PRESS RELEASE
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Physical neural networks, the new frontier for sustainable artificial intelligence

An international study conducted with the contribution of the Politecnico di Milano has been published in the prestigious scientific journal *Nature*

Milan, 9 September 2025 – Artificial intelligence is now part of our daily lives, with the subsequent pressing need for larger, more complex models. However, the demand for ever-increasing power and computing capacity is rising faster than the performance traditional computers can provide.

To overcome these limitations, research is moving towards innovative technologies such as **physical neural networks**, analogue circuits that directly exploit the laws of physics (properties of light beams, quantum phenomena) to process information. Their potential is at the heart of the **study published by the prestigious journal *Nature*.** It is the outcome of collaboration between several international institutes, including **the Politecnico di Milano**, **the École Polytechnique Fédérale** in Lausanne, **Stanford University**, the **University** of **Cambridge,** and the **Max Planck Institute**.

The article entitled *"Training of Physical Neural Networks"* discusses the steps of research on **training physical neural networks,** carried out with the collaboration of **Francesco Morichetti**, professor at **DEIB** – Department of Electronics, Information and Bioengineering, and head of the university's ***Photonic Devices Lab***.

Politecnico di Milano contributed to this study by **developing photonic chips for the creation of neural networks,** exploiting integrated photonic technologies. Mathematical operations, such as **sums and multiplications, can now be performed through light interference mechanisms on silicon microchips barely a few square millimetres in size.**

"*By eliminating the operations required for the digitisation of information, **our photonic chips allow calculations to be carried out with a significant reduction in both energy consumption and processing time**,*" says **Francesco Morichetti**. A step forward to make artificial intelligence (which relies on extremely energy-intensive data centres) more sustainable.

The study published in *Nature* addresses the theme of training, precisely the phase in which the network learns to perform certain tasks. «*With our research within the Department of Electronics, Information and Bioengineering, **we have helped develop an "in-situ" training technique for photonic neural networks**, i.e. without going through digital models. The procedure is carried out entirely **using light signals**. Hence, network training will not only be faster, but also more robust and efficient»,* adds **Morichetti**.

The use of photonic chips will allow the development of more sophisticated models for artificial intelligence, or devices capable of processing real-time data directly on site – such as autonomous cars or intelligent sensors integrated into portable devices – without requiring remote processing.

LINK TO THE FULL PUBLICATION

LINK TO THE PHOTOGALLERY

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