Contributed Talk

Revival of oscillation in diffusively coupled d-dimensional limit-cycle oscillators

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Oscillation is a fascinating phenomenon found in various aspects at scales from atoms to astronomical bodies. When oscillators are coupled, they exhibit rich and emergent dynamics. One prominent type of coupled oscillator is the Stuart-Landau oscillator, a limit-cycle oscillator that undergoes a supercritical Hopf bifurcation. These oscillators are particularly significant because they possess both radial and rotational degrees of freedom, allowing them to display even more interesting behaviors. For instance, they can exhibit amplitude death, a phenomenon where oscillators cease to exhibit sustained oscillations under certain parameter conditions, effectively modeling the behavior of many real physical and biological systems. Since oscillatory behavior is fundamental in many biological processes, understanding how to prevent the cessation of oscillations is critical in the study of dynamical systems. While much of the research on limit-cycle oscillators has focused on two-dimensional systems, high-dimensional limit-cycle oscillators remain less explored. In our work, we explore the effects of limiting the diffusive coupling in models of d-dimensional limit-cycle oscillators. Our study reveals that introduction of a limiting factor in the diffusive coupling is able to prevent amplitude death even in d-dimensional limit-cycle oscillators. The order parameter as a function of the coupling strength for distinct values of limiting factor unveil the phenomenon of reviving oscillations in d-dimensional limit-cycle oscillators. We also deduced the analytical stability condition for the death state, which in turn elucidates the stability of the oscillatory states.

References

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