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Synchronization in neuronal oscillator networks with input heterogeneity and arbitrary network structure ELIZABETH DAVISON, BISWADIP DEY, NAOMI LEONARD, Princeton University — Mathematical studies of synchronization in networks of neuronal oscillators offer insight into neuronal ensemble behavior in the brain. Systematic means to understand how network structure and external input affect synchronization in network models have the potential to improve methods for treating synchronization-related neurological disorders such as epilepsy and Parkinson's disease. To elucidate the complex relationships between network structure, external input, and synchronization, we investigate synchronous firing patterns in arbitrary networks of neuronal oscillators coupled through gap junctions with heterogeneous external inputs. We first apply a passivity-based Lyapunov analysis to undirected networks of homogeneous FitzHugh-Nagumo (FN) oscillators with homogeneous inputs and derive a sufficient condition on coupling strength that guarantees complete synchronization. In biologically relevant regimes, we employ Gronwall's inequality to obtain a bound tighter than those previously reported. We extend both analyses to a homogeneous FN network with heterogeneous inputs and show how cluster synchronization emerges under conditions on the symmetry of the coupling matrix and external inputs. Our results can be generalized to any network of semi-passive oscillators.

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