On-line SPICE-SPIN+X Seminars

Wednesday, 30th November 2022, 15:00 (CET)

The seminar will be via Zoom (Meeting ID: 833 5214 8027) and live streamed in the SPICE YouTube Channel.

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Multilayer spintronic neural networks with radio-frequency connections

The combination of the two key effects of spintronics, magnetization dynamics and magneto-resistive effects, allows the realization of nano-neurons and nano-synapses with high computational capabilities. However, multilayer spintronic neural networks have never been realized with these nanodevices because there is no way to connect them that can work on a large scale. I will show that it is possible to exploit the two key effects of spintronics to connect together magnetic tunnel junctions that implement both neurons and synapses of a multilayer network. The magnetic tunnel junctions perform neural operations on DC signals and output the result as RF, operate synaptic operations on RF signals and output the result as DC thus giving rise to multilayer networks based on successive, clean, and fast conversions from RF to DC and from DC to RF. I will give a proof of concept with a two-layer neural network composed of nine interconnected magnetic tunnel junctions functioning as both synapses and neurons and experimentally demonstrate its ability to solve non-linear tasks with high performance. I will show that with junctions downscaled to 20 nm, such a network would consume 10fJ per synaptic operation and 100fJ per neuronal operation, several orders of magnitude less than current software neural network implementations. Finally, I will show through physical simulations that these networks, which can process DC data, can also natively classify RF inputs, achieving state-of-the-art drone identification from their RF transmissions. This study lays the foundation for deep spintronic neural networks at the nanoscale.