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Improving synchronization via local rewiring in networks of Kuramoto oscillators LIA PAPADOPOULOS, JASON KIM, DANIELLE BASSETT, University of Pennsylvania — Synchronization of non-identical oscillators coupled through complex networks is an important example of collective behavior, and many studies examine how the architecture of interactions shapes synchronization patterns. Here, we focus on adaptive networks, where the structure of the underlying network changes in response to the node dynamics. In particular, we use the Kuramoto model to investigate how via a local rewiring rule, an initially random network converges to a topology that supports improved synchronization. The adaptation strategy preserves the total number of edges, and depends only on instantaneous, pairwise phase differences of neighboring nodes. In the case of binary, undirected networks, a local rule that preserves connections between more desynchronized oscillators, and that breaks and rewires connections between more in phase oscillators, can improve synchronization. Furthermore, in line with results from studies on optimal synchronization, throughout adaptation the Laplacian spectra and the relationship between its eigenvectors and the intrinsic frequencies undergo specific changes. Finally, we find that after sufficient adaptation, the resulting network exhibits degree - frequency and frequency - neighbor frequency correlations that have been associated with explosive synchronization transitions. By considering the interplay between structure and dynamics, this work helps elucidate a mechanism through which emergent phenomena can arise in complex systems.

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