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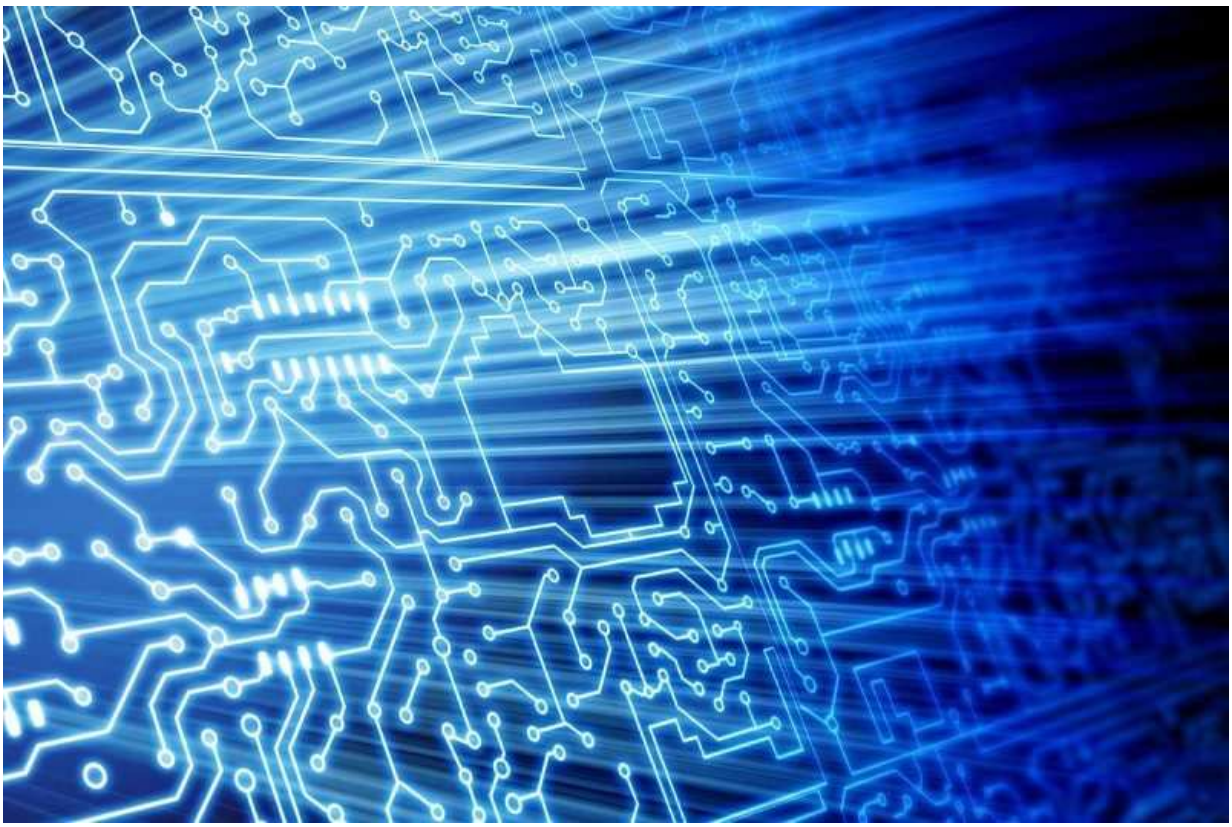
# Computers that calculate with light could make superfast AI



Henrik5000/Getty

By **Timothy Revell**

The future of artificial intelligence might be bright. Computers that use lasers to carry out computation are showing that they can do complex algorithms faster and more efficiently than standard chips.

If the rate of progress continues they may be able to head off the impending crisis that threatens Moore's Law, the idea that computing processing power doubles every two years, and herald a new type of computers that are cheaper, faster, and much less energy intensive.

Although similar claims have been made since the 1960s, the tide may finally be starting to turn, as a host of new optical computing companies and start-ups are racing

ahead. One of the most advanced is Optalysys, based in Yorkshire, UK. Its lasers are already being used to search for patterns in genomic data, and this week it is announcing that its processors can run an important type of artificial intelligence algorithm, called a convolutional neural network, too.

"Compared to a standard processor, we can do around ten to a hundred times the processing power, with a quarter of the energy consumption," says Nick New, CEO of Optalysys. "And this is just the start, there are easy improvements to make," he says.

Convolutional neural networks are now the go-to algorithm for computer vision tasks, from Facebook's automatic photo tagging features to eyes for autonomous cars. But the algorithms are complicated and require a lot of computer power. They are typically run only on high-performance computers and specialised chips. These are expensive, both to buy and to run.

Optalysys's systems work together with regular chips, performing particularly useful mathematical functions called Fourier transforms. Electronically, Fourier transforms are computed in several stages, but optically, laser beams encoded with data simply interact with each other performing the process in a single step.

## Cool it

Additionally, as light doesn't have to fight against electrical resistance it hardly produces any heat, saving on the cooling bill which amounts to around half of the total energy cost for a standard processor.

"The applicability of their technology is very broad and touches numerous fundamental scientific fields and disciplines," says Marcello Ferrera at Heriot-Watt University. Comparing long DNA strings, predicting stock market fluctuations, and training robots to understand their environment, are all problems of pattern recognition using Fourier transforms, he says.

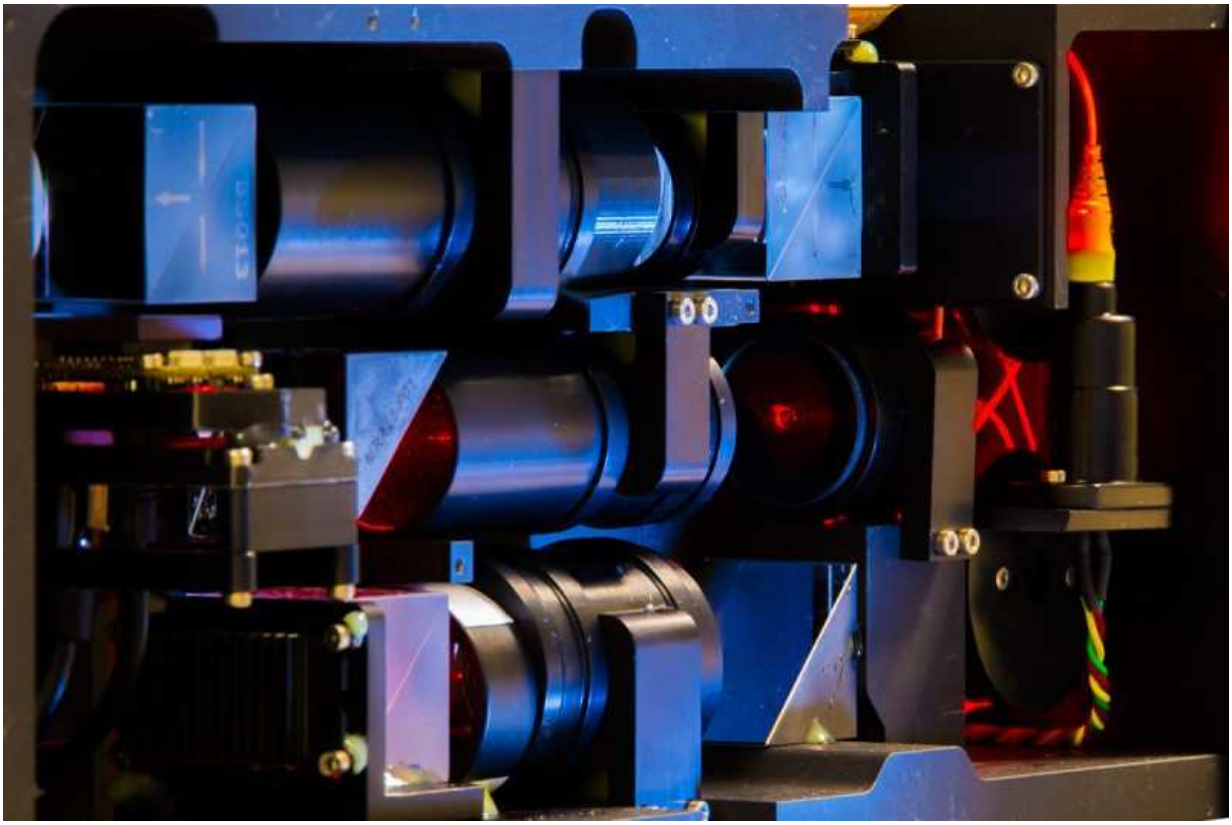
Optical processors work in tandem with standard electronics, as they can do currently only do one important task very well, says Jürgen Jahns at the University of Hagen in Germany. This means that standard processors do much of the leg work, and then whenever an optics friendly task like a Fourier transform or matrix multiplication is required it's farmed off to the optical processor.

Showing this in action, Optalysys have a demonstration that performs a famously difficult task for computers – recognising hand written digits. Their system is currently at 70 per cent accuracy, which is well below the current best systems, but New believes it will improve.

The team also recently completely a trial with the Earlham Institute, a genomics research centre in the UK, finding short snippets of DNA inside genomes. Compared to running the same task on standard high-performance computers, there was a 90 per cent energy saving.

## Light fantastic

Optalysys aren't the only group developing optical processors. Lightmatter won a competition last year at the Massachusetts Institute of Technology after demonstrating speech recognition on an optical processor.



**The Optalysys system is quite large at the moment – could will be shrunk down in the future**
Optalysys

Rather than Fourier transforms, Lightmatter's processor does matrix multiplication, another crucial process for many artificial intelligence algorithms that essentially involves multiplying large grids of numbers together. The company has since received significant funding from Baidu, a Chinese technology company that has the second largest search engine in the world.

Another company, Fathom Computing have also demonstrated the ability to recognise hand-written numbers using optical processors, but with matrix multiplication instead. And Paris-based start-up LightOn recently reported that their optical processor has been installed at a data centre, and on a particular task has a thirtyfold energy saving over traditional electronics.

Optical processors aren't going to make it into your computers any time soon. But Moore's law is starting to slow. This means making super-fast computers faster is becoming more difficult using traditional methods.

So for computation-hungry tasks like computer vision for autonomous cars or finding patterns in huge data sets, optical processors might just be the answer. "We've proven the first step. There's no massive hurdle to making this more mainstream," says New.

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A shorter version of this article was published in *New Scientist* magazine on 24 March 2018