17th Chico Topology Conference
Titles and Abstracts
(As of April 20, 2022)
All talks are in HOLT 175

Invited Speakers

Speaker: **Aaron Abrams**, Washington & Lee University
Title: A polynomial invariant for square triangulations

Abstract: A celebrated theorem of Monsky from 1970 implies that it is impossible to dissect a square into an odd number of triangles of equal area.

This begs the question: which (tuples of) areas can be the areas of the triangles in a dissection of a square?

It turns out that for each combinatorial type of triangulation, there is exactly one polynomial relation that is satisfied by the areas of the triangles in every geometric realization of the given triangulation. I will talk about recent discoveries and current mysteries surrounding this polynomial invariant.

Speaker: **Ian Agol**, UC, Berkeley
Title: Ribbon concordance of knots is a partial order

Abstract: We will discuss a resolution of a conjecture of Gordon that ribbon concordance of knots is a partial order. The proof makes use of representations of knot groups to SO(N) and the subquotient relation between them induced by ribbon concordance.

Speaker: **Anna Marie Bohmann**, Vanderbilt University
Title: Free Loop Spaces and Topological coHochschild Homology

Abstract: Free loop spaces arise in many areas of geometry and topology. Simply put, the free loops on a space X is the space of maps from the circle into X. This is a main object of study in string topology and has important connections to geodesics on manifolds. In this talk, we discuss a new approach to computing the homology of free loop spaces via topological coHochschild homology, which is an invariant of coalgebras arising from homotopy theory techniques. This approach produces a spectral sequence for the homology of free loop spaces with algebraic structure that allows us to make new computations. This is joint work with Teena Gerhardt and Brooke Shipley.

Speaker: **Spencer Dowdall**, Vanderbilt University
Title: Orientability for fully irreducible free group automorphisms

Abstract: Every automorphism of a free group comes with two natural notions of growth rate: a homological stretch factor, which is the spectral radius of the action on homology, and a geometric stretch factor that measures the exponential word-length growth of elements under iteration of the automorphism. This talk will explore the relationship between these numbers with the goal of understanding when and how they can be equal. Motivated by a well-known phenomenon in the study of pseudo-Anosov surface homeomorphism, we show that a fully irreducible free group automorphism has equal stretch factors if and only if it respects a certain type of "orientation" of the free group. By connecting this to polynomial invariants of free-by-cyclic groups, we are also able to study the extent to which this property of having an orientable monodromy automorphism persists among distinct splittings of a given free-by-cyclic group. Joint work with Radhika Gupta and Samuel J. Taylor.

Speaker: **Joshua Howie**, UC, Davis
Title: Geography of Surfaces

Abstract: The geography problem for spanning surfaces asks for a classification of all pairs of Euler characteristic and slope which can be realized by a spanning surface for a given knot in the 3-sphere. It is enough to understand the meridionally essential one-sided spanning surfaces, a somewhat larger class of surfaces than the geometrically essential spanning surfaces. I will discuss the existence of such one-sided surfaces, and give an algorithmic solution to the geography problem.

Speaker: **Jeffrey Meier**, Western Washington University
Title: Classifying fibered, homotopy-ribbon disks

Abstract: I will discuss the classification of fibered, homotopy-ribbon disks bounded by generalized square knots. Up to diffeomorphism rel-boundary, such disks are in bijection with the rational numbers with even numerator. However, there is a unique such disk up to diffeomorphism. This is joint work with Alex Zupan.

Speaker: **Andrei Pavelescu**, University of South Alabama
Title: Minor Minimal Intrinsically Knotted Graphs and the Colin de Verdière Invariant

Abstract: A graph is called intrinsically knotted (IK) if every embedding in $\mathbb{R}^3$ contains at least one self-knotted cycle. A graph is minor minimal intrinsically knotted (MMIK) if it is intrinsically knotted, but every minor of it admits a knotless embedding. The set of knotlessly embeddable graphs is closed under taking minors; by the graph minor theorem of Robertson and Seymour, it follows that there are finitely many MMIK graphs. While more than 300 of them are known, a consistent amount of machinery and work is needed to classify them all. In this talk I will present possible avenues to attempt such a classification and discuss connections with other minor closed families of graphs. I will discuss some connections to the Colin de Verdière invariant, a graph parameter which can detect several topological properties, such as planarity and linkless embeddability.

Speaker: **Ben Williams**, University of British Columbia
Title: Using algebras to approximate classifying spaces of linear algebraic groups

Abstract: If A is a finite-dimensional complex algebra with automorphism group G, then spaces of generating r-tuples of elements in A can be used to produce a sequence of manifolds $B(r)$ approximating the classifying space BG. I will explain this construction and how it extends some well known examples. Then I will discuss the manifolds $B(r)$, and how their topology can be used to produce examples of algebras of various kinds requiring many generators. If time permits, I will discuss the analogous construction for real algebras, and some unanswered questions. This talk is based on joint work with Uriya First and Zinovy Reichstein.

Contributed Talks

Speaker: **Holt Bodish**, University of Oregon
Title: Remarks on reducible surgeries on knots and slice genus bounds

Abstract: The cabling conjecture asks which knots admit Dehn surgeries that are non-prime three manifolds. In this talk we show that reducible surgery on a slice knot always has an integer homology sphere summand. As a corollary, we show that if a slice knot K has two reducing slopes, r and $r+1$, then $r+1 \leq g(K)$. Along the way we will indicate some work obtaining slice genus bounds for knots that admit reducing slopes of the form $2p$ and $3p$. The techniques involve d invariants and the mapping cone formula from Heegaard Floer homology.

Speaker: **Marion Campisi**, San Jose State University
Title: Kirby-Thompson distance for trisections of knotted surfaces

Abstract: We adapt work of Kirby-Thompson and Zupan to define an integer invariant $L(T)$ of a bridge trisection T of a smooth surface K in S^4 or B^4 . We show that when $L(T) = 0$, then the surface K is unknotted. We also show show that for a trisection T of an irreducible surface, bridge number produces a lower bound for $L(T)$. Consequently L can be arbitrarily large.

Speaker: **Christian Carrick**, UCLA
Title: A new proof of the Segal conjecture via Real bordism theory

Abstract: We discuss the Segal conjecture for $G = C_2$ and its relation to the Real bordism theories $MU^{((G))}$ used by Hill, Hopkins, and Ravenel in their solution to the Kervaire invariant problem. We show that the Segal conjecture for C_2 is equivalent to the Borel completeness of $MU^{((C_4))}$. We show the latter by using chromatic methods adapted to the C_4-equivariant setting.

Speaker: **Nicholas Cazet**, UC, Davis
Title: Surface-Knots with Arbitrarily Large Triple Point Numbers

Abstract: Analogous to a classical knot diagram, a surface-knot can be generically projected to 3-space and given crossing information to create a broken surface diagram. A generic compact surface in 3-space has finitely many triple points. The triple point number of a surface knot is the minimal number of triple points among all broken surface diagrams representing the surface-knot. I will introduce quandles and the cocycle invariant to generate a result about the triple point number of surface-knots: There exists orientable surface-knots of arbitrary genus with arbitrarily large triple point number.

Speaker: **Matthew Nuyten**, CSU, Fresno
Title: Extending the Kauffman 2-variable Polynomial to Singular Links

Abstract: In the late last century, the discovery of the Jones polynomial led to an explosion of research in knot theory, in particular with polynomial invariants. My work is based on the Kauffman (2-variable) polynomial, which is an invariant of regular isotopy for links. Similar to L. Paris, who extended the HOMFLY-PT polynomial to singular links by means of trace functions and algebras. I will use methods similar to J. Birman & H. Wenzl who used the existence of the Kauffman polynomial to construct an algebra which allows for a trace; this trace is an invariant of regular isotopy. I extend the the notion to constructing an algebra which admits a trace, this is an invariant for singular links which is a generalization of the classical Kauffman 2-variable polynomial for links.

Speaker: **Riccardo Pedrotti**, UT, Austin
Title: Fixed point Floer cohomology for a Dehn twist on a w+-monotone manifold with rational symplectic form

Abstract: In this paper we give an explicit description of the Floer cohomology of a family of Dehn twists τ about disjoint Lagrangian spheres in a w+-monotone symplectic manifold whose symplectic class $[\omega]$ admits a rational representative. To do so, we generalize the approach developed in [Sei96] and [Gau03] and apply it to the modified Floer cohomology groups defined by K. Ono in [Ono95] which can be shown to be isomorphic to the standard ones. As a byproduct of this new framework, we are able to define a class in the fixed point Floer cohomology group of a single Dehn twist by counting half-strips bound to the Lagrangian sphere and prove that it must vanish in the monotone case. In subsequent work we plan on using this class to give a geometric proof of the exactness of the triangle P. Seidel defined in [Sei03].

[Sei96]: P. Seidel. The Symplectic Floer Homology of a Dehn Twist. Mathematical Research Letters, 3(6):829–834, 1996.
[Sei03]: P. Seidel. A long exact sequence for symplectic Floer cohomology. Topology, 42(5):1003– 1063, 2003.
[Gau03]: R. Gautschi. Floer homology of algebraically finite mapping classes. J. Symplectic Geom., 1(4):715–765, 2003.
[Ono95]: K. Ono. On the Arnol'd conjecture for weakly monotone symplectic manifolds. Invent. Math., 119(3):519–537, 1995.

Speaker: **Sarah Petersen**, University of Notre Dame
Title: Ravenel-Wilson Hopf ring methods in C_2-equivariant homotopy theory and the $H\underline{\mathbb{F}}_2$-homology of C_2-equivariant Eilenberg-MacLane spaces

Abstract: This talk describes an extension of Ravenl-Wilson Hopf ring techniques to C_2-equivariant homotopy theory. Our main application and motivation for introducing these methods is a computation of the $RO(C_2)$-graded homology of C_2-equivariant Eilenberg-MacLane spaces. The result we obtain for C_2-equivariant Eilenberg-MacLane spaces associated to the constant Mackey functor $\underline{\mathbb{F}}_2$ gives a C_2-equivariant analogue of the classical computation due to Serre at the prime 2. We also investigate a twisted bar spectral sequence computing the homology of these equivariant Eilenberg-MacLane spaces and suggest the existence of another twisted bar spectral sequence with E^2-page given in terms of a twisted Tor functor.

Speaker: **Patrick Shanahan**, Loyola Marymount University
Title: Remarks on the nonorientable 4-genus of double-twist knots

Abstract: The nonorientable 4-genus of a knot K in S^3 is defined to be the minimal first Betti number of any smooth, properly embedded, connected, and nonorientable surface in B^4 that spans the knot. This invariant is denoted by $\gamma_4(K)$ has been determined for some infinite families of torus knots and twist knots. In this talk, which is joint work with Jim Hoste and Cornelia Van Cott, we will investigate the nonorientable 4-genus of double-twist knots. Using results about the nonorientable 3-genus it is easy to see that γ_4 is at most 3 for double-twist knots. Furthermore, using to work of Lisca, which established the ribbon-slice conjecture for 2-bridge knots, we can classify the double-twist knots which are slice (and hence have $\gamma_4 = 0$). We will present explicit topological constructions and algebraic obstructions to produce upper and lower bounds, respectively, on γ_4. For infinitely many double-twist knots, the upper and lower bounds match and therefore determine γ_4. However, there remain infinitely many double twist knots where we can only say that γ_4 lies in one of the sets $\{1, 2\}, \{2, 3\}$ or $\{1, 2, 3\}$.

Speaker: **Maria Trnkova**, UC, Davis
Title: Approximating embedded surfaces by triangular meshes

Abstract: We will talk about problems which arise when visualizing a surface embedded in $\mathbf{R}^3$. Such problems appear in numerous applications such as MRI or CT scans dat. Their goal is to replace a surface of a body by a mesh, a piecewise-flat triangulated surface, used in Computer Graphics. Many algorithms are written on the presentation of a surface as a mesh that approximates it. We present a new method of approximating a surface by a high quality mesh based on the Normal Surface theory and Marching Cubes algorithm. The main advantage is improved mesh quality guaranteed for smooth surfaces. The GradNormal algorithm generates a triangular mesh that gives a piecewise-differentiable approximation of F, with angles between 35.2 and 101.5 degrees. As the mesh size approaches 0, the mesh converges to F through surfaces that are isotopic to F. This is joint work with J.Hass.