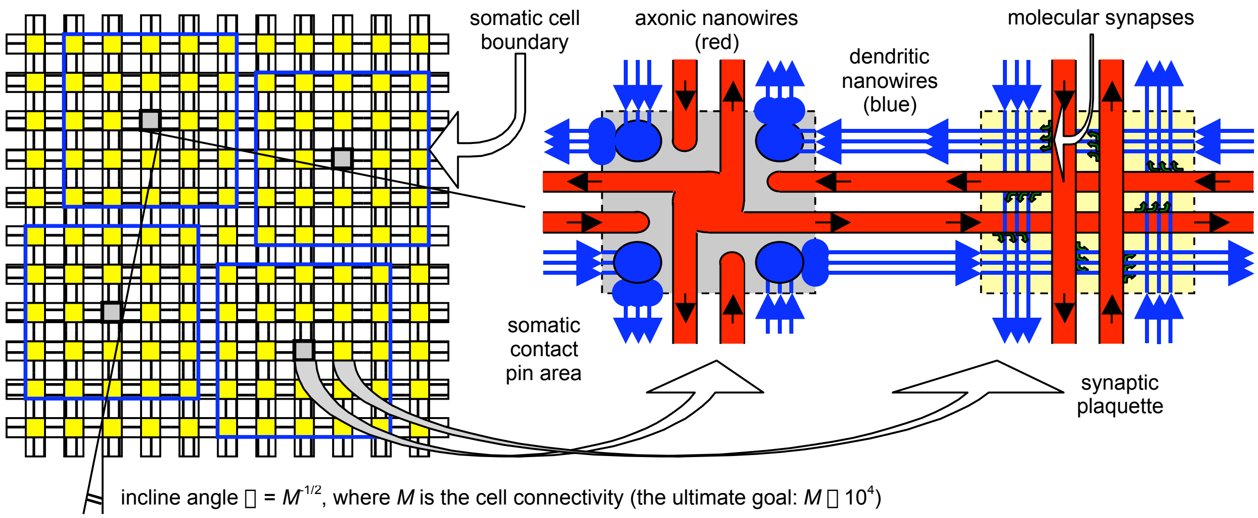
NIRT Highlight (Devices and Architectures)

"Nanoscale Single-Electron Switching Arrays for Self-Evolving Neuromorphic Networks"

We have suggested and analyzed a highly effective architecture ("InBarNet", standing for Incline Crossbar Network) of 2D switching arrays for future self-evolving neuromorphic networks. This architecture allows to combine high density CMOS-based somatic cells (up to 10^8 per cm^2) with extremely high density of single-electron latching switches working as synapses (up to 10^{12} per cm^2) necessary for our "final" goal: placing a hardware analog of a mammal cerebral cortex on a 10□10 cm^2 silicon area.



Estimates show that this architecture, implemented using gold EUV-interference-patterned nanowires and chemically assembled single-molecular synapses, may allow to reduce the average intercell latency below 100 ns, i.e. make the network at least 5 orders of magnitude faster than their biological prototypes, at acceptable power consumption (below 100 W/cm^2). If success along these lines materializes, extremely efficient signal processing may become available, and virtually all spheres of information technology will be significantly impacted. The work on the experimental implementation of nanowires and molecular synapses is in progress.

References

NSF Award #CCR-0103059 to SUNY at Stony Brook, P.I.: Prof. Konstantin Likharev

S. Fölling, Ö. Türel, and K. Likharev, "Single-Electron Latching Switches as Nanoscale Synapses", in*: Proc. of the Int. Joint Conference on Neural Networks* (Int. Neural Network Society, Mount Royal, NY), pp. 216-221 (2001).

Ö. Türel and K. Likharev, "BarNets: A Family of 2D Crossbar Arrays of Single-Electron Latching Switches for Ultra-dense Neuromorphic Networks", paper in preparation.