16th Chico Topology Conference &
60th Cascade Topology Seminar
Titles and Abstracts
(As of April 19, 2018)

Invited Speakers

Speaker: **Marion Campisi**, San Jose State University
Title: Distortion and the bridge distance of knots

Abstract: We show that there is a lower bound on the distortion of a knot in $\mathbf{R}^3$ proportional to the minimum of the bridge distance and the bridge number of the knot. We also exhibit an infinite family of knots for which the minimum of the bridge distance and the bridge number is unbounded.

Speaker: **Włodzimierz Charatonik**, Missouri University of Science and Technology
Title: Universal Continua

Abstract: We discuss the existence of universal continua for some classes. We recall constructions of universal continua of a given dimension, the proof of existence of universal arc-like and tree-like continua, universal smooth dendroid, universal dendrites of a given order, and proofs of non-existence of universal elements for some classes.

Speaker: **Terry Gannon**, University of Alberta
Title: Modular tensor categories and the search for the exotic

Abstract: Modular tensor categories were invented in the early 1990s as a way to make sense of all the knot invariants that were known back then. They also appear in several different contexts, e.g. as the category of representations of vertex operator algebras. Nevertheless, our zoo of known examples is fairly bland: they all come from standard methods applied to standard examples. Is that blandness the nature of the beast, or is it because we are just too dumb to notice all the other examples lurking out there? My talk will address this. It is meant for a general mathematical audience – in particular, I will assume neither familiarity with, nor much tolerance for, matters categorical.

Speaker: **Hyoungjun Kim**, Ewha Womans University
Title: Ropelength of $(n, 2)$-torus knots with supercoil structure

Abstract: In this talk we investigate the optimal conformation of 4-strand superhelical strings that minimizes the ropelength. The unique ropelength-minimizing conformation of the standard double helix is taken into account so that the conformation of a superhelical curve is controlled by the twist number and the helical radius. From the estimation of these values, which satisfy the distance condition, we derive a general upper bound on the ropelength of $(12n + 1, 2)$-torus knots. Finally the efficiency of the superhelical model for $(n, 2)$-torus knots is discussed in comparison with the circular model. This work is in collaboration with Youngsik Huh and Seungsang Oh.

Speaker: **Danielle O'Donnol**, Indiana University
Title: Planar Legendrian Graphs

Abstract: An embedded graph is Legendrian if it is everywhere tangent to the contact structure. I will define a contact structure and give an overview of some invariants used in this area. I will talk about our recent work on several classification problems for planar Legendrian graphs. We have results on geography problem, botany problem, and stabilization equivalence.

Speaker: **Candice Price**, University of San Diego
Title: Unravelling Biochemistry Mysteries: Knot Theory Applied to Biochemistry

Abstract: Mathematical modeling is an effective resource for biologists since it provides ways to simplify, study and understand the complex systems common in biology and biochemistry. Many mathematical tools can be applied to biological problems, some traditional and some more novel, all innovative. This presentation will review the mathematical tools that I use to model and study biological issues of DNA-protein interactions.

Speaker: **Matt Rathbun**, CSU, Fullerton
Title: Hyperbolic manifolds containing high topological index surfaces

Abstract: If a graph is in bridge position in a 3-manifold so that the graph complement is irreducible and boundary irreducible, we generalize a result of Bachman and Schleimer to prove that the complexity of a surface properly embedded in the complement of the graph bounds the graph distance of the bridge surface. We use this result to construct, for any natural number $n$, a hyperbolic manifold containing a surface of topological index $n$.

Speaker: **Ed Tymchatyn**, University of Saskatchewan
Title: Cell Structures

Abstract: (with Wojciech Debski) A combinatorial graph is a discrete set of vertices together with a set of edges. Cell structures are inverse systems of graphs with mild convergence conditions. The inverse limit of a cell structure is a complete Hausdorff space with small inductive dimension zero. A cover of a topological space defines the graph whose vertices are the elements of the cover and where two vertices are joined by an edge if they intersect as sets. (This graph is simply the 1-skeleton of the nerve of the cover.) If $X$ is a paracompact Hausdorff space the set of locally finite closed covers of $X$ directed by refinement gives rise to a cell structure . The inverse limit of this cell structure admits a perfect map onto $X$. Cell structures determine all paracompact Hausdorff spaces. Cell maps between cell structures determine the continuous maps between such spaces. One may regard cell structures as systems of discrete approximations of spaces. We will indicate why cell structures are much easier to work with than the traditional inverse limits and resolutions which use the entire nerves of covers.

Contributed Talks

Speaker: **Maria Elena Aguilera Miranda**, Missouri University of Science and Technology
Title: Whitney properties without Whitney maps

Abstract: We use a characterization of Whitney levels to propose a new definition of Whitney properties that does not requiere the existence of Whitney maps, so it can be used in investigation of non-metric continua. Several topological properties have been considered. In this talk, we want to focus in the property of being chainable.
Coauthor: Włodzimierz J. Charatonik

Speaker: **David P. Bellamy**, University of Delaware
Title: An Irreducibility Property of a Class of Subcontinua of Homogeneous Indecomposable Continua

Abstract: In the early 1980's, J. T. Rogers, jr. asked whether there exist homogeneous indecomposable continua of dimension greater than one. This work provides what I hope may lead to some insight into this question. I am going to call it a lemma; it seems too technical to qualify as a theorem.
**Lemma.** Let $X$ be a homogeneous indecomposable continuum. Suppose $O$ is a regular open subset of $X$, with $O \neq X$, and suppose $W_0$ is a component of $O$. Let $W =$ the closure of $W_0$. Let $V$ be any open subset of $X$ such that $W \setminus W_0 \subseteq V$. Then $W$ is a continuum irreducible about $W \cap V$.

Speaker: **Jack Fogliasso and Skip Moses**, CSU, Chico
Title: The Search for Jacobian Varieties with Complex Multiplication

Abstract: In this talk we outline a new method of constructing Jacobian varieties with complex multiplication (CM) from finite-index subgroups of the modular group $\mathrm{PSL}_2(\mathbb{Z})$. We will also discuss the theory behind the computational methods we used to implement this in Sagemath, which includes computing normal subgroups of $\Gamma(2)$ using the low index normal subgroups procedure outlined by Marston Conder and Peter Dobcsányi in 2004.

Speaker: **Rachel Hardeman** University of Calgary
Title: An Introduction to A-Homotopy Theory: A Discrete Homotopy Theory for Graphs

Abstract: A-homotopy theory was invented by R. Aktin in the 1970s and further developed by H. Barcelo and others in the early 2000s as a combinatorial version of homotopy theory. This theory respects the structure of a graph, distinguishing between vertices and edges. While in classical homotopy theory all cycles are equivalent to the circle, in A- homotopy theory the 3 and 4-cycles are contractible and all larger cycles are equivalent to the circle.

In this talk, we will examine the fundamental group in A-homotopy from the perspective of covering spaces. We will also establish explicit lifting criteria and examine the role of the 3 and 4-cycles in these criteria.

Speaker: **Hidefumi Katsuura**, San Jose State University
Title: From Holditch to New Kepler Type Laws

Abstract: In 1981, Broman proved a beautiful theorem that generalizes Holditch's theorem in Math Magazine. By interpreting his result carefully, we will strengthen Holditch's theorem and prove the following: Let C be a **simple** closed curve such that a chord $AB$ can be slid once completely around the curve $C$. Let $P$ be a point on the **line** $AB$. Let $AP = a$ and $BP = b$, and let $C'$ be the locus of $P$ as the chord $AB$ rotates around $C$. If $C'$ is a simple closed curve, then the difference between the areas bounded by $C$ and $C'$ is given by $\pi ab$.

Motivated by the modified Broman's theorem, we will also prove that the locus of a point generated by a toy called BS-grinder has similar properties to the Kepler's first and second laws of planetary motion.

Speaker: **Sergio Macías**, UNAM
Title: Induced maps on the $n$-fold pseudo-hyperspace suspension of continua.

Abstract: Let $X$ be a continuum. If $n$ is a positive integer, then $C_n(X)$ denotes the space of all nonempty closed subsets of $X$ with at most $n$ components and let $F_1(X)$ denote the space of singletons. The $n$-fold pseudo-hyperspace suspension of $X$ is the quotient space $C_n(X)/F_1(X)$, with the quotient topology. For several classes of maps between continua, we study the induced maps between $n$-fold pseudo-hyperspace suspensions.

Speaker: **Marcus Marsh**, CSU, Sacramento
Title: A fixed point theorem for conical shells

Abstract: (Co-author: Andras Domokos) We prove a fixed point theorem for mappings $f$ defined on a conical shell $F$ in Euclidean $n$-space, where the image of $f$ need not be a subset of $F$, nor even a subset of the cone that contains $F$. Sufficiency for fixed points of $f$ is dependent only on the behavior of $f$ on the boundary of $F$, and is related to notions of compressing or extending $F$ as defined by Krasnoselskii. We also discuss possible extensions of our theorem to infinite dimensional Banach spaces.

Speaker: **Faruq Mena**, Missouri University of Science and Technology
Title: A family of generalized inverse limits homeomorphic to 'the Monster'

Abstract: We show that two generalized inverse limit spaces that one might suspect are not homeomorphic are in fact homeomorphic.