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Stochastic transitions in neuronal systems: taste, decisions and timing

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Abstract

Stochastic transitions between discrete states, or barrier-hopping, is a means whereby fast noise at a small scale can get amplified into slower, larger scale random fluctuations. Living organisms use such methods to amplify inherent microscopic noise in order to ultimately produce non-deterministic and variable behavior. Stochastic transitions between discrete states of neuronal activity in the brain form a key stage in producing non-deterministic behavior, but such randomness can become unobservable in the standard approach of averaging data across many trials. However, multi-electrode recordings of neural activity, combined with Hidden Markov Analysis allows one to analyze the underlying states. I compare model results with such analysis of data from rat cortex during taste processing and investigate the roles of noise-induced transitions between discrete states in decision-making and time estimation.