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Non-linear dynamics in recurrently connected neural circuits implement Bayesian inference by sampling ALESSANDRO TICCHI, ALDO A. FAISAL, Imperial College London, BRAIN AND BEHAVIOUR LAB TEAM — Experimental evidence at the behavioural-level shows that the brains are able to make Bayes-optimal inference and decisions (Kording and Wolpert 2004, Nature; Ernst and Banks, 2002, Nature), yet at the circuit level little is known about how neural circuits may implement Bayesian learning and inference (but see (Ma et al. 2006, Nat Neurosci)). Molecular sources of noise are clearly established to be powerful enough to pose limits to neural function and structure in the brain (Faisal et al. 2008, Nat Rev Neurosci; Faisal et al. 2005, Curr Biol). We propose a spking neuron model where we exploit molecular noise as a useful resource to implement close-to-optimal inference by sampling. Specifically, we derive a synaptic plasticity rule which, coupled with integrate-and-fire neural dynamics and recurrent inhibitory connections, enables a neural population to learn the statistical properties of the received sensory input (prior). Moreover, the proposed model allows to combine prior knowledge with additional sources of information (likelihood) from another neural population, and to implement in spiking neurons a Markov Chain Monte Carlo algorithm which generates samples from the inferred posterior distribution.

Alessandro Ticchi
Imperial College London

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