GUEST EDITORIAL

This special issue on chaos engineering is a collection of extended papers originally presented at the 3rd International Conference on Fuzzy Logic, Neural Nets and Soft Computing (Iizuka '94), at Iizuka, Japan, in August 1994.

Deterministic chaos has been studied intensively in the past twenty years. Although the discovery of deterministic chaos can be traced back at least to the pioneering works by Poincaré and Hadamard about one hundred years ago, it was in the 1970s that deterministic chaos became a main area of research in science and engineering. It should be noted, on the other hand, that such prominent researchers as Van der Pol and Van der Mark (1927), Ulam and von Neumann (1947), Kalman (1956), and Lorenz (1993) gained insight into chaotic phenomena before the 1970s. In Japan, great work was achieved in the field of electrical engineering; in the 1960s, Ueda, Kawakami, and other researchers at Hayashi Laboratory of Kyoto University carefully observed and analyzed strange nonlinear oscillations, which correspond to today's "strange attractors" (Horiuchi and Koga, 1990; Ueda, 1992).

Since this pioneering work, deterministic chaos and related topics have been studied continuously by engineering researchers in Japan, and in 1990 one of the guest editors (KA), advocating "chaos engineering," organized several research committees at the Japan Electronic Industry Development Association (JEIDA) etc. and began promoting long-term fundamental research in this area (Aihara, 1992, 1995).

Generally speaking, a serious problem in Japan is that many researchers in the field of engineering publish their results primarily in Japanese because, of course, it is much easier for most Japanese than writing in English. Although Japanese engineers can understand and utilize the fruits of a paper quickly if it is written and published in Japanese, there are, unfortunately, many interesting results that are either not translated into English until much later or never published in English at all. It is therefore our great pleasure to be given this opportunity to introduce the latest results of chaos engineering research in Japan directly to the readers of the prestigious *Journal of Intelligent & Fuzzy Systems.*

One of the promising applications of chaos engineering is the short-term prediction of chaotic time series. Iokibe and his colleagues propose a new short-term prediction method with local fuzzy reconstruction. It is shown that the proposed method is better than other conventional prediction methods (such as the Gram–Schmidt orthogonal method and the Tessellation method) in terms of computational costs and robustness for linearly dependent data sets. They demonstrate the effectiveness of the method through the prediction of not only data obtained with mathematical models but also real data concerning tap water demand, electric power demand, and traffic density.

Kuwata, Watanabe, and Katayama deal with nonlinear signal processing in digital communication systems. In conventional communication systems, linear transversal equalizers have usually been applied to signal equalization. Because the equalization problem is nonlinear in nature, however, it is necessary to incorporate some nonlinear structure into the equalizer. The authors introduce a radial basis function network (RBFN) to realize nonlinearity in a decision feedback equalizer, and they propose an efficient self-generating design method for RBFN called a maximum absolute error (MAE) selection method. They show that a nonlinear equalizer incorporating RBFN with the MAE method exhibits performance superior to that of conventional nonlinear equalizers in terms of bit error rates.

Estimating correlation dimensions is a fundamental task in measuring the complexity of strange attractors. Ikeguchi and Aihara treat this problem. In estimating correlation dimensions, the Grassberger–Procaccia algorithm (GPA) has been widely used; careless use of the GPA, however, may lead to spurious dimension estimates. To overcome this problem, Judd proposed a new method (the J-method) based on a maximum likelihood estimation. Ikeguchi and Aihara introduce the surrogation algorithm into the J-method in order to avoid several possible artifacts, and they demonstrate the practicality of the method through an analysis of biological time series data.

The final two articles are concerned with the applications of chaotic neural networks. Yamada and

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Aihara study the spatiotemporal complex dynamics of dynamical neural networks and their relationships with combinatorial optimization of the traveling-salesman problem (TSP). They suggest that spatiotemporal structure common to not only the chaotic neural networks but also the devil's staircase model plays an important role in combinatorial optimization by the nonlinear neurodynamics.

Ishii proposes a modified associative memory based on a globally coupled map model, which is a network of chaotic elements, and he shows that spurious memories are noticeably reduced by modifying the chaotic dynamics of the system. As a result, the system's memory capacity and the basin volume are expanded a great deal.

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