Interview with Pr. Cristell Maneux

Question: Hello Cristell, can you tell us a bit about your professional background?

Cristell Maneux: Of course. I started with studies in electronics, then continued with a master's degree at the University of Bordeaux before completing a Ph.D. at the IMS (Integration of Materials into Systems) laboratory. The following year, I was appointed as a lecturer, and a few years later, I was promoted to professor, still at the University of Bordeaux. Today, I lead this wonderful multidisciplinary laboratory of 400 people, with a core expertise in electronics.

"We've demonstrated it's possible to design dense, distributed neural networks embedded in pocket-sized devices transforming AI applications like real-time translation without internet connectivity."

Question: As the director of the IMS laboratory, what are your main responsibilities?

Cristell Maneux: IMS is made up of about 400 members, the majority being PhD students, post-docs, and engineers, which requires significant management of non-permanent staff. It's crucial to ensure their integration, their development, and support them until they obtain their degree. Additionally, for my permanent colleagues, my role is to stimulate innovative projects, particularly by developing international collaborations or maintaining strong partnerships with industry. Our laboratory is also a reference at the University of Bordeaux for relationships with companies such as STMicroelectronics, Stellantis, NXP, and CEA-LETI.

Another major challenge is attracting young talent to science and engineering at a time when these fields are experiencing a decline in appeal. We've launched initiatives to train young researchers to succeed in academic competitions, which has already paid off: by 2025, we tripled the number of applications for positions in our lab.

Question: You have extensive experience in the compact modeling of advanced emerging devices. In your opinion, what are the most promising developments in this field?

Cristell Maneux: Currently, a lot of efforts in Europe are focused on InP transistors on silicon substrates. This allows us to take advantage of the mechanical and thermal properties of silicon while benefiting from the performance of InP transistors. My team and I are actively contributing to this field through two major ongoing European projects. These technologies are not limited to microelectronics; they also extend to photonics, in connection with the next generation of networks like 6G. We are also exploring emerging technologies, in collaboration with academic colleagues. For example, we are working on 3D integration, both at the transistor and logic cell levels. I feel that it is never easy to be right too early. Although these approaches are promising, they may require a "side step" to mature further before widespread adoption.

Question: Of all the projects you've contributed to, is there one you're particularly proud of?

" It's never easy to be right too early—promising technologies often need a side step to mature before widespread adoption."

Cristell Maneux: I would say it's often the most recent project that makes me the proudest. Recently, in collaboration with ETH Zurich, we demonstrated a record operating frequency for a bipolar transistor. We were able to measure performance up to 500 GHz and extrapolate up to 1.1 THz, which is a first. These results open up exciting possibilities, and we hope to continue in this direction.

Question: Can you tell us about the FVLLMONTI project and its main objectives?

Cristell Maneux: FVLLMONTI is an ambitious project from the Horizon 2020 program. It aims to develop neural networks tailored for embedded artificial intelligence, with optimal energy efficiency. Unlike computing farms, we focus on embedded devices, such as those you could carry in your pocket or bag. For this, we are working on a completely vertical technology, using vertical nanowire transistors. This approach enables deep integration, which is essential for creating high-

performance and compact neural networks. While we have demonstrated several proofs of concept, some challenges remain, particularly in the stacking of logic cells. We are working closely with partners like NaMLab and LAAS, and we remain confident in achieving our goals by the end of the project.

Question: What are the major challenges that FVLLMONTI aims to address in the field of embedded AI?

Cristell Maneux: Two crucial aspects still need to be fully demonstrated: the stacking of logic cells and the integration of ferroelectric materials into the vertical nanowires. These challenges are complex, but we have strong collaborations to overcome them. These technologies are essential for designing neural networks where memory is as close as possible to the computing units, which is crucial for reducing size and improving energy efficiency.

Question: How is the technology of vertical ferroelectric nanowire transistors integrated into the project, and what are the benefits for neural networks?

"Moving beyond von Neumann machines is essential to meet today's demands for compact, energy-efficient neural networks."

Cristell Maneux: The technology of vertical ferroelectric nanowire transistors is integrated into the project as a core building block, with a typical microelectronics value chain. This includes performance measurement, the creation of compact models, and the development of a design kit for circuits. The goal is to create a new system architecture where neural networks are designed with memory close to the computing unit. This approach aims to move beyond von Neumann machines, which were efficient in the past but are no longer suitable in terms of size and energy efficiency for the current needs of neural networks.

FVLLMONTI

Question: How do you see the evolution of research on nanoelectronics devices and their application to artificial intelligence in the coming years?

Cristell Maneux: Artificial intelligence imposes challenges at all levels of the value chain, from hardware to software. With FVLLMONTI, we have shown that it is possible to design distributed and dense neural networks embedded directly in pocket-sized devices. Such an advancement could transform applications like simultaneous translation, performed locally without an internet connection. This would not only reduce energy consumption on the device but also avoid the use of internet data.

Question: Finally, what advice would you give to young researchers wishing to get into nanoelectronics or device modeling?

Cristell Maneux: We are living in an incredible time, with an explosion of electronic devices and immense opportunities. My advice would be to explore all the possible paths without prejudice and to remain curious to address the multitude of future possibilities. If I had to redo my PhD today, I wouldn't hesitate for a second, as the perspectives are so exciting.

Question: Any final words to conclude?

Cristell Maneux: I would like to thank all the partners of the FVLLMONTI project. The consortium is solid, and each partner brings ideas and solutions that allow us to move forward. See you at the end of August 2025 to discover the final results of the project!