

Friday April 26th 2019 - 10h 00

Amphitheater of C2N

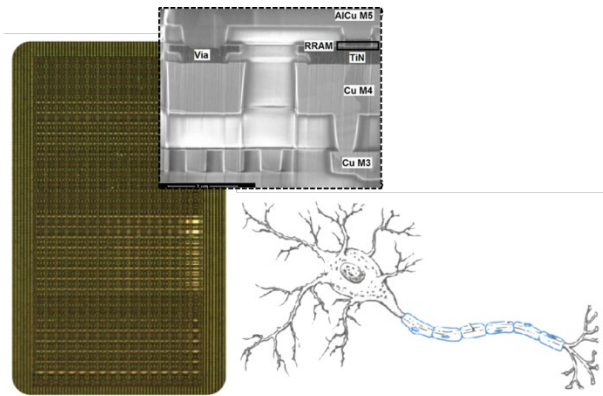
Neuroinspired Artificial Intelligence with Memory Nanodevices

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When performing artificial intelligence tasks, computers and graphics cards consume considerably more energy for moving data between logic and memory units than for doing actual arithmetic. Brains, by contrast, achieve vastly superior energy efficiency by fusing logic and memory entirely, performing a form of "in-memory" computing. Currently emerging memory nanodevices such as (mem)resistive, phase change and magnetic memories give us an opportunity to achieve similar tight integration between logic and memory.

In this talk, we will look at neuroscience inspiration to extract lessons on the design of such systems. We will first study the reliance of brains on approximate memory strategies, which can be reproduced for artificial intelligence. We will give the example of a hardware neural network relying on resistive memory. Based on measurements on a hybrid CMOS and resistive Hafnium oxide memory chip, we will see that such systems can exploit the properties of emerging memories without the need of error correcting codes, and achieve extremely high energy efficiency. Second, we will see that brains use the physics of their memory devices in a way that is much richer than only storage. This can inspire radical electronic designs, where memory devices become a core part of computing. We will illustrate this concept by our works using magnetic memories as artificial neurons. We have fabricated neural networks where magnetic memories used as nonlinear oscillators implement neurons, and their electrical couplings implement synapses. We will see that such designs can harness the rich physics and dynamics inherent to magnetic memories, without suffering from their drawbacks. This physics-rich approach nevertheless raises important challenges that we will highlight.



Damien Querlioz is a researcher at Centre de Nanosciences et de Nanotechnologies. He focuses on novel usages of emerging non-volatile memory and other nanodevices, in particular relying on inspirations from biology and machine learning. He received his predoctoral education at ENS, Paris and his PhD from Université Paris-Sud in 2009. Before his appointment at CNRS, he was a Postdoctoral Scholar at Stanford University and at the CEA. Damien Querlioz is the coordinator of the interdisciplinary INTEGRANO research group, with colleagues working on all aspects nanodevice physics and technology, from materials to systems (<http://integnano.c2n.u-psud.fr/>).

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