The 17th KOOK-TAPU Joint Seminar on Knots and Related Topics and The 19th Graduate Student Workshop on Mathematics

Program of The 17th KOOK-TAPU Joint Seminar on Knots and Related Topics

July 28 (Tuesday)

9:40–9:50 **Opening Remarks**

(Chair: Seiichi Kamada)

9:50–10:20 **Sam Nelson** (Claremont McKenna College)
Permutation Jones Polynomials

10:20–10:50 **Seung Yeop Yang** (Kyungpook National University)
On the set-theoretic Yang–Baxter cohomology of Alexander biquandles

(Chair: Sam Nelson)

11:00–11:30 **Taizo Kanenobu** (Osaka Metropolitan University)
Q polynomials of knots with small degree

July 29 (Wednesday)

(Chair: Haruchika Tsuno)

9:50–10:20 **Seongjeong Kim** (Jilin University)
On braids for Knots in $S_g \times S^1$

10:20–10:50 **Jumpei Yasuda** (Osaka Metropolitan University)
On the classification of 2-plat 2-knots

(Chair: Seongjeong Kim)

11:00–11:30 **Yoosik Kim** (Pusan National University)
From wiring diagrams to cluster algebras and applications to symplectic geometry

11:30–11:50 **Haruchika Tsuno** (The University of Osaka)
On punctured ch-diagrams of surfaces embedded in 4-manifolds and their bracket polynomials

July 30 (Thursday)

(Chair: Sang Youl Lee)

9:50–10:20 **Hyoungjun Kim** (Kyungpook National University)
Ropelength optimization of nonidentical superhelices

10:20–10:50 **Naoko Kamada** (Nagoya City University)
On a Multivariable Polynomial Invariant for Twisted Links

(Chair: Taizo Kanenobu)

11:00–11:30 **Sang Youl Lee** (Pusan National University)
Affine G-Multibiquandle Modules for Colored Links

14:00–17:00 **Free discussion**

Program of The 19th Graduate Student Workshop on Mathematics

July 28 (Tuesday)

13:20–13:30 **Opening Remarks**

(Chair: Yeonhee Jang)

13:30–14:30 **Ryosuke Miki** (The University of Osaka)
Satellite 2-knots and their fundamental quandles

Galmandakh Tsog-Ochir (Kyungpook National University)
S-SFT modules and its applications

Yuri Yamashita (Osaka Metropolitan University)
Geometry of left-invariant pseudo-Riemannian metrics on Lie groups and closed orbit spaces

Hongdae Yun (Kyungpook National University)
From Tutte Homology to Khovanov Homology of Adequate Links

(Chair: Seung Yeop Yang)

14:45–15:45 **Hyungu Lee** (Kyungpook National University)
Temporal Muon: Switching from Matrix-Wise Progress to Late-Phase Retention

Hiroya Iwasaki (Osaka Metropolitan University)
Left-invariant Lorentzian steady Ricci solitons on nilpotent Lie groups

Seungbin Kim (Pusan National University)
Minimal Surfaces and First Eigenvalue Problems in the Sphere

Ryo Kiyono (Osaka Metropolitan University)
Convergence to pulled fronts and the behavior of level sets in monostable reaction-diffusion equations

(Chair: Jumpei Yasuda)

16:00–17:00 **Haruki Imamura** (Osaka Metropolitan University)
The canonical height gap for polynomial maps and portraits of preperiodic points of polynomials with height 0

Jin Young Heo (Kyungpook National University)
On the extreme Khovanov homology of 2-bridge links

Kotaro Shoji (Osaka Metropolitan University)
On the Mahler measure of the Q polynomial of links

Joy Nana Okogun-Odompley (Pusan National University)
A Mathematical Model for Vector-Borne Disease Transmission

July 29 (Wednesday)

(Chair: Yoosik Kim)

13:30–14:30 **Jin Ju Choi** (Pusan National University)
Freeness and Reduced Spaces of Circle Actions on Coadjoint Orbits

Natsuki Asai (Nagoya City University)
On the classification of twisted doodles

Dagyeong Ryu (Kyungpook National University)
Mathematical Modeling of Bullying Evolution in Psychosocial Development

Yoshiya Oshikane (Osaka Metropolitan University)
GNS Representations of C^*-Algebras

(Chair: Hirotaka Akiyoshi)

14:45–15:45 **Mitsuru Kuramoto** (The University of Osaka)
On a KTQ coloring condition for spatial graphs

Junyeop Lee (Pusan National University)
Entropy and Asymptotic Volume Ratio of Minimal Submanifolds

Jiyong Shin (Osaka Metropolitan University)
Dynamical Systems on the Character Variety of a Four-Punctured Sphere

Ji Young Oh (Kyungpook National University)
Generalized spherical mean and its properties

(Chair: Hyoungjun Kim)

16:00–17:00 **Jinseok Oh** (Kyungpook National University)
On the Third and Fourth Homology of Yang–Baxter Operators Yielding the HOMFLYPT Polynomial

Tomo Narahara (Osaka Metropolitan University)
A determination theorem for holomorphic modular forms on non-tube type unitary symmetric domains

Mi Ji Kim (Pusan National University)
Event-Informed Multi-Task Learning for Spatiotemporal SST Forecasting and Marine Heatwave Severity Prediction

Kazuki Sato (Osaka Metropolitan University)
Serrin's Overdetermined Problem and its Application

July 30 (Thursday)

11:30–12:10 **Group Photo, Awards Ceremony, Closing Remarks**

14:00–17:00 **Free discussion**

On a Multivariable Polynomial Invariant for Twisted Links

Naoko Kamada
Nagoya City University

A multivariable polynomial invariant of virtual links, called the DKM invariant, was introduced by Dye, Kauffman, and Miyazawa. This invariant has been extended to twisted links. An alternative definition of the DKM invariant for virtual links can be obtained from virtual link diagrams equipped with cut systems. In this talk, we present an alternative definition of the DKM invariant for twisted links using twisted link diagrams equipped with cut systems.

Q polynomials of knots with small degree

Taizo Kanenobu
Osaka Metropolitan University

The Q polynomial is a one-variable specialization of the Kauffman polynomial and is one of the fundamental polynomial invariants of knots and links, introduced by Brandt, Lickorish, Millett, and Ho. In this talk, we completely classify knots whose Q polynomials have degree at most four. We also discuss possible Q polynomials of knots with degree at least five. Furthermore, we present corresponding results for links with two or more components.

This is joint work with Tsuneo Ishikawa, Kengo Kishimoto (Osaka Institute of Technology), and Toshio Sumi (Kyushu University).

Ropelength optimization of nonidentical superhelices

Hyoungjun Kim
Kyungpook National University

We study the ropelength efficiency of nonidentical four-strand superhelices, allowing unequal helix radii at both the parental and descendant levels. Motivated by the efficiency of nonidentical double helices, we first optimize standard nonidentical double helices and obtain $\mathrm{Rop/cr} = 7.2013$. Using these optimized geometries, we construct eight types of four-strand superhelices. The best configuration, in which both parental curves and their children have nonidentical radii, gives $\mathrm{Rop/cr} = 7.1430$, improving the previous identical-radius value 7.6034. This also yields the upper boundof ropelength of $(2, n)$-torus knots K,

$$\mathrm{Rop}(K) \leq 7.1955c(K) + 30.52$$

where $c(K)$ is the crossing number of K. This is joint work with Youngsik Huh and Seungsang Oh.

On braids for Knots in $S_g \times S^1$

Seongjeong Kim
Jilin University

For an oriented surface S_g of genus g it is shown that links in $S_g \times S^1$ can be presented by virtual diagrams with a decoration, so called, *double lines*. In this paper, first we define braids with double lines for links in $S_g \times S^1$. We denote the group of braids with double lines by VB_n^{dl}. Alexander and Markov theorem for links in $S_g \times S^1$ can be proved. We restrict our interest to the group B_n^{dl} generated by braids with double lines and compare it with the affine Hecke algebra.

From wiring diagrams to cluster algebras and applications to symplectic geometry

Yoosik Kim
Pusan National University

Given a reduced expression of the longest element in a symmetric group, one can associate a wiring diagram. By Tits' theorem, any two reduced expressions of the same element are related by a sequence of braid moves. This combinatorial model plays a role in a parametrization of dual canonical basis elements and in the study of the geometry of flag varieties. In this talk, I will explain how wiring diagrams can be understood through the framework of cluster algebras and how this can be applied to symplectic geometry. In particular, I will discuss how cluster algebras can be used to construct and distinguish a certain important class of Lagrangian submanifolds in partial flag varieties.

Affine G-Multibiquandle Modules for Colored Links

Sang Youl Lee
Pusan National University

We introduce the notion of a G–multibiquandle associated with a fixed group G, together with several general constructions of G–multibiquandles and their corresponding modules. These algebraic structures provide a natural framework for defining computable invariants of G–colored links, that is, links in S^3 whose components are assigned elements of G.

For a G–colored link diagram (D, σ), where $\sigma : \pi_0(L) \to G$, we associate a finitely presented $R[G]$–module

$$M_u(D, \sigma, R[G]) = \operatorname{coker}\big(\mathcal{A}(D, \sigma)\big).$$

We prove that this module is invariant under Reidemeister moves, and hence defines an invariant of the underlying G–colored link. The presentation matrix $\mathcal{A}(D, \sigma)$ gives rise to a two-parameter deformation of the classical multivariable Alexander theory. From this module, one obtains computable decategorified invariants, including determinantal ideals and Fitting ideals.

Our construction extends the classical Alexander module by incorporating a deformation parameter $u \in R[G]$. In particular, specializing to $u = 1$ recovers the classical multivariable Alexander theory.

Permutation Jones Polynomials

Sam Nelson
Claremont McKenna College

We introduce a generalization of the Jones polynomial using colorings by permutations. A type of biquandle virtual bracket, these invariants reduce to the Jones polynomial for classical knots but contain different information for classical links and for virtual knots and links.

On punctured ch-diagrams of surfaces embedded in 4-manifolds and their bracket polynomials

Haruchika Tsuno
The University of Osaka

Punctured ch-diagrams are link diagrams with two kinds of intersections, crossings and markers, drawn on the punctured plane $\mathbb{R}^2 \setminus \{0\}$. They represent surfaces embedded in 4-manifolds whose Kirby diagrams consist of a single dotted circle or a single framed unknot. In this talk, we define a polynomial $[[D]](A, h, x, y)$ associated with a punctured ch-diagram D. We also determine necessary and sufficient relations among A, h, x, y for this polynomial to be invariant under the moves corresponding to isotopies of the represented surfaces. This is joint work with Koki Iwakura (Kyushu University).

On the set-theoretic Yang–Baxter cohomology of Alexander biquandles

Seung Yeop Yang
Kyungpook National University

In this talk, we study the set-theoretic Yang–Baxter cohomology of finite Alexander biquandles. By introducing suitable structure group actions on the cochain complex, we obtain explicit upper and lower bounds for the Betti numbers and determine families for which these bounds are attained. We then construct cocycle invariants from Alexander biquandles and apply them to torus links. These invariants distinguish some torus links, illustrating the effectiveness of biquandle cocycle invariants in knot theory.

On the classification of 2-plat 2-knots

Jumpei Yasuda
Osaka Metropolitan University

An n-plat 1-knot is one isotopic to the plat closure of some 2n-braid, which is also called an n-bridge 1-knot. Schubert classified 2-bridge 1-knots by considering their double branched covers which are homeomorphic to lens spaces. A 2-knot is a 2-sphere smoothly embedded in 4-space or 4-sphere. An n-plat 2-knot is one isotopic to the plat closure of some 2-dimensional 2n-braid. The aim of this talk is to classify 2-plat 2-knots. By a result of Montesinos, double branched covers do not distinguish 2-plat 2-knots. Thus, we introduce a new invariant to classify them. Furthermore, it is an obstruction to invertibility of 2-knots.

On the classification of twisted doodles

Natsuki Asai
Nagoya City University

A doodle is an equivalence class of flat link diagrams under flat Reidemeister moves I and II. As an extension of doodles, virtual doodles were introduced by Bartholomew, Fenn, N. Kamada, and S. Kamada. A twisted doodle diagram is a virtual doodle diagram with bars on its arcs, and a twisted doodle is an equivalence class of twisted doodle diagrams under an equivalence relation similar to that for twisted links. In this talk, we classify one-component twisted doodles with three flat crossings using twisted double colorings and other methods, and present the resulting table.

Freeness and Reduced Spaces of Circle Actions on Coadjoint Orbits

Jin Ju Choi
Pusan National University

A coadjoint orbit admits a Hamiltonian maximal torus action with moment map, and every circle subgroup of this torus has a moment map $\mu_{S^1} : \mathcal{O}_\lambda \to \mathbb{R}$. As in Morse theory, the critical values of μ_{S^1} divide $\mathbb{R}$ into chambers consisting entirely of regular values. We completely characterize the circle subgroup actions of this maximal torus for which the action is free on every regular level set of the corresponding moment map. Using the Duistermaat–Heckman theorem, we describe a chamber structure on $\mathbb{R}$ such that the reduced spaces at values in the same chamber are diffeomorphic. This is joint work with Yoosik Kim.

On the extreme Khovanov homology of 2-bridge links

Jin Young Heo
Kyungpook National University

Khovanov homology, introduced as a categorification of the Jones polynomial, is a bigraded invariant of knots and links. The extreme part of Khovanov homology can be described in terms of Lando graphs and their independence complexes. This led to a conjecture by Przytycki and Silvero that these independence complexes are homotopy equivalent to wedges of spheres. Motivated by previous work on the geometric realizations of the extreme Khovanov homology of pretzel links, we study the corresponding problem for 2-bridge links. In this talk, we show that the extreme Khovanov homology of every 2-bridge link is isomorphic to $\mathbb{Z}$. We also use chromatic homology to determine part of the Khovanov table above the real extreme grading.

The canonical height gap for polynomial maps and portraits of preperiodic points of polynomials with height 0

Haruki Imamura
Osaka Metropolitan University

The difference between the canonical height and the naive height for polynomial maps on $\mathbb{P}^1$ plays a fundamental role in arithmetic dynamics. Although explicit upper bounds for this height gap generally depend on the degree d in the case of rational maps, we establish a refined bound for polynomial maps that is independent of d. As an application, we determine the set of rational preperiodic points for polynomial maps whose height is 0 and classify their realizable portraits.

Left-invariant Lorentzian steady Ricci solitons on nilpotent Lie groups

Hiroya Iwasaki
Osaka Metropolitan University

Although Riemannian and pseudo-Riemannian geometries share many similarities, important differences also arise. To investigate the differences between the Lorentzian and Riemannian cases, we focus on homogeneous steady Ricci solitons. In the Riemannian case, every homogeneous steady Ricci soliton is known to be flat. In this talk, we consider particular 1-dimensional extensions of nilpotent Lie groups with left-invariant Lorentzian metrics, and study the relation of their Ricci curvatures. As an application, we obtain an infinite family of 2-step nilpotent Lie groups admitting non-flat, non-Einstein left-invariant Lorentzian steady Ricci soliton metrics.

Event-Informed Multi-Task Learning for Spatiotemporal SST Forecasting and Marine Heatwave Severity Prediction

Mi Ji Kim
Pusan National University

Accurate prediction of marine heatwave (MHW) properties—including onset, intensity, and duration—remains a critical challenge in ocean forecasting, with direct implications for ecosystem management and coastal risk mitigation. Conventional deep learning approaches to sea surface temperature (SST) prediction treat all seasons uniformly, resulting in systematic underestimation of anomalous warm events that disproportionately occur during summer. This limitation reduces their operational value in MHW early warning contexts. To address this gap, we propose an extreme-event-aware multi-task architecture grounded in ConvLSTM-based spatiotemporal representation learning. Rather than framing MHW prediction solely as a binary classification problem, our framework simultaneously optimizes for SST regression, MHW occurrence detection, and continuous estimation of MHW intensity and duration through dedicated task-specific heads. A unified spatiotemporal encoder serves as the shared backbone, enabling cross-task feature transfer while preserving task-specific representations through branched output layers. Experiments conducted on coastal SST observations from the east coast of Korea reveal that the proposed architecture consistently outperforms single-task baselines—including standalone LSTM, CNN, and CNN-LSTM models—particularly during summer months when MHW risk is highest. Notably, the incorporation of intensity and duration regression objectives provides richer supervisory signals that reinforce the model's sensitivity to extreme thermal events. Our findings suggest that reframing SST forecasting as a joint characterization problem, rather than a pure regression task, offers a principled path toward operationally useful MHW prediction systems.

Minimal Surfaces and First Eigenvalue Problems in the Sphere

Seungbin Kim
Pusan National University

The study of minimal surfaces in spheres has revealed deep connections between differential geometry, topology, and spectral theory. A fundamental observation is that minimal immersions into spheres naturally give rise to eigenfunctions of the Laplace–Beltrami operator, leading to a variety of questions concerning the spectral properties of minimal surfaces. Among these, the first eigenvalue problem has attracted considerable attention due to its close relationship with the geometry of the underlying surface. In this talk, we provide a brief introduction to first eigenvalue problems arising in the study of compact minimal surfaces in spheres. After reviewing the geometric background and several motivating examples, we discuss why the first eigenvalue plays a distinguished role in

spectral geometry. We then survey some important developments in the area and highlight several open questions and current directions of research. The emphasis will be on geometric intuition and the interplay between minimal surface theory and eigenvalue problems.

Convergence to pulled fronts and the behavior of level sets in monostable reaction-diffusion equations

Ryo Kiyono
Osaka Metropolitan University

In this talk, we consider the asymptotic behavior of solutions of monostable reaction-diffusion equations in the multi-dimensional whole space, with particular emphasis on the behavior of their level sets. For bistable reaction-diffusion equations, it is known that the level sets are approximated by the mean curvature flow. We observe that, for monostable reaction-diffusion equations, the behavior of the level sets depends on the decay rate of the initial data at infinity and that they can be approximated by the graph of a function satisfying some parabolic equation different from the mean curvature flow.

On a KTQ coloring condition for spatial graphs

Mitsuru Kuramoto
The University of Osaka

A Knot-theoretic Ternary Quasigroup (KTQ), introduced by Niebrzydowski, is an algebraic system consisting of a set and a ternary operation, which is referred to as a tribracket. By assigning elements of a KTQ to the regions of a link diagram such that a specific condition is satisfied at each crossing, a region coloring is defined, and the number of such colorings is a link invariant. Such colorings can be extended to spatial graphs, which are generalizations of knots and links. However, the coloring condition around a vertex depends on the algebraic structure of the KTQ and the degree of the vertex. In this talk, we propose a new coloring condition at vertices for spatial graphs and show that the number of colorings by certain tribrackets is an invariant of spatial graphs. Furthermore, we demonstrate that by comparing the number of colorings, several pairs of spatial graphs can be distinguished.

Temporal Muon: Switching from Matrix-Wise Progress to Late-Phase Retention

Hyungu Lee
Kyungpook National University

This work investigates Temporal Muon, a one-way optimizer schedule that uses Muon for early matrix-wise progress and switches to a late optimizer for retention. Empirically, continued Muon updates often achieve strong early checkpoints but can suffer from late spectral drift and final-best degradation. Switching to AdamW or SGDM after the early phase improves last-checkpoint stability across vision classification and a small Transformer language-modeling task. The results support a temporal role-separation view of optimization: Muon rapidly moves matrix parameters toward useful representations, while the late optimizer controls update scale, curvature cost, and post-best drift. We connect these observations to finite Newton-Schulz stability, augmented optimizer-state stability, and curvature-aware retention diagnostics.

Entropy and Asymptotic Volume Ratio of Minimal Submanifolds

Junyeop Lee
Pusan National University

Entropy is a fundamental quantity in the study of mean curvature flow and is often regarded as

a measure of geometric complexity. In this talk, we explore the geometric meaning of entropy for complete minimal submanifolds. We first recall the Euclidean case, where entropy is characterized by the asymptotic volume ratio. We then formulate and study the analogous problem in hyperbolic space. Under a natural finiteness assumption for the hyperbolic heat-kernel functional, we show that its large-time limit is governed by the hyperbolic asymptotic volume ratio. As a consequence, hyperbolic entropy can be characterized in terms of asymptotic volume growth.

Satellite 2-knots and their fundamental quandles

Ryosuke Miki
The University of Osaka

Satellite knots are a well-known generalization of connected sums of knots. Satellite 2-knots are defined analogously, with connected sums of 2-knots as a special case. Also, the fundamental quandle is a well-known and powerful invariant in knot theory. It is known that the fundamental quandle of a satellite knot can be described in terms of the fundamental quandle of the pattern knot and the knot group of the satellite knot. In this talk, I will show that this description extends naturally to satellite 2-knots.

A determination theorem for holomorphic modular forms on non-tube type unitary symmetric domains

Tomo Narahara
Osaka Metropolitan University

We consider the problem of whether a holomorphic modular form is uniquely determined by a distinguished subset of the coefficients of its Fourier expansion. Yamana (2009) proved a determination theorem for holomorphic modular forms on classical tube domains in terms of primitive Fourier coefficients. In this talk, we extend his method to non-tube type Hermitian symmetric domains associated with unitary groups of signature $(n+m, n)$, where $n \geq 2$ and $m \geq 1$. More precisely, we show that a holomorphic modular form vanishes if every primitive Fourier–Jacobi coefficient vanishes.

Generalized spherical mean and its properties

Ji Young Oh
Kyungpook National University

Spherical means and wave forward operators play a central role in wave-based inverse problems, including photoacoustic tomography (PAT) and related imaging models. This talk presents a generalized spherical mean operator that unifies the classical spherical mean and the wave forward operator. We show that this generalized transform satisfies a generalized Euler–Poisson–Darboux (EPD) equation, and discuss its analytic structure using Fourier techniques and explicit representation formulas.

We derive inversion formulas for several choices of the spatial measurement set. In the hyperplane case, the reconstruction is obtained through an analogue of the Fourier slice theorem. In the unit sphere case, spherical harmonic expansions lead to a series inversion formula. When the measurement set is the boundary of an arbitrary bounded domain, we use a Kirchhoff-type integral representation related to the wave forward operator.

In each setting, the derivation extends methods from earlier works on the classical spherical mean and the wave forward operator. Taken together, these results give a unified analytic approach to inversion in wave-based imaging across different geometric configurations.

On the Third and Fourth Homology of Yang–Baxter Operators Yielding the HOMFLYPT Polynomial

Jinseok Oh
Kyungpook National University

Yang–Baxter operators arise naturally in knot theory through their connections with knot invariants, 2- and 3-cocycle invariants, and algebraic structures such as biquandles. Furthermore, a homology theory for Yang-baxter operators generalizes both quandle homology and the homology of set-theoretic Yang–Baxter operators. In this talk, we consider a specific family of Yang–Baxter operators, denoted by $R_{(m)}$, which was introduced by Vaughan Jones and yields the HOMFLYPT polynomial. We focus on the standard construction of the homology theory $H_n(R_{(m)})$, modeled on the homology of pre-cubic modules. To evaluate higher-order homology groups $H_n(R_{(m)})$, we prove that the total chain complex can be rigorously decomposed into a direct sum of mutually independent sub-complexes.

A Mathematical Model for Vector-Borne Disease Transmission

Joy Nana Okogun-Odompley
Pusan National University

Mathematical models play an important role in understanding the spread of infectious diseases. In this presentation, we study a vector-borne disease model involving interactions between human hosts and disease-carrying vectors. The model consists of an SIS structure for humans and an SI structure for vectors.

We analyze the model by deriving equilibrium points and computing the basic reproduction number, a key threshold that determines whether an infection can invade a population. Using tools from dynamical systems theory, including Jacobian matrices and eigenvalue analysis, we investigate the local stability of the disease-free equilibrium.

The results provide insight into the conditions that lead to disease elimination or persistence and demonstrate the usefulness of mathematical modeling in epidemiological research.

GNS Representations of C^*-Algebras

Yoshiya Oshikane
Osaka Metropolitan University

In this talk, we introduce GNS representations, which are a fundamental construction method in C^*-Algebras. Given a C^*-Algebra A, the GNS representation involves constructing a Hilbert space and a representation of A from a positive linear functional on A. The key to this construction is to use the positive linear functional as the basis for the inner product. First, we construct an appropriate quotient space to remove "degenerate" elements, define an inner product on this space, and complete it to obtain a Hilbert space. Next, we realize each element of A as a bounded linear operator on this Hilbert space, obtaining a representation that preserves the product and the involution of A.

Mathematical Modeling of Bullying Evolution in Psychosocial Development

Dagyeong Ryu
Kyungpook National University

Social and psychological behaviors often involve transitions between multiple latent states over time, leading to complex developmental trajectories. To understand these processes, a framework

or mathematical model is needed to describe the temporal evolution of latent-state transitions. Latent transition analysis (LTA) has been widely used to identify latent states and estimate transition probabilities from longitudinal psychosocial data. However, traditional LTA primarily defines transition structures at discrete observation points and does not account for the temporal evolution of transition dynamics or the long-term behavior of latent-state distributions. In this study, we propose a mathematical model that extends LTA by treating latent state transitions as a time-evolving process. This model reconstructs the temporal evolution of transition processes from empirical transition patterns and enables analysis of long-term latent state evolution. We apply this model to longitudinal data on bullying behavior to demonstrate how complex psychosocial processes can be characterized through their underlying transition dynamics. This research provides a general approach for investigating the evolution of latent states in complex social and behavioral systems.

Serrin's Overdetermined Problem and its Application

Kazuki Sato
Osaka Metropolitan University

In this talk, we consider Serrin's overdetermined problem and its applications. Serrin studied an overdetermined boundary value problem for an elliptic partial differential equation with both Dirichlet and Neumann boundary conditions. He proved that the existence of a solution implies that the domain must be a ball. After reviewing Serrin's results, I will introduce overdetermined problem involving Kirchhoff-type nonlocal terms and overdetermined problem in exterior domains. This is joint work with Futoshi Takahashi.

Dynamical Systems on the Character Variety of a Four-Punctured Sphere

Jiyong Shin
Osaka Metropolitan University

In this talk, we discuss dynamical systems defined on the character variety of a four-punctured two-dimensional sphere. By constructing an analogue of the trapping region in the dynamics of the complex Hénon map on $\mathbb{C}^2$ for the dynamics of hyperbolic elements on the character variety, we clarify the underlying reasons for the similarity between these two dynamical systems. Furthermore, in a more specific case, we show that the number of periodic orbits with exact period are closely related to the Fibonacci numbers.

On the Mahler measure of the Q polynomial of links

Kotaro Shoji
Osaka Metropolitan University

In this talk, we show that the Mahler measure of a variable-transformed Q-polynomial of a link converges to a certain limit under two-strand twisting. Furthermore, using this result, we demonstrate that the roots of the Q-polynomial accumulate in a specific interval on the real axis as the number of twists increases.

S-SFT modules and its applications

Galmandakh Tsog-Ochir
Kyungpook National University

Let R be a commutative ring with identity and S be a multiplicative subset of R. In 1973, J. Arnold introduced the concept of SFT (strong finite type) rings, showing that the SFT condition is necessary for the finiteness of the Krull dimension of the power series ring R[[X]]. In 2017, Lim introduced S-SFT rings to study the Krull dimension of localization of R[[X]] at the set S . More

recently, in 2023, Abdelamir and Benhissi constructed SFT modules as a generalization of SFT rings. In this talk, we investigate the construction of S-SFT modules, an extended notion of SFT modules, and examine their definitions and properties. Specifically, we focus on properties of S-SFT rings that can be generalized to S-SFT modules. This talk is based on joint work with J. W. Lim.

Geometry of left-invariant pseudo-Riemannian metrics on Lie groups and closed orbit spaces

Yuri Yamashita
Osaka Metropolitan University

A Lie group is an object that combines a group structure with a differentiable manifold structure, representing continuous symmetry. In this research, we consider the existence and non-existence of distinguished left-invariant pseudo-Riemannian metrics for a given Lie group. Here, "distinguished" means flat, Ricci-flat, Einstein or Ricci soliton. There is a natural group action on the space of left-invariant pseudo-Riemannian metrics on a Lie group by scalar multiplication and automorphisms. In this talk, I introduce our research focusing on the closed orbit space of this action.

From Tutte Homology to Khovanov Homology of Adequate Links

Hongdae Yun
Kyungpook National University

The Jones polynomial is one of the fundamental invariants in knot theory. Its categorification by Khovanov replaces the polynomial with a bigraded homology theory, yielding a richer invariant that has played an important role in the development of modern low-dimensional topology.

Connections between the Jones polynomial and classical graph polynomials suggest that Khovanov homology can also be studied from the perspective of graph homology. This viewpoint provides a useful framework for comparing link homologies with categorifications of graph invariants.

In this talk, we present a Tutte complex constructed as a refinement of the complex introduced by Jasso-Hernandez and Rong. We investigate some of its algebraic and homological properties and explain how the resulting Tutte homology is related to the Khovanov homology of adequate link diagrams.
