Bocconi

28 JANUARY 2025
12:00 PM
Room 3-B3-SR01
Via Röntgen 1, Milan, 3° floor

"Clickety-clack": a non-equilibrium model of cortical activity for decision-making

Speaker

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Abstract

How does sensory cortex interpret unstable and ambiguous inputs in terms of lifelong prior experience? Current theories postulate attractor dynamics (accumulation-to-threshold and/or winner-take-all) and, implicitly, a variational principle of equilibrium. Once the network represents the given decision problem, noise drives neural activity to a minimal energy state (the selected choice). In this view, decision-making is episodic and has a beginning and an end.

I propose an alternative theory in which mental processing and cortical activity have neither beginning nor end, namely, attractor dynamics in a non-equilibrium steady-state (NESS). Processing is continuous and ongoing, but punctuated by occasional choice states. All choice states are unstable and thus automatically subject to refinement and revision. Negative feedback between cortical levels keeps all cortical sites perpetually far-from-equilibrium.

Without sensory input, choice states are spontaneous and unprompted and mere hallucinations. With consistent input, choice states come to represent inferences about hidden states of the sensory environment. In simplistic toy environments, the choice-performance of this model approaches statistical efficiency. I conclude that variational principles of non-equilibrium (maximum caliber) offer alternative theories for cortical decision-making.

[1] Cao, Mattia, Braun (2021) Binocular rivalry reveals an out-of-equilibrium neural dynamic suited for decision-making. eLife

[2] Ghosh, Dixit, Agozzino, Dill (2020) The maximum caliber variational principle for nonequilibria. Annu. Rev. Phys. Chem

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