ONLINE MINI-WORKSHOP "KNOTS + MORE"

http://www.stoimenov.net/stoimeno/homepage/kam

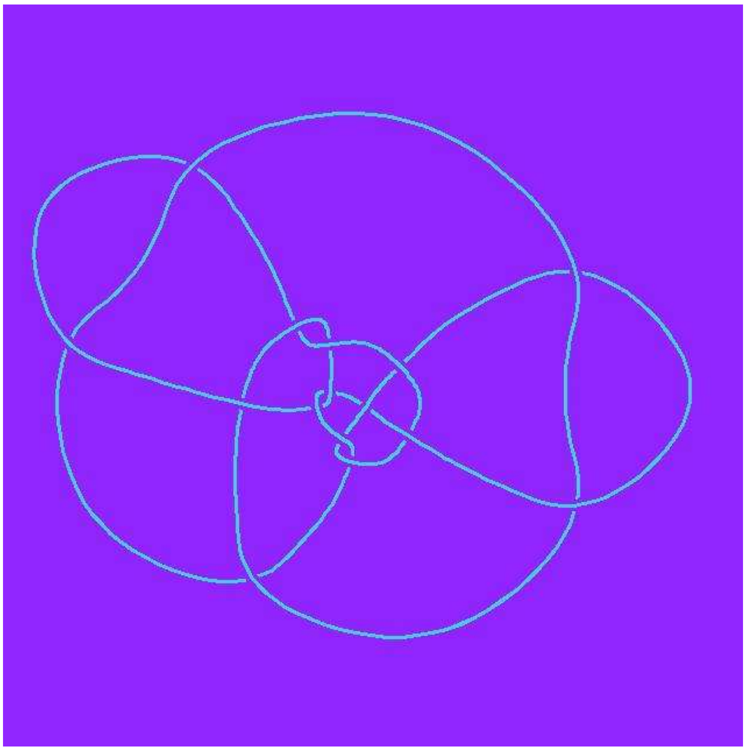
organizers: Alexander Stoimenow, Hyunwoo Lee

hosted by Prof Martin Ziegler's lab at

KAIST, School of Computing

18th – 25th August, 2021

Program



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Talk time should be **25-50 minutes** (+ possible questions). **Times are KST** (= GMT +0900).

It is a follow-up to the previous workshop on "Computational Knot Theory", held May 26-June 2, 2021, at the same lab.

Eleni Panagiotou (University of Tennessee, Chattanooga) **8/18 10am**

Knot polynomials and Vassiliev measures of open and closed curves in 3-space and their applications

Many physical systems are composed by entangled filamentous structures whose entanglement greatly affects their mechanical properties. Measuring entanglement complexity of physical systems has been a challenge because these can be seen as open curves in 3-space for which the conventional measures of topological complexity do not apply. In this talk we introduce the Jones polynomial for open curves in 3-space. We show it is a continuous function of the curve coordinates that, as the ends tend to coincide, it tends to the Jones polynomial of the resulting knot. We show how this Jones polynomial can be applied to diblock polymers to detect phase transitions. The calculation of the Jones polynomial for real physical filaments can be intractable. In this talk we also introduce Vassiliev measures of open curves in 3-space. These are also continuous functions of the curve coordinates and tend to the Vassiliev invariant of the resulting knot as the endpoints coincide. We show that the second Vassiliev measure can provide a measure of entanglement complexity of open curves in 3-space that may be preferable for applications.

Homayun Karimi (McMaster University) **8/18 8pm**

The Gordon-Litherland pairing for links in surfaces, and applications to the alternating links and the concordance

We introduce the Gordon-Litherland (GL) pairing for knots and links in thickened surfaces that bound unoriented spanning surfaces. Using the GL pairing, we define several invariants (signature, determinant, and nullity). We will discuss several applications to problems such as detecting the minimal supporting genus, determining sliceness, and slice genus of virtual knots. The GL pairing can also be regarded as the relative intersection pairing on a 4-manifold obtained as the 2-fold cover along the surface. We will also give an application to the problem of characterization of alternating links. This talk represents three papers, one is a joint work in progress with Hans Boden, and Micah Chrisman and the other two are joint work with Hans Boden.

Jieon Kim (Pusan National University) **8/19 10am**

On symmetric biquandles

A biquandle is a non-empty set with two binary operations. When an invariant is constructed by using biquandles, orientations are needed. Biquandles are generalizations of quandles. For constructing invariants by using quandles, we need orientations. Kamada and Oshiro defined symmetric quandles, which will be used for constructing invariants for unoriented (surface-)links. In this talk, we define symmetric biquandles, which are generalizations of symmetric quandles. Also we construct invariants for unoriented (surface-)links by using symmetric biquandles.

Nafaa Chbili (United Arab Emirates University) **8/19 8pm**

Quasi-alternating links, new examples and obstructions

Quasi-alternating links represent an important class of links that has been introduced by Ozsváth and Szabó while studying the Heegaard Floer homology of the branched double-covers of alternating links. This new class of links which share many homological properties with alternating links, is defined in a recursive way which is not easy to use in order to determine whether a given link is quasi-alternating. In this talk, we shall review some of the main obstruction criteria that have been established to characterize quasi-alternating links. Then we shall explain how to extend the twisting technique of Champanerkar and Kofman to introduce new examples of quasi-alternating links.

Serge Tabachnikov (Pennsylvania State University) **8/20 10am**

Cusps of caustics by reflection and Legendrian knots

The boundary of a planar oval is an ideal mirror, and one has a point source of light inside the oval. Consider the rays of light that have undergone N reflection in the mirror, where N=1,2,... The envelope of this system of rays is the Nth caustic by reflection. I shall explain why, for every N, this caustic has at least four cusps. This result is a consequence of a far reaching generalization of the 4-vertex theorem, conjectured by Arnold and proved by Chekanov and PushkarâĂŹ using Legendrian knot theory. Similar problems for convex surfaces were considered before: Caratheodory proved that the locus of points conjugated to a given point has at least four cusps, and Jacobi stated, in his "Lectures on dynamics", that this number is exactly four in the case of the ellipsoid (this is known as the "Last Geometric Statement of Jacobi"). Our problem is a billiard version of these problems of differential geometry of surfaces. Conjecturally, ellipses are characterized by the property that all caustics by reflection have exactly four cusps.

Ken Perko (Juris Doctor, New York) **8/20 8pm**

Looking at Linking Numbers

Linking numbers between branch curves of non-cyclic covering spaces were first discovered by Reidemeister and used to complete the classification of prime knots through 9 crossings. Algorithms for calculating them were originally limited to 2-bridge examples (then known as "Viergeflechte") and set forth rather confusingly in a 1934 paper by Bankwitz and Schumann that never got properly cited in Reidemeister's 1932 book on "Knotentheorie." At Fox's suggestion, our 1964 Princetion senior thesis set forth a general algorithm for their calculation (when they exist). This talk will discuss some short cuts for intuitively "seeing" such linking numbers, when they are integers, along with various relationships between them when crossings of diagrams are reversed.

Ken Millett (University of California, Santa Barbara) **8/24 8pm**

Some observations concerning the Conway and Kinoshita-Terasaka Knots

We discuss the 11 edge equilateral polygonal representations of the Conway and Kinoshita-Terasaka knots. By removing edges of the configurations, we study the HOMFLY-PT spectrum of the resulting open arc conformations using DMS closures whose superposition defines an average HOMFLY-PT polynomial of the open arc. Defining the spread of this polynomial gives a new measure of the complexity of the knotting entanglement of the open arc. The spectrum, its superposition polynomial and the associated spread provide new methods to compare the Conway and Kinoshita-Terasaka knots and provide new information supporting the view that despite their similarities, the Conway knot is more entangled and more complex than the Kinoshita-Tereasaka knot. This work is in collaboration with Eleni Panagiotou.

Teruhisa Kadokami (Kanazawa University) **8/25 10am**

On amphicheirality of links

An n-component link L in S^3 is amphhicheiral if there is an orientation-reversing homeomorphism f of S^3 such that $f(L)$ is equivalent to L. We show some results on amphicheirality of links.

Mikami Hirasawa (Nagoya Institute of Technology) **8/25 8pm**

On Alexander polynomials of degree over 764 of alternating knots with over 778 crossings

Let K be an alternating knot with Alexander polynomial f(t). Since J. Hoste raised the question, it had been believed over 17 years that the real parts of the zeros of f(t) are greater than -1. Note that there are 491327 alternating knots up to 16 crossings available to check. The conjecture has evaded many attacks and yielded only partial positive answers but no concrete counter example. To find a counter examples, we narrowed the candidate to a special subclass of 410141 alternating Montesinos knots up to 1000 crossings, and found first 45 counter examples. The minimal one has 778 crossings and the degree of f equals 764. We made explicit Seifert surfaces for the candidates, made formula for the polynomial, and after numerical calculations, gave a rigorous proof that they have a zero whose real part is less than -1. This is a joint work with Katsumi Ishikawa (Kyoto University) and Masaaki Suzuki (Meiji University).