2025 KWMS 국제학술대회

2025 KWMS THE 19th INTERNATIONAL CONFERENCE

June 30 Mon. - **July 1** Tue., 2025

KIAS Bldg 1, Room 1503

Plenary Lectures

- **Mihyun Kang** / Graz Univ. of Tech., Austria
- **Bruce Berndt** / Univ. of Illinois, USA
- **Seonhee Lim** / Seoul National Univ., Korea
- **Juhi Jang** / Univ. of Southern California, USA

Public Lectures

- **Youngmok Jeon** / President of KSIAM
- **Seonja Kim** / Chungwoon Univ.

Award Lectures

- **Hyangdong Park**
  / KIAS, 2024 KOFWST Future Talent Award Winner

Session Presentations

- **Algebra, Analysis, Applied Mathematics**
- **Geometry and Topology, Mathematics Education**

Poster Presentations

KWMS 한국여성수리과학회
Korean Women in Mathematical Sciences

KIAS 고등과학원 KOREA INSTITUTE FOR ADVANCED STUDY

아주 수리과학 미래인재양성 교육연구팀 BK21 FOUR

BK21 FOUR 아주대학교 대학원 혁신지원사업 BK21 Graduate School Innovation

Contents

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SunSook Jin (Chair, Gongju National University of Education)

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Hyoseon Yang (Kyung Hee University)

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Greetings from the President

Yoonjin Lee
President of KWMS
Professor in Ewha Womans University

On behalf of the Korean Women in Mathematical Sciences (KWMS), it is my great honor to welcome you to the 2025 International Conference of KWMS.

This year marks the 22nd anniversary of our society, founded in 2004 to support and promote the work of women in mathematics. Over the past two decades, KWMS has played a crucial role in recognizing the remarkable achievements of women in our field, thereby helping to build "Women Leadership in Mathematics" and contributing meaningful networks among women mathematicians. We also reflect with deep gratitude on the dedicated efforts of our founding members. Their vision and enthusiasm laid the groundwork for KWMS advancement.

As we look ahead, we acknowledge the rapid transformations in society and industry driven by technology, artificial intelligence (AI), and data science. Mathematics stands at the core of these changes. We are confident that KWMS will continue to contribute actively to the advancement of mathematics and its central role in shaping high-tech industries.

This international conference is co-organized with the School of Mathematics at the Korea Institute for Advanced Study (KIAS). This conference aims to promote academic exchange at both domestic and international levels, identify outstanding women mathematicians, and

expand research networks among women in the mathematical sciences.

We would like to express our gratitude to President Tae Won Noh of KIAS, President Sijong Kwak of KMS, President Yun Sung Choi of NIMS, and President Youngmok Jeon of KSIAM for their strong support to KWMS. Specially, our sincere thanks go to the BK team of the Department of Mathematics at Ajou University for their financial support of this conference. We are also deeply thankful to the members of the organizing committees, invited speakers, presenters, and all participants for their contributions to the success of this conference.

For this two-day event, we have three plenary lectures, two public lectures, and five session presentations and a poster session. We are pleased to host an award lecture by the recipient of the 2024 KOFWST Excellence Award for Young Scientists in Mathematics.

We're especially proud of a team of student journalists, consisting of female undergraduate math majors. We have appointed the fourth team of student journalists. Since 2022, they have played an important role in publicizing our activities and has provided meaningful opportunities for young female students to connect and find community in mathematics. They will cover the conference and conduct interviews with speakers and attendees. Please extend your support and cooperation to them throughout the conference.

Thank you for joining us in this conference. We hope this conference inspires, connects, and strengthens our community.

2025 the 19th KWMS International Conference

June 30 - July 01, 2025

Korea Institute for Advanced Study, Seoul

Korean Women in Mathematical Sciences

Contact us: kwms2004@gmail.com

Time Schedule

Day 1 – June 30 (Monday)		Main Venue: Room 1503, Bldg. 1, KIAS	
Time	**Program**	**Speaker**	**chair**
10:00 - 10:30	**Welcome Reception / Registration**		
10:30 - 10:50	Opening Ceremony	**Opening Remarks** Yoonjin Lee (President of KWMS)	SunSook Jin (Gongju National Univ. of Education)
		Welcoming Remarks Tae Won Noh (President of KIAS)	
		Congratulatory Remarks Sijoing Kwak (President of KMS)	
		Congratulatory Remarks Yun Sung Choi (President of NIMS)	
10:50 - 11:30	Plenary Lecture Ⅰ	**Matchings on Random Graphs** Mi Hyun Kang (Graz University of Technology)	Boram Park (Ajou University)
11:40 - 12:20	Public Lecture Ⅰ	**The Past, Present of Applied Mathematics and Toward the Era of AI & QC** Youngmok Jeon (President of KSIAM)	Soomin Jeon (Dong-A University)
12:20 - 12:30	**Conference Photo Ⅰ**		
12:30 - 14:00	**Lunch**		
14:00 - 14:40	Plenary Lecture Ⅱ	**Ramanujan's Notebooks and Lost Notebook** Bruce Berndt (University of Illinois)	Soon-Yi Kang (Kangwon National University)
14:50 - 17:50	Session Presentation	**Session Ⅰ Algebra**	**Room 1503**
		Session Ⅱ Geometry and Topology	**Room 1423**
		Session Ⅲ Mathematics Education	**Room 1424**
18:00 - 20:00	**Banquet (KIAS)**		

Time Schedule

Day 2 – July 1 (Tuesday)	Main Venue: Room 1503, Bldg. 1, KIAS		
Time	**Program**	**Speaker**	**Chair**
9:30 - 10:00	**Welcome Reception / Registration**		
10:00 - 10:40	Award Lecture	**Shocks and Contact Discontinuities for the Steady Euler System** Hyangdong Park (KIAS, 2024 KOFWST Future Talent Award winner)	Hyoseon Yang (Kyung Hee University)
10:50 - 11:30	Public Lecture Ⅱ	**Maps of Algebraic Curves to Projective Space** Seonja Kim (Chungwoon University)	Seong-A Shim (Sungshin Women's University)
11:40 - 12:20	Plenary Lecture Ⅲ	**Dynamics of Newtonian Stars** Juhi Jang (University of Southern California)	Myoungjean Bae (KAIST)
12:20 - 12:30	**Conference Photo Ⅱ**		
12:30 - 14:00	**Lunch / NGC of KWMS**		
14:00 - 14:30	Poster Session		
14:30 - 15:10	Plenary Lecture Ⅳ	**Dynamics, Number Theory and Post-Quantum Cryptography** Seonhee Lim (Seoul National University)	Youngju Kim (Konkuk University)
15:20 - 18:20	Session Presentation	**Session Ⅳ Analysis**	**Room 1423**
		Session Ⅴ Applied Mathematics	**Room 1424**

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- Session Schedule -

Session Presentation Schedule

I : Algebra		
Day 1 - June 30 (Monday)	**Room 1423**	
Time	**Talk**	**Chair**
14:50 - 15:30	Invited Talk **ANTI-MORDERLL-WEIL FIELDS AND LARSEN'S CONJECTURE** Bo Hae Im (KAIST)	Yoon Kyung Park (Seoul National University of Science and Technology)
15:30 - 15:35	**Break**	
15:35 - 15:55	**MOMENT FORMULAS OF SIEGEL TRANSFORMS WITH CONGRUENCE CONDITIONS IN DIMENSION 2** Seul Bee Lee (Seoul National University)	
15:55 - 16:15	**A NEW CANDIDATE FOR RESOLVING GROMOV'S OPEN QUESTION** Jan Kim (Ewha Womans University)	
16:15 - 16:25	**Break**	
16:25 - 17:05	Invited Talk **COMBINATORIAL DESCRIPTION FOR THE HALL-LITTLEWOOD EXPANSION OF UNICELLULAR LLT AND CHROMATIC QUASISYMMETRIC POLYNOMIALS** Meesue Yoo (Chungbuk National University)	Hayan Nam (Konkuk University)
17:05 - 17:10	**Break**	
17:10 - 17:30	**DOMINATION NUMBER VERSUS PACKING NUMBER IN A GRAPH WITH BOUNDED MAXIMUM DEGREE** Eun Kyung Cho (Hanyang University)	
17:30 - 17:50	**INFINITELY MANY PRIME VALUES IN A CUBIC POLYNOMIAL** Ji Young Ham (Kangwon N. Univ., Seoul N. Univ. of Science and Technology)	

Session Presentation Schedule

II : Geometry and Topology		
Day 1 - June 30 (Monday)	**Room 1503**	
Time	**Talk**	**Chair**
14:50 - 15:20	Invited Talk **RECENT DEVELOPMENTS ON WEAKLY EINSTEIN MANIFOLDS** Jeonghyeong Park (Sungkyunkwan University)	Eunjoo Lee (Soongsil University)
15:30 - 16:00	Invited Talk **SMOOTH TORUS ORBIT CLOSURES IN G/P** Seonjeong Park (Jeonju University)	
16:10 - 16:30	**LIECHTI-STRENNER'S POLYNOMIALS ARE IRREDUCIBLE** Ji Young Ham (Kangwon N. Univ., Seoul N. Univ. of Science and Technology)	
16:35 - 16:55	**COLLARS OF COMPLEX HYPERBOLIC MANIFOLDS** Youngju Kim (Konkuk University)	Aeryeong Seo (Kyungpook National University)
17:00 - 17:20	**ON CAYLEY MAPS AND SKEW-MORPHISMS** Jihye Park (Yeungnam University)	
17:25 - 17:45	**MODIFIED HAWKING MASS AND RIGIDITY OF THREE-MANIFOLDS WITH BOUNDARY** Jihyeon Lee (IBS-CGP)	

Session Presentation Schedule

III : Mathematics Education		
Day 1 - June 30 (Monday)	**Room 1424**	
Time	**Talk**	**Chair**
14:50 - 15:50	Invited Talk **WILL MATH BE INTERESTING OR META-AFFECT?** Sun Hee Kim (Kangwon National University)	Hyeyun Jung (Gongju National University of Education)
15:50 - 16:20	**THE EXPLORATION OF DIRECTIONS FOR MATHEMATICS CURRICULUM INNOVATION** Min Hee Lee (Korea Institute for Curriculum and Evaluation)	
16:20 - 16:50	**ANALYSIS OF ELEMENTARY GIFTED STUDENTS' FERMI PROBLEM-SOLVING PROCESS** Nayoung Ku (Gyeonggi Science High School)	
16:50 - 17:20	**ANALYZING PRE-SERVICE TEACHER EDUCATION USING AN AI-BASED CHATBOT** Yujin Lee (Korea National University of Education)	Mimi Park (Gyeongin National University of Education)
17:20 - 17:50	**A STUDENT'S THOUGHTS AS A SOURCE OF RESEARCH AND PRACTICE IN MATHEMATICS EDUCATION** Seung Eun Lee (Baegotnuri Elementary School)	

Session Presentation Schedule

IV : Analysis		
Day 2 - July 01 (Tuesday)	**Room 1423**	
Time	**Talk**	**Chair**
15:20 - 15:50	Invited Talk **FREE ENERGY EXPANSIONS OF 2D COULOMB GAS ENSEMBLES** Seong Mi Seo (Chungnam National University)	Sukjung Hwang (Chungbuk National University)
15:50 - 16:00	**Break**	
16:00 - 16:20	**POSITIVE SOLUTIONS FOR ELLIPTIC EQUATIONS ARISING IN A THEORY OF THERMAL EXPLOSION** Eunkyung Ko (Keimyung University)	
16:20 - 16:40	**GLOBAL SMOOTH SOLUTIONS TO THE IRROTATIONAL EULER-RIESZ SYSTEM IN 3D** Yoonjung Lee (Yonsei University)	
16:40 - 16:50	**Break**	
16:50 - 17:10	**ENDPOINT ESTIMATES FOR MAXIMAL OPERATORS ASSOCIATED TO THE WAVE EQUATION** Chuhee Cho (Seoul National University)	Hyerim Ko (Jeonbuk National University)
17:10 - 17:30	**MUTIPARAMETER MAXIMAL FUNCTIONS** Juyoung Lee (Korea Institute for Advanced Study)	
17:30 - 17:50	**ISOPERIMETRIC INEQUALITIES ON CLOSED MANIFOLDS** Hanna N. Kim (University of North Carolina at Chapel Hill)	

Session Presentation Schedule

V : Applied Mathematics		
Day 2 - July 01 (Tuesday)	**Room 1424**	
Time	**Talk**	**Chair**
15:20 - 16:00	Invited Talk **SINGULAR VALUE DECOMPOSITION-DRIVEN INFORMATION OPTIMIZATION IN MEDICAL IMAGING AND LEARNING SYSTEMS** Soomin Jeon (Dong-A University)	Darae Jeong (Kangwon National University)
16:00 - 16:40	Invited Talk **OVERCOMING BIAS IN ESTIMATING EPIDEMIOLOGICAL PARAMETERS WITH REALISTIC HISTORY-DEPENDENT DISEASE SPREAD DYNAMICS** Sunhwa Choi (National Institute For Mathematical Sciences)	
16:40 - 17:00	**Break**	
17:00 - 17:40	**QUANTUM ANNEALING-BASED OPTIMIZATION ALGORITHM FOR ROBUST CT IMAGE RECONSTRUCTION** Hyunju Lee (Dongguk University)	Soomin Jeon (Dong-A University)
17:40 - 18:20	**NUMERICAL STUDY OF DENDRITIC SOLIDIFICATION USING PHASE-FIELD MODELING WITH ORIENTATION EFFECTS** Darae Jeong (Kangwon National University)	

Session Presentation Schedule

Poster Session	
Day 2 - July 01 (Tuesday)	**Room 1503**

Time	Presentation
14:00 - 14:30	[Algebra] **DISTINGUISHED FILTRATIONS OF THE 0-HECKE MODULES FOR DUAL IMMACULATE QUASISYMMETRIC FUNCTIONS** So-Yeon Lee (Sogang University)
	[Algebra] **BINARY FEW-WEIGHT OPTIMAL LINEAR CODES, t-DESIGNS, AND OPTIMAL QUANTUM CODES** Jihye Jeong (Ewha Womans University)
	[Geometry and Topology] **EXACT THREE-PAGE INDICES FOR SEVERAL TORUS LINKS** Minseo Lee (Sunchon National University)
	[Applied Mathematics] **VACCINE-INDUCED IMMUNE ESCAOE AND THE ROLE OF ASYMPTOMATIC TRANSMISSION IN VIRAL EVOLUTION** Minjin Kim (Soongsil University)
	[Applied Mathematics] **PRIVATE INFORMATION RETRIEVAL BASED ON HOMOMORPHIC ENCRYPTION, REVISITED** Hyewon Sung (Ewha Womans University)
	[Applied Mathematics] **VERIFIABLE FHE WITH LINEAR PROOFS FOR MULTIPLICATIVE DEPTH VIA LATTICE-BASED SNARKS** Yu Jin Chang (Ewha Womans University)

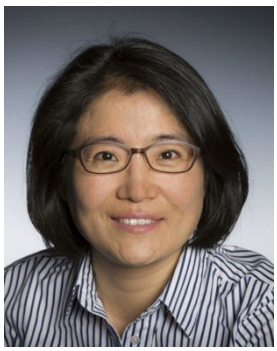
2025

The 19th KWMS International Conference

- Abstracts -

Plenary Lecture I

MiHyun Kang
Graz University of Technology



PhD in Mathematics, Korea Advanced Institute of Science and Technology (KAIST)	(2001)
Postdoc/Privatdozentin, Humboldt University of Berlin (HU), Germany	(2001-2008)
Heisenberg Fellow of German Research Foundation (DFG)	(2008-2011)
Full Professor, Graz University of Technology (TU Graz), Austria	(2012- present)

Matchings on Random Graphs

We will briefly overview classical and recent results concerning matchings on random graphs. We will also discuss a connection between the matching number of sparse random graphs and the rank of sparse random binary matrices.

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Plenary Lecture II

Bruce Berndt
Univ. of Illinois, USA

PhD in Mathematics, University of Wisconsin–Madison, USA	(1966)
Lecturer, University of Glasgow, UK	(1966-1967)
Assistant–Full Professor, University of Illinois at Urbana-Champaign, USA	(1967-2019)
Professor Emeritus, University of Illinois at Urbana-Champaign, USA	(2019- present)

Ramanujan's Notebooks and Lost Notebook

Srinivasa Ramanujan is universally regarded as India's greatest Mathematician. After a brief biography of Ramanujan, I will provide histories of Ramanujan's earlier notebooks and his later lost notebook, with some examples from each of them. Along with these histories, I will relate how I began my interest in the notebooks. If time permits, Gauss's unsolved 'Circle Problem' and Ramanujan's relation with it will be discussed.

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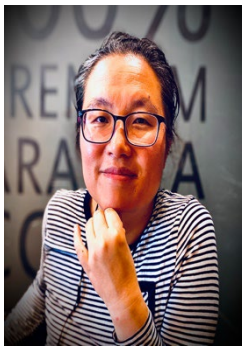
Plenary Lecture III

JuHi Jang
USC, USA



B.Sc. in Mathematics, Seoul National University	(2000)
Ph.D. in Mathematics, Brown University	(2007)
Member, Institute for Advanced Study, Princeton	(2007-2008)
Courant Instructor, Courant Institute, New York University	(2008-2010)
University of California Riverside	(2010-2015)
University of Southern California	(2015-present)

Dynamics of Newtonian Stars

In astrophysical fluid dynamics, stars are considered as isolated fluid masses subject to self-gravity. A classical model of a self-gravitating Newtonian star is given by the gravitational Euler-Poisson system. In the talk, I will review some recent progress on the local and global dynamics of Newtonian star solutions and discuss self-similar Newtonian gravitational collapse and stability of the Larson-Penston solution for isothermal stars.

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Plenary Lecture IV

Seonhee Lim
Seoul National Univ.

Seoul National Univ., B. S.	(1999)
Yale Univ. - ENS Paris, Ph. D.	(2006)
Univ. of Notre Dame, Visiting assistant professor	(2006-2007)
MSRI, Postdoctoral fellow	(2007)
Cornell Univ,. H.C.Wang Assistant professor	(2008-2009)
Seoul National Univ., Assistant/associate/full professor	(2009-present)

Dynamics, Number Theory and Post-Quantum Cryptography

From ancient times to the present day, we have always used rational numbers to approximate irrational ones. But what kind of sequences of rational numbers provide good approximations to irrationals? Are there rational numbers that approximate particularly well, or irrational numbers that resist good approximation? How well can a matrix with irrational entries be approximated by a matrix with rational entries?

These questions are deeply connected to lattices, which are used in post-quantum cryptography, and to certain geometric spaces of lattices. In this lecture, we will explore these spaces, orbits closures in them, and explain how dynamics of "lattices" relates to rational approximation.

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Public Lecture I

Youngmok Jeon
President of KSIAM

Ph.D. (Kendall Atkinson), Mathematics, The University of Iowa, Iowa City	(1988-1993)
Research Associate, University of New South Wales, Sydney, Australia (Ian Sloan)	(1993-1994)
Assistant, Associate and full Professor, Ajou University	(1994- present)

The Past, Present of Applied Mathematics and Toward the Era of AI & QC.

In this talk, I will begin with a historical review of applied and industrial mathematics, tracing its origins back to ancient Greek. The advancement of computational power in the 20th century shifted modern applied mathematics toward computational modeling, optimization, and cryptography, which enabled breakthroughs in science and industry.

Now, at the dawn of the Artificial Intelligence (AI) and Quantum Computing (QC) era, applied mathematics is undergoing another transformative shift. AI, powered by deep learning is revolutionizing data-driven modeling, while QC promises to redefine problem-solving in optimization, cryptography, and beyond. We explore how these emerging technologies will reshape mathematical research and applications, presenting both unprecedented opportunities and new challenges.

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Public Lecture II

Seonja Kim
Chungwoon Univ.

Ph. D. Seoul National University	(1989)
Dept. of Electronic Engineering, Chungwoon University,	
Assistant /Associate/Full Professor	(1996-2023)
Chungwoon University, Research Professor	(2023- present)
Medal of Innovation of the Order of Science and Technology	(2017)

Maps of Algebraic Curves to Projective Space

Let C be a compact Riemann surface, which is a smooth irreducible complex algebraic curve. In 1865, B. Riemann and G. Roch gave a theorem on the dimension of the space V of meromorphic functions with prescribed zeros and allowed poles. Such a space V of functions without common zero gives rise to a map of C to the projective space P(V). Further, if the degree of the map equals one then that image is a kind of realization of C in P(V). It is an interesting classical problem to describe all the ways in which a given smooth algebraic curve could be mapped into a projective space with xed degree. The theory related this problem is called the Brill-Noether theory. A. Brill and M. Noether established the basis of this theory in the 1870s. In this talk we will consider basic notions mentioned above together with their background or context, and then brie y review some results related to the Brill-Noether theory.

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Award Lecture

Hyangdong Park
KIAS

Ph.D. Mathematics, POSTECH (2019)
Postdoctoral Researcher/ Research Professor,
Center for Mathematical Analysis and Computation (CMAC), Yonsei University (2019-2022)
Research Fellow, School of Mathematics, Korea Institute for Advanced Study (KIAS) (2022- present)

Shocks and Contact Discontinuities for the Steady Euler System

There are two types of discontinuous transition phenomena in inviscid compressible flows, shocks and contact discontinuities. We will discuss the existence and stability of shocks and contact discontinuities for the steady Euler system. The Helmholtz decomposition method and the iteration method for 2-D and 3-D axisymmetric flows with nonzero vorticity will be introduced.

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ANTI-MORDERLL-WEIL FIELDS AND LARSEN'S CONJECTURE

BO-HAE IM

The rank of an elliptic curves over a number field or more generally, of an abelian variety over a number field is one of the important research topic in number theory. We will discuss the historical progress on the rank of abelian varieties over certain infinite extensions of a number field, especially we will introduce Larsen's conjecture and its progress.

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MOMENT FORMULAS OF SIEGEL TRANSFORMS WITH CONGRUENCE CONDITIONS IN DIMENSION 2

JIYOUNG HAN AND SEUL BEE LEE*

The Siegel transform was developed to study the average properties of lattice points in the real plane. It has been applied to problems in counting theorems and Diophantine approximation. In this talk, we introduce Siegel transforms associated with principal congruence subgroups, along with their first and second moment formulas. We then consider problems of counting primitive lattice points satisfying congruence conditions. We apply these results to obtain analogs of Schmidt's random counting theorem and a quantitative Khintchine theorem. This is joint work with Jiyoung Han.

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A NEW CANDIDATE FOR RESOLVING GROMOV'S OPEN QUESTION

JAN KIM* AND YOONJIN LEE

In geometric group theory, Gromov's longstanding open question asks whether every hyperbolic group is residually finite. In this talk, we introduce a new candidate for resolving Gromov's open question by constructing a hyperbolic group that has the potential to be non-residually finite. Specifically, we construct a hyperbolic one-relator group by developing based on the Baumslag-Gersten group, which is a well-known example of a non-hyperbolic, non-residually finite group. This is a joint work with Yoonjin Lee.

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COMBINATORIAL DESCRIPTION FOR THE HALL-LITTLEWOOD EXPANSION OF UNICELLULAR LLT AND CHROMATIC QUASISYMMETRIC POLYNOMIALS

SEUNG JIN LEE, JANG SOO KIM, AND MEESUE YOO*

In this work, we obtain a Hall–Littlewood expansion of the chromatic quasisymmetric functions by using a Dyck path model and linked rook placements. By using the Carlsson–Mellit relation between the chromatic quasisymmetric functions and the unicellular LLT polynomials, this combinatorial description for the Hall–Littlewood coefficients of the chromatic quasisymmetric functions also gives the coefficients of the unicellular LLT polynomials expanded in terms of the modified transformed Hall–Littlewood polynomials. This is joint work with Seung Jin Lee and Jang soo Kim.

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(M. Yoo) DEPARTMENT OF MATHEMATICS, CHUNGBUK NATIONAL UNIVERSITY, CHEONGJU, REPUBLIC OF KOREA

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DOMINATION NUMBER VERSUS PACKING NUMBER IN A GRAPH WITH BOUNDED MAXIMUM DEGREE

EUN-KYUNG CHO*, MINKI KIM, AND CHANGQING XI

In 2011, Henning, Löwenstein, and Rautenbach observed that the domination number of a graph is bounded from above by the product of the packing number and the maximum degree of the graph. Inspired by this result, in 2023, we proved that if a graph is subcubic, then the independent domination number of the graph is bounded from above by three times the packing number of the graph. Recently, we proved that for a graph with maximum degree at most 4, the independent domination number of the graph is bounded from above by four times the packing number of the graph if the graph is $(K_{1,4} + e)$-free, where $K_{1,4} + e$ is a graph obtained by adding an edge to $K_{1,4}$. Moreover, we also prove that for a graph with maximum degree at most 4, the bipartite domination number of the graph is bounded from above by four times the packing number of the graph. This talk is a combination of a joint work with Minki Kim and a joint work with Changqing Xi.

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INFINITELY MANY PRIME VALUES IN A CUBIC POLYNOMIAL

JI-YOUNG HAM* AND JOONGUL LEE

A prime number is a natural number greater than 1 that cannot be divided by any natural number other than 1 and itself. Prime numbers are important numbers that form the basis of number theory, but they also form the basis of cryptographic algorithms such as the RSA algorithm and cybersecurity. So far, we have learned how to find prime numbers using the Sieve of Eratosthenes, Euler proved that there are infinitely many prime numbers, and Dirichlet showed in the Dirichlet arithmetic sequence theorem that the arithmetic sequence $a + dn$ (n is a natural number) where the first number a and the difference d of the terms are coprime contains infinitely many prime numbers.

The Dirichlet theorem is equivalent to the statement that when a and d are coprime, the linear function $a + dn$ has infinitely many prime values. However, there are not many known rules about prime numbers. Here, we show that a cubic polynomial has infinitely many prime values. Landau raised the question of whether $n^2 + 1$ has infinitely many prime values, but it remains an unsolved problem. No one has yet been found among the one-variable polynomials of degree 2 or higher that have infinitely many prime values. Our results also suggest a way to solve the Bunyakovsky conjecture.

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RECENT DEVELOPMENTS ON WEAKLY EINSTEIN MANIFOLDS

JEONGHYEONG PARK

A Riemannian manifold (M, g) is said to be weakly Einstein if the tensor $R_{abci}R^{abc}{}_j$ is a scalar multiple of the metric tensor g_{ij}. The concept of weakly Einstein manifolds, along with several applications, was introduced by Euh, Park, and Sekigawa in the context of a curvature identity that holds on every 4-dimensional Riemannian manifold. The fact that every 4-dimensional Einstein manifold is weakly Einstein served as the original motivation for the definition. Analogous to the Einstein condition, compact weakly Einstein manifolds admit a variational characterization: they arise as critical points of the integral of the squared norm of the Riemann curvature tensor on the space of fixed volume with parallel Ricci tensor.

In this talk, we discuss our recent progress on weakly Einstein manifolds. In particular, we provide a complete classification of weakly Einstein hypersurfaces in spaces of constant curvature, present new results on weakly Einstein Lie groups, and explore the structural properties of weakly Einstein curvature tensors. (This is joint work with Y. Euh, J. Kim, S. Kim and Y. Nikolayevsky).

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SMOOTH TORUS ORBIT CLOSURES IN G/P

SEONJEONG PARK

Let G be the general linear group of degree n, and let P be a parabolic subgroup of G. The homogeneous space G/P can be described in terms of flags in $\mathbb{C}^n$, where a flag is an increasing sequence of subspaces. The maximal torus T of G acts naturally on G/P. The topology and geometry of torus orbit closures in G/P are closely related to combinatorics (see [1, 3]).

In this talk, we introduce the construction of toric varieties using Schröder trees, as developed in [4] and [2], and show that these varieties arise as smooth torus orbit closures in G/P.

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LIECHTI-STRENNER'S POLYNOMIALS ARE IRREDUCIBLE

JI-YOUNG HAM* AND JOONGUL LEE

We show that Liechti-Strenner's polynomials in [2] are irreducible.

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COLLARS OF COMPLEX HYPERBOLIC MANIFOLDS

YOUNGJU KIM*

We will talk about a tubular neighborhood theorem for an embedded complex geodesic in a complex hyperbolic 2-manifold where the width of the tube depends only on the Euler characteristic of the embedded complex geodesic. We give an explicit estimate for this width. We supply two applications of the tubular neighborhood theorem, the first is a lower volume bound for such manifolds. The second is an upper bound on the first eigenvalue of the Laplacian in terms of the geometry of the manifold.

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ON CAYLEY MAPS AND SKEW-MORPHISMS

JIHYE PARK* AND YOUNG SOO KWON

This talk introduces Cayley maps and skew-morphisms and presents the classification of Cayley maps for a given group. A Cayley map is a structure defined by a group and its generating set, with applications in fields such as cryptography, graph theory, and network analysis. Meanwhile, skew-morphism is a transformation that preserves certain algebraic properties and plays an important role in the classification of Cayley maps. In this talk, we present the classification results and the approach used.

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MODIFIED HAWKING MASS AND RIGIDITY OF THREE-MANIFOLDS WITH BOUNDARY

JIHYEON LEE* AND SANGHUN LEE

In this talk, we present a local rigidity theorem for three-dimensional Riemannian manifolds with boundary under scalar curvature and mean curvature bounds. Assuming the manifold has scalar curvature at least -6 and mean convex boundary, we consider a properly embedded, two-sided, free boundary strictly stable minimal two-disk that locally maximizes a modified Hawking mass. We prove that its Gaussian curvature must be constant and equal to $\frac{1}{a^2}$, and its boundary geodesic curvature vanishes in a neighborhood. As a consequence, the ambient manifold is locally isometric to a portion of the half anti-de Sitter-Schwarzschild manifold.

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WILL MATH BE INTERESTING OR META-AFFECT?

SUN HEE KIM*

Interest has long been recognized as a pivotal element in mathematics learning. However, current emphasis increasingly focuses on the deeply interdependent relationship between cognition and affect. Meta-affect, exemplifies this complex interplay. Defined as the affect of affect, encompassing affect about affect, affect within and about cognitive processes related to affect, and the cognitive and/or affective monitoring of one's own affect (DeBellis & Goldin, 2006, p. 136), meta-affect, which involves the awareness, evaluation, regulation, and utilization of emotions in learning, remains a crucial yet under-researched area in mathematics education. I investigated the concept of meta-affect, developed two test tools of meta-affect, and applied to students. One test tool employed self-report Likert-scale items, while the other utilized scenario-based assessments on website. The collected data on meta-affect were analyzed in multiple dimensions. First, the concept of meta-affect was validated through a Delphi survey (Kim, 2019; Kim et al., 2022). Second, the two assessment tools demonstrated both validity and reliability (Kim, 2020; Kim et al., 2023). Third, instructional approaches focusing on meta-affect proved to be a significant method in mathematics education (Kim, 2021). Fourth, the structural relationship between affect, meta-affect, and metacognition was established (Kim & Kim, 2020). Finally, providing feedback to students on their meta-affect was shown to enhance it. These findings significantly contribute to the understanding of meta-affect in mathematics education and pave the way for future research aimed at improving educational practices by leveraging students' meta-affect in mathematics learning.

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THE EXPLORATION OF DIRECTIONS FOR MATHEMATICS CURRICULUM INNOVATION

MIN HEE LEE

This study is a study to explore the future direction of mathematics education required for the intelligent information society. It aims to derive the direction of school education and curriculum through theoretical exploration, educational policy and curriculum analysis, and actual school case review targeting Finland, the U.S, Singapore, and Japan. The results from our analysis of educational policies are following. First, the countries we studied are pursuing policies aimed at enhancing the competencies that are required for future society and can facilitate students' well-being and expanding educational opportunities by ensuring basic academic skills with a focus on student-centered learning. Second, the countries examined are actively pursuing policies that focus on establishing a digital-based learning environment, enhancing digital literacy skills, and providing educational support using digital and AI technology. Third, these countries are promoting policies that are designed to offer tailored school curriculum suitable for students' learning levels, support personalized education with consideration for diverse career paths, and help to design and implement individualized school curriculum. he results from our analysis of school curriculum are following. First, the countries we examined are designing competency-centered educational programs in diverse ways. Second, to enhance digital/AI education, the countries are systematizing the content of information-related curricula and establishing a foundation for the application of digital/AI-related content and methods in school subjects beyond information-related courses. Third, to realize student-centered personalized education, the countries are establishing the groundwork for differentiated curriculum, expanding student choice, and linking career education. They are also enhancing the effectiveness of student-centered personalized education by integrating student perspectives throughout written curriculum. Through a comprehensive analysis of four countries' educational policies, curricula, and school education practices, the following implications were drawn regarding the direction of mathematics and curriculum innovation: (1) reconceptualization of the essence of mathematics and related competencies, (2) restructuring curriculum content to align with the demands of the intelligent information society, (3) development of personalized courseware that considers internal and external connections in mathematics, and (4) establishment of guidelines for the utilization of digital and AI technologies that consider learners' developmental stages.

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ANALYSIS OF ELEMENTARY GIFTED STUDENTS' FERMI PROBLEM-SOLVING PROCESS

NAYOUNG KU*

The Fermi problem is an open-ended problem in which problem solvers establish assumptions and derive approximate values through estimation when clear information is not provided [1]. This study aims to analyze the processes through which elementary gifted students solve Fermi problems. The research questions are:

RQ1. What problem-solving strategies do elementary gifted students employ when solving Fermi problems?

RQ2. What justifications do elementary gifted students use when simplifying problems to derive approximate values?

This study adopted a case study method and involved 46 elementary gifted students enrolled in a gifted education center. During the lessons, three magnitude estimation problems were presented: two problems involved discrete magnitudes, while the third addressed a continuous magnitude. Prior to solving Problem 1, the instructor provided a brief introduction to Fermi problems and offered the necessary information for problem-solving. For Problems 2 and 3, students were allowed to freely search for information and independently solve the problems.

The analytical framework was developed with reference to prior research [2], [3]. To address RQ1, the strategies employed by students were categorized into four types: iteration of a base unit, use of proportion, concentration measurement, and the grid distribution model. To address RQ2, students' justifications were classified into four categories: guesstimation, experimentation, data search, and statistical data collection.

The findings revealed that iteration of a base unit and use of proportion were the most frequently employed by participants. Approximately half of the students relied solely on personal experiences and intuition to derive their approximate values. Based on these results, this study highlights the need for pedagogical support to broaden elementary gifted students' problem-solving strategies for Fermi problems and underscores the importance of guiding them to employ a range of justifications beyond simple guesstimation.

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ANALYZING PRE-SERVICE TEACHER EDUCATION USING AN AI-BASED CHATBOT

YUJIN LEE

Pre-service elementary teachers are required to cultivate pedagogical content knowledge through direct engagement with students. However, limited opportunities for authentic classroom experiences often hinder their ability to engage meaningfully with students (Cooper & Nesmith, 2013). In response, virtual field experiences leveraging technological tools have received growing attention (Hixon & So, 2009), particularly generative AI, which has the potential to simulate teacher–student interactions in instructionally meaningful ways. This study implemented a teacher education program utilizing an AI-based chatbot to offer indirect opportunities for pre-service teachers to engage in simulated interactions with students. The chatbot, based on ChatGPT-3.5, was designed to act as a fourth-grade student. It engaged with a task aligned with the newly introduced standard on the equal sign and equivalence in the 2022 revised Korean mathematics curriculum. To simulate authentic student responses, it was programmed with prompts grounded in common patterns of student understanding. These were based on levels of understanding of the equal sign defined by Matthews et al. (2012). Through structured conversations with the chatbot, pre-service teachers were encouraged to identify and respond to students' mathematical understanding. The findings revealed that pre-service teachers were able to detect student misconceptions and implement instructional strategies that guided students' thinking by posing appropriate questions and problems. Notably, several participants exhibited responsive teaching practices, adjusting their instructional strategies in alignment with the perceived level of student understanding. These findings highlight the potential of AI-based chatbots to foster responsive teaching in pre-service teachers and inform the design of AI-integrated teacher education programs.

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A STUDENT'S THOUGHTS AS A SOURCE OF RESEARCH AND PRACTICE IN MATHEMATICS EDUCATION

SEUNG-EUN LEE*

Previous studies have examined elementary teachers' general motivations for teaching, as well as motivations arising from their interest in mathematics. However, general teaching motivations are not directly tied to the nature of mathematical knowledge and may not effectively drive teachers to engage in consistent research and practice in mathematics education. While motivations based on an interest in mathematics may suit secondary teachers, they may not fully align with the context of elementary teachers, who teach multiple subjects.

Elementary teachers spend the entire school day with their students, observing their growth across lessons. This continued engagement fosters in teachers a deep interest in how their students develop. Students' thoughts during math lessons spark curiosity in elementary teachers and motivate them to engage in mathematics education research. For example, when students interpret 1/2 kg of apples as the weight of half an apple, a teacher who becomes curious about such a response may begin to wonder how students interpret the notation and what kinds of learning experiences could help deepen their understanding. Furthermore, incorporating students' thoughts into lessons encourages teachers to move beyond conventional instruction, often leading to shifts in their teaching goals and practices. Lesson goals may be reoriented to focus on learning progress through students' ideas as a foundation for deeper exploration.

Research that stems from teachers' attention to students' thoughts contributes first to the development of teachers' knowledge of content and students, and further to their specialized content knowledge and knowledge of content and teaching. When instruction and research are grounded in students' thoughts, teachers not only strengthen their ability to respond to unexpected situations but also build a broader foundation for mathematics education through the accumulation of such reflective experiences. Moreover, when teachers respond to students not by judging ideas as simply right or wrong, but by showing genuine interest in how those ideas emerged, students learn to value and respect their own thinking. In doing so, they internalize the idea that what matters is not immediate correctness, but the ongoing process of progress and transformation in their thinking.

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FREE ENERGY EXPANSIONS OF 2D COULOMB GAS ENSEMBLES

SEONG-MI SEO*

The free energy expansion of a Coulomb gas ensemble is one of the most fundamental topics in this area and has received considerable attention in recent years. The coefficients in the expansion not only contain electrostatic quantities but also provide topological and geometric information about the system. In this talk, I will present a precise free energy expansion for a class of 2D Coulomb gas models with determinantal or Pfaffian structures. Our results provide explicit coefficients beyond the entropy term, revealing their dependence on the topological properties of the system and verifying Zabrodin-Wiegmann conjecture regarding the spectral determinant emerging at the $O(1)$ term in the free energy expansion. This talk is based on joint works with Sung-Soo Byun, Meng Yang, and Nam-Gyu Kang.

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POSITIVE SOLUTIONS FOR ELLIPTIC EQUATIONS ARISING IN A THEORY OF THERMAL EXPLOSION

EUNKYUNG KO*

In this talk, extending [1], we present the existence of positive solutions of a mathematical model arising in a theory of thermal explosion which is described by the boundary value problem

$$\begin{cases} -\operatorname{div}\left(|\nabla u|^{N-2}\nabla u\right) = \lambda e^{u^{\alpha}}, & x \in \Omega, \\ |\nabla u|^{N-2}\dfrac{\partial u}{\partial \nu} + g(u)u^{N-1} = 0, & x \in \partial\Omega, \end{cases}$$

where $0 \in \Omega$ is a bounded domain in $\mathbb{R}^N$, $N \geq 2$, $\partial\Omega$ is the smooth boundary of Ω with outward unit normal ν, $\alpha \in \left(0, \frac{N}{N-1}\right]$ and λ is a positive parameter. Under the weaker assumption on g than in [1], we establish that there exists $0 < \Lambda < \infty$ such that the problem has at least two positive solutions if $0 < \lambda < \Lambda$, no solution if $\lambda > \Lambda$ and at least one positive solution when $\lambda = \Lambda$. We employ the variational methods for the proof.

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GLOBAL SMOOTH SOLUTIONS TO THE IRROTATIONAL EULER-RIESZ SYSTEM IN 3D

YOUNG-PIL CHOI, JINWOOK JUNG, AND YOONJUNG LEE*

The compressible Euler system is one of physical models which obeys the hyperbolic conservation law with no dissipation. It is known that the pure compressible Euler flows generally blows up in a finite time though, a remarkable work of Y. Guo [1] discovered that the Poisson interaction force makes some oscillation and leads to some dispersion such as the Klein-Gordon effect. Such dispersion prevents the singularity formation phenomenon for the Euler–Poisson system and allows us to construct a global irrotational solution in the three dimensional case. In this talk, we are interested in the Euler system with the Riesz potential in 3D. The Riesz interaction serves as a generalization to the Poisson case and has been extensively studied in the physics literature. We investigate a dispersion feature of the linearized Euler–Riesz system. Unlike the Euler-Poisson case, the main difficulty in constructing the global irrotational solution arises from the singularity of the nonlinearity. We would like to explain a strategy to control the singularity, motivated by the work [2] of Y. Guo and B. Pausader for ion dynamics model and present the recent result of the global irrotational solution to the 3D Euler–Riesz system.

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ENDPOINT ESTIMATES FOR MAXIMAL OPERATORS ASSOCIATED TO THE WAVE EQUATION

CHUHEE CHO*, SANGHYUK LEE, AND WENJUAN LI

We consider the H^s–L^q maximal estimates associated to the wave operator

$$e^{it\sqrt{-\Delta}}f(x) = \frac{1}{(2\pi)^d}\int_{\mathbb{R}^d} e^{i(x\cdot\xi + t|\xi|)}\widehat{f}(\xi)d\xi.$$

Rogers–Villarroya proved H^s–L^q estimates for the maximal operator $f \mapsto \sup_t |e^{it\sqrt{-\Delta}}f|$ up to the critical Sobolev exponents $s_c(q,d)$. We obtain the endpoint $H^{s_c(q,d)}$–L^q bounded on the maximal operator $f \mapsto \sup_t |e^{it\sqrt{-\Delta}}f|$. We also prove that several different forms of the maximal estimates considered by Rogers–Villarroya are basically equivalent to each other. This talk is based on joint work with Sanghyuk Lee and Wenjuan Li.

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MUTIPARAMETER MAXIMAL FUNCTIONS

JUYOUNG LEE*, SANGHYUK LEE, AND SEWOOK OH

In this talk, I will introduce a brief history of maximal functions, especially maximal averages. Since Stein's work on boundedness of the spherical maximal function, many works have been devoted to study the boundedness of various maximal functions. Our work focuses on the multi-parameter maximal functions. Precisely, I will consider maximal averages over ellipses in the plane and tori in the 3-dimensional Euclidean space.

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ISOPERIMETRIC INEQUALITIES ON CLOSED MANIFOLDS

HANNA N. KIM

We study problems involving the optimization of eigenvalues in various boundary conditions. The Steiner symmetrization was the important key to solving the classical isoperimetric inequality, where the solution is the ball. Based on this problem, analogous problems were introduced in spectral problems with Dirichlet, Neumann and Robin boundaries and so on. I will discuss recent results on showing maximization of third Robin eigenvalue for negative parameters. This work is based on joint work with R. Laugesen.

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SINGULAR VALUE DECOMPOSITION-DRIVEN INFORMATION OPTIMIZATION IN MEDICAL IMAGING AND LEARNING SYSTEMS

SOOMIN JEON*

In this talk, we present two applications of Singular Value Decomposition (SVD) as a core mathematical tool for solving practical problems in medical imaging and machine learning. The first study focuses on medical image compression, where we propose an SVD-based method to determine the optimal rank that preserves clinically relevant information while reducing the data size. The second study investigates the use of Neural Tangent Kernels (NTKs) in active learning, aiming to identify an informative data batch for efficient model training. Here, SVD plays a central role in analyzing the spectral structure of the NTK matrix to guide the selection process. Although these studies target different domains, they share a unifying mathematical foundation in SVD, offering an integrated perspective on data-driven optimization across both image processing and learning systems.

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OVERCOMING BIAS IN ESTIMATING EPIDEMIOLOGICAL PARAMETERS WITH REALISTIC HISTORY-DEPENDENT DISEASE SPREAD DYNAMICS

SUNHWA CHOI

Infectious diseases spread by pathogen transfer between individuals. After exposure, a latent period is followed by an infectious period. Because pathogen numbers change over time, the chances of becoming infectious during the latent period increases over time since exposure, and the chances of recovering during the infectious period increases over time since becoming infectious. These history-dependent result in non-Markovian systems, which are challenging for modeling and inference. To overcome these challenges, conventional approaches have assumed unrealistic history-independent transitions whereby the chance of becoming infectious or recovered remains unchanged regardless of time since exposure or being infectious, i.e., the latent and infectious periods are exponentially distributed. Here, we find that these approaches cause serious bias in estimating epidemiological parameters such as reproduction number, R, which drive policy decision making. To address this bias, we developed a Bayesian inference method by adopting more realistic gamma distributions for the latent and infectious periods. Unlike conventional approaches, our method accurately and precisely estimates R and the infectious period distribution solely from confirmed cases data, which are easy to obtain through testing. In particular, it revealed how the infectious period distribution changed throughout the COVID-19 pandemic, which would have provided valuable information for healthcare systems and on the effectiveness of testing and intervention strategies. This advancement represents a significant leap forward in infectious disease modeling, offering researchers and public health officials with a valuable tool for improved decision-making.

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QUANTUM ANNEALING-BASED OPTIMIZATION ALGORITHM FOR ROBUST CT IMAGE RECONSTRUCTION

HYUNJU LEE*

In this presentation, we propose a robust and efficient quantum optimization framework for CT image reconstruction by leveraging quantum annealing. Our approach begins with a formulation that encodes the target CT image into qubit variables and compares their forward projections with given sinograms using a QUBO (Quadratic Unconstrained Binary Optimization) model, as initially proposed in [1]. This model enables high-accuracy reconstruction by minimizing the mismatch between the computed and measured sinograms. Building upon this, we integrate a representation method where pixel values are expressed as weighted combinations of qubits using mass attenuation coefficients, as introduced in [2]. This technique significantly reduces the required number of qubits while preserving the fidelity of reconstructed images. To further enhance robustness, we consider scenarios with noisy or corrupted sinogram data. A measurement masking strategy is adopted to eliminate noisy sinogram entries, ensuring that only the high-confidence data contributes to the QUBO formulation. This selective data usage prevents noise propagation and stabilizes optimization. Experimental results compare four approaches: a classical reconstruction method using FFT-based Filtered Backprojection (FBP), two classical QUBO-based solvers (Gurobi and Simulated Annealing), and the D-Wave hybrid quantum solver. Our findings show that only the hybrid solver successfully reconstructs accurate images even when 50% of the sinogram data is corrupted. These results highlight the potential quantum advantage in robust CT image reconstruction.

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NUMERICAL STUDY OF DENDRITIC SOLIDIFICATION USING PHASE-FIELD MODELING WITH ORIENTATION EFFECTS

DARAE JEONG*

This study presents a numerical investigation of dendritic solidification using a phase-field modeling that incorporates orientation effects and thermal dynamics. The governing system consists of a phase-field equation for the solid-liquid interface evolution, a heat equation accounting for latent heat, and an additional equation describing the orientation field. Analytical examination of the model reveals a strong coupling between the thermal and phase variables, which significantly influences growth morphology. To efficiently handle the computational cost associated with long-time simulations, we adopt a time-dependent narrow-band method, solving the phase-field equation only in regions near the evolving interface. An operator splitting scheme is applied to separate nonlinear and linear components, enhancing computational stability. The heat and orientation equations are discretized using explicit Euler methods within their respective domains. Numerical experiments demonstrate the formation of complex dendritic patterns and highlight the role of orientation and thermal parameters in shaping anisotropic crystal structures.

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DISTINGUISHED FILTRATIONS OF THE 0-HECKE MODULES FOR DUAL IMMACULATE QUASISYMMETRIC FUNCTIONS

SO-YEON LEE* AND YOUNG-TAK OH

Let α range over the set of compositions. Dual immaculate quasisymmetric functions $\mathfrak{S}^*_\alpha$, introduced by Berg, Bergeron, Saliola, Serrano, and Zabrocki, provide a quasisymmetric analogue of Schur functions. They also constructed an indecomposable 0-Hecke module $\mathcal{V}_\alpha$ whose image under the quasisymmetric characteristic is $\mathfrak{S}^*_\alpha$. In this paper, we prove that $\mathcal{V}_\alpha$ admits a distinguished filtration with respect to the basis of Young quasisymmetric Schur functions. This result offers a novel representation-theoretic interpretation of the positive expansion of $\mathfrak{S}^*_\alpha$ in the basis of Young quasisymmetric Schur functions. A key tool in our proof is Mason's analogue of the Robinson-Schensted-Knuth algorithm, for which we establish a version of Greene's theorem. As an unexpected byproduct of our investigation, we construct an indecomposable 0-Hecke module $\mathbf{Y}_\alpha$ whose image under the quasisymmetric characteristic is the Young quasisymmetric Schur function $\hat{\mathscr{S}}_\alpha$. Further properties of this module are also investigated. And, by applying a suitable automorphism twist to this module, we obtain an indecomposable 0-Hecke module whose image under the quasisymmetric characteristic is the quasisymmetric Schur function $\mathscr{S}_\alpha$. This is joint with Young-Tak Oh.

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BINARY FEW-WEIGHT OPTIMAL LINEAR CODES, t-DESIGNS, AND OPTIMAL QUANTUM CODES

JIHYE JEONG*, JONG YOON HYUN, AND YOONJIN LEE

Error-correcting codes were invented to correct errors on noisy communication channels since Shannon in 1948. A major issue in Coding theory is to construct good error-correcting codes such as optimal codes, few-weight codes, and so on. Recently, a subject of quantum error-correcting codes has drawn much attention due to their important role in quantum information theory. In this presentation, we present new infinite families of binary optimal few-weight codes by using the shortening method; we use certain families of multivariable functions and interpret the shortening method followed by puncturing in terms of multivariable functions. We emphasize that we found new infinite families of few-weight optimal linear codes. As applications, we find infinitely many optimal quantum codes from our binary linear code families obtained. Furthermore, we produce support t-designs ($t = 2$ or 3) which cannot obtained by Assmus-Mattson Theorem; t-designs are related to many other mathematical objects such as linear codes, projective planes, graphs, and so forth.

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EXACT THREE-PAGE INDICES FOR SEVERAL TORUS LINKS

USEONG JANG, MINSEO LEE*, AND HYUNGKEE YOO

Abstract contents: In 1999, Dynnikov proposed a presentation of knots and links in the three-page space. This presentation is called a three-page presentation. In this presentation, each page contains disjoint arcs. We define the minimum number of arcs needed to represent L in this format is called the three-page index, denoted by $\alpha_3(\mathrm{L})$. In this talk, we determie the exact three-page indices for (n, n)-torus links. Also we suggest the bound of three-page indices for $(2, \mathrm{n})$-torus links by superbridge indices.

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VACCINE-INDUCED IMMUNE ESCAOE AND THE ROLE OF ASYMPTOMATIC TRANSMISSION IN VIRAL EVOLUTION

MINJIN KIM* AND EUNHA SHIM

Introduction: Asymptomatic transmission poses a significant challenge in managing infectious disease spread, as asymptomatic carriers—unaware of their infection—may drive transmission dynamics in unexpected ways. While vaccines reduce disease severity at the individual level, they may contribute to viral immune escape, especially if asymptomatic cases persist. This study examines how different vaccine efficacies and coverage levels influence escape pressure, focusing on the role of asymptomatic transmission in shaping population-level outcomes. Materials and Methods: We developed a compartmental model incorporating vaccine efficacy in preventing infection, reducing symptomatic cases, and limiting transmission. The model also accounts for varying contributions to immune escape from vaccinated and unvaccinated hosts, allowing an assessment of how vaccination strategies impact escape pressure under different transmission scenarios. Results: Our findings reveal that high vaccine efficacy in preventing infection effectively reduces escape pressure by limiting breakthrough infections. Conversely, lower efficacy in preventing infection, combined with high asymptomatic transmission, can sustain escape pressures, particularly at moderate coverage levels. When asymptomatic individuals are more infectious than symptomatic ones, escape pressure remains elevated even at higher coverage, while reduced asymptomatic infectiousness allows vaccination to more effectively lower escape risks. Discussion: This study underscores the critical importance of targeting asymptomatic transmission in public health strategies, alongside ensuring high vaccine efficacy and coverage. Understanding how asymptomatic spread interacts with vaccination can better inform control measures, reducing the likelihood of immune escape and supporting long-term control of disease variants.

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PRIVATE INFORMATION RETRIEVAL BASED ON HOMOMORPHIC ENCRYPTION, REVISITED

JAESEON KIM, JEONGEUN PARK, AND HYEWON SUNG*

Private information retrieval (PIR)[1] enables a client to retrieve data from a server while preserving the confidentiality of the client's query. When PIR is instantiated with fully homomorphic encryption (FHE), the protocol becomes non-interactive, requiring only a query-answer exchange, and it achieves asymptotically optimal communication and computation complexity. Although several FHE-based PIR protocols have been practically implemented with the desired properties, there has been little detailed comparison among them. As a result, it remains unclear which protocol is most efficient in practice with respect to various aspects such as performance and scalability.

In this talk, we categorize existing protocols [2, 3] into two structural classes and analyze their respective advantages and drawbacks, with a focus on practical implementation. We also compare homomorphic algorithms for query optimization, discussing their trade-offs in terms of performance and applicability. In doing so, we correct common misconceptions that often lead to inefficient choices in real-world deployments. Our findings reveal that, contrary to widely held assumptions, the less-explored design achieves up to 90% lower communication cost and an 8× reduction in computational overhead, making it the most efficient choice for practical use.

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VERIFIABLE FHE WITH LINEAR PROOFS FOR MULTIPLICATIVE DEPTH VIA LATTICE-BASED SNARKS

YU JIN CHANG*

Concerns over privacy, integrity, and efficiency have emerged with the growing demand for delegating computations to cloud servers. Fully Homomorphic Encryption (FHE) enables computation on encrypted data, ensuring privacy, while Verifiable Computation (VC) provides integrity guarantees. However, neither FHE nor VC alone satisfies both requirements. This has motivated research into combining the two primitives, often referred to as verifiable FHE. Initial approaches relied on garbled circuits, followed by constructions improving efficiency and compatibility with ring-based FHE schemes.

Our construction follows the outline of Atapoor et al. (CiC 2024) of utilizing the double-CRT representation used in FHE schemes to generate SNARK proofs over each CRT prime field. Compared to prior works, our construction provides a new perspective for reducing the proof size to be linear in the multiplicative depth of the underlying FHE computation. Moreover, we propose a segmented version of the construction to handle FHE bootstrapping.

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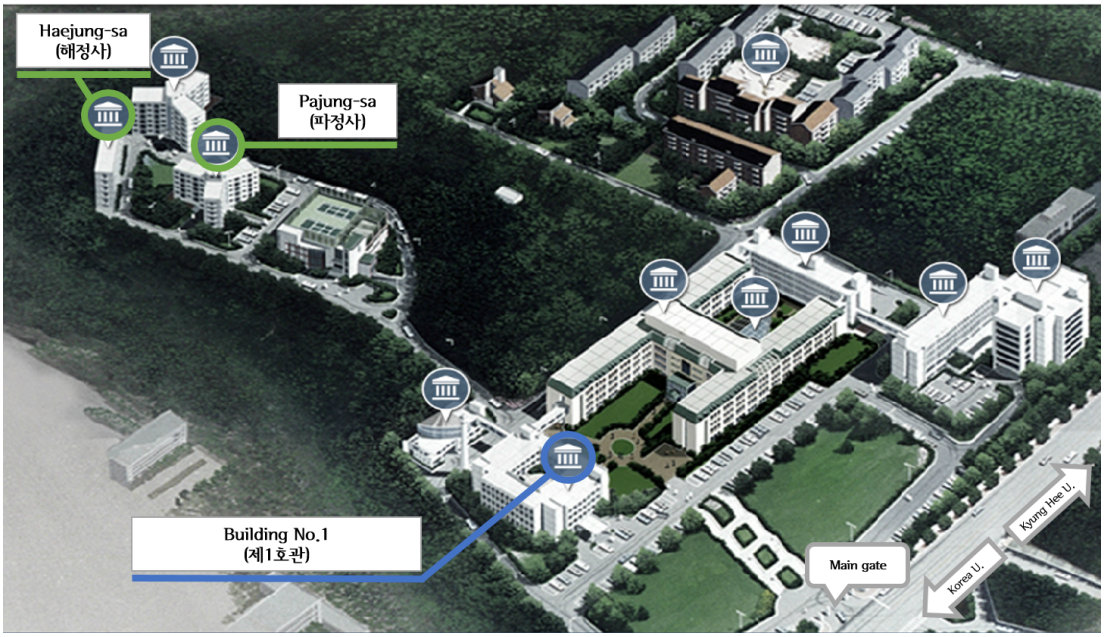

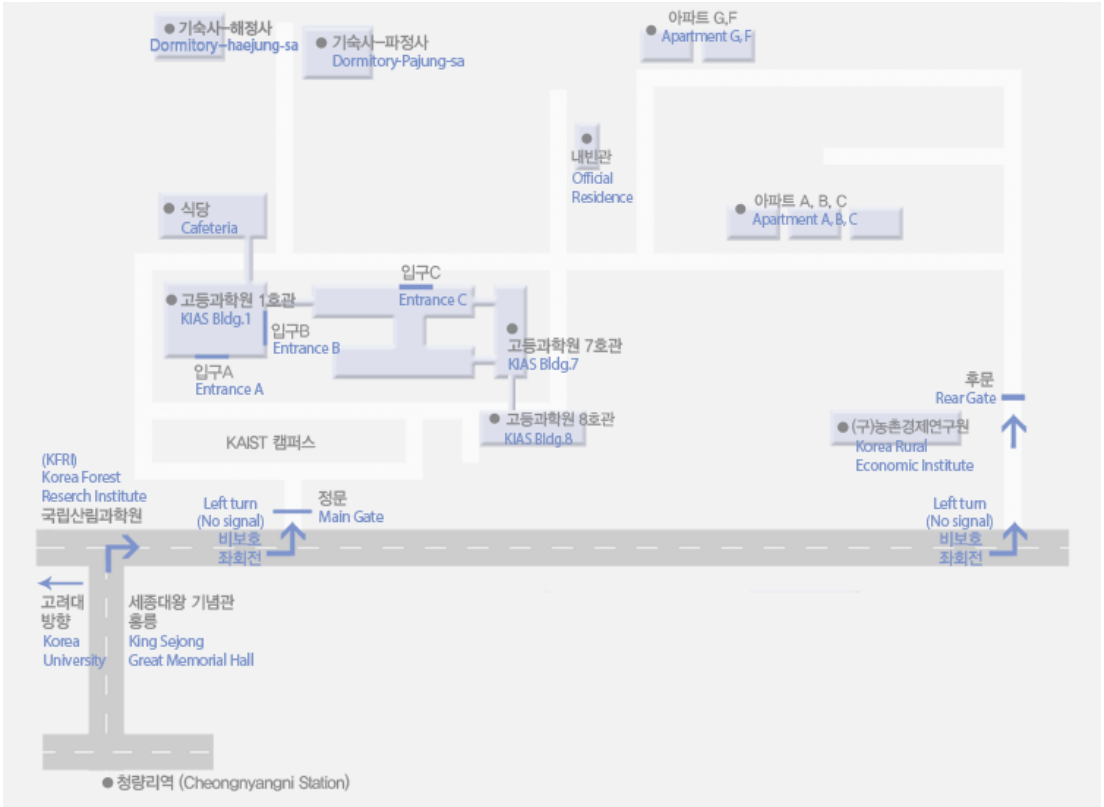

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김가연 (전주대 수학교육과)

김현아 (동아대 정보수학과)

이다현 (공주교대 수학교육과)

이슬기 (경희대 수학과)

최서연 (성신여대 수리통계데이터사이언스학부)

주요 활동

국제학술회의 및 리더스 포럼 등 KWMS 행사 참석

초청 강연자 및 패널 인터뷰, 기사 및 후기 작성

KWMS 뉴스레터 제작

SNS를 활용한 학회 홍보

한국여성수리과학회 안내

1. **설립 목적**

한국여성수리과학회는 한국수학자의 학문적 발전과 활발한 교류 및 여성수학자들의 저변확대를 도모하고 수리과학기술의 발전과 보급에 기여하고자 2004년에 설립된 학회입니다.

2. **활동**

한국여성수리과학회는

- 여성수학자의 평등적 활용 지원
- 여성수학자의 연구활동 및 교류 지원
- 여성수학자의 권익보호 및 복지 증진
- 수학에 관한 자료수집 및 연구서 발간
- 전문지식을 이용한 사회 봉사(수리과학의 대중화)
- 기타 본회 목적 달성에 필요한 사항

을 위해 노력합니다.

3. **연간 주요 사업**

가. KWMS 국제학술대회

국내의 여성수학자 및 대학원생들에게 학문적 소통의 장을 마련함으로써 상호교류를 통한 학문적 발전과 네트워크 활성화를 도모하고자 하며 매년 1회 개최합니다.

나. 차세대 리더스 포럼

차세대 여성수학자들의 리더십 함양과 수학전공자의 다양한 진로 탐색을 위하여 첨단 분야 전문가들의 초청강연 및 멘토링으로 구성된 프로그램으로 전국 지역을 순회하며 매년 1회 개최합니다.