

Cellular Nonlinear Network based on Memristive Devices

Artificial neural networks based on memristive devices are receiving increasing interest in recent years. These neural networks are using the mature structures which are well mathematically defined but less biologically plausible. One of the more biological plausible neural networks is the cellular nonlinear network. It is composed of localized connections between adjacent neurons. The system can automatically evolve to minimization points in the energy landscape of the system. How to use memristive devices (RRAM, PCM, etc) in this kind of neural network is not well studied.

In this project, theories of the cellular nonlinear network will be studied and the possibilities of using memristive devices in these networks will be investigated. A simulation of prototype cellular nonlinear neural network accounting the behaviors of memristive devices as the synaptic connections should be carried out.

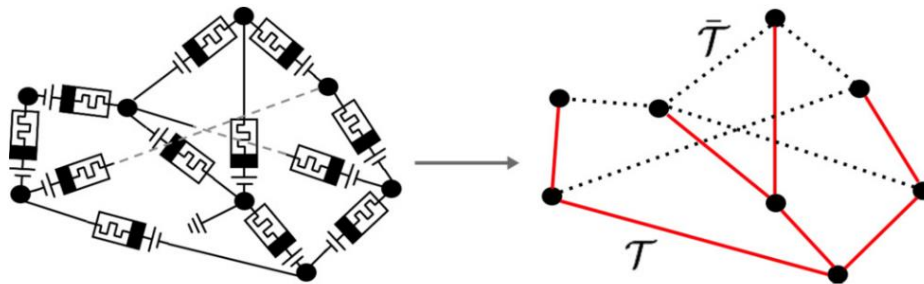


Figure 1: Concept of the memristor-based cellular nonlinear neural network [F. Caravelli, et al., Physical Review E, 95, 022140, 2017].

Schedule

- Study the working mechanism of the cellular neural network, carry out simulations to get hands-on about the network operation.
- Learn knowledge about memristive devices, for instance, resistive switching memory STT-MRAM (MTj)
- Construct a cellular neural network with memristive devices as connections.
- Simulate the memristive devices based cellular network with real memristive device behavior.
- Based on previous work, build the network using VLSI lab GK 22FDX MTj 22nm. Run simulations. Observe results.

Prerequisites: Matlab/Python,

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