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Journal

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Publication Date

2015

Peer reviewed

Topological Dependence of Rate Code Stability

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Abstract: How does network topology affect neural coding? We approached this question with a large parametric study simulating clustered network topologies of cortical excitatory spiking neurons with inhibitory interneurons, while taking into account variance in axonal length and spike propagation times. To evaluate the stability of rate coded information, we systematically varied within cluster conduction delay means, variances, and connection densities, as well as between cluster conduction delay means, variances, and connection densities. Networks received rate coded stimulation from one cluster, and we varied frequency and spike jitter of this input. Networks contained 960 excitatory and 240 inhibitory neurons, divided evenly between 6 recurrently connected clusters. We found that variances of inter-spike intervals in the presence of rate coded stimulation were greatly increased with the introduction of even small variances in between cluster conduction delays and by changes in inter-cluster and within-cluster connection density, identifying topologies that resist stable rate coding.