

## Abstract

Multi-electrode array recordings indicate that many forms of neural computation may be implemented by low-dimensional dynamics unfolding at the population scale. What are the mechanisms by which neural phase trajectories tend to settle to lower dimensional manifolds in many regions? And how the existence of these geometrical features are related to the emergence of cortical computations?

In this talk, I am going to sketch some results from my latest article, entitled “Emergence of universal computations from neural manifold dynamics”, where I address these questions through a rigorous mathematical analysis of two firing-rate models, equipping them with low-rank structured connectivities.

It is this hypothesis regarding synaptic strengths the one which sustain the main results I am going to be presenting. The first one guarantees that both neural models possess invariant and globally attracting manifolds, whose intrinsic dimensionality equals that of the rank of the connectivity matrix, giving rise to a plausible hypothesis from which to understand the formation of neural manifolds; the second assures that the dynamics unfolding on these manifolds are universal, meaning they can approximate, with arbitrary level of accuracy, any smooth dynamical system. As a consequence, we will be able to discuss the computational universality of neural manifold dynamics.

The exposition of these topics will be complemented with experimental evidence supporting our perspective. As an example, I will discuss how the presented hypothesis predict the parsimonious correlation structure observed in the activity of some cortical regions. All in all, I will introduce a novel theoretical framework from which geometric and computational aspects of neural dynamics are inseparably understood.