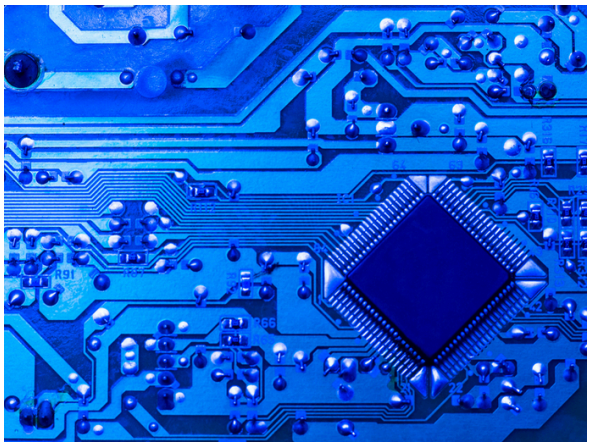
Programmable photonic circuits: One chip, many different applications

EU-funded researchers explore the recent developments and potential applications of optical circuits that can be programmed by end users.

DIGITAL ECONOMY



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Photonics, the science of generating, detecting and manipulating particles of light, forms the basis of many of the technologies we use in our everyday life. In the evolving branch of integrated photonics, increasingly large and complex optical circuits can be built on the surface of a chip. The majority of these circuits are currently designed for specific applications in telecommunications, sensing and other fields. However, photonic technology is finding application in more and more areas. Because of this, we need "'general purpose' optical circuits that can be programmed directly by the end user," according to a press release posted on the website of the Polytechnic University of Milan, a project partner in the EU-funded Super-Pixels project.

The potential of such programmable photonic circuits is the focus of a study supported in part by Super-Pixels and the EU-funded projects PhotonICSWARM, MORPHIC, UMWP-CHIP and FPPAs. Published in the journal 'Nature', the study discusses recent developments in this emerging technology and potential applications in various fields.

Programmable photonic circuits and how they work

Programmable photonic circuits are the optical version of field-programmable gate arrays (integrated electronic circuits designed to be configured by a customer after

their manufacture). The fact that such an optical circuit can be used for many different applications makes the technology more accessible and reduces costs, as well as research and development time.

According to the press release, the most frequently used strategy for creating these circuits is to set up interconnected optical tracks (mesh) on a photonic chip. Since the mesh's nodes can be configured and managed using software and algorithms, the light can be made to perform the desired function rapidly and without consuming much energy. Changing the circuit's function then simply entails reprogramming it.

"With the same optical circuitry, we can choose to carry out mathematical operations, implement artificial intelligence and machine learning systems, create networks of on-chip sensors and imaging systems, and manipulate quantum states of light. Furthermore, the rapid convergence between electronic and photonic technologies will soon lead to all this being possible on the same silicon chip," stated Polytechnic University of Milan's Prof. Francesco Morichetti in the same press release.

Prof. Andrea Melloni, who is head of the Photonic Devices Lab at the same university, observed: "While it is still premature to think of photonic devices so advanced that they operate on light in a similar way to current electronic processors, we have come very close to the possibility of creating programmable photonic co-processors that are capable of processing data in the optical domain to perform classes of operations extremely efficiently."

The Super-Pixels (Super-Pixels: Redefining the way we sense the world.) project intends to co-develop a new-generation sensor platform that will revolutionise the way we process light. The project ends in August 2022.

For more information, please see:
Super-Pixels project website

Keywords

Super-Pixels, optical circuit, photonic circuit, light, chip

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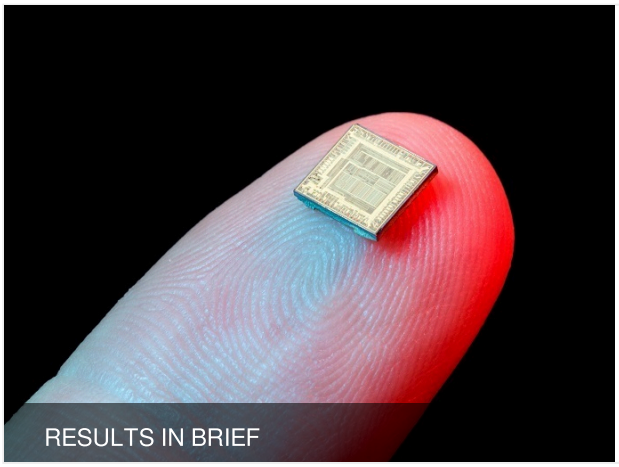

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