

# AIHARA LAB.

## [Biological Information Systems]

Department of Informatics and Electronics

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

### Mathematical Modeling of Biological Information Systems

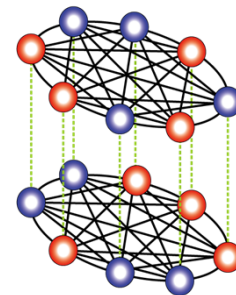
Dept. of Mathematical Informatics, Grad. School of Information Science and Technology  
Dept. of Electrical Engineering and Information Systems, Grad. School of Engineering

## Mathematical Modeling of Biological Information Systems

Many real world systems such as human brains, biological systems, and social systems are characterized by their complex dynamics. We investigate these complex systems through mathematical modeling and data analyses. We also apply mathematical theories and algorithms to medical and engineering systems in collaboration with the Collaborative Research Center for Innovative Mathematical Modelling.

### Physics: Modeling of "Aging"

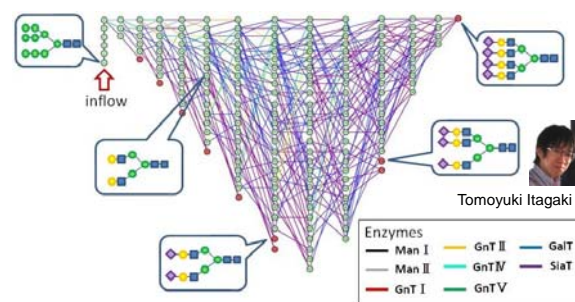
We study the fundamental mechanisms of "Aging". When the ratio between normal nodes (red) and abnormal nodes (blue) reaches the critical value, the whole system may lose the functionality. This phenomenon is known as "aging transition" in globally coupled oscillators. We reveal that this phenomenon also depends on the network structure.



A network model of aging

### Biology: Synthesis of Sugar Chains

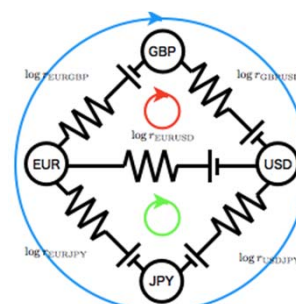
We study the biosynthetic process of sugar chains through mathematical modeling. Sugar chains cover cells' surfaces, and play important roles in immune systems and cell-to-cell communications. The synthetic pathway is very complex, which involves many enzymes and intermediates. We focus on the dynamical aspect of the process.



Simulation of sugar chain synthesis

### Economy: Currency Exchange Market

We study the market of currencies such as Japanese yen, US dollar, and Euro. Although the exchange rates change rapidly, any triangular trade (ex. JPY->USD->Euro->JPY) rarely makes a profit. In this case, the market is called "efficient". We find that such an efficient market of currencies corresponds to an electrical circuit.



$$\begin{aligned} & \text{EUR-GBP-USD-JPY} \\ &= \text{EUR-GBP-USD} \\ &+ \text{EUR-USD-JPY} \end{aligned}$$



Relationship between currency exchange market and an electrical circuit