Schedule

Time	Contents	Place	Chair & Setup
03:40 PM	The short self-introduction time	Room 220, Bld.27	Satoshi Handa & Seong-Mi Seo
04:10 PM	The poster session time	Room 323, Bld.27	Satoshi Handa
05:25 PM	The closing of the poster session	Room 323, Bld.27	Seong-Mi Seo

Order of short self-introduction

Time	Name	University
03:41 PM	Satoshi Handa	HU
03:43 PM	Eunhee Jeong	SNU
03:45 PM	Keita Hikita	HU
03:47 PM	Junkee Jeon	SNU
03:49 PM	Kogo Yoshikawa	HU
03:51 PM	Minjung Gim	SNU
03:53 PM	Takaaki Minomo	HU
03:55 PM	Hyoungsuk So	SNU
03:57 PM	Shu Eto	HU
03:59 PM	Jaeseung Lee	SNU
04:01 PM	Mamoru Okamoto	HU
04:03 PM	Hyerim Ko	SNU
04:05 PM	Ikki Fukuda	HU
04:07 PM	Seong-Mi Seo	SNU

Abstracts of posters

From SNU

1. **Name:** Eunhee Jeong

   Title: Uniform Sobolev inequalities for second order non-elliptic differential operators

   Abstract: We consider uniform Sobolev inequalities for the second order differential operator of non-elliptic type and its applications to Carleman estimates and unique continuation properties. Our results are based on the dyadic decomposition of multiplier operators and real interpolation argument. This is a joint work with Yehyun Kwon and Sanghyuk Lee.

2. **Name:** Junkee Jeon

   Title: An integral equation representation approach for valuing Russian options with a finite time horizon

Abstract: In this paper, we describe a method for valuing Russian options with a finite time horizon using Mellin transform techniques. Russian options with a finite maturity are usually formulated into the inhomogeneous free-boundary Black-Scholes partial differential equation with a mixed boundary condition. Utilizing Mellin transforms, we derived an integral equation which is satisfied by Russian options with a finite time horizon. Furthermore, we present some numerical solutions and plots of the integral equation using recursive integration methods.

3. **Name:** Minjung Gim

   Title: Recurrence criteria for generalized Dirichlet forms

   Abstract: My academic advisor and I develop sufficient analytic conditions for recurrence and transience of non-sectorial perturbations of possibly non-symmetric Dirichlet forms on a general state space. As an application, we consider a generalized Dirichlet form given on a closed or open subset of $\mathbb{R}^d$ which is given as a divergence free first order perturbation of a non-symmetric energy form. Then using volume growth conditions of the sectorial and non-sectorial first order part, we derive an explicit criterion for recurrence. In my poster session, I will introduce our main results and the counterexamples show that the non-sectorial case differs qualitatively from the symmetric or non-symmetric sectorial case. Namely, we make the observation that one of the main criteria for recurrence in these cases fails to be true for generalized Dirichlet forms.

4. **Name:** Hyoungsuk So

   Title: Weighted estimates for generalized steady Stokes systems in nonsmooth domains

   Abstract: We consider a generalized steady Stokes system with discontinuous coefficients in a nonsmooth domain when the inhomogeneous term belongs to a weighted L^q space for $2 < q < \infty$. We prove the global weighted L^q-estimates for the gradient of the weak solution and an associated pressure under the assumptions that the coefficients have small BMO (bounded mean oscillation) semi-norms and the domain is sufficiently flat in the Reifenberg sense. On the other hand, a given weight is assumed to belong to a Muckenhoupt class.

5. **Name:** Jaeseung Lee

   Title: Emergence of local synchronization in an ensemble of heterogeneous Kuramoto oscillators

   Abstract: We study the emergence of local exponential synchronization in an ensemble of heterogeneous Kuramoto oscillators with different intrinsic dynamics. We generalize the constant natural frequency assumption to a smooth function that depends on the state and time so that it can describe a more realistic situation arising from neuroscience. In this generalization, we introduce the relaxed synchronization which is also known as "practical synchronization". We also focus on the complete synchronizability of a subensemble consisting of Kuramoto oscillators with the same intrinsic dynamics.

6. **Name:** Hyerim Ko

   Title: Fourier transform and regularity of characteristic functions

   Abstract: We will present problems about the regularity property of χ_E and the integrability of $\widehat{\chi_E}$ when its domain has an appropriate boundary condition. It is well-known that they are contained in L^p spaces or Sobolev spaces when their boundaries have finite Minkowski contents, but these fail at the critical exponent in general. We use a refined version of Littlewood-Paley inequality to give endpoint results in Lorentz and Lorentz-Sobolev spaces. This is a joint work with Sanghyuk Lee.

7. **Name:** Seong-Mi Seo

   Title: Edge scaling limit of the spectral radius for random normal matrix ensembles at hard edge

   Abstract: In this poster presentation, I investigate the edge behavior of the spectral radius of a random normal matrix ensemble which potential is localized to a certain compact set. With a proper rescaling at the boundary of the compact set, the limiting law of the spectral radius follows an exponential distribution. I prove this edge universality for radially symmetric subharmonic potentials.

From HU

1. **Name:** Satoshi Handa

   Title: The random current representation of the Ising model and its applications

   Abstract: We would like to introduce the classical Ising model and recent solved problems and still open problems I am thinking about now. The Ising model is well known as a statistical ferromagnetic model, which shows a phase transition mathematically. At or around the critical temperature, we can see a lot of critical behaviors, e.g. the divergence of the susceptibility, the loss of the spontaneous magnetization... etc. To analyze these behaviors, we use the random current representation, which is one of the graphical representations. The random current representation is a very useful expression in the sense that we can regard it as the percolation model and this representation does not depend on temperature. In this poster, we also introduce this random current representation and explain it by using many graphs.

2. **Name:** Keita Hikita

   Title: Introduction to Persistent Homology and its Applications

   Abstract: This poster explains persistent homology. Persistent homology is an algebraic tool for measuring topological features of shapes and functions. It is a very powerful method that can apply to various sciences, for example, material science, life science, chemistry, and engineering.

In addition, statistical approach to persistent homology is one of the most promising methods for the study of big data.

3. **Name:** Kogo Yoshikawa

   Title: Benjamin-Ono equations and their soliton solutions

   Abstract: We know Benjamin-Ono equation has a soliton solution. It has single soliton solution which is algebraic, it also has N-soliton solution. We demonstrate several computer simulation to see how their solitons behave. We obtain accurate numerical solutions for B-O equation by using an exponential time differencing method.

4. **Name:** Minomo Takaaki

   Title: Mathematical model of the cell population movement

   Abstract: The purpose of this study is understanding of the cell population movement. Especially this poster describes the study of wound- healing cell migration. A wound is a type of injury which happens relatively quickly in which skin is torn, cut, or punctured. It is significant that understanding the mechanism of wound healing in medical perspective. Movements of cell population is generally modeled by the interaction of the mass system. To elucidate wound-healing mechanisms, we use the mathematical model: Vertex Dynamics Model*(hereafter V.D.M.) formulated by Honda HISAO(Professor at Kobe University). This model is ordinary differential equation of vertices using by gradient system. We did simulation using V.D.M in order to understand the interesting move of MDCK cell

5. **Name:** Shu Eto

   Title: The Strichartz type estimate for the CGL evolution operator

   Abstract: We consider the following initial data problem:

   $$(\mathbf{CGL})_\alpha^\theta \quad \begin{cases} u_t = \exp(i\theta)u_{xx} - i|u|^{\alpha-1}u, \ t > 0, \\ u(0) = u_0 \in \widehat{L}^p(\mathbf{R}), \end{cases}$$

   where u is a function as $u(x,t) : \mathbf{R}\times [0,\infty) \to \mathbf{C}$. In this poster, we discuss the case of $\alpha = 3$ and $\theta \in (-\frac{\pi}{2}, \frac{\pi}{2})$.

6. **Name:** Mamoru Okamoto

   Title: Influence of convection to self-motion of camphor

   Abstract: Look at the next page.

7. **Name:** Ikki Fukuda

   Title: Large time behavior of solutions to the viscous conservation law

   Abstract: Look at the next page.

Influence of convection to self-motion of camphor

○Mamoru Okamoto, Masaharu Nagayama, Yasuaki Kobayashi, Mina Kaneko, and Masakazu Akiyama

1 Introduction

Many researchers have studied the self-motion of camphor and it is now said that the motion of camphor (atop water) is caused by differences in surface tension. The gradient is induced by a camphor layer development atop the surface. Mathematical models for the camphor motion have been constructed used the above mechanisms [1], and the models reproduce the motion of camphor disks.

Convection caused by differences in surface tension has also been observed [2]. Although convection induced by differences in surface tension seems to influence the self-motion of the camphor, there are only a few reports discussing mathematical models that include convection explicitly.

We have constructed a mathematical model for the self-motion of camphor driven by convection, and have observed motions that the previous models cannot reproduce.

2 Mathematical Model

Our model for camphor floating on a sufficiently narrow aqueous circular route was constructed. Previous models only consider differences in surface tension as the drive force. Our model considers that the motion of camphor is induced by convection, so that we let the speed of the camphor equal the average of the convection within the range of the camphor. Our model also considers convection so that the equation describing the surface concentration of the camphor layer includes an advection term. Convection is also described in Navier-Stokes equations, where the driving force that is the difference in surface tension is introduced as a boundary condition.

3 Results and discussion

We observed uniform motion as a numerical solution (Fig. 1.). This motion is also observed in experiments and easily arises from our model equation.

In actually, uniform motions are “almost uniform motions.” Uniform motion includes small vibrations, but the wavelength of vibrations are long enough in comparison to the computation's mesh. We thus consider that it is not a numerical instability.

Next, the position of the vortex is out of position. In the experiment, the center of the two vortices is nearly directly below the camphor.

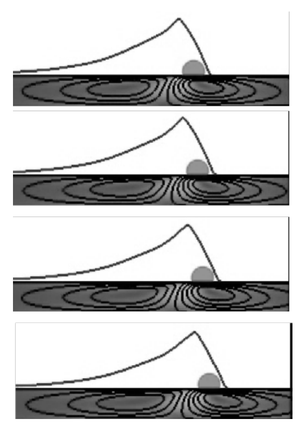

Figure 1. Uniform motion

4 Conclusion

We constructed a mathematical model for the self-motion of camphor, driven by convection. The model seems to work at the qualitative level, and we will also discuss areas for its improvement.

References

[1] Masahatu Nagayama, Satoshi Nakata, Yukie Doi, Yuko Hayashima, Physica D, 2004, 194, 151-165

[2] Takashi Yabe, Feng Xiao, Takayuki Utsumi, J.Comput.Phys., 2001, 169, 556-593

Large time behavior of solutions to the viscous conservation law

Ikki Fukuda

Viscous conservation law

In this talk, we consider large time behavior of solutions to the initial value problem for the viscous conservation law:

$$\begin{aligned} u_t + f(u)_x &= u_{xx}, \quad t > 0, \quad x \in \mathbb{R}, \\ u(x,0) &= u_0(x), \quad x \in \mathbb{R}, \end{aligned} \tag{1}$$

where $f(u) \in C^\infty(\mathbb{R})$ and $u_0 \in L^1(\mathbb{R}) \cap H^1(\mathbb{R})$. It is known that the solution of this initial value problem tends to a nonlinear diffusion wave which is a self similar solution to the Burgers equation $\chi_t + \left(\frac{b}{2}\chi^2\right)_x = \chi_{xx}$. We set

$$w_0(x) = \exp(-(b/2)\int_{-\infty}^x u_0(y)dy) - \exp(-(b/2)\int_{-\infty}^x \chi(y,0)dy).$$

Matsumura and Nishihara [1] showed that if $\|w_0\|_{H^2(\mathbb{R})} + \|w_0\|_{L^1(\mathbb{R})} + \|u_0\|_{L^1(\mathbb{R})}$ is sufficiently small, then the following estimate holds.

$$\|u(\cdot,t) - \chi(\cdot,t)\|_{L^\infty(\mathbb{R})} \le C(1+t)^{-1}\log(2+t)(\|w_0\|_{H^2(\mathbb{R})} + \|w_0\|_{L^1(\mathbb{R})} + |\delta|^{3/2}), \tag{2}$$

where $\delta \equiv \int_{\mathbb{R}} u_0(x)dx$.

Kato [2] showed that if $f(u) = (b/2)u^2 + (c/3)u^3$ and $\delta \neq 0$, $c \neq 0$, $u_0 \in L^1_1(\mathbb{R}) \cap H^1(\mathbb{R})$, and $\|u_0\|_{L^1_1(\mathbb{R})} + \|u_0\|_{H^1(\mathbb{R})}$ is sufficiently small, then the decay rate (2) is optimal, where $\|u_0\|_{L^1_1(\mathbb{R})} \equiv \int_{\mathbb{R}} |u_0(x)|(1+|x|)dx$. In order to show this result, we introduce auxiliary linearized equation and L^p estimates of heat kernel and nonlinear diffusion wave. In this talk, I will give the outline of the proof of [2].

References

[1] A. Matsumura and K. Nishihara: *Global solution of Nonlinear Differential Equation-Mathematical Analysis for Compressible Viscous Fluids*, Nippon-Hyoron-Sha, Tokyo, 2004, (in japanese).

[2] M. Kato: *Large time behavior of solutions to the generalized Burgers equations*, Osaka J. Math, **44**, (2007), 923-943.