Neuromorphic Oscillatory Neural Networks for Edge AI Computing

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Topic(s):
neuromorphic computing, oscillatory neural networks, edge AI computing, sense-to-action computing

Abstract:
With the ever-increasing number of edge devices and the amount of data to process at the edge requires innovation in hardware implementation that not only is energy efficient but also enables continuous online learning capability. Current AI algorithms such as deep learning are power-hungry to be deployed at the edge and most of the current research efforts are focused on training algorithms while hardware implementations remain a major challenge. Recently, neuromorphic computing inspired by biological neural networks presents a viable opportunity to implement not only energy efficient architecture but also enable online learning by emulating biological plasticity. Oscillatory neural networks are a promising neuromorphic computing paradigm that intertwines the dynamics of a physical system based on coupled oscillators with neural networks. Oscillatory neural networks (ONNs) are a promising neuromorphic computing paradigm for AI at the edge. ONNs are networks of coupled oscillators using their natural synchronization behavior to compute. The main computing element is an oscillator and information are encoded in the phase difference among oscillators, which allows to reduce drastically supply voltage amplitude resulting in low-power computing. In this talk, I will cover aspects of both analog circuit design and digital design implementation for ONNs. I will also present the current progress and challenges with respect to novel materials, devices and computing architectures for ONN implementation – ongoing efforts in the frameworks of EU H2020 NeurONN[1] and Horizon EU PHASTRAC[2] projects.

Brief Bio:
Aida Todri-Sanial is a Full Professor in the Electronics Systems Group in the EE Department at TU/e and PI of the Nanocomputing Research Lab. Her research interests focus on quantum computing, quantum error mitigation, physics-based computing with coupled oscillators, and neuromorphic computing. Prior to joining TU/e, she has held several R&D positions at CNRS, STMicroelectronics, Cadence Design System, and IBM TJ Watson Research.
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[1] www.neuronn.eu
[2] https://phastrac.eu