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# Interactions

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## *Interaction of real and virtual worlds*

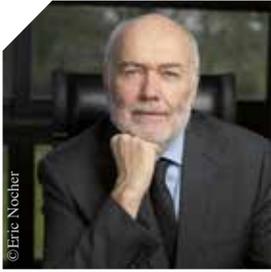
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**PROF. CHRISTOPHE GUY**  
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**BIOMEDICAL INNOVATION** P. 10

**A RENDEZ-VOUS TO ENCOURAGE  
AND ENHANCE BIOMEDICAL INNOVATION**





EDITO

**V**irtual reality technology (or VR), associated for a long time solely with video games, has since invested many sectors. UTC was one of the pioneers given that this University introduced virtual reality courses at the beginning of the 2000s and launched research in this field within the UTC-Heudiasyc laboratory.

Since then, the number of VR headsets sold has literally taken off, rising from 5 million units in 2014 to 68 million in 2020, their cost dropping and the technology itself evolving. We are now talking about immersive technologies including virtual reality, augmented reality and mixed reality. They were initially deployed in the field of learning, particularly in technical and manual sectors such as construction and industry. Thanks to immersive technologies and artificial intelligence, learners can repeat complex operations ad infinitum, at a lower cost and without risk, until they achieve perfect mastery of the technical gesture to be performed. This is notably the case of the Kiva project conducted within Heudiasyc, the objective of which is to lead the learner to integrate the expert gesture of cleaning impurities off the surfaces of aluminium cylinder heads that have just been cast.

Today, these breakthrough innovations hold the promise of strong growth, especially as the interaction between the real and virtual worlds opens up widespread fields of application. For the better, such as civil applications in medicine, education, civil engineering or industry, as well as for the worse in certain military applications. This can raise eminently ethical questions. The technological developments of the last ten years, with their dangerous and even deadly uses, have put ethics back at the centre of the reflections of artificial intelligence researchers.

We have seen this with the lethal use of drones or, more recently, with the \$22 billion, 10-year contract between the Pentagon and Microsoft to equip GIs with VR fitted helmets.

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

PORTRAIT

# Strengthening links between UTC and Industry

**Professor Christophe Guy, the newly appointed Director, as of February 1, 2021,** (equivalent to President and Vice-Chancellor) of the University of Technology of Compiègne (UTC) was previously a UTC Academic Board Member for three years. An internationally recognised scientist, Prof Guy is also an ardent supporter of university-industry relations, which he intends to strengthen within the institution while ensuring its development in training and research, but also its international outreach.

**C**hristophe Guy grew up in Villefranche-de-Rouergue, a small township of 3,500 inhabitants in Aveyron. It must be said that he had a 'knack' for science and it was quite natural that he joined a preparatory class at the Pierre-de-Fermat Lycée in Toulouse before admission at the Institut national supérieur de chimie industrielle (INSCI) in Rouen. This engineering school has since been transformed into the National Institute of Applied Sciences (INSA).

But the call to "cross the oceans and explore the great beyond" and do research was stronger. So, with his engineering diploma, he decided to enrol for a Master's degree at the Polytechnique-Montreal (Canada), where he gained his Ph.D. in chemical engineering. «In fact, it was more a specialisation in process engineering, even though the actual degree bears the name of the department. Namely: chemical engineering,» explains Christophe Guy. He then returned to France for two post-doctorate courses «The first was at the Gaz de France research centre in Paris, since renamed Engie, and the second at the French Petroleum Institute (IFP) in Rueil-Malmaison,» he says. In short, during these two post-doc periods, he was immersed in «gas and oil», he says.

*Ensuring the development of UTC in engineering training and research; strengthening the links with industry; giving it a greater influence and finally reinforcing our international outreach and presence.*

He then went back to Montreal where he was appointed as a professor in the chemical engineering department of the Polytechnique-Montreal. As a research scientist, he was particularly interested in «the impact of industrial activities on the environment and the on health of those living near industrial sites», he says. This led him and one of his students to found Odotech, a spin-off company specialising in foul odour problems. «It was a first in this field,» says Christophe Guy. The company quickly set up a subsidiary, Odotech France, in Lyon. The company, with its patents and its market-ready technologies were bought out a few years later by an Australian group.



Over the years, he has held various positions within the Canadian school. First as Head of Department, then Director of Research and Innovation and finally President of the school for two terms of five years each, the maximum allowed. Still in Montreal, he joined Concordia University, an English-speaking university located in the same city, at the end of his two terms as Vice-President in charge of Research and Graduate Studies as well as international relations. He stayed there for two and a half years. «At Concordia, we changed dimension. The Ecole Polytechnique, with 8,000 students and doctoral candidates, was an engineering school, even if, within the framework of partnerships with HEC-Montreal and the University of Montreal, they completed their training with subjects that were not 'pure' engineering. At Concordia, there are 50,000 students taking courses in almost every field - law, economics, science and engineering, music, theatre, literature, cinema (Xavier Dolan is one of the graduates),» explains Christophe Guy. After Concordia University, he came to UTC, an institution that is no strange setting to him since he was one of its Academic Board Members for three years.

His plans for the university? «This will involve ensuring the development of UTC in engineering education and research; strengthening the links with industry; giving it a greater influence and finally reinforcing our international outreach and presence, in particular in South America and in Asia, and especially so in South Korea, a very advanced country technologically but also to help others which are less so, such as Vietnam, for example,» he concludes. ■ MSD



## THE HUMAN-TECHNOLOGY INTERFACE

# Prof. Bernard Stiegler, an emblematic figure-head at UTC-Costech

Following suit to the PHITECO 2021 seminar on the theme «Reflecting on technology with Bernard Stiegler», three members of the CRED (Cognitive Research and Enactive Design) team, Charles Lenay, Professor of Philosophy and Cognitive Sciences, Florent Levillain, Senior Lecturer, and Vincenzo Raimondi, Lecturer and Research Scientist look back over the legacy of this emblematic figure from the Knowledge, Organisation and Technical Systems (Costech) Laboratory.

**Bernard Stiegler, was noticed in 1988 by Liliane Vézier, then Director of the Technology and Human Sciences Department (TSH) at the UTC,** as the designer of an exhibition entitled «Memories of the Future» at the Centre Pompidou, Paris. At the same time, she was conducting a somewhat aggressive campaign to recruit temporary staff, and Bernard Stiegler, who had not yet defended his PhD thesis, was among them. At the time, there was also Véronique Havelange, who had organized a seminar on «Cognitive Sciences and Philosophy» in a European context. Bernard Stiegler, who at that time was developing an assisted reading unit for the Bibliothèque Nationale de France (BNF), made a plea - when he arrived at UTC - in favour of a philosophy involved in the innovation process. This is how the seminar «Philosophy, Technology and Cognition» or PHITECO was renamed and the most recent edition, dedicated to his work, was held in January 2021. This edition was co-organised by Florent and Vincenzo», explains Charles Lenay who knew him in 1989 when he arrived at the UTC. Bernard Stiegler was a key figure in the field of humanities at UTC. As a philosopher of technology, he developed a rich and profound reflection on the idea of the «technical 'constitutivity' of human beings».

In short? «We speak of «ACT» or anthropologically constitutive technology. This means that being human implies being a technical being, and this has always been so. Human evolution, since the dawn of time, has taken place in a technical environment. There is no relationship of exteriority between human sciences and technology. In other words, there is not, on the one hand, Man who gives meaning and, on the other, technology which would only reflect, so to speak, on existence of material conditions. On the contrary, it is our technical environment that makes us «human», supports our thinking, supports our consciousness of time that would not exist without our technical mediations and our technical environment. This is Stiegler's thinking, a man of commitment and action. This is why, in 2005, he created the Ars Industrialis association in order to combat the submission of intellectual technologies to market criteria alone,

for example.» he explains.

Vincenzo Raimondi agrees: «The thesis of the intermeshing of human and the technical spheres has become the DNA of Costech. It has played a fundamental role in research in our laboratory and permeates much of our work. Not only Stiegler's research, but that also of many other research scientists.»

What is special about Stiegler's thinking compared to other philosophers of science and technology? «Stiegler's profound originality in relation to other thinkers of technology, such as Jacques Ellul for example, is that he does not separate the historicity of technology and that of humans. In his view, both are intimately linked, and the history of technology gives rise to a certain psychological structure in our contemporaries. Human thought is itself 'historicised' by its inscription in the history of technology; it is particular to a given era; it is situated in a time, an era defined by the artefacts it has constructed. Our era, for example, is the digital era, a particular form of technology that authorises certain thoughts that were unthinkable in the last century.» says Florent Levillain.

«It is thus a question of not reducing technology to something that could impoverish human experience, diminish our experiences of the world,

*Stiegler's profound originality in relation to other thinkers of technology, such as Jacques Ellul for example, is that he does not separate the historicity of technology and that of humans.*

but rather to consider it as 'constitutive' of our experience,» adds Charles Lenay.

However, Bernard Stiegler entertains a lucid view of the risks of drift. «For Stiegler, any technique or technology is a «pharmakon». It can be both a remedy and a poison in the sense that it brings both solutions (curative power) and potential new problems (destructive power). This is why, in his view, all technology must be subjected to a pharmacological critique,» concludes Vincenzo Raimondi. ■ MSD

A specific file focused on the theme «Reflecting on technology with Bernard Stiegler», is posted on the UTC-Costech's Website «Cahiers».





**# ACADEMIC RANKING - UTC STILL LEADS THE FIELD**

The UTC-Hutech programme (Humanities and Technology) is ranked first in the 2021 line-up of the best post-bac engineering schools by the magazine L'Obs, which highlights the hybrid nature of this university's courses. UTC is also ranked 2nd among public post-baccalaureate schools in the «Schools of excellence» category (schools targeted by students from the so-called "grandes prépas" and the best baccalaureate graduates), in the Figaro's ranking of the best engineering schools in 2021. It is also in 17th place for all «Schools of Excellence» combined (post-bac and post-prep). Moreover, UTC comes 2nd in the category «Industrial engineering - mechanical engineering» and 7th in the category «Digital - computer science - mathematics». The UTC also obtained the 2nd place of the post-bac public schools (12th overall in terms of score, all schools included) in the annual ranking of



the best engineering schools of the magazine

L'Étudiant.

In the QS 2021 world ranking of universities, UTC is ranked 352nd in the «Engineering & Technology» category; between 151st and 200th place in the «Engineering - Mechanical» category; between 301st and 350th place in the «Computer Science and Information Systems» category; between 351st and 400th place in the «Engineering - Chemical» category. This ranking is published annually by Quacquarelli Symonds and is one of the three most reputable university rankings, together with the Times ranking and the University of Shanghai ratings.

**# UTC-PERSONNEL TRAINED IN CLIMATE CHANGE/ENERGY ISSUES**



Last January (2021), the UTC organised a 100% virtual training day for its staff in order to train them on climate change and energy related issues. Animated in a collaborative, dynamic and "gaming" way, this day allowed the participants:

- to understand the scientific phenomena underlying climate change, the systemic links between these phenomena, the impact of human activity on these changes and their societal consequences;
- to understand the links between energy consumption and human production and consumption patterns
- to exchange/debate on the individual and collective levers of action, on a personal and professional basis. ■ PS

**RANKING**

# Humanities & Technology, first cum laudae !

According to the French magazine L'Obs, UTC's Hu-Tech (Humanities & Technology) course was ranked first among the Post bac engineering training courses.



**This ranking that has not gone unnoticed in the world of post-baccalaureate engineering schools.** Released in March, L'Obs's ranking of post-baccalaureate engineering courses singled out the Humanities and Technology (Hu-Tech) course at UTC (the University of Technology in Compiègne). Launched in 2012, this course aims to train "technosophical" engineers, which includes technologists (specialists in technological systems and tools) and philosophers. Accessible after the baccalaureate, it offers three years of multidisciplinary training that combines human sciences and more traditional sciences, and enables students who wish to do so to continue in one of the specialist majors offered UTC or to follow a Master's degree in another HE institution.

This ranking is based on several criteria: the number of cum laudae "Très bien" Bac results accepted into the course, the percentage of admissions, and the percentage of favourable responses from applicants. This highlights the excellence and attractiveness of the course.

"We are delighted at gaining this first place," explains Nicolas Salzmann, the director of this programme. "It demonstrates that the gamble we took a few years ago was a 'winner'". The attractiveness of the course is based, according to the teacher, on several pillars. «Many students want to pursue a solid humanities education while acquiring computer skills, and that's what they

*"This ranking demonstrates that the gamble we took a few years ago was a 'winner'"*

like about the courses we offer.» Another point that explains the attractiveness of this training? The range of possibilities open to candidates once they graduate. "If they decide to continue with an engineering course, former Hu-Tech students can reach the same positions as students who have followed the traditional core curriculum,» continues Nicolas Salzmann. "But they have skills that are appreciated on the job market; strong thinking that links technology and society and that can be appreciated in professional situations, such as the ability to read and write long texts, to work in heterogeneous environments, etc.» And for some years now, job offers specifically aimed at graduates of the Hu-Tech course have been flourishing on the job market. «Positions in research, participative research, consulting and design offices, and in project management assistance,» concludes Nicolas Salzmann.

The UTC common core is not left behind in this ranking either, since it comes in third position. A ranking which confirms the attractiveness of UTC observed for several years already. ■



# Interaction between Real and Virtual Worlds

Virtual reality (VR) technology associated for a long time solely with video games, has since experienced a major boom, particularly in the field of training. The «democratisation» of VR headsets is no stranger to this. The number of headsets sold has exploded from 5 million units in 2014 to 68 million in 2020, their cost has dropped and the technology itself has evolved. We are now talking about immersive technologies including virtual, augmented and mixed realities (VR/AR/MR). UTC has been a pioneer since it introduced, as early as 2001, teaching in virtual reality and launched, within its Heudiasyc laboratory, research on both the fundamental and application levels. The interaction between the real and virtual worlds opens up immense fields of application, particularly in relation to robotics. For example, we can interact with a drone that maps the damage caused by a natural disaster in places that have become inaccessible. Obviously, these new possibilities can be used for malicious purposes, and this raises several ethical issues. UTC's academics are aware of this.

## A front-line, cutting-edge laboratory for digital sciences



Professor Philippe Bonnifait, has been director of the UTC-Heudiasyc Laboratory, created in 1981, since January 2018. A cutting-edge laboratory dedicated to digital sciences, which specialises in scientific methods related to artificial intelligence, robotics, data analysis, automation and virtual reality.

**C**reated in 1981 and associated with the CNRS since its foundation, the UTC-Heudiasyc Laboratory (Heuristics and Diagnosis of Complex Systems) is attached to the INS2I (Institute of Information Sciences and their Interactions), one of the ten CNRS national institutes and initially headed by Prof. Ali Charara, former director.

Can we single out a particularity of UTC-Heudiasyc? «It is a laboratory that brings together research scientists in computer science and computer engineering, two specialities that are often addressed separately; we are one of the first laboratories to have this vision in France.» explains Philippe Bonnifait.

As the world of computer science is, by nature,



evolving, the themes addressed by the laboratory's lecturer cum research scientists have themselves naturally evolved and quite considerably so.. The proof? The development of research in the field of virtual reality. «A development that coincided with the arrival of Indira Thouvenin in 1995 at the UTC, a personality who is very well known in her field. The projects led by Indira were in strong interaction with cognition, human and social sciences, and involved numerous collaborations with other laboratories, notably UTC-Costech,» emphasises Prof. Bonnifait.

Since the restructuring of the laboratory in January 2018 and the down-sizing from four to three teams - CID (Knowledge, Uncertainty, Data), SCOP (Safety, Communication, Optimisation) and SyRI (Interacting Robotic Systems) – various interdisciplinary themes have been identified. This is the case of VR (virtual reality), an eminently cross-disciplinary subject, which thus 'straddles' the SyRI and CID teams. «Within CID, we are interested in adaptive systems and the personalisation of systems; themes where we find a number of elements linked to immersive environments, one of Domitile Lourdeaux's research fields. At SyRI, where Indira Thouvenin is based, we are particularly interested in robotics, with subjects such as robot autonomy – smart, autonomous vehicles and drones for our part -, control, perception and data fusion, and interacting multi-robot systems,» explains

*Since the UTC-Heudiasyc laboratory was reorganised in January 2018 and with the changeover from four to three research teams, several interdisciplinary themes have been identified. This is the case of VR (virtual reality).*

Philippe Bonnifait. In short? «In the case of multi-robots, there are three types of interaction: those with their environment, those with other robots and finally those with humans. In my opinion, it is very important to put the human being back at the centre of all the projects we develop. If we take the concrete case of the windscreen of the future, for example, a project by Indira, it is a question of creating mixed reality on the windscreen, head-up displays, an application intended for the autonomous vehicle in the long term,» he explains.

These interactions are evolving as we talk more and more about symbiotic autonomous systems. «We are moving towards the symbiosis of intelligent machines with humans in a large number of areas. One example? The Xenex robot, an American invention, which has been deployed in a number of hospitals for disinfecting rooms

using UV light. This is very useful, especially in these times of Covid,» he says.

While in this case we are dealing with a truly autonomous machine, this is not the case in all sectors. «Let's take drones. They always need a remote pilot, and what we are trying to do at Heudiasyc is to have a remote pilot for several drones; a remote pilot who can take control in the event of a problem, because a drone in a crowd, for example, can cause a lot of damage. This is also the case for the autonomous vehicle, which, even in the long term, will need the vigilance of the driver. However, there is a middle way open to us: moving towards this human-machine symbiosis so that we can imagine new ways to drive,» adds Philippe Bonnifait.

The interaction between the real and virtual worlds opens up huge fields of application. For the better - the drone that monitors the state of drought in certain areas - and for the worse - certain military applications. This poses eminently ethical problems. «For a long time, ethics remained rather remote from our concerns, but the technological developments of the last ten years, with dangerous or even lethal uses, have put ethics back at the centre of the reflections on AI (artificial intelligence). ■ MSD

## The rapid growth of VR (virtual reality) and AR (augmented reality) research

As a lecturer-cum-research scientist, Indira Thouvenin set up a virtual reality (VR) and, more recently, an augmented reality (AR) activity when she arrived at the UTC in 2001. An activity that is to be understood as taking place as much at the level of course work as at the level of research.

**Initially attached to the UTC-Roberval laboratory, Indira Thouvenin joined the UMR CNRS UTC Heudiasyc Lab in 2005.**

Among her fields of research? «I am working on informed interaction in a virtual environment. In other words, 'intelligent' interaction where VR adapts to the user. This involves analysing the user's gestures, behaviour and gaze. We then define descriptors for his or her level of attention, intention, concentration or understanding, for example. I also work on interaction in an augmented environment. In this case, the aim is to design explicit and implicit assistance, the latter being invisible to the user,» she explains.

This research is leading to applications in the fields of training, health, education and industry, among others. «The descriptors allow us to define the user's attitude, in particular, his level of concentration or distraction, his skills: does he already have experience, or is he a beginner?

From all this data, we will make a selection of «sensory feedback» or adaptive feedbacks, since VR uses visual, sound, tactile or haptic feedback. All these sensory feedbacks will thus allow us

to help the user to understand the environment without imposing all the feedbacks but only those which are most appropriate to him. In short, it is a highly personalised modelling of



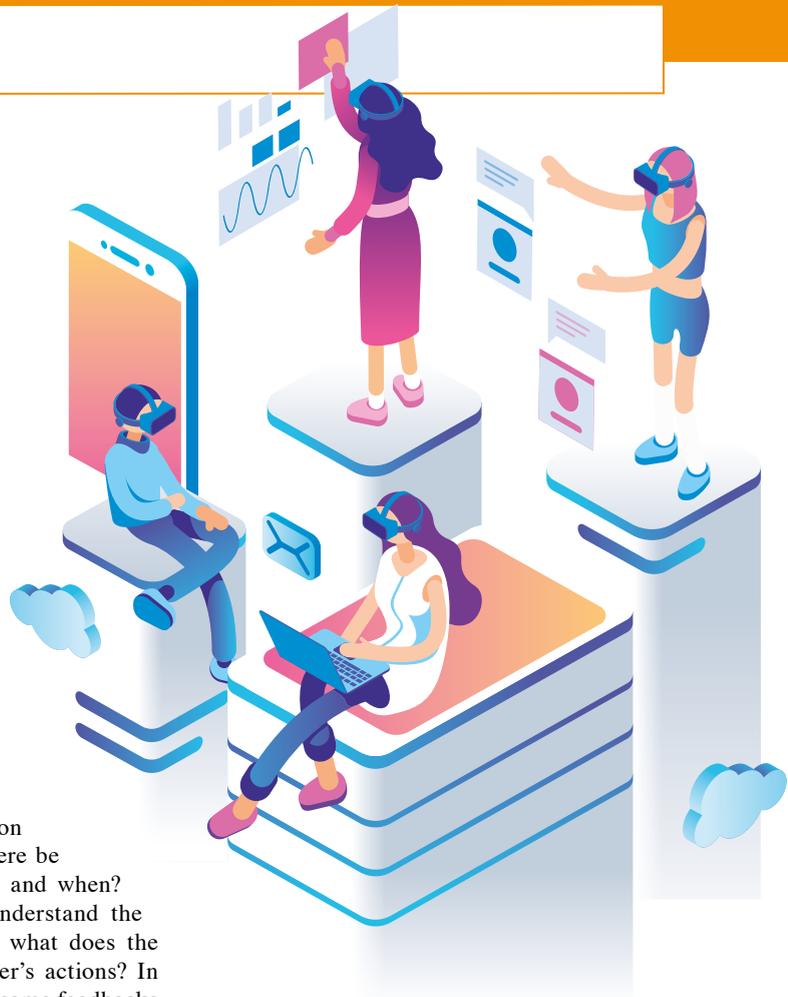
INDIRA THOUVENIN

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YOHAN BOUVET

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interaction in a virtual environment,» explains Indira Thouvenin.

Is a task that calls for lots of simulation and modelling? «For my part, I work on three simulation platforms dedicated respectively to the railway, the autonomous vehicle and VR. The latter consists of two main pieces of equipment: VR headsets intended, in particular, for teaching, and the Cave system (cave automatic virtual environment, i.e. an immersive room) in which you can visualise at scale 1. We have a Cave with four sides, each supporting a screen with a rear projection system. The screens are displayed in stereoscopy or 3D. The Cave allows you to see your own body, whereas in a helmet you have to reconstruct a virtual body,» explains Yohan Bouvet, head of Heudiasyc's simulation & modelling department.

Today, virtual reality and augmented reality are booming in various fields. Hence the multiplication of projects both at the academic and application levels.

A flagship augmented reality project? «We are working with Voxar, a Brazilian laboratory

specialising in augmented reality, to develop an augmented windscreen for semi-autonomous cars. A project that is the subject of Baptiste Wojtkowski's doctorate, as part of the chair of excellence on intelligent surfaces for the vehicle of the future, financed by Saint-Gobain, the UTC foundation, the FEDER (European Regional Fund) and the Hauts-de-France region,» she points out.

What does this mean in concrete terms? «It will be a question of defining what we will visualise on this "future window". Should there be visual feedback from AR? How and when? When does the user need to understand the state of the robot (vehicle) and what does the vehicle understand about the user's actions? In real time, we will not display the same feedbacks all the time but take into account the user's fatigue, concentration or lack of concentration,» explains Indira Thouvenin.

Other projects in progress? «In particular, there is a project on «social touch» between a virtual agent embodied in the Cave and a human. This is a project funded by the ANR, led by Télécom Paris, integrating UTC-Heudiasyc and ISIR (the UPMC robotics laboratory). In this project called «Socialtouch», Fabien Boucaud is doing

his PhD and developing the agent's decision model. Finally, the last project underway is the Continuum team. The idea? To bring together the majority of VR platforms, thirty in all in France, in order to advance interdisciplinary research between human-computer interaction, virtual reality and the human and social sciences,» she concludes. ■ MSD

*This research leads to applications in the fields of training, health, education and industry, to mention just a few.*

## Demystifying Virtual Reality (VR)

Romain Lelong, who graduated in computer sciences from UTC, is one of the two founders, in 2008, of Reviattech<sup>1</sup>, specialised in Virtual Reality (VR) for industrial training. He co-authored, with Indira Thouvenin «La réalité virtuelle démystifiée<sup>2</sup>».

**W**hat is the key idea underpinning this book? «Virtual reality (VR) is, for most people, generally associated with video games. With this book, we are trying, in

a simple manner, to broaden the subject-matter, to show all the possible fields of application, in particular in training or industry, for example, that are fields constantly evolving,» says Romain Lelong.

The general principles of virtual reality? «It is a technology that is at the crossroads of image generation - we used to talk about synthetic images at the time - and interaction with



something that does not really exist. A situation that impacts in particular on cognitive aspects but also on psychosocial aspects; the latter can be induced by the type of relationship that the user establishes with a virtual character,» he explains.

«We also address more technical subjects, for example: the construction of a virtual world or the perspectives that are emerging with closely related themes such as artificial intelligence, transhumanism and communications,» he adds.

This is a timely book for all those

who want to know more about VR. A popular work that provides a complete overview of VR today: history, operation, evolution of equipment, the boom in VR headsets, sales rising from 5 million units in 2014 to 68 million in 2020, areas of application both professional and private, social and psychological consequences, but also the prospects without obscuring the developments that can conceal the best and the worst. ■ MSD

<sup>1</sup><https://reviatech.com>

<sup>2</sup>Éditions Eyrolles – Novembre 2020



# From real to virtual drones

Pedro Castillo is a CNRS research scientist who works at the UTV-Heudiasyc Lab. and a member of the Robotic Systems in Interaction (SyRI) team. He is specialized in automatic control applied to robotics. His research focuses, in particular, on the automatic control of UAVs, autonomous UAVs but also, more recently, virtual UAVs.

**A**rriving from Mexico with a scholarship, Pedro Castillo started a PhD thesis, in 2000, in automatic control, more particularly on the automatic control of drones, at UTC. His thesis won him the national prize for the best thesis in automatic control in early 2004. During these years, he did a series of post-docs in the United States at Massachusetts Institute of Technology (MIT), in Australia and in Spain, then applied for a position with the CNRS, which he joined in 2005, appointed to the Heudiasyc mixed research unit, where he continued his research on the control of miniature drones. «As early as 2002, during my thesis, we conducted the initial tests. We were the first team in France to work on this subject at that time and one of the first to develop an autonomous four rotor drone,» he explains. This explains the recognition that the laboratory enjoys in this field, both in terms of theoretical and experimental research. «UTC-Heudiasyc is known for having developed fundamental platforms. And it was during my thesis that we started to develop experimental platforms dedicated to flight modes in order to validate the theoretical research that we were carrying out. As early as 2005, we worked on setting up a common platform for the validation of aerial drone control systems, which was completed



in 2009”, he explains. While many researchers are placing their bets on autonomous drones, Heudiasyc has adopted a different gamble. «We realised that we cannot leave all the work to a drone. There may be situations that it will not be able to handle. In this case, the human must be able to take over. In robotics, we talk about a control loop where the human can interact with the robot at any time,» says Pedro Castillo. Until recently, in the field of human-machine interaction, rather classical approaches have dominated. Those that use joysticks or remote operation, which, thanks to feedback from the system to the operator, allow the control of a

remote robot. The idea of introducing virtual reality? «It’s to introduce visual and audio feedback. In a word: to see what the robot sees by equipping it with cameras and to be able to hear, for example, in the event of a motor problem. This will make it easier to control and therefore navigate the drone,» he explains. But Pedro Castillo and Indira Thouvenin decided to go further and explore a new theme: virtual robotics. «We decided to represent our aerial drone test room in the Cave, i.e., with highly immersive technology. We also created a small virtual drone that can be manipulated, which can be given different trajectories and carry out different missions. It is a sort of assistant to the real drone, since the latter will then carry out all the tasks that the operator indicates to the virtual drone,» explains Pedro Castillo. Concrete applications? «We are interested in civil applications and there are many. We can mention the inspection of buildings, for example, or the occurrence of any natural disaster. There may be inaccessible places and drones allow us to take stock of the material or human damage and act quickly and in the right place,» he concludes. ■ MSD

# Kiva - training in gestural expertise

Sébastien Destercke is a CNRS research scientist and head of the Knowledge, Uncertainty and Data (CID) team at UTC-Heudiasyc. His field of research concerns modelling and reasoning under uncertain conditions, in particular in the presence of high or severe levels of uncertainty.



**C**oncretely? «Strong uncertainties are defined as missing or imprecise data, poor or qualitative information. What are the underlying ideas? “The main idea is to model this type of information in a mathematical language in order to carry out reasoning tasks. This can be automatic learning, i.e., learning from examples, or making decisions in the face of uncertainty,» explains Sébastien Destercke. Is there a transition to virtual reality? «At Heudiasyc, we have strong expertise in theories

that generalise probabilities, such as theories of evidence or imprecise probabilities. These are rich mathematical languages that allow uncertainty and incompleteness of information to be modelled in a very accurate manner. Such expressiveness is particularly useful in certain applications of virtual reality, especially in the case of designing training aids. Among the uncertainties requiring fine modelling, we can cite those concerning the learner's competence profile or even his emotional states. Taking uncertainty into account in the reasoning will make it possible to better adapt training scenarios, which can be better personalised for each profile.» he adds.

This work on uncertainty has, among other things, led to the Kiva project, which is built around an «informed virtual environment for training in technical gestures in the field of aluminium cylinder head manufacturing»; a project that won an award in the «Training and Education» category at the Laval Virtual trade fair.

What is Kiva's objective? «We focused on a special training gesture: how to blow impurities off the surface of aluminium alloy cylinder heads that have just been cast? The aim is get the trainee to reproduce the 'expert' gesture. However, in this situation, we have at least two sources of uncertainty: on the one hand, the «expert» gesture can change from one expert to another and, also, the recognition of the gesture which cannot be done perfectly. The trainee is equipped with sensors; he or she will make movements that are not necessarily regular or collected in a continuous manner. This gives us partial information on the basis of which we must define the recognition of the trainee's gesture and try to measure how this gesture matches the 'expert' gesture. Now, in the system that will guide the learner, it is necessary to include these sources of uncertainty» , adds Sébastien Destercke.

«An 'expert' gesture that the learner is asked to reproduce in a Cave. The use of virtual reality in



companies for training purposes is recent. Until now, it has often been limited to improving the ergonomics of workstations, where issues related to man-machine interaction are less critical. With these training objectives, they have become fundamental,» he concludes. ■ MSD

## Scenery adaptation in VR (Virtual Reality)

Domitile Lourdeaux, a university lecturer at UTC, is a member of the Knowledge, Uncertainty, Data (CID) research team at the UTC-Heudiasyc Lab. Her investigations focus on personalised adaptive systems in VR (Virtual Reality).

**VR** is a field of research that she has been exploring since gaining her PhD. «I am interested in the adaptation of scripted content according to a dynamic user profile and, more particularly, in virtual environments dedicated to training. Inasmuch as we are dealing with learners, I am working in particular on the adaptation of educational content and narration. In a word: how to stage learning situations in virtual reality (VR),» explains Domitile Lourdeaux.

The fields of application are varied and past or current projects attest to this. There was Viteams on the training of 'medical leaders', a project funded by the ANR and the Directorate General of the French Armed Forces (DGA) and ongoing programmes Orchestraa as well as Infinity<sup>1</sup>, a European project involving eleven countries and twenty partners including Manzalab, coordinated by Airbus Defense & Space. The former was launched in November 2019, thanks to funding from the DGA and has among its partners Réviatech, Thalès as well as CASPOA, a NATO centre of excellence, the latter in June 2020; both for a duration of three years.

«Orchestraa aims to train air command leaders in military air operations centres. There are about forty people in the room coordinating military operations. The learner is given a VR headset and interacts with his team of autonomous virtual characters; these are linked to fighter pilots, helicopters, drones, etc. They will therefore play out a scenario planned several days in advance. They will therefore play out a scenario planned several days in advance, but on the day, there may be unforeseen circumstances that disrupt the original scenario and that they

must be able to manage. These may be unforeseen requests for air support or a plane crashing, in which case the pilots must be rescued in the field. These hazards will require a reallocation of resources, ultimately creating a chain reaction impacting the entire operation. In this case, the adaptation concerns the difficulty of the scenario, which will increase according to what the learner is capable of managing. This will require them to demonstrate progressive skills,» she explains.

Infinity concerns a completely different field. This



large-scale European project aims to provide tools – AI (artificial intelligence), VR for data visualisation and analysis - to improve the collaboration of European police in investigations against cybercrime and terrorism. «We have three use cases: analysis of the behaviour of cyberattacks during an ongoing event, rapid analysis in the aftermath of a terrorist attack and finally hybrid threats, resulting from the convergence of cyberterrorism and terrorism,»

explains Domitile Lourdeaux.

Infinity is a project in which URC-Heudiasyc is the leader of a monitoring tool on recommendations to guarantee the well-being of police officers using VR, a technology that indeed causes side effects due to the helmets (cybersickness, visual fatigue) and can also generate cognitive overload and stress related to the tasks to be performed in VR. «In this project, we are focusing on the side effects. We are trying to measure them in real time while the users have the headset on to diagnose their condition. We are interested in «three states» in particular: the cybersickness common to all VR headset users, the mental load related to the complexity of the task and stress and its multiple causes. To detect these side effects, we use physiological sensors ((ECGs) electrocardiograms, electrodermal activity, oculometry and pupillometry), behavioural data (task efficiency) and questionnaires», stresses Alexis Souchet, a post-doc student also at the UTC-Heudiasyc Lab.

Virtual reality does, however, raise various legal and ethical problems. «Manufacturers are going to make VR tools available to people without taking into account the harmful impacts on their health. This is a real problem when you consider the explosion in the sale of headsets, which has risen from 5 million units in 2014 to 68 million in 2020,» concludes Domitile Lourdeaux. ■ MSD

<sup>1</sup><https://cordis.europa.eu/project/id/883293>



BIOMEDICAL INNOVATION

# A rendez-vous to encourage and enhance biomedical innovation

The 3rd UTC Biomedical Rendezvous was held on Friday 22 January, 2021. A virtual edition with online exchanges and conferences. On the programme, Stéphane Kirche, Regional Director for Innovation and Biomedical Engineering and Alexandre Benoist, Clinical Engineer at the Saône-et-Loire Bresse Morvan Hospital Group, spoke about «The digital hospital: innovation in medical practices, training and management of a ‘GHT’ (Territorial Hospital Group).

**S**téphane Kirche, Regional Director for Innovation and Biomedical Engineering, and Alexandre Benoist, Clinical Engineer at the Saône-et-Loire Bresse Morvan Hospital Group, were able to present, during the recent (3rd) Biomedical Rendez-vous their day-to-day vision of a “digital hospital” and to share with the audience some innovations that can be observed in medical practice, training and the management of their establishment. «New medical devices are now more complex, more mobile, interconnected and include artificial intelligence. The skills of professionals must also progress. Caregivers are also becoming producers of data at the patient’s bedside. This is the famous «augmented caregiver»,

they explained. “We need solutions that improve the quality of work and reduce the pressure to attain more predictive, preventive, personalised and participatory medicine. At the same time, five billion people cannot benefit from medical imaging techniques. Health research, care and innovation must constantly evolve.»

### Value-adding to biomedical data

By 2022, 70% of care will have to be provided on an outpatient basis. This is a new situation, which is pushing health establishments to communicate with the outside world (town medicine,



ALEXANDRE BENOIST



STÉPHANE KIRCHE

GPs, public health organisations, etc.). «In a healthcare establishment, there are three levels of information: the first is at the patient's level and concerns identity monitoring, the second is at the level of the healthcare team, this data will enable the management and coordination of healthcare professionals, and finally, the collection of data will advance research.» summarises Stéphane Kirche. The standardisation of the medical device management policy in our health territories facilitates the collection of data produced, makes it possible to have all the data available at each stage of the patient's journey, reduces the risk of error and makes the care environment safer. «The issue is a major one, because in just a few years it has become the cornerstone of the performance assessment of our healthcare institutions.» says Alexandre Benoist.

### Research lends weight

This edition also featured the remarkable intervention of Christophe Eglès, professor at UTC-BMBI, who presented the applications of additive manufacturing for the design of specific patient prostheses. This topical subject elicited numerous reactions both from the point of view of the materials used and usable and the regulatory approach for successful integration into the patient care pathway. Christophe Eglès explains: «Approaching patients from the start of the project to assess the acceptance of technological choices is an essential prerequisite for the success of a medical innovation». Through working on bioengineering and the development of health technologies, in phase with the social and societal stakes and at the service of the patient, the research laboratories of the UTC, including the BMBI, Costech and Heudiasyc Laboratories, all serve as support and lend their weight to those biomedical training courses singled out as exemplary during this event.



CHRISTOPHE EGLÈS

*By 2022, 70% of all health-related care will have to be provided on an outpatient basis. This is a new situation, which is pushing medicare establishments to communicate with the outside world (GPs, public health organisations, etc.).*

### Pioneers in biomedical training

UTC has been a pioneer in the training of biomedical engineers who work in health establishments as well as in companies. Therefore, it has a very important and active network of graduates in this field (from 50 to 70 graduates per year over the past 40 years). Today, its training courses include the diploma in biological engineering, the biomedical major, the Master's degree in health engineering, which organises the Biomedical Rendezvous, the Master's degree in Biomechanics and Bioengineering, and the specialised Master's degree in Biomedical Technologies. They are the heirs of pioneering courses such as the DESS in Biomedical Engineering and the IBMH master's degree. «These courses meet the needs of the health sector, which is highly innovative in terms of technology and subject to imperative quality requirements, standards and regulations. They enable the training of reactive and multidisciplinary players capable of designing, operating and maintaining high-performance medical technical platforms while taking into account organisational and safety constraints. Their expertise on medical devices is put to good use in a complex environment (ecosystem including companies, health establishments and institutional and regulatory bodies) for the benefit of the patient», stresses Isabelle Claude, Head of UTC's Master's degree in Health Engineering, Biomedical Technologies and Health Territories.



### Rendez-vous January 22, 2022

«However, other schools and universities (Polytech Lyon and Marseille, ISIFC Besançon) have opened such courses and the competition is growing. UTC has to keep and consolidate its leading position. The Biomedical Rendezvous was created in order to propose an annual event for the French biomedical community and to make it become a yearly "must" venue. It contributes to the animation of the biomedical network, which relies on the very dynamic and diverse health sector via conferences of professionals and researchers,» says Jean-Matthieu Prot, lecturer-cum-research scientist in charge of the UTC Medical Devices and Regulatory Affairs course. It is also an ideal moment to encourage and enhance contacts between the students of the biomedical courses at UTC, the lecturers, research scientists and the professional world, to present different professional trajectories illustrating the diversity of the outlets of the courses of the UTC and to throw light on work and studies carried out by the biomedical students. We look forward to seeing you at the next edition, scheduled January 21, 2022. ■ KD

### ZOOM ON SOME BIOMEDICAL STUDENT PROJECTS AT UTC

Célestin Garcelon and Justin Lanne have developed an interface between patient and hospital-based equipment in partnership with the Amiens-Picardie University Hospital. In the palliative care department, many nursing calls cannot be made because of the patient's physical condition. «The idea is to design a universal tool via an EMG signal detected when the patient has a contraction. We are in the process of prototyping. It is not up to the patient to adapt to the equipment but more the reverse,» they insist. Paul Brochet and Megane Fosso Matchinde have worked with a Nantes-based start-up to propose a regulatory roadmap to facilitate the marketing of its photoacoustic imaging innovation. The applications of virtual reality in health were presented by Marie

Pincemail's team. In particular, she emphasised the benefits of this tool for training health professionals by simulating exceptional situations that complement traditional training. Yunshi Han has developed a magnetically controlled robot capsule for micro-biopsies and drug delivery with the University of Waterloo (Belgium). Another student project among many others - that of Vincent Millot-Maysounabe - is based on the 3D reconstruction of the bile ducts with the ISIR, the Saint-Antoine Hospital in Paris and the BMBI laboratory of the UTC. «The aim is to simplify endoscopic retrograde cholangio-pancreatography or ERCP. This operation accounts for 30 000 cases per year in France, with a complication rate of 5 to 9% and a failure rate of 20%,» he stresses. The idea is to create a 3D model of the patient's bile ducts to increase the success rate.»



#### TO VIEW THIS EVENT

[www.youtube.com/watch?v=\\_3Y-34AqMV8&t=132s](https://www.youtube.com/watch?v=_3Y-34AqMV8&t=132s)

#### TO VIEW STUDENTS' WORK

[www.youtube.com/watch?v=c2SslyNb13U&list=PLfeKGUNAEjdlc5zT5vfydppTBKg2M7Bw](https://www.youtube.com/watch?v=c2SslyNb13U&list=PLfeKGUNAEjdlc5zT5vfydppTBKg2M7Bw)

Cf. also the Master's degree catalogue library at : [travaux.master.utc.fr](https://travaux.master.utc.fr)

GOING PLACES

# Four UTC 'grads' set up shop in Bali, Indonesia

Raphaël, Lucas, Alaric and Romain, four inseparable friends from UTC decided, a few weeks ago, to leave everything to live, set up shop and work on the island of Bali, Indonesia. For Interactions readers, they talk about this daring gamble.

**What courses did you take at UTC ?**

**Raphaël** : I graduated from UTC with the major "Computer sciences and applications" » and first directed my professional career in software development & engineering.

**Pierre** : Likewise for me, after graduating in 2020, having completed the major "Computer sciences and applications", I have been doing loads of freelance work in computer apps development.

**Alaric** : I also graduated from UTC with the major "Computer sciences and applications" but in 2018.

**Romain** : Can't be different can I ? I graduated from UTC with the major "Computer sciences and applications" too.

**So, why Bali?**

**Pierre** : I had already had the opportunity to visit this island and I had a real crush on this place. It's a place where it's warm, where you can surf, a sport I love above all else, and where "life is good".

**Raphaël** : For my part, I was thirsty for adventure, and "internationality". I didn't have the opportunity to go on an Erasmus trip during my studies, so I really wanted to soak in another culture, another universe.

**Alaric** : I really wanted to change my surroundings and remote-work from another country, to see something other than France and my flat.

**Romain** : I joined the adventure a bit later, they had already started to go through the visa procedures and I thought I would join them. We settled in the south of the island, in Jimbaran and the advantage of this small fishing village is that everything is cheaper there.

*I'm afraid I won't be able to find enough new job assignments to stay, but I'm doing all I can to succeed.*

**What effects did the lockdown measures in France have on your desire to go international?**

**Raphaël** : It's a project we've have shared for a long time, the lockdowns just delayed it a bit. But as soon as certain restrictions were lifted, we were able to take out an express visa to be able to settle in as quickly as possible.

**Alaric** : For me, the health crisis accelerated my desire to leave and change my surroundings. Since March 2020, I have been remote-working and I have lived through the successive lockdowns and curfews alone. I needed to be in the company of people again and to live in a nicer environment.

**Pierre** : I will admit that the fact that everything closed in France has made me want to head elsewhere...

**What was the transition like, between your professional life in France and life in Bali? Did you, for example, have to resign from prior positions?**

**Pierre** : I've been working freelance for several months, I'm what we call a "digital nomad", so the fact that I work in France or elsewhere has no impact on my clients. My only requirement is to

have a good wifi connection.

**Raphaël** : For my part, it was a big decision; I was on a permanent contract and I took a sabbatical for this change of life, the time to see if it would succeed or not. I went freelance and started looking for development work. The advantage is that IT is a sector where there is always a high demand.

**Romain** : For me it's a bit more complicated. At the moment I'm just on holiday, I'm staying for a month. But my objective is to come back in August, and why not to settle permanently like the other boys. I'll give myself time to think about it and, above all, to see what happens.

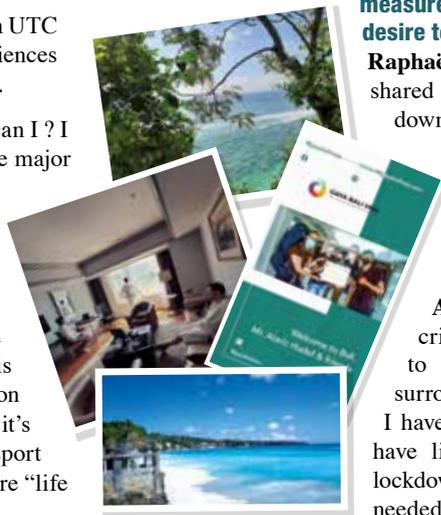
**Alaric** : I was lucky enough to be able to negotiate to keep my French permanent contract while working in Bali with local hours (ed. note: 6 hours plus difference with France). In return, I have to make myself available from time to time in French time to be able to exchange with my colleagues.

**Describe a typical day working in Bali.**

**Pierre** : There is the daily work load, of course, but here everything is far more peaceful. We live in a beautiful villa, we have access to the beach very quickly. In short, it's really another way of life that suits me perfectly.

**Raphaël** : When I told my parents that I wanted to leave everything behind and move to Bali, they were a bit scared, but in the end they understood my choice. I'm afraid I won't be able to find enough new assignments to stay, but I'm doing my best to succeed.

**Alaric** : The arrival in Bali went very well and I'm starting to adopt my new work rhythm, I can't wait to see how the next few weeks go. ■ GO



## How UTC digitised its Open Days aka “e-JPOs”

The pandemic ongoing health crisis, social distancing, maximum gauges and closure of establishments receiving the public; the academic year was eventful for UTC. And the traditional «Open Days» (JPO), cancelled last year because of Covid-19 measures, had to reinvent itself. But faithful to its motto, viz., lending meaning to innovation, UTC reinvented its operations to propose 100% «dematerialized» Open Days as «e-JPOs».

**What is the new Open Day concept? Answer in short - a mix of several channels, such as Facebook® and YouTube®,** installed by the University’s pedagogical support unit, a real livestreaming studio which, during the two Open Days, involved about thirty speakers who came to present the “major” branches of the UTC, the Master’s degree courses, the engineering common

core curriculum, student life, the international outreach and possibilities, internships, etc.

It was not an easy exercise, but it was brilliantly handled by the various speakers. “I was a bit anxious at the idea of having to speak in front of a camera,» confides one of the students who came to present her course, «but in the end everything went well, like a simple discussion”. And if the viewing statistics and the comments posted by the students and their parents are to be believed, the operation was well received. So much so that there are rumours that it could be repeated next year, in addition to the physical actions already in place... The videos shot during these two virtual days are still accessible and can continue to inform students and parents on the UTC’s Facebook® channels and Instagram® page.

Second highlight of these virtual JPO, the virtual chat rooms which allowed exchanges between the educational teams, the future students and their families. These virtual spaces of exchange piloted

by the (UTC Computer Service Directorate) DSI allowed to create a link, certainly distant but very present, between the families and the university. This provided students with tailor-made answers.

Last highlight of these “e-JPO”, the hard

work of the student-ambassadors of the UTC communication service.

This small group of fifteen students, from the 1st to the 5th year, is the relay of the field for the UTC Academic Administration. Instagram Lives, photos taken in the university, videos broadcasted on social networks; this small communication team was able to contribute to the visibility of the school via the social networks.

In total, tens of thousands of people were able to benefit from these virtual events, which saw the contribution of many departments of the UTC, from the admission to the communication, including the ISD, the internship and apprenticeship department, for example. This is a great proof of the synergy of the administrative teams and a precise adaptation to the health constraints. ■ GO



### STUDENT SOLIDARITY

## UTC students’ organized faced with the Covid-19 pandemic

Meal distribution, COVID testing, course tutoring: in this period of COVID-19, student life at UTC has reinvented itself.



**No one is hiding the fact that in recent weeks the sanitary crisis has had a heavy and significant impact on society but also on everyone’s morale.**

The reopening of certain places and venues to the public comes as a real relief for everyone. But for the students the situation has had an even more bitter taste; that of doubts, fears and apprehension for their future, this combined with an even more sour sensation; that of precariousness. For many, the successive lockdown measures have meant the end of student jobs and therefore stopped a very large source of income. For many, the successive

confinements and reconfigurations have meant the end of student jobs and therefore of a very important source of income. Consequently, the situation, already complicated for student morale, has also become complicated for their financial resources. At UTC, the situation was taken very seriously by the University’s administrative and management teams. «From the beginning of the health crisis last year, measures were taken to ensure the support and well-being of the students,» explains Karine Sliwak, Head of the engineering apprenticeship programme. And a few months ago, the school took a further step by appointing three “solidarity referents”, including Karine Sliwak herself. Their role? To develop and coordinate solidarity for students and to be the first point of contact for those experiencing difficulties. “We have set up an e-mail address where students can write to us as soon as they encounter the slightest difficulty, whether financial, psychological or of any other kind,» continues Karine Sliwak. We then set up actions to support them. A concrete example? “The financial difficulties experienced by students. It is quite normal for a student to face difficulties,

especially when they no longer have a student job,» she continues. “We have put in place extraordinary support so that they can have extra money when they need it. But other systems exist for specific needs. Computer loans, for example, for students who have difficulties with their existing computer. For psychological discomfort, the Solidarity Advisers can accompany students to professionals who can help and support them”.

And the solidarity advisors also set up distribution actions, whether it be foodstuffs (in conjunction with the student association EPI), distributions of hygiene and health products and basic necessities, in conjunction with partner companies. Some of the city’s restaurants also joined the operation to offer meals to students. Couscous or paella were offered to students. «These operations are open to all, with priority given to students who have the most financial difficulties”

But the logic of solidarity went further for the students. They created an association, mischievously named TUT’UT, to create support workshops and exchanges between students on their courses. ■ GO



HEALTH

# Digital modelling for an innovative implant device

Anne-Virginie Salsac, senior CNRS research director at the UTC 's Biomechanics and Bioengineering Laboratory (BMBI) and Laurent Lanquetin, Head of the Fluid Mechanics programmes at Segula Technologies Group, Trappes, have decided to join forces and go further in the mitral valve implant project intended for the treatment of functional mitral insufficiency. An excellent example of a working university-industry partnership.



Once again, the adventure began with an e-mail sent by Laurent Lanquetin to Anne-Virginie Salsac at the end of 2015, followed by a telephone conversation explaining what «digital modelling in the field of fluid biomechanics» is, she explains. It must be said that Anne-Virginie Salsac shows a fine sense of continuity in her ideas and she also enjoys the privilege of seeing them work. She very quickly suggested to Laurent that they work together on an internship project for a student at the end of his/her studies and that they select a student. The question of the subject remained. «It was then, at the end of the conversation, that I told him about an innovative project that we were working on and which could therefore appeal to them. I proposed to model the dynamics of a mitral valve and eventually the insertion of an implant to repair it in the event of mitral insufficiency,» she explains.

So what is the underpinning idea? «It's about applying digital modelling to improve the effectiveness of a medical device,» she adds. This idea appealed to Laurent Lanquetin. The proof? Very quickly, a formal partnership was formed with Segula Technologies, a leader in engineering fields such as the automotive, railway, naval and energy industries. «At the Trappes site, we are mainly specialised in the automotive sector with a computer based design office of around one hundred people, engineers and doctoral students. Our role is to support customers in various projects for the development of specific parts. However, in

an effort to diversify, we had started to develop more and more projects in bioengineering and biomedical, and Anne-Virginie's project fitted in perfectly with this,» explains Laurent Lanquetin.

This is how Thibaut Alleau, a final year student at an engineering school in Toulon, came on board as an intern. «Every year, we work with the group's research and innovation division and regularly take on students for their end-of-studies internship in order to develop, in particular, different digital methodologies. Thibaut was very motivated and interested in the subject. This would allow us to work on the development of simulation strategies in a new field. Namely, biomedical,» emphasises Laurent Lanquetin. But in this field, a six-month



ANNE-VIRGINIE SALSAC

THIBAUT ALLEAU

internship is short. «Thibaut was beginning to grasp all the problems associated with blood flow, but the rest was going to require a huge amount of work. It must be admitted that modelling fluid flows in large vessels is already not simple, but in the case of the heart, an additional complexity results from the movement of the valves, which open and close in a strong interaction with the blood flow... In a word: even simplified, the problem remains complex,» explains Anne-Virginie Salsac. Having developed a taste for research, Thibaut opted for a doctorate at the UTC. A Cifre thesis was set up to advance the project. Its objective? To answer the question of 'how'. How to model? What approaches and tools to use? «Today, as the thesis draws to a close, we have a working valve model that will allow us to test implants. We hope to find funding, particularly within the framework of the national recovery financial aid plan, so that Thibaut can optimise the implant prototypes. If not, we shall keep our fingers crossed for a new Cifre thesis,» she concludes. ■ MSD

PORTRAIT !



After a six-month internship at Segula Technologies Group, Thibaut Alleau opted to do a PhD at UTC. He received funding from the ANRT and completed a Cifre thesis between the UTC-BMBI laboratory and the company on biomedical modelling. What was the subject? «The internship was about the digital modelling of the mitral valve. It was very complex work, but rewarding because there was a real medical interest,» he says. This complexity did not put him off and made him want to pursue an adventure that, in his eyes, makes sense. The challenge was to create a digital platform that would eventually enable the testing of cardiac implant devices. The subject of the thesis? «The aim was to digitally recreate the mitral valve and model its dynamics during the cardiac cycle. A digital model makes sense, because mitral valves vary greatly from patient to patient in terms of size, function and dysfunction. It is still easier to parameterise the models digitally than in vitro,» he stresses.



YOU HAVE  
THE FLOOR



## A new look at Innovation & development in a time of crisis

ANTOINE MACRET

Antoine Macret is the Director of the Hauts-de-France region Innovation & Development Agency (HDFID) since March 2019. This UTC graduate reviews for Interactions the management of an unprecedented economic crisis, offering his views and, above all, relating his actions in the management of an unprecedented economic crisis. What role does the Hauts-de-France regional development and innovation agency play in supporting companies and the Region's innovation strategy?

**The Hauts-de-France Regional Development & Innovation Agency aims to intervene at all points in the chain :** helping young people to become entrepreneurs, whether it be traditional (Starter programme for the creation and takeover of businesses) or innovative (Innovation Park), to develop businesses through innovation, but also internationally (European programmes and networks). «Our three missions remain more essential than ever. It is up to us to continue to support start-ups and companies in their innovation and industrial performance projects. It is up to us to develop entrepreneurship and support the economic development policies of the Hauts-de-France Region,» says Antoine Macret, who at the same time emphasises the importance of the fruitful collaboration with the Region. «Indeed, through its diversified skills, our agency provides an operational deployment of

the strategic orientations (SRESRI, SRDEII, S3...) of the Regional Council.» More than a thousand companies have been visited, five hundred projects receiving financial support, three hundred of which have been financed to the tune of two million euros via various regional schemes.

### The ongoing crisis reshuffles the deck

With this crisis context, recovery is based on different foundations. «Entrepreneurship remains strong. Some even decide to take the plunge. The crisis becomes a trigger for them. For other business leaders, this is a time to activate dormant projects. They have the will to relaunch themselves through innovation,» says Director Macret. The situation remains very critical in the aeronautical sector, which was already under great pressure before the pandemic. A group such as Airbus, which is always seeking better competitiveness, relies on numerous subcontractors, which are themselves very dependent on this highly specialised market. It is not surprising that these companies are collapsing with this crisis. «One solution among others is the notion of diversification. You have to learn to bounce back in other sectors. The same applies to railway companies, car companies and others. It's part of our job to make these companies visible to the major contractors via an industrial marketplace,» says Antoine Macret, whose objective is to have a real impact on our economy. «Not only to maintain employment, but to develop it. We must rely on all the research and innovation players in the region and play a unifying role.» ■ KD

### A UTC GRADUATE HEADS THE HDFID AGENCY

Antoine Macret graduated from UTC with the Mechanical Engineer (GM) major. He has held positions as industrial project manager and design office manager in several large international groups (Bosch Braking Systems, Hutchinson, Faiveley Transport, now Wabtec), before becoming the industrial director for Induxial, a subsidiary of four mechanical machining companies working in the aeronautics field in the Albert-Méaulte region (80). He was also Vice-President of the aeronautical cluster of Hauts-de-France, PHMA - ALTYTUD. Aged 36, he decided to join the HDFID Agency as director, to put his expertise at the service of the Region's economic development.





### 3 QUESTIONS FOR...

**DANIEL LECA**  
VICE-PRESIDENT OF THE  
REGIONAL COUNCIL OF HAUTS-  
DE-FRANCE, IN CHARGE OF  
HIGHER EDUCATION,  
RESEARCH, EUROPE AND THE  
STATE-REGION CONTRACT PLAN

#### What assessment would you make for the situation as it stands today?

It is true that the crisis has shown how important it is to innovate in order to deal with its economic and social consequences. This is the condition for inventing tomorrow's economic model. Indeed, the crisis has raised a number of questions that we must answer. Innovation is therefore the key. We are fortunate to have "nuggets" of innovation and research in our region, whether in the South of the Oise Department, where the UTC is an example, or in the Lille Metropolitan Area, which hosts numerous R&D laboratories. We must also reinforce the interactions between the private and public sectors in order to create a real emulation that is essential to the development of the Hauts-de-France Region. We can rely on the sectors of excellence in which we continue to invest: precision health, circular economy and new materials, AI (artificial intelligence), creative industries, bioeconomy, energy efficiency and cyber security.

#### What actions are you undertaking currently to maintain economic development for the Hauts-de-France Region?

The Region's vocation is both to protect the region's economic players in this period of crisis, but also to project itself by investing in the sectors of the future, and this calls for innovation. The Hauts-de-France remains an industrial Region and we intend to remain so, but we also want to move towards an economy with high added-value. This is why we have decided to double the budget allocated to the Industry of the Future call for projects. Our aim is obviously to strengthen our Region's position. Consequently, we are relying on a very attractive regional innovation ecosystem that includes seven competitiveness clusters, numerous innovation parks, and also very dynamic public and private research laboratories. In this context, HDFID's role in leading and structuring regional innovation is essential. Furthermore, the Region is the leader in terms of economic development. We have created all the necessary tools to support the Region's businesses. We are the natural gateway for companies that need support or to prepare for the future. A one-stop shop exists at: <https://entreprises.hautsdefrance.fr/>

#### As you see it, our future will rely on research and the digital revolution more than ever before – is that correct?

It is clear that the current period and successive lockdown measures demonstrate clearly how essential digital processes are in our lives, both for communities and for businesses. We must therefore continue to invest in digital technologies, and this is what the Region is doing. To do so, we need more research than ever before to support digital, ecological and social transitions. It is in this context that UTC and its research scientists have a role to play to make the Hauts-de-France Region the champion of innovation. ■ **KD**

### INNOVATION/TERRITORY

# The First Innovation Tour de France...

## Now you can read the Report!



The Report with the findings of the first Innovation Tour de France, 2021, is now available and can be accessed via: <https://lnkd.in/g4D9CUG> Prof. Alain Storck, former President & Vice-Chancellor of UTC and President of the Hauts-de-France Innovation and Development Agency (HDFID), was in charge of editorial coordination and writing of certain chapters of the Report, entitled: «Regards croisés sur le développement de l'innovation et l'international dans les PME-PMI de territoires d'industrie : bilans et perspectives» [Analyses of Innovation and International Development Policies for SMEs & SMIs in industry-intensive territories: status reports and future prospects].

**The first « Innovation Tour de France » in its industrial territories, which took place from June to October 2019 and in which UTC participated, was a success.** The assigned objective was to identify the needs of SMEs and SMIs in terms of innovation and international skills. Among the thirty-six staging towns of the first edition of the Innovation Tour de France in industrial territories, four were in Hauts-de-France, including Albert-Méaulte and Saint-Quentin. Some thirty HE (higher education) establishments, including UTC, were mobilised to support this initiative of the InnovENT-E Institute with the support at national level of the Interministerial Delegation for Industry-intensive territories, BPI France, the Ministry of Higher Education, Research and Innovation, the CPME, the Pink Innov' association, the MMA Entrepreneurs of the Future Foundation, APEC and several other economic and social development players from each territory analysed.

#### A report that focuses on innovation and international development

This Innovation Tour de France resulted in a summary document, a useful tool for companies and local players, in order to meet the needs of the field via a skills reference framework. «We were able to draw conclusions and write a 252-page report. Beyond the



ALAIN STORCK

#### PROMOTING INNOVATION

The InnovENT-E Institute is a partnership-based Foundation created in 2018 to promote the development of innovation and international skills among SMEs. It is a continuation of the IDEFI (the French Government Initiative of Excellence in Innovative Training) actions of the same name launched in 2011 as part of the Future Investment Programme (PIA). The institute promotes the grouping of economic and academic players, structured in a network of territorial networks. It aims to contribute to the development of employment and the competitiveness of companies through the co-construction of a training offer around the themes of innovation, creativity and entrepreneurship (ICE), labelled and adapted to the specificities of SMEs.

<https://rapport-tournee-innovation1.innovent-e.com/>  
<https://tournee-innovation.fr/synthese-rapport-premiere-tournee-innovation-territoires.htm>

restitution of the thirty-six stages and the portraits of the companies, we were able to highlight the benefits observed and the obstacles encountered around innovation as a factor of economic development, human resources and the territory. And above all, to make recommendations. I am particularly proud of this work», confides Alain Storck, President of the HDFID Agency and of the InnovENT-E institute. What's next? "A second edition will be scheduled between September 2021 and April 2022, this time following a call for applications during which the territories will be able to put forward all their specificities. At the same time, we are launching the territorial clubs, the aim of which is to identify the needs of SMEs and SMIs, to identify and invent ways of meeting them with partners, and to propose solutions,» invites Alain Storck. "The third line of work is the setting up of an innovation observatory, providing a database and associate case studies to help with decision-making.» From its very first edition, this Innovation Tour de France has been rich in actions and commitments for the benefit of the territory.. ■ **KD**

# POLARIS : ad astra - sky's the limit !

«Make your life a dream, and your dream a reality». These words of Antoine de Saint Exupéry, Vincent Martin has adopted the adage. This 5th year computer engineering student has always been fascinated by space and has embarked on a crazy project: designing and flying a rocket propelled by a hybrid engine! Interactions met this future engineer who has his head in the stars but his feet firmly planted on the ground.

## How did you come up with the idea of designing a rocket with a hybrid engine?

“I have always been passionate about space, so during the spring of 2019, I wrote a review on the feasibility of students designing a hybrid rocket engine. This type of engine is simpler and much less dangerous to handle than a conventional engine, but it is still very interesting to study for engineering students. I concluded in my work that it was quite possible to embark on such a project at the UTC. In autumn 2019, I left for an internship, but when I came back to UTC, in February 2020, we launched the project «UTC Rocket Propulsion

Laboratory» with Patrice Simard. The objective was to design and launch to between 20 and 30 km altitude a rocket propelled by a hybrid engine of 10 kN of thrust, engine also designed by UTC students.

## How does your project look today?

Today we are about fifteen students, from different UTC specialities (computer engineering, mechanical engineering, process engineering, common core...), divided into various teams to enable us to work more efficiently. There is the mechanical engineering and design team, the launch and landing team, the avionics and systems

team, the multiphysics fluid simulation team, etc. This semester we are really starting to get down to business: for example, we have successfully carried out a first parachute test, launching a two-kilogram mass from the third floor of a building. The next parachute test is planned for the near future, and this time a slightly heavier mass will be thrown from the top of Benjamin Franklin. The IT team has had a PCB (printed circuit board) printed and delivered for the on-board computer, and they have also ordered an antenna. There are still a lot of problems to be solved and a lot of work to be done, but the project is generating a lot of enthusiasm from the students involved. ■ MB

**Hybrid engine :** A hybrid rocket engine uses a liquid or gaseous oxidizer (e.g., nitrous oxide), and a solid fuel (viz. the propellant), unlike a conventional engine where both are liquid.

**Thrust (in kilonewton, kN) :** In aerodynamics, thrust is the force exerted by the acceleration of gases through an engine moving in the opposite direction to the direction of travel of the rocket.

## THE PROJECT SCHEDULE

**Spring of 2021 :** designing and assembling the 1 kN prototype – static test firing

**Autumn of 2021 :** designing and assembling the 5kN, optimization the engine design, first launch

**Spring of 2022 :** designing and assembling the Polaris version(10kN), building the engine and launch config. assembly static test firing

**Autumn of 2022 :** Polaris launch, to attain 20 km altitude



ENGINEERING DESIGN

# For the *sheer beauty of sound*



At the beginning of each academic year, students have the opportunity to take part in multidisciplinary inter-semester activities (IPA), enabling them to acquire new knowledge plus theoretical, technical and practical skills. For those interested in design or acoustics, Nicolas Dauchez and Christoph Harbonnier, both lecturers-cum-research scientists in the Engineering Vibration Acoustics (AVI) and Industrial Design Engineering (IDI) courses at UTC, together with Thomas Boutin, Head of the UTC prototyping workshop, have created «the perfect IPA» in 2019: entitled ‘acoustic design’.

**The objective of this API is simple: to build a loudspeaker with the best possible acoustic qualities, without resorting to the traditional parallelepiped case, via a team work assignment and in 5 days, using the machines of the prototyping workshop, and on a limited budget.** In 2020, in order to confront their students with new challenges, UTC and the Lycée des Métiers d’Art (LMA) of Saint-Quentin joined forces. Engineering students, art cabinetmakers and apprentice wood turners shared their knowledge, both in design and in wood transformation processes, to build

wooden case enclosures that are both aesthetic and functional. For Raphaël Hazo, a student in the Industrial Design Engineering (IDI) programme: «It is important to be open to other forms of art and creation, and woodworking is one of them. The LMA students do not have the same skills as we do, and vice versa, so it has been a continuous flow of information between us. «This pedagogical collaboration between the LMA - Saint-Quentin and UTC has shown that the world of engineering and craftsmanship are complementary,» adds Thomas Boutin.

In 2021, a new challenge, just as stimulating and in the air of time: to build a new enclosure from two old ones, with a very limited budget. After five days of analysis, dismantling, design and reconstruction, the tests were conclusive: the upcycled speakers are of better quality! What about 2022? Those in charge have plenty of ideas for revving up the next IPA! Maybe our next generation speakers will be made from recycled glass containers or cast artificial stone; who knows ? ■ MB

TECHNOLOGY / CITIZENSHIP

# L’Hermitage, tomorrow’s world is here today

In a town called Autrêches, near Compiègne, L’Hermitage is a large «playground» for citizen experimentation, open to its territory. It is animated around the themes of agro-ecology, energy and digital transition. It is a location with a collective approach in search of innovation on impact projects.

**H**ermitage, , *noun. sing.1. a place active in the themes of living together, agro-ecology, energy transition and citizen hacking.* For the past four years, L’Hermitage on a 30-hectare site has been devoted to rural and civic innovation. Twenty-one buildings, 21 hectares of woodland and 3 hectares of arable land for resourcing, experimenting, undertaking and concretely connecting to the challenges of transforming our societies. Among the strong points developed in this unique site, putting new technologies at the service of the general interest, are the need to live and feed oneself in an environmentally friendly way, the need to live with dignity in low-energy buildings and the need to share ideas and know-how. «It all started with a group of friends who, at the end of 2016, wanted to give a future to this emblematic place which was

the scene of fighting during the First World War, then a medical centre and the headquarters of an international NGO. Today, a whole ecosystem can be found there. Entrepreneurs, a market gardener, a brewer, an associative café, a seminar centre and a digital school,» explains Loïc Pentecôte, a founding member of L’Hermitage, who is in charge of the eco-renovation of the building and the energy and climate referral. In 2020, he was also appointed as an external member of the TSH department council, and is involved in the UTC’s sustainable ‘Collective Engineering’ (CIS).

### Four UTC graduates work full time at the Hermitage

Loïc Pentecôte, who graduated from UTC in 2013 with an engineering degree in the major Process

Engineering (GP), is part of the team developing the site with Mathieu Karinthi, who majored in Urban Engineering (GU-2015), founding partner of L’Hermitage, Raphaël Langaret, majoring in biological engineering (GB-2016), co-founder of Végéto, an aquaponics company based in L’Hermitage, Jacques de Bucy, who graduated in Process Engineering (GP-2011), CEO of SCIC-SENS, a company based in L’Hermitage and co-sponsor of the SCEA Les Jardins de l’Hermitage (agroecological market gardening micro-farm). Several professors and researchers from the UTC have found in L’Hermitage a place of inspiration and potential partnerships for their work, such as Clément Mabi, Olivier Gapenne, Pascal Jollivet, Frédéric Huet, David Flacher... The singular dynamics of this network is based on the great variety of its actors, from citizens equipped with 3D printers to specialized territorial actors (fab labs, hackerspaces, third innovation places), including VSEs and SMEs. A very concrete example is the unprecedented and massive mobilisation of these actors at the beginning of the health crisis to produce masks and visors. In this context, L’Hermitage was at the centre of the creation of the FabriCommuns collective and platform (fabricommuns.org), which made it possible to manufacture more than one million items. ■ KD



## INNOVATION/IMPROVISATION

# The Lobster-Jazz Quartet and UTC have a jam-session!



UTC has enjoyed a partnership with the Lobster' Jazz Quartet, working for several months on a research and innovation programme entitled «Jazz & Innovation». A new step was made, December 1, 2020 in the cloisters of the Saint-Corneille Library, Compiègne.

**F**ollowing an artistic residential stay by of the Quartet hosted at the Saint-Corneille Cloister, a jazz jam-session concert took place. The concert was observed and discussed by various personalities from “civvy street”, sportsmen, entrepreneurs and UTC research scientists. This event, followed live on social networks, is the result of a programme linking jazz and innovation. A project that is more than inspiring, since it is already the result of the implementation of a new way of support for companies in order to reveal and develop

their own potential for innovation. In partnership with the City of Compiègne and with the support of the Hauts-de-France Region, this artists' residency enabled the members of the Lobster' Jazz Quartet to practice musical improvisation.

### From an expert to a creative mode

«We tried to demonstrate through a musical discourse and an interactive debate that the jazz improvisation process releases a potential for creativity that can be extrapolated to the field of business innovation by mobilising an original community of action. The musician, like the engineer, has followed a rigorous and structured path. The musician, like the engineer, can, through consistent work, acquire a recognised and appreciated expertise. However, this background is not sufficient, or even discriminating in the practice of improvisation and creativity. We therefore hypothesize that other parameters are mobilized to go from an expert group to an agile and creative group», explains Pascal Alberti, Director

of Innovation and Territorial Development at UTC who on November 5, 2019, had already carried out a first experimentation and illustration of this project in the Sacem auditorium in front of an audience made up of innovation and business experts.

### Pursuing the project in the Hauts-de-France Region

Following this experience, UTC is committed to a second phase in the deployment of sessions in representative cities of the Hauts-de-France region. And this will start with Amiens, on October 1st at the Maison de la Culture. The aim of this event, like the previous ones, is to promote artistic activities using improvisation to illustrate and serve as a field of analysis for a socio-economic innovation approach. This has enabled and will enable the development of methods and processes for creating value to support the economic, managerial and technological dynamics of innovative companies in the Region. ■ KD

## CONTINUING EDUCATION & TRAINING

# The « Rebond Cadres » Fair : where executives bounce back : a “first” both live and on-line



The 8th «Rebond Cadres» Fair took place on February 4; 2021 in on-line mode but live via social networks in particular. A first which was a success and providing companies and executives with possibilities to engage in professional transition or thinking about reconversion to discover the scheme. *Horizon Emploi Cadres.*

**O**rganised by UTC, APEC, Pôle Emploi and the Hauts-de-France Region, the 8th edition of the “Rebond Cadres” Fair, offered in virtual mode at the beginning of February, served as a gateway for exchanges in order to establish connections between the different actors in the service of employment: entrepreneurs, institutional partners, professionals in the field of recruitment, training and executives in professional transition or with transition projects. During this “networking” day, visitors were able to attend two «live conferences» and numerous workshops. The themes were rich and varied, ranging from the benefits of soft skills to the toolbox for finding a job and which networks are essential for finding a job? «It is essential for executives to get out of their isolation when looking for a job. So this kind of meeting, even by videoconference, is a great opportunity to bounce back. Maintaining one's network, sharing webinars, round tables and events like “Rebond Cadres” is



a chance.» says Eric Ertzbischoff, production and continuing improvement director at EJ Picardie.

### Solidarity is a bonus factor

One of the lectures addressed the question of how to bounce back with UTC from the crisis when you are a decision-maker or an executive. «Since the beginning of 2020, the health crisis has hit both companies and their employees. It has also had an impact on the recruitment of executives in

professional transition. Based on this observation, UTC's continuing education team wondered about the actions it could undertake in order to contribute to the economic stimulation of the territory. From this reflection was born Horizon Emploi Cadres. The UTC proposes, in fact, to private and public organisations to join it by committing themselves to one of its two solidarity programmes which are «Digital skills» and «A diploma for employment»», invites François Velu, director of the continuing education at UTC. It is thus a question of participating in a solidarity approach alongside the UTC. By entrusting employees in continuing education to UTC, the latter puts in reserve a part of the revenues. This reserve makes it possible to fund certified training courses for executives in professional transition, registered with Pôle Emploi and admitted in the “Rebond Cadres” support scheme of UTC. An assessment of this action will surely be discovered during the “Rebond Cadres” 2022 exhibition! ■ KD



FLORENT LATRIVE

# A passion for the media

Florent Latrive graduated from UTC majoring in Computer Science Engineering in 1995 but never in fact worked as an engineer. With a driving passion for the press and the impact of technology on Society, he is Editorial Director of digital journalism at France Culture and associate lecturer in digital journalism at the French Press Institute (University of Paris 2 Panthéon-Assas). Here Interactions offers a portrait of a man whose passion for the media has allowed him to open many hard-locked doors.

**H**ow did he acquire his passion for the media? He already cultivated it during his years at UTC, which he joined for «modularity of the courses taught there and their diversity, in particular the part of human sciences which was in the programme such as philosophy with Bernard Stiegler or ethics.

What was exciting, he found, was that, whatever the course, the teaching philosophy at UTC was to encourage us to reflect on what we were doing, what we were learning, on the profession in general and on the impact of technologies on society in particular. As an avid reader of the press, I was particularly interested in this last aspect,» he says. How did he get into the media circles? When I returned from my end-of-study internship in Hungary, I was wondering, like any other young graduate, what I wanted to do. That's when I met the Editor-in-Chief of Oise Hebdo, one of whose journalists had just broken a leg and who was looking for a replacement to report on a jubilee wedding celebration ceremony in a small village not far from Compiègne. And that was a revelation. I enjoyed it so much that I said to myself: «This is what I want to do. It became obvious to me, and I have become passionate about the press,» explains Florent Latrive.

After a few months at Oise Hebdo, Paris beckoned, so to speak. «With my background in computer science and a mastery of new technologies, I set out to exploit them as a journalist. But in the second half of the 1990s, the Internet began to take off for the general public, and the arrival of mobile phones raised a number of questions. Questions of regulation, questions of use, societal questions, political questions, all things that fascinated me,» he says. In Paris, he opted for the newspaper Libération [better known as "Libé"] which already had an eight-page weekly multimedia section that dealt with these issues.

«They took me on a fixed-term contract and I worked on various subjects such as wolf hunting and sudden infant death syndrome. Subjects that are far removed from technology. But for Libé, not having graduated from a journalism school, it was a way of testing me, of shaking me in all directions by putting me in competition with young journalism school graduates. At the end of this fixed-term contract, I signed a long-term contract followed by a permanent contract. I held various positions here but I have always been interested in science, technology and their impact on Society; the rise of the Internet and the questions of governance it raises, those of copyright and intellectual property. I have written books on all these varied issues,» he says.

He worked with Libé for almost twenty years, including seven years, from 2007, as Editor-in-Chief of the paper's website. «I accompanied the digital transformation of the newspaper and created, for example, «Libé Labo», the audio and video workshop of Libération. Back in 2007, we were already doing what seemed avant-garde at the time, podcasts and video formats,» explains Florent Latrive.

In 2014, he took advantage of a staff redundancy plan to explore other horizons and it turned out to be France Culture. Among the reasons for this career choice? «France Culture was a response to something that has always motivated me: the question of transmission. It is a medium that relies heavily on knowledge and know-how. It is a medium of long time. Its blockbusters are programmes on philosophy or the history of science that last an hour. Lastly, it comes at a time when digital transformation is at the heart of the profession and I was very keen to accompany this process. I must have been convincing because I was taken on and I am still there,» he concludes. ■ MSD

## BIO-NOTES

- 1995** : graduated from UTC, majoring in Computer sciences and their applications (UTC-GI)
- 1996** : hired as a journalist à Libération
- 2007** : launched the « Libé Labo » (podcasts, videos) at and for Libé
- 2015** : appointed Digital Editorial Director at France CultureCulture



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