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Cluster dynamics of pulse coupled oscillators KEVIN O'KEEFFE, STEVEN STROGATZ, Cornell University, PAUL KRAPIVSKY, Boston University
— We study the dynamics of networks of pulse coupled oscillators. Much attention has been devoted to the ultimate fate of the system: which conditions lead to a steady state in which all the oscillators are firing synchronously. But little is known about how synchrony builds up from an initially incoherent state. The current work addresses this question. Oscillators start to synchronize by forming clusters of different sizes that fire in unison. First pairs of oscillators, then triplets and so on. These clusters progressively grow by coalescing with others, eventually resulting in the fully synchronized state. We study the mean field model in which the coupling between oscillators is all to all. We use probabilistic arguments to derive a recursive set of evolution equations for these clusters. Using a generating function formalism, we derive simple equations for the moments of these clusters. Our results are in good agreement simulation. We then numerically explore the effects of non-trivial connectivity. Our results have potential application to ultra-low power "impulse radio" & sensor networks.

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