Synchronization properties of noisy coupled Kuramoto oscillators under inhomogeneous noise intensity

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The phenomenon of spontaneous synchronization, occurring in many systems, has been extensively studied in the last decades, especially in the framework of the Kuramoto model. The original form of this model, that decribes globally coupled oscillators with distributed natural frequencies, has been extended in several directions, in order to better reproduce the features of the synchronizing systems that are found in the physical and the biological world. One of the earliest extension has been the introduction of noise, that often can modify significantly the synchronization properties. The noise, meant to modelize the fluctuations in time of the natural frequencies, from the mathematical point of view is equivalent to that due to thermal fluctuations at a given temperature. However, representing natural frequency fluctuations, it is sensible to consider the case in which different oscillators are subject to noise of different intensities, contrary to the case of thermal fluctuations, where the temperature determinig the intensity of the noise is the same for the whole system. In this work we study simple examples of Kuramoto oscillators under inhomogeneous noise, both analytically and with numerical simulations. The results show that the introduction of inhomogeneity, besides enriching the set of possible states of the system, the states being characterized by the behavior of the degree of synchronization, can also modify the nature of the transition between synchronized and unsynchronized states. The bibliography lists some earlier works where the properties of the dynamics and the statistical behavior of systems of globally coupled oscillators have been studied.

References

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