12th Chico Topology Conference
Titles and Abstracts
(Last Updated: June 1, 2010)

Invited Speakers

Speaker: **Alexander Coward**, UC, Davis & Oxford
Title: Upper bounds on Reidemeister moves

Abstract: (Joint work with Marc Lackenby.) Given any two diagrams of the same knot or link, we provide an explicit upper bound on the number of Reidemeister moves required to pass between them in terms of the number of crossings in each diagram. This provides a new and conceptually simple solution to the equivalence problem for knot and links.

Speaker: **Allejandro Illanes**, UNAM
Title: Models for hyperspaces

Abstract: A continuum is a compact connected metric space. For a continuum X, the following hyperspaces are defined.

$$\begin{aligned} 2^X &= \{A \subset X : A \text{ is closed and nonempty}\}, \\ C(X) &= \{A \in 2^X : A \text{ is connected}\}, \\ C_n(X) &= \{A \in 2^X : A \text{ has at most } n \text{ components}\}, \\ F_n(X) &= \{A \in 2X : A \text{ has at most } n \text{ elements}\}. \end{aligned}$$

The hyperspace 2^X is metrized with the Hausdorff metric.

Given a hyperspace $\mathcal{H}(X)$, a model for $\mathcal{H}(X)$ is a more familiar space Y, where the elements of Y are points (instead of certain subsets of a continuum X) and such that Y is homeomorphic to $\mathcal{H}(X)$. The simplest model is the one constructed for the hyperspace $C([0,1]) = \{[a,b] : 0 \le a \le b \le 1\}$ which can be identified with the triangle $Y = \{(a,b) : 0 \le a \le b \le 1\}$ in the Euclidean plane. The number of hyperspaces that have a model is limited. In this talk we present most of the known models for hyperspaces, including some new ones recently constructed.

Speaker: **Marcus Marsh**, CSU, Sacramento
Title: Constructing Hausdorff spaces with the fixed point property.

Abstract: (Joint work with J. Prajs.) Many basic topological constructions do not preserve the fixed point property (fpp). For example, the fpp is not preserved under product, cone, and quotient constructions. We introduce a construction that yields a connected Hausdorff space that need not be compact. We call these spaces *brush spaces* and show that if the "building block" spaces have the fpp, then the resulting brush space will have the fpp. These spaces include dendrites, generalized Alexandroff-Urysohn squares as defined by Hagopian and Marsh, and many particular spaces such as the harmonic comb, the Cantor fan, and the Warsaw circle.

Speaker: **Chris Mouron**, Rhodes College
Title: Monotone equivalence of dendrites

Abstract: A *dendrite* is a locally connected, uniquely arcwise connected, compact metric space. In this talk, I will discuss how to classify dendrites under monotone equivalence. A continuous function $f : X \longrightarrow Y$ is *monotone* if $f^{-1}(y)$ is connected for each $y \in Y$. We say that two dendrites X and Y are *monotone equivalent* if there exist monotone onto functions $f : X \longrightarrow Y$ and $g : Y \longrightarrow X$. A dendrite X is *monotonically isolated* if X being monotone equivalent to Y implies that X is homeomorphic to Y. In this talk I will discuss why the only monotonically isolated dendrites are one with a finite number of ramification (branch) points. Other consequences of this classification may also be discussed.

Speaker: **Ramin Naimi**, Occidental College
Title: Intrinsically knotted and linked graphs in S^3.

Abstract: A graph is called intrinsically knotted (linked) if every embedding of it in S^3 contains a nontrivial knot (link). In the early 1980's, Sachs, and independently, Conway and Gordon, showed that K_6, the complete graph on six vertices, is intrinsically linked. Conway and Gordon also showed that K_7 is intrinsically knotted. In 1995 Robertson, Seymour, and Thomas classified all intrinsically linked graphs by proving a conjecture of Sachs: a graph is intrinsically linked if and only if it contains as a minor K_6 or a graph obtained from K_6 by triangle–Y or Y–triangle moves. Intrinsically knotted graphs have so far resisted classification. We will start with the Conway and Gordon theorems and then go through a (partial) survey of old and recent results and some open questions in the field.

Contributed Talks

Speaker: **Ma. Elena Aguilera Miranda**, UNAM
Title: Small Whitney blocks

Abstract: Given a metric continuum X, let $C(X)$ be its hyperspace of subcontinua. Given a Whitney map $\mu : C(X) \to [0,1]$ and a number $t \in (0,1)$, $\mu^{-1}([0,t])$ is called a Whitney block, which is a subcontinuum of $C(X)$. In this talk we give some partial answers to the following questions:

1. Let P be a topological property. If a continuum X has property P, then do its Whitney blocks have property P?
2. If the Whitney blocks have a topological property, is it true that the space X has the same property?

Among others, we have considered the following properties: aposyndesis, contractibility, being an absolute neighborhood, having trivial fundamental group, unicoherence, the property of Kelley and the fixed point property.

Speaker: **Gerardo Acosta**, UNAM
Title: A class $\Omega(X)$ and the uniqueness of the continuum X.

Abstract: In this talk, given a continuum X, we consider a class $\Omega(X)$ of subcontinua of X that has been used to show that if Y is a continuum such that the hyperspaces $C(X)$ and $C(Y)$ are homeomorphic, then continua X and Y are homeomorphic as well.

Speaker: **Jamison Barsotti**, CSU, Chico
Title: Intrinsic Knotting of graphs on 9 vertices.

Abstract: We give an overview of a project to describe the intrinsically knotted graphs on 9 vertices.

Speaker: **Mauricio Esteban Chacon Tirado**, UNAM
Title: Large Order Arcs

Abstract: Given a metric continuum X, let $C(X)$ be the hyperspace of subcontinua of X. A Large Order Arc (LOA) in $C(X)$ is a subcontinuum of $C(X)$ such that A is an arc joining an element of the form $\{x\}$ (x in X) to X and satisfying that if B,C are elements of A, then B is a subset of C or C is a subset of B. Let LOA(X) be the space of all LOA in $C(X)$, considered as a subspace of $C(C(X))$. For a given x in X, let LOA(x, X) be the subspace of LOA(X) consisting of all LOA in $C(X)$ that contain $\{x\}$. In this talk we present some results on LOA(X) and LOA(x, X), for example, LOA(x, X) always is either a singleton or a Hilbert cube. We study some properties of X that LOA(X) inherits.

Speaker: **David Crombecque**, Gettysburg College
Title: Nonorientable contact structures on 3–manifolds

Abstract: A contact structure on a 3–dimensional manifold is a smooth distribution of planes which is nowhere integrable. There is a dichotomy between TIGHT and OVERTWISTED contact structures. While overtwisted structures are well understood, the study of tightness from a 3–dimensional perspective is still at its early stage and tight contact structures carry topological information on the ambient manifold. In most studies, contact structures are always considered orientable. (a contact 3–manifold is always orientable, but its contact structure does NOT have to be). It is often thought that if one has to deal with a nonorientable structure, one may work with its orientation double cover. Our motivation is to realize that one cannot merely switch to the orientation double cover when studying tightness. In this talk, we will get introduced to the world of contact geometry and we will see some examples of nonorientable tight contact structures which have an overtwisted orientation double cover.

Speaker: **Yusuf Z Gurtas**, C.U.N.Y.
Title: Mapping Class Groups and Lefschetz Fibrations

Abstract: In this talk we will present how a two dimensional phenomenon is linked to a four dimensional one, namely, Mapping Class Groups of two dimensional closed, oriented, compact surfaces and 4–dimensional Symplectic Manifolds. Classifying 4–manifolds is a long lasting problem, perhaps ever lasting. Even classification of the symplectic ones is far from being complete. In that category, however, 4–manifolds (after perhaps some blow-up) present themselves as Lefschetz Fibrations due to a magnificent theorem of S. Donaldson in the '90's of the last century. Earlier R. Gompf had proven that (Chiral) Lefschetz Fibrations carry symplectic structure. Therefore studying Mapping Class Groups gives us answers to some questions in classification of Symplectic 4–manifolds. We will demonstrate how Mapping Class Groups come into the play in that seemingly unrelated question of classifying symplectic 4–manifolds.

Speaker: **Hamid Mottaghi Golshan**, Islamic Azad University, Iran
Title: Note on Best Approximation in Fuzzy and Intuitionistic Fuzzy Metric Spaces

Abstract: (Joint with Manochehr Kazemi and Hassan Naraghi.) In this paper we introduce and extend some notions of Veeramani (2001) and Vaezpour and Karimi (2008). Also we introduce a notion of t–best approximatively compact sets in intuitionistic fuzzy metric spaces. We also introduce t–best approximation points, t–proximinal sets and t–boundedly compact sets. The results obtained in this paper are related to the corresponding results in metric spaces and fuzzy metric spaces and fuzzy normed space.

Speaker: **Charles Hagopian**, CSU, Sacramento
Title: Fixed points of composant–preserving maps in tree–like continua

Abstract: Every composant-preserving map of an indecomposable k–junctioned tree-like continuum has a fixed point [1]. Marcus M. Marsh, Janusz R. Prajs and I constructed an indecomposable tree–like continuum that admits a fixed–point–free composant–preserving homeomorphism. This continuum contains copies of Bellamys second tree–like continuum without the fixed–point property. It is not known if every planar tree–like continuum has the fixed-point property for composant–preserving maps.

[1] C. L. Hagopian, Fixed-points in indecomposable k–junctioned tree–like continua, Proc. Amer. Math. Soc. 138 (2010), 1511-1515.

Speaker: **Sophy Huck**, CSU, Chico
Title: Intrinsic knotting of bipartite graphs

Abstract: (Joint work with A. Appel, M-A. Manrique, and T. Mattman.) We further identify and categorize intrinsically knotted bipartite graphs. We are motivated by a conjecture that a bipartite graph with $E \geq 4V-17$ is intrinsically knotted. We verify the conjecture for graphs that have exactly six vertices (respectively seven) in one part and at least six (resp. exactly seven) in the other. We also provide similar bounds for all bipartite graphs.

Speaker: **Slaven Jabuka**, UN, Reno
Title: Cosmetic surgeries and Heegaard Floer homology

Abstract: For about 5 decades, it has been known that every closed, oriented 3–manifold Y can be obtained by Dehn surgery on a framed link. The framed link describing Y is highly non-unique but the relation between the different framed links yielding Y, is well understood. This non-uniqueness phenomenon persists if one restricts to framed knots, showing that any notion of uniqueness of obtaining Y via Dehn surgery, calls for even more stringent restrictions. Such restrictions are the content of the "Cosmetic Surgery Conjecture" by which Y cannot arise as two different surgeries on the same nontrivial knot K. Said differently, the surgery slope for nontrivial knot K yielding a specific 3–manifold Y, is unique.

This conjecture has been verified in some special cases. The talk will discuss these and present some new results in this direction, obtained by an application of Heegaard Floer homology.

Speaker: **Hidefumi Katsuura**, San Jose State University
Title: Tetrahedra and spheres

Speaker: **Steven Leth**, University of Northern Colorado
Title: An example of the use of nonstandard methods in continuum theory

Abstract: In this talk I will outline some ways in which a nonstandard approach can give insight into topological problems in the plane. The result in the theorem below was obtained by nonstandard methods, i.e. by working in a set constructed using ultrafilters in which there are "infinitesimals."

Definition 1 *If a_1 and a_2 are two points in the plane and A is an arc we write $A[a_1, a_2]$ for the subarc of A from a_1 to a_2. If S is a simple closed curve in the plane we will write V_S for the bounded region whose boundary is S.*

*If $\delta > 0$ we will say that a set A in the plane contains a **sizeδ Y-set** if there exist four points a, b, c, and x in A, and arcs C_{ax},C_{bx}, and C_{cx} in A intersecting only at x from a to x, b to x, and c to x, respectively, such that none of the points a,b, or c are within δ of any point on the arcs joining the others to x (thus, for example, no point of C_{ax} is within distance δ of b or c).*

We will say that a set in the plane is δ-chainable if it can be covered by a chain with mesh less than δ.

Theorem 1 *Let E be a non-separating plane continuum that contains a simple dense canal, and let C be an infinite arc in the complement of E with the property that $\overline{C} - C = E$ and for every $\varepsilon > 0$ there exists a point p on C such that all points on the arc beyond p are on a transverse cross cut of distance less than ε. Then for any $\delta > 0$ there exist points p_1 and p_2 on C, and an arc of a circle A, such that $C[p_1, p_2]$ together with $A[p_1, p_2]$ forms a simple closed curve S that is within δ of every point in E and is such that V_S contains no size δ Y-set.*

There are natural nonstandard conditions that guarantee that certain sets in the nonstandard plane cannot contain a size δ Y-set unless δ is infinitesimal, and the theorem above is one standard result that follows from this. There is strong reason to believe that these same conditions actually guarantee that such sets are δ-chainable for some infinitesimal-sized δ. If so the conclusion of the theorem above can be improved from "contains no size δ Y-set" to "is δ-chainable."

Speaker: **Sergio Macias**, UNAM
Title: Sharing hyperspaces

Abstract: A continuum is a nonemtpy compact, connected, metric space. A continuum is decomposable if it can be written as the union of two of its proper subcontinua. A continuum is indecomposable if it is not decomposable. Given a continuum X, we consider its hyperspace of subcontinua defined as:

$$C(X) = \{A|A \text{ is a subcontinuum of } X\}$$

topologized with the Hausdorff metric. Professors Eberhart and Nadler gave an example of two continua X and Y such that X is indecomposable, Y is decomposable and $C(X)$ is homeomorphic to $C(Y)$. We present sufficient conditions in order that this does not happen.

Speaker: **Veronica Martinez de la Vega y Mansilla**, UNAM
Title: Maximal dendrites embedded in locally connected continua

Abstract: We show which dendrites can be embedded in locally connected continua with dimension greater or equal to 2. And we talk about the applications of these results.

Speaker: **Gabriel Maybrun**, CSU, Chico
Title: 2–bridge knot boundary slopes: diameter and genus

Abstract: (Joint with T. Mattman and K. Robinson.) We prove that for 2–bridge knots, the diameter, D, of the set of boundary slopes is twice the crossing number, c. This constitutes part of a proof that, for all Montesinos knots in S^3, $D \leq 2c$. In addition, we characterize the 2–bridge knots with four or fewer boundary slopes and show that they each have a boundary slope of genus two or less.

Speaker: **Van Nall**, University of Richmond
Title: Inverse limits with set valued functions and connectedness.

Abstract: An inverse limit with n–dimensional connected factor spaces and continuous single valued bonding maps is an n–dimensional continuum. On the other hand, there are very simple set valued interval maps with connected graphs whose inverse limit is not connected. We concentrate on methods for constructing the graph of a set valued function that assure that the inverse limit will be connected.

Speaker: **Hamed M. Obiedat**, The Hashemite University, Jordan
Title: On types of connectedness and some of their applications

Abstract: We present several types of connected spaces and concentrate on those unfamilier types of connectedness and some of their applications. For example, we discuss α–connected spaces, by which, we introduce the degree of connectedness of such spaces. Moreover, we introduce new types of connectedness; we call them linearly connected and locally α–connected spaces.

Speaker: **Janusz Prajs**, CSU, Sacramento
Title: Generalized continuous invariants

Abstract: In this talk we discuss some ideas and open questions related to generalized continuous invariants. A generalized continuous invariant is a property P such that if two spaces, X and Y, have continuous surjections $f : X \to Y$ and $g : Y \to X$, and X satisfies P, then Y satisfies P.

Speaker: **Anastasiia Tsvietkova**, University of Tennesee, Knoxville
Title: Hyperbolic structures on alternating link complements

Abstract: As a result of Thurston's Hyperbolization Theorem, many 3-manifolds have a hyperbolic metric or can be decomposed into pieces with hyperbolic metric (W. Thurston, 1978). In particular, Thurston demonstrated that every knot in S^3 is a torus knot, a satellite knot or a hyperbolic knot and these three categories are mutually exclusive. It also follows from work of Menasco that an alternating link represented by a prime diagram is either hyperbolic or a $(2, n)$-torus link.

The method for describing the hyperbolic structure of hyperbolic links was suggested by M. Thistlethwaite. Although the method is applicable to all hyperbolic links, it works particularly well for alternating links. The talk will introduce the method. Hyperbolic structures may be computed by hand only in the simplest examples and computer calculations are essential for systematic study. That is why we implemented a C++ program and will demonstrate a few examples. Further original applications of this method, such as an algorithm for computation of hyperbolic volume, will also be discussed if time allows.

Speaker: **Ryan Watson**, CSU, Chico
Title: Analysis of Connected Graphs on 9 Vertices with H_8 and A_9 Minor

Abstract: Let H_8 and A_9 denote graphs obtained from K_7 and $K_{3,3,1,1}$ by a single Δ–Y move. As the complete graphs are intrinsically knotted (IK), the same is true of H_8 and A_9 as well as any graph that contains either of these as a minor. We give an analysis of connected graphs on 9 vertices with H_8 or A_9 minor.

Speaker: **Svetoslav Zahariev**, C.U.N.Y.
Title: Transferring Curved A_∞–Structures and Simplicial Chern-Weil Theory

Abstract: (Joint with Nikolay M. Nikolov.) A curved A_∞–algebra is a non–associative generalization of the notion of a curved differential graded algebra. I will discuss how curved A_∞–algebras arise as deformations of A_∞–algebras and how the former structures can be transferred along chain contractions using homological perturbation theory. As an example, given a vector bundle on a Lipschitz manifold M, I shall exhibit a natural curved A_∞–structure on the complex of matrix-valued cochains of any fine enough triangulation of M. (Recall that every topological manifold of dimension different than 4 admits a Lipschitz structure.) I will use this curved A_∞–structure to develop a simplicial version of Chern- Weil theory on triangulated, not necessarily smooth, topological manifolds.