Workshop: Architectures for post-CMOS Switches • Tuesday, August 18, 2009 • University of Notre Dame

Biologically Inspired Intelligent Signal Processing

Dan Hammerstrom
Portland State University

Abstract

"If at first, the idea is not absurd, then there is no hope for it," Albert Einstein.

As Moore's law continues, the semiconductor industry is facing a number of challenges including power density, interconnect reverse scaling, device defects and variability, memory bandwidth limitations, performance overkill, density overkill, and increasing design complexity.

Although none of these is a potential show-stopper, taken together they could be. Another challenge is the growing reliance on parallelism for performance improvements. As multiple core machines become more common, software and application vendors struggle to parallelize existing software and to develop new parallel applications and programming tools.

The semiconductor industry is now looking to new kinds of denser circuits which promise continued scaling and increased computational density. However, many of the circuits and devices being considered do not really address the challenges facing the industry. And in fact they tend to aggravate most of them.

And there is another problem. In spite of the compute bounty of Moore's law, there is a large class of problems that computers still do not solve well. These problems involve the transformation of data, sometimes referred to as *Intelligent Signal Processing*, across the boundary between the real world and the digital world. Computer vision, speech recognition, and robotics are examples of these kinds of problems, which occur wherever a computer is sampling and acting on real world data. As embedded computing becomes ever more pervasive, our inability to act intelligently on real world data is becoming an increasingly serious barrier to applications and markets.

There is a small, but passionate group of researchers who believe that studying biology will yield insight into new capabilities in Intelligent Computing. In this presentation I will discuss this fascinating aspect of computing, and speculate on its future and its potential impact, not only on the problems facing the semiconductor industry, but also on computer architecture, circuits, and device structures.