Bocconi

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12:00 PM

Bocconi University
Room COMMON ROOM
Via Röntgen 1, Milano (2° floor)

Stable adaptation and learning in dynamical systems

Speaker

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Abstract

While we may soon have AI-based artists or scientists, we are nowhere near autonomous robot plumbers. The human brain still largely outperforms robotic algorithms in most tasks, using computational elements 7 orders of magnitude slower than their artificial counterparts. Similarly, current large scale machine learning algorithms require millions of examples and close proximity to power plants, compared to the brain's few examples and 20W consumption. We study how modern nonlinear systems tools, such as contraction analysis, virtual dynamical systems, and adaptive nonlinear control can yield quantifiable insights about collective computation and learning in large physical systems and dynamical networks. For instance, we show how stable implicit sparse regularization can be exploited online in adaptive prediction or control to select relevant dynamic models out of plausible physically-based candidates, and how most elementary results on gradient descent and optimization based on convexity can be replaced by much more general results based on Riemannian contraction.

Time permitting, we will also introduce briefly very recent results on a new approach to neural network architecture directly inspired by astrocyte biology. The approach creates a computational continuum to be explored between dense associative memories

and transformers, and may be the first contribution to AI of neuroscience results from the last 50 years.

A systematic way to compute quantum wave functions exactly from the multipath solutions of classical and relativistic least action, implying a smooth transition between physics across scales.

The result shares tools with the earlier discussion, as technically it originates from the contraction analysis of Hamilton-Jacobi p.d.e.’s under spatial inequality constraints.

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DEPARTMENT OF COMPUTING SCIENCES