Synchronization in networks with heterogeneous coupling delays

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Synchronization in networks of identical oscillators with heterogeneous coupling delays is studied. A decomposition of the network dynamics is obtained by block diagonalizing a newly introduced adjacency lag operator which contains the topology of the network as well as the corresponding coupling delays [1]. This generalizes the master stability function approach, which was developed for homogeneous delays. As a result the network dynamics can be analyzed by delay differential equations with distributed delay, where different delay distributions emerge for different network modes. Frequency domain methods are used for the stability analysis of synchronized equilibria and synchronized periodic orbits. As an example, the synchronization behavior in a system of delay-coupled Hodgkin-Huxley neurons is investigated. It is shown that the parameter regions where synchronized periodic spiking is unstable expand when increasing the delay heterogeneity.

[1] Otto A., Bachrathy D., Orosz G., Radons G., Synchronization in networks with heterogeneous coupling delays, *Physical Review E* **97**:012311, 2018.