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Topic: EXPLORING NOVEL TECHNIQUES FOR DESIGNING ENERGY-EFFICIENT AND ROBUST NANOELECTRONICS CIRCUITS

Department: Electronics & Communication Engineering, Faculty of Engineering and Technology, JMI.

Keywords: FinFET; Power Dissipation; PVT variations; Monte-Carlo Simulations; Adder circuits; Schmitt trigger circuit; LCINDEP; Domino logic; INDIDO; Spiking Neural Networks; LIF Neuron; Energy Efficient.

Findings

- FinFET-based logic circuits were designed, demonstrating improved power efficiency, energy savings, and robustness against process, voltage, and temperature variations compared to conventional designs.
- A leakage reduction technique (LCINDEP) was proposed and applied to various circuits, significantly reducing leakage power while enhancing reliability under varying operating conditions. The technique effectively minimized power dissipation in different logic circuits and benchmark circuits, offering a more efficient alternative to conventional designs.
- Different FinFET-based adder circuits were designed, demonstrating better leakage control and performance improvements compared to traditional approaches, while a Schmitt trigger circuit was designed using a low-power technique, resulting in lower power consumption, enhanced energy efficiency, and strong immunity against variations.
- Multiple full adder topologies were analysed, with the proposed designs exhibiting lower power-delay product variability and reduced layout area, making them suitable for high-performance applications. A specific full adder topology was identified as the most efficient due to its optimal trade-off between power, delay, variability, and area.
- A novel approach (INDIDO) for domino logic circuits was introduced, providing significant improvements in power dissipation, delay, noise tolerance, and robustness against variations.
- Low-power neuron circuits were designed for spiking neural networks, achieving high energy efficiency, area optimization, and biologically plausible behaviour.
- The proposed neuron circuits demonstrated substantial energy savings compared to existing designs, making them well-suited for neuromorphic computing applications.