Title:	Suppression and Revival of Oscillation and Control of Chaos in Nonlinear Systems
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Abstract:	The rapidly growing science of complex systems has helped in understanding spatiotem poral pattern formation in wide-ranging systems. A particular phenomenon of special significance in complex systems is the stabilization of steady states. In this context, we have considered the collective behaviour of an ensemble of chaotic oscillators diffusively coupled only to an external chaotic system, whose intrinsic dynamics may be similar or dissimilar to the group. We find that a dissimilar external system manages to suppress the intrinsic chaos of the oscillators to fixed point dynamics, at sufficiently high coupling strengths. We have also explored the behaviour of chaotic oscillators in hierarchical net works coupled to an external chaotic system whose intrinsic dynamics is dissimilar to all the oscillators in the network. We find that coupling to one such dissimilar external system manages to suppress the chaotic dynamics of all the oscillators at all levels of the network, at sufficiently high coupling strength. The chaos suppression is independent of system size and occurs irrespective of whether the connection to the external system is direct, or indirect through oscillators at another level in the hierarchy. Next we investi gated the impact of a common external system, which we call a common environment, on the oscillator death (OD) states of a group of Stuart-Landau oscillators. The group of oscillators yield a completely symmetric OD state when uncoupled to the external sys tem, however, remarkably, when coupled to a common external system this symmetry is significantly broken. For exponentially decaying external systems, the symmetry break ing is very pronounced for low environmental damping and strong oscillator-environment coupling. Further, we consider time-varying connections to the common external environ ment, with a fraction of oscillator-environment links switching on and off. Interestingly, we find that the asymmetry induced by environmental coupling decreases as a power law with increase in fraction of such on-off connections. Lastly, we have explored the emergent dynamical patterns in a system of coupled Stuart-Landau oscillators whose coupling form varies in time. We find, through bifurcation diagrams and Basin Stability analysis, that there exists a window in coupling strength where the oscillations get suppressed. Beyond this window, the oscillations are revived again. A similar trend emerges with respect to the relative predominance of the coupling forms, with the largest window of fixed point dynamics arising where there is balance in the occurrence of the coupling forms. Further, significantly, more rapid switching of coupling forms yields large regions of oscillation suppression. We also propose an effective model for the dynamics arising from switched coupling forms and demonstrate how the bifurcations in this model capture the basic fea tures observed in numerical simulations and also offers an accurate estimate of the fixed point region through linear stability analysis.
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