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Compiègne

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# Interactions

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*The first master plan for improving student life at UTC*

## *a concrete and achievable action plan*



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EDITO

**T**oday's world is undergoing a profound transformation, affecting such vital areas as the environment, health and social equality, to name but a few. These areas present Society with some primordial challenges, underlining the urgency to implement ecological transformation and unprecedented societal commitment. Environmental issues require us to work on complementary approaches, e.g., reducing carbon emissions and optimising use of energy resources. Above all, we must not overlook the issue of preserving biodiversity, often relegated to second order in relation to other environmental priorities. Yet it is an imperative for the future of our planet and its inhabitants. Furthermore, achieving successful ecological transition is not just about reducing carbon emissions or preserving ecosystems, but is also about creating healthier and more equitable environments for all. Promoting health and well-being is an integral part of our commitment to society.

Faced with these changes, UTC, its academic management, all its staff including its lecturers, research scientists and students, is fully committed to education, research, innovation, campus life and student life.

Our research embodies rich multidisciplinary and enables us to explore innovative solutions such as hydrogen stored in solid form, the recovery of non-conventional organic waste, soil decontamination using micro-organisms and phytosanitary alternatives to chemical products. In the field of health, significant progress has recently been made at UTC, such as the development of a new device that enables the rigidity of the liver to be assessed non-invasively and, in the near future, the lungs as well.

In its constant desire to train active, responsible citizens, committed to building a more just and equitable Society, and to encourage students to flourish in their academic and personal lives, in January 2024 UTC proposed its first Master Plan for improving student life 2024-2028. This Plan - resulting from extensive consultation involving all UTC stakeholders, local players and with students at the heart of the process - was designed from the outset with the issues of ecological transition and societal commitment as its common thread, placing them at the heart of its priorities.

Claire Rossi,  
President

PORTRAIT

# Defining an academic research strategy

Professor Frédéric Lamarque teaches at the University (UTC) and also is a research scientist at UTC's Roberval laboratory's Mechanical Engineering department. Since July 2023, he has been UTC's Director of Research ; his term of office runs for 3 years.

*The aim is also to enrich and enhance UTC's profile both nationally and internationally and to seize the best opportunities for developing the institution's research in line with the research strategy recently approved by the Board of Directors.*



FRÉDÉRIC LAMARQUE

**S**ince he joined UTC in 2000, Frédéric Lamarque has held various positions within the institution. In particular, he headed the Mechanical Systems Engineering Department from end 2012 to end of 2016 and was one of the key players in the merger of this ISM Department with the Mechanical Engineering department. After a break from management roles, he took over in March 2022 as Head of the UTC IG (Mechanical Engineering) Department, and in July 2023 he was appointed Director of Research for UTC. This demanding role has meant that he has had to reduce his teaching and research time in order to better manage the activities associated with his new role.

In practical terms what does this imply? «As Director of Research, my job is to develop new interactions with partners such as the Hauts-de-France Region, the Sorbonne University Alliance, the CNRS, other the Universities of Technology (UTs), industrial partners, etc., as well as representing the institution on a number of steering committees for research programmes where UTC is involved and has commitments. The aim is also to enrich

and enhance UTC's profile both nationally and internationally and to seize the best opportunities for developing the institution's research in line with the research strategy recently approved by the Board of Directors. I have been able, nonetheless, to maintain some time for teaching in my speciality - optics and sensors - and am also pursuing my research activities», he explains.

Can you illustrate please, with an example? «Yes indeed, with the PARS project, a Franco-German project supported by the ANR. PARS is being carried out in collaboration with Braunschweig University of Technology. Our aim? To develop a new instrument to measure the size and shape of nanoparticles in a fluid medium. The UTC's role in PARS is to introduce small restrictions in microchannels through which a fluid containing nanoparticles flows. These restrictions are positioned at well-chosen points and are controlled using optically-controlled micro actuators so as not to interfere with the electrical measurement of very low-amplitude signatures. The medium-term goal is to be able to identify and sort nanoparticles, this having applications in the manufacturing of new drugs and vaccines. This project was conceived and agreed during the Covid period», concludes Frédéric Lamarque. ■ MSD



## STUDENT LIFE

The first master plan for improving student life at UTC

# a concrete and achievable action plan



The University of Technology Compiègne is home to some 4 500 students registered for engineering, bachelor's or professional degrees, master's degrees and doctorate courses. They now can refer to the very first Student Life Master Plan, entitled the "Student Life Improvement Master Plan". Its strength: a co-construction approach that puts students at the heart of the reflection and drafting of proposals.

**T**he master plan for improving student life is the result of a genuine consultation between students, UTC staff and various local stakeholders. The actions programmed by this plan, covering a 5-year period 2024-2028, are based on three main themes: feeling good in mind and body, living well and fulfilling oneself within one's environment and having a transformative and transitional student experience looking ahead to their future professional lives «It took over a year to draw up this plan, based as it was on an inventory of the current situation and brainstorming workshops with, as "pilots", students who were asked to think and dream big around five initial themes (being well in mind and body, living well together, living well at the UTC, being well supported and living well in one's environment). This led to a series of ambitions and concrete actions, such as facilitating access to care by strengthening the medical presence via shifts for health professionals such as speech therapists, occupational therapists or neuropsychologists. Or setting up a one-stop shop, staffed by students, to provide personalised assistance with administrative formalities. But we also need to recognise student commitment by creating a new 'asso-élite' course for highly committed students, and include the existing ITC 'elite' courses (sport, music, asso, entrepreneurship) in the diploma supplement.» explains Véronique Hédou, a lecturer and research scientist in applied mathematics at UTC who has been in charge of student life for ten years.

### The 'green' thread of the plan: ecological transformation and social commitment

The ecological transition and societal commitment (TE&ES) is also a central concern for the UTC, its staff and its students. This is why TE&ES is a transversal strategic axis, an integral part of all of the institution's missions, which are research, education, innovation, student life and campus life. «Our developments and choices are viewed through this major prism, so it is naturally present in a large number of actions in this Master Plan. We have chosen to make it a common thread, an integral part of all our actions». Monitoring and implementing the Plan will therefore require a great deal of work. Sometimes via their associations, sometimes via their elected representatives, the students will have to work alongside the UTC departments to make the Plan a reality. It is a toolbox of ideas that should ensure that all those involved in student life who want to take action will not be bored for at least the next four years. ■ **KD**



Find out more about the Master plan for improving student life at UTC 2024-2028 : [www.utc.fr > UTC > student life](http://www.utc.fr > UTC > student life)



### 3 QUESTIONS FOR ROMAIN MARCHAL, AGED 21, IN HIS 2ND YEAR OF THE UTC ENGINEERING CYCLE - MAJOR IN URBAN ENGINEERING

#### How did you become involved in the drafting of this Plan?

In May 2022, I was invited by the UTC Student Life Office to take part in the steering committee for the implementation of the SDVE Master Plan as an elected student member of Academic Board of Directors. We worked with the student union (BDE), the elected members of the CEVU, the preventive medicine service, the disability advisor and the training and teaching department. This wide-ranging panel enabled us to take stock of the situation and identify the strategic areas around which student life at UTC is structured. It was during these working meetings that we came up with the idea of consulting students directly through lunchtime workshops. We wanted to give priority to qualitative work in 5 areas in order to come up with concrete proposals that would meet students' needs.

#### What specific points did you focus on?

I had the pleasure of co-chairing one of the working groups on the theme of «Living well in the city». For a week in April 2023, we met every lunchtime with a dozen or so students chosen at random,

volunteering to discuss mobility, housing, culture, sport... and all matters that affect life in Compiègne and its surrounding area. UTC staff such as the SD/RS project manager and the quality project manager joined us during the week. Arielle François, Compiègne's Townhall cultural counsellor also came to talk to us. After a quick review of the existing situation, we started to work on proposals for improvements. At the end of the week, we submitted a list of suggested improvements, ranked in order of importance, to the Student Life Office, which then did a fantastic job of summarising them to produce the final version of the SDVE Master Plan.

#### Why is such a plan useful?

This Master Plan provides a strategic vision of student life for the UTC in the medium term. I think its strength lies in the consultation process. The plan was drawn up with all the parties involved in student life, placing students at the heart of the process. Participating in this scheme enabled me to realise just how wide-ranging student life is, and that many things are already in place for the well-being of students at UTC. This plan is part of a continuous improvement approach and is all the more effective that it was unanimously approved by UTC's governing bodies. Indicators are associated with the objectives; they will make it possible to monitor the evolution of student life and the usefulness of the actions put in place.



VÉRONIQUE HÉDOU



**# A SHOWER OF AWARDS FOR UTC**

At the start of academic year 2024, our students and PhD candidates have brilliantly defended the colours of the UTC.

Sandra Ear, a double-degree student at Escom and UTC in the Formulated Product Engineering Master's programme, was awarded 2nd prize for «Innovation and Formulation» in the U'Cosmetics competition, after developing an innovative cosmetic product called «Ocean Pills».



Augustin Brassens, a PhD student at the UTC-BMBI laboratory, won the internet users' prize in Sorbonne University's My Thesis in 180 seconds competition on Monday March 25. In the final round of presentations, he defended his thesis on the subject of «organ-on-a-chip technology has enormous potential for the future of health research».



On the club side, the UTC's women basketball team won the French Schools Basketball Championships 2024, which took place in Douai from March 19 to 21. A total of 12 students represented by Cléa Larqué, head of the women's basketball team are all FFSU members.



**# 2024 : THE YEAR OF 25 YEARS OF URBAN ENGINEERING AND 10 YEARS OF MOCOPEE**



On Saturday March 23, UTC's Urban Engineering (UTC-GU) department

brought together a host of graduates to celebrate its semi-Jubilee and its 1 500 graduates during a full day of conferences at the Marbrerie de Montreuil.

It was at the 2nd edition of its conference that the Mocopée programme celebrated its 10th anniversary on March 26. Created in 2014 by the Syndicat interdépartemental pour l'assainissement de l'agglomération parisienne (SIAAP) in partnership with UTC and the Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement (INRAE), the aim of the programme is to develop innovative, practical solutions for efficient, sustainable wastewater treatment facilities and to support the adaptation of wastewater treatment plants to the challenges of the Ile-de-France Region's ecological and energy transition.

**# FREE HANDOUT OF BOOKS FROM THE ROBERVAL PRIZE LIBRARY, FROM 1987 TO 2009**

The UTC's Scientific, Technical and Industrial Culture Centre (CSTI) is donating books from the Prix Roberval library from 1987 to 2009. 03 44 23 43 58 or 03 44 23 79 09 to come and pick up books on site

**# BLOOD BAGS COLLECTED IN 2 DAYS FOR DON'UTC**

As it does every semester, the blood donation association Don'UTC organised a two-day blood campaign at the Benjamin Franklin centre. A total of 223 blood bags were collected, of which 50% were first-time donors. ■ PS

**50 YEARS OF UTC**

# A retrospective on UTC's Jubilee

On Thursday December 14, 2023, UTC welcomed and celebrated its pioneers and former colleagues to close this anniversary year together!

**A look back at the closing ceremony of UTC's 50th anniversary...**



Dominique Barthès-Biesel, Paul Gaillard and Gilbert Touzot took part in the conference «Regards croisés sur la création de l'UTC».



Claire Rossi et Anne-Virginie Salsac



A hundred or so participants, former colleagues, pioneers and current staff gathered together.

Conference «Regards croisés sur la création de l'UTC» (Crossed views on the creation of UTC)



Jean-Paul Barthès



Gérard Béranger



Jean-François Large



Louis Reynes



Round table «UTC today and tomorrow» with Antoine Jouglet, Director of Training and Education, Joanna Daaboul, Director for International Relations, Samuel Veillerette, Director of Socio-economic Partnerships and Entrepreneurship and Isabelle Cailleau, Director of Ecological Transition and Social Commitment.



# Facing up to environmental challenges



In a rapidly changing world where environmental issues show multi-facets, UTC is getting its act together, so to speak. The laboratories are mobilising their forces. This is the case for UTC-TIMR, whether it be in the field of green energy with solid hydrogen, research into alternatives to phytosanitary products for agriculture or chemical products for soil decontamination and finally recovery processes for both organic and non-conventional waste. Projects with external academic and industrial partners are expanding. These include the Living Lab for optimum management of electrical charging points as part of EE4.0 and the Industrial Chair designed to pursue research in eco-design. Finally, the arrival of two Nvidia supercomputers at the Biomechanics and Bioengineering Laboratory (UTC-BMBI) will benefit the lab's research activity as well as that of UTC as a whole. These supercomputers, which each provides comparable performance levels, have seen their energy consumption cut by a factor of 1 000, from one megawatt for a cluster of machines to two kilowatts.

## Research targeted on environmental issues

**Professor Khashayar Saleh, director of UTC-TIMR, with activities focussed on green chemistry and associate processes.** Research areas such as decarbonised energy processes, bio-sourced products and the recovery of non-conventional waste are prioritised.

**O**ne of our flagship carbon-free process projects? «One of our main areas of research concerns the storage of solid hydrogen, an energy carrier with very high energy capacities. Generally speaking, we use gaseous carriers to achieve high yields and efficiency. And the gaseous state implies the need for storage under pressure. Hydrogen is the smallest chemical element after helium, so you need a very high pressure of several hundred bars to liquefy it, calling for a lot of energy,» he explains.

This problem prompted an industrial partner to ask the UTC-TIMR-IMiD team to explore alternatives to hydrogen storage. «The idea is to store the hydrogen in a powder based on metal hydrides, which are absorbent carriers made up of matrices capable of condensing the hydrogen into chemical form,» he says.

How can this be seen as of interest? «Well, we

shall be able to store hydrogen at much lower pressures. If we look at the issue of mobility, in other words on-board use, we'll be able to replace the petrol tank with cartridges. This already exists, fitted to some scooters. We'll also be able to power batteries with fuel cells. It's also safer storage, because the risks are not the same in the event of an accident, with a 20-bar tank compared with nearly 700-800 bar for a liquid storage tank. We have clearly demonstrated the capacity to absorb hydrogen on a solid support and at pressures and temperatures compatible with the use of a vehicle,» explains Khashayar Saleh.

The feasibility of this technology has therefore been demonstrated, although a number of challenges do remain. «The first concerns the density or quantity of hydrogen that can be incorporated into the solid, given that the current yield is 2%, i.e. for every 100 kg of solid, we only get 2 kg of hydrogen. To have a range of 500 km, you need

5 kg of hydrogen. So that's the second challenge, that of density, because we need to incorporate 250 kg of solid matter into the matrix. At a time when constructors are lightening the weight of vehicles to make them more fuel-efficient, this poses a problem. These are two challenges that can be solved in stationary applications, but are more difficult to meet in on-board applications. The third challenge is loading and unloading on command. If we take the example of a hydrogen station, charging needs to be fast. There are two possible scenarios: either you charge directly or you purchase pre-charged tanks, a solution that has been adopted for scooters and electric bicycles. It's a technology that works for both small and heavy vehicles, but the equation has yet to be solved for intermediate vehicles such as cars, vans and so on. It's a technology that has real environmental advantages over fossil fuels, with zero CO<sub>2</sub>, CO or NO<sub>x</sub> emissions,» he points out.



KHASHAYAR SALEH

As well as energy, the UTC-TIMR team is also interested in finding alternative solutions to chemical plant protection products. «In this area, we are faced with both environmental and economic concerns. Again, there is the problem of the yield of a crop protection application. When spraying plants, over 50% of the product may be dispersed into the environment for a variety of reasons: either it misses its target because of the wind, for example, or it encounters rebound phenomena and finally it is subject to evaporation. This creates not only a problem of pollution, but also of efficiency. One of the solutions lies in the formulation of anti-drift plant protection products, a combination of formulation and technology. This is the objective we are pursuing with the STIMULE FAUVE project, funded by the Hauts-

de-France Region and led by Audrey Drellich, a lecturer-cum-research scientist working in this UTC-TIMR unit. The aim is to anticipate the advent of new practices (e.g., treatment by drone) or the end of certain phytosanitary products by developing bio-sourced products», he assures us.

Can you mention other areas of research? «In the long term, we have defined three areas of research: the first concerns all decarbonised energy processes; the second relates to bio-sourced products; and finally, the third area is the reduction of environmental impact and the recovery of waste, whether the latter be conventional or non-conventional», concludes Khashayar Saleh. ■ MSD

## AGEC : the challenge of recycling organic waste



**Olivier Schoefs is a lecturer-cum-research scientist working in the TIMR process engineering department and has also been its director since 2022. He works with Frédéric Huet from the UTC-THS department on the Integration of a so-called Environmental, Economic and Social Dimensions (IDEES) project to develop a decision-making tool for local authorities.**

**H**is research focuses on environmental bioprocesses. In other words, the use of micro-organisms either in soil or water decontamination processes, for example, or to transform matter into high added-value products such as biofuels, biomolecules or biomaterials. These skills have led Olivier Schoefs to become interested in the recovery of local authority waste, particularly since the passing of the anti-waste law for a circular economy (AGEC) in 2020. This law requires local authorities to offer citizens solutions for recovering organic waste. These solutions cannot be standardised, because no two geographic areas are alike. «That's where research can come in. The ideal solution doesn't exist for everyone. Let's take a look at two extreme examples. In the first, the responsibility for recycling waste is delegated to citizens, who are given individual composters. In the second, the public is asked to sort their rubbish and the waste is collected, transported and recycled in an industrial plant. Neither of these scenarios offers any convincing advantages from an environmental, economic or social point of view. In the first case, the problem is not one of cost or transport, but one of ownership by the citizen

and then it has to be done properly. Otherwise, it is a product that cannot be put to good use and which, if badly prepared, can even have harmful effects on the environment and on human beings. In the second case, there is certainly an economic cost, that of transport, but the recovery is optimal in industrial units, either by producing biogas or labelled composts, for example», he explains.



OLIVIER SCHOEFS

These two scenarios show that tensions can arise between economic, environmental and social issues. Tensions that local authorities find themselves at a loss to resolve.

Hence the idea of the project Integrating Economic, Environmental and Social Dimensions (IDEES) in a circular economy approach, launched in early 2023 and co-financed by the Hauts-de-France Region, as part of the «circular economy and new development model» programme, and UTC. «The aim is to develop a decision-making tool by studying the various possible scenarios in order to provide decision-makers with objective information, bearing in mind that there may be hybrid scenarios between the two extreme scenarios mentioned. In rural areas, for example, individual composters are more appropriate and people are more inclined to use them, whereas in more densely populated areas the choice of collection and recovery in industrial units would be more appropriate. Recycling plants managed locally in a spirit of the circular economy», concludes Olivier Schoefs. ■ MSD

# A fungus that removes pollution

**Antoine Fayeulle is a senior lecturer in microbiology and a research scientist at the URC-TIMR Laboratory.** In particular, he is conducting research into the properties of a fungus capable of 'digesting' hydrocarbons that have accumulated over the years in soils. The champion of decontamination is *Talaromyces helicus*.

He owes his passion for fungi to teachers at the Université du Littoral Côte d'Opale (ULCO) where he studied.

«ULCO research scientists realised that the fungi that degraded wood lignin were no longer very effective with heavy PAHs (Polycyclic Aromatic Hydrocarbons, viz., a class of organic compounds) when inoculated into soils. So I became interested in telluric fungi in my second year of undergraduate studies, during which I did a voluntary work placement with them», he says.

It was a passion that never left him, witness the fact that as soon he obtained his engineering degree from ESBS (specialty biotechnologies) in Strasbourg, he undertook a joint thesis, between ULCO and the Technical University of Munich. His thesis was devoted to bioremediation. In other words, how to use micro-organisms to degrade xenobiotics, or molecules of human origin that have an impact on the environment, such as medicines, cosmetics, pesticides and petroleum derivatives. «At ULCO, the researchers were working on fungi, but only in the laboratory, whereas the German team specialised in bioremediation using bacteria, carrying out experiments directly in the soil. Thus, during my thesis I became interested in "mycoremediation", particularly in soils.» he recounts.

This led him to work on the problems associated with organic molecules and polycyclic aromatic hydrocarbons (PAHs). These are natural constituents

*«That's how we started working on bacteria/fungi communities, to get closer to what actually happens in Nature.»*

of oil and coal. Antoine Fayeulle has made mycology his field of research for a good cause: safeguarding the environment. «Fungi are known to be better at degrading heavy PAHs than bacteria. In fact, fungi can degrade complex molecules - with more than four aromatic cycles, which is the case for heavy PAHs - whereas bacteria are only effective with molecules with one, two or three cycles. So, in Nature, only fungi know how to degrade wood lignin», he explains.

When Antoine Fayeulle joined the UTC-TIMR laboratory in 2014, he brought with him new skills, as the laboratory's work had until then focused mainly on bacteria. While extending his areas of research to processes other than soil decontamination, he nonetheless retained this theme as a research focus. «That's how we started working on bacteria/fungi communities, to get closer to what actually happens in Nature. And it was during discussions with Anne Le Goff from UTC-BMBI, who uses microfluidic systems to study the deformation of red blood cells, that the idea of a partnership took shape», he adds.



ANTOINE FAYEULLE

This partnership led to a co-directed thesis with Anne Le Goff. «The aim was to understand how the fungus invades the microporosities of the soil in order to gain access to the pollutants. Hence the idea of growing mushrooms in a microfluidic system. We set up two chambers, one where we inoculated the fungus, and another for the pollutant, which has the advantage of being fluorescent, the two being linked by microchannels. This set-up enabled us to see the cellular incorporation mechanisms of the pollutant, and *Talaromyces helicus* demonstrated its full effectiveness», concludes Antoine Fayeulle. ■ MSD

## A Living Lab awaiting a V2G terminal

**Fabrice Locment is a university full professor and a research scientist in the UTC-Avenues research unit, where he has been Deputy Director since January.** He is also Director of the Urban Engineering Department. His research into electromobility has led to the creation of STELLA, which has been transformed into a Living Lab as of June 2023.

**In concrete terms? «After validating the concepts in the laboratory, in short, we shifted up a gear. We've now moved on to a platform where human interaction has become a reality.** For example, since June 2023, staff members with a badge for access to the charging points have been able to charge their vehicles. There are various types of charging point: alternating current and high-power direct current.

Users can charge their electric vehicle (EV) and in exchange their data will be retrieved. Since autumn 2023, data collection has been even easier, since a graphic interface has been developed by a computer engineering student using the OCCP (open charge point) protocol (programmed in Python via a database) to manage the 'dialogue' between an EV and the charging points. This interface asks users for a certain amount of information, such as the

state of charge of their vehicle when they arrive, the time at which they intend to leave again, the distance they are going to cover when they leave, etc. This data is then processed by the system. This data is then processed by an algorithm for intelligent management of the system. A system which - in real time - will use the vehicle as an energy store, either by limiting charging power or, in the event of a grid demand peak, injecting



FABRICE LOCMENT

the vehicle's energy into the grid. This is known as V2G (Vehicle to Grid). Since June, we've been gathering quite a lot of data on loads, which we're using to refine our simulation models,» he explains. However, today, very few vehicles and charging points are equipped with V2G. Only two Nissan models, two Mitsubishi models, one Citroën model, one Peugeot model and the Renault 5 are compatible with V2G. Notwithstanding, this technology is set to take off. The proof? Since 2018, the UK has been working on a Bus2Grid project, in which buses will be able to inject energy into the national grid when consumption demand peaks.

UTC is currently waiting for a V2G terminal, a bidirectional terminal funded as part of the CPER's Electric Energy 4.0 (EE4.0) project. «It's a project that aims to develop the ecosystem by promoting excellent research in electrical engineering while taking into account environmental and societal

constraints. The project involves more than twenty local authorities and industrialists, 85 researchers and 7 laboratories at universities in the Hauts de France region, including Lille, UPJV (Jules Verne, Amiens) and the University of Artois. At UTC, two laboratories are involved in the project are Roberval and Avenues,» explains Fabrice Locment.

What UTC-Avenues' role in the EE4.0 project? «The aim is to develop a Living Lab by integrating new functionalities, in particular V2G. At the moment, to my knowledge, there are only two or three models of V2G terminals on the market, one of which is sold by ABB E-Mobility (ABB is a world leader in electrification and automation technologies). We are waiting for an ABB terminal to refine our simulation models,» he concludes. ■ MSD

## Developing eco-design tools for industry

**Benoît Eynard is a lecturer and research scientist in the Mechanical Engineering Department at UTC and is also head of an industrial engineering research team in the UTC's Roberval laboratory. Together with Bertrand Marconnet from ECAM LaSalle (Lyon), he will be co-directing the 'ProActive Design for Sustainability' industrial chair at the request of PTC (Parametric Technology Corporation), a global software company based in the USA.**

**W**ith its 7 000 employees, this American group offers software solutions and platforms to help manufacturers adopt a sustainable and global approach to their product development. In other words, manufacturers need to think about product sustainability from the design stage right through to the end of the product's life, including the manufacturing, operation and maintenance phases.

Why UTC and why ECAM LaSalle? «The Chair is a major project for PTC, which wanted to deepen its research into eco-design tools or Design for Sustainability. UTC has been a long-standing partner of the American group, with links dating back to the mid-90s. As for ECAM LaSalle, they have close links with the software publisher's teams in Lyon and also bring expertise that complements that of UTC. This led us to develop a joint project to create a four-year Industrial Chair», explains Benoît Eynard.

Can you cite one of PTC's objectives with this Chair? «The aim is to develop research into eco-design in order to improve PTC's software solutions in the areas of life cycle analysis and calculation of a product's environmental impact. UTC has some definite assets, as well as a number of theses - some of which I personally supervised - carried out on this subject over the last ten years. With Bertrand Marconnet, as part of this Chair, we are going to propose methodological frameworks for improving

best practice and eco-design methods, all within a software integration framework that is PTC's, whether in computer-aided design software or life-cycle management software, or in more recent solutions such as the Internet of Things. In fact, the environmental assessment or life cycle engineering component is not sufficiently present in PTC's software suite. Their objective is to enhance their product package offer and provide more effective solutions that meet the need to control a product's environmental impact as early as possible», he adds.

Are there some theses starting soon? «Yes, two theses funded by PTC are about to be launched.



BENOÎT EYNARD

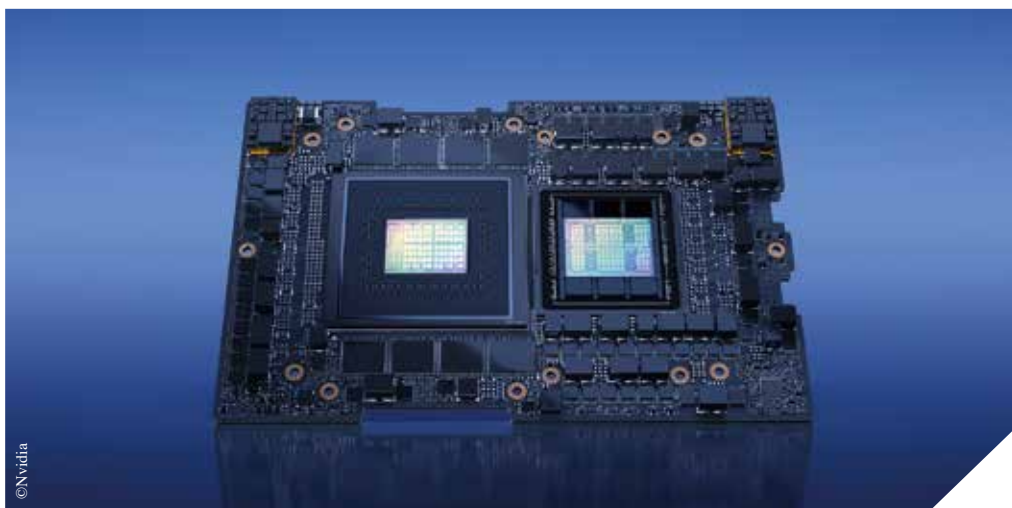


One will focus on proactive eco-design methods enabling simplified dismantling of assemblies to be planned from the design phase, as well as improved circularity of product components and sub-assemblies. In a word: improving the ability to repair products and reuse components in order to limit their environmental impact. The second focuses on product life-cycle management, integrating environmental indicators. The nomenclature of the parts making up the product will include information on the type of material used, their recyclability or, for example, their CO2 equivalent impact depending on the manufacturing process or the uses chosen. A PLM platform will collect, trace and justify all the environmental data and characteristics associated with the product's life cycle, including those for the material extraction and processing, manufacturing, use, maintenance and dismantling phases,» concludes Benoît Eynard. ■ MSD



# Latest-generation supercomputers at UTC

Anne-Virginie Salsac, Director of Research at the CNRS and Florian De Vuyst, Full Professor at UTC, researchers at the Biomechanics and Bioengineering Laboratory (BMBI), are hosting two supercomputers dedicated in particular to applications in biomedicine and bioengineering.



Supplied by Nvidia and funded by the European Research Council (ERC), this new-generation high-performance computing (HPC) equipment makes UTC a pioneer among French engineering schools. So, what seemed like a real Christmas story came true? During the summer of 2023 in Marseille, I took part in a summer school on intensive computing and GPUs (Graphics Processing Units). It was there that members of the CEA, with whom I had worked for a long time before, told me about the imminent release of these processors, which I was able to preview and meet Cristel Saudemont, Director of Nvidia France. The company was preparing the worldwide release of these 'SuperChips', whose name 'GH200 Grace Hopper\*' was a tribute to the woman who invented the Cobol machinelanguage», Florian De Vuyst recounts.

The opportunity to have machines that are a concentrate of innovative technologies was obvious, but the price was an obstacle. In the end, the solution came from Nvidia. «We learned that the group was offering research institutions the possibility of acquiring a maximum of two supercomputers at a much lower price than that initially quoted. The icing on the cake was that the ERC agreed to finance the cost of the two machines,» explains Anne-Virginie Salsac.

What are the features of the GH200 Grace Hopper? «This «SuperChip» comprises two types of processors placed side by side. The first, the CPU, is a conventional processor with 72 cores or ARM-type logic processing units; the second is a GPU (graphic processor) with 20 000 cores, compared with a few thousand in recent conventional GPUs. In our algorithms, it's not so much the computing power that slows us down as the communications, i.e., the back and forth exchanges between the elements. The Grace Hopper SuperChip is the only

*These super-machines will benefit the research activities of UTC in general and the UTC-BMBI laboratory in particular,*

one to offer this kind of joint architecture, which allows us to optimise and improve communication between elements without using intermediary elements such as an external communication bus, for example, as the bus is integrated into the machine. As a result, processing power is multiplied by a factor of around sixty Teraflops (Tera Floating-Point operations per second), equivalent to the power available to the major computing centres in the years 2000-2005. Grace Hopper's other innovation is a 500 Gigabyte memory, where

previously we were limited to 32 Gigabytes. This will enable us to do real 3D computing. Another advantage, which echoes one of the UTC's major areas of research, is energy consumption, which, for comparable performance, is divided by 1 000, dropping from one megawatt for a cluster of machines to two kilowatts», describes Florian de Vuyst.

These super-machines will benefit the research activities of UTC in general and the UTC-BMBI laboratory in particular, which specialises in understanding the biomechanics of the human body and its repair, whether related to the flow of fluids such as blood or lymph, the musculoskeletal system or tissue engineering.

Can you quote some projects? «In particular, we are working on seeding biomaterials with cells to create faithful tissue models, multi-scale and multi-physics characterisation of tissues and the design of medical devices. Among the latter, a new implant, designed in collaboration with Hospital Henri Mondor and the CNRS, was patented in 2018 with the aim of repairing the mitral valve by passing through the blood vessels without opening the heart. Another project involves microcapsules protecting an active substance, such as a drug, which can be injected to bind to a specific target area,» explains Anne-Virginie Salsac.

Studying the dynamics of these devices requires complex numerical simulations, because of the strong interactions between their movement/deformation and blood flow. These are areas where simulation needs are considerable. «The Grace Hoppers are going to change the game. Their computing power will make us much more efficient. We should be moving towards computing times that are compatible with clinical practice», she concludes. ■ MSD

\*<https://www.historyofdatascience.com/grace-hopper-the-mother-of-computer-science>



ANNE-VIRGINIE SALSAC



FLORIAN DE VUYST



TRAINING



# TSH, more inclusive and responsible

UTC's Technology and Human Sciences Department is changing its name to Technology, Societies and Humanities. The Department's previous name dates back to 1986, the year THS was founded at UTC.



PIERRE STEINER

©PopsyImages

**Three challenges have been identified, increasingly faced by today's and tomorrow's engineers: imagining new alternatives; telling the story of a desirable future; inclusion and care.**

Since its creation in 1972, the UTC has been characterised by its desire to give an important place to humanities and social sciences in the training of its students. The conviction of the UTC's founder-President, Guy Deniélou, was that you can't really know human beings without knowing the objects they build, and vice versa.» Today, this has almost become commonplace in the engineering training landscape. Everyone recognises the importance and interest of the human and social sciences. For UTC, the difference must continue to be made in the demands we make, which do not reduce the humanities and social sciences to utilitarian, entertaining or professionalising pf knowledge. We need to extend and strengthen the links between technology and humanities and social sciences. This project makes

even more sense today, in the context of the ecological, information and political crises we are experiencing. This is also demonstrated by the success of the 'Humanities and Technology' course, which offers a real synergy between the human and social sciences and engineering at UTC.» says Professor Pierre Steiner, Director of the TSH Department and professor of Philosophy.

## An evolving department

This change of name is in line with a new way for the department to present and give meaning to its educational offering: 'TSH challenges'. Three have been identified, increasingly faced by today's and tomorrow's engineers: imagining new alternatives; telling the story of a desirable future; inclusion and care. «It was therefore an opportune moment to review the way we are called and how we are known inside and outside UTC. The new name is more open and inclusive. It also better reflects the diversity of the hundred or so courses we offer at the UTC. «Technology» has been retained, because we are still pursuing the project of understanding the ways in which technology makes possible and transforms our ways of knowing, interacting, communicating and organising ourselves. «Societies' refers to social sciences and economics, but also to the responsibilities that engineers bear today, whatever the situations in which they work and operate,» continues Pierre Steiner. 'Humanities' covers our teaching of languages, communication, philosophy, history, linguistics and the numerous ways in which Humanity inhabits the Earth via techniques and technology».

## Engineers must also be accountable

New courses have also been launched, such as the course on Philosophies of Nature and the contemporary engineer, and a primer course in Political philosophy. Here too, the aim is to offer courses that enable students to understand the challenges posed by the ecological crisis, challenges that are not just scientific or technical. «Increasingly, engineers and the organisations that employ them are being called to account. This is one facet of what is known as 'societal responsibility'. How does the innovation to which I contribute serve to a world, a planet or a Society we see as

desirable, inclusive or sustainable? Whom does it empower? What does it make invisible? What does it invite us to renounce? Engineers need to be able to position themselves and listen to other stakeholders. They can no longer hide behind efficiency criteria, impersonal standards, or a «neutrality» that has never been anything other than a way of ratifying established order. These questions of ethical and societal positioning cannot be resolved by algorithms, but that doesn't mean that they don't concern engineers. On the contrary! These are skills that are just as important as scientific and technical skills.

## A long way from the general knowledge department

Linking the humanities and social sciences with technology, taken in the sense of the study and design of technical systems, is the basis of TSH. There are at least two reasons for this. The first is that engineers have to work in many situations that are not just scientific or technical. «They don't just design, calculate, parameter, modelize or control. They also have to argue, manage, communicate, negotiate, imagine, comply with law, etc. Engineers don't just interact with engineers, they also interact with workers, citizens, litigators, users, etc. The second reason - more transversal - is that designing a technical device also means designing the environment in which the uses of a technology-intensive device will take place, transforming - and this is fundamental - the projects, the experience and the capacities of the users. Consequently, we're not a 'general culture' department, a department that offers students methods for getting into the job market, such as writing CVs, or a department that puts a humanist veneer on top of their scientific and technical training,» he concludes. The link between technology and the humanities and social sciences must be built around technical objects. At UTC, humanities and social sciences study technology using technology. Many of the TSH courses are linked to the technological platforms of the UTC-Costech laboratory: the aim here is to understand in order to act, and to act in order to understand. ■ KD

## INTERNATIONAL

# An internship to understand the world



The curriculum core course, TN07, is a four-week intercultural placement that takes place during the summer holidays or between semesters abroad, in any country enabling students to familiarise themselves with the culture and living conditions of the chosen country and to practise a foreign language.

The N07 placement has existed since 1974, at the very beginning of UTC. Brazil, Italy, Japan, Canada, Chile, Cambodia, Norway, Mexico, Slovenia and Saudi Arabia are just some of the many and varied destinations chosen by core students for this intercultural work placement. On average, between 30 and 50 students go wherever they want each semester, according to their own wishes and networks. «We accumulate «experience capitalisation» which is requested from students after their stay to facilitate the departure of subsequent students from a practical point of view and to find their placement. The

international placements coordinator works with them to refine their project and help them find a suitable placement. There is a wide range of destinations, in Europe and America, but also in sub-Saharan Africa, for example Tanzania, Rwanda and Namibia. Students can also work in youth hostels, on farms or even in wildlife refuges! The TN07 work placement gives them the opportunity to develop their intercultural and linguistic skills in a practical, hands-on way, and then to analyse their experience in a report and presentation. It's generally a very enriching experience for students who are still young and at the start of their training,

and the demand for a real intercultural analysis is designed to help them overcome cultural clichés,» says Hadrien Coutant, head of the course, lecturer in sociology and research scientist at the UTC-Costech laboratory.

### Alone on the other side of the world aged 19



After a maths/SVT (life sciences) baccalaureate, Maelys Luc was admitted to UTC in September 2021 and is currently majoring in Urban Engineering. She would then like to specialise in BAT (the elective specialty in Building science). In the summer of 2022, she spent five weeks in South Africa, in the town of Greyton (near Capetown) in an animal sanctuary: Greyton Farm Animal Sanctuary. The placement was made possible by 'Workaway', a 'Wwoofing' service. «I based my research on this country, which I'd wanted to visit for a long time, then I looked for hosts on Workaway and that's how I found my destination. This holiday really gave me independence, as I was on my own in another country. It also allowed me to meet some great people. From a professional point of view, I discovered values that I would like to keep and enhance in my job as an engineer, such as mutual aid, team spirit, empathy and ecological values, respectful of the world around us. My English has also improved a lot. ■ KD



### CHILEAN IMMERSION WITH HUGO JIMENEZ IN HIS FIRST SEMESTER IN THE MECHANICAL ENGINEERING DEPARTMENT

#### Why did you choose the UV TN07?

I really wanted to discover Latin America. Also, like all UTC students in the core curriculum, I had to do either a work placement in a company or an intercultural placement. TN07 was therefore the ideal format. The aim was also to step outside my comfort zone and have a unique experience, as I was going off on my own to the other side of the world for a month. To find this placement, I sent out a large number of applications in Latin America to research centres, associations, NGOs, schools and museums. In fact, the TN07 UV

leaves plenty of scope for professional activities to maximise each student's chances of finding a placement abroad.

#### What was it like once you got there?

I did my placement in the north of Chile, in the city of Tocopilla to be precise. I was housed and fed by the family of Ghia Duran Camus, my placement supervisor and HR manager for the regional bus company Sucesion Luis Camus Calderon. The first week enabled me to familiarise myself with the Chilean way of life and discover Tocopilla and the surrounding area. The following two weeks were organised so that I could take advantage of longer weekends to visit typical Chilean tourist sites. Finally, I spent the last few days with my host family. They were very welcoming and shared their daily life and customs with me.



#### What do you think are the benefits of this UV?

First of all, I don't know any student who has done a TN07 and regretted. The experience offered by this course can only be beneficial. «Indeed, 'travel is for the young'. This experience has had a strong impact on me and has enabled me to become more open-minded, to learn a lot about Chilean society and also about French society thanks to the cultural perspective that this work placement has given me. I also 'grew' personally, because being alone for four weeks on the other side of the world changes you. Above all, working abroad required me to adapt, because the working conditions [working hours, assignments, relationships between colleagues and clients, the labour code] really are really different.



ART & TECHNOLOGIES



# Technology in the service of art

With a nod and a wink to the Paris 2024 Olympic Games and the future materialisation in Songeons Park of the path linking the Musée Antoine-Vivenel and its outsourced temporary exhibition room, the nine 3D-printed so-called 'hermes' head-dresses mounted on pillars that two UTC students have created illustrate the long-standing partnership between UTC and the museums of Compiègne.

At the Musée Antoine-Vivenel in Compiègne, you will have to wait until 15 June and the opening of the So Greek! exhibition organised around the museum's collection of Greek vases (the second largest after that of the Musée du Louvre in Paris) before you can see the installation of nine 3D-coloured copies of the marble Hermes head-dresses that it holds. As part of the 2024 Olympic Games, the exhibition will feature the Panathenaic vases presented to the winners of the ancient Greek Games, several of which are held by the museum. It will also be an opportunity to display the head of Hermes, the original model of those made in 3D to mark out the path linking the Musée Antoine-Vivenel to its temporary exhibition room in the park at Songeons. These life-size reproductions, mounted on pillars, are the result of work carried out between September and December by Mélissa Rousson-Marchand, a student from Utrecht in TC03, and Swann Courme, enrolled this year in IM01. To address the issues of accessibility and visibility in a site with listed surroundings, to appeal to younger audiences and to dust down our ways of mediation, we took as our starting point the head of Hermes which, in Ancient Greece, was installed on quadrangular pillars to mark out roads, crossroads and the gardens of wealthy houses,» explains Delphine Jeannot, Director of the Museums of Compiègne, who initiated this project commissioned from UTC. It was interesting to pick up on this usage by using bright pop colours. The hermes head-dresses have a very modern, anachronistic feel to them, which is both offbeat and assertive.

## A project using an agile evolutionary method

For this project, Mélissa Rousson-Marchand and Swann Courme understood the technical constraints inherent in respecting the work and

completing a project using an agile evolutionary method. At the UTC Fablab, the duo developed their technical skills in 3D printing, image capture and STL file conversion. «We chose the methodology and carried out a technology watch focusing on the methods for digitally capturing an object for 3D reconstruction, as well as the most suitable materials,» explains Mélissa Rousson-Marchand. Like the ASA (acrylonitrile styrene acrylate) resistant to climatic conditions, humidity and ultraviolet radiation chosen for printing the nine hermes caps. The duo began by taking two hours of images of the model from every angle in order to reconstruct it. «They rearranged the photos and recovered a cloud of points to reconstitute a volume, which was then post-processed to insert the fixing functions,» explains Nicolas Piton, head of the prototyping platform who accompanied the two students. The base was one of the topics of discussion. «We were very focused on the technical aspects and the attachment system, while the museum had an aesthetic vision. We had to speak the same language so as not to alter the integrity of the work or add elements. Finally, the nine 3D prints of the hermes head-dresses were launched at the UTC's Fablab, each lasting 40 hours. «Combining art and technology is interesting, concrete and outside the UTC framework», says Mélissa Rousson-Marchand.

For Nicolas Piton, working with the art world is nothing new: «We've already worked with the Espace Jean-Legendre, for example. As the Fablab is the UTC's only prototyping platform, I have a global vision of the projects that I support in terms of teaching, research, industrial development, start-up creation, etc. There are around a hundred projects a year. A connected football table is among the project currently underway, just as the Fablab is currently working with a local manufacturer in the luxury goods sector.



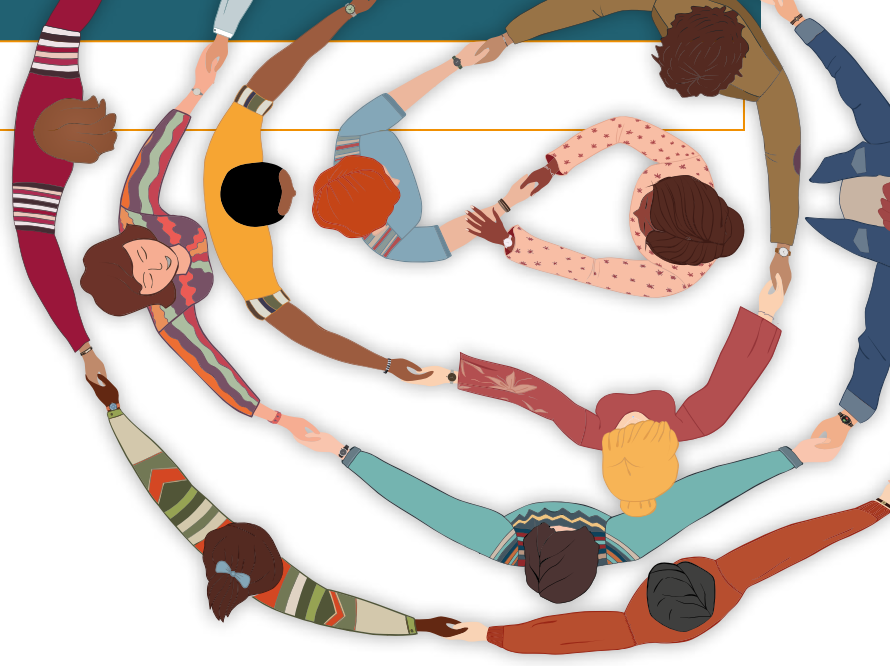
## Partnerships for mutual benefit

The engineering work carried out by the students encourages a professional approach through an interactive project with the outside world. This allows us to ask ourselves the right questions and never forget our objectives, which may be different,» emphasises Emmanuel Doré, a lecturer-research scientist in Mechanical Engineering who supervised the two Utrecht students. The UTC's strong presence in the region enables us to position ourselves at events and to highlight possible and virtuous collaborations. Partnerships are the common thread running through the teaching programme as a means of developing both technical and intercultural skills in response to a commission. Art is possible through technological diversion, using the tools, software, resources and methods of the UTC, which provides training in construction methodologies and the geometric modelling of mechanical parts,» explains Emmanuel Doré. For the museums of Compiègne, located in the same local ecosystem, the influence is mutual. In the context of the renovation of the Musée Antoine-Vivenel, its ambitions and the limitation of financial costs, the focus on new technologies and the possibilities they offer is important,» continues Delphine Jeannot. Today, we can no longer do without this knowledge. For the general public, it's also a real attraction. » ■ IL



## SOCIAL COMMITMENT

# A month to reaffirm equality



Awarded the prize as the most active school in 2023 at the 13th edition of Les Ingénieuses for organising its first Equality Month, UTC repeated the event from March 14 to April 15. This provides an opportunity to remind everyone of the progress that has been made, but also the progress that still needs to be made, in terms of discrimination, gender equality and the fight against sexual and gender-based violence.

**S**tereotypes still die hard when it comes to gender equality. The Month of Equality at UTC highlights the university's strong commitments here, and was rewarded with the prize for the most 'mobilised' school in the CDEFI's Les Ingénieuses competition (Conference of Directors of French Engineering Schools) in 2023. This Equality Awareness project, initiated by Marie-Hélène Abel, head of UTC's IT department and equality coordinator at UTC, «has taken up the principle of conferences, round-table discussions, workshops and live broadcasts on social networks, but with more events focusing on the sciences». The



programme includes three workshops led by the student association Stop VSS (Sexist and Sexual Violence), promotion of science in secondary schools by the association Sciences égales, sketches based on discriminatory situations performed by Profit'roles (UTC's theatre association), internet "lives" on building a working relationship and disability, a round-table discussion with women managers (see box)... Rich, interactive and constructive, Equality Month opened with a lecture by Camille

Van Belle, science journalist for Science et Vie junior, on the theme of «How history dismissed women pioneers of science! «and an exhibition of illustrations from her comic strip Les oubliés de la science.

### 3 QUESTIONS TO MARIE-HÉLÈNE ABEL, ACADEMIC DELEGATE FOR EQUALITY AT UTC



**Why is the Equality Month important?**

This month was initiated with the help of colleagues who contributed to the content and involved all UTC, which is very committed to the issue. The prize for the most committed school in 2023 was very encouraging. This month facilitates

exchanges and tackles equality in the broadest sense, in order to raise awareness of discrimination occurrences in everyday life. The abolition of all types of discrimination, the promotion of gender equality and co-education in engineering courses and professions are just as important as attracting young girls to this sector and to gendered positions of responsibility. They must be daring!

**What is the distribution of enrolments at the UTC?**

UTC is lucky to have 52% girls and 48% boys enrolled in the first year. With the two years of core courses, this figure remains balanced at 50.32% girls and 49.68% boys.

**What other examples of action is UTC proposing?**

With the Sciences Égales student association, we are planning a workshop in primary schools in priority areas to introduce algorithms to the pupils. The aim is to break down stereotypes, such as the belief that computing is the preserve of male geeks. If these workshops work, we will adapt them for nursery schools. Regardless of gender, social background or societal formatting, we need to enable everyone to see themselves in the fields of science, with the same opportunities and to open fields of possibilities. ■ KD

### Out of the shade, into the light

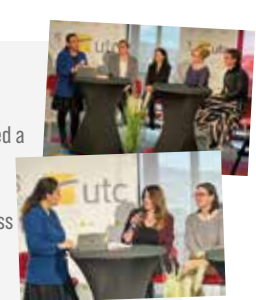
Not by omission but by racism and ordinary sexism, Vera Rubin, the American astronomer who consolidated the existence of dark matter, the British Rosalind Franklin, the pioneer of molecular biology who formulated the structure of DNA and the British Ada Lovelace who created the first computer programme, have remained in the shadows. Usurped works, erased from the collective memory, these women whose «work is not anecdotal», Camille Van Belle points out, are brought out of oblivion by the humorous pencil strokes of the thirty-year-old, «so that they continue not to be forgotten». The comic strip Les oubliés de la science, published in 2022, does justice to «the women who have made history and overcome many societal obstacles, such as access to universities. The argument that women don't have enough self-confidence is false. Today, things have changed. The feminist movement and the liberation of speech have contributed to this, just as awareness and mea culpa have enabled more Nobel Prizes to be awarded to women in recent decades».

### Banning violence

In order to shed light on the mechanisms that lead to sexual and gender-based violence, which

### AN INSPIRING ROUND TABLE

On Thursday, March 28, the UTC hosted a round table discussion on the theme of inspiring women leaders. The speakers were Céline Anciaux, Business Development Manager at Brézillon, Alicia Bailon-Plaza, Customer Services Engineering Director at Renault Group, Emmanuelle Hardy, Director of Heritage and Logistics at UTC and Sophie Sellier, Sales Manager for the Industry market at Sopra Steria. They were able to talk about their career paths as part of the Equality Month organised at UTC. It is an inspiration for the younger generations. You have to be daring, act like a warrior at times, know how to assert yourself and not forget the soft skills that often make all the difference,» emphasised Alicia Bailon-Plaza. And it's true that it's good to be an engineer to face up to the many challenges that await you as a woman in the professional world. There's still a long way to go, but things are moving forward for women and diversity in the business world.



For a replay version of the round table, scan the QR code



is often modelled on the reproduction of a patriarchal system, the Stop VSS association, which has been involved at UTC since 2020, has organised interactive workshops dedicated to students who are confronted with these issues or who wish to delve deeper into subjects such as domestic violence and inclusion. A prevention and awareness-raising module set up in 2022 and funded by the Contribution de vie étudiante et de campus (CVEC) and the French Ministry for Higher Education, has led to the creation of a listening and reporting unit. «A dissuasive measure that raises awareness and limits the problems,» says Clara Jean, president of the Stop VSS association. The UTC has also contacted the VSS Formation network, an external organisation responsible for training and raising awareness in higher education and research. «Last semester, nearly 500 people were trained. Since February, training courses have become compulsory for all new students. ■ IL



RESEARCH

# The hepatogram: measuring liver rigidity

Sabine Bensamoun is a research director at the CNRS and works in the CNRS/BMBI joint research unit at UTC. She is also a research associate at the Mayo Clinic (Rochester, USA) and a member of the CNRS National Committee (CoNRS). With Dr Fabrice Charleux of ACRIM, she took part in the international liver study that led to the hepatogram.

**In practical terms?** «Until now, to analyse the level of rigidity of the liver, a doctor would prescribe an examination of the organ using the magnetic resonance elastography (MRE) technique. From 2024, as with an electrocardiogram, doctors will be able to prescribe a hepatogram, a name that will be approved in 2023, for a specific examination of the liver. It's a quick, non-invasive test that provides a more accurate diagnosis. MRI gives a purely anatomical image of the organ analysed, whereas MRE gives us an image that indicates the degree of rigidity of the tissue analysed,» explains Sabine Bensamoun.

The story of MRE began when she returned to France after her post-doc at the Mayo Clinic, a world reference in medical research. She joined the CNRS and continued her collaboration with the Mayo Clinic, where a module had been developed which, coupled with MRI (magnetic resonance imaging), aims to better characterise the mechanical or functional properties of soft organs, including the liver. This is known as magnetic resonance elastography (MRE). This was not available in France when it was introduced in 2006. According to Sabine Bensamoun, what does this technique offer compared with other imaging techniques? In particular, it enables us to obtain a better diagnosis

of the severity of pathologies, improve patient follow-up and, lastly, personalised treatments, etc.». All that remained was to validate the MRE clinically..

The UTC is one of ten research centres selected by the Mayo Clinic worldwide, and the only one in France, to benefit from this module. It was still to be coupled it to an MRI machine. «I got in touch with Dr Fabrice Charleux, a radiologist at ACRIM and told him about my plans; he was interested, particularly by the research aspect. At the time, he was working on General Electric machines, which proved opportune and useful because the module developed by the Mayo Clinic, which was only a prototype, only worked with this type of machine. For more than 10 years, I continued to improve the protocol I had first developed at the Mayo Clinic on muscle tissues, in particular for the disorder known as Duchenne muscular dystrophy and muscle ageing», she points out.

After years of research, the data collected from all over the world was analysed at the Mayo Clinic.



DR. CHARLEUX ET SABINE BENSAMOUN

For all the parties involved, including UTC and ACRIM, the gamble paid off. The result is the MRE, a non-invasive diagnostic tool for analysing the entire liver to establish the stage of fibrosis.

And what is your interest in the human liver? «In fact, the Mayo Clinic continued to improve the module for future

commercialisation. At the time, they were working extensively on the liver organ and wanted to have broader sources of data. To do this, several research centres had to be equipped with this new module. As far as we were concerned, we started working on the liver, but with the former module,» she says.

How does an MRE work? «If we take the liver as an example, we can see that the more diseased it is, the more rigid it becomes. Thanks to MRE, we can quantify the organ's rigidity, with stages ranging from one to four, the highest indicating liver cirrhosis (4). The module takes the form of a box fitted with a speaker that sends low-frequency air pressure through a stimulator that is placed on the tissue to be analysed. The movement of this low-frequency vibration is then monitored and, depending on the speed at which the wave propagates through the organ concerned, the degree of severity of the pathology can be estimated. It's a real alternative to biopsy,» describes Sabine Bensamoun.

Of all the soft tissues, the liver is currently the one where MRE is performed as a routine clinical procedure. In the United States, more than 100 000 examinations, now known as hepatograms, were carried out in 2023, and more than 2,300 new-generation MREs have been installed worldwide, including the one at ACRIM.

What's next? «Our expertise in fibrous pathological tissues (muscle, liver) was invoked during the COVID-19 pandemic. We are already working on a clinical protocol applied to lung tissue,» she concludes. ■ MSD





## A look at the **‘chemistry’** between “E=M6” and UTC

The biomechanics of human body movements, the preservation of charcuterie, out-of-date meat, the properties of rusks - these are just some of the subjects on which UTC is often the setting for the popular science TV programme “E=M6”, hosted by the iconic French TV presenter and producer that every family in France knows: Mac Lesggy. Let’s meet him!

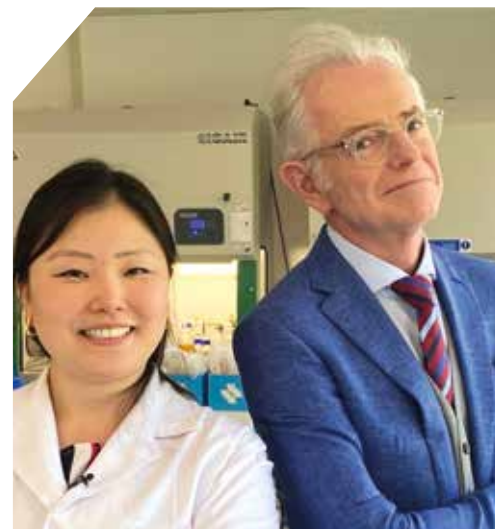
**M**irian Kubo, a lecturer-research scientist in the Department of Chemical and Biological Engineering at UTC, is the regular expert who answers popular science questions on the E=M6 programme hosted by Mac Lesggy. The French television presenter and producer, whose real name is Olivier Lesgourgues, trained as an agricultural engineer. He has produced and presented the programme E=M6 since 1991, which won the Grand Prix de l’Information Scientifique in 1995, awarded by the Académie des Sciences, as well as the “7 d’or” for «best educational programme» in 2001. Author of several books, including *Le corps humain* (2005), *Les chiens et les chats* (2006) and *L’histoire au quotidien racontée aux enfants* (2016), Mac Lesggy is the central character of this family science magazine par excellence. For several generations now, M6 has been providing a fun way to learn through visual experiments, testimonials and insights from specialists who answer the questions that everyone is asking. «Over two million viewers tune in every Sunday evening. Parents let their children watch the programme before going to bed. And those same parents watched it themselves when they were children. My leitmotiv has remained the same: to make a serious programme without taking itself

too seriously. I’m careful not to be pontificating. It’s a programme for curious people who like to learn. Which is totally what I do,» confides the 61-year-old presenter, who doesn’t hesitate to give of himself and regularly finds himself in awkward positions, on ice skates, on a trapeze, or wearing the suit developed at the UTC’s Biomechanics and Bioengineering Laboratory (BMBI), which works either in an obesity mode, i.e., in an overweight situation or in ageing simulation with reduced visual and auditory acuity.

### The world seen through the magnifying glass of science

«UTC is a school that really fits in with this TV programme. Unlike other schools, UTC’s teaching and research are focused on a wide range of applications. Its experts know how to help us decipher our everyday environment and the world around us in a scientific way,» adds Mac Lesggy, who believes that science has a lot to teach us.

For him, engineers are the right people to talk to in this constantly changing world. «Technology and science are advancing fast. Take artificial intelligence, for example, which is revolutionising every field. Engineers have the curiosity and open-mindedness to keep pace with progress,» he concludes. This is a real opportunity for well-trained engineers. Our companies need engineers more than ever. For his part, Mac Lesggy and his teams are continuing to prepare new programmes on increasingly interesting subjects such as: why do we have pins and needles in our legs or white hair, or how to clean the machines that clean. «We’re also thinking about a programme that would explore prehistory and see what we know about early man”. It should be enough to bring parents and children together again on the sofa in the living room on Sunday evenings at 8.25pm... on TV channel M6. ■ KD





### 3 QUESTIONS FOR...

**VÉRONIQUE BÉRÉZIAT, PROFESSOR VÉRONIQUE BÉRÉZIAT, CHAIR OF PHYSIOLOGY AT SORBONNE UNIVERSITY ALLIANCE**

#### Tell me more about UTC's "Winter School"?

It's a wonderful and highly rewarding cooperation between UTC and Sorbonne University Alliance. It provides two weeks of hard work that have resulted in the development of innovative and healthy food products. This is a long-standing collaboration with Prof. Claire Rossi to offer teaching on the theme of food and health at UTC. Over the course of our interactions, as Claire Rossi had set up a Summer university with more or less the same format, we thought it would be very interesting to be able to set up something similar. Thus, for almost two years, we prepared a project that we submitted to the Sorbonne University Alliance. This is also the objective of having a Sorbonne University Alliance. It encourages interaction and we can take advantage of each other's facilities to train our students for excellence in every field. Consequently, this teaching is really part of the educational contract for the apprentices we register each year. We hope to secure long-term funding and continue to offer these courses with UTC.

#### How did the project come about?

We have a course called Nutrition, Health Quality within a Master's degree in Integrative Biology and Physiology at Sorbonne Universities. In this course, students are trained in questions pertaining to food safety, nutritional communication and nutritional innovation and we wanted to set up an apprenticeship version. In the traditional pathway, students choose a specialisation and in the apprenticeship pathway, we want to train them in all three areas. What was missing from the training we were offering was expertise in nutritional formulation. That's why we set up this Winter School on Training and Innovation in Nutrition. We had sufficient funding to welcome the students and pay for their accommodation. They were provided with food and lodging, as well as having all UTC facilities at their disposal. This winter saw the first intake of students, small in numbers, but that was by design. The time was ripe to get things up and running and to be able to do enough publicity to recruit more and more apprentices.

#### What is the added value of this teaching?

The added value of this course is that it looks at the relationship between food and health. From a theoretical point of view. We also give them innovation projects in which they can imagine either the foods of tomorrow, or start-ups to create these new products. They were able to test their ideas using UTC equipment. In fact, what we really want is to professionalise them and enable them to touch on the aspects of innovation in nutrition in the theoretical parts, which are even stronger at UTC than what we give them at Sorbonne Université and, above all, the practical part using the technology intensive equipment that exists already at UTC. It also enables them to think about the harmful side of ultra-processing and to develop new recipes that could be made at home, that combine food and health aspects. ■ KD



### WINTER SCHOOL

# Winter is cooking

From January 29 to February 9, 2024, UTC hosted the International Winter School in Food Engineering and Nutrition, taught in English and dedicated to innovative food formulation and nutrition.



Developed as part of the Innovation, Food, Agrosources (IAA) Biological Engineering specialty course at UTC, students from the Nutrition, Quality and Health master's degree in Integrative Biology and Physiology at Sorbonne University (SU) and others from the UTC's international partner universities were able to take part in the Winter School in Food Engineering organised at UTC from January 29 to February 9, 2024. The Université de Technologie de Compiègne and Sorbonne Université had proposed the theme «food engineering school». On the programme for the participants: the latest knowledge in nutrition and the science of gastronomy, approached from a theoretical point of view, but also and, above all, from a practical point of view. It was a highly rewarding experience, and provided new ideas that may one day find their way onto our plates.

#### THE OPINION OF JULIA LENTIN, AGED 25, A MASTERS STUDENT AT SORBONNE



Julia Lenin specialising in health and quality nutrition with a view to becoming a health, hygiene and safety quality manager in the agri-food industry.

«What I've learnt from this experience is that making a product is no easy task. We experimented a lot during the practical work on texturisers, what can be used to replace sugar and fat, and I realised that this requires a lot of trials, failures and numerous tests. We tinkered with fibres and proteins. And using one or the other doesn't give the same result at all. It was quite challenging. With my group, we created 'compotes' and 'purées' based on sweetened vegetables, with senior citizens as the main target consumers».



Funded by the Alliance Sorbonne Université (ASU), this Winter School is another fine example of an innovative joint project between UTC and Sorbonne Université. «Yes, I would remind you that UTC is a member of the Alliance Sorbonne Université (ASU) and that we want to be even more inclusive, proposing new formats and combining our skills to offer something innovative to all our students and partners,» says Prof. Claire Rossi, President and Executive Vice-Chancellor of UTC, responsible for the international winter school programme on food engineering and nutrition. The school's theme is fully in line with the SOUND project, «Sorbonne University for a New Deal», co-constructed with Sorbonne University and the partners of the Sorbonne University Alliance. The approach used in this Winter School is a combination of theoretical courses, workshops and project-based learning. Teams of participants were able to develop an innovative food product over the course of two weeks, with the aim of presenting a prototype at a final “defence” in front of a jury made up of members of Sorbonne Université and UTC. The teams were supervised by Biological Engineering teachers, experts in the field of food science and food innovation.

### An innovative combination of food science, nutrition and French gastronomy

The latest trends and knowledge in gastronomy and nutrition were covered in theory and applied in practice to the preparation of famous French dishes with an added touch of health. «This international winter school is an original blend of food science, technology and French gastronomy. The programme involves learning how to improve the level and nutritional profile of food products, by modulating their composition, textures and cooking methods, while retaining as much of the flavour and nutrients of the original ingredients as possible. The aim of the course is to provide a theoretical and practical overview of the development of food products using a reasoned formulation approach,» explains Mirian Kubo, head of the Food and Agrosources Innovation programme and lecturer-research scientist at UTC. Innovative technological solutions were presented and applied to prepare healthier versions of world-famous food specialities. «The theoretical

#### A CRUNCHY CHOCOLATE AND PEANUT CAKE FOR TOM LAPERCHE

The cakes were developed for skipper Tom Laperche by five Biology Engineering students: Amandine Guillou (Bio-Engineering major - specialty IAA course), Anais Sanchez (Bio-Engineering major ), Idriss Ait-Tahar (Bio-Engineering major specialty MPI course), Manon Langelez (Bio-Engineering major IAA course) and Socheata Duk (Bio-Engineering major IAA course). This project was carried out as part of the BT07 UV (Formulation, Innovation, Nutrition) and supervised by Claire Rossi and Mirian Kubo. The cakes were sources of proteins and were rich in fibre. The aim of the project was to provide Tom Laperche with a sweet snack that he could eat every day on his boat for the Arkea Ultim Challenge, a fifty-day solo round-the-world race on a giant trimaran. «This



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snack also had to be interesting from a nutritional point of view, taking into account the fact that Tom Laperche is making a regular physical and mental endurance effort. First of all, we drew up a specification for our product based on Tom Laperche's requests. We then produced several prototypes by

mixing different protein flours, a low Glycemic Index sweetener, eggs, fibre, oilseeds and chocolate. The prototypes were sent to Tom Laperche so that he could taste them and give us his initial opinion,» explains Anais Sanchez, a student in biological engineering. Following his feedback, we optimised our biscuits, particularly in terms of texture (cooking time and thickness). The final product is rich in fibre, a source of protein, contains good lipids and has a chocolate/peanut flavour, with a Nutriscore C. They were packaged in batches of seven to reduce plastic packaging as much as possible and the packaging was vacuum-packed to preserve all the organoleptic properties of our product.



part covered the physico-chemical processes involved in the production of food products, the biochemical, nutritional and functional aspects of ingredients, the various texturing agents and the latest innovations in offering substitutes for diets that are too rich in saturated fats, sugars and foods with a high glycaemic index, among other things. All these concepts were put into practice during the workshops organised in the afternoon,» she adds. Chef Ludovic Colpart, chef and owner of the Auberge du Pont restaurant in Rethondes, came along to lead a lemon meringue tart workshop. Participants were able to discover French gastronomy through the preparation

of typical sauces, dishes and desserts, such as “macarons”, with an added healthy touch... while applying innovative approaches to food formulation. ■ KD

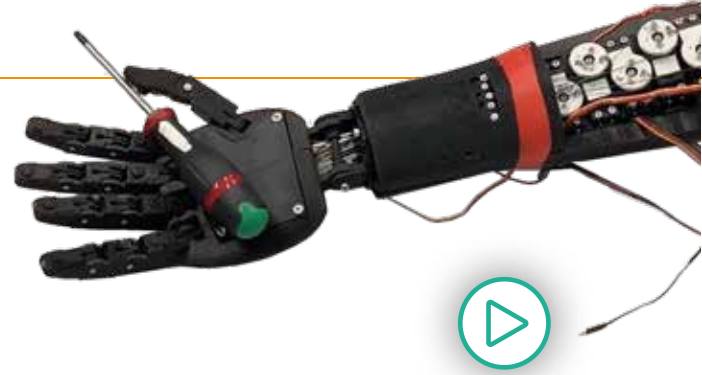


To see the Winter School video, scan this QR code



*The programme involves learning how to improve the level and nutritional profile of food products, by modulating their composition, textures and cooking methods, while retaining as much of the flavour and nutrients of the original ingredients as possible.*





STUDENT PROJECTS

# TN25 gets to grips with biomechatronics

From design to manufacture, the biomechanical hand prototyped at UTC is the concrete expression of the new TN25 CC project, at the end of the Integrated Mechanical Design course (bac+5), for an experimental and mechatronic implementation of the skills acquired in various courses.

**R**eproducing the functionalities of a hand and its complex system of movements using mechatronics - a synergistic and systemic combination of mechanics, electronics, automatic control and information technology - is the confrontation with a real case in a constrained environment undertaken during a semester (from September to January) by two groups of seven students supervised by seven research scientists and engineers from UTC\* specialising in mechanics, electronics, manufacturing systems, sensors, signal processing and control. "This is the first time that we have offered this CC course, which is linked to technological developments and the identification of new needs and skills acquisition by the companies with which we have partnerships," stresses Laurent Petit, lecturer at the UTC, who supervised the project with Hani Al-Hajjar, also a lecturer at UTC. The prototyping and experimental aspects characterise this CC, which is an extension of the work carried out by the lecturer-research scientists on the study of micro-mechatronic and micro-robotic systems. This implies real

interactions. The aim was to interest students in the design of complex systems and to make them aware of the integration of functions in a collaborative and experimental implementation».

## From simulation to application

The biomechanical hand was an imposed challenge that required «reflection on the functional complexity of a hand and its movements», explains Hani Al-Hajjar. The two groups came up with two different solutions, one of which incorporated more actuators in order to translate gestures more accurately. "The challenge was to accommodate a multitude of components in a small space. How do you arrange them so that they don't affect the function to be performed? How do you manage the connections so that they don't interfere with movement? How do you integrate temperature and pressure sensors at the fingertips to detect and squeeze an object and identify the presence of a heat source to prevent degradation? Producing a prototype means understanding situations and aspects that cannot be simulated, managing a

project in real time and reviewing the design to meet requirements. «We weren't looking for innovation, but for a way to take into account the integration of technologies and functions, to become aware of the feasibility of the project within a given timeframe, with the resources available, in particular the 3D printer specifically acquired by the UTC to manufacture the parts that the students would need. That's what our teaching method is all about», explains Hani Al-Hajjar. A second session of the UV TN25 is planned for the start of the new academic year, especially as the enthusiasm of the students for the application of their skills is fuelling the prospects. The biomechanical hand could be used in other courses as a case study for systems design and simulation. ■ IL

\* including Muneeb Khan, research engineer in charge of the micro-mechatronics platform at UTC's Roberval laboratory, Erwan Dupont, lecturer-research scientist in the Mechanical Engineering department and working at UTC's Roberval laboratory, Christine Puelle, professor in Mechanical Systems Engineering at UTC's Roberval laboratory, Nicolas Piton, head of the UTC Fablab and Frédéric Lamarque, Director of Research, UTC.



# "Made in UTC" sound design on Radio France



Last January, Enora Labidurie and Carmen François, students in Mechanical engineering, won the Radio France sound design prize for their multichannel Olympic Games jingle, organised for the first time during the international biennial Le Mans Sonore.

**T**he jingle lasts just a few seconds and will be broadcast on Radio France as a preamble to programmes devoted to the Paris 2024 Olympic Games. The multichannel sound creation devised by Enora Labidurie and Carmen François, Mechanical Engineering students at the UTC, won over the jury and was awarded the Radio France Sound Design Trophy, presented for the first time at the international biennial event Le Mans Sonore last January. This was a great recognition, and a real challenge that the two UTC students tackled with flying colours as part of their DS01 Sound Design course in the autumn. «This competition was a real plus in terms of our course. We had strict specifications, with no recognisable vocals or harmonic sounds,» explains Carmen François. Movement, momentum and

energy were the three key words we were given to create a concept. Enora is a great designer. As for me, I've been making music since I was a child and that helped me to formalise the sounds we created, layered, refined and worked on in the studio. The line may seem complex but it's still very understandable. The software we used helped us to grasp the notion of perception.

For Nicolas Dauchez, Director of the Mechanical Engineering department, and co-initiator with Arthur Givois of the Acoustics and Vibration for Engineers specialty course, and sound designer and musician Christoph Harbonnier, of the Acoustics and Vibration for Industrial Design Engineering specialty course, «this competition was an opportunity to apply our knowledge in real time and space, which best suited our project. Creating sounds

means meeting a set of specifications, defining your intentions, working on your vocabulary... First you have to sketch out the subject, then classify a score of events over time according to different frequencies, draw up a sound guide and think about how to implement it. In their creation, Enora and Carmen have, for example, imagined the "sound" of the Olympic flame. It means something and it makes sense. Their spontaneity and fresh approach won over the jury. Competing against specialist engineering schools and professionals, it was a bit of a surprise and quite incredible». Between now and April/May, the duo, whose skills have proved to be highly complementary, will visit the Radio France studios to rework their creation so that it can be broadcast. UTC female engineers "in the starting-blocks", so to say ! ■ IL

UTC FONDATION FOR INNOVATION

# Changing the world by changing the way we look at innovation

The partnership Foundation and Founding members Group Saint Gobain and Sopra Steria are working hand in hand with UTC to support scientific excellence, in particular via the «Social Awareness and Innovation» Chair. **The aim is twofold: to broaden social awareness within UTC, but also to have an impact on technological innovation within the Region's industries.**

In the French academic landscape, UTC occupies a prime position in terms of technological innovation. UTC's slogan is to «lending meaning to innovation», invites reflection on the conception, design and future of technology. The question of the social composition of the groups involved in these innovations all too often remains a blind spot in innovation-oriented studies in France. The «Social Awareness and Innovation» Chair proposes to focus particularly on this issue and to experiment with concrete actions. In scientific terms, the Chair headed by Michaël Vicente, lecturer in sociology at UTC, with other members of UTC's Costech laboratory. Alexandre Longa, a research engineer, has been recruited to coordinate the Chair's work. «We have ongoing activities with platforms such as UTC's digital hall and the fab lab. The players also include institutions. We are already working with around ten secondary schools, and other collaborations are being developed throughout the Hauts-de-France Region and in the Seine-et-Marne Department. The financial backers, viz, the Hauts-de-France Region, the bank Crédit Agricole Brie Picardie Foundation and the UTC Foundation for Innovation, are also involved in these initiatives,» explains Michaël Vicente. The aim of this Chair is to develop a series of research-action projects on the role of social awareness in innovation contexts. The aim is to highlight and describe the mechanisms that link social

awareness and innovation, in their historical, statistical and experimental dimensions. The aim is to develop this type of research and make it visible internationally.

## An impact on the social diversity of students

This Chair will be based on three pillars: awareness-raising, support and action research. This type of project will require the introduction of awareness-raising measures in secondary schools, which could be coordinated with the work carried out by the «cordées de la réussite». This could be done by mobilising students or former students to work in local establishments. The five-year objective is to have a real impact on the social diversity of students. «The support dimension will involve either the introduction of specific modules or a reinforced tutoring programme and will be aimed at more specific and voluntary monitoring of the new cohorts integrated: monitoring of the fundamentals (Mathematics, Physics), but also mastery of the French language and writing. All of these actions will be in support of and in line with existing actions within UTC. From a pedagogical point of view, the aim is to put technology at the heart of the educational system,» he adds.

## Thinking about the plurality of possibilities in innovation processes

Here, innovation is seen as a factor in the economic and social development of a given Region. Some economists estimate that an increase of between 1 and 1.55% of GDP in annual growth could be achieved if innovation professions were made more widely accessible (Jaravel, 2023). «The aim of this Chair is to understand the obstacles to this democratisation and to propose ways of encouraging it. The aim of the project is to develop workshops to encourage people to become engineers, particularly those from disadvantaged backgrounds, rural areas or women. Our ambition is first and foremost to understand. It's about understanding why disadvantaged people don't apply, or don't apply



### WHAT DOES THE FUTURE HOLD FOR

### THIS CHAIR FUNDED BY SPONSORSHIP?

«Since we recruit people from all over France, we want to extend our activities nationwide. More specifically, next year we will be starting a series of more experimental projects with BTS classes. Very few of them apply to our schools, and even fewer join us at UTC. Over and above questions of skills and training, we think it would be interesting to look at the way in which our students and BTS students pose problems and perceive innovation, what solutions are envisaged, and who these innovations are aimed at in particular. This Chair is financed by sponsorship, which means that we need ongoing funding to maintain our activities. We're delighted to be working with our current partners, but we'd also be delighted to collaborate with other local players or with other companies and institutions where our alumni work,» concludes Michaël Vicente. This would be an opportunity for them to maintain their links with the school and contribute to its influence and development.

very much, for admission to our schools and to UTC in particular. The longer-term ambition is to ensure that there is greater social diversity at UTC, even though we know that this is a long-term task. That's one of the reasons why we're involved from secondary school onwards. After all, a vocation and ambition for education are forged quite early on in life. ■ KD



MICHAËL VICENTE



DELPHINE KERVAREC-VICQ

# «Our professional lives are built, step by step»

Delphine Kervarec-Vicq, 50, is Director of Functional Safety with the Valeo Group. She graduated from the UTC in 1996 majoring in Mechanical Engineering, and she believes that she now has a job to do in the field of safety, where 'argumentation' plays an important role.

**D**elphine Kervarec-Vicq has accumulated over 28 years' experience in the automotive industry. She began her professional career as an NVH (noise vibration harshness) engineer at General Motors and then held various executive engineering positions with the Renault Group, working on technical aspects, regulations, quality assurance on ADAS (automated driving assistance systems), operating safety and general product safety. «I joined the Valeo Group in March 2023 as Director of Operational Safety. I graduated from UTC with a degree, majoring in Mechanical Engineering and specialising in Acoustics and Industrial Vibrations, and also have an MBA in business law from the Law Faculty, rue d'Assas, Paris. In my final year, I wasn't sure whether I wanted to study engineering or business. As UTC also offers an education rich in the humanities, I opted for this university, convincing myself that I could always do something else afterwards, whereas the reverse is not possible. I also liked mathematics and abstraction,» says the engineer who has spent her entire career in the automotive engineering sector. She soon realised that working in acoustics and vibrations wasn't for her, but that she much more enjoyed managing technical issues. «I was passionate about technical and legal issues. I was very lucky at Renault because they allowed me to progressively move into this sector. And when you're in the right place, you flourish, so you perform well.... Technical regulations were a real revelation for me, as someone who loves words. Naturally, I was very enthusiastic about the general safety of the product. In her spare time, she enjoys climbing and meditation. «Meditation to get to know myself and climbing for both body and mind.

## «UTC is the engineering school of my heart».

One of her strongpoints is that she understands what is at stake in a large company. «I was the right-hand (wo)man to a big boss at Renault. I understood what a manager expects from a very good technical presentation in order to make the right decisions. The quality of a decision already depends on the quality of the dossier presented. After that, I wanted to go back to the technical-legal side and focus on general product safety. After a few years in management,

I was appointed Expert Leader, Operating Safety and General Product Safety, and then I was "poached", in essence, by the Valeo Group to become their Director for this area. I'm delighted to have developed in this way, because it calls into question some of what I had to call my certainties,» confides Delphine Kervarec-Vicq, who is always eager to learn new things. The automotive sector in which she has been working since graduating from UTC comes precisely from her engineering school placements. «If

I'd done an internship in aeronautics, I might still be in aeronautics today. I think that our work placements as students at UTC, which will always remain the school of my heart, predispose us to our future careers. So yes, in this sector I've had to deal with sexism, but that hasn't stopped me from evolving. Things are changing and today there are a lot of mentoring programmes for women. If you want a pay rise, you have to know how to ask for it... just like our male counterparts do,» continues the woman whose motto in life is «do well, be happy and share». Yes, I do my best to instil this vision in my two teenage children and my colleagues. Nothing is impossible if you're in the right place, the place that suits you and makes you tick. Good vibrations here again ?... ■ **KD**

### BIO EXPRESS

- 1996: Graduated from UTC, majoring in Mechanical Engineering (UTC-ME)
- 1996-1998: Test and Quality Engineer with General Motors Inc.
- 1999-2023: Renault Group: Acoustics Engineer (1999-2005) - Production Regulatory Compliance Team Manager (2005-2010) - Head of Functional Safety and General Product Safety Department (2011-2021) - Lead Expert in Functional Safety and General Product Safety (2021-2023);
- 2023: Director of Functional Safety at Valeo.



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## AGENDA

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