The 9th Taiwan-Japan Joint Workshop
for Young Scholars in Applied Mathematics

March 03-05, 2018

Venue: Ger-Jyh Hall, Small lecture hall, College of Science
       National Cheng Kung University (Cheng Kung Campus)
       國立成功大學成功校區，理化大樓，格致廳小講堂

Website: http://ncts.ntu.edu.tw/events_2_detail.php?nid=178
On-Line Registration: https://goo.gl/forms/kekCD7g5zGfu1Wmo2

From Taiwan:
Tamkang University
National Center for Theoretical Sciences
National Taiwan University
National Central University
National University of Tainan
National Cheng Kung University

Organizers:
From Taiwan:
TKU: Jong-Shenq Guo, Yan-Yu Chen
NTU: Chuin-Chuan Chen, Chun-Hsiung Hsia
NCU: Jann-Long Chern
NTHU: Dong-Ho Tsai
NCKU: Yung-fu Fang, Yu-Chen Shu, Yu-Yu Liu
NUTN: Chang-Hong Wu.

From Japan:
Meiji University
Hiroshima University
Ryukoku University
Tohoku University
Shimane University

Meiji University: Hirokazu Ninomiya, Kota Ikeda, Elliott Ginder
Hiroshima University: Yuichi Togashi
Ryukoku University: Yoshihisa Morita, Shoji Yotsutani, Tatsuki Kawakami, Yoshikazu Yamagishi
Shimane University: Mayuko Iwamoto.

From Taiwan:
TKU: Jong-Shenq Guo, Yan-Yu Chen
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Taiwan:
National Center for Theoretical Sciences
National Central University
National Cheng Kung University
NSCMRPC

Japan:
Department of Applied Mathematics and Informatics, Ryukoku University
Research Center for the Mathematics on Chromatin Live Dynamics, Hiroshima University
Graduate School of Advanced Mathematical Sciences, Meiji University
Meiji Institute for Advanced Study of Mathematical Sciences
Shimane University

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Research Center for the Mathematics on Chromatin Live Dynamics, Hiroshima University
Graduate School of Advanced Mathematical Sciences, Meiji University
Meiji Institute for Advanced Study of Mathematical Sciences
Shimane University
# The 9th Taiwan-Japan Joint Workshop for Young Scholars in Applied Mathematics (at NCKU)

**2018/03/03 ~ 2018/03/05 at NCKU, Tainan, Taiwan**

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**Note:**
- The schedule includes sessions for Master's, Undergraduate, PhD, and Postdoc students.
- Each day's schedule is divided into morning and afternoon sessions, with specific times and topics.
- The schedule also includes breaks, evaluations, and excursions.
- A key event is the Banquet on the last day.
- The workshop includes a group photo session.
- The location is at NCKU, Tainan, Taiwan.
The 9th Taiwan-Japan Joint Workshop for Young Scholars in Applied Mathematics (at NCKU)  
2018/03/03~2018/03/05 at NCKU, Tainan, Taiwan

Program

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Saturday (03/03)
Chair: Yui Matsuda

0900-0910 Pin-Yu Wang
0910-0920 Shota Yamakawa
0920-0930 Yu Masuda
0930-0940 Hisashi Matsubara
0940-0950 Ya-Lin Huang
0950-1000 Guan-Ting Lin

Chair: Jen-Hsu Chan

1000-1025 Break

1025-1035 Takuto Ogasawara
1035-1045 Yuki Yagasaki
1045-1055 Yu-Hsun Lee
1055-1105 Yuka Fukase
1105-1115 Yu-Shiuan Su

Chair: Shota Enomoto

1115-1200 Break

1140-1150 Bing-Ze Lu
1150-1200 Takeru Kameda
1200-1210 Chia-Hsin Lin
1210-1220 Jo-Yun Chou
1220-1230 Takahito Watanabe
1230-1240 Yen-Chen Chen

Chair: Gyeongha Hwang

1240-1330 Lunch

1330-1340 Chin-Hsun Lu
1340-1350 Riku Kanai
1350-1400 Katsuhiko Kayahara
1400-1410 Yu-Hsian Lan
1410-1420 Yoshito Yamada
1420-1430 Yiwen Cheng

Chair: Chi-Jen Wang

1430-1455 Break

1455-1505 Zhi-Haung Ke
1505-1515 Kana Mizuno
1515-1525 Ting-Yang Hsiao
1525-1535 Koya Noda
1535-1545 Shun-Chieh Wang
1545-1555 Kazuki Ikeda
1555-1620 Break

Chair: Yu-Shuo Chen

1620-1630 Yu-Hsiaang Tsai
1630-1640 Wei-Chien Liao
1640-1650 Masahiro Nakao
1650-1700 Xiaochen Duan

Chair: Gyeongha Hwang

1700-1725 Break

Notes on Chebyshev polynomial of the first kind
Toward an understanding of a mechanism for dynamic pattern formation in cuttlefish
Estimates of population sizes for traveling wave solutions of Lotka-Volterra competition systems with non-local diffusion
The effect of diffusions on the Lotka-Volterra prey-predator model in spatially heterogeneous environments
Traveling wave solution of a 3-species competition-diffusion model with weak competition
Reaction-diffusion equation in growing region

A divide-and-conquer Contour Integral Eigensolver
An Efficient Contour Integral Based Eigensolver for Surface Plasmon Simulations
Experimental Study of Situation-Dependent Task Allocation in Camponotus japonicus
The variable-yield model with the wall growth under the exchange rate
Chair: Lorenzo Contento
1725~1735 Ti-Wen Lu
1735~1745 Yueh-Chun Kuo
1745~1755 Masami Koshino
1755~1805 Yu-Kai Lin
1805~1815 Ming-Hsiu Lu

Sunday(03/04)
Chair: Yueyuan Gao
0900~0915 Kabir Muhammad
0915~0930 Wei-Chiao Hsu
0930~0945 Kota Ohno
0945~1000 Shih-Hsin Chen
1000~1025 Break
Chair: Kabir Muhammad
1025~1040 Huai-hua Lu
1040~1055 Romero Llano
1055~1110 David Yang
1105~1125 Eduardo Jatulan
1125~1150 Break
Chair: Kota Ohno
1150~1205 Romain Amyot
1205~1220 Yu-Chiao Hsu
1220~1235 Pu-Zhao Kow
1235~1400 Lunch
Chair: Hsin-Yi Lee
1400~1420 Shota Enomoto
1420~1440 Shih-wei Chou
1440~1500 Gyeongha Hwang
1500~1540 Break
Chair: Shih-wei Chou
1540~1600 Yu-Shuo Chen
1600~1620 Yueyuan Gao
1620~1640 Hsin-Yi Lee
1640~1700 Lorenzo Contento

Chair List
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7 Yueyuan Gao
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16 (郭鴻文) Hung-We n Kuo
17 (連文璟) Wen-Ching Lien
18 (劉育佑) Yu-Yu Liu
19 (蔡東和) Dong-Ho Tsai
20 (史習偉) Hsi-Wei Shih
21 (柳文巨) Wen-Ching Lien
22 (郭鴻文) Hung-Wen Kuo
23 (陳彥宇) Yan-Yu Chen
24 (陳志鵬) Jong-Shenq Guo
25 (蔣家祥) Dong-Ho Tsai

DNA Topology-Topological Enzymology for Site-Specific Recombination and the Tangle Model
Thistlethwaite's method to the FULRD problem of Rubik's cube
A Survey of Curved Document Image Rectification
A description of object in space and 3D point cloud segmentation
Modeling of the effect of farming technology in the Neolithic transition of Europe
Linear Algebra and Dynamical System for Control Theory
Global feedback to oscillatory
Synchronization and Kuramoto Model
A mutation-selection model
Origami Pattern Design for Building 3D Irregular Shapes with a Robot System
Mathematical model and Decision
Dispersion relations for some periodic quantum graphs
The role of the binding domain of the enzyme Pin1 in a system
2D semantic segmentation assisted point clouds segmentation
Schauder's Estimates & Asymptotic Behavior of Sol'ns of Stationary Navier-Stokes Eqn in Exterior Domain
Large time behavior of the solution to compressible Navier-Stokes equation around space-time periodic flow
Global Well-posedness of Cauchy problem for Compressible Euler equations in Transonic Nozzle Flow
Existence and symmetric properties of solution to the Neumann problem of Hardy-Sobolev equation with Hardy potential
Existence and Instability of Traveling Pulses of Keller-Segel System with Nonlinear Chemical Gradients and Small Diffusions
Existence and uniqueness results for a first order conservation law involving a Q-Brownian motion
The generalized Riemann solver to a multi-lanes model in traffic flows
The mechanism behind traveling wave interaction in a reaction-diffusion system
Banquet
The 9th Taiwan-Japan Joint Workshop for Young Scholars in Applied Mathematics (at NCKU)

Date: 2018-03-03 ~ 2018-03-04

Venue: Ger-Jyh Hall, Small lecture hall, College of Science
National Cheng Kung University (Cheng Kung Campus)

Website: http://ncts.ntu.edu.tw/events_2_detail.php?nid=178
Online Registration: https://goo.gl/forms/kekCD7g5zGfU1Wmo2

Title and Abstract:
Saturday (03/03)

"M1-(王品瑜) Pin-Yu Wang" <benquanmany@gmail.com>, NCKU

Title: The Local Well-Posedness of Quantum Zakharov System in One Spatial Dimension

Abstract: In this talk, we will a little introduce the local well-posedness of QZ system in one dimension. The main result here which was introduced by YF Fang, HW Shih, KH Wang, 2017, and the main idea here is from J. Ginibre, Y. Tsutsumi, G. Velo, 1997.

"M1-Shota Yamakawa" <t17m008@mail.ryukoku.ac.jp>, Ryukoku U

**Multiplicity of stationary solutions of a limiting SKT cross-diffusion equation**

Shota Yamakawa
Graduate School of Science and Technology Ryukoku University
t17m008@mail.ryukoku.ac.jp

We consider the following stationary limiting equation:

\[
\left\{ \begin{array}{l}
\int_0^1 \left( a_1 \frac{\partial}{\partial x} v - c_1 v \right) dx = 0 \quad \text{in } (0,1), \\
\int_0^1 \left( \frac{\partial}{\partial x} v + \left( a_0 - b_0 \frac{\partial}{\partial x} w - c_0 v \right) \right) dx = 0 \quad \text{in } (0,1), \\
t_\infty(0) = t, \quad t_\infty(1) = t \quad \text{in } (0,1).
\end{array} \right.
\]

for a stationary cross-diffusion equation. Here, \(v(x)\) is an unknown function, and \(t\) is an unknown constant. The constants \(b_2, a_i, b_i, c_i (i = 1, 2)\) are all positive. We remark that the important quantities involving the constants \(a_i, b_i, c_i (i = 1, 2)\) are \(A := a_1/a_2, B := b_1/b_2, C := c_1/c_2\). It seems natural to consider the following two cases separately: the "strong competition" case \(B < C\) and the "weak competition" case \(B \geq C\). The original equation for \((S^\infty_\infty)\) was proposed by Shigesada-Kawasaki-Teramoto in [1].

Lou-Ni derived a stationary limiting equation to investigate the effect of cross-diffusion in [2] and [3]. Lou-Ni-Yotsutani showed theorems about existence, non-existence of non-constant steady state solutions, the shape of the solution, and clarified the structure of solutions of \((S^\infty_\infty)\) in [4]. For the case \(B < C\), precise study has been done.

We are interested in a existence and non-existence of solutions of \((S^\infty_\infty)\) for the case \(B \geq C\). In this talk, we will show our numerical results.

This is a joint work with Y.Lou, T.Mori, W.-M.Ni, S.Sukclin and S.Yotsutani.

**References**


Stability of stationary solutions of a limiting SKT cross-diffusion equation

Yu Masuda
Graduate School of Science and Technology Ryukoku University
t17m005@mail.ryukoku.ac.jp

We consider the following stationary limiting equation

\[
\begin{align*}
\int_0^1 \frac{x}{v} \left( a_i - b_i \frac{\tau}{v} - c_i v \right) dx = 0 & \quad \text{in } (0,1), \\
\frac{du}{dx} + v \left( a_1 - b_1 \frac{\tau}{v} - c_1 v \right) = 0 & \quad \text{in } (0,1), \\
v(x) = 0, & \quad v(x) = 0, \\
v(0) = 0, & \quad v(x) > 0 \\
v(x) > 0 & \quad \text{in } (0,1)
\end{align*}
\]

for a stationary cross-diffusion equation. Here, \(v(x)\) is an unknown function, and \(\tau\) is an unknown constant. The constants \(d_i, a_i, b_i, c_i (i = 1, 2)\) are all positive. We remark that the important quantities involving the constants \(a_i, b_i, c_i (i = 1, 2)\), are \(A := a_1/a_2, B := b_1/b_2, C := c_1/c_2\). It seems natural to consider the following two cases separately: the "strong competition" case \(B < C\) and the "weak competition" case \(B \geq C\). The original equation for \((S^1_\infty)\) was proposed by Shigesada-Kawasaki-Teramoto in [1].

Lou-Ni derived a stationary limiting equation to investigate the effect of cross-diffusion in [2] and [3]. Lou-Ni-Yotsutani showed theorems about existence, non-existence of non-constant steady state solutions, the shape of the solution, and clarified the structure of solutions of \((S^1_\infty)\) in [4]. For the case \(B < C\), Mori-Suzuki-Yotsutani have just recently obtained numerical stability of solutions of \((S^1_\infty)\).

We are interested in a stability of solutions of \((S^1_\infty)\) for the case \(B \geq C\). In this talk, we will show our numerical results.

This is a joint work with Y.Lou, T.Mori, W.-M.Ni and S.Yotsutani.

References


Uniqueness proof of stationary solutions of a limiting SKT cross-diffusion equation

Hsashi Matsubara
Graduate School of Science and Technology Ryukoku University
t16m008@mail.ryukoku.ac.jp

We consider the following a stationary limiting equation

\[
\begin{align*}
\int_0^\tau \left( a_1 - b_1 \frac{\tau}{\tau} - c_1 t \right) dx &= 0 \quad \text{in } (0, 1), \\
\frac{d}{dx} v_{xx} + v (a_2 - b_2 \frac{\tau}{\tau} - c_2 v) &= 0 \quad \text{in } (0, 1), \\
v_2(0) &= 0, \quad v_2(1) = 0, \\
v_2(x) &> 0, \quad v_2 > 0 \quad \text{in } (0, 1)
\end{align*}
\]

for a stationary cross-diffusion equation. Here, \(t(z)\) is an unknown function, and \(\tau\) is an unknown constant. The constants \(d_1, a_1, b_1, c_1\) are all positive. We remark that the important quantities involving the constants \(a_i, b_i, c_i (i = 1, 2)\), are \(A := a_1/b_1, B := b_1/b_2, C := c_1/c_2\). We consider the strong competition \(B < C\).

The original equation for \((S_0^\infty)\) was proposed by Shigesada-Kawasaki-Teramoto in [1]. Lou-Ni derived a stationary limiting equation to investigate the effect of cross-diffusion in [2] and [3]. Lou-Ni-Yotsutani showed theorems about existence, non-existence of non-constant steady state solutions, the shape of the solutions, and clarified the structure of solutions of \((S^0_0)\) in [4]. However, the uniqueness and the multiplicity of the solutions have not been clarified. They conjectured that uniqueness holds for \(1 < C/B < 7/3\) and does not hold for \(7/3 < C/B\).

To show the uniqueness for all \(A > 0\) under the assumption \(1 < C/B \leq 7/3\), we obtain representation formula of all solutions \((v(x), \tau)\) for \((S_0^{\infty})\). By regarding the constant \(A\) to be unknown, we represent \(A\) by two parameters \(d_2, \alpha\).

In this talk, we show the monotonicity of \(A(h; d_2)\) in \(h\) for each fixed \(d_2 > 0\). Thus, we obtain the uniqueness, moreover existence and non-existence.

This is a joint work with Y.Lou, T.Mori, W.-M.Ni and S.Yotsutani.

References


Title: The scattering of the Klein-Gordon-Zakharov system.

Abstract: We would consider the 3-dimension Klein-Gordon-Zakharov system with radial symmetry and given the theorem about small energy scattering. In the proof, we use the strichartz estimate to get the contraction mapping.

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"M-Takuto Ogasawara" <cs171001@meiji.ac.jp>, Meiji U

Droplet Motion Depending on the Size and the Rate of Interfacial Chemical Reaction
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In recent years, research is conducted to clarify the motion of living things by using a model experimental system that utilizes a self-propelled object. For example, an aqueous droplet spontaneously moves in an oil phase containing surfactant [2]. Some surfactants are adsorbed at the oil/water interface and decrease interfacial tension. If the distribution of surfactants at the interface is isotropic, interfacial tension is decreased homogeneously. However, once perturbation is added, interfacial tension gradient is induced on the interface and it generates hydrodynamic flow on the interface, i.e., Marangoni flow. With coupling to interfacial chemical reaction, the Marangoni flow is kept stably and continuous motion of the droplet can be induced (FIG. 1).

The theoretical approach indicated that the size and the reaction rate dependency of speed is convex upward (FIG. 2) [1]. We observed self-propelled motion of an aqueous droplet in an oil phase containing surfactant in order to confirm the theoretical prediction. The oil phase was monooolein squalane solution (10 mM) and the aqueous droplet composed of bromate ion (0.8 M), sulfonic acid (0.3 ~ 1.8 M) and ferroin (4.0 mM). With high concentration of H₂SO₄, the relationship between speed and size was convex upward, whereas the opposite relationship was observed with the low concentration.

FIG. 1. Schematic diagram of droplet motion.

FIG. 2. Size dependency of speed[1].

Title: Unraveling the Mystery of Alzheimer's Disease - A Mathematical Model for Onset and Progression

Abstract: Alzheimer's disease (AD) is a progressive and irreversible neurodegenerative disease that destroys memory and eventually the cognitive skills. Despite the extensive research, the pathogenesis of AD remains incompletely understood and no effective cure is available till now. Hence, mathematical models (mathematics combined with numerical methods) can serve as a powerful tool to help us to know better the complex cross-talks involving multiple cell types during disease progression. AD is primarily characterized by the presence of extracellular senile plaques consisting of amyloid-beta peptides (A-beta) and intracellular neurofibrillary tangles consisting of tau protein. In this talk I will present a mathematical model of AD based on a system of differential equations and the amyloid hypothesis and the model involves A-beta peptides, microglia, astrocytes and neurons. The novelty is that I also define a health indicator according to the model to serve as the indicator of the AD global development.

Analysis of a mathematical model for interfacial behaviors under drying and aggregating processes

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Several studies have found that fluids composed of volatile solvents and nonvolatile particles form spacial patterns when dried [1]. Recently, many studies have been conducted on interface behaviors of fluids under various conditions, including several mathematical studies on drying processes of nonvolatile particles and volatile solvents. The mathematical models are proposed in previous articles and reduced from the equations of motion of fluid. In those models, viscosities and densities in fluids are supposed to be constant, although these elements are actually varied with concentrations of the solvents and particles [2]. For that reason, we apply the lubrication approximation to the Navier-Stokes equation and derive the following partial differential equations, taking account of the change in viscosities and densities of the fluid;

\[
\begin{align*}
    \frac{\partial h}{\partial t} &= -\frac{\partial K}{\partial x} - \frac{\rho}{\rho_t} \alpha (1 - \phi) - \frac{D}{\rho_t} \frac{\partial}{\partial x} \left( h \frac{\partial h}{\partial x} \right), \\
    \frac{\partial \phi}{\partial t} &= -\frac{1}{h} \frac{\partial }{\partial x} \left( h \frac{\partial \phi}{\partial x} \right) + \frac{\rho}{\rho_t} \frac{\partial}{\partial x} \left( \frac{\partial h}{\partial x} \right) + \phi \frac{\rho}{\rho_t} \alpha (1 - \phi), \\
    K &= \frac{1}{\mu} \left( \frac{5}{24} g h \frac{\partial h}{\partial x} - \frac{1}{3} h^3 \left( \frac{\partial}{\partial x} \left( ph - \gamma \frac{\partial h}{\partial x} \right) + \sigma \frac{\partial \phi}{\partial x} \right) \right)
\end{align*}
\]

The function \( h \) is the height of the fluid and \( \phi \) is the volume fraction of nonvolatile particles in the fluid. All parameters in the equations are positive. Our aim in this study is to carry out numerical simulations for several parameters, and analyze the linear stability of a steady state.

References


Title: Multi-scale Computation and Analysis for Heterogeneous Data in Epidemic Models

Abstract: I worked on infectious disease model in the period of master study. The reason why I study in this model is that Tainan experienced severe dengue epidemics in 2015. According to the open data, some interesting issues are found. First, the result shows that the distance between new patients and existed patients obeys exponential distribution. Second, we use SEIR model and adjust the parameters in the smooth effective contact rate to fit historical data. By comparing the optimized effective contact rate and the epidemic prevention works by the government, the decay after prevention works gives a positive evidence for those works of government. In the future, we will integrate the multi-scale method with geographic map data, and establish different materials such as social information, climate, community to establish a multi-scale heterogeneous data epidemic model and discuss its computational efficiency and related error analysis.

"M-Yuka Fukase" <cs171010@meiji.ac.jp>, Meiji U
Title: Brian Reconstruction and Segmentation from CT and T1/T2 MRI Image

Abstract: Nowadays, according to the advanced medicine progress, clinicians highly depend on the medical imaging technique which allows them to visualise the representations of the interior patient body, such as computed tomography (CT) and magnetic resonance imaging (MRI). However, these medical images are outputted to the two-dimensional pictures which may not provide the sufficient information for doing three-dimensional computation research. Due to the previous reason, we would like to collect these images from the brain CT or MRI via the machine learning algorithms to obtain the segmentation and reconstruction of the brain imaging. During this research work, there’s some noise after processing. Therefore, we plan to develop a suitable algorithm including the cutting edge concept of image processing, the statistical method based on the solid mathematical definition in order to get the better results. Finally, we would like to represent an algorithm, which may work on CT image and T1/T2 MRI image to generate high-quality imaging for the three-dimensional object. Hopefully, this research will be able to deliver a promising framework to aid clinicians to make the more precise decision. (Joint work with Yu-Chen Shu and Dean Chou.) Keywords: T1/T2 MRI, CT, brain extraction, brain segmentation, 3D reconstruction

"M1-(呂秉澤) Bing-Ze Lu" <jackie84061258@gmail.com>, National Cheng Kung University

Title: A Theoretical Study of the Internal Structure and Dynamics of Single Nucleosomes Focusing on Effects of Core-Histone Proteins

Abstract: Eukaryotic chromatin is composed of nucleosomes consisting of 147 base pairs of DNA and 4 types of core-histone proteins such as H2A, H2B, H3, and H4 [1]. The amino-acid sequences of these histones have been widely conserved among eukaryotes. DNA is wrapped around the core histone to form a nucleosome structure that make the chromatin compact and enable long DNA to be conned in the nucleus. The positioning of nucleosomes on DNA sequences and their structural stability influences chromosome dynamics and functions [2]. Nucleosomes often change their position through their reconstitution. Here, the binding and dissociation of different types of histone are regulated by different proteins [3, 4], and the exchange of H2A/H2B complex occurs more frequently than that of the other. From these facts, the presence or absence of each histone may contribute to the stability of nucleosome. However, the details were unknown.

In this study, we performed fully-atomic molecular dynamics simulation of several types of nucleosomes to analyze the contribution of each core-histone to nucleosome structure stability. We particularly focused on the characteristics of typical conformations, free-energy landscape structures, and global correlative motions of the nucleosome containing all histone, that lacking one H2A/H2B hetero-dimer, and that lacking one H3/H4 hetero-dimer.

References

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Title: Online Selling Forecast - Part I - Factor Analysis
Abstract: Forecasting store sales is one of the key aspects of the retail loan evaluation. A reasonable credit limit can be evaluated by precise sales estimations, and so the utilization of bank funds can be raised. Small online business financing makes the online stores be available to check their loan limits at any time, and also bank funds can be directly transferred to the merchant-related accounts. Online shopping mall combined with commercial credit uses of embedded online services and technology capabilities to achieve the integration of online financial services.
Our problem is to establish sales-forecasting model through the six months of sales orders, customer evaluations, advertizing costs and other information. In part I, we will describe how to analyze the most representative factor. In part II, we use several statistical prediction results (random forest, neural network, ...) for comparison, and find a suitable prediction model for this data.

Title: Online Selling Forecast- Part II - Model Selection
Abstract: Forecasting store sales is one of the key aspects of the retail loan evaluation. A reasonable credit limit can be evaluated by precise sales estimations, and so the utilization of bank funds can be raised. Small online business financing makes the online stores be available to check their loan limits at any time, and also bank funds can be directly transferred to the merchant-related accounts. Online shopping mall combined with commercial credit uses of embedded online services and technology capabilities to achieve the integration of online financial services.
Our problem is to establish sales-forecasting model through the six months of sales orders, customer evaluations, advertizing costs and other information. In part I, we will describe how to analyze the most representative factor. In part II, we use several statistical prediction results (random forest, neural network, ...) for comparison, and find a suitable prediction model for this data.

Title: Analysis of Sand Dune Dynamics under unidirectional steady flow Using Lattice Boltzmann Method
Abstract: Understanding of the dynamics of sand dunes, which are the largest sand topographies on the earth, have been developed through field observations, laboratory experiments, and numerical modeling. However, sand dunes require enormously long time for their movement, in addition, their dynamics are driven by the complex interactions between fluid and sand particles along dune surface. Therefore, various aspects of full-scale dynamics of dunes have little been elucidated until now. In this research, we focus on the Barchan dunes which have a typical shape, the crescentic form, of dunes. They have been observed also on the surface in other planets such as Mars and Titan in recent years. We use a mathematical model combining fluid movement and sediment transport in order to elucidate the mechanism of forming and maintaining the characteristic shape of Barchan dunes, in which we calculate the fluid (wind) dynamics using Lattice Boltzmann Method and the sediment transportation using a stochastic cellular automaton [1]. Here, we investigate the relation between the shape of sand dunes and the flow pattern of fluid over...
dunes with changing the Reynolds number \( Re \), which is defined by the ratio between the unidirectional inflow speed and the initial height of dunes. As a result, the dynamics of the fluid were divided into three characteristic patterns according to \( Re \). In the case of low \( Re \), no vortex was generated in the flow field and the height of dunes monotonically decreased with time. On the other hand, the steady vortices were observed behind dunes within an appropriate range of \( Re \) in which case the steady shape of Barchan dunes was kept for long time. Reference:

Title: "Prostate Pathology Image Classification"
Abstract: Deep learning has recently been proved to be very effective for image recognition since 2012. Medical images, as one of the most important category of images, however, hasn’t been well studied with deep learning. Researchers encounter problems like lack of data number and robustness, extremely large data size, etc. Pathology images are images of dyed human tissue, which is often used for cancer diagnosis. In this research, I use various of deep learning techniques to classify prostate pathology images of different grades. The accuracy we achieved has been the best so far to our knowledge.

Title: Parallelization of a Code for Solving Multidimensional Cardiac Models
Abstract: In our work, we develop a package method to simulate the action potential wave propagation on cardiac tissues and use the OpenMP and CUDA technique to accelerate the code. We consider the monodomain model in our project. The monodomain electrocardiac wave equation is a reaction-diffusion equation and the reaction term is governed by a cardiac cell model which consists of many ordinary differential equations. For a preliminary study, we use the finite difference method to discretize the differential equations. To improve the performance, we use the OpenMP and CUDA to accelerate our code. The packages can be used to study medical problems, for example, phenomena related to the cardiac fibroblasts, ion-channels related heart disease, etc in the future.
Mathematical modeling for the inverse imaging of phononic crystals

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Abstract

We will present a mathematical framework for performing the sub-micron acoustic imaging of phononic crystals. Our proposed framework is based on computational tomography techniques, paired with experimental observations of surface acoustic waves (SAW). In particular, we have developed mathematical, computational and experimental methods for investigating the inverse imaging of PnC, where mineral thin-sections are used in the SAW imaging experiments.

In addition to discussing the mathematical model for expressing the propagation of elastic waves through multiphase PnC, we will show experimental results for the motion of SAWs. Regarding the computational tomography, a Lagrangian approach has been used to gain information about the gradient of the inverse imaging problem’s cost functional and we will show numerical results for the numerical solution of the corresponding state and adjoint problems. The experimental results are joint work with O. Wright and P. Otsuka at Hokkaido University.

Figure 1: (Left): A multiphase PnC. (Center): SAW imaging result. (Right): Simulation.

References


"M2-(鄭怡玟) Yiwen Cheng" <chywen18@gmail.com>, NUK

Title: Mathematical Model of Complement System

Abstract: When pathogens attack our body, immune system will avoid the invasion. We usually classify immune system into innate and adaptive immune systems. Complement system is made up of proteins. After being activated, complements trigger the following functions: phagocytosis (by opsonizing antigens), inflammation (by attracting macrophages and neutrophils), membrane attack (by rupturing cell wall of bacteria) and coagulation (by agglutinating pathogens). Complement system also connects innate and adaptive immune system. Certain substances of complements could be the indicator of effectiveness of immune system, that is the reason we build the model. In this talk, we will introduce the mechanism, modeling, and the extending problems.
Title: Numerical Methods of Poisson-Nernst-Plank Based Models with Parallel Implementation and Applications

Abstract: Poisson-Nernst-Plank (PNP) equation is a well-known model for describing ion transport in many physical and biological phenomena. Due to the ionic size, steric repulsion may be caused by crowded ions in several biological systems, so the modified PNP with additional steric terms has been proposed, which are nonlinear, highest-order derivatives terms, and coupled by all kinds of ions. I’ll present spectral element schemes and implementation for solving unsteady and steady-state PNP-steric model in the Argonne-developed scalable high-order software package, NekCEM. I’ll also demonstrate convergence studies for validating our schemes, provided with some preliminary results of applications to ion transport simulations with a real protein structure of KcsA potassium channel. The complex geometry is taken care by imposing internal boundary condition, and simulations are performed on more than thousands of CPU cores on the Argonne Leadership Computing Facility (ALCF).
Title: Hydrodynamic Analysis of turning mechanism of Euglena gracilis by propagating a solitary wave on single flagellum
Abstract: Euglena gracilis is a microorganism swimming with the single flagellum stemming from the head (the direction of the swimming). This way of swimming is different from other microorganisms such as E. Coli and sperm. The flagellum motion of E. gracilis during swimming, especially during turning mechanism, has not been clarified. We analyzed the swimming Euglena, and found characteristic flagellum motion. In particular, Euglena had a characteristic motion when the body changes the direction. In this situation, the flagellum is not twisting around the body but extends off the body and a solitary wave is propagated from the base to the tip, by which a torque to turn is generated. We constructed mathematical models and calculate the hydrodynamic force by several methods. We report differences in natures of several models based on calculated result. Efficiency of these models and comparison with experiments will be discussed.

"M1-(柯智煌) Zhi-Haung Ke" <shadowblue597@gmail.com>, NCKU

Title: Notes on Chebyshev polynomial of the first kind
Abstract: In this talk, I shall present the Dickson polynomial of the first kind, the Chebyshev polynomial of the first kind and the Stirling numbers. Especially, I will refer to present their relations and their application to the Riordan group.

"M-Kana Mizuno" <true.blue.sky20@gmail.com>, Shimane U

Title: Toward an understanding of a mechanism for dynamic pattern formation in cuttlefish
Abstract: Some mechanism of pattern formation on animal skin has been understood by reaction diffusion equation such as Turing model. In this model, the spatial pattern changes with time evolution, but it converges to a stable pattern. On the other hand, pattern formation of cephalopods changes instantaneously, and the time scale is fast compared with the Turing pattern formation. In the case of cephalopods, the patterns are changed by muscle contraction around pigment cells. In this study, toward understanding pattern formation in cuttlefish, as the first step, we aim to build a simple model by capturing the characteristics of cuttlefish’s skin structure.

"M3-(蕭定洋) Ting-Yang Hsiao" <r04221011@ntu.edu.tw>, NTU

Title: Estimates of population sizes for traveling wave solutions of Lotka-Volterra competition systems with non-local diffusion.
Abstract: For the two species Lotka-Volterra discrete competition-diffusion system, Chen-Hung-Hsiao obtained total mass estimates for the traveling wave solutions. In this talk, we are interested in the problem if similar estimates also hold for the traveling wave solutions of Lotka-Volterra competition systems with non-local diffusion.
The effect of diffusions on the Lotka-Volterra prey-predator model in spatially heterogeneous environments

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In [1] the authors consider a Lotka-Volterra prey-predator model in heterogeneous habitats of source and sink, assigned in patches. They assume that the only the predator moves between the patches by diffusion and numerically show that the slower diffusion benefits the total population of the predator. Motivated by their work, we study the following Lotka-Volterra prey-predator diffusion model in an interval with a heterogeneous carrying capacity $K(x)$:

$$
\begin{align*}
\frac{\partial u}{\partial t} &= d_u \frac{\partial^2 u}{\partial x^2} + u \left( 1 - \frac{u}{K(x)} - v \right), \\
\frac{\partial v}{\partial t} &= d_v \frac{\partial^2 v}{\partial x^2} + v (-\alpha - \beta v + \gamma u),
\end{align*}
$$

$0 < x < 1, \ t > 0$,

$u(0,t) = u(1,t) = 0, \ v(0,t) = u(1,t) = 0.$

Here, $u(x,t)$ and $v(x,t)$ stand for the population of the prey and the predator respectively. $d_u$ and $d_v$ are diffusion rates. The constants $\alpha$, $\beta$, $\gamma$ are all positive. $\alpha$ is the mortality of predator, $\beta$ the interspecific competition rate of predator, and $\gamma$ the efficiency of conversion of prey to predator. We assume $K(x)$ so that the domain is separated by source and sink region, namely, the diffusion-free system allows the coexistence of the prey and predator in the source region while only the prey can survive in the sink. In this talk, I will report the research on how the total populations depend on the emigration by the diffusion of prey and predator. This is a joint work with Prof. Y. Morita (Ryukoku University).

References

"M2-(王舜傑) Shun-Chieh Wang" <fashionalhero@yahoo.com.tw>, NTU

Title

Traveling Wave Solutions of a 3-Species Competition-Diffusion Model with Weak Competition

Abstract

In this presentation, we will first introduce basic properties of traveling wave solutions of the Lotka-Volterra competition-diffusion model of 2-species $(u,v)$. For $\xi = x - st$, the equation will be

$$
\begin{align*}
\frac{\partial u_{\xi\xi}}{\partial \xi} + s u_{\xi} + u(1 - u - cv) &= 0, \\
\frac{\partial v_{\xi\xi}}{\partial \xi} + s v_{\xi} + v(a - bu - v) &= 0, \\
(u,v)(-\infty) &= (0, s), \ (u,v)(+\infty) = (1, 0).
\end{align*}
$$

Then we will consider 3-species $(u,v,w)$ problem with the competitions between $u$ and $w$ and between $v$ and $w$ being $\epsilon$.

$$
\begin{align*}
\frac{\partial u_{\xi\xi}}{\partial \xi} + s u_{\xi} + u(1 - u - cv - \epsilon w) &= 0, \\
\frac{\partial v_{\xi\xi}}{\partial \xi} + s v_{\xi} + v(a - bu - v - w) &= 0, \\
\frac{\partial w_{\xi\xi}}{\partial \xi} + s w_{\xi} + w(\gamma a - C_{uv} u - C_{uw} u - C_{vw} v) &= 0, \\
(u,v,w)(-\infty) &= (0, a, 0), \ (u,v,w)(+\infty) = (1, 0, 0).
\end{align*}
$$

This talk focuses on the question: when $\epsilon \to 0$, how does the $(u,v)$-component of the solution converge to the solution of the 2-species system without $w$? We will give some estimate for the convergence rate of the solution.

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Title: Reaction-diffusion equation in growing region
Abstract: When we study reaction-diffusion equations, we usually treat them in a fixed domain. However, it is often observed that distributions of chemical substances fluctuate by the effect of reaction and diffusion, while the domain varies in biological phenomena, such as animal coat pattern. Thus, it is natural to consider the effect of changes of domain. In this talk, we propose one of the manners of growing domain and study its property. I will apply it to a model for pattern formation of snakes’ skin that was proposed by Murray [1].

Title: A divide-and-conquer Contour Integral Eigensolver
Abstract: Implement the contour integral eigensolver with a divide-and-conquer method. The eigensolver based on Contour Integral is a powerful tool to solve the whole eigenpairs in a specific region. For some reasons, we need to split the interval. Thus, how to divide the interval without losing eigenpairs is a significant problem. Moreover, apply the conquer technique to pick up those eigenpair lost in the dividing step.

Title: An Efficient Contour Integral Based Eigensolver for Surface Plasmon Simulations
Abstract: In this talk, I will introduce the surface plasmon problem modelled by the Maxwell equations, derive the corresponding eigenvalue problem from the model equations and discuss my research on developing an efficient contour integral based eigensolver to the problem.

Title: Experimental Study of Situation-Dependent Task Allocation in Camponotus japonicus
Abstract: Activity for performing several kinds of tasks by ants in each colony shows hierarchical structures. That is, some fraction of ants in a colony are more diligent to fulfill each task than the remaining part of ants in the same colony. In this sense ants in a colony can be divided into two types, lazy and diligent based on their degree of activity on a task. When ants in a colony are separated into two groups, the lazy group and the diligent group before separation, some ants in the lazy group become more diligent than before separation, and some ants in a diligent group become more lazy than before [1]. This behavioral change is well explained by Response Threshold Model [2]. However, there is not enough argument whether the Response Threshold Model is applicable when the separated ants groups are recombined again to one group. We observed behavioral change of each individual ant when recombining the separated ant groups of Camponotus japonicus. We confirmed the behavioral changes which can be explained by the Response Threshold Model.

References
[1] Yasunori Ishii, Eisuke Hasegawa, “The mechanism underlying the regulation of work-related behaviors
Title: The variable-yield model with the wall growth under the exchange rate
Abstract: In this talk, I will talk about the exchange situation with the wall growth by using the variable-yield model. We will review the traditional fixed-yield model by Paul Waltman and give our motivation for studying the variable-yield model. After that, we will give some mainly theoretical and numerical results. We can take the classical method from the boundedness to develop our analysis, such as locally stability analysis, some global stability analysis.

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"UG4-（盧提文）Ti-Wen Lu" <ivy19951114@gmail.com>, NCKU

Title: DNA Topology-Topological Enzymology for Site-Specific Recombination and the Tangle Model
Abstract: DNA Topology began in the last decades of the 20th century, and is still the focus of biophysical discussions. These all started from a simple question about the spatial structures of DNA, which opened the door to an interesting research area for both Biology and Mathematics. In this talk, I will show you Topological aspects of DNA structures that will provide an insight into biochemical mechanisms.

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"UG4-(郭玥均) Yueh-Chun Kuo" <zxcv9869@gmail.com>, NCKU

Title: How to Plan Optimize Your Loan
Abstract: To discuss that how to arrange the principal repaid more, during the loan period and analyze the amortization schedule, which shows the interrelationships between the balance, principal payments, and interest payments over the duration of a loan. Then show that how to use the amortization schedule in our reality.

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UG4-Masami Koshino" <t130034@mail.ryukoku.ac.jp>, Ryukoku U

Title: Thistlethwaite's method for the FULRD problem of Rubik's cube
Abstract: Rubik's cube group $G$ is a finite group of order $4.3*10^{19}$. Rokicki et al. (2010) showed that in the FTM(Face Turn Metric), the diameter of G is 20, which was called God's number. It is known that the cube can be solved by the moves in only 5 faces, for example F(forward), U(up), D(down), L(left), and R(right). That is, the 90 degree move in the back face B can be reproduced by some combinations of F, U, L, R and D's. Our task is to estimate the diameter of G in the FULRD-FTM metric, which we call FTM5. The classical by M.Thistlethwaite can be applied directly to FTM5. It considers a sequence of subgroups $G = G_0 > G_1 > G_2 > G_3 > G_4 = id$, and calculate the sum of the diameters of $G/G_1$, $G_1/G_2$, $G_2/G_3$, and $G_3/G_4=G_3$. In the ordinary FTM, which we denote by FTM6, the sum of the diameters is $7+10+13+15 = 45$ (Thistlethwaite, 1981), whereas in FTM5, the sum of the diameters is $11+11+13+16=51$. The diameters $G/G_2$ and $G_2/G_4=G_2$ give better estimate of God's number. In FTM6, $\text{diam}(G/G_2) + \text{diam}(G_2)$...
= 12 + 18 = 30 (H. Kociemba, 1995). In FTM5, we have diam(G/G2) + diam(G2) = 14 + 18 = 32.

"UG2-(林育愷) Yu-Kai Lin" <stephen359595@gmail.com>, NCU

Title: A Survey of Curved Document Image Rectification
Abstract: Optical Character Recognition (OCR) is widely-known in modern image processing; however, the annoying problem is that OCR may fail in dealing with document images of distortion occasionally. In this discussion, we will expound some methods of curved document image rectification. Additionally, we will discuss a model associated with distorted document images, and apply this model to each method mentioned above. With some experimental results, we will analyze the difference of each method in detail, and eventually make our own opinion.

"UG3-(呂明修) Ming-Hsiu Lu " <hugo572G@outlook.com>, NCU

Title: A description of object in space and 3D point cloud segmentation
Abstract: In this talk, I will introduce a way to descript the object in space – point cloud. At the same time, I will focus on the goal which I be asked to hit and make discussion of the current progress and future work. In discussion, normal and curvature will be the principal mathematical tool.

Sunday(03/04)

"D-Kabir Muhammad Humayun" <kabir@meiji.ac.jp>, Meiji U
Title: Modeling of the effect of farming technology in the Neolithic transition of Europe
Abstract: The Neolithic transition is a demographic shift from hunter-gatherers to farmers, which is one of the major transformations in the course of human evolution. Archeological evidence of Neolithic transition suggests that expanding velocity of farmers is roughly constant [1,2]. To understand such phenomenon, many theoretical attempts have been progressed through mathematical modeling [2]. Existing modeling approaches on Neolithic transition indicates that expanding velocity is faster than the observed one. For understanding of this difference, we propose a three-component reaction-diffusion system which involves two different types of farmers: sedentary and migratory ones [3]. Moreover, we introduce the 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 when the expanding pattern of farmers is radially symmetric. Finally our model suggests that the minimal velocity of traveling waves explains the spreading velocity of farmers when expanding pattern exhibits radial symmetry. Numerical result reveals that the minimal velocity of traveling wave solutions becomes slower when farming technology is suitably developed [4]. Furthermore, we address the question: Does the radial symmetry of expanding patterns always hold or not? This is a joint work with Jan Elias (Univ. Graz, Austria) and Je-Chiang Tsai (National Tsing Hua Univ., Taiwan).

References:
Title: Global feedback to oscillatory reaction diffusion system with Belousov-Zhabotinsky reaction

Abstract: Pattern dynamics that is observed in chemical reaction, biology and physiology et al. has been explained by using reaction diffusion systems (RD system). However, we have not understood sufficiently that we control patterns in oscillatory RD system[2]. So, it is an important problem for understanding pattern dynamics to give feedback control to RD system. Swinney et al. reported that photo-sensitive Belousov-Zhabotinsky(BZ) reaction transformed a rotating spiral wave to a labyrinthine standing-wave pattern by giving periodic light stimulation[3]. On the other hand we reported theoretical research. If we give global feedback to the activator of RD system, we can observe hexagon pattern and stripe pattern stably. (These patterns are unstable normally.)[1, 4]

Under the above background, we tried to apply global feedback control system to photo-sensitive BZ reaction. At first, we considered to give global feedback to inhibitor of Oregonator model in order to adapt to BZ reaction. In this system, we observed standing wave oscillation. And we can approach feedback system to 3-component RD system. So we might expect that this standing wave is a natural behavior of BZ reaction system unlike the case of Swinney's experiment. By considering reducted-ODE system, we consider that this standing wave oscillation relates to period-doubling bifurcation. And we tried to observe corresponding results by using real BZ reaction.

References
[4] Y. Umezu , T. Ogawa , K. Kashima , Selective Stabilization of Unstable Standing Waves in a Reaction-
Title: Synchronization and Kuramoto Model
Abstract: In this talk, I will introduce some phenomenon of synchronization and the first order Kuramoto model. The sufficient condition of frequency synchronization will also be contained in this presentation.

References

Title: Origami Pattern Design for Building 3D Irregular Shapes with a Robot System
Abstract: Today, the ancient art of paper-folding formally known as origami has attracted the attention of the scientific community, due to its applications in vast number of fields, such as: air-spatial panels, medicine, architecture, and packaging. Be able to do automatic paper-folding using a robot has been a challenge for almost 20 years.

For a human being, that has a vast number of censoring systems, creating a three-dimensional (3D) origami figures, is in many occasions very simple. On the other hand, for a robot, that has a limited number of reachable movements and censoring, the complexity in a crease pattern plays an important role to determinate which patterns can be folded by the robot.

The origami patterns from previous works were intended to be assembled by hand and have folds that are very difficult to execute with a robot due to handling problems. In in our previous work [1], a crease pattern design methodology was proposed to create 3D shapes based in surface of revolution and able to be folded by a robot. This methodology uses a combination of simple folds with gluing segments to simplify the crease pattern. In this methodology, the crease patterns are created from a two-dimensional (2D) profile, that is divided into $K$ number of equal segments and rotated by $\frac{2\pi}{N}$, from 0 to $2\pi$. The resulting pattern, are two sets of trapezoids, one of them are the base panels that forms the final 3D shape, and the other ones are the resulting gluing flaps. Although this methodology can be used to build interesting 3D
shapes it is limited to only figures based in surface of revolution. 
In this paper, a novel methodology to design crease patterns of irregular shapes is proposed. This methodology is created from the surface of revolution methodology, but instead of having a single profile, we have two or more. The profiles are extracted directly form a STL file and used to create the crease pattern. The method uses the spatial information of the vertices to perform a triangulation, preserving the cylindrical projection that is required to generate symmetrical gluing areas required by the robot to perform an automatic folding.
Several examples are shown to demonstrate the reliability of this crease patterns. Apart of this, a general solution is exposed to applying this methodology to any type of shapes. This methodology not only can be used to perform automatic folding, but also can be used to simplify complex crease patterns to be made by hand and reduce the time to create these shapes.


"D2-(楊大緯) David Yang" <l18051015@mail.ncku.edu.tw>, NCKU

Title: Mathematical model and Decision
Abstract: We study the war of two armies under some hypothesis, write down the simultaneous differential equations, and solve it.
Next we observe the behavior of the solutions, and find out the discriminate of the simultaneous differential equations. The discriminate tell us which team wins.

"D2-Eduardo Jatulan" <eojatulan@up.edu.ph>, NSYSU

Title: Dispersion relations for some periodic quantum graphs
Abstract: We study the periodic spectrum of some differential operators, in particular the Schrödinger operator acting on infinite polygonal graphs. Using Floquet-Bloch theory, we derive and analyze on the dispersion relations of the periodic quantum graph generated by triangles and rectangles. The analytic variety, also called Bloch variety, gives the spectrum of the differential operators. Furthermore, it is well known that there are 11 types of Archimedean tilings in the plane. We take two of them, the trihexagonal tiling (3,6,3,6) and truncated hexagonal tiling (3,12,12). Through a systematical characteristic function method, we are able to derive the dispersion relation on the graphs formed by these tilings. We note that these dispersion relations are surprisingly simple, making it possible for further analysis.

"D2-Romain Amyot" <romain-amyot@hiroshima-u.ac.jp>, Hiroshima U

Title: The role of the binding domain of the enzyme Pin1 in a system.
Abstract: The prolyl isomerase Pin1 is a two-domain enzyme consisting of a reactive domain accelerating reactions of some proteins and a binding domain which binds its targets. It is thought that Pin1 helps the folding of proteins and thus alters their shape and their functions. Indeed, proteins should adopt a specific conformation to carry out their roles, then, Pin1 could act as a regulator by activating proteins. In vitro
experiments suggest the binding domain binds to a site in the substrate and the reactive domain catalyses another site. The binding domain is thus thought to bring the reactive domain near its substrates enhancing the reactivity. But how is the reactivity in a system where many Pin1 molecules interact with many substrate molecules? The overall reactivity should depend on several parameters including the number and the structure of molecules and the binding affinity. Considering an abstract model consisting of substrates which switch between a folded state and an unfolded state within reactions with Pin1 molecules, we aim to infer some properties in the role of the binding domain on the overall dynamics. Especially, we are interested in its role in cases ranging from systems with an excess of Pin1 molecules to systems with an excess of substrate molecules since these situations are present in some diseases as cancers (over-expression) and Alzheimer’s disease (down-regulation). Using stochastic simulations, we observe that the distribution of active and inactive substrates at the steady state can vary a lot regarding the number of molecules. In particular, for an excess of either Pin1 molecules or substrate molecules, the distribution resembles those of the case without considering the binding suggesting that the effect of the binding domain is neglected if one of the reactants are in excess over the other.

"D-(張育晟) Yu-Cheng Chang", <andyyczhang@gmail.com>, NCU

Title: 2D semantic segmentation assisted point clouds segmentation
Abstract: Simultaneous localization and mapping (SLAM) is the problem of constructing a map of an unknown environment by a mobile robot while at the same time navigating the environment using the map. In this talk, we consider some errors of map caused by matching algorithms, and we propose a method for accurate point clouds segmentation based on discrete normal, curvature, and 2D semantic segmentation.

"D1-(邱普照) Pu-Zhao Kow" <kow4896@gmail.com>, NCKU

Title: Schauder’s Estimates and Asymptotic Behavior of Solutions of the Stationary Navier-Stokes Equation in an Exterior Domain
Abstract: In this paper, we improve the result in [1], which concern about the asymptotic behavior of an incompressible fluid around a bounded obstacle. Under some assumptions weaker than [1], any nontrivial velocity field obeys a minimal decaying rate $\exp(-C|x|^{-3/2} \log|x|)$ at infinity. Our proof is based on appropriate Carleman estimates and the regularity result, namely the Schauder’s estimate for stationary Navier-Stokes equation. (Joint work with Lin, Ching-Lung) Reference:

"PD-Shota Enomoto" <s_enomoto@meiji.ac.jp>, Meiji U

Title: Large time behavior of the solution to compressible Navier-Stokes equation around space-time periodic flow
Abstract: We consider the compressible Navier-Stokes equation around space-time periodic solution in an infinite layer of $\mathbb{R}^n$ ($n = 2, 3$) 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.

"PD-(周世偉) Shih-wei Chou" <kevieschou@gmail.com>,

Title: Global Well-posedness of Cauchy problem for Compressible Euler equations in Transonic Nozzle Flow

Abstract: In this talk, we consider the Cauchy problem of one-dimensional compressible Euler system for the transonic nozzle flow. We provide the global well-posedness of such problem for the case of expanding nozzles. The global existence of entropy solution is established by the generalized Glimm method. The stability of solution is obtained by extending the results of Bressan, Ha, Liu and Yang to the case of which subsonic and supersonic states both exist.

"PD- Gyeongha Hwang" <ghhwang@ncts.ntu.edu.tw>, NCTS

Title: Existence and symmetric properties of solution to the Neumann problem of Hardy-Sobolev equation with Hardy potential

Abstract: In this talk, we consider the following nonlinear Neumann problem

$$\begin{cases}
-\nabla u - \gamma \frac{u}{|x|^2} + \mu u = \frac{|u|^{2^*-2}u}{|x|^s} & \text{in } \Omega \\
\frac{\partial u}{\partial \nu} = 0 & \text{on } \partial \Omega
\end{cases}$$

where $0 \leq \gamma < \gamma^* := \frac{(N-2)^2}{4}$, $0 < s < 2$, $2^* = \frac{2(N-s)}{N-2}$ and $\Omega$ is $C^2$-bounded domain with $0 \in \overline{\Omega}$.

Firstly, we address the problem of existence and non-existence of solution with isolated singularity on $\Omega = B_R$. We prove that solution does not exist under some condition on $\gamma$, $\mu$ and $s$. And we establish existence of infinitely many radial solution under some condition on $\gamma$, $\mu$ and $s$. Secondly, we are concerned with the problem of existence and symmetric properties of a least energy solution on $\Omega = B_R$. Existence of a least energy solution is established. Furthermore, we verify that a least energy solution is radially symmetric or axially symmetric. Lastly, we establish the existence of infinitely many solutions under some condition on $\Omega$.

"PD-(陳彥穎) Yu-Shuo Chen" <formosa1502@gmail.com>, Tamkang University

Title: Existence and Instability of Traveling Pulses of Keller-Segel System with Nonlinear Chemical Gradients
and Small Diffusions

Abstract: In this paper, we consider a generalized model of 2x2 Keller-Segel system with nonlinear chemical gradient and small cell diffusion. The existence of the traveling pulses for such equations is established by the methods of geometric singular perturbation (GSP in short) and trapping regions from dynamical systems theory. By the technique of GSP, we show that the necessary condition for the existence of traveling pulses is that their limiting profiles with vanishing diffusion can only consist of the slow flows on the critical manifold of the corresponding algebraic-differential system. We also consider the linear instability of these pulses by the spectral analysis of the linearized operators.

"PD-(高月圓) Yueyuan Gao" <yueyuangao.wh@gmail.com> (MathAM-OIL, AIST c/o AIMR, Tohoku University, Japan)

Title: Existence and uniqueness results for a first order conservation law involving a Q-Brownian motion

Abstract: Inspired by the works of Bauzet et al. [1, 2], we consider a first order stochastic conservation law with a multiplicative source term involving a Q-Brownian motion. We first present the result that the discrete solution obtained by a finite volume method converges along a subsequence in the sense of Young measures to a measure-valued entropy solution as the maximum diameter of the volume elements and the time step tend to zero [3]. This convergence result yields the existence of a measure-valued entropy solution. We present the Kato's inequality and as a corollary we deduce the uniqueness of the measure-valued entropy solution as well as the uniqueness of the weak entropy solution. The Kato's inequality is proved by a doubling of variables method; in order to apply this method, we study an associated nonlinear parabolic problem. Finally we show some numerical results of stochastic Burgers equation by applying finite volume method and Monte-Carlo method. This is joint work with Tadahisa Funaki (Waseda University) and Danielle Hilhorst (CNRS and Universite Paris-Sud).

References


[3] T. Funaki, Y. Gao and D. Hilhorst, Convergence of a nite volume scheme for a stochastic conservation law involving a Q-Brownian motion, Accepted for publication by DCDS-B, AIMS, hal-01404119.


"PD-(李信儀) Hsin-Yi Lee" <apostol2000@hotmail.com>, NCU

Title: The generalized Riemann solver to a multi-lanes model in traffic flows

Abstract: In this talk, we consider a multi-lanes model of traffic flow, which is governed by a hyperbolic system of balance laws. The system of balance laws is given as a 2 b Mizuno 2 nonlinear hyperbolic system with discontinuous source. The physical meaning of the model will be described in the first part of the talk. Secondly, we study the generalized solution to the Riemann problem by using Lax's method and the construction of perturbation solving associated linearized hyperbolic equations. The residuals are
estimated for the consistency of the generalized Glimm scheme.

"PD-Lorenzo Contento" <lorenzo.contento@gmail.com>, Meiji U,

Title: The mechanism behind traveling wave interaction in a reaction-diffusion system

Abstract: One-dimensional traveling wave solutions are an important tool for the study of reaction-diffusion systems. In particular, their interaction and their planar stability can be used to explain the occurrence of complex patterns in two-spatial dimensions. In this talk we will present a couple of fronts which interact in different ways depending on the value of a free parameter. We will reveal the mechanism behind this change of behaviour by studying the bifurcation structure of the traveling wave solutions.