Making computer processors faster with the help of light

Researchers have developed a next-generation computer accelerator chip that uses light to process data faster than ever while consuming less energy.

DIGITAL ECONOMY

© kkssr, Shutterstock

We're entering the age of cognitive computing, where machines will simulate the way humans think when dealing with complex problems that have no clear or definite solutions. To be able to replicate human thought, this type of computing requires vast amounts of data to be processed at high speeds – something current computers can't do efficiently. Now, a revolutionary approach demonstrated by an international research team promises to significantly speed up machine learning.

Supported in part by the EU-funded Fun-COMP, PINQS and PROJESTOR projects, the researchers have developed a specialised hardware accelerator that processes data using light. As stated in their paper published in the journal 'Nature', the integrated photonic hardware accelerator is capable of performing trillions of operations per second. "Conventional computer chips are based on electronic data transfer and are comparatively slow, but light-based processors—such as that developed in our work—enable complex mathematical tasks to be processed at speeds hundreds or even thousands of times faster, and with hugely reduced energy consumption," explains co-author Prof. C. David Wright of Fun-COMP project coordinator University of Exeter in an article posted on the 'Phys.org' website.

What's in the technology?

The integrated photonic hardware accelerator, or tensor core, uses phase-change–material memory arrays and photonic chip-based optical frequency combs to achieve parallelised photonic in-memory computing. The computation is capable of operating at frequencies higher than 14 GHz, “limited only by the speed of the modulators and photodetectors,” according to the paper. “Our study is the first to apply frequency combs in the field of artificial neural networks,” states co-author Prof. Wolfram Pernice of PINQS project coordinator University of Münster, Germany, in the ‘Phys.org’ article.

AI applications for photonics processors

“Our results could have a wide range of applications,” remarks co-author Prof. Harish Bhaskaran of the University of Oxford in the same article. “A photonic TPU [tensor processing unit] could quickly and efficiently process huge data sets used for medical diagnoses, such as those from CT, MRI and PET scanners.” Other data-intensive AI applications for which integrated photonics show great potential include autonomous driving, live video processing and next-generation cloud computing services.

The 4-year Fun-COMP (Functionally scaled computing technology: From novel devices to non-von Neumann architectures and algorithms for a connected intelligent world) project is focusing on developing industry-relevant technologies that will go beyond current mainstream processing and storage approaches. PINQS (Photonic integrated quantum transceivers) is using nanophotonic circuits integrated with superconducting nanostructures and carbon nanotubes to create scalable quantum photonic chips that overcome obstacles encountered in linear quantum optics and quantum communication. PROJESTOR (PROJECTED MEMRISTOR: A nanoscale device for cognitive computing) is exploring the projestor concept, a device that remembers the history of the current that flowed through it previously. The latter project ends in June 2021, while the first two projects conclude in 2022.

For more information, please see:
Fun-COMP project website
PINQS project
PROJESTOR project

Keywords

Fun-COMP | PINQS | PROJESTOR | photonic | computing | data | accelerator | light

Related projects

Photonic integrated quantum transceivers

PINQS

6 September 2024

PROJECT

PROJECTED MEMRISTOR: A nanoscale device for cognitive computing

PROJESTOR

23 August 2022

PROJECT

Functionally scaled computing technology: From novel devices to non-von Neumann architectures and algorithms for a connected intelligent world

Fun-COMP

6 September 2024

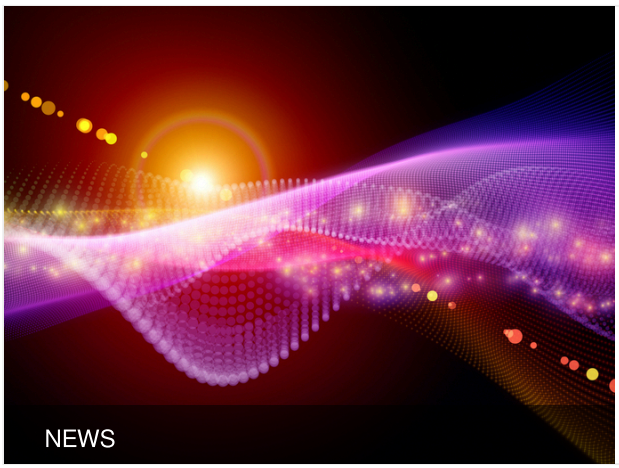
PROJECT

Related articles

SCIENTIFIC ADVANCES

Introducing the first certification-ready multicore timing analysis solution

10 May 2022



SCIENTIFIC ADVANCES

Europe’s photonics industry holds 2nd place global ranking

4 August 2021

SCIENTIFIC ADVANCES

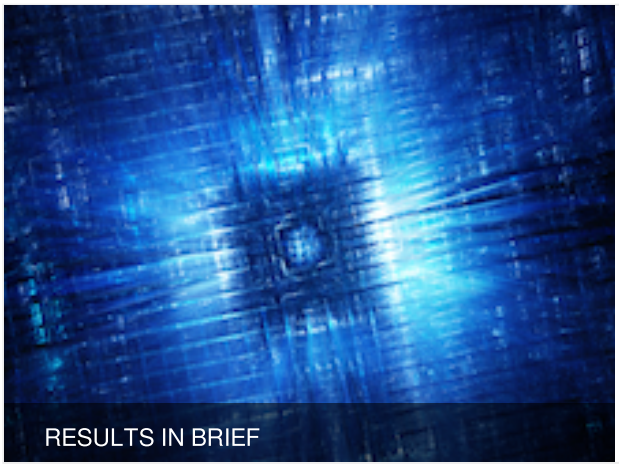
Computing at the speed of light? How to achieve faster and more energy-efficient memories and processors

15 January 2020

SCIENTIFIC ADVANCES

Plasmonic technology opens the way to mass manufacture of high-performance chips

19 June 2019



New-generation GPGPUs increase energy efficiency by an order of magnitude

27 March 2018

Last update: 27 January 2021

Permalink: https://cordis.europa.eu/article/id/428910-making-computer-processors-faster-with-the-help-of-light