Title:	Competitive interplay of repulsive coupling and cross-correlated noises in bistable systems
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Abstract:	The influence of noise on synchronization has potential impact on physical, chemical, biological, and engineered systems. Research on systems subject to common noise has demonstrated that noise can aid synchronization, as common noise imparts correlations on the sub-systems. In our work, we revisit this idea for a system of bistable dynamical systems, under repulsive coupling, driven by noises with varying degrees of cross correlation. This class of coupling has not been fully explored, and we show that it offers new counter-intuitive emergent behavior. Specifically, we demonstrate that the competitive interplay of noise and coupling gives rise to phenomena ranging from the usual synchronized state to the uncommon anti-synchronized state where the coupled bistable systems are pushed to different wells. Interestingly, this progression from anti-synchronization to synchronization goes through a domain where the system randomly hops between the synchronized and anti-synchronized states. The underlying basis for this striking behavior is that correlated noise preferentially enhances coherence, while the interactions provide an opposing drive to push the states apart. Our results also shed light on the robustness of synchronization obtained in the idealized scenario of perfectly correlated noise, as well as the influence of noise correlation on anti-synchronization. Last, the experimental implementation of our model using bistable electronic circuits, where we were able to sweep a large range of noise strengths and noise correlations in the laboratory realization of this noise-driven coupled system, firmly indicates the robustness and generality of our observations.Coupled bistable systems provide a particularly simple, yet rich, platform to explore the interplay of noise and coupling. This is a problem that has garnered long-standing attention, as it has bearing on our basic understanding of the collective behavior of noise-driven coupled nonlinear systems and also offers opportunities for potential applications. For instance, it has been recently demonstrated that in the presence of attractive coupling, noise-induced transitions in such systems can synchronize, and this happens even when the noises driving the subsystems are uncorrelated. While most research efforts have focused on the constructive effect of noise in aiding synchronization, in this work, we explore systems coupled through repulsive interactions that may oppose the effect of noise, and we present the new implications of this competitive interplay of noise and coupling. The test-bed of our study is prototypical repulsively coupled bistable systems, subject to noises with different degrees of cross correlation. This allows us to explore the nontrivial interaction between repulsive coupling and noise, as well as ascertain the role of noise correlation in the synchronization of such noise-driven subsystems. We find that this system exhibits a rich variety of behavior including complete synchrony, complete antisynchrony, and a unique regime with windows of synchrony interspersed with antisynchrony. To reiterate, anti-synchronization refers to the state when the bistable subsystems are pushed to different wells. The behavior of this system is characterized over a large range of noise strengths and noise correlations, including a measure reflecting the random hopping between synchronized and anti-synchronized states. All observations are verified experimentally using electronic circuit experiments, indicating the robustness of our central results.
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