Chaos synchronization in nonlinear networks with time delayed couplings

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Nonlinear networks with time delayed couplings have a trend to become chaotic. In general, we distinguish between two kinds of chaos, strong and weak, depending on the scaling of the Lyapunov exponent with the delay time. Only units with weak chaos can synchronize, the trajectory is still chaotic but all units have the same trajectory. We relate chaos synchronization to the eigenvalue gap of the coupling matrix. As a consequence, rings with unidirectional couplings cannot synchronize. But if additional time delays with specific ratios are added, even rings show chaos synchronization.

In this contribution we show new results on directed networks with two time delays. For Bernoulli systems, we calculate the phase diagrams analytically from the roots of polynomials including the eigenvalues of the two coupling matrices. We compare the results with networks, where the long delay time is replaced by nonlinear units, such that some network has only a single delay.

References:

Chaos in networks with time-delayed couplings
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