Theme B: Energy Harvesting-Aware Computation Circuits

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Harvested energy could be regarded as having an unlimited supply of energy in the long run, but limited power at any time. This theme explores ways of designing circuits which take advantage of these properties.

On-chip reference-free sensing
To properly take advantage of harvested energy the computation circuits must be able to operate efficiently over a large range of Vdd variation. In order to properly control the computation to best track the available energy or power over time, knowledge of these physical parameters is necessary. We developed sensors capable of operating under non-deterministic power supply (e.g. harvested energy), without needing stable references.

Self-timed (asynchronous) SRAM
Memory that can work under radically variable Vdd down to subthreshold levels is difficult to realize. We developed the world’s first truly self-timed SRAM in several versions which demonstrates a number of advantages including functionality across large range run time Vdd variations and data retention capability down to very low Vdd.

On-chip power delivery
Power flow can be smoothened through storage elements but the usual off-chip solutions with their large capacity and slow operation may not always be necessary. We developed novel on-chip solutions which have been demonstrated to work well under energy harvesting and asynchronous computation assumptions.

Sub-clock power gating
Traditional low power techniques such as voltage and frequency scaling do not target leakage power loss whose relative significance is increasing. Power gating targets this with detaching circuits from Vdd during idle modes, but leakage is not exclusive to idle modes and our novel techniques of sub-clock power gating extends this to active modes. A chip with an ARM Cortex-M0 core was fabricated and tested to demonstrate this method.
Publications

see http://www.holistic.ecs.soton.ac.uk/publications.php


Other Resources

see www.holistic.ecs.soton.ac.uk/resources.php

Energy-modulated computing lecture and SRAM demo videos

Prof Yakovlev's DATE'11 lecture on energy-modulated computing and async SRAM videos are on the Holistic website.