Excellent Poster Presentation Award

Poster Presentation

1. **"Rupture dynamics of biopolymer bubbles"**

   Wei Chen (OIST), and Eliot Fried (OIST)

   The rupture of thin aqueous films is a phenomenon occurring on short timescales and resulting in visually stunning features. While the bursting of soap bubbles has been classically established as an axisymmetric process, we show that the bursting of bubbles made from biopolymer gels results in instabilities leading to the formation of jagged fissures. By means of high speed imaging and digital transmission holography, we observe plastic deformation occurring locally on the biopolymer film surface. Owing to film heterogeneity, different modes of rupture are observed by varying the concentration of biopolymers in solution.

2. **"Mathematical modeling of phononic crystals"**

   Riku Kanai (Meiji Univ., MIMS), Elliott Ginder (Meiji Univ.)

   We will also present about the mathematical modeling of phononic crystals. We aim at utilizing shape analysis methods for performing inverse acoustic imaging, where our experimental data is obtained from a surface acoustic wave imaging device. This research is a joint work with Oliver Wright's group at Hokkaido University.

3. **"In-situ Pore Filling of TiO_2 Nanoparticles in Honeycomb Patterned Porous Films: A Modified Breath Figure Method"**

   Bo Kyoung Shin (Inje Univ., Korea), Umashankar Male (Inje Univ., Korea), and Do Sung Huh (Inje Univ., Korea)

   Polystyrene (PS) honeycomb patterned porous films filled with titanium dioxide (TiO_2) nanoparticles were prepared by a modified breath figure method. The honeycomb patterned porous films filled with TiO_2 nanoparticles were obtained by pouring titanium butoxide over partially dried PS solution during the fabrication of the PS films under humid conditions. TiO_2 nanoparticles were obtained by the hydrolysis of titanium butoxide in the condensed micro water droplets at the PS solution/air interface. Morphology, elemental mapping, X-ray diffraction (XRD), X-ray photoelectron spectroscopy, and UV−Visible analysis support the formation of TiO_2 nanoparticles in the honeycomb patterned pores. XRD studies showed that the formed TiO_2 nanoparticles are anatase. Photo-activity of the incorporated TiO_2 nanoparticles was examined by the change of the water contact angle of the films before and after UV irradiation. Water contact angles was decreased by UV irradiation, implying the transformation of the surface from hydrophobic to hydrophilic due to the photo-induced wettability by TiO_2.

4. **“Spontaneous Formation of a Revival Wave in a Modified B-Z Reaction System Using 1,4-Cyclohexanedione”**

Bo Kyoung Shin (Inje Univ., Korea), and Do Sung Huh (Inje Univ., Korea)

The bromate-1,4-cyclohexanedione-ferroin oscillating reactions are uncovered to support two types of wave activities, in which spontaneous formation of circular waves has been achieved after the disappearance of initial waves. The induction period of the revival wave is typically above 10 hours and its dependence on the initial concentrations of reactants is qualitatively different from that of initial waves. In addition to their differences in propagating speed and wavelength, the initial waves and the revival patterns have different colors, suggesting that different reaction mechanisms are involved in the formation of these spatiotemporal behaviors. Our experiments further show that the addition of hydroquinone to the reacting system can significantly shorten the induction time of the revival wave, which implicates that hydroquinone is not only a product in the bromate-1,4-cyclohexanedione-ferroin oscillating reaction but also plays a critical role in the following reactions.

5. **“Global feedback to reaction diffusion system by using Belousov-Zhabotinsky reaction”**

Kota Ohno (Meiji Univ.), Toshiyuki Ogawa (Meiji Univ.), Nobuhiko J. Suematsu (Meiji Univ.)

In this research, we study oscillatory reaction diffusion systems. We observe many kinds of complex patterns in oscillatory reaction diffusion systems. Recently, it began to clear to stabilize some of the oscillate pattern by using control. Among them, we would like to clarify to stabilize standing wave oscillation. Here we report that we can observe standing wave oscillation by a certain feedback control to reaction diffusion systems in numerical simulation. And we tried to observe corresponding results by using Belousov-Zhabotinsky reaction.

6. **“A Reaction-diffusion Algorithm for Segmentation of Liver Sinusoid in Rats and their Evaluations”**

Hiroto Shoji (Kwansei Gakuin Univ.)

Microstructures in hepatic lobule form three-dimensional (3D) periodic network patterns. To observe these structures, we utilize a confocal laser scanning microscope (CLSM). However, the obtained image alone cannot detect 3D structures, for example the endothelial cells that compose blood vessels require segmentations for 3D interpretation. Here, we investigated the segmentation of hepatic sinusiodal veins, which form periodic 3D networks. We propose a new approach for image segmentation based on the Turing reaction-diffusion (RD) model. We performed segmentation of CLSM images of sinusoidal endothelial cells using the proposed RD algorithm. Moreover, we discuss potential applications of this algorithm.

7. **“The size and the solution concentration dependence of droplet motion driven by interfacial chemical reaction”**

Takuto Ogasawara (Meiji Univ), Nobuhiko J. Suematsu (Meiji Univ., MIMS)

Self-propelled object driven by surface tension gradient is expected as experimental model of living things because of appearing various motion by being given specific conditions. A droplet in the liquid phase containing the surfactant moves spontaneously due to the Marangoni flow generated by an interfacial chemical reaction. It was theoretically clarified that the motion of self-propelled droplet depends on its size and the reaction rate of surfactant. Therefore, we experimentally investigated the relationship between droplet conditions (the size and the concentration) and mode of motion.

8. **“Bifurcation of camphor motion depending on the surface concentration”**

Yui Matsuda (Meiji Univ.), Yumihiko Ikura (Meiji Univ., MIMS), Kota Ikeda (Meiji Univ., MIMS), and Nobuhiko J. Suematsu (Meiji Univ., MIMS)

Investigation of behavior of insects and animals by using a reduced simple inanimate system is important to understand how the living organisms since they are composed of complicated parameters. A camphor system is well known as a simple inanimate system. When a camphor disk is floated on water, the gradient of the surface tension due to the camphor concentration around the disk induces self-motion. In this study, we report the bifurcation of camphor motion depending on the surface concentration and discuss the mechanism from the experiments results and mathematical models.

9. **“Variational construction of solutions to the fully parabolic Keller-Segel system”**

Yoshifumi Mimura (Meiji Univ., MIMS)

The dependence on the boundary conditions of the threshold mass for global existence and blow-up is studied.

10. **“Cell membrane permeabilization and acetaldehyde scavenging explain responses to chitosan in the individual and collective glycolytic oscillations in yeast cells”**

Kenichi Shibata (Yokohama Natl. Univ.), Takashi Amemiya (Yokohama Natl. Univ.), Yu Kawakita (Yokohama Natl. Univ.), Kohei Obase (Yokohama Natl. Univ.), Kiminori Itoh (Yokohama Natl. Univ.), Masahiro Takinoue (Tokyo Institute of Technology), Satoshi Nakata (Hiroshima Univ.), and Tomohiko Yamaguchi (Meiji Univ., MIMS)

We investigated the effects of chemical disturbances on the individual and collective glycolytic oscillations in yeast cells encapsulated into alginate microparticles. The addition of chitosan (an antimicrobial agent) decreased the duration of the oscillations. In

contrast, the periods and the synchronicity states showed biphasic responses to chitosan treatments. These findings can be explained by the balance between two chitosan properties, increasing cell membrane permeability and acetaldehyde scavenging. At low concentrations, chitosan presumably acts as a synchronization promoter that does not mediate the synchronization itself but induces an increase in intercellular coupling.

11. **“A method for early detection of neighbor equilibria of a trajectory of bacterial population change”**

Shinji Nakaoka (JST PRESTO, Univ. of Tokyo)

The gut microbiota is comprised of several different bacterial species which perform diver metabolic activities. Recent progress on measuring genomic sampling of the microbial community, referred to as microbiome, has revealed the association of bacterial species loss with the development of several diseases such as inflammatory bowl disease in the gut, or atopic dermatitis at the skin tissue. In order to understand mechanisms underlying species diversity loss, mathematical modeling and numerical simulations are employed to investigate possible patterns of species composition change with respect to perturbation (parameter change). We specifically consider generalized Lotka-Volterra equations describing dynamical change of population densities of bacterial species, and developed a novel method to numerically determine an equilibrium state with maximum number of species coexisting. By utilizing the method developed, we also undertake a problem for early detection of a set of microbial species going extinct in advance to dynamical change. This application might be helpful in preventing species extinction by giving external intervention.

12. **“How does farming technology influence on the spread of farmers into a region occupied by hunter-gatherers?”**

M. H. Kabir (Meiji Univ., MIMS), and M. Mimura (Meiji Univ., MIMS, and Musashino Univ.)

The Neolithic transition is one of the most significant single developments in human history. Archeological evidence of Neolithic transition suggests that expanding velocity of farmers is roughly constant. To understand such phenomenon, many theoretical attempts have been progressed through mathematical modeling. Existing modeling approaches on Neolithic transition indicates that expanding velocity is faster than the observed one. For understanding this difference, we propose a three-component reaction-diffusion system which involves two different types of farmers: sedentary and migratory ones. Moreover, we introduce influence of farming technology on the spread of farmers. Our goal is to study the relation between the expanding velocity and farming technology. In this talk, we focus on the one-dimensional traveling wave solution with minimal velocity and finally our model suggests that the traveling wave explains the reason why the expanding velocity of farmers slow down when farming technology is suitably developed.

13. **“Global-in-time existence results for the two-dimensional Hasegawa-Wakatani equations”**

Shintaro Kondo (Gifu Univ.)

In order to describe the resistive drift wave turbulence appearing in nuclear fusion plasma, the Hasegawa-Wakatani (HW) equations were proposed in 1983. We consider the two-dimensional HW equations, which have numerous structures (that is, they explain the branching phenomenon in turbulence and zonal flow in a two-dimensional plasma). We prove the global-in-time existence of a unique strong solution to the HW equations in a two-dimensional domain with double periodic boundary conditions.

14. **“Asymptotic behavior of the solution to the compressible Navier-Stokes equation around space-time periodic flow”**

Shota Enomoto (Meiji Univ.)

We consider the compressible Navier-Stokes equation around space-time periodic solution in an infinite layer of R^n (n=2,3) under the action of a space-time periodic external force. If the external force is small enough, then the compressible Navier-Stokes system has a space-time periodic solution. We show that the space-time periodic solution is asymptotic stable under the sufficiently small initial perturbation if Reynolds and Mach numbers is small enough. Furthermore, it is shown that the asymptotic leading part of the perturbation is given by a product of a solution of the one-dimensional viscous Burgers equation and a space-time periodic function when n=2, and by a product of a solution of the two-dimensional heat equation and a space-time periodic function when n=3. This talk is based on a joint work with Prof. Y. Kagei of Kyushu University and Mr. M. N. Azlan.

15. **“Motion of spots on surface”**

Ayuki Sekisaka (Meiji Univ.,MIMS), Takashi Teramoto (Asahikawa Medical Univ.), and Shin-Ichiro Ei (Hokkaido Univ.)

Usually, spot solutions in the reaction-diffusion system are considered in the flat two-dimensional plane. In particular, interaction of two spots produces two type of motion. In this poster, we present spot dynamics on two-dimensional surface. Spots interact with each other, and these spots move under the influence of the curvature of the curved surface. Therefore, the motion of spots is decided by the balance between interaction and curvature.

16. **“Spiky patterns and spatial heterogeneity”**

Hiroko Yamamoto (Meiji Univ., MIMS)

Patterns formed by reaction-diffusion equations have attracted much attention. In 1972, A. Gierer and H. Meinhardt discovered spiky patterns by numerical simulations of an activator-inhibitor system. Spiky patterns are nontrivial solutions of the activator-inhivitor system that the activator concentrates in a very narrow region around finitely many points.

In such a pattern, it is interesting and important where concentration points are in the domain. We especially consider the stationary spiky patterns of the system with spatially heterogeneity. In this poster, we show that the concentration points become critical points of the locator function composed of coefficients.

17. **“A mathematical model for representing collective rotational migrations of cell groups covered by basement membrane”**

Takamichi Sushida (Hokkaido Univ., RIES), Hitomi Mori (Hokkaido Univ.), Sumire Ishida (Hokkaido Univ.), Kazuya Furusawa (Hokkaido Univ.), Hisashi Haga (Hokkaido Univ.), and Masakazu Akiyama (Hokkaido Univ., RIES)

Recently, it has been attended the relation between the elongation phenomena and rotational migration of cell group since they are observed in three-dimensional morphogenesis such as fruiting body formation of Dictyostelium Discoideum and somite formation of zebra fish. In particular, although it is known that the somite is covered by basement membrane, it is not clear the reason why rotational migration occurs. In order to understand cellular mechanism for rotational migration of cell groups covered by basement membrane, we propose a mathematical model which consists of a self-propelled particle model representing cellular migration and a phase-field model representing basement membrane. Moreover, we will show phase diagram of parameters for migration modes and give a theoretical suggestion for biological experiments.

18. **“Proposal of method for characterization of formation structure in team sports by using Delaunay triangulation”**

Takuma Narizuka (Chuo Univ.) and Yoshihiro Yamazaki (Waseda Univ.)

We propose a method to identify the formation structure in team sports based on Delaunay triangulation. The adjacency matrix obtained from the Delaunay triangulation for each player is regarded as the pattern of the formation. Combining our method and the hierarchical clustering, the classification algorithm of formations is also proposed.

19. **“Height Reversal Illusion Caused by Human Preference for Rectangularity”**

Kokichi Sugihara (Meiji Univ., MIMS)

Schroeder staircase generates a depth reversal illusion, in which we have two alternative interpretations of a 3D structure seen from above and seen from below. We can create a new type of illusion by expanding the staircase picture in the vertical direction, placing it on a horizontal plane, and seeing it from above obliquely. This modification itself creates the same illusion as the Schroeder staircase, but if we add 3D decorations that indicate the direction of gravity, a new type of illusion occurs in the sense the ambiguity disappears whereas another stable interpretation is evoked when the picture is rotated around the vertical axis by 180 degrees.

20. **“KANSEI evaluation by application of our own deep learning”**

Hiroe Abe (Meiji Univ., MIMS), Luis Diago (Meiji Univ., MIMS), Ichiro Hagiwara (Meiji Univ., MIMS)

Recently, it has been a great problem to deep learning, that the input data itself must be provided from the big amounts of data. However, it depends on the problem how much data and what type of data are necessary. This problem is not solved generally. In this study, we examined the type and quantity of big data as an example of a healing structure which is one of KANSEI.

21. **“Application of pairing origami structure to aluminum cans”**

Aya Abe (Meiji Univ., MIMS), Yang Yang (Meiji Univ., MIMS), Chie Nara (Meiji Univ., MIMS), Yuko Adachi (Meiji Univ., MIMS), Ichiro Hagiwara (Meiji Univ., MIMS)

Polyhedrons by Nojima and by Tachi-Miura, which both are two symmetrical origami structures, can be folded in the axial or radial direction, and it is convenient if they can be applied to aluminum cans. In this paper, we investigate whether both structures are rigid folding or not, and consider the influence of this on the energy absorbing characteristics. Moreover, we studied the crushing and spring back characteristics of both structures by simulation, and explore their possibility.

22. **“The strongest and the best optimized foldable safety helmet by using origami structures”**

Yang Yang (Meiji Univ., MIMS), Chie Nara (Meiji Univ., MIMS), Maria Savchenko (Meiji Univ., MIMS) and Ichiro Hagiwara (Meiji Univ., MIMS)

The helmets play an important role in protecting the head of people when earthquake or tumble happens. The existing safety helmet has some disadvantages: expensive, take up space, and inconvenient to carry. Therefore, considering the foldable/deployable and impact characteristics of origami structures and the cheapness of recycled cardboard, it is an interesting challenge to design of a new folding helmet to satisfy the performances of safety, storability, light-weight, and low-price from two attempts: the strongest and the best optimized.

23. **“Study on design of assembly truss score panel”**

Yuko Adachi (Meiji Univ., MIMS), Aya Abe (Meiji Univ., MIMS), Haruka Takiguchi (Meiji Univ.,), Kousuke terada (NIT,Fukushima College), Ichiro Hagiwara (Meiji Univ., MIMS)

The structure constructed by space filling of tetrahedron and octahedron, invented by Nojima et al. is called an octet type truss core. Terada et al. proposed and promoted the Origami folding method to overcome the limit of the aspect ratio. As a result, based on the pattern, after the cutting and bending process, the cores are assembled into a panel shape called an ATCP (Assembly Truss Core Panel). We printed patterns on each surface of ATCP to be a unified painting as a whole.