

NEW  
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ACADEMIC YEAR  
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# Interactions

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## EDITORIAL FROM THE PRESIDENT'S DESK

The health crisis that we have endured for the past two years has highlighted the importance of our health and, more specifically, of public health issues. Everyone agrees that health crises like the one we have experienced will be frequent in the future. But other major public health issues are foreseeable. We can mention the ageing of the population – by year 2050, one person in three will be over 60 and one in ten over 80 – or the galloping obesity problem, due to an increasing sedentary lifestyles, especially among the younger generations. Statistics show that the 15-25 year olds walk less today than the 55-65 year olds. Encouraging young people to take more exercise, for example, and preserving one's autonomy when ageing for as long as possible are reasonable objectives. In both cases, the environment and modern lifestyles have an important role to play. But this may not be enough. Thus, it is the medical and biomedical advances underway that can help here. Research that focuses as much on prevention, thanks to predictive models, as on health related body and organ repair.

UTC, a pioneer in biomedical technologies and today a leader in France, contributes to progress here, with its partners, on its own scale. Our research scientists are working on tissue reconstruction for example, others on models intended to mimic the functioning of certain natural tissues and organs or the design of devices intended to repair a heart approaching failure. In the future, it will be possible to reconstitute muscles, tendons or bones with properties that are almost identical to those of the human body. We could also check the effectiveness of drugs by testing them directly on devices known as 'Organs-on-Chips' that mimics a liver, a kidney or a pancreas, thus avoiding in vivo animal testing. We can perceive here the outlines of the medicine of the future as they develop.

**Prof. Christophe GUY**  
Executive Director, Principal & Vice-Chancellor

## PORTRAIT

# Broadening my horizon

After 15 years as their Chief Executive Officer, Jean-Louis Chaussade became Chairman of Suez in 2019. **In 2016, he was co-opted by the UTC's Academic Board of Directors and appointed President.** His mandate was renewed in December 2021 for a period of 4 years.

*"It's about making sure that the board works according to the rules; that all the board's stakeholders listen to and understand each other and to involve the whole board in the UTC's strategic thinking about its partners."*



**W**ith a father who was a Government Prefect, he naturally moved houses around a lot during his childhood. First it was Châlons-sur-Marne where he was born, then Algiers where his father was appointed Secretary General of Algeria, Montpellier and finally Rouen. Raised by the Jesuits in the town of Sarlat (Dordogne), the country from which his family came, Chaussade's father wanted the same type of education for his son. His parents therefore opted for the private La Providence Lycée in Amiens. A point in common with the E Macron, President of the French Republic.

After seven years at boarding school and two years of preparatory classes, Jean-Louis Chaussade entered the École supérieure de travaux publics (ESTP) in Paris. "In 1976, my last year of engineering studies, I wanted to broaden my horizon by preparing a master's degree in economics at the Sorbonne," he explains. From then on, his horizons never ceased to expand. After his military service, he was hired in 1978 by Degrémont, a company specialised in water treatment, which later became a subsidiary of the Suez Group and saw him as expatriate to Jamaica for a year. Upon returning to France, he decided to study at "Sciences Po", graduating in 1981.

From that pointy on, his career really took off. He became successively project engineer and manager of the Group's international subsidiaries, and once again sought and found more new career paths. "Following an ETA firebomb explosion that destroyed everything – no more plans, no more accounting, etc. – in our subsidiary in Bilbao, he decided to take the plunge. – I was called in to restore some degree of order and get the situation back on a more stable footing," he explains.

Mission accomplished, Jean-Louis Chaussade set off again for new horizons and became, in a way, a "Mr. Recovery" for companies that were going downhill. "After Bilbao returned to normal, I was called to Barcelona to salvage Dumez Copisa, subsidiary of the Dumez group in Barcelona, which had just merged with Lyonnaise des Eaux," he says. "In 1997, we headed for South America. First it was Argentina, where the group had won the water distribution and sanitation contract in Buenos Aires, to which the concessions in Cordoba and Santa Fé had just been added. But little by little, the scope of my responsibilities was extended to other South American countries such as Bolivia and Chile," he points out.

Returning to France, in 2004 he became managing director of Suez, upgrading this group into a company listed on the CAC 40 (top 40 on the Paris Exchange) in September 2008 before finally being appointed their chairman in 2019.

What is his vision of his role as Chairman of the Board? "It is to ensure that the Board functions according to the rules; that all the stakeholders of the Board listen to and understand each other and to involve the whole Board in the strategic reflection of UTC in regard to its partners – the Hauts-de-France regional authorities, the other French Technology intensive Universities (UTBM and UTT), the Sorbonne University Cluster, etc. –, its internationalization, the integration of sustainable development or AI and big data in the curricula". In 2016, Jean-Louis Chaussade was promoted to the rank of Officer of the French Legion of Honour. ■ MSD





## TRAINING / INNOVATION

# Today we train tomorrow's engineering-managers!

On February 2nd, the signing of a Double degree agreement - BBA Digital Engineering and Management - between UTC-Compiègne and EDHEC, Lille took place on the Lille campus of EDHEC Business School. This is a 4-year course designed to develop a dual set of skills in engineering sciences and management sciences and to specialise in one of the three proposed majors: Marketing, Finance or Engineering.

**EDHEC (Lille) and UTC are now linked by a double degree option that trains high-profile graduates the heart of the Hauts-de-France Region.** The Digital Engineering and Management Double Degree comes at the right time in a context of increasing digitalization of the national economy. This partnership responds to a strong ambition of both schools: to train hybrid profiles, at the interface of management and science, capable of meeting the challenges of a world undergoing profound changes. The EDHEC-UTC partnership agreement will result in the creation, from September 2022, of a 4-year post-bac double degree course in which students will be able to learn and develop new skills in the fields of engineering sciences and management sciences. They will also be able to specialise in one of the three majors offered: Marketing, Finance or Engineering. The programme is mainly aimed at baccalaureate students who have taken mathematics in the first and last years of secondary school (lycées), as well as economic and social sciences or political science. "This new programme - initiated and developed as it was in close collaboration with EDHEC, is in line with the UTC's DNA: lending meaning to innovation!", recalls Prof. Christophe GUY, Executive Director, Principal & Vice-Chancellor, UTC.

### Following the trend

This double degree is part of a dynamic and close collaboration between these two major academic institutions in the Hauts-de-France Region, placed under the responsibility of lecturers Jean-Christophe Meyfredi at EDHEC Business School and Nathalie Darene at UTC-Compiègne. It completes a cooperation scheme between EDHEC and UTC launched in 2020 with the opening of the EDHEC Executive MBA "Healthcare, Innovation & Technology" specialising in the field of health. "The agreements signed with UTC, one of the best evaluated engineering schools in France, anchor our courses of excellence in the Region while accelerating the implementation of our knowledge hybridization policy, one of the major pillars of our



EDHEC  
BUSINESS SCHOOL

**EDHEC, LILLE: 50 000 GRADUATES  
WORKING IN 130 COUNTRIES**

EDHEC is one of the best evaluated business schools in France and internationally for all its training programmes: post-bac (EDHEC International BBA), 'grande école', masters and executive education. It has been offering high-level management training for over 100 years. The EDHEC International BBA is an intensive post-baccalaureate programme, approved by the French government, ranked as the leading French 4-year Bachelor's degree by the review L'Etudiant in 2021, which offers students a unique opportunity to modulate their curriculum according to their aspirations and career plans.

2025 strategic plan. "In a society where the jobs of the future have yet to be imagined, the challenge today is to pass on to the younger generations the multidisciplinary knowledge that will enable them to invent new, more responsible and more sustainable models in the future," emphasises Emmanuel Métais, Director General of EDHEC Business School.

### Professional openings today and tomorrow

Among the major business challenges that led to the creation of this double degree is, without question, the acceleration of the digital sector professions in order to better respond to the transformations of society and the needs of consumers and citizens. "It is crucial today to mix skills to better respond to these numerous changes. Digital professions are notably following the evolution of data management. Hence the interest in combining skills, meeting the needs of companies and encouraging new practices," says Florian Pelgrin, professor of economics and statistics at EDHEC. Among the new jobs are those of data miner, credit

analyst, growth hacker, cloud computing engineer, digital brand manager, data ethnographer, web evangelist, creative technologist, traffic manager and data analyst. "Among the skills and knowledge taught are the ability to manage innovation, design, computer skills, databases, operational research, Internet law and many other aspects, adds Marie-Hélène Abel, director of UTC's Computer Sciences Department.

### Agile engineering-managers headed for a sustainable professional future

Nicolas Pfeffer and Tangi Gouez are two 2020 graduates of the EDHEC BBA (Bachelor of Business Administration) course. They are now data analysts in two Parisian start-ups. For them, this double degree will prove a real asset for students who, thanks to the study of these multidisciplinary fields, can also gain in open-mindedness and adaptability. "For future generations of graduates, this is a chance to be immediately operational in a market. Our professions are constantly changing," they say. "The acquisition of this multi-faceted expertise will certainly prepare them for careers in the fields of finance, e-commerce, marketing and technology, but it will also help them, thanks to high-level programmes and by using the best of both training, to create a new common language". ■ KD

Detailed information about this Double Degree at  
**Bachelor in Digital Engineering & Management** with EDHEC Business School, Lille





#### # UTC IN NATIONAL AND INTERNATIONAL RANKING SYSTEMS

UTC remains at the top of the national and international rankings in 2022! It is in the 2nd place of the post-bac schools of excellence in the ranking of the French engineering schools 2022 of the Figaro list. UTC is ranked 4th in terms of parity with 39.6 % females. UTC is also 2nd of the post-bac engineering schools in the category "Excellence-intensive engineering schools". The UTC ranked 2nd among the public post-bac schools in the 2022 ranking of engineering schools by the magazine L'Étudiant. It is at the head of the public post-bac schools in the "Academic excellence" category and 2nd of the public post-bac schools in the "Proximity to companies" category.

In the 2022 ranking of the best engineering schools by Usine Nouvelle, UTC is ranked 3rd among public post-bac schools. It keeps the 3rd place of the Eduniversal ranking of the post-bac general engineering schools 2022.

At the international level, the UTC is situated between the 1001st and 1200th place in the general ranking of the Times Higher Education 2022. It is ranked 4th French university in the "international outlook" category and 13th French university in the "industry income" category. UTC is ranked between 301 and 350th place in the overall Times Higher Education 2022 - Young Universities ranking and takes 20th place in their national ranking.

#### # UTC-HEUDIASYC LAB'S DRIVERLESS VEHICLE TAKES TO A PUBLIC HIGHWAY FOR THE 1ST TIME



Last July, 2021, the Renault ZOE of the UTC-Heudiasyc laboratory drove autonomously and carried out roundabout insertions for the first time in the Gazeran commercial zone in Rambouillet. This experiment was carried out by safety drivers on roads open to public traffic, under the authority of the Ministry of Ecological Transition. Equipped with a 3D lidar allowing a 360° perception of its environment, the vehicle was able to cross this complex navigation zone thanks to an intelligent and communicating infrastructure camera, which can extend the autonomous vehicle's field of view and thus better anticipate the driving situation and make safer decisions.

#### # PRISMES : A RESEARCH PROJECT JOINTLY CONDUCTED BY DASSAULT SYSTÈMES, AP-HP, ONERA AND... UTC !

Under the aegis of a UTC research scientist cum lecturer Martin Morgeneyer, the PRISMES project aims to develop a digital platform for diagnosing the risks of airborne transmission of micro-organisms within health care establishments, combined with proposals aimed at reducing these risks, particularly in order to deal with a future health crisis linked to emerging infectious diseases. The pooling of the partners' scientific expertise will allow for the improvement of fundamental knowledge related to bio-aerosols through experimental trials, the innovative use of the digital twin through 3D simulation as well as their implementation in a medical context and environment. This platform will provide health care institutions with a decision-making tool for transmission risk reduction measures via a unique scientific approach. ■ PS

## SCIENTIFIC CULTURE

# The « Festives », a festival of science and culture

Launched by the Sorbonne University Cluster in the framework of the Sorbonne University Alliance, of which UTC is a partner, and of the European Alliance 4EU+, the "Festives" event aims at promoting the dialogue between science, culture and society. The first edition was held from November 25-28, 2021.

### What will be the main theme of this first edition of "Festives" ? « Let's imagine the Future ».

A future explored this year via three themes. "The first is "Nature: what future for humanity? Building new relationships and a new "contract" between humanity and its environment;

the second focuses on "The human being tomorrow: augmented, assisted, modified, redesigned from scratch? From evolution to repair" and the last theme deals with "Art, culture and heritage: what roles in the social transition? Creating in tomorrow's world", Karim El Kirat explains.

Among the reasons that led to the launch of this festival: "It is not a 'science festival'. For the designers, of which UTC is a stakeholder, the objective was to organise an event that is both cultural and scientific in a festive atmosphere. The idea was to invite the public to join the different places of the Sorbonne University Cluster spread out over Paris for meetings on various subjects and with very different formats. This can take the form, for example, of a DJ animating the UPMC (University Paris 6) esplanade transformed into a "Dance Floor", conferences-debates or even theatre for example. It is a festival of knowledge

and debate with society on major issues, in short," explains Karim.

UTC-Compiegne actively contributes to the Festives with numerous proposals, most of which accepted, coming from research scientists were

working in UTC's laboratories as well as from students and student associations. Among the researchers' contributions? "For example, Pascale Vigneron, along with other colleagues and students, set up an exhibition dedicated to bioengineering of living matter with the aim of showing what we do for the patient and the clinician, within the BMBI. Marie-Christine Ho Ba Tho and Zoheir Aboura moderated a round table on "reasoned, sustainable technological research". Another round table on "repairing the human being by

bioengineering" was organised by Xavier Guchet (UTC-Costech) and Cécile Legallais; the latter, together with Professor Devauchelle, gave a lecture on "the repaired and connected patient", while Pascal Alberti spoke on the theme of "jazz and innovation". Finally, a workshop entitled "Let's invent a low-carbon life" was led by the Ingénierie soutenable [sustainable engineering] group. "As for me, I gave a conference-debate on biomimicry," he explains.

The students were not forgotten here and, in particular, the local comic strip students' association Bibliothèque De Bandes Dessinées Des Etudiants de Compiègne (BDBDEC). "The latter mounted an exhibition on the theme "The future seen by the 9th Art". Anticipation comics oscillating between dystopia and utopia while underlining the intertwining of technology and society," concludes Karim El Kirat.

A festival combining science and culture no doubt destined to develop every year, around new themes. ■ MSD



*The idea was to invite the public to come to the various venues of the Sorbonne University cluster spread over Paris for meetings on various subjects and with very different formats [...]. In short, it is a festival of knowledge and debates with society.*





# Medicine in the Future

UTC's Biomechanics and Bioengineering Laboratory (BMBI), a UTC-CNRS joint research unit since it was established in 1982, is dedicated to engineering for health, a field in which UTC, a leader in France, was a pioneer. Work combining biomechanics of the living (whether human or animal), and bioengineering, carried out by scientists in three research teams. Fields of research that cover, for example, the theme of ageing, the repair of valves in the case of functional mitral insufficiency, the modelling of lymph flow, organs-on-a-chip devices or, more recently, the questions surrounding green dialysis. These are all areas that are shaping the Medicine of the Future.

## Aiming at improving our health status

Cécile Legallais is a senior research director with the CNRS. Since January 2018, she has been director of the UTC's Biomechanics and Bioengineering Laboratory (BMBI), a joint UTC/CNRS research unit since its creation in 1982.



CÉCILE LEGALLAIS

**With some 7 personnel, including – academic professors, research scientists, contract researchers and technical staff –, UTC-BMBI is organised around 3 research teams dedicated to health engineering,**

**a field where the UTC has always been a pioneer in France.** "This research investigates the biomechanics of living organisms, both human and animal, and their bioengineering aspects, where we will combine approaches from the engineering sciences with those from the biological sciences involving the study of tissues or cells," explains Prof. Cécile Legallais.

Can you identify some objectives? "The aim is to contribute, through devices or methods, to improving the health of patients. By understanding how the body, a particular organ or tissue functions, we can propose methods of treatment, diagnosis and even repair through artificial organs or tissue engineering," she explains.

What are the research themes of the various teams? "One team is working on the personalised characterisation and modelling of the musculoskeletal system. In this case, we seek to understand the functioning of the entire body, such as our muscles, tendons or bones. The second team look at our cardiovascular system and more generally in the flow of blood and lymph in the

body, using a multi-scale approach. These two teams combine experimentation and modelling and rely in particular on medical imaging techniques. The 3rd team specialises in tissue engineering, the aim of which is to reconstruct tissues or even organs – skin, liver, nerves, etc. – with different tools (living materials and cells). – with different tools (materials and living cells) and at different scales," explains Cécile Legallais.

This research is of great interest to the clinical world. This is reflected in the increasing number of partnerships with the medical world. "We are working with the Amiens University Hospital and, in particular, Professor Devauchelle's 'Faire Faces' Institute. We also have agreed to collaborations with the Pitié-Salpêtrière Hospital on diabetes and sarcopenia, in other words, the ageing of the body, with the Henri-Mondor University Hospital on heart valves and with the Paul-Brousse Hospital on liver pathologies and the bioartificial liver project. More recently, we have been interested in green dialysis in various nephrology departments," she concludes. ■ **MSD**



# Green dialysis

Nearly 50,000 people suffering from kidney failure in France require treatment by haemodialysis or an artificial kidney. These are people waiting for a kidney transplant or who cannot be transplanted.



**F**or a long time the notion of sustainable development in the field of health care was unheard of, since access to health care for the entire population was considered to be a sustainable development objective per se.

But things are changing and the environmental impact of certain techniques is beginning to be

questioned. This is particularly true of dialysis protocols. "First of all, it requires very complex medical devices that have to be produced, transported, etc. It is also very "greedy" in terms of single-use plastics - 1.5 kg of them/ dialysis, thrown away per patient and per session. There is also the transport of patients to the centres and finally the consumption of

water. It should be noted that 400 litres of water are used to produce the dialysis fluid for each session. In the end, each patient consumes 75 m<sup>3</sup> (75 tonnes) of water per year," explains Cécile Legallais.

It was in Morocco, where the problem of water shortage is obvious, that the question of dialysis came up. "It all started four years ago when Ahmed Abarkan, a student of Professor Sqalli Houssaïni, head of the nephrology department at Fez Hospital, who was working on the problem of recycling dialysis water, contacted me to do his thesis under our joint supervision," she points out.

What then is the theme of the thesis? "How to reduce the environmental impact of dialysis? It should be noted that the reverse osmosis process used generates the discharge of large quantities of moderately salty water. How can we desalinate it so that it can be reused? We worked on this problem in collaboration with Professor Grimi of UTC's TIMR laboratory and the dialysis centre of the Saint-Côme polyclinic, Compiègne, a long-standing partner of the lab," she concludes. ■ **MSD**

## Outlining and designing Future Medicine

Co-leaders of the team (C2MUST) within the UTC-BMBI laboratory, Karim El Kirat and Sofiane Boudaoud are both tenured UTC professors.

**A team devoted to investigating the "Characterisation and personalised modelling of our musculoskeletal system".**

So, what their respective areas of research? "I work mainly on the characterisation and biomechanical properties of bones, whether human or animal. I also lead the transverse programme 'Biomechanics of biomimetic and bioinspired systems' involving the lab's three teams. And what is the underlying thematic? "The idea is to be inspired, for our often clinical purposes, by the structures and properties seen in humans and in nature in order to manufacture medical devices. The

shape and mechanical properties of a tibia prosthesis, for example, must be as close as possible to a natural tibia," explains Karim El Kirat.

More concretely? "In my field, which concerns the manufacture of bone in vitro, it is extremely important that the bone, on a microscopic scale, has all the characteristics of natural bone but also all its mechanical properties. Why is this so? "The materials developed must be able to be integrated into the body, be recognised as a non-toxic material and finally display the expected biomechanical properties," he adds.

"This is an area where modelling plays a major role. "My work focuses on signal processing and modelling. These are biomedical signals and, more particularly, electrophysiological signals obtained from measurements of biocurrents on the surface of the human body. Within C2MUST, we have considerable expertise in surface electromyography (EMG). One of the team's strong themes concerns the characterisation of the neuro-musculo-skeletal system thanks to multiple, varied and complementary measurements; measurements that can be mechanical, electrical and non-invasive", Sofiane Boudaoud explains.

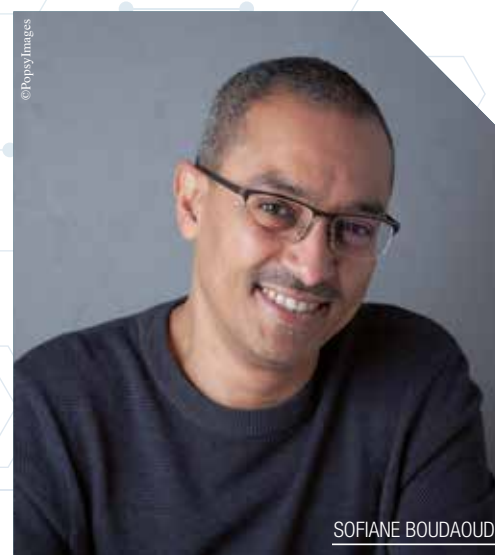
This is how the outlines of a future medicine based on increasingly powerful models are taking shape. "We think that, in the future, medicine will be predictive, preventive and personalised. It will be possible to make diagnoses, sometimes with the help of the model, before the onset of pathologies; robust, early and precise diagnoses, made using the least invasive techniques possible, acceptable to the patient. To achieve this, we will rely on signal processing, advanced data analysis, bioinspired and biomimetic modelling. Thus, the models of the musculoskeletal system on which we are working have been created to mimic natural behaviour in both healthy and pathological conditions. The aim is to provide additional information, in other words, diagnostic assistance to the clinician who is going to make a medical decision," he explains.

They apply this know-how to a variety of problems, particularly the characterisation of the ageing of the musculoskeletal system. "We know that by 2050 one in three people will be over 60 and one in ten over 80. There is also the fact, demonstrated by the statistics, of the increase in sedentary behaviour, particularly

*To be inspired, for our purposes - which are often clinical - by the structures and properties seen in humans and in nature in order to design and manufacture medical devices.*



KARIM EL KIRAT



SOFIANE BOUDAUD

among young people. Thus, 15-25 year olds today walk less than the 55-65 year old generation. The concomitance of these two phenomena will lead to an acceleration of the problems of ageing and loss of autonomy. This will pose a real public health problem," he explains.

Among the team's medium-term objectives? "Our aim is to develop devices worn on the person and connected to the mobile phone that can indicate, for example, to a person suffering from joint pain in the knees or muscular weakness that his or her gait shows all the signs of an imminent fall," says Karim El Kirat.

"In a partnership with Professor Kinugawa

of the AP-HP (public hospitals) and the Sorbonne University Cluster, (SU) we have also developed an indicator called "motor functional age" which may be different from the chronological age. The idea is to alert young and old alike to the state of ageing of their musculoskeletal system," adds Sofiane Boudaoud.

This problem has led to an industrial partnership. "As part of the French national economic recovery plan, we obtained a project with BioSerenity, a company specialising in connected devices". What is the aim here? "It is to be able to evaluate ageing using electromyography," he concludes. ■ MSD

## Targeting reconstruction

Muriel Vayssade is professor of Cell Biology and Tissue Engineering and is in charge of the Biomaterial Cells and Bioreactors (CBB) team within the UTC-BMBI laboratory. Rachid Jellali, a research engineer, has a transverse role given that he works with both the CBB and IFSB (Biological Fluid Structure Interactions) teams.

**What is tissue engineering? "First of all, it is an interdisciplinary field that brings in and combines biology, chemistry, physical chemistry and biomechanics.** The underlying idea is to be able to reconstruct in vitro tissues and even organs with all their natural complexity," explains Muriel Vayssade. What techniques can be used? "These involve cultivating several cell populations together, as a native tissue is made up of

different types of cells. The idea? It is to use biomaterials, natural or synthetic, which will provide a three-dimensional environment for the cells, and then to find the optimal experimental conditions so that they differentiate (specialise) and constitute a functional tissue, similar to a native tissue," she explains.

The techniques have various fields of application. "For example, we use collagen hydrogels and fibroblasts to reconstitute

dermis (skin tissue)," she adds.

This know-how has led to various projects with a number of partners. One of these, established with the Dermatology Department of the Amiens University Hospital, concerns the treatment of metastatic melanoma. "Clinicians were confronted with both successes and failures and wanted to understand why certain molecules were effective on one patient and not on another. We therefore





set up a dermis model recreating a tumour microenvironment, in which we can cultivate patients' tumour cells (isolated from biopsies), test the response of the cells to the treatments and thus identify in vitro the sensitivity of the patient to this or that type of molecule," says Muriel Vayssade.

Work in partnership with the University of Hanover, Germany and financed by the French national ANR is also being carried out on the reconstitution of bone, tendon and muscle, in the same continuity, using a biomimetic approach. "We are going to use materials shaped according to the desired tissue: for example, associated with minerals such as hydroxyapatite (a natural component of bone), or organised in the form of fibres (like muscles) and apply mechanical stresses (stretching) in order to encourage the differentiation of cells into bone, muscle, etc.", she emphasises.

Another line of research? "We have set up an organs-on-chip technology. The idea? It is to cultivate cells in microfluidic devices (a technology inspired by microelectronics) or mini-bioreactors. Among the advantages of this technology, we have in a 3-dimensional,



well-controlled microenvironment that can be perfused and whose shape can be adapted to the organ we want to study. My main goal is to use them in toxicology to replace animal testing in particular. For example, in

drug screening, many drugs pass the animal test phase and fail because the difference between animal and human physiology is enormous," explains Rachid Jellali.

What are the organs concerned? "We started working on the liver, the 'metabolising' organ par excellence, and then, step by step, we started looking at all the organs that interact with the liver, such as the kidneys and the pancreas, the aim being to reproduce the interactions between several organs," he explains.

These skills have led to various projects with a number of partners. One, conducted jointly with two Lille laboratories, SMMIL-E and IEMN, with partners HCS Pharma and Fluigent, is financed by the ANR. This MimLiverOnChip project aims to develop a biomimetic liver on a chip. The team is also working on projects funded by ANSES (IMITOMICS, LuLi) and the UTC Foundation, and is using these organs on chips to study the toxicity of pesticides on the liver and lungs. ■ MSD

## Modelling lymph flow dynamics

Badr Kaoui is a member of the IFSB (Biological Fluid Structure Interactions) team in the UTC-BMBI Laboratory. His research interests include the numerical modelling of fluid-structure interactions coupled with transport phenomena in biological and biomedical systems. He is an expert in the Boltzmann network method and is a pioneer in France in the modelling of lymph pumping.



**A**mong the application areas ? "My research is in the biomedical field - the calculation of flow and mass transfer in biomedical systems such as artificial organs on microfluidic chips, for example - but also in biology, in particular the study of the lymphatic system. It is thanks to multiphysical simulations that we can calculate, for example, the flow of a given fluid and the diffusion-advection-reaction of chemical entities," he explains.

Can you describe one of the techniques used for modelling? "Firstly, the Boltzmann method. What's in it for me? It is simple to

program and allows the code to be made increasingly complex depending on the problems dealt with; it can also be easily 'parallelized', i.e. simulations can be run on several processors to reduce the calculation time; finally, it is useful for calculating both the flow of a fluid and mass transfer. We can also couple the two in the case of the transport of a drug by a fluid such as blood, for example", he stresses.

A numerical method that he now couples with the immersed boundary method, which is more modern, very advanced and particularly well suited to deformable structures. "Thus,





if we take the lymphatic system, we can go from biomechanics - the flow of a fluid in a living system - to mechano-biology, where we are interested in biochemical signals that induce forces that lead to the dynamics of the walls and valves of lymphatic vessels," adds Badr Kaoui.

What is his specific interest in the lymphatic system? "It was when I was at Massachusetts General Hospital (MGH), known worldwide for their expertise in cancer treatment that I first heard about the lymphatic system and its link to cancer. A complex system that has not been extensively studied. Far from shying away from the difficulty, I decided to make it a new focus of my research and to use all the digital tools I had developed," he explains.

A line of research that interests Dr Lance Munn, associate professor at Harvard Medical School, researcher at the MGH, and also Visiting Professor at UTC. "We have set up a joint project, financed by the ANR and conducted in collaboration with the MGH, to understand the lymph pumping mechanism at the vessel level," he says.

What is special about the project? "Usually, we work on the biomechanics and interaction of structural fluids in the UTC-BMBI-IFSB team. In this project, we are going to add biochemistry, the functioning of valves and then progress towards 3D models," concludes Badr Kaoui. ■ **MSD**



## Reducing musculo-skeleton disorders

Khalil Ben Mansour, a research engineer, has been co-director of the Centre of Expertise for the Biomechanics of Movement since 2020. He designed the ErgoSkel, a handling aid, which has been patented nationally as well as in the United States and Japan and will be market launched in April 2022.



**In 2011, he joined UTC for a three-year European project dedicated to the development of a diagnostic tool for musculoskeletal back disorders as a post-doc.** At the end of the project, he was recruited as a research engineer, responsible for the "Technology, sport, health" platform,

which has since been renamed the "Centre of expertise for the biomechanics of movement".

Among the platform's objectives? "The aim is to evaluate the movements of humans and animals in order to understand them better, to find solutions for improving the environment in which they move and to reduce the risks of musculoskeletal disorders, accidents, etc. I carried out various projects in areas such as sport and health, ergonomics at work and monitoring rehabilitation in the medical field," he explains.

A recognised know-how. The proof is "Ergoskel", a flagship project launched in 2017 at the initiative of FM Logistic, a company with almost 29 000 employees operating in 14 countries in Europe, Asia and Latin America. "Faced with the number of work stoppages due to musculoskeletal disorders affecting its employees, the company invited us to think about a device that would be light, inexpensive and enable the workload on the upper limbs to be reduced in order to avoid the onset of limb and back disorders," he says.

The ergoskeleton, which on sale as of April 2022, is a success. "It is a device that is worn like a backpack. It weighs 1.8 kg and can reduce muscle fatigue by a factor of three," concludes Khalil Ben Mansour. ■ **MSD**





## Patents for innovative devices

Two devices for the treatment of functional mitral insufficiency are currently the subject of international patent applications.

**The first one relates to the implantation of a balloon between the two mitral valve leaflets in order to fill the residual space between them, has already been patented in France and is awaiting international patenting.**

However, Anne-Virginie Salsac, director of research at the CNRS working at in the Biomechanics and Bioengineering Laboratory (UTC-BMBI), admits that this technique is very complex and may not be suitable for all situations of functional mitral insufficiency.

Hence the idea of a second device characterised by a purely metallic structure, covered by a membrane to avoid abrasive effects, this device being protected by an international patent application. "After numerous market studies, the project was judged to be sufficiently innovative and to have great industrial potential. This earned it the support of the SATT Lutech in Paris. All that remained was to find a partner specialised

in the medical field who would be prepared to take on the role of 'co-maker'," explains Anne-Virginie Salsac. This was achieved with 3D Med Lab, a company specialised in the printing of 3D devices. "The idea is to implement 3D printing both with biopolymers for the "balloon" solution and with "metal" printing such as Nitinol, a shape memory alloy," she explains. ■ MSD

## 4<sup>th</sup> edition of the Biomed- R/V



A pioneer in the training of actors in the biomedical sector, UTC is still the leader in France. But other actors have now invested the field.

**This Bio-Med Rendezvous was launched by Isabelle Claude and Jean-Matthieu Prot, both lecturer-cum-research scientists in bio-engineering, and whose fourth edition was held on January 21, 2022**

The reason for this initiative? "One of the reasons is the 40 year long history and proximity of UTC with the biomedical field, which gives it a great reputation. However, for the last fifteen years, new actors have invested this field with a lot of dynamism

and in particular by creating recurrent events which give them an important visibility. So we agreed among ourselves that UTC should not be satisfied with its good reputation but that it should better communicate on its know-how and thus increase its participation in the French biomedical network", explains Isabelle Claude.

"For us, this event aims at highlighting all the biomedical activities of UTC, promoting the students' projects, developing

the research activities carried out within the university but also to consolidate its links with privileged external partners. Thus, we always bring in either a hospital practitioner or a biomedical industrialist", adds Jean-Matthieu Prot. What was the theme of the last biomedical meeting? "We focused the day on surgical robotics and the modernisation of the operating theatre," he concludes. ■ MSD

## Depolluting mushrooms

Senior lecturer Anne Le Goff is a member of the IFSB team in the UTC-BMBI laboratory. A research project on soil bio-remediation brings together both UTC-BMBI and UTC-TIMR Laboratories.

**The project title « Myco-fluidics for soil bio-remediation», in other words, the use of fungi for soil decontamination, this cross-disciplinary project brings together the skills of two UTC laboratories.** "Our objective is to visualise, within a micro-fluidic system, the way in which a fungus accesses a pollutant such as hydrocarbons, for example. We know that certain filamentous fungi can be effective. It remained to demonstrate how.

By 'solubilising' the pollutant or by feeding on it," she explains.

A project that is the subject of three theses. "Claire Baranger's thesis, based on video-microscopy monitoring of fungi and the pollutant incorporated into microfluidic chambers, demonstrated the coexistence of the two approaches; Jérémy Audierne's thesis aims to define the optimal conditions under which the fungus can develop at the micro

level and whether this can be verified in the field; and Salomé Bertone's thesis is devoted to the biological aspect of the project. Searching for other microbial candidates, for example," she explains.

How are these PhD theses funded? "The first two were supported by the Ministry of HE, Research & Innovation and the Region, and the 3rd by the MSTD Institute," concludes Anne Le Goff. ■ MSD







RESEARCH

# Heading for safe and robust AI

Sébastien Destercke is a CNRS research scientist and head of the Knowledge, Uncertainty, Data (CID) team at the UTC Heudiasyc Lab., a joint UTC/CNRS unit. He is also Professor of the Industrial Chair in Safe Artificial Intelligence (AI) launched in early 2022.

**A**n academic Chair involving, over and above UTC, The Sorbonne Centre for Artificial Intelligence (SCAI), the CNRS and Sopra Steria, sponsor & founder of the UTC Foundation for Innovation, a chair which, at UTC, mobilises 2 laboratories working on AI itself - the CID team of Heudiasyc and UTC-LMAC (mathematics) whose work is partly at the heart of AI - and 3 others – UTC-Roberval, UTC-BMBI and UTC-Avenues - specialised in domains where AI will play a growing role in the future. UTC-Heudiasyc is also involved in AI applications.



The arrival of Sopra Steria as a partner of the Chair? "Our relationship with the company goes back a long way. We started working on the integration of AI in areas of concern to Sopra Steria, such as real estate, human resources or banking, within the framework of the university Foundation, well before the creation of the Partnership Foundation," says Sébastien Destercke.

This fruitful collaboration will take a new turn with the establishment of the Safe AI Chair. Its objective? It is to "focus on scientifically relevant themes while meeting industrial needs in the context of the deployment of AI tools. The aim is to develop artificial intelligence systems that are both safe and robust. These systems are part

of the broader issue of trustworthy AI. Indeed, manufacturers must have confidence in the tool they are going to deploy," he explains.

What do we mean by 'robust systems'? "A compelling analogy is that of an airplane which you board, not because you understand everything about its operation, but because you know that the risk of accident or critical error is very low. The criterion of robustness is a decisive aspect in many industrial applications and particularly in AI systems. Their robustness is measured by their ability to adapt, without losing quality, to changes in deployment conditions and in the environment," he explains.

And what about system safety factors? "This is the second essential criterion for trustworthy AI. It's about being able to quantify the uncertainty associated with the system's predictions. The aim is for the system to be able to quantify its own confidence in its predictions. If I say I am 90% sure that a given prediction is right, I would like it to be right 90% of the time. It is therefore this aspect of 'certainty' that we will ensure," emphasises Sébastien Destercke.

How long will this chair last? "It is an ambitious project mainly financed by the UTC Foundation for Innovation and its members, with human resources made available by all the partners for a period of five years," he concludes. ■ MSD

## UTC'S FOUNDATION FOR INNOVATION

Created at the end of 2018, the UTC Foundation for Innovation is supported by Saint-Gobain Group, the UTC university and the UTC Alumni association. Patrick Dupin, Deputy General Manager of Saint-Gobain, is Chairman of the Foundation's Board.

Where did the idea behind the creation of the Foundation come from? "A partnership foundation, unlike a company foundation, is supported by a public institution. This allows UTC to establish a strong institutional alliance with certain industrial partners. Especially given that the links with the economic world, in particular industry, have been part of the UTC's DNA since its creation in 1972," explains Sylvie Lemonnier-Morel, the Foundation's General Secretary.

Among the objectives of the Foundation? "The aim is to accompany UTC and its ecosystem in innovation projects that make sense in tomorrow's world; to encourage entrepreneurship among students and alumni as well as the spirit of initiative; and finally to accompany the most deserving and enterprising students, but sometimes also the most socially fragile, along their career paths in order to increase their chances of success", explains Patrick Dupin. What is his vision of his role as president? "It is to support our team in achieving these objectives, and that we do not deviate, whether in spirit or in substance. I also make sure that the founders, UTC, and our industrial partners are perfectly aligned," he concludes.—



SÉBASTIEN DESTERCKE



RESEARCH

# e-BioMed : preventing falls chutes, stress and falling asleep at the steering wheel

Dan Istrate is a lecturer-cum-research scientist at UTC and is responsible for the academic Chair e-BioMed dedicated to connected biomedical tools. Vincent Zalc, a CNRS research engineer, is also attached to the chair.

**W**hat are this chair's aims? "The e-Biomed chair was created in 2014 at the initiative of Sorbonne University in order to combine skills in the field of e-health. It administratively reports to the UTC-BMBI UMR 7338 joint UITC-CNS Laboratory, notes Dan Istrate.

What are the chair's research areas? "The first concerns equipment for the homes of elderly people. It is a question of being able to remotely monitor everything relating to physiological data in order to be able to react quickly, if necessary. This monitoring will make it possible to prevent the risk of falling, but also to monitor the condition of people suffering from chronic illnesses by detecting warning signals," he explains.

And what are the tools you use? "We try to combine different types of sensors integrated into the environment. For example, for localisation, we will use motion detectors. Above all, we will process the sound environment in order to detect, not necessarily speech, but sounds that allow us to identify the person's activities and in particular their condition," he stresses.

"The sounds to be recorded can be of various origins. It could be the appearance of a cough,



DAN ISTRATE

heavy breathing or sneezing. These are all symptoms that are at risk, especially for an elderly person. A scream would indicate a situation of distress, just as a tap that runs a little too long would indicate that the person cannot get up, etc.," adds Vincent Zalc.

Tools designed not only to detect events such as a fall, for example, but above all to anticipate their



VINCENT ZALC

occurrence. "Thus, we can imagine that a person is beginning to suffer a loss of autonomy if he or she makes fewer movements in a room or to move from one room to another," he says.

These devices are useful in other situations, particularly in homes for the elderly. "We have worked with the company Legrand in particular on EHPADs. Faced with a shortage of staff, equipping rooms makes it possible to optimise the use of existing resources," explains Dan Istrate.

Are other areas of research explored by the chair? The detection of stress or the early detection of falling asleep while driving. "Many studies show that chronic stress is not only dangerous in the case of chronic illnesses such as hypertension, but can also lead to other illnesses. Using information such as heart rate, skin conductance, back muscle contraction, etc., we hope to develop a device, such as a watch, to measure stress levels continuously. Finally, the last line of research concerns the early detection of sleepiness while driving, a project carried out with CoreForTech, a start-up from Lille," he concludes. ■ MSD

## MICRO-ORGANS-ON-A-CHIP

The partnership between the UTC and Tokyo University is not new. The creation of the international chair of which Cécile Legallais and Éric Leclerc are co-holders is a proof.

Entitled "Disruptive Organoids Technology", this international chair was created in 2021 as part of the collaboration between UTC-BMBI on the one hand and the LIMMS, a joint unit of the CNRS and the University of Tokyo, on the other. "The creation of the chair meets the need to consolidate the collaboration between the two partners around the construction and validation of these micro-organs-on-a-chip and, more specifically, the study of metabolic disorder syndrome. Called the 'disease of the 21st century', it combines obesity, diabetes and many other metabolic disorders," explains Cécile Legallais.

Some objectives of the chair? "Firstly, to evaluate in vitro therapeutic solutions for patients suffering from this syndrome, but also to conduct studies to understand the mechanisms and interactions between organs in this disease. The idea is to try to reproduce a model in our microfluidic devices in order to understand the genesis of the pathology," she adds.

Why the University of Tokyo? "On the one hand, we are both interested in future therapeutic applications, and on the other hand we have complementary skills in the development of these organs-on-a-chip, particularly in the study of the liver," concludes Cécile Legallais.



# Molecular printing : a state-of-the-art technology

Karsten Haupt is Professor of biochemistry at UTC-Compiègne and has directed UTC's Enzyme and Cellular Engineering (GEC) laboratory since 2012. As a specialist in molecular printing, he has been ranked as the world's leading expert on this cutting-edge technology by the website 'Expertscape'.

**This is a technology that makes it possible to produce 'synthetic antibodies', supramolecular receptors designed to recognise and bind to target molecules.** What does this mean in practice? "It involves moulding a synthetic polymer around an individual target molecule (this is called a template), which will then create a cavity in the polymer. This template mimics the target molecule in size, shape and chemical functionalities and will contain the chemical groups that allow interactions with the target molecule," answers Prof. Haupt.

Historically, in the 1980s, molecularly imprinted polymers (MIPs) were first used in the chemical field. But it was not until the early 1990s that the first scientific publication was published showing that it could be used as an antibody mimetic in an ELISA-type immunoassay. "Since then, these materials have been used to replace biological antibodies in any form of application requiring inter-molecular recognition," he adds.

In the years 2000, molecular printing reached such a stage of maturity that other fields of application were widely opened up. "These include cosmetology, food processing, environmental analysis, and the chemical and 'biotech' industries in general. The most recent trend is direct use in medicine, particularly in therapy but also in diagnosis. One example is the use of MIPs in biosensors, taking advantage of their high physical and chemical stability," says Karsten Haupt.

What are biosensors? "Biosensors are a category of chemical sensors. They consist of two parts: the recognition element (the 'sensitive layer') that specifically recognises the molecule to be detected, and the transducer. The transducer translates the signal emitted when the target molecule binds to an electrical signal. Biosensors are used when the recognition element is a biological molecule. MIP-based sensors are among these and are biomimetic materials in the sense that they are able to mimic the behaviour of biological receptors," he explains.

*These include cosmetology, food processing, environmental analysis, and the chemical and 'biotech' industries in general. The most recent trend is direct use in medicine, particularly in therapy but also in diagnosis.*

Why biosensors? "Unlike traditional analysis laboratories which, in addition to heavy investment in equipment, require travelling in order to deliver samples for analysis, biosensors are transportable. They can be moved to the samples, for example, on a farm to detect contamination in milk. They can even be implanted in the human body for continuous detection of disease biomarkers, which proves highly convenient for patients suffering from chronic diseases in particular. Rather than having to go to the hospital regularly, biosensors make it possible to measure a particular molecule, such as blood glucose, at home," he points out.

But the growing interest in MIPs does not end there. They should make increasingly personalised medicine possible. "These materials, often called synthetic antibodies, are used to target certain cells or molecules associated with pathologies such as tumours, inflammations or infections. Synthetic antibodies have many advantages. Firstly, there is no need to use animals in the laboratory; they are tailor-made for a particular target or disease; they are cheaper and more stable, making them easier to engineer," explains Karsten Haupt.

This is a welcome innovation, since molecular recognition is the basis for all processes in the human body and we now avail of a chemical technology bio-inspired and bio-mimicked that today extends far beyond the biological field.

Hence the growing interest of many partners. "We are working in particular with Sanofi in the field of medical therapies, but also with other companies, hospitals and academic partners on fundamental and applied projects such as medical diagnosis and treatment," concludes Professor Haupt. ■ MSD



KARSTEN HAUPT

## STUDENT CAMPUS LIFE

# Véronique Hédou, *totally engaged in exercising her functions*

Véronique Hédou is a lecturer-cum-research scientist in applied mathematics at UTC and has been in charge of "student campus life" for over 7 years now; she solves mathematical problems as well as the questions of the students who rely on her in their associative projects. Her objective: to let them remain the masters of their project, to accompany them without doing it for them, to provide them advice without deciding things for them. A successful equation!



**P**ure graduate product from the University Rennes I, Véronique Hédou did all her studies there and obtained her PhD in Mathematics and Applications. She took up a position as a lecturer at UTC after gaining her PhD. Today, she is mainly involved in the UTC core curriculum, in the CC courses that are essential for any future engineer. A few years ago, a skills assessment showed her how much she is attached to this school. "UTC is an integral part of my life and sometimes overflows on my personal life, even more since I am in charge of the student life", she admits. She is in charge of overseeing student campus life. At the beginning, her mission consisted mainly in accompanying the somewhat more than 120 UTC student associations, in collaboration with the 'Bureau des élèves' (BDE), as well as various inter-semester activities. This was enriched over the years with the follow-up and the accompaniment of preventive actions (alcohol issues, sexist and sexual violence...) in connection with the preventive medicine, management of all the student jobs at the UTC (more than 300 per year), management of the contribution to student and campus life, representation of UTC concerning the student life in general.

### "Our students are fantastic!"

"As I often say during meetings with my counterparts from other engineering schools or universities: 'Our students are fantastic! They engage themselves, whatever the personal cost, in the campus life of UTC and show a very

great maturity in their associative projects while brilliantly succeeding in demanding studies. They have a degree of autonomy that many envy us. This is undoubtedly the reason for their success on the job market. Their opinion is really taken into account. For example, the student representatives on the Council for Studies and University Life (CEVU) have supported the "participatory budget" project resulting from the Student and Campus Life Contribution (CVEC), or a working group made up of students has launched the implementation of a policy to take account of sexist and sexual violence." They are really everyday collaborators, whether the elected representatives or the members of the BDE.

### A matter of confidence and means

The means at their disposal are mainly in budgets allocations from the Region Hauts-de-France, the Sorbonne University cluster, or the CVEC (see above). Thus, the students have access to a large number of student jobs within UTC every year and in particular, for the last year, to both methodological and pedagogical tutoring, by and for the students, with the help of the Regional authorities. Depending on the subject, the work is carried out with the preventive medicine service, the logistics service, or other services of the UTC. "We created a student campus life office a little over two years ago, just before the start of the pandemic, with administrative staff. The aim is that each student can find help to orientate themselves with whom to contact for a certain question, how to apply for a student job. We hope that this office will be operational at the start of the new school year," Véronique Hédou has also created a section in the ENT entitled "Students: need some help?", so that students can easily find help when faced with a problem, be it psychological, financial or something else "These are just a few examples, but it takes a lot of time. That's why I regularly call on a project manager to help me, in addition to the person in the student life campus office. I hope to be able to hire her part-time soon, as the number of projects is growing."

### "Life goes on, after and outside the class-room!"

Véronique Hédou's main goal is to improve student campus life for all UTC students, so that no

one is left out. "To make sure that they can find solutions to their problems and develop themselves in parallel with their studies because, as the BDE reminds us, there is a life after and outside the class-room!" This provides them with a framework that is more conducive to their studies and personal development. Some actions respond directly to a request from them, others are designed to help them without them necessarily being convinced at the outset, such as limiting the degree of beer at parties. "She is sometimes called the 'student's mother'. Thanks to her, we have a rich student life at UTC," assures Pierre Kidzié, 22 years old, student in Urban Engineering. "She has a good memory and an unfailing commitment. She answers our questions 24/24." We would need a complete Interactions magazine to relate all that Véronique Hédou brings to UTC student life. ■ KD

### 2022 FOLLOW-ON

New projects are born every year, such as Imaginarium, a music festival that brought together 13 000 people over two days in 2019, run entirely by students. "Accompanying them from the beginning of the idea to the realisation of the project is always a real pleasure. They are so inventive that there is never a dull moment! This year, we hope to see the festival return on June 4 and 5. We also hope to see Compiègne in the spotlight again, Festupic enchanting us with its street walk and shows at the Espace Jean-Legendre, and to finally see the innovative solidarity grocery shop move to new premises. Let's continue to give coherence to student life as a whole with human and financial support to carry out projects," concludes

Véronique Hédou. "And, above all, let our students no longer be muzzled and confined in a cage because of the health crisis and let them enjoy their youth."







YASMINA CHIBANI



## A new look at apprenticeships : an alternate attractive path to a diploma award

Within the Renault automobile group, apprenticeship is a real challenge that allows us to support young people when acquiring their diplomas by offering them a first operational experience, but also to contributing to identifying possible recruitment pools.

**T**hrough its 'Young Generation' policy, the Renault Automobile Group contributes to the training of pupils and students with two strong and complementary orientations: to have the younger generations as professionals throughout their training course and to develop new knowledge in conjunction with training establishments. More than 700 apprentices are recruited each year within the Renault SAS scope. In 2021, the company recruited more than 800 work-study students despite a difficult pandemic health context. It should be noted that in 2021, the rate of young women is slightly up, at 33%. The aim is both to maintain the core business lines of the automotive sector and to support the employability of young people in the areas where the company is based. "Renault is a historical partner of UTC with which we have had strong links for many years. We appreciate the quality training that this engineering school provides and that meets our business needs. We also appreciate the diversified profiles and the fact that the UTC students manage to integrate very quickly into the company world", assures Yasmina Chibani, in charge of the College Relations within the French Human Resources Directorate (HRD) of Renault. And she adds: "Whether it is within the Renault Group or in another company, our apprentices are endowed with enriching and formative experiences in order to achieve good careers. They are better equipped because they know the world

of industry, its developments and its challenges. Former apprentices in turn become ambassadors to testify about the benefits of choosing to follow an apprenticeship."

### Added-value of apprenticeship schemes for both student and company

For the student, apprenticeships are above all synonymous for personal autonomy. Apprentices are at the heart of the company's activity, which allows them to put into practice what they learn in class to increase their skills more quickly. They learn to adapt to their work environment and to become a source of ideas to support their colleagues. Not forgetting the financial aspect, which is not insignificant as it offers them the possibility of both financing their course and meeting their personal living expenses. Hiring an apprentice has many advantages for the company too. It is an opportunity to train a young person in the company's working methods and culture and, possibly, to have an employee who is immediately operational once the apprenticeship period is over. "And I would even add that the contractual relationship can lead to a first job. This increases the attractiveness and retention after

the apprenticeship period. We set up induction sessions for our apprentices. This enables them to get to know the company better and therefore to integrate better. Being part of a team allows them to understand complex processes through the transmission of knowledge."

### Hands-on experience in the field

Apprenticeship allows students to take responsibility and to be confronted with the reality of the field. The apprentice is considered as a collaborator who carries out missions that contribute to the company's performance. Apprenticeship masters have an essential role in supervising and supporting the apprentice and passing on knowledge. "Welcoming sandwich course students allows our businesses to respond to complex issues or subjects with a fresh perspective," is the conclusion drawn by Renault, which donates its apprenticeship tax to around a hundred schools and associations each year. "The aim is to support the schools with which we are used to working in order to participate in their development, whether in the creation of new training courses or in their equipment". ■ KD





### 3 QUESTIONS FOR...

**ARNAUD DECAGNY**  
VICE-PRÉSIDENT OF THE  
RÉGION HAUTS-DE-FRANCE, IN  
CHARGE OF APPRENTICESHIPS,  
ARTISANAT AND DIGITAL  
TRANSFORMATION.

#### Do you feel that the image of apprenticeships has changed in recent years?

The image of apprenticeships has completely changed with regard to the students themselves. In 3 years, we have gone from 40 000 apprentices in the Hauts-de-France to more than 51 000. Apprenticeship is a real subject with a big overall increase in Bac +2 to Bac +5 students who are increasingly choosing this route, far removed from the "dead end" routes of the past. Before, apprenticeships were for BEP, CAP and Bac pro. Today, universities are opening up diplomas at Bac +5 level. The image of apprenticeships among companies is also constantly evolving. Their intake capacity is rising sharply, with a clear upturn in the technical fields. There is a real demand for vocational training and the business world is constantly looking for human resources. These young people are this resource and they are really perceived as employees within the company that welcomes them during their apprenticeship.

#### What are the main virtues of choosing an apprenticeship scheme in your opinion?

It should be noted that 7 out of 10 apprentices find a job within six months of leaving school on a fixed-term or permanent contract basis. Apprenticeships offer a real route to professional integration. Of course, apprentices benefit from a theoretical basic training but also from operational training which is highly appreciated in the world of work that awaits them. Their acquired skills are recognised because they are trained by real professionals. With the major reform of 2018 launched by the Ministry of Labour in order to boost apprenticeship and more generally vocational training, the Hauts-de-France Region has continued to provide financial assistance, particularly for investments by Adult Training Centres (CFA) in their projects for extensions, new training courses and other requests. All this while ensuring that there is no competition between CFAs and that the training needs are met.

#### Will you continue your efforts to develop apprenticeships?

More than ever, yes. It is one of the Region's vocations to help apprentices and academic and private CFAs. We are one of the few regions in France that provides the most support for its apprentices. We are registering excellent results and are going in the right direction. For example, we continue to take part in the WorldSkills France, organised to promote the know-how of manual trades and apprenticeships. More than 600 young people competed in this 2022 edition, representing 64 different trades. Some of the professions are ancient, such as pastry-making, sheet metal work and carpentry. But the competition also highlights skills that meet the needs of tomorrow's professions, such as cybersecurity, fashion, decoration or IT. We plan to increase the number of young people for the next edition to one thousand. ■ KD



### TRAINING / SANDWICH COURSES

# The apprentice speaks out

In 2018, UTC celebrated the 10th anniversary of the apprenticeship training scheme for engineers. One thing is certain, the added value of apprenticeship for the student lies in the professional experience they gain. They arrive on the job market with a wealth of skills and new experience. And with a much stronger sense of confidence. Here is the testimony of Elias Limouni, 22, a computer engineering student.

#### Why did you choose to follow the apprenticeship course?

I signed up for the apprenticeship scheme in September 2020, after obtaining a DUT in computer science in Amiens. The signing of my contract with OppScience in Paris 9e, following an internship carried out there to obtain the DUT. I chose to study computer engineering because, ever since I was quite young, I was interested in this field, first in cybersecurity, then in robotics, and finally in the field in which I am now working thanks to my sandwich course programme: artificial intelligence or data science. The choice of a sandwich course programme came quite naturally after my DUT internship. Indeed, having discovered the world of the company and what it could offer me, I decided to continue along this path in order to couple the knowledge learned at UTC with the skills developed during the projects in the company.

#### Is it easy to adapt to the rhythm of a sandwich course and what purpose does this serve?

The sandwich course rhythm at UTC allows us to combine the best of both worlds: approx. five weeks in a company, then five weeks at the school of engineering. This allows us to be fully integrated for several weeks in one of the two worlds without having to disconnect to worry about the second. My apprenticeship master taught me a lot. In addition to the widespread knowledge he gave me in data science, he helped me whenever I faced a difficulty by showing me the different approaches. He explains concepts previously unknown to me in order to achieve the objectives set for the projects in which I participated. Beyond the countless skills acquired, this learning methodology acts as a springboard for integration into the professional world after school. Indeed, with the same diplomas as initial training, the "concrete" experience acquired makes the difference, and therefore makes you much more competitive on the market.

#### What benefits do you see accruing from this mode of teaching?

The skills acquired in three years of apprenticeship go far beyond what is possible to obtain through internships. Indeed, spending this time and evolving in the same environment, noting how it evolves, and seeing how the company too evolves over the years, allowed me to be much more agile and able to propose useful innovations. I learned a lot through the training I followed in courses



*I decided to continue with a sandwich course programme in order to combine the knowledge taught and learned at UTC with the skills developed through doing project work in a company setting.*

at UTC first of all, but also by applying and adapting this knowledge to the business world. This allows me to serenely enter the professional world. The apprenticeship has given me the rigour necessary to understand the problems in industry. I followed methodologies, applied agile dynamics, and used team management tools that will prove useful for the future. Moreover, I learned a lot of concrete notions in artificial intelligence (AI), consolidating the theoretical notions in mathematics and statistics acquired during the course, sometimes even helping me to understand them. Finally, I learned a lot about how a company works, whether it be in terms of hierarchy, services or team management. ■ KD





# UTC's in-house Adult Training Centre (CFA) outlining a future scheme

UTC is launching its own in-house CFA for the coming academic year. The aim is to meet the demand from companies and to intensify apprenticeship training. This already involves doubling the number of students in computer and mechanical engineering.

**T**he number of apprentice trainee students in computer sciences and mechanical engineering through apprentice schemes has increased from 24 to 48 students. These larger classes respond to a real interest in the apprenticeship engineering degree. "We also intend to propose to all the courses at UTC which wish to be accompanied towards training via apprenticeship to rely on this in-house CFA. Just like what has been done by the team of the Master's degree in Health Engineering and its two courses: proposed by apprenticeship since the beginning of the academic year 2021", reveals Dany-Laure Lavillette, Director of the UTC-CFA in charge of the training and the corporate pole at UTC. "In computer science, two courses are already on offer. The first is in software engineering and the second in infrastructure and interaction and knowledge engineering. In mechanical engineering, the apprentice can choose between the design or industrialisation courses. The CFA will be the base for this increase in numbers, with almost 250 apprentices spread over the three years of training from the start of the next school year," continues Dany-Laure Lavillette. This will optimise the administrative and financial organisation of this increasingly popular form of education. The CFA will be operational as of May. It is a department of the UTC in its own right.

*We made this choice a long time ago, giving our apprenticeship diplomas the same requirements, the same pedagogical objectives and the same skills as those under undergrad. student status.*

## A diploma of equal value

The content, the organisation and the structure of the teaching designed at UTC aim at providing the engineering students, in addition to the scientific and technical competences, professional skills particularly important for the companies. An apprenticeship is part of this continuity. "For a long time now, we have embodied this choice to give our apprenticeship diplomas the same requirements, the same pedagogical objectives and the same competences as those under student status. Our recruitment criteria are the same. The future apprentices must also have excellent records", assures Etienne Arnoult, Dean of Training and Pedagogy at UTC. Thus, the diploma obtained by the apprentice at the end of the training is the same for all the students of UTC. "We were already pioneers in this field when we opened these mechanical and computer science courses to



DANY-LAURE LAVILLETTE

apprenticeship in the 2000s," he adds. "Moreover, companies like the sandwich system very much. The CFA is a way of approaching these companies close up, inasmuch as they are looking for young people trained in their own DNA, so to speak. I am also a lecturer in mechanical engineering and I observe that apprentices develop a quicker and more refined understanding of the company and its challenges. They are better able to predict what it will be like tomorrow". ■ KD



## PORTRAITS !

**Bruno Da Silva, Associate Director of Leanovia - System Architecture and Performance Consultant**

"I have been an apprentice master for several years now. I recruit apprentices from UTC, from which I myself graduated. I wanted to give back what I received as an apprentice. Each year, we accompany several of them and we follow them whether in the office or in the customer's office. All of them are subsequently recruited on permanent contracts. I am very satisfied with them. In our sector of activity, the performance part of the System Architecture is not something that can be learned at school. So we need time to train our employees in these very specific aspects over two to three years. In my opinion, an apprenticeship is the ideal formula. The apprentice engineers are efficient, they have good reflexes and they have this perspective on engineering schools which gives them a lot of maturity. This is the best way to meet the needs of our demanding clients in the various sectors of banking, insurance, government services and e-commerce"

**Mehdi Serairi, lecturer-research scientist - head of Computer Science Engineering**

"I have been teaching apprentices at UTC for eight years now. The rhythm of the sandwich courses is an essential characteristic in this teaching which must be taken into account. This is organised by the sequence of sequences of the order of six weeks. The first sequence is carried out at UTC then the students go to the company before coming back to UTC and so on. When they come back from the company sequence, they generally wish to stay with field cases in order to better apprehend the scientific knowledge taught. The teaching methods implemented by the teachers take into account this particularity. Inductive teaching methods are thus favoured. Let us recall that at UTC we train generalist computer engineers, they are thus competent to intervene in various fields of digital engineering such as artificial intelligence, data science, networks, cybersecurity, robotics, optimization. The work-study programme with the partnership

of a company allows students to be trained in a specific computer science profession in addition to their engineering degree."

**Christine Suard, Group Campus Manager at Safran Group**

"The Safran Group supports apprenticeships at all levels. For several years, sandwich course programmes have been an important means of welcoming young people. As for UTC apprentices, we mainly favour young people from mechanical engineering and computer science courses. Some of the apprentices continue their studies, others are hired at the end of their course or return after a few years of experience. At Safran, we particularly appreciate the fact that we can train a young person over a three-year period, with a presence throughout the academic year. Every year, we welcome more than 2 300 sandwich course students at the various Safran sites in France. It's an excellent training course in the field!"



## PROFESSIONAL TRANSITION

# Exploring possible futures

The Rebond Managers' Fair 2022 was held on February 3-4, 2022 in the format "webinars". The theme chosen was: Take the risk, explore your professional transition! Are you about to change your career path or are you thinking about it? Whatever your situation, the Rebond Manager's Fair helps you move the frontier lines.

With the help of the Hauts-de-France Region, the Conseil départemental de l'Oise, the Agglomération de la Région de Compiègne, Pôle Emploi and Apec, UTC organised a new edition of the Rebond Managers' Fair. This event was expected to be a bridge of exchange enabling connections to be established between the various players in the employment service and executives in professional transition or with transition projects. At the heart of the rich programme, the large number of registered participants were able to discover the original and innovative "Talents & Transitions Patchwork" method unveiled by David John Bourne, work psychologist. "This method allows you to revisit the activities that make up your professional and extra-professional experiences with the aim of evaluating them through three prisms: the interest in each of the identified activities, the feeling of

personal effectiveness experienced in each of them and the relative importance of each of them with regard to the time you devote to them. The aim of the method is to enable you to identify new professional activities that will better correspond to your deepest aspirations," he explained at the exhibition to those who were wondering about their professional orientation.

### Perspective of a co-construction

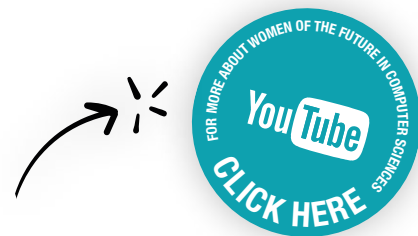
The mobilisation of this socio-constructivist method authored by David John Bourne is increasingly used by career development professionals. The method has been the subject of various presentations at international professional conferences. As a practitioner-researcher in career development coaching, this expert uses this method on a daily basis, generally in addition to the Jungian typological

approach. "In France, recent legislation has led practitioners to accompany increasingly diverse groups of people at different stages of their lives, with complex problems that reflect a constantly changing world. Constructivist approaches conceive of professional development from a global perspective where, on the one hand, work and private life are closely linked and, on the other hand, where the individual is considered as the true expert of his or her life capable of actively constructing his or her professional development," he added. Many Fongecif counsellors have been trained in the past years, as well as counsellors from various CIBCs and GRETAs in France. Practitioners have also been trained in the Czech Republic and there are plans to train some in Quebec next year. Elsewhere, it is people who carry out a skills assessment who benefit from the contributions of this particularly effective method. ■ KD



## COMPETITION TIME

# In Computer science, women also display their genius



On November 23, the final of the 'Femmes d'Avenir en informatique' 2021 competition took place. This competition, organised by Marie Hélène Abel, director of the Computer Science Department at UTC, rewards projects which aim at promoting the orientation of young women towards scientific and technological training in computer sciences.

**T**here is nothing quite like having a competition to motivate women to enter the field of computer engineering in all its forms. The under-representation of women among engineers varies according to the field.

Indeed, they are still largely in the minority in computer engineering. Hence the idea of the Femmes d'Avenir en informatique competition, created with the support of the UTC Partnership Foundation for Innovation. "Organized last November for the first time, with a jury composed of partners from the economic world, communicators, teachers and experts, this contest aims at promoting the training given at UTC and the engineering professions in computer science to young women. But also to fight against preconceived ideas and gender stereotypes, without forgetting to promote gender equality and to encourage young women to become engineers in computer science," insists Marie-Hélène Abel, director of the Computer Science Engineering department, the first woman in this department since March 2020. A Department that has less than 25% female participation. As for graduates, in 2021 there will be 40 women compared to 115 men.

### Women are the soul and future for the digital world

Among the projects proposed are the organisation of conferences held by female lecturer-research scientists and graduates of the UTC, as well as an exhibition on computer science heroines. Another proposal consists of creating video tutorials to present the computer science professions. The idea also arose to change the name of the Computer Science department to Digital. A group of students from UTC even want to go and speak in secondary schools to raise awareness of this subject among the youngest. "Others suggested creating an Instagram account or even an association. In all, six projects were presented by students and graduates, and several of their ideas will be implemented very soon. We will certainly relaunch the competition at the end of the year in a different form," says Marie-Hélène Abel, who has been UTC's 'equality' advisor since December 2021. ■ KD





## TALENTS

# Two projects distinguished at the event Future Engineers' Trophies

On December 1, 2021, event known as Trophées des ingénieurs du futur [Future Engineers Trophies] took place. Two projects developed by students of the Industrial Design Engineering course of UTC-Compiegne competed in the "digital" section: Orfey and Cosette. Two highly different projects, but with the same ambition: to place the latest technological advances at the service of users! Cosette won not only the "digital" prize, but also the public prize during this evening!

**You work on this file for thirty minutes, but cannot get started.** You then put on your ear-phones and start the "concentration" playlist, which the audio system has created just for you, by studying your electroencephalogram and your musical tastes. And indeed, you finally manage to work serenely. An e-mail alert appears on your screen: it's your grandmother. Since she has this system mounted on a touch-sensitive tablet, sending an e-mail or going on the Internet is no longer a problem for her! This scenario is still fiction, but it could soon become reality, thanks to three students from UTC.



## Cosette : the digital world at our fingertips

As the pandemic health crisis has shown, we need digital technology more than ever before, to communicate, make purchases, fill in administrative forms, etc. But this is not always easy for the elderly or people who are unfamiliar with digital technology. Agathe Boulet and Louise Thouron, supervised by Emmanuel Corbasson, have found the solution: Cosette, a device that is attached to a touch-sensitive tablet and facilitates digital access for seniors. It is a device that perfectly meets the needs of today's consumers, as evidenced by the "public prize" it won at the Trophées des Ingénieurs du Futur ceremony, in addition to winning the prize in the "digital" category.

## Orfey : the right music for the right spirit

Orfey is a connected headset that looks like a classic set, but hides a secret: electrodes in the headset measure brain activity, which is then analysed by an AI (artificial intelligence) device. The latter will then suggest playlists adapted to each user to promote concentration or relaxation, for example. This intelligent headset was developed by Athénaïs Oslati, and the project is accompanied by Anne Meuleau, a lecturer-research scientist at UTC. ■ MB



## SUSTAINABLE DEVELOPMENT

# etrémaÔ : a zero waste surgical faced-mask made in Canada

For a long time, the notion of sustainable development and recycling had no valid place in the medical field, but this is no longer the case. After the recycling of water used for dialysis (cf. page 6 above), now we have washable masks for use in hospitals!

**It has been part of our daily life for two years now. It follows us everywhere, as soon as we leave our homes, to the point where we hardly notice it. And yet, the surgical face-mask, so commonplace, is also a disaster for the environment.** "About 50,000 are thrown away every second in the world and degrade, spreading their synthetic fibres in the environment," says Antoine Palangié.

For this 1997 UTC graduate, majoring in Process Engineering (with the elective specialty Quality Safety Environment), who has always been interested in sustainable development, the use of these disposable masks, whether in medical environments or by the general public, is no longer conceivable today. "With the reduction of greenhouse gases, the problem of disposable masks in the health sector has been raised for several years, and it has become even more glaring with the pandemic.

The problem is that the alternative to such polluting masks is not without its faults: "We have seen a profusion of washable fabric face-masks come onto the market. The problem is that they don't filter

fine particles, which are the most dangerous, they wear out quickly when washed, they don't breathe well enough and therefore don't protect the wearer very well," Antoine concedes.

But where some people give up, others choose to roll up their sleeves. This is the case of Michelle Secours, head of the textile company Frétt Solutions in Canada. Called upon by the Government in March 2020 to urgently produce reusable masks, she called on Antoine to be the project's scientific director. Enthused by the prospect of making a real difference, he began looking for suppliers to test all possible fabrics.

While their first choices were natural fibres, such as cotton or hemp (the subject of Antoine's PhD thesis), the initial results showed that these did not have sufficient properties to make surgical masks or FFPs. But the team is not giving up. "We have come up with a polypropylene suit, designed to protect the very fine fibres from wear and tear during washing. This prevents them from being released into the environment or inhaled by the mask wearer, two major issues for the durability

of the filter and against microplastic pollution. Our products are also zero waste, because the fabric scraps and used masks are recovered and recycled, for example into plastic accessories for better comfort when worn for a long time," explains Antoine.



The etremaÔ masks can be washed at least 100 times without losing their effectiveness. "We have calculated that using one of our masks saves a minimum of 200 disposable masks, or more than one to five kilograms of plastic depending on the type!"

After having their face-masks certified according to several standards, Antoine and Michelle are in the process of registering a patent for their filtering media, which could then be used under licence by other manufacturers, in exchange for guarantees of good environmental, social and economic practices. "Blue masks" may soon be a thing of the past in the street... but also in hospitals! ■ MB



ANNE-FLEUR ANDRLE

## There is a need for more creativity

Anne-Fleur Andrle graduated from UTC majoring in Bio-engineering in 2011 and went on to do a Master's degree in research at the State University of New York (SUNY), Buffalo. Interactions presents a portrait of a woman who started podcasting to satisfy her need for creativity.

**H**er objective after gaining her "Bac" in the city of Brest My dream was to become a doctor. I wanted a job where I would have an impact on people's lives, to be able to help them and to be as close as possible to people," she explains. This goal was thwarted by the fierce competition in this field. After a short period of hesitation, Anne-Fleur Andrle was inspired by an internship she did in a biochemistry laboratory at the State University of New York at Buffalo. "I found lab work fascinating," she says. And it was on her return that she chose to register at UTC.

The reasons? "UTC had the same semester system as the United States, which allowed me to join in the first semester of 2008 and that it allowed me to build a career path, mixing biology and human sciences, which resembled me," she explains. Buffalo, where she left behind her 'lover', she adds. A lover who has since become her husband.

But UTC has, in her eyes, other attractions. "It is a university that gave us a solid training in engineering sciences while opening up other horizons," she explains.

This is how Anne-Fleur Andrle joined the Graf'hit radio station, hosted on campus. "They had a popular science programme called 'Biotine' and I offered to do a column on it, which I did from 2009 to 2010. It was a revelation for me. Then, at the end of 2010, with a few students, we transformed this column into a fortnightly programme," she points out. A radio station which she chaired for a year and which revealed her passion for sound.

After graduating in Engineering Sciences, she went on to do a master's degree. "I wanted an international degree. So

I applied for a research master's degree at several American universities, and returned to SUNY Buffalo," she says. With her Master's degree in hand, she continued her American adventure. But this time, on the job market. "I joined a French start-up, Olea Medical, specialising in diagnostic assistance, in Boston as an application engineer. There I found a little of what attracted me to medicine," she says.

But Anne-Fleur Andrle likes challenges and is not afraid to take up a different path. She joined another French company, AMA, which specialises in augmented reality, particularly in the medical field, and which wanted to establish itself in the United States. "On paper, it was a very interesting and challenging job. I learned a lot and it was exciting. But soon the commercial component of the job took over, which was not really to my liking. I needed some creativity in my work," she says.

After suffering a personal burn-out and spending some time at MIT, she returned to her first passion: radio. "It was at MIT, which I joined in the summer of 2019, that I felt the need for creativity. So it was also there that I created my first podcast 'French Expat'. It very quickly found a very large audience. However, I continued at MIT until the online media French Morning offered me a regular collaboration in June 2021 to produce French Expat. In parallel, I work for other media and institutions to create podcasts in their image. Since the summer of 2021, I live only from my podcasts," concludes Anne-Fleur Andrle. ■ MSD

### BIO EXPRESS

2008 : registered at UTC in the major Bio-engineering

2011 : obtains his engineering degree, specialising in Biomechanics and Biomaterials

2013 : obtains a research master's degree in biomedical engineering from the State University of New York in the United States

2019 : launches her first native language podcast, 'French Expat'

Since 2021 : producer of audio content in France and the United States



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May 30, 2022  
UTC - Centre Pierre Guillaumat

www.utc.fr

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