“DARPA Has Seen the Future of Computing … And It’s Analog …” Wired Magazine

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ABSTRACT

Today’s defense missions rely on massive amounts of sensor data collected by intelligence, surveillance and reconnaissance (ISR) platforms. Not only has the volume of sensor data increased exponentially, there has also been a dramatic increase in the complexity of the required analysis. Moore’s Law is slowing down and will be ending soon, and power scaling (via Dennard Scaling) has already stopped, significantly limiting the speed and type of analyses that can be done in real time.

DARPA’s Unconventional Processing of Signals for Intelligent Data Exploitation (UPSIDE) program had a goal of orders of magnitude improvements in power efficiency by breaking the status quo of digital processing with methods of video and imagery analysis using computation based on the physics of nanoscale devices. UPSIDE processing was to be non-digital and fundamentally different from current digital processors and not subject to the power and speed limitations associated with them.

The key was to find a computational abstraction that could be used throughout a signal processing pipeline and that also could be mapped directly to devices. The abstraction used by UPSIDE is based on probabilistic inference, the “Inference Module,” which becomes a building block for creating complex data analysis systems with orders of magnitude improvements in speed and power efficiency. Furthermore, these arrays would self-organize and adapt to inputs, rather than being manually programmed.