# Effect of parameter mismatch in mean-field-diffusion–induced oscillation suppression

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Coupled oscillators provide useful means of modelling the collective behaviour of complex systems, e.g. physical, chemical, biological and ecological systems. They exhibit a diversity of cooperative phenomena, such as synchronization, oscillation quenching, chimera states, etc. In recent years, the phenomenon of oscillation quenching has attracted considerable attention due to their connections and relevance in the biological systems, control applications, physics, etc [1]. In system of coupled oscillators, there exists two structurally distinct oscillation suppression processes, namely amplitude death (AD) and oscillation death (OD). In AD, oscillations cease and the coupled oscillators populate a common stable homogeneous steady state. But, in the case of OD, the oscillators populate coupling dependent stable inhomogeneous steady states resulting from a symmetry-breaking bifurcation. In many practical systems, e.g. in laser applications, neuronal systems and chattering in mechanical drilling process AD is desirable to suppress unwanted oscillations. Subsequently, the OD state arises in many biological and physical systems, such as lasers, synthetic genetic oscillators, neural networks, cardiovascular phenomena, cellular differentiation, etc.

In this paper we consider a network of paradigmatic Van der Pol oscillators interacting through mean-field diffusive coupling and explore the role of parameter mismatch in inducing several transitions between AD and OD. Unlike the network of identical oscillators, where we observe a symmetric OD and a nonzero bistable homogeneous steady state (NT-AD) [2, 3], a slight parameter mismatch in the coupled system gives birth to an asymmetric OD state and destroys the NT-AD state. Figure 1(a) represents the detail bifurcation scenario in the $\epsilon - \Delta$ parameter space ($\epsilon$ is the coupling strength and $\Delta$ denotes the parameter mismatch). Here the AD state, which appears through an inverse Hopf bifurcation broadens with decreasing parameter mismatch. We extend our study to a network of a large number of nodes with a linearly increasing distribution in parameter mismatch and identify the transition scenarios. Fig. 1(b) shows the space-time plot of a multi-cluster pattern formation in a network of 100 mean-field coupled Van der Pol oscillators.

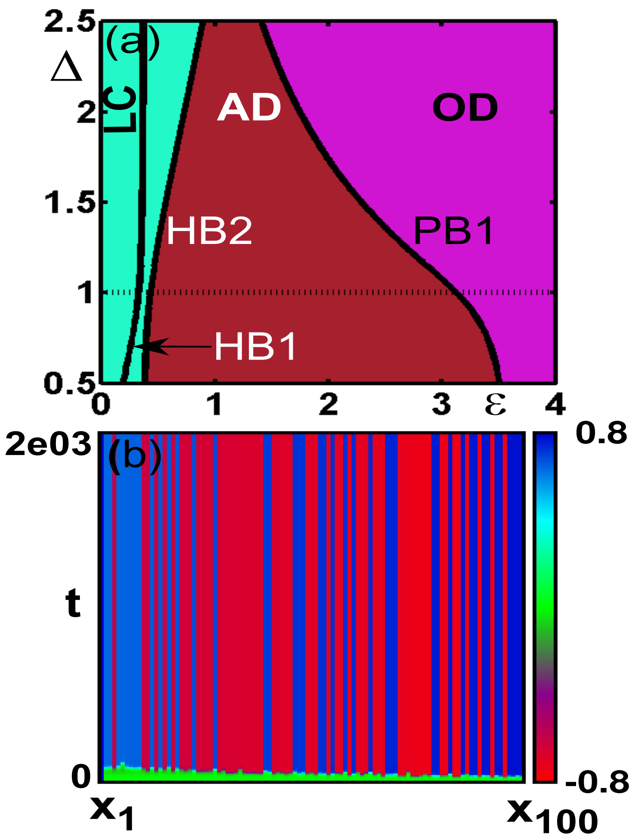


Figure 1: (a) Phase diagram in $\epsilon - \Delta$ space. Other parameters are, $Q = 0.25$, $a_1 = 0.32$. (b) Multi-cluster pattern formation: Space-time plot of network of 100 mean-field coupled Van der Pol oscillators with a linearly increasing distribution in parameter mismatch at $\epsilon = 5$ and $Q = 0.25$.

## References

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