Disparity-driven Heterogeneous Nucleation in Finite-size Adaptive Networks

Poster

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Phase transitions are crucial in shaping the collective dynamics of a broad spectrum of natural systems across disciplines. Here, we report two distinct heterogeneous nucleation facilitating single step and multistep phase transitions to global synchronization in a finite-size adaptive network due to the trade off between time scale adaptation and coupling strength disparities. Specifically, small intracluster nucleations coalesce either at the population interface or within the populations resulting in the two distinct phase transitions depending on the degree of the disparities. We

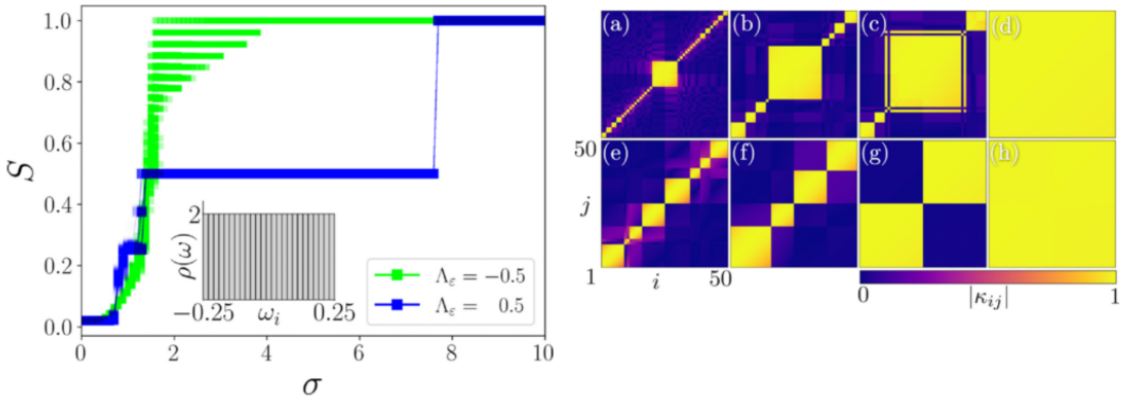

Figure 22: Synchronization transition of the system of adaptively coupled phase oscillators for 500 realizations. The system undergoes a distinct synchronization pathway(multi-step/single-step) depending on the adaptation rate disparity ($\Lambda\epsilon$).

find that the coupling strength disparity largely controls the nature of phase transition in the phase diagram irrespective of the adaptation disparity. We provide a mesoscopic description for the cluster dynamics using the collective coordinates approach that brilliantly captures the multicluster dynamics among the populations leading to distinct phase transitions. Further, we also deduce the upper bound for the coupling strength for the existence of two intraclusters explicitly in terms of adaptation and coupling strength disparities. These insights may have implications across domains ranging from neurological disorders to segregation dynamics in social networks. Full paper published in Phys. Rev. E, 109, 2024, pp. L052301.

References

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