Bocconi

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Via Röntgen 1, Milano (3° floor)

Interplay between feedforward and recurrent inputs in a network model of motor cortex

Speaker

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Abstract

The motor cortex is a key brain area involved in the control of limb movement. Activity in this area has been shown to be implicated in both motor planning and motor execution. An important observation to understand how the motor cortex plans upcoming movements without prematurely executing them is that preparatory and movement-related activities occupy approximately orthogonal low-dimensional subspaces of the neural state space. While this finding has been influential, the dynamical rules that govern the underlying cortical activity are still unknown. We explored the hypothesis that the observed activity's evolution emerges as the result of a specific recurrent functional architecture in which synaptic connections store information about two distinct patterns of activity that underlie movement preparation and movement execution. I will show that our model explains how the network can stably encode information at the population level while single-neural responses drastically rearrange over time, resulting in two orthogonal representations during the preparatory and movement-related epochs. The model accurately recapitulates the temporal evolution of single-neuron and population-level activity recorded from the primary motor cortex of a macaque monkey performing a center-out reaching task. It also makes specific predictions about the role that external inputs and recurrent inputs play at different stages of the motor action, addressing the open debate on whether the motor cortex is an autonomous or input-driven dynamical system.

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