14th Chico Topology Conference
Titles and Abstracts
(As of April 23, 2014)

Invited Speakers

Speaker: **Carmen Caprau**, CSU, Fresno
Title: Quantum invariants for singular links

Abstract: Quantum invariants for knots and links play a central role in knot theory and its ramifications. In the recent years, there has been a great interest in the study of knot-like objects, including singular links, knotted graphs, and virtual knots. A knotted graph is an embedding of a graph in three-dimensional space, and a singular link is an immersion of a disjoint union of circles into three-dimensional space, which admits only finitely many singularities that are all transverse double points.

In this talk, I consider known (quantum) polynomial invariants for classical knots and links and extend them to singular links. In doing so, an interesting relationship between two distinct state models for the sl(n)-link invariant is revealed. Time permitting, I will also discuss some efforts made in extending these state models to invariants of 4-valent knotted graphs.

Speaker: **Moon Duchin**, Tufts University
Title: The Heisenberg group viewed from up close and very far

Abstract: In geometric group theory we often study infinite groups at large scale, or asymptotically. Finitely-generated nilpotent groups carry natural coordinates making it possible to visualize their asymptotic geometry as Euclidean space with unusual ambient metric. I'll survey some results, both fine and coarse, that can be obtained from this geometric description, focusing attention on the simplest nontrivial nilpotent group: the classical Heisenberg group.

Speaker: **Logan Hoehn**, Nipissing University
Title: Isotopies of compact sets in the plane

Abstract: An isotopy of a set $X \subset \mathbb{C}$ is a homotopy $h : X \times [0,1] \to \mathbb{C}$ such that for any $t \in [0,1]$, the function $h_t : x \mapsto h(x,t)$ is a homeomorphism of X.

Oversteegen and Tymchatyn (2010) proved that any isotopy of a continuum in the plane, starting at the identity, can be extended to an isotopy of the entire plane. Their argument involves several useful techniques in plane topology, including hyperbolic geodesics, the Kulkarni-Pinkall stratification, and equidistant sets. I will present some of these, and discuss our work on extending isotopies of more general compact sets in the plane.

Speaker: **Marcus Marsh**, CSU, Sacramento
Title: Additivity (or not) of the Fixed Point Property

Abstract: Let each of X, Y, and $X \cap Y$ be a continuum with the fixed point property (fpp). We say that *the fpp is additive for X and Y* if $X \cup Y$ has the fpp. If $\mathcal{G}$ is some class of continua with the fpp, we say that *the fpp is additive for the class $\mathcal{G}$* provided that whenever X, Y, and $X \cap Y$ are in $\mathcal{G}$, the fpp is additive for X and Y.
Question. For what classes $\mathcal{G}$ of continua is the fpp additive?
We discuss the history of this question, reviewing both positive and negative results. We end with recent examples of Hagopian and Marsh that show the fpp is not additive for the class of tree-like continua.

Speaker: **Chris Mouron**, Rhodes College
Title: Finding complicated subcontinua

Abstract: A continuum is a compact, connected metric space. A continuum X is *indecomposable* if every proper subcontinuum has empty interior. A continuum X is *semi-indecomposable* if for every two disjoint subcontinua of X, at least one must has empty interior. Sufficient conditions for a continuum to be indecomposable or semi-indecomposable are well known and understood. Sufficient conditions for a continuum to contain an indecom- posable or semi-indecomposable subcontinuum are not so understood. This talk will present some sufficient conditions for a continuum to contain such complicated subcontinua and a few examples of interesting continua that do not have indecomposable or semi-indecomposable subcontinua.

Speaker: **M. Y. Bakeir** Assiut University, Egypt
Title: Supra topological rough classes and relations

Abstract: Wiweger (1989), has introduced a very important generalization of the notion of rough sets in an approximation space, by introducing the concept of topological rough sets. Also he has defined topological rough pairs and has investigated some of their properties. In this work, we give a further study for supra topological rough classes, supra topological rough pairs and introduce some properties for these concepts.

Speaker: **Alejandro Illanes** UNAM
Title: Problems related to the pseudo-arc, some solutions

Abstract: In his paper in the book "Open problems in topology II", David P. Bellamy asked some problems about the pseudo-arc. In this talk we present some partial or total solutions on some of them.

Speaker: **Kenneth Kellum** San Jose State University
Title: Uniform Limits of Connectivity Functions

Abstract: A function $f : \Re \to \Re$ is a *connectivity function* if f, as a subset of the plane, is connected.

In 1972 Andrew Bruckner and Jack Ceder conjectured a characterization of the uniform limit of connectivity functions. Until now, that conjecture has remained an open problem. I am able to, at last, prove their conjecture true by first proving a technical result.

A continuum M is said to *jump* a function f if M contains points both above f and below f. We say M is a Garrett continuum if the intersection of M with each vertical line that hits it is connected.

Theorem. A function $f : \Re \to \Re$ is a connectivity function if and only if f hits every Garrett continuum with jumps it.

Speaker: **Wayne Lewis** Texas Tech University
Title: Open problems concerning the pseudo-arc

Abstract: We give brief background concerning the pseudo-arc and then discuss a few open problems concerning the pseudo-arc.

Speaker: **Sergio Macías.** UNAM
Title: On continuously type A' θ_1-continua.

Abstract: A *continuum* is a nonempty, compact, connected, metric space. A continuum X is a θ_1-*continuum* provided that for each subcontinuum K of X, we have that $X \setminus K$ is connected. Following Professor E. S. Thomas, Professor Eldon Vought defined: A θ_1-continuum is of *type* A' if there exists an upper semicontinuous decomposition $\mathcal{G}$ of X such that for each $G \in \mathcal{G}$, G is a continuum, $Int_X(G) = \emptyset$, and the quotient space, $X/\mathcal{G}$ is a simple closed curve. Following Professors L. Mohler and L. G. Oversteegen, we say that a θ_1-continuum X is a *continuously type* A' θ_1-*continuum* provided that the decomposition $\mathcal{G}$ is continuous. We present properties of this type of continua.

Speaker: **Verónica Martínez de la Vega** UNAM
Title: Generalized Inverse Limits resulting in the Hilbert Cube

Abstract: We show a family of closed sets of the Interval, such that the inverse limit associated to each element of the family results on a Hilbert cube. We also present other examples.

Speaker: **Naomi Miller** CSU, Chico
Title: A computer search for MMNA graphs

Abstract: We give an overview of a project to use parallel processing techniques to search for MMNA graphs.

Speaker: **Mike Pierce** CSU, Chico
Title: Classifying the Finite Set of Minor-Minimal Non-Apex Graphs

Abstract: We say that a graph is non-apex if the removal of any vertex results in a non-planar graph. We say that a graph is minor-minimal non-apex (MMNA) if it is non-apex but none of its proper minors are non-apex. As a consequence of the Robertson & Seymour's Graph Minor Theorem (2004), we know that the set of MMNA graphs is finite. The objective of this research is to find and classify this finite set of graphs.

We developed properties of MMNA graphs based on the size of order of a graph, the connectivity a graph, and the effects of triangle-Y and Y-triangle transforms on a graph. We have classified all MMNA graphs that have at most 10 vertices, are disconnected, and have connectivity one. So far we have found more than 120 MMNA graphs.

Speaker: **Janusz Prajs** CSU, Sacramento
Title: Pseudo-path connected homogeneous continua.

Abstract: It is shown that every pseudo-path connected homogeneous continuum, that is, a homogeneous continuum connected by continuous images of the pseudo-arc, is weakly chainable.

Speaker: **Candice Price** USMA, West Point
Title: A discussion on the combinatorial version of knot Floer homology

Abstract: One of the main aspects of knot theory is to provide techniques to determine whether two knots are equivalent. Thus modern knot theory is concerned with the development of knot invariants properties of a knot that stay consistent under continuous deformation of a knot projection. Invariants are usually functions from the set of all knots into some mathematical object such as a polynomial or group. In recent years, link homology theories have become a popular invariant to develop and study. One such invariant knot Floer homology, was constructed by Peter Ozsvth, Zoltn Szab, and independently Jacob Rasmussen, denoted by HFK. It is also a refinement of a classical invariant, the Alexander polynomial. In this discussion, we will focus on the combinatorial version of knot Floer homology developed by Ciprian Manolescu, Peter Ozsvath and Sucharit Sarkar including necessary definitions and an example.

Speaker: **K. Ramesh**, Indian Institute of Technology, Bombay
Title: Inertia groups of projective planes

Abstract: A closed smooth $2n$-manifold M^{2n} is called projective plane-like manifold if it has the homotopy type of $\mathbb{R}\mathbf{P}^2$, $\mathbb{C}\mathbf{P}^2$, $\mathbb{H}\mathbf{P}^2$ or $\mathbb{O}\mathbf{P}^2$. For a projective plane-like manifold M^{2n}, we show that the group $\mathcal{C}(M^{2n})$ of concordance classes of smoothings of M^{2n} is isomorphic to $\mathbb{Z}_2$ for $n = 4$ and $\mathcal{C}(M^{2n}) \neq 0$ for $n = 8$. We consider three types of inertia groups $I(M^{2n})$, $I_c(M^{2n})$ and $I_h(M^{2n})$. We show that the concordance inertia group $I_c(M^{2n}) = 0$ for $n = 4$, 8, the homotopy inertia group $I_h(\mathbb{H}\mathbf{P}^2) \neq I_c(\mathbb{H}\mathbf{P}^2)$ and any homeomorphism $f : N \to \mathbb{H}\mathbf{P}^2$ where N is a closed smooth manifold is homotopic to a diffeomorphism. We then calculate $\theta(\mathbb{H}\mathbf{P}^n)$, the tangential structure set of $\mathbb{H}\mathbf{P}^n$, for $n = 2$, 3, 4. On the way, following Wall's approach [2] we present a new proof of the main result in [1], namely, for $n = 4$, 8, the inertia group $I(M^{2n}) \cong \mathbb{Z}_2$.
[1] L. Kramer and S. Stolz, A diffeomorphism classification of manifolds which are like projective planes, *J. Differential Geom.,* **77(2)** (2007) 177-188.
[2] C.T.C. Wall, Classification problems in differential topology. VI. Classification of $(s-1)$-connected $(2s+1)$-manifolds, *Topology* **6** (1967) 273-296.

Speaker: **Soumen Sarkar**, University of Regina
Title: Triangulation of real projective spaces with few vertices.

Abstract: P. Arnoux and A. Marin showed that any triangulation of RP^n contains more than $(n+1)(n+2)/2$ vertices if $n > 2$. We construct some natural triangulations of RP^n with $n(n+5)/2+1$ vertices for all $n > 2$. We also construct some equivariant triangulations of RP^n with $n(n+1)$ vertices for $n > 2$.

Speaker: **Jeremy Thomas** CSU, Chico
Title: On 2-connected minor minimal non apex graphs

Abstract: We describe progress in classifying MMNA graphs that are at most 2-connected. There are exactly three disconnected MMNA graphs and none of connectivity one. A 2-connected graph has a cut set consisting of two vertices a and b. We are near a classification in the case that ab is an edge of the graph. We also present some conjectures in case it is not.

Speaker: **Muhammad Arshad Zia**, International Islamic University, Islamabad, Pakistan.
Title: Fixed points in topological vector space (TVS) valued cone metric spaces