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Synchronization in Random Pulse Oscillator Networks KEVIN BROWN, Departments of Biomedical Engineering, Physics, Chemical and Biomolecular Engineering, and Marine Sciences, University of Connecticut, Storrs, CT, ANN HERMUNDSTAD, Howard Hughes Medical Institute, Janelia Farm Research Campus — Motivated by synchronization phenomena in neural systems, we study synchronization of random networks of coupled pulse oscillators. We begin by considering binomial random networks whose nodes have intrinsic linear dynamics. We quantify order in the network spiking dynamics using a new measure: the normalized Lev-Zimpel complexity (LZC) of the nodes' spike trains. Starting from a globally-synchronized state, we see two broad classes of behaviors. In one ("temporally random"), the LZC is high and nodes spike independently with no coherent pattern. In another ("temporally regular"), the network does not globally synchronize but instead forms coherent, repeating population firing patterns with low LZC. No topological feature of the network reliably predicts whether an individual network will show temporally random or regular behavior; however, we find evidence that degree heterogeneity in binomial networks has a strong effect on the resulting state. To confirm these findings, we generate random networks with independently-adjustable degree mean and variance. We find that the likelihood of temporally-random behavior increases as degree variance increases. Our results indicate the subtle and complex relationship between network structure and dynamics.

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