MS28: Control of nonlinear systems

Application of act and wait control to oscillatory network desynchronization

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We propose the algorithm for desynchronization of globally coupled oscillators. The problem is actual for neuroscience, where the suppression of pathological neuronal synchronization may remove the symptoms of various diseases. Our algorithm consists of two stages. In the first stage, we measure and memorize the output of the control-free system. In the second stage, we apply the feedback control using the memorized signal. Operation of the algorithm is demonstrated by numerical experiments with all-to-all coupled Landau-Stuart oscillators and Hodgkin-Huxley neurons. From these experiments we found that it is possible to implement charge balance condition for Hodgkin-Huxley network. In the limit of infinite large population of Landau-Stuart oscillators some analytical estimations are derived. Our approach is particularly important for applications to physical and biological systems which do not allow for a simultaneous registration and stimulation at the same time.

Granular fronts in parametrically forced shallow granular layers

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We present an experimental and theoretical study of the granular front formation process of standing subharmonic waves in a fluidized quasi-one-dimensional shallow granular bed. The fluidization process is driven by means of a time-periodic air flow, analogous to a tapping type of forcing. Measurements of the subharmonic instability curve for the homogeneous layer are performed, and the subharmonic amplitude of the critical mode close to the transition is characterized to be found in quite good agreement with those inferred from a universal stochastic amplitude equation. This allows us to determine both the bifurcation point of the deterministic system and the corresponding noise intensity. For larger amplitudes of the forcing, a localized structure develops over the granular layer connecting to regions of the uniform layer oscillating in out-of-phase, which we term a granular front. We propose a simple phenomenological model to describe the dynamics, stability and bifurcation diagram of such structures, which is found in good agreement with experimental observations.