PRESS RELEASE

MEMRISTIVE NETWORKS AND AI:

UNVEILED THE RELATIONSHIP BETWEEN EMERGENT COMPUTING ARCHITECTURES AND THE PHYSICS OF DYNAMICAL SYSTEMS

An article published on Nature Communications shows the discovery of researchers from INRiM, Politecnico of Torino and Universitat Autònoma de Barcelona in the field of neuromorphic computing

Turin, May 6, 2025

The rise of Artificial Intelligence (AI), driven by developments of deep learning and machine learning, has profoundly pervaded our society. However, the ever-growing demand for computing power, associated with huge energy consumption and high environmental impact, is unsustainable with current digital computing technologies. In the race toward future computing technologies, bio-inspired systems based on self-organizing memristive networks represents promising unconventional computing hardware platforms for emulating information processing capabilities of our brain [1-2]. However, the relationship between dynamics of these physical complex systems and their information processing capabilities remained a challenge.

Now, the article "*Self-organizing neuromorphic nanowire networks as stochastic dynamical systems*" published on the prestigious journal ***Nature Communications*** show that self-organizing memristive networks based on nanowires can be described as stochastic dynamical systems, providing for the first time a unifying framework able to correlate dynamics of these physical complex systems with their computational properties.

These results, obtained in the framework of a collaboration between researchers from the **National Metrology Institute of Italy** (INRiM), **Politecnico di Torino** and **Universitat Autònoma de Barcelona**, pave the way for the development of new hardware architectures exploiting deterministic and stochastic dynamics in the same physical substrate in a similar way to what our brain does.

“These results, obtained in the framework of my ERC starting grant, shed new light on how the physics of nanoscale systems can be leveraged for the realization of computing architectures with high energy efficiency”, says **Gianluca Milano**, researcher of the group Advanced Materials & Devices at INRiM and responsible of the ERC MEMBRAIN project and the MEMQUD project that financed the research.

[1] Milano, Gianluca, et al. "In materia reservoir computing with a fully memristive architecture based on self-organizing nanowire networks”. *Nature materials* 21.2 (2022): 195-202.

[2] Milano, Gianluca, et al. "Tomography of memory engrams in self-organizing nanowire connectomes”. *Nature Communications* 14.1 (2023): 5723.

Publication link: https://www.nature.com/articles/s41467-025-58741-2

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