

研究集会 「トポロジーとコンピュータ 2018」

トポロジー研究連絡会議の支援するトポロジープロジェクトの一環として、
科学研究費補助金(基盤研究(A))「結び目と3次元多様体の量子トポロジー」
(研究代表者:大槻 知忠, 課題番号:16H02145)
科学研究費補助金(新学術領域研究(研究領域提案型))「指数定理の展開とトポロジカル表面状態」
(研究代表者:古田 幹雄, 課題番号17H06461)
の協力を受け、下記の日程で研究集会「トポロジーとコンピュータ 2018」を開催致します。

日時:2018年10月12日(金)午後~14日(日)午前
場所:奈良女子大学 コラボレーションセンター Z306 教室
http://www.libe.nara-k.ac.jp/~han/topology_comp_2018_j.htm

プログラム

10月12日(金)

- 14:00 - 14:30 今泉 匡道 (大阪大学)
Twisted Alexander Polynomial and Half twists
- 14:45 - 15:15 金信 泰造 (大阪市立大学)
結び目の2重ケーブル絡み目のジョーンズ多項式
(共同研究者 角 俊雄 (九州大学))
- 15:30 - 16:15 下川 航也 (埼玉大学)
Knots, links, and spatial graphs in the simple cubic lattice
- 16:30 - 16:45 上河 恵理 (明治大学)
組みひもエディターの構想と実装
- 16:45 - 17:00 力石 優武 (明治大学)
曲面結び目エディターの構想と実装

10月13日(土)

- 9:30 - 10:15 Yo'av Rieck (University of Arkansas)
The unbearable hardness of unknotting
- 10:30 - 11:00 Nicholas Owad (Okinawa Institute of Science and Technology)
Straight Number and Volume
- 11:15 - 12:00 Robert Tang (Okinawa Institute of Science and Technology)
The geometry of saddle connection complexes of translation surfaces

13:30 – 14:00 阪田 直樹 (埼玉大学)

Volume maximization on some non-geometric veering triangulations

14:15 – 15:00 中村 聡史 (明治大学)

数理科学によるひとつの手書きの理解とその応用

15:30 – 16:00 田島 慎一 (新潟大学)

An algorithm for computing generic Lê numbers

16:15 – 16:45 横山 知郎 (京都教育大学/JST さきがけ)

Topological representation of surface flows and its implementation

17:00 – 17:30 林 晋 (産総研/東北大 MathAM-OIL)

Topological invariants and corner states for Hamiltonians on a three dimensional lattice

10月14日 (日)

9:30 – 10:00 市原 一裕 (日本大学)

A lower bound on the number of diagonals for polyhedra
(共同研究者 小島 俊祐 (日本大学))

10:15 – 10:45 鈴木 正明 (明治大学)

Two filtrations of the Torelli group

11:00 – 11:20 平澤 美可三 (名古屋工業大学)

Alternating knots with Alexander polynomials having unexpected zeros

11:35 – 12:05 和田 昌昭 (大阪大学)

Fractal Gazer - computer program for exploring fractals

アブストラクト

10月12日(金)

14:00 – 14:30 今泉 匡道 (大阪大学)

Twisted Alexander Polynomial and Half twists

Twisted Alexander 多項式不変量は向き付けられた結び目とその結び目の群の表現に対して定義される。本講演では、三彩色可能な結び目と $SL(2; F_2)$ 表現を考える。三つ葉結び目の Twisted Alexander 多項式と、三つ葉結び目に三彩色可能性を保つように、ある仕方で $6n$ 回 half-twist を加えた結び目の Twisted Alexander 多項式とが一致することを示す。

14:45 – 15:15 金信 泰造 (大阪市立大学)

結び目の2重ケーブル絡み目のジョーンズ多項式
(共同研究者 角 俊雄 (九州大学))

We call the $(2, 0)$ -cable Jones polynomial of a knot K to be the Jones polynomial of the $(2, 0)$ -cabling of K . It is known the $(2, 0)$ -cable Jones polynomial of a knot is derived from the Kauffman polynomial of the same knot. For prime knots with up to 16 crossings we show there is no pair with the same Kauffman polynomial but distinct $(2, 0)$ -cable Jones polynomial. This is a joint work with Toshio Sumi, Kyushu University.

15:30 – 16:15 下川 航也 (埼玉大学)

Knots, links, and spatial graphs in the simple cubic lattice

Knots, links, and spatial graphs in the simple cubic lattice Entanglements appear in DNA, protein and polymers. We will use knots, links and spatial graphs in the simple cubic lattice to model such structures. In this talk we will discuss minimum step numbers, ergodicity classes, and exponential growth rate of knots, links and spatial graphs in the simple cubic lattice.

16:30 – 16:45 上河 恵理 (明治大学)

組みひもエディターの構想と実装

Topologists who study and research braids calculate formulae with a lot of basic braids (σ_i and σ_i^{-1}) by hand. Thus, in this study, we implement a braid editor in purpose of drawing a complicated braid easily by mouse dragging in the screen instead of handwriting method. This system allows us to put basic braids anywhere you like and to apply Reidemeister moves II and III. Also, it can save a Plink file for SnapPy and SnapPy can read the file. When we save a Plink file, we can choose the data of “closure” of a braid or a “braided link”. In the future we want to implement a “disk twist” and some other functions relating train tracks (seem in Trains by Toby Hall).

16:45 – 17:00 力石 優武 (明治大学)

曲面結び目エディターの構想と実装

When we represent a surface knot, we often use a motion picture method and a 3D diagram. But a motion picture method is troublesome because we must draw many figures in a row. So we will suggest a conception of a computer system to draw a motion picture and a 3D diagram easily. Architecture of the systems is as follows: Each succession of cross sections of a surface knot is represented by Reidemeister Moves 1,

2, 3 and by a band surgery. In the motion picture mode, we are allowed to apply Reidemeister moves or a band surgery on a knot diagram, and the system displays these diagrams in a row. In this system we represent a knot diagram by discrete points in a curve, thus the system draws a 3D diagram by connecting of proper points on cross sections. If this application is implemented completely, we expect that this will help researches of surface knots.

10月13日(土)

9:30 – 10:15 Yo'av Rieck (University of Arkansas)

The unbearable hardness of unknotting

We show that calculating the number of Reidemeister moves needed to untangle an unknot diagram is PN-hard (this answers a question of Koenig and Tsveitkova). Time permitting we will discuss examples of link invariants whose computation defines NP-hard problems.

This is joint work with Arnaud de Mesmay, Eric Sedgwick, and Martin Tancer.

10:30 – 11:00 Nicholas Owad (Okinawa Institute of Science and Technology)

Straight Number and Volume

We will define straight knots and straight number, a new diagrammatic invariant.

We will then discuss how we calculated all knots with 10 or less crossings straight number. This leads to their apparent relation with volume, which gives us some interesting new conjectures.

11:15 – 12:00 Robert Tang (Okinawa Institute of Science and Technology)

The geometry of saddle connection complexes of translation surfaces

For a half-translation surface (S, q) , the associated *saddle connection complex* $A(S, q)$ is the simplicial complex where vertices are the saddle connections on (S, q) , with simplices spanned by sets of pairwise disjoint saddle connections. This complex can be naturally regarded as an induced subcomplex of the arc complex. In this talk, I will discuss similarities and differences between the arc complex and the saddle connection complex.

Our main result is that any simplicial isomorphism $\phi : A(S, q) \rightarrow A(S', q')$ between saddle connection complexes is induced by an affine diffeomorphism $F : (S, q) \rightarrow (S', q')$. In particular, this shows that the saddle connection complex is a complete invariant of affine equivalence classes of half-translation surfaces.

This is joint work with Valentina Disarlo and Anja Ranadecker.

13:30 – 14:00 阪田 直樹 (埼玉大学)

Volume maximization on some non-geometric veering triangulations

Agol proved that every pseudo-Anosov mapping torus of a surface, punctured along the singular points of the stable and unstable foliations, admits a canonical “veering” ideal triangulation. In this talk, we consider the “maximum volumes” of some non-geometric veering ideal triangulations. The volume is defined on “angle structure” on an ideal triangulation. The angle structure corresponds to a linear part of Thurston’s gluing equations.

14:15 – 15:00 中村 聡史 (明治大学)

数理科学によるひとの手書きの理解とその応用

In this talk, we will talk about collaboration work by Human-Computer Interaction researchers and a Mathematical science researcher (Prof. M. Suzuki, Meiji University). Here, we understand people's handwritings using mathematical science and realize a method to generate average handwriting. In addition, we develop several applications based on the averaging method.

15:30 – 16:00 田島 慎一 (新潟大学)

An algorithm for computing generic L \hat{e} numbers

We consider L \hat{e} cycles and L \hat{e} numbers, introduced by D. Massey in the context of symbolic computation. We propose an effective method for computing generic L \hat{e} numbers, complex analytic invariants of non-isolated hypersurface singularities. Basic ingredients of our approach are comprehensive Gr \ddot{o} nbner systems and parametric local cohomology systems. Algorithms are implemented in a computer algebra system Risa/Asir. We shall discuss as applications, relations with vanishing cycle sheaves, or holonomic D-modules associated to roots of b-function.

16:15 – 16:45 横山 知郎 (京都教育大学/JST さきがけ)

Topological representation of surface flows and its implementation

語表現と木表現という「曲面流を解析するためのトポロジカルな方法」とその実装を紹介します。実際、この話は3部構成で、はじめに流れの表現の応用を紹介し、次に理論的な背景を紹介し、最後に時間の許す限り、関連する話題と「データ構造とトポロジーの関係」(e.g. アルゴリズムの実装, 画像データから流線の抜きだし, 円順序を持つように拡張した正規木文法と木表現のデータ構造, 工業製品の改良, 渦の反転現象の予測, 海流, 血流)について議論します。

17:00 – 17:30 林 晋 (産総研/東北大 MathAM-OIL)

Topological invariants and corner states for Hamiltonians on a three dimensional lattice

In condensed matter physics, topologically protected (codimension-one) edge states are known to appear on the surface of some insulators reflecting some topology of its bulk. In this talk, we first revisit these classical results from the mathematical point of view. We then introduce another/secondary invariant and see that this invariant is related to (codimension-two) corner states by using K-theory and index theory. Results of numerical calculation applied to an explicit example predict some mathematical result and it turns out to be true.

10月14日 (日)

9:30 – 10:00 市原一裕 (日本大学)

A lower bound on the number of diagonals for polyhedra
(共同研究者 小島 俊祐 (日本大学))

In 1996, WADA-YAMASHITA-YOSHIDA gave a lower bound on the number of interior diagonals for polyhedra by using computer. In this talk, we will explain alternative method to obtain it without using computer.

10:15 – 10:45 鈴木 正明 (明治大学)

Two filtrations of the Torelli group

There are two filtrations of the Torelli group: One is the lower central series and the other is the Johnson filtration. They are closely related to Johnson homomorphisms

as well as finite type invariants of homology 3-spheres. We compare the associated graded Lie algebras of the filtrations and report our explicit computational results. Then we discuss some applications of our computations. This is a joint work with Shigeyuki Morita and Takuya Sakasai.

11:00 – 11:20 平澤 美可三 (名古屋工業大学)

Alternating knots with Alexander polynomials having unexpected zeros

This work is a joint work with K.Ishikawa (kyoto univ.) and M.Suzuki (Meiji univ.). In 2002, J.Hoste conjectured the following: If z is a zero of the Alexander polynomial of an ALTERNATING knot, then $\operatorname{Re}(z) > -1$. This conjecture has initiated many computer aided experiments and motivated various works on the zeros of the Alexander polynomial. In this talk, we give concrete counterexamples to this conjecture. Our knots have alternating Montesinos diagrams and the simplest one has 778 crossings with Alexander polynomial of degree 763, whose crucial zeros are complex. Quandle theory guided us to a reasonable class of knots to examine, numerical calculations by computer detected counterexamples, and we give a rigorous mathematical proof for them to be so.

11:35 – 12:05 和田 昌昭 (大阪大学)

Fractal Gazer - computer program for exploring fractals

I am working on a new program for exploring 2-dimensional fractals. I will show a prototype of the program, and explain what I am planning to do.