Invited Talk 15

Emergent Dynamical States in Globally Coupled Conformist and Contrarian Populations with Asymmetric Interactionsg

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We study two globally coupled populations of phase oscillators, categorized as conformists and contrarians. Introducing an asymmetry parameter for the contrarians reveals various collective states, including incoherent, chimera, phase clusters, quasiperiodic chimera, and frequency clusters. Chimera, quasiperiodic chimera, and frequency clusters emerge only for specific conformist-contrarian fractions and sufficient asymmetry. Increasing asymmetry reduces the bistable region, triggers a second-order transition at higher contrarian coupling, and decreases the spread of incoherence in phase diagrams. To understand these dynamics, we derive macroscopic order parameter equations using the Watanabe-Strogatz reduction, with analytical stability conditions aligning well with simulation results. Our findings highlight the rich variety of collective behaviors in coupled oscillator systems and the role of asymmetry in shaping emergent dynamical states.

References

[1] M. Manoranjani, D. V. Senthilkumar, and V. K. Chandrasekar, Phys. Rev. E **110**, 064207 (2024).

[2] Hyunsuk Hong and Steven H. Strogatz, Phys. Rev. Lett. **106**, 054102 (2011).