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Inhibition-stabilized balanced dynamics account for stimulus-induced changes of noise variability in the cortex

Theories of cortical dynamics have traditionally relied on trial-averaged neuronal responses, largely ignoring neural variability beyond its most basic aspects. Here we developed novel nonlinear analysis techniques to utilise a growing body of data on the variability and co-variability of cortical responses allowing us to delineate the operating regime of cortical dynamics. We show that in a simple yet physiologically realistic cortical circuit model, the stochastic supralinear stabilized network, external inputs dynamically modify efective connectivity, thus modulating the variability of neuronal responses in a stimulus-dependent manner. This accounts for variability quenching following stimulus onset, a phenomenon ubiquitously observed across multiple cortical areas, as well as more intricate interactions between the external input and the stimulus tuning of individual neurons in determining Fano factors and noise correlations in area MT. These results challenge a commonly accepted interpretation of variability quenching as a hallmark of noisy atractor dynamics.

This is work done in collaboration with Dan Rubin, Yashar Ahmadian, Ken Miller and Máté Lengyel.