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Recent Progress on Neuromorphic Computing Using Adiabatic Josephson Devices

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***Abstract* — Adiabatic Quantum-Flux-Parametron (AQFP) logic has demonstrated the potential to build highly energy-efficient computing systems, thanks to the adiabatic switching of Josephson junctions. In this paper, we present our latest progress on developing AQFP-based neuromorphic computing systems, including a binarized neural network architecture, a stochastic number-based computing paradigm, and a hardware-software co-optimization framework. We have also fabricated a prototype neural neuromorphic processor with AIST 10kA/cm2 high-speed standard process, consisting of 2236 Josephson junctions. The target operating frequency is 5 GHz, and the energy dissipation is 11.18 aJ without the cooling cost. Compared to a representative CMOS-based BNN framework, our design can achieve about 7.8 × 104 times higher energy efficiency with a similar model accuracy level on the CIFAR-10 dataset.**

***Keywords (Index Terms)* —AQFP, bnn, neuromorphic computing**

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