord to complete the 3D survey using a laser scanner. Stations were then assembled on ReCap™ software to generate the point cloud of the Tour Lanterne. The resulting 3D model was then processed with Blender to creates cuts, notches and reservations. Once all the modifications are done the model can be printed. We also carried out tests to choose the right materials for the black slates and the stained glass window. The materials selected are black plastic plates for the slates and transparent plastic plates for the window. The materials have been ordered and are ready for use. We have not finished our project yet. Indeed, we did not have enough time to print our model.


Cloud points of the chateau of Chambord

Keywords: 3D modelling, 3D printing, identical, double helix staircase, Tour Lanterne

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Application of Reliability-Based Design Optimization method in the dimensioning of geotechnical structures

Civil engineering


M. KAZMANE


A. RISAL

Mohammed KAZMANE / Aurélie RISAL
Academic supervisor: D.P. DO
Industrial supervisor: L. AUBRY

Institution: LaMé Laboratory

Objective/motivation

Traditionally, the dimensioning of geotechnical structures is based on the application of the factors of safety recommended by the codes of Eurocode 7 to deal with the inherent nature of the uncertainties of geomaterials. However, this approach, called the determinist approach, does not guarantee an optimal conception of the construction project. In this project, this approach is compared with the Reliability-Based Design Optimization approach (RBDO) which considers the uncertainties of the system, represented by the soil and the structure to be built, and allows for the best trade-off between cost reduction and reliability assurance by verifying the targeted reliability level. For the example of retaining wall dimensioning, this project aims to study the RBDO method and compare it with the probabilistic one. The final goal would be to find a way to improve the determinist approach, integrating the RBDO.

Results

By studying Excel® files of simulation of the RBDO application, in the dimensioning of a retaining wall, we discovered that:

> for a fixed structural safety factor value, and a defined probability of failure for the RBDO method, the deterministic method leads to an over-sizing or under-sizing of the structure after a comparison of the results with those of the reliability method, and
> the results of the probabilistic method are mainly affected by the dispersion of the values (standard deviation) of the friction angle of the soil grains from the geotechnical surveys of the soil under consideration.

Keywords: RBDO, determinist, probabilistic, retaining wall, dimensioning

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Comprehension of exchanges between ground water and the Loiret River in the Orléans valley

Environmental engineering


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L. RONTE

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POLYTECH ORLÉANS
School of Engineering of the University of Orléans

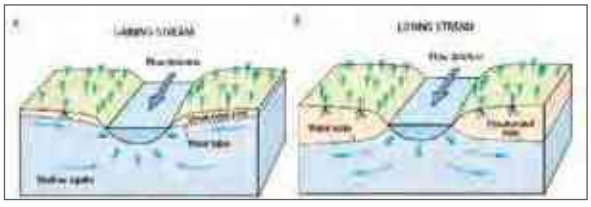
Institution: Polytech Orléans

Objective/motivation

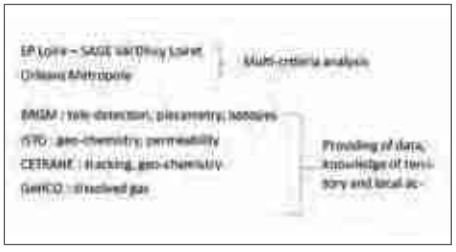
Aiming to improve the hydrological knowledge of the Orléans region, we must build a Geographic Information System, an interactive map of the Orléans region, to present the different hydrological parameters characteristic of groundwater and surface water exchanges. This GIS includes information on the heights of water, the position of the karsts (underground galleries dug naturally in limestone), and the value of the flows in the watersheds, etc. In addition to this task, we created a database to gather all the non-spatial information and make the link with the map. From this map and database, we will be able to precisely map out the direction of the exchanges (from the river to the water table or vice versa) from a spatial and temporal point of view. Ultimately, this map and the GIS will serve as a state of the art to initiate the CENARI-O project. The ultimate mission of the project will therefore be to provide a precise report of the missing data.

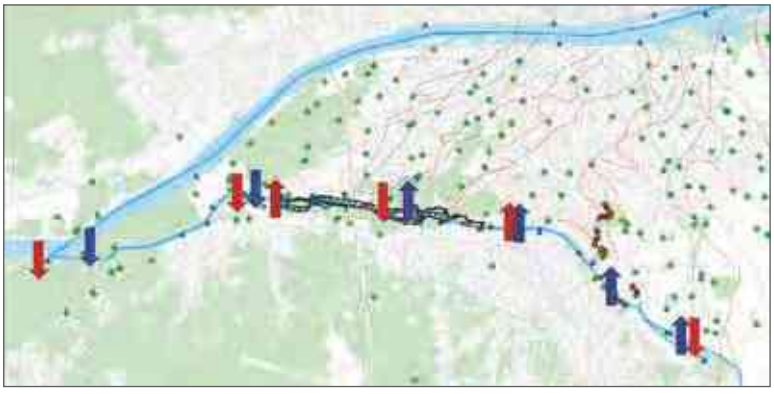
Results

Currently, the project is composed of a GIS which includes data on hydrology (by the water flow in the river), topology (by the localization of karsts), geo-chemistry and piezometry. We are now able to map out the direction of exchanges and show the significant difference of behavior of the river between low and high tide. The database is also completed and gathers all the main studies about the Loiret river from the beginning of nineteenth century until now. It shows interesting samples of articles and the scope of the related study. This database also makes it possible to highlight missing measurements and makes a link between GIS and bibliographic data.


Infographic provided by BRGM to explain how the direction of exchanges changes

Keywords: water cycle, water exchange, hydrology, Loiret


Presentation of the actors intervening on the project


Simplified view of the GIS showing the direction of the exchanges between the ground water and the river

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Creation of blueprints for the construction of the -1 level of the Saint-Denis Pleyel railway station for the "Grand Paris Express"

Civil engineering


J. DELALOYE


E. VILLIE

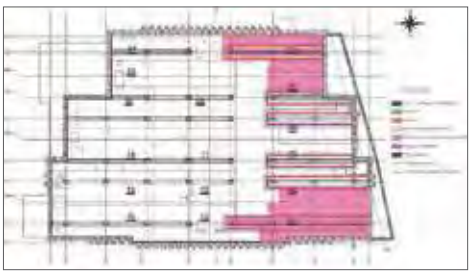
Julie DELALOYE / Elodie VILLIE
Academic supervisor: N. BELAYACHI
Industrial supervisor: N. SIMONNET

Company: Eiffage Civil Engineering

Selected Participant
14th Annual Final Year Projects Forum

Objective/motivation

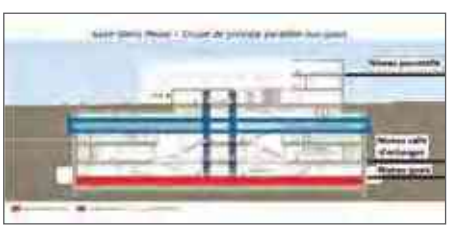
The main goal of our project is to create the organization of the construction of the first underground level of the railway station of Saint Denis Pleyel. For that, we have to make blueprints describing the different stages of construction. These blueprints will be used by the workers to make them understand well the steps of the construction. That's why we have to draw them on the software AutoCAD. The construction of the future railway station of Saint Denis Pleyel is complex in many ways. It is located in an urban environment so the space available is limited. Moreover, the station is made in an uncommon way, from the top to the bottom, which makes the process of construction even more difficult. So, our objective is to optimize the different stages of construction of the -1 slab so that it is made fast and safely.


A step of our Autocad blueprints

Results

To achieve our objective, we first did technical visits of the sitework to understand well all the constraints of construction. Then we described the stages of construction on paper blueprints. We made three different propositions of construction. In accordance with our supervisor from EIFFAGE Génie Civil, we chose one, which was the most efficient. In total, it takes 21 stages to make the entire slab of the -1 level. After that, we made those blueprints on the software AutoCAD. We met two engineer method of the company who explained us how to use the software as they do so that they can modify our blueprints after the project if necessary. Finally, to have a better comprehension of the steps of construction, we decided to make detailed blueprints, like "cuts", on AutoCAD of some specific points of the slab.

Keywords: Grand Paris express, slab construction, underground station, construction site, blueprints


In blue: the -1 level of the station on which we worked


The construction site of the Saint-Denis Pleyel station

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Deformations measurement of Orléans' cathedral portal

Civil engineering


A. CHEHADE


M-A. GENDRY

Alaa CHEHADE / Marc-Antoine GENDRY
Academic supervisors: X. BRUNETAUD, L. JOSSERAND

Institution: Regional Directorate for Cultural Affairs, Centre-Val de Loire

Objective/motivation

This project aims to study the stresses and deformations of the Orléans cathedral's portal. 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 cathedral's portal 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 portal. With this model, we observe the elements precisely, enabling us to link the stresses to the deformations by analyzing them on AutoCad.


Cracks over the vault

Results

We spent three different days doing scans which provided us about 100 scans mainly located in the frame and inside the portal. With this model, we were able to have different horizontal and vertical cross-sections of the whole portal. 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 vertical elements of the narthex. 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 due to major modifications on the vaults.

Keywords: cathedral, deformations, portal, scan, structure


Complete view of the portal


Cross section of the portal

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Design of underground structures taking into account spatial variability of the properties of geomaterials

Civil engineering

M. EL-HAJJAR

N. YOUNES

Mohamad EL-HAJJAR / Nabil YOUNES
Academic supervisor: D.P. DO

Institution: LaMé Laboratory

Objective/motivation

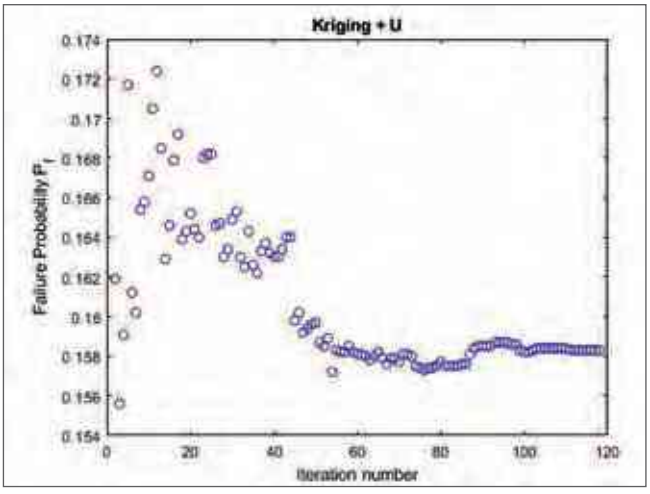
The spatial variability of physical properties presents an intrinsic characteristic of geomaterials (soils, rocks, concrete) due to their heterogeneous nature. By ignoring this characteristic, the deterministic approaches such as Eurocode, ACI, and BAEL, used for designing underground structures, provide overestimated results. Therefore, a probabilistic method has been studied to guarantee optimum results at the lowest possible price. This project aims at designing a buried tunnel in rheological rock. Probabilistic Method (Monte Carlo Simulation along with Uncertainty Method) has been proposed to solve the problem. Since this strategy is extremely time-consuming, an interpolation method (Kriging) has been used. Moreover, an Inverse Method has been applied in order to design the tunnel.

Results

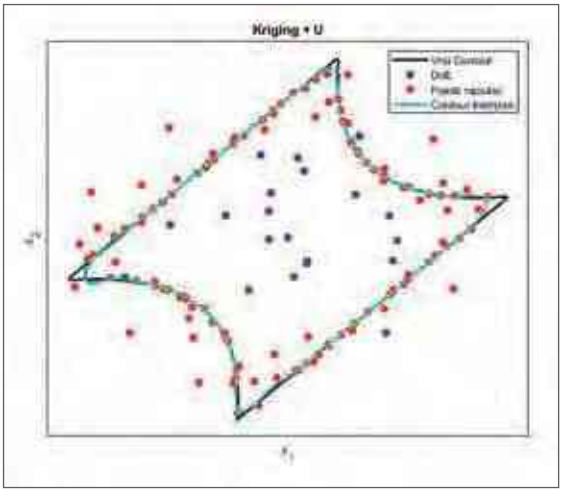
As a result, a methodology has been developed and approved in order to design the tunnel. This methodology revolves around determining the thicknesses of liners of the tunnel under the constraint of a certain failure probability.

Keywords: tunnel, soil, uncertainty, variability, heterogeneity, Monte Carlo simulation

Diagram of the tunnel



Application of Kriging in order to fit the failure contour



The convergence of the failure probability contour

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Development of a health area

Civil engineering

C. CHAVANEL

G. DE FERLUC

Clara CHAVANEL / Gabriel DE FERLUC
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POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Selected Participant
14th Annual Final Year Projects Forum

Objective/motivation

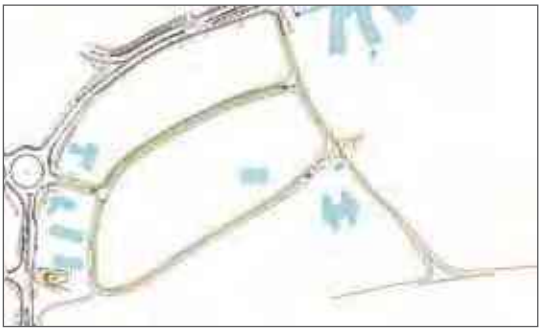
Within the scope of its economic development, the conurbation committee of Béthune–Bruay wants to build a business park on a strategic place. Our assignment is to design the health area of the Futura II business park. Currently, this area is a wilderness and has to become a showcase of the region. We have to design an optimized road network inside the zone and manage the rainwater system. We also have to make the way to the hospital easier. Different constraints were imposed such as conservation of the wetland in the southwest part of the area or the improvement of soft mobility by constructing pedestrian and cycle paths.

Results

At the end of the project, we delivered a clear plan of the road, pedestrian and cycle paths that could be built. We also designed the roads according to the expected traffic and harsh winters. Once this was done, we modelled it on the software Geo Mensura to have a good idea of what the area will look like. This will also help the clients to take a decision according to their expectations. The rainwater sewer system has been designed and, for most of it, we succeeded in connecting it to the existing network. The missing part has been designed for infiltration because it is better for the environment and it was possible there.

Keywords: road design, rainwater system design, 3D modeling

Streetviewed area before the project (Google maps)



Plan of the road network we designed on AutoCad

3D model of our planning proposition (made on Mensura)

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Development of a specific calculation module for calculation software using the finite element method

Civil engineering


Y. CAO


Z. ES SAID

Yves CAO / Zakaria ES SAID
Academic supervisor: H. RAMEZANI
Industrial supervisors: N. AYOUB, C. EL KHOURY

Company: Cabinet Jaillet-Rouby

Objective/motivation

The industrial project we carried out was proposed by Cabinet Jaillet-Rouby, a design office specialized in steel and composite structures and located in Orléans. They develop their own calculation software, Hergos. The company needs a new module that will be implemented by the company's IT manager. This module will be used in order to simplify the automatic verification of steel and composite structures for buildings and bridges. That is to say, this module will help create a module allowing to check the sections automatically on their calculation software, by determining the stresses in the structure. Then, it will be possible to establish a specification by including therein a general flowchart. And for each function of the flowchart, to establish a detailed flowchart according to its complexity. We also have to differentiate whether these parameters are input, intermediate or output data and, for each formula, indicate its domain of validity.

Results

We first had to gather material using the documents made available by the Cabinet Jaillet-Rouby, in order to understand the calculation steps necessary to be able to design a flowchart corresponding to their expectations. Once we finished gathering information, and we understood the missions entrusted to us, we started by listing and understanding the different formulas that would be useful to us in order to create this flowchart. Differentiating the cases is important to represent reality as well as possible, distinguishing the classes of mixed sections (classes 1,2,3 or 4) which will lead to different calculations, be they plastic or elastic. All in all, it's necessary to check each step of this flowchart in order to differentiate as much as possibe all the different cases.

Keywords: Hergos, module, flowchart, mixed sections


Example 1


Example 2

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Development of a tool to calculate energy consumption for the thermal rehabilitation of a building

Civil engineering


F. GUERLUS


O. ILALEN

Francois GUERLUS / Oussama ILALEN
Academic supervisor: N. BELAYACHI

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

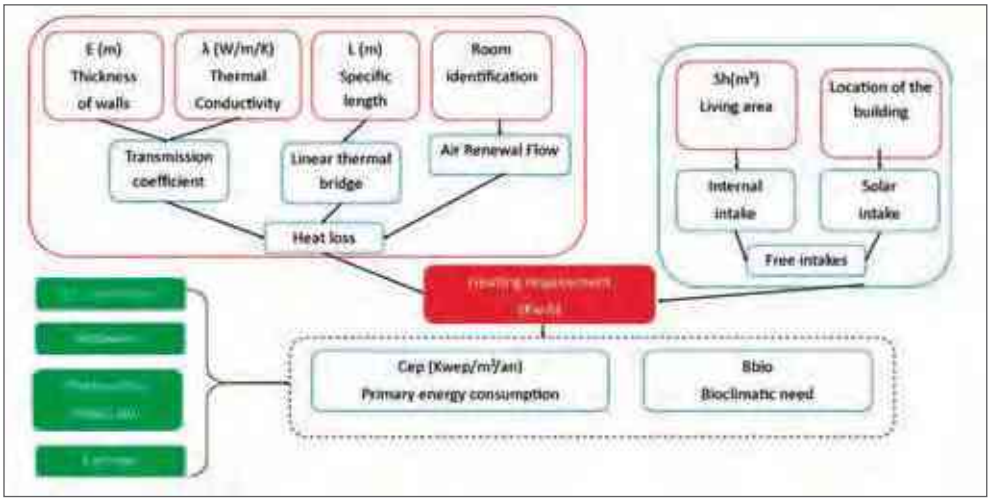
Selected Participant
14th Annual Final Year Projects Forum

Objective/motivation

As part of our fifth-year project we were asked to create a calculation tool in the form of an operational Excel® sheet which allows us to calculate heat losses as well as heating consumption, and obtain results similar to PHPP with a 10 % tolerance. Our Excel® sheet is easy to use and take in hand and allows the user to view their energy consumption before and after the rehabilitation of their building and make comparisons between different types of insulation proposed by the sheet. In the end, the interest for the consumer or the citizen is to save energy, to visualize both the interest in carrying out an energetic rehabilitation, and to choose from the various possible technical solutions. This project has real potential for us with the possibility of having a major impact in the field of rehabilitation.

Results

Our project is part of a sustainable development approach to better manage our impact on the environment, to favour the medium- and long-terms over the short one. Our Excel® sheet aims to do a set of calculations allowing us to know the heating need and the primary energy consumption of a building. Then, in a second step, its purpose is to simulate the impact that different solutions can have in the perspective of an energetic rehabilitation. Our Excel® sheet allows the user not only to reduce their heating costs but also to protect the environment by reducing the consumption of their energy.



Project plan

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Diagnosis and control of the geometry of sports surfaces by lasergrammetry

Civil engineering

N. CAPITAIN

Nicolas CAPITAIN / Jean-Cédric HONORINE
Academic supervisor: X. BRUNETAUD
Industrial supervisors: D. MIRANDA, P. THERRE

J-C. HONORINE

Company: Novarea

Objective/motivation

The main task of the project is to develop a new method of flatness control for indoor sports grounds by using a 3D scanner. During the design of a sports ground, Novarea must respect norms imposed by France and the European Union, and also rules made by the National and International Federations. Novarea mostly works in France but they can be solicited abroad. For example, they worked in Gabon during the 2017 Africa Cup of Nations in order to control the quality of some football fields. The fact that it is a company outside Polytech Orléans motivated us to rank this project first in our wishes. We were immersed in a professional working atmosphere. The second element that motivated us was to discover the technology which is lasergrammetry and which we had never heard of before in class.

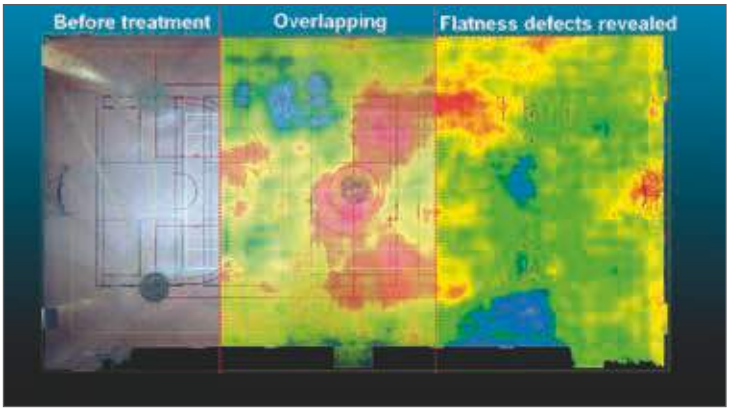
Faro 3D Laser Scanner

Results

We were able to process the technical data acquired during a scan of the André Gresle gymnasium located at La Source. We shared our results with Novarea, which is very satisfied with the results because they are consistent with the data observed during our site visit. Using the 3D scanner survey, we concluded that the gymnasium has bumps of approximately 11 mm in height and hollow spaces of 8 mm in depth. In addition, we were invited to a meeting within the company Qualidal, which is a control company specializing in industrial paving. This meeting allowed us to clarify the problems that we encountered when processing our data. The company Novarea now has bases and will be able to continue to develop this technology and integrate it into its customer quotes within a few months.

Keywords: gymnasium, lasergrammetry, development, method

View of a scan of a laser station



The different processing steps

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Diagnosis of the works of the Sauldre canal

Civil engineering

B. COMATTI

I. MOUCHRIK

Bassel COMATTI / Ikram MOUCHRIK
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Industrial supervisor: M. ROTAT

Company: Sologne Ingénierie

Objective/motivation

The Sauldre canal is a canal connecting the towns of Lamotte-Beuvron and Blancafort. It is 45 minutes south of Orléans. It was built during the Napoleonic era and was originally used to transport marl from Blancafort to Lamotte-Beuvron. Unfortunately, shortly after the canal was inaugurated, the road network and the railway began to develop. From then on, marl was more easily transported by road or by train and, over time, the canal was abandoned. This canal has not been used at all for almost 100 years. The works of this canal such as bridges, banks, aqueducts, and especially the locks, have a heritage interest for the region. Our project therefore aims to diagnose the condition of these structures, and to propose, if necessary, renovation or rehabilitation projects. These projects would serve to maintain the good condition of the structures but also to develop a tourist aspect around this canal.

A masonry bridge over the Sauldre canal

Results

Since this canal is more than 40 km long, we have focused on the Loir-et-Cher department, which represents around 15 km of its length. We have covered the entire 15 km to take pictures of all the works and find out their condition. The structures of the Sauldre canal are more or less in bad condition and this is mainly due to the lack of maintenance and monitoring. Now useless, the locks have been walled up one after the other. Therefore, unless some potential rehabilitation work is carried out, recreational boating is not yet possible today when it would present a certain tourist interest for the region. This is why we plan, thanks to this diagnostic work, to raise awareness among the people responsible for this canal and show them the high tourism potential. Indeed, these structures, shaped by men, constitute an endearing river heritage.

Keywords: diagnosis works Sauldre canal

The Beauval lock

Reach near the port of Lamotte-Beuvron

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Feasibility study of cycle path development on departmental road 311 in the municipality of Le Vésinet

Civil engineering


E. DEBAUGE


B. KAPLAN

Emma DEBAUGE / Burak KAPLAN
Academic supervisors: L. JOSSERAND, E. REMOND
Industrial supervisor: J. LUCY

Company: Iris Conseil

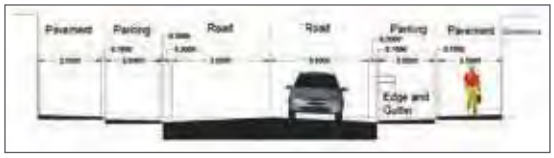
Objective/motivation

For our fifth year project as civil engineering students majoring in public works, we chose a feasibility study of cycle path development on departmental road 311 in the municipality of Le Vésinet in France. This project was suggested by Iris Conseil, a French company based in Montigny le Bretonneux. This two-kilometre road is one of the main accesses to Paris and is often very crowded. Nothing has been currently done for cyclists on this way. This study allowed us to measure the technical, financial and property feasibility of a two-kilometre cycle path across this road. A few requirements have been introduced by Iris Conseil, such as the effect of this construction on parking spaces (removal of some parking spaces), accident risks, and pedestrian safety.

Results

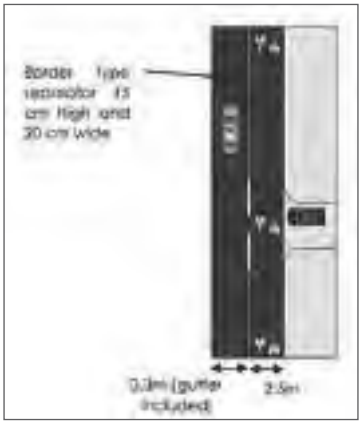
First, we were able to carry out various state-of-the-art cycling facilities. Then, for each section (differentiated by their cross-section profile), we suggested different cycling development proposals. In addition, we performed the multi-criteria analysis and the financial estimation of these proposals for each area. Finally, we produced 2D plans in order to materialize the possible routes of the cycle lane by mixing the variants in a logical, coherent and relevant way.

Keywords: feasibility study, cycle path



Technical profile

The different areas of the project


Future development of residential area

Contact: emma.debauge@etu.univ-orleans.fr ; burak.kaplan@etu.univ-orleans.fr

Feasibility study of the implementation of a concrete base as foundation

Civil engineering

A.E.K. AGBEKO

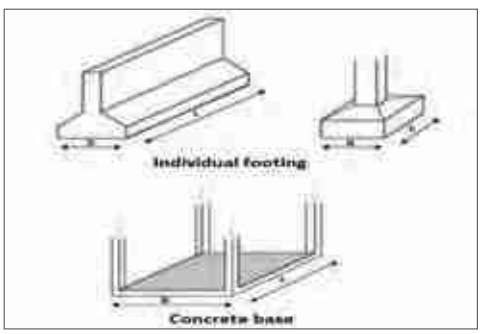
M-T. MINLEKIBE

Ayele Esther Kristy AGBEKO / Marie-Thérèse MINLEKIBE
Academic supervisor: N. BELAYACHI
Industrial supervisor: B. ADRIANSEN

Company: EBI

Objective/motivation

The aim of this project is to verify to what extent the use of a raft foundation can be technically and/or financially attractive, based on a given geotechnical hypothesis. The raft foundation (concrete base) is a shallow foundation in the form of a continuous concrete slab spanning the entire surface of the building. This system allows the distribution of loads on an unstable ground like the ground of this project. The study was made for a building composed of eight floors and two basements. This project involves different stages. The first part of the work concerns the calculation of the vertical loads to apply on the structure. The second and the third part consist in studying the possibility of implementing "individual footing" and then "pile footing". The final part of the calculation is the modelling of the raft foundation to estimate its technical and economic feasibility.

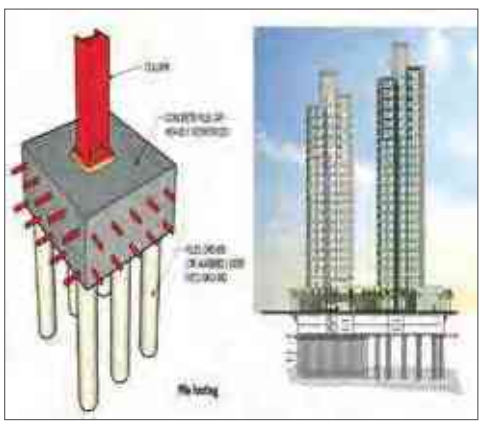


Individual footing and raft foundation

Results

The results of the second and third part revealed that individual footing will be too big, so too expensive and too difficult to be implemented. As regards pile footing, we noted that they are also expensive but technically more advantageous to be implemented than the individual footing. For the final part, there is not a lot of documentation on the calculations of base concrete. To overcome this, we decided to calculate the base concrete as a slab because it is modeled in the form of an inverted slab. To make our calculation more precise we decided to make the assumption of the presence of water in the soil and re-calculate the raft foundation with water pressure as the geotechnical report notified the presence of underground water. After calculation, we concluded that the raft foundation is the most technical and economical foundation to be implemented.

Building of the project



Pile footing

Keywords: individual footing, pile footing, raft foundation

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Identification by inverse analysis of thermal parameters of a bio-sourced insulation

Civil engineering

D. SACIKANTHAN

S. TAIEB

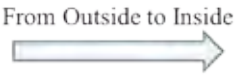
Dineshkumar SACIKANTHAN / Sacha TAIEB
Academic supervisor: D. HOXHA

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

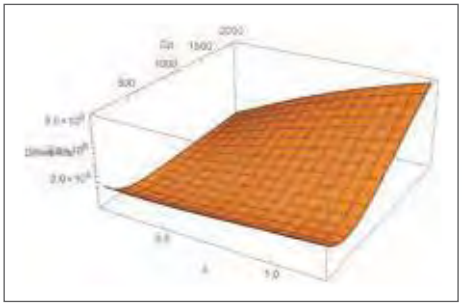
Objective/motivation

A former project called PROMETHÉE developed bio-sourced insulation based on wheat straw. They found the values of the parameters in the laboratory and they tested the materials on a demonstrator in Tours. Determining the in-situ parameters is necessary to measure the difference between laboratory and in situ values. They defined a succinct method to calculate the in-situ parameters, but the precision was low. Our project is designed to find the thermal parameters of this insulating material based on in-situ temperatures and humidity saved by sensors of the demonstrator. We must improve the method by using different tools to find the in-situ parameters with a better degree of precision. If this project succeeds, we can apply the method to other insulating materials.



Results

For our calculation, a script is written from heat diffusions laws established by Fourier. Our script calculates the temperature at different times and for each position on the wall. With these temperatures, it also calculates the thermal flow and we select only the temperatures and the flows at the sensor position. This operation is repeated for each couple of thermal parameters and all these values are compared to the sensor's data to find the best couple of parameters. We use a comparison algorithm to interpolate between the couples calculated and gain more precision. As this protocol is completed, we complete the script with humidity coupling. To confirm our result, we model the system on a diffusion simulation software and ascertain the difference with the laboratory values.



Diffusion coefficient curve as a function of conductivity and heat capacity

Wall configuration diagram

Photo and 3D model of the Prométhée's demonstrator

Keywords: insulation, bio-sourced, characterization, analysis, programming

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Improvement of a teaching unit "Geoscience tools for the engineer"

Civil and Environmental engineering


N. BERNIER


T. LELEU

Nathan BERNIER / Thomas LELEU
Academic supervisor: C. MALLET

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

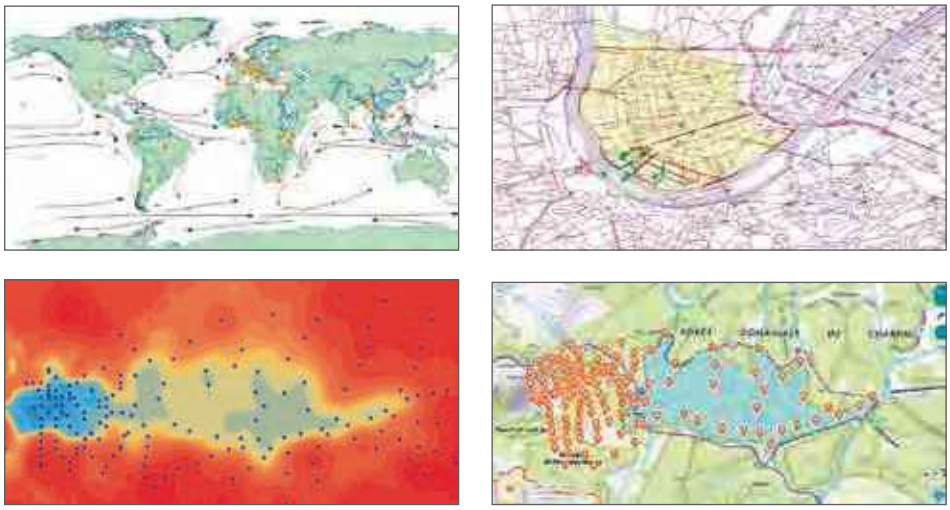
Objective/motivation

The objective of this project was to improve the teaching unit "Geoscience tools for the engineer". This objective was defined starting with the feelings of students from previous years who considered that this teaching unit was composed of several unrelated subjects and that there were problems in some courses. Our motivation was therefore to make this teaching unit more suitable to student through more practical teachings and links between lessons. We wanted to improve the lessons that appeal to students in order to consolidate concepts that seem useful to them for the future. We have made sure to suggest improvements that may suit students but also the constraints of the teachers. It was therefore necessary to consider the concept of hours allocated according to the different lessons as well as their successions.

Results

The first action carried out was to collect the different opinions of the students in order to observe the positive points to be deepened as well as the negative ones to modify. The results are that we have created new subjects for the GIS teaching unit in order to deal with global warming and environment as required by our tutor. We have provided another subject for a geostatistics link to topography in order to connect both classes. This is the reason that we also offered new schedule arrangements in order to link courses to each other because this was a main issue noticed in our survey concerning this teaching unit. Moreover, we tried to offer new practical teachings in addition to the current topography study to cover more aspects and use modern tools like drones. We have redone the total station practical work to improve the instructions and to bring in the IR functionality.

Keywords: reorganization, coordination, homogeneous, experience


Images from coursework modules in geostatistics

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Influence of the characteristics of the granular skeleton on the rheological behavior of cementitious mortars

Civil and Industrial engineering


E. DEGERT


Y. FRINDI

Emma DEGERT / Yeza FRINDI
Academic supervisor: S. REMOND
Industrial supervisor: S. REMOND

Institution: LaMé Laboratory

Objective/motivation

Nowadays we try optimize the use of materials more and more. We have to work on the granular mixes in mortars to optimize cement quantities to have better results regarding ecological and economical aspects. In fact, the less we use cement, the more we preserve the environment. We want to know how the behavior of a mortar can be changed by the small modification of the grain size distribution of sand. We try to quantify this difference by the spreading of the mortar. To have different mortars, we create new sand by changing their grain size distribution and we leave all the other parameters constant. If the difference is noticeable, we will try to validate the grain size distribution on a computer through a software program to see the difference of compacity.


Mixers

Results

For now, eight sands have been created. That took us a lot of time but then we had the compositions of the new sands to create the new mortars. To achieve our work, we used the regular sand available at Polytech. We sieved our sand to have the correct proportions to have different mortars. The quantities used are always the same and we change only the grain size distribution of the sand: 270ml of water, 450g of cement and 1350g of sand. After this step, we use the right protocol to create the mortar by mixing our sand with water and cement. The last step is to use the MBE cone to measure the spreading of the mortar. Results now have to be analyzed to know the influence of the grain size distribution in a mortar.

Keywords:
mortars, rheology, grain size distribution, spreading


Mortars


MBE cone


Sieve

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Measures harmonization to limit water use during drought

Environmental engineering

N. DEVAUX

B. LANOY

Nathan DEVAUX / Brice LANOY
Academic supervisor: C. DEFARGE
Industrial supervisor: F. VERLEY

Institution: Regional Directorate for the Environment, Planning and Housing, Centre-Val de Loire

Objective/motivation

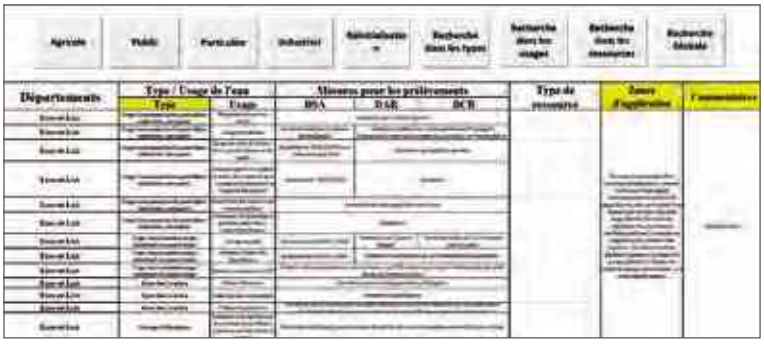
The measures taken in drought periods are a critical point of plans that protect us against water shortage. Today, however, there are many actors working on water issues in each region and department. This has brought about a variety of different measures, taken by each actor, to manage the resource. These measures produced by various and separate entities are triggering conflicts and misunderstandings for the population and the system, creating uncertainty as to which directives apply. We wanted to create a table that will resume and sort all the measures and values concerning the drought protection system of the region.

Results

This table is a simple file that can reject limit drought values associated with the restrictions for every water use, in every place. The table is so large that, in order to gain usability, we decided to add a Visual Basic sorting code. Initially, this was used to highlight measures, sorted by usage. Now, the program permits the Directorate to highlight every case that contains a typed word. This version will allow our client to compare measures, with a fully flexible research system. It will be easy to highlight and correct conflicts or to find any information about any region and measure. Therefore, the Directorate can also use the table to discuss and exchange information with other actors and regions simply and quickly.

Keywords: measure, drought, resource, table, code

Multiple directives



Coding and resulting consolidated table of directives

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Mechanical modeling of the frame of the cathedral of Orléans

Civil engineering

Georgii LEGOSTAIEV / Bassirou SOW
Academic supervisors: D. HOXHA, L. JOSSERAND

G. LEGOSTAIEV

B. SOW

Institutions: Archeological Federation of the Loiret,
Regional Directorate for Cultural Affaires, Centre-Val de Loire

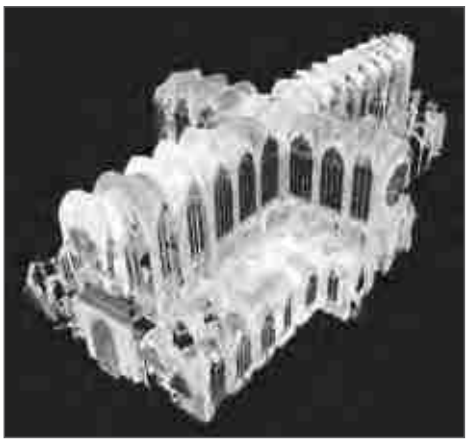
Objective/motivation

The objective of this project is to scan the frame of the cathedral and create a 3D model to simulate its behavior under the load of the self-weight. Indeed, there are some deformations of the main frame of the building. The objective of our project is to replicate the structure of the main frame and its loads, and finally verify if the deformations are logical or not. After achieving that, we will also be able to predict future deformations of the structure. There are multiple aims to that project and among them is the ability to mimic the efficiency of mechanical devices destined to support the structure. To achieve that goal, we must make 3D scans and use several softwares to treat the file thus obtained.

Results

The scans we made were quite numerous (roughly 50 stations or one quarter of all the scans made by Polytech). They created a file containing a point cloud representing the surroundings of the scanner. Since all the files had to be consolidated into a single one containing the entire building, we had a big file. We reduced the area of study and used different software to sample the frame, create a mesh, and a surface covering it. Right now, we are trying to find a way to clear all the holes in the mesh and create a volume in order to create a 3D solid with which we can finally work.

Keywords: cathedral, scan, tridimensional, modeling



Scan images of the cathedral and of two details

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Optimization of the building logistic of the Saint-Denis Pleyel railway station roofing slab

Civil engineering


V. AKA

Vaitiare AKA / Abdou DIAO
Academic supervisor: N. BELAYACHI
Industrial supervisor: N. SIMONNET


A. DIAO

EIFFAGE GÉNIE CIVIL

Company: Eiffage Civil Engineering

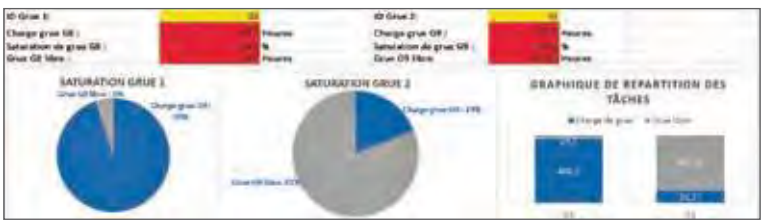
Objective/motivation

Our final project consisted in collaborating with Eiffage Civil Engineering on the Grand Paris Express. During the first part of the project, our goal was to give some solutions to optimize the circulation traffic of the trucks and working machines by taking into consideration the limited and urban character of the jobsite.

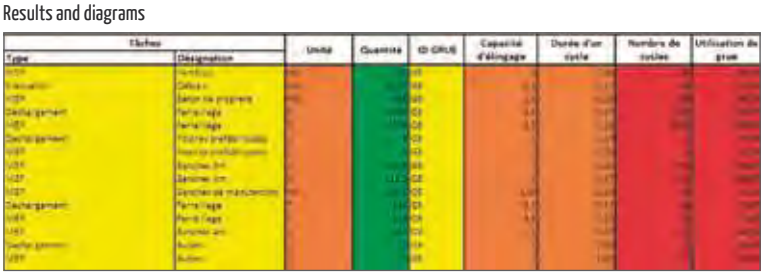
Results

We developed an automatic Excel® sheet for crane saturation calculation. The load of the crane is calculated from the working rate of the crane. Indeed, saturation is the rate of crane occupancy over a working day or over the entire duration of the project. We had to identify every task for the crane, its execution time and quantity, to create a graph which shows the crane saturation. To make this software automatic, we added a database allowing the user to choose any parameter according to a task of the crane for a given period, so that the user receives the result directly, depending on those parameters.

Keywords: Grand Paris Express



Results and diagrams


Details of the calculations


Footprint of the jobsite


The construction site of the Saint-Denis Pleyel station

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Optimization of the realization and phasing of construction of ventilation flues

Civil engineering

M. FAVE

K. PASTORELLI

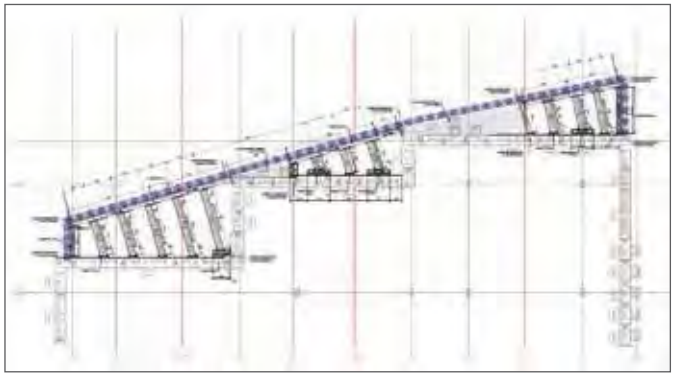
Mathieu FAVE / Killyan PASTORELLI
Academic supervisor: N. BELAYACHI
Industrial supervisor: T. BLATTER

EIFFAGE GÉNIE CIVIL

Company: Eiffage Civil Engineering

Objective/motivation

Together with Eiffage, we worked on a part of the construction of the biggest subway station which will be part of "Le Grand Paris Express", the metro station "Saint-Denis Pleyel". The project's aim is to optimize the realization and the work phasing of the construction of ventilation flues. It consists of large openings along the east side of the station that will be used to bring air flow inside during the service life. This reflection on the operating modes must lead us to design a procedure on how to realize such a building. We were willing to work there because of the size of the project. With an easement of 17000m² and a station that will be composed of eight stages, four in infrastructure and four in superstructure, this site is among the biggest in the field of civil engineering.



Map of the east slots

Results

For this project we have to write a procedure to detail the operations of construction of ventilation shafts. In this procedure, it's very important to detail as much as possible. For each stage of construction, we must find a solution that is technically feasible and economically acceptable. It is therefore up to us to choose the vehicles and equipment that will be used on the construction site. We detail the different solutions with the help of 3D drawings and sectional views. We also carry out measurements on plans, to estimate the cost and duration of the various phases of work. Safety is also an important aspect of our work. We have to think and write in the procedure every measure that will be put in place to guarantee general security on the site and safety of the workers on the construction site.

Keywords: ventilation flue, metro station, Grand Paris Express

3D view of one of the three ventilation flues to build

Overview of the construction site

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Preliminary study for choice of pilot site for the renovation of a tufa building using a coating

Civil engineering


E. MUNTONI


C. SIEGLER

Eugénie MUNTONI / Clémentine SIEGLER
Academic supervisors: K. BECK, X. BRUNETAUD

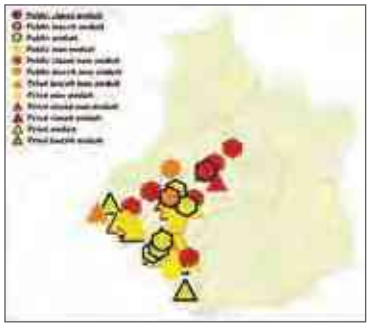
Companies/Institutions: Vega Industries, Centre Sciences, LaMé Laboratory, Envirobat, Valorem, BHPR

Objective/motivation

This task is the selection of a pilot site for an energetic renovation of a building in tufa stone. Our project is a part of a research program named "RESPECT" (Sustainable renovation of Built Heritage by the use of a coating based on limestone and tufa powder). This research work consists in developing coatings for the interior and exterior of a tufa building in order to serve as a thermal and hygrometric regulator for inside and protect the facade from the weather. For the purpose of testing both coatings, our task is to find the perfect building respecting several criteria. The building must be in the Centre-Val de Loire region, must be built in tufa stone, need renovation and be a public building, such as a school or a town hall. Our project is to reference all the buildings which meet these criteria.

Results

For this preliminary study, we made a map with the different quarries of the area to know where each stone is located, in order to see the places where it is possible to confound two different stones on the facade of a building. In addition, with data from the Heritage and Inventory Service of Centre-Val de Loire region and Google Street View, we identified and analysed all the buildings made in tufa. With these data, we created a GIS (Geographic Information System) map with QGis software where all the buildings are referenced according to different criteria chosen wisely: public, classified heritage, and already coated or not. In addition, we superimposed the quarries map and the GIS map to highlight their relationship. During a meeting with the actors of the research program, we exposed our work on the different maps and were able to offer them the locations where the tufa stone is the most used for buildings and where the possibility of finding the pilot site is the highest.


GIS map


Quarries map


Data base

Keywords: tufa, GIS (Geographic Information System mapping), coating, building renovation, thermic properties, hygrometric properties

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Professional training contract in a design office for roads and networks

Civil engineering

Corentin ANSEL
Academic supervisor: L. JOSSERAND
Industrial supervisor: F. BESNARD

Company: Soderef Development

Objective/motivation

This is the first year that Polytech Orléans offers fifth year students in civil engineering the chance to make a contract as an intern in the company of our choice. It looked like the best opportunity I could have to enter the transition period and get a stronger work experience as an engineer than the basic six months internship the fifth year must do. Therefore, I have been hired by Soderef Developpement, which is a civil engineering design office for roads and networks located in Le Mans. I mainly deal with a housing scheme where I create a plan of roads and networks but also write technical clauses and put a cost on the project I manage.

Results

The professional training contract makes me feel more and more confident each time I come back to the company. The company periods made me learn many things which had been beneficial for me during the academic period because I have more experience and saw much that the school couldn't teach us. I think that the professional training contract is truly the best way to start the engineering life and I clearly would do that again if I had to.

Keywords: design office for roads and networks

Contact: corentin.ansel@etu.univ-orleans.fr

Reducing the risks associated with musculoskeletal disorders (MSD) by creating a connected system

Civil engineering

Maxime BODIN
Academic supervisor: L. JOSSERAND

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Objective/motivation

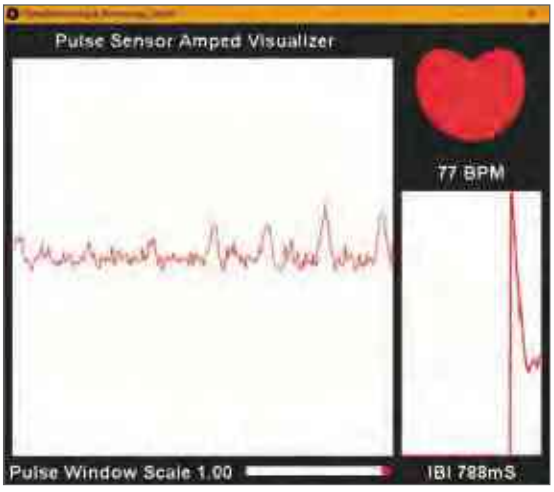
The objective of this entrepreneurial project is to offer a solution which reduces the risks associated with musculoskeletal disorders (MSDs). In France, MSDs are the leading cause of professional diseases. The development of MSDs and their effects (absenteeism, high turnover, etc.) has continued to grow over the years. It was from these various observations that this project was born. In order to respond to the various problems linked to these diseases, we created a connected system which would allow the detection of dangerous postures. This will help the company analyzing the most dangerous gestures and positions of their employees in order to modify workstations or the process of production.

Results

Working on this project allowed me to use skills that I learned throughout my studies at Polytech Orléans but also to develop my adaptability and my sense of innovation. I studied a lot of documentary research concerning musculoskeletal disorders in order to understand their functioning, their causes, etc. By carrying out research on MSDs, I have realized the importance of these problems. It was therefore a real challenge for me to think about a coherent and usable solution in order to reduce their risks. Thanks to this project, I was able to make a prototype that measures elbow flexion, the user's heart rate, etc. By analyzing the data, it is possible to determine the different stresses on the body and protect the user from MSDs.

Keywords: musculoskeletal disorders, professional diseases, arduino, entrepreneurial project

Code for Arduino



Heart rate result

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Securing the RD311

Civil engineering

P. BERTRANET

E. ROBERT

Paul BERTRANET / Edouard ROBERT
Academic supervisors: L. JOSSERAND, E. REMOND
Industrial supervisor: J. LUCY

Company: Iris Conseil

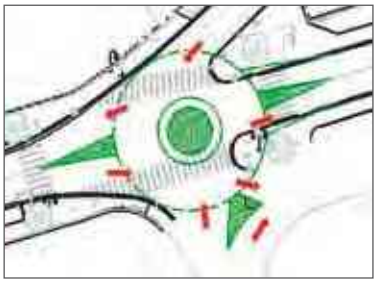
Objective/motivation

The aim of the project was to find solutions to develop crossroads such as roundabouts, traffic circles, speed bumps, modifications of the sidewalk layout or signage in order to mitigate accidents that have occurred on the studied route. At the beginning of this project, we had to learn the road standards for crossroads. In addition, we wanted to see how a feasibility study is carried out in a project management office. In order to find the most appropriate solution, we suggested at least three variants per intersection, which we compared according to several criteria such as speed of implementation, dangerousness, impact on light vehicles and pedestrians, etc. These comparison criteria included adaptation with a related project, which was one of the most important for us since our project had to be in line with a project dealing with soft traffic (pedestrians and cyclists).

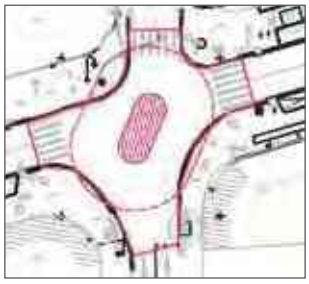
Results

On the most dangerous junctions, we found that the standards in force are respected, so the problems were not at that level. The analysis of the conditions of the various accidents allowed us to conclude that the errors were more of human origin than due to the existing facilities. Nevertheless, we have suggested additional facilities to further reduce the risk of accidents for light vehicles or pedestrians. These proposals include, for example, shortening pedestrian crossings by redesigning pavements and adding speed bumps to reduce the speed of drivers approaching junctions considered as dangerous. Thanks to a multi-criteria analysis we have determined the best solutions for each crossroads. Sometimes the "no change" solution proves to be the most advantageous, notably for financial reasons. However, for larger junctions, the best solution is often the roundabout for safety and traffic fluidity reasons.

Keywords: security, road, crossroad, traffic



Traffic circle



Traffic circle bean

Study area

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Separation of the sanitation network of Ouzouer-sur-Loire

Civil engineering

Younes AHJAM
Academic supervisor: E. REMOND
Industrial supervisor: O. FAREZ

Company: Eiffage Route

Objective/motivation

The municipality of Ouzouer-sur-Loire has decided to separate its unitary sanitation network present in several streets of the town. The work consists of creating a new used water network, lining the current unitary network so that it becomes a rainwater network, and remaking sanitation connections in the public domain and in private homes. Connection work in the private sector consists of working with individuals who have mixed used water and rainwater networks, and creating a specific network for used water. Rainwater is separated by connecting it to a sump or to the existing network which will serve as a rainwater network.

Results

The company has entrusted me with the organization and execution of connections in the private sector. I had, therefore, two roles at the same time. First is the role of project manager, by preparing the weekly intervention planning, contacting individuals for visits and confirming the execution date, preparing the list of materials and staff scheduled on construction site each week, and participating in the weekly meeting. Second is the role of construction site manager, by managing the teams on the construction site, organizing the works, animating the weekly sessions of the quarter-hour of security, writing the construction site reports and ensuring the proper execution of works.

Installation of a sump

Keywords: sanitation network, used water, rainwater

Construction of a trench for sanitation connection

Use of the GPS rod to determine the altimetry

Contact: younes.ahjam@etu.univ-orleans.fr

Setting up of a roundabout

Civil engineering


R. GOBIN


L. HOUILLE

Raphaël GOBIN / Lilian HOUILLE
Academic supervisors: L. JOSSERAND, E. REMOND
Industrial supervisor: J. LUCY

Company: Iris Conseil

Objective/motivation

The French department Seine Maritime launched the renovation of the RD6015 road to improve its safety. Our mission is to build a roundabout near a small town named Les Trois Pierres which is about 50 kilometres from Rouen. The project must be consistent with the environmental characteristics of the site. Concerning the sewage system, we have to think about the setting up of a reservoir. We also have to keep the bus stops and think about their functioning and location. Finally, we have to set up drop off areas to allow public transport users to take the bus and our project must be built so as to allow pedestrians access to the bus stops.

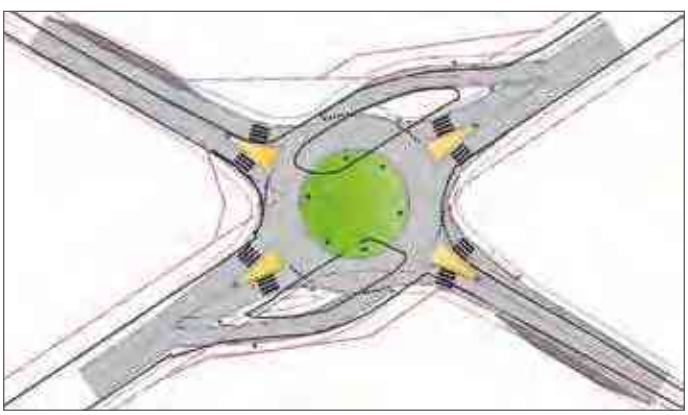

Site before the project

Results

So as to insure the accessibility to the bus stops and the safety of pedestrians, we decided to create a roundabout with six branches. This arrangement allows the reuse of the road instead of its demolition. Safety will be improved thanks to the fact that the bus stops are going to be separated from the road. Moreover, the setting up of crosswalks and pavements are going to allow pedestrians to circulate more easily between the bus stops and the drop off areas. Concerning the construction site, the difficulty is to build the roundabout without disturbing traffic. The setting up of the roundabout will take place in four different phases so as to allow users to cross the intersection throughout the works.

Keywords: roundabout, setting-up, modelling, budget, schedule


Project site


Project solution chosen

Contact: raphael.gobin@etu.univ-orleans.fr ; lilian.houille@etu.univ-orleans.fr

Stability of dams affected by dynamic stresses

Civil engineering


C. ACHOUR


C. KONDE KOBO

Chafic ACHOUR / Cédric KONDE KOBO
Academic supervisor: D. HOXHA
Industrial supervisor: C. PEREZ

Companies/Institutions: Polytech Orleans, LaMé Laboratory, BRGM, Antea Group

Selected Participant
14th Annual Final Year Projects Forum

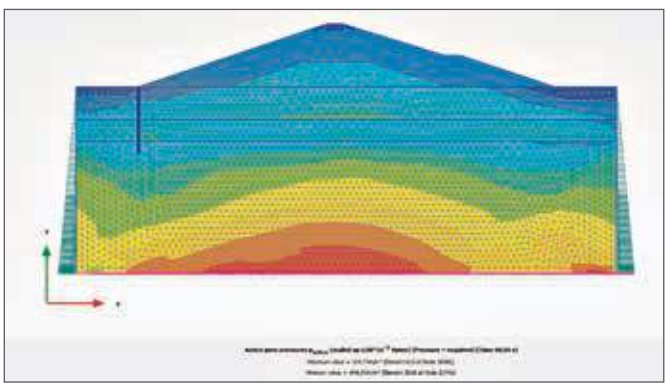
Objective/motivation

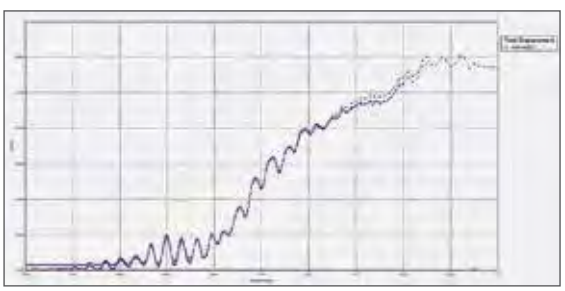
We exploited the development of a method of analysis of this embankment dam by taking into account the dilating behavior and the generation of pore pressures under the dynamic stresses of its materials.

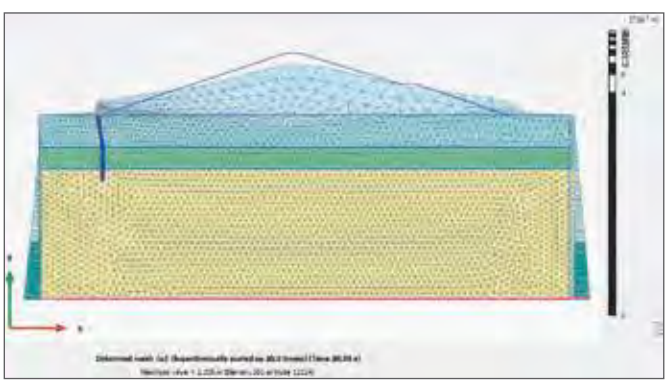
Results

We then established relations between the damage caused on the dam and the seismic signature of the earthquakes that lasted 20 seconds, so we dimensioned our dam according to the 20-second seismic recording, focusing on the side effects and the dam's geometry. Finally, we analyzed the obtained results in terms of maximum acceleration, deformations, stresses, permanent deformations and settlement in the crest.

Keywords: earthquake, stability of dams, dynamic, earth dams, soil


Pore pressure


Displacement


Final state

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Study of the buildability of 3D-printing mortar

Civil engineering

R. AVABY

Radjee AVABY / Rebecca YAPO
Academic supervisor: S. REMOND

R. YAPO

Institution: LaMé Laboratory

Objective/motivation

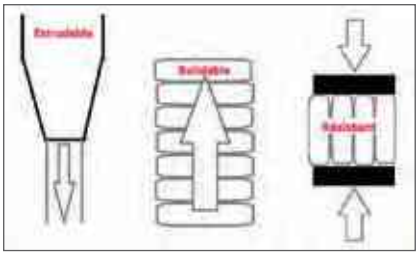
Our project is related to a thesis (Bilal BAZ) in which one of the professors of the establishment took part and is linked to the MATRICE project, dealing with the 3D printing of cementitious materials for construction. This MATRICE project has allowed us to identify the main formulation parameters to control mortar blockages during extrusion in the print head. This project also allowed us to identify a methodology for the formulation of cementitious mortars printable in 3D. In order to carry out these prints, it is necessary to have a mortar whose rheological behavior changes rapidly: it must pass from a "fluid" state (necessary for extrusion) to a "structured" state (necessary to take up the weight of the upper layers). Our objective is to validate Bilal BAZ's experimental methodology (fall cone test) to measure the thixotropic behavior (Athix parameter) on different kinds of materials.

Manual gun for extrudability test of 3D-printing mortars

Results

The objective of this project is to validate an experimental methodology and to develop a shear measurement protocol using cone penetration tests to characterize thixotropy, which is a quantity related to the buildability of the mortar. We tested the consistency of our formulations using VICAT and cone penetration tests. These first tests allowed us to adjust our formulation before carrying out the 3D mortar printing tests. First, we varied the W/C ratio and then the number of shocks when making test specimens. These shocks allow the mortar to be well distributed in the test specimens and reduce the air content of the mortar. We found that the number of shocks applied influences the segregation of the materials. Thus 15 shocks seem to be the ideal number. Finally, in order to limit this segregation phenomenon, we chose to use a viscosity agent.

Keywords: 3D-printing, mortars, extrudability, buildability, thixotropy



Mortar objectives

Fall cone test for consistency of mortars

Contact: radjee.avaby@etu.univ-orleans.fr ; rebecca.yapo@etu.univ-orleans.fr

Study of the waste of economic activities of ASTEE members

Civil engineering


N. MANGIAPANE


S. NGUYEN

Nicolas MANGIAPANE / Son NGUYEN
Academic supervisors: C. DEFARGE, L. LE FORESTIER
Industrial supervisor: S. LE FUR

Association: ASTEE

Selected Participant
14th Annual Final Year Projects Forum

Objective/motivation

This project is carried out by ASTEE, which is an association of organizations specialized in waste, water production and treatment. The 'Association Scientifique et Technique pour l'Eau et l'Environnement' is a French association recognized to be of public interest. It connects almost 4000 members from water and waste professional sectors. Its purpose is to seed knowledge, and share technical practice and expertise for the benefit of all. This association is also sought out for advice and recommendations by public authorities. Our project is focused on waste from economic activities of waste treatment and water production and treatment organizations. Indeed, it represents 19 millions tonnes of waste in 2012 in France (source: ADEME). Astee aims at identifying, quantifying and finding ways to valorize this waste from economic activities; that's why our objective was to collect information, thanks to the members of ASTEE, about waste quantities produced by these members and the different ways to valorize it.

Results

To start our mission, we researched documentation and laws about waste to deepen our knowledge on this subject. We then created a survey according to the different types of economic activities (waste treatment and water production and treatment organizations). We have been able to contact members of ASTEE by email for appointment and do an interview by phone. During these interviews, we asked professionals what is the amount of each type of waste (inert, non-hazardous or hazardous) produced, how they proceed to reduce and valorize their waste production, and if they have future projects which deal with these actions. Then we used all this information and data collected and created a database of all these organizations. Finally, we interpreted this database to estimate the amount of waste produced by each type of actors (public institutions, private companies, etc.). We highlighted the actions used to valorize it and we tried to find other potential solutions to go further concerning waste from economic activities issues.


Project presentation at the Final Year Projects Forum

Keywords: waste, water, economic activities, treatment, valorization

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Use of Python language for environmental studies

Environmental engineering


M. LAURENT


L. MONTEIRO

Maëlys LAURENT / Lisa MONTEIRO
Academic supervisor: C. DEFARGE
Industrial supervisor: A. CHEVALIER

Company: Antea Group

Objective/motivation

For our 5th year project, we are working for Antea Group, an international engineering and environmental consulting firm which specializes in water resources management, polluted site and soil, infrastructure and data. We were assigned to the team of water management and geotherm. Even though a huge part of Antea Group work concerns the theme developed earlier, our project consists in developing a Python program through an environmental database in order to ease calculations. In fact, when analysing water and soil, a lot of data are generated (water level, porosity, quality of water, etc.). Engineers have to make calculations in order to give their valuation. The calculations are often the same but it took a long time to do and that's why developing a program that could read all the data and generate all the calculation will be a huge gain of time. In that order, the company expects us to elaborate a program, using computer science, that will automatize their calculations.

Results

We have successfully developed a working program that the company will soon use with a manual to help them understand its use. This is how it works: when the engineer receives multiple Excel® files from their probe, the program, previously put in the same location as the Excel® file, will do all the calculations (variations of the level of the aquifer in function of the piezometric level), finding all the data it needs in this file. Then it will produce a new Excel® file with all the calculations made plus the associated graphs. Thanks to R. Shiny, we have develop an application with our code to ease the interpretation for engineers.

Keywords: Python, database, environmental analysis, water management, programming

Screen shots of work during the project

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Engineering Physics and Embedded Systems

Alumina thin film deposition by reactive plasma sputtering

Electrical engineering

Adèle GIRARDEAU
Academic supervisor: A-L. THOMANN
Industrial supervisor: M. CAVARROC

Company: Safran
Institution: GREMI Laboratory

Fourth Place and High Schoolers' Choice Award
14th Annual Final Year Projects Forum

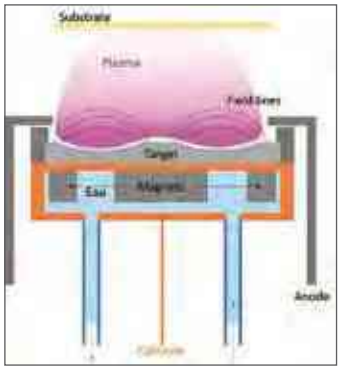
Objective/motivation

Alumina is a ceramic with excellent properties, especially the α phase which is the only one thermodynamically stable that melts at a high temperature (2051°C). Its properties are multiple: electrical insulation, wear-resistance, hardness, transparency in visible light, and diffusion barrier. All of these properties are retained at high temperature. In this project, the most needed property is transparency at high temperature. Until now, industries have used high temperature processes to deposit α-alumina but this requires temperatures up to 1000°C or more that most of the used substrates cannot withstand. Therefore, another way is to use reactive plasma sputtering at a temperature lower than 400°C.

Results

Two generators were used for this project, an HiPIMS generator and a DC pulsed one. Different deposition temperatures were tested, from room temperature (20°C) up to 800°C for all tests. The distance between the substrate and the target was changed and the electrical parameters of the discharge, too. All the samples were observed by XRD and found to be amorphous. The energy wasn't low or high enough to create the alpha-phase. Thermal annealing at 800°C and 1000°C were done in order to evaluate the ability of the obtained amorphous films to be crystallized. This is a way to verify whether the proportion of oxygen is sufficient to create α-alumina. At 800°C, the layer is still amorphous and for now, the layers at 1000°C have not yet been observed.

Keywords: plasma, alpha-alumina, thin films, PVD, research



Magnetron PVD principle

Picture of a plasma during deposition

Failed deposition with delamination of the layer

Successful deposition

DEPHY reactor

Contact: adele.girardeau@gmail.com

Analysis of materials resistance under severe conditions

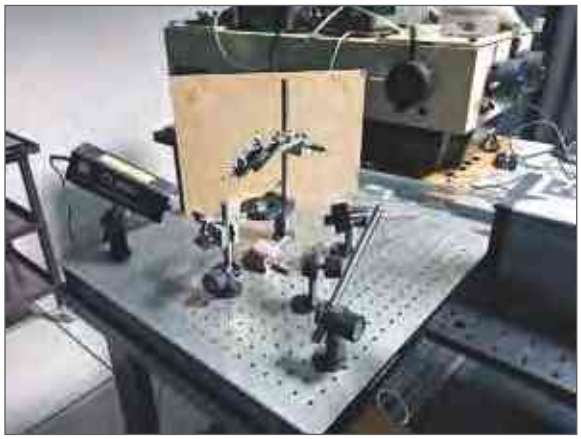
Materials

Clément LANUSSE
Academic supervisor: S. RAGER
Industrial supervisor: F. LEROY

Company: Cilas ArianeGroup

Objective/motivation

The study of laser damage on optics is nowadays a major field for obtaining new high-power laser systems. In fact, laser-induced damage can cause deterioration in other components present on the same optical path, for example. As part of this project, we are going to study materials resistance under severe conditions (temperature conditions: -55◦C to +100◦ C). First, work is done on the study of laser damage theory, in order to create a laser-induced damage and ablation bench. For that, specific components will be used and characterize (like the laser). Then, with the use of the bench, we carry out tests on different samples and finally we characterize the damage or not, first on the bench with diffusion method and then with microscopes in the clean room.



Schematic of the laser-induced damage bench created for the project

Results

As a result for this project, the laser-induced damage bench has been created with the components available. Characteristics like the spatial profile, the temporal profile and the energy of the laser have been studied. Finally, tests have been carried out on samples available at Polytech and characterized with microscopes. This project will be continued by another student, to carry out other tests with other samples.

Keywords: laser, materials, damage, ablation, analysis

GREMI digital microscope Keyence VHX5000

Observation of laser-induced damage on silicon

Contact: clement.lanusse@etu.univ-orleans.fr

Characterization of DC plasma microreactors on silicon fabricated in cleanroom

Electrical engineering

Théo LE CARPENTIER
Academic supervisor: R. DUSSART
Industrial supervisor: R. MICHAUD

Institution: GREMI Laboratory

Objective/motivation

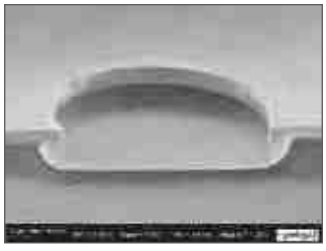
Microplasmas are usually used for surface or gas treatment (lighting sources and integrated sensors, for example). This research project aims to demonstrate that microplasma can be convenient for photodetection applications. Elaborated with the microfabrication process in a cleanroom, its micrometric scale allows the photodetector to work at atmospheric pressure and voltage close to that of wallplugs. The first objective is to set up the initial facility and prepare it for practical work, allowing students to study the topic in the future. The second consists in fabrication and characterization of samples designed for stable microdischarge to notice the regimes for different parameters. Finally, the last objective is to evaluate light detection under the same experimental conditions and draw conclusions concerning the sensing performances.

The lift-off, the last step of a long fabrication process

Results

> Microdischarge facility suitable for student use which allows users to characterize microdischarges by varying the main parameter such as pressure, voltage, current and gas (Ar,He)
> Monitor of the plasma propagation in the microcavities with a diameter of 100µm
> Electrical characterization of 18 silicon-based samples fabricated in the cleanroom that highlights the abnormal regime and the self-pulsing regime

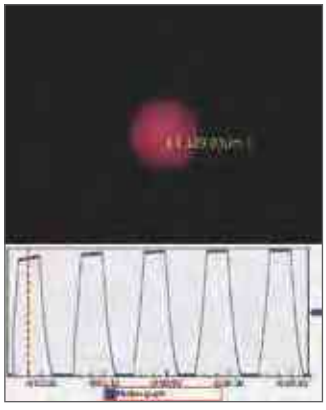
Picture of the generated tiger pattern made of 1813 microplasmas, He 200 torr



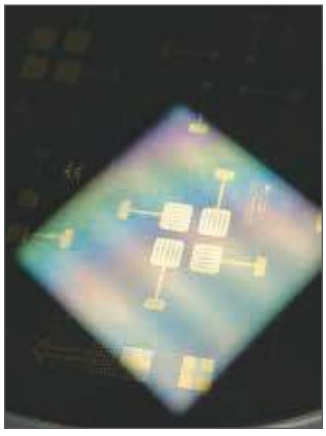
SEM photography of the microcavity

Keywords: silicon, microplasma, cleanroom, characterization, photodetector

Generated microplasma (tiger pattern purple glow)



Photography of a single microdischarge x100 magnification



Photodetector sample photography

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Design and improvement of a plasma reactor

Physical engineering

Théo GUENIN
Academic supervisors: R. DUSSART, P. LEFAUCHEUX
Industrial supervisors: R. DUSSART, P. LEFAUCHEUX

Institution: GREMI Laboratory

Objective/motivation

The current reactor is used to study plasma composition with different gases. The plasma is created thanks to a radiofrequency antenna which is provided with a supply generator, connected to a matching box for the matching impedance. The electromagnetic field created by the antenna ionize nuclei and light a plasma. This is an Inductively Coupled Plasma (ICP) supply. However, the reactor needs some improvements. The chassis needs to be redesigned because it does not suit the reactor. It must operate in capacitive mode (Capacitively Coupled Plasma) wherein plasma is created by a potential difference between two electrodes. Moreover, it must have a door in order to put samples in it to study reactions with plasma. Finally, some diagnostics tools must be installed (a Langmuir probe, a current-voltage probe).

Results

The new design of the chassis reactor was done using Solidworks. It allows you to have a 3D overview and an inventory of the components. The structure is entirely built using Bosch profiles struts and the placement of controlling boxes has been redesigned. This kind of strut has the advantage of being adjustable for future improvements. The gas controlling box has been changed to facilitate the flow control. Two new flanges with windows have been implemented on the reactor to do spectroscopy. To place samples in the reactor, a substrate holder has been built. It will also be one of the two electrodes for the capacitive mode. Finally, some diagnostic tools have been installed, such as a Langmuir probe, a mass spectrometer and a current-voltage probe.

Keywords: mechanical vacuum, CAD, plasma reactor

Current plasma reactor

3D model of the new plasma reactor

Contact: theo.guenin@etu.univ-orleans.fr

Determine the inclination of a vehicle

Electrical engineering

Kévin PATINOTE
Academic supervisor: J-Y. CADOREL
Industrial supervisors: M-A. RISS, T. XU

Company: Inteva Products

Selected Participant
14th Annual Final Year Projects Forum

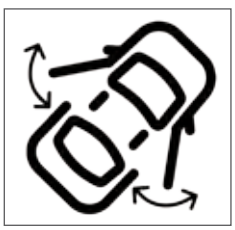
Objective/motivation

This project is included in a global project which is the motorization of car doors for opening and closing. The motorization of the doors will eliminate the need for human assistance and be more comfortable for users. It will also provide more design opportunities by removing the handles. One of the problems is that if the vehicle is tilted, the weight of the door, which is about 30 kg, will have a different impact on the motorization. One solution is to determine the orientation of the vehicle along the longitudinal and lateral axis. The project was to check the state of the different sensors which are able to give this information. The study was focused on the reliability, precision, and resolution of the sensors.

MPU9250, an accelerometer and gyroscopic sensor

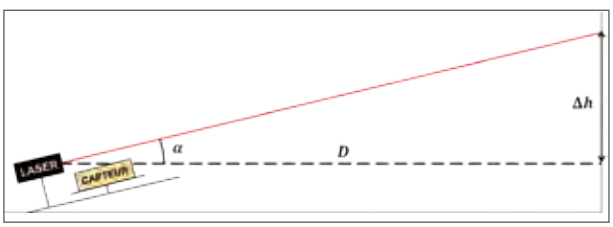
Results

The study of a sensor which returns an angle is a complex thing, as accelerometers and gyroscope and components which work with electromagnetic fields and gravitational force. Moreover, the objective in precision of the sensor is about ± 0,5°. This value represents a significant difference of the mechanical influence of the car door weight. 0,5° is quite precise, thus, this is one of the main challenges of the project. By pointing a laser at a wall, it is possible to get the angle measured when this laser is inclined by using a simple trigonometric law (see schematic), then, the angle calculated is compared to the angle returned by the sensors. This study concludes with a report of the tests of the different sensors to the company Inteva Products of Sully-sur-Loire.

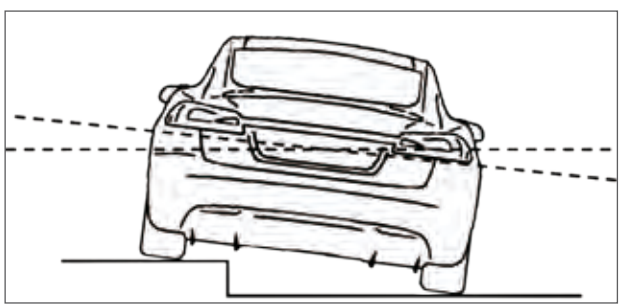


Open logo

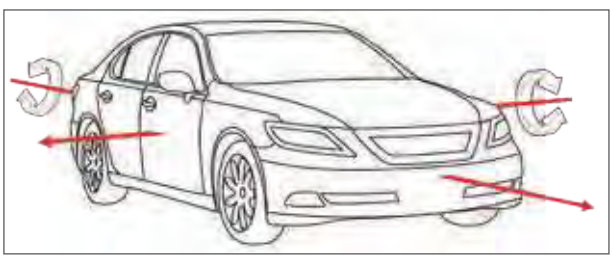
Keywords: accelerometer, sensor, car, inclination



Protocol to test the sensors



Inclined vehicle



Longitudinal and lateral axis (red)

Contact: kevin.patinote@gmail.com

E-PNOS service

Computing engineering

A. MIGNUCCI

Alexis MIGNUCCI / Maurine SANTIGNY
Academic supervisor: A. CHETOUANI
Industrial supervisor: M. VILTET

M. SANTIGNY

Company: PSASS

Objective/motivation

PSASS is the first innovative service company in the field of sleep disorders pathologies. It offers the E-PNOS service, which is the very first platform for pre-reading by remote medical monitoring of diagnostic recordings of sleep disorders, which must also meet RGPD standards. Today, PSASS technicians work with several accountancy software packages which manufacturers have designed for data processing, each with its own qualities and faults. This company asked us to create an interface integrated if possible with its exchange platform: a viewer which would allow us to work with a single tool calibrated according to their preferences for scoring sleep patterns. For this project, the first step is to carry out a feasibility study and to realize, in a second step, the functionalities of displaying, processing and reading .edf files.

Results

This project aims to do a feasibility study about what it is possible to use as technologies to reproduce software in a web interface. For this, we decided to use the framework ASP.NET, and the languages C# and JavaScript to develop it. For displaying graphs, the library named Dygraph.js is used. With these different technologies, we are able to read an .edf file, display each record on different graphs, highlight and change the color of each curve. However, we have noted it must take a long time to display all data of record in one graph (7 million). Finally, we showed it's possible to carry out this project. In fact, the customer can display the neurological graph, score it and trace the hypnogram of the patient.

Language

Keywords: sleep disorders, web interface, scoring, JavaScript, ASP.NET

Screenshot of the interface

At work on the project

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Formula-E embedded electronics and telemetry

Electrical engineering

Tanguy PIERRE
Academic supervisor: R. LEDEE
Industrial supervisor: T. SABARLY

Association: Polytech Racing

Objective/motivation

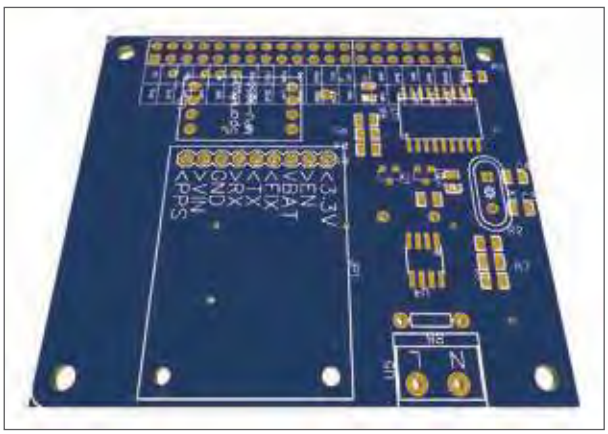
Polytech Racing is an association in Orléans which aims to compete in the FSAE International championship with a Formula-E, a mini electric racing car. They are developing it from the ground up, all the way from simulation to the final product. The goal of this part of the project is to gather information from the car and its environment through sensors, and to analyze and improve performances. The team needs to log, display and wirelessly send the data coming from the motor and battery, as well as measures of position, speed, and acceleration.

Results

The result of this specific part of the project is a connected dashboard for the car. The system acquires raw data from a GPS, an accelerometer, the motor controller and the battery charge monitor at a frequency of 10Hz. The data is then displayed on a screen for the driver, to create a dashboard for the car, and is saved onboard for further investigation. Moreover, distant communication is established between the car and the booth so the team can analyze the information from the race in real-time and change parameters live.

Keywords: embedded, electronics, car, IoT

Layout of the dashboard



Screen capture of the printed circuit board system

FormulaE EcurieAix Rita 2018 on Flickr

Contact: tanguy.pierre@etu.univ-orleans.fr

Laser ablation of carbon nanotubes

Materials

Alex CAPELLE
Academic supervisor: N. SEMMAR
Industrial supervisor: F. FOURREAU

Company: Sense In

Objective/motivation

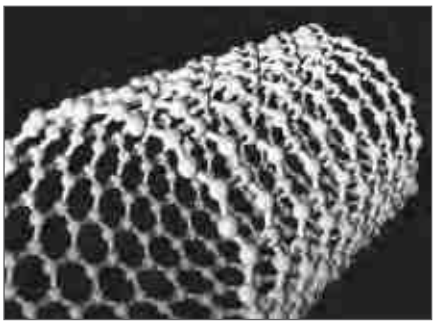
Sense In is a startup located near Lorient (Brittany) and aims to create a new production line using lasers to pattern carbon nanotubes-based sensors. This project is divided into multiple steps. The first is to study whether the laser can do this. The second is to make sensors and optimize their production. The third is to transfer the production line to Lorient, which involves determining the right laser characteristics and all the devices around it, also doing a market study to fit the budget imposed by Sense-in.

Results

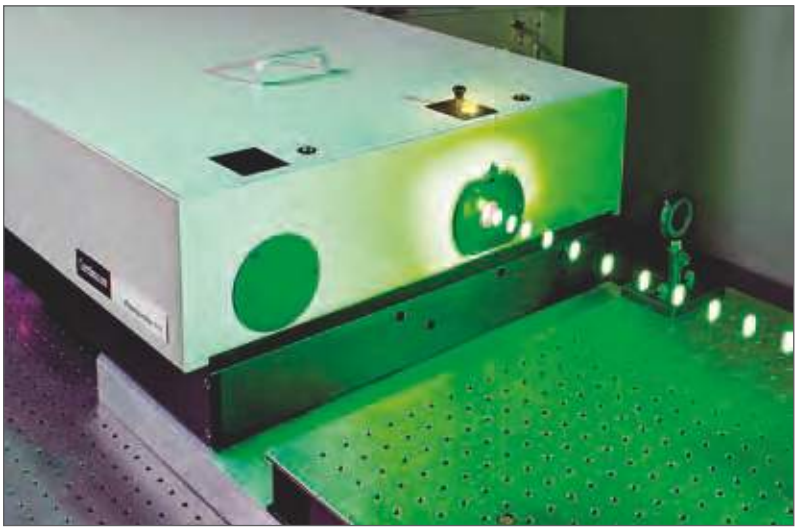
The ablation has been characterized for UV-range and showed positive results, which are good electric characteristics modification with no damage of the supporting material. However, devices working at UV-range are too expensive and the energy of the lasers would be too low. Therefore, the process has been studied to work in the visible range, which has also showed positive results.

Laser marking on epoxy

Keywords: laser ablation, sensor, carbon nanotubes, market study, production line



Carbon nanotubes



Pulsed laser (©Sense In)

Contact: alex.capelle@etu.univ-orleans.fr

Opéra2.0, smartphone application

Electrical engineering

Y. FU

M. PELUAU

Yiliang FU / Mathieu PELUAU
Academic supervisors: P. RAVIER, C. ZAHND
Industrial supervisor: C. JOUBERT

Company: La Fabrique Opéra Val de Loire

Selected Participant
14th Annual Final Year Projects Forum

Objective/motivation

The purpose of this project is to create a smartphone application to popularize opera among teenagers. With this application, people can learn about opera by exploring a playful and funny interface. This project was a perfect opportunity for the team to develop an application from beginning to the end. As a result, our work will be published on both Apple Store for Apple devices and Play Store for Android devices. Moreover, it was not only a chance for us to learn a new coding language but also to discover an art, opera, by working in collaboration with a real customer (La Fabrique Opéra) for the first time in one of our Polytech projects.

Results

After more than six months of work by programming on Android Studio/XCode and with regular meetings with our client, the application is finally ready to be released with some playful content like face filters to disguise yourself as opera characters, a quiz to test your knowledge with your friend, audio & video content about opera world and QR code flashing to extend content from the La Fabrique Opéra booklet to the application. In addition, this product is available on Android devices as well as iPhones. It was really a challenge for us to learn a new coding language, Swift, on our own and an opportunity to discover opera which, unfortunately, is not too popular among young people. We believe that with this brand new and unique app on the stores, things may change in the next months!

Keywords: smartphone application, programming, Android, IOS, art

Main menu of the app

"Test Your Knowledge With Our Quiz"

Face filter functionality

QR code flashing functionality

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Pollen sensor data transmission

Electrical engineering

Romain DELMAS
Academic supervisor: K. ABED-MERAIM
Industrial supervisors: M. JEANNOT, J. RICHARD

Company: Lify-Air

Fifth Place
14th Annual Final Year Projects Forum

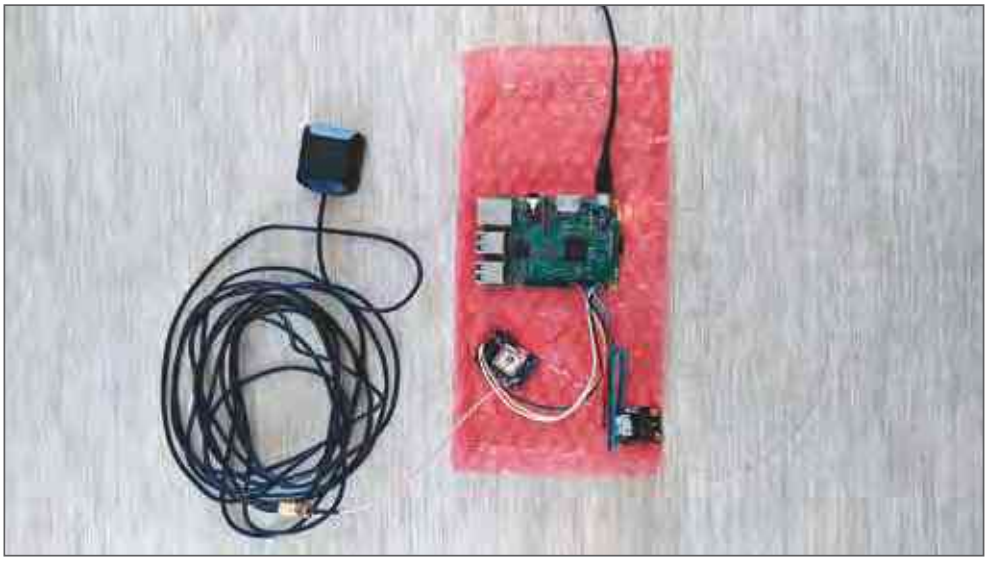
Objective/motivation

Along with the development of a reliable and operating pollen sensing device by the start-up Lify-Air, my project is dedicated to the programming of the internal software that gathers data and broadcasts them to a server. The idea is to access pollen quality and quantity via the sensor designed by the company, temperature pressure and humidity data via multiple sensors, and, finally, acquire date, time and position via a GPS board. All this information must be organized in a file that I can then upload to a server using a GPRS communication device.

Results

All the data acquisition is completed and can be organized in a .CSV file for compatibility with the company analysis software. This file is then uploaded every 10 minutes on a dedicated server and can be downloaded by the company for later data treatment and to organize pollen activity prediction (based on pollen and environmental data). I used the language Python to program this software and the targeted computer is a Raspberry pi 3 B+ because of the complete connectivity and calculation power it offers.

Keywords: pollen, Raspberry, data, Python, broadcast



Project materials

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Retrieval and transmission of the data of a tractor

Electrical engineering

Enguerran CHEVRY
Academic supervisor: R. CANALS
Industrial supervisor: J-Y. CADOREL

Company: 3ZA Engineering

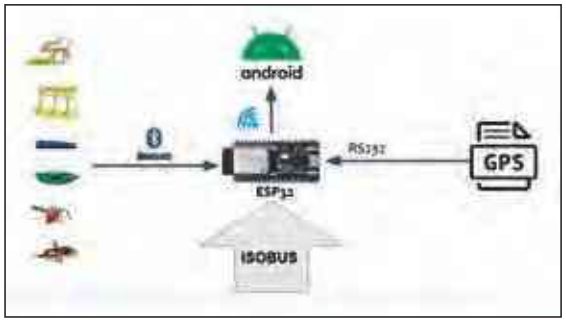
Objective/motivation

The project is for a company owning more than 1000 tractors and even more implements of different types and from different brands, in Cameroon. The purpose is to collect data while the tractors are running and provide it to the company so they can optimize their agricultural machinery according to the fields and monitor the drivers' conduct. The project must create an electronic module that retrieves GPS coordinates, mount the implement and ISOBUS data on a tractor, save these and send them to an Android device so they can be treated. ISOBUS is a universal communication protocol implemented on every recent tractor's electronic system. Thus, we can create a standard electronic module for every type and brand of tractor.

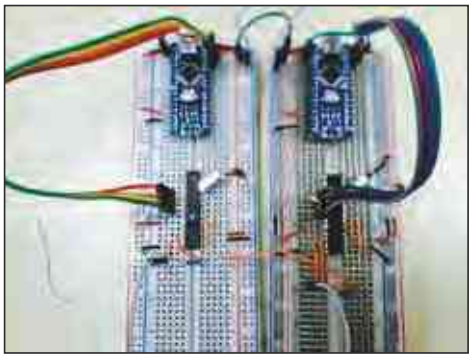
Results

The translation of ISOBUS data into readable data is done. It remains to send the data from a computer that simulates the tractor to a microcontroller using a CAN bus (Controller Area Network) and to automatically translate the data as it is received. Later, this will be done using a real tractor, but most likely not during the project as the tractor is not yet available. It also remains to save the data and filter it to keep only the data that interests us, such as the rotation of the wheels or the speed of the tractor.

Keywords: agriculture, tractor, embedded system, ISOBUS, data retrieval



Project summary



CAN bus

[redacted]

Data translation

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Safety zone light

Electrical engineering

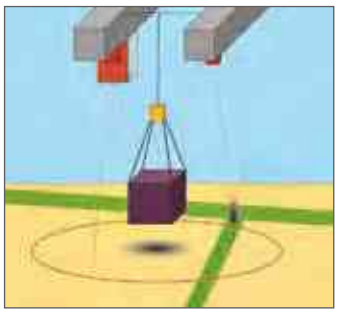
Nicolas BAPTISTA
Academic supervisor: R. WEBER
Industrial supervisor: E. RIVAIN

Company: EDF Dampierre-en-Burly

Selected Participant
14th Annual Final Year Projects Forum

Objective/motivation

When one of the four reactors of the nuclear power station of Dampierre-en-Burly is not in use, a lot of maintenance has to be done in the engine room. However, the reactor components are extremely heavy (between 50 and 300 tons). To move them, a crane system is used. The movements of the crane are dangerous, and they are the cause of too many severe accidents. Nowadays, a static beaconing system is used to signal the danger. Unfortunately, accidents still happen since employees keep approaching the danger area during the procedure. The project idea is to create a second lighting signal which will be moving with the crane. Our system will generate a lighting circle on the floor around the moving crane load, to warn employees that they are in a danger zone. This system will be an addition to the current static area tagging.



Computer image of the project

Results

The lighting circle diameter must adapt to the shape of the load, and the horizontal and vertical movements of the crane load. The vertical position is estimated with a camera through an image processing procedure which uses the crane hook as a reference object in the camera field of view. The crane and the camera have the same referential. Thus, by calculating the pixel size and the position of the hook in the image, the vertical position of the hook can be estimated. This parameter will define the circle diameter. The circle itself is generated by using four laser sources, each one generating part of the circle to prevent any shadowing from the load. This optical system will be attached to the crane, and it will thus move horizontally with it. The optical system will be based on the spirograph effect by using a turning mirror.

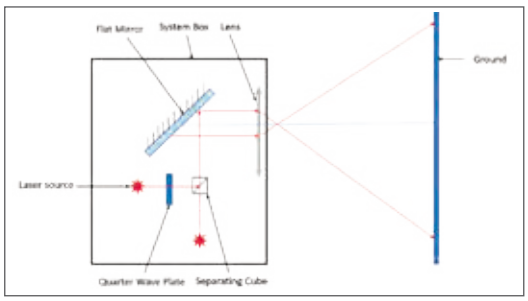


Diagram 1

Keywords: safety, laser, image processing, optics, camera

At work on the project

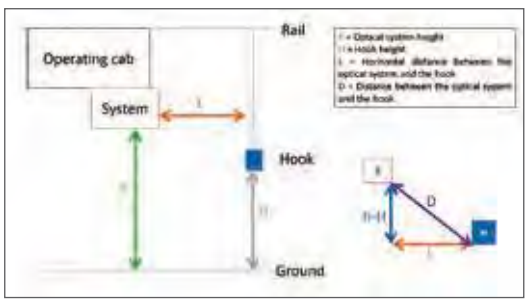


Diagram 2

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SiO_2 thin films processes and characterization with PECVD, and MOS capacitor realization

Physics engineering

Céline BOUFFAULT
Academic supervisor: R. DUSSART
Industrial supervisor: C. PICHARD

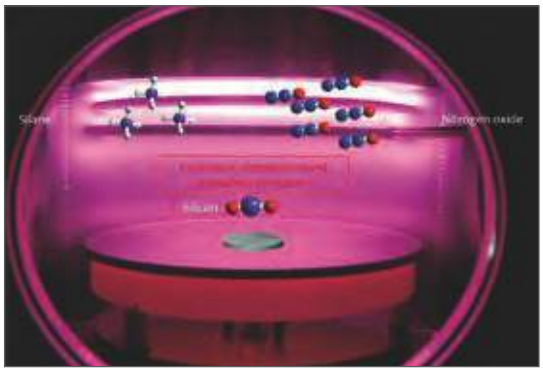
Institution: Gremi Laboratory

Objective/motivation

The Gremi laboratory recently purchased a PECVD machine. It is used to make some material deposits using a plasma technology at a lower temperature than with a standard CVD process. Given that, the project, carried out in the clean room, has to achieve two goals : to help Gremi understand the function and influence of each parameter to use the machine, and to prepare myself for my internship by making me work with a plasma reactor. This project has two different parts: first, characterization. There is a need to do some plasma optical characterization and SiO_2 deposits characterization, according to several recipes (depending on pressure, temperature, power, etc.). The second part is a MOS capacity production, using the PECVD to perform oxide deposit.

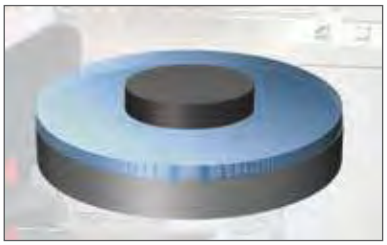
Results

To characterize the behavior of the deposition rate depending on temperature, pressure, power, time and flow, I did between four and six measurements for each parameter. Those measurements were done twice, to verify the reproducibility of the processes. Measurements were done with the ellipsometer. Then, the data was put into graphs to show the influence on deposit thickness. Identification of the species inside the plasma was made by spectroscope, in a range of 200nm to 850nm. As for MOS capacity realization, several steps had to be followed: deposition, lithography, metal deposition, lift-off, etching and wafer probe. It was carried out two different ways, on two different types of deposits, to obtain four different kinds of MOS capacity.



Inside the PECVD machine

Keywords: processes engineer, plasma, characterization, electronic device, deposition rate



MOS capacitor at the final step of production

Samples of SiO_2 deposition

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ZenBenne, a dump truck security device

Industrial engineering

M. FRANCOIS

K. LALLET

Manon FRANCOIS / Kyllian LALLET
Academic supervisor: R. WEBER
Industrial supervisors: Business creation – M. FRANCOIS, K. LALLET

Company: ZenBenne

Third Place and Innovation Award
14th Annual Final Year Projects Forum

Objective/motivation

At the end of her fourth year internship, Manon was asked to find a solution for a dumpster-truck related accident. The drivers of these dumpster-trucks would sometimes forget to lower the dumpster while driving and hit high obstacles such as bridges or road signs. We realized that the main cause of these accidents was the lack of information in the cabin of the truck. When we realized there were no existing solutions, we decided to create our own company called ZenBenne. The ZenBenne device consists of two boxes: one on the dumpster to check its position and one in the cabin to warn the driver. We are now creating a company to develop and commercialize this product.

Results

The project comprises two main aspects: technical development and business creation. Concerning the development of the prototype, we managed to build a proof of concept prototype during the first semester. It was used to test the principle of ZenBenne: the dumpster box checks if the dumpster is raised while the cabin box checks the truck's speed. These two parameters will help determine the danger level and consequently warn the driver. This first prototype helped in building the second prototype by highlighting issues with the system. Concerning the business creation, we ended by building a business plan which contains all the documents relative to the project: finances, market analysis, project description, etc. This document will be presented to investors and future partners.

Keywords: safety, IoT, truck, dumpster, construction

Dumpster box

Cabin box

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Industrial Engineering applied to Cosmetics, Pharmacy and Food Processing

Aseptic connector implementation

Industrial engineering

Illan ROY
Academic supervisor: S. LEROUX
Industrial supervisors: G. AUBAULT, B. CALLOUD-GABRIEL

Company: Novo Nordisk

Objective/motivation

My main objective with this apprenticeship was to develop, in an industrial environment, all the theorical knowledges that I acquired during my studies at Polytech Orleans. In fact, the industrial world is formative and allow to discover new challenge that you can't find in school. So, I first decided to look for an apprenticeship in a pharmaceutical company because I think those companies could help me to acquire a very strict and standardized professional conscience which could be helpful for my future career. I also decided to focus on project department because project management is one of the fields where you can have the best transverse vision of all the major issues and objectives of an industrial company.

Flexpen (Insulin pen after assembly)

Results

So, I found an apprenticeship contract in Novo Nordisk, a Danish pharmaceutical company, which manufactures insulin treatment for diabetic people. I'm currently working in the project management office where I'm looking for a new aseptic connection solution for our insulin tank. In fact, operators work in very restricted area where a lot of material must be sterile because the insulin pen that we deliver to diabetic people must not be contaminated with particles for example. So, this is a very challenging project which request me to consider a lot of aspects like technical, finance or people management.

Insulin container

Aseptiquik G assembly on container

Aseptiquik G (Solution 1)

Lynx CDR assembly on container

Lynx CDR (Solution 2)

Keywords: pharmaceutical industry, diabetes treatment, project management

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Changeover time decreasing and industry 4.0

Industrial engineering

Pauline LANFROY
Academic supervisor: L. DELPLANQUE
Industrial supervisor: A. LENORMAND

L'ORÉAL

Company: L'Oréal

Objective/motivation

L'Oréal is the 1st cosmetic group worldwide and the leader in beauty including haircare, skincare, make-up and perfume. The plant where I work is a multi-brand and multi-division plant specialized in three technologies: aerosol, spray and roll-on. The challenge of the plant is to be more agile and flexible in order to produce as leanly as possible. To do this, we need to improve our production capacities. The goal of my project is to decrease the changeover time. On a production line, we have three different changes. My assignment is to deploy a tool of industry 4.0. The goal is the optimization of changes on production lines.

Results

Currently, we found one solution to decrease changeover times for country changes. This solution is set up on four of the 13 production lines. The tool of industry 4.0 is available on one production line. At this time, we don't measure its benefits. In the next three months, we will deploy the solution and the tool on the other lines of the production unit. Moreover, we will pay attention to juice changes. During the three last months of my internship, it will be important to measure the results of the project.

Keywords: production, improvement, industry 4.0

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Continuous improvement in the maintenance department

Industrial engineering

Margaux TAQUIN
Academic supervisor: G. HIVET
Industrial supervisor: C. ROUSSEAU

Company: Novo Nordisk

Objective/motivation

Novo Nordisk is a global healthcare company with more than 95 years of innovation and leadership in diabetes care. The company has a production site in Chartres, France, since 1961 in which insulin cartridges and vials are filled and insulin pens are produced. To ensure quality products, and thus the patient's safety, contamination requirements are becoming more and more important. Therefore, to ensure aseptic conditions and containment, there are two alternatives: using pharmaceutical isolators on filling lines or not intervening at all close by the product during its production. Novo Nordisk chose the second one by producing Golden Filling Batch, namely a batch produced without human intervention. Working within the Maintenance Department, my project consists in identifying the optimal combinations of parts and machine parameters that do not cause stops, and consequently any human intervention.

Results

The strategy is to show whether there is a causal relationship between the choice of parts and machine parameters and the number of stops of the filling lines. I realized that the data concerning the parts and the parameters used on the line are not correctly filled out by the setting operator. Therefore, I will analyze the data I already have, and at the same time, I will optimize the data flow using a continuous improvement tool.

Novo Nordisk site, Chartres

Keywords: aseptic products, contamination requirements, human interventions, machine

Machine parts

Filling station

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Continuous improvement of infeed robot

Industrial engineering

Elisama DE OLIVEIRA MACEDO
Academic supervisor: J-B. VIDAL
Industrial supervisor: P-Y. CHEVAL

Company: Novo Nordisk

Objective/motivation

During my studies at Polytech Orléans, I had the opportunity to gain experience at Novo Nordisk S/A. Leader in diabetes treatments and specialized in hemophilia and growth disorders, this pharmaceutical company is still increasing their production capacity in order to provide for a growing demand in diabetes treatments. The support filling vials department has pointed out the need to enhance unproductive activities, especially waiting time and failure modes due to machine downtimes. In this context, the project to be carried out aimed to improve the performance of the first machine (infeed robot) of vials production line. My first approach was to observe and understand infeed robot operations and the failure mode identification on alarm data with a grid based on Failure Mode and Effects Analysis (FMEA) principles.

Novo Nordisk site, Chartres

Results

The failure modes were identified according to alarm data analysis and failure occurrences from a survey of operators. As a result, we could start an investigation with a problem solving tool. To connect information from personnel and machine, we installed a camera to record failure moments in the feeding robot area to have an accurate data analysis process to conduct our next steps. In order to find solutions, I also met the project engineer and project manager from other production sites to share information about the robot operation. Possible improvement actions and suppliers we could work with were identified. The next steps in this ongoing project of type 6Sigma will be to go further into the investigation to define how we will conduct tests to optimize the infeed robot.

Infeed robot

Keywords:
Continuous Improvement, AMDEC (FMEA), TRS (OEE), KPI , Lean 6Sigma

Novo Nordisk vials products

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Continuous performance improvement in production

Industrial engineering

Lucas SANCHEZ
Academic supervisor: T. SAYET
Industrial supervisor: M. THOREAU-GUYET

Company: Sanofi

Objective/motivation

Sanofi is a French pharmaceutical company engaged in research and development, manufacturing and marketing of pharmaceutical products. Within the visual inspection/packaging department of the injectable production area of the Ambares site, various missions have been entrusted to me. At first, my activity of support function for a project of automatic visual inspection line requalification allowed me to work in collaboration with a project manager and different operators and thus to integrate myself in the department. I was then entrusted with a requalification project of manual visual inspection tables, mainly aimed at updating lighting technology. Once again, this project allowed me to interact with people from different hierarchical levels and from different departments, as with the quality department for writing test protocols and carrying them out.

Manual visual inspection table

Sanofi industrial site, Ambares

Results

The process of requalification of visual inspection lines is continuing. After carrying out sensitivity studies, the creation of different defect kits used to the qualification of the lines according to the specialties produced is in progress and other actions are to be carried out particularly in order to empower operators to inspect according to these new defect kits. Regarding the manual visual inspection tables, after an exchange with the supplier, a new lamp was sent to us for testing. These trials are currently in progress and the first results tend to show an interest in updating all the factory's tables with the new technology tested.

Automatic visual inspection line

Keywords: pharmaceutical industry, production, continuous improvement, performance, quality

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Digitalizing and automating the measurement of Overall Equipment Effectiveness

Industrial engineering

Amine ASSEM
Academic supervisor: J-M. AUFRERE
Industrial supervisor: O. SFAXI

Company: Sanofi

Objective/motivation

Today, the measurement of Overall Equipment Effectiveness (OEE) as well as the hourly monitoring of packaging is done manually. During a major stop on the line, it is the operators who have to list the causes of the stop as well as the stop time. Therefore, they not only must intervene on the line to resolve the problem, but also must take the time to notify all of this on the logbook, possibly incurring concerns that can be encountered because of this method (wrong information on logbook, lack of causes, no standard). All this makes it more difficult for managers to analyze for improvement. Thanks to this project, the objective will be to digitalize and automate gathering of this information thanks to the OEE software. This software will be able to take the cause of the stops in real time and record them on the platform. Thus, having access to this information can be done remotely from the offices.

Sanofi site

Results

This project will digitalize and automate information gathering and the calculation of OEE. Thanks to this software, the service will be able to consult the cause of the stops as well as the OEE without moving to the lines. The completion of this project will facilitate loss analyses in order to improve production, but also aid in having important and understandable information concerning the various outages.

Keywords: improvement, digitize, automate, software, production

Contact: amine.assem@gmail.com

Eco-friendly warehouse air handling unit, temperature regulation and monitoring

Industrial engineering

Hajar KERMASS
Academic supervisor: J. ROUSSEL
Industrial supervisor: F. BOURGAULT

Company: Delpharm

Objective/motivation

Delpharm is a French CDMO (Contract Development and Manufacturing Organization) which produces most pharmaceutical dosage forms in various sectors. Delpharm l'Aigle, is specialized in solid dosage forms and managed a network most of 22 clients. Raw materials and finished products are sensitive; their physicochemical properties are intended to evolve and need to be stored in a controlled environment. To ensure the stability of the products and their safety, critical parameters have to be controlled which include temperature regulation and monitoring between 15°C to 25°C. Within the L'Aigle plant, the warehouse holds an air heater system which provides heating in winter. However, this system does not cool the warehouse in summer. We therefore cannot provide a compliant atmosphere regarding temperature issues even during a heatwave. In order to meet this requirement, the project was implemented to ensure that our products are stored in compliant conditions all year round.

Results

The project consists of setting up a dedicated air handling unit ensuring temperature regulation and control of the warehouse, and ensuring pharmaceutical requirements in winter as in summer. It is also a CEE saving energy certified project, because of recommended eco-responsible solutions (such as the use of the new refrigerant gas R1234ze) whose performances are optimized with a low impact on the environment. The project is implemented and now the process of qualification is in progress by the achievement of a temperature mapping of winter and summer seasons. Therefore, in order to accomplish the qualification aspect, fields have been elaborated throughout installation, operational and process performance. Finally, as required by the management of the newest project, a set of procedures defining the use of the system and ensuring the equipment's maintenance has been drawn up.

Keywords: CDMO, R1234ze

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Global planning associate project to improve team communication

Industrial engineering

Andrew ABDELMALEK
Academic supervisor: T. SAYET
Industrial supervisor: C. MASSON

Company: Sanofi Pasteur

Objective/motivation

Teams within the clinical service usually communicate data to the clinical planning support service with too much detail and scientific information that results in wasted time. That is because the clinical team does not know how the planning function operates so instead of giving specific information that is easy to use by planning support, they share all information related to a clinical project without filtering what is essential. The objective of this project is to implement a communication tool in order to reduce the meeting times between the team members by helping them communicate and collect only the essential data about a clinical project in order to centralize activities and enable core business functions to focus on their fields of expertise. The tool should be user-friendly, easy to communicate and not complicated to modify.

Results

First, I became completely comfortable with the planning tool and function. I gained knowledge about the clinical world and the clinical trials to understand the big picture and the sequences of a clinical process. I met with all the planning team members to understand specifically the constraints that they are facing, attended some team meetings in order to analyze the problem on field, and was able to categorize the issues due to these previous actions.

Keywords: project management, clinical, planning, international, pharmaceutical

At work on the project

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Golden Filling Batch: removal of all human intervention under laminar flow

Industrial engineering

Samad DJILALI
Academic supervisor: S. LEROUX
Industrial supervisor: E. TRI

Company: Novo Nordisk

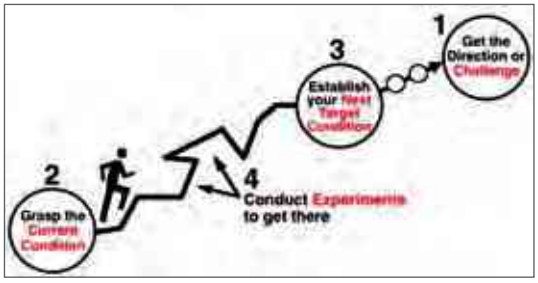
Objective/motivation

Since 1961 at their site in Chartres, Novo Nordisk produces penfills, assemblies and packages flexpens. In the filling support service we handle two filling lines installed in a controlled atmosphere. To be in accordance with regulatory authorities and to avoid potential contamination during the production of penfills, we want to remove human intervention under laminar flow during production. For this, I lead the Golden Filling Batch project especially by using the KATA method, which consists of setting target conditions related to the type of intervention we want to remove, for a defined period. To reach each target condition defined, we make several PDCA. The objective is to work alongside the operational part, push people forward, make the mindset evolve and set up improvement actions. We can measure the efficiency of actions realized by measuring the number of interventions under laminar flow.

Novo Nordisk site, Chartres

Results

This project is still in progress. In parallel with experiences realized, we have collected data of batches produced for five months which allow us to analyze data and thus know what causes problems. We continue to work on each fixed target condition. Depending on the intervention type, we experiment with different ways to remove it. Since the beginning there is a downward trend in the number of interventions under laminar flow. The mindset of people is changing, and we can see new behaviors and different ways of thinking. We have made three Golden Fillng Batches, three batches without any human intervention. The goal is to get 100% of Golden Filling Batches in 2023. The next step is to benchmark with other sites and organize workshops with operators and team leaders to make groups brainstorm about potential improvements.



The KATA method

Insulin cartridges production

Keywords: golden filling batch, process optimization, performance, KATA method, aseptic process

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Implementation of a temperature monitoring system of climatic chambers for stability studies

Industrial engineering

Mariam HOCINE
Academic supervisor: T. SAYET
Industrial supervisor: N. MABON

L'ORÉAL

Company: L'Oréal

Objective/motivation

Stability studies are conducted to predict cosmetic product stability on the market according to an accelerated ageing model chosen by L'Oréal. Samples are placed in climatic chambers. To properly carry out these studies, it is important that the programmed temperatures are stable with time and within a fixed tolerance interval. In other words, it is essential to be able to monitor temperatures in real time. In this context, we need to implement a system of temperature monitoring to follow the variation. This project is part of my main mission: the control of equipment, some of which is being also used for stability controls such as viscosimeters, suntests, etc. Annual verifications are carried out on laboratory equipment. My job is to organize and improve the verification campaigns, and analyze the verification reports and non-compliances. This work is being led with the help of procurement, suppliers and laboratories.

Results

The project is in progress. Different types of monitoring systems already exist at other L'Oréal sites. To begin, information has been collected about these systems. This made it possible to have a general view of solutions and to be aware of advantages and disadvantages of each system. This benchmark will allow us to choose the supplier adapted to our requests. The specifications have been drawn up. In the meantime, I am also checking the reports of the last climatic chambers verification campaign to anticipate and improve the 2020 one.

Keywords: quality assurance, research, innovation, equipment, stability

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Implementation of an Automatic Guided Vehicle (AGV)

Industrial engineering


C. DUFOUR


V. HAYS


L. XUE

Cécile DUFOUR / Victor HAYS / Lei XUE
Academic supervisor: G. HIVET
Industrial supervisors: C. CAPDESSUS, J. ROUSSEL

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

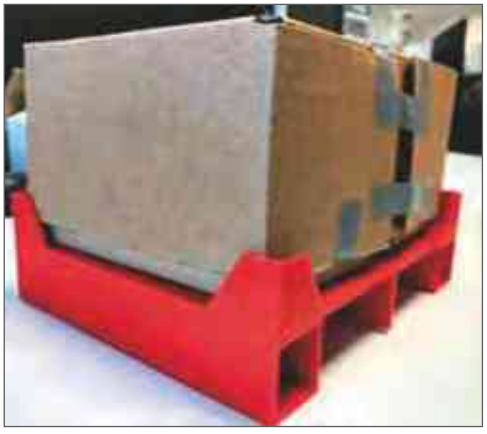
Objective/motivation

This project is part of a continuous project of the industrial engineering speciality. Based in Chartres, the industrial engineering specialty of Polytech Orléans is composed of a conditioning line for micellar solution flasks. More precisely, this factory is the best work environment for the engineering student to understand and think about current industrial issues. Today, several automatization projects like ours are in progress to make the factory autonomous and smart, thanks to the use of new technologies. Now, at the end of the line, the cardboard boxes containing finished goods are transported to the stock manually. Here, the project's goal is to remove this manual action by the implementation of an Automatic Guided Vehicle (AGV) solution. To do so, we will use "Robotino", a robot of the FESTO brand.

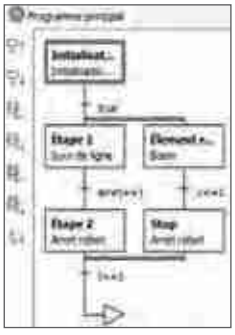
Results

After six months of the project, a small animation showing Robotino unloading and transporting a cardboard box has been programmed. Thus, Robotino is able to move around thanks to the programming of its webcam, which allows it to orientate itself by following the black line that was previously set up in order to define the trajectory. Moreover, Robotino moves in complete safety because it is able to detect obstacles and stop to avoid hitting them. Nowadays, manufacturers use pallets for storage and transport of raw materials, finished products, etc. Thus, as is done in the industry, a prototype pallet has been created using 3D printing technology. Robotino is now able to grasp the pallet.

Keywords: industrial handling, robot, security, 3D printing, conditioning line


Palette created through 3D printing


Robotino transferring finished goods


Robotino View software programming

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Implementation of data integrity in a production unit

Industrial engineering

Mamy SENE
Academic supervisor: E. COURTIAL
Industrial supervisors: L. LE COSTOEC, L. MIALANES, M. POTONNIER-GUINTRAND

Company: Sanofi

Objective/motivation

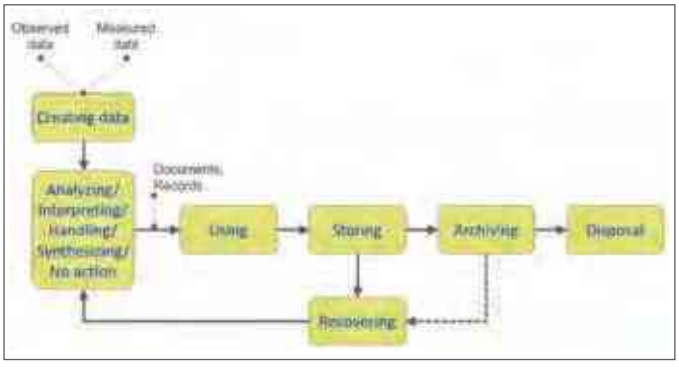
Data integrity is the maintenance and assurance of the accuracy and consistency of GMP data over its entire lifecycle. Recently, due to several cases of fraud involving data integrity, pharmaceuticals authorities have become vigilant and have increasingly observed those violations. Indeed, serious consequences can affect both the company and the patient. This has led to a global concern on data integrity in the pharmaceutical field. For my fifth-year project, I have the chance to work inside the IS QA service (dedicated to the management of computerized systems) of Sanofi Aramon, a chemistry site specialized in the manufacturing of API (Active Pharmaceuticals Ingredients). The aim of this project is to build data integrity management for the manufacturing area.

Results

The project consists of evaluating data integrity per API (Active Pharmaceuticals Ingredients), and setting up action plans to cope with eventual gaps in accordance with global policies. My role is to carry out the data integrity project alongside my managers in the production unit. Once GMP data and equipments are identified per API, computerized process systems or electronic equipments will be evaluated on the following points: access management, GMP data management and protection, backup and restore process, date and hour locking, management of audit trail, etc. To date, I've been able to start the project by transcripting Sanofi's Global SOP (Standard Operational Procedure) on data integrity throughout the Aramon site. Also, I am working on the data integrity evaluation of one biotech API.

Keywords: data integrity, active pharmaceutical ingredient, computerized system

Data integrity attributes



GMP data lifecycle

Technical, operational and organizational mechanisms put in place to achieve data reliability

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Improved management and action planning in production services

Industrial engineering

Roxane DENEUVE
Academic supervisors: J-P. BLONDEAU, G. HIVET
Industrial supervisor: H. LEGER

Company: Puig

Objective/motivation

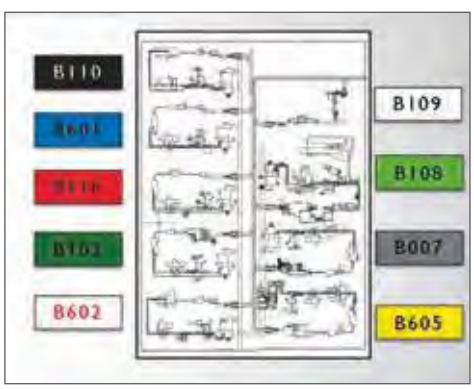
Puig is a group that sells its products, including several well-known brands (Paco Rabanne, Nina Ricci, Jean-Paul Gauthier, etc.), in more than 150 countries. One of its factories, which produces the majority of its products, is located in Chartres, France. Once a year there is an audit called PPS in each factory in the group and the goal is to evaluate the management system of each department. Last year, the production department did not reach its objectives. This means that there was not enough traceability of actions and that their implementation and content were not clearly defined. One way to improve this lack of follow-up is to create an "event" with several actions when a point of improvement of a certain issue is proposed. In 2019, the number of events was five. My objective is to achieve four per month starting in January 2020.

Results

I started this part of my mission in January. During the first month, I was able to create three events and I have achieved four in February. For each event, we associated actions that had to be defined and closed according to the deadline. This processing time is also considered in our production indicators. My mission allows me to work with several different fields (manufacturing, maintenance, method, engineering, etc.) and to learn from a variety of experienced people.

Keywords: production, planning, event management

Puig brand products



Machine park

The Puig site in Chartres

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Improvement of waste recycling of the Lactalis-Nestlé plant in Lisieux

Industrial engineering

Thomas VANDER-GUCHT
Academic supervisor: J. ROUSSEL
Industrial supervisor: D. LE GOFF

Company: Lactalis

Objective/motivation

The Lisieux production site, which was created from the joint venture between Lactalis and Nestle, produces milk-derived products such as Greek yogurts, drinking yogurts or classical yogurts for the "Lactalis Nestle produit frais" division. As an assistant engineer in human safety at work, I was in charge of different projects during the year. One of the biggest was the improvement of waste recycling at the factory. The account balance in 2015 was positive and throughout the year the balance became more and more negative due to the collapse of the price of oil. The objective therefore was to invert the tendency and to have the balance at zero as soon as possible.

Results

As this is an ongoing project which takes a long time to put in place, there are currently no definitive results but only progress. First, I had to investigate the cost of recycling our different wastes and which provider could do that. There are only two: GDE and Veolia. Then make a study of the two contracts to see if it is possible to work with one provider and introduce competition between the two. As I worked on my project, I also had daily tasks such as updating security communication inside the factory, supervision of worksite inside the plant whether or not done by an external company, and updating the risk assessment document. Finally, I had another project which consisted of adding the security aspect during the pre-diagnostic on a production line when a breakdown happens.

Keywords: safety, environment, waste recycling

Project site

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Improving manufacturing performance by reducing nonconformities

Industrial engineering

Ella-Mae SAGUN
Academic supervisor: J. DOUSSOT
Industrial supervisor: A. TINGRY

Company: Faproréal (L'Oréal Rambouillet)

Objective/motivation

L'Oréal Rambouillet's plant is specialized in the production of haircare products and shower gels. It manufactures products for the brands DOP, Elsève, L'Oréal Men Expert and Dessange. Our company places the consumer at the heart of its concerns. This is why the formulas of our products have evolved a lot recently to offer organic, innovative and Yuka-compatible products. All these changes make their production more complex, and during the process, we have to face lots of nonconformities that we must correct. Therefore, the quality of the product is assured at all costs but the performance of the manufacturing is strongly impacted. The goal of my project is to improve manufacturing performance by reducing the number of nonconformities, which is also an irritating point for manufacturers.

Faproréal Rambouillet

Results

I started the project with an analysis of the current situation. Thanks to an adapted database, I could create some Pareto charts that showed the most frequent nonconformities and revealed some of the causes. However, most root causes do not appear transparently and a thorough study is needed to identify them. That is what makes this project both tedious and rewarding. At this point in time, the average number of nonconformities per batch has almost halved, and the number of batches manufactured with nonconformities was also down 10% from the worst we had to face. However, there is still room for improvement, and that can be achieved thanks to four main pillars: processes, manufacturing engineering, technical aspect and management.

Faproréal Rambouillet

Keywords: performance, nonconformities, quality, bulk manufacturing

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Lean Office project: timetable improvement

Industrial engineering


M. BELKEBIR


M. GERMOND


Y. YANG

Maha BELKEBIR / Marc GERMOND / Yue YANG
Academic supervisors: A. HIVET, G. HIVET

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

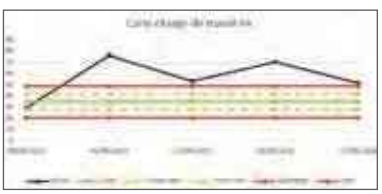
Institution: Polytech Orléans

Objective/motivation

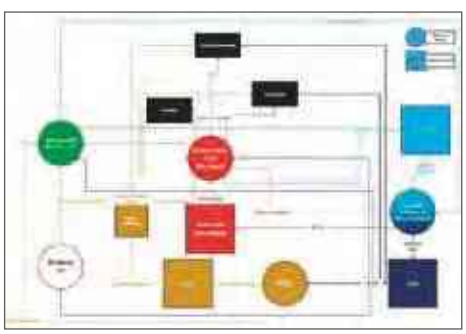
The Industrial Engineering specialty is based in Chartres because of its proximity to local biotech companies. Due to this specific organization, the timetable for the specialty is subject to several problems, including errors in room numbers and dates or teachers unaware of when they are supposed to come. This leads to an uneven distribution of the workload, and alternating periods of lower and higher intensity. Polytech aims to get its organization improved and each year dispatches a group of students to deal with the different problems.

Results

We have successfully identified the root causes of the problem with the timetable creation (namely, a lack of coordination between Polytech and the structure managing the site in Chartres, different software programs used by these same structures that lead to compatibility errors, and a somewhat rigid process that cannot take into account the flexibility needed by our specialty). However, due to time constraints, we haven't been able to implement solutions as of yet. The next step will be done by the following groups assigned to this project.


Control card

Keywords: lean, timetable, continuous improvement


Value Stream Mapping


University center in Chartres

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Load port reduction

Industrial engineering

Elfie BUELUZEYI-LUSAKUENO
Academic supervisor: L. DELPLANQUE
Industrial supervisor: D. TRAISNEL

Company: L'Oréal

Objective/motivation

L'Oreal Group, the first worldwide beauty company, is in a growth context. I work in L'Oréal SICOS plant, a key factory for luxury product production for Europe, North America and Asia. Today, the luxury cosmetics market is on the rise. Therefore, my missions take place in a growth dynamic of the group. My main mission is in quality performance in laboratories. There is one important project I work on which is load port reduction in laboratories. Indeed, for the plant, security and ergonomy are really important. Recently, the plant decided to enact a new policy: no load port higher than 10 kg. The aim is to reinforce security for the employees. In a growth context, it's important to avoid any accident. Indeed, it causes perturbations in production flow and implies an economic impact. Therefore, we must improve working comfort in order to reduce work constraints and, finally, improve efficiency at work.

Results

So far, I have been working on the most important cause of important load port in laboratories: finished product boxes located in sample libraries. Sample libraries are important for traceability, for reasons such as consumer complaints, and everyday laboratory operators place and move more or less heavy boxes. Therefore, I have tested different boxes which could automatically lower load charge to 10 kg maximum. However, this would have implied more boxes and a far too small storage space. I am now, therefore, currently working on keeping the actual boxes, but their weight cannot be higher than 10 kg. In order to do so, I must estimate the number of additional boxes that we would need and evaluate what it would represent in terms of space.

Keywords: quality performance, important load port, security

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Methods and reliability project management

Industrial engineering

Fatima Zahra SADIK
Academic supervisor: D. TRIHAN
Industrial supervisor: E. ROBINET

Company: GlaxoSmithKline

Objective/motivation

GlaxoSmithKline (GSK) is a British multinational pharmaceutical company that works on three global businesses: pharmaceutical medicines, vaccines and consumer healthcare products. The site I am working in, Mayenne, is dedicated to the manufacture and packaging of antibiotics in dry oral forms. I'm working in the methods and reliability department on projects management. The import of my projects is to improve the performance of processes and to have control over the reliability and maintainability of installations. To achieve that, the goal is to identify and manage asset reliability risks that could adversely affect plant or business operations.

Example of a GSK product

Results

To carry out this project, I used the six-sigma methodology to the analysis of data. This technique helped me to spot repetitive failures and other problems that adversely affect plant operations. After that, I worked in collaboration with other departments (maintenance, packaging, quality, etc.) to develop engineering solutions to these technical problems. The strategy was to study initially the current situation by analyzing information and data and try to find root causes of the problems. Then workshops were organized with operators, technicians and engineers in order to brainstorm about potential improvements. Currently, I'm working with suppliers on the development of new equipment for a better packaging process on a packaging line.

Keywords: reliability, process, improvement, performance, maintenance

GSK site, Mayenne

An operator working in the production area

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Obsolescence of finished products

Industrial engineering

Valentin SAXE
Academic supervisor: E. COURTIAL
Industrial supervisor: S. BOURGES

Company: Laiterie de Saint-Denis de l'Hôtel

Objective/motivation

At La Laiterie de Saint-Denis de l'Hôtel, my objective is to create a new tool to follow the company's obsolete products to reduce the number of products destroyed every year because we cannot sell or consume them. The objectives are to notice as soon as possible when a product could cause a problem and to find a solution with different people to avoid their destruction.

Results

With this new tool, the number of obsolete products could be reduced. This assignment has several impacts. First of all, there is an economic one: indeed, if we reduced the number of products destroyed, the company could sell more products and, especially, reduce waste. Moreover, we could gain time because it is easier to update, and we could make some decisions more quickly. Then, there is an environmental impact as well. Destroying products that we can consume could cause some ecological problems. Moreover, if we can act as soon as possible for a product, we could anticipate the decisions and thus avoid destroying it.

Keywords: obsolete products

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Operational training in filling

Industrial engineering

Marion ROUSSEL
Academic supervisor: G. HIVET
Industrial supervisor: M. MURE

Company: Novo Nordisk

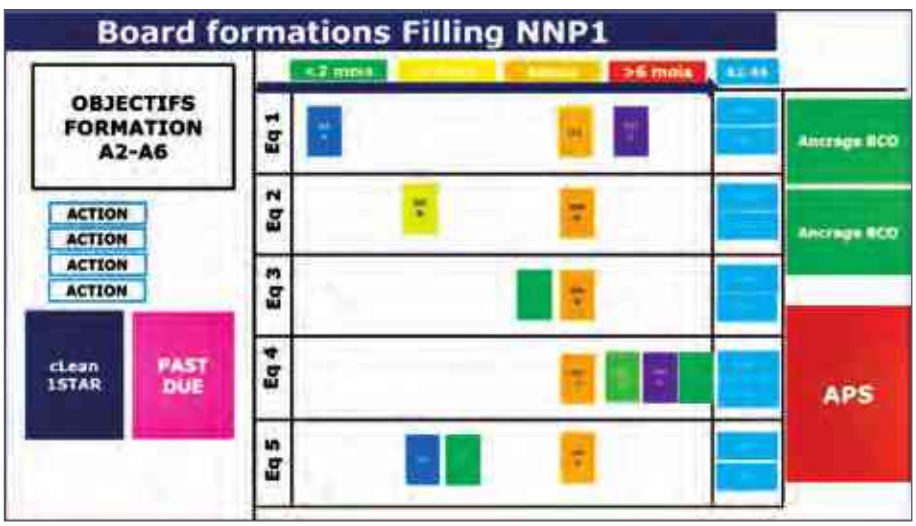
Objective/motivation

Training and certification for operators are requirements for Good Manufacturing Practices (GMP). The company has to be able to prove that employees are trained to work for all tasks. At Novo Nordisk, we apply GMP as a pharmaceutical company which produces sterile products. We have many constraints due to the controlled atmosphere environment (special gowning, stainless steel pieces, critical operations) so we want to train our operators in real conditions, directly in production. To be able to work, operators need to repeat the same activity three times. The goal of my project is to help the filling service get functional teams which are flexible and adaptable. For 2021, the objective is to have all operators trained for all filling production activities on our two production lines.

Results

I follow Key Performance Indicators (KPI) to illustrate the evolution of skills for operators. The most important indicator is the quantity of Job Training Plans signed (JTP). This is a document which proves the certification for each activity. I review this KPI every month for all teams. The other training tool is a special board for training in production. The goal of this board is to expose results for everyone and to discuss the issues during a weekly meeting with the available team leader. It is a visual way to follow our KPI. Our results are dependent on the training plan, on the presence of an operator targeted for activity with his trainer, and on the production plan. Currently, the training project is still undergoing improvement due to the complexity of training in aseptic filling.

Keywords: pharmaceutical company, GMP, training, certification



Board for training in production

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Optimization and continuous improvement of quality assurance documentation

Industrial engineering

Aude MARTIN
Academic supervisor: E. BEURUAY
Industrial supervisor: C. GALLARD

Company: Laboratoire Science et Nature

Objective/motivation

The main idea of this project is to optimize the document system in place for quick and simple use, not only for quality assurance personnel but also for production operators. Today, documentation relating to the quality assurance system is very detailed and dense. The goal of this project is therefore to take the elements of the ISO 22716 standard and to optimize and update documents in order to be in agreement with the various standards of the company.

Results

At the start, an inventory of existing documentation must be carried out: instructions, procedures, registrations, etc. Following this, it is possible to establish an action plan and a plan for future editorial work. It is important to keep in mind the different points of the ISO 22716 standard because it is on them, and also the different values of the company, that the documents are based. At completion of this work, the documents will be presented in order to judge their effectiveness, their understanding and their correctness.

Keywords: cosmetics, detergents, quality, documentation

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Performance improvement project

Industrial engineering

Anthony VILAIN
Academic supervisor: E. COURTIAL
Industrial supervisor: T. LEMOINE

Company: Sanofi

Objective/motivation

Sanofi is a French pharmaceutical company engaged in research and development, manufacturing and marketing of pharmaceutical products. I am working in a site specialized in the production of pharmaceutical active ingredients. My project "Fit4Future" is an international program about transforming the sites to position them as best-in-class in terms of operational excellence. We are implementing this program in Aramon. This is focused on a relatively short time frame in order to make the change tangible and visible right from the beginning. This project is a lot about making our people grow by empowering them, making their plants great places to work in, and developing their pride in belonging to a high-performance industrial network.

Results

A multidisciplinary team is mobilized fulltime on this project. We observed processes, diagnosed current plant performance and identified irritants in daily operations. This conduced to propose and implement solutions for improvement. We are developing new methodologies and tools, and we agree on more efficient ways of working and monitoring our performance. We are also instilling a new mindset focused on serving our customers the best we can. There are three items and nine initiatives for performance: management, individual and collective organization (digitalisation, standardization, skill matrix and irritants) and equipments. This is the first wave in the site and four others will follow within the next two years to support the site transformation.

Keywords: performance, lean, optimization

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Process safety: chemical risk analysis

Industrial engineering

Yohann COSTENTIN
Academic supervisor: H. BOUSOURA
Industrial supervisor: R. PIOT

Company: Sanofi Chimie Sisteron

Objective/motivation

The main objective of my mission is to analyze chemical risk in order to set up safety barriers in the production workshops of the HSE department. More specifically, Sanofi is planning to build a new production building and with Rachel Piot I should carry out risk analyses in order to guarantee the safety of people and goods. In an explosive or anoxic atmosphere, incidents may occur leading to damage to people, processes and/or environment. With Rachel, we have to carry out some HAZOP (HAZard and Operability) studies by creating all the possible incident scenarios that could occur in the production environment. I would like to continue in the pharmaceutical sector, and this mission allows me to know all the potential risks in production workshops, especially how to deal with them.

Aerial view of the site

Results

I am still in a learning phase as of early March. HAZOP studies are quite heavy in terms of complexity and application, so there is a lot of preliminary work to be done such as method studying and process understanding in order to have a global view before the real application. We are going to start carrying out the various risk studies based on different diagrams, called PID (Piping and Instrumentation Diagram). These diagrams are the basics of the HAZOP. The aim is to find out where problems can occur, such as a valve that can be not properly closed, or a nitrogen leak, creating overpressure and leading to the explosion of a reactor. The result of a study is a scenario table, showing causes and consequences of a deviation (e.g. pressure increase) and concluding on the implementation of safety elements.

Keywords: hazard management, explosive atmosphere

Sanofi site, Sisteron

Sanofi reactor

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Processing service digitalization

Production engineering

Charline MAZEAU
Academic supervisor: L. DELPLANQUE
Industrial supervisor: A. SILVANI

Company: L'Oréal-Usine de Gauchy

Objective/motivation

L'Oréal was founded in 1907 by Eugene Schuller and quickly became one of the main players in the cosmetic industry. Over the years, L'Oréal acquired many different brands to have a diversifed offering and became the world leader. Today's challenge is to remain number one in a constantly changing world. To be reactive to trends and always connected, L'Oréal is counting on the industry 4.0. With this guideline, Gauchy's plant wants to digitalize the different "operational excellence tools" as much as possible. More specifically, my mission is to deploy digitalized audits, a computer-assisted maintenance management, and a digital board for the processing department.

Results

The first task of my project was to digitize the internal audits. Indeed, a few months ago internal audits were still carried out on paper so there was no traceability. Today, with the Iauditor application, which offers the possibility to take photos and add comments, we can extract some analysis and reduce the audit duration. Then, I started to work on the set up of a computer-assisted maintenance management called Mobility Work wich allow us to report all technical breakdowns and preventive maintenance. Finally, I also worked on the creation of a digital dashboard. This dashboard displays the key indicators of the manufacturing department, updated automatically every day. It will allow the service to challenge itself on its performance.

Keywords: digitalization, industry 4.0, cosmetic Industry

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Project Maraude Restos du Coeur

Industrial engineering

Z. HOURY

C. MONTOLIO

Zoé HOURY / Cyril MONTOLIO
Academic supervisors: A. HIVET, G. HIVET
Industrial supervisor: L. BIANCONI

Association: Restos du Coeur

Objective/motivation

For this project, we chose to collaborate with the Maraude which is a part of the association "Les Restos du Coeur" in charge of giving food to the homeless in Chartres. They give hot meals, food bags, clothes, etc. We have chosen this project for two reasons: first, because Zoé Houry was already a volunteer and, second, because we detected a need in the organisation of the warehouse. There are different steps for the groundwork. Before the distribution and sometimes during the preparation step, some volunteers are new and they don't know what to do or where to find the products to prepare. Another problem was that volunteers don't know exactly what and which quantities of goods are in stock. In consequence, they don't pay attention to the warehouse's stock and that causes a big mess on shelves.

Results

We did a 5S site (method of continuous improvement which consists of disposing of useless things: sort, shine, set in order, standardize and sustain) and a visual management board to facilitate the communication between volunteers. For the 5S worksite, everything has been categorized according to its use (what is most used is most at hand), with labels on each shelf so that an object can be found immediately. The 5S site is over and the visual management board is integrated into the functioning of Maraude teams after an adaptation period of one month. Now, there is no oversight during the distribution, and there is a reduction in the time taken to search for items in the stock: we have gone from 19 minutes to search for ten different items to five minutes following the 5S job.

Keywords: Maraude, continuous improvement, 5S methodology

Visual management board

Warehouse plan

Zoé at the visual management board

Cyril creating the ground markings

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Quality requirements enhanced in the bulk wagon shipping area of the Connantre sugar refinery

Industrial engineering

Camille CERESUELA
Academic supervisor: H. BOUSOURA
Industrial supervisor: O. COPIN

Tereos

Company: Tereos Sucre France

Objective/motivation

Connantre's sugar refinery produces and delivers sugar only for major industrial groups, which are very demanding clients. It is therefore crucial that the sugar refinery quality requirements are raised from year to year. However, bulk wagon shipping did not follow this evolution because it is an unseen area for clients and auditors as well. Consequently, the bulk wagon shipping area was not a priority for the sugar refinery, especially concerning quality. Today, however, it is no longer possible to continue to neglect any area because of the quality requirements which are increasingly demanding. Therefore, as a quality engineer apprentice, I had a project to raise the quality requirements of this shipping area to the level of other plant areas so that it can respect the quality requirements imposed by our clients, the group and current standards.

Dust removal box

Results

As it is an ongoing project, there is currently no final result. In order to compare multiple observations such as the work environment of the bulk truck shipping area, which is a high-quality level area, meetings with operators had been held to identify issues which must be treated. In collaboration with quality and shipping managers, I have done a prioritization of these issues. Today, overall objectives which have to be treated are as follows: provide an area more hermetically sealed because doors are often open and therefore the area is exposed to pests and dust; redefine hygiene and food safety, and make this obvious for everybody; clean the entire area and set up some devices to make it healthier; and adapt the dust removal box for the area. Works will begin soon.

Keywords: quality, food hygiene, food safety, improvement

Bulk wagon shipping area

Wagon in the bulk wagon shipping area

Wagon outdoors

Bulk wagon shipping area with wagon inside and doors open

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Refurbishment of two assembly tables: gluing station and pressing station

Industrial engineering

Manon PHILIPPE
Academic supervisor: D. TRIHAN
Industrial supervisor: E. LE CHEVILLER

Company: Albéa

Objective/motivation

Albéa Group is the world leader in the packaging and plastics industry and offers a wide range of solutions in the fields of luxury beauty products, perfumes and skin care. As a beauty packaging supplier, Albéa serves prestigious and emerging brands, those who are independent and those steeped in history, small brands and large, local and international. The Albéa plant in Plouhinec (Brittany) has become the group's European center of excellence in the manufacture and marketing of lipsticks based on plastic injection, the assembly of parts (base, mechanism and cap), and the fitting of decorations on the cap. As an apprentice in the industrialization section of the technical department, I am in charge of the refurbishment of two assembly tables for the manufacture of lipstick: gluing and pressing stations. The goal of this project is to temporarily supply one customer while waiting for the arrival of a new automated machine.

Results

For this project, I was able to recover old assembly tables used about ten years to adapt to our new needs, and the 2D plans of these of the lipstick we need to manufacture. For the realization, I applied the Kaizen spirit. Thus, after analyzing the 2D plans, I was able to draw up an inventory (1st and 2nd steps of the 5S method: Sort and Eliminate) of the parts that we could recover from the old tables, parts in bad condition to be refurbished and parts to be thrown away, which are not usable. Then, the majority of my work was to design new parts for machining and then assembly on the different tables according to the mechanical clearances and therefore the tolerance of each machined part. The last step will be to make production tests to adjust the parameters, such as the height of the gluer and the press.

Keywords: industrialization, refurbishment, mechanical adjustment, 2D drawing, machining

Assembly table recovered for the project

Assembly table being refurbished for the project

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Resources management and improvement in QA department

Industrial engineering

Pauline VOLLE
Academic supervisor: G. HIVET
Industrial supervisor: A. FLEURIOT

Company: Novo Nordisk

Objective/motivation

Novo Nordisk is a global healthcare company aiming to defeat diabetes and other serious chronic diseases though innovation and simplicity. To achieve these goals, numerous projects are conducted every year within the company. However, ideas of improvement are so abundant that the resources of each department aren't sufficient. As a result, each year projects need to be prioritized according to the goals and targets of the company. The resources assigned to the prioritized projects need to be monitored to ensure a smooth execution. My role within this process will be to manage and improve the follow-up of these critical resources in the QA department and to contribute to the priorization process of the projects.

Site Project Board - Quality Assurance Validation

Results

As critical resources for the projects, Quality Assurance Validation employees are essential to this follow-up process and thus they have been implicated in this optimization. Even though the project is currently ongoing, some improvements have already been made. For example, a project board was reinitiated and improved with visual management to facilitate information transmission. Moreover, general KPIs were also implemented to increase the reactivity of the team in case of a drift. Feedback from the team after realizing the changes is positive because they improve efficiency and simplicity. Continuous improvement will be pursued on the project board and the prioritization process is yet to begin.

Board meeting - Quality Assurance

Keywords: pharmaceutical industry, quality, continuous improvement, project management, KPI

Novo Nordisk Chartres production site

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Service performance improvement

Industrial engineering

Leslie Elizabeth VALDEZ PEREZ
Academic supervisor: S. BRUNEL
Industrial supervisor: J-B. VIDAL

Company: Pierre Fabre Dermo-Cosmetics

Objective/motivation

Pierre Fabre Dermo-Cosmetics is one of the top companies in its field. It manufactures and distributes skin care and hair care solutions following four main ethics principles: innovate, protect, guarantee and respect nature and beauty. Therefore, customer satisfaction is very important for them. That is why, currently, the finest challenge of our supply chain has been to become agile in order to ensure the availability of products around the world while maintaining the objectives of quality, cost and service rate. To do so, they need to master their global supply chain processes and, as apprentice in continuous improvement in procurement service, my objective is to develop, execute and provide the necessary resources and tools in order to master service performance and be able to reach to the company goals.

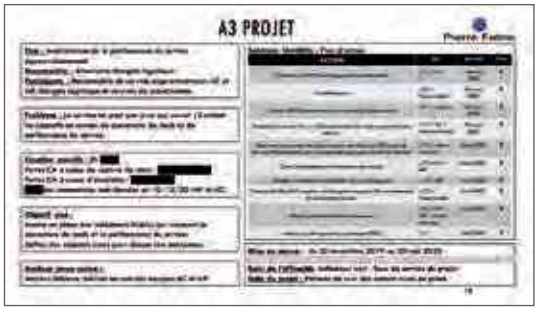
Results

The project carried out focuses on the control of procurement service performance, which consists of creating internal and automated tools to measure and follow up service. This will permit us to implement necessary actions to respond to procurement service goals and to define quantifiable objectives. At the same time, I am in charge of implementing continuous improvement actions in order to facilitate the execution of procedures and internal service communication such as application of visual management, procedures standardization, follow up of suppliers' KPIs reporting, and the implementation of regular meetings between supply chain departments of the Soual industrial site.

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

New service dashboard

Soual industrial site



A3 project

Contact: leslieelizabethv@gmail.com

Setting up a GMP gowning airlock in the school factory

Industrial engineering


R. CAI


C. SINARONG

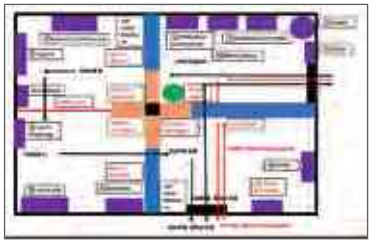
Rongfang CAI / Cynthia SINARONG
Academic supervisor: G. HIVET
Industrial supervisor: G. HIVET

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Objective/motivation

In order to get familiar with ongoing regulations in the pharmaceutical, cosmetics and agri-food industries, a dedicated zone intended to simulate a factory was implemented with a mini manufacturing line and a laboratory. However, to emulate real industry conditions, a GMP airlock must be set up. This is a room one has to go through before entering the production zone in real factories. GMP (Good Manufacturing Practices) are guidelines covering all parts such as equipment, premises, production, documentation, etc., with specific ones for sterile products, for instance. It can be considered as a quality assurance tool to ensure a standard, but also safety, purity and efficiency of the product. The aim of our project was therefore to create an educational room for students of our specialty, but also other potential learners, according to current legislation.

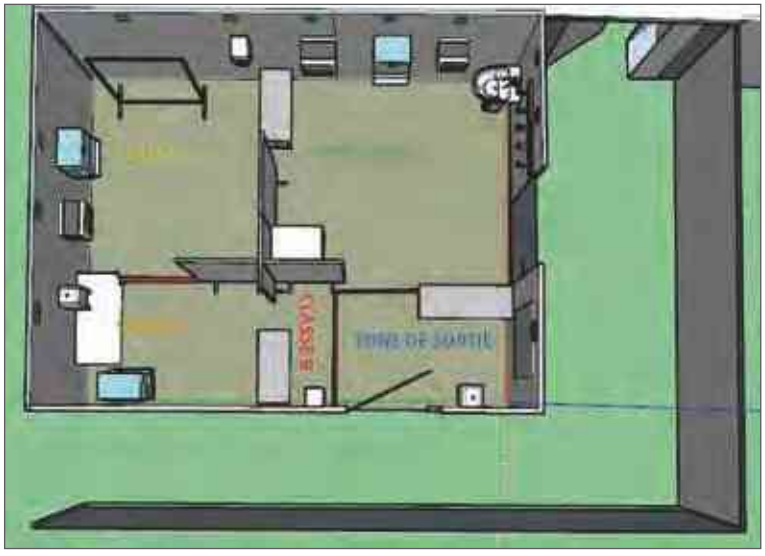

Feed


2D plan

Results

First, we started with a planning part which involved researching legislation, focusing on specific directives involving professional consulting for suggestions and retrieving information from students working in actual factories. With only one premise available for our project, the only option we could agree upon was to divide the room into five zones: “Unclassified”, “Class D”, “Class C”, “Class B” and the exit zone. Each zone has its own equipment, which guides students and visitors to dress in the proper way. In order to improve space efficiency, we set up two possible flows in the room to meet different hygiene requirements according to the process. As for the operational part, it is in an on-going phase requiring management, as there are many challenges in terms of budget, delivery, planning, and stock management.

Keywords: gowning airlock, GMP, sterile


3D plan

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Supporting the deployment of a transformation project

Industrial engineering

Fanny DENET
Academic supervisor: J. DOUSSOT
Industrial supervisor: P. ROUZAUD

Company: Ipsen

Objective/motivation

The Ipsen site of Dreux is a pharmaceutical company which has to be agile and competitive. To achieve this, Transformation service is in charge of supporting services to be more effective and optimize processes. It deploys the five steps of Lean Manager, which is a model to leverage the approach of daily Lean Management. It is a step-by-step approach with a logical link between Enterprise Excellence tools and systems. In 2020, the focus is on driving team performance with performance visual management and fostering problem solving and Kaizen events. In this context, I participated in these objectives and more specifically in the deployment of Kaizen events. I also took part in background tasks of service such as training, coaching and responses to requests of support. My tasks also included restructuring the idea generation system.

Results

This was the beginning of the deployment of Kaizen events, and several Kaizen events were launched on site. A system to quantify Kaizen events was established in order to quantify opened and closed Kaizen events. The objective is that collaborators will be independent in the realization of Kaizen events by the end of 2020. To achieve this, standards such as frame, guide, and toolworks were created to form a methodological structure. Standards are currently tested for improvement and employees are trained.

Keywords: pharmaceutical company, continuous improvement, Kaizen event, idea generation system

Five steps of the Lean Manager

Kaizen event versus problem solving

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Total Productive Maintenance in a manufacturing plant

Industrial engineering

Mary-Catherine KIRUPATHASAN
Academic supervisor: J-B. VIDAL

Company/Institution: undisclosed (confidential)

Objective/motivation

I am an apprentice engineer working in continuous improvement at an international leading dermo cosmetics company. The main characteristics of the group are to be independent, multidisciplinary and attached to its territory. I am working within an area of production because one of my wishes was to have projects in this field. The subject that I am working on is about total productive maintenance. To respond to one of the challenges called "accelerate the performance", I am responsible for the set-up of a deployment strategy of the autonomous management of a machine. Currently, the strategy does not exist and after I create it, it will be applied for other projects by my department. I am also able to deal with some problem solving in manufacturing area.

Results

I am currently working on the project deployment from a pilot line. I lead the project entirely and I must set up a follow-up. The goal of the main project is to understand, eradicate and prevent loss, and the challenge is to develop operator skills. I am working on a new way to synthetize format sheets by checking notional values which will be an improved process for the team and production unit. My role is also to be a methodological support and lead the change management by training sessions, for example. I am looking to deploy the project done on one line to four lines in parallel, so I am working with a big team. I can share my continuous improvement skills and organizational skills from other experiences. One of my goals is to bring methods to technic.

Keywords: continuous improvement, methods, total productive maintenance, dermo-cosmetics

Machinist doing a notional value

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Training coordinator assistant in the documentation and training service for candling and packaging

Pharmaceutical engineering

Oriane GUILLOUET
Academic supervisor: J. ROUSSEL

Company/Institution: undisclosed (confidential)

Objective/motivation
Daily work: The training coordinator animates training courses and qualifies production workers and new recruits at different critical operations. The training coordinator ensures the traceability of the training thanks to a software called ISOtrain.
Task 1: Improvement of a training course. Training courses are improved thanks to anomaly analysis and process deviations in order to find the root cause.
Task 2: Creation of a defautheque: the goal is to identify all the deviations that can occur on a vial, a syringe, a label, a needle, and the packaging in general. Defects are voluntarily created and put in a box called defautheque, which has to be included in the employee training process. It allows employees to see the possible defects but also to know how to recognize them during production controls.

Results
Currently, I'm learning my daily work. I have validated a few trainings in order to be autonomous as soon as possible. I know how to use ISOtrain and I can qualify production workers. I'm also working on the improvement of the training course called "Enumeration and Reconciliation". In fact, there are plenty of deviations due to non-conform enumerations, so I need to analyze deviations and anomalies to find the root cause. After that, I will be able to modify the training process: for example, activities and games will be set up instead of PowerPoint. The aim is to facilitate understanding of complicated concepts. For the defautheque, I'm creating a strategy and an action plan to find and to create all the possible defects.

Keywords: training service, improvement, packaging

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Training system

Production engineering

Julie PEAN
Academic supervisor: J. ROUSSEL
Industrial supervisor: M. SAMAKE

Company: Novasep Process

Objective/motivation

At Novasep, we have to review the training system and especially the certification system. The process is very difficult and we have a lot of manipulations and differents operations. There are many possibilities for human error so it's very important to have a strong training system. The current one is too complicated and it takes 18 months. My mission is to make it easier and more reliable. The objective is to train an operator in six months. To do that, it's important to work with operators and involve them in the project.

Results

At the time of publication, it is too early to report results.

Keywords: chemical, production, training, pharmaceutical

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Updating the global risk assessment

Industrial engineering

Eloïse MEYER
Academic supervisor: G. HIVET
Industrial supervisor: N. PECQUEUX

Company: Ebly (Mars Food)

Objective/motivation

Here at Ebly, we want to ensure health and safety for everyone on the site. For that, Mars' standards and French law require the establishment of a global risk assessment, which needs to be regularly updated. This mission is part of the broader objective of Mars to decrease each year accidents rate of 10%.

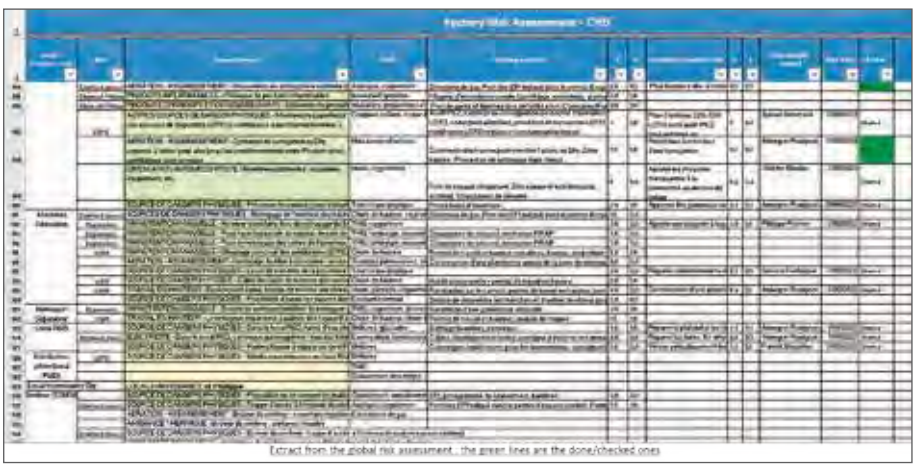
Results

Today, at the middle of the year, 80% of the global risk assessment has been updated. In other words, 80% of the site current risks are properly identified and own an action plan related to their criticality. The project might be finished in approximately three weeks.

Keywords: safety, risk assessment, update, food industry

Example of hazard source embedded in the global risk assessment: manual movement

Preliminary stage of the global risk assessment: information gathering



Factory risk assessment

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Virtual Reality (VR)

Industrial engineering

Q-M. NGUYEN

A. YOUSSOUFI

Quang-Minh NGUYEN / Ayoub YOUSSOUFI
Academic supervisors: C. CAPDESSUS, J. ROUSSEL
Industrial supervisor: G. HIVET

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Objective/motivation

The objective of this project is to design a Virtual Reality resolution of the RAVOUX machine in the premises of Polytech Orléans in Chartres. It is a packaging line for liquid solutions in bottles. This simulation is part of a presentation of the Industrial Engineering specialty during forums or events. We need to set up an interactive scenario that is simple to present at events. The purpose of the simulation is also to set up different scenarios to understand and optimize the process in order to be able to carry out training courses. The simulation will also allow us to understand and optimize the process and to implement continuous improvement actions and Six Sigma methods necessary to improve the efficiency of the machine through different scenarios.

Results

Our project had been part of the scientific event “La Fête de La Science”. We had around 60 visitors who tried our virtual reality immersion. As preparation for this typical event and in order to make people curious about our project, we created a poster. It shows the advantages of implementing Virtual Reality in the industry. As a result, by wearing 3D glasses which have been made available to us, the users at La Fête de La Science can feel the similarity between the real model and the virtual one. The users of 3D glasses can see the production process of the RAVOUX machine. In addition, we added three buttons that users can interact. These buttons command the arrival of raw materials. However, the simulation is not completely done. Some adjustments have to be taken into account in order to make the simulation more realistic.

Keywords: 3D simulation, modeling, virtual reality, simulation

3D simulation of the RAVOUX machine

Bottom view of RAVOUX's space

The RAVOUX machine in the department

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Innovations in Design and Materials

Automatization of electrical conductivity measurement and design of measuring bench

Electrical and Mechanical engineering, Materials


E. LARNICOL


N-L. LIGER


L. ZHANG

Ewen LARNICOL / Noah-Louis LIGER / Longfei ZHANG
Academic supervisor: L. DEL CAMPO
Industrial supervisors: J. FANTINI, M. MALKI

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Objective/motivation

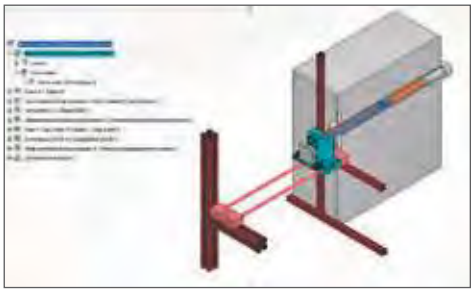
Our final year project consists on the improvement of a measuring bench that had been designed a few years ago to study electrical conductivity of solid materials for students' practical works and researchers' projects. A sample hold by a structure was heated inside a tubular furnace so as to study its electrical behavior as function of the temperature. Moreover, the structure, which had been rapidly designed, was aging and in very bad condition. Thanks to an electronic test equipment (RLC-meter), data were manually acquired and saved to a USB key, which was laborious and tedious. Thus, this bench needed some improvements, especially for ease of use. Delivered by Polytech Orleans, our project was to redesign the carrier device as well as the sample holder, to choose the electrical connections and structural purposes, to automatize the conductivity measurements and data acquisition, and to simulate the electrical behavior in metalized glass samples for various forms and dimensions.

Results

Using the LabVIEW application, we set up a man-machine interface to enable the user to enter input parameters in order to control the electronic test equipment. We have automated the data acquisition using a thermocouple that measures the temperature near the sample. We also designed on the CAD software 3D Experience a newly conceived sample carrier and ordered components that we did not have or that could not be reused from the previous model. Finally, a study was made to quantify the influence of the edge effects on the electrical behavior of our samples. By modifying the thickness and the diameter of the sample, we finally worked out the main parameters influencing this electrical behavior.


Man-machine interface on LabVIEW

Keywords: design, automatization, simulation, electrical conductivity, CAD, practical work


CAD of the measuring bench


COMSOL simulation

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Characterisation of fibrous reinforcement behavior

Materials mechanics


C. BENEDETTO


A. ROMANE


A-H. STEINHAUSSER

Cédric BENEDETTO / Antonin ROMANE / Amaury-Hubert STEINHAUSSER
Academic supervisor: A. SHANWAN

Institution: LaMé Laboratory

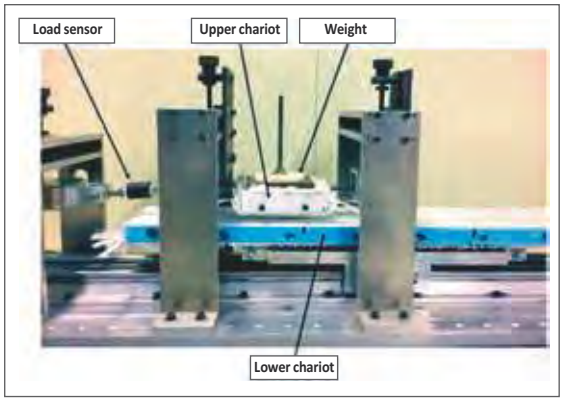
Objective/motivation

In this project we focus on the characterisation of fibrous reinforcements used in the manufacturing of composite materials by means of the Resin Transfer Molding process. RTM is a two-step process: first, a preform made of fibrous reinforcement is shaped inside a mold. Then, a liquid resin is injected in the mold, under a defined pressure, and polymerised inside a weave, in order to obtain the final composite piece. During the first step of the process, preforming defects can appear, especially in the case of multilayers preforming. In this case, a friction between the layers generates preforming defects which could impact the final product properties. In order to characterise this phenomenon, we will carry out several mechanical tests (friction, bending and tensile tests) on tows and fabrics of glass and carbon materials. The goal of those tests is to understand the reinforcement behavior and how to reduce the defect appearance during the manufacturing steps.

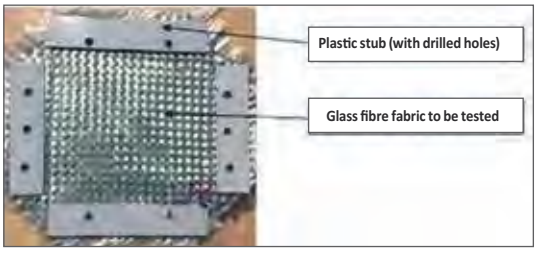
Results

We obtained our first results on the friction tests by studying glass fiber woven reinforcements. Using a load sensor, we are measuring the force of friction resulting from the sliding of two reinforcement samples. Knowing the normal force applied on the system, we can calculate the friction coefficient of the material, which enables us to optimize the forming process. We are currently studying the effect of different parameters on the coefficient value, like the normal force applied and the angle between the two samples.

Keywords: friction, bending, tensile, fiber, composite



Machine of friction tests



Glass fiber sample

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Create your own molten steel ladle

Materials

A. CORDIER

Auriane CORDIER / Fifi EZZEKMI
Academic supervisor: J. GILLIBERT
Industrial supervisor: D. HELLAL

F. EZZEKMI

Company/Institutions:
Centre Sciences, LaMé Laboratory, Athor

Second Place
14th Annual Final Year Projects Forum

Objective/motivation

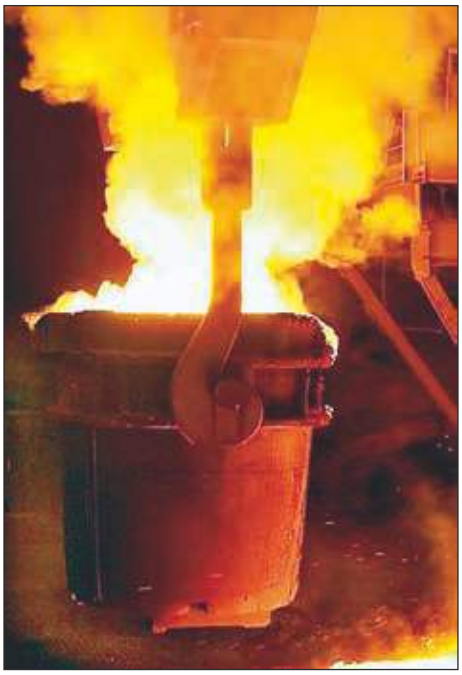
The project's aim is to support LaMé Laboratory and Centre-Sciences with the creation of one element of an interactive exhibition. This exhibition will present ceramic and refractory sciences for the general public, notably scholastic. Our objective is to highlight the refractory ceramic firebrick in the design of a molten steel ladle. The steel ladle plays an essential role in steel production. We will create the simulation of an augmented reality insulating wall, which will be used in a molten steel ladle. The visitor will be able to choose different refractory ceramic firebrick to create their own ladle. The aim is to understand the impact of the molten steel on the materials and to know how long the ladle will resist the process without breaking. We have implemented four materials and their properties in the program: spinel, bauxite, MgO-C and Al2O3-MgO-C. This project will use an opensource software which will allow anyone to use or to modify the software in order to simulate other kinds of insulating walls such as one for a building.

Open ladle

Results

The simulation of an augmented reality molten steel ladle with refractory firebricks is performed with Python program. Aloïs Segret (student of Polytech Orléans) carried out a previous version, and we had to improve it by adding thermal, mechanical and chemical behavior laws. These three types of constraints will have different impacts on the bricks. We represent their effects with black pixels for corrosion, colors (green, orange and red) for stress and thermometers with different levels for temperature. We decided to add four buttons with different levels of difficulty: thermal, thermomechanical, thermochemical and thermo-mechanico-chemical. This will help the players to understand easily the impact of the different constraints. For the project forum and the exhibition, we prototype a structure for the game that will hold all its components. This structure is composed of a white drawing table, a web-cam, a video projector and steel bars.

Ladle game



Steel ladle

Keywords: interactive exhibition, augmented reality, discovery of sciences, refractory ceramic, metallurgy

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Design and production of an on-board pressure measurement system

Industrial engineering

M. GERBAULT

M. MIKULEC

Mehdi GERBAULT / Manon MIKULEC
Academic supervisor: R. HAMBLI
Industrial supervisor: O. LAUDE

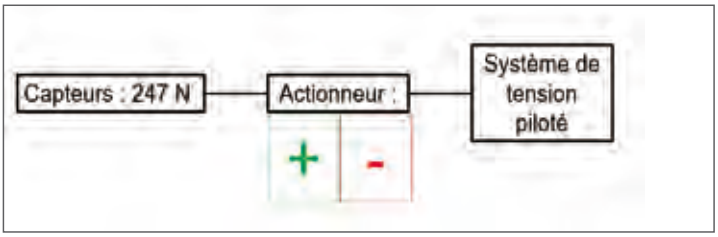
Company: Hutchinson

Objective/motivation

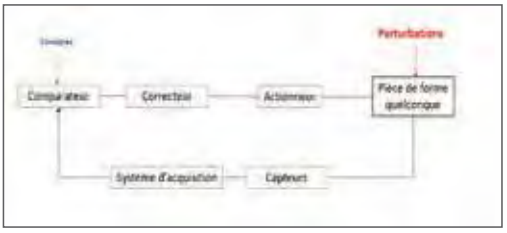
The goal of this project is to help automate a stamping process within Hutchinson's factory. For each form to be stamped, the operators have to adjust each time the necessary pressure. In addition, there is a significant excess of material to hold the system in place, which generates a higher cost. Since materials are expensive, it is important to automate the system. To do this, at first, it was necessary to determine the extensometer. Then the acquisition card and the actuator system have to be bought. We finally had to find the elements which correspond to our needs through research in specialized literature. We chose this project because it is a project that brings us closer to industrial life. We have to be creative to be able to meet our goals. It's this part of the project that mostly attracted us.

Results

At first, the sensors were quickly determined. Our industrial tutor showed us the sensors he wanted. Fortunately, this corresponded to the sensor we had suggested. It is a half-bridge extensometer, which is a sensor commonly used in the industrial world. Although a stepper motor could meet our needs, we chose linear cylinders because of the size of the system. The speed of the cylinder had to be sufficient (400mm/s) to be able to follow the stamping process. We found different cylinders and let our industrial supervisor take what he wanted. We also found another solution that could be interesting to investigate: a step-by-step engine. To be able to make the connection with the cylinder and the sensors, we can propose National Instrument acquisition cards, specifically the NI-9237 module. This module allows us to read the half-bridges assembly and give the instruction to the engine.



Global system command chain



System control loop

Keywords: sensor, linear cylinder, stamping, industrial, automate

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Design and simulation of a braking system for FSAE vehicle

Mechanical engineering

D. DESNOYERS

A. GESLIN

Dylan DESNOYERS / Antoine GESLIN
Academic supervisor: T. SAYET
Industrial supervisor: T. SABARLY

Association: Polytech Racing

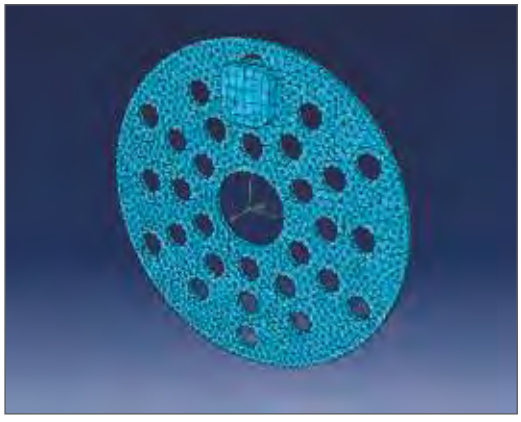
Objective/motivation

This project, which is in collaboration with Polytech Racing, consists of modeling and numerically simulating a pedal and a brake disc, according to the rules imposed by the Formula Student race, in which the association wishes to participate. The project is based on a thermomechanical study of the disc and a mechanical study for the pedal. In order to determine the heat flow and mechanical stresses applied to these parts, we need to find the dimensions for each part, the loads applied, the interactions between objects and their environments and the boundary conditions to simulate a model both optimal and realistic. Our models will allow Polytech Racing to manufacture parts that meet their expectations in order to participate in the Formula Student motor race.

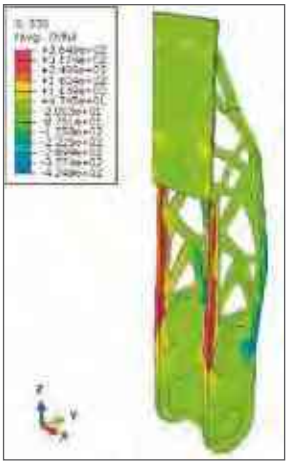
Results

We modeled a 3D pedal using the 3DExperience software. Then, we simulated a force of 2000N applied on this pedal on the Abaqus software, by fixing the boundary conditions so as to correlate with reality. We optimized the pedal to reduce its mass and at the end we managed to reduce the mass of the pedal by 20% compared to the initial mass. About the brake disc part, we modeled a 3D disc according to the dimensions given by Polytech Racing. We established the boundary conditions, applied loads and interactions between the disc and pads. However, as this part of the project was started later, it has yet to be developed and optimized. At the end of the project, we will be able to define the areas with the most important mechanical stresses and heat flows.

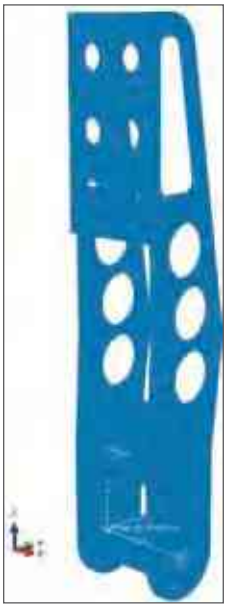
Keywords: simulation, design, ABAQUS, brake system, mechanics



Disc mesh



Stresses S33 of the optimized pedal



Final brake pedal hemstitched

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Design of a domestic blender used to cook a particular African dish

Mechanical engineering

L. ENOS

P-A. TEYSSIER

Lucas ENOS / Pierre-Alexandre TEYSSIER
Academic supervisor: J. GILLIBERT
Industrial supervisor: E. KWASSI

Company: CADSIM3D

Selected Participant
14th Annual Final Year Projects Forum

Objective/motivation

The goal of the project is to design a blender that will be used to make a traditional African recipe: fufu. This dish is made by crushing cooked tubers like manioc or yam with a mortar and pestle for 30 minutes, resulting in a doughy paste. It will then be eaten with a saucy meal as a side. As this dish is quite labor intensive, a machine like a blender would be ideal to save time and energy. The user should able to weigh, cook and mix the tuber with this blender. This blender must also cost less than 200€ and respect European regulations.

Results

Firstly, we made a FAST diagram (Function Analysis System Technique). This tool is used to break down user functions into technical functions. Then we researched technical solutions that matched the requirements. We also studied the European standards and regulations that the blender would have to respect. Once this task was completed, we integrated these solutions one by one into a 3D model using a CAD software (CATIAv5). The goal of this model is to represent all the solutions together. The components are simplified as is the form of the blender. The following objective is to further improve the blender during a six months' internship with a prototype.

Keywords: design, blender, fufu, regulations, function analysis

3D model of the blender

Traditional way of making fufu

Fufu once cooked

Manioc

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Design of a mobile bandsaw mill

Mechanical engineering

G. DHIERSAT

A. FILLOUX

Gaëlle DHIERSAT / Alexis FILLOUX
Academic supervisor: P. CHAUVIN
Industrial supervisor: J-N. GAPTEAU

Company: Jean-Noël Gapteau

Objective/motivation

The final goal of the project is the production of a French mobile bandsaw mill with the help of an existing German mobile bandsaw mill for Mr. Gapteau. A mobile bandsaw mill is a machine which is transportable to the place where the logs are. The machine can cut nine-meter by one-meter logs The dimensions of the machine are 12x2.55x2.55 and it weighs 3.5 tons. The machine can be driven with a driver license BE. The first part of the study is to analyze the functions, to find the needed specifications of the machine and design a CAD model of the chassis and the saw crossbar. Our task was to find a way to remove the engine from the saw crossbar and put it in the chassis.

Results

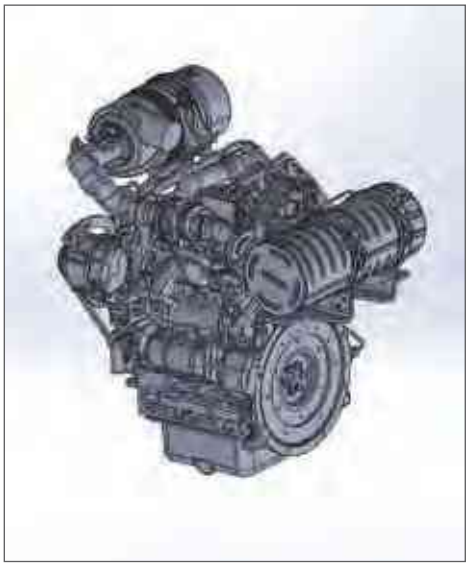
For our study, we did research about the patent right in this domain and we didn't find anything that could be a problem for us. We also learned a lot of things about how this machine works. Indeed, to design the main components we had to find values for the sawmill, in different ways. A first one was Serra website and the main one was Mr. Gapteau himself. He gave us the optimal speed for the bandsaw which is between 35 to 40 m/s. Another important value was the torque needed to drive the bandsaw, which was found by estimating the torque of an electrical motor used on a similar machine. Finally, we can say that our goal for this project has been reached because we found the needed specifications for the sawmill and a first design for the machine.

Keywords: woodworking, bandsaw mill, mobile, CAD, prototyping

First design of the sawmill

Second design of the sawmill

A Serra bandsaw mill at work



CAD of the chosen Kubota engine

Contact: gaelle.dhiersat@gmail.com ; alexis.filloux24@yahoo.com

Design of a student Formula Racing front impact attenuator

Mechanical engineering

N. RODRIGUEZ

F. TSE YENT CHEONG

Nina RODRIGUEZ / Florian TSE YENT CHEONG
Academic supervisor: J-L. DANIEL
Industrial supervisor: T. SABARLY

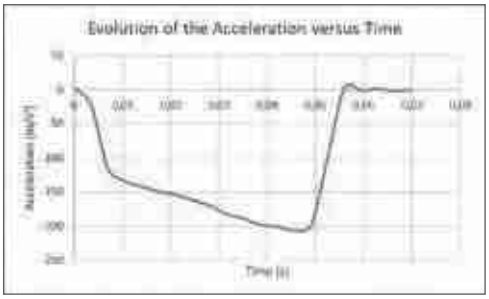
Association: Polytech Racing

Objective/motivation

Polytech Racing, a student motor club, has decided to participate in the international design competition, Formula SAE. This event challenges teams of university graduate and undergraduate students to conceive, design and develop a Formula-style vehicle. Therefore, some projects have been set up to design the Formula car which will allow them to reach their goal. Our project aims to design the front impact attenuator respecting the requirements fixed by Formula SAE Rules. First, we need to create and think about the shape of the attenuator. Then an analysis has to be done to find the perfect material matching with our expectations and requirements.

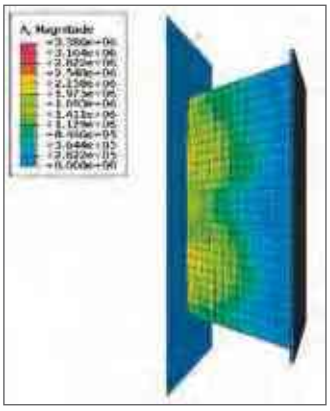
Results

First, the 3D Model has been created on 3D Experience. It is composed of the attenuator and an anti-intrusion plate which is made of aluminium and its dimensions are 330x384mm. For the attenuator, we used the approximate dimensions of the Standard Attenuator provided by the Formula SAE. Both the rubber and polyurethane foam were potential solutions for the attenuator. To find out which was better, we modelled a rigid plan in order to simulate the crash of the device on a wall. Due to its hyperelastic behaviour, the computations of the rubber did not converge and deliver results on the solver. The foam seems to be the best choice although the requirements have not yet been met. The next step is to upgrade the model, especially the material data, in order to match the expected requirements.

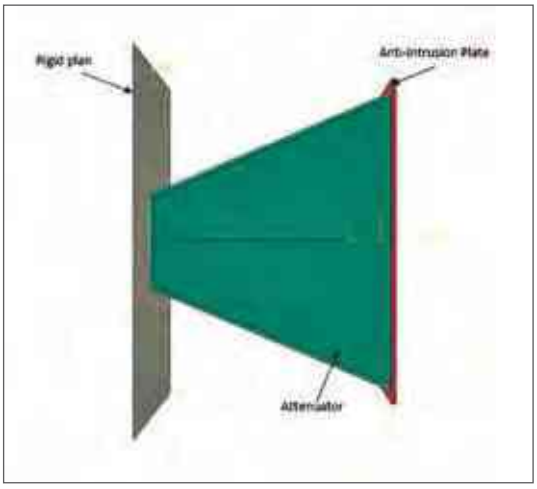


Graph of impact attenuator

Keywords: numerical simulation, Abaqus, crash test, Formula SAE, design



Results of impact attenuator



3D model of impact attenuator

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Design of a test bench for a pellet press roller

Mechanical engineering

A. CARRON

A. HENNEQUIN

Anthony CARRON / Antoine HENNEQUIN
Academic supervisor: J-M. AUFRERE
Industrial supervisor: J. DE SMET

Promill
A Moret Industries Company

Company: Promill

Objective/motivation

This project is about designing a test bench for Promill, which designs and produces pellet mill machines for other firms. Indeed, Promill needs to carry out many tests on their rolls, especially the bearings inside these rolls. The purpose of these tests is to improve the capacity and the lifespan of the rolls. In order to ensure the quality of the test results, they need to control different parameters like the rotation speed or the variation of the load. Our tasks in the project were to design the test bench reflecting the high load and strain applied on the different parts of the bench. The objective is to identify the hotspot and give a solution to carry out the tests without any maintenance for at least 25000 hours.

Results

With our industrial tutor, we agreed about the achievement of this project. The deliverable is a mechanical architecture of the test bench for rolls with the following specifications: lifespan must be more than 25000 hours, the maximum load applied onto the roll is 600kN, the rotation speed of the roll is 192 rpm and the conditions of the test must be close to real conditions. In order to respect the lifespan, we worked on the fatigue failure due to the Hertz pressure and the design of a bearing. To apply the load, we selected hydraulics actuators and made a hydraulics diagram. And for the rotation of the roll, we used the fundamental principle of dynamics and the rolling resistance to calculate the torque that our system needed to rotate. We then selected a motor corresponding to our purpose.

Keywords: pellet mill, mechanical design, test bench

Pellet press

Students at work

Test bench

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Development of a cell for a microwave oven to enamel ceramics and melt glass

Materials

G. BERGERARD

V. DAVID

Geoffroy BERGERARD / Victor DAVID
Academic supervisor: M-L. BOUCHETOU
Industrial supervisor: M-L. BOUCHETOU

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

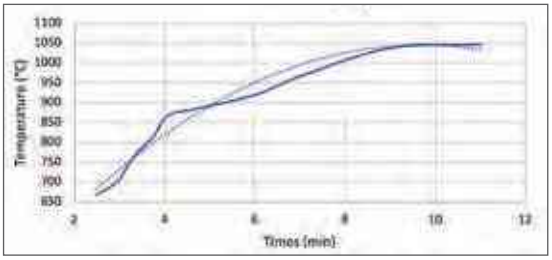
Institution: Polytech Orléans

Objective/motivation

The goal of this project is to develop a cell to enamel ceramics and to melt glass in a microwave oven. This academic project follows up the previous works started in 2019. This process is designed for the laboratory classes in order to reduce the time and energy consumption of the heat treatment. Today, this process which takes more than 8 hours, is done in a classic thermal inertia furnace, but microwave power can lower this period. The challenge is to find materials for the two following applications: a susceptor which will transform microwaves into heat, and an insulating material to protect the oven and keep the warmth in the cell. Moreover, these materials have to be high temperature corrosion resistant.

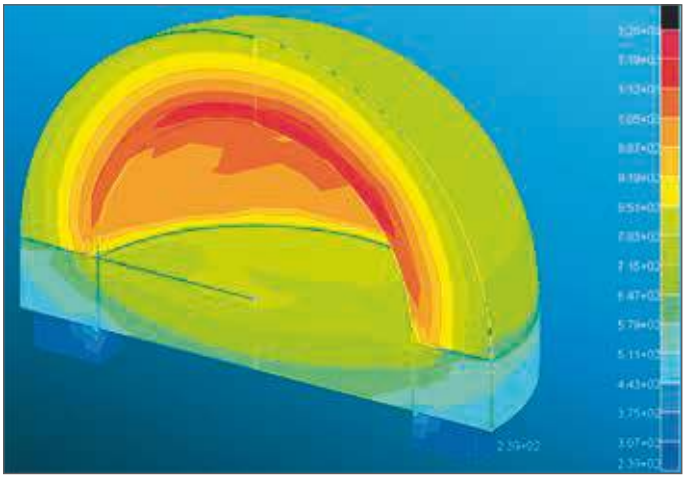
Results

The first solution found by the previous group was to use graphite powder as the susceptor and a refractory brick as the insulating material. The shape of the cell has been designed as a semi-spherical cavity, which concentrates the warmth in the best way. This result has been confirmed by some digital simulations on the PATRAN/NASTRAN software. Graphite powder as a susceptor material was able to enamel ceramics but was highly damaged by the high temperature corrosion. Thus, molybdenum disilicide was used to replace it. After some experiments, it was found that this new material is as performant as the first one but more resistant to high temperatures corrosion. Furthermore, the refractory material meets the requirement about the insulation of the cavity so we kept it.



Evolution of temperature vs time at 900 Watts

State of the cell after three minutes at 650 Watts



Digital simulation of the cell

Keywords: heat treatment, susceptor, microwaves, economical, functional

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Equip a heat exchanger prototype with sensors in order to analyze stresses and strains in operation

Industrial engineering


V. CAZIN

Vincent CAZIN / Flavian MARTY
Academic supervisor: J. GILLIBERT
Industrial supervisor: N. GALLIENNE

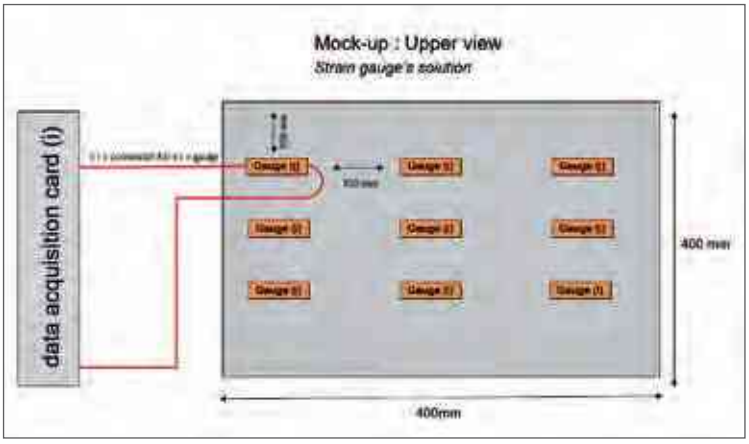

F. MARTY

Company: Air Liquide

Objective/motivation
The challenge of this project is to equip a heat exchanger prototype with instruments (such as sensors), with the aim of measuring and analysing the mock-up's movements and strains. To do so, we first had to understand the working process of a heat exchanger by running some numerical simulations on an equivalent model. Thereby we have the knowledge to choose the right sensors we need to test the prototype and confirm our theoretical hypothesis.

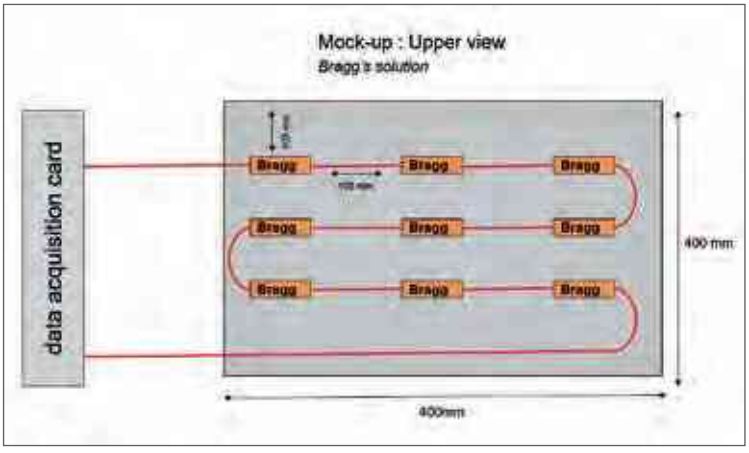
Results
Confidential

Keywords: heat exchanger, cryogenic, mock-up, sensors, simulation



Strain gauge's solution scheme


Model simulation



Bragg's solution scheme

Contact: cazin.vincent@gmail.com ; Flavian1004@gmail.com

Exploring material in virtual reality

Materials

F. DENERF

E. MARQUET

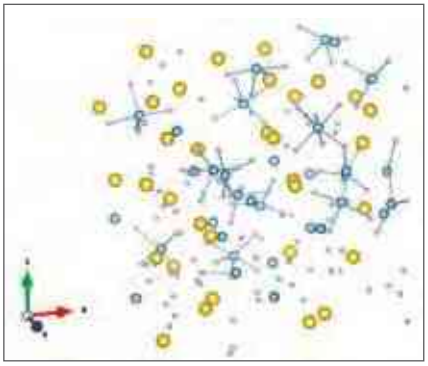
Florian DENERF / Erwann MARQUET
Academic supervisor: J. GILLIBERT
Industrial supervisor: M-L. BOUCHETOU

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Objective/motivation

The goal of this project was to have a visualization of atoms in an ionic liquid. Interactions in this liquid represent what happens during the process of electrolysis for the creation of aluminium. To see the movement of atoms in detail, virtual reality was used in order to have an immersive visualization. Immersive reality design is a modern tool to observe a structure within the material. This project allowed us to explore 3Dexperience software and to understand how immersive virtual reality works, having the awareness of its benefits and limits. Positive points of this project were the fact that a lot of different software programs (VESTA, 3Dexperience, MATLAB® and Excel®) were used in a concrete case. We were able to apply what we learnt during our engineering cursus. Moreover, the use of virtual reality was something new for us and a state-of-the-art technology.

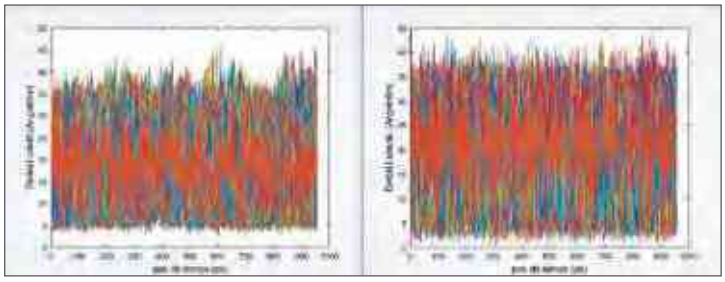


Vizualization of bonds on VESTA software

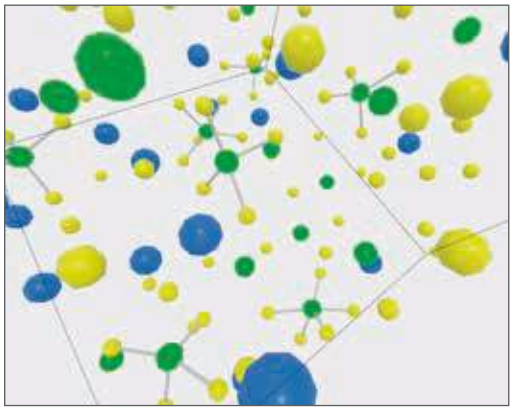
Results

After a visualization of atoms (Al, Na, F) and bonds on VESTA thanks to coordinates given at the beginning of the project, a check of the travelled distance by atoms was done on MATLAB®. The maximum distance was around 40 angströms which is a suitable distance for an atom after 1 picosecond. Then, a crystallized phase of the liquid was designed and observed through virtual reality glasses. This static part was the first time increment and was composed of 13 molecules (AlF_6^{3-}, AlF_5^{2-} ou AlF_4^-). The last stage was the dynamic part which represents exactly what happens in the ionic liquid at each time increment. Bonds are automatically formed when atoms of aluminium and fluor are at a distance inferior or equal to 3,779 ua (atomic unit). This project allows an overview of how bonds are created between anionic complex.

Keywords: virtual reality, HTC Vive, 3Dexperience, atoms, ionic liquid



Distance travelled by atoms at each step of time (1 ps)



Atoms and bonds obtained in virtual reality on 3Dexperience

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Feasibility study of a device for the automatic application of resins

Industrial engineering


M. CARDENAS


J. TOKOUDAGBA

Mario CARDENAS / Johann TOKOUDAGBA
Academic supervisor: E. COURTIAL
Industrial supervisor: Y. PIALAT

Company: Kemica Coatings

Objective/motivation

The objective of this project is to guarantee that the proposed solution is able to apply a layer of resin with a constant thickness over long distances. We were presented with different requirements and limitations such as dimensions, weight, movement velocity, storage capacity, resin application methods, etc. It is our job then to list all these different restrictions and analyze them. We had to find the best location to place the resin applier device, the best mobile robot to fit to the control requirements and the best actuators/sensors to make the vehicle autonomous. With the intention of choosing the most optimal solution, we will base all our decisions in different technical and administrative criteria (budget, robot architecture, applying tool), as well as the results obtained from the different research, calculations and simulations done.

Results

We used SolidWorks to simulate the device with different trajectories to be followed by each of the configurations while alternating its positions. The remaining surfaces not covered by the resin have been measured to quantify the percentage of uncovered space. While the results were good, the best solution would be to add a robotic arm instead of a fixed one, allowing a complete coverage of the surface. We analyzed different references using three selected configurations (Ackerman, tricycle and omnidirectional) and the possible robotic arms to be used after applying the same criteria as the platforms. In the end, we came up with 3 solutions for the client, each one with its advantages and drawbacks, and we let it to his decision about which one to select.

Keywords: resin, mobile platform, robotics, feasibility study, trajectory


Platform


Plaque

Contact: mario.cardenas-mantilla@etu.univ-orleans.fr ; johann.tokoudagba@etu.univ-orleans.fr

Hot coloring of decorative aggregates

Materials engineering


A. LEMAIRE


N. ZENTILIN

Alexis LEMAIRE / Noémi ZENTILIN
Academic supervisor: M-L. BOUCHETOU
Industrial supervisor: A. AUGUSTE

Company: Colas Lorient

Objective/motivation

The company Colas Lorient aims to diversify its production by offering decorative gravel to private individuals. They want to maximize the production of their coating plant to make it more profitable. Our project therefore consists in finding a technique that enables aggregates to be colored sustainably and is compatible with existing installations. The Colas company produces colored coatings but doesn't know how to create colored gravel. Indeed, pigments are located in bitumen so they can fabricate tarmac but no free gravel because bitumen is a sticky substance. First, we have to find a process that allows pigments to adhere to the gravel without the grains gathering between them. Then, we have to verify if our technique is compatible with the current installations of the company.

Results

We started by making tests with a bitumen emulsion to color the aggregates. We carried out three tests, changing the proportions of pigments and bitumen emulsion. We obtained free and not sticky coated gravel but, unfortunately, we didn't obtain a sparkling color. Actually, the problem is that the bitumen emulsion is dark brown, so it is very difficult to change its color. We decided to try to coat the gravel with translucent resin. Therefore, we created a mini cement mixer with a can to mix the aggregates coated with resin and we heated it with a heat gun. This allows us to be close to the Colas installations and to see if, in this context, the resin will stick the gravel together. We finally succeeded in obtaining free gravel with the resin, but the first tests with the pigments in powder and paste form were not successful because the color was not homogeneous. We therefore changed our approach and were successful. First, we used acrylic paint on the gravel and allowed it to dry. Then, we used the resin on them to protect the first layer of color.

Keywords: aggregate, colored, resin, pigment


Natural gravel and coated gravel obtained after three different tests with different proportions of pigments and bitumen emulsion


Natural gravel and coated gravel with uncolored resin


Aggregates coated with the resin/coloring paste mixture


Aggregates coated with the resin/coloring powder mixture


Aggregates coated with a coloring layer of acrylic paint and a protective layer of resin

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Improvement of control of the means of production

Production engineering


A. BUISSONNIER


C. LEDIEU-DHERBECOURT

Adrien BUISSONNIER / Clément LEDIEU-DHERBECOURT
Academic supervisor: B. LE ROUX
Industrial supervisor: B. KIOTA

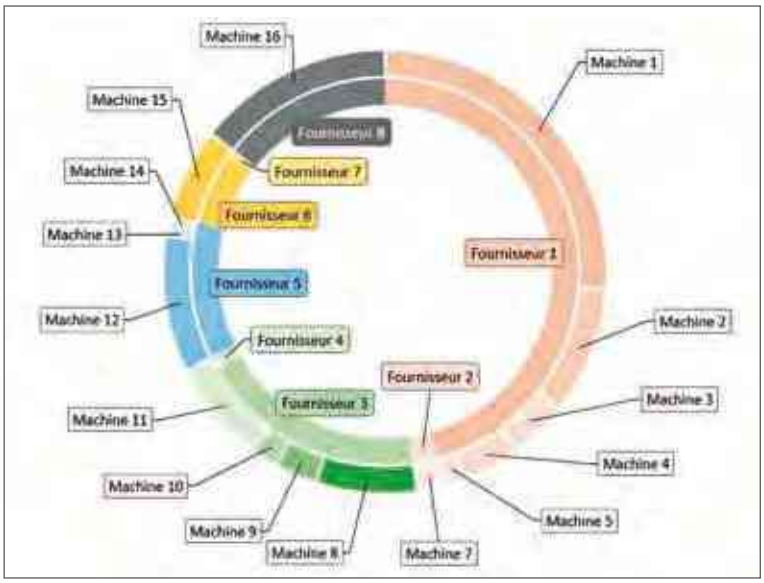
Company: Glassolutions

Objective/motivation

Saint-Gobain Glassolutions, manufacturer of double glazing, needs to improve their maintenance in order to achieve their goals. A production line involves different industrial machines which may have failures that involve the replacement of parts. The enterprise, based in Orléans, receives large glass panels which are processed to obtain various double-glazed windows by cutting, insulating and framing. Given a serial production, if a problem occurs on a machine, it will affect the entire production line. The mission is to find solutions using all the data collected by the factory employees and the mechanical datasheets of the machines. The project implies knowledge in CMMS (Computerized Maintenance Management System), design and a few visits in the factory.

Results

It is crucial to master and anticipate the mechanical and electrical failures that occur in order to drastically improve the performance. To reduce and avoid downtime, specific parts need to be available and changed regularly. First we analysed the downtime of every machine (MTTR and MTBF) to have a better overview of the critical machines as well as the cost of maintenance. Then we made a classification of each type of failure in order to identify redundancies. This work helped us to set criteria subsequently to define a critical part, such as the probability of failure or the impact on production. At the end we established a list of parts that need to be kept in stock. The understanding of the different data and documents was challenging because we had a limited access to resources, but thanks to a close collaboration with Benjamin KIOTA, the technician in charge of maintenance, we managed to overcome those difficulties. All this information gives the company the keys to elaborate the appropriate strategy.



Comparative proportion of parts cost per machine and per supplier (Fournisseur) [June 2018 - January 2020]

Keywords: maintenance, stock management, failure, prediction, glass

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Machine learning for mechanical simulations

Mechanical engineering

Q. MEYGRET

R. SOUMIER

Quentin MEYGRET / Romain SOUMIER
Academic supervisor: R. HAMBLI

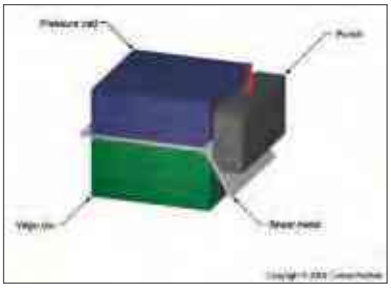
Institution: LaMé Laboratory

Objective/motivation

Neural Networks are a powerful tool used in more and more applications such as signal processing or for the approximation of an unknown function. The aim of the project is to demonstrate the efficiency of neural networks to perform mechanical simulations for the press forming of a slab of sheet metal. A database has been created by a huge number of simulations on Abaqus software. This database is used to train a model using the machine learning method and neural networks in order to make predictions on output parameters by giving input parameters. In this way, we can evaluate the accuracy between the theoretical values given by the simulations, and values given by machine learning method through different software.

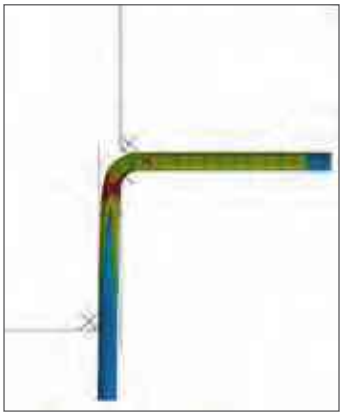
Results

First we designed the slab of sheet metal on Abaqus software to get the database through a huge number of simulations by changing three entry parameters, which are the friction coefficient, the radius of the wipe die for the folding of the sheet metal, and the distance between the pressure pad and the punch. After that, we determined the maximum value of stress, and the folding angle of the sheet metal at the end of the press forming as exit parameters. Then, we created a program on Python using TensorFlow which is an open-source platform for machine learning. After obtaining predictions from our program quite similar to those given by the simulations, we compared different software. First our Python program, then NeuroMod software which was designed by our supervisor, Mr. Hambli, and finally nntool toolbox on MATLAB®.

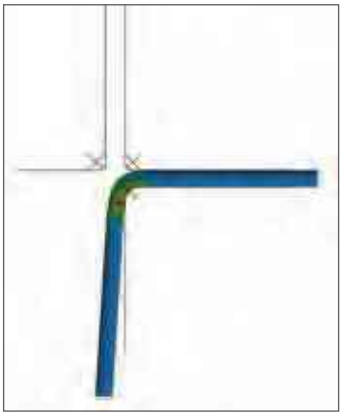


Press forming process

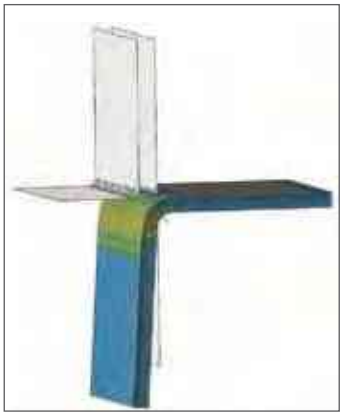
Keywords:
machine learning, sheet metal, finite element method



2D simulation in X-Y plan



Results for a 2D simulation in X-Y plan



Results for one of the simulations on Abaqus®

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Mechanical and thermal optimization of a connected beehive

Mechanical engineering


L. MOULIN


L. TOUSSAINT

Léonie MOULIN / Loïc TOUSSAINT
Academic supervisor: M. MEKHILEF
Industrial supervisor: B. LAURENTIN

Company: Bee Angels

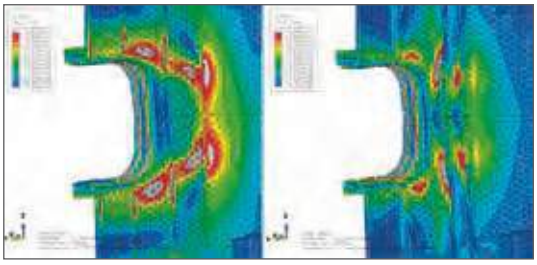
Objective/motivation

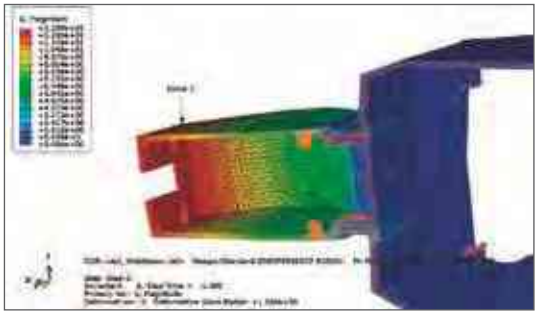
We worked on the optimization of a device making a beehive connected. As it turns out, the device has several design problems. In fact, during periods of heat, the temperature in the sensor module is higher than outside, sending wrong information. In addition, while being transported, the device appears to break, so we had to find a solution to solve this problem. Furthermore, we needed to take care of some minor issues from the defect library. However, at first, Mr. Laurentin wanted to change neither the mold, nor the design or shape of the product. Moreover, the cost of the possible modifications would be the principal criteria. Thus, we used Abaqus, software of finite element analysis, to carry out this project after the simplification of the 3D model under CAD software.

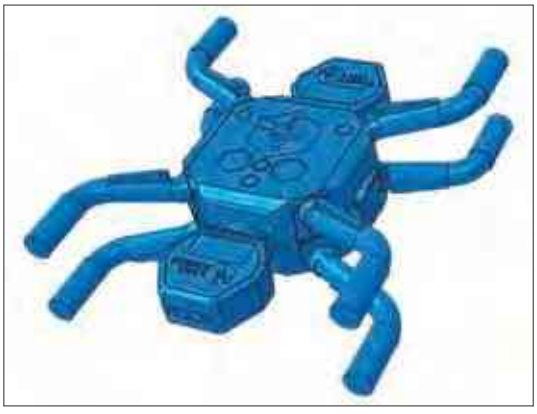
Results

For the temperature issue, on Abaqus, we tested the impact of small openings in the sensor module to create a natural aeration in order to have the same temperature inside and outside of the device. For this, we had to create enough openings on the bottom and on the lateral surfaces of the sensor module. For now, the thermal simulation of the air flow inside the sensor module, combined with the effect of the sun, is not perfect as the model cannot yet converge to a real solution. For the logistical issue, the crash-test of the 3D model was too complex (number of elements/computing capacity) even after strong assumptions. Instead, we performed statics cases to get information on the failure of the structure, and add either foam or stiffeners.

Keywords: computer simulation, crash-test, thermal simulation, Abaqus


Rigidity comparison after the addition of stiffeners


Force on the sensor module


3D model of the device

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Modelling of a granulation chain

Mechanical engineering


L. ARAUJO-DUARTE


S. CANNESSON


J. LIEGEY

Lucas ARAUJO-DUARTE / Stéphane CANNESSON / Julie LIEGEY
Academic supervisor: A. GASSER
Industrial supervisor: J. DESMET

Promill
A Moret Industries Company

Company: Promill

Selected Participant
14th Annual Final Year Projects Forum

Objective/motivation

The goal of our project is to model a granulation chain of Promill, to understand the behavior of wood and to explain some cracks inside this granulation chain. This company is the main supplier of industrial technology for grinding and granulation. They produce a pelleting press that transforms wood powder into pellets by compaction. These pellets are used to keep the flames in stoves. The pelleting press is made with granulation chains that break after a variable lifetime at Promill. We need to understand the efforts of wood in the granulation chain in order to prevent future cracks. The wood is put inside a pelleting press and the granulation chain is a part of that press. The granulation chain is spinning on itself, making the rollers inside of it press on the powder.

Results

To model the granulation chain, we need some parameters to simulate the wood compaction. To understand the wood behavior, we did some bibliographic research on existing models of compaction and we have chosen the Cam-Clay model. To identify this model, we tested the wood powder experimentally by doing compaction tests. After identification, we simulated, using a finite element software, the model of a cone which is inside the granulation chain, and through which the powder is compacted, to determine the stresses in the cone.

Keywords: modelling, granulation, wood, effort, compaction behavior


Example of granulation chain break


A granulation chain

Compaction test on wood powder


Function of a granulation chain with its rollers inside

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Modelling of the thermoradiative properties of an infrared ceramic emitter

Industrial engineering


M. LEBEAU


R. OKCU


E. ORLAY

Matthieu LEBEAU / Renas OKCU / Emmanuelle ORLAY
Academic supervisor: M. MALKI

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

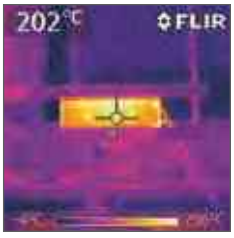
Objective/motivation

Our project consists in studying and modeling an electric ceramic radiator with a finite element software called Patran Nastran. This radiator has different areas of industrial applications such as food, plastic processing, surface treatment, and glassware. Its main use is drying. The heater given to us can be connected to the domestic electrical network and provides a power of 1050 watts and reaches temperatures close to 700°C. It was designed with efficiency in mind, which means giving off a large amount of heat very quickly while avoiding large temperature gradients (heterogeneity). Consequently, theoretical knowledge in heat transfer is compulsory to carry out a simulation as close as possible to reality. The simulation must be optimized by defining the distance between the radiator and the tile, the number of radiators necessary to dry the tile, and their space configuration.

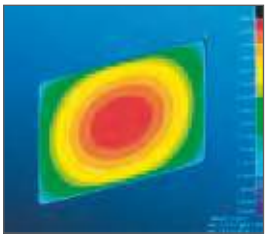
Results

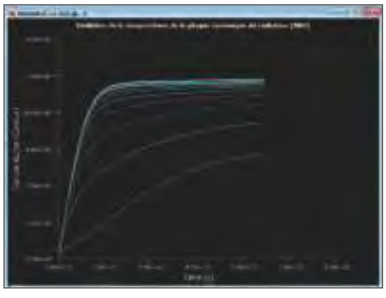
The first part of our project was to analytically determine the temperature values of our heating system. For this, we did some research on the heat transfer of a black body and on the view factors. This allowed us to compare our results with those obtained with the simulation and have a better understanding of the mathematical tools used by the finite element software. We also carried out measurements experimentally using a pyrometer and a thermocouple to verify the accuracy of our simulation results. In parallel with this work, we did simulations with the different parts of the radiator to study temperature variations. Our last task was to find the best conditions for drying, so we had to put several radiators at a distance of 15 cm from the tile in order to reach a temperature of at least 110°C on the whole surface.


Simulations mesh



Infrared thermal camera


Temperature results


Graph of the temperature of the ceramic plate over time


Radiator, 1050 Watts

Keywords: heat transfer, Patran Nastran, black body, simulation, finite elements

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Numerical simulations of the dynamic fracture of human femurs

Mechanical engineering

H. HENRY

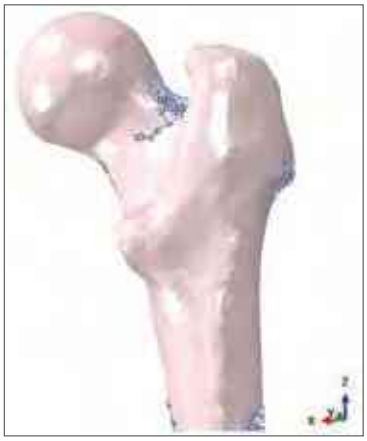
Hugo HENRY / Abdellah SANBA
Academic supervisor: R. HAMBLI
Industrial supervisor: R. HAMBLI

A. SANBA

Institution: LaMé Laboratory

Objective/motivation

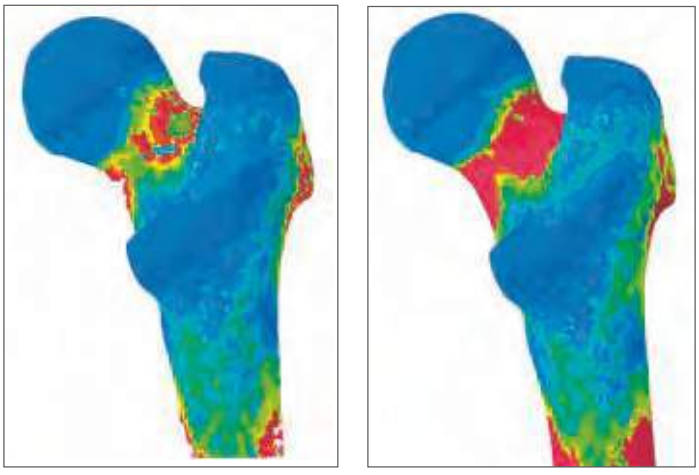
This final year project consists of the development of a numerical simulation of the dynamic fracture of human femurs under the action of a side fall impact. The objective is to compare the results of finite element simulations with existing experimental results. The real and destructive fracture tests are carried out on the femurs of deceased people. The femurs are modeled with SimpleWare software and exported in 3D. Abaqus software recovers the geometric data and the material properties making up the femurs. Then the parameters of simulations, mechanical loadings and the boundary conditions are defined by our team to find results similar to destructive tests. If the simulation is validated, the bone clincians will be able to carry out orthopedic prevention on living patients using scanned femurs and the simulation. They will be able to offer prostheses with more suitable medical care and reduced costs.



Results

After many training sessions in Simpleware, the femur is modeled and exported in 3D. The boundary conditions and desired speed are applied. All displacements and rotations are blocked on the femur body. Abaqus simulation is set up and worked well. The first crack will appear on the femur neck with a stress between 100 MPa and 120 MPa. In the experimental data, the first crack appeared with a force of 5,564 Newton. To compare these different unities, we plotted a graph of stress as function of force and we noticed that a force of 5,564 Newton corresponds to a stress of 108 MPa. It is therefore in the range of crack stress. To approve the project, the simulation will be tested on a large sample.

Keywords: femur, human, crack, fracture, finite element model



Computer models of fractures

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Study of the gripping of a product to be heat treated

Mechanical engineering

C. DUVAL

S. ORAIN

Coralie DUVAL / Simon ORAIN
Academic supervisor: A. FONTE
Industrial supervisors: A. LEMELIN, B. PIERRE, G. SAUJOT

Company/Institution: undisclosed (confidential)

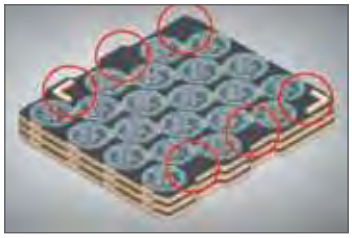
Objective/motivation

During this project, we worked with a company for two months from January 6th to March 10th. In their factory, some of the pieces that are made need to go through a heat treatment process using a flow-through furnace. The conveyor of this furnace is very slow, about 50 to 70 mm per minute, and is currently supplied by an operator. The task of placing the manufactured pieces on the conveyor is not very ergonomic and represents a loss of production time for the company. Therefore, we were offered the opportunity to work on a solution to this problem. Indeed, we were asked to find a gripping solution to transfer the pieces from one conveyor to the other without any human action.

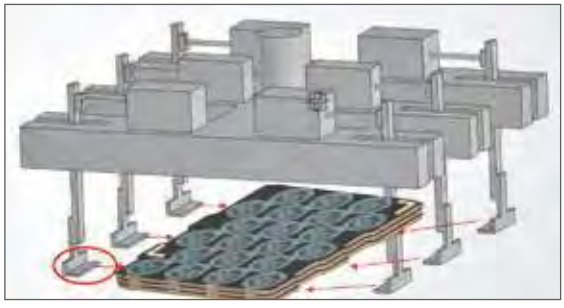
Results

After more than a month working on this industrial project, we were close to the end and had eliminated two of the four solutions that we were thinking of presenting. There are many reasons for that, including feasibility, life expectancy or the complexity of setting it up. Therefore, with only two solutions to present, we went further in our study and designed our solutions on 3D Experience®. We also calculated the force that our gripping tools would be able to lift and did a simulation in order to determine if these solutions would break under the weight of the objects to be lifted. We can see in the following pictures our two gripping solutions and the product to be lifted.

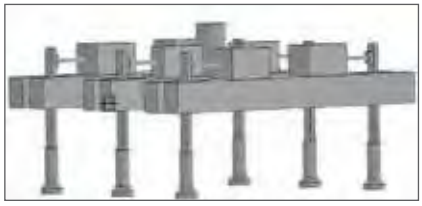
Keywords: robotics, design, engineering, production



Product to be lifted, with gripping points circled in red



L gripper



Suction cup gripper

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Production Management

Automation of manual bonding

Production engineering

Bastien PITAUD
Academic supervisor: S. GROSSELIN
Industrial supervisor: M. LEMEUNIER

Company: Brandt France

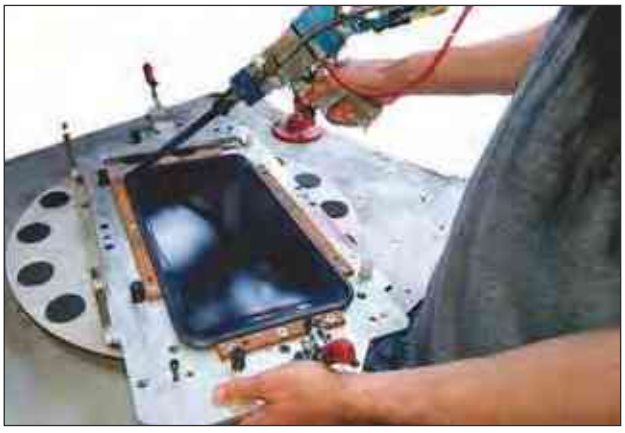
Objective/motivation

My project consisted in automating the application of glue on a counter-door. A glass was glued to a storm door on a manual station. The glue application wasn't repeatable and needed a specific training. This then caused the operator working on the station to make a bad bonding that would not meet the quality criteria. This project was part of a QRQC (Quick Response Quality Control) launched at the end of 2018 when an abnormal amount of waste was noticed. It consisted in setting up a sustainable solution to eliminate the waste which stemmed from this assembly. Moreover, the ergonomics at the workstation wasn't acceptable. Therefore, the aim of this automation was to eliminate the bad gluing that is made today on the manual station and to create a more ergonomic workstation.

Results

The transfer of the operation to a bonding robot already in service for further bonding allows the elimination of a non-ergonomic and also non-reliable workplace. This project was carried out with a minimal investment and some modifications on the equipment have been done in-house. The bonding of the glass is now repeatable and allows the operator to perform operations during the application of the glue on the workpiece. The ergonomy of the station is better and the operator can be trained easily. In addition, after my own self-training, I trained a person to program the gluing robot, thus allowing the facilitation of interventions. With a very low investment, a difficult position was thereby replaced by a repeatable process.

Keywords: programming, automation, bonding



Before

After

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Creation of a maintenance plan for four gridding machines

Maintenance, Personnel management

Benoît GALLOU
Academic supervisor: C. DUROS
Industrial supervisor: G. PELLAT

Company: SKF France

Objective/motivation

The four machines processed during my project are “new” as they have been in activity for only four years. Even though they’re new, they are in the top ten of the most critical machines in the whole factory. The equipment is identical so that a maintenance plan created for one will be applicable to the others, almost without study cost. By implementing a maintenance plan, which includes preventive and autonomous maintenance, we seek to reduce by half the cost due to breakdowns and micro stops.

Results

At the end of the project, the entire maintenance plan is put in place in the system. Some important actions still need to be completed, such as operators and technicians training, establishing an audit control, implementation of the specific KPI linked to the maintenance plan, and an audit to validate the completed project.

Keywords: maintainability, optimization, performance, precision

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Creation of a methodology to reduce production waste

Production engineering

Ilyass HIDA
Academic supervisor: S. LEROUX
Industrial supervisor: N. PURDOM

Company: Caillau

Objective/motivation

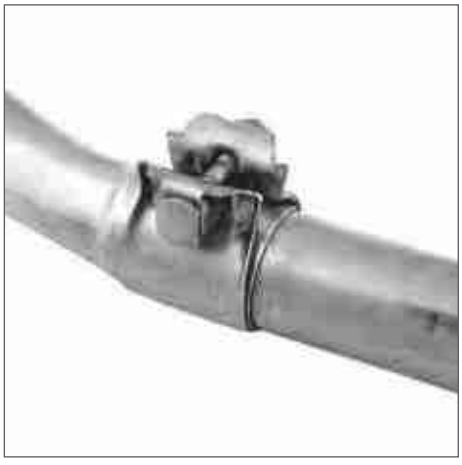
I had the objective of creating a methodology to reduce production waste by 30%. The methodology was applied to the assembly machine BB3. This clamp, inspired by the B-B® 2 clamps, has been developed to meet low-cost connection requirements on automotive exhaust lines. Its innovative design gives it excellent weight/performance and cost/performance ratios. It consists of an integral band, a screw and a nut. Finished clamps are made by machines which generate lots of waste. This methodology is part of the company's quality strategy, which consists of satisfying our customers as well as possible, whether in terms of delivery time or product quality. Our job consists of ensuring the quality of products and delivering the product which our customers expect. This methodology permits us to decrease waste and to satisfy the customer.

Results

Thanks to the application of the methodology to a pilot machine, the production waste of the machine has been reduced by 42%. This result permits a validation of methodology, but certain points of the methodology will be upgraded, such as the application for other processes (automatic assembly). Currently, the methodology has been shared with other machines. Moreover, waste reduction is reviewed every month with the persons in charge. The purpose of these meetings is to advise managers and to verify the effectiveness of the actions implemented. Each unit production has a quality engineer who is responsible for the quality of products and responsible for reducing waste production.

Keywords: clamps, process, waste, production, quality production service

BB3 clamp



BB3 application

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Creation of a pilot group inside an assembly workshop

Production engineering

Guillaume CHOLAY
Academic supervisor: A. HIVET
Industrial supervisor: E. DARDEL

Company: Aptiv

Objective/motivation

Inside the company Aptiv, the objective of my project was to reduce the costs of production. In order to achieve this goal, I was tasked to improve the productivity of the assembly workshop by reducing the number of operators necessary to handle the production workload. In order to do that, our group of work called into question the workload distribution between the operators. The distribution was unbalanced due to the difference of pace between the machines; therefore, we had to find a way to harmonize the workload for each operator. Our main response was to bring together several machines into a single group that will be handled by only two operators. That way we could significantly improve the rate of production of each machine of the group by reducing the time necessary to do any operations.

Results

After a year, we were able to set up one pilot group to try out the new workload repartition that our project group has designed. With this new repartition, we were able to handle a group of five machines with only two operators. Therefore, we reduced the number of people necessary for these machines by 40%. Also, the new workload repartition did not affect the quality of the process which was one of the requirements of the project. Indeed, the indicators of production (OEE) and quality (PPM) weren't raised after the creation of the group. Given the encouraging results for the pilot group, we will now standardize this new repartition for every machine of the workshop by creating numerous other groups.

Keywords: continuous improvement, flow management

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Deployment of Master Production Scheduling (MPS)

Industrial engineering

Yoan BATTUT
Academic supervisor: P. GRILLOT
Industrial supervisor: P. NAHARBERROUET

AIRBUS

Company: Airbus SAS

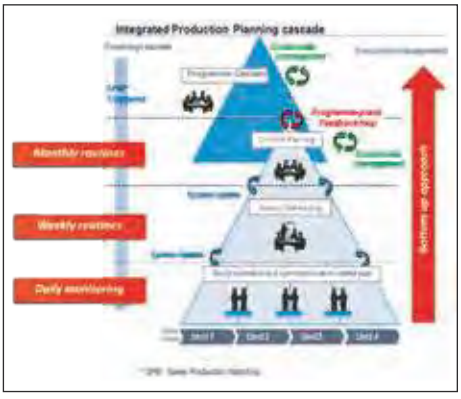
Objective/motivation

The objective of my project is to deploy MPS in order to guarantee customers on-time and quality deliveries. Indeed, with the increase in demand (+8.7% between 2018 and 2019), 70% of our aircraft are delivered late. This leads to additional costs for several reasons: because we hire temporary staff, we have late penalties, planning instability, stock shortages and high storage costs. MPS will eliminate these problems through the management of human and material capacities. I therefore deployed MPS on the final assembly line of the A320 in Toulouse but also on the final assembly line in Hamburg with a project team of four people. Since I was located in Blagnac, the central entity site, I was in charge of developing the projects and they were in charge of applying them. I audited the production and support departments to determine the information missing from the MPS deployment. Then, I determined which departments should participate in operational, tactical and strategic meetings.

Results

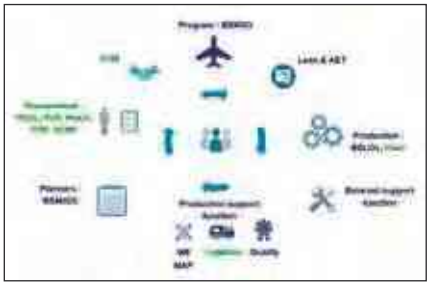
In conclusion, MPS was implemented using a set of monthly, weekly and daily routines that allowed us to break down customer demand into objectives. This organization into several meetings allowed me to have a strong staff commitment to the project. The project allowed us to improve our adherence to the schedule from 30% to 90%. This improvement also enabled us to secure the A320 assembly line's production rate (17 A320 to 19 A320 per month). The standardization of the project, which has been validated by the FAL A320 Industrial Director, will enable me to deploy the project now on all the Airbus plants present in Toulouse, as well as in Germany, for a period of three months.

Keywords: MPS, hazards production, customer planning, multi-functional team



MPS routine

Stakeholders monthly



Stakeholders weekly

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Electrical retrofitting of a 3-axis milling machine

Industrial engineering

Julien LELEU
Academic supervisor: B. LE ROUX
Industrial supervisor: D. BERNIER

Company: Brandt France

Objective/motivation

As an apprentice engineer attached to the Methods and Industrialization department, I have been entrusted this year with the electrical retrofitting of a 3-axis milling machine. This milling machine, located in the tooling department, is old and has henceforth become obsolete due to its old numerical control, which is a true risk for our sheet metal stamping production line. Furthermore, Brandt is encountering issues in finding a suitable milling machine operator having the necessary knowledge to use those kinds of antique numerical controls. Consequently, finding a solution by changing this milling machine for a new one, or changing the numerical control of the current one, is mandatory.

Validation part designed to check future retrofitting

Results

First of all, after having analyzed and defined the specific needs of my company as well as understanding the industrial and personal context Brandt is facing, I decided what the best choice would be between purchasing a new machine or retrofitting our current one. Once this choice was made, I established all the requirements allowing us to ensure our objectives (namely: making the miller's recruitment easier, increasing the tool-makers' versatility, etc.) by writing the corresponding functional specifications. Afterwards, I found specialized suppliers, contacted them, and asked them for quotations which suited our requirements. Finally, to this date, we currently have in our possession all the quotations needed and everything else required to launch the project. Henceforth, we have to wait for the allocated cost envelope which be given next year, once the yearly investment meetings within the executive committee will be over.

The 3-axis milling machine which requires an electrical retrofitting

Keywords: retrofitting, milling machine, quote, project

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Equipment cleanup and security of lead pollution in a nuclear power plant storage warehouse

Production engineering

Kévin OGER
Academic supervisor: E. BEURUAY
Industrial supervisor: M. DECAUX

Company: EDF - CNPE Dampierre en Burly

Objective/motivation

Nuclear power is the main source of energy in France and is a solution to meet the energy needs of an industrial country. While ensuring the power plants safety and the personnel security, a perpetual effort is held to obtain quality production at a lower cost. Therefore, it is necessary to improve the logistic performance of the activities and carry out maintenance operations on the nuclear unit. My industrial project is fitting in this perspective. The main motivations that pushed us to implement this project are the respect of all the legal requirement and the industrial constraints. Indeed, some equipment stored warehouse was been diagnosed plumb positive. My main goal is to undertake the solution to preserve workers security and to make available the whole important material for the company and keep the facilities operable.

Results

After the successful set of workers safety procedure, the main objectives are to be able to use the materiel necessary for the nuclear unit maintenance without endangering the workers and the installations. The first step was to diagnose all the material in order to know which equipment was concerned. The polluted and necessary equipment was prioritized and cleaned up to make it available for the maintenance works while keeping workers safety and maintenance planning without delays. The second step was to prepare the depollution of the rest of the concerned facilities and all the procedures are undertaken to put all available the workplaces back. About this step, all the preparation work is ready to engage all the cleaning procedure. For now, all the project objectives are complete and everything is ready to process the cleaning step.

Keywords: logistics, maintenance, workplace, nuclear, flow

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Improvement of press tooling revision times

Production engineering

Arthur LEFAUCHEUX
Academic supervisor: B. ROUSSEAU
Industrial supervisor: V. HERVE

Company: Caillau

Objective/motivation

Caillau company is reducing its stocks. Production orders are launched more regularly in order to satisfy customer demand. Because of this, there are more series changes, and therefore it was decided to work on the maintenance ranges for press tools. In a first part all family ranges have been written. The second part consisted of analysing the realisation of these times to then set up short-, medium-, and long-term action plans on the hazards in order to improve these ranges.

Results

The objective of this project is to reduce tool maintenance times by 5% but also to be able to follow the workload according to series changes.

Keywords: improvement, press, time

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Improving a layout in the steel pipe sector

Production engineering

Flavie DESBORDES
Academic supervisor: L. DELPLANQUE
Industrial supervisor: J. BOUDIN

Company/Institution: undisclosed (confidential)

Objective/motivation

The project target is to define a new layout for the forming and crimping area in the steel pipe sector to improve the environment and working conditions. Several topics are concerned by this project, such as safety and ergonomics or design, and, therefore, human resources are a mandatory success factor. The project has been split to four steps: 1st, specifications development; 2nd, preparation to move the machines; 3rd, moving the machines; and 4th, improvement and standardization. The timing target is June and the cost target to be profitable is €25,000. I was in charge of this project and my personal goal was to make the groups work together to achieve a common objective: improving working conditions and safety.

Results

Concerning the economic part, the improvements made will save approximately €11,657 for an investment of €7,364, which represents a Return On Investment of 60% over one year. On the project management part, we faced delays which prevented the deadline from being respected, despite the risks analysis and planning I had come up with. These delays were mainly due to collaborators and suppliers' lack of availability. In the future, to avoid such a situation, I would plan regular follow-up meetings with the team and define a substitute if I am out of the company. On the human part, the challenge is reached. Employees felt invested in the project, and they are satisfied with the first results. The area has not changed for a long time, so its improvement is very remarkable and operators now have a healthier and protected environment.

Keywords: working conditions, layout, management, budget, gaps

Personal development

Project steps

Contact: flavie.desbordes@etu.univ-orleans.fr

Improving operator effectiveness

Production engineering

Jason ARRACHART
Academic supervisor: P. GRILLOT
Industrial supervisor: C. GOMEZ

Company: Les Apiculteurs Associés

Objective/motivation

The company will be the first seller of honey in France within a couple of years. Today, Les Apiculteurs Associés is second but has good perspectives. For the moment, the company wants to improve how the operators are working. This way, it will ease their work and stabilize the production process. Furthermore, I am doing the maintenance of the machine to gain the operator's confidence, in order to know how those packaging machines work and also how operators work. I will thus be able to improve the process and set a better way to work.

Results

As I have recently changed companies for my internship, I have no results to show for the moment. Indeed, I've been working at this company for only two months so my work is only at its beginning.

Keywords: maintenance, continuous improvement, packaging, tools, honey

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Integration of a Manufacturing Execution System (MES) for a syrup factory

Production engineering

Paul ROBERT
Academic supervisor: E. COURTIAL
Industrial supervisor: M. EL AZHAR

Company/Institution: undisclosed (confidential)

Objective/motivation

Today's industrial environment highlights a development trend towards Factory 4.0 with a digitalization of production monitoring and transparency of the value chain. The problems of the project of a new syrup factory are directly linked to this evolution of the industrial environment. This is why one of the needs of the project is to implement an MES. This software is at the heart of a company's manufacturing process since it allows real-time collection of all the data related to production, from reception of raw materials to shipment of finished products. It is even referred to as a workshop management software package because, by collecting data related to manufacturing, it allows the implementation of real-time monitoring indicators such as overall effectiveness.

Results

By choosing to work with an MES, this company will digitalize and increase the exchange of information between services, software and their use. Indeed, this software allows access to accurate and fast information. The MES is a software product with many possible functions. However, it is necessary to integrate it into the functioning of the company in several steps by choosing the required functions. In our case, only two functions are required to meet our needs in the future syrup factory. Following this new building, the company would like to extend the use of MES in the management of production lines, up to the storage of finished products.

Keywords: Industry 4.0, productivity, quality

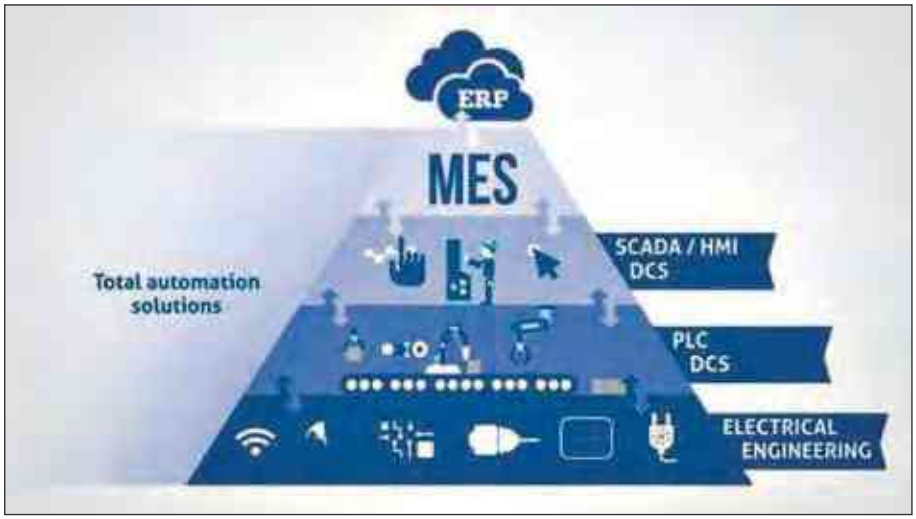

Diagram of a Manufacturing Execution System

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Kanban computer system

Production engineering

Ambroise PASCAL
Academic supervisor: S. GROSSELIN
Industrial supervisor: C. BROSSE

Company: Brandt France

Objective/motivation

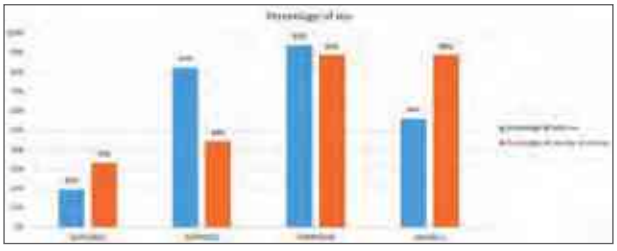
The project aims to reorganize the supply of kanban parts on an assembly line. With the installation of a new workstation on the line, it was decided to review the replenishment of parts and in particular kanban parts. These parts, common to most of the products in the range, are the most used in the range and must be replenished regularly. The objective is to create a system allowing the restocking of the line by reducing outstanding inventory and quality risks as well as oversight of restocking. Once the system has been tested and validated on this line, the objective is to extend this system to all the assembly lines in the factory. It is motivating to develop a system from A to Z internally and to set it up.

Results

The software was developed by one of the company's programmers. One part was developed for a computer (system supervision) and the other for personal digital assistance (for employees). The system has been used for one year. A number of IT issues have been resolved as well as a number of issues related to employee misuse of the system. The system made it possible to reduce the kanban reference number, to maintain the kanban replenishment system by detecting anomalies, and to control the replenishment frequency. The matter information is essential for the implementation of a larger logistics project which is to implement a logistic train. Today, the system is capable of being extended to all assembly lines in the factory.

Keywords: kanban, programming, organization

Label and scanner



Indicator

Software

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Optimizing stocks of production components

Production engineering

Yassine EL KHARBIBI
Academic supervisor: J. FANTINI
Industrial supervisor: N. JOURDREN

Company/Institution: undisclosed (confidential)

Objective/motivation

The logistics department is an essential pillar in a business. It includes planning operations aimed at managing the physical and information flows of the supply chain from the first supplier to the final customer, the scheduling of supplies, and finally making the product available to the end customer at the best possible cost and time. The project entrusted for this year involved more knowledge than I acquired in the previous years. I had the opportunity to work on an important problem in industrial companies: the reduction of inventory levels. The logistics parameters of the machines are available on the enterprise Resource planning-ERP-(Movex). However, the machines have experienced technical improvements which have increased or reduced the demand for production without adapting the Qe and order point in Movex, which can therefore cause stock shortages or overstock. My objective is to recalculate the Qe and the control points based on consumption history.

Stocking components

Results

During this project I found that the following parameters can be the main cause of the increase in the level and cost of stock: (1) the batch size (Qe) of a given item must be "economical", because when Qe is much higher than the demand, we are left with a significant overstock; (2) when we receive the Qe batch, it must be consumed until the order point which will trigger the replenishment. Logically, Qe must be greater than the control point. For some references, the PC is greater than or equal to Qe in the ERP, which can cause breaks; (3) obsolescence or dormant stock. Based on the consumption history and applying the rules of probability, I was able to apply the formulas for calculating the new order points and economic batches and obtain a reduction of 39% in the stock of components of the production. These new parameters will be programmed in the ERP of the company.

Stocking components

Keywords: logistics, stocks, flow, optimization

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Outsourcing of a production area

Production engineering

Alicia DAULEUX
Academic supervisor: J-M. AUFRERE
Industrial supervisor: C. LEFRANC

Company: Chereau

Objective/motivation

For the last ten years, Chereau has experienced very strong growth, doubling its turnover and number of employees. New problems arose due to the lack of capacity of our buildings, the difficulty of hiring the necessary staff, and outdated production management. Thus, the company decided in 2017 to switch to a Lean approach and to map all flows using the VSM (Value Stream Mapping) tool. Activities that do not bring added value to our finished products are highlighted. It is in this context that we have decided to outsource some of Chereau's metalworking activities which do not bring added value. The aim of the project is to receive finished parts manufactured externally from Chereau. The quality of the parts and the cost must not exceed what was done internally at Chereau and it must have no impact on production.

Results

After comparative studies between potential suppliers through audits, suppliers were selected for different categories of parts. Indeed, batches of parts were created in order not to have too much turnover with a supplier. The complexity of obtaining the part was also a factor in defining the most relevant supplier for the procurement process. Subsequently, studies were carried out in logistics in collaboration with suppliers to better define this aspect. An indicator was created to determine when a part is completely validated and can go into production. Within the time frame of the project, the indicator showed us that 87% of the parts were put into production. Moreover, in an ecological aspect towards which Chereau is working, we have set up 62% of returnable packaging. The packaging is returned to suppliers so that they can reuse it for new parts.

Keywords: outsourcing, logistics, flow

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Production management support system

Production engineering

Justin CHEVILLON
Academic supervisor: C. DUROS
Industrial supervisor: F. PERRIN

Company: Flowserve Pompe SAS

Objective/motivation

The objective is to set up a system that responds to the problems identified in the third year. The problems concern the management of hours. The management of the database will allow us to carry out the following studies, allowing the production manager to have reliable indicators and helping with the decision-making concerning the production system. The PM2S will enable us to study the hours worked on the cost centers linked to overheads, to study the impact of the cost and to estimate a forecast for the end of the year. It will also allow us to study the hours that affect the company's results and to estimate its results according to seasonality and short-term indicators.

Results

This project in four files was integrated over five weeks. The planning was done to adapt to mine and at the same time to be as fast as possible in order to be able to exploit the results quickly. A system of juxta-position of periods was therefore set up in order to meet the deadlines. The results of this project are satisfactory, despite an efficiency slightly below the objectives set by the calculation. Yet, the overhead costs are below the limit. The cost of overhead is estimated at the end of the year at around 30%, which is positive for the Arnage site.

Keywords: Lean manufacturing, industrial organization, data analysis

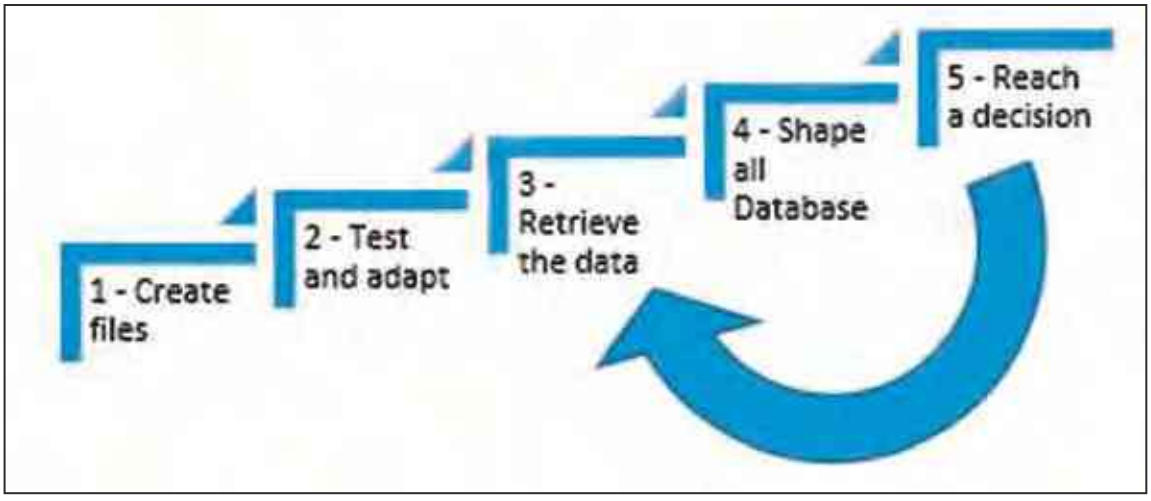

Diagram of the project process

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QRQC implementation in a lost-wax smelter

Production engineering

Manon LANDUREAU
Academic supervisor: P. VRIGNAT
Industrial supervisor: S. RENAUD

Company: CPP France

Objective/motivation

The objective of implementing the QRQC (Quick Response Quality Control) method is to automate the resolution of problems occurring in production. This three-level resolution (operational, functional and strategic) aims to reduce our scrap rate and improve productivity. This Lean method will involve all levels of the company in problem resolution, especially the operators who share their experience and daily routine with the managers. When you want to make a continuous improvement project succeed, it is important to empower people and help them to develop. Therefore, we spent time training all the people involved in the project on the use of quality tools and on how to facilitate meetings, especially for team leaders who have a key role in solving problems in their workshops.

Results

Since the start of the QRQC project, we have mainly increased our productivity, especially in the straightening department where operators have divided by three their time spent working on complex parts. We have also reduced travel waste by investing in handling equipment, and at the same time reduced the risk of MSDs (Musculoskeletal Disorders). Today, we have implemented the QRQC method in three out of seven workshops. We will therefore devote the next few months to the implementation of this method in the other four workshops, and then we will deploy it in administrative services such as methods, purchasing, human resources and commerce.

Keywords: QRQC, problem resolution, Lean method, human development, continuous improvement

Diagram of the QRQC process

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Renewal of checkweighers on two production lines

Production engineering

Lucas SIMONOT
Academic supervisor: E. COURTIAL
Industrial supervisor: V. LUGIEN

Company: Les Crudettes

Objective/motivation

The first challenge is to satisfy the consumer. Consumer satisfaction is achieved by controlling the weight of the products they buy and ensuring that mixed leaves are free of metal contamination. The second challenge is to satisfy the operator. Operator satisfaction is linked to the ergonomics, practicality and reliability of the tool. The third issue is productivity. It is harmed because of the current supervision. It no longer corresponds to our expectations. The differences in rates are not taken into account because of a loss of reactivity when there are anomalies. In addition, the failure rate on lines 83 and 84 is high. These unplanned shutdowns (downtime) reduce the synthetic rate of return. So, my project is part of the company's development, in search of impeccable production quality and higher profitability. The project to renew these checkweighers is a key project for the company.

Results

To this date, the project has been completed. The objective of customer satisfaction is achieved by obtaining a result of 100% of the metallic contaminants rejected by the machines. The checkweighers installed also ensure weight conformity by complying with the legal metrology regulation R051. The monitoring of the weekly outage indicator over the year has confirmed the reliability of the new tools by obtaining a weekly failure time of less than 1% of the weekly opening time of the production lines. The increase in operator satisfaction linked to the use of checkweighers from 49% to 82% confirms the success of the objective. The company will now be able to start standardizing checkweighers in its workshops. The strategy is to create an environment conducive to the development of performance.

Les Crudettes mixed salad

Keywords: formative, enriching, essential


Consumers satisfied with our healthy products


Mix controlled by the checkweigher

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Reorganization of the after-sales process

Production engineering

Damien LEFEVRE
Academic supervisor: B. LE ROUX
Industrial supervisor: B. ARNOUX

Company: FFDM Tivoly

Objective/motivation

My project at the FFDM Tivoly company consisted of standardizing the after-sales process. In the after-sales service (AS), we propose repair of the customer's product, according to different commercial offers: warranty, restoration and/or repair. It's a challenging environment, as the AS process involves several departments of the company (commercial, logistics, production, quality). The links between those departments are not well-defined, which leads to AS delays that leads to customers' dissatisfaction. In fact, the AS is an added value to the customer that needs to be considered carefully, as the customer's production can be impacted by the absence of its machine. Thus, we have to define a communication and planning strategy. To make AS efficient, we also have to define the role and responsibility of each stakeholder, and we have to standardize the organization monitoring.

Situation

Results

By following the AS process step by step, I spotted, analyzed and solved the anomalies and understood each service's needs. I directed meetings with the departments' managers to define and validate the standard organization. We defined a planning strategy so that we can produce spare parts on time, and a communication plan so that the customer is aware of the advancement of the treatment of its products. I edited a procedure and flowchart of the different kinds of handling, so that the organization can be followed by the different service departments. To monitor this organization, an AS stakeholder has been designated as a pilot to monitor the advancement. I created instructions and trained the AS pilot in order to be sure that the process is well understood and followed. This organization will allow us to deal with a bigger AS demand.

Keywords: after-sales, quality, production

The product

Product in AS service

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Research on the composition of a copper alloy powder for embedding steel particles

Production engineering

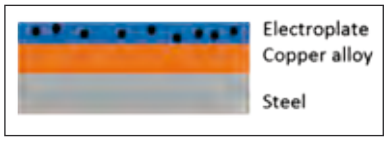
Diane SOLLIER
Academic supervisor: B. ROUSSEAU
Industrial supervisor: A. GESTE

Company/Institution: undisclosed (confidential)

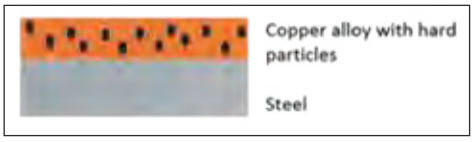
Objective/motivation
Lead-containing bearing materials show good embeddability properties, but a European regulation forbids lead in automotive components. Thus, copper materials without lead have been developed, and are less resistant to hard particles present in the lubricant. Some coated materials like electroplated bronze bearings have a good embeddability. The electroplated layer has a soft matrix with hard particles. They are more expensive and need new investment in many plants of the group if we want to produce them. Thus, we need to improve the uncoated copper materials, with the addition of an additive. The aim of my project was to determine the composition of additives in a copper alloy to obtain the same structure of electroplated materials.

Results
The project is not yet finished, but four powders have been selected to pursue the investigation. With this alloy, we measured the hardness and tensile strength, and checked the micro structure. The best powder will be selected to have more tests like the embeddability test. This test will confirm if the composition of the powder is good or if the trials need to be pursued with other powder compositions.

Keywords: sintering, copper alloy, bearing, research and development



Electroplated copper alloy structure



Goal structure of a copper alloy


Embeddability of a steel chip in a bearing

Thermic engine

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Set up and integration of a new logistical tool in the component APU

Industrial engineering

Joris LONGUET
Academic supervisor: A. FONTE
Industrial supervisor: L. ROY

Company: Wilo Intec

Objective/motivation

The main objective of this project was to find a new way of allowing logisticians to handle one of our components, a pump housing, by means of a forklift. The goal was to free an area in the workshop whose surface is about 200m^2 and which is totally dedicated to the storage of the pump housing in order to be able to install a new production machine in the near future. This will also eliminate any risk of injury during the loading and unloading of trucks, will facilitate the work of the logisticians, and permit an operator whose work had no added value to be reassigned to an added-value job such as production. Last but not least, the amount of trucks needed to send the pump housing to one of our subcontractor will be reduced.

Results

At the end of this project, the various objectives set were reached through the set-up of the new logistics tool allowing the logisticians to easily handle the pump housing. This is then stored in the reception warehouse and no longer in the workshop, and thus the 200m^2 area is cleared. Moreover, the loading and unloading of trucks is done more quickly and safely because there is no longer any manual handling since this can be done with a forklift in about 20 minutes, as opposed to more than 30 minutes before. The non-added-value operation has been totally deleted and the operator has been reassigned to production operations. Thank to this, a return on investment in less than five years is expected. Finally, the time of transportation from the storage area to the workshop has also been divided by two.

Keywords: logistic, muda

The new logistic tool

Area packed with pump housing

Emptied area after the project

Pump housing

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Skills development plan

Production engineering

Akram MANOLY FOTY
Academic supervisor: A. FONTE
Industrial supervisors: C. GARREAU, Y. VIGNAU

Company: Lisi Automotive

Objective/motivation

During the last two years of my studies in engineering school and my apprenticeship in the Lisi Automotive company in Saint-Florent-sur-Cher, I had one project. This project is a part of a larger approach of skill improvement of all Lisi Group employees. For my project I had to build up the skill of all team leaders of Saint-Florent-sur-Cher. The objective of this project is to ensure a minimum level of skills (meeting facilitation, communication, Lean tools) necessary for our team leaders.

Results

My project is divided into three parts spread over two years. The first part consists of taking a snapshot of the current state by carrying out evaluations for each of the team leaders of the two sites of Saint-Florent-sur-Cher. A second part is to check off and train the team leaders in the different skills and knowledge required. A third part, which is linked to the first, is to carry out an evaluation in order to measure the progress of each one. During this project, we will follow its evolution by determining steering indicators which enable monitoring to be carried out and which can, in particular, be used as decision support. In our case we will follow three indicators that will allow us to determine the added value that has been achieved by our project.

Keywords: skills improvement, formation, coaching

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Standardization of sensitive components packaging

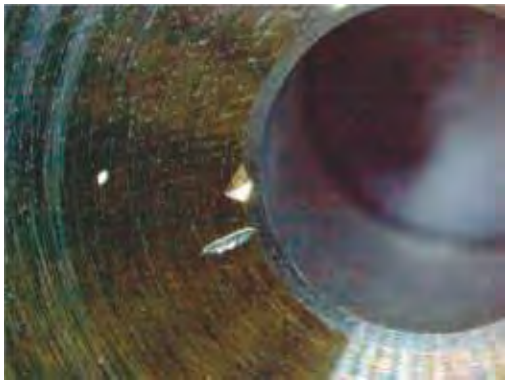
Production engineering

Jérôme TYPAMM
Academic supervisor: G. HIVET
Industrial supervisor: M. KOUADRI

Company/Institution: undisclosed (confidential)

Objective/motivation

A sensitive component is a component composed of a machined area, a toleranced area, or a specific paint, such that if this characteristic is damaged, the component can't be used and must be considered waste. In a process of continuous improvement and waste limiting, the objective is to reduce loss due to non-quality cost. The main problem is that, due to bad packaging or a lack of packaging, the components come into contact with each other so that they are damaged and can't be used. The sensitive components are manually transported with a trolley from the machining arena, after which they are checked in the main storage. Once the check is made, they go to the production lines to be assembled.

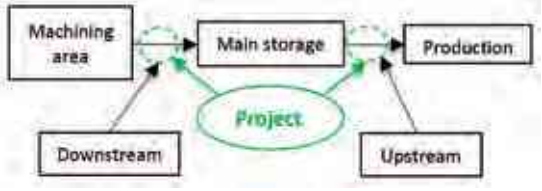


Impact on a component

Results

First of all, after some thought, I had to confirm that the non-quality cost was caused by the transportation of components and their manipulation without packaging. Then I had to make an action plan as to how I would solve this problem. Afterwards, different kinds of solutions had to be tested and chosen. Five types of packaging were chosen in order to create a standard and reduce buying cost, and the solutions were validated by the group project. The packaging solutions were ordered and deployed in the different storage areas created specially for the packaging. In order to train the operators, operational modes were created. Finally, when the project was finished, the scrap rate due to contact among components was greatly reduced, new storage areas were created, and packaging was simplified.

Keywords: sensitive components, standardization, scrap rate, training, suppliers



Simplified diagram of sensitive components transportation

Packed components

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Total Productive Maintenance

Production engineering

Edouard GENTAIRE
Academic supervisor: S. TOUTAIN
Industrial supervisor: G. RICHARD

Company: Carbonex

Objective/motivation

The main objective of implementing Total Productive Maintenance (TPM) is to improve the bagging line and support part of the increase of charcoal and briquette production. It is necessary to organize all line stops and then solve those that are not planned in order to increase the line rate. In a second phase, the other objective is staff development. In fact, TPM has many benefits for the employees involved in this project such as increasing the level of confidence, making the work areas cleaner and more attractive, developing teamwork, involving the staff more strongly, and increasing the staff's skills. Finally, TPM has benefits for the company such as increasing productivity without reducing product quality, reducing waste and reducing accidents.

Results

Eight weeks after the introduction of TPM, there was a significant change. In fact, the TRS increased by five percent only five weeks after its start, which is a lot. Many improvements have taken place. TPM has stabilized daily production and improved the quality of our bagging and schedule maintenance actions. In fact, if necessary, Thursday mornings are reserved for maintenance actions and line improvements. In human terms, this project has improved the working conditions of the operators. In fact, they are less stressed and make fewer moves since the line is more stable. This project has also made the operators more autonomous. Other benefits such as mutual aid and teamwork are not to be neglected. The line is not yet at maximum capacity but will be able to answer customer demands until the second line is in place.

Keywords: production, maintenance, improvement

Total Productive Maintenance

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Smart Building

Building Management System of a nursing home

Smart building

Killian LAMBERT
Academic supervisor: S. RAGER
Industrial supervisor: S. RENON

Company: Arcom Automation

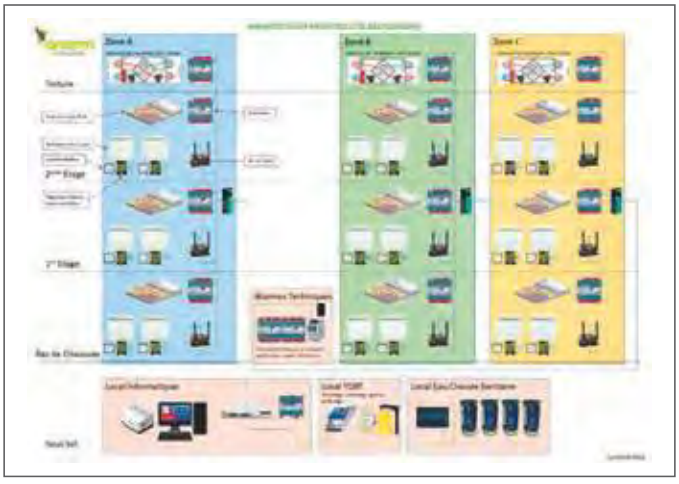
Objective/motivation

As an engineer, I have been in charge of managing a nursing home at Belfontaine, a site where automations and supervision need to be changed. The Building Management System (BMS) has existed since 1999. There are three zones and three floors. Therefore, there are nine automated-controlled heating floors, three air handling units (AHU) which have an automation each. The 300 radiators are equipped with a controller made by Arcom. The AHUs don't work so the regulation and the electrical cabinet have to be modified, and every safety device checked. A study on an electrical diagram has to be made. The automations from the heating floors must be programmed and integrated into an old electrical cabinet. Each new regulator made by Arcom communicates by radio and each is a repeater.

Results

Currently, the AHUs are working and are controlled by the new BMS. The heating floors work well for day-degrees regulation. One third of the regulators have been changed and are controlled by the new BMS. However, two thirds stay on the old one, and therefore there are two BMSs in parallel. Each automation is on the BMS, about 13 LOYTEC automations. They communicate in OPC. Nine gateways made by Arcom, which communicate in modbus / IP, are on the new BMS. Supervision is conducted on PCVue. Therefore, the client can control and see three AHUs, nine heating floors and approximately 100 regulators.

Keywords: management, building management system, automations, electrical diagram



Project diagram

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City of the Tanma Lake

Smart building

Nabil SADIKI
Academic supervisor: J-M. ROUSSEL
Industrial supervisor: C. THOUVENIN

Company: Enekio

Objective/motivation

Enekio France has created a subsidiary in Senegal whose main objectives are electrifying rural areas and participating in the country's development. The project consists of building 3,000 225-square-meter energy self-sufficient homes in the Thiès region. This is carried out in collaboration with the Senegalese state through the housing program "One family, one roof". This project will create the first green city in Senegal. Several social infrastructures will also be created such as schools, health posts, a sports stadium, and shopping centers but also green spaces. This city will integrate waste recycling systems because it is necessary to keep this place clean. All this aims to improve the living conditions in this region of Senegal and to highlight the positive effects of renewable energies.

Results

In this ambitious project, my role was to size the solar installations for each type of housing. I had to size the area of the panels and the type of solar equipment to install. At the beginning of the project, we had planned to build only housing with three bedrooms, a kitchen and a bathroom, but the enthusiasm around the project was so great that we were asked to plan the construction of larger housing. Therefore, we planned to build houses with four and five bedrooms and I had to do calculations for this new housing. To meet the need on time and comply with our environmental policy, we will build industrial units near the city to produce all that is necessary for the building construction. We are currently preparing the construction of the show houses which are expected for June.

The green city of tomorrow

Three-room house with kitchen and sanitary facilities

Larger house

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Development of a Building Management System

Smart building

Rémi BEVING
Academic supervisor: P-O. LOMBARTEIX
Industrial supervisor: H. AFTATI

Company: Engie Cofely

Objective/motivation

As an apprentice engineer in Smart Building for Engie Cofely, I am working in the technical unit. My project was to set up a Building Management System (BMS) for six buildings in which regulations are already in place and these buildings are located at the University of Tours. The regulation allows us to manage all the equipment to regulate the ambient temperature of facilities such as classrooms and amphitheaters. The goal of this project is to help maintenance technicians because they have to move through these buildings for each check and change so it takes a long time. The aim is to save time but also to have data information and track different meters for energy monitoring.

Results

The installed BMS provides real-time monitoring of the installation and the consumption by using an automated supervision system in order to save energy. This makes possible easy energy tracking of the entire building, which allows an economic gain in all the buildings. The technicians can also manage all the plant equipment from the BMS and thus manage the boiler room with the different boilers, the Air Handing Unit and the distribution circuits. All the settings, such as time schedules or temperature set points, can be configured from this BMS. With this visualization tool, technicians have access to all the information they need without moving. In addition, the BMS will continuously improve for requests and changes made by technicians or customers.

Keywords: building, optimization, automation, regulation

Synoptic of the Building Management System

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Development of a lighting solution

Smart building

Marvin AHIALEY
Academic supervisor: G. LAMARQUE
Industrial supervisor: L. SENECHAL PARFAIT

Company: LED Light Group

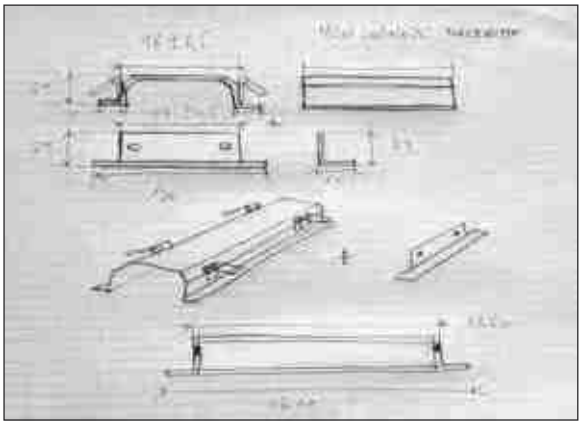
Objective/motivation

To achieve my internship at LED Light Group, a company specialized in lighting systems, I work as an assistant in the design office. Our products are mainly conceived for tertiary, industrial and museography buildings. My main mission is to carry out lighting studies to assist clients in their construction or renovation work. A computerized mock-up on Dialux software guarantees them quality of lighting and visual comfort, in compliance with current lighting standards while observing capital and operating budgets. This work aims to limit the emission of carbon dioxide by reducing the energy consumption of lighting installations. This is the reason why we only provide light-emitting diode lamps which have a high luminous efficiency and a weak power consumption.

Results

The first phase of the project involves the analysis and response of a call for tenders. The specifications contain the entire technical elements related to the construction or renovation of a building. After proposing a light for each type of room requested, I can start modeling these rooms. Desiring to be as close to reality as possible, I work on the building plans with the exact position of the lamp and the composition of the walls that reflect light. The results of the calculation allow me to have the illumination level of the part and thus to adjust the technical characteristics of the lamp main power and luminous flux. Then I can send my technical data to our plant for a feasibility study that will result in the manufacture of a sample.

Keywords: lighting, building, architect, software, light-emitting diode



Sketches for lamp proposition

Museum display ©MARTIN ARGYROGLO

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Development of an update and maintenance system

Smart building

Léo ARMAND
Academic supervisor: R. HARBA
Industrial supervisor: S. DARGENT

Company: Gilles Leroux Industrie

Objective/motivation

As part of my final year apprenticeship for GLI, a company specialized in biometric solutions, I worked on an update and maintenance system for their biometric devices. The main customer using these devices is the CANAM, which is the national health insurance fund of Mali. Our devices can be used in buildings, such as a town hall or a hospital, to identify people. Many of our customers are far away from France and we need to be able to ensure the update and maintenance of our devices with an easy-to-deploy, fast and simple solution. This is the reason why we decided to build a web server which will be able to push updates and will let both our customers and us gather information on every installed device. This way we should be able to find and fix issues quickly.

Results

The project began by expressing the needs into specifications documents. Then we evaluated the technical aspect, found a solution and began production. We implemented Application Programming Interfaces (API) on the server and also on the devices so that they could communicate with a secure protocol. It is now possible to do several actions remotely, such as rebooting a device. The system is able to change the position and even the configuration of a device. Therefore, for example, if you want to move a device from a town hall to a hospital, you can change the software used remotely so that it fits its new use. For now, the system supports only Windows and Linux devices, but we plan to add Android devices and we want to be able to support more devices in the future, including devices not owned by the company.

Devices used by the system

Keywords:
software,
web, update,
maintenance,
biometrics

A biometric device in a Malian hospital

User interface of the system

Contact: larmand@gl-industrie.fr

Development of normative software for electricians

Electrical engineering

Pierre-Jean BELHAJ
Academic supervisor: P. RAVIER
Industrial supervisor: W. GRUET

Company: DESA Logiciels

Objective/motivation

Software is a product that is constantly evolving. French standards are also continuously improving. The software evolution is based on customer requests, new functions, retakes of what exists and improvements of the interface, together with the evolution requested by the technical director. I joined the development team and had all the necessary software and equipment to carry out the numerous tasks I was given. One of them was the improvement of our tertiary symbol library. There were two main objectives in this task: creating them, and making them look recent and better for our customers. The second objective must be done because of the many updates in our software and those that we use that will allow us to improve our tools, such as single-line diagrams.

Results

There are two important parts of symbols: those that can be placed on a plan and those that can be placed on single-line diagrams. There were many ways to reach our goal: importing the DXF symbols that already exist in other software, and creating others with symbol creation software. In spite of a 100-symbol list and many problems that could not be anticipated, all the symbols were finally created. In addition, after a lot of tests, we were able to integrate them into our software and send them to our customers. They were very pleased with this improvement.

Keywords: building, software, electrical engineering, standards

Two symbols which were created

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Digitizing the utilities department of Procter & Gamble

Smart building

Kenza EL YAZIGHI
Academic supervisor: M. JABLOUN
Industrial supervisor: V. CHAPOTAT

Company: Engie Ineo

Objective/motivation

As part of my final year of apprenticeship for Engie Ineo in the automation department, I spent three months in the utilities department of Procter & Gamble. My mission was to observe the work of the utilities technicians and suggest improvement ideas. In this department, they collect data manually so they spend two hours walking through the plant two times a week. I suggested digitizing the data collection from the water meters, pressure sensors and temperature probes. Then I had to find suitable technical solutions to carry out this project. Its difficulty is the dispersal of data throughout the plant, including the areas not served by the Ethernet network. Finally, I suggested collecting the data by the system installed as close to the equipment as possible. For the areas not served by the network, I suggested radio technology.

Results

After presenting my suggestions to the customer, I began working on the project. At the end of the project, we could see we got really good results. The technicians of the utilities department were satisfied and my three months working with them was the best way to identify their needs. Thanks to this project, I acquired skills such as project organization and notions of communication with the customer. Thanks to the fact that I had to look for technical solutions, I learned how to look for information and to ask relevant questions of suppliers.

Keywords: data, digitize, project organization, communication

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Energy tracking application

Smart building

Etnik HALILI
Academic supervisor: T. GIBERT
Industrial supervisor: P. RIFFAUD

Company: Delphi Technologies Blois

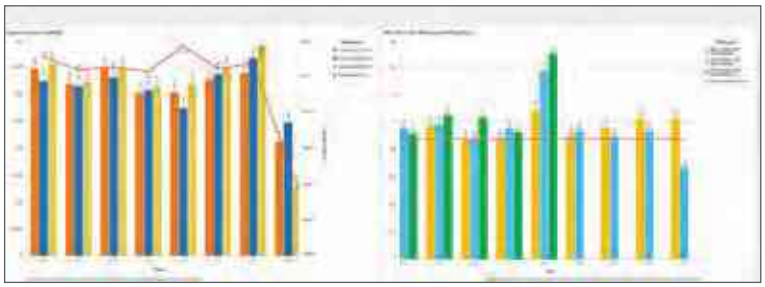
Objective/motivation

Delphi Technologies is an international high-tech company that integrates enhanced security, ecology and connectivity solutions in the automotive and transportation industries. The Blois site is responsible for the development and production of diesel and gasoline injection systems. During my apprenticeship at Delphi Technologies Blois, I had to manage several projects related to energy management. One of the main projects I had to carry out at was to improve the monitoring of the energy consumption of the entire plant in order to easily identify possible energy savings but also to meet the ISO 50001 standard. This project allowed me to practice some of the skills I was taught at Polytech but also to enrich myself with additional useful working knowledge.

Results

First, it was necessary to define the right indicators (KPIs) for each sector. The second important step was to identify all the electricity meters and other counting devices on the site with their precise location. These preliminary steps allowed me to collect enough data to build an overall mapping of the energy counting system of the site. The final task was to make the energy tracking visualization tool interactive, attractive and easy to use. The application I made using Qlik Sense gives a real-time global overview of energy consumption for the entire site. Also, it allows you to target a specific period or a sector with all the different filters available, and thus update the other displays dynamically. The application is being used daily by all the sectors since August 2019.

Keywords: automotive industry, energy tracking, database analysis, project management



Energy indicators for the production sectors

Global energy consumption window

Contact: etnik.halili@etu.univ-orleans.fr

Heating regulation and supervision of a building

Smart building

Cédric OLLITRAULT
Academic supervisor: R. LEDEE
Industrial supervisor: J-P. COELLIER

Company: SA Gallier

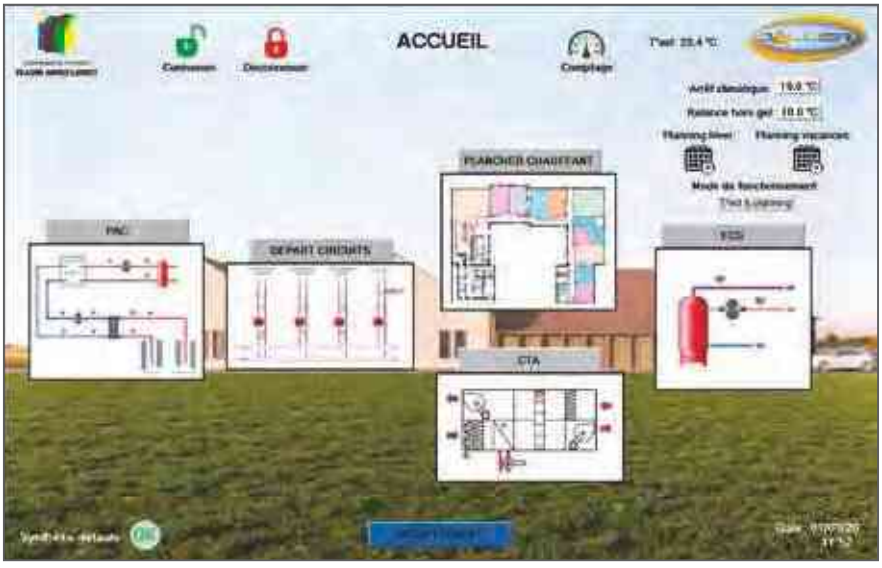
Objective/motivation

As an apprentice engineer in Smart Building for SA Gallier, a company specialized in the installation of HVAC (Heating Ventilation Air Conditioning) systems, I worked on heating regulation and the supervision of a school. The school is equipped with a heat pump to produce heat and distribute it in rooms via valves. My goal in this project is to develop a program where I can efficiently control all the heating equipment in order to maintain a comfortable temperature in every classroom while reducing the energy consumed by the building. Moreover, supervising the buildings is necessary to measure and store all kinds of data (temperature, energy production, power consumption) and to improve its energy management by acting directly on the heating equipment.

Results

At the beginning of the project, I started to create a functional specification to better understand the needs of the client. Then I gathered all kinds of information concerning the programming of the heating system like electrical and hydraulic schematics in order to determine precisely how the whole system works. This part and the programming were developed in my office while I later worked in the field to test if everything worked correctly in order to make some adjustments. As for the supervision, I needed to connect all the physical input of the heating equipment to graphic points in order to command them from the control station. Finally, the work ended with the reception of the site by the client who validated it and also signed a maintenance contract with us.

Keywords: HVAC regulation, supervision, energy efficiency, optimization, building comfort



Building supervision

Contact: cedric.ollitrault@etu.univ-orleans.fr

Implementation of a laser scanner for operator safety

Production engineering

Victor OLIVIERO
Academic supervisor: R. CANALS
Industrial supervisor: P. TALLET-PINET

Company: Clemessy

Objective/motivation

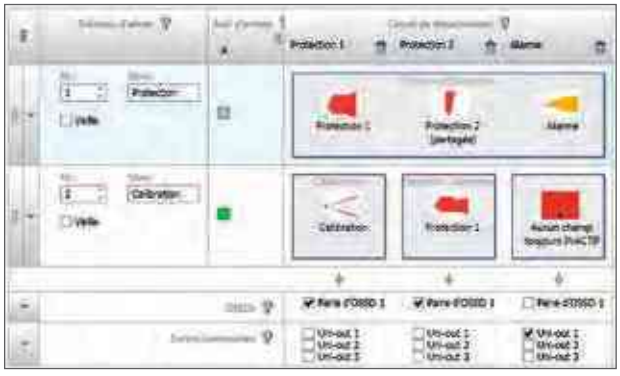
As an apprentice for Clemessy, and working in the automatism office, I developed solutions for clients on many technologies and automatism software but also in industrial computing. One project I worked on was the implementation of a security device for operator safety on a production line. Indeed, the old security system had problems with the new production process: a handling robot was installed and the intangible barriers of the old security system detected the rotation of the robot. The client asked us to create a new security system. The objective of this project was to ensure operator security without hindering them. Upstream, we discussed the technology to choose and my mission was then to develop the program to ensure security and make a calibration test of the laser scanner for the maintenance operator.

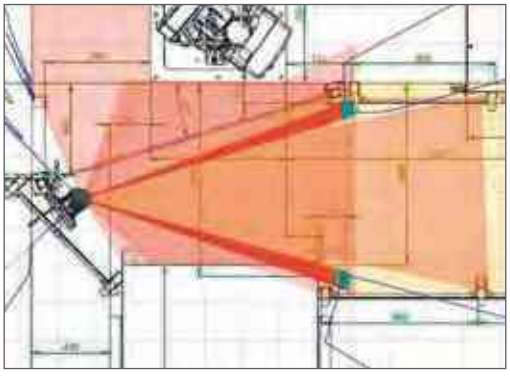
Laser scanner

Results

To meet the client's productive and security needs, we have opted for a laser scanner on the floor to detect ground movements. The product chosen was a SICK S300 safety laser scrutineer. The programming of the detection for safety was organized in three separate zones to avoid false detection and allow optimal productivity: a normal operating area, an alert zone and an emergency stop zone. The alert zone and the emergency stop zone interrupt the handling robot at different degrees. We also wrote a calibration test consisting of sight placement and laser scanning to ensure the correct placement and angle of the sensor. Today we have positive feedback on our facility in terms of safety and production.

Keywords: production engineering, operator safety, laser detection, automatism, electricity


Software


Zoning

Contact: voliviero@eiffage.com

Implementation of an energy monitoring system

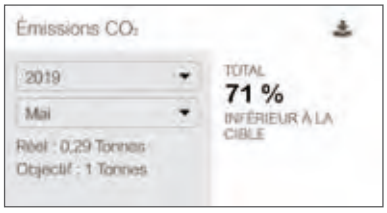
Energy efficiency

Soufiane LEMJAJ
Academic supervisor: G. LAMARQUE
Industrial supervisor: C. DAVID

Company: Applications Electriques Services (AES)

Objective/motivation

For several years, saving energy has been a major challenge. Following that aim, my project consists of implementing an energy monitoring system for GESEC offices. GESEC is a national network of independent and local companies in all regions of France. They offer consulting, installation and multi-technical maintenance services necessary for owners, tenants, builders and occupants of buildings and dwellings. The important point to consider is that the client has an installation in photovoltaic panels in injection on the nation's electric power system, then the client adds a self-use installation. My work was to give the client the possibility of seeing their production and consumption on a screen in order to make them pay attention to thier own environmental impact. In addition, this system allows them to see the savings made and raise the energy efficency of the building.



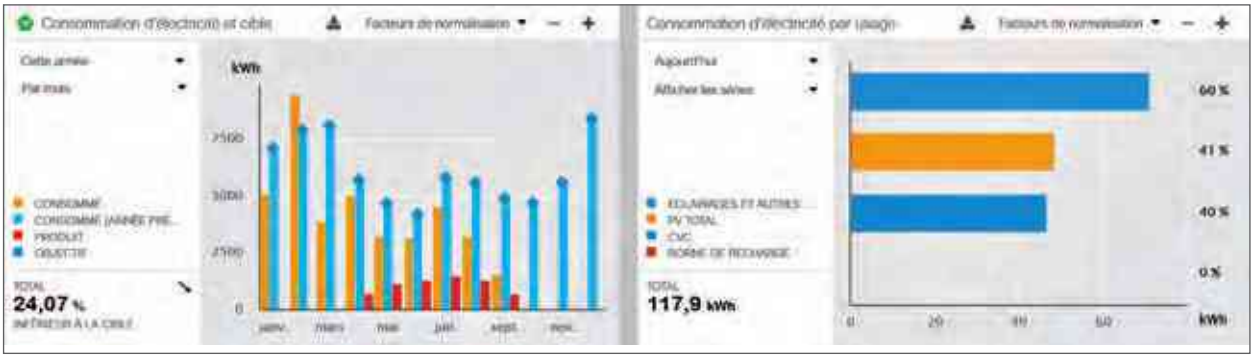
CO_2 emission

Results

The system has been installed successfully in the building so that, at the entrance of his office, the client is able to see all the data from sensors on a screen. Currently, co-workers can see their production and consumption daily with the representation of savings in euros. Regarding the software, the representation of these data has been made on the screen in order to facilitate their reading.

Energy efficiency

Keywords: energy, energy gain, monitoring, solar panels, money saving



Electricity use and objectives

Contact: soufiane.polytech@gmail.com

Lighting design project for the Zénith Paris-La Villette

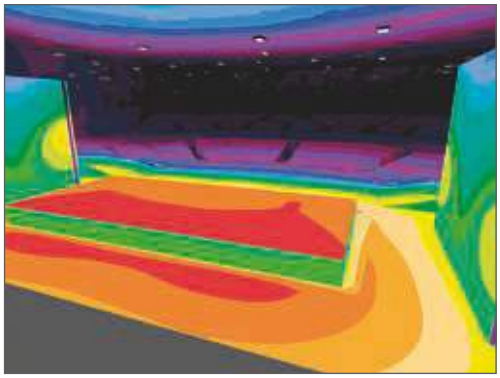
Smart building

Romain PROTON
Academic supervisor: C. CACHONCINLLE
Industrial supervisor: D. CHAFAUX

Company: Signify France

Objective/motivation

As part of my apprenticeship at Signify France, I carried out a large number of lighting design studies. The Zénith Paris-La Villette project is an invitation to tender that consists of offering a new functional lighting solution for this concert hall, in accordance with European standards defining the correct illumination and uniformity levels for each situation (arrival of the audience, cleaning and maintenance, etc.). The main objective for the Zénith manager is to maintain energy savings and give the audience better visual comfort. The study has to take into account the particular architecture of the hall and the light set-up constraints, while guaranteeing that the people sitting on chairs will not be blinded. The lights must have good durability and also withstand high temperatures.



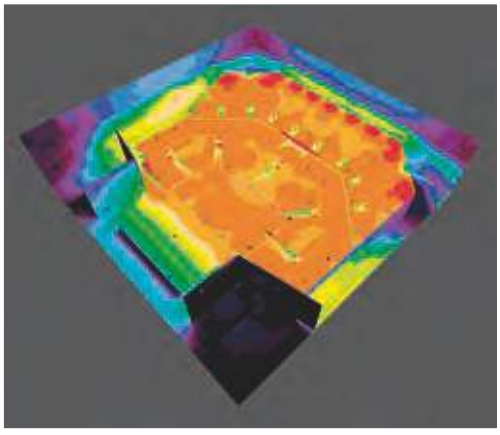
Light distribution with colors (stage)

Results

The project began with a meeting at the Zénith to define the objectives with the manager and note some important points of consideration. Then came a period in which we tried out many possible locations for the lights by means of a specific lighting software, DIALux Evo. The solution we finally suggested is composed of around a hundred lights distributed on the whole metal framework. Each light is chosen in such a way that its luminous flux and its power offer the best results in the hall. We created different lighting scenarii: arrival of the audience, assembly on the stage, maintenance, catering, etc., designed for the users of the Zénith. These scenarii can be activated on a central control box using a Dali protocol. This is a really tailored project, designed especially for the Zénith Paris-La Villette.

Keywords: lighting, LED, building, comfort, Zénith Paris-La Villette

Hall lighting



Light distribution with colors (hall)

Contact: romain.proton.168@gmail.com

Participation in group strategy and development of a BIM technology tool

Electrical engineering

Oussama LABBACI
Academic supervisor: S. RAGER
Industrial supervisor: L. DESPREZ

Company: Spie Industrie & Tertiaire

Objective/motivation

During my apprenticeship at Spie, I had the opportunity to work at the UK subsidiary in London. My role was to assist the Director of Strategic Solutions and my assignments were diverse and varied. In a political context focused on ecology and energy saving, we set up a collaboration with a start-up company developing charging stations for electric vehicles to promote eco-mobility in London and across England. I was also able to develop a 3D-digital model of the Imperial College sports centre. This approach is part of Building Information Modeling (BIM), a new way of working which allows us to have, within a few clicks, the digital twin of a building with all the information and resources necessary for the user or designer of this model.

Results

After numerous meetings, Spie showed that it could be a powerful ally in the eyes of the start-up. This is why the collaboration between the two players was born. This mission enabled me to learn about business and how to invest in the strategic market of electric cars. Finally, the digital version of the sports building has become an interactive place containing information allowing the user who travels there to be able to situate themselves in their environment and find the information they need in one click. The 3D scan is used not only for maintenance, it is also a real communication tool. Imperial College attracts the best students from all over the world. In just a few clicks, they can enter and visit the school while they're at home.

Keywords: eco-mobility, partnership, strategy, BIM, maintenance

Chargers deployed by SPIE as a result of the collaboration

Interface of the digital mock-up with location-related information

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Reorganization of a sector

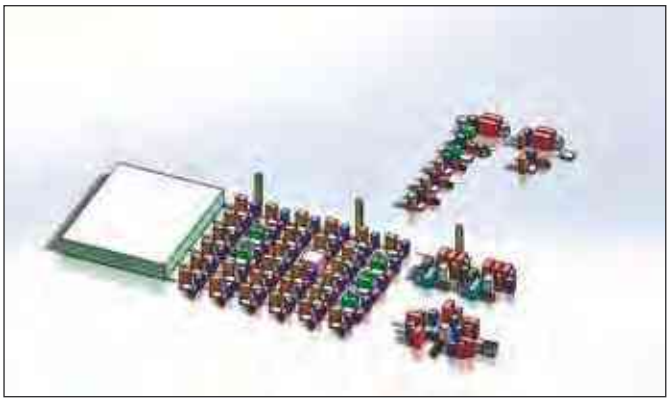
Civil engineering

Mehran HAIDARI
Academic supervisor: J-M. FAVIE
Industrial supervisor: S. FERT

Company: Ressort Huon Dubois

Objective/motivation

I am an apprentice engineer in the Smart Building specialty. I work in Paris in a spring production company called Ressort Huon Dubois as an automation engineer to follow up projects in a design office. My company's machine stock is made up of several sectors and I had to reorganize the machines of one of the latter. The aims of the project were to standardize the organization of the machines, optimize the movement of technicians and operators, increase production time and decrease downtime, increase the number of machines and spring production, automate the transfer of cartons as much as possible to reduce the strain of heavy loads and the risk of injury to operators. Therefore, for this I suggested solutions that meet the specifications, that would cost as little as possible, and which would have a very fast construction time while remaining efficient.



Computer rendering of a proposed solution

Results

Currently, the project is only in the study phase. I'm in the process of calculating the total cost in more precise ways, to see the downtime of the machines, request quotes, etc., to make a file and present it to the managers of the company. They will then choose which solutions best suit them and best suit the company in order to start the work. I am also optimizing the current solutions with the aim of making them as efficient as possible, as cheap as possible to minimize the costs incurred by the company, and with the shortest possible downtime while meeting the specifications. I also meet with architects and experts to obtain advice on civil engineering for construction and to receive approval of my solutions so that I comply with French construction standards.

Research on proposed solutions

Keywords: optimization, reorganization, production, collaboration, improvement

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Restructuring and extension of a high school

Smart building

Lionel DA SILVA PILON
Academic supervisor: A. CHETOUANI
Industrial supervisor: F. TARDIF

Institution: Centre-Val de Loire Regional Council

Objective/motivation

As an apprentice at the Centre-Val de Loire Regional Council, and the person in charge of operations, I lead missions concerning high schools in the department of Loiret (45): construction, renovation, fire security systems, etc. For all of my missions, I represent the contracting authority. Therefore, I represent the final client. One of my projects this year is the restructuring and extension of a high school in Orléans. This project has many objectives: improving the reception conditions of students and teachers, technically optimizing the built environment, strengthening the visibility and identity of the school, and improving the environmental framework. As the person responsible, the challenge of my mission is to properly steer the operation, thus enabling us to coordinate each phase by involving the various players.

New area for teachers

Results

Today, the building is still under construction. It is an occupied site operation which receives the public. Therefore, it was necessary to divide the work into three phases to ensure continuity of service. Currently, we are in the second phase of work. The first phase was delivered on time. This is the result of good organization and collaborative work with the various trades involved in this operation. Once a week, I meet with each of them to assess the progress of the project. This allows me to maintain efficiency in the management of the project. The feedback from users is already promising.

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

New area for students

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Study, design and realization of automated and regulated HVAC systems

Smart building

Omar BOUGHAZIF
Academic supervisor: K. ABED-MERAIM
Industrial supervisor: J-P. DE OLIVEIRA

Company: MBP Autorem

Objective/motivation

As part of my apprenticeship for Autorem, a building temperature automation and regulation company, I am asked to perform different project parts: studies and commissioning. Today, power saving is a great challenge for tertiary buildings. Indeed, the building field has the highest energy rate (41%), ahead of transport, industries and agriculture. Therefore, it is essential to offer the best solutions which allow tertiary building owners to optimize energy consumption and, at the same time, provide better comfort. I perform the commissioning of programming controllers for heating, ventilation and air conditioning in order to provide good comfort in building offices, schools, hotels, administration buildings, etc. In addition, I act as a technical building supervisor in order to monitor the HVAC systems.

Results

My experience at Autorem was really rewarding. Two dimensions emerge in this experience: technical and social. Even if important leaders in this field are trying to standardize the systems, technologies evolve permanently; therefore, I must stay in touch with new technologies and know the particularities of the different brands of PLCs, actuators, sensors, etc. Concerning the social part, I learned more about dealing with professionals who come from some other fields. As we are the last people who intervene during the commissioning, we have to deal with electricians, computer programmers, maintenance services, power suppliers, thermal engineers, etc. Therefore, the automation requires multidisciplinary skills.

Keywords: automation, regulation, programmable logic controller (PLCs), HVAC (heating ventilation air conditioning), Technical Building Management

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WESTT
PRICE

Technologies for Energy, Aerospace and Engine

CFD tools comparison: air intake and cooling system

Industrial engineering


Y. BO


V. DOUET

Yaqing BO / Victor DOUET
Academic supervisors: I. FEDIOUN, P. HIGELIN
Industrial supervisor: F. CLAUDE

Company: Segula Technologies

Objective/motivation

Segula Technologies is looking at changing its CFD software. The company wants to compare results obtained with OpenFOAM, a free access software package, with those obtained with ANSYS. The project is about achieving numerical simulations regarding internal combustion engine air intake and cooling systems with ANSYS in order to evaluate pressure drops. Then, a comparative study will be performed to identify the causes (physical and numerical) and their impact. Five different parts from an internal combustion engine air intake subsystem were studied. The comparison parameters are turbulence model, discretization scheme and initial conditions. Finally, a complete pressure drop cartography for each part will be established.

Results

First, we needed to modify the geometry of parts in order to get a good mesh for each one of them. We subdivided them according to their category and separated some complicated elements which were simulated apart. Then we optimized meshes, in order to make them more accurate, based on y+ calculation, sensitivity analysis, etc. We performed simulations varying the following parameters: turbulent model, discretization schemes, velocity, nature of fluid, etc. Using total pressure measurements along each part, we were able to quantitatively evaluate different singular and lineic pressure losses depending on their nature. Simulation results were then compared as a function of parameters.

Keywords: CFD, pressure drop, comparison, ANSYS, air intake

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Concept study of a 155mm long-range artillery projectile

Aerospace engineering


V. COULON


L. MARTIN


Q. MORELLE-DELOFFRE

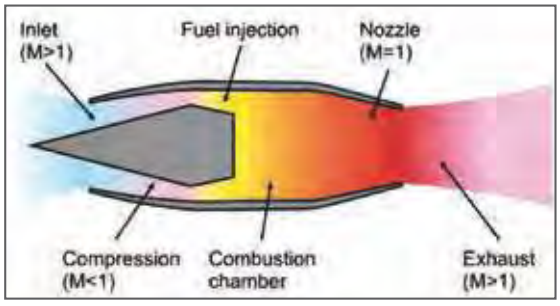
Victor COULON / Loïc MARTIN / Quentin MORELLE-DELOFFRE
Academic supervisor: N. MAZELLIER
Industrial supervisors: N. GRANGE, M. ZEIDLER

Company: Nexter Munitions

Objective/motivation
With the resurgence of conflicts, servicemen requirements have established a technological need: to increase the range and accuracy of artillery systems. To do so, we must couple standard artillery shells with an additional propulsive equipment. The objective of this project is to design a propulsion system that will generate additional thrust to the projectiles in order to extend their range of action. To that end, a MATLAB® model of the propulsion system was requested in order to estimate the major physical phenomena throughout the flight of the ammunition. In parallel, a study using Computational Fluid Dynamics (CFD) was conducted to complete the results on the air intake.

Results
First, the model created using MATLAB® software and literature gave us a first glimpse of the performance and the dimension of the propulsion system. Some CFD studies were carried out using the ANSYS Fluent® software and the results of the MATLAB® model. These studies aimed to model more precisely the air flow. Finally, we calculated the performance of the system with updated parameters giving us some promising results.

Keywords: artillery ammunition, propulsion, air intake, Computational Fluid Dynamics



Ramjet (Source: Wikipedia)


Caesar truck

Contact: victor.coulon@etu.univ-orleans.fr ; loic.martin1@etu.univ-orleans.fr ; quentin.morelle-deloffre@etu.univ-orleans.fr

Control of an electronic power system board for a small educational satellite

Aerospace engineering


T. HARBULOT


C. PROFIT

Thibaut HARBULOT / Clément PROFIT
Academic supervisor: R. LEDEE
Industrial supervisor: H. DIAZ

Institution: CNES (National Center of Space Research)

Objective/motivation

Cubsats are small alternatives to conventional satellites. They weigh much less and thus are a cost-effective solution for universities and labs to send payloads and experiments into space. However, due to their limited dimensions, they are only designed for specific predetermined tasks and are not as diversified and precise as their counterparts. The purpose of the EPS board is to dispatch, according to the need of the mission, the power from the batteries and solar panels to the different subsystems (communication, sensors, onboard computer, etc.) of the Cubsat. The goal of our project is to find a new battery and solar panels to improve the capacity of the satellite and be able to output 12V while keeping the global cost low and making sure of its perfect integration with the EPS board and subsystems.

Results

A more powerful battery associated with voltage converters was found which allows the output of 3.3V, 5V, and 12V depending on the needs and applications of the satellite. Furthermore, two new panels of 0.5W were added in series to the original one to increase the voltage and time exposure. All these changes forced the complete redesign of the EPS board and its electrical circuit to be compatible with the new battery and needs. Finally, an EPS prototype board was made before testing and making sure of its perfect integration with the battery, solar cells, and all subsystems.

Keywords: satellite, electronic, battery, solar cell, energy


The assembled Cubsat

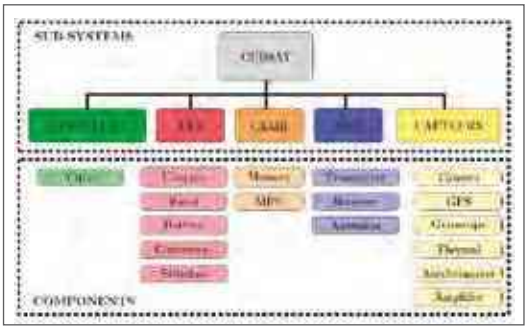


Diagram of the Cubsat subsystem operating

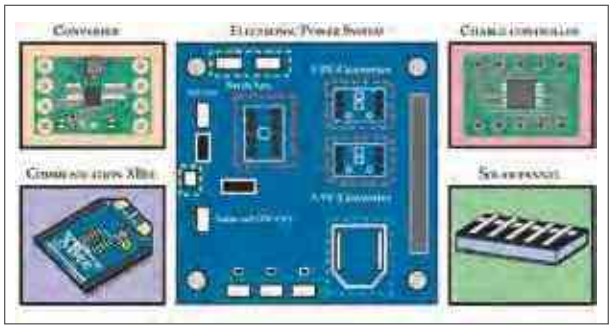


Diagram of the EPS card architecture

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Creation and optimization of the motor control on an electric race car

Mechanical engineering

A. DELESSARD

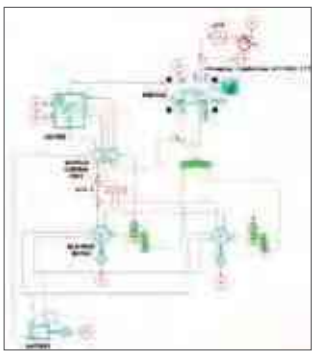
Y. LUO

Antoine DELESSARD / Yixin LUO
Academic supervisors: C. BOURILLON, G. COLIN
Industrial supervisor: T. SABARLY

Association: Polytech Racing

Objective/motivation

Polytech Racing is a student association that includes students who want to discover and get involved in motorsports, especially karting. This year, Polytech Racing launched a new project which is to participate in SAE Formula Student which is an international competition whose objective is to develop students' engineering skills through a project: the design and production of competition single-seaters. In this project, we are focusing on the powertrain design, with the creation and optimization of the motors control. First, we focused on the design of accurate models using Simcenter AMESim®. Then, we focused on the control part with the creation of different driving modes on the car. These driving modes will be implemented on the vehicle in the SEVCON® variator which will control the electrical machines torque as a function of the throttle input.

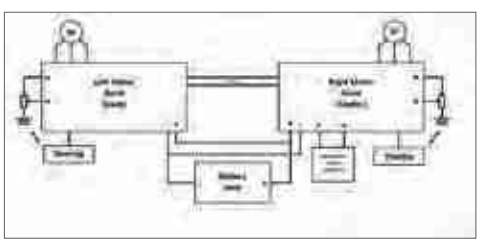


Electric car model on AMESim®

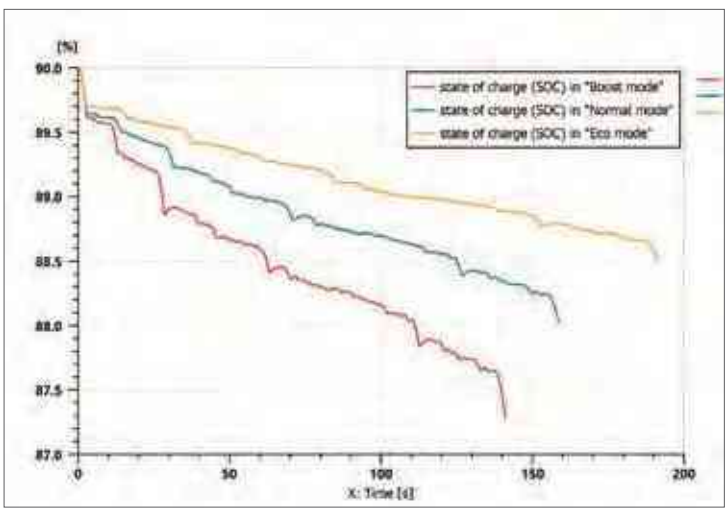
Results

First, we built a 1D longitudinal model in order to test the maximal theorical acceleration of the vehicle. We needed a representative road law, so we set the mass of the vehicle and the aerodynamic parameter such as drag coefficient and frontal area to the mean values that we can find in the literature. This allow us to obtain the optimal acceleration performance depending on the electrical machine used. Then, by using a model built for endurance, we simulated our driving modes: "Boost", up to 150% of the maximum power of the electrical machine, "Normal" up to 100% and "Eco" up to 70%, to see the influence of theses modes on parameters such as the engine's temperature or the state of charge of the battery. We also created a list of all the useful functions for the control in the SEVCON® interface and a simplified wiring architecture.

Keywords: SAE Formula Student, motorsport, simulation, optimization, powertrain



SEVCON® simplified wiring diagram



Evolution of the State Of Charge (SOC) for the different modes

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Design and aerodynamic study of an UrbanConcept car body

Mechanical engineering

N. BERNARD-GUILLON

J. GAUCHERAND

Noémie BERNARD-GUILLON / Jessica GAUCHERAND
Academic supervisors: B. BERNALES-CHAVEZ, P. BREQUIGNY
Industrial supervisors: F. HURAULT, L. WALTER

Institutions: Exergie and Hyperbole++ Student Associations

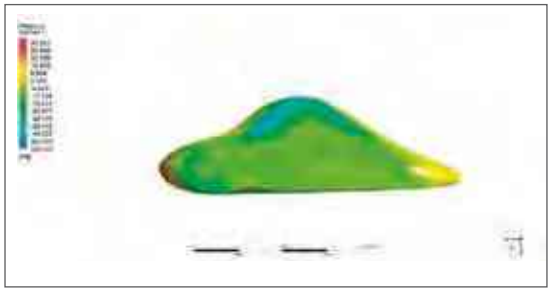
Objective/motivation

Competitions such as the Shell Eco Marathon or the Challenge EducEco encourage students to develop vehicles with a good efficiency that also take security into account. The UrbanConcept category of such a competition focuses on vehicles that are similar in shape and specification to personal-use vehicles. The clubs from the University of Orléans, Hyperbole ++ and Exergie, have commissioned this project in order to develop the car body of a vehicle that could compete in the UrbanConcept category. In order to reach this goal, the first step is to design several vehicles in CAD (Computer Aided Design) then to proceed with their aerodynamic study. Both a numerical study using CFD (Computational Fluid Dynamics) and an experimental study using a wind tunnel were carried out.

Results

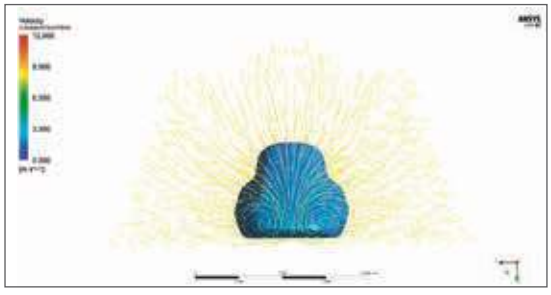
Three car bodies were designed using a CAD software with the freestyle modelling tool. The car bodies were analysed to ensure they could be moulded in the future and their aerodynamic study was carried out. To start with, a CFD analysis of the vehicle using RANS simulation was carried out. The drag coefficients obtained with CFD for the three car bodies were compared, as well as the behaviour of the flow around the bodies. Small-scale models of the vehicles were milled into polyurethane foam blocks to a scale of 1/20. The vehicles were varnished to ensure a low porosity, and later put into a wind tunnel to experimentally study their aerodynamics. CFD study resulted with the best performing vehicle having a drag coefficient of 0.13.

Keywords: aerodynamics, drag, car body, Shell Eco Marathon, Challenge EducEco



Contour of pressure over one of the vehicles

Small scale model of one of the vehicles made with polyurethane foam



Velocity streamline behind one of the vehicles

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Design and realization of a model of isolated µ-grid the size of a hamlet or small village

Electrical engineering


F. MONICO


A. NIARE


A. SAOUIKI

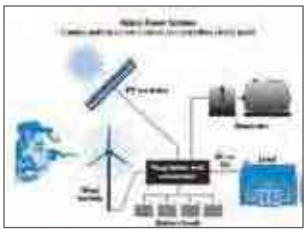
Fabien MONICO / Abdel NIARE / Amina SAOUIKI
Academic supervisor: C. ROUSSELLE
Industrial supervisor: P. BLANCHET

Company: Cod Eau Khmer Association

Selected Participant
14th Annual Final Year Projects Forum

Objective/motivation

According to the International Energy Agency, there are over 1.4 billion people living without electricity in the world and among these, there are 85% living in rural areas. Cambodians are some of these and our project was developed to create a prototype in order to train Cambodian engineering students who will subsequently be able to electrify villages located outside the national electric grid. That electrification will be with a µ-grid which is an electricity distribution system, developed at the level of a hamlet, a village or even a city, which can operate without being connected to the main electricity distribution network. The energy is produced from local renewable energies connected to an energy storage system or even to an emergency generator.


Description of an autonomous electrical micro off-grid

Results

Before creating these installations for real, we created a prototype on MATLAB®/Simulink (multi-physics system modeling software) to model charge/discharge of an energy storage system connected to a wind turbine, solar panels and battery storage. So, firstly, we modeled all of these elements. Then we created converters in order to connect the renewable energy systems to a battery. And to coordinate the functioning of all these elements we modeled a regulation and a control of this set. We also studied the functioning of energy storage by flywheel because it is a more environmentally friendly system than batteries. Thanks to this we were able to create a MATLAB®/Simulink model of this type of system. Finally, we wrote a practical tutorial to show engineering students how these technologies work and, in the future, they will be able to size their own µ-grid.


Houses by the Tonle Sap lake in Cambodia


Student working on the MATLAB®/Simulink simulation of a solar panel

Keywords:
energy, rural, electrification, numerical simulation

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Design of an electric powertrain vehicle test bench

Electrical engineering

G. DIPPERT

T. SABARLY PAPI

Guillaume DIPPERT / Thomas SABARLY PAPI
Academic supervisors: C. BOURILLON, A. CHARLET
Industrial supervisors: F. FRANCO, B. MATRAS

Company: Transition One

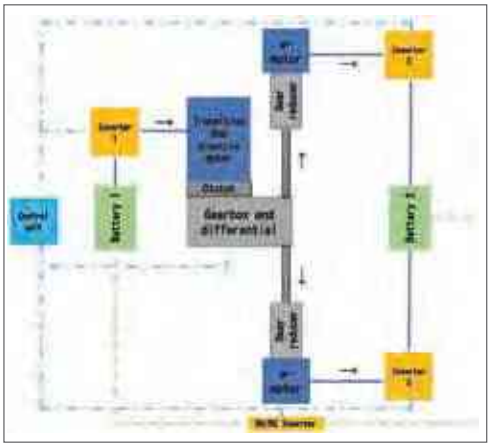
Objective/motivation

Transition One is convinced of the climate emergency we are facing; simple and rapidly quick solutions are essential to initiate profound changes. Small urban vehicles are Transition One's first retrofit targets. It consists of removing the internal combustion engine and replace it with an electric motor-battery unit, while maintaining the vehicle's technical characteristics.In order to make their first prototypes more reliable and to identify potential mechanical defects, Transition One wishes to create an automatic test bench to validate the endurance of the vehicle's drive train. The study has focused on the choice of design for the test bench, a study of the different possible technologies, as well as the piloting and automation of the tests, with the creation of CAD drawings.

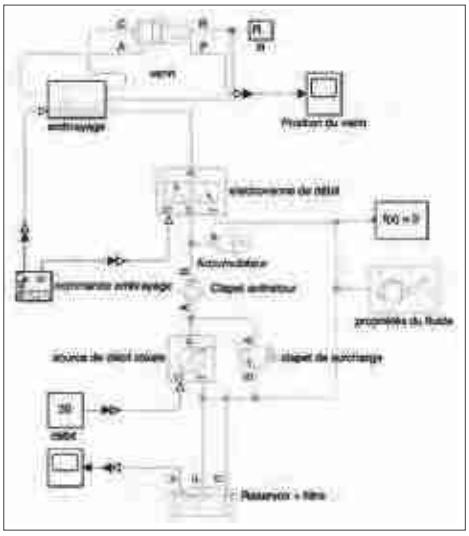
Results

During this project, we have precisely determined the desired geometry for the bench to achieve maximum measurements and functionality. The use of a double electric machine configuration offered the opportunity to control the bench on-road and endurance cycle, while allowing electric motor mapping. Hence, the comparative study of numerous solutions was an important part of the project. In these, several electric machine technologies were considered, as well as sensors and data acquisition means, making it possible to determine the entire instrumentation of the bench and to put forward control solutions. National Instrument's Compact RIO solution was an interesting compromise. Thanks to an FPGA and real-time programming, the circuit board will allow the acquisition and control of the whole test bench. Finally, we created a user interface on LabVIEW as well as 3D representations for the Transition One team.

Transition One's Fiat 500



Test bench configuration schematic



Clutch automation with Simulink-Simscape

Keywords:
automotive, retrofit, powertrain, automation, benchmarking

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Development of a car driving robot on a chassis dynamometer for endurance tests

Mechanical engineering

A. HASSAN-ABDOU

J. STECCHINO

Assala HASSAN-ABDOU / Julien STECCHINO
Academic supervisor: A. CHARLET
Industrial supervisor: P. RIVIERE

Company: Privtech Engineering

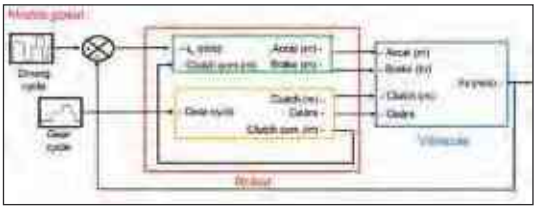
Objective/motivation

Today, a car must be able to travel up to 200,000 kilometers without showing a single sign of failure. Its development is subject to strict reliability criteria imposed by car manufacturers. The Privtech company was recently mandated by one of its customers to carry out endurance tests on a vehicle over distances of 3,000 to 160,000 km on a chassis test dyno. As human error will understandably be quite intense over such a long driving distance, the aim of the project is to create a robot capable of driving the vehicle instead of a human driver by following a predefined road cycle. The objectives of the requested project are to size the actuators allowing to move the pedals and the gear shift of the vehicle and to set up a system to control the robot's behavior.

Results

The first step of our project was to carry out a benchmarking study of the technologies available on the market. This analysis enabled us to identify the technical characteristics of the driving robots and to fix the operating limits of ours. Indeed, we decided to focus its use only on series or competition vehicles with manual transmission. Then, we sized the robot's actuators and determined the forces, strokes and speeds they must provide. As a result of our findings, our technological choice turned to electric ball screw actuators that we modelled using CAD software. Finally, we modelized the robot and the vehicle on MATLAB®/Simulink software. We have been working on the setting up of the control laws that govern the global system in order to allow the control of the robot and the driving of the vehicle.

Keywords: driving robot, endurance testing, automatic, automotive, chassis dynamometer



Global diagram of the system

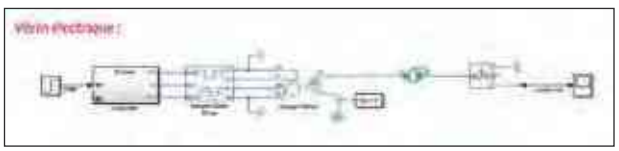


Diagram of the electric actuator

CAD model of the robot

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Development of an unsteady heat exchange model for insulated ICEs

Mechanical engineering, Energetics, Materials

J. CHANG

T. HILL

Jiahao CHANG / Thomas HILL
Academic supervisor: C. CAILLOL
Industrial supervisor: A. WHAL

Companies: OpenLab, PSA Groupe

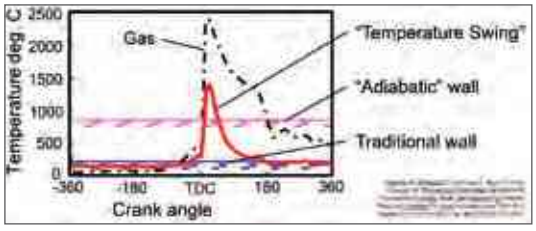
Objective/motivation

Advances in the field of materials offer new opportunities such as the possibility of using a new strategy called "Temperature swing insulation" to minimize heat losses at the walls of internal combustion engines. This coating on the walls of the combustion chamber induces an important variation of the surface temperature during the cycle. In this case, the temperature of the surface with this insulating layer follows the transient temperature of gas which allows to reduce heat losses and prevent the intake air to be warmed and therefore to avoid the increase of NOx and soots. Our objective is to build an exchange model on the walls that will include the unsteady components in order to assess the relevance of this new approach to the combustion chamber adiabatization.

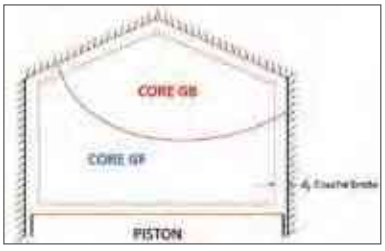
Results

After researching related scientific documents, a combination of two types of commonly developed models were used. The first method and most precise is to do an FEA resolution of the energy equation. The second method which is "0D" is to determine a "wall function" expression. The advantages intended by combining both methods are speed and precision as the model must be time-dependent. In this model, the temperature in the viscous sublayer is resolved using a 1D resolution of the energy equation. The temperature of the remaining part of the boundary layer is solved using a "wall function" that is adapted to be included in the 1D resolution. The calculation was programmed using MATLAB® and the model was validated using experimental data. This model will be used to perform some parameter sweeps to determine the optimal thickness of engine wall insulation.

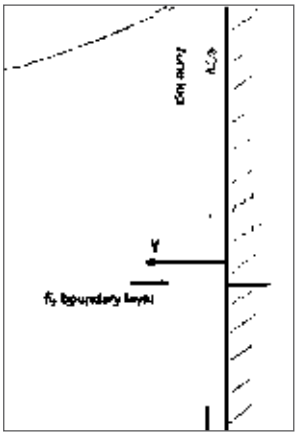
Keywords: heat transfer, ICE engine, law-of-the-wall, temperature swing, thermal barrier coating



Gas and wall temperature histories



Two-zone model diagram



Zoom on boundary layer

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Development of an unsteady heat transfer model of the filling process of liquified natural gas carrier tanks

Energetics


H. FENG

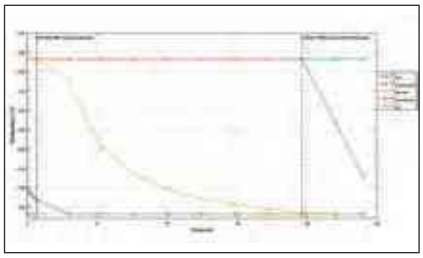

A. QUANSAH

Haiqiang FENG / Asamaning QUANSAH
Academic supervisor: C. CAILLOL
Industrial supervisor: N. BORDET

Company: OSE Engineering

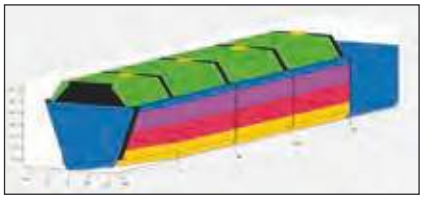
Objective/motivation

As of January 2020, a new regulation set by the International Maritime Organization (IMO) requires all seagoing vessels to cut their Sulphur Oxides (SO2) emissions by 85%. Which led to an increase in the use of Liquified Natural Gas (LNG) as a fuel, since it produces less SO2 than Heavy fuels. However, one way to keep Natural Gas in a Liquid state is to store it at temperatures below -162°C, and maintaining such a low temperature is problematic. Therefore, a numerical model; that would take every LNG tank walls, heat sources and annex compartments into account; is needed to make a simulation of each and every heat flux interacting with the stored LNG. The final objective is to reduce money loss due to the evaporation of the stored LNG, thanks to a better evaluation of the heat flow inside the tanks.

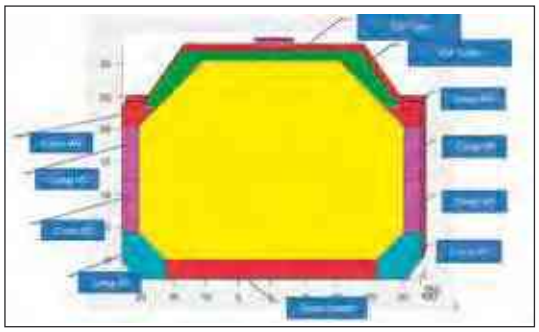

Interface temperature between LNG and Main LNG tank walls

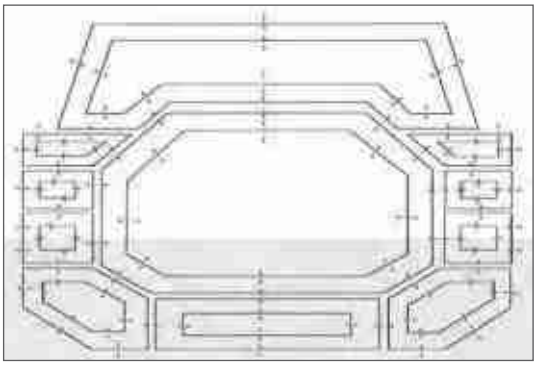
Results

The heat transfer model of the filling process of Liquified Natural Gas carrier tanks is designed in a way that allows the temperature of every LNG tank walls and annex compartments to change as a function of time (unsteady model). To achieve this model, the first step was to recreate the geometry of a complete LNG carrier using MATLAB® (a programming platform). Then, a simulation tool was created with MATLAB® to compute all the heat fluxes across the carrier. This tool will allow the model to be adaptable to the geometry inputted by the user, as well as, to the boundary temperatures fixed by the user before computing the solution of this heat transfer simulation tool. But, to simplify the model and reduce computation time, the heat fluxes were computed by assuming a homogeneous temperature distribution in space.


Recreated GNL carrier geometry

Keywords:
PDE,
unsteady,
simulation,
cryogenic,
LNG


Neighbouring containers of the 4th GNL tank (yellow) map


Map of conductive heat fluxes across an entire tank geometry

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Effect of an additive on the combustion of fuel type heavy fuel oil

Energetics

C. DESCHATRES

S. GAGNAGE

Clément DESCHATRES / Sébastien GAGNAGE
Academic supervisor: C. ROUSSELLE
Industrial supervisor: J-P. RAVIX

Company: Ecosoftec

Selected Participant
14th Annual Final Year Projects Forum

Objective/motivation

In the current maritime context, the reduction of pollutant emissions and consumption is the main subject. Our project is based on the study of CP19. It is an additive used by EcoSoftec in boilers thanks to their innovation, the "FireCube", and allows for the increase of efficiency, the reduction of pollutants and clean boilers. The objective of the project is to provide scientific evidence on the effect of this additive in combustion. To do so, an oil lamp type burner has to be created and CP19 is injected into it in order to observe the consequences on efficiency and the formation of soot. Thanks to the results obtained, EcoSoftec will know if they can adapt their innovation to marine diesel engines.

Results

The first part of the project focused on the theoretical study and design of the burner under CAD. We had several specifications. We designed several air tanks with different laminarization and encapsulation systems, a fuel tank, a setting system to modify the height of the flame and also the frame. In addition, we had a fuel heating and air intake system regulated by a PID regulator. The second part focused on the experiments. First, the burner was checked with dodecane. A camera was added in order to obtain results on the flame heights and then the smoke. The effects of the change in richness, the change in inlet temperature and the addition of the CP19 were analysed. A report was produced but the project needs to be continued.

Keywords: energy, combustion, additive, manganese, pollutants

Burner bench

Burner

Flame

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Experimental study of high-pressure direct injection of ethanol

Mechanical engineering

S. AMGHAR

Y. SUN

Sabrina AMGHAR / Yaxuan SUN
Academic supervisor: C. HESPEL
Industrial supervisors: J. BOURIOT, F. FOUCHER

Company/Institution: PSA Groupe, PRISME Laboratory

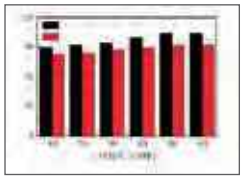
Objective/motivation

The objective of the project is to study and characterize the behavior of GDI sprays running on ethanol. This will involve understanding and showing the impact of direct ethanol injection parameters on spray characteristics. We will therefore control the quantity of fuel injected, control the overall richness and thus the impact on the emission control system through the measurement of introduction rate. We will vary different parameters in order to see the influences such as injection pressure, back pressure and chamber pressure while remaining under direct injection conditions. To allow us to study this, we will use the fast brightfield visualization method coupled with image analysis under MATLAB® to be programmed. Once the analysis is complete, it is necessary to compare the results we will obtain with those in the literature, as well as those of iso-octane other ethanol blends like E85 and commercial E85.

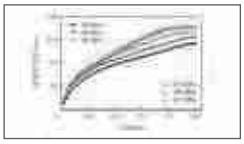
Results

After changing different parameters in order to see the influences such as injection pressure, back pressure and chamber pressure while remaining under direct injection conditions, we get the change law of penetration distance and spray angle with varying injection pressures.

Keywords: motor, new energy, ethanol, high pressure, injection



Variation of cone angle at core area with varying injection pressures



Variation of whole spray penetration with varying injection pressures

At work on the project

Project equipment

Project equipment

Contact: amghar.sabrina@gmail.com ; sunyaxuan419@gmail.com

Expertise of an air pollution control system

Environmental engineering


G. GALISSON


M. ROUAULT

Grégoire GALISSON / Mathéo ROUAULT
Academic supervisors: B. BERNALES-CHAVEZ, N. MAZELLIER
Industrial supervisor: M-S. GESSAT

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

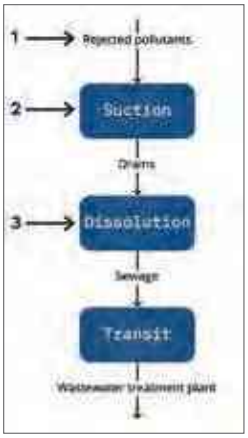
Selected Participant
14th Annual Final Year Projects Forum

Objective/motivation

Nowadays, more and more cities are facing pollution peaks, due to traffic, industries and many other sources which reject pollutants like SO2 and greenhouse gases such as N2O. In this context Mrs. Gessat, thought about a depolluting system using the wastewater network as a vector of transport to water treatment plants. The idea is to suck the air full of pollutants and greenhouse gases from the roads and add it to the wastewater network. The main challenge of the project is to calculate how much pollution the water can carry and how efficient the dissolution process is. The purpose of this project is to build a feasibility report of this system which includes an estimation of energetic and financial costs.

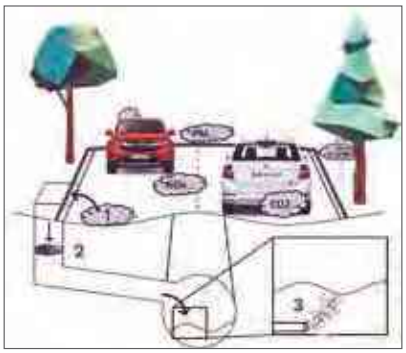
Results

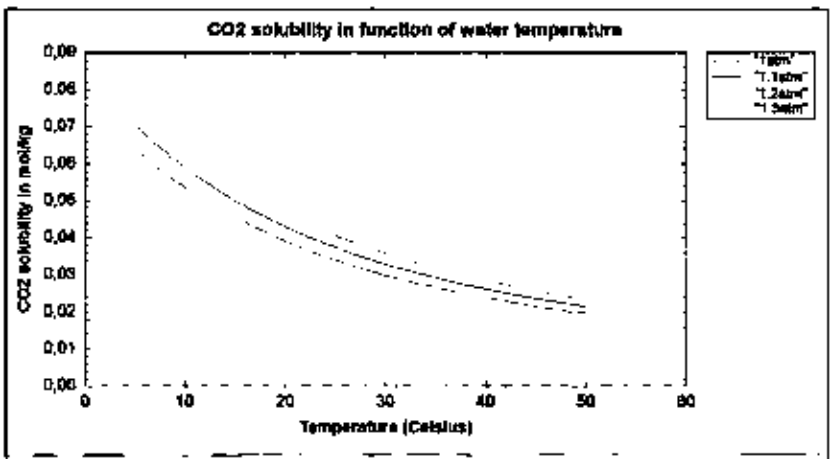
First, we needed to understand the dissolution phenomena and how to improve it. In addition, we were looking for gas/liquid mixer systems that would be suitable for our project. In parallel, we studied the solubility of gases such as CO2 in wastewater. Our feasibility study was based in Orleans, air composition and wastewater network data were provided by local organisations. Thanks to that and the chemical properties of the gas, we were able to size the system. We computed how much CO2 and pollutants the wastewater could carry due to the dissolution process. The results revealed that the quantity of air was enormous, as were the energetic and financial costs (billions of Euros), mainly because the dissolution process has a bad efficiency and the concentration of pollutants and greenhouse gases is very low in the total mass compared to dinitrogen, dioxygen and argon one (99,9%).



Steps of the process

Keywords: pollution, gaz, sewage, dissolution, environment


System diagram



CO_2 solubility in function of water temperature

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Flow control over a ramp using a sweeping jet actuator

Mechanical engineering


C. GUYONNET


N. HEITMANN


J. LIU

Clément GUYONNET / Nicolas HEITMANN / Jie LIU
Academic supervisor: A. KOURTA

Institutions: Research Group 2502, PRISME Laboratory

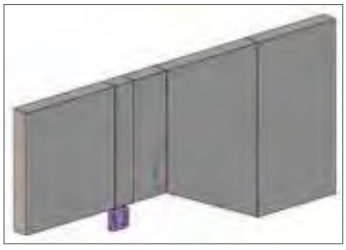
Objective/motivation

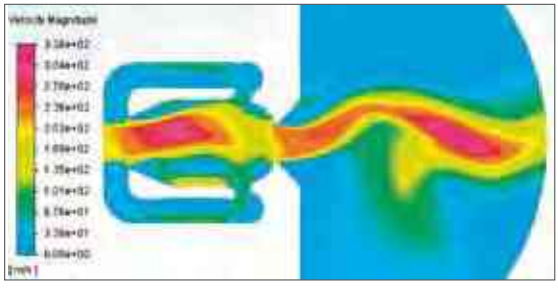
When a fluid flow passes a ramp, a phenomenon of boundary layer separation happens. Controlling it is interesting because it creates a recirculation bubble of the flow that induces the drag force. Also, the smaller the recirculation bubble, the less drag. Thus, we studied the flow passing over a 25° sloping step. We controlled this flow, and the recirculation bubble that is created over the step, using a sweeping jet actuator placed upwind. The asset of this actuator is that it does not use any moving part. The sweeping movement of the flow relies on the Coanda effect inside the actuator. The aim of the project is to develop and characterize the performances of a new type of fluidic actuator. The study was being performed on Fluent® software. It will then be tested in the wind tunnel of the Prisme laboratory.

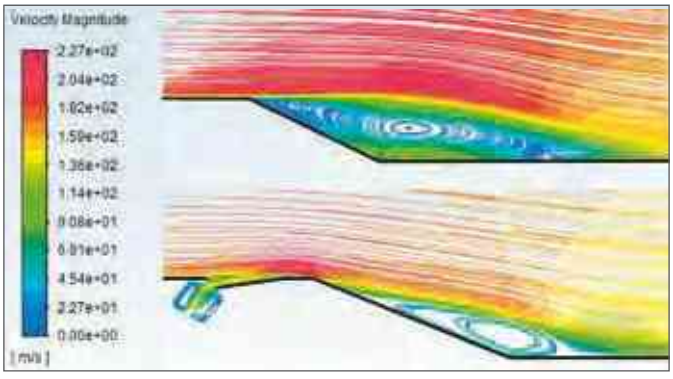
Results

Using numerical RANS simulation, we were first able to characterize the sweeping jet (SWJ) actuator in frequency and amplitude. During this time, we also determined our reference step design and measured the reattachment length of the flow at Lr/h≈5. We then implemented the sweeping jet into the step to see how they interact with each other. We began with 2D simulations and we tried different positions and injection angles of the injected flow. These parameters were combined with the wide range of frequency and amplitude, respectively, from 0.5 to 2 kHz and from 50 to 300 m/s, to define the best set of parameters. This study demonstrated that the SWJ actuator reduced the size of the recirculation bubble and that the reattachment point moved upstream.

Keywords: sweeping jet, aerodynamics, drag, CFD


3D design of the ramp and the sweeping jet


Sweeping jet with Coanda effect



Comparison between controlled and uncontrolled ramp

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Impact on engine thrust of the addition of solid particles to fuel

Aerospace engineering


R. CIDEME


J. DEBACKER

Robyn CIDEME / Julien DEBACKER
Academic supervisor: I. FEDIOUN
Industrial supervisor: T. QUERREC

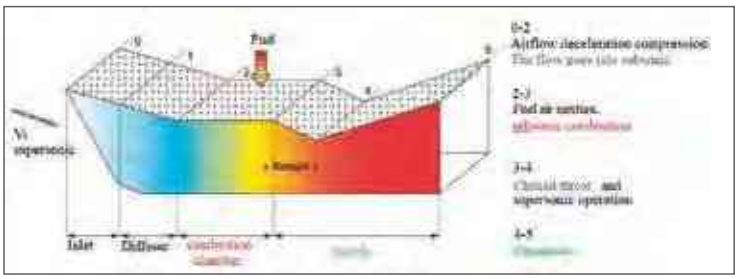
Company: MBDA Systems

Objective/motivation

Our project deals with the use of nanofuels (fuel and aluminium solid particles) in ramjets, supersonic propulsion devices used for missiles or experimental aircrafts. Their use has been shown to improve combustion efficiency as well as specific impulse. However, the addition of these particle is accompanied by a loss of thrust that is yet to be quantified. Our purpose is to compute this loss by modelling a ramjet nozzle with a gas flow first alone and then with solid aluminium particles. In order to reach this goal, several simulations will be carried out on the multi-physics software ANSYS®. A ramjet geometry was designed and input parameters for ANSYS Fluent® resulting from the combustion chamber were computed before starting the simulations. The results were then compared according to a parametric study of particle diameter, mass fraction and injection velocity.

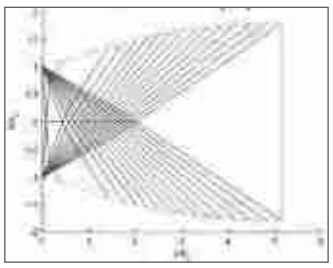
Results

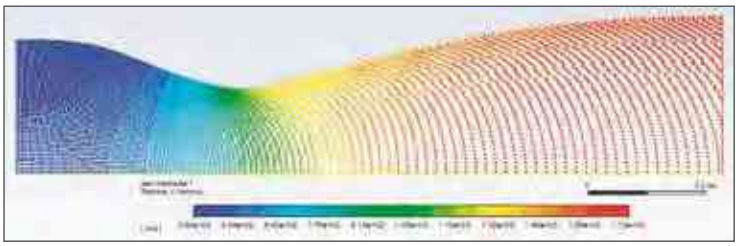
A particle-free flow was first modeled accounting for the flow conditions inherited from the combustion chamber. That way, the thrust obtained for the reference flow could be compared to that of the analytical solution for an isentropic flow with a great agreement, therefore allowing us to validate our reference model. In order to proceed, particles of aluminum were introduced within the domain. By covering a set of properties for the particles, it was demonstrated that thrust losses were indeed induced by increasing particles mass fraction. A reason for these results includes a drop of flow velocity at the exhaust which, based on Hugoniot's law, is explained by cross section reductions when accounting for particles.



Descriptive schema of a ramjet engine

Keywords: CFD (Computational Fluid Dynamics), aerospace propulsion, ramjets, solid particles


Mach lines across the Prandt-Meyer expansion fan


Particles progress throughout a ramjet nozzle

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Modeling the Lotus "Active Valve Train" system on GT-Power

Mechanical engineering


A. ALVES BARBOSA

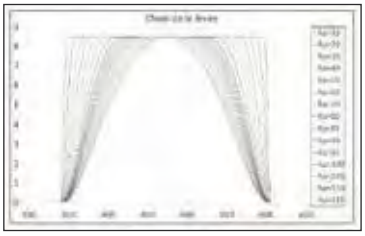

J. POUJOL

Amanda ALVES BARBOSA / Jérémy POUJOL
Academic supervisor: F. FOUCHER
Industrial supervisor: J. BOURIOT

Company: PSA Groupe

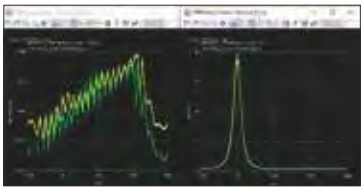
Objective/motivation

The automotive industry is constantly developing new systems to increase engine efficiency and performance. A few years ago, the car manufacturer Lotus designed an "AVT" (Active Valve Train) system that enables studies that a camshaft would not be able to do. This project which is in collaboration with the Prisme laboratory consists in creating a single cylinder engine on GT Power and on Amesim software to model and study the functionalities of this fully variable valve timing system. Thus, the purpose is to analyse the modeling in order to study different applications such as the Miller cycle or the HCCI (Homogeneous Charge Compression Ignition) technology and then, carry out some tests on a test bench with the DW10 engine equipped with the electro-hydraulic AVT system lent by PSA to compare the simulation results with the experimental results.

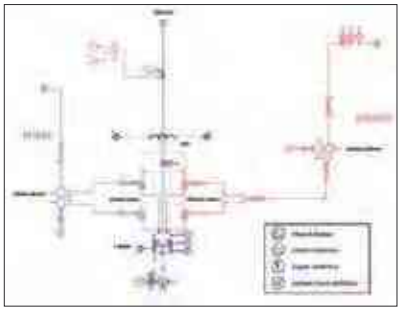

Study of valve lift strategies with the AVT system on GT Power

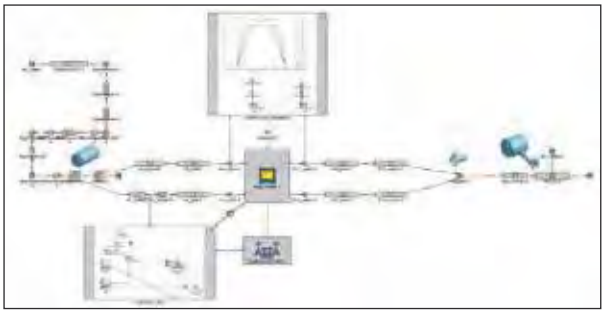
Results

Initially, a bibliographical analysis was done to understand the ultra-variable valve system and its capabilities. Then, the DW10 engine model was created on GT Power, where all its parameters were implemented in order to calibrate the model acoustically. This modeling allowed us to design a valve system with different lifting strategies. After optimization, we noticed that a variable lifting system gives a much better performance than a fixed camshaft system. In addition, the experimental results found are quite close to those predicted by the simulation software. In parallel, the GT Power and Amesim simulation enabled us to highlight the combustion and acoustic models implemented and to anticipate the experimental results that were established at the PRISME laboratory and to validate our hypotheses.


Intake and cylinder pressure calibration monitor on GT Power

Keywords: electro-hydraulic VVT (Variable Valve Timing), internal combustion engine, Miller cycle, AVT (Active Valve Train) system, GT Power


Digital model of the DW10 motor on Amesim


Digital model of the DW10 engine calibrated and equipped with the AVT system on GT Power

Contact: amanda.alves-barbosa@etu.univ-orleans.fr ; jeremy.poujol@etu.univ-orleans.fr

Numerical study of space debris aerodynamic interactions during atmospheric reentry

Aerospace engineering


M. BOYER


L. SOMBAERT

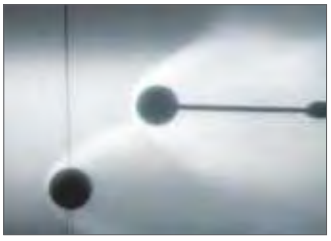

B. VANBERSEL

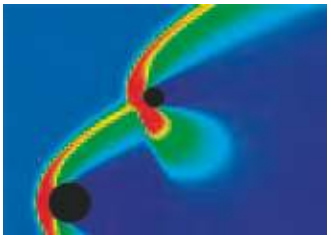
Maxime BOYER / Loïc SOMBAERT / Benjamin VANBERSEL
Academic supervisor: I. FEDIOUN
Industrial supervisor: R. JOUSSOT
Institutions: ICARE Lab, CNRS

First Place and High Schoolers' Choice Award
14th Annual Final Year Projects Forum

Objective/motivation

Millions of human-made objects orbit the Earth, and most of these objects are debris from space missions. Each of them is bound to fall onto Earth one day, and, depending on their sizes, the damage can be very great. Even today, the prediction for the impact zones of these debris can be to a certain degree unsure. As they fall into the low-density upper atmosphere, their behavior is hard to predict. This unpredictability is increased even more as they usually fall not as a single piece but as a cloud of objects that interact together, aerodynamically speaking. To improve the predictions, the ICARE laboratory is conducting tests in a hypersonic wind tunnel to observe the behavior of different debris configurations. The goal of the project is to use numerical simulations to compute the same configurations as the laboratory and state the validity of numerical models in these extreme conditions.


Example of an interaction in the wind tunnel


Numerical simulation of a two-object interaction

Results

First, a basic case was studied with simplified geometry. The debris were considered as spheres in a hypersonic flow. A single debris was studied to investigate the representativity of computational fluid dynamics in these extreme conditions. By comparing the numerical results with the experimental data from the ICARE laboratory, a model was obtained that fits the observations and accurately reproduces the real aerodynamics, proving that numerical simulation can still be effective in this scenario. Based on these data, the work was continued now considering two interacting spheres. The main goal was to observe the different possible interactions depending on the relative position of the debris. The aerodynamic coefficients were also investigated on the spheres to quantify the strength of the interactions.

Keywords: space debris, atmospheric reentry, CFD, rarefied flow, hypersonic


MARHy wind-tunnel at ICARE

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Reliability of a pedagogical engine test bench

Mechanical engineering

A. LIDON

L. MENARD

Antoine LIDON / Léo MENARD
Academic supervisor: P. BREJAUD
Industrial supervisor: P. BREJAUD

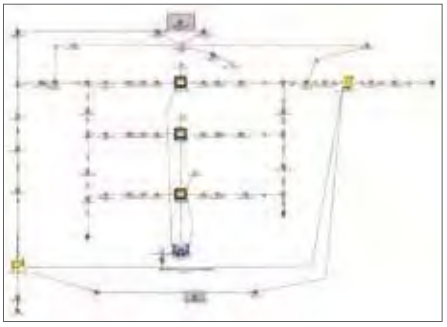
Institution: Institute of Technology of Orléans

Objective/motivation

The aim of this project is, above all, pedagogical; the engine, once implemented, will be used by professors of the Orléans IUT and Polytech Orléans schools. Indeed, this engine test bench will allow students to become familiar with engine tuning. Therefore, it is necessary to fully calibrate the engine and make the engine test bench as reliable as possible. In addition, a simulation is carried out in parallel to this. The aim of this simulation is to observe the engine behavior with an EGR system. This technology makes it possible to recycle exhaust gases and thus reduce pollutant emissions. This system is generally used on diesel engines. Based on the simulation carried out, the gasoline engine will be equipped with this EGR system.

Results

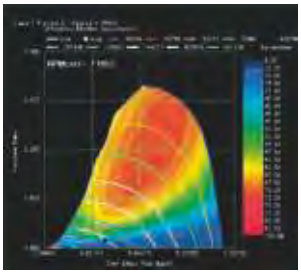
To ensure the reliability of an engine test bench, it is necessary to identify the risks to which it is exposed. First, the wiring of all electrical components must be rewired. The risks associated with those are very significant and are a factor in loss of efficiency. Furthermore, an installation of temperature, pressure and knock sensors allows a better diagnosis of recurring engine test bench failure. The engine test bench is equipped with a fully programmable ECU and it is important to use it to its full potential. As far as the simulation is concerned, measurements were carried out on the same engine as the one installed on the test bench. Moreover, the model was built starting with a single cylinder and then gradually increasing the number of cylinders. Finally, the turbocharger and EGR systems are implemented in the model.



Numerical model used for simulations

Standalone engine management system

Keywords:
engine test bench, simulation, engine tuning



Compressor mapping used for GT-ISE simulations

Engine test bench

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Signal processing for shaker test

Mechanical engineering


M. CADIER


Y. DABBAB

Maxime CADIER / Yassine DABBAB
Academic supervisor: P-Y. PASSAGGIA
Industrial supervisor: C. GUILLON

JOHN DEERE

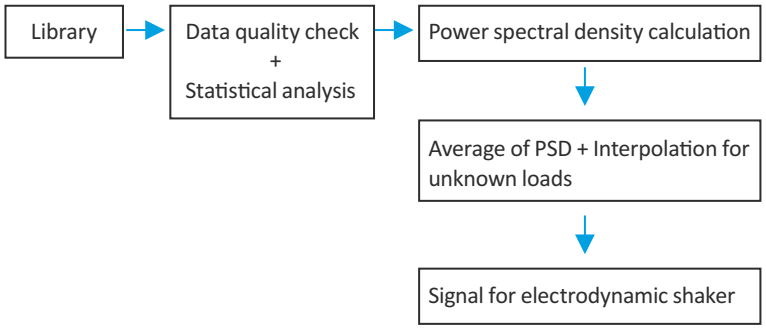
Company: John Deere Power Systems

Objective/motivation

As part of our studies we did an industrial project for a company that manufactures industrial diesel engines. Their parts are specifically designed to maximize performance and maintain emissions compliance. However, some mechanical part in the engine experience a lot of vibrations and needs to be inspected and may be tested in order to reduce downtime. Accordingly, this project is about analyzing time-based data from mechanical tests including real accelerations and stress from eight sensors fitted on a part. Fatigue analysis are generally performed using an electrodynamic shaker. However, we can't use directly time-based data on the equipment, they need to be converted into a frequency-based signal, more precisely a power spectral density (PSD). Our main objective was to create a representative PSD from a measurement campaign.

Results

First and foremost, an interface has been created in MATLAB® to facilitate the use and calculation of experimental data. Our main difficulty was to extract and organize the huge amount of data. We met the challenge by creating a library for all signals, using a batch program. Our interface can create a data matrix based on sensor's location, direction (inputs) and percentage of load (between 0 and 100%). The program loads automatically the corresponding file and makes the following calculation on it:



For each step, we can set up calculation settings easily (frequency range, window type, sample rate, etc.) Main result: Using our interface, a PSD for shaker test was created successfully.

Keywords: data, acceleration, PSD, correlation, FFT


Example of fatigue damage test on a rocket (source: Crystal Instrument)

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Sizing of production and storage systems on buildings, with comprehensive inventory of regional, state and European Union aid

Energetics


A. MENAGER


C. N'SEMI

Antoine MENAGER / Chryst N'SEMI
Academic supervisor: J-M. FAVIE
Industrial supervisor: L. PRUD'HOMME

Company: LaCen

Objective/motivation

In France, the building sector is the biggest energy consumer and represents about 25% of greenhouse gas emissions. To reduce these emissions, one of the solutions is to use renewable energies. Our project is about sizing some sustainable energy production (photovoltaic, wind, etc.) and storage systems (fuel cells, flywheel) on buildings. The final goal is to make our building self-sufficient energetically. This project was proposed by LaCen, a small French company specialized in computing. They develop software tools to make people self-sufficient in their workplace.

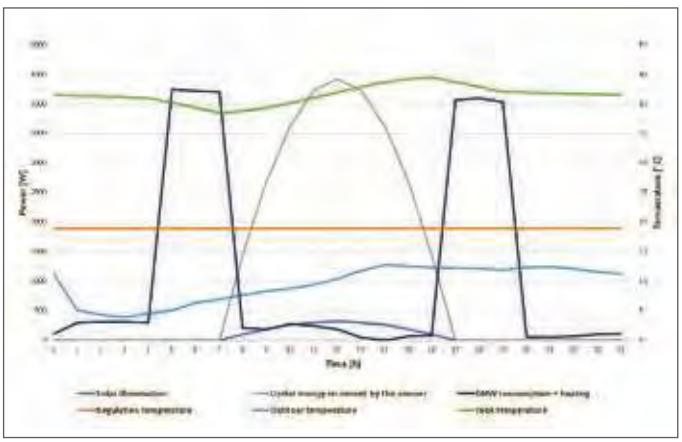
Results

In order to achieve the final objective, set out above, we have divided the work into three main parts: definition of domestic hot water requirements, heating and cooling over one year. Then we dimensioned production systems to meet these needs. Finally, we identified all types of aid that can be provided when making the transition or energy renovation. Regarding energy production systems, we have dimensioned a wind turbine and solar panels to meet our electrical needs. To produce hot water, we have dimensioned a thermal collector and as a complement, we have chosen a pellet boiler. As the energy sources used are intermittently, we have dimensioned a hydrogen fuel cell to store the surplus of energy produced in summer. All the results will be sent to the LaCen company and will be capitalized on a website developed by the company.

Keywords: self-sufficient, buildings, energy, sustainable, renewable


Studio land use plan


Module to study


Change in energy needs of the studio on a winter's day

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Stallion Project, flight simulator for the French Air Force

Aerospace engineering

Fabio DA SILVA
Academic supervisor: P. HIGELIN
Industrial supervisors: B. CARDOT, X. SOULARUE

Institution: CIET, French Air Force

Objective/motivation

We are working on a flight simulator for training future French Air Force soldiers. It deals with the aerodynamic modelisation of the Lockheed C-130 Hercules, a military transport aircraft often used by the French Air Force. The modelisation of the plane has to be as realistic as possible for soldiers training. The main purpose of this project is to help pilots acquire good flying habits and erase the negative attitude to the training because this simulator should not be considered in the same way as a video game. Meanwhile, we have to look for and find different aerodynamic data like all applied forces on our plane and the inertia by doing some theoretical calculations. Thereafter we will have to acknowledge the software language as well as the research into the aircraft data. Moreover, we will do simulations of our plane and bring necessary modifications to our flight simulator.

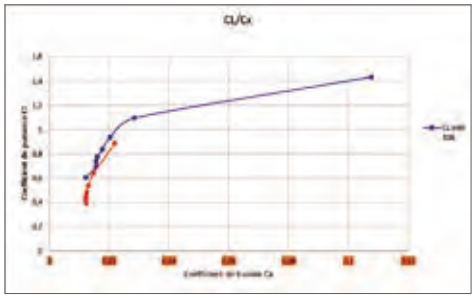
Lockheed C-130 Hercules

Results

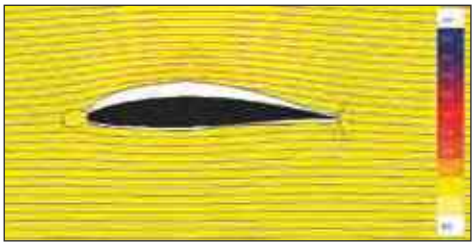
We did some research on the simulation software language, and found what the main forces induced on the aerodynamic effects of the plane are. Indeed, we acknowledge how to code with this language and recognize all necessary coefficients to bring a realistic modelisation of the airplane to the simulator. Next we used some declassified documents of the French Air Force to know the NACA airfoils. With the application of Javafoil software, we were able to find the real lift and drag coeficients depending on the aircraft speed. Moreover, we compared the findings with the former lift and drag parameter and input those data on the main code. Finally, we built a flight simulator in a Polytech school room to see if there were a real modifications on flight sensations with our new aerodynamic data and corrected other parameters like rotation speed, inertia and engine modelisation.

Flight simulator of Bricy French Air Force military base

Keywords: flight simulator, aerodynamic, Air Force, language code, 3D modelisation



Aerodynamic code on the simulator software



NACA airfoil study depending on air flow

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Study of the influence of the macroscopic homogenization of DTS models on equivalent conductivity and thermal flows

Energetics

M. CORNET

J. DEBAILLEUL

Marine CORNET / Jason DEBAILLEUL
Academic supervisor: J-M. FAVIE
Industrial supervisor: L. PRUD'HOMME

Company: LaCen

Objective/motivation

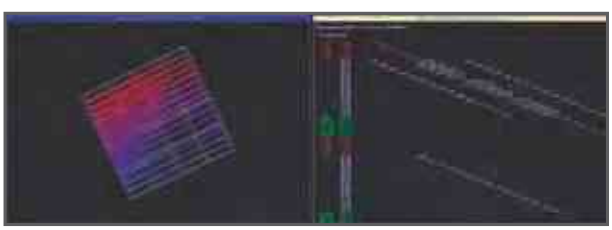
The building industry is an area where energy efficiency is an important issue considering today's energy transition challenge. The main goal of this project is to create a 3D model to understand the evolution of thermal flows in an environment composed of numerous bodies of different nature (wood, metal, air, glass wool, brick and so on). This 3D model should be able to compute the temperatures on each point of a meshed environment and plot isotherms to visualize thermal flows. It should help us understand the influence of the conductivity of the materials chosen and their arrangement on the mean standard calculation. It would therefore make possible the development of energy efficient and low-cost homes, which will thus democratize energy comfort at a lower cost for people in need.

Results

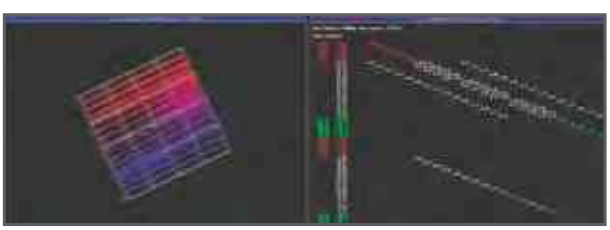
The program developed is currently able to create a geometry with both 3D and 2D kinds of mesh (triangles, squares, cubes, etc.). Moreover, it offers the possibility to instantaneously change the mesh, the numbers of dots and the different lengths of the geometry. In addition, we made the change of the thermal conductivity coefficient λ of some parts of the volume as well as the percentage of presence of one λ possible and thus simulated a multi-phase environment. The program calculates the thermal distribution and we have implemented the drawing of isotherms. In addition, we have calculated the flux going through the walls, so it will allow us to analyze the influence of the chosen parameters on the thermal distribution and the thermal loss. The results will be the object of the writing of a scientific paper that will be published.

Keywords: : Dynamic Thermal Simulation, homogenization, energy efficiency, heat loss, programming

Processing interface (background) and program display (front)



Program display and results for an example of random distribution



Program display and results for another example of random distribution

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Study of the wake of a porous disc: application to wind turbines

Fluid mechanics


M. BEAUCOUESTE


M. BUISSON


M. MAGNIER

Marine BEAUCOUESTE / Marie BUISSON / Maëlys MAGNIER
Academic supervisors: N. MAZELLIER, P-Y. PASSAGGIA

Institution: PRISME Laboratory

Objective/motivation

Development of carbon-free energy production is a major societal and environmental issue. As wind energy represents a viable source of carbon-free energy, wind farm projects are increasing in numbers but the related physics and in particular, the interaction between two subsequent wind turbines has yet to be understood. Energy extraction from wind turbines can be fully characterized through their wake dynamics and the present work considers a reduced-scale model using porous discs. In particular, a new design of porous disc is considered where the solidity can be varied in the radial direction but remains constant in the azimuthal direction. This project investigates how these parameters control the near wake of the porous disc, using wind-tunnel testing and turbulence measurements at Polytech Orléans to evaluate the relevance of this new design for the modelling of wind turbine wakes.

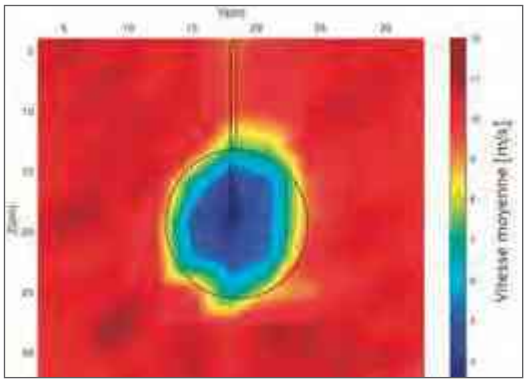
Results

First, three discs with different degrees of porosity were created with a laser cutting machine. Each disc has the same pore size. The second part of the work considers discs designed with different distribution of porosity in the radial direction. While comparing discs with different porosities to wind turbine literature, it would appear that the porosity affects the velocity deficit and the disc wake symmetry. Turbulence intensity was also studied using hot-wire anemometry. Data were collected using LabVIEW while time series were analyzed using MATLAB®. With turbulence intensity along the test section, power spectral density, Taylor microscale and dissipation range, a large body of information about turbulence generated by the different discs was provided. First results indicate that dissipation in the flow can be parameterized using the disc parameters, and can be tied to the energy recovered by the wind turbine.

Keywords: wind turbines, porous disc, wind tunnel, turbulence, near wake


Three discs tested with different porosities


Picture of the porous disc in the wind tunnel


Mean streamwise velocity downstream of the porous disc

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Thermal design and dimensioning of the propellant supply of a rocket igniter

Aerospace engineering

A. EL GUINDI

P. LEROUX

Adam EL GUINDI / Pierre LEROUX
Academic supervisor: P. BREQUIGNY
Industrial supervisors: M-S. LACHESNAIS, D. TCHOUKIEN

Institution: CNES (National Center of Space Research)

Objective/motivation

The goal of this project is to build a test bench for a rocket engine torch igniter. Its function is to initiate the combustion in the main chamber and to ensure the ignition of all of the species injected. The igniter has already been designed and just has to be tested in order to adjust it and provide the correct flows. Two kinds of propellants will be used: CH4/Ox and E75/Ox. Then, tests will be conducted to determine the characteristics of the flame and in particular its length. To allow the use of only one igniter for these two fuels, sonic throats were chosen. These throats are easily removable to allow flexibility for the propellants used.

Results

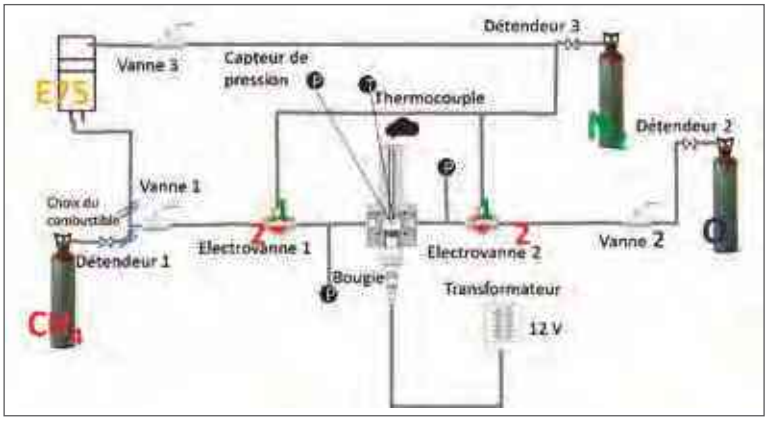
All the needed pieces were designed and ordered. Moreover, everything has been done in accordance with the security engineer of the university. We also chose our connection systems to be able to easily change our throats to adapt our igniter to the propellants used. Nevertheless, because of the delays of the orders, we were not able to obtain a flame. We focused our work on the preparation of the tests and on numerical studies. Thus, we modeled our system on ANSYS Fluent©. First, we observed the mixing inside the chamber, and secondly we initiated the combustion and obtained the flame characteristics.

Keywords: igniter, rocket, methane, PERSEUS, ethanol

Modelling of our test bench

Example of firing

Swagelok connection for our throats



Synoptic drawing of our test bench

Contact: elguindiadam@gmail.com ; pierreleroux10@hotmail.fr

Towards an analytical solution for eco-driving

Energetics


C. DELAYE


F. DUENAS


Z. HUANG

Charles DELAYE / Felipe DUENAS / Zhiyuan HUANG
Academic supervisors: G. COLIN, K. GILLET
Industrial supervisor: J. BOURIOT

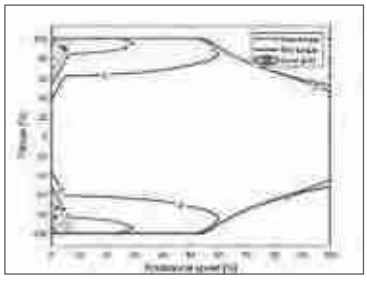
Company/Institution: PSA Groupe, PRISME Laboratory

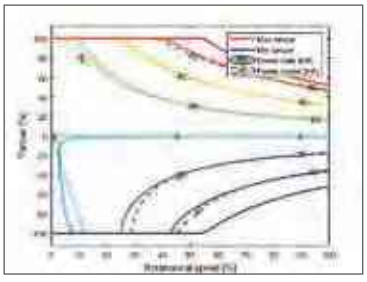
Objective/motivation

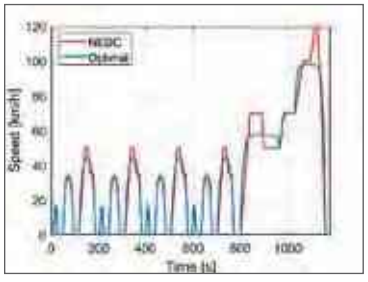
The main objective of our project is to optimize a given speed profile in order to minimize energy consumption. There is already a solution that exists but it uses dynamic programming which can be slow and might need a large amount of calculation memory. Therefore, what we want now is to establish an analytical equation based on optimization methods such as Pontryaguin minimum principle to minimize the calculation time. This project derives from a context of mobility transition and increasingly severe emissions regulations. Our solution should be suitable to every type of motorization (electric, hybrid or combustion engines). At the end, the analytical solution could be used, for instance, in the Vehicle Control Unit directly or it could give feedback to the driver letting him know how he should drive in order to minimize energy consumption.

Results

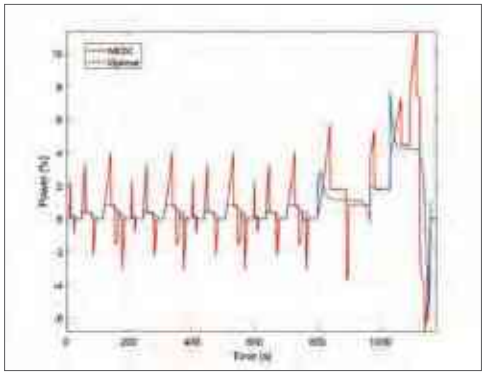
The first step of our project was to study several research papers summing up previous studies on this topic. Those papers use a method of optimal control to find the analytical solution. First of all we focused on electric vehicles which are the easiest to model because they don't have gear ratios. Inspired by some research papers, we programmed a model of the electric vehicle. Next, we evaluated the accuracy of this model by conducting an analysis of the error between the experimental data given by the company and the model output. Once we verified that our model was accurate enough, we moved on to the study of different speed profiles based on reglementary driving cycles. The optimal trajectories of these speed profiles were computed thanks to an algorithm provided by a research engineer working with us.


Error between model and data [kW]


Comparison MAP model vs data



Comparison optimal speed profile vs real NEDC cycle



Comparison of power: NEDC vs optimal speed profile

Keywords: eco-driving, motorization, optimization, environment, Advanced Driver Assistance Systems (ADAS)

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Unsteady modeling of a two-phase exchanger for the active cooling of a scramjet

Aerospace engineering


L. COPIL


E. TERRASSE

Léandre COPIL / Eddy TERRASSE
Academic supervisor: I. FEDIOUN
Industrial supervisor: S. POEUF

Company: MBDA Systems

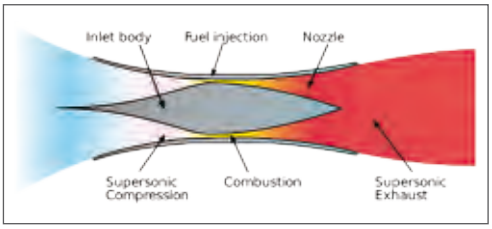
Objective/motivation

The objective of this project is to model the evolution of temperature in a two-phase flow between two parallel plates (which represent the heat exchanger) depending on inlet velocity and the kind of fluid used in it. The temperature is modeled in 1D in the streamwise direction thanks to the heat equation and the model is coded using MATLAB®. The goal is to check, by knowing the wall temperatures, whether or not the exchanger will be able to maintain structural integrity of the engine. Since an internship will prolong this project in September, the code and the report must be as clear as possible in order to make them easy to understand.

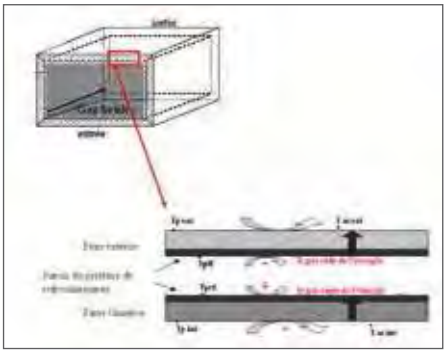
Results

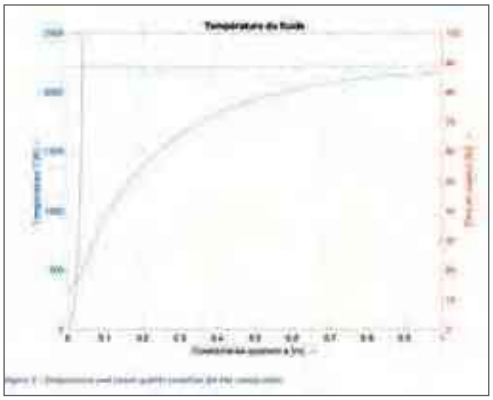
The problem is first modeled using some simplifying physical hypotheses in order to set up the basis of the code. The goal is to have a working code for a very specific situation and make it gradually general by suppressing hypotheses one by one. For instance, the phase change is not considered first, and the different physical properties of the fluid are supposed constant. Presently, the code is physically accurate and can be used for different kinds of fluids in the heat exchanger and the user can also decide what physical phenomenon they want to consider. The next step will be to compare this 1D code with CFD modeling in order to prove the accuracy of the model.

Keywords: scramjet, cooling, modeling, unsteady, two-phase flow



Schematic drawing of a scramjet (Source: Wikipedia)


Schematic drawing of the heat exchanger (Source: MBDA project presentation)


Temperature and steam quality evolution for the steady state

Contact: leandre.copil@etu.univ-orleans.fr ; eddy.terrasse@etu.univ-orleans.fr

Unpublished project in Technologies for Energy, Aerospace and Engine

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

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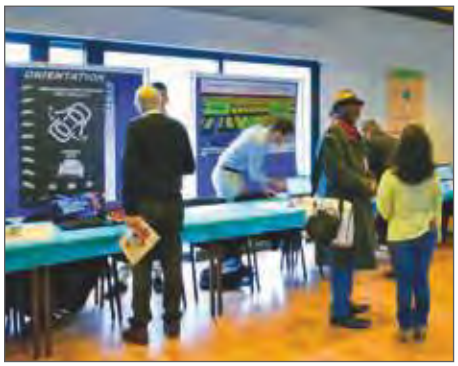
The Final Year Projects Forum

Each year, students who are completing their final year of studies at Polytech Orléans compete to participate in the Final Year Projects Forum 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 listing of all participants in the Final Year Projects Forum of 2019-20, please see page 190-191.



Our remarkable equipment

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

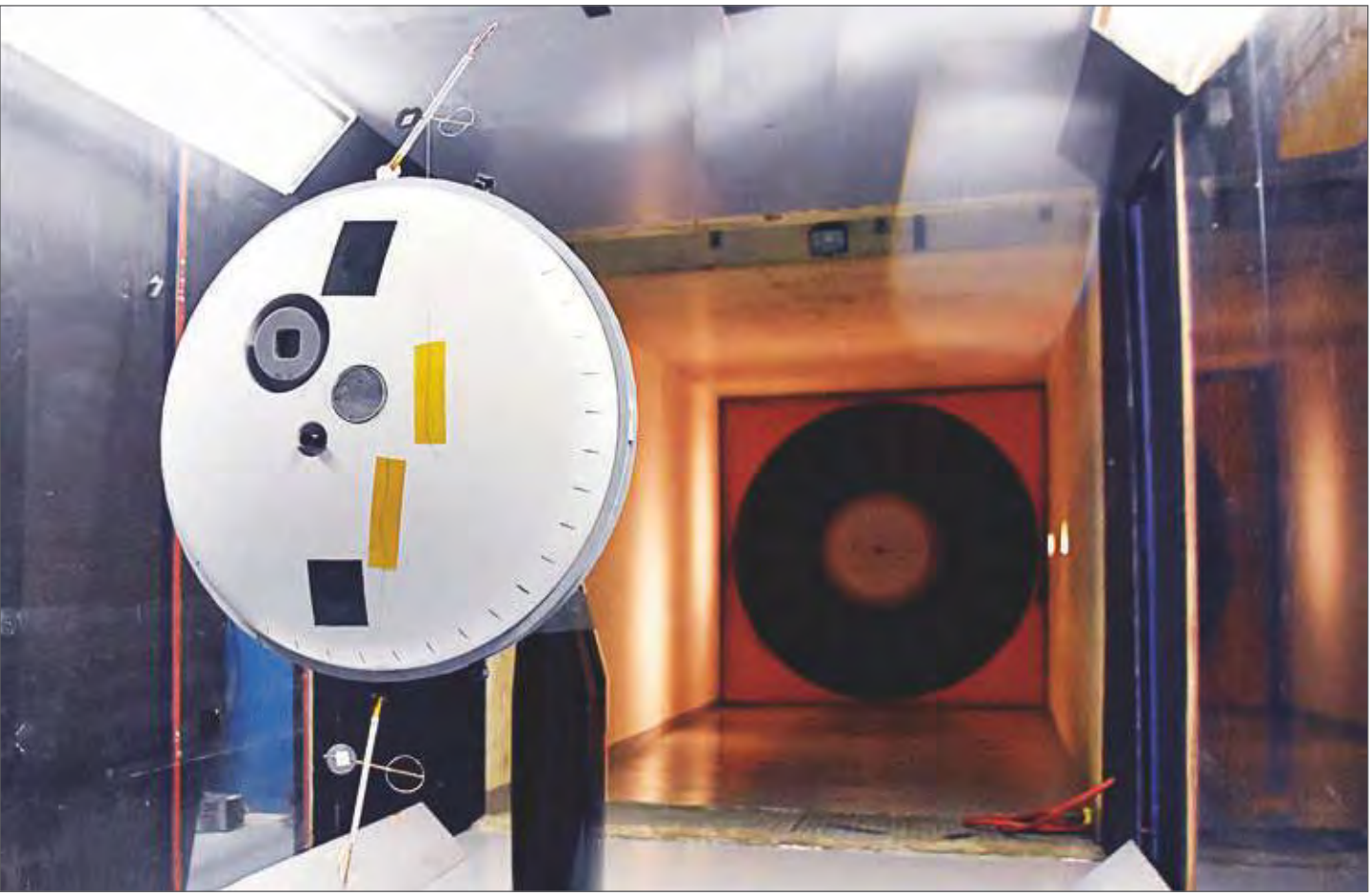
Clean Room
A class 10,000 clean room of 100m^2 is in service at the GREMI laboratory of Polytech Orléans. Students working in the Engineering Physics and Embedded Systems specialty carry out their practical work study projects in micro/nano-technologies and plasma processes in this facility.

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

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

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

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



Index of students

Final Year Projects Forum Awards

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

Index of participating companies and institutions

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