Synchronization of Nonlinear Interconnected Systems: an Input-Output Approach

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February 11, 2011

I will present a formalism to analyze synchronization in networks of dynamical systems where each component of the network (referred to as a "compartment") itself consists of subsystems (referred to as "species") represented as nonlinear operators. The input to the species includes the influence of other species within the compartment as well as a diffusion-like coupling term between identical species in different compartments. The synchronization conditions are provided by combining the input-output properties of the subsystems with information about the structure of the network. The model is motivated by cellular networks where signaling occurs both internally, through interactions of species, and externally, through intercellular signaling. The theory is illustrated providing synchronization conditions for networks of genetic oscillators and convergence conditions for nonlinear state observers. If time permits I will also present some ongoing research directions to extend these ideas to study synchronization in basic coupled neuronal models.