AIHARA LAB.

[Complex Systems Mathematical Modeling]

Dept. of Informatics and Electronics, Institute of Industrial Science
Dept. of Mathematical Informatics, Grad. School of Information Science and Technology
Dept. of Electrical Engineering and Information Systems, Grad. School of Engineering

http://www.sat.t.u-tokyo.ac.jp/index.html

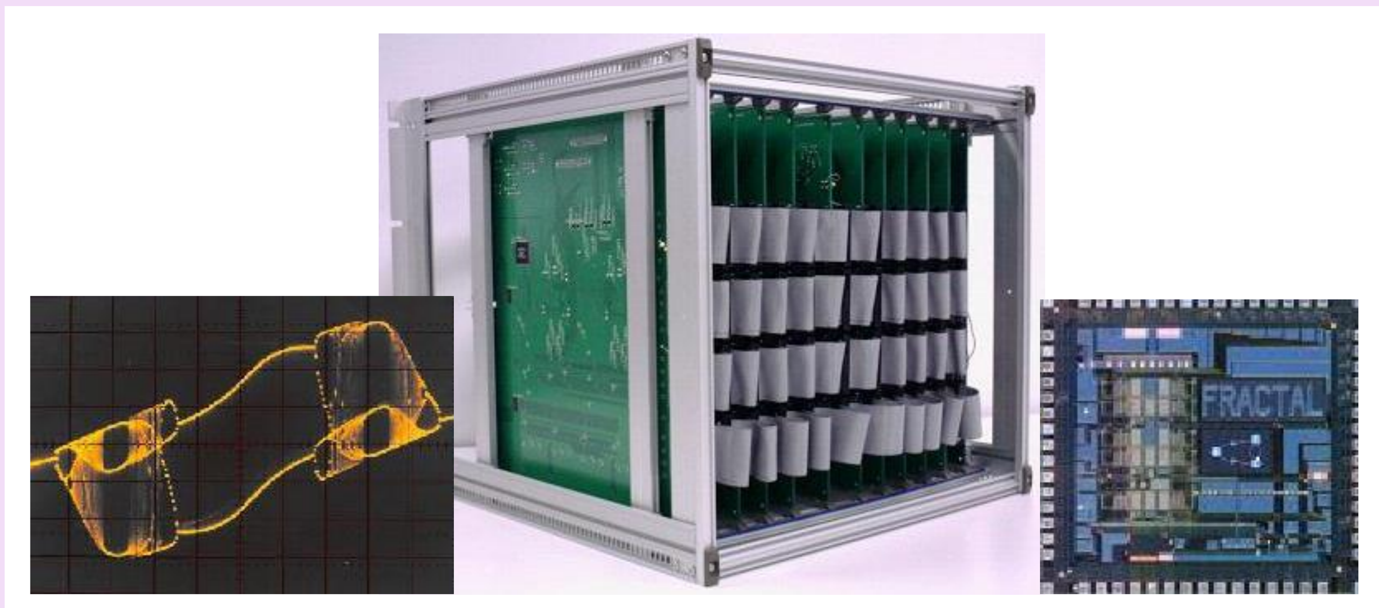
Special Field of Study: Biological Information Systems

Complex Systems Mathematical Modeling

We study a variety of complex systems and problems—biological systems, social systems, economic systems, diseases, energy problems, natural disasters, and so on—through mathematical modeling and data analyses. We also try to establish fundamental theories and methods for analyzing those specific systems. We aim at further development of researches based on the joint works with the Collaborative Research Center for Innovative Mathematical Modelling.

Dynamics of Neural Networks and Its Applications

We are trying to clarify the mechanism of real neural networks and to reveal the high-order functions of the brain through developing mathematical models of neurons/neural networks and identifying underlying non-trivial mathematical structure. As an application, we are also developing analog silicon neural networks and AI in collaboration with Kohno lab.



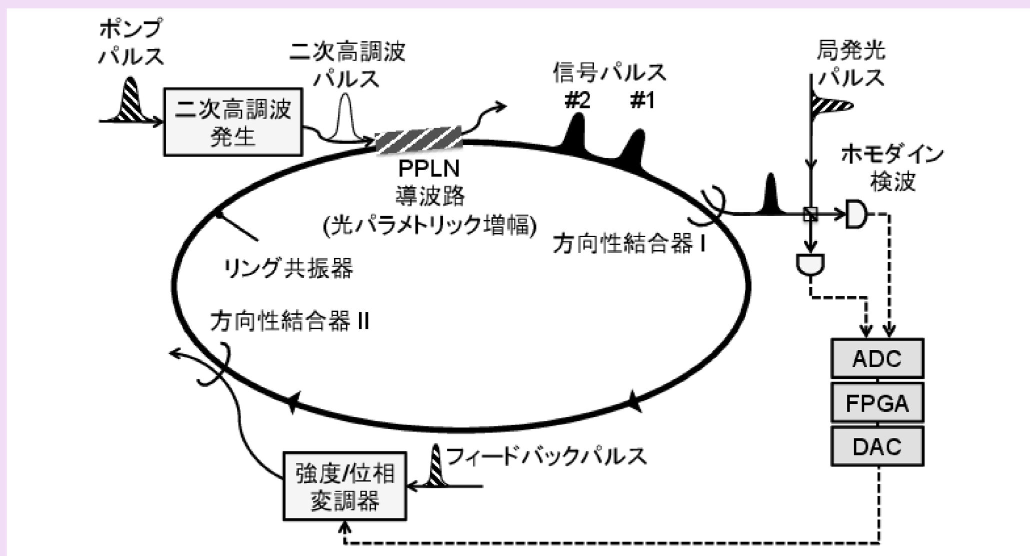
Applications of chaos and fractal: analog silicon neuron and chaotic neuro computer

Nonlinear Systems Analysis and Its Applications

We are studying chaos and many other complex phenomena in the world that have some regularity behind the complexity, by using nonlinear dynamical systems theory. We focus on the “nonlinearity” of the target systems, develop mathematical models that can reproduce the complex phenomena, and analyze the models to reveal the essential factors. Topics include: synchronization of coupled oscillators, forecast of renewable energy generation, analysis of economic and seismic data, etc.

Quantum Artificial Brain and Combinatorial Optimization

We are mathematically studying a new paradigm of computation—quantum artificial brain—based on neural information processing and optical quantum computing. It aims for solving problems that are difficult for conventional computers such as combinatorial optimization problems in a rapid and accurate manner, which may contribute to resolve many social issues.



Quantum artificial brain based on degenerate optical parametric oscillators