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MARIE CURIE ACTIONS

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Pattern selection in a ring of Kuramoto rotators

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Collective oscillation modes are investigated in a ring of identical and locally coupled Kuramoto rotators. Known results [1,2] were reproduced by using a novel theoretical framework. We identify all the possible stationary states including a new class of unstable fixpoints. Following the previous studies the stable stationary modes are characterized by a winding number, m. Numerical experiments show that the complexity of the dynamics increases with the system size, N. The number of stable stationary states is growing linearly with $N(-N/4 < m < N/4)$ and therefore it becomes more and more demanding to foresee the final state when the dynamics is randomly initialized. We show however that the final state of the system is always predictable after a time-moment, t_s . In order to do this this first a generalized Kuramoto order parameter $r_m(t)$ is introduced. We then find that there is always a time moment, t_s, from where on only one of the order parameters (r_m) is increasing. At this time moment the final stationary state is predictable. For random initial phases the average value of this time moment, $\langle t_s \rangle N, K$, scales inversely proportional with the coupling strength, K. For large systems we found that $\langle t_s \rangle N, K$ scales with a nontrivial exponent $(\beta \approx 2.4)$ as a function of the system size.

References

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