KU THE UNIVERSITY OF KANSAS
Center for Technology Commercialization

Superconducting Neuromorphic Computing Devices and Circuits

Application

KU Investigators have developed a 3D scalable neural unit that can perform neuromorphic computing well suited to addressing the critical issues in modern computing platforms and provide hardware for thriving artificial intelligence (AI). Successful fabrication of ultrathin memristors with relevant properties such as high-state resistance tunability at the atomic scale has occurred. Furthermore, this neuromorphic computing circuit technology processes and stores information in the same units, thus overcoming the data-movement bottleneck (i.e. von Neumann bottleneck) problem often observed in modern computing systems.

Key Benefits

- High-quality, high yield and uniform memristors due to atomic scale tunability
- Energy and area efficient devices (SQUIDS) as driving and readout circuits are in each neural layer
- Highly compatible technologies in the fabrication of both memristors and SQUIDS given that the electrodes of the memristors and the SQUIDS are made of the same superconducting material
- Significantly increase the energy-efficiency of the hardware and significantly eliminates scaling issues
- 3D scalable in contrast to the 2D scalable limitation of CMOS logic circuits

Market Summary

The goal of neuromorphic computing is to develop computer architectures and systems that mimic biological neural networks. One of the motivations behind neuromorphic computing is to improve energy efficiency in computing systems. Emulating the brain's energy-efficient processes may lead to significant power savings compared to traditional computing architectures. Neuromorphic computing has applications in various fields and can excel at tasks such as image and speech recognition, and processing data in real-time. Because of the ability to interface directly with the brain, applications such as prosthetic control and communication aids for individuals with disabilities have received a lot of attention. This is an emerging market with several challenges and opportunities within the hardware and programming models, as noted with the development of the KU technology.

Technical Summary

The KU technology is a neuromorphic computing circuit including multiple memristors that function as synapses. The neuromorphic computing circuit also includes a superconducting quantum interference device coupled to the memristors. The SQUIDS function as a neuron such that the memristors and the SQUIDS form a neural unit. The memristors also include a high level of atomic tunability in which parameters can be controlled over 3 orders of magnitude or more, therefore allowing different memristors to have different operating parameters, like real synapses within the brain.

Key Words AI, Artificial Intelligence, Neural Unit, Neuromorphic Computing, Superconducting, SQUIDS, Memristors

Patent Information

App Type	Country	App No.	Patent No.	File Date	Issued Date	Expire Date	Patent Status
Utility	US	18/280,530	N/A	9/6/2023	N/A	N/A	Filed

Contact: Patrick Hanway, Licensing Associate, (785) 864-1775, patrickhanway@ku.edu
Tech ID: 21KU032L
Inventor(s): Hao Li, Judy Wu