Collaborative Research Center for Innovative Mathematical Modelling

[Innovative Mathematical Modelling Develops New Worlds]

Institute of Industrial Science

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

Complex Systems Modelling

Innovative Mathematical Modelling

Mathematical modelling is a way to describe a system of phenomena using mathematical language. We are studying mathematical theory for innovative mathematical modelling and its transdisciplinary applications in order to resolve complex issues in science and technology.

We are promoting the project "Mathematical Theory for Modelling Complex Systems and its Transdisciplinary Applications in Science and Technology" (Core-Researcher: Kazuyuki AIHARA), which is supported by Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST Program).



Dynamical System Approaches to Spatiotemporal Chaos

Spatiotemporal chaos appears to show complex and random behavior in both space and time. It is, however, considered that the spatiotemporal chaos is constructed from countably infinite numbers of unstable periodic solutions, that is regular patterns in both space and time, which are embedded in spatiotemporal chaos. A goal of our research is to understand properties of spatiotemporal chaos by analyzing the unstable periodic solutions.

(JST Researcher Miki KOBAYASHI)





Spatiotemporal pattern showing spatiotemporal chaos in the Kuramoto-Sivashinsky equation

Spatiotemporal pattern showing order in both space and time

Fracture Phenomenon of a Soft/Hard Composite

Forming a composite of hard and soft materials sometimes increases the strength and/or toughness of the resulting material.



Fracture experiments Gong et al. (Adv. Mater, 2003)



ents Fracture simulation

With a mathematical model, we investigate the fracture phenomenon of a soft/hard composite in order to reveal why does such material have high strength or toughness. (JST Researcher **Chiyori URABE**)

Mathematical Foundation of Animal Communication

Birdsong is an acoustic communication signal used for male-male competition and male-female attraction. While some sing monotonous one, other birds sing a complex timeseries of a variety of notes. The network analysis of a rich transition patterns among notes enables to reveal the generative mechanism of complex birdsong. (JST Researcher Kazutoshi SASAHARA)



Science in Fashion



California thrasher and sonagram of its song

Birdsong network

The logistic map is a polynomial mapping of degree 2. It is known that the logistic map brings a chaotic behavior.



Based on the bifurcation diagram of the logistic map, a beautiful dress was designed by Eri MATSUI (fashion designer), Keiko KIMOTO (adjunct research assistant), and Kazuyuki AIHARA (director of this center).



Bifurcation diagram dress