dHAN Model of Neural Networks in the Light of Experimental Neuroscience

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A dense and homogenous associative network (dHAN) model of neural dynamics has gained some attention recently. This model, as a top-down model, is capable of reproducing some important phenomenological properties of a cognitive system, including efficient data representation, pattern recognition, and associative thought process. In this work, we ask if this model is capable of reproducing some key results in empirical neuroscience. In particular, we focus on two sets of experiments on the collective dynamics of synchronized states in the mammalian brain. In the first set of experiments [1], the UP-DOWN dynamics of the synchronized states is manipulated by applying pulses of various strengths and off-durations. In the second set of experiments [2], the frequency of the synchronized states is studied as a function of the structural properties of the brain (e.g. average connectivity). We find that the dHAN model is capable of reproducing these results with surprising accuracy. We show that one can in fact understand the key features of these experiments in terms of the generic properties of the dHAN model, i.e. competitive and transient-state dynamics. Our results is somewhat unexpected since such top-down phenomenological models are not generally expected to reproduce detailed experimental results of neural dynamics.

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