FMfI2023 Booklet

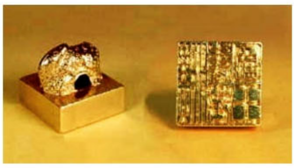
ICIAM 2023 TOKYO
August 20-25 2023, Tokyo

Forum "Math-for-Industry" 2023 — MfI 2.0 —

Institute of Mathematics for Industry, Kyushu University, Fukuoka, Japan

Nishijin Plaza, August 29 – September 1, 2023

A Satellite Meeting of the 10th International Congress on Industrial and Applied Mathematics (ICIAM 2023)




Forum "Math-for-Industry" 2023 —MfI2.0—:

The fifteenth installment of the FMfI series initiated by Kyushu University under the auspices of the Asia Pacific Consortium of Mathematics for Industry (APCMfI)

Kyushu University Nishijin Plaza
2-16-23 Nishijin, Sawara-ku, Fukuoka 814-0002, JAPAN

29 August - 1 September 2023

https://apcmfi.org/fmfi2023/index.html

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Asia Pacific Consortium of Mathematics for Industry

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Foreword:

It is our pleasure to welcome you to the fifteenth installment of the Forum "Math-for-Industry" (FMfI) conference series, which will be held in Fukuoka, Japan, under the auspices of the Asia Pacific Consortium of Mathematics for Industry (APCMfI). The FMfI series was initiated by Kyushu University and has since grown to become a premier conference for exploring the interface of industrial and applied mathematics to solve challenges with and for industry.

This year, the FMfI2023 is planned to be a satellite conference of the 10th International Congress of Industrial and Applied Mathematics (ICIAM2023), held on August 20-25, 2023, in Tokyo, Japan. The theme of this year's forum, "MfI2.0", highlights the ongoing evolution of the field of mathematics for industry. As industries become increasingly reliant on data-driven decision-making and automation, the importance of practical applications of mathematics in industry continues to grow. The FMfI series has been at the forefront of this development, promoting collaboration between mathematicians, researchers, and industry professionals.

The program for this year's forum includes a series of invited talks ranging from emerging mathematical ideas in MfI to large-scale academia-industry collaborated projects. Our esteemed speakers will share their knowledge and expertise on a variety of topics related to the application of mathematics in industry, and we hope that this will inspire and encourage new collaborations and innovative solutions. In particular, we have invited speakers from the International Council for Industrial and Applied Mathematics (ICIAM), the European Consortium for Mathematics in Industry (ECMI), and the Society of Industrial and Applied Mathematics (SIAM), by which we expect to strengthen the relationship with the international communities.

In addition, we are excited to host a poster session for early career researchers, providing an opportunity for them to share their research and ideas with a wider audience. We hope that this session will foster the next generation of mathematicians who will continue to push the boundaries of mathematics for industry.

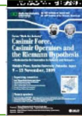
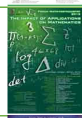
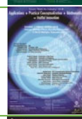
We are thrilled to host FMfI 2023 in Fukuoka, Japan, and we look forward to welcoming you to this exciting and informative conference. We hope that you will find this conference to be a valuable opportunity to share your knowledge and learn from others, and we wish you a productive and enjoyable experience at FMfI 2023. Also, Fukuoka is famous and popular for its fine local special foods, such as fresh fish, ramen (soup noodles), and yakitori (grilled chicken). We hope that you enjoy much of Fukuoka as well!

Chair of FMfI2023 Organizing Committee

Kenji Kajiwara

Forums History

Forum "Math-for-Industry" (FMfI) 2023 is the fifteenth installment of the FMfI series initiated by Kyushu University under the auspices of the Asia Pacific Consortium of Mathematics for Industry (APCMfI). aims and locations of past Forums are listed below.

FMI2008 16 - 17 September 2008	Tokyo, Japan	Math for Industry	
FMI 2009 9 – 13 November, 2009	Fukuoka, Japan	Casimir Force, Casimir Operators and the Riemann Hypothesis -- Mathematics for Innovation in Industry and Science--	
FMI2010 21 - 23 October, 2010	Fukuoka, Japan	Information security, Visualization, and Inverse problems, on the basis of optimization techniques	
FMI 2011 24 - 28 October, 2011	Honolulu, U.S.A.	"TSUNAMI - Mathematical Modelling" Using Mathematics for Natural Disaster Prediction, Recovery and Provision for the Future	
FMI 2012 22 - 26 October, 2012	Fukuoka, Japan	Information Recovery and Discovery	
FMI 2013 4 - 8 November, 2013	Fukuoka, Japan	The Impact of Applications on Mathematics	
FMI2014 27 - 3 1October 2014	Fukuoka, Japan	Applications + Practical Conceptualization + Mathematics = fruitful Innovation	
FMI 2015 26 - 30 October 2015	Fukuoka, Japan	The Role and Importance of Mathematics in Innovation	
FMfI 2016 21 - 23 November 2016	Brisbane, Australia	Agriculture as a metaphor for creativity in all human endeavors	
FMfI 2017 23 - 26 October 2017	Honolulu, U.S.A.	Responding to the Challenges of Climate Change: Exploiting, Harnessing and Enhancing the Opportunities of Clean Energy	
FMfI 2018 17 - 21 November 2018	Shanghai, China	Big Data Analysis, AI, Fintech, Math in Finances and Economics	
FMfI 2019 18 - 21 November 2019	Auckland, New Zealand	Mathematics for the Primary Industries and the Environment	
FMfI 2021 13 - 16 December 2021	Hanoi, Vietnam	Mathematics for Digital Economy	
FMfI 2022 21 - 24 November 2022	Melbourne, Australia	Mathematics of Public Health and Sustainability	
FMfI 2023 29 August - 1 September 2023	Fukuoka, Japan	MfI2.0 Restart to form the upwinding spiral	

FMfI2023 Program at a glance

	Aug. 29	Aug. 30	Aug. 31	Sep. 1
9:00 - 9:30	Registration			
9:30 - 10:00	Opening Kenji Kajiwara Philip Broadbridge Wil Schilders Motoko Kotani			
10:00 - 10:30 chair	①Neil Budko W. Schilders	⑩Amit Singer R. Oishi-Tomiyasu	⑲Kana Shimizu K. Nuida	㉓Sven Leyffer H. Waki
10:30 - 11:00 chair	②Ichiro Hasuo W. Schilders	⑪Busayamas Pimpunchat S. Taylor	⑳Yusuke Aikawa K. Nuida	㉔Yuko Araki M. Y. Hirose
11:00 - 11:30				
11:30 - 12:00 chair	③José Alberto Cuminato O. Saeki	⑫Konrad Polthier H. Ochiai	㉑Hiroe Tsubaki S. Kurata	㉕Philip Broadbridge H. Nguyen
12:00 - 12:30 chair	④Mark McGuinness O. Saeki	⑬Tomohiro Tachi H. Ochiai	㉒Masayo Y. Hirose S. Kurata	㉖Kaname Matsue H. Nguyen
12:30 - 14:00				
14:00 - 14:30 chair	⑤Yasuaki Hiraoka S. Kaji	⑭Hiroaki Yamada N. Kamiyama	Poster session	㉗Stephen Taylor P. Broadbridge
14:30 - 15:00 chair	⑥Jae-Hun Jung S. Kaji	⑮Satoru Tokuda N. Kamiyama	Poster session	㉘Nor Haniza Sarmin P. Broadbridge
15:00 - 15:30 chair	⑦Daisuke Sakurai S. Kaji	⑯Yoshikazu Terada N. Kamiyama	Poster session	Closing Philip Broadbridge
15:30 - 16:00			Poster session	
16:00 - 16:30 chair	⑧Maria J Esteban Y. Fukumoto	⑰Naoki Hamada Y. Mizoguchi	Poster session	
16:30 - 17:00 chair	⑨Alfio Quarteroni Y. Fukumoto	⑱Jun Sese Y. Mizoguchi	Poster session	
17:00 - 17:30			Poster session	
18:30 -		Banquet		

(orange box) : Online talk

TIME TABLE

Monday 28 August 2023	
14:00 -15:00	**IMI International Advisory Board Meeting** Participants: IMI International advisory board members
15:30 - 16:30	**Asia Pacific Consortium of Mathematics for Industry Board Meeting** Participants: APCMfI council members
16:30 -17:30	**Asia Pacific Consortium of Mathematics for Industry General Meeting** Participants: All APCMfI members
17:30 - 18:00	**IJMI Editorial board meeting** Participants: IJMI Editorial Board Members
Tuesday 29 August 2023	
9:00 - 9:30	**Registration**: Please register for FMfI2023 at the reception counter, and confirm receipt of the forum materials and your name tag. If you wish to participate in the banquet, please pay in Japanese yen. Also, if necessary, please check in your baggage.
9:30 - 10:00	**Opening ceremony** Congratulatory speech: ・**Kenji Kajiwara** (Kyushu University, JPN) ・**Philip Broadbridge** (La Trobe University, AUS) ・**Wil Schilders** (Eindhoven University of Technology, NLD) ・**Motoko Kotani** (Tohoku University, JPN)
10:00 - 10:30 Chair	① **Neil Budko** Wil Schilders
10:30 - 11:00 Chair	② **Ichiro Hasuo** Wil Schilders
11:30 - 12:00 Chair	③ **José Alberto Cuminato** Osamu Saeki
12:00 - 12:30 Chair	④ **Mark McGuinness** Osamu Saeki

12:30 - 14:00 **Lunch**	Before lunch Group Photo 
14:00 - 14:30 Chair	⑤ **Yasuaki Hiraoka** Shizuo Kaji
14:30 - 15:00 Chair	⑥ **Jae-Hun Jung** Shizuo Kaji
15:00 - 15:30 Chair	⑦ **Daisuke Sakurai** Shizuo Kaji
16:00 - 16:30 Chair	⑧ **Maria J Esteban** (online talk) Yasuhide Fukumoto
16:30 - 17:00 Chair	⑨ **Alfio Quarteroni** (online talk) Yasuhide Fukumoto
Wednesday 30 August 2023	
10:00 - 10:30 Chair	⑩ **Amit Singer** (online talk) Ryoko Oishi-Tomiyasu
10:30 - 11:00 Chair	⑪ **Busayamas Pimpunchat** Stephen Taylor
11:30 - 12:00 Chair	⑫ **Konrad Polthier** Hiroyuki Ochiai
12:00 - 12:30 Chair	⑬ **Tomohiro Tachi** (online talk) Hiroyuki Ochiai
14:00 - 14:30 Chair	⑭ **Hiroaki Yamada** Naoyuki Kamiyama
14:30 - 15:00 Chair	⑮ **Satoru Tokuda** Naoyuki Kamiyama
15:00 - 15:30 Chair	⑯ **Yoshikazu Terada** Naoyuki Kamiyama
16:00 - 16:30 Chair	⑰ **Naoki Hamada** Yoshihiro Mizoguchi
16:30 - 17:00 Chair	⑱ **Jun Sese** Yoshihiro Mizoguchi

18:30 -	**Banquet**
	Thursday 31 August 2023
10:00 - 10:30 Chair	⑲ **Kana Shimizu** Koji Nuida
10:30 - 11:00 Chair	⑳ **Yusuke Aikawa** Koji Nuida
11:30 - 12:00 Chair	㉑ **Hiroe Tsubaki** Sumito Kurata
12:00 - 12:30 Chair	㉒ **Masayo Y. Hirose** Sumito Kurata
14:00 - 18:00 Chair	**Poster session**
	Friday 1 September 2023
10:00 - 10:30 Chair	㉓ **Sven Leyffer** (online talk) Hayato Waki
10:30 - 11:00 Chair	㉔ **Yuko Araki** Masayo Y. Hirose
11:30 - 12:00 Chair	㉕ **Philip Broadbridge** Dinh Hoa Nguyen
12:00 - 12:30 Chair	㉖ **Kaname Matsue** Dinh Hoa Nguyen
14:00 - 14:30 Chair	㉗ **Stephen Taylor** Philip Broadbridge
14:30 - 15:00 Chair	㉘ **Nor Haniza Sarmin** Philip Broadbridge
15:00 - 15:30	**Closing** ・**Philip Broadbridge** **Poster Prize-Giving** 

Presentation Abstract

Usage Guide

Information on speakers is listed in order of presentation number.

(0) Time
(1) **Name**
(2) Affiliation
(3) **Lecture title**
(4) Abstract
(5) Keywords
represents.

①
(0) Aug.29, 10:00 - 10:30
(1) **Neil Budko**
(2) Delft University of Technology
(3) **ECMI: Cooperating, Promoting and Teaching Industrial Mathematics in Europe**
(4) The European Consortium for Mathematics in Industry (ECMI), established in 1987, is actively engaged in promoting the role of mathematics in industry, teaching new generations of applied mathematicians to work directly with industry, and helping the members of academia to acquire European and industrial funding. In this talk the structure and activities of ECMI will be described, including: nodes, study groups, special interest groups, modeling weeks, bi-annual conference, prizes, and publications. Current research directions and initiatives at various ECMI nodes will be presented.

②
(0) Aug.29, 10:30 - 11:00
(1) **Ichiro Hasuo**
(2) National Institute of Informatics
(3) **Proving Safety of Automated Driving Vehicles**
(4) I will introduce our recent work on using mathematical logic to rigorously prove the safety of automated driving vehicles. The main challenge in such formal verification attempts for real-world systems is the absence of target system models. We follow the methodology called RSS (responsibility-sensitive safety, Shalev-Shwartz et al., 2017) that tells what to model (and what not to model) in a both technically and socially sensible way. Our logical formalization and extension of RSS allows us to handle complex driving scenarios in a compositional manner. Overall, the work suggests the potential of mathematical logic as a social infrastructure for establishing trust in novel ICT.

③
(0) Aug.29, 11:30 - 12:00
(1) **José Alberto Cuminato and Débora de Oliveira Medeiros**
(2) Institute of Mathematics and Computer Sciences, University of São Paulo - USP
(3) **A Lagrangian-finite difference scheme for viscoelastic fluid flows**
(4) We present new numerical schemes based on writing the upper-convected time derivative of the polymeric tensor in terms of the Generalized Lie Derivative (GLD) on a Lagrangian framework and then discretizing it by finite differences. The viscoelastic models are rewritten considering the GLD with the method of characteristics. The polymeric tensor derivatives are approximated by methods of first or second order in time, combined with linear, or quadratic, spatial interpolations in order to improve the stability of the scheme, in preparationfor the study of the High Weissenberg Number Problem.
This is a joint work with Cassio Oishi and Hirofumi Notsu.

④
(0) Aug.29, 12:00 - 12:30
(1) **Mark McGuinness**
(2) Victoria University of Wellington
(3) **Real Time Moisture Measurement using Microwaves**
(4) An important factor when delivering bauxite ore to an alumina factory is the moisture content in the shipment. A microwave analyzer can be mounted across a conveyor belt to measure phase shift, attenuation, and ore depth to infer moisture content in real time using a linear calibration.

The moisture content is a important because it affects the weight of the ore, with direct impact on the true value of the ore. Accurate and reliable continuous moisture measurement is important to both buyer and seller.

Our study is informed by data provided to a European Study Group with Industry that was collected from a number of shipments to a factory in Ireland. We use Maxwell's differential equations to develop a four-layer model of microwave propagation that captures the effects of reflections at multiple interfaces between ore and air. These reflections cause interference effects in phase shifts and attenuation as the ore depth varies on the conveyor belt.

Our model explains the strongly nonlinear dependence of attenuation data on ore depth, and improves understanding of and confidence in the real-time measurement of ore moisture content using microwaves.

⑤
(0) Aug.29, 14:00 - 14:30
(1) **Yasuaki Hiraoka**
(2) Kyoto University
(3) **Persistent homology from viewpoints of representation, probability, and application**
(4) Topological data analysis (TDA) has emerged in this century and shed new light on data science. A particularly important tool in TDA is persistent homology, which can provide useful information about "shape of data" in a multi-scale way. Much of the development of theoretical research on persistent homology has been motivated by applications. This talk will survey the progress of persistent homology from the perspective of both mathematical and applied research.

⑥
(0) Aug.29, 14:30 - 15:00
(1) **Jae-Hun Jung**
(2) POSTECH
(3) **Topological data analysis of time-series data**
(4) Time-series data are found in a wide range of industrial applications. We consider topological data analysis (TDA) as an effective method for identifying inherent cyclic structures in the data. We illustrate some applications of TDA to music and periodic signals using the extracted cyclic patterns.

⑦
(0) Aug.29, 15:00 - 15:30
(1) **Daisuke Sakurai**
(2) Kyushu University, JPN
(3) **Maps and Their Topological Singularities in Visualization**
(4) Computation of topology and singularity has become a recognized tool for understanding scalar field data over a volumetric continuum. In the real world, however, volumetric data are rarely scalar, requiring analysis of vector-valued fields. It is thus interesting to consider how computational topology for scalar fields, which are functions, can be generalized for maps. In this talk, the speaker shares his experience on this topic, especially for visualization. Data are treated as PL-maps for the simplicity of topological analysis, and algorithms are studied in a variety of concepts relating to Reeb graphs and Morse theory. Indeed, one key is the generalization of Reeb graphs and the analysis of their structure for understanding data. In particular, the talk sheds lights on how Reeb spaces and singular fibers appear in the context of computation, and recent work on benchmarking multiobjective optimization solvers.

⑧
(0) Aug.29, 16:00 - 16:30
(1) **Maria J ESTEBAN**
(2) Université Paris-Dauphine, FRA
(3) **A new European initiative to facilitate the interaction of industry and academic mathematicians**
(4) In September 2022 was officially launched the OpenDesk of EU-MATHS-IN. In this talk I will present this one-stop-shop for tailor-made solutions for industry, commerce, public administration and startups and comment on its functioning since its launching.

⑨
(0) Aug.29, 16:30 - 17:00
(1) **Alfio Quarteroni**
(2) Politecnico di Milano, Milan, and EPFL, Lausanne, ITA
(3) **Physics-based and data-driven mathematical models for the simulation of the heart function**
(4) This presentation will focus on an integrated numerical model to simulate the cardiac function.
Physics-based models will represent the backbone of our approach, however their synergistic use with data driven models will be addressed as well.
Applications to several problems of clinical relevance will be discussed.

⑩
(0) Aug.30, 10:00 - 10:30
(1) **Amit Singer**
(2) Princeton University
(3) **Computational Mathematics for Cryo-Electron Microscopy**
(4) Single-particle cryo electron microscopy (cryo-EM) is an increasingly popular technique for elucidating the three-dimensional structure of proteins and other biologically significant complexes at near-atomic resolution. It is an imaging method that does not require crystallization and can capture molecules in their native states. In single-particle cryo-EM, the three-dimensional molecular structure needs to be determined from many noisy two-dimensional tomographic projections of individual molecules, whose orientations and positions are unknown. The high level of noise and the unknown pose parameters are two key elements that make reconstruction a challenging computational problem. Even more challenging is the inference of structural variability and flexible motions when the individual molecules being imaged are in different conformational states. The talk will overview the underlying mathematical theory, computational methods, and notable challenges for structure determination by single-particle cryo-EM.

⑪
(0) Aug.30, 10:30 - 11:00
(1) **Busayamas Pimpunchat**
(2) King Mongkut's Institute of Technology Ladkrabang, Thailand
(3) **The role of AI in society and communities for sustainable progress**
(4) The presented research emphasizes the potential of AI to contribute significantly to greater social good. This technology addresses the world's most pressing challenges. A more resilient and sustainable future can be built by using AI as a powerful tool. By focusing on flood protection, agricultural yields, and social security, we showcase the diverse applications of AI in these domains. In the realm of flood protection, AI algorithms are employed to identify high-risk areas, facilitating improved flood protection systems. This approach aids in minimizing casualties and injuries caused by flooding events. AI techniques also play a vital role in forecasting agricultural yields. By leveraging data-driven insights, farmers can make informed decisions regarding planting and harvesting, leading to enhanced food security. Furthermore, our discussion highlights the application of AI in estimating compensation and determining contribution rates for the Social Security Fund. Such analyses enable governments to establish appropriate rates, ensuring the long-term sustainability of social security systems.

⑫
(0) Aug.30, 11:30 - 12:00
(1) **Konrad Polthier**
(2) Free University of Berlin
(3) **Vibrations of Geometric Shapes**
(4) The vibrations of musical strings are well understood by Fourier analysis while the vibrations of geometric shapes exhibit surprising properties triggered by careful choices of differential geometric energies. We will review solved problems and introduce novel approaches with applications in biology, computer graphics and crystallography.

⑬
(0) Aug.30, 12:00 - 12:30
(1) **Tomohiro Tachi**
(2) The University of Tokyo
(3) **Computationally Designing Macroscopic Behaviors of Origami**
(4) Origami, the traditional art of folding sheets of paper, is attracting the attention of scientists and engineers as an approach to obtaining programmable metamaterials with shape-morphing abilities and mechanical properties. To control and design such exotic behaviors of origami, we are developing a novel framework to handle the macroscopic behaviors of origami through computation. The talk shows our recent works on self-organized wrinkling behaviors, conservative systems of origami tessellations, and STEAM collaboration.

⑭
(0) Aug.30, 14:00 - 14:30
(1) **Hiroaki Yamada**
(2) Converging Technologies Laboratory, Fujitsu Ltd.
(3) **Advancing Social Simulation by Fusing with Machine Learning**
(4) Social simulation is a simulation that reproduces various social phenomena. Social simulation has the advantage of visualizing future and past events that are difficult to observe directly and analyzing counterfactual events. In the fields of logistics, traffic management, and pedestrian management, there has been a lot of social simulation research to visualize the whole perspective of large-scale complex social systems and to analyze policies that are difficult to experiment with. In recent years, there has been growing interest in machine learning, such as deep learning, in the social simulation domain, due to the desire to deal with a large amount of accumulated social data and to link social simulation with the real world (digital twin). Specifically, it is expected that machine learning can be helped to build simulation models using large-scale social data and to analyze massive data generated from simulations. In this presentation, we introduce our research which tries to integrate social simulation and machine learning in order to meet recent expectations.

⑮
(0) Aug.30, 14:30 - 15:00
(1) **Satoru Tokuda**
(2) Research Institute for Information Technology, Kyushu University
(3) **Scaling relations between observed data and Occam's razor in Bayesian model selection**
(4) We show how observed data scale Occam's razor in Bayesian model selection, a guiding principle that models should be simple enough to describe the data. This work is motivated by mathematical modelling for understanding physical phenomena.

⑯
(0) Aug.30, 15:00 - 15:30
(1) **Yoshikazu Terada**
(2) Graduate School of Engineering Science, Osaka University / Center for Advanced Integrated Intelligence Research, RIKEN
(3) **A statistical theory of clustering**
(4) With recent advances in computer and measurement technologies, large and complex datasets have become common in various application fields. The importance of unsupervised learning has been recognized. Clustering, one of the most important tasks in unsupervised learning, aims to discover hidden groups for a given set of data points. However, the theoretical properties of clustering methods have received less attention. In this talk, we will discuss the minimal requirements that clustering methods should satisfy from a theoretical standpoint. We will explain the theoretical properties of several clustering methods and present our recent works related to this topic.

⑰
(0) Aug.30, 16:00 - 16:30
(1) **Naoki Hamada**
(2) KLab Inc.
(3) **Two-Parameter Extension of Regularization Path for Elastic Net**
(4) Elastic net is one of the most successful methods in sparse modeling because its two regularization terms achieve sparseness and robustness simultaneously. However, its regularization path varies only one regularization factor while the other is fixed. This talk gives a two-parameter extension of the regularization path and a method for its approximate computation. This is a joint work with Yusuke Mizota, Shunsuke Ichiki and Kenichi Hayashi.

⑱
(0) Aug.30, 16:30 - 17:00
(1) **Jun Sese**
(2) Humanome Lab., Inc.
(3) **Health forecast machine learning model with 25 million measurement data**
(4) We are conducting health measurement research that measures the daily lives of people with IoT devices, analyzes them and returns the results to subjects. Here, we introduce a machine learning method to predict health conditions based on over 25 million data points and questionnaire results.

⑲
(0) Aug.31, 10:00 - 10:30
(1) **Kana Shimizu**
(2) Waseda University
(3) **Secure string search using a succinct data structure**
(4) The secure multi-party computation (SMPC) enables computing a function among mutually untrusted parties. We introduce an efficient SMPC protocol for a database search using a succinct data structure and show the application to genome sequence search.

⑳
(0) Aug.31, 10:30 - 11:00
(1) **Yusuke Aikawa**
(2) The University of Tokyo
(3) **Expander Families for Post-Quantum Cryptography**
(4) The security of public key cryptography is supported by computational hardness of problems derived from mathematics. For example, the integer factoring problem is a basis for the security of RSA cryptography. However, in 1994, Shor proposed an efficient quantum algorithm solving these problems, for example factoring and discrete logarithm problem (DLP). This means that emergence of large-scale quantum computers will break public key cryptography in use today. So, we need cryptography that are resistant to cryptanalysis by quantum computers. Such cryptographic primitives are called post-quantum cryptography, PQC for short. In order to construct PQC, it is necessary to introduce mathematical computational assumptions that are different from factoring and DLP.

In this talk, the speaker will talk about constructing a candidate of PQC from random walks on expander graphs, including our recent results. In particular, isogeny graphs of abelian varieties and Cayley graph expanders will be discussed.

㉑

(0) Aug.31, 11:30 - 12:00

(1) **Hiroe Tsubaki**

(2) The Institute of Statistical Mathematics, Research Organization of Information and Systems

(3) **Statistical Science for Society**
~ Process and Professionals for Progress ~

(4) Statistical science, which was born as a Grammar of Science, generated the process of customer value generation in industry mainly in the field of quality management. After a brief review of its history, I will discuss how these knowledge management processes should be utilized current social issues that cannot be solved without integrating knowledge from diverse fields, how to incorporate new technologies such as statistical machine learning into the processes, and how to foster professionals who possess necessary knowledge of mathematical scientific methods and competencies of utilizing them.

㉒

(0) Aug.31, 12:00 - 12:30

(1) **Masayo Y. Hirose**

(2) Institute of Mathematics for Industry, Kyushu University

(3) **Poverty Mapping in Japan based on Area Level Model Approach using Japanese Official Microdata**

(4) It has been considered a social problem related to poverty in Japan, especially for a decade. To address such a big issue, making a reliable document to understand some poverty situations for small domains may be essential. In this study, we map the poverty rate of a small demographic domain for each prefecture, which was constructed using official Japanese microdata. We also modified one statistical estimating method under the area-level model to analyze the data obtained using a complex sampling design. This is joint work with Dr. Mayumi Oka at the Institute of Statistical Mathematics.

㉓

(0) Sep.1, 10:00 - 10:30

(1) **Sven Leyffer**

(2) Argonne National Laboratory

(3) **Topological Design Problems and Integer Optimization**

(4) Topological design problems arise in many important engineering and scientific applications, such additive manufacturing and the design of cloaking devices. We formulate these problems as massive mixed-integer PDE-constrained optimization (MIPDECO) problems. We show that despite their seemingly hopeless complexity, MIPDECOs can be solved efficiently (at a cost comparable to a single continuous PDE-constrained optimization solve). We discuss two classes of such methods for solving MIPDECOs that do not require exhaustive tree-searches: rounding techniques, and trust-region methods. Surprisingly, both methods converge asymptotically under mesh refinement to a globally optimal integer solution under a convexity assumption. We illustrate these solution techniques with examples from topology optimization.

㉔

(0) Sep.1, 10:30 - 11:00

(1) **Yuko Araki**

(2) Tohoku University

(3) **Statistical modeling of time-varying physical quantities for tactile evaluation of automotive materials**

(4) In the automotive manufacturing industry, there has been significant progress in automating the production process. When it comes to material selection, some companies evaluate multiple materials using a pressure needle, and based on the results, humans choose the materials that provide a comfortable tactile experience. In this study, we developed a statistical model to investigate how the time-varying physical quantities observed on the surface of each material impact the sensory evaluation through touch. Our proposed model predicts a group based on a set of functions, taking into account quantities that vary over time as a function of time. This approach enables a more precise and quantitative assessment of the tactile properties of materials. Additionally, by utilizing the Karhunen-Loeve expansion of the set of time functions, we uncover the waveform characteristics of the physical quantities over time.

㉕
(0) Sep.1, 11:30 - 12:00
(1) **Philip Broadbridge**
(2) La Trobe University, Australia and IMI-Kyushu University, Japan
(3) **Reaction-diffusion models for fish populations with realistic mobility**
(4) Nonlinear reaction-diffusion equations, with Fisher logistic growth and constant diffusion coefficient, have been used in fisheries research to estimate sustainable harvesting rates and critical domain sizes of no-take areas. However, constant diffusivity in a population density corresponds to standard Brownian motion of individuals, with a normal distribution for displacement over a fixed time interval. For available good data sets on mobile fish populations, the distribution is certainly not normal. The data can be fitted with a long-tailed Lévy distribution that corresponds to diffusion by fractional Laplacian. Optimal foraging theory shows that an order-0.5 Lévy process is optimal for sparse populations.
We have developed exact solutions for realistic Fisher-Kolmogorov-Petrovski-Piscounov models with diffusion by fractional Laplacian. These have also been extended to hyperbolic diffusion models with a Cattaneo-type delay between gradient and flux, as an individual will persist with overcrowding for some time before emigrating. It is then shown how to modify critical domain sizes of protected areas.

㉖
(0) Sep.1, 12:00 - 12:30
(1) **Kaname Matsue**
(2) Institute of Mathematics for Industry / International Institute for Carbon-Neutral Energy Research, Kyushu University, JPN
(3) **Nonlinear dynamics of hydrodynamically unstable premixed flames with physicochemical interactions**
(4) Dynamics of hydrodynamically unstable premixed flames are studied. The nonlinear hydrodynamic model and the Sivashinsky equation are considered to extract intrinsic nature of nonlinear flame morphology through numerics and the bifurcation theory. This talk is based on the joint works with Prof. Moshe Matalon (UIUC).

㉗
(0) Sep.1, 14:00 - 14:30
(1) **Stephen Taylor**
(2) University of Auckland
(3) **Dairy Farm Modelling**
(4) Milk production is a major global industry and it is New Zealand's largest export earner.
We use mathematical modelling to analyze common issues faced by dairy farmers in NZ and abroad, including how long cows should be grazing in a particular field before being rotated to another, and the effects of urination and defecation on soil and waterways.

㉘
(0) Sep.1, 14:00 - 14:30
(1) **Nor Haniza Sarmin**
(2) Department of Mathematical Sciences, Faculty of Science, Universiti Teknologi Malaysia
(3) **DNA Splicing : Emerging Technologies in Recombinant DNA Using Formal Language Theory**
(4) The diversity of mathematical applications in various scientific concepts has led to significant advancements in understanding complex biological processes. One area where this interdisciplinary collaboration thrives is DNA splicing, a basic biological process in manipulating genetic information and simulated by the technique of recombinant DNA molecules that relies on restriction enzymes. This presentation explores the idea of DNA splicing in various concepts. Firstly, the fundamental mathematical framework behind DNA splicing is presented. Also, the interplay between mathematical models and wet lab experiments is shared to validate the theoretical findings. The emergence of DNA splicing in computer science where some computational models such as graphical user interface (GUI) is also discussed. Finally, the graphical approach to studying DNA splicing is presented to emphasize the role of visual representation in comprehending complex biological processes.

Poster Session
Poster Outline

Usage Guide

Information on the Poster is listed in alphabetical order by the Author's family name.

(0) **Name**
(1) Affiliation
(2) **Poster title**
(3) Abstract
(4) Presenter's Short Bio

poster image

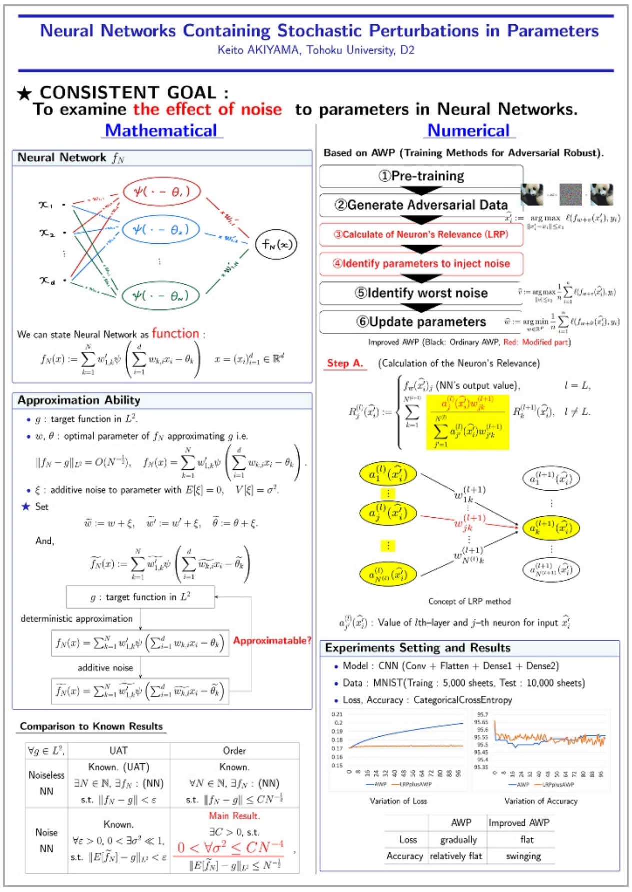
❶

(0) **Keito Akiyama**
(1) Mathematical Institute, School of Science, Tohoku University, Japan

(2) **Neural Networks Containing Stochastic Perturbations in Parameters**

(3) Neural networks is a mathematical model, which is including many parameters. We consider neural networks whose parameters contain stochastic perturbations. From mathematical perspective, we derive the approximation ability of noise-injected neural networks, quantitatively. From numerical perspective, we introduce the result of numerical experiments, adding partial perturbations to parameters of the neural network.

(4) I'm Keito AKIYAMA, from Mathematical Institute, Tohoku University. I'm studying neural networks using analysis. I'm interested in the effects of stochastic perturbations(noises) on neural networks. I've investergated mathematical analysis of the effect of noise on function approximation ability and numerical experiments on the localization of noise in neural networks. Recently, I've been working on mathematical analysis of mean field neural networks.



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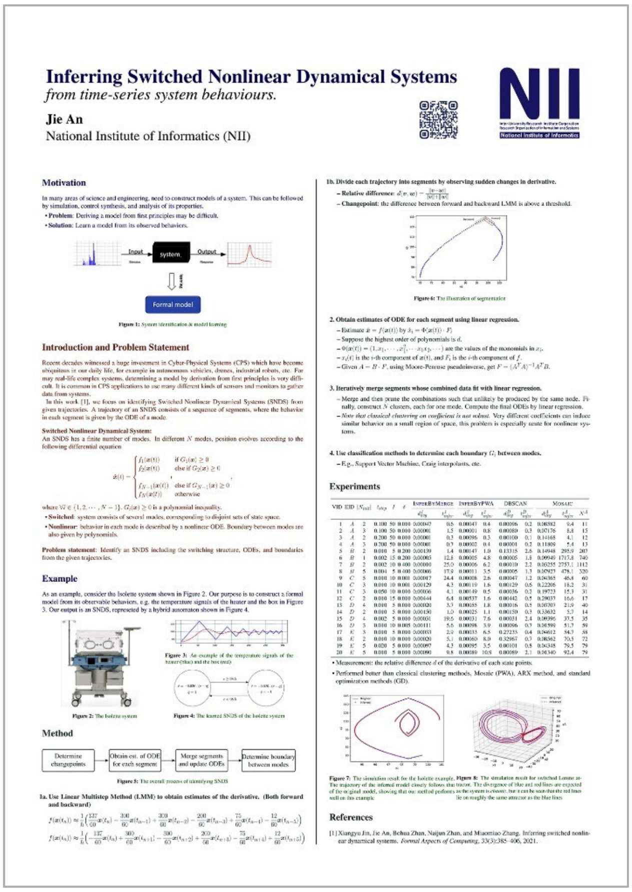
(0) **Jie An**
(1) National Institute of Informatics, Tokyo, Japan

(2) **Inferring Switched Nonlinear Dynamical Systems**

(3) Identification of dynamical and hybrid systems using trajectory data is an important way to construct models for complex systems where derivation from first principles is too difficult. In this paper, we study the identification problem for switched dynamical systems with polynomial ODEs. This is a difficult problem as it combines estimating coefficients for nonlinear dynamics and determining boundaries between modes. We propose two different algorithms for this problem, depending on whether to perform prior segmentation of trajectories. For methods with prior segmentation, we present a heuristic segmentation algorithm and a way to classify the modes using clustering. For methods without prior segmentation, we extend identification techniques for piecewise affine models to our problem. To estimate derivatives along the given trajectories, we use Linear Multistep Methods. Finally, we propose a way to evaluate an identified model by computing a relative difference between the predicted and actual derivatives. Based on this evaluation method, we perform experiments on five switched dynamical systems with different parameters, for a total of twenty cases. We also compare with three baseline methods: clustering with DBSCAN, standard optimization methods in SciPy and identification of ARX models in Matlab, as well as with state-of-the-art identification method for piecewise affine models. The experiments show that our two methods perform better across a wide range of situations.

(4) Dr. Jie An is a Project Assistant Professor at the National Institute of Informatics (NII) in Tokyo, Japan. From November 2020 to October 2022, he was a postdoctoral researcher working in the Rigorous Software Engineering Group at the Max Planck Institute for Software Systems (MPI-SWS), Kaiserslautern, Germany. Prior to that, he received a Ph.D. degree in Software Engineering from Tongji University, Shanghai, China in 2020. From 2017 to 2020, he was also a visiting Ph.D. student at the State Key Lab. of Computer Science, Institute of Software, Chinese Academy of Sciences.



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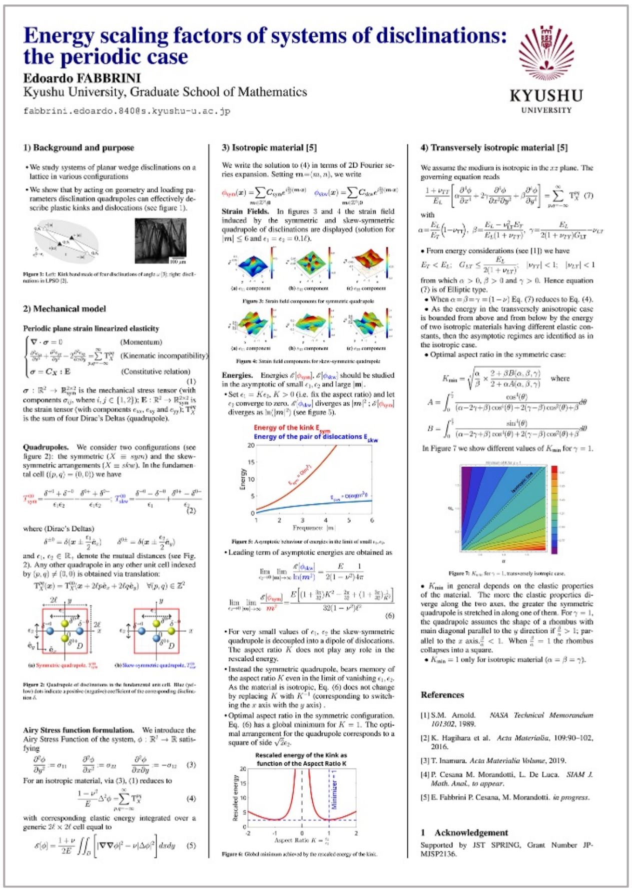
(0) **Edoardo Fabbrini**

(1) Graduate School of Mathematics, Kyushu University, Japan

(2) **Energy scaling factors of systems of disclinations: the periodic case**

(3) I focus on systems of disclinations by analysing the associated effective energy regimes depending on geometry aspect ratios and mutual distances.
Specifically, I target disclination dipole and quadrupoles under the assumption of linear hyper-elastic material with no external loads in plane strain conditions. Field equations (mechanical equilibrium and kinematic incompatibility) are written in terms of the Airy stress function. My main result is the full characterization of configurations of disclination quadrupoles in terms of existence of a minimal energy configuration and optimal geometry for both isotropic and transverse-isotropic hyperelastic materials.

(4) Born in Rome (Italy), after a bachelor in mechanical engineering and a master's degree in aeronautical engineering, both obtained from Roma Tre University, I started a PhD in applied mathematics at Kyushu University working under the supervision of Prof. Pierluigi Cesana. My academic interests reside on studying mathematical models of plastic deformation occurring in metals and on the design of functional materials.



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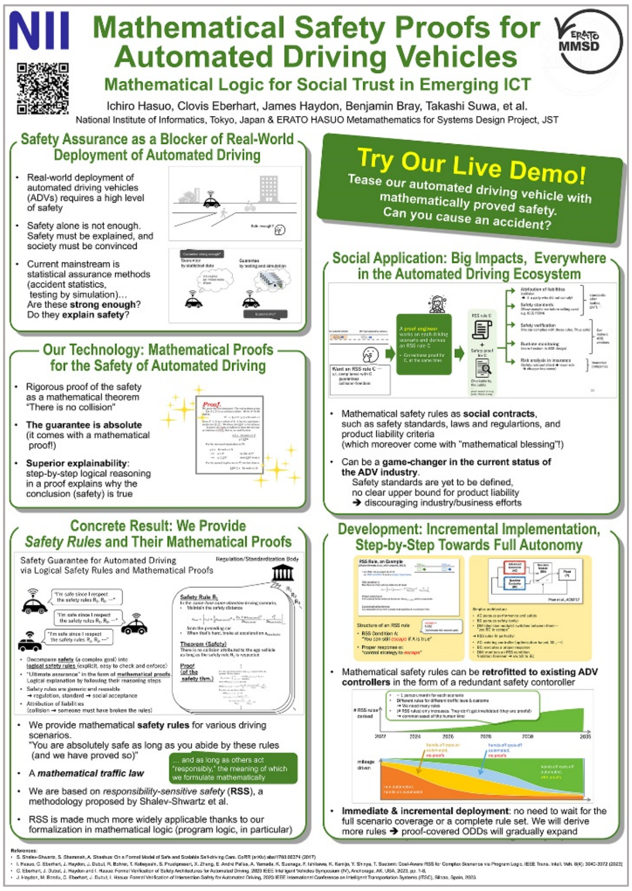
(0) **James Haydon**

(1) ERATO MMSD, National Institute of Informatics, Japan

(2) **Mathematical Safety Proofs for Automated Driving Vehicles**

(3) We introduce our methodology to provide strong mathematical safety guarantees to automated driving vehicles. Building on the existing methodology called "Responsibility-Sensitive Safety (RSS)" for mathematical proofs of automated driving safety, our research established its extension called "Goal-Aware RSS (GA-RSS)" that expands RSS's application domain to a variety of real-world driving scenarios. The techniques in GA-RSS derived from theoretical results in formal logic enable one to provide mathematical safety proofs to more complex driving scenarios than before, especially those which require achievement of certain goals such as an emergency stop.

(4) James Haydon, Ph.D., is a Technical Specialist at the JST ERATO "Metamathematics for Systems Design" Project at National Institute of Informatics (NII), Tokyo, Japan. He received a PhD in Mathematics from the University of Oxford (UK), in 2014, where he was supervised by Prof. Minhyong Kim. Before his current position, he held positions as a software engineer in industry, mainly working on formal systems and domain specific languages. His interests include formal systems, programming language design and category theory. He created the lawvere categorical programming language.



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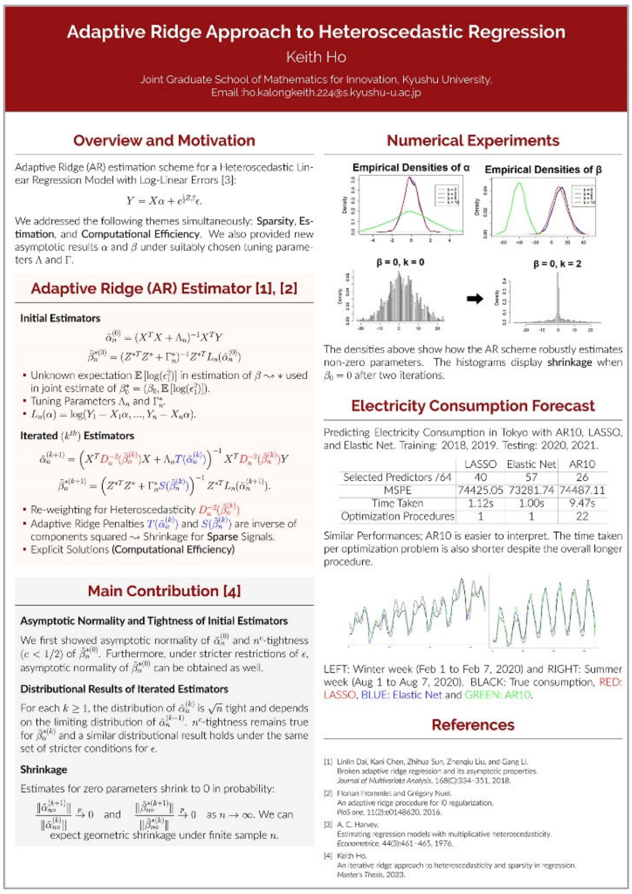
(0) **Ka Long Keith Ho**

(1) JGMI, Kyushu University, Japan

(2) **Adaptive Ridge Approach to Heteroscedastic Regression**

(3) We propose an Adaptive Ridge-based estimation scheme for a heteroscedastic linear model equipped with log-linear errors. We show new asymptotic distributional and tightness properties under sparsity and also show iterating will shrink estimates for zero parameters under suitable assumptions. We present numerical evidence that illustrates the efficacy of the proposed estimation scheme and incentivizes extensions of this paper's results.

(4) Keith graduated from Jesus College, University of Cambridge reading Mathematics in 2019. He began his postgraduate studies in April 2021 at Kyushu University and is currently in his first year PhD Course. One of his research areas in Statistics is regularization, where he has recently completed his Master's Thesis in.



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(0) **Rinki Imada**

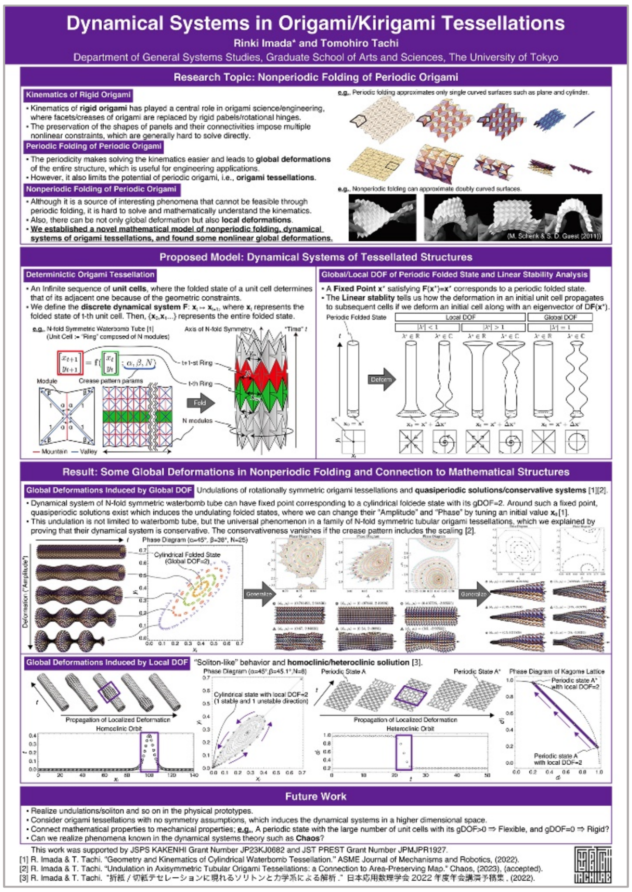
(1) Department of General Systems Studies, The University of Tokyo, Japan

(2) **Dynamical Systems in Origami/Kirigami Tessellations**

(3) Many origami/kirigami-based engineering applications have developed based on the periodic-folding of periodic patterns. Though nonperiodic-folding of periodic patterns paves the way to nonlinear phenomena that cannot be feasible through periodic-folding, its high complexity makes it challenging to capture the phenomena mathematically. In this presentation, we propose a novel mathematical model for the analysis of nonperiodic-folding, which we call the dynamical system of origami/kirigami tessellations induced by the coupled folding motion of unit cells. Using the model, we introduce some phenomena, including the undulation of tubular origami tessellations and the solitons with the propagation of the localized deformation.

(4)

Rinki Imada is a Ph.D. student in the Graduate School of Arts and Sciences at the University of Tokyo. He studied computer sciences and mathematics and received his M.S. in multidisciplinary sciences from the University of Tokyo. His research interests lie in the kinematics of geometric objects such as origami, kirigami, and linkages. He is now trying to understand the hidden mathematical structure behind phenomena that arose in such geometric objects and create novel characteristics using the theory of dynamical systems.



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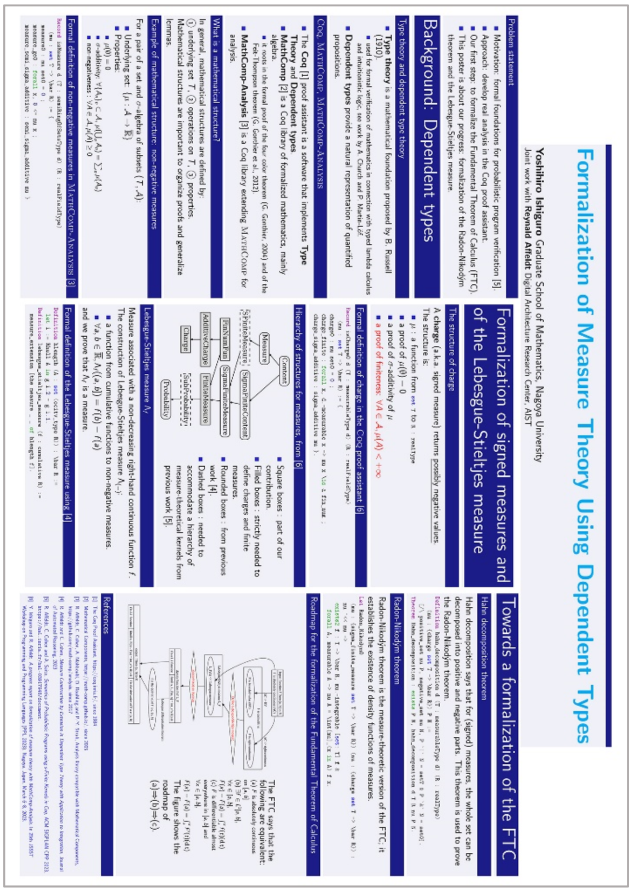
(0) **Yoshihiro Ishiguro**
(1) Graduate School of Mathematics, Nagoya University, Japan

(2) **Formalization of Measure Theory Using Dependent Types**

(3) Formal verification of computer programs is best done with proof assistants, which are typically software implementations of type theory to verify mathematical proofs. Our concern is that the semantics of probabilistic programs relies on advanced measure theory whose support is lacking in the Coq proof assistant. Our project is to formalize advanced measure theory using the dependent type theory of Coq. We target the formalization of the Fundamental Theorem of Calculus as a milestone and in this poster we explain our first results in this direction: the formalization of the Radon-Nikodym theorem and of the Lebesgue-Stieltjes measure.

(4) My interest is mainly on formal varification of mathematics. I also be intesting in program semantics and category theory and categorical logic.
I studied formalization of analysis with Coq proof assistant in my master course. The formalization of Radon-Nikodym theorem and Hahn decomposition is among the results.
Now I studying further extension of Coq library for analysis, MathComp-Analysis, and my goal is make good tool for formal varification of computer programs with advanced theory of analysis.



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(1) **Naoyuki Ishimura**
(2) Faculty of Commerce, Chuo University, Japan

(3) **Insurance Design for the Loss of Epidemic Outbreaks involving the Cram¥'er -Lundberg Model**

(4) A simple model of the insurance coverage for the damage of COVID-19 is introduced. Concerning the estimation of the numbers of patients and/or deaths, we employ the Cramer-Lundberg model for the risk process, which is combined with the discrete SIR model. Under various premium principles, we are able to design suitable insurance. Numerical research with the data of Tokyo region are also performed.

(5) Naoyuki Ishimura obtained his PhD from University of Tokyo in 1993. He was Research Associate of Mathematics at University of Tokyo from 1989 to 1996. He moved to Hitotsubashi University, Japan as Associate Professor of Mathematical Sciences from 1996 and became full Professor from 2005. His interest gradually involves Mathematical Finance and he has moved to Chuo University from 2015. Ishimura is a member of JSIAM. His area of research includes the applied analysis, the theory of nonlinear partial differential equations, and the mathematical finance.

Insurance Design for the Loss of Epidemic Outbreaks involving the Cramér -Lundberg Model

Chenwei SUN[1], Andres Mauricio Molina Barreto[2], Naoyuki Ishimura[3], and Koichiro Takaoka[3]
[1] Graduate School of Commerce, [2]Institute of Business Research, [3]Faculty of Commerce, Chuo University
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1 Introduction

After a cluster of certain infections was reported at Wuhan in December 2019, the worldwide confusion was followed and our way of life has been forced to change. In the academia, intensive studies have been performed from various point of view. It is also important to provide suitable insurances for the loss of epidemic outbreaks, in order to mitigate the disaster in some extent. In this respect one of the authors considers certain insurance for the epidemic bursts in 2016 [2], three years before COVID-19. Here we take a different approach to design better insurances for the loss of COVID-19.

2 Our Model

2.1 Risk process

We consider a discrete time risk process given by

$$U(n) = u + cn - C(n), \qquad n = 0, 1, 2 \cdots \quad (1)$$

where $u = U(0)$ is the initial surplus, and c is the insurer's rate of premium income per unit time. Here

$$C(n) = \sum_{k=1}^{N(n)} X_k \quad (2)$$

denotes the total claim process. $\{N(n)\}_{n=1,2,\ldots}$ is the number of claim process, which is a Poisson process with parameter λ. $\{X_k\}_{k=1,2,\ldots}$ is the nonnegative i.i.d. sequence of insurer's aggregate claim with common distribution function $F_X(x)$. The process $\{N(t)\}_{t\geq 0}$ and the sequence $\{X_k\}_{k=1,2,\ldots}$ are assumed to be independent. See [1][3] for further information.

Our motivation is that we employ the risk model (1) for the insurance coverage due to the loss of COVID-19:

$N(n)$ = the number of infectives at date n.

$\{X_k\}$ is modelled by the infectious distribution of real data.

2.2 SIR model

The original SIR model is the system of ordinary differential equations for three sub-populations: $S(t)$ is the number of susceptibles to the disease, $I(t)$ is the number of infectives, and $R(t)$ is of removals.

$$S'(t) = -\beta S(t)I(t),\ I'(t) = \beta S(t)I(t) - \gamma I(t),\ R'(t) = \gamma I(t),$$

where the constants β is the infection parameter and γ is the removal parameter representing the rate at which infectives become immune. The important parameter is $\varrho = \gamma/\beta$ which is related to the reproduction number. The total population $N = S(t)+I(t)+R(t)$ is preserved.

Following Singh, Lal and Kotti [4], and Wacker and Schlüter [5], we employ the implicit discrete system.

3 Empirical Study

Principally, the insurance should be designed so that the ruin does not occur:

$$\phi(u) = P(U(t) > 0 \text{ for all } t > 0).$$

There are also known several premium principles which an insurer charges to cover a risk; to name afew, the expected value principle, the variance principle, the Esscher premium principle, and so on. The crucial part in our model is the estimation of $C(n)$. Here we undertake an empirical study on the treatment of $C(n)$. The dataset can be downloaded from https://covid19.mhlw.go.jp . The details will be shown at the conference place.

4 Conclusion

We have proposed an insurance coverage model for the loss of epidemic outbreaks. Our model is based on the Cramér -Lundberg risk process with the SIR model. We have developed empirical studies with the data of COVID-19 in Tokyo area. Our method seems work well.

References

[1] Dickson, D.C.M. (2017). *Insurance Risk and Ruin, 2nd Edition*. Cambridge University Press, Cambridge.
[2] Ishimura, N., Kounadel, D., Yoshizawa, Y. (2016). Risk estimation model on epidemic outbreaks for an insurer. presented in *ASTIN Colloquium Lisbon 2016*, available at: http://actuaries.org/lisbon2016/papers/19.NaoyukiIshimuraPaper.pdf
[3] Panjer, H.H., Willmot, G.E. (1992). *Insurance Risk Models*. Society of Actuaries, Schaumburg, IL.
[4] Singh, R.A., Lal, R., Kotti, R.R. (2022). Time-discrete SIR model for COVID-19 in Fiji. *Epidemiology and Infection*. 150, e75. pp.1–40. https://doi.org/10.1017/S0950268822000590
[5] Wacker, B., Schlüter, J. (2020). Time-continuous and time discrete SIR models revisited: theory and applications. *Advances in Difference Equations*. 2020:556. https://doi.org/10.1186/s13662-020-02995-1

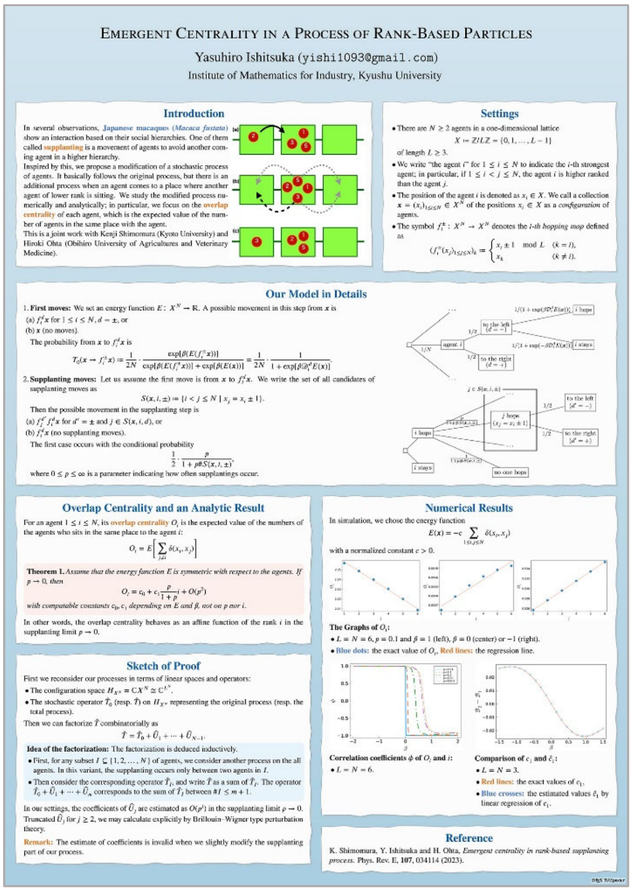
❾

(0) **Yasuhiro Ishitsuka**
(1) Institute of Mathematics for Industry, Kyushu University, Japan

(2) **Emergent Centrality in a Process of Rank-Based Particles**

(3) We propose a stochastic process where many agents interact depending on their rank, based on the supplanting moves of Japanese macaques. We study a zero-supplanting limit of overlap centrality, a quantity measuring how often an agent sits in the same place as another agent. Along the way, we use a combinatorial factorization of the transition matrix.

(4) Yasuhiro Ishitsuka is an assistant professor at Institute of Mathematics for Industry at Kyushu University. His main field is diophantine geometry, especially concerns on the statistical behavior of arithmetic objects, and he also works on co-projects on statistical physics and bioinformatics. His hobby is mineral collecting, and his favorites are minerals including strontium.



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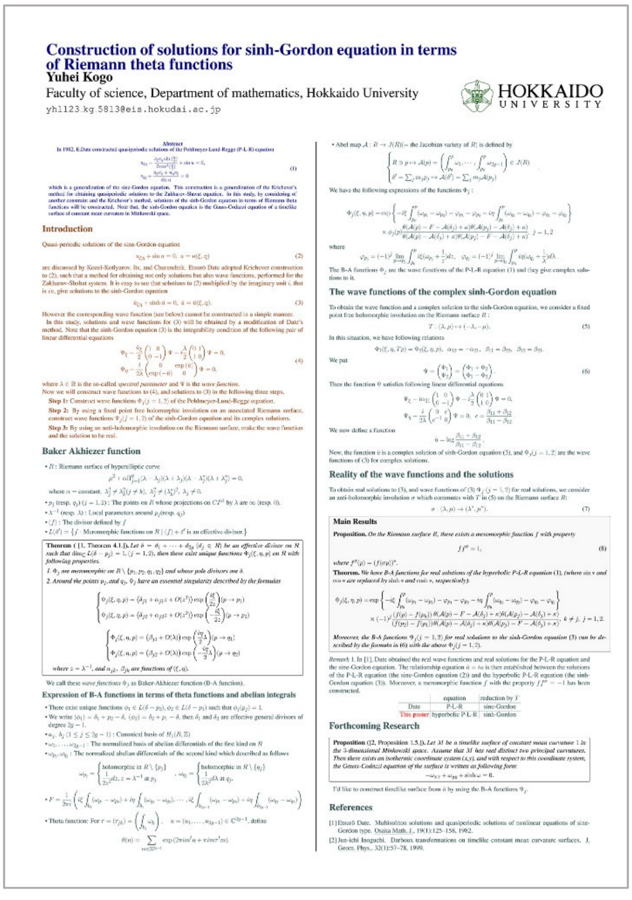
(0) **Yuhei Kogo**
(1) Faculty of Science, Department of Mathematics, Hokkaido University, Japan

(2) **Construction of solutions for sinh-Gordon equation in terms of Riemann theta functions**

(3) In 1982, E.Date constructed quasiperiodic solutions of the equation Pohlmeyer-Lund-Regge which is a generalization of the sine-Gordon equation, and it was known that solutions could be explicitly expressed using Riemann theta functions. This construction is based on the Krichever's method for obtaining quasiperiodic solutions to the Zakharov-Shavat equation.
In this study, by considering of another constraint and the Krichever's method, solutions of hyperbolic sinh-Gordon equation in terms of Riemann theta functions will be constructed.
Note that, the sinh-Gordon equation is the Gauss-Codazzi equation of a timelike surface of constant mean curvature in Minkowski space, and we will investigate the structure and properties of such surfaces.

(4) I am a second-year master's student in the Faculty of Science, Department of Mathematics, Hokkaido University. My supervisor is Prof. Shimpei Kobayashi at Hokkaido University. I am currently interested in the integrable systems, particularly quasiperiodic solutions of it, and differential geometry.



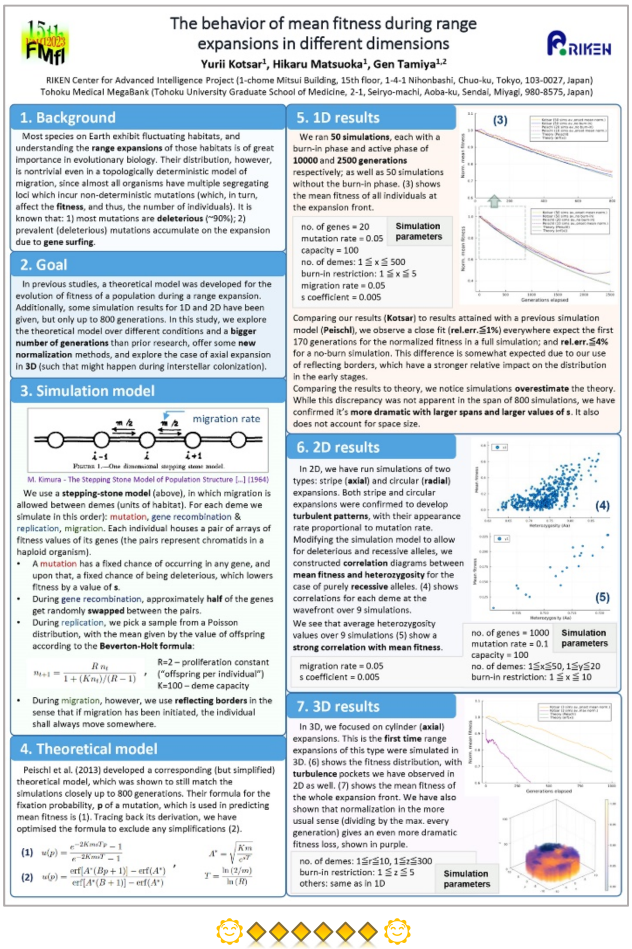
⓫

(0) **Yurii Kotsar**
(1) RIKEN Center for Advanced Intelligence Project, Japan

(2) **The behavior of mean fitness during range expansions in different dimensions**

(3) Most species on Earth exhibit fluctuating habitats, and understanding the range expansionsof those habitats is of great importance in evolutionary biology. Their distribution, however, is nontrivial even in a topologically deterministic model of migration, since almost all organisms have multiple segregating loci which incur non-deterministic mutations. In previous studies, a theoretical model was developed for the evolution of fitness of a population during a range expansion. Additionally, some simulation results for 1D and 2D have been given, but only up to 800 generations. In this study, we explore the theoretical model over different conditions and a bigger number of generations than prior research, offer some new normalization methods, and explore the case of axial expansion in 3D (such that might happen during interstellar colonization).

(4) A ukrainian-born genetics researcher in Japan. Graduated with a BSc degree in astrophysics from Kyiv University in 2018. Moved to Japan in 2019 to pursue a Master's course in particle physics at Kobe University. Enrolled in said course in 2020, and developed practical research skills during the two-year MSc course; graduated in 2022. Was employed at RIKEN SPring-8 the same year as an engineer. Moved inside RIKEN to a research post at the Center for Advanced Intelligence Project (AIP) at the start of 2023. Presently engaged in big data analysis and probabilistic research in the field of genetics.



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(0) **Kohei Noda**
(1) Joint Graduate School of Mathematics for Innovation, Kyushu University, Japan

(2) **Integrable Structure of the Overlap of the non-Hermitian Random Matrices**

(3) As widely known, a non-Hermitian matrix features distinct left and right eigenvectors, which form a bi-orthogonal system. We study the determinantal structures of the k-th conditional expectation of the overlaps for the induced Ginibre unitary ensemble (IGinUE) and induced spherical unitary ensemble (ISUE) and their scaling limits depending on spectral parameters.

(4) Kohei Noda is a Ph.D. student at Joint Graduate School of Mathematics for Innovation, Kyushu University. His research interests are random matrix theory and the statistical mechanics of Coulomb systems. He is currently focused on investigating the overlap defined by the left and right eigenvectors of non-Hermitian random matrices, which is related to integrable systems such as orthogonal polynomials and skew-orthogonal polynomials.

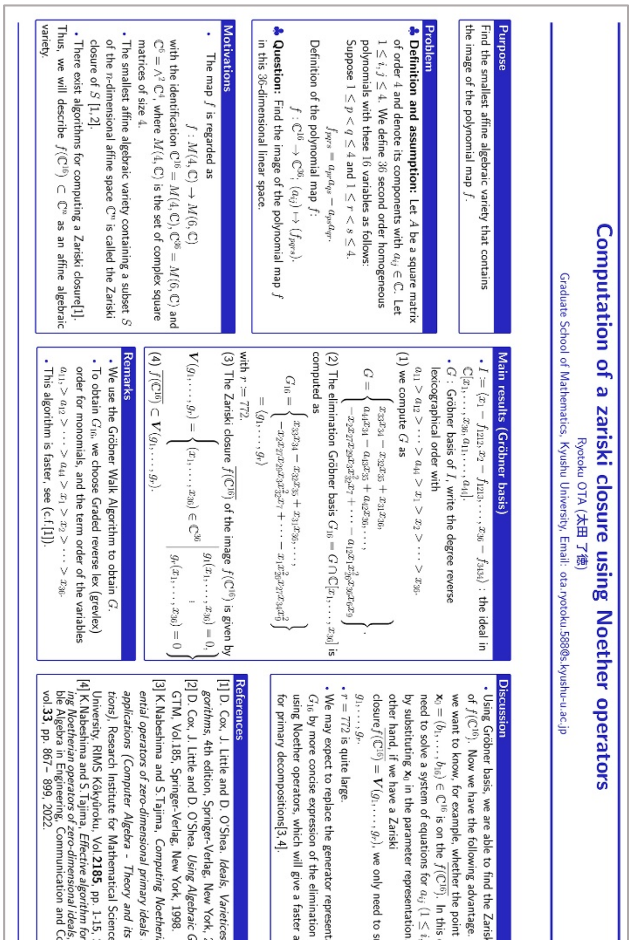
⑬

(0) **Ryotoku Ota**
(1) Graduate School of Mathematics, Kyushu University, Japan

(2) **Computation of a zariski closure using Noether operators**

(3) We will give a set of generators of the ideal defining the zariski closure of the image of polynomial mappings. The standard method is based on the Gröbner basis computed by using elimination theory.
However, if the number of generators of the Gröbner basis is too large, it may not be practical to find them.
We will perform a primary decomposition of the ideals using prime ideals and Noether operators, and give the representation of the ideals.
We also recover the Gröbner basis from the Noether opereators.

(4) Ryotoku Ota is a second-year doctoral student in the Graduate School of Mathematics at Kyushu University. He is particularly interested in Gröbner bases and properties of algebraic varieties. In the future, he would like to study algebraic varieties using Noether operators and local cohomology.



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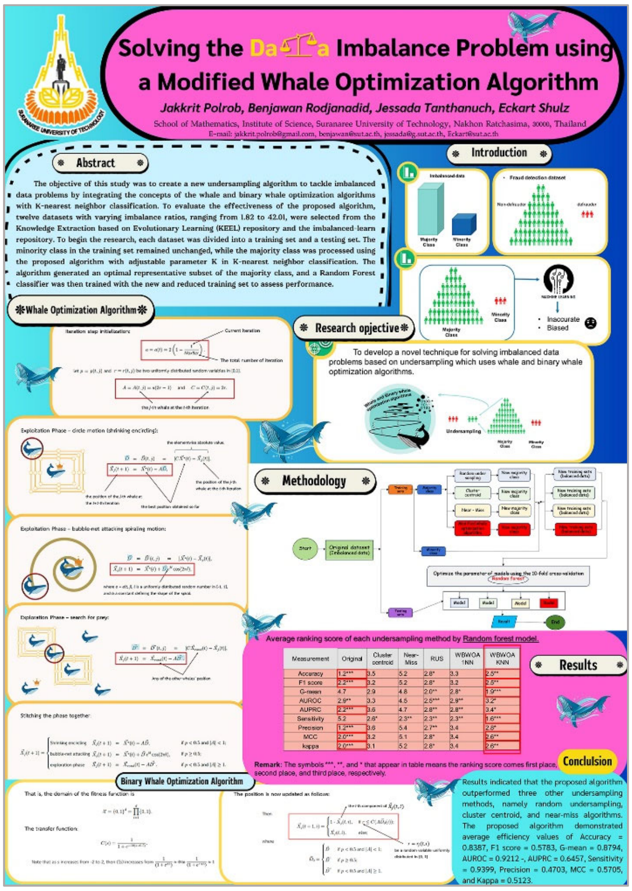
(0) **Benjawan Rodjanadid**
(1) School of Mathematics, Institute of Science, Suranaree University of Technology, Nakhon Ratchasima, Thailand

(2) **Solving the Data Imbalance Problem using a Modified Whale Optimization Algorithm**

(3) The objective of this study was to create a new undersampling algorithm to tackle imbalanced data problems by integrating the concepts of the whale and binary whale optimization algorithms with K-nearest neighbor classification. To evaluate the effectiveness of the proposed algorithm, twelve datasets with varying imbalance ratios, ranging from 1.82 to 42.01, were selected from the Knowledge Extraction based on Evolutionary Learning (KEEL) repository and the imbalanced-learn repository. To begin the research, each dataset was divided into a training set and a testing set. The minority class in the training set remained unchanged, while the majority class was processed using the proposed algorithm with adjustable parameter K in K-nearest neighbor classification. The algorithm generated an optimal representative subset of the majority class, and a Random Forest classifier was then trained with the new and reduced training set to assess performance.

(4) I'm Benjawan Rodjanadid, an Assistant Professor in Mathematics at Suranaree University of Technology in Thailand. My expertise lies in the field of Analysis, Topology, and Fixed point theory, where I have conducted valuable research. Over time, I have developed a keen interest in the fascinating realms of machine learning and artificial intelligence.



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⑮

(0) **Hiroki Sasaki**

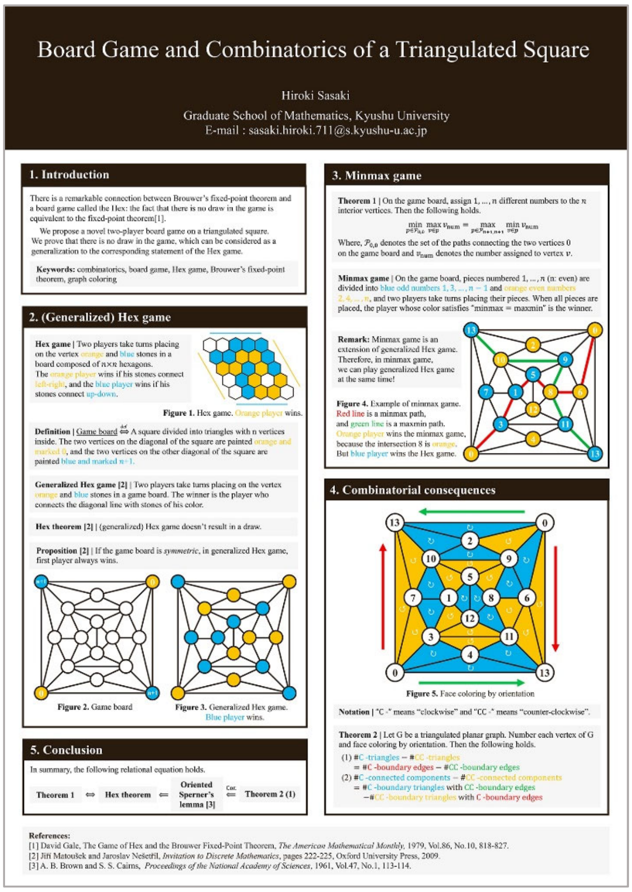
(1) Graduate School of Mathematics, Kyushu University, Fukuoka, Japan

(2) **Board Game and Combinatorics of a Triangulated Square**

(3) There is a remarkable connection between Brouwer's fixed-point theorem and a board game called the Hex: the fact that there is no draw in the game is equivalent to the fixed-point theorem.

We propose a novel two-player board game on a triangulated square. We prove that there is no draw in the game, which can be considered as a generalization to the corresponding statement of the Hex game.

(4) Hiroki Sasaki is a student at the Graduate School of Mathematics, Kyushu University.
He specializes in combinatorics and board games. He enjoys playing and watching board games such as Shogi and Mahjong. He also creates board games and will be exhibiting at a board game event in Tokyo in December. His motto is to research interesting board games from both an academic and hobbyist perspective.



⑯

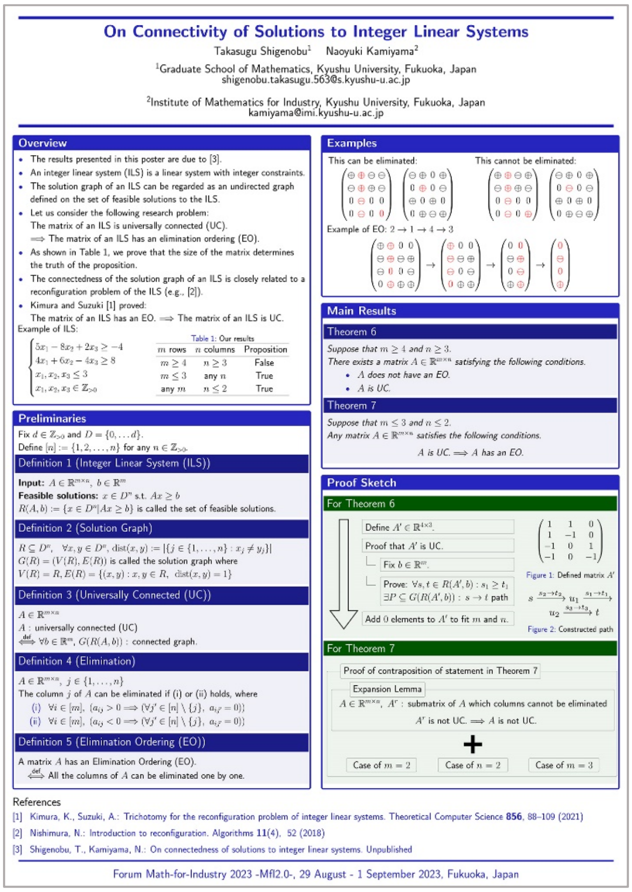
(1) **Takasugu Shigenobu**

(2) Graduate School of Mathematics, Kyushu University, Fukuoka, Japan

(3) **On Connectivity of Solution to Integer Linear Systems**

(4) An integer linear system (ILS) is a linear system with integer constraints. The solution graph of an ILS is defined as an undirected graph defined on the set of feasible solutions to the ILS. A pair of feasible solutions is connected by an edge in the solution graph if the Hamming distance between them is 1. We consider a property of the coefficient matrix of an ILS such that the solution graph is connected for any righthand side vector. Especially, we focus on the existence of an elimination ordering (EO) of a coefficient matrix, which is known as the sufficient condition for the connectedness of the solution graph for any right-hand side vector. That is, we consider the question whether the existence of an EO of the coefficient matrix is a necessary condition for the connectedness of the solution graph for any right-hand side vector. We first prove that if a coefficient matrix has at least four rows and at least three columns, then the existence of an EO may not be a necessary condition. Next, we prove that if a coefficient matrix has at most three rows or at most two columns, then the existence of an EO is a necessary condition.

(5) Takasugu Shigenobu is currently a doctor course student at Graduate School of Mathematics, Kyushu University. He graduated from School of Mathematics and Physics, Kanazawa University in 2020, and then he finished the Master's Course in Mathematics, the Graduate School of Mathematics at Kyushu University, in 2022. His reasearch topics include the theory of discrete optimization. Especially, he is currently working on structures of the solution graph of an integer linear system.



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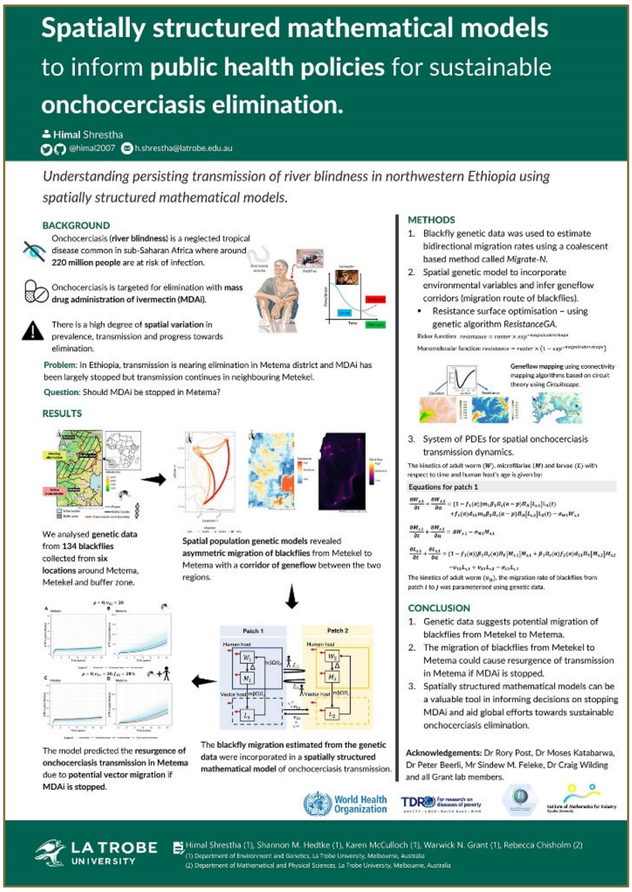
(0) **Himal Shrestha**

(1) Department of Environment and Genetics, La Trobe University, Melbourne, Australia

(2) **Understanding persistent transmission of river blindness in northwestern Ethiopia using spatially structured mathematical models.**

(3) River blindness/onchocerciasis, caused by a filarial parasite transmitted by blackflies, is targeted for elimination with mass drug administration of ivermectin (MDAi). Despite progress, transmission persists in some areas, including Metema and Metekel in northwestern Ethiopia. Transmission is continuing in Metekel, and nearing elimination in Metema, where the MDAi has stopped except for few positive communities. Using spatially structured mathematical models, we show that blackfly migration from Metekel to Metema is likely driving some onchocerciasis transmission in Metema, with the potential for its resurgence if MDAi is stopped. These models can inform decisions on stopping MDAi and aid global efforts towards sustainable onchocerciasis elimination.

(4) Himal recently submitted his PhD in Bioinformatics and currently working as a researcher in the vector and nematode genomics lab at La Trobe University, Melbourne, Australia. His project is focused in developing spatially explicit models of transmission of a parasitic disease called onchocerciasis (river blindness), a vector-borne neglected tropical disease common in sub-Saharan Africa. He uses genetic, epidemiological, and environmental data to understand onchocerciasis transmission in Africa. His research interests include modelling of infectious diseases, genomic epidemiology, geospatial modelling, impact of climate change, and spatial genetics.



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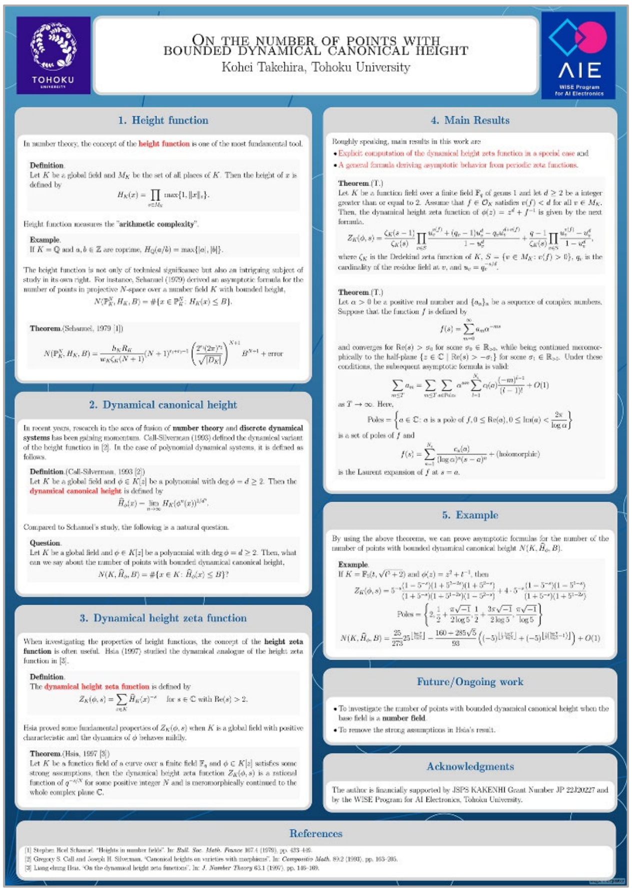
(0) **Kohei Takehira**

(1) Department of Mathematics, Tohoku University, Japan

(2) **On the number of points with bounded dynamical canonical height**

(3) The concept of the height function plays a fundamental role in number theory, serving as a measure of "arithmetic complexity." It is not only of technical significance but also an intriguing subject of study in its own right. For instance, Schanuel (1979) derived an asymptotic formula for the count of points in projective n-space over a number field with bounded height, including crucial arithmetic invariants such as the class number. Call-Silverman (1993) introduced the dynamical variant of height functions known as the dynamical canonical height. Hsia (1997) investigated the counting problem of points with bounded dynamical canonical height, using the dynamical height zeta function. Our research aims to provide more precise formulas for the counting problem of points with bounded dynamical canonical height in specific cases. The discussion relies on the explicit computation of the dynamical height zeta function and establishing statements in analytic number theory.

(4) The presenter graduated from the Department of Mathematics at Tohoku University's Faculty of Science in 2020. In 2022, the presenter completed the Master's program in Mathematics within the Graduate School of Science at the same university. Currently, the presenter is in the second year of the doctoral program, specializing in mathematics, at Tohoku University's Graduate School of Science. The presenter holds the position of JSPS Special Research Fellow (DC1). Additionally, the presenter is a member of the WISE program for AI Electronics at Tohoku University.



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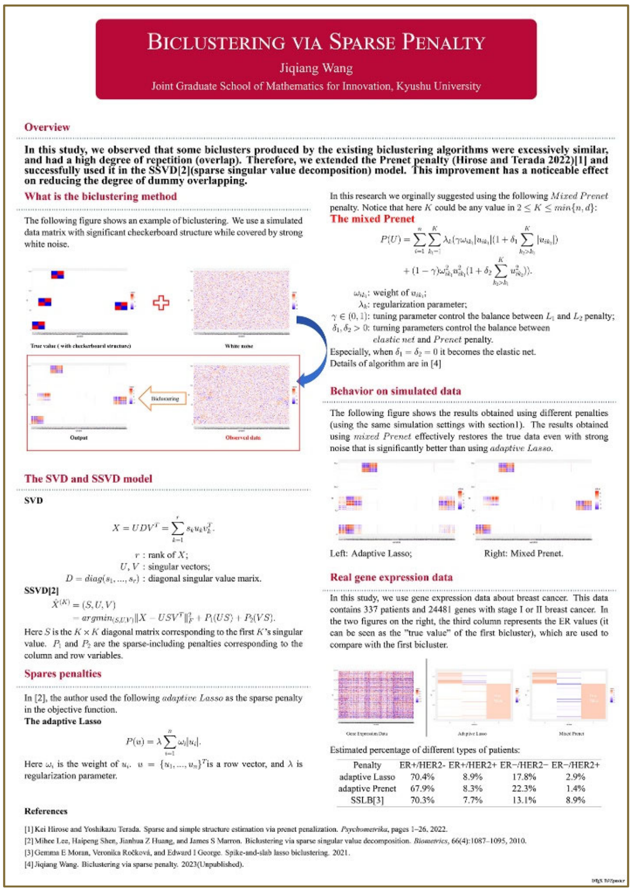
(0) **Jiqiang Wang**
(1) Joint Graduate School of Mathematics for Innovation, Kyushu University, Japan

(2) **BICLUSTERING VIA SPARSE PENALTY**

(3) This research proposes a new biclustering method via sparse penalty (mixed Prenet penalty). The method is very effective in dealing with overlapped biclusters. And it is more effective in finding non-overlapped biclusters and identifying small biclusters compared with some other biclustering methods.

(4) Jiqiang Wang received a B.S. degree in Mathematics from Wuhan University, Wuhan, China, in 2020 and an M.S. in Mathematics from Kyushu University, Fukuoka, Japan, in 2023. He is currently working toward a Ph.D. degree in Mathematics at the Joint Graduate School of Mathematics for Innovation, Kyushu University. His research interests include biclustering, optimization, and Bayesian statistic.



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To FMfI2023 Banquet Attendees

Meet at 17:00 at the main entrance of Nishijin Plaza.

Three buses leave here for the banquet venue at 17:15 at the entrance.

Bring your banquet ticket with you.

FMfI2023 Banquet:

- **Date: Wednesday, August 30, 2023, 18:30-20:30**
- Venue: Seido, Koumyo-den 4th floor
- 1-35 Kamikawabatamachi, Hakata-ku, Fukuoka-shi, Fukuoka 812-0026
- TEL: +81-92-710-4305
- Website: https://www.tomyoden.com/
- Format: Standing buffet

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