Donnons un sens à l'innovation

Interactions

Coveille
a structuring project
for the Compiègne Applied Mathematics Laboratory

FROM THE PRESIDENT'S DESK

The Covid-19 crisis has affected the entire world population in health, economic and social terms. It is a race against time, or rather against the spread of the SARS-CoV-2 virus that has been set in motion all round the globe since its appearance in Wuhan, China, in November 2019. This race is based not only on the development, validation an approval of vaccines, but also on modelling the spread of the virus in order to forewarn populations of the risks of epidemic upsurges. This modelling work is a long-term development, given that the creation of the most reliable models possible requires the collection, aggregation and assimilation of huge amounts of data appertaining to the evolution of the pandemic.

The first data came from China, the country of origin of the pandemic. Then, in January 2020, the Johns Hopkins University, whose experts were surprised by the scale of the epidemic and the speed of its spread, became the global referee of statistical data on this particular coronavirus. France also is in the forefront for the collection of data. Santé Publique France presents a daily dashboard on confirmed cases, deaths, the positivity rate, patients hospitalised in ICUs (intensive care units), the number of clusters under investigation and the number of departments with a high vulnerability situation. This provided valuable information for the modelling specialists who, from last March, were called upon to take action.

In response to this call, the National Institute of Mathematical Sciences and their Interactions (INSMI), one of the ten CNRS institutes, decided to set up, while the county was in full lock-down, a platform, MODCOV19, to coordinate modelling actions on COVID-19. Lecturer-cum-research scientists from UTC and more particularly from UTC-LMAC (the Compiègne Applied Mathematics Laboratory, spontaneously responded to the call. First, individually and then, following the call for expressions of interest launched by the research division of UTC, a group of 3 "pairs" was formed around the Coveille project - a modelling project with several levels of granularity. The Coveille project can thus both meet the needs for monitoring as well as forecasting the spread of the SARS-CoV-2 virus among the population. This tool will be a valuable aid to decision-taking.

Prof. Claire Rossi,
Interim President and Vice-Chancellor

PEDAGOGICAL INNOVATION

An academic year start
unlike any other at UTC

The students of the University of Technology of Compiègne have just started a new academic year unlike any other. Some will say it is 'out of the ordinary', others 'abnormal'. And yet we had to adapt to a very complex health context.

The keyword for this new school year was pedagogical innovation.

First there was the admission procedures for new students, quite different from other years, of course. "Until now, admission to UTC was based on an analysis of the candidates' academic record and possibly with an oral interview conditioned by results above a certain threshold," explains Valérie Kopinski, head of the UTC Admissions Office. "This year, due to the health context, we had to cancel the oral interviews, but we still took the option of maintaining an additional element to the academic file; an individual project dossier." As an alternative to the oral interviews, the dossier allowed us to discover the candidates' motivations, their extra-curricular activities and their career desires after their studies. This initiative also helped maintain equality between candidates, as the Ministry of Higher Education has said that it is not in favour of on-line interviews, which prove to be too random depending on the candidates' Internet connections.

And then we had to come back to the class-rooms and lecture-halls at the beginning of the academic year. For the September intake, first of all. "Even if we were able to initiate back-to-"Uni" activities as we do every year, but with our masks and hydro alcoholic gels, all the evenings of the student induction-integration period were cancelled, and that period had a different taste," says Pierre Gibertini, a UTC third-year student (read his testimony on page 12). Distance learning lectures, a semi-remote system for seminar group classes (TDs, with half of the class present and the other half at home); the keyword for this new school year was pedagogical innovation. To accompany these transformations, the UTC's Pedagogical Support Unit has been developing distance learning platforms since last March. "We didn't start from scratch," explains its manager Manuel Majada. "We already had distance learning platforms. But the lock-down and this hybrid back-to-"Uni" season have forced us to develop new systems on a massive scale."

Seen from the students' angle, the system is very popular. "I must admit that I was reassured at the start of the new year to see that all the precautionary measures have been put in place," continues Pierre Gibertini. "I was happy to come back to the TD room, but I was also very happy to see that I didn't have a neighbour sitting just next to me and that the distancing measures were respected."

Alas, a few weeks after the start of the academic year, the UTC was forced to close in the face of an increased numbers of COVID-19 cases. This was fortunately not enough to shatter UTC's resolve, and it once again adapted its teaching protocols, moving to 100% on line classes.

With the new lockdown and closing of all French higher education institutions, UTC continues its digital transformation against the backdrop of 'Moodle', 'Zoom' and other 'Discord' platforms.

Consequently it is true to say that time can sometimes seem long for students, but here and there initiatives are emerging to maintain social links. Thus in line with the virtual "team building" operations organised by several UTC associations, used to "forge solid, remote on-line links", or the live show-programmes on UTC's school's social networks, run by the administration and animated by students. A major competition was even held, bringing together students and local residents to elect the Compiégnois' favourite bar. A welcome memory of life before ...

Nevertheless, in these confined periods, time takes its toll. "Honestly, I can't wait to get back to class, I can't wait to see my friends again and I can't wait to get back to normal student life," says one female student who happened to be active in a Messenger chat exchange. "It's not easy to be 20 years old in 2020," said the President in one of his most recent speeches. At the UTC, as elsewhere, we're waiting for better days. ■ **GO**

Preventive medicine and the students' health relay centres, coping with successive lockdowns

One of the issues with the successive lockdowns decided over the last few months is how to maintaining good physical and, above all, psychological fitness. From the temporary lowering of vitality and physical condition to the occasional minor bout of depression, these periods of forced isolation are having an impact on the psychological health of the students.

ALICE HOOGENDOORN

CHRISTELLA LEQUEUX

DOMINIQUE ALBANESE

preventive medicine and students. "We are intermediaries between the medical profession and the student body," explains Manon, a student at the health relay centre. "Our role is to make it easier for students to speak up and contact with the medical services and to discuss subjects that are sometimes taboo with them."

Whether it was through listening to students suffering from temporary depression, or helping some of them to find the right people to assist in overcoming financial difficulties, the health relay students had their work cut out for them during these lockdowns. "For this second lockdown, we have set up a group for confined, isolated students where we offer live sessions on Facebook with sports, cooking recipes, where we open the floor for everyone to express their difficulties." It's a great way to brighten up the lives of confined students and recreate links... while complying with the social distancing rules. ◼ **GO**

"With my friends, we have all experienced a spot of uselessness at one time or another," explains a fourth-year student at the school. "But with time you get used to it and it goes away." The fact remains that the University of Technology of Compiègne has tackled the problem head on and moved out the heavy artillery to deal with the students' discomfort and misgivings.

Starting with the Preventive Medicine Bureau. Dr Alice Hoogendoorn, UTC's house physician, and nurse Dominique Albanese look after the students who stay in Compiègne. "The students can contact us by e-mail", says the doctor. "We take care of them or we redirect them to such contacts dedicated specifically to their difficulties."

The first lockdown provided an opportunity to observe some recurrent problems among young students. "We were able to observe things like burnouts for certain young people," continues the doctor. So we set up on-line "teleconsultations" with our psychologist to accompany the students experiencing the most difficulties. "In parallel with this medical support, audio sophrology sessions

have been implemented by the administration. With the aim of enabling students to refocus and relax. What I am hearing is the combination of studying, excessive work, stress," explains Christella Lequeux, sophrologist at the UTC. "But you have to manage to develop good moments and see the better side of things."

In order to support the house physician, nurse and sophrologist, UTC has drawn its secret weapon; the student health relay centre. For the past two years, the region has been accompanying, training and employing students to create a link between

UTC IN THE TIMES HIGHER EDUCATION (THE) 2021 AND TIMES HIGHER EDUCATION YOUNG UNIVERSITIES (THEYU) 2020 RANKINGS.

The international ranking of Times Higher Education 2021 has been published: UTC lies between 801st and 1000th place in the overall ranking. UTC is also the 3rd French university in the "International Outlook" category (international outreach) and the 15th French university in the "Industry Income" category. UTC is ranked between 201st and 250th position in the overall Times Higher Education (THE) Young University Rankings 2020, which highlights universities under the age of 50. In addition, it is in 3rd place among French universities in the "International Outlook" category (international outreach) and 5th in the Industry Income category. ◼

UTC GAINED 50 PLACES IN THE "YOUNG UNIVERSITIES" CATEGORY OF THE THE RANKING.

The international Times Higher Education 2020 ranking has been published: UTC is between 601st and 800th in the overall ranking. UTC is also the 4th French university in the "International Outlook" category (international influence) and the 13th French university in the "Industry Income" category. ◼

THE BEST PAPER COPA 2020 AWARD GOES TO SOUNDOUSS MESSOUDI (UTC-HEUDIASYC)

Soundouss Messoudi, a PhD student at the UTC-Heudiasyc Laboratory (CID team), was awarded the prize for the best student publication at the COPA 2020 conference, for her publication on conformal prediction entitled "Conformal multi-target regression using neural networks". ◼

THE "WELCOME TO FRANCE" LABEL AWARDED TO UTC FOR 4 YEARS.

UTC has been awarded the "Welcome to France" label, at the 2-star level, for the quality of its welcome for international students, and this remains valid until 2024. A sign of confidence, the label attests to the quality of the welcome and represents a promotional and outreach tool for the HE establishment. The indicators particularly recognised for the UTC are those of the quality and accessibility of information, the quality and accessibility of the reception facilities, the quality and accessibility of the training offer and teaching support, the accommodation and quality of life on campus, and the quality of post-graduate follow-up for non-French students. ◼ **PS**

ECOLOGY & SOCIETY

For an *ecological reconversion*

Professor Dominique Méda is a sociologist and philosopher, Chair of Sociology at the University of Paris-Dauphine, where she directs the Institute for Interdisciplinary Research in Social Sciences (IRISSO), a joint CNRS unit. She gave the second inaugural lecture at the UTC on September 2, 2020.

Labour sector issues are familiar to her, since in her earlier career, Dominique Méda was initially Inspector General of Social Affairs, the controlling body of the Ministry of Labour and Social Affairs. She then worked for 15 years as head of research at the Directorate for the Coordination of Research, Studies and Statistics (DARES) in the same ministry and as Director of Research at the Centre for Employment Studies.

Why and what initiated this interest? "In the early 1990s, the dominant discourse emphasised the exclusive importance of work. Work was seen as an essential and structuring activity for individuals: I wanted to understand the genesis and causes of such a valuation of work and its central place in our society," she explains.

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DOMINIQUE MÉDA

This interest led her to undertake philosophical research, and to write her first book in 1995: Le travail, une valeur en voie de disparition? [Is work losing ground?] (published by Flammarion). "I wanted to understand philosophically how work came to be recognised as the central social activity. My proof here? In the GDP, only work is taken into account and political, family, domestic and leisure activities are completely ignored," she adds.

An interest that has also led her to do research in the sociological field. "By conducting field surveys in France, I have shown that work is indeed a central value for people. I would even say that they have a "pathological" relationship with work, unlike the Nordic people, for example, who, while respecting work, consider that their other activities - family, leisure, civic commitment - are every bit as important", says Dominique Méda.

An interest that has also led her to question the relevance of the "fetishisation" of GDP as measured and to relativize its relevance. "We need to pay attention to other indicators, two of which are, in my opinion, major. The first is the carbon footprint, the reduction of which is our absolute challenge faced with climate change. The second is the indicator of social cohesion. A social health index that measures the degree of inequality in a society," she points out.

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An interest that has finally led her, even more so as the Covid-19 health crisis developed, to advocate a total paradigm shift in the way our societies function. "Our societies must embark on a genuine "ecological reconversion" in which it will no longer be a question of promoting the biggest GDP, or the biggest profits, but of satisfying the social needs of all. An ecological reconversion which, moreover, should create many jobs", concludes Dominique Méda. ◼ **MSD**
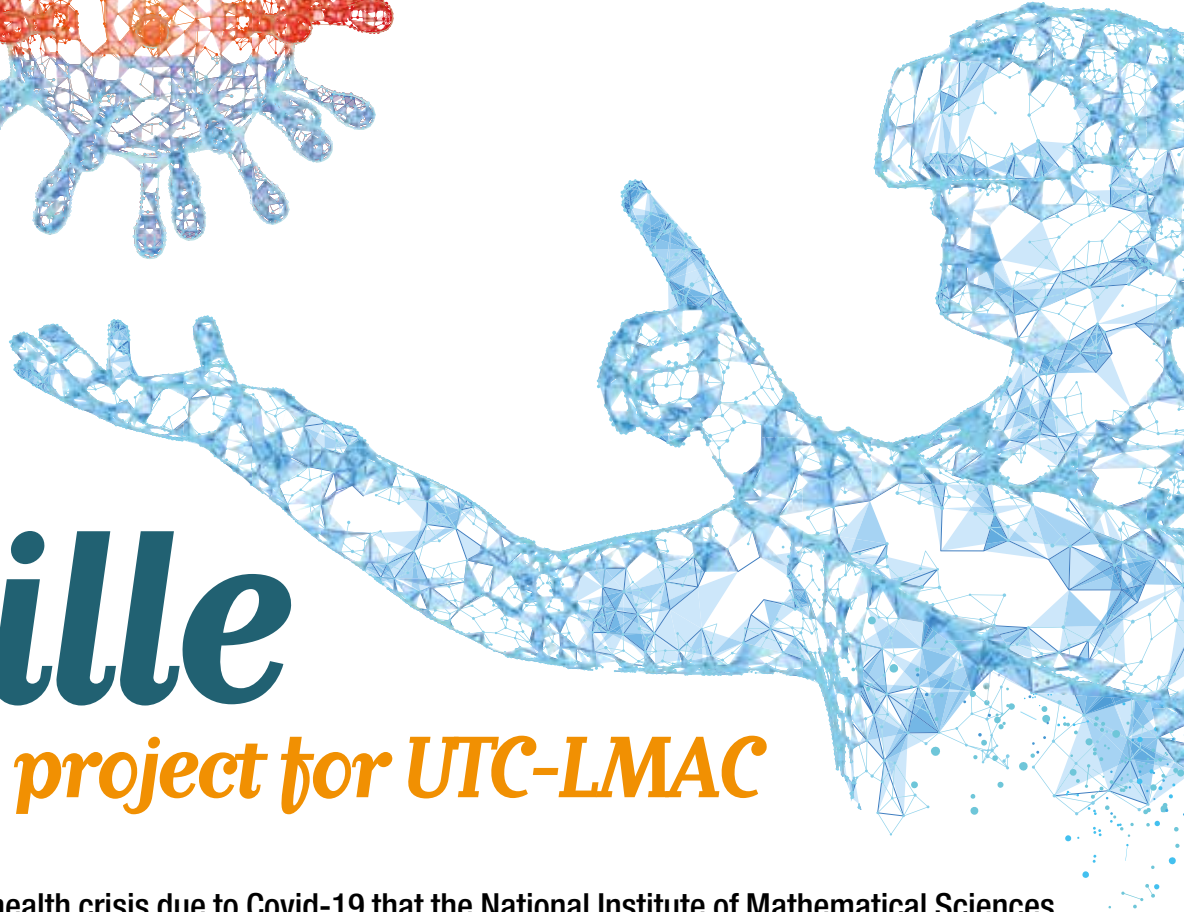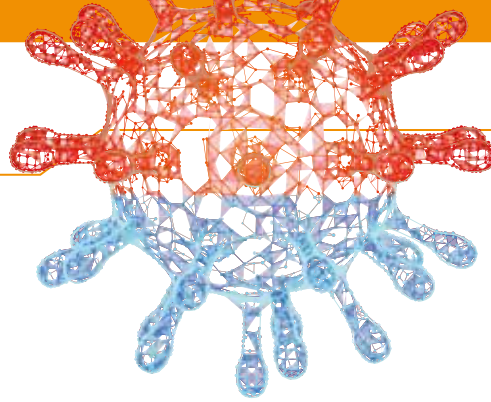
Coveille
a structuring project for UTC-LMAC

It was in the context of the ongoing health crisis due to Covid-19 that the National Institute of Mathematical Sciences and their Interactions (INSMI), one of the ten CNRS institutes, decided to set up a platform to coordinate actions involving modelling Covid-19 phenomena. This platform, MODCOV19, was set up under full lockdown in France. Quite naturally, several lecturer-cum-research scientists from the UTC-LMAC Lab. (the Compiègne Applied Mathematics Laboratory), interested in the problem, were mobilised. First, individually on the platform MODCOV19, then with the call for expression of interest launched by Marie-Christine Ho Ba Tho, Director of Research at UTC. Immediately, 3 "pairs" of lecturer-cum-research scientists were formed around the Coveille project. The first two, consisting of Ghislaine Gayraud, professor, Miraine Davila Felipe, lecturer, and Nikolaos Limnios and Salim Bouzebda, both professors, are particularly interested in stochastic models and tools. In other words, models where factors of randomness are introduced. The last "pair", with Florian De Vuyst and Ahmad El Hajj, both professors, works on deterministic mathematical models and approaches. So, what is the aim of COVEILLE? It is to model the dynamics of the Covid-19 epidemic at different levels of granularity of data analysis. In short, models which will be used to help monitor the spread of the SARS-CoV-2 virus and the risks of secondary upsurges.

UTC-LMAC beyond Coveille

A full university professor, Florian De Vuyst has been Director of the Compiègne Laboratory of Applied Mathematics (UTC-LMAC) since 2018. With more than 30 personnel – lecturer-cum- research scientists, associate professors, temporary teaching and research attachés (ATER), doctoral and post-doctoral students – UTC-LMAC has two teams. The first, EPIA, is devoted to "inverse problems and numerical analysis"; the second, S2, to "stochastic systems". Currently, 6 lecturer-cum-research scientists, are mobilised on Coveille, a modelling project linked to the Covid-19 epidemic.

After 15 years as a university professor - 8 years at the engineering school, Ecole Centrale Paris in the laboratory of mathematics applied to systems, followed by an additional 7 years at the École normale supérieure de Cachan in the Centre of mathematics and their Applications - Florian De Vuyst came to UTC in 2017, a year before taking over the direction of UTC-LMAC in January 2018. "Currently, LMAC has 13 lecturer-cum- research scientists, 2 associate professors, 2 ATERs and some 15 PhD students. Within the lab, we work of course on purely theoretical aspects but also on algorithms and more practical applications", explains Florian De Vuyst. As a host team, LMAC is also a member of the Fédération de mathématiques des Hauts-de-France (FMHF), a CNRS research federation.

What are the specialities of the two research teams? "EPIA works on the problems of "inverse problems", "partial differential equations" or "numerical model reduction". Pure deterministic modelling with practical applications in many fields. We can mention the detection of anomalies, medical imaging, fluid mechanics or road

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FLORIAN DE VUYST

Far from the image of disembodied mathematics, LMAC's teams collaborate on concrete applications, in particular with health-related institutions and/or industrialists.

traffic, for example. The S2 team is particularly interested in stochastic modelling, characterised by the introduction of randomness, mathematical statistics, data analysis or even machine learning. Theoretical fields which lead to models allowing, among other things, the extraction of knowledge, forecasting under uncertainty, detection of changes in trend, robust estimation, etc. Models applicable, in particular, in the fields of health, physical

systems such as mechanics - the study of cracks in a material, for example - the reliability of complex systems, or simply human activity", he stresses.

What can we see as a LMAC's strong point? "It is the existence of two teams, one with a so-called "deterministic" approach, i.e., working on so-called "continuous", homogenised models, and the other with a stochastic approach which is interested in finer samples or scales of time and space. This makes it possible to describe a reality in two different but often complementary ways and to give elements of response in different ways and with different criteria", details Florian De Vuyst. Far from the image of disembodied mathematics, the UTC-LMAC teams collaborate on concrete applications, particularly with health institutions and industry.

"The EPIA team has notably worked with the Amiens University Hospital. The objective was to detect anomalies in the brain or other parts of the body based on the response of living tissue to

different types of waves emitted by medical devices. In short, the aim is to reverse the perspective of unintelligible observations or measurements in order to make them intelligible. The team is also collaborating, within the framework of Cifre PhD theses, with the manufacturer Renault on a project to optimise vehicles. A first task related to the problem of making the vehicle lighter while maintaining the same performances or "services". A second, to come, will concern the reduction of drag, i.e., the so-called CX coefficient, due to air friction. This translates into lower energy consumption," he explains.

Finally, LMAC has been involved in collaboration with other UTC laboratories. "A joint collaborative platform has been set up with Adnan Ibrahimbegovic of the UTC-Roberval laboratory and a senior member of the Institut universitaire de France. The aim? To work together on joint projects dedicated to digital mechanics. We are also working with the BMBI, particularly with Anne-Virginie Salsac, on problems related to microcapsules and their transport in blood vessels. The main objective is to enable innovation in medicine. In particular, we have a PhD student under co-supervision who is pursuing a thesis on model reduction techniques", concludes Professor De Vuyst. ■ **MSD**

Leading the Coveille Project,
a sign of confidence

Miraine Davila Felipe is a senior lecturer at UTC-LMAC Compiègne Applied Mathematics Laboratory (LMAC). She is a member of the S2 team dedicated, in particular, to stochastic models and tools. In other words: models where a degree of randomness is introduced. She is leading the Coveille Project, a modelling project based on COVID-19.

I t was after a call for expressions of interest (CEI) that three pairs, presenting jointly skills in deterministic and stochastic approaches and tools, were formed within LMAC to work on Coveille. . "I'm the most recently arrived colleague at UTC in 2019. The fact that my colleagues chose me to lead this

project touches me enormously, because they are showing, by this gesture, a great mark of confidence in me", assures Miraine Davila Felipe.

It was while she was teaching at the University of Havana, Cuba, that the idea of coming to France first occurred to her. What triggered this? "Well, I met French research scientists from the École polytechnique visiting my university and was won over by the quality of mathematical research in France. This motivated me to apply for a Master 1 in Applied Mathematics at the same school. I was selected and won a scholarship. I continued with a joint Master 2 at Ecole Polytechnique and Paris VI - Sorbonne University - in mathematics applied to biology. This enabled me, during an internship at Télécom Paris, to gain initial experience in epidemiology. In particular, I worked on methods for estimating rare events in the case of communicable diseases, which could possibly lead to crisis situations from a public health point of view," she explains.

> *This is a new field of research makes it possible, for example, to estimate the date of the beginning of the epidemic and which researchers are trying to apply to COVID-19.*

Hence her interest in epidemiology. She then went on to complete her PhD within a multidisciplinary team of biologists, mathematicians, statisticians and probabilists, led by a professor from Paris VI at the Collège de France.

The theme of this thesis? "I worked on phylodynamic models, a relatively recent field of research. The aim is to study the spread of diseases in the population using the genetic data of the pathogen - virus or bacterium. These are models used particularly for diseases such as flu', HIV or Ebola, characterised by a high mutation rate of the pathogens involved. Finding different genetic sequences of a given pathogen in patients allows us to reconstruct the transmission tree. In a nutshell: to say who infected whom over time, provided we have enough data to reduce uncertainty," says Miraine Davila Felipe.

This is a new field of research that makes it possible, for example, to estimate the date of the beginning of the epidemic and which research scientists are trying to apply to Covid-19. In this, they are helped by the emergence of sampling techniques that are fairly quick and inexpensive compared to what existed previously. "Currently on Covid-19, there is a site on which nearly 10 000 patient genetic sequences are stored. It should be noted that each individual hosts a certain number of viruses, with, however, always one that is over-represented. In general, it is the one that is most likely to be transmitted. Hence the possibility, thanks to the signature left by the virus, of reconstructing, with the help of statistics, phylogenetic trees of transmission. Of course, there are still many uncertainties, but this nevertheless allows us to make estimates in relation to the evolution of epidemics. We can thus estimate the reproduction rate of the virus or R0," she points out.

This is a field of research that she explored further during her post-doc at the Institut Pasteur from 2017-18 and then as a temporary teaching and

research associate at the University of Nanterre, which she has been pursuing since her arrival at the UTC. "I have developed this type of model from a mathematical point of view and have obtained fairly robust theoretical results from an epidemiological point of view. The idea is to couple two very different but highly correlated variables: the dynamics of the epidemic at the population level, through the curves of patients over time, and the genetic dynamics of the virus thanks to mathematical transmission trees. We thus have dual sourced information", concludes Miraine Davila Felipe.

Finally, this is a field of research that she intends to apply, with other colleagues, at Coveille, a transverse project based on the modelling of Covid-19. ■ **MSD**

MIRAINE DAVILA FELIPE

Forecasting and Monitoring Objectives for the Coveille Project

Six lecturer-cum-research scientists - forming three pairs - are involved in Coveille, a project to model the dynamics of the Covid-19 epidemic at several levels of granularity. **The aim of Coveille is to be able to monitor the spread of the virus and warn of the risks of secondary surges.**

What are the specific features of the Coveille Project? The involvement of lecturer-cum-research scientists with expertise in mathematical models and approaches, whether deterministic, stochastic or random, who will be supported, from January 2021, by two students on a final internship. How will the Coveille project unfold? "It consists of three phases: the first involves classical statistical analysis, with Miraine and Ghislaine, the second, with Florian and Ahmad, establishes ordinary differential equations; as for Salim and myself, in a third phase, we will add randomness to the deterministic equation," explains Nikolaos Limnios, a university full professor.

Coveille's research is based on two lines of research, the first dealing with deterministic and random modelling, estimation and quantitative forecasting, and the second with identifying classes of interacting individuals. However, these two axes are in no way disjointed and the success of the project will, they are aware, depend on a permanent dialogue between the three pairs.

The first phase led by Ghislaine Gayraud, university

Concerning Covid-19, we have the expertise, by taking a direct model of the virus, to determine the rates of infectivity, incubation and death, the recovery time, etc. These are all epidemiologically relevant variables that can be calculated from observable data such as the number of infected people, hospitalized people, etc.

professor, a specialist in mathematical statistics and Miraine Davila Felipe, lecturer, specialist in probability? "With Coveille, we want to develop tools that would allow us to describe the evolution of the pandemic at different levels. Indeed, the great difficulty in epidemics in general, and for Covid in particular, is due to the heterogeneity of the population in terms of age and social background, for example. This, from a mathematical point of view, poses a major challenge. Ghislaine and I are more specifically interested in the contact network of individuals. Our aim is to model the social network through which Covid is likely to spread," explains Miraine Davila Felipe.

"The idea is not to predict who will or will not be infected in the long term, but to be able to monitor and identify clusters within the population based on individuals' contacts. In short: we are more interested in the network of relationships through which the virus will spread than in the transmission itself", adds Ghislaine Gayraud.

What are some characteristic of the models and deterministic approaches of the second phase? "We are working on models that do not take into account the random aspect. In fact, in the deterministic approaches where the theme of "inverse problems" and numerical analysis in general are addressed, we consider that we know very well the parameters used to build the models. Modelling that applies, among others, to mechanics or biology. In this field, several projects have thus been carried out with the Amiens University Hospital, notably on the detection of cancer cells in the human body based on measurements of the electrical brain activity of patients, or the characterisation for epilepsy, a project carried out by the region and on which we collaborated with the mathematics department of the University of Amiens", explains Ahmad El Hajj, university professor and head of the deterministic team.

Prof. Florian De Vuyst, director of LMAC, agrees: "It is indeed a question of characterising a tumour, for example, at a certain place in the body, on the basis of signals or measurements that are not

images in the strict sense of the word. This is what we call "inverse problems". In short, it is possible to transform signals that cannot be directly interpreted into intelligible data that can be used to establish a diagnosis".

Concerning Covid-19, we have the expertise, by taking a direct model of the SARS-CoV-2 virus, to determine infectivity, incubation and death rates, recovery time, etc." These are all epidemiologically relevant variables that can be calculated from observable data such as the number of infected people, hospitalized people, etc. "With Covid-19, we have the expertise, using a direct model of the virus, to determine the infectivity, incubation and death rates, the recovery time, etc. ", he adds.

So what are the possible hazards that could be taken into account in the case of Covid? Based on the previous data available, for example on individuals susceptible to infection, asymptomatic individuals, those with severe symptoms, those with undeclared symptoms and finally those cured or deceased, Florian and Ahmad will propose a deterministic

SEIR (Susceptible–Infected–Removed) model enriched with categories that best reflect the reality of the current epidemic. To this model, we are going to assign random disturbances such as the rate of infectivity or the percentage of severely infected people that depend on several factors and cannot be totally controlled in a deterministic way", explains Nikolaos Limnios.

The objectives set for such models? "The first objective is to determine the dynamics and evolution of the virus in the population. However, the development of stochastic models is mainly a response to the need for forecasting. It is a question of being able to say that, if we have a number of patients N at time T, we will have, for example: N X 2 patients at T+10. A reliable forecast is a valuable tool for decision support. In the case of Covid, it would make it possible to decide on the containment of this or that territory or to resize the capacity of hospitals, for example," concludes Salim Bouzebda, university professor, head of the stochastic team. ■ **MSD**

USING THE SEIR MODEL FOR COVID-19

The SEIR model (susceptible, exposed, infected, recovered), is a system of differential equations which models the evolution of four population classes in the total population (N). The variable S (susceptible) represents the number of people likely to contract the virus; the variable E (exposed to the virus) represents the number of people who are infected but in an incubation state; class I (infected) refers to those who are infectious, while class R (recovered) is that of those who have recovered from the disease. The SEIR model is summarised by the following system of equations:

$$\dot{S}(t) = -\frac{\beta S I}{N},$$
$$\dot{E}(t) = \frac{\beta S I}{N} - \sigma E.$$
$$\dot{I}(t) = \sigma E - \gamma I,$$
$$\dot{R}(t) = \gamma I,$$

where $N = S + E + I + R$ R is the total population ; β, σ and γ being model parameters representing the infectivity rate, the inverse of the incubation time and the recovery rate respectively. In the evolution equation for S, the rate of people exposed to the

virus is proportional to the number of people likely to be infected (S) as well as to the fraction of the infectious population (I/N ratio). In the equation on E, there is a gain term coming from the population S and a loss term proportional to E for people becoming infectious. In the third equation on I, there is a gain term coming from population E and a loss term proportional to I that expresses the rate of people recovering. The latter term is found as a positive value in the equation on R. Figure 1 shows an example of a numerical simulation carried out with the SEIR model taking into account a period of confinement (between day 95 and day 190 after the start of the epidemic). The model intrinsically "captures" a second wave which begins around the 9th month after the start of the epidemic in January.
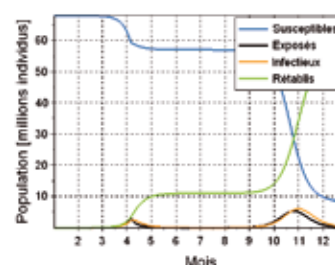
INNOVATION

A stop-Covid system

Martin Mogeneyer, lecturer-cum-research scientist at UTC in its TIMR laboratory, specialising in particle systems and Professor Jérôme Robert, head of the Bacteriology Department and head of the Hygiene team at the Pitié-Salpêtrière Hospital in Paris, have, each in their own field, lent their support to the **"stop-Covid" system set up in the Allard restaurant of chef Alain Ducasse**.

It was during the first full lockdown that these two research scientists met, at least virtually, since personal travel was impossible. The reason for this "contact"? "It was to work with Martin Morgeneyer's team on the problem of aerosols and droplets associated with Covid-19 in the air. A project designed to manage the health safety of the hospital's patients as effectively as possible. Indeed, since the beginning of the Covid-19 crisis, I have been helping my colleagues in the various departments to organise infection prevention and to provide better care for Covid patients", Jérôme Robert assures us.

Martin Morgeneyer agrees with him: "The collaboration came about quite naturally and we started to do 'experimental' work even before taking on the red tape paperwork part of the project in a good spirit of "all locked down now". We just rolled up our sleeves and thought about what we as engineers could do with the doctors on the front line."

A collaboration that accelerated with the adventure of Alain Ducasse's restaurant Allard, an institution in the heart of the Latin Quarter. Martin Mogeneyer's team was called in to test and validate the quality of the chosen system. "Alain Ducasse quickly understood that barrier gestures and distancing would drastically reduce the number of tables available. As specialists in particle systems, we developed a system that allowed us to simulate all possible permutations. In short, to simulate all potential aerosol contamination paths from table to table by reproducing the various behaviours of people at the table. For example, there are those who are chatting quietly, others who are talking loudly or laughing out loud. Tests have shown that the air quality is optimal with regard to airborne particles and, as a side effect, allergens", explains Martin Morgeneyer.

But the adventure began well in advance, since Alain Ducasse called on designer Patrick Jouin, designer of the Plaza Athénée restaurant room, and architect Arnaud Delloye to think about a solution that would save the restaurant's economic model. A solution that could only emerge through intense collaboration between his team, doctors and particle specialists.

"The latter asked Professor Thomas Similowski, whom he knew well, to think about the "Covid and restaurant" issue. As a pneumologist and specialist for respiratory diseases, Thomas Similowski then asked me to support him as a prevention specialist," explains Jérôme Robert.

Alain Ducasse's decision to start with this restaurant, symbol of the Latin Quarter... "He could have taken a larger restaurant in a large hotel, for example, but he made this choice because there are thousands of restaurants of this size in France. His only concern being the safety of the customers, he wanted to find a solution so that they would feel really reassured and that this solution would be reproducible. We started from the premise that hand hygiene and social distancing were under control, but that air ventilation and air movements in an enclosed space could facilitate the circulation of the virus from one table to another. Sprays can be stopped mechanically. Hence the idea of screens between each table. There was still the problem of the small particles that remain in the air for a long time and can therefore circulate through mechanical ventilation or draughts. So we and the architect came up with the idea of a sort of hood, with filters similar to those in operating theatres, which would suck the air over each table. We still had to prove that it worked. That's where Martin Morgeneyer and his team came in", says Robert Jérôme.

A stop-Covid device that has been validated, in particular by Uteam, a UTC subsidiary and the National Institute for Research and Security. "An innovation that Alain Ducasse wants to open up so that it can be used by the greatest number of people and which could be duplicated in all places welcoming the public, for example," concludes Martin Morgeneyer. ■ **MSD**

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JÉRÔME ROBERT

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MARTIN MORGENEYER

RECHERCHE

A *new and patented* medical implant device

Like the three musketeers who, as everyone knows, were four, Anne-Virginie Salsac, director of research at the CNRS in the Biomechanics and Bioengineering Laboratory (BMBI), Professor Jean-Paul Couetil and Dr Éric Bergoënd, both cardiac surgeons, and Adrien Laperrousaz, then an engineering student at the UTC, designed **an innovative implant for the treatment of functional mitral insufficiency.** The implant is already patented nationally and is awaiting approval for a European extension patent.

> *The creation of any new system is always accompanied by a phase of experimentation. The aim is to see how it works under the most realistic conditions possible.*

ANNE-VIRGINIE SALSAC

©PopsyImages

It all began in 2014 with an e-mail sent to **Cécile Legallais, director of UTC-BMBI, by Professor Jean-Paul Couetil, then head of the thoracic and cardiovascular surgery department, and his colleague, Doctor Éric Bergoënd, both cardiac surgeons at the CHU Henri-Mondor de Créteil.** They explained the concept of a new type of cardiac implant and wanted to put their idea into practice with the help of BMBI researchers and engineers. The e-mail was sent to Anne-Virginie Salsac and led to a meeting to assess the feasibility of the project.

"They were looking for people specialised in biomechanics, with skills in medical device technology and bioengineering, familiar with the world of research and who could collaborate with them. In short, for a research team with the ability to see the needs from a clinical point of view and

capable of proposing device ideas, design them and support the project through to completion. It was at a meeting held shortly afterwards that they explained to us the problem of functional mitral insufficiency, its serious consequences from a clinical point of view, particularly on patients who cannot tolerate existing devices", explains Anne-Virginie Salsac.

We therefore had to think about other solutions. "Discovering means defining the problem or issue precisely. They are the ones that, depending on your state of mind, you have the certainty that there will be various possible solutions. It's up to the team to try to find the best one," says Jean-Paul Couetil, who has several patents in cardiac surgery to his credit. It's important to recognize that he's come from a good school, since he was one of the last students of Professor Alain Carpentier, a leading specialist in mitral

reparatory surgery and mitral valve repair at the Broussais Hospital. A field that he continued to explore when he joined the CHU Henri-Mondor in 2010 as head of department.

What reasons led Jean-Paul Couetil and Éric Bergoënd to think about a new system? "There are two types of mitral insufficiency: organic mitral insufficiency and functional mitral insufficiency. In the first case, the mitral valve that is structurally defective. In short, the valvular tissues, pillars or cords attached to the left ventricle which may be defective. In the second case, it is the valve function that is damaged but not the structure itself. A function that may be impaired due to an anomaly in the anatomy of the valve. In principle, the valve allows blood to flow in one direction only from the left atrium to the left ventricle, like a double non-return valve. However, when the two sheets of the valve, for example, no longer come fully into contact during the contraction of the ventricle, some of the blood flows back into the atrium, making the heart less efficient as a pump. This can eventually lead to heart failure, i.e., a severe deficiency of the ventricular muscle. This is all the more critical that some patients cannot tolerate existing treatments", explains Professor Couetil.

So, how did the idea of a new type of implant come to be? "Professor Couetil's particularity

> *Discovery means defining the problem or issue precisely. This is what gives you the certainty that – depending on your state of mind – there will be various solutions possible. It is up to the team to try to identify the best solution.*

is to have several ideas per minute. We often discuss pathologies for which existing treatments are either ineffective or too invasive, and how to improve patient care. We have been particularly interested in the treatment of functional mitral insufficiency, which is due to a deterioration in valve function characterised by an imperfect contact between the two leaflets of the valve in systole. It was during discussions on this topic in 2011-2012 that he launched the idea of compensating for this lack of contact by filling the unwanted space between the leaflets with an implantable device; the exact nature of the device had not yet defined," says Dr Éric Bergoënd.

Until now, the only existing technique for repairing a defective valve in a "minimally invasive" way (transcutaneously, without open-heart surgery) consists of placing a small clamp connecting the two valve leaflets in the middle. This promotes improves the contact between the two sheets, but it does disturb the functioning of the valve and the blood flow.

And what about the particularity of the project being carried out within UTC-BMBI..."Once the problem was defined, we thought that the design of a new device consisting of re-establishing the valve's tightness was an ideal project for setting up a research project for engineering students as part of their training. This is how a project team was set up, bringing together heart surgeons Jean-Paul Couetil and Éric Bergoënd, multidisciplinary groups of UTC students (bac+3 to bac+5) and some UTC-BMBI research scientists," emphasises Anne-Virginie Salsac, adding "We formed groups of 5-6 students who worked on the project over a six-month period. Of course, as lecturer-cum-research scientists, we monitored the project at regular meetings with them to check that it was moving in the right direction and to provide the students an appropriate level of impetus."

As a 4th year engineering student in mechanical engineering, Adrien Laperrousaz served, according to Dr Salsac, as a guide throughout the entire project. "Until then, I had only been interested in mechanics in the sense of the science of movement of mechanisms and had never approached the medical field," says Adrien Laperrousaz. "In February 2014, Anne-Virginie Salsac submitted a CC-project subject ("PR" in UTC jargon) on the dedicated UTC digital workspace around this new mitral valve repair device. I was interested and was selected among the five students for the start of the first PR dedicated to the cardiac implant. I was the only one from mechanical engineering, the other four from bioengineering, and the only one to master the design software to do 3D modelling. This makes it possible to create more meaningful visuals. We then met, accompanied by Anne-Virginie Salsac, the two surgeons who described their idea to us and we set to work for five months", Adrien Laperrousaz explains.

JEAN-PAUL COUETIL

ÉRIC BERGOËND

ADRIEN LAPERROUSAZ

The creation of any new system is always accompanied by a phase of experimentation. The aim is to see how it works under the most realistic conditions possible. Hence the idea of implanting the prototype in vitro, in an experimental heart model - at University College London (UCL) — a model which accurately reproduces the flow of blood as in a human heart.

"Once the CC is over, what can you do?" he wondered. All the more so as the four other class mates had left for their final internship. Having taken a liking for what he was doing, he decided to reapply in September 2014. Being the only one present from the beginning and the only one who had mastered the state-of-the-art for this project, we decided to set up several PR groups - one group working on materials, for example; another on the patient status, etc.", he says. "In January 2015, we realised that we had enough material to put together a dossier and start looking for funding to develop prototypes," he says.

Thus, in March 2015, Adrien and his colleagues submitted an application to the national I-Lab competition in the category "Emerging Projects" and were declared laureates, in May 2015. At the end of the competition, they received a grant of 25 000 euros. This allowed UTC to finance Adrien's final internship at the UTC Daniel Thomas Innovation Centre. "It was in September 2015, during this internship, that I started to develop a prototype implant in order to be able to carry out in vitro tests", adds Adrien Laperrousaz.

The innovative approach developed by this UTC-

CNRS team consists in restoring the valve's tightness by attaching an inflatable balloon to one of its leaflets, via a transcutaneous insert route.

"The creation of a new system is always accompanied by a phase of experimentation. In short, we wanted to see how it works in the most realistic conditions possible. Hence the idea of implanting the prototype in vitro, on an experimental heart model - at University College London (UCL) - which reproduces the flow of blood as in a human heart. The pathologies linked to the mitral valve were also reproduced to be as close as possible to reality. These tests were successful, as there was a real reduction in residual leakage. This enabled us to provide a proof of concept," describes Anne-Virginie Salsac.

What motivated the choice of UTC? "A colleague who has developed several projects in the field of biotechnology advised us to call on the engineers and researchers of the UTC if we wanted this project to succeed. An opinion shared by a teacher-researcher from the École polytechnique whom I had contacted and who gave me the names of Cécile Legallais and Anne-Virginie Salsac. They both praised the dynamism of UTC and assured me that we would find real skills in bioengineering there," explains Éric Bergoënd.

It took a lot of energy for the whole team to come up with such a successful concept and work on the drafting of the patent claim.

But the adventure is not over given that a Cifre PhD student, Thibaut Alleau is pursuing - under the supervision of Anne-Virginie Salsac, in partnership with the company Segula Technologies - the creation of a digital model of the dynamics of the mitral valve, enabling the positioning of implants to be modelled and tested. ■ **MSD**

GOING AWAY ONE DAY

I studied for one semester
in Sofia, Bulgaria

Augustin Clément, third year student at UTC, chose to go to Sofia in Bulgaria for his Erasmus exchange semester. **Between apprehensions about the possible cancellation of his stay, travel and courses in very small groups, he tells Interactions about his experience**.

Where did you go to study this semester?
I went to Sofia, Bulgaria to study at the UCTM, the Bulgarian University of Chemical Technology and Metallurgy.

Why did you choose this destination?
I am a student in my final semester of the common core (Editor's note: the first two years of study at the UTC) and I didn't have many courses to do here. So I told myself that the best thing to do was to validate these last courses abroad, in a context that I didn't know. I was very keen to discover Eastern Europe, but the situation in Poland worried me and only Bulgaria offered biology courses adapted to the branch I wanted to follow. So my choice was quite easy and natural.

Were you afraid that your semester would be cancelled?
It's true that with the health situation, the closer I got to the departure date, the more I stressed. I had nevertheless had prepared a plan B if I stayed in Compiègne with certain courses I had chosen. But all the same, I was hoping to be able to leave. In the end everything went well, my flight was not cancelled and I was able to fly to Bulgaria last September.

How was your arrival there?
The first thing that struck me was the fact that the Covid-19 is not very present among the population. Social distancing was clearly not a priority and, unlike France, restaurants, nightclubs and bars remained open. It must be said that to pass the COVID tests here you have to spend more than 60€. It's a high price for people and that surely explains the low number of cases recorded. But since December 8, 2020, the country has taken measures to close some establishments.

And what about your integration in the university, how did it go?
On site, there is an association that takes care of welcoming all Erasmus students. There were a lot of activities and meetings at the beginning of the semester and there is a real follow-up throughout the year. It's really ideal. But meeting Bulgarians proved a bit more complicated.

Why so?
Well, because I didn't have a lot of classes with them. I'm in a French-speaking biology course, and there are only three or four of us in my classes. In other words, it's not the best way to meet new people...

And what does the pedagogy in your Bulgarian school look like?
I must admit that the mentality there is quite different from the French one. I have the feeling that people are less stressed and this can be felt in the organisation of the courses. The start of the school year was postponed for a few weeks but that didn't worry anyone at school. I have both face-to-face and some distance learning courses. But unlike the distance learning courses I followed at UTC, where there was a lot of video-conferencing, here the distance learning is more like a few PDF files sent by email and reminders from the teachers to find out where we are in our

But unlike the distance learning courses I followed at UTC, where there was a lot of video-conferencing, here the distance learning is more like a few PDF files sent by email and reminders from the teachers to find out where we are in our course primer reading.

course primer reading. It's a shade quieter. And then we can be absent from certain classes and arrange personally for our exams. Our teachers have understood that as Erasmus students we are above all there to gain in interculturality and local discovery.

So, you were able to make some trips?
Yes, of course! I visited Bulgaria a lot. It was a country I didn't know at all and I fell in love with it. Between the mountains, the hot springs, the small villages. There is something very wild in the places I visited. I also went to Istanbul and Macedonia. I also wanted to venture into Rumania but I was turned back at the border because of the COVID measures.

And how do you envisage the end of your stay?
I will try to stay as long as possible in the country. Why go back to France for the holidays, for example, when there is a lockdown and I am not sure I will be able to return here? I have so many other things to explore in Bulgaria that I won't be bored!

Are you fluent in Bulgarian?
Far from it! I learnt the Cyrillic alphabet so that I could get by a little but I have a lot of progress to make yet. ■ **GO**
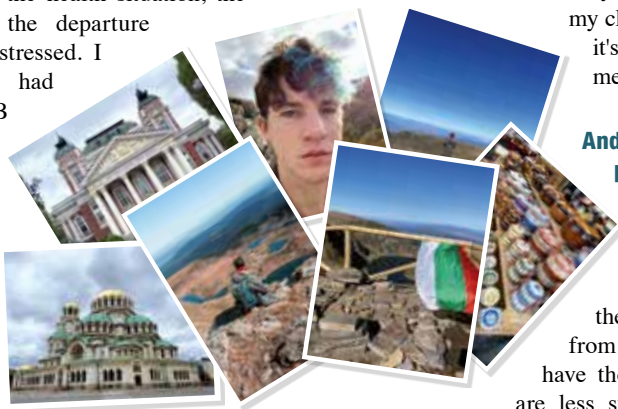
Tuli, the menstrual cup
inspired by origami and tulips

THE JAMES DYSON AWARD

UTC students Auxane Caseiro and Charlyne Kerjean won the national James Dyson Award 2020 for designing Tuli, a tulip-shaped menstrual cup. **Their goal? To democratise access to these hygienic protections**. We zoom in on this 100% feminine and 100% innovative project.

How did your Tuli Cup project originate? It began with a disappointing observation made by the two students: "Today, there is no hygienic period protection adapted for women", explains Auxane Caseiro. "Too expensive, poorly adapted to our anatomy, sometimes dangerous for health, and above all polluting". The situation seemed bleak for the two industrial design students. So they decided to carry out research on the subject. "We discovered that menstrual cups are the most suitable devices for women," continues Charlyne Kerjean. "But when we looked more closely at this device and conducted a survey of 1 344 women, we realised that there were problems with folding and use." What were the problems? The suction created when the appliance is removed.

So, in February 2020, the two young women decided to look into this everyday object to try to find solutions. Long evenings of research, analysis and tests to build a prototype different from the cups already existing on the market. By choosing to give their device a tulip shape, they have created a system that is easier to remove and therefore more practical for its users.

Last July, they decided to be candidates for the James Dyson Award, an innovation and design competition. "With the help of Anne Meuleau and Emmanuel Corbasson, lecturer-cum-research workers at UTC, and Nicolas Piton, head of the prototyping platform at the UTC Daniel Thomas Innovation Centre, and thanks to the long hours spent on the FaceTime video-conferencing channel, which we spent in lockdown, we set up this new device for women. First in the form of an origami, then in the form of a real prototype."

And their innovation proved attractive. Last September, the two inventors won the national competition prize ahead of dozens of other participants. "Three reasons explain the success of our two students in this competition, explains Emmanuel Corbasson, Director of the Industrial Design Department of UTC at the time. Firstly, they put together a very relevant product to meet a need expressed by millions of women all over the world. Secondly, because it is a subject not frequently dealt with by engineers, which nevertheless it remains a highly taboo topic.

Finally, because it's an ecological issue to which Dyson has been sensitive. "

I there a future for Tuli cups? First of all, the two students want to refine and enhance their prototype and 3D print it in medical silicone for testing in real conditions. "There might be a lot of changes compared to our usual prototypes," Auxane anticipates, "but it will be proof that our idea is a good one. "And who knows, maybe tomorrow they will be able to start their own business? "Why not, but for now, our goal is to have a product that works well," concludes Charlyne Kerjean. ■ **GO**

"The days go by and begin to look alike"

We have been following Pierre Gibertini's academic path at UTC for three years now. Now majoring in mechanical engineering, Pierre tells us about his autumn semester between meeting class mates, lockdown and a lost PCR test.
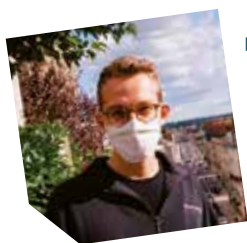
The first time I sat in a classroom again I thought it was really cool. After nearly six months in lockdown, the start of the new academic year was an opportunity to see people I had totally lost sight of. The start of the new year was quite similar to previous years, the difference being that everyone wore a mask and the usually busy freshmen integration evenings were cancelled. But we were nonetheless able to meet the new students. Then classes resumed in a hybrid format; the lectures were on-line and we only went to face-to-face seminars and lab sessions every other week. The rest of the time we had to follow them by videoconference. At the beginning it was not easy for all the lecturers, but as time went on everyone adapted. I liked this rhythm because it allowed me to keep in touch and enjoy some social contact.

But in mid-October, UTC had to close following a massive screening of students. I was one of the students tested but the lab that did the PCR managed to lose my results. So I will never know whether or not I had COVID at that time. Then we came back to UTC for a few days, followed by the holiday break, then the mid-term exams and re-lockdown.

For once, by the way, I succeeded in my mid-terms pretty well. I don't know if it's because I had fewer distractions on the side, but my work paid off. Since the lockdown, the days have gone by and they have begun to seem alike. As we always did our practical work in the classrooms, I've stayed in Compiègne. It makes me go out a bit and see other students. I know that the fact of keeping the practical work in the classroom was badly experienced by some of my classmates who live alone and who stay in the Oise for only one hour of class per week. I, for my part, am lucky enough to share a room with two other UTC students, including a childhood friend. As a result I feel somewhat less lonely.

But we like goldfish in a bowl, go "round in circles" every day in the flat. There's not really any distinction between working and relaxing. So it's true that we all had moments of discouragement and loss of motivation in the flat, but we were all there to support each other. I imagine that it must be much harder for those who stay alone... I still have one more semester of courses at UTC and then I will leave for my final project session, called TN09, the first internship as an assistant engineer. I have no idea what I will do there or where I will go. Canada attracts me, but I still have time to make arrangements... Six months is a long time! ! ■ **GO**

TECHNOLOGY & DEMOCRACY

Digital citizenship called to question

To adapt to the situation created by the Covid-19 pandemic, UTC organised its "Interactions-Press" event in early November in the form of a "Live LinkedIn". On the programme: an online conference by **Clément Mabi, UTC a research scientist, who explained how digital tools are overturning participatory democracy**. Some excerpts.

THIS YOU SHOULD KNOW...

His latest publications in 2019 include: "La démocratie numérique au défi de la critique sociale en France", Le Mouvement Social, vol. 268, no. 3, 2019, pp. 61-79. And "Does contributory innovation strengthen citizen power in the digital city? Le cas du Grenoble CivicLab ", Réseaux, vol. 218, no. 6, 2019, pp. 143-169 (with V. Peugeot and B. Chevallier).

An e-democracy specialist, Clément Mabi questions the state of public debate today and takes a critical look at the tools proposed by the industrial sector, particularly the GAFA, and their uses. Digital technology is gradually becoming a culture that is transforming our relationship with democracy and citizenship. "Technologies don't create fake news per se but make it more visible. Depending on the digital tool used, we create a relationship in a different sense. The important thing is the space in which we express ourselves. When we do it with people who look like us, speech is freer. But can digital technology bring democracy up to date? The more we use digital technology, the more we need to put people behind it", says Clément Mabi, who has taken a strong interest in these "citizen-oriented technologies" better known as "civi-tech".

Digital tools for citizen participation

"Civi-tech" refers to all the applications and platforms that make it possible to use our collective intelligence and to strengthen the democratic link between citizens, communities and the State. No wonder that civic engagement, commitment and citizen participation offer one of the favourite playgrounds for digital entrepreneurs today. But digital tools are not for everyone. "About twelve million French people are far from it. Public meetings still have a bright future ahead of them. There is a kind of Internet democracy with a form of regulation. Even if it is the strength of popularity and emotions that circulates content, for example YouTubers. There is an emotional mobilisation behind this mechanism of the Internet and social networks where, in order to optimise visibility, you can stand behind key words such as #I am Charlie or #MeToo." Then there is the legitimate question of the democratic regulation of these social networks. ■ **KD**

CLÉMENT MABI

©Léandre Leber

A new look at
Management of the Covid-19 pandemic

VINCENT VESSELLE

The Saint-Côme Polyclinic, Compiègne, like many other French hospital sites, has had to deal with the first wave of the coronavirus. The establishment was, with those of Compiègne and Creil, among the first in the country to be affected by this new disease at the end of February 2020 with the Oise cluster. Its teams had to mobilise and reorganise themselves to deal with the then epidemic in order to ensure, in collaboration with the public hospital, the care of Covid-19 patients.

Close to Crépy-en-Valois, France's first noted Covid cluster, the hospitals of Creil, Compiègne and the Saint-Côme polyclinic were the first to enter crisis mode. Three weeks before the rest of the country, they were already heavily impacted by the coronavirus SARS-CoV-2. "Crépy-en-Valois was one of the first epidemic foci. Then we were heavily impacted, because of the government's hesitation about what to do at first. It's true that at that time we didn't know much about the virus and its extent. We quickly had to organise ourselves to deal with this epidemic with Covid patients and staff quarantined," says Vincent Vesselle, director of the Saint-Côme polyclinic, the largest private clinic in the Picardy region. It has nearly 800 workers, including 550 salaried staff, the city's second largest employer. Apart from Covid-19, the establishment treats 15 000 other patients every year, 25 000 in A&E visits, 1 300 maternity deliveries, 5,000 chemotherapy treatments, i.e., one in three cancers in the Oise region, and 15 000 dialysis treatments. The integration of new practitioners and new activities have moreover called for the completion of a building extension in 2019 (cost €10m) for this establishment, which was only recently opened in 2009.

Public and private hospital hand in hand

Between the GHPSO (Groupe Hospitalier Publicier Sud Oise), the Beauvais hospital, the Compiègne hospital and the Saint-Côme clinic, a territorial coordination unit has been organised to exchange and offer mutual assistance. This includes a daily telephone conference with the Samu's regulating doctor. "At the beginning of the Covid-19 health crisis, it was very complicated to deal with all the actions that needed to be taken. Especially in regard to masks. One day, they were recommended; the next, they were not. Not to mention the problems with the supply of medicines and materials. We are lucky in this area to live in very good harmony with the public hospitals. So we worked together," says the director, who very quickly decided to suspend all non-urgent interventions in order to admit Covid-19 patients in support of the hospital. In May, the activity resumed almost normally with the care programme of patients who had not been able to be taken care of before. The clinic has a total of 270 beds, places and posts. "The second wave has been easier to manage because we are less unprepared and better prepared. There is even a lull at the end of the year." Picardy was very affected for the first wave; however, for the second wave, it was more preserved than the Hauts de France (Nord) and Ile-de-France. Nevertheless, it was necessary to increase the capacity of intensive care units (ICUs) to meet the needs of Covid-19 patients, knowing that other pathologies continued to be treated to avoid loss of opportunity for patients. ■ **KD**

A UTC GRADUATE AT THE HEAD OF THE SAINT-CÔME POLYCLINIQUE

Vincent Vesselle, a biomedical engineering graduate by training, is a UTC alumus. He has been at Head of the Saint-Côme Polyclinic, Compiègne since 2006 and also chairs GIE CIMA, Compiègne's advanced medical imaging centre. This GIE is a 50/50 collaboration between the Saint-Côme Polyclinic and the Compiègne Hospital. It manages the authorisations for Compiègne's 3 MRIs, its PET scan and 2 gamma cameras. Historically, there is a strong partnership between the GIE and UTC and the engineers from UTC have access to the MRI units for training purposes. The UTC also has an Inserm unit that works closely with the radiology department - ACRIM - set up on the site of the Saint-Côme Polyclinic for imaging research work. This involves work on the new technique of elastography by magnetic resonance (ERM), in a collaborative venture with the Mayo Clinic (Rochester, USA).

3 QUESTIONS FOR...

MICHEL SLAMA
DEPUTY HEAD OF THE INTENSIVE CARE & REANIMATION SERVICE AT THE AMIENS PICARDIE TEACHING HOSPITAL

Looking back on the events, how do you view the health crisis we are experiencing?

It is indeed an immense upheaval at the economic, societal and hospital levels that we are undergoing. It is also pushing us in a positive way. On the one hand, as this is a new pathology, it is leading us to increase our research capacities, to better understand this condition and to improve patient care. Moreover, this crisis has led us to a great surge of solidarity and union between hospitals, doctors and hospital administrations. We have all worked in the same direction and it has worked well. Our processes are coherent and efficient for the successful care of all seriously ill patients.

For students in France, such as those at UTC, it is no longer possible to follow face-to-face courses during confinements. What can we envisage the future?

It is noticeable that coronavirus SARS-CoV-2 infection in young people leads to asymptomatic or little symptomatic forms. More than 80% of serious cases are over the age of 65. And this is what we see at the hospital. The fact that students become infected has little effect on their health in the short term, even if the long-term effects are not known. What we need to be reactive and attentive to are the measures to be put in place in the universities, as the UTC has been doing since the beginning of this academic year: hydro alcoholic solutions, masks inside the lecture halls and class-rooms in sufficient number to respect the social distancing rules. Because, in my opinion, for the future, it will not be necessary to restrict face-to-face teaching but to find adapted solutions to avoid any risk of contamination as much as possible. On the other hand, the real concern is when these young people meet in parties, soirées and bars, that's when they get contaminated.

So what is the health priority for this student population?

One can only have a pedagogical attitude, but it is a duty. We must explain to them that they can contaminate themselves, they must protect their families, fathers, mothers and grandparents. Without acquired collective immunity, they must keep their distance and continue to respect all measures, because that is where the danger lies, namely that the younger will contaminate their elders, who will then develop serious forms of this disease. We can also convince them by showing them figures, results and strong images. Students from UTC have had the idea of going into lecture halls with explicit but not guilt-tripping slide shows. A strong, preventive and benevolent message. ■ **KD**

INNOVATION SOCIALE

Bip Pop Co-operative
wins a 'la France s'engage' award

Among the twelve 2020 winners chosen by the Fondation "La France s'engage", among the social entrepreneurs who innovate to build a fairer and more socially responsible society, we find the Compiègne-based Bip Pop Cooperative designed within the UTC Costech laboratory. **It has been noted at the national level for its application of mutual aid among citizens, associations and communities aimed at alleviating isolation.**

The health crisis we are going through has unfortunately accentuated inequalities in our society. The mission of Bip Pop takes on an even stronger meaning in this period. The co-operative offers a platform of local self-help services for communities that wish to broaden their social offer in order to fight against people's isolation. Bip Pop is a social and solidarity economy enterprise (société coopérative d'intérêt collectif). Its partnerships with local authorities, MDS, RPA, EHPAD, CAS, CCAS, CSR aim to provide a service to as many isolated people as possible. "The situation in France is worrying. Two million senior citizens are in a situation of isolation and this figure is constantly increasing. By putting people in need of a service in touch with other people or entities offering their services, Bip Pop is making it easier for them to stay at home by providing access to the last mile and local services," explains Mathieu Ribeil, Bip Pop's development director.

A recognised social innovation

Conviviality visits, reading aloud, computer assistance, help with administrative formalities, accompaniment on walks, races, events and even senior-junior advice, I need help, I "beep" Bi, and Pop answers me, referring to the immediacy of Internet and mobile uses. But here it is transposed to pure social contact. The idea is to popularise these local self-help services. Here again the pop popularises. Anne Guénand, lecturer-research scientist at UTC designed this social and solidarity innovation at the UTC-Costech laboratory. "Bip Pop is indeed the fruit of several years of development and research work in partnership with UTC and the Godin Institute. Winner 2016 of the Impact Ashoka

programme, winner 2016 of the Inclusive Mobility Laboratory, winner 2017 and 2018 of the Oise Financeers' Conference, as well as of the Hauts-de-France region, the Bip Pop platform was deployed in 2020 in the Hauts-de-France and beyond. "

The citizen commitment is affirmed at this particular time

This tool for coordinating local solidarity makes it possible to respond easily to the specific and sometimes very simple needs of isolated people through a voluntary and local response. The network thus formed promotes home care for the elderly and brings more life into their homes. As former President of the Republic, François Hollande, Chairman of the Foundation La France s'engage, points out: "Bip Pop is a real bulwark against exclusion and will aim to break the isolation of more than 30,000 elderly people living in rural areas within three years. Our project is to contribute to building a fairer and more supportive society, based on the fulfilment of each individual. "The Fondation La France s'engage is part of the extension of the programme of support for social and solidarity innovation initiated by the State in 2014. Each year, it identifies and rewards the most innovative projects. Once approved, the projects are accelerated by the Foundation, which provides them with support for three years in addition to funding. The aim is to help them spread throughout the country. ■ **KD**


ANNE GUÉNAND & MATHIEU RIBEIL

Ubikey reinvents itself with
Ubikey Office

Ubikey propose une version hybride de sa solution de management visuel, Ubikey Office, pour répondre à l'évolution actuelle du travail. Ubikey est une idée lancée en 2009 à l'UTC avec le projet de la table tactile interactive du laboratoire Costech.

Ubikey announces its innovative visual management solution: Ubikey Office. This collaborative software allows any employee to follow the real time evolution of a project on a tablet, smartphone, computer, at the same time as it is displayed on the company's interactive screen. Each employee can thus view and interact on the digital Post-it board, wherever he or she is, on his or her own missions as well as those of the whole team for greater efficiency. This tool has already been adopted by companies such as Sanofi, Thales, Bouygues, Michelin and Ariane Group. "I am responsible for continuous improvement within Ariane Group and, in this capacity, I lead workshops where many exercises are the subject of Post-it workshops. With the health crisis, a protocol has been put in place within Ariane Group limiting contact and handling of objects such as the famous paper Post-it notes. Ubikey offers a lasting solution beyond the crisis, since this environment
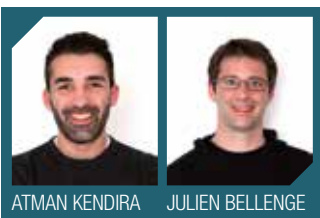
ATMAN KENDIRA   JULIEN BELLENGE

allows me to run the workshops both face-to-face and remotely, with participants sharing the handling of Ubikey at the beginning of each workshop", says Jean-Marc Goyon, Improvement & Change manager with the Ariane Group, who has successfully experimented with various concrete uses such as visual performance management, World Café workshops or an interactive game board based on lean management.

A response to the needs of companies during the crisis

"With Ubikey Office, we want to be part of the current evolution of work, i.e., the presence for each company of employees present on site and others working remotely at home. The ambition is to keep all its teams involved and informed, in real time, as to the evolution of a project in a context where the health crisis is forcing companies to manage their teams distributed both on site and remotely", assures Atman Kendira, CEO of Ubikey. Created in 2015 following research work carried out at UTC, this start-up now has nine employees and a number of prestigious customers, including Sanofi, Plastic Omnium and Sorbonne University. Ubikey also

Ubikey offers a long-lasting solution beyond the crisis, since this environment allows us to ensure both face-to-face and remote workshops.

benefits from strong support from its institutional partners BPI-France, the Hauts-de-France region, Paris & Co, UTC, French Tech and the Cap Digital competitiveness cluster. "Visual management, in these troubled times, appears to be the solution to better manage these teams," concludes Julien Bellenger, Director of Development at Ubikey. "Never before has the need for meaning and a global and rapid understanding of the project one is involved in been so important for employees around the world. Ubikey is a long-term tool for a new way of working that will be both face-to-face and remote and which we describe as a hybrid." ■ **KD**
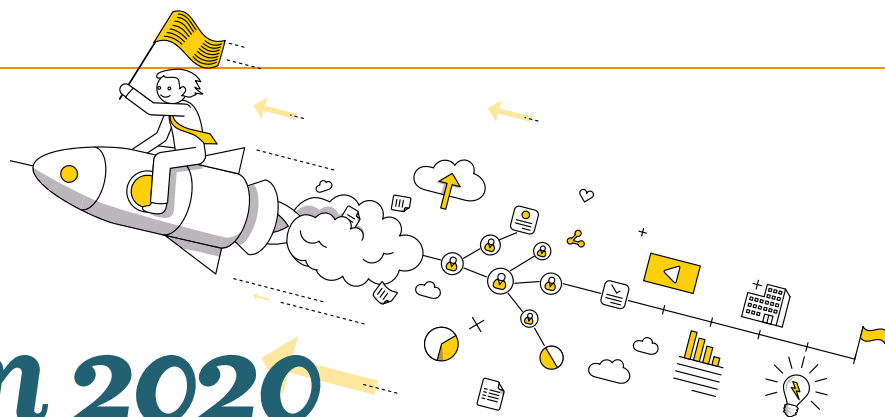
START-UP

Surviving as a start-up *in 2020*

The year 2020, marked by the Covid-19 pandemic, has proved difficult for many French companies, especially start-ups. How did they experience the lockdown, how did they adapt and do they envisage the future? **A status review, with 4 UTC grad-entrepreneurs.**

What did the confinement bring about for the development of your start-up?

LG : At the beginning of the lock-down, we made much more use of the written word to communicate. Decisions were also made in writing, which created misunderstandings and may have led to certain tensions within the team.

CB : We have generalised teleworking for all our employees by providing everyone, in an emergency, with the necessary equipment for decent working conditions. Unfortunately, given the deadlines, it was not optimal for everyone

PH : With my partner, we decided to mobilise our team and focus on our internal Medicamentum project, the 1st INCI beauty* drug, because Beyowi's consulting and mobile and web application development activity was very affected by the containment.

How did you adapt? Have you made any long-term changes to the way you work?

SC : We stopped assembling our 3rd prototype and started designing the 4th in order to propose a more successful system once the health crisis was over. Within the team, we had already been working remotely for two years between Germany and France, so it was more the relations with the outside world that were impacted, because it is simpler to propose a videoconference.

CB : We organised regular meetings and contacted each person individually to update our status knowledge. We were careful not to organise too many meetings, so as not to weigh too much on the schedules and avoid the feeling of being "spied on". A project was born out of the confinement: the opening of a Coddity site in the Limousin countryside, a spacious and quiet working environment. In the long term, we plan to develop an activity in this little-known and often neglected region.

What is this year's outcome? How do you plan for 2021?

SC : As our initial event-related activity was impossible under the current conditions, we decided to put it on hold and embark on a new adventure by seeking to respond to the problem of access to energy on the African continent. Several field studies in Africa are planned, as well as the meeting of a large number of actors and the production of the first prototypes.

LG : Our communication has evolved over time, we know how to differentiate between exchanges that can or cannot be done in writing, which saves time and limits frustration between team members..

PH : Our incubation at H7 (a living space dedicated to entrepreneurs in Lyon) and our 4th place out of 50 projects in the Digital InPulse #App4Good competition in October made Medicamentum visible. We also recruited 3 additional people to accelerate development. ■ **MB**

* Application d'analyse de composition des produits cosmétiques

SVEN CUSSEAU
Mechanical engineering student, founder of the start-up ChargEos (automated mobile phone charging stations powered by solar panels).

LUCIE GRATREAU
Apprentice engineer at UTC in IT, founder of the start-up company Bring Lights (co-operative survey board game).

CHRISTOPHER BELLIARD
Founder of Coddity, specialised in web development and data science activities.

PASCAL HUYNH
Founder of Beyowi, mobile and web development studio made in Paris.

TALENTS

AtmosGear, *Soft mobility in an urban settings*

Christine Kerdellant, Editorial Director of Infopro Digital and Manuel Moragues, Editor-in-Chief of Industrie & Technologies, together with partners, unveiled the four 2020 winners of the 17th edition of the Trophies for Engineers of the Future. After having been "a favourite" at the 2019 edition, **Mohamed Soliman, 23 years old, won this year's prize in the "Innovation" category with his electrically assisted rollerblade project: AtmosGear**.

AtmosGear was chosen in the Innovation category of the Engineers of the Future 2020 Awards. It is the world's first electrically assisted, self-contained and connected rollerblade model. A highlight at the 17th edition of the Engineers of the Future Trophies held on December 1st in a 100% digital format. Organised by the editorial staff of the review Usine Nouvelle, they reward engineering students in four categories: Innovation, Research, Tech For Good and Digital. Mohamed Soliman, a 23 year old engineer, is a UTC student. In 2019, this entrepreneur created a startup in the field of electric urban mobility. Its flagship product, AtmosGear, aims to be the first ecological mobility

alternative that is at the same time intelligent (no need for a joystick), practical (no need to take off your shoes) and fun (challenges and community social network).

Mobility, an everyday issue

"Our ambition is to change the travel habits of the French by democratising soft mobility. Whether it's to go to work, to class, or on a walk, AtmosGear provides the benefits of a sporting activity while reducing your efforts to help you find pleasure in your daily journeys," emphasises the young company director for whom mobility means being

able to move where you want to, when you want to and how you want to. "And what we want above all is to link our users to each other so that they can exchange and even challenge each other via our connected application," he continues. "This community of enthusiasts is called AtmosRiders".

Five technological solutions for an innovative system

AtmosGear are rollerblades equipped with motorised wheels with intelligent assistance that will understand the user's movements and adapt to them automatically. Result: no need for a joystick and no need to take off your shoes because the retractable frame adapts to your size. "With AtmosGear, we will recover the energy from skating and reuse it in two ways. When going downhill, freewheeling, with regenerative braking. And when the battery is dead, if you skate long enough, you regain more autonomy," explains Mohamed Soliman. Finally, thanks to the AtmosRiders application, users will be able to exchange with each other and challenge each other on courses that they themselves have created." ■ KD

CONTINUING EDUCATION

"Management through Quality"

The NQCE specialised Master's degree (post-master 2) accredited by the Conférence des grandes écoles (CGE), entitled "Managing through quality: from strategy to operations", has been able to evolve by anticipating the constraints due to the health crisis. **Focus on this course, which after 15 years in e-learning, can be followed entirely on-line and while maintaining a full-time professional activity**.

As early as 1972, UTC considered "quality" to be a major challenge, creating a course of study in Industrial Reliability and Quality. Opened in 1992, the NQCE specialised Master's degree was accredited by the Conférence des grandes écoles [CGE] in 2002 and offered an on-line option as of 2005. In 2019, Nicolas-Louis Duclos, lecturer-cum-research scientist in charge of the MS-NQCE and his predecessor, emeritus professor Jean-Pierre Caliste, had the idea of strengthening international teaching and developing partnerships with foreign universities.

Managing, improving, anticipating

This specialised Master's degree provides a high level of management skills and uses methods and know-how from the quality professions. It is based on the technological culture of the UTC to take into account the impact of the digital transformation of the economy and business practices. "The coronavirus crisis has shown the need to strengthen the capacity to be reactive and innovative in order to remain effective in crisis situations. The growing uncertainty and

complexity of today's world is forcing us to change the way we look at things and to change our ways of thinking and working methods. Agile know-how helps us to move forward despite complexity, for example by generalising the project culture, by better taking into account the transversal and intangible aspects of activities", explains Nicolas-Louis Duclos, specialised research scientist at the UTC-Costech-CRI (Complexities, Networks and Innovation research unit).

Future-oriented remote on-line learning

The new formula integrates innovative teaching methods such as self-assessment quizzes, team marks and peer assessments (students marking students): "Our teaching method and individualised support allow both the acquisition of theoretical knowledge and its concrete appropriation, thus developing operational skills." Considering that over the last thirty years, many managers have gradually been put on the defensive, giving priority to reporting and justification logics rather than to the added value of the job, Nicolas-Louis Duclos is convinced of the need to

offer high-level international training to enhance management and quality know-how: "Using the Internet to adapt this diploma to everyday life is a step in the right direction." ■ KD

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NICOLAS-LOUIS DUCLOS

©Jean-Pierre Delpech

"Curiouser & Curiouser"*

Sabine Allouchery graduated from UTC majoring in computer engineering (with elective specialist option robotics) in 1988. Since 2005, after a career in the computer industry, Sabine Allouchery has been a coach and therapist. Portrait of a woman with boundless curiosity.

SABINE ALLOUCHERY

Curious? Did you say curious? Sabine Allouchery demonstrated this in her years in "preparatory classes". While the grandes écoles [French engineering schools] opened their arms to her, but she chose UTC. Why so? "I saw UTC as modern. It worked with a UV system, which was innovative for an engineering school. The other schools seemed more classical to me. UTC was also more human in the sense that, alongside technological knowledge, it also included a management dimension. It required a one-year internship in a company, 6 months in the second year and 6 months at the end of the cycle, and offered many partnerships abroad. I absolutely wanted to have an experience outside our borders," she says.

After a first internship at Poclain on real-time computing, she joined Philips Kommunikation A.G. in Nuremberg for her final year internship. "During the first internship, it was the separation between the blue-collar workers who had lunch at noon and the white-collar workers at 1 p.m. that struck me. I'm also delighted to experience the programme I developed by driving a hydraulic excavator myself. At Philips, I came to love the international atmosphere, and taking part in the development of the first mobile phone compiler," she explains.

Still curious? "My colleagues were motorcyclists and I started accompanying them on their motorbike rides. I caught the virus and as soon as I got back to France, I passed my Big Bike* licence", she jokes. [special "A" licence required for bikes over 35 kW (47/6 HP)]

After graduating from the UTC, rather than turning to industry, the logical continuation of her Robotics speciality, she prefers to join a management IT services company. "I did very little programming. Having easy contact, the managers quickly offered me the position of "solutions architect", then that of manager of a team of consultants. I was barely 25 years old," she says.

Curiosity once again? "I changed companies several times, each time valuing my experience and my thirst to learn, my thirst for new things. My last position in the software world was at BMC Software as sales director and then marketing director," she says.

Still curious? "You are a sales director, you talk more about people than numbers", says a headhunter. "I reply that numbers are a consequence of good management. The job of manager fascinated me, much more complex than a robot, much richer than millions of euros," she adds.

New curiosity and a change of direction? A trip to the desert with a Tibetan lama creates a new inner lane 'fast-track' route. Sabine wants to deepen her understanding of humans. She leaves BMC to set up her own consulting business and continues her training. First in Sophrology, then at the Gregory-Bateson Institute (IGB) where she trains in short-term and strategic therapy, which comes from the work of the Palo Alto school. "After 11 years as a therapist in my practice and as a consultant in companies, I am passionate about people and nature. I am looking forward to continuing to discover and learn through life experiences," says Sabine.

Ultimate curiosity and new orientation? "Yes as a novelist. Seeking a publisher for my new novel is my goal today," she concludes. ■ **MSD**
www.senseways.fr

* NdT - borrowed from Lewis Carroll's Alice, another intrepidly curious lady.

BIO EXPRESS

1988 : engineering graduate from UTC
2000 : discovered meditation in the Mauritanian desert
2002 : qualified in sophrology and personal coaching. Created several companies: GO Elan Conseil, Nautic TV and A2 Partner
2009 : opened her consultancy agency for short therapy programmes
2015 : self-edited: « Réussir contre toute logique » et « Maigrir contre toute logique » ["Illogical Success" and "Illogical Slimming"
2017 : 1st novel : « Mon premier jour » ["My First Day"] – Ed. Mélibée

📅 AGENDA

THE UTC BIOMEDICAL RENDEZ-VOUS

Friday, January 22, 2021
100% virtual via LinkedIn®, YouTube® & Facebook®

www.utc.fr/le-rendez-vous-biomedical

EXECUTIVE REBOUND

Thursday, February 4, 2021
100% virtual via LinkedIn®, YouTube® & Facebook®

www.utc.fr

UTC OPEN DAY

Saturday February 20, 2021
100% virtual via LinkedIn®, YouTube® & Facebook®

www.utc.fr/journee-portes-ouvertes