

Biologically-Inspired Massively-Parallel Architectures – Computing Beyond A Million Processors

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Abstract: Moore's Law continues to deliver ever-more transistors on an integrated circuit, but discontinuities in the progress of technology mean that the future isn't simply an extrapolation of the past. For example, design cost and complexity constraints have recently caused the microprocessor industry to switch to multi-core architectures, even though these parallel machines present programming challenges that are far from solved. Moore's Law now translates into ever-more processors on a multi-, and soon many-core chip. The software challenge is compounded by the need for

increasing fault-tolerance as near-atomic-scale variability and robustness problems bite harder.

We look beyond this transitional phase to a future where the availability of processor resource is effectively unlimited and computations must be optimised for energy usage rather than load balancing, and we look to biology for examples of how such systems might work. Conventional concerns such as synchronisation and determinism are abandoned in favour of real-time operation and adapting around component failure with minimal loss of system efficacy.