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Extended finite-size scaling in the Kuramoto model

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We present a systematic analysis for the time evolution of the phase order parameter for coupled oscillators and its steady-state limiting behavior in terms of the Kuramoto model. This provides another comprehensive view of the phase synchronization transition. In particular, we extend the finite-size scaling (FSS) approach [1] to dynamics, and focus on how to determine critical exponents and the critical coupling strength using dynamic scaling. The extended FSS analysis enables us to measure both the FSS exponent and the dynamic exponent associated with the correlated volume and the correlated time. In addition, we discuss how the sampling of natural frequencies and thermal noise affect the FSS exponent for various network topologies, which are numerically confirmed [2].

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