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Spin Orbit Torque Based Electronic Neuron

A new device based on current-induced spin-orbit torques functions as the thresholding unit in electronic neurons, leading to significantly lower power consumption and increased efficiency in artificial neural networks.

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 charge current through heavy metal places the magnetization of a nanomagnet along the hard axis at an unstable point for the magnet.

2. The device 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

Technology ID

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Category

Artificial Intelligence & Machine Learning/AI Model Optimization & Acceleration Tools
Semiconductors/Devices & Components
Materials Science & Nanotechnology/Nanomaterials & Nanostructures

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