A Testbed of 2D Locally Coupled Relaxation Oscillators for Spiral Waves Generation

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Abstract

Spiral waves have been observed in chemically reactive solutions, in the heart muscle and in the human brain. Over the last years, experiments and theoretical models have converged on the idea that the propagation of a single spiral wave of electrical activity is responsible for Ventricular fibrillation which is an often fatal cardiac arrhythmia. Therefore it is important to study the spiral waves. However, computational complexity of spiral waves which is a spatiotemporal dynamics of the excitable media, is a drawback for the experimental studies. In this work we introduce a testbed for Spiral Waves Generation. The testbed allows to simulate 128×128 locally coupled relaxation oscillators which can programmed to generate spiral waves. These oscillators form a cellular nonlinear network. The testbed holds 4×4 nonlinear processing elements and the network is emulated by this processor group. It is easy to set some nodes to fixed values and initial values can be assigned to the network. Some special initial conditions generate spiral waves. The rotation direction of the spiral wave can be determined by different initial conditions. The interaction between spiral waves and fixed nodes can easily be observed with the testbed. We have experimented that the spiral waves rotating in the same direction generate a child spiral wave in the opposite direction while two opposite spiral waves do not generate a child. Also, it is experimented that the location, shape, largeness and number of the fixed nodes area on the network has great act on generation of the child spiral waves.

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On the duality of guaranteed control-estimation problems for hierarchical systems

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Recently problems of route planning for the team of objects overcoming obstacles in the common motion are of great interest. The central point for route planning algorithms design is how to describe obstacles and choose the route in the complicated circumstances. The information structure appropriately presenting team motion of objects with constrained dynamics is under discussion in the paper. The model presented may provide the unified description of organizational structure, routes and geography. The investigation is inspired by the needs of navigation and net tracing.

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Spiral waves have been observed in chemically reactive solutions, the heart muscle and the human brain. Over the last years, experiments and theoretical models have converged on the idea that the propagation of a single spiral wave of electrical activity is responsible for Ventricular fibrillation which is an often fatal cardiac arhythmia. Therefore it is important to study the spiral waves. However, computational complexity of spiral waves which is a spatiotemporal dynamics of the excitable media, is a drawback for the experimental studies. In this work we introduce a testbed for Spiral Waves Generation. The testbed allows to simulate 128 × 128 locally coupled relaxation oscillators which can programmed to generate spiral waves. These oscillators form a cellular neural/nonlinear network. The testbed holds 4 × 4 nonlinear processing elements and the network is emulated by this processor group. It is easy to set some nodes to fixed values and initial values can be assigned to the network. Some special initial conditions generate spiral waves. The rotation direction of the spiral wave can be determined by different initial conditions. The interaction between spiral waves and fixed nodes can easily be observed with the testbed. We have experimented that the spiral waves rotating in the same direction generate a child spiral wave in the opposite direction while two opposite spiral waves do not generate a child. Also, it is experimented that the location, shape, largeness and number of the fixed nodes area on the network has great act on generation of the child spiral waves.