Synchronization of Kuromoto Oscillators on Simplicial 4 Complexes: Hysteresis, Cluster Formation and 5 Partial Synchronization

Invited Talk 12

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The analysis of the synchronization of oscillator systems based on simplicial complexes presents some interesting features. The transition to synchronization can be abrupt or smooth depending on the substrate, the frequency distribution of the oscillators and the initial distribution of phase angles. Both partial and complete synchronization can be seen as quantified by the order parameter. The addition of interactions of higher order than the usual pairwise ones, can modify these features further, especially where the interactions tend to be of opposite signs. Cluster synchronization is seen on sparse lattices, and depends on the spectral dimension, and whether the networks are mixed, sparse or compact. Topological effects and the geometry of shared faces are important and affect synchronization patterns. We identify and analyse the factors such as frustration that lead to these effects. We note that these features can be observed in realistic systems such as nanomaterials and the brain connectome.