Complexity Modelling and its Applications

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Abstract

In this plenary talk, I review our study on creating an artificial brain with chaotic dynamics and its possible applications.

Finally, I discuss importance of several bifaces in modelling complex systems, namely generality / universality & individuality / specialty, abstracted & detailed, and stability & instability.

keywords: Complexity, Chaos, Mathematical Modelling, Neural Networks, Combinatorial Optimization

Recent progress in nonlinear systems analysis has made possible mathematical modelling of complex phenomena not only in natural systems but also in engineering systems [1, 2]. Among various complex systems in this real world, the brain is a typical example of a complex system with much complexity and many superior functions. In this plenary talk, I review our study on creating an artificial brain with chaotic dynamics, or a chaotic brain [3].

Biological neurons are highly nonlinear and dynamical devices. For example, we can observe chaotic responses and different bifurcations in nonlinear dynamics of nerve membranes both experimentally with squid giant axons and numerically with nerve equations [4]. The chaotic properties of nerve membranes have provided a clue of making a chaotic brain composed of chaotic neural networks with spatio-temporal chaos, which are derived based on the experimentally observed neuronal chaos and described by coupled bimodal maps [5]. Moreover, the chaotic brain has possible applications to biologically inspired computation like combinatorial optimization such as traveling salesman problems and quadratic assignment problems [6, 7] and hardware implementation with analog electronic circuits [8, 9].

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