Neurodynamical Mechanisms Underlying Decision-Making: The Role of Statistical Fluctuations

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Resumen

Decision-making has become the paradigm of choice for many neuroscientists aiming to understand the neural basis of intelligent behavior, seen as the link between perception and action. Behavioral, neurophysiological, and theoretical studies are converging to a common theory that assumes an underlying diffusion process which integrates both the accumulation of perceptual and cognitive evidence for making the decision and motor choice in one unifying neural network. Biologically realistic neural circuits have been designed in computational and theoretical neuroscience to implement stochastic noise driven decision-making. Such models generally involve two populations of excitatory neurons engaged in competitive interactions mediated by inhibition. Sensory input may bias the competition in favor of one of the populations, potentially resulting in a gradually developing decision in which neurons in the chosen population exhibit increased activity while activity in the other population is inhibited. In this scenario both the spontaneous state, in which both populations of excitatory neurons exhibit low-level activity, and the decision-state are stable for the same set of parameter values, i.e. they are bistable. Decision-making is then understood as the fluctuation-driven, probabilistic transition from the spontaneous to the decision state. In this talk, we will analyse and discuss the role of statistical fluctuations due to finite size noise in the decision-making process.