Welcome to
Posters & Demonstrations

Aihara LAB.

[Biological Information Systems]

Department of Informatics and Electronics

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Mathematical Modelling of Biological Information Systems

Dept. of Mathematical Informatics, Grad. School of Information Science and Technology
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Mathematical Modelling of Biological Systems

Understanding Biological Information Systems through Mathematical Modelling

The highly sophisticated information processing in living systems such as the brain is the main issue to be studied in our laboratory. Through mathematical modelling and data analyses, we are trying to reveal how the advanced functionalities in the living systems are generated. We also apply mathematical theories and algorithms to medical and engineering systems in collaboration with the Collaborative Research Center for Innovative Mathematical Modelling.

◆Information Integration in the Brain

Although visual, audio, and tactile information are individually processed in different areas of the brain, they need to be appropriately combined to realize important brain functionalities such as cognition and judgment. We are trying to reveal how various kinds of information are integrated in the brain by using mathematical models.

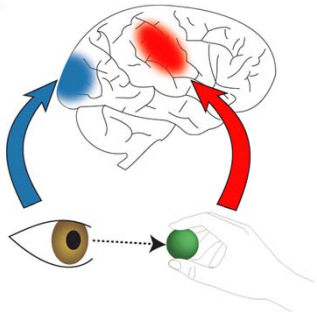

Fig. 1: Judgment of the size of the ball in the hand

◆Pedestrian Behavior with Theory of Mind

Mathematical modeling of pedestrian activity is useful to handle crowd control and relieve congestion in the station and the building. In particular, we have tried to understand the collision avoidance behavior and the development of lanes from microscopic viewpoint. We have constructed a mathematical model of pedestrian flows by incorporating mental processes of pedestrians (theory of mind) and analyzed the resulting flows. We have shown that efficient flows are realized when there exist both selfish people who do not care others and thoughtful people who care others very much.

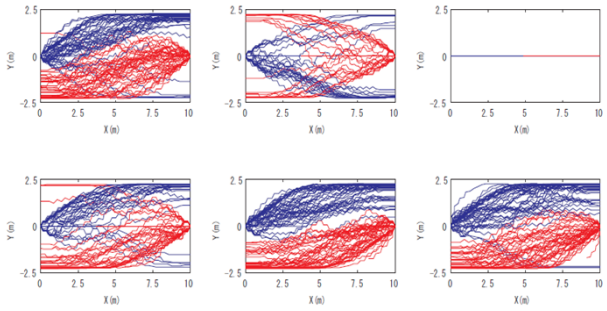

Fig. 2: Collision avoidance behavior in the mathematical model of pedestrian flows.

◆HPV infection and Immunization Strategy

Human papillomavirus (HPV) is spread during sexual contact and a long-term infection of HPV can be responsible for cervical cancer. Vaccination for females can prevent the infection of HPV, but it is expensive. Therefore, people weigh the vaccination cost against the benefit to reduce the risk of infection to determine whether they get immunized or not. As a result, the optimal vaccination rate for human population can be different from that in the case where each individual behaves optimally for herself. We have shown how different the optimal vaccination rate for a group and that for individuals by using mathematical models.

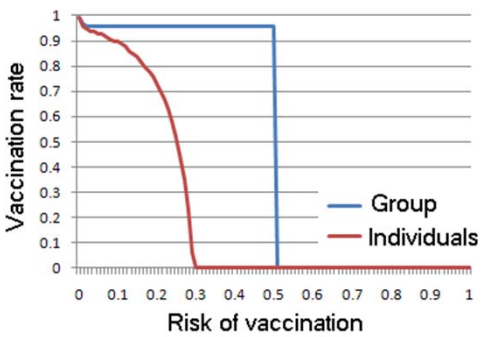

Fig.3: The optimal vaccination rate for a group and that for individuals