Spike-Based Hybrid Computers Project

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Sponsorship

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This project attempts to combine the best of analog and digital computation to compute more efficiently than would be possible in either paradigm of computation. (Rahul Sarpeshkar and Micah O'Halloran, "Scalable Hybrid Computation with Spikes", in press, Neural Computation, 2002). This project is inspired by the duality of analog spike-time and digital spike-count codes of the brain's neurons. It is being applied to create low-power time-based analog-to-digital converters, analog memories, and novel event-based control architectures. Several design issues that are important in mixed-signal systems including good power supply rejection are being explored.

Figure 37 shows the layout of a low power analog-todigital converter that uses time as a signal variable rather than the traditional variables of voltage or current to perform quantization. A technique for achieving good power supply rejection without sacrificing the gain bandwidth product of an amplifier has been reported (Micah O'Halloran and Rahul Sarpeshkar, "A Low Open-Loop Gain High-PSRR Micropower CMOS Amplifier for Mixed-Signal Applications", paper, IEEE International Symposium on Circuits and Systems, Arizona, May 2002).



Fig. 37: Layout of the Spiking Neuronal Analog-to-Digital Converter. Total area of chip is 4.84mm² in 1.5um technology.