Workshop
Topology and Computer 2018

A workshop "Topology and Computer 2018" will be held as follows. This Workshop is supported by Grant-in-Aid:
Scientific Research (A) No.16H02145 (Tomotada Ohtsuki, Kyoto University)
Grant-in-Aid for Scientific Research on Innovative Area No.17H06461 (Mikio Furuta, Tokyo University).

Date: October 12 – 14, 2018
Venue: Nara Women's University, Collaboration Center Z306
`http://www.libe.nara-k.ac.jp/~han/topology_comp_2018_e.htm`

Program

October 12 (Fri)

14:00 – 14:30 Masamichi Imaizumi (Osaka University)
Twisted Alexander Polynomial and Half twists

14:45 – 15:15 Taizo Kanenobu (Osaka City University)
Jones polynomial of the 2-cable link of a knot
(joint with Toshio Sumi, Kyushu University)

15:30 – 16:15 Koya Shimokawa (Saitama University)
Knots, links, and spatial graphs in the simple cubic lattice

16:30 – 16:45 Eri Kamikawa (Meiji University)
A conception and implementation of braid editor

16:45 – 17:00 Yumu Rikiishi (Meiji University)
Conception and implementation of Surface Knot editor

October 13 (Sat)

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 Naoki Sakata (Saitama University)
Volume maximization on some non-geometric veering triangulations

14:15 – 15:00 Satoshi Nakamura (Meiji University)
Understanding of Handwritings by Mathematical Science and Its Applications

15:30 – 16:00 Shinichi Tajima (Niigata University)
An algorithm for computing generic Lê numbers

16:15 – 16:45 Tomoo Yokoyama (Kyoto University of Education / JST PRESTO)
Topological representation of surface flows and its implementation

17:00 – 17:30 Shin Hayashi (AIST/TohokuU MathAM-OIL)
Topological invariants and corner states for Hamiltonians on a three dimensional lattice

October 14 (Sun)

9:30 – 10:00 Kazuhiro Ichihara (Nihon University),
A lower bound on the number of diagonals for polyhedra
(joint with Shunsuke Kojima (Nihon University))

10:15 – 10:45 Masaaki Suzuki (Meiji University)
Two filtrations of the Torelli group

11:00 – 11:20 Mikami Hirasawa (Nagoya Institute of Technology)
Alternating knots with Alexander polynomials having unexpected zeros

11:35 – 12:05 Masaaki Wada (Osaka University)
Fractal Gazer - computer program for exploring fractals

Abstracts

October 12 (Fri)

14:00 – 14:30 Masamichi Imaizumi (Osaka University)
Twisted Alexander Polynomial and Half twists

The Twisted Alexander polynomial invariant is defined for an oriented knot and a representation of its knot group. In this talk,we consider tricolorable knots and representation in $SL(2; F_2)$. We prove that the Twisted Alexander polynomials of knots obtained by applying $6n$-times half-twists to the trefoil in certain ways preserving tricolorability coincide with the Twisted Alexander polynomial of the trefoil.

14:45 – 15:15 Taizo Kanenobu (Osaka City University)
Jones polynomial of the 2-cable link of a knot
(joint with Toshio Sumi, Kyushu University)

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 Koya Shimokawa (Saitama University)
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 Eri Kamikawa (Meiji University)
A conception and implementation of braid editor

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 Yumu Rikiishi (Meiji University)
Conception and implementation of Surface Knot editor

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 R-moves or a band surgery on a knot diagram, and the system display 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.

October 13 (Sat)

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 answer a question of Koenig and Tsvietkova). 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 $\phi : A(S, q) \to A(S', q')$ between saddle connection complexes is induced by an affine diffeomorphism $F : (S, q) \to (S', q')$. 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 Randecker.

13:30 – 14:00 Naoki Sakata (Saitama University)
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 Satoshi Nakamura (Meiji University)
Understanding of Handwritings by Mathematical Science and Its Applications

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 Shinichi Tajima (Niigata University)
An algorithm for computing generic Lê numbers

We consider Lê cycles and Lê numbers, introduced by D. Massey in the context of symbolic computation. We propose an effective method for computing generic Lê numbers, complex analytic invariants of non-isolated hypersurface singularities. Basic ingredients of our approach are comprehensive Gröbner 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 Tomoo Yokoyama (Kyoto University of Education / JST PRESTO)
Topological representation of surface flows and its implementation

We introduce topological methods, called a word representation and a tree representation, for analyzing 2D flows. Moreover, we also demonstrate an implementation of their representations. Our talk consists of three parts. First we present applications of our methods. Second we introduce the theoretical background. Finally we discuss the relative works and the relations between topological structures and data structures (e.g. implementation of representation algorithms, contour extraction of streamlines from image data, generating all word representation by an automaton, generating all tree representation by "regular tree grammar + cyclic order", improvement of industrial machines, possibilities of analyzing reversal phenomena, ocean phenomena and medical phenomena).

17:00 – 17:30 Shin Hayashi (AIST/TohokuU 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.

October 14 (Sun)

9:30 – 10:00 Kazuhiro Ichihara (Nihon University),
A lower bound on the number of diagonals for polyhedra
(joint with Shunsuke Kojima (Nihon University))

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 Masaaki Suzuki (Meiji University)

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 Mikami Hirasawa (Nagoya Institute of Technology)

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 $\mathrm{Re}(z) > -1$. 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 Masaaki Wada (Osaka University)

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.