

11th Chico Topology Conference & 40th Cascade Topology Seminar
Titles and Abstracts

Invited Speakers

Speaker: **Tullia Dymarz**, Yale University

Title: Large scale geometry of certain solvable groups.

Abstract: Finitely generated groups can be viewed as metric spaces when endowed with a word metric, which is unique up to quasi-isometry. A group theoretic property is said to be geometric if it is invariant under quasi-isometries. Gromov initiated a program of investigating which algebraic properties of finitely generated groups are geometric, by showing that (virtual) nilpotence is a geometric property. Recently, Eskin-Fisher-Whyte conjectured that being (virtually) polycyclic is also a geometric property and developed tools to approach this problem. I will give a proof of quasi-isometric rigidity for one class of polycyclic groups. This will involve, among other things, ideas from hyperbolic geometry and quasiconformal analysis.

Speaker: **Jim Hoste**, Pitzer College

Title: On the partial ordering of 2-bridge knots.

Abstract: A partial ordering of knots in the 3-sphere is given by declaring K greater than or equal to J if the fundamental group of the complement of K maps onto the fundamental group of the complement of J , preserving peripheral structure. In the case of 2-bridge knots, Ohtsuki, Riley and Sakuma exhibit a construction that, for a given knot J , will produce infinitely many knots K with K greater than or equal to J . It has been shown by Gonzalez-Acuna and Ramirez that this construction creates all possibilities when J is also a torus knot. If the Ohtsuki construction produces all possibilities for all 2-bridge knots, then it appears that (non-torus) 2-bridge knots with small numbers of distinct boundary slopes must be minimal, that is, only greater than the unknot. We prove this is true for 2-bridge knots with three distinct boundary slopes. This is joint work with Tomasz Przytycki and Pat Shanahan.

Speaker: **Slaven Jabuka**, University of Nevada, Reno

Title: The slice-ribbon conjecture for 3-stranded pretzel knots

Abstract: The slice-ribbon conjecture is a classical problem in knot theory which asserts that every smoothly slice knot is ribbon. While this conjecture goes back to at least the 1960s, the first substantial progress has only been made in 2006 when P. Lisca solved the conjecture for 2-bridge knots using tools from 4-dimensional gauge theory.

The talk will present an extension of both Lisca's results and his techniques and explain how they can be used to prove the slice-ribbon conjecture for 3-stranded pretzel knots. In parallel, we find new obstructions for certain Seifert fibered 3-manifolds to bound a rational homology 4-ball. The presented results are joint work with Josh Greene.

Speaker: **Sergio Macias**, UNAM

Title: On Continuously Irreducible Continua

Abstract: A continuum is a nonempty, compact, connected metric space. A continuum X is indecomposable provided that every time X is written as the union of two subcontinua A and B , either $A = X$ or $B = X$. A continuum X is irreducible if there exist two points p and q of X such that no proper subcontinuum of X contains both p and q . A continuum X is of type lambda if X is irreducible and every indecomposable subcontinuum of X has empty interior. We study a special kind of type lambda continua called continuously irreducible continua.

Speaker: **Piotr Minc**, Auburn University

Title: Nontrivial loops and inverse limits of trees.

Abstract: Since every loop in a tree is trivial (homotopic to a constant), the fundamental groups are not very useful in studying properties of tree-like continua (inverse limits of trees). Yet, the collection of loops near a tree-like continuum can be quite rich and complex. To see that complexity we must relax our definition of

what is nontrivial to include loops that cannot be factored (or, more precisely, ϵ -factored) through an arc. We show that under this approach, some tree-like continua, including the Ingram continuum, are similar to solenoids and other not pointed 1-movable continua.

Speaker: **Janusz Prajs**, CSU, Sacramento

Title: Semi-terminal continua in Kelley spaces II

Abstract. This is a continuation of the study of semi-terminal continua recently introduced in my talk at the 2008 Spring Topology and Dynamics Conference. Using semi-terminal subcontinua, I will present new structural results on Kelley continua. Among these results, there are two decomposition theorems for Kelley continua. One of these theorems is an improved version of the aposyndetic decomposition theorem for Kelley continua.

Speaker: **Jennifer Schultens**, UC, Davis

Title: Width complexes for knots and 3-manifolds

Abstract: We define the width complex of a knot and of a 3-manifold. The width complex of a knot encodes distinct embeddings of a knot. It is connected but not, for instance, locally finite. Similarly, the width complex of a 3-manifold encodes distinct handle decompositions of a knot and it too is connected but not locally finite.

Contributed Talks

Speaker: **Robbie Beane**, Missouri University of Science and Technology

Title: Inverse limits of continua with upper semi-continuous set-valued bonding functions

Abstract: We will discuss connectedness in inverse limits with set-valued functions, and provide a new sufficient condition for such an inverse limit to produce a continuum.

Speaker: **Harold Bell**

Title: Prime ends as channels.

Abstract: Let A be a compact subset of the plane C . $T(A)$ denotes the union of A and the bounded complementary domains of A . If x is in C/A then $St(x, A)$ is defined to be the union of all half open intervals $[x, a)$ such that a is a nearest point to x in A . If A is a continuum and x, y are in $C/T(A)$ then we say $x \leq y$ if x is in $T(St(y, A) + A)$. Any subset of $C/T(A)$ that is maximally ordered by \leq is called a channel.

Speaker: **Bill Breslin**, UC, Davis

Title: Curvature bounds for Heegaard surfaces in hyperbolic 3-manifolds

Abstract: Given a Heegaard splitting of a hyperbolic 3-manifold, how much can it be flattened via isotopy? We use thick geodesic triangulations and normal surface theory to show that if the Heegaard surface is strongly irreducible, then it is isotopic to a surface with principal curvatures bounded in absolute value by a fixed constant. The constant depends on neither the surface nor the ambient 3-manifold.

Speaker: **Włodzimierz J. Charatonik**, Missouri University of Science and Technology

Title: Pseudo-contractibility

Authors: Włodzimierz J. Charatonik and Janusz R. Prajs

Abstract: A continuum X is called pseudocontractible if there are a continuum T , two points t_0, t_1 in T , point p in X and a continuous function $H : X \times T \rightarrow X$ such that $H(x, t_0) = x$ and $H(x, t_1) = p$ for all x in X .

We will show basic facts about pseudo-contractible continua, for example that they have trivial shape; we will discuss connections of pseudo-contractibility to various versions of connectedness of the space of continuous functions from X into itself, and we will demonstrate some conditions that imply non-pseudocontractibility.

Speaker: **Daniel DeWoskin**, San Francisco State University

Title: Predicting Cancer Patient Prognosis from CGH Profiles Using Algebraic Homology

Abstract: The Array Comparative Genomic Hybridization (CGH) method generates a full picture of an individual's genome. The multidimensional nature of this data, however, has not been fully explored. Current methods for CGH analysis focus on specific markers, but deeper understanding can be gained by examining overall genomic instability in entire chromosomes. I will discuss a novel method for characterizing CGH profiles mathematically using algebraic homology, specifically looking at the betti numbers of a surface generated from breast cancer patient CGH profiles. This model is able to distinguish between frequency of cancer recurrence in chemotherapy and non-treated patient populations.

Speaker: **Elizabeth Gasparim**, UC, Berkeley

Title: Topology of Moduli Spaces

Abstract: Topological data of moduli spaces has fundamental applications in mathematical physics. I will present some new results on topology of moduli spaces of vector bundles, together with their consequences in mathematical physics.

Speaker: **Alejandro Illanes**, UNAM

Title: Whitney Determined Continua

Abstract: A continuum is a compact, connected metric space. Two continua X and Y are Whitney equivalent if each positive Whitney level for $C(X)$ is homeomorphic to a positive Whitney level for $C(Y)$ and vice versa. A continuum X is said to be Whitney determined provided that the following implication holds: if X and Y are Whitney equivalent, then X and Y are homeomorphic. In this talk we present several classes of continua whose elements are Whitney determined.

Speaker: **Hidefumi Katsuura**, San Jose State University

Title: Arcs, Squares, and Cubes

Abstract: I will talk on peculiar geometric properties of these objects.

Speaker: **Steven La Fleur**, UN, Reno

Title: The Configuration Space and Pure Braid Groups of the 2-Torus

Abstract: Braid groups have many applications in the study of knots, links and topological manifolds as well as other areas of mathematics such as dynamical systems. We study the pure (or colored) braid groups on the 2-torus and present a geometric interpretation of the group which we then use to calculate a presentation of the pure 2-braid group as an extension of the fundamental group of the 2-torus. To accomplish this, we use the Fadell-Neuwirth exact sequence as well as an algebraic result to show that the pure 2-braid group of the torus is isomorphic to $\pi_1(F_2(T^2), (x_1, x_2))$ where $F_2(T^2)$ is the second configuration space of the 2-torus. The proof is constructive, and using a method similar to Jiang, we calculate the relations for the 2-braid group on the 2-torus and the precise number of generators and relations on the general n -braid group on the 2-torus, as well as the k -punctured 2-torus.

Speaker: **Wayne Lewis**, Texas Tech University

Title: Composants of the Pseudo-Arc

Abstract: We present some observations on the structure of composants of the pseudo-arc.

Speaker: **Fabiola Manjarrez-Gutierrez**, UC, Davis

Title: Knot exteriors and circular handle decompositions

Abstract: A circle-valued Morse function on the knot complement $C_K = S^3 \setminus K$ is a function $f : C_K \rightarrow S^1$ which is Morse and behaves *nicely* in a neighborhood of the knot. Such a function induces a handle decomposition on the knot exterior $E(K) = S^3 \setminus N(K)$, with the property that every regular level surface contains a Seifert surface for the knot. In this talk we will discuss nice properties that can be obtained from such a decomposition.

Speaker: **Verónica Martínez de la Vega**, UNAM

Title: Space of selections of Smooth Fans.

Authors: Mauricio Chacón and Verónica Martínez de la Vega

Abstract: In 2001 R. McParland showed some properties of the space of selections of a dendrite. Following this research in 2007 R. Cauty showed that the space of selections of a dendrite is homeomorphic to the space L_2 . In this talk Mauricio Chacón and myself will show some properties of the space of selections of a smooth fan.

Speaker: **Christopher Mouron**, Rhodes College

Title: Finding necessary and sufficient conditions of a continuum to admit an expansive homeomorphism

Abstract: A homeomorphism $h : X \rightarrow X$ of a compactum X is *expansive* provided that for some fixed $c > 0$ and every $x, y \in X (x \neq y)$ there exists an integer n , dependent only on x and y , such that $d(h^n(x), h^n(y)) > c$. Recently it has been shown that if a circle-like continuum admits an expansive homeomorphism then it must be a solenoid. I will discuss how this can be generalized and improved.

Speaker: **Kei Nakamura**, UC, Davis

Title: The Girth-Alternative for Mapping Class Groups

Abstract: The girth of a finitely generated group G is defined to be the supremum of the girth of Cayley graphs of G over all finite generating sets. For many classes of groups satisfying some versions of the Tits-alternative, it turns out that the dichotomy between the groups with finite girth and the ones with infinite girth coincides with the dichotomy in the Tits-alternative. In particular, we show that a finitely generated subgroup G of a mapping class group is either a non-cyclic group with infinite girth or is a virtually free-abelian group.

Speaker: **Van Nall**, University of Richmond

Title: Inverse Limits with Set Valued Functions

Abstract: We will explore the possible continua that can be obtained as inverse limits of a single set valued function from an interval onto the subsets of the interval. Infinite dimensional sets are possible but no compact n -dimensional manifold can be obtained in this way.

Speaker: **Alice Stevens**, UC, Davis

Title: Knots in Heegaard surfaces for S^3

Abstract: Given a knot K in S^3 , I will define a notion of equivalence between embeddings of K in Heegaard surfaces for S^3 . I will then give conditions for two such embeddings to be equivalent.

Speaker: **Patrick Vernon**, Rhodes College

Title: Preimages of Chainable Continua

Abstract: It is simple to show that if X is an arc in the complex plane with one endpoint at the origin, and f is the map $z \mapsto z^n$, then the preimage of X under f is again an arc. This fact might lead us to believe that the preimage under f of any chainable continuum with the origin as an endpoint is also chainable. However, this is not the case. The speaker will provide a counterexample and discuss characteristics of preimages of chainable continua.

Speaker: **Eldon Vought**, CSU, Chico

Title: Density of Arc Components in Hereditarily Decomposable Plane Continua

Abstract: Let X be such a continuum with the property that whenever $X = A \cup B$, where A and B are proper subcontinua of X , either A or B is unicoherent. Then, whether X itself is or is not unicoherent:

1. X does not have two dense arc components.
2. If X is almost arcwise connected, then X has a dense arc component.

Speaker: **Luke Williams**, UN, Reno

Title: Obstructing sliceness in a family of Montesinos knots

Abstract: We consider a family of Montesinos knots with three rational tangles and ask the question of when such knots are smoothly slice. We analyze this question by employing a method recently used by Lisca for 2-bridge knots and Greene-Jabuka for 3-stranded pretzel knots. In their method one considers when the 2-fold branched cover of the knot and a natural plumbing 4-manifold bounded by the branched cover, embed into a smooth closed 4-manifold with diagonalizable intersection form. This obstruction leads to a concrete combinatorial problem, one which we completely solve in the said class of Montesinos knots.

Speaker: **Evan Wright**, Missouri University of Science and Technology

Title: Monotone hierarchy for dendrites.

Abstract: We may put a partial order on the class of all dendrites by saying that X is less than or equal to Y iff there is a monotone surjection from Y onto X . An open problem, and one that touches a number of other open problems, is whether this hierarchy contains any non-well-ordered chains or infinite antichains. By proving the equivalence of a subset of this hierarchy of dendrites to a hierarchy whose points are partial order types and whose order is that induced by order embeddings, we are able to answer this question in the negative for a large subclass of all dendrites.