CEA - Saclay 91191 Gif-sur-yvette Cedex
Service de Physique de l'Etat Condensé - UMR 3680

SÉMINAIRE

Mercredi 18 janvier 2017 à 11h15

Orme des Merisiers SPEC, Salle Itzykson, Bât.774

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Neuroinspired computing based on the physics of emerging nanodevices

Artificial intelligence tasks are essential for the modern applications of electronics, but traditional computers do not perform optimally on such assignments. This is due to the separation of computing and memory in computers, unlike in brains, where computing and memory are fused. However, emerging nanodevices, such as memristive devices and spin transfer torque magnetic tunnel junctions offer an opportunity to design systems that work more like the brain. They make a true fusion of computing and memory technically possible. In this work, we follow this general idea and use a neuroscience-inspired model of learning (spike-timing-dependent plasticity) to develop a bioinspired approach for programming memory devices, which naturally gives rise to an “inference engine”. The method is adapted to different memory devices, and relies actively on their intrinisic physics. In particular, we highlight the case of STT-MTJs, where intrinsic stochastic effects can be harnessed for the learning process. We investigate several applications, including image recognition and pattern detection within video and auditory data. Monte Carlo simulations demonstrate a strong robustness of the inference engine with respect to device variations and other device issues. These results highlight a novel bioinspired paradigm for programming emerging memory devices, where the physics of the memory devices plays an active role. In conclusion, we mention more radical ideas going into the same direction, such as schemes where noise is the basis for computing.

References: D. Querlioz, O. Bichler, A. F. Vincent, C. Gamrat, "Bioinspired Programming of Memory Devices for Implementing an Inference Engine", Proceedings of the IEEE, Vol. 103, No. 8, p. 1398, 2015.
J. Grollier, D. Querlioz, M. D. Stiles, "Spintronic nano-devices for bio-inspired computing", Proceedings of the IEEE, Vol. 104, No.10, p. 2024, 2016.

A coffee break will be served at 11h00. The seminar will be given in English.

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