

Spin Orbit Torque Based Electronic Neuron

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- Computer Technology
- Electrical Engineering

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- Energy Efficient

Artificial neural networks (ANNs) attempt to replicate the remarkable efficiency of the biological brain for performing cognitive tasks, such as learning, pattern recognition and classification. The two main computational units of the artificial neuron are weighted summation of inputs followed by a threshold. The implementation of large scale ANNs on general purpose computers requires significant computational capability and consumes energy that is orders of magnitude larger than a biological brain. These inefficiencies are due to the significant mismatch between the functionality of a biological neuron and the CMOS devices, which are better suited for Boolean logic.

Researchers at Purdue University have developed a device based on current-induced spin-orbit torques that function as the thresholding unit of an electronic neuron. This technology includes a two-step switching scheme:

1. A large current through heavy metal places the magnetization of a nanomagnet along the hard axis at an unstable point for the magnet.
2. A reverse current receives a current that moves the magnetization from the unstable point to one of the two stable states.

This technology results in three times lower power consumption, while reaching approximately 80 percent accuracy.

Advantages:

- Increases the efficiency of artificial neural networks
- Decreases power consumption of ANNs by up to three times

Potential Applications:

- Artificial neural networks
- Neuromorphic engineering

People:

- Roy, Kaushik (Project leader)
- Choday, Sri Harsha
- Kim, Yusung
- Sengupta, Abhronil

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Contact OTC:

Purdue Office of Technology Commercialization
The Convergence Center
101 Foundry Drive, Suite 2500
West Lafayette, IN 47906

Phone: (765) 588-3475

Fax: (765) 463-3486

Email: otcip@prf.org