

UTC GRADUATES  
INTERACTIONS  
INTERVIEW THE  
2020/2021 CLASS  
GODFATHER &  
GODMOTHER  
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## SORBONNE UNIVERSITY/ INITIATIVE

Master's degree in Safe and  
Sustainable Technology-  
intensive Systems

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improvisation to  
technological innovation

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# Interactions

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## *In favour of a sustainable world of sound*



YOU HAVE THE FLOOR PAGE 15

**BERTRAND PICCARD**  
A SPIRITED HIGH-FLYING  
PIONEER



In a sustainable development approach, this issue of Interactions will be the last paper version.

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#### FROM THE PRESIDENT'S DESK

Noises or sounds are an integral part of human activity. They are also present in Nature. Depending on their characteristics, they can be a source of information - thunder announcing a storm - or a source of nuisance - the noise of pneumatic drills, road traffic or aircraft.

Albeit noise pollution has long been perceived as the price to be paid for economic development, it has become increasingly intolerable. Its impact on health - stress and cardiovascular diseases in particular - and wildlife - by disrupting the tranquillity of protected areas - is recognized. According to the World Health Organisation (WHO), environmental noise causes at least 12 000 premature deaths per year in Europe and is the second most common cause of morbidity among environmental risk factors, after air pollution.

This observation has led public authorities to make standards more stringent and industry to adapt itself. This is the case, for example, in the automotive and aeronautics industries, where researchers and engineers in acoustics and vibration are working to find innovative solutions to reduce noise pollution.

But there are noises that cannot be heard yet they are associated with environmentally damaging activities. This is the case of the stridulations of beetle larvae which infest 2/3 of the Compiègne forest, but also elsewhere in Europe, at various densities. These larvae quietly devour the roots of trees and plantations over a period of four years, thereby preventing the natural regeneration of the forest.

However, not all sound is noise. Sound designers who are interested in everyday sounds are trying to isolate useful sounds from 'useless' ones, with the ultimate goal of attaining and producing pleasurable sounds.

In all these fields of research, UTC has numerous trump cards in hand and are to be found in the framework of UTC's «Acoustics and Vibrations for Engineers» specialist programme.

**Christophe GUY,**  
Principal & Vice-Chancellor, UTC



#### INAUGURAL LECTURES

## Artificial intelligence and knowledge engineering

Marie-Hélène Abel is a full professor at UTC and, since 2020, is director of the Department of computer engineering (UTC-GI). Specialized in the field of artificial intelligence (AI), and more precisely, in knowledge engineering, she gave an inaugural lecture on 1st September 2020.

**A**fter successfully defending her doctoral thesis in AI, in 1994 at UTC, more precisely, on "explanatory expert systems", she was recruited by the University of Picardie Jules-Verne (UPJV) as a lecturer, then, in 2000, moved to UTC.

What exactly is "an "explanatory expert system"? It is a system to which one provides a certain amount of information, linked to a given problem, from which it will implement specific reasoning and come up a set of varied solutions. It will also be able to explain its approach to solving the problem so that the user can accept or reject the proposed solution.» she explains.

*We should not be afraid of AI because often we are afraid of what we do not know.*

Her areas of research? «I am interested in AI and, more specifically, in knowledge engineering, i.e., the work of tool-making of knowledge. Since knowledge is specific to each person, it may seem surprising to work on this theme via tools and machines. However, in the field of AI, the aim is to ensure that humans and machines can communicate and that humans enjoy a sense of mutual understanding. The machine gives an answer that is considered relevant by the human who made the request. In other words, the idea is to use a language that it is able to read and interpret in the same way that a human can,» she says.

These are areas that require increasingly sophisticated algorithms. «An algorithm is a



sequence of instructions that must be readable and interpretable by the machine so that it knows what action to take. Take the Highway Code, for example. It is a sum of information from which we all derive the same knowledge. A Stop sign is thus interpreted by all as demanding a vehicle stop. In the case of algorithms, we can speak of symbolic manipulations carried out by the machine. Manipulations that make sense to the user,» she adds.

Your message to students? «That they should not be afraid of AI because we are often afraid of what we do not know. You have to seize the tools of AI, take advantage of all its potential while admitting its inherent limits and risks. We must therefore be vigilant and impose an ethical framework on ourselves,» concludes Marie-Hélène Abel. ■ **MSD**

# « Make France shine all over the world »

Christine Kerdellant is the editorial director of L'Usine Nouvelle, L'Usine Digitale, Industrie & Technologies, Bip and Enerpresse. She is the Godmother of the 2021 graduation ceremony. Interactions interviewed her!

**C**an you tell our readers why you accepted the role of Godmother of this 2021 UTC graduation ceremony?

It's an honour! And it's the first time I've been asked to do this.

**What does this engineering school represent for you?**

First of all, it was the school of Charles Foucault, the ex-editor and quasi-founder of Usine digitale, a brilliant and imaginative journalist with whom I loved to work before he left for Switzerland to found a start-up. So I had a good image of him from the start! Then, it was at the UTC that I got into an autonomous self-drive car for the first time, an experience that really amused me and opened up new horizons. Finally, UTC was our partner for the exhibition «Industry seen from above»... All this creates links.

**What do you expect from this class for the rest of their professional career?**

That many students choose to go into industry! Engineers can have great careers here, and "the sky is the limit"... There are not enough engineers in France, so the doors are wide open for the best of them! And then, in the race to carbon neutrality by year 2050, which is our obsession, industry represents 20% of the problem and 80% of the solutions. We won't make it without technological innovation in all areas, especially energy.

**What do you wish them?**

I wish them to do like Gustave Eiffel, very fashionable this year (and about whom I wrote my latest book): to succeed in making France shine throughout the world. The engineers' France was so much more innovative than that of the bureau-technocrats!

**What qualities and skills make the difference today?**

Adaptability, intelligence, initiative, a taste for risk... But these are the same, I think, as those that enabled people to have a great career and a good life a century ago!

**You very often highlight the engineering professions in your columns. What are the beliefs of your media about the world of engineering?**

We address industry executives, but mainly engineers. We show them that the world of engineering is infinite! It leads to a wide range of activities and professions, depending on whether you choose to go into AI, hydrogen, agro-food...



CHRISTINE KERDELLANT

**If your career had been different, would you have chosen to become an engineer? In what field? Why would you do that?**

I dreamt of becoming a journalist ever since childhood. I didn't want to hear about anything else. I had to fight to get there, because everyone around me absolutely wanted me to become an engineer. In the end, I went to HEC, which seemed more logical to become a journalist (it wasn't in reality, and being an engineer would have allowed me to become a scientific journalist rather than an economic journalist). Today, we regularly recruit young engineers who want to become journalists. They are the best profile to follow aeronautics, cars or energy at L'Usine Nouvelle, L'Usine digitale or Industrie & Technologies...

**You very regularly put forward the engineer of the future, via very successful articles and events, how do you see this engineer of the future?**

They will be familiar with AI and more generally with our new digital tools. But whether he creates his own start-up or joins Thales or L'Oréal, I imagine him/her wanting to work on the key issues of the world to come, with saving the planet in mind... He/she is also someone who works by «try

and learn», who is not afraid to make mistakes. Today's Steve Jobs, Bill Gates or Elon Musk like to surround themselves with people who know what failure is: they had some themselves in their early days and know that these 'scars' are the passport to greater success.

**Has the health crisis reshuffled the deck?**

Yes, it has caused an acceleration of trends, whether it be the use of teleworking or the rise of China. The boss of Camif - which sells items related to our homes, advocates recyclability and short circuits, and has taken the initiative of no longer buying anything outside Europe - told me a few days ago that his results have progressed as much in 1 year as he had hoped for in 5 years!

**Your rankings help choose an engineering school. How do you proceed?**

For four months we collect data from the schools or the CDEFI (it's a long process, because we judge on dozens of criteria), we validate them, and then we establish scores on about ten items (international influence, proximity to companies, research, etc.). We change the criteria every two years or so.

**Finally, what is the end-of-year news for your media company and its prospects for 2022?**

Usinenouvelle.com is the leading BtoB website in France! The audience is constantly growing on the subjects of Aero, Space or Energy... And it is not about to be dethroned, because over the next few months we are going to integrate into L'Usine Nouvelle other brands from the group's industry division: Info-chimie, the magazine Packaging, etc. At the same time, the monthly paper magazine continues to be the industry reference, and with the lockdowns it has continued to consolidate its position. ■ KD







#### # BRUNO LE MAIRE MEETS THE STUDENTS OF UTC.

Last October, the students of UTC had the

honour to welcome the French Minister of Economy, Finance and Economic Recovery, Bruno Le Maire, within the framework of the France 2030 National Investment plan. On this occasion, the Government wished to gather the high-level concerns of students for a more sustainable and united world. Together three major topics: the major challenges of tomorrow's engineering; digital transformation and the industry of the future; the automobile and mobility of the future were debated.

**# 30 YEARS OF THE SCIENCE FESTIVAL VENUE AT UTC.** Ever since 1991, UTC has been participating in the Fête de la Science! As a pioneer of this event, the UTC has always had at heart to make the public aware of science and its stakes, to favour the sharing of knowledge between researchers and citizens, to value the work of the scientific community in order to arouse vocations among young people. Throughout its thirty years of participation, it has never ceased to spread the values of the science festival, which are sharing, creativity, conviviality and responsibility. This year, the national theme was based on «the emotion of discovery». For this anniversary edition, UTC organized an inaugural conference on «the challenges of a reasonable and sustainable technological research», with our partners Renault, ArcelorMittal, Safran around the aeronautics of the future, the automobile and the materials of the future. In conclusion, a round table was moderated by Jérôme Favereon, director of the MSTD initiative «Mastering safe and sustainable technological systems» of the Alliance Sorbonne University.



>> This event can be consulted in full on the UTC's YouTube® channel.

**# LTHE HS2 LABEL AWARDED TO THE BIP-BOP COOPERATIVE.** After being chosen by the Foundation "La France s'Engage" as 2020 laureates, among the social entrepreneurs who innovate to build a more just and united society, the Bip-Pop cooperative developed by Anne Guénand, lecturer-cum research scientist at the Costech laboratory, has obtained the HS2 (High Health Security) label. This label aims to respond to the challenge of an ageing population. Indeed, its ambition is to enable elderly people who are losing their independence and who wish to remain at home as long as possible. Ms Guénand was also awarded the Medal of Chevalier in the National Order of Merit by Nadège Lefebvre, President of the Oise Department Council. ■ **PS**

#### CLASS OF 2020

## Key words: resilience, agility and initiative!

Distance learning courses, telecommuting, placements/ internships... UTC students had a complicated year over 2020. **The 2020 graduates have also been deprived of one of the highlights of their lives, the graduation ceremony. A celebration is therefore dedicated to them before the gala that will be held on December 4 at the Hippodrome de Chantilly (Racetracks).** For this graduating class, marked by the health crisis, a Godfather was needed to reflect the resilience they had to show. The person chosen for this role is Patrick Hokayem, a UTC-Compïègne graduate, who supervised the commissioning of the «Military field hospital» in Mulhouse in March 2020.



PATRICK HOKAYEM

#### What are the elements to take into account before considering a military career?

It is important to remember that the Army offers consideration first and foremost and transcends academic diplomas. What the armed forces are looking for are young people with character, courage, charisma, enthusiasm and initiative. In short, 'a personality more than a CV' as General de Villiers used to say. On this point, UTC provides all the qualities in its training to lead to excellent officers... Indeed, the UTC student is very early on plunged into teamwork as early as the CCs of the core curriculum begin, and one quickly sees who has it to be a leader... Moreover, he or she constantly monitors technological developments, without being technocratic, that allows to apprehend the technicality of a project without drowning in it and not to obviate the opportunities for innovation and quick resolution of the problems.

#### Looking back, what lessons did you learn from 2020?

Success in terms of agility relies on the delegation of tasks being implemented correctly.

In a crisis situation, a person or a team trying to juggle with multiple tasks will not succeed: work must be limited to one or two specific tasks by giving full data and trust. There is little or no room for control; you have to move forward with the results produced by the team. If the initial expectations have been made clear, the result is there!

On the personal aspect, I remember from my days at UTC that 'there is a life after the courses'... Fortunately, my wife and my son were of an unfailing support in spite of the subjection and the operational availability which were required of me. Even if it was not easy, one must preserve one's own as much as possible: Family and friends are not the «spill over» of work-related emotions!

#### In the end, do you think that the year 2020 will be an asset or a weakness?

In all sectors, working remotely has often been a keyword, and this is not going to diminish... Engineering students have learned this the hard way, but have probably acquired (willingly or unwillingly) a certain number of skills to make the most of this remote work, to convince, and to obtain results through this means. From this point of view, this year is probably a strength for the future.

On the other hand, we have to remain vigilant to the fact that people paradoxically need proximity management, especially when difficulties arise. So it's not just progress meetings by video, face-to-face remains crucial! ■ **MB**

Read the article on the **implementation of the military resuscitation element of the health service in Mulhouse :**

<https://interactions.utc.fr/thematiques/vie-de-luniversite/un-hopital-pour-sauver-un-hopital.html>





# *In favour of a sustainable world of sound*

Since the discovery of fire, noise has always been associated with human activity. The industrial revolution, with the development of transport and industry in particular, led to an unprecedented increase in noise pollution. The scale of noise pollution grew throughout the 20th century with the exponential increase in the number of cars and road transport, air and sea traffic and industry. These nuisances, which were tolerated as the price to pay for development, have gradually become intolerable. Their impact on our health but also on the surrounding fauna has led the public authorities to issue more stringent standards and industry to adapt. However, not all sound is noise. There are pleasant sounds, the song of a nightingale for example, and others that are unpleasant, such as the croaking of a crow or the noise of a pneumatic drill. UTC's Acoustics and Vibration team works in this context to reduce unwanted noise as much as possible and make every day sounds more pleasant, particularly in the automotive and aeronautical sectors. But the team's skills can also be used to protect the environment, for example to detect the stridulations of the chafer larvae that threaten the forest of Compiègne. In short, the team is helping to create a sustainable sound universe.

## *The health and environmental issues of noise pollution*



JEAN-DANIEL CHAZOT

Jean-Daniel Chazot is a lecturer qualified to direct research and is in charge of the Acoustics and Vibrations for Engineers (UTC-AVI) programme within the mechanical engineering department.

**N**ot all sound is noise. Sounds and even vibrations are part of the natural human environment. But 'noise' has taken on a particular significance with the growth of human activity.

«Engineers are not only trying to limit these noises but also try to improve the sounds made by everyday objects. In practice, they even try to adapt the sound to the user. Acoustics is thus a major marketing argument in all sectors. Moreover, reducing vibrations also makes it possible to

increase the lifespan of equipment for more sustainable development,» he says.

However, the role of the vibro-acoustic engineer is changing. Why? «The evolution and tightening of regulations linked to noise pollution in order to protect the consumer, but also the environment, following an awareness of the effects of noise pollution. The WHO estimates that noise pollution is the second main cause of morbidity – 12 000 premature deaths in Europe - after air pollution.



We can also cite a study by Bruitparif which concludes that people in the Paris region lose 10 months of their healthy life due to noise pollution, which causes stress, hypertension, sleep disorders and cardiovascular problems,» emphasizes Jean-Daniel Chazot.

Reducing these

nuisances is therefore a major health issue for human beings but also for ecosystems. «For example, an American study shows that human activity doubles the background noise in 63% of natural areas that are supposed to be protected. Nuisances that affect the health of animals, disturb their communications and cause them to move away from their territory. Another example is the

harmful effects of shipping, which doubles its noise level every ten years, on underwater life,» he adds.

A reduction that is therefore a major challenge for vibro-acoustic engineers. «At UTC, we give our students a solid theoretical and practical training so that they can measure, model, understand and treat vibrations and associated acoustic emissions. With these different skills, they can reduce nuisances at source and treat structures to reduce their acoustic radiation,» he explains.

These problems also give rise to research, very often carried out with industrial partners but also with public funding from the French government,

the Hauts-de-France region and Europe.

«For example, a thesis is underway, with the Regional Centre for Innovation and Technology Transfer (CRITT), on the experimental characterization of turbine generated noise,» he explains.

Other projects in progress? «We are currently working with Saint-Gobain, as part of a thesis on the vibroacoustic modelling of a windscreen. Another is underway with Safran. The aim? To understand and reduce the unpleasant noise of electric motors,» concludes Jean-Daniel Chazot. ■ MSD

# Hornets, an invasive species



Jean-Daniel Chazot details the nuisances associated with the Asian hornet, a species on the list of invasive alien species in Europe. A ministerial thesis is devoted to what has become a research topic.



**T**his species poses both health and environmental problems. «Hornets are dangerous for humans; they are also dangerous for bees. This causes damage to beekeepers but also to the environment, as bees play a major role in pollination,» he explains.

What can be done to limit the nuisance, especially since nests can often only be detected in autumn when the trees lose their foliage? Jean-Daniel Chazot then had the idea of contacting Pedro Castillo from UTC-Heudiasyc, who works on drones. «For us, we are thinking about a drone system equipped with an acoustic antenna that would make it possible to follow a hornet equipped with a small sound beacon in order to locate the nests without waiting for autumn,» he says.

What was supposed to be a student project eventually took a different course. «We responded to calls for projects that allowed us to benefit from a ministerial thesis on this research subject, which involves, in addition to Roberval and Heudiasyc of the UTC, the Jean-le-Rond-d'Alembert Institute of Sorbonne University, »emphasizes Jean-Daniel Chazot.

A subject that requires specific skills. «At the UTC, our skills relate to drones and acoustic

imaging. As for the Institut d'Alembert, it brings its expertise in MEMS sensors. What we plan to do is to attach a MEMS speaker to a hornet and follow it with a MEMS microphone antenna on the drone. These are very light miniaturised sensors that can be installed in numbers but with

a reasonable additional mass. However, before we can do this, we will have to remove certain scientific and technological barriers, such as the difficulty of tracking a moving acoustic target,» he concludes. ■ MSD

## DETECTION OF CHAFERS' LARVAE THAT HAVE INFESTED THE FOREST

**After two years of preparatory classes in Arras, Camille Leblanc was admitted to UTC in the 3rd year of mechanical engineering and continues his studies in the Mechatronics, Actuators, Robotics and Systems (MARS) programme. He will start a thesis in embedded acoustic imaging at Roberval as of autumn 2021.**

It was following a CC on "Sound signal processing" with Solène Moreau, a UV that I really enjoyed', he says, that he discovered a passion for the subject. Lacking credits in his 4th year, he was able to bounce back by opting for a project to be carried out between the two semesters in order to make up for the lack of CCs. This was a good opportunity because, at the same time, Jean-Daniel Chazot proposed an inter-semester project on the study of the signal emitted by beetle larvae threatening the forest of Compiègne but also elsewhere in Europe. «Three students applied and all three were selected, as the work to be done was substantial,» he explains.

The project itself? «We took up the work of Ms Görres, a German research scientist, who used a fractal method to detect the presence of larvae and, above all, to quantify it. We therefore used her script as a starting point and then improved it by testing it on real cockchafer chirps,» concludes Camille Leblanc.

**Stéphane Brault is a research assistant at the ONF (French National Forestry Commission), where he monitors the forests of Compiègne and Laigue. Specialist of entomology questions, he has his**

**sights set on the chafer larvae that infest two-thirds of the forest surface, albeit with varying densities.**

These larvae devour the roots over a period of 4 years, preventing natural regeneration and planting. The idea behind the collaboration with UTC? «In entomology, some species can only be determined by acoustics. However, while searching the scientific literature, I realized that very successful scientific research had been carried out on chafer infestations in sugarcane fields in certain countries of the Indian Ocean. At the ONF, we thought that this was an avenue to explore with the UTC,» he explains.

Jean-Daniel Chazot, head of the AVI course, seized the opportunity to set up an intersemester project on the study of the signal emitted by the larvae. It was too short a project for such a complex subject. «It should be noted that four years pass between the laying of the eggs and the initial flight of the chafer. Long-term studies would therefore be necessary as part of a thesis, for example,» he stresses.

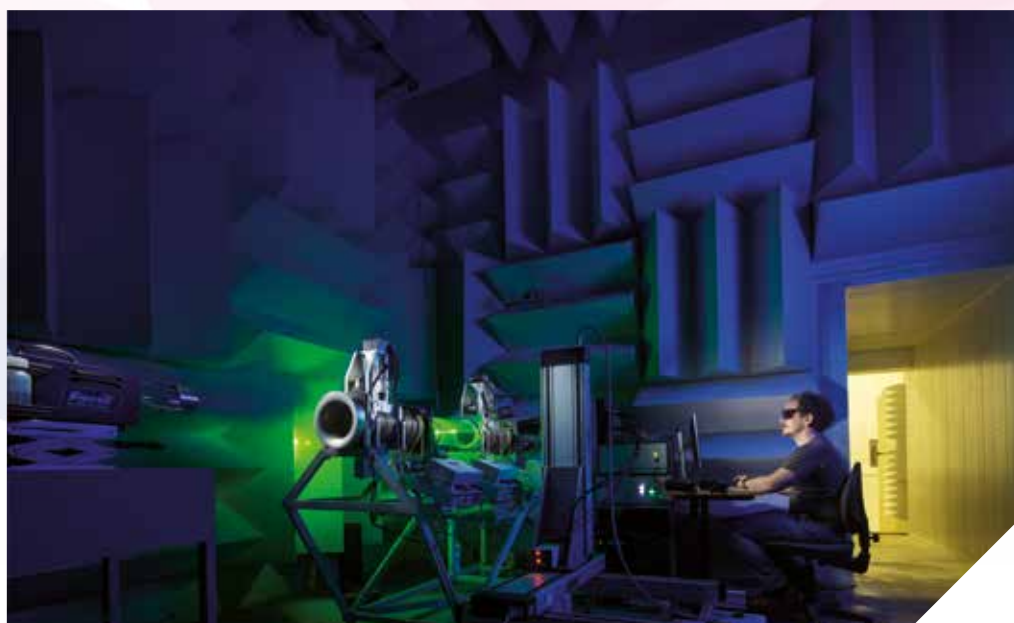
Especially as there are many obstacles to overcome. «One of the main ones is not having a tool for monitoring the insect, i.e., we are unable to say how many there are. Today, the only way we have is to make holes in the ground. However, populations can vary from 1 to 10 from one hole to another that is one metre apart,» concludes Stéphane Brault.

After two years of preparatory classes in Arras, Camille Leblanc was admitted to UTC in the 3rd year of mechanical engineering and continues his studies in the Mechatronics, Actuators, Robotics and Systems (MARS) programme. He will start a thesis in embedded acoustic imaging at Roberval in the fall of 2021.



# Noise abatement, metamaterials' and sound design

Professor at UTC since 2012, **Nicolas Dauchez** is a member of the Acoustics and Vibration team within the Roberval laboratory. He is specialized in the reduction of noise pollution by means of so-called «passive» methods.



**W**hat does it mean in practice? «Depending on the context, we try to reduce nuisance by using absorbent materials that have the property of being porous, such as foams or fibrous materials. In the automotive industry, for example, this involves lining the roof, the floor, the door linings, the dashboard and also everything around the engine block with the appropriate material. In the case of aeronautics, it is a question of using a lining with a dual function: a thermal and acoustic insulation role,» he explains.

The tightening of noise standards is having an impact on a large number of sectors. This has led to a boom in vibro-acoustics, the study of vibrations that generate sound. «We are interested in the vibrations of structures. In the automotive industry, for example, the vibrations of a car body are generated by various sources. In particular, there are aerodynamic vibrations, road vibrations and engine vibrations that can produce sound both inside and outside the vehicle. We will therefore model various situations and try to find ways of limiting the nuisance, using suitable materials, etc.,» explains Nicolas Dauchez. To do this, the vibro-acousticians use two approaches, one dedicated to digital simulation, the other experimental.

What is the role of digital simulation? «We will develop models to explain the observed phenomena. In fact, in our approach, we try to compare measurements with calculations. If the results are conclusive, we deduce that the model is

correct and we will use it to optimize a number of solutions and verify their validity experimentally,» he stresses.

Experimental tools? «The lab is equipped with a large amount of measuring equipment, such as an anechoic chamber, i.e., one that does not cause an echo, in which we can carry out measurements without any noise pollution or acoustic resonance. We also have the opposite. In other words, a reverberation chamber with opposite properties but useful for measuring power or sound insulation. Several acoustic ducts allow us to study silencers and a laser vibrometer allows us to measure structural vibrations without contact. Finally, a laboratory is dedicated to the characterization of acoustic materials,» he explains.

This know-how, combined with a growing need to track down noise pollution in a number of sectors, has led to several partnerships with the industrial world.

The proof? Numerous projects such as Ecobex, with Renault, Saint-Gobain, Vibratex and ESI Group, a company specializing in digital simulation in vibro-acoustics, or Sempae, with Renault, ESI Group and Trèves.

Ecobex's objective, for example? «In Europe, the method of calculating noise has been modified to be more in line with city driving, which includes acceleration episodes, episodes at constant speed,

etc. Stricter standards have been introduced with the aim of ensuring that the noise level of internal combustion vehicles does not exceed that of electric vehicles by 2024. The three sources of car noise are exhaust noise, engine noise and tire contact with the road. The idea was to simulate "passing" noise and to develop innovative acoustic screens by modelling the properties of porous materials, foams or fibres, subjected to the thermos-compression process,» explains Nicolas Dauchez. This project has resulted in the publication of three scientific articles.

A problem that continues with the Sempae project launched in 2020. «This time, the idea is to place the acoustic screens - either insulating or absorbing - directly in contact with the engine to gain in mass. This generates additional constraints, for example the behaviour of the material in relation to the temperature or vibrations of the engine,» he concludes.

Two development prospects for this theme are currently emerging: on one hand, the use of metamaterials structured in such a way as to surpass their original properties, thanks to resonances or their periodicity; on the other, beyond the reduction of noise nuisance, taking into account the user's sound experience, a step towards sound design. ■ **MSD**



NICOLAS DAUCHEZ

©Poppy Images





# Mufflers that absorb noise

Solène Moreau, who has been a lecturer at the UTC since 2011, is a specialist in measurement techniques in acoustics in the presence of flow, in particular in the aeronautical and automotive sectors. She works, in particular, on silencers made of noise-absorbing materials.

**W**hat is the underlying idea? «The idea is to develop new measurement techniques to characterize the propagation of noise with airflow and to study new silencers or aerodynamic phenomena that generate noise. Phenomena that combine acoustics and flow. We know that the predominant sources of noise in aircraft, for example, are engine noise, which can be reduced by silencers, and aerodynamic noise, she explains.

Reducing these noises is a major health issue, especially since the WHO was forced in 2018 to tighten its thresholds for airborne noise, which is considered to be the most harmful to health.

This has stimulated a great deal of research. A thesis has thus enabled the development of a measurement technique for validating acoustic impedance models of silencer/mufflers units.

In concrete terms? «The acoustic impedance of a material is what determines its behaviour. In other words, its capacity to absorb sound. The numerical impedance models developed in the



literature have been validated experimentally on our aero-acoustic bench, which can go up to a Mach number of 0.25, i.e., an air flow speed of about 300 km/h, for classic units or Single Degree of Freedom Systems (SDOF). These are micro-perforated metal plates with a honeycomb structure underneath, which is supported by a rigid base. This configuration absorbs noise like that of an aircraft turbojet engine. Engine noises, in short, that are heard mainly during take-off and landing,» she explains.

However, in planes, for example, it's not only the engines that generate noise. We also have aerodynamic noise. In other words, the noise generated by an airflow on contact with an obstacle. In this case, it's aircraft wings. «A thesis devoted to this problem is currently underway, with two lines of research :

Firstly, to develop a laser measurement technique for airflow acoustics, and secondly to study the noise generated by a flow on an aircraft wing profile. This is generally the noise that is heard when aircraft are high in the sky. At present, we know how to describe the noise generated, but we know less about the generation mechanisms. This is what we are going to try to understand,» concludes Solène Moreau. ■ **MSD**

## CHARACTERIZATION OF POROUS ACOUSTIC MATERIALS

Alexandre Wilkinson did all his studies at UTC. A graduate of the mechanical engineering department (UTC-IM), majoring in Acoustics and Vibrations, he started a doctorate in the UTC-Roberval laboratory in October 2020 after his end-of-studies engineering internship at Renault.

The subject of his thesis? «The objective of this thesis is to characterize porous engine encapsulation materials, such as foams or fibrous materials. This thesis is part of SEMPAE, an industrial project that includes, in addition to the UTC, Renault, the equipment manufacturer Trèves and ESI Group, which specializes in digital simulation,» he explains.

A project dedicated to tracking down noise pollution, particularly in motor vehicles. «The aim of the project is to develop software to simulate the behaviour of porous materials encapsulating a car engine and to calculate the noise radiated or, conversely, attenuated by the use of a particular material. My role in the project is to characterize these different porous materials, find the models adapted to their use and, ultimately, model their behaviour in this software,» he explains.

These materials are not easy to simulate and will be modelled in stages. «I started by comparing the measurements with simulations using the simplest methods, mainly transfer matrices where we assume that we have an infinite plane of foam. Then we will move on to the finite element method, which consists of discretizing a space that may have a more complex geometry, and calculating a quantity at each point (or node) created,» concludes Alexandre Wilkinson.



SOLÈNE MOREAU



# Decors in sound

As a specialist in sound design, Christoph Harbonnier lectures in the UTC Design Department within the Mechanical Engineering department (UTC-IM). For the past fifteen years, he has been managing the Audionaute studio, founded by the contemporary music composer Michel Redolfi.



**A**s a designer and a musician, it is quite natural that Christoph Harbonnier became interested in all aspects of sound. «For me, it is a question of thinking about the timbre of sounds according to the context. Within the framework of the Audionaute studio, for example,

we have carried out sound design operations in public transport, in particular in the tramways of cities such as Brest, Besancon and Nice,» he explains.

His approach to sound design? «The most important thing is to «revisit» the comfort of users, particularly in the sound content. We study the history, culture and architecture of the city closely in order to personalize the sound atmosphere chosen for each operation as best we can. It's an exciting but complex job, where we try to create a specific look for each station, but also to adapt the sound of the messages, for example, depending on whether it's during the day, generally noisier, or in the evening, when it's a question of calming the passengers. A sound package that must 'speak' to users by combining function, comfort and pleasure,» he says.

This approach sometimes leads them to intervene upstream in the choice of audio equipment,

for example.» The basic equipment of trams, whether they are made by Bombardier, Alstom or the Spanish company CAF, is catastrophic in terms of acoustics and deemed "unworthy" of the comfort of users. We have therefore systematically replaced the basic loudspeakers with a system of small loudspeakers that we developed with Audax, a French loudspeaker manufacturer,» stresses Christoph Harbonnier.

This know-how is of interest to all the big names in the sector in France: Keolis, Véolia and Transdev. He also tries to pass on this know-how to students as part of the UTC Acoustic Design course. This is a first for a university of technology. «It's a joint course for AVI and IDI students that links the acoustics and industrial vibrations department, which uses measurement tools to analyse the physical characteristics of sound, and the design department, where we design, imagine and create sounds,» he concludes. ■ MSD

# From noise to sound

Pierre-Henri Dejean, an architect, urban planner and ergonomist, joined the UTC in 1984. He is responsible for the Industrial Design Engineering (IDI) programme.

**H**is first feeling about sounds? «At the time, I could say that my 'encounter' with sound was negative because, as an architect as well as an ergonomist, sound, in the industrial sector, is associated with noise - machine noise, for example. Since then, industry has moved on, driven by standards and regulations,» he says.

However, by working in the product area, he changes the way he looks at noise to sound. «I had indeed already evolved a lot by moving from the world of working conditions in industry to the product field. When I arrived at UTC, I integrated the 'design' course and I naturally tried to interest the Acoustics and Vibration course in the problematic of the product, a field that requires thinking about the user,» he underlines.

How can we move from noise to sound when we know the health and environmental nuisances caused by the former and the operational interest of the latter? «I would say that sound is inherent to human activity. Wasn't the first designer the one who created the first flint-stone tool? The sounds in our environment constitute a very strong information system. A stormy sea, for example,

*Sound is inherent in human activity. Wasn't the first designer the one who created the first flint-stone tool?*

does not emit the same sounds as a calm sea,» he maintains.

The role of acousticians for the ergonomist and/or sound designer? «With acousticians and in particular their measuring devices and recording systems, we will try as ergonomists and then as designers to distinguish useful sounds from those that are useless,» explains Pierre-Henri Dejean.

In concrete terms? «We're going to eliminate non-useful sounds, which are considered to be noise, for two reasons. The first is that they serve no purpose and the second is that they can interfere with really useful sounds. Then we isolate the useful sounds and try to see what the human being retains, whether he is aware of it, etc. We talk about acoustic intelligence, which, in the case of the human being, is the most important thing. We talk about acoustic



intelligence, which is often a reflex. If you close a door, for example, you know, just by the sound it makes, whether it is closed or not. In a car, for example, we know from the sound alone that something is wrong with the engine. Finally, the designer's objective is to go further: to arrive at the pleasure sound configured to be both useful and pleasant,» he concludes. ■ MSD





# Master's degree in safe and sustainable technology-intensive systems

Jérôme Favergeon was appointed Director of the UTC-Roberval laboratory in 2015 and is also director of an 'Initiative' devoted to a Master's degree in safe and sustainable technology-intensive systems as part of the 'Institutes and Initiatives' programme launched in 2019 by the Sorbonne University alliance.

**T**he SU Alliance brings together the assets and talents of ten institutions, including UTC, the Muséum national d'histoire naturelle and INSEAD and covers all the disciplines of literature, medicine, science and engineering, technology and management. The idea behind this programme is that «given that the so-called "Labexes" (government certified "excellent laboratories"), including the UTC's Master's degree in Technological Systems (MS2T), are due to disappear, the Alliance has decided to set up another framework in order to promote multidisciplinary research around structuring initiatives. Our Labex will end in 2022, so we have decided, motivated by the experience we have accumulated over the last ten years, to propose the 'a Master's degree in Safe and Sustainable Technology-intensive Systems',» he emphasises.

The funding for this programme comes from an annual grant via the Alliance's Idex SUPER funds, which can be used to finance

theses, post-docs, Master's degrees and even be used to invite foreign researchers,» he explains. What is the key word of 'Institutes and Initiatives'? «It is multidisciplinary. The Institutes were created around themes or research objects for which the Alliance was already internationally recognized, with the aim of federating the forces present, bringing disciplines closer together and achieving a certain critical mass. The Initiatives concern emerging themes on which there is little history and not necessarily a defined scientific community. They are therefore younger in terms of maturity. Thus, in the framework of the initiative that I lead, I have not predefined a precise perimeter of actors who will be working on the subject. It is "open", in the sense that any researcher of the Alliance can take part in the research work carried out within this Initiative supported by UTC, as long as he carries a technological research project answering the challenges of the Initiative', explains Jérôme Favergeon.

Pluridisciplinarity is not always easy to implement. «It is difficult to get researchers from different backgrounds to work together. Indeed, researchers are judged on their discipline, assessed in relation to their specialty discipline; they know how to be recognized in that area. Asking a researcher to work in an interdisciplinary way is, unfortunately, not such a natural approach. Especially as this is not the way careers are built. It is therefore a real challenge to succeed in blending disciplines together around common projects while ensuring that each specialty is involved. For our part, we try to associate at least two laboratories or even two institutions in our projects,' he says.

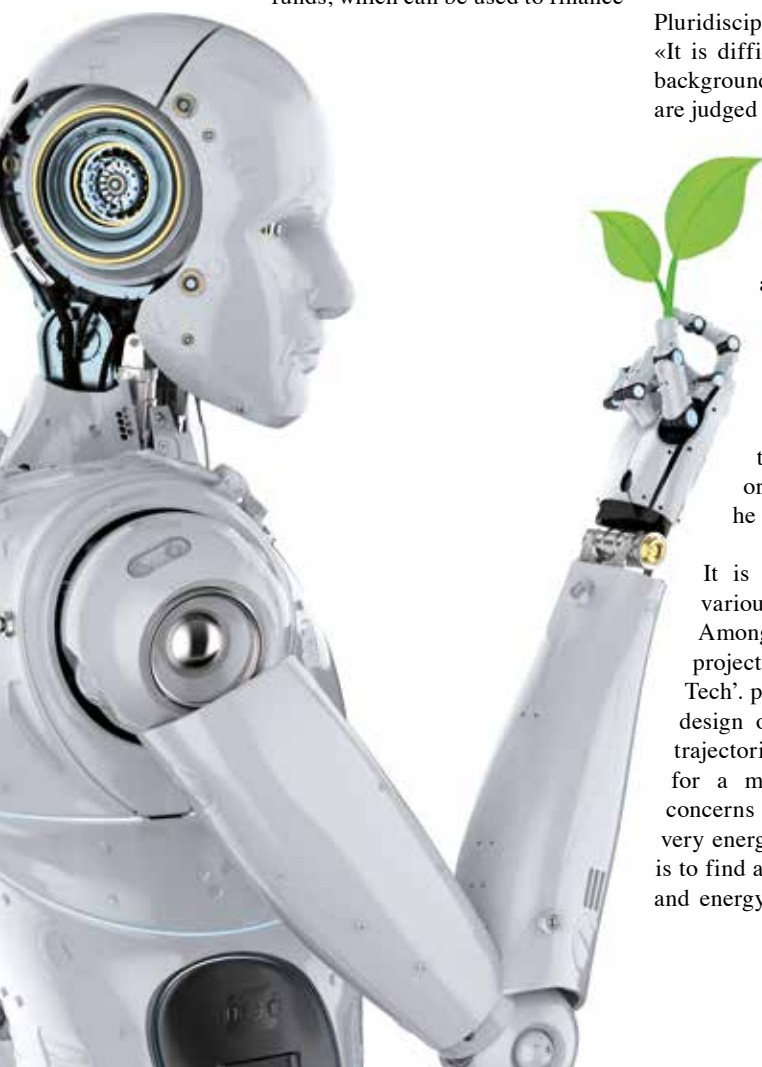
It is an initiative that has given rise to various theses and post-doctoral projects. Among the themes addressed by these projects? «One of them focuses on 'Low-Tech', principles that advocate reorienting the design of digital technologies on innovation trajectories that take into account aspirations for a more sustainable world. The second concerns network security, which is based on very energy-intensive algorithms. Here, the idea is to find a consensus between the level of safety and energy consumption. In a word: combining

*It is "open", in the sense that any researcher of the Alliance can take part in the research work carried out within this Initiative supported by UTC, as long as he carries a technological research project answering the challenges of the Initiative.*



JÉRÔME FAVERGEON

security and sustainability. As for the most recent ones, they respectively concern the depollution of soils through the use of particular fungi - a natural depollution in short - and the design of antibiotics. As for post-doc work, this concerns the following projects: finding a solution to the failure of current face-masks by increasing the efficiency of the filter through an appropriate choice of composition, size and structuring of the fibres making it up; developing perception systems for autonomous vehicles that can reliably detect nearby "vulnerable" obstacles; and finally, the last one proposes to draw inspiration from the strategies of intestinal parasites to eventually create new autonomous mechatronic medical devices, capable of being attached in the intestines and delivering a regular dose of medicine there,' concludes Jérôme Favergeon. ■ MSD





# Heading for Africa

Jean-Pierre Caliste has been a lecturer and research scientist in mechanical engineering at UTC since 2001. He was the co-initiator of the **Master's degree in Quality and Performance of Organisations (QPO)**. He became an emeritus professor in 2013. This has allowed him to devote himself to training, particularly in Africa.

**A**t UTC, he was also responsible for the specialised Master in Standards, Quality, Certification and Testing (NQCE). «As early as 2005, I set up two options: a traditional face-to-face training course and a remote-learning course, the latter operating in hybrid mode, every five or six weeks, with group meetings,» he explains.

His transition to emeritus status: «Freed as I was from teaching duties, I was able to devote more time to research, in particular in the field of project management and quality, to accompanying professional theses, but also to the development of training courses or the setting up of new ones,» he says.

But it was well before his rise to emeritus level that Jean-Pierre Caliste became interested in international cooperation in the field of training, in particular with African countries. What triggered this? «We noticed that many students, especially from West Africa, were interested in this specialized Master's programme but were not coming to France for family or financial reasons. As a result, the introduction of the remote learning option in 2005 was a great opportunity to open up to Africa. Students from most West African countries were thus able to follow the master's programme at a distance and, for many, to complete their professional thesis on local issues. In this logic, in 2017, an agreement was signed between UTC and the University of Abomey Calavi in Benin so that regular face-to-face

*The immediate objective is no longer student exchange but development aid. In short: to develop the country's higher education systems by improving them and even developing pedagogical innovations.*

meetings could be held there, further reducing the costs for students coming in from neighbouring countries,» he emphasizes.

This international experience did not go unnoticed, in particular with the Centre International d'Etudes Pédagogiques (CIEP), renamed France Education International in 2019. Jean-Pierre Caliste was thus involved in several Tempus projects. «In this framework, I was able to contribute to the development of cooperation with Eastern European countries, in particular Russia, and also more significantly with the Maghreb countries,» he says.

But the call of Africa is the strongest. And this is fortunate, since in 2016, UTC was invited by the CIEP to set up a Master's degree in Industrial Engineering as part of a bilateral cooperation agreement between France and Angola at the intuitive and supervised by the French Embassy in Angola. «Here, the immediate objective is no longer the exchange of students but development aid. In short, it is a matter of setting up an Angolan «master's degree» at the Agostinho Neto University in Luanda, the country's main university. In a word: to develop the country's higher education systems by improving them and even developing pedagogical innovations,» he explains.



JEAN-PIERRE CALISTE

The Angolan HE project is financed by the French Ministry of Foreign Affairs as part of the support fund for innovative projects (FSPI) and Jean-Pierre Caliste decided to innovate. «Very quickly, I decided to set up tandem pairs of Angolan and French professors for all the courses in the Master's programme. These pairs were called upon to immerse themselves fully in both systems: the French professors going to Angola and the Angolan professors coming to France to see how each CC worked, to understand our teaching methods, project-based teaching, etc.,» he explains.

What happened next? «The file was put together and submitted for accreditation in November 2016 to the Angolan Ministry of Higher Education, which gave the "go ahead" light in April 2017. From there, Angolan colleagues launched the registration process for the start of the Master 1 year. We selected 36 students and 30 graduated in 2019. The agreement now renewed, we are starting the second class of the Master's degree in 2021/2022. The experience has been deemed positive and, consequently, a second Master's degree is on the way,» he concludes. ■ MSD



## UNDERGRAD. PORTRAITS

# The economist UTC engineer

Discovering and becoming your real self, honing your new-found potential, revealing yourself as a future professional; these are the leitmotifs of Compiègne University of Technology when it comes to defining the path of its students. With five specialties and twenty or so courses, students are “spoilt” when it comes to building their professional project. But some decide to venture down more winding paths and find their own way. **This is the case of Matthieu Bordenave, 24 years old, freshly graduated from UTC and on his way to a career as an economist.**



**M**atthew's journey is like walking along a profile that seems traditional at first sight. He was first an excellent lycée student in his final science stream year and with his baccalaureate S in hand, Matthieu ventured into the first year of a scientific preparatory class. A course that did not suit him and he decided to leave after one year. He then went through the DUT before gaining admission to UTC's third year «Of course I knew of UTC by reputation and I wanted to get into a training curriculum which mixes sciences and humanities.

So here he was, propelled at the dawn of autumn 2018 at UTC into UTC's Mechanical Engineering major branch. Of his three years spent in the lecture halls of the engineering school, the young man has excellent souvenirs: «Following an engineering course allowed me to structure my thinking and to acquire practical skills in programming for example, he confides. It is also an intense multidisciplinary background with mechatronics, hydraulics, etc.»

But one meeting will definitively transform the destiny of the student-engineer, that of David Flacher, lecturer – doctoral supervisor – at the University of Paris 13, director of the research centre in Economics of Paris Nord and lecturer at UTC. I took a fascinating introductory course in economics and immediately the themes he was talking about spoke to me,» says the young man. I went to see him at the end of the course to ask him questions and to nourish my train of thought. Very quickly, an intellectual complicity was established between the student and his teacher; Mathieu was nourished by the recommendations of readings and conferences provided by his teacher, and the latter saw this student eager for knowledge kindly. And something obvious emerged in Matthieu's mind: «I loved the courses I was taking as part

of my engineering course, but I was passionate about economics,» he says. So for two years, while continuing his engineering course, the student enrolled at the CNAM to take economics classes by correspondence. This was enough to obtain 24 additional ECTS credits (CCs). This was a good complement to his engineering course and a solid passport to further studies in the field. After negotiations, he obtained an internship as a junior economist at the French Development Agency (AFD). This is a dream for any aspiring economist. «The approach to economics that I have is to rethink traditional models in the light of the climate and ecological transitions that we are going to undergo. AFD was an ideal playground to be able to advance in this sector. In February 2021, he will join a department set up by Gaël Giraud, a renowned economist whose work has been unanimously acclaimed. The objective of his missions?

«To create a new economic model integrating climate and biodiversity loss into its analyses. The beginnings were complicated for the student-engineer. Long accustomed to physics problems and the arsenal of formulas to answer them, he found himself having to move through the economic literature in an attempt to develop the right formula to analyse the impacts of transitions in the economic world. It is a commitment that is above all personal. «Like many young people of my time, I wonder about the period we are living through and the impact it will have on individuals and the planet. With the support of the AFD, Matthieu Bordenave finally developed a model combining two studies: one theorised by Gaël Giraud himself and presenting the impact

of temperature rises on the economy, the other found in the scientific literature and putting the economic impact of agroforestry into perspective. From his analysis it emerges, with calculations to back it up, that a halt to deforestation by 2050 and reforestation by 2100 could have substantial impacts on mitigating climate change. That is the broad outline. The details of his work are being written up in the privacy of his student room, and he plans to submit them to scientific journals in the coming weeks. «When I presented my research in my department, my tutor told me that if I worked even harder on formalizing my research process, I could expect a proper publication. This is a dream for anyone who plans to become a lecturer-researcher in economics.

## The first UTC student admitted to the prestigious Erasmus Mundus Master's degree

But before that, another dream came true in September: when he was admitted to follow EPOG, a prestigious Erasmus Mundus master's programme, a collaboration between a dozen institutions and universities around the world, supported by the European Union. «The Economic Policies for the Global transition master's degree offers the best students from Europe and from the world the opportunity to study and work in the field of economics and transition policies.



This two-year course, accessible in various European universities – including UTC – allows its students to explore the impact of digital, social and ecological transitions with economics overarching. Around 50 hand-picked students are selected each year to join the Master's programme. I am the first student from UTC to follow this programme,» says Matthieu. «It is a real pride for me because it allows me to go even further in my work in economics and to really consider launching a research career». The icing on the cake is that the student was part of the small cohort selected for a merit-based scholarship. «There were five of us in the entire class who obtained it, and it was an important signal to show my parents that even though I was an engineer, this new world of economics was open to me. For the future, Matthieu therefore plans to work in the world of research and teaching, with a strong emphasis on the world's current ecological situation. There is still a long way to go for the young man who could, why not, lecture on economics at UTC in the future... (inter alia). ■ GO



## EVENT

# And suddenly... the Pierrefonds Château lit up

**23** April 2021 turned out to be a busy day at the Château de Pierrefonds on. On site, a hundred or so students carrying heavy trunks, unrolling kilometres of cable and positioning lights. That very evening, the castle was to be the scene of the Compiègne en Lumière event. Founded in 2018, the Light-Up-City association produces an annual cultural event combining illuminations in the city, a stroll and a concert.

But in February 2020, almost everything went wrong. The whole organization of the event fell through. The reason? The early stages of the

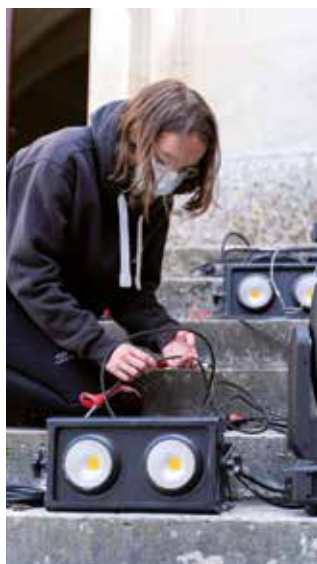
Covid-19 pandemic crisis that had turned the North of France into one giant cluster. One year later, the event took its revenge as the first to be reintroduced in the cultural universe. This year, therefore, the event was “dematerialized” with a live transmission via Facebook®, but it has not lost its ambition. A stage was set up at the entrance of the castle, several hundred spotlights were scattered throughout the estate and the singer Mat Bastard from the group Skip-The-Use offered a DJ set in real time. It seemed important to me to organize an event that would give young people hope,» explains Nacim, who initiated the project. It was a question of taking revenge as young people, especially for those who have just entered higher

education, who feel alone and who need to dream. Since last winter, the young man has been working behind the scenes to bring together partners around this somewhat crazy project to illuminate this focal place of culture. The world of culture has only one idea in mind, and that is to do its job, with young people,» adds Xavier Bailly, administrator-curator of the Pierrefonds Château. “We are always delighted to organize events with young people”.

The result is amazing, and is a powerful representation of the organizational and innovative skills of the students at the University of Technology in Compiègne. ■ GO

## Photos of the event ...

Credits go to the two photographers of the UTC Association Pics'Art from the UTC, Thomas Lerner and Maya.







AÉRONAUTICS / ENVIRONMENT

# The success-story of composite materials

Zoheir Aboura's team, fully aware of the environmental impact that aeronautics has on the planet, **develops and maintains partnerships with numerous industrialists such as Safran**, to meet the technological challenges of the aeronautics, space and defence sectors. Composite materials are popular.

**Z**oheir Aboura is a university professor. He heads the Materials and Surfaces research team in the UTC-Roberval laboratory (Mechanical Engineering, Acoustics and Materials). His work is based, among other things, on the development of knowledge on the mechanical behaviour of composite materials. Professor Aboura's team develops and maintains partnerships with many industrialists interested in the results of his research, particularly in the development of original investigation techniques for the detection, monitoring and understanding of damage mechanisms, which are very complex in the case of composite materials, particularly with 3D reinforcement architectures. In particular, the Safran industrial group has been seeking answers to the technological challenges brought up by the requirements of aeronautics, space and defence. «The development of new materials in the aeronautical sector is based on strong climatic challenges. Organic or ceramic composite materials have very high specific properties (ratio between intrinsic property and density) and are therefore becoming very competitive. They make it possible to lighten structures. This is the key word in aeronautics. This opens the way to energy savings and consequently to a reduction in the impact on the environment,» explains Zoheir Aboura.

## Intelligent materials

Current research work is geared towards the development of materials for the aeronautics, space and automotive industries that are both 'intelligent' and 'communicating', enabling them to monitor their state of health continuously. This means that it is possible to reduce safety coefficients (dimensioning to the minimum) and therefore potentially less weight and therefore less fuel, less pollution, but also more safety. The success story of these new materials is based on performance gains and reductions: reduction of polluting gas emissions, reduction of debris, noise, reduction of engine masses and increased efficiency. «The stakes are enormous. At the UTC-Roberval laboratory, a

team of six researchers, three PhD students and three post-docs are working on these subjects. Environmental protection is important. We have been contributing to this for a long time by trying to make the structures lighter. When I started, I was already focussed on these issues. Now we are even more alert. Collaborating with industrialists who are concerned about this is also very important for us, as it enables us to apply the products of our research,» insists Zoheir Aboura.

## Engineers in action

Safran achieved a real technological breakthrough when it introduced 3D-reinforced composite materials into its engines, under the impetus of Bruno Dambrine, a senior expert at Safran. Thus, under his leadership, the first work began in 1995-1996, in search of candidate materials for the production of fan blades to replace titanium. UTC was involved very early on in the initial research to support the industrialist Safran. A decade later and several hundred thousand hours of research, tests and calculations, the LEAP engine was certified (2016). It was the development of 3D woven reinforcement composites obtained by RTM (Resin Transfer Moulding) injection that enabled the creation of a new generation of blades and fan cowling in the LEAP engine. This has truly revolutionary engine design.

Lighter and stronger than the metals and alloys they replace, composite materials represent a major area of progress for the aeronautics industry. They are one of the major innovations of the new LEAP engine, selected by Airbus to power its A320neo, by Boeing for its 737-MAX, and by COMAC for its C-919. The LEAP engine has reduced its weight by 450 kg, is less polluting (16% reduction in CO<sub>2</sub> emissions and 50% reduction in NO<sub>x</sub>) and allows a 15 dB reduction in noise levels. Ongoing research into new generations of materials (such as ceramic matrix composites for very high temperature applications) and their introduction into engines offers the prospect of additional weight savings and efficiency. «There is still a lot of work for our engineers and doctors in these areas. Developing new materials, understanding their behaviour, developing robust models, integrating them into the computational codes for the most accurate dimensioning (reduction of safety factors, also known as 'ignorance factors', he concludes.

These are all levers that will help reduce our impact on the environment. We train our engineers and doctors with this in mind. They will be major players in companies in the future and will therefore have a key role to play in reducing our environmental footprint. Global warming affects us all and is therefore becoming everyone's business. ■ KD



ZOHEIR ABOURA

*Current research work is focused on the development of materials for the aeronautics, space and automotive industries that are both 'intelligent' and 'communicating', enabling them to monitor their "health-integrity" status on a continuous basis.*



BERTRAND PICCARD

## A new look at **Bertrand Piccard** a spirited high-flying pioneer and self-styled “SAVANTURIER”\*

At the beginning of October, UTC had the privilege and pleasure to welcome the ‘scientist-adventurer’ Bertrand Piccard to the Maison de la Culture in Amiens. He gave a lecture on the theme: «When pioneering spirits invent the future» against the background of his experience with Solar Impulse. A look back at the amount of creativity and improvisation it takes to achieve the impossible sometimes.

### **S**olar Impulse was not designed nor built to carry passengers but to carry a message.

We want to demonstrate the importance of the pioneering spirit, encouraging people to question their certainties. Our world needs new solutions to improve the quality of life for humanity. Clean technologies and renewable energies are part of this,» Bertrand Piccard reminds us from the outset during the conference he held in Amiens at the invitation of UTC. In 2016, Bertrand Piccard and André Borschberg accomplished the feat of flying around the world without fuel, using only the energy of the Sun, aboard the solar plane Solar Impulse 2. A human and technological epic, capable of inspiring the environmental policies and society of tomorrow. Its strength: creative innovation at the service of a vision. The combined strengths of more than fifty employees, supported by a hundred experts and advisors, have made it possible to push back the limits and achieve impressive technological progress. Numerous anecdotes in this adventure also remind us of the

extent to which adaptability and improvisation were also required in what was so well-prepared. «For example, the Solar Impulse 2 solar plane had to be sheltered in a specially designed hangar in Nagoya, in central Japan, during the journey. We had to make a stopover there while waiting for good weather. We had to improvise and our team had a difficult time.

### **Ambition and humility**

In this cutting-edge and futuristic project, empiricism is not the order of the day. Each concept, each part of the solar aircraft must pass several tests to be certified “certified ready to fly”. «I have set up a whole mechanism for innovation through creativity. For me, innovation is also based on psychological notions. It means getting into a state of mind. It’s about looking for something other than what you know. It requires a lot of honesty, humility and ambition,» says the Swiss ‘scientist’ who is also a psychiatrist. He immediately accepted the invitation of UTC, because ‘it is a technical

university and it is very important to recall the creative, innovative and ecological role that technology must advocate’. For him, to innovate is to break with the status quo, with what we have always done and always thought. Artistic creativity and technological innovation ultimately use the same process. «We try to break the paradigms to break away and try to find other things. The artist, like the explorer, like the innovator, are people who are not satisfied with what they have. They want something else, something different and better. The aviation industry is now caught in a straitjacket. If you are bigger according to them, you are heavier. However, with Solar Impulse, despite its size, we have managed to make it light. In fact, it was the naval industry that managed to build this plane, because the aeronautics industry thought it was impossible. ■ KD

\* Play on “savant” and “adventurer”







EVENT

# From artistic improvisation to technological innovation

On Friday October 1, 2021, a conference/debate entitled «From artistic improvisation to technological innovation» was organized at the Maison de la Culture in Amiens, organised by UTC in the presence of the «scientist-adventurer» Bertrand Piccard and an audience of nearly five hundred people.

**UTC, in partnership with the Hauts-de-France region, organized at the Maison de la Culture in Amiens, a new and original event on the theme of artistic improvisation, as a source of inspiration for technological innovation.** This exceptional evening was organized with the support of Greater Amiens area, the CCI Amiens-Picardie, the CPME 80, HDFID, I-Trans, the Altytud cluster, the ESAD and ESIEE/UniLaSalle. In the first session of the evening, the public was able to attend improvisational performances by artists from different worlds. There was jazz with the trios of Boris Pelosof and François Thuillier, theatre with Mayel Elhajaoui, actor of the series *Demain nous appartient* (TF1), a 'beatbox' with Antoine Pinchaud, 2015 French Beatbox champion and Adrien Contesse, creator of Vocal Grammetics, but also a «breakdance» performance with Kamil Bousselham. The dancer will perform in the Paris 2024 Olympic Games. The target audience for this event was made up of industrialists and companies from the region, institutions and representatives from the world of culture, research and higher education and students.

## From orchestra conductor to becoming an innovative project leader

In the second half of the evening, the audience in the large theatre of the Maison de la Culture in Amiens was able to listen to and discuss with the Swiss «scientist-adventurer» Bertrand Piccard, during a conference on the theme: «The pioneering spirit for inventing the future» against the background of his experience with the Solar Impulse. This event represents a particular and specific activity of a research project born, at the end of the 1990s, from a metaphor commonly used in the field of innovation projects, that of a conductor. The «innovative» project leader is presented as a conductor who mobilizes the skills of a musical group, following an established score. «This metaphor and connection makes sense when talking about incremental innovation. When we approach the field of disruptive innovation, as we like to say at the moment, the metaphor of the conductor is no longer appropriate. I therefore

considered using another musical practice, that of jazz improvisation», explains Pascal Alberti, teacher-researcher at the Costech/UTC laboratory.

## How is jazz improvisation relevant?

Taking an interest in jazz improvisation is in itself an innovation. Nevertheless, a literature review showed that links between jazz improvisation and certain economic activities had already been envisaged in a fairly classic research format. «Moving off the beaten track – which, be it said, is in UTC's DNA - we envisaged different formats of action, including events like the one we experienced at the MCA. We previously organized a meeting of this type at the SACEM's grand auditorium, then at the Sainte-Corneille cloister in Compiègne,» continues Pascal Alberti, for whom the musical field is indeed very interesting when it comes to innovation. The parallel that can be drawn between

the training of a musician and that of an engineer is therefore entirely relevant. «Our engineering students also acquire knowledge in the heart of structured and structuring Cartesian bodies of knowledge. We can see that classical

musicians, even those who are virtuosos in their musical practice, do not have the appetite and agility to improvise, just as certain engineers who are experts in their field do not have

*We have opted for a pragmatic approach with musicians, dancers, actors, sportsmen and women and industrialists who implement improvisation and innovation in the field.*

the capacity to make disruptive innovations. On the other hand, other musicians, particularly jazz musicians, who have also been through the mill of music theory and the conservatory, improvise, just as some engineers who have been through higher education are capable of innovation.

## Soft skills more in demand than ever

This research also leads to a questioning of the processes of knowledge acquisition and the 'soft skills' of these people and the work envisaged around people's individual skills. We all know that, as we are reminded, for example, at each major sporting event - the 1998 or 2018 football World Cup, the 2021 Olympic Games with handball or volleyball - a team is more than the sum of the individuals, more than the sum of the parts,» concludes Pascal Alberti. What we are working on is this extra value in addition to the basic sum. We have opted for a pragmatic approach with musicians, dancers, actors, sportsmen and women, and industrialists who implement improvisation and innovation in the field. Because, let's remember, our objective is to create tools and methods to help innovation aimed at creating socio-economic value in the region. ■ KD



## 3 HIGHLY APPRECIATED MASTERCLASSES

During the afternoon session, UTC invited a number of company CEOs and managers and about forty UTC students to participate in different masterclasses. There was theatre with the actor Mayel Elhajaoui, beatbox with Antoine Pinchaud, 2015 French Beatbox champion and Adrien Contesse, creator of Vocal Grammetics, but also a «breakdance» masterclass with Kamil Bousselham.

Each in their own field led the experience for more than two hours around artistic improvisation. «I really liked the beatbox masterclass. It was a real change of scenery that pushed me to my limits. The members of Vocal Grammetics inspired me a lot. I find it a perfect tool for my team building operations to stimulate cooperation in a fun-seeking spirit,» says Christine Debureaux, President of Expert RH in Amiens. The evening that followed was equally high quality, dynamic and really original".





# Creativity and aeronautics

**Jean-François Georges is Honorary President of the Aéro-Club de France.** This civil aeronautical engineer, a former Dassault test-pilot, an expert in the fields of safety, is also the author of the book *Blues dans les nuages* published this year. Amongst his passions, jazz is in a good place. His view on creativity and creative improvisation is more than relevant.



*This notion of improvising together in the business world seems essential to me. It is ambitious. It doesn't mean doing anything. It's one of the most powerful ways of generating creativity.*

**J**ean-François Georges is a graduate engineer from 'Supaero' (ENSAE-SUPRAERO)). He began his career at Dassault as a flight test engineer. He then joined the technical department and took part in the Mercure, Mirage 2000, Hermès and Rafale programmes, among others, and became a recognised specialist in safety and flight control problems. He was General Manager of Civil Aircraft until his retirement in 2003, he then chaired the Aéro-Club de France for eight years. He is also an author. «I inherited three rather pervasive passions from my parents, but I have tried to satisfy them throughout my life. There are planes, mountains and music. I was lucky enough to be able to make one of them my profession, which made things easier,» he says. For him too, the aircraft of tomorrow will have to take into account the current concerns of experts in the field: budgetary constraints, fuel economy, noise pollution... and at the same time satisfy what remains a fundamental component of travel: speed. What will the aircraft of the future look like? It will probably adopt new shapes, for example very large flying wings...? Will there still be a pilot in the plane? Will the sky be inhabited by science fiction machines?

## An artistic vision of creativity

«Can you imagine that we can have within engineering schools, like UTC, a training which arouses the students' capacity for innovation, their creativity? In the company, saying to a small team: «Go ahead, let yourself go», means: «Improvise, follow your inspiration with what you

know to try to invent something. «If you leave it to the basic engineers that the schools train, for example, and I was one of them, you end up with this extraordinary fact that everything is always the same. You only have to look at the car industry, which has a certain monotony in its engineering. The vehicles all look the same. Remember when the R16 and DS19 came out in the French industry. No two rolling objects are so different. At that time there were fewer protocols and more calls for creativity. According to Jean-François Georges, the flaw in the current industry is that it lacks creative daring. This is why the idea of UTC to work on this field of creative improvisation resonates with him. «Look at the airliners. Unless you're really in the business, it's hard to tell them apart. Not to mention the Chinese and the Russians who arrive with exactly the same planes. It would be good to add a bit of improvisation in there too, yes. You have to let people improvise. Certainly give them a framework and tell them to go ahead!

## «Improvisation is first of all culture, an education»

For the former pilot, the crash-landing by pilot Chesley «Sully» Sullenberger, in 2009, on the icy waters of the Hudson River, thus saving the lives of the 155 passengers on board, is a magnificent exercise in improvisation. An airline pilot may have to improvise when everything is perfectly in order with checklists and procedures. But not everything goes according to plan. «Frankly, when both engines stop just after take-off from La Guardia, you have to have the idea of landing on the Hudson anyway.

Improvisation is first of all culture, an education. In my humble opinion, the greatest improvisation in the history of aerospace is epitomized in Apollo 13. You can't imagine anything worse. With the scale of this incident, they must surely die. NSA brought them back alive thanks to a huge amount of rapid improvisation», illustrates Jean-François Georges. Talking about improvisation in the industry is scary at first, in a world used to processes, protocols and other methods. «However, when we explain to non-musicians what real improvisation is, namely something very well defined, strict and particularly demanding, especially in jazz music, that it is something that enriches creation rather than a slacker, industrialists can understand this and take it on board.

## What about collective improvisation?

A business company's capitalised knowledge is an ideal breeding ground to stimulate creativity. And this is the case in a great many activities, notably aeronautics and space. «This notion of improvising together in the business world seems essential to me. It is ambitious. It doesn't mean doing anything. It's one of the most powerful ways of generating creativity». Business leaders can understand this today. It means knowing a whole range of techniques. I watch myself as a musician improvising. Given my age, I have accumulated a lot of musical models, conscious and unconscious harmonic transitions. I'm just bringing out things I've heard and assimilated. It's not a spontaneous, ex nihilo creation, but a proposal that goes looking everywhere in your cortex for things acquired in the past, concludes the author. It's a recreation, a regurgitation! ■ KD



**Blues dans les nuages**  
Aviator, mountaineer, musician

by Jean-François Georges  
208 pages  
Éditions Feuillage



PROTECTING THE ENVIRONMENT

# Safran tackles Climate Change

Any sector that does not fully understand the challenges of tomorrow cannot remain in the lead, especially when it is so international. Interview with Valérie Guénon, Safran's director of product environmental policy, on the issue of climate change. She has been with this Group for 33 years and holds a Master of Applied Sciences degree from the University of Delaware (USA). And environmental protection is at the heart of her missions.

## What precisely are your missions?

**W**I represent my company in organizations and institutions that set policies and regulations for aviation and the environment. The environmental footprint of an aircraft covers the greenhouse effect (mainly through CO<sub>2</sub> emissions), air quality (polluting emissions) and noise. I have in-house Safran engineers working in this area. I have spent part of my career bridging the gap between policy and regulation on one hand and science and technology on the other. I also spend an increasing amount of my time on training and internal and external information on these subjects.

*For over thirty years now the sector has identified the environment as an additional priority and we are working to reduce noise, pollutant emissions and CO<sub>2</sub> emissions.*

## What is your environment-related strategy?

Decarbonising aviation is a priority for the Safran group and for aviation in general. It was a priority before Covid-19, and it is just as much a priority now, if not more so. We are contributing to the global and European aviation roadmaps, which include many levers: more fuel-efficient aircraft, the use of sustainable fuels, electric and hydrogen technologies, operational and air traffic management measures, decarbonisation of airport and manufacturer ground operations, etc. As an engine and equipment manufacturer, we will contribute through future ultra-efficient engines, electrification and the use of hydrogen and sustainable fuels. We are also contributing as an equipment manufacturer by making equipment lighter and more electric (landing gear, aircraft seats and interiors, nacelles, etc.).

## Has the group for which you work on a daily basis fully grasped the challenges of tomorrow?

Aeronautics has always been a cutting-edge sector, an area where we have to be irreproachable. It started with safety, then performance. We have divided CO<sub>2</sub> emissions per passenger and per

kilometre by a factor of five over fifty years by reducing aircraft consumption. For more than 30 years the industry has identified the environment as a priority on top of these and we are working to reduce noise, pollutant emissions and CO<sub>2</sub> emissions. In 2008, the aviation sector was one of the first to make collective commitments to reduce its carbon footprint by 2050. Safran has developed itself remarkably over the past decades and is now tackling the climate challenge, despite the unprecedented crisis we are experiencing.

## Is environmental protection one of your professional concerns?

They are at the heart of my professional activity. I took this job three years ago because I was convinced that it is the main issue for my company and because it lends sense and meaning to my work. The issue of climate change brings together science, politics, economics, society and even philosophy. This subject needs interdisciplinarity, cooperation and a sense of community. It's quite a challenge for the human race. It is exciting.



## What posture do UTC students need to grasp in order to succeed in Safran's industrial sector?

Knowing that Safran devotes 80% of its research and technology investments to reducing the environmental footprint of aircraft, there is a strong probability that, when you work for Safran, you will contribute to this objective. There are many skills in demand. Materials and processes, aerodynamics, mechanics, electricity and electronics, systems engineering, etc. Behavioural skills are very important. We need engineers who are open-minded, who know how to listen, who dare to innovate, who are motivated to win as team-members, and who are at ease with interpersonal and international relations. The variety of profiles is a richness and, I will never say it enough, women are not yet numerous enough in our professions. UTC cultivates adaptability and openness, notably through international experiences and teaching which is not only scientific and technical. ■ **KD**





## DESIGN

# UTC on the podium of the 2021 James Dyson Award for the 8th time in 9 years

Jeanne Raynaud and Corentin Vercoor are the national finalists of the Dyson Award 2021 with their project Slive. Another great award for the UTC and its Design department.

**J**eanne Raynaud and Corentin Vercoor are UTC undergraduate students of the Industrial Design Engineering (IDI) of the UTC Major in Mechanical Engineering. At the end of August, they reached the second step of the podium of the prestigious James Dyson Award competition organized by the Dyson Foundation. This result opens the doors to the international competition for these two laureates. Supervised by Emmanuel Corbasson, a lecturer-cum-research scientist working in the IDI programme at UTC, Jeanne and Corentin focused on the problem of nosocomial contamination. «A topical subject, nosocomial contaminations are one of the major

issues of hospitals today» as underlined by Doctor Christophe Boyer, head of the SMUR/SAMU service of the Teaching Hospital, CHU-Amiens-Picardie who accompanied these students throughout the project.

### Protection and comfort

The Slive project consists of antibacterial sleeves for hospital care workers. It allows them to stay warm and comfortable while fighting against nosocomial infections. Indeed, medical staff are obliged to wear short sleeves in order to protect patients from possible contamination risks. In designing their Slive, Jeanne Raynaud and Corentin Vercoor took

into account the medical cleansing of forearms while ensuring that the device was adapted to the hospital laundry service by going to the Amiens-Picardie University Teaching Hospital. In addition to Emmanuel Corbasson's guidance as part of their design course at the University of Technology in Compiègne, the two students benefited from the expertise of Drs Boyer and Domisse. For the past nine years, Emmanuel Corbasson, a teacher-researcher, has accompanied the students every year on the Dyson Award. With eight podiums, including five national firsts, he has enabled UTC to be the most successful school at the James Dyson Award France. ■ KD

## GRADUATE AND CREATOR

# Kendrick, combining the photographer's eye and the engineer's brain

A shoe is composed mainly of three parts: the sole, the heel and the upper, covering the top of the foot. The art of shoe design is to juggle with these three elements to create unique pieces viz., shoes. Kendrick, a UTC graduate, has also patiently assembled very different elements throughout his professional life to obtain his creation today: his own shoe brand, which is already making a name for itself.

**T**he base-line, or sole, of Kendrick's professional life is his engineering degree in mechanical systems, obtained in 1998.

Entre UV de design et parcours associatif, il Between CC design and community work, he is already beginning to realize that creativity is a vital necessity. But before he could take his thoughts any further, his military service caught up with him and sent him to Mexico, as an international volunteer in a company for Valéo. A brutal uprooting, from which he will come back with two personal assets: an enhanced talent for photography, which he will even use in a travel guide, and a fascination, fed by his distance from France, for a fantasized image of the Parisian woman in high heels.

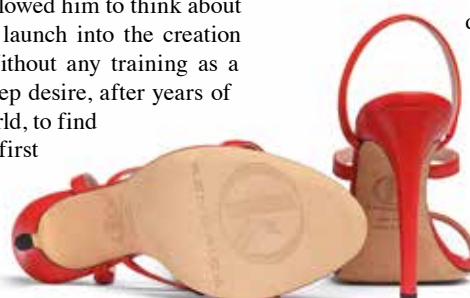
The heel is a vertiginous heel, of course, for the man who collects the most diverse lines on his CV. As a fashion photographer, he goes to fashion weeks and red carpet events. As a web designer, he worked on the development of digital platforms for

the daily newspaper Le Figaro. As an entrepreneur, he bought a company that produces styling software, which is sold worldwide to large groups. An eclectic CV, but dominated by Kendrick's passion for fashion and aesthetics.

If the sole and the heel are good, it's now time to dress the foot, to create the shoe that will sublimates the person wearing it. Developing his own models is exactly what Kendrick has been thinking about for years. His dual background as an engineer and a fashion photographer allowed him to think about shoes differently, and to launch into the creation of his first prototype. Without any training as a shoemaker, but with a deep desire, after years of working in the digital world, to find a manual activity. And a first pair was born. A simple, uncluttered sandal that caught the eye of certain designers. And in addition to taking

pride of place in trendy Parisian boutiques, they ended up on the feet of television presenters or stars on the same red carpets he walked as a fashion photographer.

After the sandal, boots, ankle boots and pumps followed, always in the same straightforward colours (red, yellow, black, nude) and with the same concern for a simple and ultra-elegant line. As his brand began to make a name for itself in the fashion world, Kendrick the engineer quickly became Kendrick the shoe designer. To facilitate this transition, he followed a training course at the French Fashion Institute, «l'Incubateur», to develop his brand. A project that already seems to be off to a good start and on the right footing! ■ MB





LAURENT FORNY

# Team-Spirit at its best

Laurent Forny graduated from UTC, majoring in Process Engineering in 2004, and then went on to do what was then called a DEA (equivalent to today's Master 2) and a PhD thesis. Since 2008, **he has been a project manager with the Nestlé Group**. In 2021, he was Godfather of the Guy-Deniélou thesis prize. Interactions is proud to offer its readers a portrait of a man who embodies a strong team spirit.

**"I am, says Laurent, "a triple graduate of UTC", as he puts it, in a nutshell. It was after his baccalaureate in Mulhouse that he was admitted to UTC.** A choice motivated by the integrated preparatory classes. «The preparatory classes scared me a little because I already had a very strong team spirit. It's the opposite of the competitive spirit which, in my eyes, bedevils the French preparatory classes», he underlines.

His choice in favour of UTC was also motivated by the wealth of international academic partnerships and the richness of student community life, both cultural and sporting. «I was able to spend my first year of specialization in the United States (UPenn in Philadelphia). During my studies, I also played rugby for a long time, as well practiced rowing», he adds.

The theme of the thesis? «I entitled it 'powdered water'. This seems rather confusing to most people. It's a powder that looks like flour, but when you knead it in your hands, it releases 98% water. Hence the use of the term 'powdered water', which I think is more meaningful than any scientific word», he explains.

As chance would have it, he met a Nestlé research scientist at a conference organized at UTC, even before completing his thesis, and expressed his interest in the group. «I wanted to join an industrial sector that mad sense for me. An everyday industry that concerns people's food in particular. The food sector is one of them. Seeing the products we develop in the shops, on the shelves, gives, in my eyes, a meaning to the work we do», he says. Laurent Forny must have been convincing because, even before his thesis was defended at the UTC-TIMR laboratory, he signed his contract. In 2008, he joined the Nestlé Group's research centre in Lausanne, where he has held

various positions. «I spent a year in Singapore working on reducing salt and sugar in products. This work was carried out in partnership with the Singaporean laboratory A-Star. It was a very enriching stay that allowed me to satisfy my curiosity and deepen my 'Asian' culture», says Laurent Forny.

As a project manager in the research and development department, he insists on the importance of ethical reflection, particularly concerning nutrition and its impact on people's health. «These are values shared by the Nestlé Group and I clearly identify myself with them.

Hence the project on reducing sugar in chocolate, for example. In this case, it was not a question of using sweeteners but of improving the 'sweetening' capacity of sugar. Another concerned pizzas. How to reduce the amount of salt by 30%? The trick we found was to put the salt under the pizza dough rather than in the dough itself or in the sauce without altering the taste for the consumer», he explains.

An ethical reflection which, in his opinion, integrates, more generally, more sustainable development objectives. «At Nestlé, our ambition

is to drastically reduce plastic packaging, for example, but also to achieve carbon neutrality (CO2) by 2050. In short, objectives that make sense to me. I have children and I want them to grow up in a more sustainable world», he adds.

Beyond his professional commitments, Laurent Forny attaches great importance to the popularisation of science. As a proof, he says: «I have a special alma mater bond with UTC. I have given a number of lectures there and this year I was invited act as Godfather to the Guy-Deniélou thesis prize», he concludes. ■ MSD

## BIO EXPRESS

**1999** : admitted to UTC after his baccalaureate

**2004** : obtains his engineering degree and DEA - 'Master 2' in Process Engineering

**2007** : succesfully defended his PhD thesis

**Depuis 2008** : research officer and project manager at Nestlé (Lausanne, Singapore, Orbe).



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