Academic Corner
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In this issue, we interview IEEE SMC member Prof. Samia Bouchafa-Bruneau, Dean of the Faculty of Science and Technology, Université d'Evry Paris-Saclay, France. Prof. Bouchafa-Bruneau received a Ph.D. degree in 1998 in electrical and computer engineering from the University Paris VI (now Sorbonne University) and the French Research Institute in Transportation (now University Gustave Eiffel). In 1999, she became an assistant professor at University Paris XI (Institute of Fundamental Electronics), and was promoted to associate professor in 2011. Since 2012, she has had a full professor position at Université d'Evry Paris-Saclay. Her research interests are in computer vision, visual perception, multimodal vision for autonomous systems, motion analysis, stereovision, visual odometry, and localization.

(1) Tell us a bit about yourself and your academic/professional background
My childhood was marked by an international school experience. I went to elementary school in Rousson (France), then Montreal (Canada) and finally Algiers (Algeria). These escapades had a profound effect on me. By discovering different educational systems, they enabled me to develop a kind of early relativism and to embrace universal values. Since then, I've become aware of multiple identities as incredible sources of richness, and I've always kept within me this desire to make the link between several cultures. I have wonderful memories of my two years in Montreal, where the Canadian education system takes into account the rhythm of each child, thus encouraging their personal development and creativity.

My higher education took place at the *École Supérieure d'Informatique* in Algiers (ESI, formerly INI), a selective national Engineering school in computer science. I chose computer science first and foremost because I was passionate about mathematics and my grandfather had given me a computer; he, who had never studied, wanted his grandchildren to have access to higher education. He had worked for 40 years as a laborer in several automobile factories in France, for which he was awarded (best work award): the values of hard work, rigor, loyalty and honesty are part of his moral heritage.

As a child, I spent my time reading, rummaging through my psychologist mother's library, and I was already fascinated by everything to do with cognitive psychology. In particular, I read two Jean-Pierre Petit comics over and over again, "*L'informagique*" and "*A quoi rêvent les robots*", featuring the endearing character Anseleme Lanturlu, who evoked the big questions of computing, robotics and AI with humor and insight.

In my final year of engineering school, I chose a final-year project on computer vision. Not surprising after all: to understand the mechanisms of 3D vision and motion analysis, which would become my specialty. You have to love geometry, mathematics and cognitive sciences, to which the addition of computer science enables the practical application of artificial vision systems for robots.

After engineering school, while my fellow computer scientists preferred to pursue their studies in fields geared towards fundamental computer science, it was to robotics that I turned for a Master year at Pierre et Marie-Curie University (formerly Sorbonne University), a rich training

in an interdisciplinary field. Robotics is by nature multi-disciplinary, and computer science plays a fundamental role in it, provided it is associated upstream with other disciplines (automatic control, mechanics, human sciences).

My thesis was an exciting experience: how to detect abnormal crowd behavior in the subway by processing images from video-surveillance cameras? My thesis work was carried out at the *Institut de Recherche sur les Transports et leurs Sécurité* and the *Université Pierre et Marie Curie*, as part of the European CROMATICA project (Crowd Management with Telematic Imaging and Communication Assistance). For six months, in weekly sessions, I collected video recordings at the Havre-Caumartin subway station in Paris and discovered the endearing world of RATP staff. I also filmed sequences to test my algorithms in the very secret station behind the Porte des Lilas platform, where many films featuring the Paris metro are shot. This period was marked by rich and fascinating encounters with researchers who were part of my supervisory team. It's during the thesis that all aspects of the scientific method (including research ethics) are really acquired.

After my thesis, I was recruited by CITILOG company as an image processing development engineer. After a few months, I realized that I was going to miss more fundamental research and the transmission of knowledge, and that I should consider an academic career.

It was then that I obtained a position as a lecturer at *the Institut d'Electronique Fondamentale* Lab at Paris-Sud University (formerly Paris-Saclay University). I spent around ten years there, with a one-year mobility at LIVIC (*Laboratoire sur les interactions véhicules-infrastructure-conducteurs*) at IFSTTAR (now Univ. Gustave Eiffel). This period confirmed my desire to teach and train in research. The encounters were rich and the brainstorming-based research sessions memorable. It was there that embedded vision became my specialty. When a robot/vehicle/drone is equipped with a visual system, how can we take advantage of its own movement (ego-movement) to perform 3D reconstruction, visual odometry and localization tasks based solely on the analysis of image sequences? This was a subject that would keep me busy for several years.

I was recruited for full professor position at the faculty of Science and Technologies in the IBISC lab (Informatics, BioInformatics, Complex Systems) in 2012. My arrival coincided with the first discussions on the integration of the University of Evry into Paris-Saclay. It was a great pleasure to work on the creation and integration of our Master's programs in Paris-Saclay. From 2015 to 2023, I created and coordinated the 2nd year of a Master in Electrical Engineering: the Master Automatic Mobile Systems specialization (SAM), specializing in perception and control of autonomous systems (intelligent vehicles, drones, robots).

Like many others, I shared this vision of Paris-Saclay as a university that would foster new opportunities for collaboration, bring together skills, go beyond one's own research theme to develop interdisciplinarity, build training courses as close as possible to research activities by dialoguing with colleagues, and set up new research activities by daring to go towards new ideas. I really enjoyed taking part in this new project, where anything is possible.

Since 2020, my involvement has continued in the construction of the Graduate Schools (GS) as deputy director in charge of doctoral studies at the Graduate school of Engineering and System Sciences. My aim has been to work to bring together four doctoral schools on common objectives and give visibility to engineering doctorates at Paris-Saclay (around 1,000 doctoral students each year). From 2019 to 2023, I was director of the IBISC research laboratory, which

has over 120 members and develops activities around complex life and artificial systems. What motivated me in this last position was to try to bring together and coordinate the laboratory's skills for an intelligent and successful integration into Paris-Saclay; to take care of internal organization and external communication so that the laboratory has a mode of operation commensurate with the challenges that lie ahead; and to initiate in-depth work to enhance the value of researchers' activities and encourage them to get involved in the federating and interdisciplinary projects that are emerging in Paris-Saclay.

Managing a multidisciplinary laboratory is an exciting experience. Practices and sensitivities are diverse, and scientific communities sometimes have different visions, even when it comes to solving the same research problem. There are many sources of discussion and controversy. We need to convince people that these differences are a source of richness. It's at the University of Evry, a young university where anything is possible, that I'm discovering in depth all the facets of the teaching-research profession. I can't imagine doing research without training students in and through research, without leading a research team, or without teaching and training doctoral students. A researcher can only be fulfilled if he or she develops all these facets of the job. Since June 2023, I have been Director of the Faculty of Science and Technology at the University of Evry. A dynamic, open faculty whose aim is to train students from bachelor to doctorate level in the fields of engineering (mechanical, electrical and computer engineering) on cutting-edge subjects linked to industrial challenges and the major scientific questions of the research world. The Faculty is home to around 1,000 students, two research laboratories, a technology hall and offers some thirty different training tracks.

(2) What are some of the challenges you see today in robotics and automation?
Over the past decade, we have witnessed a veritable revolution in the field of artificial perception: the development of computing and digital resources has enabled learning-based methods, long reputed to be costly in terms of computing time, to be envisaged and finally applied to extract knowledge from simple data, provided the latter is sufficiently numerous and varied. This craze for so-called AI found an immediate echo in fields exploiting image data, and revolutionized computer vision and image processing before any other field. I'm looking forward to the new period that's just around the corner, when data-driven approaches will need to model and understand the physical models that govern the “key features” that come into play in perception processes, starting with the very nature of sensors. Data-driven approaches are destined to come to terms with model-based approaches and AI. Today's challenge concerns the explicability of AI algorithms and trustworthy AI, which are key to guaranteeing the use of AI-based systems in sensitive fields, where the safety of people and systems is an essential prerequisite.

(3) Where do you see your research field going in the next 5-10 years?
When artificial systems are equipped with visual sensors to assist humans in tasks where they use their visual sense, it is necessary to design reliable algorithms that can adapt to a variety of visual conditions. These algorithms also need to be as fast as possible. To meet these challenges, it is possible to propose ever more efficient algorithms, but another approach is to look at unconventional visual sensors. I'm currently interested in neuromorphic cameras, which have great potential in the field of embedded systems. Event-driven cameras are bio-inspired sensors that operate at the lowest level in a radically different way to traditional cameras. Instead of acquiring images with a fixed acquisition frequency, changes in brightness for each pixel are calculated completely asynchronously. The result is a stream of events, each with its own timestamp, x and y position, and the sign of the change in brightness at that point, called polarity. These cameras have exceptional properties compared with conventional cameras: a

very high dynamic range (140 dB vs. 60 dB), high temporal resolution (of the order of μs) and very low power consumption. What's more, the movement of objects or the camera does not generate blur. These advantages make them cameras with great potential for robotics and computer vision in scenarios that challenge traditional cameras, particularly in cases of high speeds and/or high dynamic ranges. However, their use requires a rethinking and readaptation of conventional algorithms. Another challenge is to include these cameras in multimodal systems that include other non-conventional sensors. Applications are numerous: localization, obstacle detection, tracking to help artificial or human systems access hostile environments (darkness, smoke, absence of localization signals, etc.).

(3) What advice would you give young researchers entering your field?
It's difficult to give advice, as the research world is rich in diversity and many different paths can lead to research. On the other hand, there are a few invariants in the temperament of robotics researchers: having developed, deep down, an element of dream and utopia to give meaning to the research objectives we wish to achieve. When we know that the robotics applications to which we hope to contribute even the smallest building block will, in the long term, improve the lives of humans, then our motivation is even greater. What's more, it's essential in this field to remain humble, to listen to others and to keep abreast of new developments and knowledge.

I'd also like to end with a word to young girls who want to go into research. In France, a great deal of effort has been made to increase parity in juries and councils and to eliminate gender bias in our evaluations and the way we work. Even if this period has been marked by an over-investment on the part of women researchers, who have been over-solicited, sometimes with little recognition from men, I'm proud to have been part of this collective effort, which has meant that it is now considered completely abnormal to have a meeting, a thesis jury, a recruitment panel or a board with no women members. Attitudes have indeed changed, slowly but surely. Increasing the proportion of women in the research landscape is a virtuous circle that will enable young girls to embark on this path.

(4) What role has IEEE played in your career?
From the very beginning of my research career, IEEE has been with me, guiding me towards the best scientific contributions to feed my bibliographic studies. My first scientific contributions were published in IEEE conferences and journals, which today remain a true guarantee of quality thanks to its demanding and efficient reviewing system.