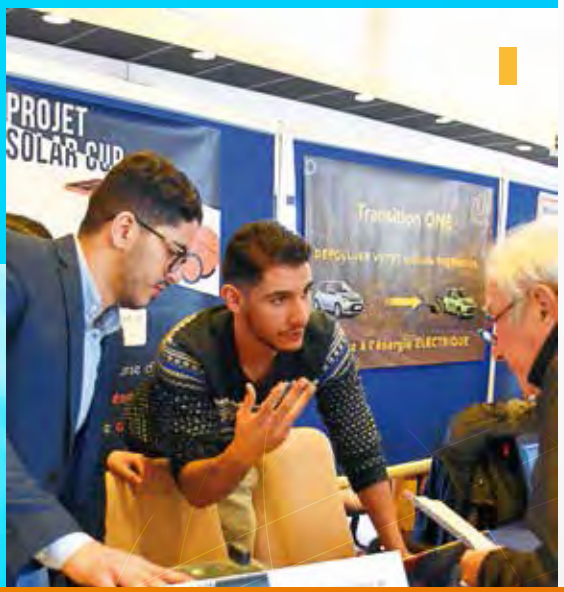
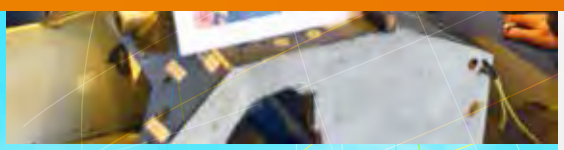




POLYTECH®
ORLÉANS
School of Engineering of the University of Orléans

Student Projects Catalogue 2017-18

Polytech Orléans

Ecole Polytechnique de l'université d'Orléans

Direction management des formations, prospective et innovation pédagogique

☎ : 02 38 49 43 56

🖷 : 02 38 41 73 83

✉ : directrice.formations@univ-orleans.fr

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

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

Site de l'IUT de l'Indre
2 rue François Mitterrand
36000 CHATEAUROUX

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

Contents

Message from the Director

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

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

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

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

Christophe Léger
Director, Polytech Orléans

For further information:
Direction des Relations Entreprises, Stages, Innovation, Formation continue
12 rue de Blois, BP 6744, 45067 Orléans cedex 2
02 38 49 48 48
relations.entreprises.polytech@univ-orleans.fr

The Final Year Projects Forum

Each year, students who are completing their final year of studies at Polytech Orléans compete to participate in the Final Year Projects Forum under the direction of Jean-Jacques Yvernault. Students may present their projects individually or in groups, after which a selection is made by each department head of those projects which will compete before a jury of knowledgeable professionals from businesses and institutions in the wider community. During the Forum, each student or group of students presents their project over the course of an entire day, beginning with a general assembly during which a brief oral description and PowerPoint® presentation is made. This is followed by in-depth discussions with each jury member at individual stands constructed by the students, where they are able to give a more detailed explanation of their work. The jury selects and makes an award to each of the five best projects of the Forum and also presents the Innovation Award.

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.

Civil Engineering

Analysis and sizing of a retaining structure of an interchange on the Quai d'Ivry road

Civil engineering


N. MORTADA


Z. OUOLOGUEM

Nourhan MORTADA / Zeinabou OUOLOGUEM
Academic supervisor: T. EGGEN

Company: Artelia

Objective/motimotivation

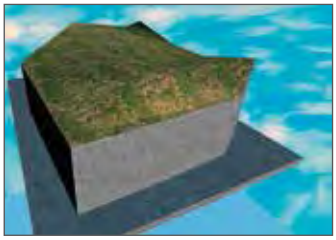
The works concern the requalification of the Quai d'Ivry interchange on the Paris road. It is part of the development project "PARIS RIVE GAUCHE", and, more particularly, of the overall development of the Bruneseau sector between Boulevard Jean Simon in Paris and the town of Ivry. The project is one of those related to Artelia, which is a construction and studies company in the domain of civil engineering. This project has already been executed, but we are going to apply our own studies to it with the university and make a comparison between our results and theirs to see if there is any error in our work.

Results

The aim of the project is to calculate a type of foundation called piles. The company decided to choose this type of foundation because of the huge loads that pass on this road. Our tasks are based on making a bibliography about this type of foundation, modeling of the area where the project will take place using the program Mensura, calculating all the loads and also calculating the dimensions of the foundation. We are satisfied with what we have provided because the results we have obtained are very similar to the results of the company, so there is not a big error rate in the calculations, which means that our method of work is correct.

Keywords: foundation, pile, modeling


Location of the project


Simulation of the terrain

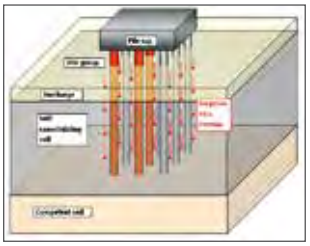

Pile in a group


Diagram of the project

Contact: mortadanourhan@gmail.com ; zeinabou.ouologuem@gmail.com

Anisotropy of elastic modulus and mechanical resistance of fractured rocks by numerical simulations

Civil engineering

B. CHEN

X. HU

Biao CHEN / Xiao HU
Academic supervisor: D.DO
Industrial supervisor: D.DO

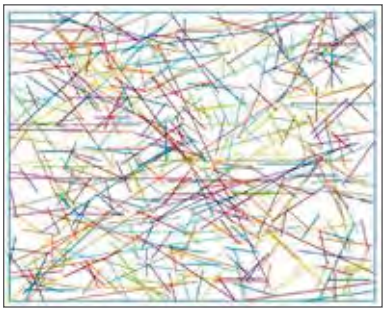
Institution: PRISME Laboratory

Objective/motivation

The study of the behavior and characterization of fractured rocks is an important subject due to its wide application in the geotechnical field (deep tunnel, storage structure, etc.). When we design an underground construction in a fractured rock mass, we tend to idealize the fractured rock mass as a homogeneous medium and simulate the influence of joint planes by weakening the rock mass parameters according to empirical models which are usually proposed in the framework of "rock mass classification". However, the empirical models are always conservative. We therefore want to use the numerical method to calculate the equivalent parameters, whether it's more accurate or not. The objective of this study is to characterize numerically the mechanical properties (elastic modulus, compressive strength, tensile) of fractured rocks.

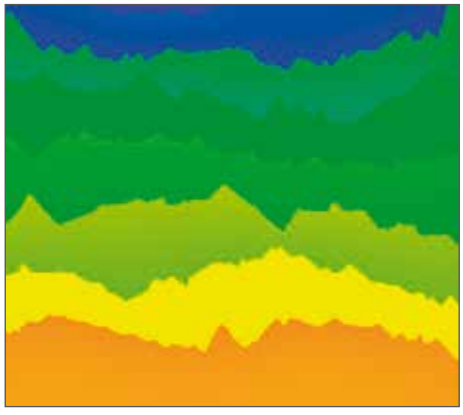
Results

In the first stage, we needed to define/reconstruct successfully the fractured rock masses by using the statistical data obtained from a real site. In the second stage, we applied the method called Embedded Fracture Continuum (EFC) in which we replace each cell mesh intersected by one/multiple fractures by an equivalent medium using the solution of the joint model. In the next step, the calculation to estimate the effective elastic properties (Young's modulus, Poisson's ratio) of the fractured rock masses was conducted by using the software Matlab and Flac3D. A simple test to calculate the effective strength of fracture rock masses was also considered, in which we used the model elasto-plastic parfait (Mohr Coulomb) for both the fractures and intact matrix.



The modeling of the fracture network

Keywords: fractured rocks, anisotropy, Matlab, flac3D, mechanical properties



The deformation schema

The equivalent medium model

Contact: biao.chen@etu.univ-orleans.fr ; xiao.hu@etu.univ-orleans.fr

Application of the surface response method to study the behavior of a deep tunnel

Civil engineering


R. KARAM


T. VERNAT

Reda KARAM / Thomas VERNAT
Academic supervisor: D. DO

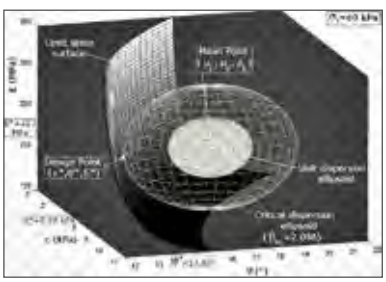
Institution: Lamé Laboratory

Objective/motivation

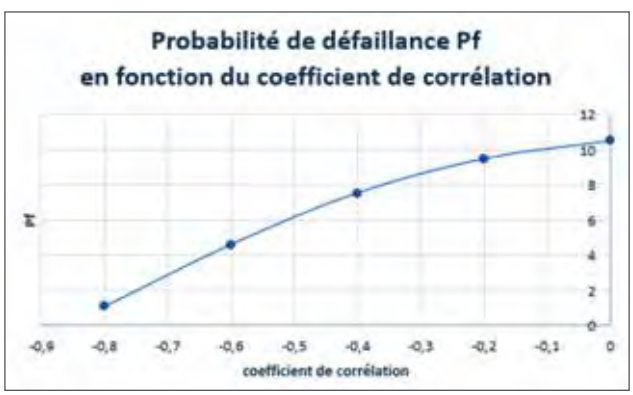
This project focuses on a probabilistic method for analyzing the behavior of deep tunnel in which the uncertainty of different parameters will be accounted for. For this purpose, the first order reliability method (FORM) and the response surface method (RSM) are considered to determine the reliability index. The former method can be utilized in the case where explicit expressions of the performance functions are found. Otherwise, if explicit performance functions are not available, the latter method, the Response Surface Method (RSM), which allows us to approximate the performance functions, is used. In sum, the RSM constitutes a bridge that will lead us to execute FORM.

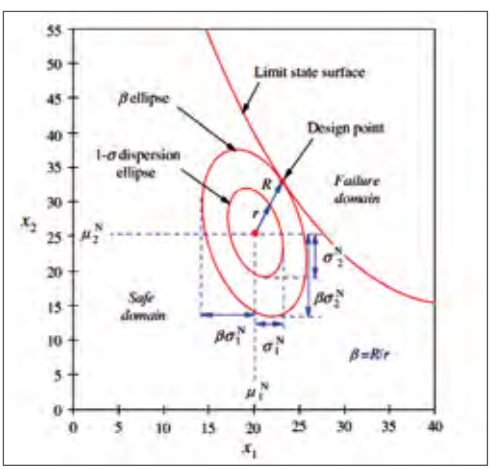
Results

First, we began reading and understanding the problematic. Then we started analyzing an Excel® spreadsheet where the FORM is already implemented for its use. To begin, we studied the case where the tunnel did not necessitate any lining, which required us to use only two performance functions. Second, we considered the presence of a concrete lining, which required us to implement a third performance function. The calculations were carried out with the solver by fixing as an objective the reliability index whose value must be minimal and have the performance functions as constraints which must be equal to zero. Finally, in the case of the unavailability of the performance functions, the RSM has been used to approximate them and thus to proceed to the calculations already made when they were explicit.



Keywords: tunnel, reliability, FORM, RSM





Contact: karamreda9@gmail.com ; thomas.vernat@etu.univ-orleans.fr

BIM development: establishment of the concrete pilot of a construction project in Montlouis (Tours)

Civil engineering


C. FIDELIN


J. NIVOSE


M. TRINEL

Cassandre FIDELIN / Jocelyn NIVOSE / Mathilde TRINEL
Academic supervisor: N. BELAYACHI
Industrial supervisor: G. LECOEUR

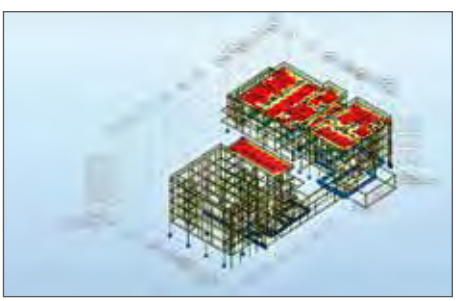
Company: Bouygues Bâtiment Centre Sud-Ouest

Objective/motivation

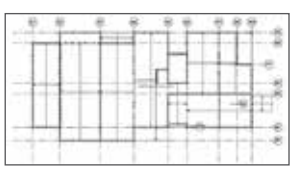
The main objective of our project is to oversee the establishment of the pilot of a construction project. All during our project, we have used innovative technology which is increasingly used by all companies in the construction field: the BIM (Building Information Modeling). It allows all trade bodies to work on the same digital model. Our tasks initially consist of deciding on the construction methods, pre-sizing reinforced concrete elements and then using the digital model created by the architect in order to provide formwork plans. This project is very enriching for us because the Bouygues Construction structural engineer works on the project at the same time as us, which allows us to compare our methods and results. Moreover, this project allows us to work like engineers, to be innovative and to join technical and computational aspects. It also teaches us to manage and find solutions when we encounter problems and, finally, gears us up for our near immersion in the world of work.

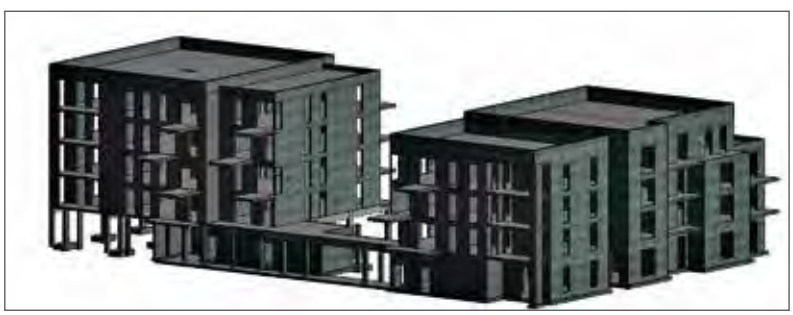
Results

First, we analysed the best technical and economical compromise to choose the construction methods designed for this project and established the structural frame. Second, we had to provide formwork plans. We updated the digital model and made necessary changes to make it compatible with a structural study. Then, using the structural software ROBOT, we calculated reinforced concrete ratio and compared our final structural study with that of Bouygues. All during this project, we used technical and project management knowledge, modeling and structural software and our skills acquired during our three-year training. It was very interesting to work on an actual project that has allowed us to develop a wide range of skills. Additionally, the conclusions we made about the use of BIM technology will enable us to be aware of contentious points and will allow us to improve them with the aim of generalizing their use.


Structural analysis (ROBOT)

Keywords: Building Information Modeling, construction methods, structural analysis, reinforced concrete ratio, formwork plans


Structural frame


REVIT model

Contact: cassandre.fidelin@etu.univ-orleans.fr ; jocelyn.nivose@etu.univ-orleans.fr ; mathilde.trinel@etu.univ-orleans.fr

Characterization and modeling of the THM behavior of a soft rock

Civil engineering

S. KHARRAZI

M. Y. RGUIBI

Salma KHARRAZI / Mohamed Youssef RGUIBI
Academic supervisors: A. HASSINE, D. HOXHA

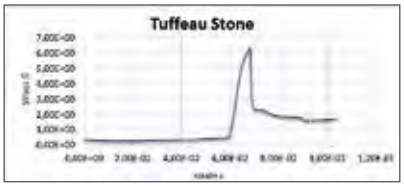
Institution: Lamé Laboratory

Objective/motivation

This project is a continuation of research that was previously conducted in collaboration with the University of Budapest on the characterization and modeling of rocks and stones, used in the construction of wine cellars operated by local artisans. The entire project will take place in the LaMé laboratory of Darcy Hall at Polytech Orleans. Our work is to measure the deformation of rock during the tri-axial compression test, applying different confining pressure, by using strain gages and a dynamic data software with the aim of establishing a behavior model for this rock. Mechanical characterization tests will also be measured by The LINSEIS TMA which measure the variation in solid length and the penetration depth of a reference probe in an elastic sample.

Results

In the beginning, we started by contacting the head of the project at the University of Budapest in order to receive the latest results. We then did a bibliographic research about strain gages to understand how they work and find the best way to paste them on rock samples. Then we started doing blank tests on regional rocks in order to master every step of the experiment and identify all sources of errors. We performed triaxial compression tests on a sample of tuffeau so we could deduce the mechanical characteristics of the stone: Young modulus and Poisson's ratio. In parallel, we prepared samples of different kinds of rock to manage the TMA machine and ensure its proper operation.



Stress-strain curve showing yield behavior of tuffeau rock

Keywords: triaxial test, Young modulus, mechanical analysis, strain gauge, behavior model

Thermo mechanical analysis (TMA)

Hydraulic press

Contact: kharrazisalma50@gmail.com ; mohamed.youssef.rguibi@gmail.com

Characterization of the Young's modulus attenuation

Civil engineering


K. EGLO


A. MORIN

Kevin EGLO / Antoine MORIN
Academic supervisor: C. MALLET

Institution: PRISME Laboratory

Objective/motivation

The aim of this project is to characterize the effect of damage on the Young's modulus attenuation. The subject comes from the desire to understand well how nuclear waste storage glasses can be properly stored. Indeed, when the glass is buried, we can imagine that all the stress due to this underground conservation could create cracks on the stored glasses. In the long term, we could imagine a disaster. Thus, to identify these cracks, we have worked on triaxial experimental data obtained under different stress conditions. These results allow us to describe the time-evolution of the deformation and the number of acoustic emissions. We then put these data into a MATLAB code calculating the Fourier transformation for each stress step leading to the frequency-dependence of these data, especially the Young's modulus and its attenuation.

Results

Working on this project allowed us to confirm that for different stress conditions, we do not obtain the same acoustic emissions. The first step of our project therefore was to sort out this data and eliminate some of them. After this stage, and the work on MATLAB which gave us the evolution of the Young modulus, we can say that due to the conditions of the sample (that is, whether or not the sample is drained), we obtain an effect on the attenuation of the modulus. We can add that temperature conditions also affect the evolution of this parameter. When the temperature is higher, the attenuation of the Young modulus is less.

Keywords: cracks, acoustic emission, Fourier transformation, MATLAB, deformation

Contact: kevin.eglo@etu.univ-orleans.fr ; antoine.morin@etu.univ-orleans.fr

Creating digital 3D model of Trinité Chapel of the Palace of Fontainebleau by 3D scan

Civil engineering

C. LI

B. TECHER

Chenyang LI / Boris TECHER
Academic supervisor: X. BRUNETAUD

Institution: Lamé Laboratory

Objective/motivation

As time passes, different patrimonial architectural works have shown several issues concerning their renovation or some scientific analysis. The purpose of our fifth-year final project is to scan the Trinité Chapel of the Palace of Fontainebleau and, subsequently, process the data collected and build a 3D model of this chapel using the software programs Recap, Scene CloudCompare and MeshLab. This 3D model can help architects and technicians with repairs and maintenance of the chapel in the future. Before the scan, we used some scan data to familiarize ourselves with the software. Under Mr. Brunetaud's guidance, we did the scan on February 27 with the permission of the managers of the Palace of Fontainebleau. The scan process went smoothly. We chose several conducive places to put the scanner which worked automatically after it was set up.

Faro scanner

Results

After we completed the scan at the Palace of Fontainebleau, we worked on the data processing. Since we scanned roughly 50 times at different locations, we collected approximately 50 sets of separate data. To process data, first of all, we used the software SCENE to rearrange individual data so that we could obtain a comprehensive scan which contained all the data collected. This work was time-consuming because it had to be done by processing each set of data. Finally, a digital 3D model was established. Then we used the software CloudCompare to correct this 3D model as there were some points which were unnecessary and needed to be deleted from the scan. We got a clear, complete and correct digital 3D model in the end. Through this project, we explored a new field that we had never before encountered. We learned to make a 3D scan for a building and to process data using different software which we had never used before. We find this project interesting and useful for our future work.

Interior scan

Exterior scan

Scanning the Trinité Chapel

Keywords: 3D Scan, Digital 3D Model, SCENE, CloudCompare

Contact: chenyang.li@etu.univ-orleans.fr ; boris.techeri@etu.univ-orleans.fr

Creation and improvement of functionalities in BIM Tekla Structures

Civil engineering

B. KOUAKOU

C. MENJIVAR

Brice KOUAKOU / Carlos MENJIVAR
Academic supervisor: T. EGGEN
Industrial supervisors: M. COMMUNAL, S. ERLICHER, N. QANG SANG

Company: Egis

Objective/motivation

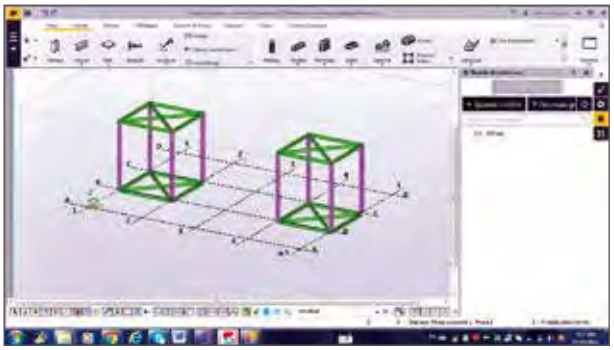
This project has been assigned to us by the Egis Company as a fifth-year final project. This company contacted us in order to solve a bug in one of their programs which is a BIM (Building Information Modeling) tool called Tekla Structures. Our task was to make a program enabling the tool to mirror any geometric shape. However, a bug in the copy mirror function from the software Tekla had initially been detected by the company as they sought to copy steel concrete reinforcing bars. Subsequently, our task was to create a function that would allow them to achieve their goal without any bugs. For that purpose, we used the coding language called C Sharp. We also used the Visual Studio software to test our program and to have, at the same time, access to the Tekla software.

Results

We encountered some difficulties to start our project because we did not have any former knowledge about C Sharp programming. The first phase of our project was a learning phase. We started from scratch and learned the basics at first. We then learned how to use the Tekla Open API which gave us access to the software using C Sharp. We then looked for existing source codes dealing with the copy mirror function to make further progress toward our objective. We carried out our function in three steps. The first was to select the object, the second was to draw an axis, and the final step was to copy the object according to the axis. We ultimately achieved our goal and made an operational function. However, that function is limited to beam-shaped objects.

Keywords: C Sharp, Open API, Tekla Structures, BIM

Illustration of the modeling of the copy mirror function



Copy mirror function in Tekla Structures

Contact: briceaimekouakou@outlook.com ; carlos.menjivar@etu.univ-orleans.fr

Definition of the flood protection system of Orléans Metropolis

Environmental engineering

O. LAOUAN

A. M'MADI

Omar LAOUAN / Adinani M'MADI
Academic supervisor: L. LEFORESTIER
Industrial supervisor: N. BILLET

Institution: Orléans Metropolis

Objective/motivation

In 2017, the city of Orléans became a metropolis, of which there are now 22 in France. This new designation means that Orléans must take over new responsibilities and new missions from the French government and from the urban community. One of these missions is GEMAPI, which concerns managing aquatic environments and flood prevention. The purpose of our project is to support Orléans Metropolis in this mission. Having responsibility for the GEMAPI mission means that Orléans Metropolis must define its flood protection system to prevent human and economic casualties so as to make the metropolis more attractive for businesses and safer for people.

Results

In order to help Orléans Metropolis, we had to make a book of specifications which will be given to a design office. First, however, an important step was to clearly define the state of the current flood protection system. This was done by making an inventory of the necessary dikes. Second, we defined the necessary steps for the metropolis to take in order to master a new flood protection system which clearly showed the current flood protection system.

Keywords: dikes, Loire, Orleans, GEMAPI, flood

Spillway at Jargeau

Spillway of the Orléans canal

Dike, rue des Hautes Levées

Dikes, quai des Augustins, levee at Orléans

Contact: lomarfarouk@gmail.com ; mmadi.adi@live.fr

Design of a well for the study of the unsaturated zone of the Beauce limestone aquifer

Civil engineering


A. BARRE


W.J. KABORE

Adrien BARRE / Wendkûni Josaphat KABORE
Academic supervisor: D. HOXHA
Industrial supervisor: A. ISCH

Companies/Institutions: ISTO - UMR 7327, University of Orléans, CNRS, BRGM

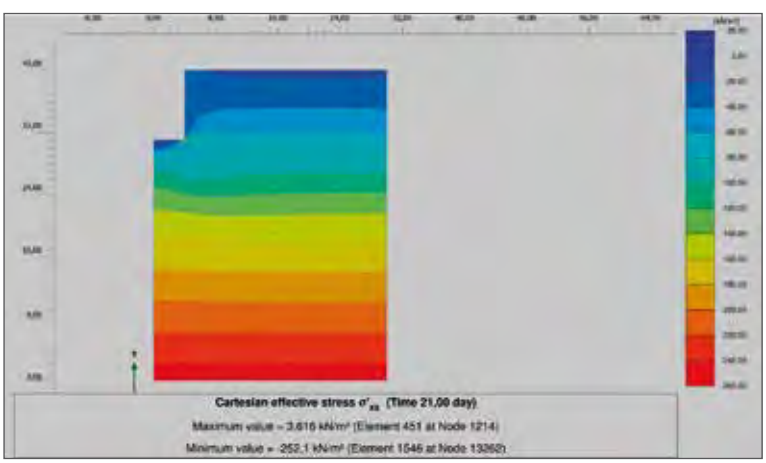
Objective/motivation

Understanding and quantifying transport processes in the vadose zone of the Beauce limestone aquifer is of significant importance. As part of the work of "O-ZNS" (Observatory for Non-Saturated Zone transports) platform (PIVOTS project), our fifth-year project consists in designing a deep well dedicated to the instrumentation of the entire vadose zone from the top of the soil down to the water table located several meters below the ground. This well will be equipped with sensors and samplers which will be put in place, removed or replaced at will all along its vertical extension. The engineering challenge will be to allow for the largest access to vadose zone materials while preserving the mechanical strength of the well walls at a faultless and durable level. Technical choices will be crucial because the building materials will have to be relatively inert with regard to the vadose zone materials and have to limit heat, water and gas exchanges between the vadose zone materials and the inside of the well. Our complementary cursus (public works and geo-environment) will allow us to meet the requirements to fulfill the project.

Results

The first step was to drill and run analysis of the vadose zone materials at the future location of the well to have its composition, physical parameters and mechanical strength. With these geological and geotechnical data, we did a simulation model to see and anticipate the behavior of the soil, and the failure points during and after the well is built. Thanks to that, we determined the weak points in the soil and decided to reinforce the structure of the well at some points. Finally, we suggested different techniques of digging and building to the ISTO and we estimated the costs of the work for the different techniques. The choice of the way to build the well comes to the laboratory.


Soil sample



Effective stress witnessed during the digging process

Keywords: Beauce limestone aquifer, geotechnics, vadose zone, well, 2D modeling

Contact: adrien.barre1@etu.univ-orleans.fr ; wendkuni.kabore@etu.univ-orleans.fr

Development of a new method to detect and quantify pollutants in soils and waters

Geoenvironmental engineering

A. MADOUCHE

C. SCHIVO

Ayoub MADOUCHE / Céline SCHIVO
Academic supervisor: C. DEFARGE
Industrial supervisor: M. GAILLARD

Company: IDDEA

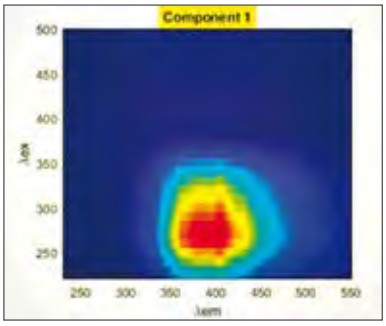
Fourth Place
12th Annual Final Year Projects Forum

Objective/motivation

The purpose of this project is to develop a quick and easy method to detect pollutants in soils or in waters. Current methods take a long time (approximately one week to get the results) and may be expensive for large quantities of samples. This new method will be quicker: approximately ten minutes to analyze a sample and one day to have the results. The method we are developing is based on fluorimetry, i.e. the measure of the fluorescence of organic compounds. Our work consists in verifying which pollutants commonly present in industrial sites can be detected and quantified by this method, and to test it with actual field samples. The project might be the first step to further development of instruments that could be used in the field.

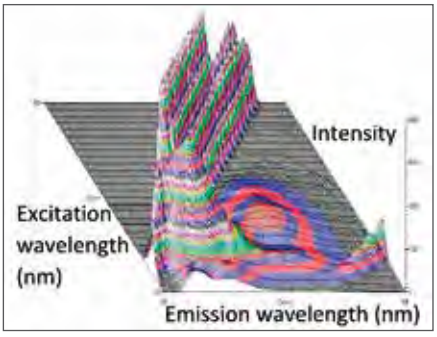
Results

With the help of the partner company, we chose samples from potentially contaminated soils. They were treated (pollutant extraction) by the analytical partner of the company (Wessling) and aliquots returned to us. Thanks to the fluorescence analysis made in the partner laboratory (R&D Unit CETRAHE of the University of Orléans) and its data bank on fluorescent molecules, we looked for determining the type of pollutants present in the sample. The first samples we analysed didn't give us clear results. For the Polycyclic Aromatic Hydrocarbons' family, a part of the results was hidden. This interference was due to the solvent used to extract pollutants. To solve our problem regarding soil samples, we looked for another solvent and found one which could be used without any risk of interference. This method is currently being developed for the purpose of making pollution diagnoses but it could also be used during pollution monitoring or natural attenuation monitoring.



2D graph of a fluorescence analysis showing the presence of a pollutant compound, after treatment by PARAFAC

Keywords:
innovation, detection, pollution of soils, fluorescence



3D graph of a fluorescence analysis

Spectrofluorometer

Contact: ayoub.madouche@etu.univ-orleans.fr ; celine.schivo@etu.univ-orleans.fr

Development of a protocol to treat soils polluted by nitrogen compounds

Environmental engineering

Y. AYDIN

C. HORI

Yilmaz AYDIN / Cheyenne HORI
Academic supervisor: L. LEFORESTIER
Industrial supervisor: Y. LE RHUN

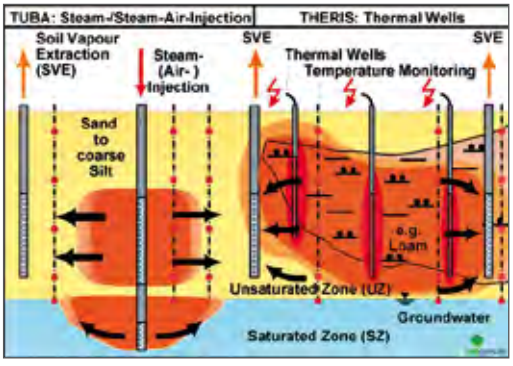
Company: OGD

Objective/motivation

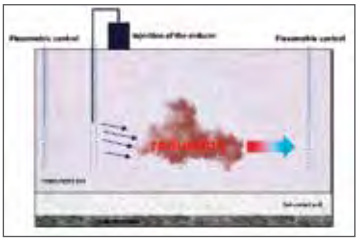
The concern about polluted soils is being taken more and more into account. Indeed, it's a real problem for human health but also for the environment. This project is in partnership with the company OGD, a member of ORTEC Group, and it deals with the pollution of nitrogen compounds. More precisely, it is about cleaning a former site of fertilizer manufacturing. Pollution gets ahold at a depth of around seven meters and the different methods usually used to counter this pollution are possible only on the surface (around two or three meters depth maximum). Solutions have already been proposed by a design firm but the client finds that they are too expensive. Our mission was to find something else to reduce the price of depollution.

Results

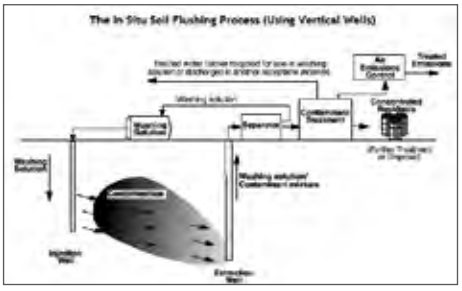
To solve the problem, we decided to establish a protocol on-site, for which we did a lot of bibliographic research. After several weeks of research, we found many solutions, but only a few are possible in our case: washing, thermal pumping or chemical reduction. We focused on these and especially on chemical reduction because the OGD required us to do so. We wanted to receive soil samples in order to begin tests in the laboratory. Unfortunately, we didn't have time to begin this part so maybe it will be done during another project or an internship this summer. Finally, we wrote the protocols of theses processes and we established a table with advantages and disadvantages for each.



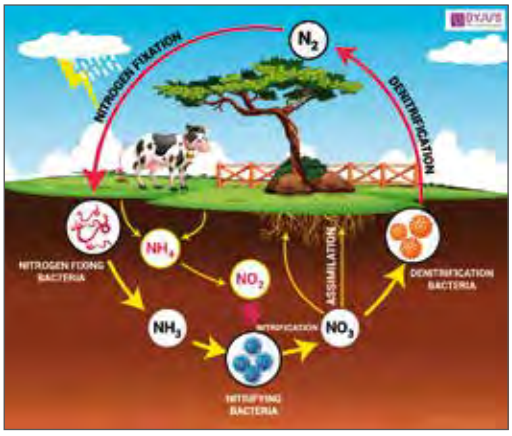
In situ thermal pumping: https://www.researchgate.net



Chemical reduction, adapted from: http://www.selecdepol.fr/fiches-techniques



In situ washing process: http://infohouse.p2ric.org/ref/07/06188/



Nitrogen cycle: https://byjus.com/biology/nitrogen-cycle/

Keywords: nitrogen compounds, pollution, soils, depth

Contact: yilmaz.aydin@etu.univ-orleans.fr ; cheyenne.hori@etu.univ-orleans.fr

Dimensioning of cold and hot water supply circuits, sewage disposal systems and stormwater

Civil engineering

Abdelhak BOUAFIA / Mimoun MOUROUDY
Academic supervisor: M. BOUASKER


A. BOUAFIA


M. MOUROUDY

Company/Institution: undisclosed (confidential)

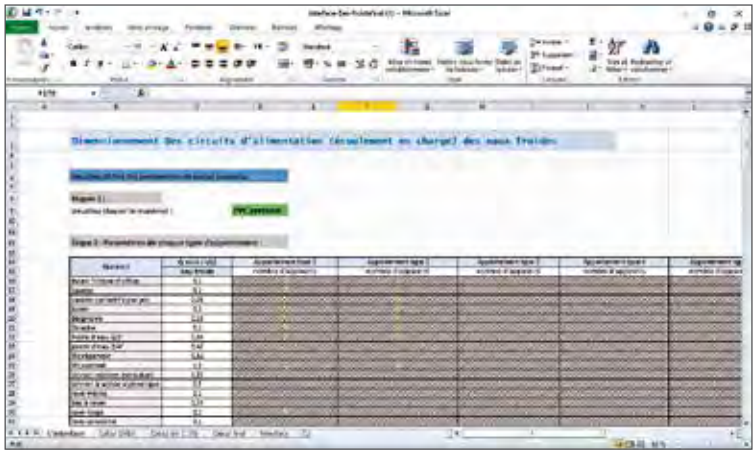
Objective/motivation

Modelling the plumbing network of a building is major because we cannot hand over buildings that do not meet the national standards. The purpose of this research is to create an Excel® worksheet that will be able to model a hydraulic system. A hydraulic system does not only supply water but also includes collecting rainwater and the disposal of domestic waste water from washing machines, washbasins, sinks, showers or bathtubs. For each part, the first phase of the project involves an analysis of how to design our Excel® table to adapt and perform correctly on any combination of systems within fixed limits. The user is invited to complete the user-friendly interface with raw data. The second phase, which is completely computerized, is to calculate for each pipe section based on "DTU 60.11 numerical rules of a domestic water system and rainwater disposal system" respecting the needs of each building.

Results

Results

The results of our project are three Excel® worksheets that calculate the outlet pressure in each section in the building and define the dimensions of cold and hot water supply tubes and evacuation tubes. We took into consideration all sorts of possibilities for all kinds of buildings. In our Excel® worksheet there are two papers which interest the user: the interface and the results. In the interface, the user is led to fill in the calculation data (type and number of apartment, materiel of the tubes, etc.). In the results, there is a table of tube dimensions for each section in the hydraulic system. Our program facilitates a very important calculation task, because there are a lot of formulas, and we succeeded in regrouping all of these formulas into one file. We also created a user manual to simplify the use of these programs for those who have no or little knowledge about the subject.


Interface

Keywords: plumbing network, hydraulic, DTU 60.11

Contact: abdelhak.bouafia@gmail.com ; mouroudymiun@hotmail.fr

Estimation of asphalt's Poisson's ratio

Civil engineering

F.K. FAYE

Fatou Ka FAYE / Mame Mané TOURE
Academic supervisors: D.P. DO, L. JOSSERAND
Industrial supervisor: A. BELKAHIA

M.M. TOURE

Company: COLAS

Objective/motivation

Asphalt's Poisson's ratio is not included in the mechanical properties that are measured during the concrete's formulations. There are values that have been used for a long time for sizing, but we do not know their origins or their degree of accuracy. These mechanical properties have an influence on the pavement structure and thus become key parameters of the design. That is why it is necessary to better evaluate these parameters, which we will do by ultrasound methods.

Results

After the ultrasound tests, we obtained different values of mechanical parameters. Then, these values were handled using the software Alize to look at their influence on a pavement structure.

Keywords: asphalts, mechanical properties, ultrasound waves, samples

Wrapped sample

Acquisition of ultrasound signal

Sensors positioned on the sample

Contact: fatou-ka.faye@etu.univ-orleans.fr ; mame-mane.toure@etu.univ-orleans.fr

Hydrogeochemical study of urban wet weather run-off in the Loiret River

Geoenvironmental engineering


C. BERNELLE


S. DOUYERE


Z. SHUANGJIANG

Clément BERNELLE / Sébastien DOUYERE / Zhao SHUANGJIANG
Academic supervisors: C. DEFARGE, M. MOTELICA
Industrial supervisor: C. MORIO

Institution: Orléans Metropolis

Objective/motivation

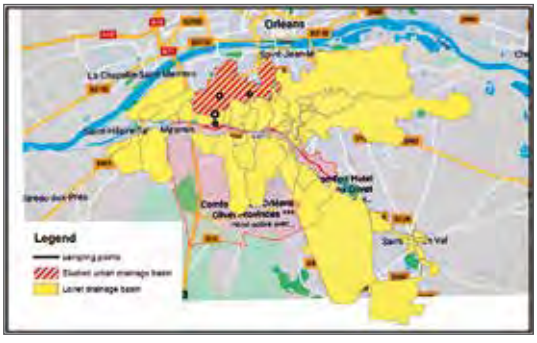
For a few years, there has been a reverse trend regarding the wastewater and storm water networks system: the separative networks. With this system, wastewater is guided toward the wastewater treatment plants, and the storm water directly toward the rivers. Yet the inhabitants of the urban community who have built a new bathroom or toilet may have connected their pipes to the pluvial network instead of the wastewater one. Thus, the storm water may carry sanitary wastewater. Furthermore, when the storm water flows along urban areas such as roads, industries or parking lots, it pulls pollutant particles along into the rivers. By studying storm water quality, it is possible to identify these phenomena and their sources. Our task consisted in studying the quality of the storm water affecting the Loiret River at four different points of the network and identifying the presence or not of unexpected pollution.

Results

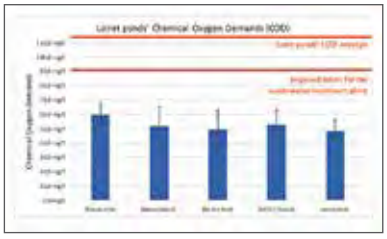
To determine the wet weather effluent quality, we measured and analyzed, both in-situ and in the laboratory, several parameters such as the pH level, conductivity, the chemical and biochemical oxygen demands and the quantity of suspended solids. The results have shown that the quality of the Loiret wet weather effluents is better than those discharged into the Loire, and below the imposed limits of the wastewater treatment plant effluents. Yet, according to the river quality assessment system, the effluents quality is "good" for all the parameters except for the Chemical Oxygen Demand, which is "poor", on a scale of "very good" to "mediocre". This project has allowed us to understand one of the several links between the public works and the geo-environment sectors, and the importance of those links. Indeed, we saw that what public works engineers do has an impact on the environment and thus on geo-environmental engineers' work.

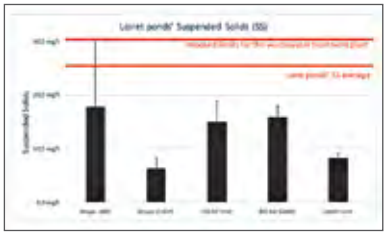
Keywords: urban run-off, storm water, Loiret, rainwater


Laboratory analysis



Studied area


Loiret ponds' chemical oxygen demands


Loiret ponds' suspended solids

Contact: clement.bernelle@etu.univ-orleans.fr ; shuangjiang.zhao@etu.univ-orleans.fr ; sebastien.douyere@etu.univ-orleans.fr

Hygromechanical behavior study of limestone

Civil engineering

H. AZIZ

I. BELKASSEM

Hajar AZIZ / Ibrahim BELKASSEM
Academic supervisors: M.A. HASSINE, K. BECK

Institution: Lamé Laboratory

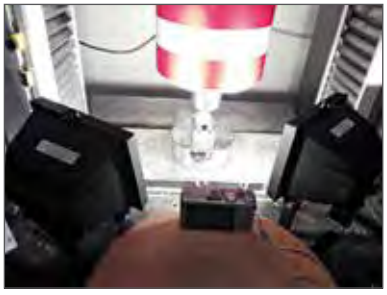
Objective/motivation

The decay of stones is caused by many factors, especially water transfer in the stone and ambient humidity, which can affect its mechanical properties. This project aims to study hygromechanical and hydromechanical behaviors of two limestones: tuffeau and richemont stone. These limestones are used in the construction of many monuments of the Centre-Val-De-Loire region, such as the Chateau de Chambord. Regarding the hygromechanical test, three cylindrical samples are prepared by coring. Then they are kept in a desiccator at constant humidity in order to impose a predefined degree of saturation. The vertical strain was deduced by displacement measurements over time. A three-points bending test was developed to determine the tenacity for two stones and to deduce the maximum stress of these stones to the propagation of cracks.

Results

We noticed from the measurements of water content that tuffeau has a high capillarity and hygroscopicity compared to richemont stone and it is due to the high porosity and poral network. We have also noticed that limestone is very sensitive to water transfer. In fact, the presence of water is able to weaken limestone, create high strains and large cracks and reduce its tenacity, which facilitates the propagation of the crack. It has also been noticed from the results of the various tests that the mechanical behavior of the two stones varies according to the direction of bedding planes.

Keywords: limestone, humidity, tenacity, anisotropy, damage



Contact: hajar.aziz@univ-orleans.fr ; ibrahim.belkassem@univ-orleans.fr

Indoor air quality control

Environmental engineering

M. DEMMER

C. GONZALEZ

Marion DEMMER / Cyril GONZALEZ
Academic supervisor: C. PROUST
Industrial supervisor: J-P. ORANGE

Institution: City hall of St. Jean de Braye

Objective/motivation

The town of St. Jean de Braye wants to adhere to a policy of sustainable development. In order to carry out this policy, they want to study the impact of construction materials on air quality in two buildings and ensure breathing air inside them is as healthy as possible. The first was built in a classic way, whereas the second was built with an environmentally responsible approach. The point is to show that the second guarantees a better air quality in order to justify its higher cost. We have to calculate a pollution rate inside each room of these buildings and determine the impact of each construction material on air quality. We have to go further than the law in our research activities because although a lot of pollutants are not standardized, they could have an impact on air quality.

Results

The main difficulty that we encountered was that we could not make any measure of air quality. Indeed, this work was too precise and we didn't have access to materials of sufficient quality. Thus, our study is based on technical data sheets of each construction material used in these buildings. Thanks to all the data, we were able to calculate a theoretical rate of pollution. In order to justify the use of ecological materials, we compared this rate to another calculated with materials with a lower emission class of Total Volatile Organic Compounds. Our work shows clearly that air quality is definitely healthier when ecological materials are used. Therefore, the choice of the city, even if it costs more, is really a good way to improve air quality and preserve peoples' health.

Keywords: air quality, TOVC, construction materials, pollution

Emission class A+ of TVOC

Espace Anne Frank, St. Jean de Braye

Dojo of St. Jean de Braye

Contact: demmermarion@gmail.com ; cyrilgonzalez7@gmail.com

Layout of a roundabout in Anisy, Calvados

Civil engineering

Q. BESNARD

G. DEVESA

Quentin BESNARD / Geoffrey DEVESA
Academic supervisors: T. EGGEN, L. JOSSERAND
Industrial supervisor: J. LUCY

Company/Institution: Iris Conseil, Calvados Dept.

Selected participant
12th Annual Final Year Projects Forum

Objective/motivation

Our project comes from the demand of the departmental council of the Calvados which wishes to secure an intersection near Anisy. In order to respond to their request, the design office Iris Conseil tasked us to carry out the pilot project phase. This project doubtlessly improved our mastery of the software Mensura. It permitted us to model the roundabout that we will implement at the intersection of two secondary roads: RD79 and RD220. The solution of a roundabout will give better visibility and driving comfort for the user. We then also must make sure that the structure will be able to manage the draining of rainwater. The final objective is to have an idea of the cost of the project before launching the calls to tender.

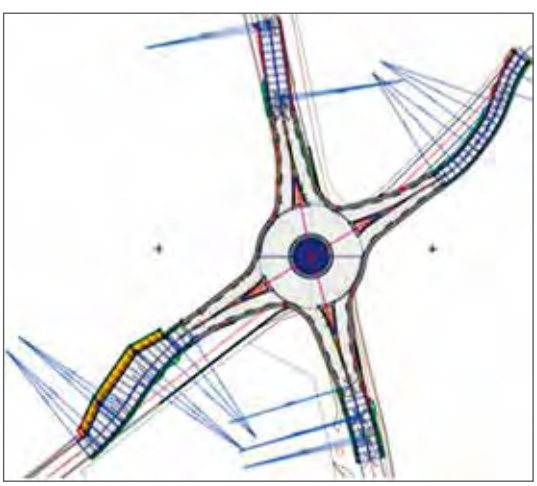
Results

As a result of our project, we fixed the new route of the intersection and the final position of the roundabout. We gave much importance to the environmental obligations which could be applicable to this area, such as the flooding risk, the fauna and flora protection sites or the purchase of as few parcels of farmers' property as possible. We designed the structure of the project using the sizing software Alize. Furthermore, we chose the appropriate draining system which flows into an existent basin. We paid attention to the filling and clearing ratio in order to optimize the realization of the project. Finally, we did the sequence of the tasks and the estimation of the cost. This project really improved our skills in the designing software Mensura and gave us the opportunity to work on the realisation of a concrete project before the call to tender phase.

Side profile of the roundabout

Keywords: layout, roundabout, environment, security, cost

Using designing software



Plan of the project

Contact: quentin.besnard1@etu.univ-orleans.fr ; geoffrey.devesa@etu.univ-orleans.fr

Making the town's technical center of St. Jean de Braye energy autonomous

Environmental engineering


J-P. TEHAHE


J. VERMOT-DESROCHES

Jean-Pierre TEHAHE / Johan VERMOT-DESROCHES
Academic supervisor: C. PROUST
Industrial supervisor: J-P. ORANGE

Institution: City hall of St. Jean de Braye

Objective/motivation

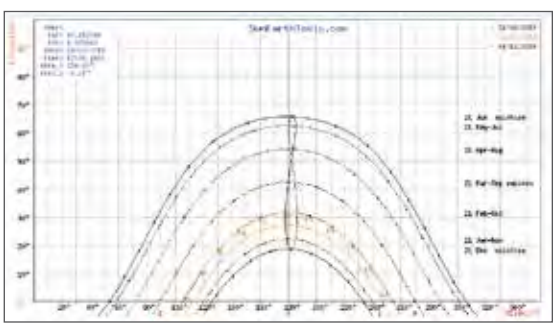
Municipal officials would like to use solar energy to produce electricity. Nowadays, they are only dependent on GRDF energies (electricity and gas to warm buildings). Our task is to make some feasibility studies (economic and technical) for the implementation of photovoltaic panels on the different roofs where it is possible and efficient. The final aim is to present a list of advantages and drawbacks to the mayor and his officials with several realistic propositions. We were particularly interested in this project because of the total freedom of action and the hall town people were open to any of our propositions, so we are holding all the cards to complete this project successfully.

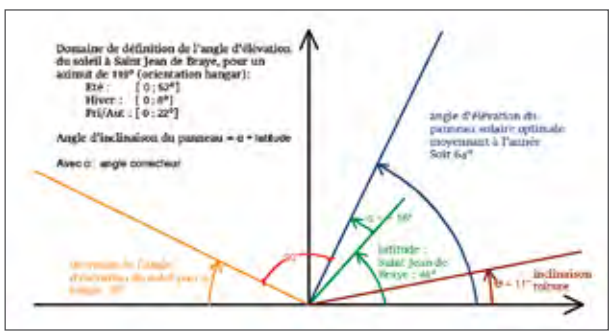

Measurement with the tachometer

Results

During this project, we did research about the functioning of a photovoltaic panel which was the most popular choice of the municipals officials. We also learned how it works and which size is the most efficient. We spent one week studying the specificities of the installation site. We identified specific-terms such as azimuth, elevation angle of the sun and the optimal angle of the solar panels. These values are primordial to know the efficiency of our total electricity production. Azimuth is the angle of the horizontal plan between the direction of an object and a search direction: the geographic north pole. To have maximal efficiency, the ray of sunshine has to be perpendicular to the panel's surface. We used Sunearthtool, a software product which is able to give us all the values according to the position of the sun: sun's path, ray of sunshine, and shadow. The next part was to know distinctly the orientation and the area of the roofs where we want to install photovoltaic panels. To do this, we borrowed an electronic tachometer to identify a number of points. We also verified the load capacity of the structure to know whether it can support the weight of a photovoltaic installation.

Keywords: energetic, sustainable, sun, photovoltaic, feasibility study


Sun orientation according to the azimuth of the roofs in St. Jean de Braye



Schema of the best place to install panels according to all data

Contact: jpierre.tehahe@hotmail.fr ; johan.vermotdesroches@gmail.com

Metrological study of compaction and landslide on the house of Venus from Volubilis

Civil engineering

A BRASSART

A. TROSSAT

Aurelie BRASSART / Arnaud TROSSAT
Academic supervisor: X. BRUNETAUD

Institution: PRISME Laboratory

Objective/motivation

The aim of the project is to study the inclination of the walls of the house of Venus based on the processing of 3D model. This house is situated in Morocco, at the archaeological site named Volubilis. The laboratory already did a 3D surveys using photogrammetry in 2013 and 2017. A 3D model was realized from this survey. In our project, we had to compare the data between both dates using a software named Cloud Compare. The first goal was to define a methodology to measure the inclination of walls thanks to point clouds. Once completed, we quantified the evolution of the inclination of the walls.

Results

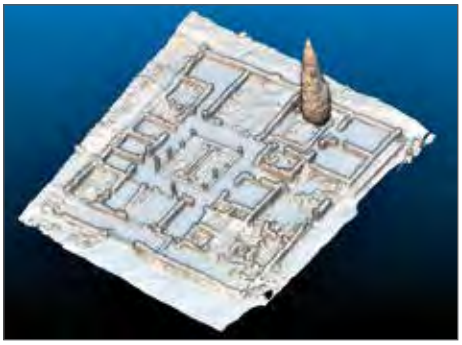
First, we had to define the horizontal plane because the 3D model had no vertical reference. After that, we divided the 3D model of the site into several segments in order to extract the equations from the plane of each wall (front and back). We did this for both dates of the 3D survey. We then compared the results and noticed inconsistencies. For example, some of the inclined walls in 2013 were assessed as standing straight in 2017. We know that there had been a restoration campaign on certain walls that could explain why they seemed to be so straight. We compared our measurement of inclination with a manual survey made in situ with a plumb line in 2015. We have unexpected results due to the precision of measurements: the manual survey is a punctual measure.

Keywords:
inclination of walls, Volubilis

Volubilis site in Morocco

A wall from the house of Venus

Mosaic in the house of Venus



Point clouds of the house of Venus

Contact: aurelie.brassart@etu.univ-orleans.fr ; arnaud.trossat@etu.univ-orleans.fr

Prediction of effective creep and relaxation of civil engineering heterogeneous materials

Materials

F.E. CHEIKH SIDI BOUBKER

G. RADJA

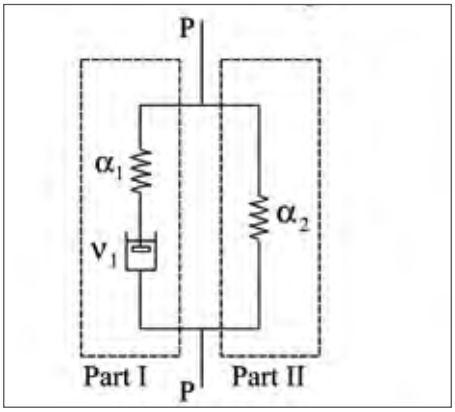
Fatima Ezzahra CHEIKH SIDI BOUBKER / Ghita RADJA
Academic supervisor: A. REKIK

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Objective/motivation

We chose this project in order to discover what researchers in the field are doing to understand the behavior of masonry, and then to propose solutions to increase the performance and predict their end of life. These researchers will then propose their results to the industrialists. The fact that components of asphaltic bitumen and masonry (mortar and brick units) do not have the same mechanical characteristics implies the heterogeneity of masonry. Moreover, since one of the components presents nonlinear behaviour, the overall behaviour of asphaltic bitumen or masonry is also nonlinear. Thanks to several rheological models (Maxwell, Modified Maxwell or Zener) and homogenization schemes (Reuss and Voigt, Mori Tanaka,etc.), we were able to predict the evolution of viscoelastic civil engineering material's overall response or effective coefficients with time or loading pulse.

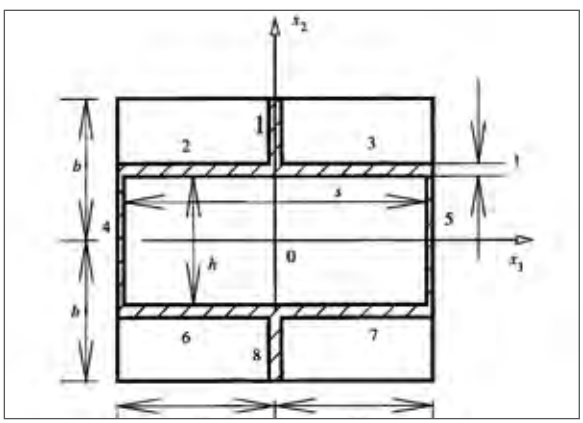


Modified Maxwell rheological model

Results

Starting with the local behavior of the constituents, their concentration and spatial distribution, we were thus able to predict the macroscopic behavior (effective creep or relaxation coefficients) of masonry and asphaltic bitumen using homogenization techniques. The factors we took into account during our study are stress and age at loading, among others. In our study, as we were interested in masonry, we started by researching its rheological modeling. We then compared them to understand how each one demonstrates viscoelastic material behavior. We proceeded to choose the one that best represents realistic long-term behavior of masonry. However, it has a complicated calculus. Therefore, we made two hypotheses so as to simplify our studied phenomenon with a homogenized viscoelastic model for masonry structures. At the end of our project, we had to find the relaxation coefficient, effective creep coefficient of masonry and the effect of sinusoidal frequency of charging.

Keywords: viscoelasticity, homogenization, harmonic loading, masonry.



Repetitive unit cell for the regular masonry material

Contact: fatima-ezzahra.cheikh-sidi-boubker@etu.univ-orleans.fr ; ghita.radja@etu.univ-orleans.fr

Response to a call to tender for the earthwork of ZAC du Moulin, Olivet, Loiret, France

Civil engineering


D. COURBE


M. DE SOUSA

Dany COURBE / Mickael DE SOUSA
Academic supervisor: L. JOSSERAND

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Objective/motivation

The aim of the project is to answer a call to tender. It consists in designing the rainwater drainage of a building, its carpark and each platform which will withstand its own weight and its use. We then need to do the cost estimation to carry out the project. The software used are Mensura and Autocad. The 3-storey-building and its carpark are located in Olivet, France. We will first define the earthwork (cut and fill) and the drainage. Afterward, we will create an Excel® sheet to calculate, in detail, the cost of each task. Finally, we have to find a compromise between the cost and the technics. The aim of a tender analysis is to deliver a tender which is low enough to win the project and, at the same time, high enough to make profits.

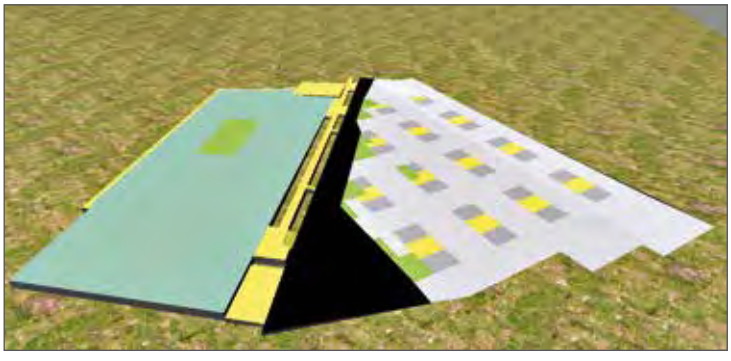
Results

As a result of the Mensura modelling, the cost of the initial project is estimated. This cost estimation deals not only with the materials needed to build but also with the equipment. When allowed by the awarding authority and the architect in charge, it is possible to give some alternatives of the project to gain time and money. We therefore had to think about how to make the project more feasible. We also thought about the environmental impact of the construction. Finally, the planning has to be scheduled. This project is useful to learn how to use Mensura. In addition, it is exactly the kind of task we should carry out in a construction company in the public works field.

Keywords: modelling, call to tender, cost estimation, drainage


Cut and fill calculation


Project blueprint


3D modelling

Contact: dany.courbe@etu.univ-orleans.fr ; mickael.de-sousa@etu.univ-orleans.fr

Securing the access of a road intersection, Saint Vigor le Grand, Normandy

Civil engineering

T. DUPUIS

O. FAREZ

Théo DUPUIS / Olivier FAREZ
Academic supervisors: T. EGGEN, L. JOSSERAND
Industrial supervisor: J. LUCY

Company: Iris Conseil

Objective/motivation

This project involves providing the most economical solution, through the construction of a roundabout, to improve the safety of an existing road intersection located in a city. It is subject to several constraints including truck traffic, the existing underground network and local pedestrians. In addition to that, rainfall management is another critical matter. The study is driven by a national project developer, Iris Conseil, which provides some engineering and technical solutions. The work stretches over eight weeks and consists of several analyses (environmental, traffic conditions, sewage system, etc.) and then a 3D modeling under a complete all-in-one civil engineering design software solution, Mensura. Through the official technical recommendation, the roundabout diameter, the pavement structure layer, and the safety features will be provided to the client. A sewage network design plan has to be proposed to manage rainfall evacuation and avoid keeping water on the pavement.

Results

After the client's agreement and through a vehicle swept path solution, the roundabout diameter will be 15.5 meters. Each branch is fitted with a splitter island to separate the road into two parts and improve access. To accommodate the rear wheels of long vehicles, a 1.5-meter truck apron is created at the roundabout rim. For safety reasons, on the main road, approaching vehicles should slow down before entering the roundabout ring. To reach this objective, we decided to keep the existing traffic island and to implement borders with a special angle of inclination along the road. This modification implies a wider sidewalk. The pavement structure has been designed to be resistant to truck traffic. Concerning the sewage network, the actual gravity-fed network is maintained thanks to the downward slope of the asphalt concrete layer.

Plan view of the roundabout

Keywords: crossroad, roundabout, safety, design, town planning, layout

Roundabout cross section

Picture of the current crossroad

Contact: theo.dupuis@etu.univ-orleans.fr ; olivier.farez@etu.univ-orleans.fr

Seismic evaluation of non-load-bearing masonry facades

Civil engineering


J. KENMOGNE MENOU


S. VALDENAIRE

Jucail KENMOGNE MENOU / Samuel VALDENAIRE
Academic supervisor: A. REKIK
Industrial supervisor: P. LEBLOND

Company: CSTB

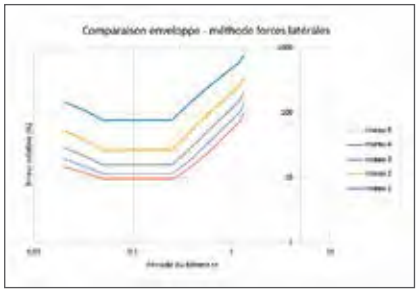
Objective/motivation

This fifth-year project, proposed by the scientific centre, CSTB, is about the seismic evaluation of non-load-bearing masonry facades. It concerns more precisely the masonry infill walls and the double walls on metal pieces, both of which are non-load-bearing walls. First of all, our task consists in studying the ductility of the double wall system and finding the adapted behavior factors related to that ductility. Moreover, we have to compare two methods of seismic loading, the envelope approach and the lateral force method (Eurocode). We are interested in this project because it treats some challenging mechanical concepts such as ductility, behavior factor, and dynamics of structures.

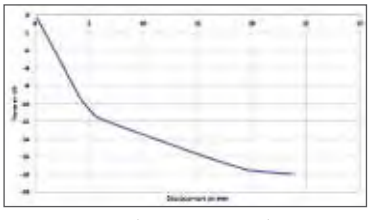
Results

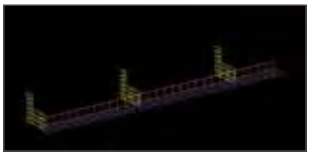
The ductility of the double wall system is due to the metallic pieces, more specifically the cantilever pieces. We modeled the metal pieces (angles and cantilevers) with software products called Robot© and Cast3M© and found out that we can use their ductility and apply a behavior factor depending on the boundary conditions, their size (especially thickness) and the type of material. Concerning the comparison of the two seismic loading methods, the studies led us to the conclusion that the envelope approach inflates the seismic loading compared to the Eurocode method and depends on different factors such as altitude, the Eurocode coefficient λ and the period of the building (T1).

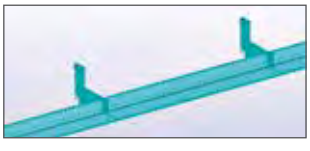
Keywords: behavior factor, infill walls, double walls, ductility, seismic loading
VEGA



Comparison Eurocode 8 and CN/PS


Non-linear analysis (force-displacement)


CAST3M modeling


ROBOT modeling

Contact: jucail.kenmogne-menou@etu.univ-orleans.fr ; samuel.valdenaire@etu.univ-orleans.fr

Soil decontamination of a building site

Environmental engineering

J. GUILLO

T. JACQUES

Joris GUILLO / Thierry JACQUES
Academic supervisor: C. PROUST
Industrial supervisor: J-P. ORANGE

Institution: City hall of St. Jean de Braye

Selected participant
12th Annual Final Year Projects Forum

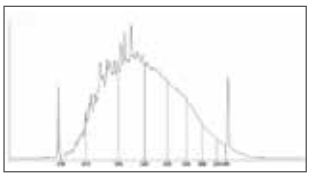
Objective/motivation

Our project is the study of the soil contamination of a building site in Saint-Jean-de-Braye. The site was previously occupied by an industrial building, partially contaminated by hydrocarbons and particularly by C10-C25 hydrocarbons corresponding to oil and diesel fuels. The future project on this ground is to build participatory housing with almost forty houses. A preliminary diagnosis and a report on health hazards have already been done by the Arcadis company. Our task is to study the reports and suggest a solution to decontaminate the soil with the best efficacy, price and rapidity.

Localisation of the pollution in the project map

Results

The solutions to treat this pollution are varied: excavation, confinement, in situ treatment, etc. The project has permitted us to determine 36 different methods to decontaminate the soil. Some are efficient, others low cost and others very quick. We have created a tool which permits us to determine the best solution by choosing the indicator which corresponds best to the people's needs. By putting the four indicators at the same level we found that the most interesting solutions are excavation, confinement, venting and composting. Four indicators were determined to give the cost of the four solutions chosen.



Chromatography of the soil sample

Keywords: soil, contamination, environment, sustainable development

Photo of the ground

Contact: joris.guillo@etu.univ-orleans.fr ; thierry.jacques@etu.univ-orleans.fr

Study of façade coating formular with controlled porosity

Civil engineering

S. BEDIER

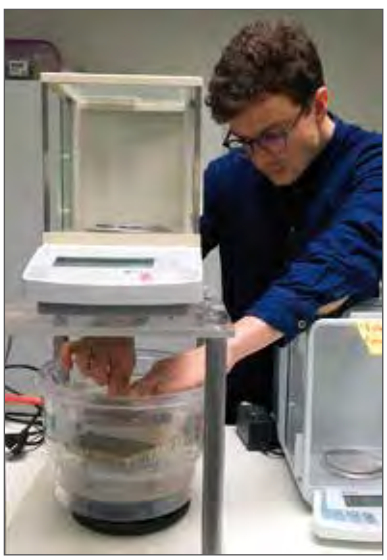
V. WEINLING

Simon BEDIER / Victor WEINLING
Academic supervisor: K. BECK
Industrial supervisor: H. DESSAPT

Company: Vega

Objective/motivation

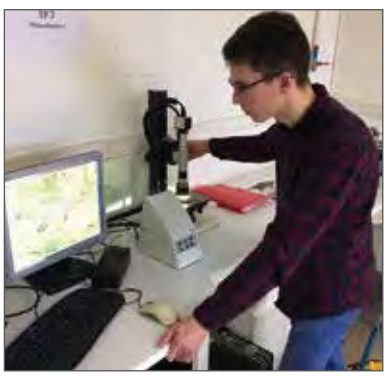
The purpose of our project is to create a lime-wash coating for the company VEGA which renovates old building façades in Paris. This lime-wash coating has to be insulating and aesthetic, and must adhere with a controlled porosity. We based our research on controlled porosity to develop a coating with stable and regular pores with good mechanical and thermal properties. With more aluminium powder, the thermal properties were better but the mechanical properties were worse. We had to find an optimal balance between these properties to find the best lime-wash coating.



Results

After having created different coatings with different amounts of aluminium powder, 0.1%, 0.2%, 0.3%, 0.4% and 0.8% of the entire mass of materials, we determined that the best lime-wash coating was close to 0.1% of aluminium powder because it has good porosity with good mechanical properties close to the standard coating. So we created new samples with 0.05% and 0.08% of aluminum powder and we found that the best lime-wash coating with a controlled porosity is the coating made with 0.08% of aluminium powder.

Keywords: lime-wash coating, aluminium powder, formular, tests



Contact: simon.bedier@etu.univ-orleans.fr ; victor.weinling@etu.univ-orleans.fr

Study of possibilities of connecting several cellars at the Orléans cathedral

Civil engineering


L. BARENS


G. TESSONNEAU

Louis BARENS / Grégory TESSONNEAU
Academic supervisors: X. BRUNETAUD, L. JOSSERAND

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Objective/motivation

The main goal of the project is to study the possibility of connecting several rooms in the basement of the Orleans cathedral. The problem is that we do not have accurate blueprints of the previous modifications of the cathedral over the centuries. First, we need to make a 3D scan of these three rooms in order to obtain a point cloud representing the cathedral interior. With this point cloud, we can extract cross sections of the cathedral and isolate the estimated position of the foundation. We can then propose the best place to drill, the geometry of the tunnel and the exact route. The goals are also to extract as much data as possible, such as the volume of soils expected.

Results

After a day spent collecting data at the cathedral, we were in position to create a point cloud representing the cathedral interior. From this point cloud, we could specifically extract several horizontal cross sections from the basement and the ground floor. With these cross sections and several vertical cross sections, we were able to create an accurate blueprint and identify the position of the foundation. We now have the ability to propose an outline for the future tunnel.

Keywords: laser scanner, Orleans cathedral, engineering


Horizontal cross section from the Orléans cathedral basement


Point cloud representing the Orléans cathedral archeological basement


Point cloud representing the Orléans cathedral ambulatory and San Therese basement

Contact: louis.barens@etu.univ-orleans.fr ; gregory.tessonneau@etu.univ-orleans.fr

The damaging of a reinforced concrete beam

Civil engineering


H. MILLIER


A. VALAYER

Hugo MILLIER / Agnes VALAYER
Academic supervisor: A. REKIK

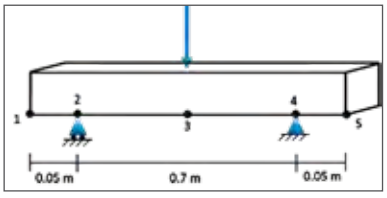
POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

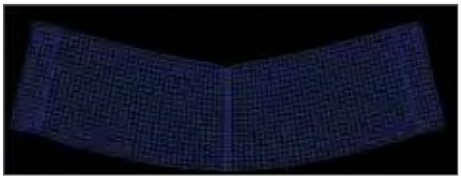
Objective/motivation
This project consists in modeling and analyzing a reinforced concrete beam. The aim is to find the evolution of the damage in relationship to the load we apply on the reinforced concrete beam. Throughout the project we will work with CAST3M which is a digital simulation software used in the mechanics of the structures, following the method of the finished elements. It is an unknown software for us, so the first step is to learn more about CAST3M and how it works. The second step will be to model a bending beam and learn more about Mazars model, which describes the damaging elastic behavior of concrete. The ultimate goal will be to find the elastic limit, namely the beginning of the cracking of the beam and to draw the force-displacement curve.

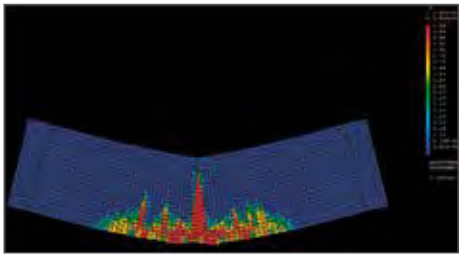
Results
The first big step of the project is the modelling of the beam, with the limit conditions. CAST3M uses GIBIANE language, so a lot of research was required, mainly on the official website of CAST3M. To complete our program, we added materials to obtain a model which is really close to reality. For the calculation, we used the model of Mazars. Using the software, we found the displacement in relationship to the known elastic limit. We found the elastic limit (beginning of the cracking) and the damage in the beam.

Keywords: concrete beam, CAST3M software



Beam modeling on CAST3M


Deflection of the beam with a forced displacement of 1cm


Damaging of the beam (pitch 50)

Contact: hugo.millier@etu.univ-orleans.fr ; agnes.valayer@etu.univ-orleans.fr

Thermal and structural renovation of an old building in Orléans

Civil engineering


C. CHAPUT


S. COUDER

Camille CHAPUT / Sarah COUDER
Academic supervisor: N. BELAYACHI
Industrial supervisor: J. BOULNOIS

Institution/Company:
Gabriel LaMé Laboratory, BHPR

First Place
12th Annual Final Year Projects Forum

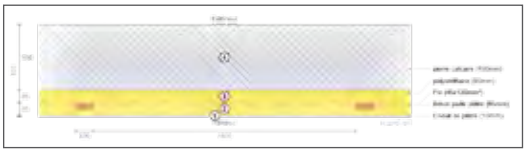
Objective/motivation

Our project concerns the thermal rehabilitation of a traditional house situated in the city centre of Orléans. The first rehabilitation was made by the architect's office. Our goal is to improve the current thermal insulation by replacing industrial insulating materials with bio-based ones, and to find an alternative to the architect's office solution. We had to test two main elements: crude earth materials mixed with sunflower and lime straw material. On Passive House Planning Package software (PHPP), we can verify the building energy consumption and compare our solution with the architect's office one. We have to reach the Enerphit label, which is given only to renovated buildings. The heating need must be lower than 25 kWh/(m2.an) (energy label A+). In comparison, most buildings in France consume around 230 kWh/(m2.an) (energy label E).


Picture of the studied house

Results

Our thermal insulation solution is made with bio-based materials which are by-products from agriculture. They are less polluting than classical building materials because they are natural, local and they can capture carbon dioxide. Their thermal properties are as efficient as industrial insulating ones. However, these materials cannot be used alone because of some limits required by the project. Indeed, as the building is situated in a listed area, the facades cannot be modified, which compels us to have an internal insulation. If we use only bio-based materials, we should propose a thicker insulation although reducing the current interior life space is forbidden by specifications. Therefore, to propose a realistic solution, we chose to combine bio-based materials with insulating industrial ones by keeping at least 50% of bio-based elements. These industrial materials have a second role: they reduce the condensation inside the walls.


Drawing of our thermal insulation solution

Keywords: rehabilitation, thermal insulation, bio-based materials, Enerphit label, passive house


Lime straw materials


Crude earth materials mixed with sunflower

Contact: camille.chaput@etu.univ-orleans.fr ; sarah.couder@etu.univ-orleans.fr

Tracing of the Réveillon River

Environmental engineering

H. LE GRIX DE LA SALLE

Hugo LE GRIX DE LA SALLE / Adrien SAGER
Academic supervisor: C. DEFARGE
Industrial supervisor: N. JOZJA

A. SAGER

CETRAHE

Institution: Cellule R&D CETRAHE

Objective/motivation

Artificial tracing is based on the injection into the water environment of products with specific marker properties (fluorescence, salinity, etc.) to track the pathways of the water and calculate its velocity and residence time in the groundwater systems, etc. This method has many applications in the management of water resources and the environment. The unknown water's pathway around the Réveillon River needs to be studied. This project consists in analyzing the geology and the water flow of the chosen area. From injecting tracers and survey at different points, samples are obtained and then analyzed at the laboratory. A relationship is finally made between locations along the river.

Survey device at the Pouillet source

Results

The laboratory's tests may confirm a relationship between the studied locations and, therefore, confirm an underground water pathway. The equipment used are spectrofluorometers, field fluorometers, spectrophotometers, and ion chromatography systems. Graphs are the best visual ways to observe the composition of the samples studied. These results are used in several sectors such as agriculture, civil engineering, drinking water supply, geotechnical investigation or land management. This project is in collaboration with the association Les Amis des Sources that will centralize those results and information in order to establish a common document concerning the studied region.

Keywords: artificial tracing, hydrogeological systems, water resources, geotechnical investigations, spectrofluorometers

Tracer injection into the Réveillon

Analysis laboratory

Contact: hugo.le-grix-de-la-salle@etu.univ-orleans.fr ; adrien.sager@etu.univ-orleans.fr

Tramway 9 Paris-Orly project management

Civil engineering

A. AL NUSAIRI

Aiman AL NUSAIRI / Nicolas TALBOT
Academic supervisor: N. BELAYACHI
Industrial supervisor: B. VIALA

N. TALBOT

Company: INGEROP

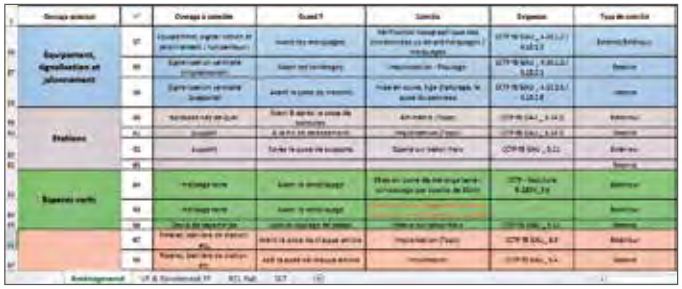
Objective/motivation

Tramway T9 is one of a series of many important projects that the city hall of Paris is financing and supervising throughout "Le Grand Paris" urban development program, which aims to improve transportation along with establishing various facilities in the entire city. Thanks to the 10 km long tramway "T9" which will connect seven different towns together, access to Orly airport from Paris will be significantly faster and smoother. Furthermore, as compared to the old transportation system, it will allow a greater number of passengers to travel. Given the fact that the project has many phases, it is crucial to track every part of it. Therefore, as part of launching construction work on T9, our objective is to create several tools that will enable engineers and other participants to keep track of the project's progress on different perspectives: financially, technically and administratively.

Results

The tools we have created during several weeks could be summarized in three major points: 1) a tracking tool for technical controls that allows engineers to supervise and easily follow up all of the controls that they need to do on the construction site and make sure that every control is done at the right time without leaving out any important details; 2) a simplified model of the client monthly report, which is a necessity in every construction project, and is used to give our client a summary of the project's progress on a regular basis; 3) a uniform procedures notice for an account statement, which describes the financial statement of construction, works at the end of every month.

Keywords: project management, follow up, organization, urban development, tramway, Grand Paris



Extract of the technical control tracking tool

Future tramway line map

Cross section of the tramway infrastructure

Contact: aiman.al-nusairi@etu.univ-orleans.fr ; nicolas.talbot@etu.univ-orleans.fr

Validating the implementation process of wood-materials bio-sourced panels for construction based on laboratory studies

Civil engineering

L. MARTINS

M. SELMANI

Lydie MARTINS / Meryem SELMANI
Academic supervisor: N. BELAYACHI

Company: Pallanche

Objective/motivation

The Pallanche construction company which is specialized in wood and metal construction, has set up wood panels filled with bio-based materials. One of these bio-based materials is hemp concrete. The aim of this project is to study three types of materials based on hemp concrete, wood chips and lime binder which come from the company. We have to study the mechanical and thermal aspects to validate or improve the implementation protocol used by the company. We also have to do a hygro-thermal study with climatic conditions of temperature and humidity.

Results

The company sent us three types of hemp concrete samples: lime1-hemp sample, lime2-hemp sample and lime2-wood sample. We began the study by carrying out thermal tests in dry and wet conditions which took us approximately two weeks. For this test, we concluded that the lime1-hemp sample would be the best insulator because it has the lowest thermal conductivity. We also noticed that the lime2-hemp sample deteriorated while it was drying, which can make us suppose that the composition must be reviewed by the company. We then started the mechanical test which consists in progressively applying a load on the sample until it cracks. We found that the lime2-wood sample is the most resistant material. Moreover, we also used WUFI software to study the hygro-thermal behaviour of the materials. Finally, we studied the DTU to find the bracing behaviour of panels filled with bio-based materials.

Keywords:
hemp concrete, thermal insulation, mechanical strength, hygrothermal performance, construction

Contact: lydie.martins@etu.univ-orleans.fr ; meryem.selmani@etu.univ-orleans.fr

Validation of a wooden puzzle construction system

Civil engineering


S. KECHID


T. MESSANT

Sabrina KECHID / Thomas MESSANT
Academic supervisor: D. HOXHA
Industrial supervisor: P. BROUILLE

Company: Puzzle House

Selected participant
12th Annual Final Year Projects Forum

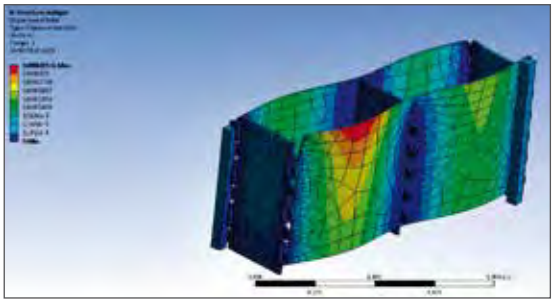
Objective/motivation

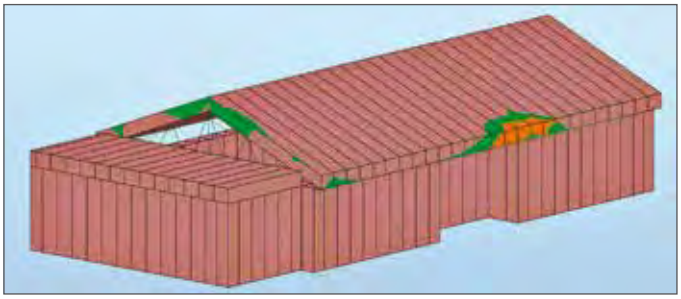
Our fifth-year project focuses on the development of an innovative construction system using OSB (Oriented Strand Board) panels. Its purpose is to build completely wood-based houses or professional buildings using puzzle connections. This new kind of construction could have benefits. Among them are the reduction of construction costs or the speed and ease of assembling the house. This project idea comes from the founder of a start-up named Puzzle House. Polytech Orléans is involved in the project as technical adviser for this start-up. Our mission is to check the resistance of buildings made with puzzle connections and the feasibility of the project. First, we had to design a computer program calculating the wind load on a building. We then had to model and analyze the resistance of a puzzle building. This will allow the optimization of the shape and the size of a puzzle connection.

Results

We were able to successfully achieve our project goals. Our first goal was to develop an Excel®-based spreadsheet capable of calculating the wind load according to the Eurocode on a building chosen by the user beforehand. To do that, we had to use Visual Basic Application coding on Excel®, a language that was new to us. We learned it over the course of the project and used it to make our Excel® spreadsheet as efficient and user-friendly as possible. Our next step was to check the resistance of the puzzle system on a building. We used Autodesk Robot Structural Analysis in order to make a model of a random building chosen by our industrial supervisor and ran different design checks in order to dimension it. We had to check the resistance of the panels and their connections to its self-load and to the wind load. Thanks to that we were able to contribute to the launching phase of start-up and also to the development of a new building process.

Keywords: wood, building, puzzle, innovative connections


3D modelling of a Puzzle Connection on Ansys


3D modelling of a building made with Puzzle Connection on Robot Structural Analysis

Contact: sabrina.kechid@etu.univ-orleans.fr ; thomas.messant@etu.univ-orleans.fr

The details of the project of these students in Civil Engineering cannot be printed here as they are subject to a non-disclosure agreement.

Yousse DAOUDI

Eren SUERSAN

Engineering Physics and Embedded Systems

3D modeling of the lighting of the Galilée building on Dialux Evo 7

Lighting

Clément DUMONT
Academic supervisor: C. CACHONCINLLE

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Objective/motivation

The goal of the project is to design a 3D lighting model of a building at Polytech using the lighting simulation software Dialux Evo. To do so, I first had to design the building walls and rooms with this software and add the necessary furniture, windows and colors. All of this is very important because it affects the reflection and, consequently, the result of the calculation of the lighting. I can then choose the luminaires and set them up in order to respect the lighting standard in each room of the building. In this project, I used LEDs in order to save energy and get a better rendering. The model created could be used in the future to replace the existing lighting at Polytech.

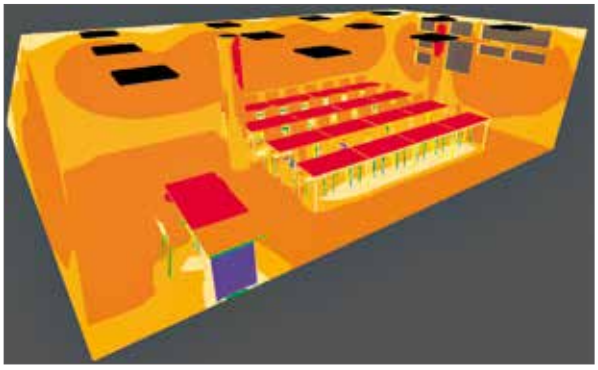
Results

In order to have good lighting in the building, I first had to determine the standards for each kind of room. For example, in classrooms we need to maintain an average illuminance of 500 lux. Afterwards, to design the building on the software, I had to use some drawings and a laser rangefinder to get the right measurements. For this part of the project, I had to make the design of the Fourier building with the elements that are likely to have an influence on the final illuminance in the room. I chose LED lights from the Philips catalogue, with recessed lamps for the classrooms and wall-mounted luminaires for the stairs, for example. It is then important to check that the illumination respects the standards.

Keywords: lighting, simulation, 3D model, Dialux

Lighting using Dialux Evo

Rendering of the exterior



Rendering in false colors

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

Analysis of images of paintings by eye-tracker

Image processing software

Xi CHEN
Academic supervisor: A. CHETOUANI

Institution: PRISME Laboratory

Objective/motivation

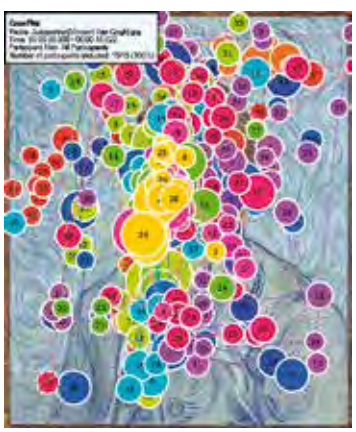
The main target of this project is to analyze the behavior of people in front of paintings in order to divide people into different groups according to the results. For that, an eye tracker hardware has been used to capture the scene and the area that catches the person's attention when they are looking at the paintings. A set of images of paintings has been selected and presented to observers. Tobii Studio software has then been used to extract information provided by the observers. In order to compare different people's interests for each painting, we stocked all the information we got from the eye-tracker during the test process into the database, which includes all the paintings we used during the test and the final result of each person (15 minutes for the test using 50 pictures and 15 persons participated).

Results

Once the database has been created, we will try to compare the results of each person in order to differentiate people by comparing the obtained data. There are three types of results: Cluster, GazePlot and Heatmap. We will analyze all the data with Excel® and then compare the results to an objective method, which was obtained from the programming in Matlab. Finally, we will conclude by analyzing the differences between these two methods and also trying to find a way to improve our test results.

Keywords: eye-tracker, Image analyse, Tobii Studio

Cluster



GazePlot

Heatmap

Contact: xi.chen@etu.univ-orleans.fr

Automatic extraction of embossed friezes on ceramic sherds by Deep Learning

Image processing software

Zuokun OUYANG
Academic supervisor: S. TREUILLET
Industrial supervisor: S. TREUILLET

Institutions: PRISME Laboratory, Fédération Archéologique du Loiret (FAL)

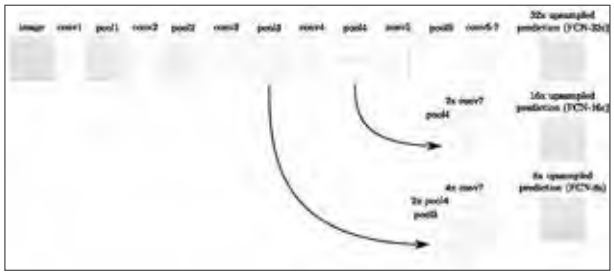
Objective/motivation

Some archaeological ceramic sherds dating from the High Middle Ages have been extracted in Saran (Loiret, France). The sherds have an engraved frieze made by the potter with a carved wooden wheel. These relief patterns can be used to date the sherds in order to study the diffusion of ceramic production. The goal of the project is to build a convolutional neural network (CNN) to automatically extract the salience region that contains the pattern from the depth maps of sherds scanned by a 3D laser scanner.

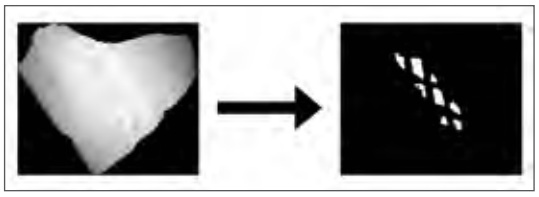
Results

In order to enlarge the database, 888 depth maps have been cropped into 44480 100x100-pixel sub-images and corresponding JSON files generated for image labelling. PyTorch, a well-developed Deep Learning framework on Python, has been used to set up and train several existing CNN models on the mentioned dataset. A famous CNN model, the Full Convolutional Network (FCN), has been constructed to realize the segmentation of the salience region. The output of the CNN is a binary image stamping the pattern in the relief. The automatic segmentation results will be compared to the manually labeled ground truth by measuring the recovery rate in the images of the data base.

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



Fully Convolutional Network



Objective

Contact: zuokun.ouyang@etu.univ-orleans.fr

Automatic sound transcription of comic books from a smartphone

Image processing software

Shanshan WANG
Academic supervisor: S. TREUILLET
Industrial supervisor: F. DAUBIGNARD

Company: Algona

Objective/motivation

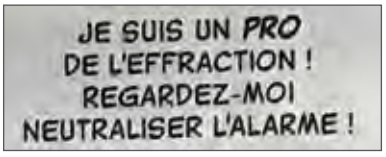
This smartphone application is developed for children and is used to detect characters in comic books. After launching and taking a photo of a page, characters in the bubble will be detected and read automatically. There was an application developed by a student last year and the new target is to improve the result of character recognition and to get a better voice synthesizer, if possible. The percentage of success should be over 80% for a certain page in a book which has been treated.

Results

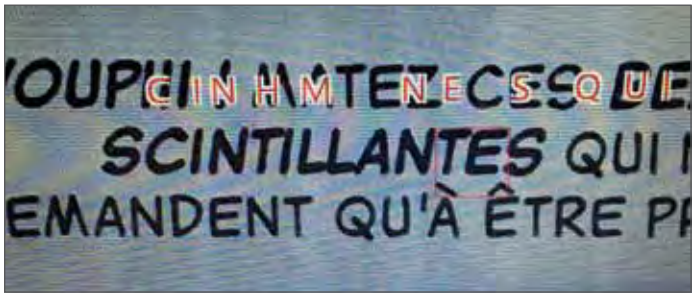
After treating a certain comic book such as Mickey, its own treatment file (as a database) was established. In order to avoid detection errors, like i and !, a treatment file of 20 example pictures was added to this application. The file is stored in the smartphone memory and will be loaded when scanning the book. The previous version of the application did not succeed in obtaining over 80% recognition. Now the result has been improved.

Keywords: OCR (optical character recognition), Android

Bubble captured



Bubble captured



Result of detection

Contact: shanshan.wang@etu.univ-orleans.fr

Conception of a system to control drawing points in laboratories

Electrical engineering

Pierre BRACONNIER
Academic supervisor: R. LEDEE
Industrial supervisor: J-D. MARTIN

Company/Institution: undisclosed (confidential)

Objective/motivation

The Thermal Comfort Research Centre (CRCT) is a unique laboratory composed of full-size twin test houses equipped with various thermal comfort solutions. The mission of the laboratory is to analyze and compare these solutions in order to measure and optimize the energy efficiency of the products in real conditions, study the interaction between products and improve the thermal comfort and air quality for customers. In order to test the products in real conditions, human occupation and activity are simulated. Resistors are used to simulate human heat generation and electrical consumption of household appliances. Hot water consumption is also automated and follows a given scenario. Depending on the need (showers, washing-up, etc.), the water temperature and flow are adjusted manually. The aim of this project is to automate the system, which should add flexibility and accuracy to the current system.

Hot water tank

Results

Currently, the laboratory is equipped with commercially available mixer taps where the output temperature is set manually but often varies by up to 3°C (+/-) depending on both the hot and cold-water temperatures. The flow rate is currently controlled by a manual valve and is also very dependent on the output temperature of the system. A prototype of an electronically controlled mixer tap has been developed by an external company, but the project was abandoned due to a lack of progress in the past 18 months. First, the system PID value for both temperature and flow rate must be determined and work individually. Initial results have shown that the temperature control was very slow and unstable, mainly since the hot water temperature is not stable (± 0,7°C). A solution to improve the temperature regulation was proposed and has been implemented. The regulation of the flow rate was implemented with success, achieving the flow rate target (± 0,2 L/min).

Motor

Keywords: automatic control of drawing points

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

Detection of identity theft on smartphone

Image processing software

Mehdi HIMMID
Academic supervisor: A. CHETOUANI

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

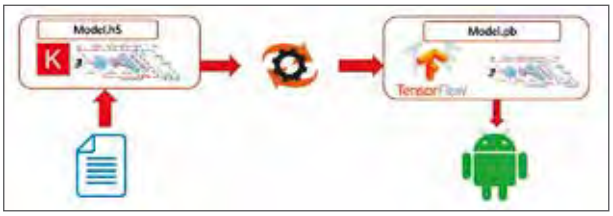
Institution: Polytech Orléans

Objective/motivation

Face recognition systems are spreading across multiple devices as computer vision has been gaining momentum in recent years. As usage and needs multiply, so are hacking attempts. The countermeasures to this are getting more and more complex. In some cases, the attacks consist of just presenting a fake image to the camera. Deep learning methods are a series of algorithms that attempt to reproduce communication patterns that occur in a nervous system in an attempt to define a relationship between an input and an output. Often, neuronal networks reproduce results that are superior to humans. Researchers at the University of Campinas used convolutional networks that have been trained on several databases to parry identity theft attempts. The aim of this project is to reproduce the results obtained on a computer onto an Android smartphone.

Results

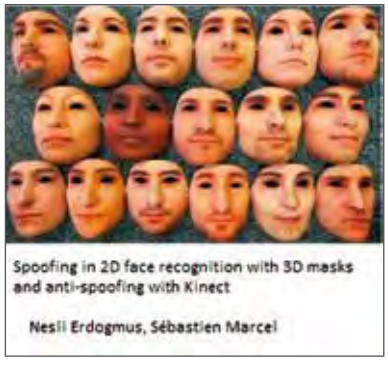
The outcome of this project is an Android application where the user can simply point their camera at a person's face or 3D facemask that has been printed to mimic the person traits. This image will become a flat tensor and will be sent through the neuronal network which will decide, based on how it was trained, if the face that was shown to it is indeed a normal human face. The results obtained are not definitive. As for developing this project further, we can first take it to other platforms rather than just Android, or even allow the user to choose between multiple neuronal networks in order to perform the task, depending on the situation and conditions. Rather than having only one rigid Android application, we can also add more flexibility in the preprocessing of the image in order to, in the end, obtain an application in the form of a toolbox allowing us to use multiple tools to respond to the multiple user cases.



Summary

Keywords: deep learning, Android, anti-spoofing

Anti-spoofing



Spoofing masks

Contact: mehdi.himmid@etu.univ-orleans.fr

Development of a polyphase filter bank on FPGA Xilinx LX9

Electrical engineering

Tiago BORBA DA SILVA
Academic supervisor: R. WEBER

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

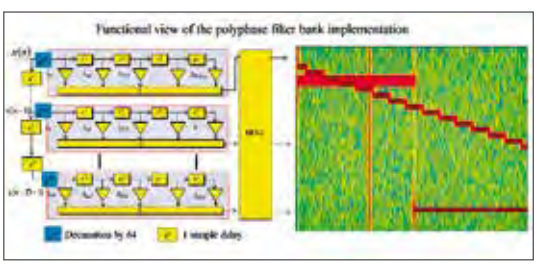
Objective/motivation

The objective of this project was to improve my knowledge of digital signal processing and high-performance digital reconfigurable components. Specifically, the project consisted of developing a time frequency sound analyzer. The algorithm, a real-time polyphase filter bank, had to be implemented in a Xilinx Field Programmable Gate Array (FPGA), the LX9 from the Spartan 6 family. Filter banks are widely used in the telecommunications field. When implementing such algorithms, an optimal trade-off must be found between expected channel rejection and filter complexity (i.e., the number of filter coefficients), between quantization noise and fixed point representation complexity (i.e., the number of bits to code all the operators and data), and between data flow bandwidth and digital resource management.

LX9

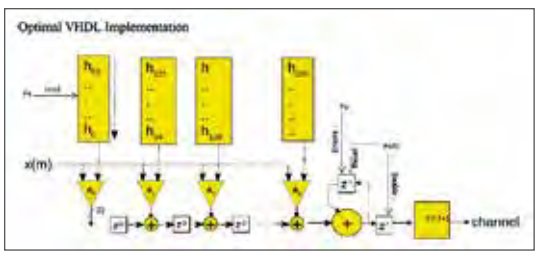
Results

The channel rejection is achieved by a 640-coefficient Finite Impulse Response (FIR) filter. Each coefficient is coded over 10 bits. The channelization is obtained by "modulating" the polyphase components of this reference low-pass FIR with a 64-bin Fast Fourier Transform (FFT). In addition, by applying some multicadence properties to this structure, the number of elementary operations (additions and multiplications) has been optimized. This design is 64 times better than a classical direct implementation of the corresponding filter bank. In terms of FPGA implementation, a full parallel design was too resource- demanding. An optimal implementation has been defined by serializing the data flow. Only one (over 64) polyphase structure of ten coefficients is implemented. This structure is reused 64 times on 64 successive input samples before delivering one output sample through a 64-bin FFT. The implementation was done with VHDL description language.

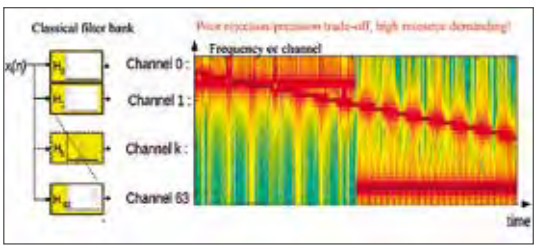


Polyphase implementation

Keywords: multiband signal processing, filterbank, polyphase filter



VHDL implementation



Classical filter

Contact: tiago.borba-da-silva@etu.univ-orleans.fr

Development of an acquisition system of medical residue in water

Electrical engineering

Romain MAZURAIS
Academic supervisor: R. WEBER
Industrial supervisor: C. CHATEAU

Company: DSA Technologies

Selected participant
12th Annual Final Year Projects Forum

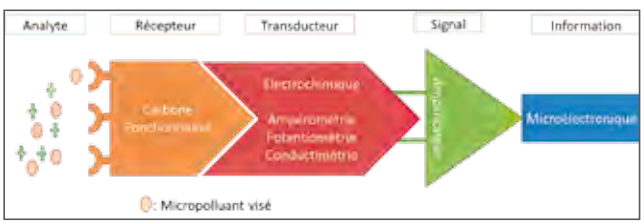
Objective/motivation

Nowadays, laws to observe pollution are more and more crucial. In our case, we want to help water treatment plants and local authorities respect water specifications and have a better pollution observation. The current measuring method needs water samples which must then be tested in a laboratory on cumbersome and expensive devices. Our solution is a device put into the area where the measurement has to be taken. This solution is based on two steps: the first is making chemical reactions that concentrate the pollutants; the second is to transform the data into work data (like mole/liter) to facilitate the worker's understanding. This will give a faster response and is a cheaper solution compared to the current one.

Results

We were looking at result to know if the solution will work. We knew that the chemical part of our device has a good repeatability and reproducibility. We wanted to test if it would still be the case if we add the miniaturized electronical part. The repeatability is important because we wanted a precision of 13% to precisely indicate the amount of medical residue. The reproducibility is also very important because we want to create a device which can be produced in big quantities and have the same response for a same amount of medical residue. The test will be done in two parts. First, we will calibrate the device and test it in a test environment. After this, and if the results are good, we will test it directly in a water treatment plant. For the test, we would need to create or choose a package to protect the device from water, dust, surrounding noise, etc.

Keywords: sensor, IoT, new technology, electro-chemical



Function diagram of the sensor

Electronic part

Contact: romain.mazurais@etu.univ-orleans.fr

Elementary characterization of nanoparticles via LIBS

Plasma physics

M. ABBOUD

M. VENET

Miray ABBOUD / Marine VENET
Academic supervisor: L. BOUFENDI, M. HENAULT

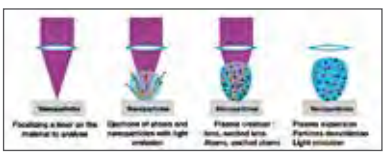
Institution: GREMI Laboratory

Objective/motivation

In order to protect the environment and human beings, we are carrying out this study to analyze some particles that could be dangerous. These particles are mainly used in construction and several parameters affect the toxicity of the chemical composition of nanoparticles. The GREMI laboratory has been working on a process to break down particles using a powerful laser and plasma in order to determine their composition and concentration with a spectrometer. This process is called LIBS (Laser Induced Breakdown Spectroscopy).

Results

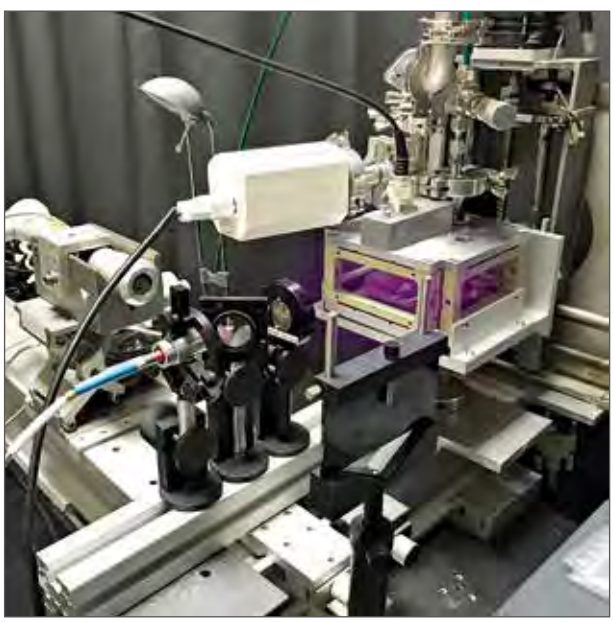
To carry out our tests, we injected nanoparticles, such as carbon and aluminum, into our plasma, which maintains them in levitation. We then broke down their chemical links with a very powerful laser. We collected the spectra of this breakdown and then observed the carbon lines of chemical elements. At the moment, our tests show the carbon lines in our spectra but they are not intense enough. For future tests, we will enhance our setup in order to get the desired intensity.



LIBS mechanism

Keywords: laser, plasma, nanoparticles, optics, electronics

LIBS effect



Experimental setup

Contact: miray.abboud@etu.univ-orleans.fr ; marine.venet@etu.univ-orleans.fr

INKJET – Study of laser sintering of printed materials

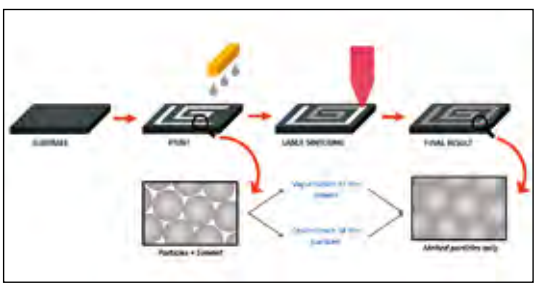
Laser processing

Jennifer NGUYEN
Academic supervisors: C. LEBORGNE, A. STOLZ

Institution: GREMI Laboratory

Objective/motivation

Nowadays, electronical devices have taken a greater place in our daily life, which has led to the constant research of innovation in this domain. My end-of-study project is related to the field of microelectronics and is being done in partnership with the GREMI laboratory. The goal of the work is to verify and optimize the laser sintering of silver nanoparticles deposited by inkjet technology. For the moment, the sintering of the ink is made on a hot plate with a dual purpose: to evaporate the solvent and to bond the nanoparticles making the printed pattern conductive. We want to control the depth of the treatment to sinter only the ink without heating the substrate. This will allow the use of flexible materials like polymers, which have a low fusion temperature, for the creation of flexible screens, etc.

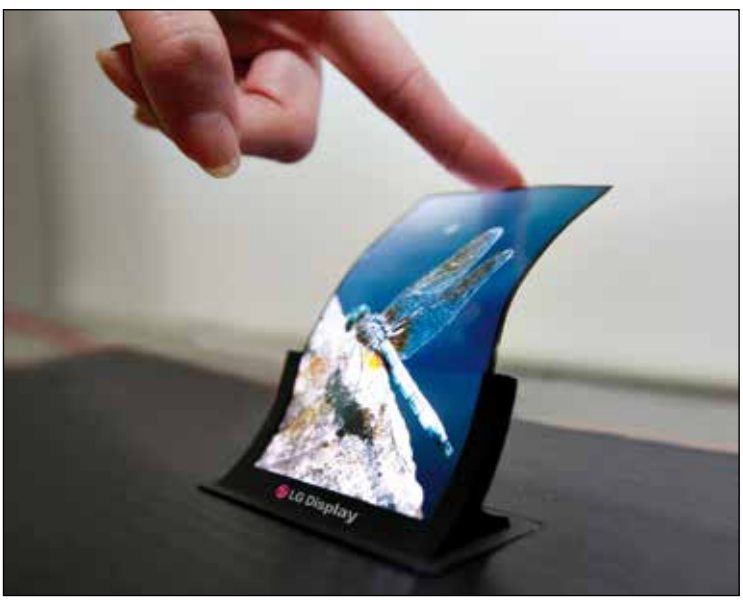


Process diagram

Results

A big part of the project was concerned with the optical assembly to transport the laser beam to the target while taking security into consideration. The choice to set the Nd:YAG laser on the fundamental wavelength (1064 nm) was for an industrial purpose: these are the most-used lasers. The coalescence or conglomeration of particles was observed when using another wavelength from the laser (355 nm) during my last summer internship in the lab. At 1064 nm and for a single laser shot under a pulse time and a quantity of energy given, only the evaporation of the solvent occurs. The next task will be to study the influence of a higher number of laser shots on the deposited particles, hoping to observe the desired coalescence effect.

Keywords: laser processing, optical assembly, microelectronics, inkjet, nanoparticles



Flexible screen

Contact: anh-jennifer.nguyen@etu.univ-orleans.fr

Interactive visit with an Android application

Software

Etienne LANGEVIN
Academic supervisor: J-Y. CADOREL
Industrial supervisor: J-Y. CADOREL

3ZA ENGINEERING
Company: 3ZA INTECH

Fifth Place
12th Annual Final Year Projects Forum

Objective/motivation

The objective of this project is to offer visitors to museums or exhibits a better user experience. This improvement will be made by using a new type of interactive visit. Visitors will access information about the works of art nearby directly on their smartphone. To do so, the artworks will be equipped with beacons which will emit a wireless signal. Visitors will be able to download an application at the entrance of the museum or exhibit which can detect and identify the signals emitted by the beacons. Therefore, when the application identifies one or several beacons, a notification will appear showing pictures of the art related to those specific beacons. By clicking on those pictures, the user will be redirected automatically to a web page containing additional information about the selected piece of art.

Results

I realized this project by making an Android application. This application can detect and identify Bluetooth low energy beacons nearby. When a beacon is detected, a notification appears. If only one beacon is detected, clicking on the notification will lead directly to a web page corresponding to the associated artwork. If more than one beacon is detected, the notification will lead to another web page which displays a slideshow of images. The images represent the detected pieces of art and each image can be selected, leading to a specific web page concerning the selected piece of art. For now, the slideshow page is written in HMTL with a CSS file. However, it could be greatly improved using PHP, for example. Doing so would make it possible to have a more dynamic slideshow and, for example, to classify the pieces of art by the strength of the Received Signal Strength Indicator (RSSI).

Keywords: Android, visit, interactive, wireless, Bluetooth

Contact: etienne.langevin@etu.univ-orleans.fr

LEGO® Star Wars™ model creation based on plasma jets

Plasma physics


T. AUBERTIN


R. PRETRE

Thibault AUBERTIN / Rémi PRETRE
Academic supervisor: C. DOUAT

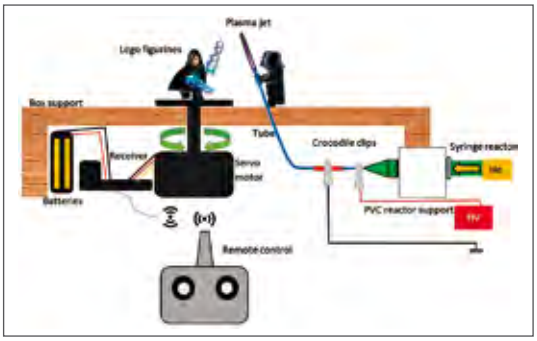
Institution: GREMI Laboratory

Objective/motivation

A plasma is an ionized (electrically charged) gas that contains ions, electrons, and neutral particles (atoms or molecules), and emits light. It is commonly used in etching, material deposition and surface treatments. A plasma is said to be cold if the temperature of the electrons is much higher than the other particles' temperature. Contrary to common cold plasmas, a plasma jet is a plasma at atmospheric pressure and able to deliver a non-thermal plasma outside the confinement of electrodes. The plasma propagates in the surrounding air and can reach very long distances of up to 10 cm. It can therefore be used in biomedical applications. The aim of our project was to initiate people into this brand-new technology. The shape and brightness of a plasma jet looks like a small Star Wars™ light saber, which is why we chose to build a LEGO® Star Wars™ model in order to promote plasma jet.

Results

First of all, we worked on the feasibility of the layout of the plasma jet reactor and we then decided to build two plasma jet reactors inside our model to create two mini light sabers. The plasma jet reactor fit under the box of our model and the LEGO® figurines' hands hold the tube where the plasma jet appears. The plasma jet was a coaxial dielectric barrier discharge reactor with a plastic capillary tube. To create the jet plasma reactor, we used a PVC tube with a metallic needle connected to pulsed high voltage, a plastic tube to guide the gas, and copper tape for the ground. The color of the two light sabers was purple, and their length was around four centimeters. We also improved the model by adding four servo-motors and an emitter-receiver assembly to let the user control the figurines as well as a safety shut-down switch. Polytech Orléans will use the model during the open house to promote plasma science.



Plamsa jet LEGO® Star Wars™ model schematic

Keywords: plasma jet, gas, high voltage, model, LEGO® Star Wars™


Plamsa jet LEGO® Star Wars™ model


Plasma jet closeup

Contact: thibault.aubertin@etu.univ-orleans.fr ; remi.pretre-heckenroth@etu.univ-orleans.fr

Micro plasma in the palm of your hand

Plasma physics, packaging

Célia LE TROQUER
Academic supervisor: R. DUSSART, A. STOLZ

Institution: GREMI Laboratory

Selected participant
12th Annual Final Year Projects Forum

Objective/motivation

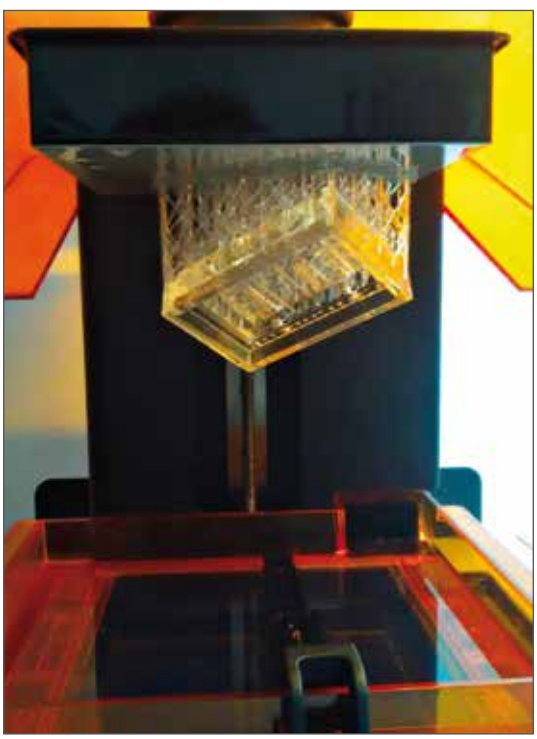
Plasma is a particular state of matter consisting of particles with a high energy level and with an unstable state. The micro discharge which generates plasma is therefore a physical phenomenon that can be observed under very specific conditions that involve imposing installations. In contact with matter, micro-plasma can be a source of innovative applications for local treatment in fields such as biology. The possibility of miniaturizing the formation chamber of micro plasma discharges and making it transportable is of great interest. Such a device would allow a simplified demonstration and a wider audience. Therefore, this project was part of this approach: to make transportable packaging of plasma micro discharges, allowing us to do a demonstration.

Matrix of micro-cavities

Results

The first part of this research project has been dedicated to micro packaging components. It appeared that for such applications, the complete design of the packaging was necessary. Therefore, the following part was about designing the shape of the silicon chip, base of the plasma micro discharges, to then be able to design a type of packaging which responds to all the constraints regarding pressure, sealing, temperature and transparency. It was necessary to think about the use of the device for a demonstration in order to make decisions. One step was also to create the final chip with a clean room process. The next step was to study the process of wire bonding to form micro electrical connections between the chip inside the packaging and outside. Of course, the final point was about assembly and testing.

Keywords: plasma, discharge, treatment, demonstration, transportable



3D box printing

Virtual 3D model of device

Device assembly

Contact: celia.lt@orange.fr

Neural command of a light source

Software

Corentin ROMAIN
Academic supervisor: F. DAUBIGNARD
Industrial supervisor: F. DAUBIGNARD

Company: Algona

Innovation Award
12th Annual Final Year Projects Forum

Objective/motivation

My project was to create a demonstrator for Algona Enterprise, a company which is located near Orléans. During this project, I had to create a Windows® app that allowed the controlling of a drone via thought. To achieve this, I had a Parrot Jumping Race drone and an Emotiv neural helmet. Because I had some difficulty controlling the drone with the Windows® OS (due to an incompatible SDK), the company and I decided to change the drone with a Philips Hue Go lamp. So my objectives changed and I had to control this lamp via thought. I had to be able to switch it on or off, and change its color and intensity. I was very interested in this project because it is very innovative and ambitious.

Results

For now, I am able to control the lamp from the app. I'm able to switch the light on or off and to change its colors and intensity. I am currently working on the Neural Helmet: how to connect and disconnect it with the app and how to use it with its integrated program (SDK). Moreover, I have to include some tutorials in my app in order to explain how to use it and how the learning phase works. In addition, I need to write some instructions to explain to my instructor how I did my work, and how he can reproduce it. This is very important because if I do not have enough time to achieve my work, my instructor will have to pick up where I left off.

Keywords: neural command, light, windows application

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

Optical control station for luggage

Electrical engineering

Enzo PASQUALINI
Academic supervisor: R. JENNANE
Industrial supervisor: J-M. DEDISSE

Company: ALSTEF

Objective/motivation

At airports, passengers may carry atypical luggage such as bicycles, baby carriers or anything similar. This type of luggage can sometimes block the flow of other luggage on the conveyors. The aim of this project is to automate the recognition of atypical luggage to avoid slowing the conveyor.

Results

The expected result of this project is the installation of sensors around a conveyor and the establishment of a means of communication between the sensors and a computer via a special software. Using different tests, this software should be able to communicate with the sensors and determine if the luggage being analyzed is atypical or not.

Keywords: luggage, airport, recognition

Arrival conveyor

Conveyor in Helsinki

LMS500-20000 sensor

Contact: enzo.pasqualini@etu.univ-orleans.fr

Physics and characteristics of vacuum arc thrusters for micro-satellites

Plasma physics

M. BUESSLER

G. HERRY

Martin BUESSLER / Gaëtan HERRY
Academic supervisor: T. GIBERT
Industrial supervisor: S. MAZOUFFRE

Institution: ICARE, Institut de Combustion Aérothermique Réactivité et Environnement

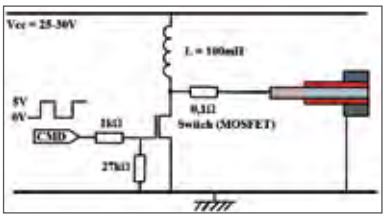
Objective/motivation

Nowadays, microsatellite propulsion is one of the main research areas for space business development. Microsatellites equipped with propulsion devices allow new possibilities for space applications at a lower cost compared to large satellites. The motivation of this project is the study of different technologies available for space propulsion with focus on a specific technology well-suited for microsatellites. We choose to focus on the arc vacuum thruster technology as it is one of the most promising technology for microsatellites. Using a part of its own solid material as propellant, this technology provides many advantages and a relatively simple structure composed in three parts: a cathode, an anode and an insulated separator. The electrical circuit of the thruster generates an electrical arc between the anode and the cathode. The material eroded from the cathode expands into the vacuum creating a net thrust.

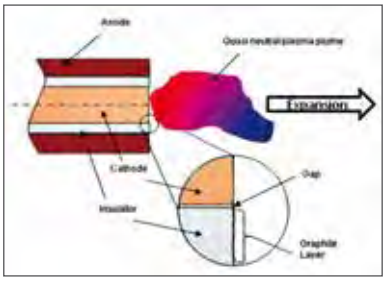
Results63

The laboratory ICARE lent us cylindrical and planar vacuum arc thrusters. To characterize and manipulate those devices, we used a vacuum chamber connected to primary and secondary pumps. We generated a background pressure of 1,3 10-5 mbar which simulates the space conditions where the thruster has to operate. We developed an electrical circuit to control the thruster. The main challenge for the vacuum arc thruster was to generate an electrical arc at low pressure. The electrical circuit provides a low voltage, so we must use some tricks to generate an electrical arc at low pressure using low voltage. The method was to create a graphite layer on the thruster insulator. When a peak of current passes through this layer, a part of the graphite is vaporized: the pressure in the local area between cathode and anode increases, allowing an electrical arc to generate at low voltage.

Keywords: space propulsion, plasma thrusters, electrical arcs, micro satellites



Electrical circuit developed for the device



Vacuum arc thruster technology operating

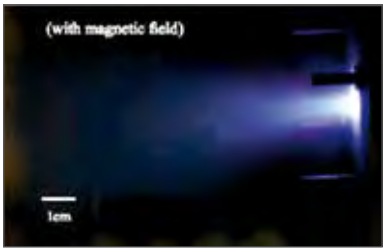


Photo of a vacuum arc thruster operating with a magnetic field to optimise the plasma plum (ref. Michael Keidar)

Contact: martin.buessler@etu.univ-orleans.fr ; gaetan.herry@etu.univ-orleans.fr

Plasma synthesis of conductive material ultrathin structure

Plasma physics

Y. PIANKALI

R. YANG

Ymelda PIANKALI / Runxiao YANG
Academic supervisors: J. BERNDT, E. KOVACEVIC

Institution: GREMI Laboratory

Selected participant
12th Annual Final Year Projects Forum

Objective/motivation

Due to the number of potential applications that we can develop with a conductive polymer, it is necessary to characterize the process at any point. Experts in this field, Dr. Eva Kovacevic and Dr. Johannes Berndt of the GREMI lab, are investigating the conductive polymer in collaboration with PhD student Cédric Pattyn. We joined the GREMI team on January 8 to work on our industrial project which concerns plasma synthesis of conductive polymer ultrathin for nanotechnology. We are involved in a project with a European dimension because the study is connected with activities within EU FET OPEN project PEGASUS. The project has lasted for two months with our contribution to the Polytech Orléans Final Year Projects Forum. Polyaniline (PANI) has been studied for a range of applications, such as in electronic devices, biosensors and super capacitors.

Experimentation

Results

In the framework of this collaboration, polyaniline (conductive polymer structure) is synthesized and investigated with infrared absorption spectroscopy to obtain tailored characteristics. The deposition of PANI in the GREMI lab is at low temperature plasma and we are trying to determine the best performance for coating. By analyzing the plasma and the material during and after the deposition, we can clearly observe that there is a link between the polymer's absorbance and the deposition time in the plasma. The characteristic of the conductive film changes also by its position in the chamber. By understanding and continuing to explore the absorbance graph, we will be able to control the plasma to perform the deposition that we want under any condition. We have inspected the deposition time and ageing of our samples by checking the absorbance of the samples.

Keywords: plasma, conductive polymer, infrared laser, silicon wafer

Plasma

Experimental set-up

Contact: ymelda.piankali@etu.univ-orleans.fr ; runxiao.yang@etu-orleans.fr

Remote-reading of environment sensors by drone

Electrical engineering

Thomas ARMENGAUD
Academic supervisor: R. CANALS

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

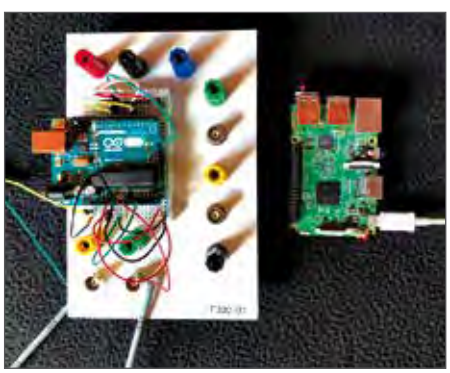
Objective/motivation

In many domains such as agriculture, some sensors are used to acquire data on temperature and humidity via a low-speed or cellular telecom network. However, there is unequal coverage of the territory and operators give priority to urban areas. Furthermore, some studied phenomena do not need real-time transmission of data. As an alternative, we want to use some short-range radio sensors, BLE4 (Bluetooth Low Energy 4), placed on the floor, and to use a drone to fly over the sensors in order to recover the data via BLE4. The main goal of this project is to reduce the power consumption of the acquisition system put on the floor (Arduino Uno). This system has to keep its energy, and, by intervals of time, take some measurements from the environment. A drone (simulated by a Raspberry Pi 3) coming automatically on the sensors then recovers the data.

Programming on Arduino

Results

We have succeeded in reducing consumption to a few milli-amperes (18 mA). Using a power sleep mode, the Arduino has improved its battery life. The system is then awakened by an acquisition phase or a secured connection phase from the drone, and it recovers and saves the data. The programming code allows the acquisition system to exit its power sleep mode by a first interruption, which starts the acquisition of data by intervals of time from a Watch Dog Timer, and, consequently, the data will be saved in the processor's memory. There will then be a second interruption via the arrival of the drone (Raspberry Pi 3). Previously paired to the acquisition system, the Raspberry Pi 3 can now connect to the Arduino Uno by BLE and recover and save the data. If another system is not manually paired to the acquisition system, it cannot connect to the acquisition system and recover the data. After recovering the data, the Raspberry Pi 3 is disconnected, and the Arduino Uno returns to its power sleep mode.



Arduino (left) and Raspberry (right) systems

Consumption measure of the Arduino

Keywords: remote-reading, drone, sensors, Bluetooth Low Energy

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

Software development for the characterization of carbon blacks by image processing

Image processing software

Cyprien SIMON
Academic supervisor: S. TREUILLET
Industrial supervisor: M-F. FALZON

Company: Hutchinson

Objective/motivation

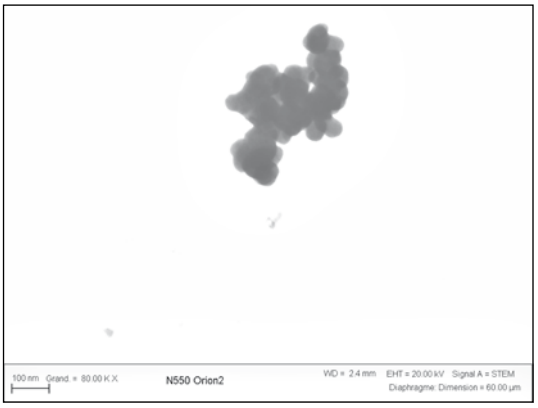
Carbon black (CB) is the most widely used filler to modify the mechanical, electrical and optical properties of industrial polymer products. Rubber producers use a standard grading of CB depending on the 3D morphological and microstructural characteristics of the aggregates which directly influence the reinforcing properties in the polymer material. Until now, several complex existing physico-chemical methods needed to be combined to access these properties; they are time-consuming and need a very experienced operator. During a doctoral research project, Hutchinson and PRISME laboratory proposed a computational method for automatic characterization of CB based on Transmission Electronic Microscope (TEM) images analysis. The goal of the project is to develop a reliable and easy-to-use software from these research results.

Results

The image processing chain is composed of several steps: segment a set of TEM images for extracting aggregates, compute a set of 37 morphological and structural features on each aggregate, and then automatic grading with a trained classifier. The first part of the project is to understand and check the different existing codes developed, based on several software tools. The main part is to verify and complete existing codes in MATLAB for image segmentation, and develop missing parts for features extraction. The developed software must be carefully validated by comparing the ground truth with a large annotated image database. The project deliverable is a report on validation tests and a reliable executable code including features extraction. The classification part will be continued during an internship to finalize the software with a user-friendly interface.

Keywords: image processing, carbon black grading

Binary image of carbon blacks



TEM image of carbon blacks

Contact: cyprien.simon@etu.univ-orleans.fr

User interface development on "System On Module" for electrical appliances

Electrical engineering


G. MONTALBAN


T. VALLIN

Gladys MONTALBAN / Thibault VALLIN
Academic supervisor: J-Y. CADOREL
Industrial supervisors: C. BERTRAND, S. CHALUS

Company: Brandt

Objective/motivation

Electrical appliances are evolving according to our society. Customers are very demanding about appliance functionalities and having a user-friendly system. The principal functions of electrical appliances, which could be for baking in the oven or washing clothes, are not enough. To add new functions to a product, there are many modifications which need to be done. One of them is about the user interface, which is why Brandt wishes to create a user interface using unusual technology to fill this need. After some research, engineers found that mobile technology could allow them to create new functionalities and graphical designs. Our main objective is tPo create a user-friendly environment with intuitive navigation.

Results

First, we made a benchmark to choose the best component according to the company's specifications. It allowed us to list an appliance supplier and a different card type which supports the graphical test we wanted to do. To create the user interface, we used a development board composed of a touch screen, system on module and connectivity components. We selected Eclipse as our development environment with C/C++ language. Our target device operates on Yocto, a lightweight Linux distribution, usually used for embedded systems. All the tests were performed on a virtual machine to be able to share our work with the Brandt Development service department.

Keywords: electrical appliance, IT, C/C++, Graphical User interface, Yocto

Operation system

The board we are working on


Brandt's product example

Contact: gladys.montalban@etu.univ-orleans.fr ; thibault.vallin@etu.univ-orleans.fr

The details of the projects of these students in Engineering Physics and Embedded Systems cannot be printed here as they are subject to a non-disclosure agreement.

Théo BOTTAIS

Mathieu NIEFERGOLD

Marine PAILLUSSEAU

The project of Engineering Physics and Embedded Systems student Rafael Augusto DA SILVA BATISTA, a joint project with students from the Innovations in Design and Materials specialty, appears on page 88.

The project of Engineering Physics and Embedded Systems student Geoffrey MEDO, a joint project with students from the Innovations in Design and Materials specialty, appears on page 91.

Industrial Engineering applied to Cosmetics, Pharmacy and Food Processing

3D modelling of a non-aseptic vials conditioning line

Industrial engineering

C. AUGE

Y. LAZRAQ

Camille AUGE / Yahya LAZRAQ
Academic supervisors: A. HIVET, G. HIVET
Industrial supervisors: J. JACQUART, B. DE ROMEMONT, B. MAHE

Company: NNE

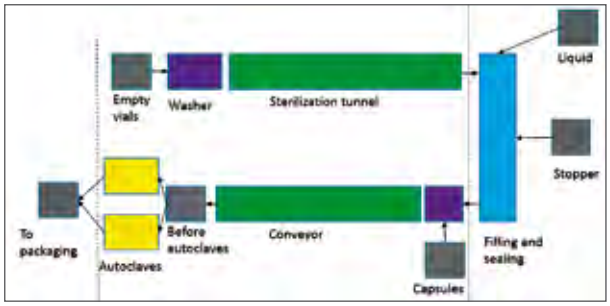
Objective/motivation

The objective of this project is to create a model of a 20ml vial conditioning line. This model will be useful to be able to visualize and understand the system more effectively in order to improve it. The information that we are looking for is how the line should be implemented in order to produce in the most efficient way possible, and to discover how long it will take to produce a batch. Today NNE uses an Excel® file, which is a 1D model. This type of model has its limit when we consider a complex system. In this project, two softwares were used: Flexsim and 3DEXPERIENCE®. The model we created is more precise because it takes into account more parameters (interactions between machines, stocks, number of workers, etc.) and is based on a hypothesis closer to reality.

Results

The results for the Flexsim software are several models of the conditioning line with calculus notes associated. These different models were chosen after experimenting on different line implantations. The models with the best production for the same amount of time were picked. It is then easy to choose a model according to the cost of the different resources. On 3DEXPERIENCE® we managed to calculate and estimate production times and loading times of the conditioning line. This information was useful to estimate the overall cycle time and to compare our results to the ones which were given by the company. Finally, we analyzed the differences between the two types of modelling and strategies.

Keywords: modelling, conditioning line, production, software



Line to model

Model on FlexSim

Contact: cam.auge@laposte.net ; yahyalazraq@hotmail.com

Analyze and decrease changeovers time

Industrial engineering

Audrey LOAEC
Academic supervisor: A. HIVET
Industrial supervisor: H. LEGER

PUIG

Company: Puig

Objective/motivation

The group Puig owned four manufacturing plants, three in Spain and one in Chartres. In terms of changeovers, Spanish factories maintain that their changeovers are thirty percent shorter than those in Chartres. The goal of this project is to decrease the changeover time for all the production lines in Chartres. In a first phase, two production lines take priority: the first because there are many changeovers compared to other lines, and the second because it is a new production line so improvements can be made. The software K-Process helps to film and analyze changeovers with glasses that have a built-in camera. We then had to view the video and take decisions about the changeovers process.

Results

At the moment, some changeovers are filmed and analyzed but the project is in progress. Standardization and training for employees needs to be planned. At the end of the project, all changeovers for each production line need to be standardized and all employees trained.

Keywords: production, cosmetics, SMED

Contact: audrey.loaec@etu.univ-orleans.fr

Continuous improvement of the maintenance department within the aseptic production

Industrial engineering

Alexia BERTHELOT
Academic supervisor: G. HIVET
Industrial supervisor: S. YAKHLEF

Company: Novo Nordisk

Objective/motivation

My industrial project consists of the continuous improvement of maintenance within the aseptic production department which owns two insulin cartridge filling lines. This production is carried out in a controlled atmosphere. The maintenance uses Failure Investigation Trees (FIT), which are the corrective maintenance standards. For now, we have low visibility regarding the use and effectiveness of the the FITs. By providing effective supports which meet the technicians' needs, we'll be able to decrease the corrective maintenance time and thus enhance the production time in order to respect the production plan. For this to happen, we will implement a continuous improvement initiative following the DMAIC sequence of steps, which will require a specific measurement tool.

Insulin cartridges produced within the aseptic department

Results

The specific measurement tool that was created is a Rashboard per line including all the filling lines' stations and the problems that are encountered the most frequently that already have a related FIT. Some empty boxes will be available for each station so that the technicians will be able to push the measurement tool forward. Moreover, the technicians will define the FITs' effectiveness during their investigations by filling the problem-related boxes with coloured dots and a specified colour coding. For the creation and improvement of FITs, technicians will provide drafts from their experience in the field that determines the effectiveness of the related FIT. Afterwards, the different data from the Rashboard and the drafts will be surveyed on a weekly basis in order to create a list of prioritized FITs to deal with. Finally, we will follow some key indicators such as the proportion of revised FITs, intervention times, and the FITs' evolution according to their effectiveness.

Keywords: maintenance, improvement, Failure Investigation Tree, DMAIC, Rashboard

FITS and the related drafts surveyed on a weekly basis

RashBoard FIT implemented within the aseptic department

Contact: alexia.berthelot@etu.univ-orleans.fr

Continuous improvement project

Industrial engineering

Laure BAQUE
Academic supervisor: J. DOUSSOT
Industrial supervisor: P. NOURIGAT

Company: Sanofi Winthrop Industrie

Objective/motivation

The Lovenox® patent expiry allows manufacturers to develop and produce biosimilar drugs through the principle of biosimilarity in Europe. Sanofi must remain competitive in the marketing of Lovenox® in order to maintain its global market share. This is the context in which a global project has been undertaken to significantly improve performance on the global industrial network. A 5S project was initiated within the industrial cleaning facilities and aims to increase the performance of an aseptic filling line. The industrial cleaning facilities are areas for washing, assembling, bagging and autoclaving the necessary material for the compounding and filling of the Lovenox® active ingredient.

Results

The 5S project has continued to develop a continuous improvement culture within the manufacturing team. This project has given more energy and motivation to the team in order for employees to pursue with the next simplification projects. A layout of the workstations was carried out so that the crossing of the soiled and the clean material would be avoided. The 5S project made it possible for the industrial cleaning facilities to have no material waiting, thus avoiding stops on the aseptic filling line. Finally, other 5S projects will be undertaken in other industrial cleaning facilities.

Keywords: pharmaceutical industry, continuous improvement, 5S project

Contact: laure.baque@etu.univ-orleans.fr

Control and optimization of the process

Production engineering

Mariétou GOUNDIAM
Academic supervisor: J-B. VIDAL
Industrial supervisors: S. KLEIN, F. ROBLOT

Company: Les Laboratoires Servier Industrie

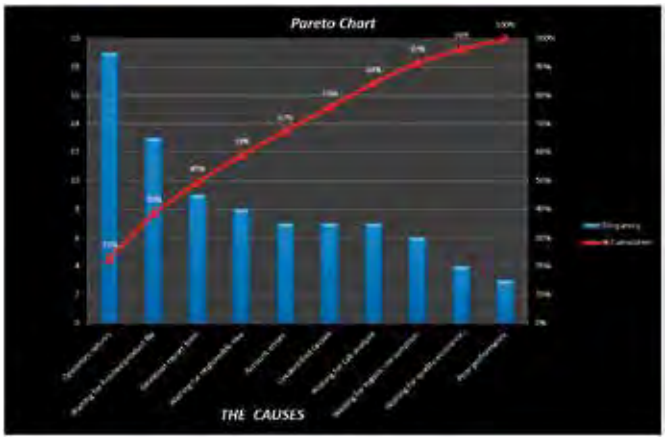
Objective/motivation

During my fifth year in industrial engineering applied to cosmetics, pharmacy and food processing, I'm carrying out my apprenticeship at Servier within the performance management department. The project deals with the analysis and fluidification of the process to reduce overall release time, and the reduction of the assessment file between the end of packaging and the release of the finished product to speed up the flow. The main objective is to analyze requests to identify the root causes. By identifying the root causes, I will analyze all of the steps of the flow between the end of packaging and the release of the finished product. Moreover, I have to establish and control an action plan in the field.

Results

First, I began with understanding the process and identifying the different actors involved, between the end of packaging and the release of the finished product. I then analyzed and identified the root causes of the highest evaluation of the file. After a long period of identifying the causes, I had a Pareto chart representing the importance of the various different causes. This chart highlights the most important causes of the total number of effects and thus allows us to target actions. The second step involves setting up the action plan to reduce and/or eliminate these causes. These actions will then be verified and controlled to improve a situation.

Keywords: optimization, process, analyze, improve, control



Contact: marietou.goundiam@univ-orleans.fr

Creation of a training program to develop operators' skills on a new machine

Production engineering

Laurine BRENEK
Academic supervisor: A. HIVET
Industrial supervisor: S. POULLET

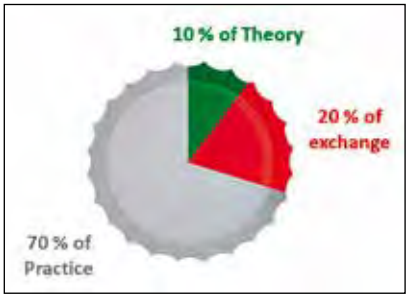
Company/Institution: undisclosed (confidential)

Objective/motivation

To meet increased demand for its product, the firm raised its capacity and invested in new machines. To support this growth, operators need to improve their skills to use equipment with autonomy. That is why, with different members of departments, a training program for a new labelling machine is established. Each member provides his own skill: technical knowledge, relationships with operators, knowledge of training and software tools, etc., in order to have the most comprehensive training program. This training program includes the identification of people to train, the definition of skill levels to be reached, practical and theoretical parts, a training module (e-learning), the assessment of operators' skills, and the training tracking and tools for feedback. The aim of a good training program is to eliminate stoppages and breakdowns, prevent accidents, limit equipment failure and, consequently, increase productivity.

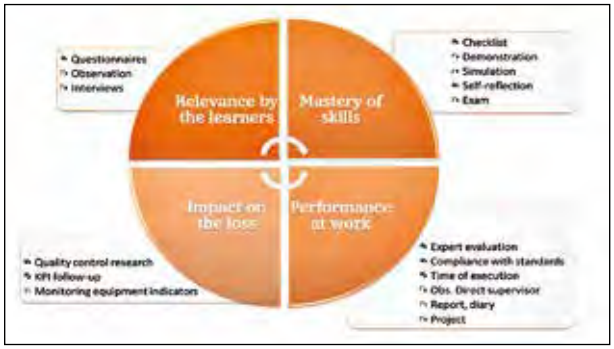
Results

After the creation of the program, we must check that the training program includes different parts which allow us to reach our objectives: 1) Eliminate short stops: with precise descriptions and explanations of the machine, operators can work calmly and react in case of an issue; 2) Eliminate breakdown: a defect checklist allows operators to detect the defect and fix it; 3) Prevent accidents: in the beginning of the module, a reminder about safety rules and personal protective equipment is done; and 4) Limit equipment failure: a CILT part (Cleaning, Inspection, Lubrification and Tightening) allows operators to do basic maintenance tasks. Then, to evaluate this project, two indicators are followed: one for the advancement and one for the performance. The project is not finished. However, the initial feedback from operators is positive.

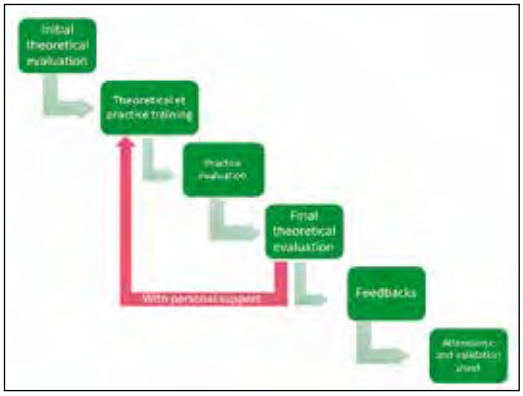


Training strategy

Keywords: production, industry, training program, skills, operators



Evaluation criteria and methods



The conduct of training

Contact: laurine.brenek@etu.univ-orleans.fr

Development of preventive maintenance standards in the creation of an autonomous production unit

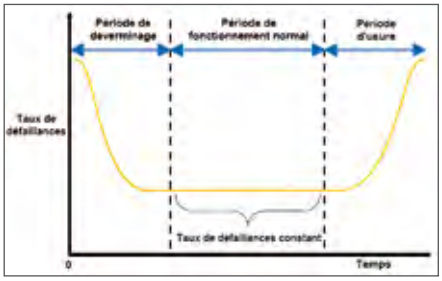
Production engineering

Hugo GOMES
Academic supervisor: S. LEROUX
Industrial supervisor: M. MELAIN

Company: Laiterie de Saint Denis de l'Hôtel

Objective/motivation

The Laiterie de Saint Denis de l'Hôtel is a packaging company cluster which processes and packages liquids and lettuces for other industrial clients and distributors. The income of the company is about 880 million for 1 billion salesL. Following a diversification policy, LSDH has set up two new production lines to make new packaging called the "EDGE" carton. Due to logistical obligations, the new lines are located in a new building and will run as an autonomous production unit, which means they don't require the other parts of the plant in order to function.



Breakdown rate (BCF Consultants)

Results

I joined the Method and New Works department which manages the "EDGE" Project. I assisted the production lines start-up and am currently working on implementing a preventive maintenance plan for pre-conditioning equipment (product tank, sterilizer, homogenizer, etc.). A production line start-up is an appropriate moment since the breakdown rate is rather significant (initial breakdown period). In addition, all equipment is thoroughly tested during installation. Thanks to that data, the supplier documentation and the collaboration of the technical team, I am implementing a preventive maintenance plan with 12 new preventive maintenance standards to maintain the new equipment.

Keywords: preventive maintenance, food processing industry, maintenance standards, autonomous production unit

EDGE packaging

Company cluster

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

Optimization of conditioning documentation

Industrial engineering

Camille MOREAUX
Academic supervisor: J-M. AUFRERE
Industrial supervisor: S. BOURNEIL

Company/Institution: undisclosed (confidential)

Objective/motivation
Today, to package a production order, the operators use packaging instructions and a tracker sheet. The packaging instructions are created with Microsoft® Word by the Administrative Manager using the data in other documents like the passed for print. The tracker sheet is printed automatically using the data in the ERP (Enterprise Resource Planning, a type of software that connects day-to-day business processes). Some data is in the ERP and some is in the packaging instructions. Therefore, my objective is to limit the duplication of data. The people who put the information in the ERP but also in the packaging instructions will be able to save time.

Results
The operators need 73 pieces of data to package a production order. There is 57% of the data In the ERP, 50% of the data in the packaging instructions, and 50% of the data in the tracker sheet. Today, it is possible to put all of the information in the ERP and print this data in a single document. Therefore, we can finalize the feasibility project to the real project.

Keywords: pharmaceutical, industrial, packaging instruction, Enterprise Resources Planning

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

Optimization of a Manufacturing Execution System

Industrial engineering

Joséphine PARLINSKI
Academic supervisor: A. HIVET
Industrial supervisor: W. RABILLE

Company: L'Oréal

Objective/motivation

L'Oréal Group is the world leader in beauty, including makeup, cosmetics, haircare and perfumes. The factory I am working in is specialized in anhydrous cosmetics and exclusive perfume series that demand specific manual handling of packaging. One of the key performance indicators of the factory is the Overall Equipment Effectiveness (OEE), which measures the manufacturing time that is truly productive. Over the last three years, the OEE has been constantly increasing. However, a huge loss is due to time without production which is not correctly identified. The goal of my project is to work on the optimization of the Manufacturing Execution System (MES) used to register all the events that occur on production lines. A better registration of events will lead to a better identification of the real causes of breakdowns and therefore lead to setup targeted actions on the real problems.

A perfume production line

Results

A multidisciplinary team was created for this project, including technicians, operators, engineers and the IT Department. The goal was to understand the need of each person using the MES and to have all the necessary skills to optimize the software. The breakdowns' specification list has been simplified and is now specific to each production line. The registration rules have been clarified for the operators. In addition, a leaflet explaining the new structure was displayed on every production line to help the operators quickly get more familiar with the changes made.

Keywords: performance, OEE, production costs, Manufacturing Execution System

The plant of Lassigny

A lipstick production line

Contact: josephine.parlinski@etu.univ-orleans.fr

Pilot factory implementation

Industrial engineering

H. EL FILALI

C. PETIT

Hamza EL FILALI / Camille PETIT
Academic supervisor: G. HIVET

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Objective/motivation

The purpose of this pilot line is to train engineers, operators or technicians, at several levels. The different type of trainee must be able to interact on the pilot line. The realization of this project is carried out in two phases: 1) phase of design and implementation of the pilot plant phase ; 2) development phase for training strategies for various levels that are required. We are working on the first phase of the implementation of the pilot plant within the industrial engineering specialty in Chartres. This pilot plant will train engineers on the various issues and constraints by having the equipment corresponding to what we can encounter in a factory these days.

Results

The result is a functional pilot line with all the quality, making, and conditioning equipment. Currently, we supply all the necessary equipment to train people on the line. The virtual implementation has been made on 3DEXPERIENCE®, a software that helps us to simulate the production and define the range we will produce.

Keywords: pilot, implementation, training

Quality control

Conditioning line

Making laboratory

Contact: hamza.el-filali@etu.univ-orleans.fr ; camille.petit@etu.univ-orleans.fr

Reducing material losses

Industrial engineering

Lilia KARRAKCHOU
Academic supervisor: D. TRIHAN
Industrial supervisor: C. BOLLA

Company/Institution: undisclosed (confidential)

Objective/motivation
As part of my final year in engineering school, I have to undergo a year's apprenticeship. I was placed in the performance department of a huge cosmetics company. This plant specializes in shampoo, conditioners and shower gels and produces more than 282 million finished products per year, which represents more than 91,152 tons of juice. Of this amount, 2.65% is lost for various reasons. My role in this project is to reduce losses to 2.48%. To do this, a Lean Six-sigma approach was conducted using the DMAIC method (Define, Measure, Analyse, Improve, and Control).

Results
The DMAIC method is done as indicated previously in five steps. To date, the Define phase has been completed and the Measure phase has been started. During the Define phase, the perimeter of work was fixed to four priority production lines in order not to be dispersed in the study. The customer needs could be clearly defined, which could lead to the identification of 20 indicators and measure points to be followed throughout the process to define the sources of losses. The Measure phase consists of collecting the data. Subsequently, the causes of major losses will be defined in order to put in place an appropriate action plan.

Keywords: DMAIC, losses, Lean, Six-sigma

Contact: Lilia_karrakchou@hotmail.fr

Reorganization of the tools of a packaging workshop

Production engineering

Alizée HERVE
Academic supervisor: B. LE ROUX
Industrial supervisor: M. MEZIANI

Company: Galien LPS

Objective/motivation

As a pharmaceutical subcontractor, Galien LPS offers services to industries in the sector. The company has a varied activity such as the graphic design of packaging but also the packaging of dry forms in blisters. It continually aims to acquire new markets and therefore industrialize new products. It goes without saying that the quality of the products delivered to the customer must be irreproachable because it concerns public health. It is then essential to have good production methods. Therefore, and in order to improve the management of the set of tools of the manufacturing plant and make employees' working conditions better, Galien LPS wants to carry out a complete reorganization of tools with a Lean approach.

Results

As it is an ongoing project, there are currently no results. The main objective of the project is to avoid wasting time in the application of non-value-added tasks with the aim of improving the availability rate of tools. This is why, when defining the project, it was obvious to rethink the reorganization of the tools of the packaging workshop. This reorganization is broken down into several main sub-processes that are the reorganization of tool storage using 5S tools and the creation of a database that will allow the real-time monitoring of the tooling for a better traceability. The return on investment of the project will be the increase in the flexibility and productivity of the company, with an indirect reduction of format changeover times that requires tool changes.

Keywords: production, equipment, Lean Manufacturing, ergonomic

Packaging line

Distribution ramp

Packaging line

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

Resumé of the technical annual stop in extraction department

Production engineering

Camille MOISAN
Academic supervisor: J. GILLIBERT
Industrial supervisor: A. POTEAUX

Company: Sanofi Chimie

Objective/motivation

I am carrying out my fifth-year of industrial engineering applied to cosmetics, pharmacy and food processing in apprenticeship at Sanofi in the production department. The plant where I am working is Saint Aubin les Elbeuf. It is specialized in fermentation and extraction processes for active drugs. For this year, I am on some projects of continuous improvement. The main objective of this first part is to make a resume of the technical annual stop, establish an action plan and control this action plan in the field. Furthermore, I have to work on lock out and tag out for some equipment in chemical environment with chemical and electrical consignation.

Results

First, I have to know and understand the process, so I started to work with a technician. To develop a tool for consignment of equipment, I spent a lot of time in production to understand schematics. This tool helps us for the technical annual stop. It is based on the lock out and tag out. During this stop, I was in charge of cataloguing problems in order to anticipate others that might occur. Moreover, I identified the different actors who can have influence. With this information, I can set up an action plan specialized for the extraction department to reduce causes of problems. For continuous improvement, these actions need to be verified and controlled in the long term. With these kinds of projects, we must use approach tools to be structured.

Keywords: optimization, process, reliability, improve, control

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

Revitalization of the continuous improvement process

Industrial engineering

Julie DEBONNE
Academic supervisor: O. SNOECK
Industrial supervisor: M. ROSSIGNOL

Company/Institution: undisclosed (confidential)

Objective/motivation

As the industrial pharmaceutical sector is developing in a highly competitive climate, pharmaceutical production sites have to improve their productivity. The process of introducing a Lean management approach is used to optimize production costs. In this way, this company wants to revitalize the continuous improvement process in its production sector. Lean efficiency is based on the employees' involvement. To reach that goal, three lines have been set. The first is to spread Lean thinking at the company by training the employees in Lean tools and creating a kind of Lean community. The second is to work on small projects directly linked to employees' ideas to encourage them to participate in Lean development, and the last is to rework the visual management boards to improve their attractiveness and thus bring them to life.

Results

The project has been in development since September, 2017, and is far from being completed in March, 2018. However, two of the three items have progressed. As regards Lean thinking, thirty-two employees have been trained in the Yellow Belt certification and eleven employees in the Green Belt certification. To complete the certification, they all have to pilot an intern project. Lean meetings are monthly to communicate projects' progress to other employees. Relating to the employees' involvement, two small projects have been launched (one Kanban project and one 5S project). The rework of the visual management will start shortly with a brainstorming with managers, production line operators, maintenance technicians and quality managers. The task of revitalizing the continuous improvement process will then continue.

Keywords: continuous improvement, pharmaceutical industry, employee involvement, Lean thinking

5S project explanation

The three project's priorities

Contact: juliedebonne81@gmail.com ; julie.debonne@etu.univ-orleans.fr

Study of performance gaps between lipstick conditioning lines

Industrial engineering

Magida AZMIRRA
Academic supervisor: G. HIVET
Industrial supervisor: N. AMBOLET

Company/Institution: undisclosed (confidential)

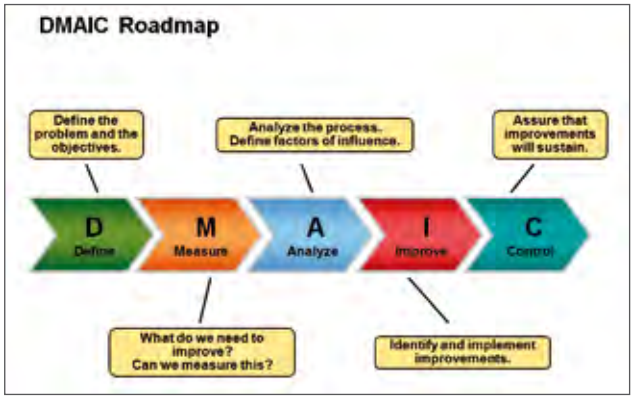
Objective/motivation

In recent years, the make-up sector of a large company has seen considerable growth, particularly in lipsticks, and is still growing significantly. The industrialization times are therefore increasingly short since the company must be able to adapt to meet market demands and satisfy the customer. This project is part of a continuous improvement process with the aim of improving the performance of the lipsticks conditioning lines. My role is to provide a critical look at the lipstick process and identify the specifics of the problems encountered by analyzing production data, working methods and equipment.

Results

The approach taken to determine the specific causes that could justify the non-performance of the lipsticks lines is the DMAIC Method, which is a 5-phase problem-solving method that makes it possible to achieve the objectives of the Lean 6 sigma. I have carried out a collection of the data as well as an inventory. I did a cutting of the information and a finer analysis of the production data initially, using the DMAIC tools. Using this analysis, I was able to highlight the three main problems that have a strong impact on performance. During the remainder of the period of internship, I have to continue the study by linking all the identified gaps, understanding their root causes and finally proposing solutions to implement.

Keywords: continuous improvement, performance, quality, availability, industrial equipment



Contact: epy@hotmail.fr

Update of the unique document of occupational risks

Industrial engineering

Anissa XICLUNA
Academic supervisor: A. HIVET
Industrial supervisor: F. BONNEAU

Company: Danone

Objective/motivation

In an increasingly demanding environment, safety is a critical factor in ensuring the well-being and integrity of all employees in a company. Therefore, safety is a decisive criteria for the survival of companies. Danone dairy is the European leader in the fruit brewed yogurt market and is specialized in the production of five brands: Activia, Danonino, Creamy Recipe, Taillefine and Velouté Fruix. The objective is to maintain the Unique Document of Occupational Risks of the Villecomtal-sur-Arros production site and to develop an identification, resolution and communication process for the "Irritants" regarding the Psychological Risks Social Work (PSR) at work and include them in the DUERP.

Results

The updating and maintenance of the Unique Document of Occupational Risks, through risk analysis, should be carried out in order to manage all the risks that the employees face on a daily basis in a more efficient way. A Unique Document of Occupational Risks to easily include Psycho-Social Risks and highlight major risks to be treated in priority should be implemented through a new listing and the establishment of criticality thresholds. An approach to identify resolutions and to communicate psycho-social risks called irritants will be deployed within the production site.

Keywords: safety, unique document of occupational risks, psycho-social risks

Aerial view of the dairy of Villecomtal

Villecomtal in celebration

Contact: xiclunaanissa@gmail.com

The details of the projects of these students in Industrial Engineering applied to Cosmetics, Pharmacy and Food Processing cannot be printed here as they are subject to a non-disclosure agreement.

Cassandre ARDISSON

Thibault PREPIN

David JOUANNEAU

Kévin PROBS

Ariane PIACERE

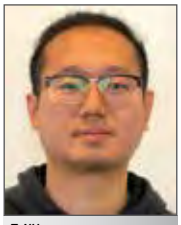
Clément SELLES

Innovations in Design and Materials

Automotive doors motorization

Embedded systems engineering and Innovations in design and materials


R.A. DA SILVA BATISTA


T. XU


A. YOMBO

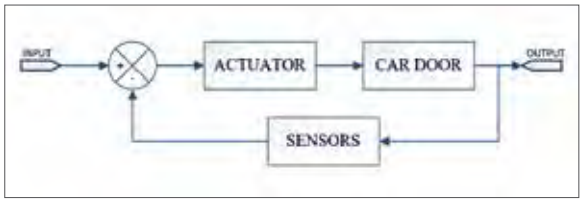
A joint project with the ENGINEERING PHYSICS AND EMBEDDED SYSTEMS specialty
Rafael Augusto DA SILVA BATISTA / Tianxiao XU / Alexandre YOMBO
Academic supervisors: B. LE ROUX, R. LEDEE

Company/Institution: undisclosed (confidential)

Objective/motivation
As a part of the 5th year industrial innovation project of Polytech Orléans, we worked in partnership with the automobile components industry to design the motorization system of an automobile door. This involved two main fields of study: mechanical conception and the programming of a control system. We were composed of a team of three students in the required field: two masters students in Mechatronics and Eco Design and one masters student in Electronics and Embedded Systems. To follow the specification needs, the system has to motorize the closing and opening of the automobile doors intelligently. It must also be able to respect the existing features of an ordinary car door. In order to do so, we had to define some types of actuation principles by studying existing systems of doors operating.

Results
The solution chosen is applicable and doable/feasible in an automotive market. The sensor used has presented really good results covering most of the requirements from the company. The mechanical models presented and studied are conceivable as well but, due to the complexity of the system, more time is needed in order to achieve solid results. Users can order the door to open or close automatically, and the system also allows users to open or close the door as a traditional door in case of lack of electricity. As a result, at the end of the project we delivered a feasibility analysis and a strength and weaknesses analysis for the mechanisms and the demonstrations, the kinematic simulations of the different solutions. The project will continue with an internship for some students who will implement a real model of our mechanism.

Keywords: embedded systems, automotive, mechanical design, 3DEXPERIENCE®



Simplified diagram of the control system


Group discussion after video conference

Contact: rafael.augusto.sb@gmail.com ; alexyombo@gmail.com ; tianxiao.xu@etu.univ-orleans.fr

Breakage analysis of door hinge of a cooking oven

Mechanical engineering


Y. JERMOUNI


F. LIPPMANN


J. PHAM


A. B. TRAORE


E. VIGOUROUX

Yasser JERMOUNI / Florian LIPPMANN / Jérémie PHAM / Awa Banzere TRAORE / Elora VIGOUROUX
Academic supervisors: S. ALLAOUI, J. GILLIBERT, M-L. BOUCHETOU, J-L. DANIEL
Industrial supervisor: M. CARMES

Company: Brandt

Objective/motivation

This project is in collaboration with the company BRANDT and consists in analyzing the breakage of an oven hinge that enables the opening and closing of the oven door. These breaks occur on some Brandt products and the goal is to identify the causes of these damages and propose solutions to avoid them.

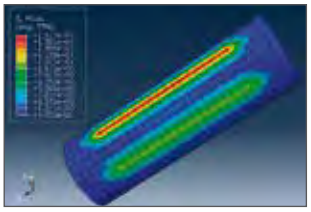
Results

In this project, we worked on different disciplinary fields necessary to solve the problem such as statics, kinematics, dynamics, materials and simulation. To achieve the project's aims, a study of the behavior of the material used, as well as a search for alternative materials, was conducted considering the environmental operating conditions. Otherwise, the study of the hinge kinematic was carried out and made it possible to identify the real efforts applied to the hinges. The results of this study, coupled with those of the digital simulation of the behavior of the hinge in service, made it possible to propose optimization of the design of the material.

Keywords: oven, hinge, kinematic, breakage, mechanic


CAD (Computer-aided design) of the Brandt oven


The hinge which breaks itself at the level of the door


Numerical simulation of the hinge axis that breaks

Contact: florian.lippmann@etu.univ-orleans.fr ; yasser.jermouni@etu.univ-orleans.fr ; jeremy.pham@etu.univ-orleans.fr ; awa-banzere.traore@etu.univ-orleans.fr ; elora.vigouroux@etu.univ-orleans.fr

Creep test bench

Mechanical engineering

Steven BESNARD / Pierre GEORGEON
Academic supervisor: J. GILLIBERT

Institution: LaMé Laboratory

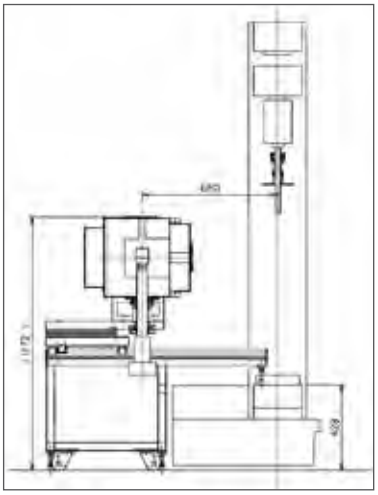
Objective/motivation

The objective of our project is to design a solution for a creep test bench that can apply a constant charge (0-2kN) on a specimen inside an oven at extreme temperature (<1000°C) for a long period of time (two weeks). Currently, this test bench is already working, but to do so our tutor, Jean Gillibert, is using a traction/compression machine that is very expensive and that could be put to much better use than this. It is also not designed to do this kind of work and in the long term could be damaged. Also, this machine may not be reliable for a two-week test as a power cut could occur and make the results false. To design our solution, we will use the CAD software 3DEXPERIENCE®.

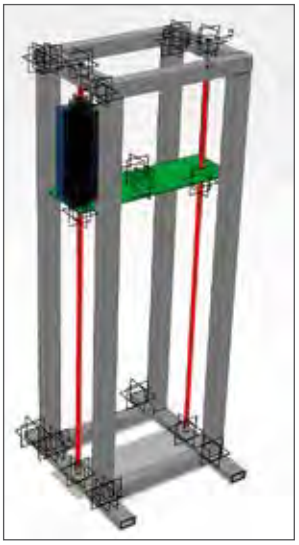
Results

The final solution we chose for this project is a system with guided mass that will apply constant pressure on the specimen. We will use a hoist to manipulate the mass. The mass will be 2kg each and they will be placed on two columns of 50. A system with a pin on each column will allow the operator to choose the charge he wants for the test. We designed all of this on 3DEXPERIENCE®, as shown in the picture below. As for the fabrication of the bench, all of the welding will be done by Polytech but the mass will be made by an outside company which is yet to be determined.

The oven with the existing traction machine



Schematic of the oven



Our system on 3DEXPERIENCE®

Design of a robotized horticultural tool

Electrical engineering, Mechanical engineering


Y. CASTELAR


G. MEDO


A. VIOLETTE

A joint project with the ENGINEERING PHYSICS AND EMBEDDED SYSTEMS specialty
Yohan CASTELAR / Geoffrey MEDO / Adrien VIOLETTE
Academic supervisor: J-M. AUFRERE

Institution: Committee for horticultural development of the Centre-Val de Loire region

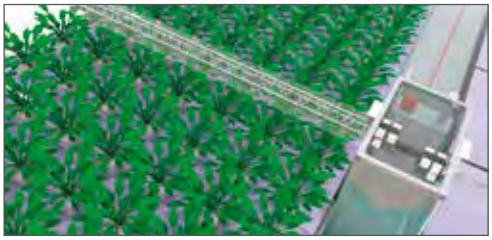
Objective/motivation

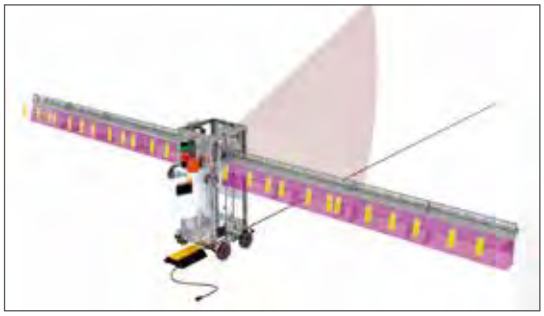
This project aims at designing an autonomous tool for thigmomorphogenesis, which is the action of stressing a plant by touching it in order to make it enlarged and leafy instead of growing. The current tool is a trolley moved around by the horticulturist of the CDHRC. It is impractical, heavy and time consuming. In order to make it autonomous and reliable, we had to design both the mechanical and electronic aspects using mostly products accessible by the public so the trolley could be put together by a contractor or a technician certificate class. The client being an association of researchers, the cost must be as low as possible. The environment in the greenhouse is considered harsh because of the high humidity and temperature between -10°C and +55°C. So as to make it durable, we had to come up with as much modularity as possible. Other tools would be UV led or insect screens.

Results

The trolley we designed is made of an open structural chassis and two booms of up to 4 meters dismountable in 2,1,1m sectors and able to bear up to 12 tools (like plastic sheet for thigmomorphogenesis) by boom. It is equipped with high end sensors in order to protect the robot and people around it from collisions using emergency brakes, and is also equipped with all the electrical protections of industrial standards as defined by the standard ISO 10218-1:2011(fr). The working height of each boom is variable, as is the number of tools and their position. The trajectory is only a linear round trip with configurable speed and cycles among a set horticultural trial. Light and easily movable, it's perfect to be transported between greenhouses when needed. Its highly resistant structure renders it reliable over time.

Keywords: robot, mechanical design, electronical design, dimensioning


Overview drawing


General schematic


Detail drawing

Contact: yohan.castelar@etu.univ-orleans.fr ; geoffrey.medo@etu.univ-orleans.fr ; adrien.violette@etu.univ-orleans.fr

Electrical energy valorization of power generators during tests maintenance

Electrical engineering


S. GABORIT


I. TAIQ

Séraphin GABORIT / Ilias TAIQ
Academic supervisor: C. BOURILLON
Industrial supervisor: P. MOREAU

Company: Enedis – Serval Department

Objective/motivation

Electricity is one of the most important blessings that science has given to mankind. It has also become a part of modern life and it has many uses in our day-to-day life. Nowadays, many projects are launched to save this energy source. Enedis Orléans has hundreds of generators used to supply electricity to consumers when the grid isn't able to deliver energy. These generators are tested as preventive maintenance; however, the electricity produced is wasted by resistances through joule effect. The aim of our project is to valorize the electrical energy produced by these generators during tests. We have to study all the possible solutions to save energy, determine the cost of each solution and finally choose the most appropriate.

Results

After a visit of the industrial plant in Orléans and the understanding of the actual test process, we studied several possibilities of saving electrical energy. We calculated the mean energy produced each day so as to size the equipment plugged to the generators. Our technical study brought us to energy storage such as domestic batteries or flywheels, but due to the amount of energy, these solutions are not viable. That's why we thought of plugging the generators into the grid in order to sell the electricity produced. This solution was quite simple at first sight, but the generators are not designed with this option, so we studied what are the materials needed to sell the energy to the grid while respecting Enedis' maintenance tests requirements.

Keywords: power generators, energy savings, environment

Contact: seraphin.gaborit@etu.univ-orleans.fr ; ilias.taiq@etu.univ-orleans.fr

Full-scale model of the Aerial Screw: Leonardo da Vinci's invention

Mechanical engineering


A. BOUKROUTE


A. CHONG-WING


M. HAJJOUBI


A. MICOU

Achraf BOUKROUTE / Alan CHONG-WING / Mouad HAJJOUBI / Adrien MICOU
Academic supervisor: J-M. AUFRERE
Industrial supervisor: J-P. ANCHISI

Company: AD Prod

Selected participant
12th Annual Final Year Projects Forum

Objective/motivation

2019 being the 500th anniversary of Leonardo da Vinci's death, in order to pay tribute to his total body of work, the French association AD Prod and its manager, Mr. Anchisi, decided to recreate one of his inventions. In this context, we have been asked to carry out a full-scale modeling of the "Aerial Screw", also called "Vite Aerea" in Leonardo's mother tongue. Our project is a part of two-year agreement and this first phase consists of making important decisions such as the elevating and rotating systems. These decisions require case studies using decision matrices and other tools. The next step is to design the prototype and model it on a CAD software. The final product should be presented in exhibitions and shows in the year 2019.

Results

The main point of our part of the project was to make decisions about elevating and rotating solutions. In fact, since the aerial screw has never worked, we are tasked with imagining and designing a convincing aircraft without forgetting that "it cannot fly". Furthermore, this project, which was undertaken in cooperation with the University of Florence and with a dozen Italian students, leads us to communicate mainly in English and to share our work with concerned third parties. When looking at the prototype done in 1999 by our applicant, we realize that we should update the machine to include newly available technologies. Consequently, we had to use different decision-making processes.

Keywords: Leonardo da Vinci, Aerial Screw, full-scale, aircraft AD

Contact: achraf.boukroute@etu.univ-orleans.fr ; alan.chong-wing@etu.univ-orleans.fr ; mouad.hajjoubi@etu.univ-orleans.fr ; adrien.micou@etu.univ-orleans.fr

Heat exchanger

Mechanical engineering


G. HENRI


O. PETIT

Gaëlle HENRI / Ophélie PETIT
Academic supervisors: E. BLOND, A. GASSER, T. SAYET
Industrial supervisors: N. GALLIENNE, N. RICHET

Company: Air Liquide

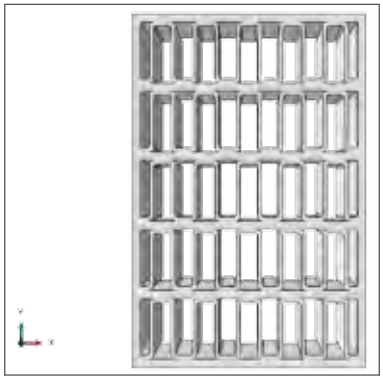
Objective/motivation

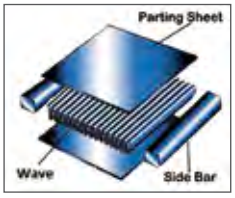
This project deals with Brazed Aluminium Heat eXchanger (BAHX) designed by the company Air Liquide. BAHX are used to cool down air before entering the distillation column. It transfers thermal energy from one fluid to another without mixing them. The mechanical design is performed to predict the strength of the exchanger, in order to anticipate burst issues. An exchanger is made of several layers, constituted of two sheets of metal separated by fins. The objective of this project is the development of a tool enabling fast mechanical simulations and the design optimization.

Results

First of all, a state of the art was written on the homogenization method, proposed to simplify calculations and simulations of complex structures. The main goal was to understand this method and figure out how to apply it on BAHX structure. The implementation of this method in the case of the exchanger enabled to find the boundary conditions and the adapted parameters, which permit to generate simulations with the software Abaqus. After proving the reliability of the results by using tools on the software, and analytic calculations, the method will be validated. It will be in this case possible to use this method for simulation of the exchanger. It will enable, for lower costs (time calculation, human necessity...), to realize more simulations to optimize dimensioning of the structure.

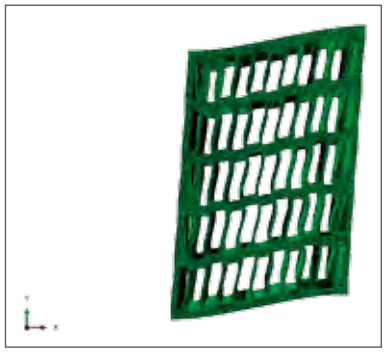
Keywords: heat exchanger, structure modeling, thermomechanical simulation, homogenization


Studied structure before deformation



Schematic of a heat exchanger


Brazed Aluminium Heat eXchanger (BAHX)


Studied structure after deformation

Contact: gaelle.henri@etu.univ-orleans.fr ; ophelie.petit@etu.univ-orleans.fr

Hotplate: new generation

Materials


M. BEAULIEU


A. EL OUALI


L. FACCA


M. NOGAL

Mathys BEAULIEU / Ayoub EL OUALI / Lucille FACCA / Marie NOGAL
Academic supervisors: M-L. BOUCHETOU, E. COURTIAL, L. DEL CAMPO, M. MALKI
Industrial supervisor: K. BELACHE
Company/Institution: Brandt, CEMHTI Laboratory

Objective/motivation

Brandt group offers a very large range of household appliances including induction hobs. Brandt is present on the world and European markets, and is an important leader in the manufacturing and selling of these hobs. However, the group doesn't have a lot of glass ceramic suppliers although it is the principal material present on the hob's surfaces. In order not to depend on these few suppliers on the market, Brandt has decided to contact some teachers and students at Polytech with the aim of looking for a new material which could replace this glass ceramic surface used today. The second item of the project consists in finding a way to detect the type of material of the containers so as to adapt the heating power of the hob heaters according to the type of container used.

Results

At the beginning, Brandt sent us several samples of their glass. The first study consisted of conducting tests with the CEMHTI-CNRS Laboratory in order to characterize the composition of the material. With the conductivity test, we were able to determine the dielectric properties of the sample. The X-ray diffraction test allowed the detection of the presence of crystals and their size. Finally, we found the characteristic temperatures using DSC (Differential Scanning Calorimetry). The second study concerned the detection of the containers. We needed to identify the ferromagnetic materials (aluminum, steel, stainless steel, cast iron) with the electrical resistivity. At this moment, we are doing measurements on these materials in order to validate if our results are close to the theoretical values. The first results are positive. As this is a long-term project, our contribution mainly consists of doing a feasibility study on these work streams.


Brandt's hotplate

Keywords: glass ceramic, container, hob, hotplate, composition


Experimental device for the measurement of the electric resistivity on a stainless steel sample


Experimental device of the conductivity test

Contact: mathys.beaulieu@etu.univ-orleans.fr ; ayoub.el-ouali@etu.univ-orleans.fr ; lucille.facca@etu.univ-orleans.fr ; marie.nogal@etu.univ-orleans.fr

Improvement of the energy consumption of engine test cells ventilation system

Energetics

A joint project with the TECHNOLOGIES FOR ENERGY, AEROSPACE AND ENGINES specialty
Guillaume BREDA / Adrien CARDUNER / Sankaran DATCHANAMOURHTY / Cédric SANZEL / Alexis STRIBERNSKY
Academic supervisor: G. COLIN
Industrial supervisor: W. SEGUIN

Company: Delphi Technologies

Selected participant
12th Annual Final Year Projects Forum


G. BREDA


A. CARDUNER


S. DATCHANAMOURHTY


C. SANZEL


A. STRIBERNSKY

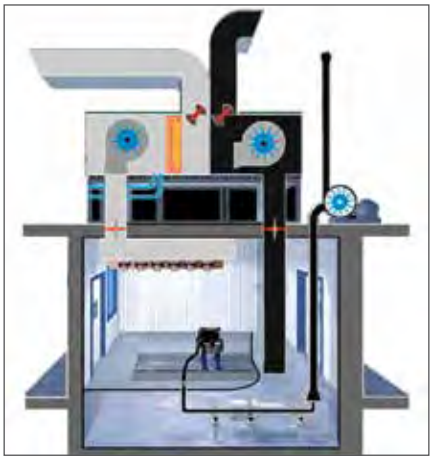
Objective/motivation

Delphi Technologies is a company that mainly manufactures automotive equipment. This project was launched by Delphi Blois; they have an ISO 50001 certification. With this in mind, they have to constantly improve their energy consumption. Inside the Blois building, the engine test cells ventilation system has been designated as one which consumes the most. It represents almost the same consumption as 250 households. This is where our team comes into action. The objective is to reduce the electrical consumption of the ventilation system of those cells. The engines tested inside the chambers release a lot of heat that the ventilation should then remove. The ventilation system must also maintain the inside at a certain temperature and humidity level as well as being adapted in case of a fire or accident.

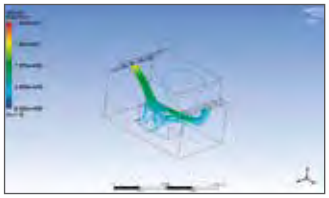
Results

To control the temperature and the humidity inside the cells, we needed to regulate the airflow of fresh air that we supply and the airflow of air that we exhaust. Also, to avoid any stagnation of oil vapors in case of a leakage or any kind of harmful fumes, the room needs to be depressurized. To this end, it is sufficient to exhaust more air than we supply. In order to fulfill those tasks, we added two speed controllers on the fan motors. These controllers are monitored by an already existing automaton that we reprogrammed. Moreover, before implementing those modifications on the site, we checked with some simulations if the standards we used and our program were enough to answer the expectations of the client.

Keywords: ventilation, energy consumption, engine tests facilities


Ventilation system of an engine test cell (source Delphi)


Engine being tested (source www.testsystems24.com)


Airflow simulation

Contact: guillaume.breda@etu.univ-orleans.fr ; adrien.carduner@etu.univ-orleans.fr ; sankaran.datchanamourthy@etu.univ-orleans.fr ; cedric.sanzel@etu.univ-orleans.fr ; alexis.stribernsky@etu.univ-orleans.fr

Neural networks

Mechanical engineering

N. DAUZET

T. LIETAR

Nicolas DAUZET / Thomas LIETAR
Academic supervisor: R. HAMBLI

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

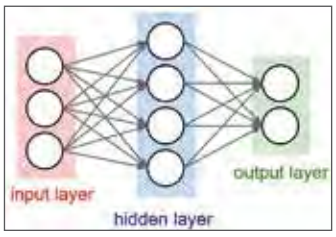
Objective/motivation

The main objective of our project is to acquire skills and knowledge in neural network. This technique has been developed in the last decades in the artificial intelligence domain. In relation with the teacher, Ridha Hambli, the project consists of simulating the stamping on ABAQUS simulation software. By modifying some parameters in the design of the experiment (geometry, properties), the simulation results will change. All of these parameters and results will be reported in the neural network and treated with a specific tool on Matlab programming software. The neural network, working like a human brain, needs to "learn" all the parameters and possible issues in order to find the best set of parameters and the best configuration to optimize the result of the stamping experiment.

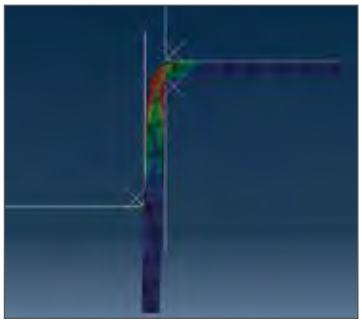
Results

After a discussion with our tutor, we decided to experiment with stamping on a CC60 steel (0.6% carbon concentration) sheet of metal. We created an experimental design with thirty-six experiments, each one with a different set of parameters. All of these sets of parameters were imported into Matlab so that the neural network could treat all these data. With a deep learning of this, the neural network found the best set of parameters and then the best configuration to perform the stamping experiment. These steps are important because in the future we can just put a set of parameters in the neural network Matlab tool and find a good result thanks to the past learning, without doing the design and the simulation in ABAQUS. It is therefore a great time savings.

Keywords: neural, ABAQUS, stamping, learning



Simulation of the neural network



Simulation of the stamping

Contact: nicolas.dauzet@etu.univ-orleans.fr ; thomas.lietar@etu.univ-orleans.fr

Optimization and parameterization of the simulation of a rotating furnace hearth in operation

Mechanical engineering


R. VEYRAT


X. YAN

Romain VEYRAT / Xing YAN
Academic supervisors: E. BLOND, A. GASSER, T. SAYET
Industrial supervisor: D. BARBIER

Company: Vallourec Research Center France

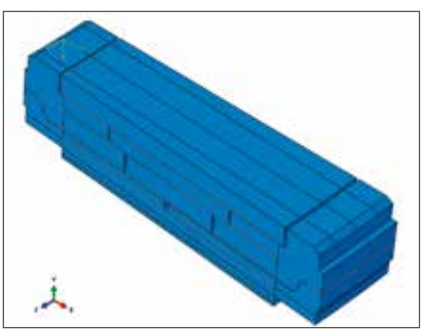
Objective/motivation

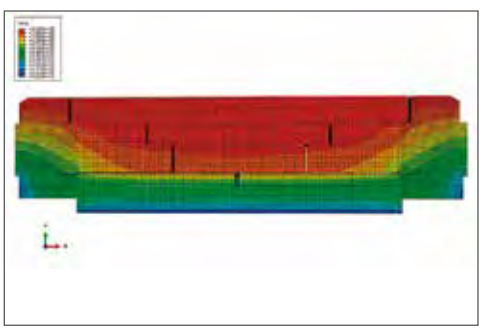
The objective of this project is to simulate the thermal and mechanical behaviors of the hearth of a rotational furnace during the production of billet. This furnace hearth consists of several layers of refractory materials, which could be damaged because of the change in temperature. In order to determine the temperature field and the distribution of stresses, we need to recreate a model in 3D, optimize the boundary conditions, and intelligently define the interactions between the different parts. With this model, Vallourec will determine the heating law the most adapted to reduce the refractory material damage.

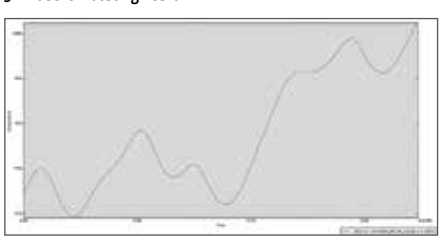
Results

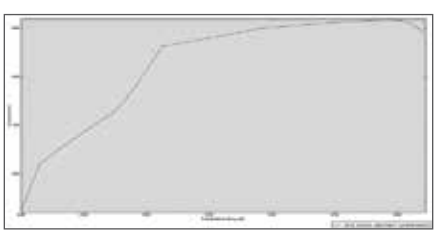
We have studied documents and numerical models that already exist (last year project & internship). Our study is done with a 3D finite element model which meets the requirements of Vallourec. In order to have a numerical model which is close to reality, we had to redefine parameters of the simulation (materials parameters, interactions ...). We have carried out this simulation with three steps (stand-by state, heating, production), then, we compared them to last year's simulation results. Finally, we realized the thermomechanical study of the hearth. The different steps were analyzed separately to verify the functioning of the simulation and finally, an analysis of the entire life cycle was done. We have been able to define the areas that are the most mechanically stressed.

Keywords: furnace, refractory materials, simulation, thermomechanical analysis, thermal treatment


3D model of rotating hearth


Temperature field in the model in degrees celsius


Temperature evolution in the rotating hearth


Evolution of the temperature in the rotating hearth height

Contact: romain.veyrat@etu.univ-orleans.fr ; xing.yan@etu.univ-orleans.fr

Solar Cup

Mechanical engineering

Malik ALLOUN / Hugo FLODERER / Nazim GOUAMI / Mohamed RICHA / Cansev YUKSEL
Academic supervisors: S. ALLAOUI, C. BOURILLON,
J. FANTINI, P. HIGELIN, B. LE ROUX, S.A. MANSOURA

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Selected participant
12th Annual Final Year Projects Forum


M. ALLOUN


H. FLODERER


N. GOUAMI


M. RICHA


C. YUKSEL

Objective/motivation

Our main objective is to build an electro-solar assisted vehicle and participate in the "CHARTRES SOLAR CUP 2018" at the end of June. We have been working on this project for the last six months. We have completed the mechanical study by examining the rules of the competition. We have also searched for the required components and found online suppliers to provide them. Since the race is in June, the prototype must be finished as soon as possible. Therefore, we have started ordering some of the main components. Once all components have been received, the prototype will need to be assembled and tested by the fourth-year students to be ready for the race in June.

Results

While the beginning of the project was a bit blurry, since we had no basis to work on, we are finally seeing the results of these two semesters' work. Indeed, we've started ordering the main components of our future car, namely the motor, the solar panels, the batteries used to power our vehicle, as well as all the necessary auxiliaries to assure the link between the components that constitute our power chain. Next, the project will be handled by the fourth-year students to finish up the ordering of all the items needed to complete our car. They will also need to conceive and make the metal chassis to implement the panels on top of the vehicle. With our updated retro-planning, we should be able to complete our car by the end of the semester, and have Polytech Orléans participate in its first ever Chartres Solar Cup race.

Keywords: electro-solar assisted vehicles, hub motor, solar panel, motor controller, voltage regulator


PHOTO: C. LATOURNERIE

Contact: malik.alloun@etu.univ-orleans.fr ; hugo.floderer@etu.univ-orleans.fr ;
nazim.gouami@etu.univ-orleans.fr ; mohamed.rica@etu.univ-orleans.fr ; cansev.yuksel@etu.univ-orleans.fr

Study of the formability of composite reinforcement

Material science


M. M. BIN AZHAR


N. BRIERE


M. DEGRES

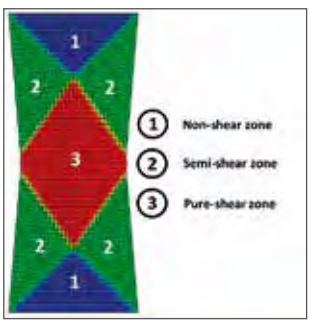

L. HENNI

Muhammad Mustaqim BIN AZHAR / Nicolas BRIERE / Mathieu DEGRES / Linda HENNI
Academic supervisor: S. ALLAOUI
Industrial supervisors: M. GATTO, G. MOUTON

CHOMARAT
Company: Chomarat

Objective/motivation

Nowadays, composite material has become more and more used in various industrial applications such as automotive, sport equipment and aeronautics, thanks to its high performance-to-mass ratio. Our collaboration with the company Chomarat aims to develop a material law which can be used as input parameters for a preforming simulation of a composite reinforcement. The type of the composite reinforcement studied in this project is a NCF (Non-Crimp Fabric). It is made up of two layers of carbon fiber both oriented in 45° and -45° consecutively and they are stitched together. This implies that NCF is a biaxial reinforcement where fiber tows are straight in two perpendicular directions to provide multi-directional properties. The material law that we will obtain will allow us to simulate a preforming process of the NCF produced by Chomarat. The simulation will be done on PAM-FORM software that is widely used in several industries.



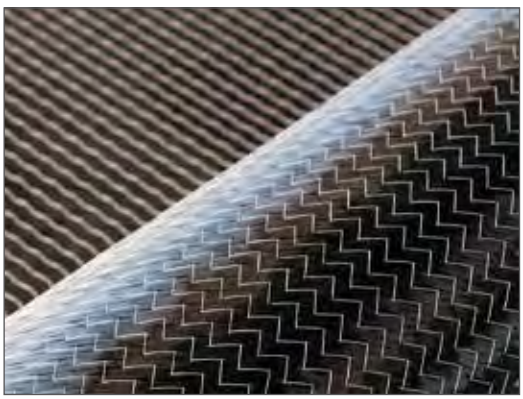
Shearing zone on a Bias Test sample

Results

The groups assigned to work on this project have conducted tensile, bending, shearing and friction tests to characterize the mechanical properties of the NCF. First, different samples were prepared according to the needed parameters to develop the behavior law. After that, tests were run and the results were analyzed to obtain Young modulus, bending modulus and shear modulus. Thereafter, the group is going to enter the data into the computer software PAM-FORM that allows giving our law behavior as an output. This behavior law will be used to simulate geometries preforming in order to investigate the feasibility of industrial parts.

Keywords: composite reinforcement, material law, experimentation, simulation, preforming


Friction test machine


Non-crimp fabric

Contact: muhammad.bin-azhar@etu.univ-orleans.fr ; nicolas.briere@etu.univ-orleans.fr ; mathieu.degres@etu.univ-orleans.fr ; linda.henni@etu.univ-orleans.fr

Thermomechanical modelling of a coke oven-heating wall

Mechanical engineering


P. BARDET


M. CARADANT


W. HUANG


A. TIXIER

Pierre BARDET / Mathilde CARADANT / Wenyi HUANG / Audrey TIXIER
Academic supervisor: A. GASSER
Industrial supervisor: M. LANDREAU

Company: Centre de Pyrolyse de Marienau (CPM)

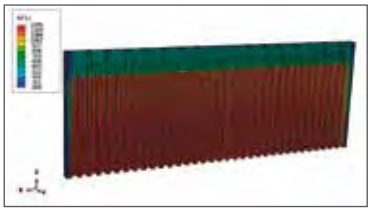
Objective/motivation

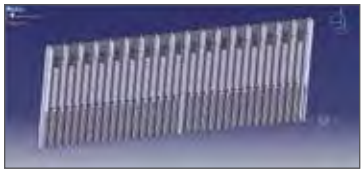
The coking process transforms coal into coke through pyrolysis (the temperature of the material is brought to 1000°C in order to change its structure and get new properties). This coke is then used to produce cast iron, which is used in turn to make steel. During this process, the furnace's walls (called heating walls) are subjected to thermal and mechanical stresses due to thermal expansion of coal and creation of gas. In order to increase the lifetime of coke ovens, our objective is to determine the maximum admissible pressure that the heating wall can support without damage. However, the heating wall is made of a masonry composed of silica bricks and mortar joints that are too complex to be separately modelled. Therefore, a behaviour law was written in Abaqus several years ago to model the masonry behaviour (bricks and joints) using a homogenisation method. This law is now used to model the behaviour of a new heating wall.

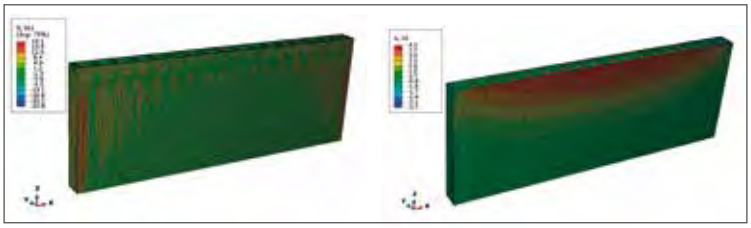
Results

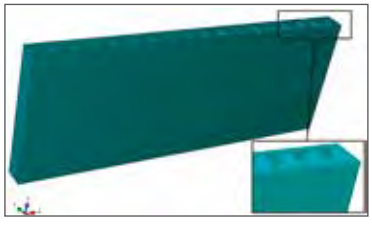
Thanks to different documents provided by the CPM (thesis, internship report, blueprints, etc.), it was possible to model the heating wall with the CAD software CATIA V5. This CAD model was then imported in the finite element software ABAQUS. Consequently, the mesh and the boundary conditions were applied. First, a thermal simulation with isotropic material was made, allowing us to obtain the thermal field in the heating wall. Secondly, using the previous thermal field as load, a mechanical simulation was performed in order to conclude on the influence of the coke pressure on the heating wall damage. At the same time, the implementation of the masonry behaviour law in ABAQUS was studied and debugged in order to use it in the final simulation of the heating wall.

Keywords: thermomechanical modelling, heating wall, coking process, finite element simulation, masonry behaviour law


First result of the thermal simulation on ABAQUS with orthotropic material


Sectional view of the heating wall on CATIA V5


First results of the thermomechanical simulation on ABAQUS with orthotropic material


Mesh of the heating wall on ABAQUS with hexa elements

Contact: pierre.bardet@etu.univ-orleans.fr ; mathilde.caradant@etu.univ-orleans.fr ; wenyi.huang@etu.univ-orleans.fr ; audrey.tixier@etu.univ-orleans.fr

Transition One: from the thermal to the electric vehicle

Energetics


S. BARBAY


F. HECQUET


D. MERCIER


M. PATINOTE

A joint project with the TECHNOLOGIES FOR ENERGY, AEROSPACE AND ENGINES specialty
Simon BARBAY / Florian HECQUET / Dylan MERCIER / Mickaël PATINOTE
Academic supervisor: A. CHARLET
Industrial supervisor: A. LIBEAU
Company: Hauzerwyse

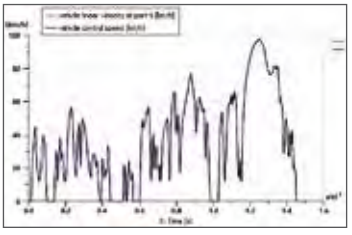
Third Place and Innovation Awards
12th Annual Final Year Projects Forum

Objective/motivation

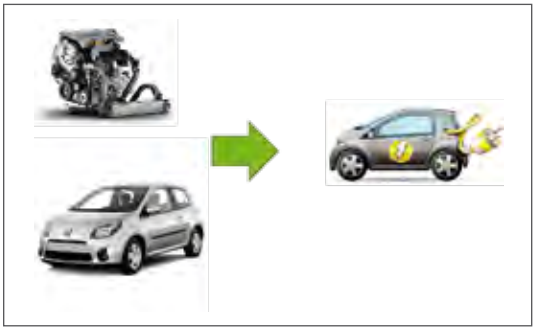
On July 6, 2017, Mr. Hulot, Minister of Ecological and Inclusive Transition in France, announced that in 2040, thermal cars would no longer be produced. That is how the idea of Transition One started. The goal is to clean up used cars by replacing the thermal engine with an electrical motor. Target customers are people with an urban car who use it for small distances and in an urban environment, and who do not have enough money to buy a brand new electric car. The purpose of the project is to determine the feasibility of the product with the conditions of the contractor, which are: autonomy: 100 km; maximum speed: 110 km/h; 3h to depollute the car; cost price for the customer: 3000€; maintaining the "Fun to Drive" aspect of the vehicle.

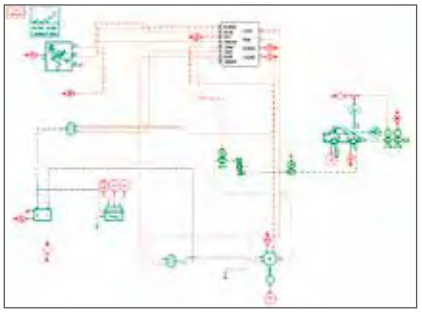
Results

The first part of our study was to develop a numerical model of the prototype. We determined physical quantities of the thermal engine to characterize the electrical motor and the battery. We validated the model with simulations on AMEsim: the model can follow the WLTC cycle and has an autonomy of 100km if the car is driven smoothly. We carried out a study on the parts to keep or to remove from the car in order to maintain the same comfort and dynamic behaviour. Unfortunately, we had some problems with calculators. The second part was to find a means to certify the prototype and then the series products. The constructor's agreement is necessary to modify his vehicle. If we have this, we need only to certify each modification made. Otherwise, the entire vehicle would need to be certified.


Project WLTC

Keywords: ecological transition, automotive industry, electric motor, ZEV (Zero Emissions Vehicles), no pollutant emission, future


Project objective


Project simulation

Transition One

Contact: simon.barbay@etu.univ-orleans.fr ; florian.hecquet@etu.univ-orleans.fr ; dylan.mercier@etu.univ-orleans.fr ; mickael.patinote@etu.univ-orleans.fr

Ubuntu robot

Mechanical engineering

J. DIAB

Joseph DIAB / Garba MOUHAMAN-AOUDOU
Academic supervisor: A. FONTE

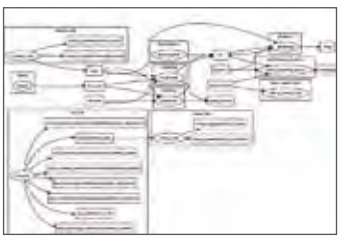
G. MOUHAMAN-AOUDOU

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

Objective/motivation

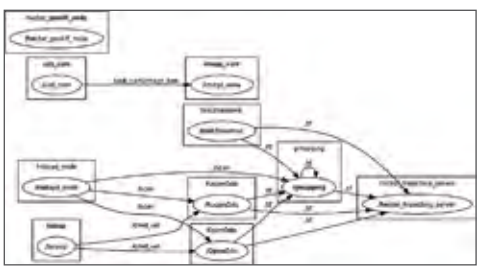
This project consists in developing an obstacles avoidance strategy and algorithm for a four-wheeled mobile robot running on Ubuntu as an operating system. To reach this goal, we subdivided this project into two small projects. The first one is mainly focusing on bibliographical research and finding a strategy to control the robot through an external keyboard using ROS (Robot operating system). To accomplish those fixed objectives, we must carry out many activities: the installation of ROS on the robot embedded system, creation of demos of the control algorithm and testing of the robot sensors. The second mini-project is all about developing and implementing the obstacle-avoiding algorithm to provide the robot with the ability to navigate autonomously in its working environment.



All topics and nodes

Results

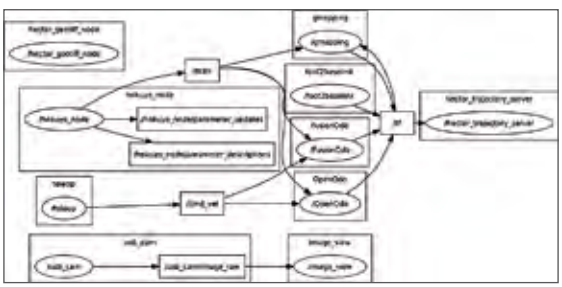
We have achieved the first mini-project objectives despite the difficulties surrounding this part. For instance, we had difficulty adapting to the Linux navigation system and working environment, the compilation, code execution and code debugging using catkin and ROS. To overcome those barriers, we dedicated two weeks of project time to fully understand ROS by doing online research and reading some documents. We reached the goals of the second part. Despite this success, we had some work to do like adjusting the performance of the algorithm to perfection. Our last test revealed an error in our strategy needed to be rectified to safely operate the robot without having any concerns about damaging the laser. As a solution, we will integrate four infrared sensors to the existing algorithm.



Active nodes

Keywords: Ubuntu, ROS, C++, nodes, master

The wifibot



Active topics with nodes

Contact: joseph.diab@etu.univ-orleans.fr ; garba.mouhaman-aoudou@etu.univ-orleans.fr

Production Management

Analysis and overhaul of the methodology for calculating the complete costs of the plant

Production engineering

Ophélie VERVEUR
Academic supervisor: B. LE ROUX
Industrial supervisors: C. BINOCHE, C. PATEK

Company: Hutchinson

Objective/motivation
The senior executive vice president of Precision Sealing Systems (PSS) has launched a program within the business. His team developed a standardized price matrix that he wants to deploy within the business. This standardization of the cost calculation methodology will allow Philippe Olivier to better manage these companies. In fact, each year, an Operational Efficiency goal (in %) is calculated by the different companies within the PSS activity. By standardizing its cost strategy, these percentages of operational performance become comparable from one company to another. On the other hand, an automated calculation spreadsheet will enable salespeople to make accurate quotations/pricing by reducing the risk of miscalculation and optimizing precision.

Results
The calculation sheet is updated each year by the accounting department. Different coefficients are calculated and integrated in our ERP (Enterprise Resource Planning) to create pre-quotes for salesmen.

Keywords: analytical accounting, full cost, cost price, encryption service, method

Contact: ophelie.verveur@etu.univ-orleans.fr

Controlling the surface temperature of sealing plates

Production engineering

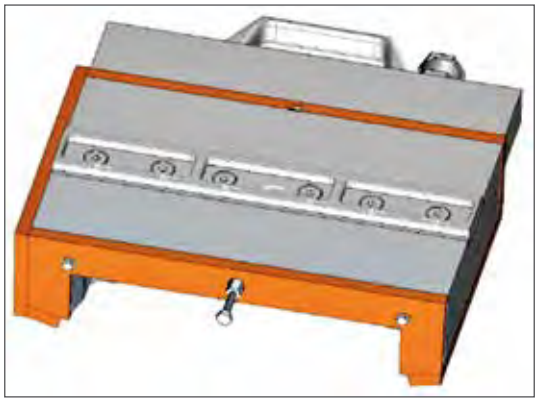
Pierre FRAIZY
Academic supervisor: A. FONTE
Industrial supervisor: L. PIERRE

Company: URGO Laboratories

Objective/motivation
At URGO Laboratories, we produce complex dressings composed of multiple material components. Every single dressing has to be airtight packaged to remain sterilized. Dressings are produced on production lines all at once from coils of raw materials to single-packaged dressings. This packaging solution is produced by contact with hot tempered sealing plates on plastic film. To be perfectly airtight, the sealing plastic has to be uniformly heated. Each sealing plate is checked yearly. During these periodic checks, surface temperature is measured at different points on the plates using a manual sensor. The problem we had was that there were a few results beyond tolerance. We made a problem resolution and a study to solve it. We looked for the justification of the tolerance (was it too strict or not) and also looked for the sensor technology used and the technician's measuring method.

Results
Thanks to problem solving, we chose to analyze different potential causes of these measures beyond tolerance. We justified that the applied tolerance was too strict and could be increased, and we tried new technology sensors and measure methods and tried with the manual sensor but with different technicians. The results from new technology measuring devices tries weren't acceptable because of the size of our sealing plates. We could see that the reproducibility wasn't acceptable and that the variation of angle and pressure applied by the technician on the sensor changed the returned value a lot with our actual manual sensor. We designed a mechanical control bench which clamps the manual sensors in the same right position during all the measuring process. After several tries of this control bench, we didn't get any measure out of the new tolerance, and the problem was solved.

Keywords: control bench, metrology, surface temperature control, measure, reproducibility



Sealing plate

Contact: pierre.fraizy@gmail.com

Creation of application

Production engineering

Geoffrey CHOLLET
Academic supervisor: S. TOUTAIN
Industrial supervisor: L. BOUTILLIER

Company: MSL Circuits

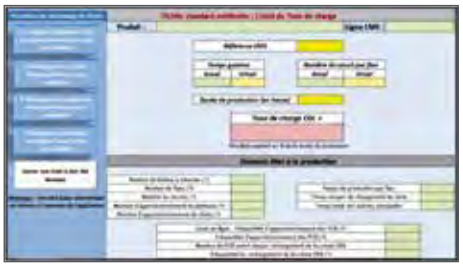
Objective/motivation

MSL Circuits is specialized in electronic sub-contracting sectors for the automotive industry. In order to increase its productivity, the company acquired new production lines. Compared to existing lines, these new production lines allow higher production rates. However, this increase in the rate of production also results in a high rate of work for one of the workplaces. For my fifth-year project, I was given the project to create an application or calculation tool to calculate the indicator corresponding to the occupation rate related to the operator regardless of the production line and the product manufactured. The aim of this project is to be able to identify the manufactured products for which the activity of the workplace is high and to take into account this indicator from the first tests in production of the new products.

Results

The first phase of this project was a field observation phase to identify all the parameters to be taken into account for the calculation of this indicator. Once the specifications were established, the second phase was to study the feasibility of generating data files stored in the production resources software used by the company. For this, the IT department provided me with four computer files compatible with Excel® software, which retrieve the data needed to calculate the indicator and include an automatic update function. With all the data in hand and the help of the Excel® software, the last phase of this project was to create a user interface. Thanks to this interface, the user fills some parameters necessary for the calculation of the indicator and starts the calculation.

Keywords: production, management, automotive industry, indicator, software



Application interface

Contact: geoffrey.chollet@etu.univ-orleans.fr

Ergonomic workstation

Production engineering

Damien NOWAK
Academic supervisor: J-B. VIDAL
Industrial supervisor: A. PERRAUDIN

Company: undisclosed (confidential)

Objective/motivation

The aim of this project is to improve a workstation. The first step is to analyse the actual situation to make sure that the workstation needs modification and improvement. There is a scoring grid which evaluates ergonomic criteria (movements, postures and handling). The goal is to measure those movements, postures and handling to see if the score obtained is higher than expected, and also if it is higher than the target of the company. This scoring grid is a requirement to do modifications on a workstation. In this case, the workstation's level exposure ergonomics is very high, which means that we have to improve it.

Results

First of all, we need to see which movement is the worst or the most repetitive. We need to focus on those points, which will be our priority for this project. The worker will be filmed during his work, which allows us to measure angles and movement by analysing the work. A study was made to improve the workstation and, of course, to reduce or cancel those bad movements. A supplier was called to make the modifications on the workstation. Once the modifications are done, we have to do a second scoring grid to see the improvement and get the feedback about the work done to achieve ergonomic exposure level objectives.

Keywords: health, safety, ergonomic, workstation

Contact: damien.nowak@etu.univ-orleans.fr

Improvement of the emptying process of industrial washing machines

Production engineering

Benjamin GAULTIER
Academic supervisor: C. DUROS
Industrial supervisor: O. SANDRON

Company: Federal Mogul Corporation

Objective/motivation

My fifth-year project consists in designing and setting up equipment to evacuate effluent between two washing processes and a recovery area outside the production workshop. This system will be installed under industrial washing machines. Each machine is installed on a production line of conrod bushings. The aim of this project is to automate the process of emptying these two machines in order to eliminate the risks of flooding, to reduce downtime, to eliminate tasks that do not add value and to improve the working conditions of operators. At present, this task is performed by an operator using a vacuum cleaner to empty the machines and it has several disadvantages, such as the time and effort required to perform the operation manually.

Results

The first step is the development of the specification in order to formalize the needs and explain them to the different actors of this project. It will then be important to cost out the price of the different parts of the equipment. Afterwards, it will be necessary to verify the profitability of the project by estimating the potential gains. The next step will be to plan a schedule in order to supervise the construction and implementation of the equipment. Finally, a performance analysis will be conducted to review the indicators put in place at the beginning of the project. The expected results are 0 overflowing baths, 85% reduction in bathroom drain time and a return on investment of less than one year.

Keywords: specification, continuous improvement, people management

Industrial washing machine

Implanted equipment

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

Increasing the capacity of a crimping machine by reducing the cycle time

Production engineering

Rémy BESSE
Academic supervisor: S. GROSSELIN
Industrial supervisor: A. CHEVET

Company: Schaeffler France, division LuK Automotive

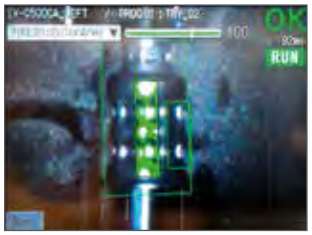
Objective/motivation

Schaeffler is a German group composed of three subsidiaries (LuK, INA and FAG) which provides solutions for automotive and industry sectors. LuK automotive is specialised in clutch systems for automotive applications. Schaeffler France - LuK Automotive, situated in Chevilly in the Loiret department, is specialized in designing and manufacturing hydraulic clutch release systems (CRS). CRS are composed of a master cylinder, a slave cylinder and a pipe. For this project, I was in the CRS sector of a LuK plant situated in Szombathely, Hungary, and the objective was to deal with a takt time reduction due to an increasing demand. The crimping machine in question is used to crimp a sleeve on a hose and a connector to make a clutch pipe. To be able to respond to this demand, it was necessary to reduce the cycle time of this machine, which had to be shorter than the takt time.

Results

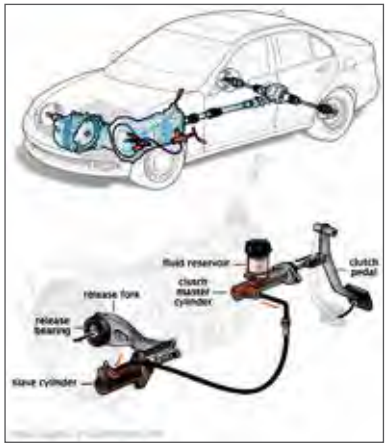
The first step was to define the targets and to create a workgroup with the industrial engineers and designers in charge of this sector. After timing the exact cycle time of the machine, we were able to analyse it and to prioritize the different actions we had to take. Because the first cause of the high cycle time was the manual crimping control, we decided to replace it with a camera control, which ensures a lower control time and a higher quality. Currently, the camera can verify that the crimping has been made. If there is any problem with the crimping, the operator is now obliged to throw the part into a scrap box, which assures the customer of the quality of our products. According to the forecasts, the cycle time should decrease by approximately 20%.

Keywords: clutch systems, methods & industrialization, productivity, cycle time, takt time



Camera control

Crimped connection



Clutch Release System (ClearMechanic.com)

Contact: besse.remy@gmail.com ; remy.besse@etu.univ-orleans.fr

Industrialization of a new product at the Legrand Polish site

Production engineering

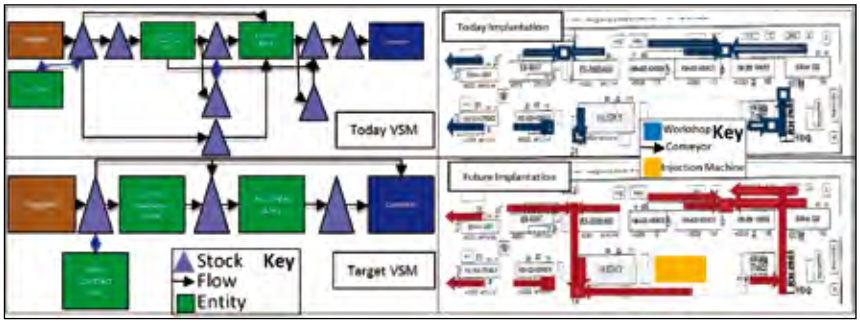
Pierrick SOUPER
Academic supervisor: A. FONTE
Industrial supervisor: M. LACHAUD

Company: Legrand

Objective/motivation
The target of the mission is to "prepare the Legrand Polish site to the industrialization of the new products", which are electric boards. Legrand produces the new products with plastic injection machines. This industrialization includes the implantation of a new injection machine, rethinking the link between the injection machines to improve the takt time of the production and smooth the assembly of plastic parts. To achieve the targets, we decided to have a Lean approach to prepare the new production of the new group standards.

Results
Thanks to a Value Stream Mapping we decided to target the stock locations first, delete one and reduce the others to improve the space for other productions, and decrease stock costs. The changeover is improved, reducing them by 25% and, in fact, increasing the production time. With a new implantation of the injection machines we rethink the conveyor lines to assemble all products, the current and future references.

Keywords: lean, VSM, stock location, SMED, takt time



Project schematic

Contact: pierrick.souper@etu.univ-orleans.fr

Installation of first and second level maintenance

Production engineering

Corentin MERLIN
Academic supervisor: S. ALLAOUI
Industrial supervisor: S. DUFRENE

Company: Hutchinson

Objective/motivation

The objective of my project is to implement or update 100% of the first and second level preventive maintenance. To do this, it is necessary to discuss and work with the maintenance technicians but also with the operators present on the machines. It is also necessary to create a standard for the records and monitoring tables of this follow-up maintenance. Through the implementation of this preventive maintenance, we want to reduce the number of breakdowns in the production machinery and the increase the reliability of each machine. I set up a PDCA in order to have a follow-up of the actions to be carried out within the framework of preventive maintenance and to have a history of those actions.

Results

I started by working on the section with the highest priorities, that of CNC machines. Following this implementation of first and second level maintenance, I set up an internal audit to check the proper functioning of first level preventive maintenance but also to listen to operators about their feelings and whether they have information or suggestions to send us back. Once everything was in place in this section, I did the same with the other sections, keeping a follow-up with the sections where everything was in place.

Keywords: production, management, maintenance

2nd level maintenance sheet

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

Installing management software on production lines

Production engineering

Adrien NAULET
Academic supervisor: E. COURTIAL
Industrial supervisor: A. CALDERONE

Company: SKF Italia

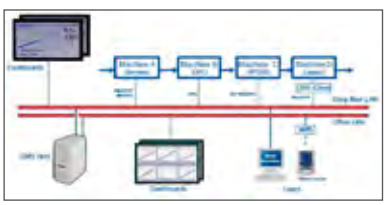
Objective/motivation

During my internship, I was entrusted with setting up an IT tool for piloting and managing production called CMS (Channel Monitoring System) on the production lines of the plant. One of the major challenges of the mission was to standardize the working method from one site to another and thus to implement a production management software common to all the plants. The second issue was relating to other projects. In fact, the installation of a SCADA-type system is only the first step in a company's computerization and management process. The group has undertaken to set up an MES tool to optimize its production follow-up as well as an ERP. In addition to all these advantages, this software will enable the site to significantly reduce its MTTR and thus increase production efficiency.

Results

I had to create the network that would host the software. I started by finding out about the different components. If for one machine the solution consisted of simply connecting an Ethernet cable, for others, I had to call on a specialized supplier based in the Netherlands to provide me with custom-made components. Afterwards, I had to connect each machine to a desktop computer acting as a server before connecting it to a TV in order to display the information gathered on the production lines. Subsequently, it was necessary to configure the outputs of the machines in order to retrieve the indicators we wanted and draw up a graph of the evolution of our production. Finally, the production manager could monitor production in real time and doesn't have to wait for the operator's alert to come and repair a breakdown.

Keywords: supervision, production lines, MTTR, automatic, software



Project schematic

Contact: adrien.naulet@live.fr

Mars Supply Excellence

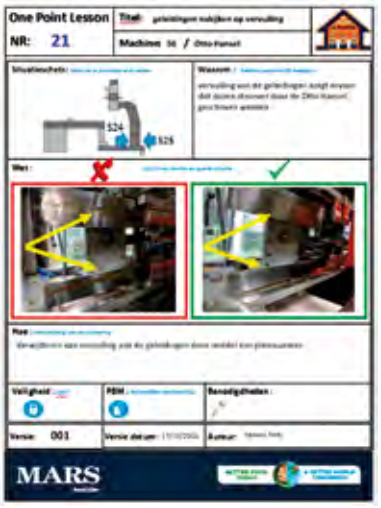
Production engineering

Thomas MOUSSET
Academic supervisor: M. HAUTEFEUILLE
Industrial supervisor: P. GIRARDIN

Company: Ebly

Objective/motivation

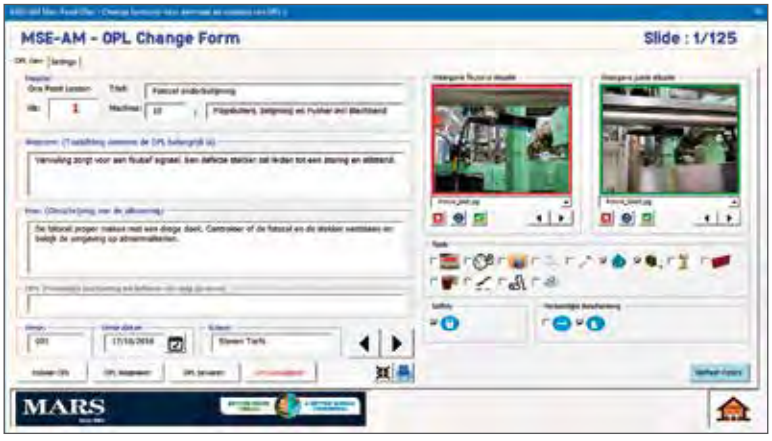
Mars Supply Excellence is a Mars program that will be set up in every factory all around the world. It is a program based on Total Productive Maintenance mixed with LEAN spirit. The purpose is to set up eight pillars: Leadership, Factory Mars Operating System, Health, Safety and Environment, Quality, Autonomous Maintenance (AM), Progressive Maintenance, Focused Improvement, and Education & Training. The aim of my project was to set up the AM pillar and particularly the Cleaning, Inspection and Lubricate (CIL) standards. AM promotes a sense of ownership that continually drives performance and delivers world-class results by building the Associates capability. Moreover, AM involves maintaining their equipment and driving the implementation of standards. CIL contributes to establishing a base condition for easy equipment maintenance. It means reducing the Mean Time Between Stops.



One Point Lesson

Results

So far, we have seen through three through of these eight steps that the program requires for the Autonomous Maintenance pillar. This means we achieved the work team's preparation to conduct the AM steps safely and successfully. We performed initial cleaning, uncovered hidden abnormalities and identifyied all the sources of contamination and hard to reach points. We started the program with one production line. We have created 120 CIL points on the machine as method forms and scheduled as a list of tasks. During the AM maintenance days on the line, we solved 75% of the anomalies such as standardization, maintenance, and painting. We reduced the Mean Time Between Stops by half. We also developed and improved a standard tool to create method forms in anticipation of using it on the other production lines.



One Point Lesson Tool

Keywords: Autonomous Maintenance (AM), pillar, standard, cleaning, inspection, lubrication, CIL

Contact: thommousset@gmail.com

Obtaining the qualification of a new prospect with high potential

Production engineering

Martin COATRIEUX
Academic supervisor: B. LE ROUX
Industrial supervisor: O. BOST

Company: Beaujoint Frères

Objective/motivation

GMC (Galvanisation Moderne du Centre) is one of the four entities of the "Beaujoint" group located in the industrial zone of Buzançais (Indre) since 1978, active in surface treatment. GMC offers electrolytic, chemical and lamellar coatings. The challenge, for GMC, is to be qualified by a new prospect with high potential and to become their reference subcontractor in order to perpetuate and develop the activity. The customer is a global supplier to major car manufacturers, a leader in interior and roof system closing.

Results

GMC is not qualified by the customer: the volume of parts received does not match the quantities of the contract between the parties, resulting in unprofitable investments and projects undertaken. GMC's production rates are too low and do not respect the contract. Recurring non-conformities (packaging, traceability, quality of treated parts), and unmanaged factory impact (the arrival of the volumes of parts to be processed from this new prospect degrades our ability to meet our engagements with other customers). In order to obtain the qualification of this new prospect, we had to make significant modifications to the production workshop: retrofit two production lines and increase our production rates by 40% on the third, ensuring that we maintain product quality and a consistent service rate.

Keywords: quality audit, workflow, staff training, risk analysis, production rate

Beaujoint Frères site map

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

Online workshop management platform

Production engineering

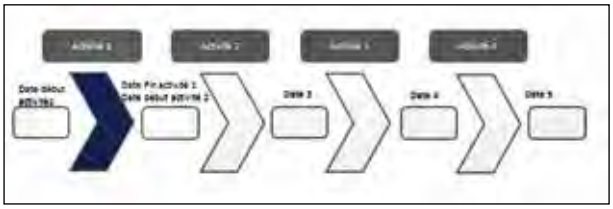
Charlély CENGIAROTTI
Academic supervisor: J. GILLIBERT
Industrial supervisor: Q. DELAHAYE

Company: undisclosed (confidential)

Objective/motivation
The company aims are to act on the delay by optimizing the flows and also to act on the quality without forgetting to minimize the costs. My department is a support for all other services since it receives and redirects all the supplies received or to be sent. Therefore, the management of the flux has a real impact on efficiency. My project is to analyse the current situation, add new tools, fix the process with the logistics team and write a specification adapted to it for the IT department. After that, the IT department will develop the platform and I will follow the progress of the development. I will then put the platform into production. It is really interesting to work with different departments.

Results
The deliverable is an online workshop management platform specification. This platform will be simplified with only the information needed for the task. Moreover, the platform will harmonize processes, following the observation of different working methods of the actors. It will also create a blockage history to anticipate and solve them.

Keywords: logistic, VSM, supply chain, traceability



Real-time progress tracking tool

Contact: charlely.cengiarotti@etu.univ-orleans.fr

Redevelopment of a workstation

Production engineering

Mélanie HONORE
Academic supervisor: C. DUROS
Industrial supervisor: R. LEGER

AEQUS
ecosystems of efficiency

Company: Aequs Aerospace Aubigny

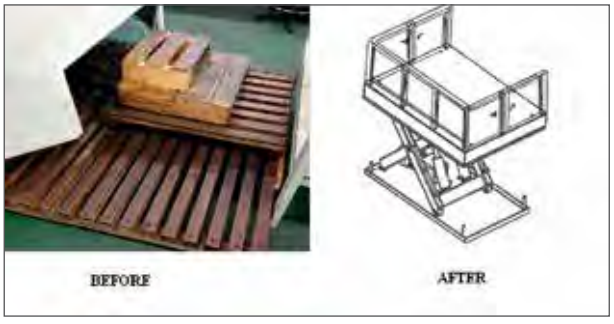
Objective/motivation

My fifth-year project consists in improving the ergonomic and safety conditions of a workstation. In fact, this workstation presents risks of musculoskeletal disorders and fall hazards. The aim is to analyze risks and recommend solutions to reduce hazards. This project had been initiated as the result of the demand of operators who work on this workstation, and of the update of the single document which identifies and evaluates risks at work. The redevelopment of the workstation has been lead to suppress risks and be adapted by every operator who works on this workstation. Indeed, in theory, it is the post which has to adapt to humans. First and foremost, to set up the best solution to the problem, I have studied each displacement and reason for the displacement.

Results

Thanks to the analysis of the situation and the displacement study, the company has received up to 80% financial support from the CARSAT organization for setting up the new safety workstation. The implementation of this project has had the following results: for industrial customers: better corporate reputation and unchanged customer delivery; for the company: flexibility, respect of quality requirements, and demonstration of the will of managers to be involved in work conditions; and for operators: safety and better working conditions. Indeed, with this project, the management wished to show its implication and engagement towards their employees. The fact is that continuous improvement is based on a true commitment pointing towards customer satisfaction.

Keywords: safety, working conditions, management, risks, ergonomics



Example of workstation improvement

Contact: melanie.honore@etu.univ-orleans.fr

Reduction of optical defects by autoclave transformation

Production engineering

Damien HAMAIDE
Academic supervisor: S. LEROUX
Industrial supervisor: S. LERAY

Company: Saint-Gobain Sully

Objective/motivation

Saint-Gobain Sully is specialized in the manufacturing of glasses and transparencies for civil and military aerospace, vessels, and armored vehicles. One of our customers, a manufacturer of civil planes, asked us to increase the production rates of windshields for their private jets. We have accepted this project because if we succeed, we could become the exclusive supplier for this product. The success of this project depended on reducing non-conformities to be competitive in terms of deadlines and costs. The mission entrusted to me was to reduce major non-conformities that increased our repair costs and lead times. The objectives were to make a preliminary study, to compose a project team, carry out the project at term and finally validate the project.

Results

The premilinary study confirmed that optical defects on the autoclave area was the major non-conformity on this product. The costs of repair and the resulting delay were the biggest. Once the axis of the mission was found, the team was composed of the operators from the autoclave area, the workshop manager, the process manager for the technical aspect and the method engineer for the methodological aspect. Together, we restated the problem and returned to the basic conditions of our manufacturing process to make an analysis and identify the root causes of our problem. Based on these causes, we drew up an action plan to eradicate the optical problem. We put in a new control system, a new standardization of all documents on the autoclave area. The result of this project is a reduction by fifteen in the number of non-conformities and a gain of a few thousand euros.

Keywords: standard-Kaizen, non-conformities, teamwork, aerospace

Private jet

View from the cockpit

Contact: damien.hamaide@etu.univ-orleans.fr

Stabilizing processes following an increase in volume

Production engineering

Thomas PLANQUE
Academic supervisor: B. LE ROUX
Industrial supervisor: P. EMERIAU

Company: undisclosed (confidential)

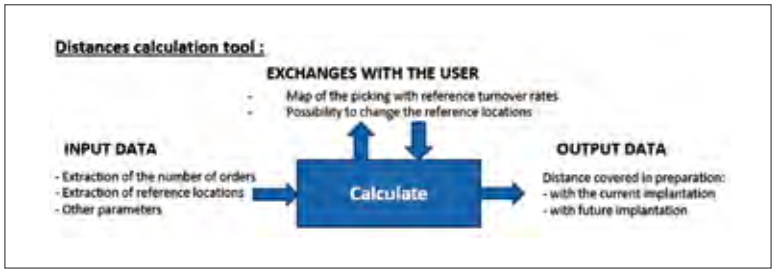
Objective/motivation

The activities of the company are warehousing and handling, packaging and transportation. As a logistics service provider, we have customers from a wide variety of industries. My project involved one of our clients in the health sector. Indeed, it is a growing customer year after year. This increase in volume has forced us to adapt our various processes so that our capacity is consistent with our client's workload. If we cannot adapt, then we will be exposed to different risks. The most obvious risk is a loss of productivity and quality in the service we provide to our client. However, we will also encounter steering problems because we will not be able to process the information flow properly. Finally, we must think about the health and safety of employees.

Results

To carry out my project, I had to separate it into different tasks. Each of these tasks aims to limit the risks described above. Initially, to meet a customer requirement, I had to create a new physical flow. To verify our information flows, we had to modify or create new files (Excel® and SQL). I also had to update the information we enter into our IT tools, such as standard times. The last major step of my project was to establish a new implantation for our picking, i.e. the area where we prepare the orders. This means, for example, getting closer to references that are usually prepared. In this context, I created a tool to calculate the distances and thus the average order picking times according to the chosen implantation.

Keywords: Excel®, SQL, standard times, picking reimplantation



Project methodology

Contact: planquethomas@gmail.com

Study and acquisition of production equipment for the assembly of 329 nuclear solenoid valves

Production engineering

Mélanie SOYER
Academic supervisor: G. HIVET
Industrial supervisor: C. ROUSSEAU

Company: ASCO SAS

Objective/motivation
ASCO designs, manufactures and markets equipment and components for industrial automation solutions. ASCO nuclear products are designed for harsh environments with high seismic, radiation and temperature requirements. The means of production must be adapted: they are "qualified" and meet the requirements imposed by the nuclear industry. For my last project at ASCO, my purpose was to acquire a device able to answer customer needs, to trace the assembly actions of 329 solenoid valves and assembled products, and, finally, to be able to maintain the process as repeatable, durable and reliable.

Results
After analysis, research and consultation of suppliers of special machines, we reached our goal. The equipment meets our expectations and, moreover, can be used for the assembly of other models of solenoid valves. The solenoid valves in question are thus correctly assembled; we participate in the nuclear safety of the country. This project is part of a process of permanent improvement of our supports and, consequently, meets multiple objectives, especially that of developing and maintaining the means and supporting actions aimed at improving production.

Keywords: nuclear, assembly, means of production, special machines

The 329 nuclear solenoid valve

Example of means of production meeting our specifications

Contact: melanie.soyer@etu.univ-orleans.fr

Total quality and productivity

Production engineering

Nicolas DRIEU
Academic supervisor: G. HIVET
Industrial supervisor: F. MARTIN

Company: Renault

Objective/motivation

1) Creation of the manufacturing program. This program will be used every week to define the need of production unit (APART = unit sheet metal spare part). It allows seeing and following manufacturing in real time and having a provisional planning.
2) Creation of a fault-tech. The fault-tech is a document with many pictures of faults in a manufactured part. The main target is to reduce the number of claims in opening panel (boot lid, side door, driver door, etc.). To reduce this, I will create a decision grid where I must find an agreement with customer (CDPA) for the acceptability of the fault.
3) Modification and improvement of news. Some works stations will change. Creation of FOS (Standard Operating Leaf). This leaf is necessary to instruct the new operator on Renault's standards. An implementation of 5S and Kaizen (lean manufacturing tool) will be used on this kind of project.

Results

No results at this time.

Keywords: productivity, quality, lean manufacturing, Renault

Contact: nicolas.drieu@etu.univ-orleans.fr

The details of the projects of these students in Production Management cannot be printed here as they are subject to a non-disclosure agreement.

Martin LE BRUN

Corentin PATURANGE

Smart Building

Building Information Modeling for lessor company

Smart building

Medhy VINCESLAS
Academic supervisor: C. FOUQUET
Industrial supervisor: P. PONZIO

Company: Groupe SNI

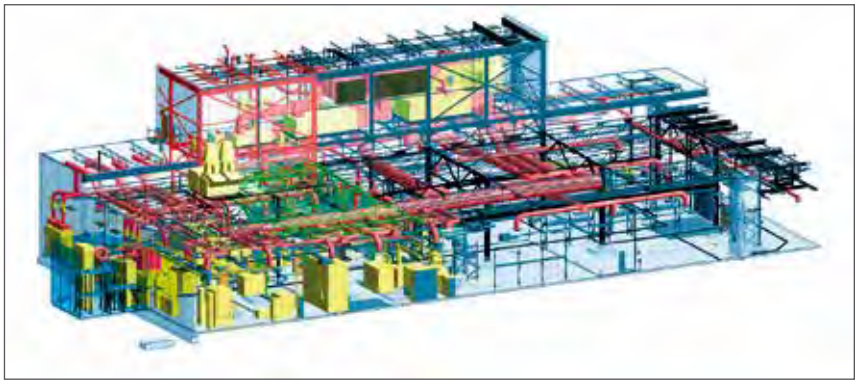
Objective/motivation

BIM (Building Information Modeling) technology is a collaborative production process. BIM allows manipulating virtual models of a building. These models make the design easier and improve the analysis of the building. Once models are done, they contain specific geometric information as well as the necessary data for construction, manufacturing, and procurement. Regarding the data, a building's life cycle is made of a short, intense period of information production (design and building production) and a long period of exploitation and information update (exploitation/maintenance). In this activity digitalization strategy of the heritage management, it's important to integrate data that could be generated by a model in order to allow current necessary treatments (construction/rehabilitation, maintenance, virtual visit, PMT management, technical visit, orders, MOA reference document) for the program procurement. In order to benefit from all these advantages, The Group SNI decided to implement BIM in the company.

BIM steps process

Results

During this year, we succeeded in defining the necessary elements to implement the BIM technology and to be eligible for the status "BIM Ready". Some elements had been modified, such as human resources, jJob process and information system. To start a BIM project, we had to produce some documents, such as the BIM Charter (generic document which defines our BIM objective in general) and the BIM Specifications (document which defines our BIM objective for a specific project. With this information, we decided to create a software that can automatically generate all of the necessary MOA documents using the numeric model of the building. This is possible because we know the information that a model can contain, and all of this information is very useful to produce an MOA document from APS to delivery phases. The numeric model file is parsed, and fit directly with the information that we need to produce a document, useful to the acquisition of the new program.



Virtual model

Keywords: building, model, data, smart, dao, management

Contact: medhy.vinceslas@etu.univ-orleans.fr ; vinceslas.medhy@gmail.com

Construction of a nursery school with BIM

Smart building

Faouzi ABRANTES
Academic supervisor: J-M. FAVIE
Industrial supervisor: S. GAY

Institution: Centre-Val de Loire Regional Council

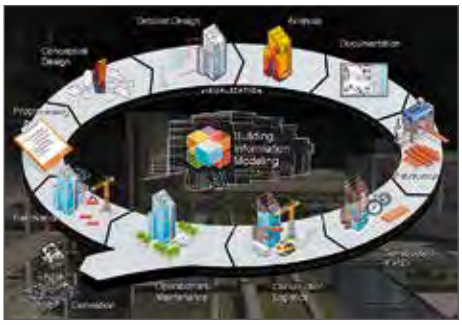
Objective/motivation

Apprentice at the Centre Val de Loire Regional Council, and as the person in charge of operations, I lead missions concerning high schools in the department of Indre et Loire (37): construction, renovation, fire security system, etc. For all of my missions, I represent the contracting authority. Therefore, I represent the final client and have to achieve all his requirements with different trade bodies. One of my projects this year is the construction of a nursery school in Amboise. For this project, we used BIM methods and bio-based materials. The advantage of using BIM is to model the building before its construction, which allows us to avoid construction problems, control construction costs, and present a model to the customers. Moreover, using BIM allows all of the trade bodies to work on the same virtual plan, which is a time-saving trick.

Results

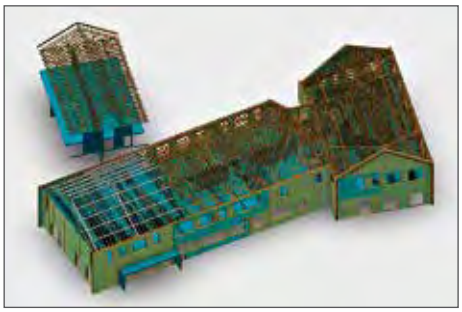
Today, the building is still in construction, but with the BIM we have already saved time and met customers' requirements. Once a week, I have a meeting with the different trade bodies to evaluate the evolution of the construction site. Currently, we are on time thanks to the BIM because all of the decisions have been made beforehand. Finally, when the BIM model is finished, we will have a virtual modelling of the building with different data from the different trade bodies that will be helpful for maintenance and for the exploitation of the building. The BIM method is not yet fully developed because it is new and it is a big investment for small companies, but thanks to projects like this one, the use of BIM is growing. Maybe, in a few years, everyone will use BIM to build a building.

Keywords: BIM, construction, school, virtual plan, contracting authority



Building information modeling

3D simulated project



3D simulated structure

Contact: faouzi.abrantes@etu.univ-orleans.fr

Design of fire detection test tools

Smart building

Baptiste NERON
Academic supervisor: R. CANALS
Industrial supervisor: A. MAILLARD

Company: FARE

Objective/motivation

The company FARE, which designs and manufactures fire detectors for industrial or public-access buildings, wants to offer products which are more and more efficient, especially against water vapour or dust, potential sources of unwanted alarms. In order to achieve continuous improvement, various test tools must be implemented for the product development phases. The objective of water vapour testing is to make our detectors even more robust against this disruptive element. The purpose of this tool is to evaluate the ability of the product not to go into alarm in the presence of steam while maintaining its ability to detect a fire. One of the major disadvantages of detectors is their dust accumulation over time, so it is important to integrate this issue into the design of future product ranges. A test tool had to be designed to assess the robustness of the products against dust.

Results

At the time of writing, both products are still under development. In reality, two steam test tools are provided, one for precise measurement and the other for functional tests. The first tool is in the refining phase, most of the work has already been done and the finishing touches are in progress. With regard to the second tool, a first version has been developed, permitting functional tests to be carried out. However, to make it more presentable, another version must be developed and the results validated again. With regard to dust testing, tests are in progress and the analysis of the results makes it possible to determine a new framework of tests to be carried out. The complexity of the work is to make hypotheses about the physical properties of the elements and to determine potential results.

Keywords: fire detection, test tools

Contact: baptiste.neron@etu.univ-orleans.fr

Electrical part of the development of a therapeutic and interventional exploration center (CETI)

Smart building

Marina DOUILLARD
Academic supervisor: P.O. LOMBARTEIX
Industrial supervisor: E. BLIN

Company: SPIE Ouest-Centre

Objective/motivation

At the University Hospital Center of Poitiers, a new CETI will be created. A CETI makes it possible to perform ambulatory surgical operations. In this project we won the part "high current electricity". I am in charge of carrying out the execution studies related to this project. First of all, the electrical installation must be dimensioned in order to know the power required for this installation. The CANECO BT software allows us to do these calculations. Then, electrical diagrams and electrical drawings must be drawn up. All of these documents are drawn with AutoCAD software, which is a CAD program. Finally, during the whole construction period, we are responsible for advising our client. I am autonomous on this project but I can ask for advice from the head of the design office as well as other members of my department.

Surgeon panel

Results

In construction or renovation projects, a control office checks all of the technical documents drawn up by the companies working on the site. It is therefore necessary to have the approval of this control office to start the work. It is also necessary to have the agreement of the project manager and the building owner. Once the documents have been validated by all of the interlocutors, we can distribute them to our teams in charge of the site. During the whole construction period, the electrical plans and electrical diagrams can change according to the customer's wishes. For the installation of the electrical equipment in the CETI, I had to take into account the surgeons' opinions. These rooms being dedicated to them, it is they who are the most likely to know exactly where to install the material, such as determining the exact positions of the plugs for surgical arms.

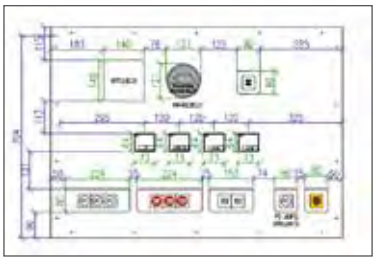


Diagram of a surgeon panel

Keywords: electrical diagrams, execution studies, electrical project, design office

University Hospital Center of Poitiers

Caneco bt software view

Contact: marina.douillard@etu.univ-orleans.fr

SCADA Project for BMS (Building Management System)

Smart building

Kévin CANTILLAC
Academic supervisor: G. LAMARQUE
Industrial supervisor: J. EGALON

Company: Codra

Objective/motivation

This project is to create a demonstration of the SCADA software of my company, CODRA. For this part of the project, I had to describe the specifications of a building supervision for customer demonstration. To do this, it was necessary to create a virtual building to control all current and future aspects of a smart building (fire detection, energy efficiency, smart control, etc.). The second part of my project was to create the SCADA software and the different offers and proposals established in the specifications. The design of the interface and the application tree of the demo have been established and the first demo versions must be edited for a 3-year period. In my last year, the goal is to change the supervision previously created: to evolve supervision towards other functionalities of the building, and to decline on mobile.

Results

Today, we have been able to propose a first version of our software demonstration. The tasks accomplished are the following: creating the tree, creation of components, creating navigation components, creating GUIs and interface design, creation of alarm windows, functionality creation, and management of connections and user profile. It is the result of this teamwork that allowed us to offer this first version of our software demonstration application in the field of BMS. The responses of our customers are already promising and some of them offered to collaboratione with us on certain projects.

Keywords: SCADA, supervision, building, CODRA, Panorama Suite

Dashboard of the building

Home page of the supervision

Contact: cantillac.kevin@hotmail.fr

VBA tools for business management

Smart building

Tuan Minh HERRY
Academic supervisor: G. CHARLES
Industrial supervisor: J. DHERRET

Company: Citeos Berry-Sologne

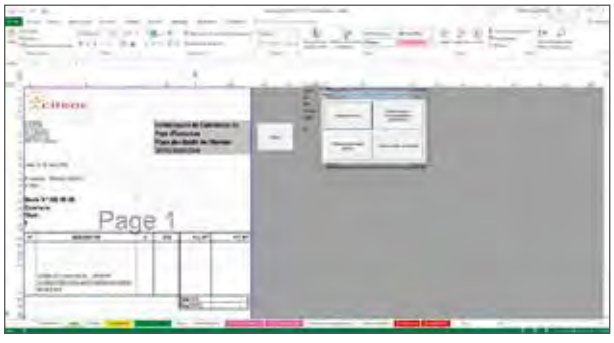
Objective/motivation

During my apprenticeship at Citeos Berry-Sologne, I created business management tools under VBA. Citeos Berry-Sologne is a company specialized in urban lighting and urban infrastructures (traffic lights, charging stations, etc.). To manage the deals, the company has Excel® files that go from opening to closing the deals. These different steps are, first, to look for potential customers/respond to calls for tender; second, to analyze specifications; third, to create a deal estimate and budget; fourth, to enter into trade negotiations; fifth, to order and purchase. Next is completion of work plans and site preparation, then works, after that control and reception and finally invoicing. The aim of this project is to optimize the time spent by technicians and business managers. To achieve that, the Excel® files have been received from optimizations such as the automation of certain tasks, for example, a function allowing you to enter a quotation more quickly or the automatic printing of certain pages of the Excel® file.

Results

In this project, my industrial supervisor, the business managers, the technicians and I have defined the different needs of users. For estimate files, the needs automatically enter articles with just their identifiers, generate an equipment list, fill in an attachment file automatically and manage page printing more effectively. For the monitoring file, the needs gather all the necessary information on the same page, automatically fill in a tracking file and create a file with file information. All the above-mentioned needs have been added to the Excel® files. Thanks to VBA, these features have been programmed inside the macros internal to the files. The fulfilment of the file saved one hour per day for the business managers and two hours per day for the technicians.

Keywords: VBA, business file, time optimization



Contact: tuan.minh.antoine.herry@gmail.com

Technologies for Energy, Aerospace and Engines

Active Drag Control

Energetics

K. EL HANOUCH

T. RIBIERE

Kaouthar EL HANOUCH / Thibaut RIBIERE
Academic supervisor: A. KOURTA

Institution: PRISME Laboratory

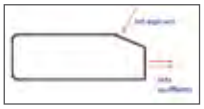
Objective/motivation

Drag force creates a depression at the rear of a car and acts like a vacuum that will slow down the car in the opposite direction. Many studies have been done on this subject, and the results show up to 20% of drag decrease. Therefore, our main purpose is to lower aerodynamic drag force using active actuators and reach a reduction of 30% of the drag coefficient. Reducing the drag of a vehicle in order to reduce its consumption of fuel is a highly topical issue. Alongside the development of diverse technologies to reduce the road impact on the environment (gas emission, NOx pollutants), our subject is strongly related to current challenges. Indeed, nowadays it is widely applied in the automobile field. It gives us a very accurate overview of what problems an engineer of our generation could face.

Results

Our work is based on numerical studies, using the "Ahmed's body" geometry as a pattern that it is used in the automotive industry for the numerical simulations on the CFD software ANSYS® Fluent. We divided our work into two parts: the first part of our study consisted in making digital simulations on the body without the actuators with a 2D view, in order to get the elementary results of drag coefficient. The second part was to run digital simulations on the body with various active actuators which we had selected, to be able to find the seamless combination between its actuators for a maximal reduction of drag force. We selected three actuators for our study: uniform jets, synthetic jets and moving walls.

Keywords: energy balance, efficiency, economy, environmentally friendly



Environmentally friendly concept car

Contact: kaouthar.el-hanouch@etu.univ-orleans.fr ; thibaut.ribiere@etu.univ-orleans.fr

Aerodynamic characterization of the ESA Huygens probe and its appendages

Energetics

J. SIMIER

G. THEBAULT

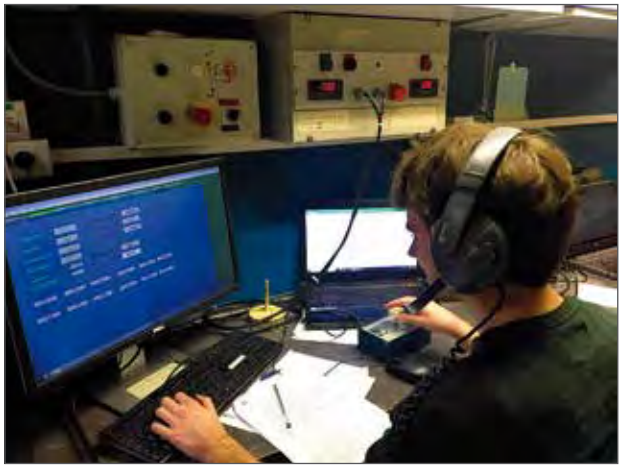
Julien SIMIER / Guillaume THEBAULT
Academic supervisors: P. DEVINANT, A. LEROY
Industrial supervisor: J-P. LEBRETON

Company: LPC2E
Institution: European Space Agency (ESA)

Selected participant
12th Annual Final Year Projects Forum

Objective/motivation

Huygens, part of the Cassini-Huygens mission, is an atmospheric probe that landed under parachute on the surface of Titan, one of Saturn's moons, on January 14, 2005. The goal of the mission was to study the physical properties of the atmosphere of Titan. The bottom of the probe was equipped with winglets to force it to spin during its descent. External devices accommodated on the probe also contributed to the spin torque. Although the probe was released with the correct spin, the spin started to reverse during the descent. This behavior is still not completely explained. Our work is part of a two-year project whose main aim is to investigate the possible causes of this unexpected spin. It is carried out by testing a mock-up of the probe equipped with its appendages in the Lucien Malavard wind-tunnel located at Polytech Orléans.



Control room of the Malavard wind tunnel

Results

A one-third scale mock-up was designed and built for the purpose of the project. The dimension of the mock-up was carefully chosen taking into consideration the descent parameters of Huygens in Titan's atmosphere and the performance of the wind tunnel. A test protocol was established that included a large number of combinations of appendages in order to characterize individually the effect of each appendage and its combination on the aerodynamic performances of the mock-up. A large number of tests was carried out. They provide a unique set of results that are being analyzed. The initial results demonstrate that each individual appendage contributes differently to the aerodynamic characteristics of the mock-up. They will also allow preparation of the work to be done during the second year of the project.

Keywords: Saturn, Titan, Huygens, wind-tunnel, aerodynamics, space probe

Huygens mock-up in the Malavard wind tunnel

Descent of the Huygens probe on Titan

Contact: julien.simier@etu.univ-orleans.fr ; guillaume.thebault1@etu.univ-orleans.fr

Analysis of a generic injection in a ramjet engine

Mechanical engineering


E. BAIRES


E. FARINA


A. MARTIN


A. MOUZE-MORNETTAS

Eduardo BAIRES / Elodie FARINA / Arnaud MARTIN / Antoine MOUZE-MORNETTAS
Academic supervisor: I. FEDIOUN
Industrial supervisor: T. ANDRE

Company/institution: undisclosed (confidential)

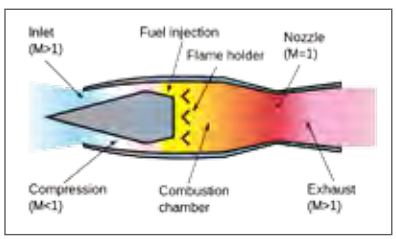
Objective/motivation

Mastering the physical phenomena taking place in the combustion chamber of scramjet engines is not an easy task. This project deals with a Liquid Jet being injected into a transverse Subsonic or Supersonic Cross-Flow (known as LJSCF) which is typical of this technological application. The interaction between a main air flow over a flat plate and a liquid jet of fuel being injected from a fixed point on the plate, perpendicularly to the air stream, is the main objective of this study. Different flow speeds for the air stream (subsonic and supersonic) are studied in order to check to what extent it affects the interaction. Computer simulations using the ANSYS® Fluent multi-physics software and reference publications dealing with experimental results are used in this work. Later on, the objective is to study the combustion of atomized jet fuel under these conditions.

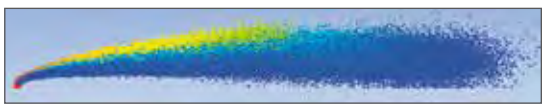
Results

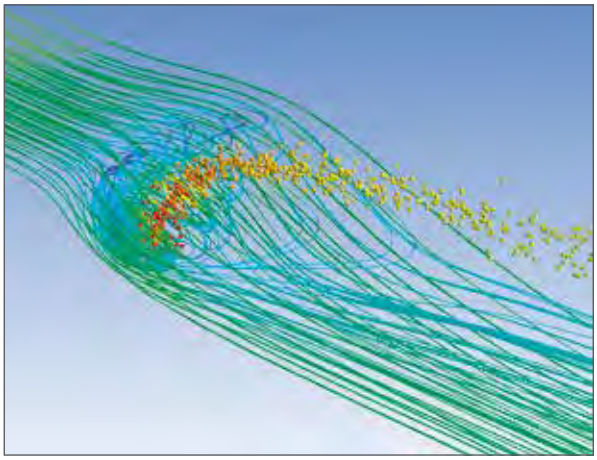
First, calculations were made for subsonic air flows. We recreated numerically the experimental conditions described in the reference publications. It was then possible to match the jet penetration into the air flow with the empirical correlations given in the bibliography. This allowed us to understand the height of the jet penetration and its behavior in the cross-flow. Then injection into a supersonic air flow were simulated. We observed shocks and structures such as eddies developing around the injected fuel flow. Once again, correlations were fitted to the injection's curvature. Finally, combustion was simulated in both environments (subsonic and supersonic air flow). We were capable of observing the flame structure, its behavior and the different chemical species involved.

Keywords: aerospace propulsion, cross flow injection, supersonic injection, combustion, ramjet, atomization



Description of a ramjet engine


Kerosene injection


Horseshoe vortices

Contact: eduardo.baires-parada@etu.univ-orleans.fr ; elodie.farina@etu.univ-orleans.fr ; arnaud.martin3@etu.univ-orleans.fr ; antoine.mouze-mornettas@etu.univ-orleans.fr

Assessment and optimization of a cogeneration system engine

Energetics

M. LONGE

Morgan LONGE / Joris NAUDIN
Academic supervisor: P. BREQUIGNY
Industrial supervisor: E. MOUILLE

J. NAUDIN

Company: NAODEN

Objective/motivation

In order to protect the environment, we must make the most of what are usually lost resources: biomass from wood or animals, and the heat produced by different machines. NAODEN uses the wood to produce a gas that is then injected inside a conventional engine. The engine then produces electricity through a generator and heat used for house or industrial process. This is the CHP: Combined Heat and Power. The goal of the project is to improve the control of this engine to enhance the electrical power produced and lower gas consumption. Thus, we will participate in improving the efficiency of the engine and increasing the power available from the system of NAODEN by proposing them technical solutions using a specific model.

Results

After a first study using the technical documents given by the company, we organized a few meetings and a visit of the existing system. We were then able to propose a few technical and practical solutions to increase the efficiency and the load of their engine. Since the company is not specialized in engine engineering, different solutions were directly available at no cost: tuning the right spark advance or controlling the air-fuel ratio through the air intake throttle. Another goal related to the project given by the company was to be as much as possible on maximum engine load. A heavy load will then produce more electricity power thanks to the generator and the engine will work with better efficiency. In this project, the solution will be proposed and presented using a model, that may be applied later in an internship context.

Keywords: CHP, cogeneration, engine, control, biomass

Contact: joris.naudin@etu.univ-orleans.fr

Calibration of an energy performance measurement system by infrared imaging

Energetics

N. LEFEBVRE

T. SILVESTRINI

Natacha LEFEBVRE / Théo SILVESTRINI
Academic supervisor: J-M. FAVIE

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

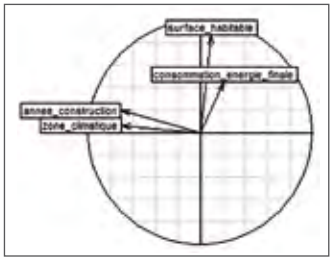
Objective/motivation

In the current context of improving the energy performance of buildings, DPE (energy performance diagnostics) are increasingly used. These documents make it possible to estimate the energy consumption of a dwelling, as well as its rate of emission of greenhouse gases. However, current methods for performing a DPE consist of many calculations based on building characteristics or consumption records, requiring many tedious hours of work. Indeed, current infra-red cameras do not quantify energy losses. They only indicate the difference in temperature between the outside air and the building wall. The project aims to estimate the thermal losses at the walls of a dwelling only from a simple infrared thermography, knowing the main characteristics of the building, in order to facilitate the realization of the DPE.

Results

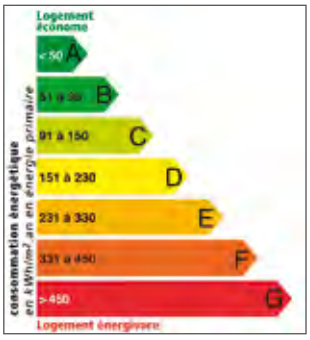
The first part of the work consisted in finding thermal pictures of houses and their corresponding characteristics such as energy consumption (DPE), the year of construction or the occupation rate. This kind of data is very difficult to find. The associations do not have any complete sets of data and the company cannot provide it free of charge. However, the data have been analyzed by a statistical method (Principal Component Analysis) to find a correlation between the temperature of the house walls given by the infrared picture and the characteristics of the building. The analysis was done with the software R.

A correlation exists between the temperature of the walls (thermographic pictures) and energy consumption (DPE), but more data are needed to enhance the study and find concluding results.



Correlation circle of a principal component analysis on buildings data

Keywords: energy performance diagnostics, thermography, thermal losses, statistic study



Energy consumption label

Thermal infrared picture of a house

Contact: natacha.lefebvre@etu.univ-orleans.fr ;): theo.silvestrini@etu.univ-orleans.fr

Configuration analysis of supersonic ejectors

Mechanical engineering


C. BIREAU


G. VAULOUP

Camille BIREAU / Gildas VAULOUP
Academic supervisor: I. FEDIOUN
Industrial supervisor: T. BEQUET

Company: MBDA

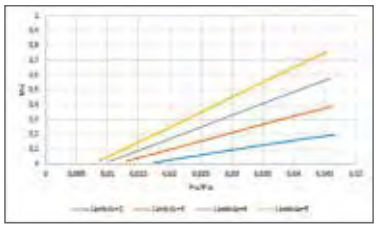
Objective/motivation

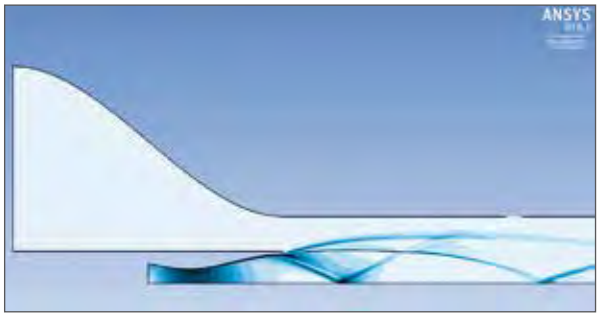
Supersonic ejectors are special devices in the aeronautic field that create a low pressure and a flow in a channel by using a driver flow that is supersonic. The primary driver flow generates the secondary one by suction and viscosity effects. The documentation that already exists is essentially based on 1D or 0D models and do not contain all the information needed by MBDA. We were asked, therefore, to build a 2D model to predict the performance of a supersonic ejector and to validate it using simple 1D calculations. After creating the CFD model, we derived empirical laws from the results. Another objective was to test different configurations by exchanging the position of primary and secondary flows.

Results

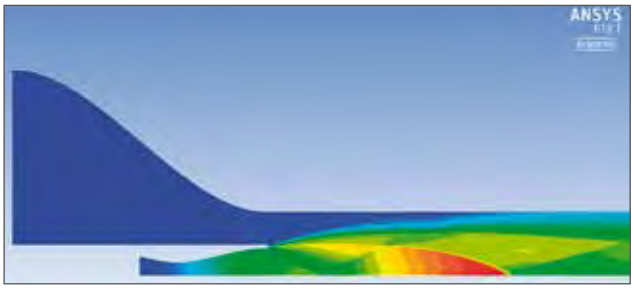
The ANSYS® Fluent software was used to set up 2D models of supersonic ejectors. The principal constraint was the necessity to make different geometrical models to vary the primary Mach number. A major problem was the time needed to converge a first calculation (from a few hours to 3 days), but after this, varying the flow parameters in a subsequent calculation just takes from 15 to 20 minutes. In order to check the validity of our numerical results, we coded a 1D analytical model on Matlab® based on an ONERA publication from 1956. From the comparison of numerical results and analytical theory, we got a better understanding of the supersonic ejector, of the influence of Mach number, temperature and pressure. We succeeded also in reproducing two different regimes, the supersonic and the saturated supersonic. We then started to work on an alternative configuration.

Keywords: CFD (Computational Fluids Dynamics), numerical simulation, supersonic ejector, modeling, fluid mechanics


Abacus made from ONERA's documentation



Numerical Schlieren in supersonic regime



Contour plot of Mach number in supersonic regime

Contact: camille.bireau@etu.univ-orleans.fr ; gildas.vauloup@etu.univ-orleans.fr

Design of an experimental set-up to assess the sustainability of super-hydrophobic coatings

Mechanical engineering

Antoine BRIGHI / Romain SANCHEZ
Academic supervisor: N. MAZELLIER

POLYTECH ORLÉANS
School of Engineering of the University of Orléans

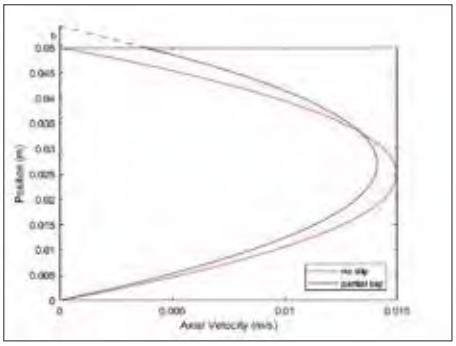
Institution: Polytech Orléans

Objective/motivation

Super-hydrophobic (SH) surfaces have attracted increasing attention since the 90s. Resulting from the combination of surface texturing and chemical repellency, SH surfaces are capable of entrapping a gas layer, referred to as plastron, in their roughness, thereby restricting the solid/liquid contact area. This feature yields slippage, which may have a strong impact in a wide range of engineering applications where wettability control is essential. However, the extrapolation of these results under realistic operating conditions is still to be demonstrated. This study is dedicated to the design of a new set-up with the objective of assessing the stability of the air plastron entrapped by SH surfaces. This project aims at providing a first preliminary study based on Computational Fluid Dynamics tools (ANSYS® Fluent). In a second step, slip conditions will be set and compared to the reference. Finally, the experimental set-up will be built based on the numerical study.

Results

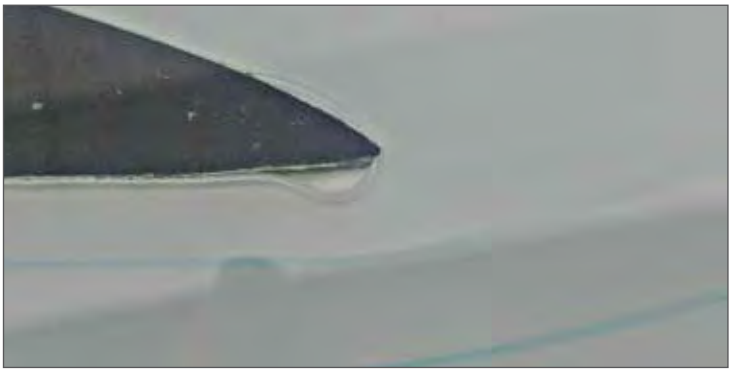
A first numerical model allowing us to determine the flow behavior near the wall with slip conditions has been developed with sufficient analytical accuracy in both 2D and 3D using the ANSYS® Fluent solver. In a first step, the numerical model was assessed against an analytical solution (laminar flow within a channel) by comparing the so-called effective slip length. A more realistic configuration was then implemented, based on the work of the team led by J.P. Rothstein, which consists in alternating raw and treated ridges. In a second step, a Hele Shaw apparatus was built to carry out studies on plane flows behaviors, in accordance with our numerical model, and to examine the resulting pressure gradient, flow rate, or even drag reduction with water repellent-coated surfaces, such as submarine or ship hydrodynamic profiles made from cut rubber.



Effective slip length for partial slip condition

Keywords: super hydrophobic, CFD, drag reduction, surface treatment, naval constructors

Streamlines around a hydrodynamic profile



Air layer trapped around a super hydrophobic profile

Contact: antoine.brighi@etu.univ-orleans.fr ; romain.sanchez@etu.univ-orleans.fr

Determination, design and pre-validation of a system for the recovery of energy from the exhaust gases of a marine engine

Energetics


S. FOUQUET


M. LE DU


T. PHAM

Simon FOUQUET / Marie LE DU / Tâm PHAM
Academic supervisor: C. ROUSSELLE

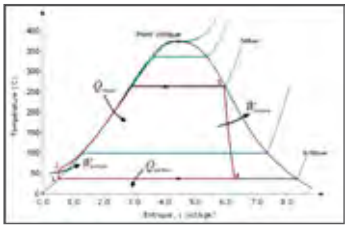
POLYTECH ORLÉANS
School of Engineering of the University of Orléans

Institution: Polytech Orléans

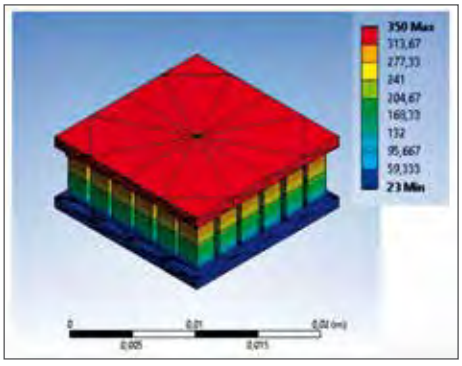
Objective/motivation
Today, marine freight transportation represents 10% of global consumption of hydrocarbon. The project is an answer to Stena's call for tender, edited in 2015, to find a new way to reduce fuel consumption. Boat engines are quite efficient and already have energy recovery procedures placed on the exhaust pipe, like a Rankine cycle or a boiler. In this call, the potential of addition of thermoelectric generators (TEG) on the exhaust to save fuel has to be studied in terms of global efficiency. TEG convert heat to electricity due to the Seebeck phenomenon (Plan 1). Since a classic recovery system can save 24% of energy from the 30% losses in the exhaust, the question is whether it is possible to convert the 6% left in electricity using TEG.

Results
TEG technology is still in development in order to improve their efficiency. Today, the best energy conversion ratio obtained with a TEG is around 7%. It allows TEG technology only to convert 0.4% of the engine heat losses, but to save up to 20 000 € in fuel on one journey. To do that, the module has to be implemented after the Rankine cycle or the boiler itself, as a large amount of exhaust gases are at temperatures between 160°C and 250°C. The amount of gas depends on the scale of the engine ship, from 4 to 220 lbs/s. We are working on big scale engine to save the most possible energy and to have a reliable return of investment.

Keywords: recovery of energy, heat transfer, Thermoelectric Generator (TEG), boat, efficiency


Rankine cycle used for waste heat recovery


Matlab simulation of thermoelectric power module



Model of the thermoelectrique module

Contact: simon.fouquet@etu.univ-orleans.fr ; marie.le-du@etu.univ-orleans.fr; tam.pham@etu.univ-orleans.fr

Development of a Boil Off Gas model

Energetics


M. FONTAINE


A. GOUHIER


T. PATROUILLER


C. THAUVIN

Matthieu FONTAINE / Antoine GOUHIER / Thibaut PATROUILLER / Clément THAUVIN
Academic supervisor: C. CAILLOL
Industrial supervisor: N. BORDET

Company: OSE Engineering

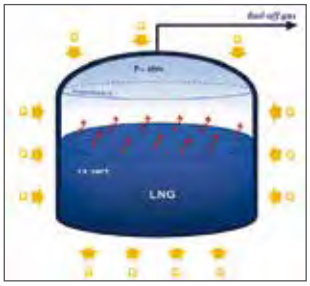
Objective/motivation

Nowadays, the use of liquified natural gas (LNG) is bigger than ever in the industry and in energetical propulsion. Naturally, the transportation of LNG has increased. LNG is transported in its liquid form as the liquid form is 580 times denser than the vapor form. In simple terms, LNG takes up far less space than its vapor form. Since the evaporation of a liquid always creates gas, in the case of LNG there is Boil Off Gas (BOG), with an accompanying increase in pressure, which is used for tanker propulsion. The aim of our project is to create a Matlab program which will predict the amount of LNG after a trip. This program will need to take into consideration many parameters, such as the tanker's movement, temperature, dimensions, the composition of LNG and, of course, the static evaporation.


LNG carrier

Results

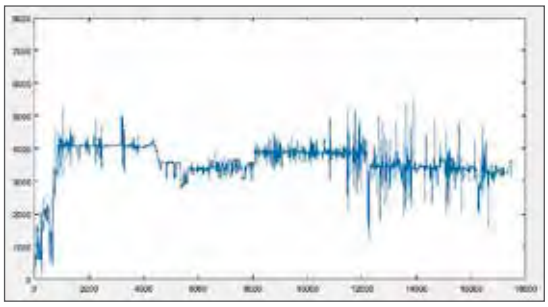
The project had two different parts: the static one, where we did some research on classic gas vaporisation due to the pressure inside the tank, and the dynamic one, which concerned gas vaporisation due to the liquid sloshing around inside the tank during transportation. For the static part, we made a program which is able to determine the pressure and the temperature inside the tank during the boat journey. Using those data, it's now possible to determine the static gas vaporisation. For the dynamic part, we made a data table which is able to determine the quantity of vaporized gas caused by the different sea states. A program has been made which is able to predict the quantity of vaporized gas depending on the journey and the sea states.



LNG tank

Keywords: Boil Off Gas, modelling, liquified natural gas, tanker

Software interface


Evaporation rate during the journey

Contact: antoine.gouhier@outlook.com ; matthieu.fontaine@etu.univ-orleans.fr ; thibaut.patrouiller@etu.univ-orleans.fr ; clement.thauvin@etu.univ-orleans.fr

Eco-driving for thermic engine, electric and hybrid vehicles

Energetics


N. BOVE


T. RAMIANDRISOA


B. ROY


A. WAHL

Nicolas BOVE / Timothée RAMIANDRISOA / Baptiste ROY / Antonin WAHL
Academic supervisor: G. COLIN
Industrial supervisor: K. GILLET

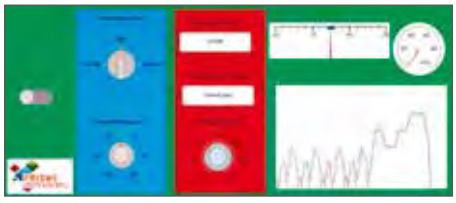
Institution: PRISME Laboratory

Objective/motivation

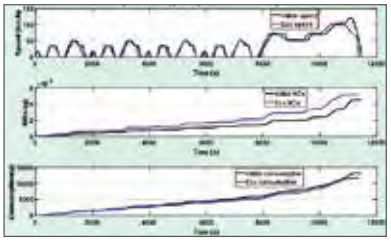
Nowadays, car manufacturers have to deal with more and more rules concerning pollutants emissions and fuel consumption. PRISME Laboratory has developed a software for a car manufacturer that is able to generate a speed outline to minimize fuel consumption on a given driving journey. There are multiple aims on this project. To begin with, we are working on a new feature for the software that can take pollutant emissions into account. Another goal is to replace some models with an analytic solution in order to be faster and consume less memory. Last but not least, we have been asked to develop a Simulink interface that can work in real time and show the cycle to follow. It has to show the efficiency of the software and the possibility to put it onboard.

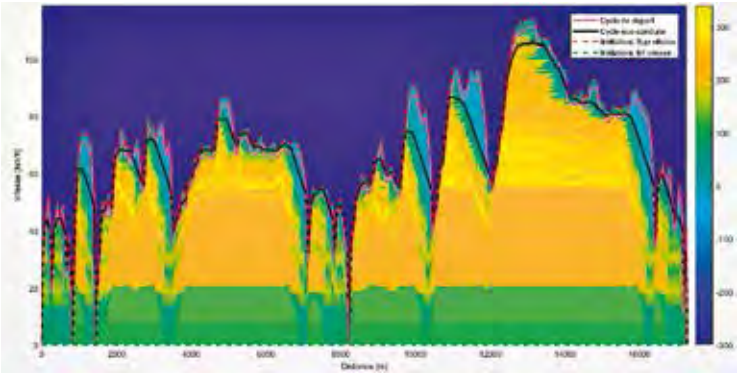
Results

During these eight and a half weeks, we developed a new software which can take pollutants into account. This new software could take consumption and NOx emissions into account at the same time. It is up to the driver to select pollution or consumption optimization. All the results from the simulation have been compared to those obtained by engine test bench. For the analytic part, a function was found and could be solved by a Simulink interface. A semi-analytic method was also created to compare the three optimization methods. A real-time Simulink interface for users was also developed to test the software. It can generate events such as emergency stop in the cycle and recalculation of the "Eco speed". To do so, we chose to model an electric vehicle and we created different drivers' models in Simulink to characterize different behaviors.


Simulink Real Time interface

Keywords: eco-driving, engine-management, optimization laws


Gain of eco driving


Optimal torque generated for a given cycle

Contact: nicolas.bove@etu.univ-orleans.fr ; timothee.ramiandrisoa@etu.univ-orleans.f ; baptiste.roy@etu.univ-orleans.fr ; antonin.wahl@etu.univ-orleans.fr

Engine tuning and mapping

Mechanical engineering


Z. MARZOUK


L.Y. WANG

Zakaria MARZOUK / Lin Yuanzi WANG
Academic supervisor: P. BREQUIGNY
Industrial supervisor: A. SAINT-CRICQ

Institution: Exergie Student Association

Objective/motivation

In a context of growing energy consumption, sustainable development is a sector of innovation where everyone can contribute in their own way and within different means. The Shell Eco Marathon is an automobile competition based on the criteria of energy performance with the purpose of creating the most innovative and environmentally friendly vehicles. The Exergie association aims to participate in this competition every year. The project 'Engine development and mapping', in collaboration with Exergie, will allow us to better understand the engine principle and achieve the competition objectives to create a fuel-efficient car. Our goal is to achieve two engine mappings to enable robust and stable engine operation and to acquire data for improvements. These maps will be carried out on an inertia bench to meet the needs of the Shell Eco Marathon competition.

Results

After installing the vehicle on the test bench, we tried several injection times from 3000 µm to 4500 µm, so that we could find the optimum injection time to start the vehicle. As a result, we had a better efficiency at 4000 µm when starting the engine. During the race at a speed of 25km/h, at this stage we shut off the engine at the speed of 30km/h and we turned it on again when the speed was about 25km/h. As a result, we got 3550 µm as the optimum injection time. Hence, we improved the performance during the star phase by 15% and by 78% during the restart phase. We got a basic mapping that would then allow us to give an honorable performance at the Shell Eco Marathon. We had also written four manuals about how to start, time and tune the engine to allow current and future members of the Exergie association to have a reliable reference.

Keywords:
engine tuning, cartography, efficient

Contact: zakaria.marzouk@etu.univ-orleans.fr ; lin-yuanzi.wang@etu.univ-orleans.fr

Flux splitting systems sizing in filtration chamber for nuclear safety

Energetics

Yann ANQUETIN / Yassine DABBAB / Elisa LAFFORGUE/ Simon OUDIN
Academic supervisor: B. BERNALES-CHAVEZ
Industrial supervisors: T. BERNARD, L. TAMPERE


Y. ANQUETIN


Y. DABBAB


E. LAFFORGUE


S. OUDIN

Company: CAMFIL

Second Place
12th Annual Final Year Projects Forum

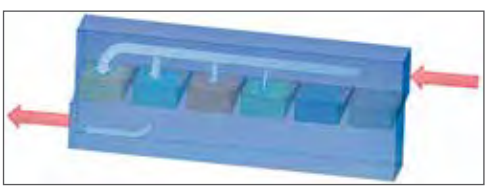
Objective/motivation

The project deals with filtration systems made for nuclear power plants. These systems are placed between the principal chamber, filled with uranium, and the exterior. A previous study showed that there was a quite bad distribution of the flux inside the filtration box and that it could be improved. This filtration box is an empty box with several filters in the middle. If the flux is not well distributed among the box, the particles contained in the flux will tend to go through some filters more than through some others. The project is to design and study flux splitters that could help to distribute the flux into the filtration box, in order to increase the efficiency of the filtration chambers, without creating too big a difference of pressure.

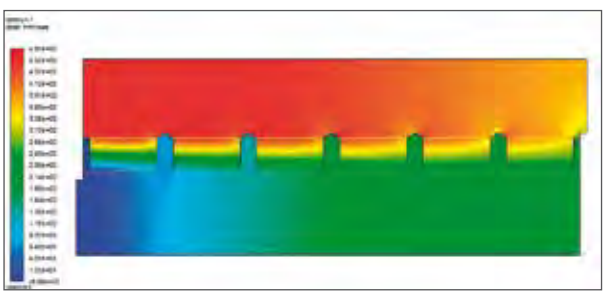

Filtration chambers installed in a nuclear power plant

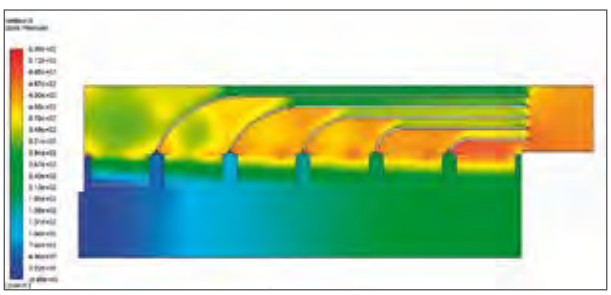
Results

We came out with ten possible systems from the bibliographic research. Seven were chosen among them by CAMFIL. For each system, we varied different parameters to find the best solution. For example, we had to work on a system of wind blades. For this system, we tested different angles of incidence, positions, length (chord), thickness and different number of blades. We proceeded the same way for each of the seven systems. Altogether, we had to make about 40 geometries that were computed with ANSYS® Fluent in order to choose the best ones. As Camfil asked, we came out with at least two good solutions for each of two different kinds of filtration chamber.


Flux circulation in a filtration chamber without flux splitting system

Keywords: filtration, flux, control, creativity, simulation


Pressure distribution in the filtration chamber without flux splitting system


Pressure distribution in the chamber with 5 deflectors

Contact: yannanquetin@orange.fr ; dabbabyassine@gmail.com ; elisa.lafforgue@gmail.com ; simon.oudin@etu.univ-orleans.fr

Impact of syngas on energy production

Energetics


C. CHEN


X. WANG

Cong CHEN / Xunan WANG
Academic supervisor: C. ROUSSELLE
Industrial supervisor: E. MOUILLE

Company: Naoden

Objective/motivation
NAODEN has developed a cogeneration unit resulting from a gasification process. A demonstrator is currently in service in the suburbs of Nantes, and NAODEN discusses the marketing of its units. In order to industrialize its solution, NAODEN wishes to benefit from the engine expertise of Polytech Orléans. This project needed to analyze the impact of syngas on energy production based on literature review and bench experiments. As a reference, some calculations of technical parameters are necessary. With these data, the influences on the performance and emission of the motor can be known.

Results
In order to analyze the impact of the syngas, the characteristics of different combustible components come from the bibliography conclusion. The calculation and simulation of the syngas and flame were done based on these theories. The calorific value varies with the component changing. Therefore, the speed and temperature of flame in the motor have different trends in terms of the variety of syngas. There are also influences of motor performance and emission. The trends for different kinds of emissions have been shown. With our analysis, NAODEN can industrialize its solution.

Keywords: syngas, gasification, energy, motor performances, emissions

Contact: cong.chen@etu.univ-orleans.fr ; xunan.wang@etu.univ-orleans.fr

Market study of combustion engines (gas) that can run on hydrogen

Mechanical engineering

Sofian BORSALI / Gabriel ESSAMI / Paolo JAUNET / Xiang LI / Xinyuan ZHANG / Xiaolei ZHAO
Academic supervisor: F. FOUCHER
Industrial supervisor: F. DE SOUSA LOPES

Company: Naturegie


S. BORSALI


G. ESSAMI


P. JAUNET


X. LI


X. ZHANG


X. ZHAO

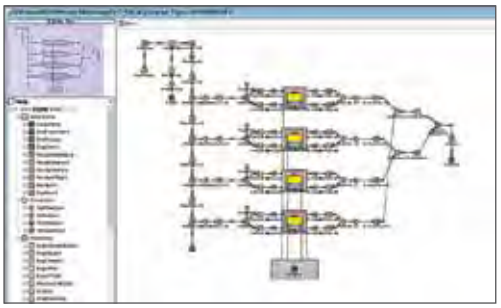
Objective/motivation

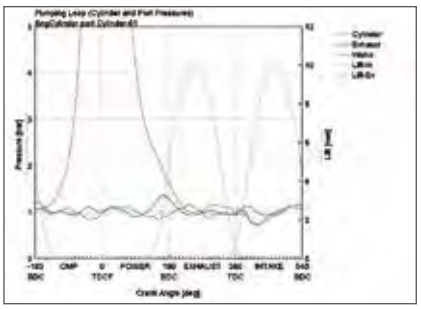
NATUREGIE SAS expects to serve an electric motor with a heat engine to its Hydrogen 2.0 generators in order to produce electricity to different power. The goal of the project is to modify an internal combustion engine corresponding to its hydrogen generator and optimize its performance in terms of efficiency, the emission of NOx considering the economy. It is necessary first to study the market of engine manufacturers that can run on natural gas or hydrogen delivering a high volumetric ratio and equipped with turbocharger if necessary. With the parameters obtained from the manufacturers, a simulation should be launched to identify the pertinence.

Results

By contacting the manufacturer of gas engines, we have compiled a list of pertinent engines including industrial information such as the price, the engine model, the output power and compression ratio, etc. As indicated by previous research, the engine should be chosen with a high compression ratio, and a large operating range for which the Cummins version B3.3L seems to be the most propitious to our client. As to the simulation, an internal combustion engine model of four cylinders has been built and the initial parameters are totally optimized regarding the indicated efficiency and the NOx emissions, such as equivalent ratio, injection timing, IVO (Intake valve opening) and EVO (exhaust valve opening). As expected, the efficiency indicated attained more than 44% with emission NOx under control with power output required on crankshaft.

Keywords: gas engine, hydrogen, market research, optimization of performance, emission NOx


Model


Results

Contact: sofian.borsali@etu.univ-orleans.fr ; gabriel.essami@gmail.com ; paolo.jaunet@etu.univ-orleans.fr ; lx36069@gmail.com ; xin-yuan.zhang@etu.univ-orleans.fr ; xiaolei.zhao@etu.univ-orleans.fr

Numerical resolution of forced convection for high Prandtl number fluids

Energetics

H. ARTAL

J. SABATIER

Hugo ARTAL / Julien SABATIER
Academic supervisor: B. BERNALES-CHAVEZ
Industrial supervisors: A. BAYLE, G. MILLOT

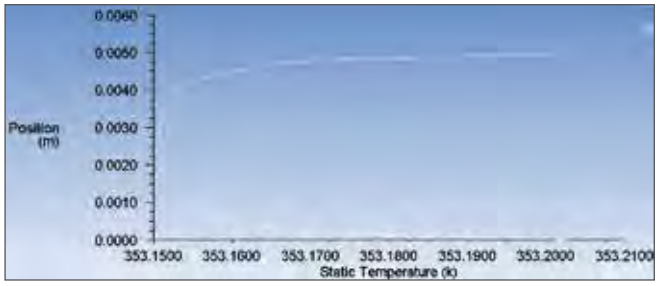
Company: Altran

Objective/motivation

High Prandtl number fluids are commonly oils and they are used as heat vectors in aircraft pipes. Nevertheless, their physical behavior is not very well documented. Altran asked us to study this using ANSYS® Fluent software. The goal was to create a 2D-conduit with different pipe diameters, fluid velocities and temperatures. We then had to compare the results obtained with different flow models. We also studied the influence of the mesh, the pressure drops, the wall temperature and the heat transfer coefficient, which are important physical parameters in forced convection studies.

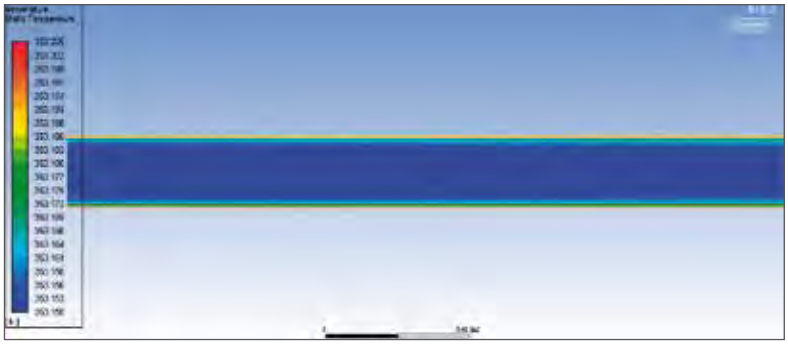
Results

With adiabatic sides, we observed an increase of the fluid temperature near the walls. However, regarding fixed wall temperature, we saw an inverse phenomenon. Otherwise, in laminar flows we noticed that the velocity and temperature profiles resemble each other whereas they are opposed in transient and turbulent ones. Lastly, we can say that the results given by ANSYS® Fluent are close to the theory. Pressure drops, heat transfer coefficient and flow behavior are barely as predicted. The mesh influences the results and, for instance, a refined one takes more time to calculate but enables better observations.



Temperature profile for a pipe with adiabatic walls

Mesh with triangles and inflation (20 elements and 5 layers)



Temperature distribution through a pipe with adiabatic walls

Keywords: CFD, heat transfer, forced convection, oils, pipe

Contact: hugo.artal@etu.univ-orleans.fr ; julien.sabatier@etu.univ-orleans.fr

Numerical study of the influence of passive controllers on a vehicle's wake

Energetics


M. ABADA


N. OUARITINI

Moussa ABADA / Nabil OUARITINI
Academic supervisor: A. KOURTA
Industrial supervisor: A. KOURTA

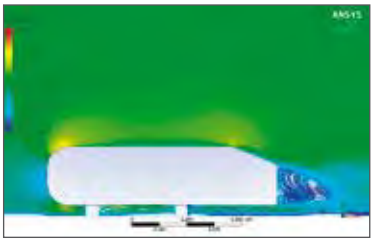
Institution: PRISME Laboratory, GdR 2502

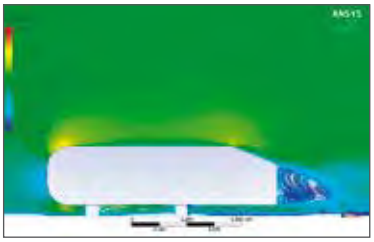
Objective/motivation

Our project is focused on the analysis of passive control solutions that reduce the aerodynamic drag and therefore the fuel consumption of vehicles. The passive solution controls, like vortex generators, are steady and require no energy by definition, contrary to active solution controls. The geometry taken into account will be the geometry of Ahmed body in order to avoid style diversity. The Ahmed body is a generic car body (a simplified vehicle model). The airflow around the Ahmed body captures the essential flow features around an automobile. Although it has a very simple shape, the Ahmed body allows us to capture characteristic features that are relevant to bodies in the automobile industry.

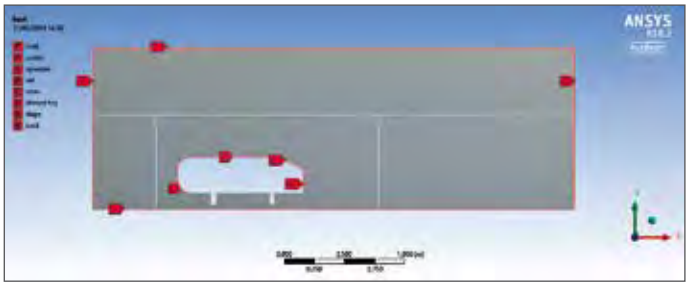
Results

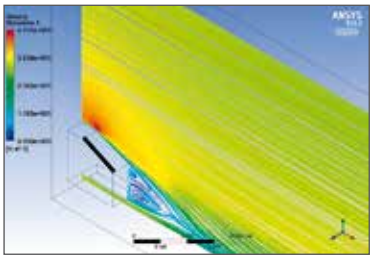
After modeling the Ahmad body in 2D and 3D on a CFD software, we had to launch the simulations without the control systems in order to have an estimation of the drag caused by the body. We then looked for numerical configurations of flow control solution in order to see which solution would lead to the best drag reduction. We modeled separately different existing technologies of passive control systems such as vortex generators and flaps, and we also made a shape optimization of the body. We managed to decrease the drag up to 24%, which is a significant gain.

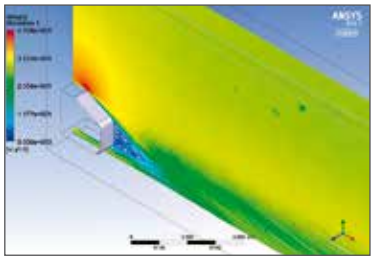


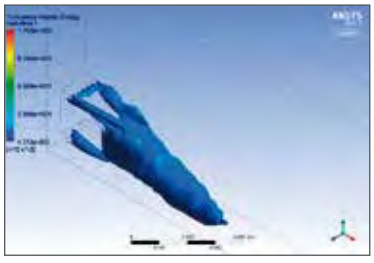


Keywords:
CFD,
fluid mechanics,
drag reduction









Contact: moussa.abada@etu.univ-orleans.fr ; nabil.ouaritini@etu.univ-orleans.fr

Optimization of the cooling system of induction cookers

Energetics


R. MADELON


M. MAILLET


B. PHAM

Rémi MADELON / Maxime MAILLET / Ba-hi PHAM
Academic supervisor: L. TADDEO
Industrial supervisor: D. GOUARDO

Company: Brandt

Objective/motivation

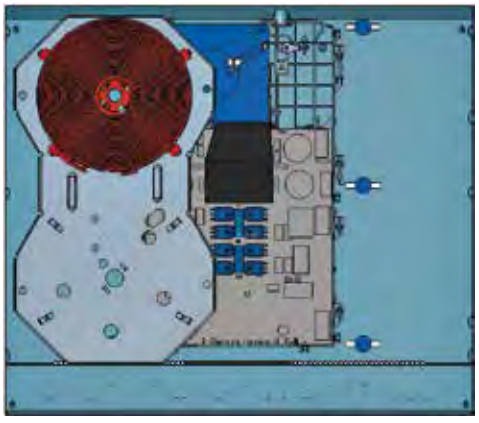
The project suggested by the company Brandt deals with the cooling of electronic and electromechanical components used in induction hobs. All electronic components are temperature sensitive and can have low performance outside particular temperature limits. In induction cookers, some of them generate heat fluxes in operation and must be cooled in order to avoid any problem and to guarantee a sufficient lifetime of the entire product. Thus, the objective of the project is to propose solutions to improve the ventilation and fins systems that already exist to optimize the cooling capacity of the components.

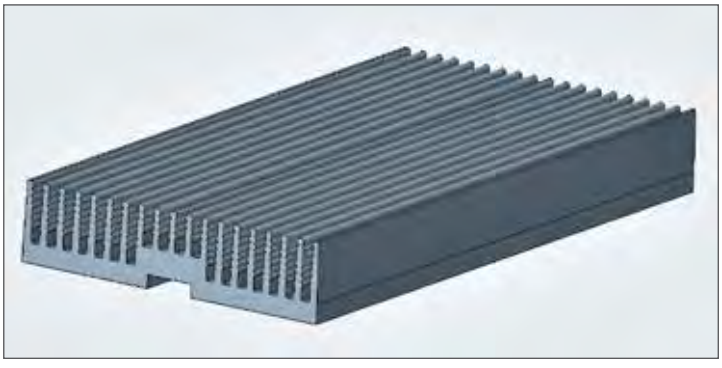
Results

A software dedicated to CAO (conception aid design), named CREO, has been used to build different kinds of fins. They have then been simulated on Fluent, a computational fluid dynamics software, in a physical environment subjected to a turbulent flow and heat transfers. The purpose was to test many geometries and define what was the most efficient fin to dissipate heat considering the configuration of the induction hobs. Almost the same process has been followed for the ventilation system. However, the optimization was focused more on the location of the openings to evacuate the hot air stuck into the cooking appliance.

Keywords: induction hobs, optimization, cooling system, fins, ventilation


Air blower


Induction cooker


Heat sink

Contact: remi.madelon@etu.univ-orleans.fr ; maxime.maillet@etu.univ-orleans.fr ; ba-hi.pham@etu.univ-orleans.fr

Participation in the first phase of the GoFly contest

Mechanical engineering

N. BERRO

N. REKIK

Nader BERRO / Naïm REKIK
Academic supervisor: P. DEVINANT

Event: GoFly

Objective/motivation

GoFly is a contest sponsored by Boeing, whose aim is to create a personal VTOL (vertical take-off and landing) system that can be used by anyone. This contest is comprised of many rules, whether to do with the maximum speed the PVTOL should have or even the noise that our equipment would generate. As an outcome, we had to write a technical report describing the technologies used in our equipment as well as a thorough description of the innovative technologies or techniques that are used in our equipment. The prototype phase as well as the testing phase will come right after phase 1. This project is a bit different from the other projects since we don't have a client. Boeing's motivations are to compete with other companies that are developing and selling this type of equipment.

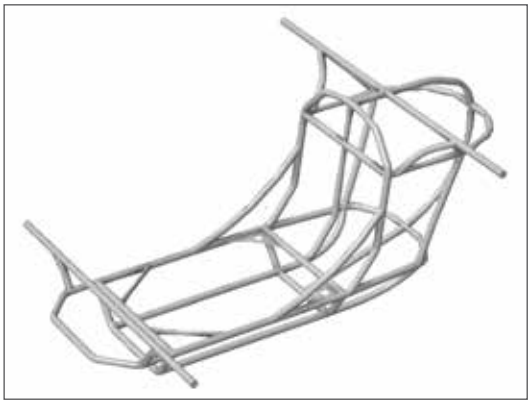
Selected rotor with multing optimiser

Results

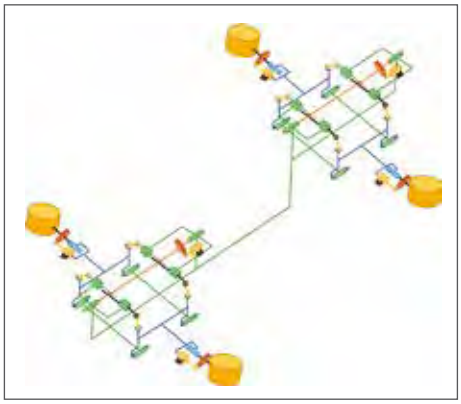
We are able to define the propulsion system that our equipment would have. It will resemble a buggy, with a tubular structure to decrease its weight. We also calculated and chose the rotors that will be used in our model. These ducted rotors will be the key element to being able to fly our equipment. We also decided on the materials to be chosen and that is after studying various materials on a structural and molecular level. We also developed the VTOL's control system, which meant defining the way that our VTOL will fly, how it will make turns, and carry out manoeuvres.

Energy pathway

Keywords: PVTOL, innovation, weight, propulsion, stability



PVTOL's structure



PVTOL's mechanism

Contact: nader.berro@etu.univ-orleans.fr ; naim.rekik@etu.univ-orleans.fr

Study of coatings and materials in an oven cavity

Materials


Y. CHEN


G. FERNIQUE


M. MONARD

Yitian CHEN / Guillaume FERNIQUE / Mélanie MONARD
Academic supervisor: N. MAZELLIER
Industrial supervisor: J-P. CARMES

Company: Brandt

Objective/motivation

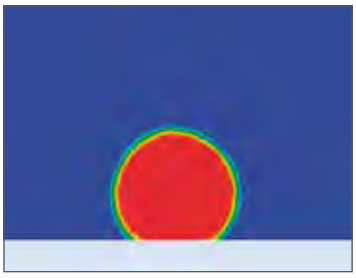
One concern of home appliance manufacturing companies is to make an oven which lasts as long as possible while remaining in a good state of repair. Oven cavities should not only last long (from 5 to 10 years) but also be resistant to cleaning products and treatment. Most of the ovens sold in France are cleaned by pyrolysis, where cooking residues are burned and turned into soot, and then cleaned off. The oven is heated to 500°C for 1 to 2 hours. Due to these requirements, there is a temperature constraint on the oven cavity's coating, which leads to early wear of the oven walls, the need for an extra pane of glass, and use of a lot of energy. Moreover, during the pyrolysis, the oven cannot be used, which is a waste of time. Therefore, the goal of this project is to find technical solutions to make oven cavities more easily cleanable and thus render pyrolysis obsolete.

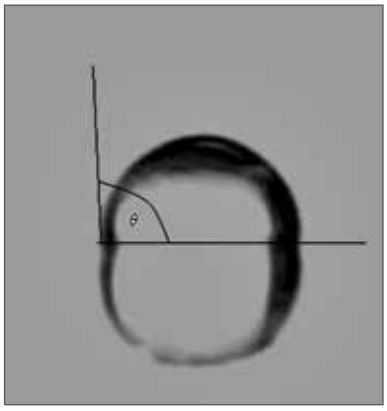
Results

At the start of the project, we did research on the state of the art in cleanable coatings and materials, in active cleaning technologies (ultrasound baths, etc.). We tested (heat resistance, wettability, etc.) some of the methods and products found during this part of the project. In order to have a complete range of data, we chose to test many different liquids, both water-based and oil-based. We also simulated those tests numerically, so as to compare numerical results to experimental results. We found that the coatings that resist high temperatures are not very oleophobic whereas hydrophobic and oleophobic coatings cannot bear heat. We also found that CFD calculations can be reliable if the parameters (multiphase models, time step, mesh size) are judiciously chosen. Overall, few coatings matched our expectations or the promises of their manufacturers. One of the most promising leads, however, seems to be the Leidenfrost effect.

Keywords: oven cavity, wettability, coating, heat resistance, hydrophobic


Dursan sample in an oven


Contact angle testing (VoF model)



θ contact angle

Contact: yitian.chen@etu.univ-orleans.fr ; guillaume.fernique@etu.univ-orleans.fr ; melanie.monard@etu.univ-orleans.fr

Our remarkable equipment

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

Clean Room
A class 10,000 clean room of 100m^2 is in service at the GREMI laboratory of Polytech Orléans. Students working in the Ecotechnologies, Electronics and Optics 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

Medallions indicate participation and award in the Final Year Projects Forum:

- 1st place
- 2nd place
- 3rd place
- 4th place
- 5th place
- Innovation Award
- Participant

Index of participating companies and institutions

Polytech Orléans
School of Engineering of the University of Orléans
8 rue Léonard de Vinci, 45072 Orléans cedex 2, FRANCE

www.polytech-orleans.fr