Title:	Ill-matched timescales in coupled systems can induce oscillation suppression.
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Abstract:	We explore the behavior of two coupled oscillators, considering combinations of similar and dissimilar oscillators, with their intrinsic dynamics ranging from periodic to chaotic. We first investigate the coupling of two different real-world systems, namely, the chemical mercury beating heart oscillator and the electronic Chua oscillator, with the disparity in the timescales of the constituent oscillators. Here, we are considering a physical situation that is not commonly addressed: the coupling of sub-systems whose characteristic timescales are very different. Our findings indicate that the oscillations in coupled systems are quenched to oscillation death (OD) state, at sufficiently high coupling strength, when there is a large timescale mismatch. In contrast, phase synchronization occurs when their timescales are comparable. In order to further strengthen the concept, we demonstrate this timescale-induced oscillation suppression and phase synchrony through numerical simulations, with the disparity in the timescales serving as a tuning or control parameter. Importantly, oscillation suppression (OD) occurs for a significantly smaller timescale mismatch when the coupled oscillators are chaotic. This suggests that the inherent broad spectrum of timescales underlying chaos aids oscillation suppression, as the temporal complexity of chaotic dynamics lends a natural heterogeneity to the timescales. The diversity of the experimental systems and numerical models we have chosen as a test-bed for the proposed concept lends support to the broad generality of our findings. Last, these results indicate the potential prevention of system failure by small changes in the timescales of the constituent dynamics, suggesting a potent control strategy to stabilize coupled systems to steady states.
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