Diversity in Large and Coupled Systems

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This work is dedicated to systems of coupled subsystems. It focuses on situations where the subsystems are not completely identical but have diversity in one of their parameters. An order "parameter expansion developed" in[1234] is followed and applied to a set of systems such as coupled active rotators, neurons forming circadian clocks[5] or cells in the intestinal wall transporting chemicals. This approach reduces N coupled systems of d dimensions (Nd equations) to $\frac{(d+1)^2+3d-1}{2}$ equations, d of them accounting for the dynamics of the mean values. This high reduction of dimension leads to few equations, which might be very nonlinear, but due to their number they are still easily integrated (numerically).
For the investigated systems we will compare the results of the approximation with the simulation of the full system and theoretical results and determine the merits and the limits of the simplification. As an example, figure (1) shows the Kuramoto order parameter for coupled active rotators. Coincidence is good for small diversity values, for larger diversity only the overall behaviour is conserved.
Another goal is to find similiar approximations which might explain the system with big paramter deviations not only qualitatively but as well quantitatively, such that the moment of desynchronization can be determined equally well as the point where synchronization starts.

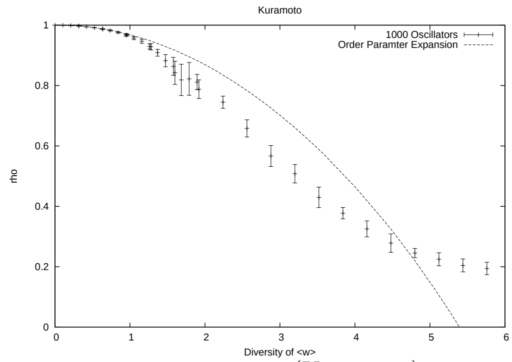

Figura 1. 1000 active rotators (Kuramoto) compared with "order paramter expansion". Shown is the Kuramoto order parameter ρ over the frequencies' deviation σ from the mean value $\langle\omega\rangle$.

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