

Abstract [Poster]

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Hybrid Discrete/Continuous Models of Brain Dynamics: Estimation from Spikes

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Some neural systems are well modeled by purely discrete variables, such as melatonin release, which switches between two rates: high and low. Other neural systems are well described by purely continuous variables, such as circadian modulation of core body temperature. However, in several cases, the behavior of the neural system may reflect a hybrid model that mixes continuous and discrete variables. Continuous concentration gradients are spent across four-state ion channels. Hippocampal place cell receptive fields evolve through a continuous set of parameters, but switch between periods of rapid and slow change. Each of the five stages of sleep corresponds to distinct continuous oscillatory patterns in EEG.

We are interested in relating spiking activity to hybrid discrete/continuous models of neural systems. Previously, estimation procedures had been developed for relating spiking activity to continuous or discrete variable models separately. Here, we address the hybrid case with the theory of point process statistics. Applications to neural data analysis and the design of brain-driven interfaces are illustrated.

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