STDC 2024 Book of Abstracts

Contents

Workshops & Panels

Continuum Theory

Geometric Topology

Plenary Talks

A classification of Hénon maps in the presence of strange attractors

Jan Boronski (*Jagiellonian University*)

In my talk I shall present my work with Sonja Štimac on Hénon maps with strange attractors (Wang-Young parameters). First I shall explain a construction (inspired by a work of Crovisier and Pujals on mildly dissipative diffeomorphisms of the plane) of conjugacy of these maps to the shift homeomorphisms on inverse limits of dendrites with dense set of branch points, and a characterization of orbits of critical points in terms of these inverse limits. Then I will explain how this leads to a classification of conjugacy classes of such maps in terms of a single sequence of 0s and 1s.

References:

1. Boronski J., Štimac S; Densely branching trees as models for Hénon-like and Lozi-like attractors, Advances in Mathematics 429 (2023) 109191
2. Boronski J., Štimac S; The pruning front conjecture, folding patterns and classification of Hénon maps in the presence of strange attractors, arXiv:2302.12568v2

The Semi-Simple Theory of Acylindricity in Higher rank

Talia Fernos (*UNC Greensboro*)

Acylindricity may be viewed as a generalization of being a uniform lattice in a locally compact second countable group. The theory of acylindrical actions on hyperbolic spaces has seen an explosion in recent years. Trees are of course examples of hyperbolic spaces, and by considering products, we start to see new and interesting behaviors that are not present in rank-1, such as the simple Burger-Mozes-Wise lattices, or Bestvina-Brady kernels. In a joint work with S. Balasubramanya we introduce a new class of nonpositively curved groups. Viewing the theory of S-arithmetic semi-simple lattices as inspiration, we extend the theory of acylindricity to higher rank and consider finite products of δ-hyperbolic spaces. The category is closed under products, subgroups, and finite index over-groups. Weakening acylindricity to AU-acylindricity (i.e. acylindricity of Ambiguous Uniformity) the theory captures all S-arithmetic semi-simple lattices with rank-1 factors, acylindrically hyperbolic groups, HHGs, and many others. In this talk, we will discuss structure theorems such as the Tits' Alternative. This structure allows us to give a partial resolution to a conjecture by Sela.

Old and new in diffeomorphisms of discs

Alexander Kupers (*University of Toronto, Scarborough*)

Discs are among the simplest manifolds, but their groups of diffeomorphisms can be very complicated. I will describe the geometric techniques that were used to understand these groups in low dimensions, their relationship to stable homotopy theory and number theory in high dimensions, and recent breakthroughs in understanding their homotopy type.

Continuum Dynamics

Van Nall (*University of Richmond*)

Many of us remember when the Spring Topology Conference became the the Spring Topology and Dynamics conference in part because continua theorists were finding so many things they wanted to work on in dynamics. Classical Interval Dynamics is now a mature field with hundreds of articles and many books. Years ago continua theorists with considerable inspiration from Devaney's accessible book began extending theorems in interval dynamics like the Sarkovski theorem to chainable continua, that is continua that are the inverse limit of interval functions. A favorite tool of continua theorists, inverse limits, have also been used in dynamical systems since whatever one might call the beginning.

Inspired by Ethan Akin our group has been constructing continua and functions at the same time that have a variety of dynamical properties using what we call Mahavier products, also known as an inverse limit with a set valued function. Akin would probably call what we are doing the dynamics of closed relations. The dynamics are those of shift maps. In other words we extend from the now classic topic of dynamics of shift maps on inverse limits with a single bonding map to continua that cannot be expressed as an inverse limit with a single continuous function on a simpler space like an arc or a tree or a circle, but can be expressed as an inverse limit with a single closed relation. Specifically in this talk we look at various ways to express the Cantor fan and the Lelek fan as a Mahavier products . We obtain transitive homeomorphisms, mixing homeomorphisms, with and without a dense set of periodic orbits and with zero or positive entropy. This is joint work with Iztok Banic, Judy Kennnedy, Chris Mouron, and Goran Erceg.

Tukey Reductions In Topology

Stevo Todorcevic (*University of Toronto*)

We shall give a brief survey of the already rich theory of Turkey reductions between directed sets. The emphasis will be given to application to set-theoretic topology with cardinal restrictions replaced by Tukey reductions.

Pseudo-Anosov Homeomorphisms

Yvon Verberne (*University of Western Ontario*)

The mapping class group is the group of orientation preserving homeomorphisms of a surface up to isotopy. In particular, the mapping class group encodes information about the symmetries of a surface. The Nielsen-Thurston classification states that elements of the mapping class group are of one of three types: periodic, reducible, and pseudo-Anosov. In this talk, we will focus our attention on the pseudo-Anosov elements, which are the elements of the mapping class group which mix the underlying surface in a complicated way. In this talk, we will discuss both classical and new results related to pseudo-Anosov mapping classes, as well as the connections to other areas of mathematics.

Semi-Plenary Talks

Counting in a mapping class group orbit of triangulations

Tarik Aougab (*Haverford College*)

We introduce the notion of a geodesic current with corners, a generalization of a geodesic current in which there are singularities (the "corners") at which invariance under the geodesic flow can be violated. Recall that the set of closed geodesics is, in the appropriate sense, dense in the space of geodesic currents; the motivation behind currents with corners is to construct a space in which graphs on S play the role of closed curves. Another fruitful perspective is that geodesic currents reside "at infinity" in the space of currents with corners, in the sense that their (non-existent) corners have been pushed out to infinity. As an application, we count triangulations in a mapping class group orbit with respect to length, and we obtain asymptotics that parallel results of Mirzakhani, Erlandsson-Souto, and Rafi-Souto for curves. This represents joint work with Jayadev Athreya.

Infinite dimensional Ramsey theory on homogeneous structures

Natasha Dobrinen (*University of Notre Dame*)

The Galvin-Prikry theorem states that Borel subsets of the Baire space are Ramsey. Silver extended this to analytic sets, and Ellentuck gave a topological characterization of Ramsey sets in terms of the property of Baire in the Vietoris topology. We present work extending these theorems to several classes of countable homogeneous structures. An obstruction to exact analogues of Galvin-Prikry or Ellentuck is the presence of big Ramsey degrees. We will discuss how different properties of the structures affect which analogues have been proved. Presented is work of the speaker for structures with SDAP^+ and joint work with Zucker for binary finitely constrained FAP classes. A feature of the work with Zucker is showing that we can weaken one of Todorcevic's four axioms guaranteeing a Ramsey space, and still achieve the same conclusion.

The problem of Nadler and Quinn on accessible points of arc-like continua

Logan Hoehn (*Nipissing University*)

Given a set X in the Euclidean plane $\mathbb{R}^2$ and a point $p \in X$, we say p is accessible if there exists an arc $A \subset \mathbb{R}^2$ such that $A \cap X = \{p\}$. This is an old and vital notion in plane topology and complex analysis, dating back to Schoenflies in the early 1900's.

For a given planar continuum X, in different embeddings of X in $\mathbb{R}^2$, the set of points of X which are made accessible may vary. One may ask, then, for a given point $p \in X$, does there exist an embedding φ of X into $\mathbb{R}^2$ for which $\varphi(p)$ is accessible, or is there some topological obstruction in X which forces p to be inaccessible in every embedding?

In 1972, Nadler and Quinn asked a question in this spirit: For any arc-like continuum X, and any point $p \in X$, does there exist an embedding φ of X into $\mathbb{R}^2$ for which $\varphi(p)$ is accessible? I will discuss some background for this problem, and describe our recent work in which we give an affirmative answer. This is joint work with Andrea Ammerlaan and Ana Anusic.

Some recent results on decomposable continua

Eiichi Matsuhashi (*Shimane University*)

This is a joint work with Benjamin Espinoza, Alejandro Illanes, Hayato Imamura and Yoshiyuki Oshima. In this presentation, we discuss some recent results on decomposable continua, in particular, Wilder continua, continuum-wise Wilder continua, closed set-wise Wilder continua, D-continua, D^*-continua and D^{**}. First, we introduce some basic definitions and terminology that are used in this talk. Then, we discuss results on the above continua related to Whitney properties and Whitney reversible properties. Also, we deal with product properties as for those continua. Finally, we show the existence of singular decomposable continua using those notion.

Metric big Ramsey degrees

Noé de Rancourt (*University of Lille*)

Distortion problems, from Banach space geometry, ask about the possibility of distorting the norm of a Banach space in a significant way on all of its subspaces. Big Ramsey degree problems, from combinatorics, are about proving weak analogues of the infinite Ramsey theorem in sets carrying structure. Both topics come back to the seventies and are still not well understood. While their motivations are quite disjoint, both problems share a surprisingly similar flavour.

In a ongoing work with Tristan Bice, Jan Hubička and Matěj Konečný, as a step forward towards the unification of those two topics, we developped an analogue of big Ramsey degrees adapted to the study of metric structures (metric spaces, Banach spaces...). Those metric big Ramsey degrees are compacts metric spaces which are invariants associated to certain monoid actions by isometry, quantifying their default of Ramseyness. We were able to prove the existence of big Ramsey degrees for certain classical metric structures and in some cases, to give an explicit description of them ; it also seems that some classical invariants from topological dynamics can be represented as big Ramsey degrees.

In this talk, I will present this theory, illustrate it on concrete examples (the Urysohn sphere and the Banach space ℓ^∞) and give an overview of its motivations and potential applications (to Banach space theory, Ramsey theory and dynamics).

Convex cocompactness: from hyperbolic geometry to surface homeomorphism

Jacob Russell (*Rice University*)

There is a long running and fruitful analogy between the mapping class group of a surface and the isometries of hyperbolic space. One responding example of this analogy is the parallel theory of convex cocompact subgroups in both settings. We will introduce the analogy between convex cocompact subgroups of the mapping class group and the isometry group of hyperbolic space, discuss the surprising consequences that convex cocompactness has for the geometry of surface bundles, and outline the major open questions remaining around this important analogy.

Parameter space of symmetric cubic polynomials

Nikita Selinger (*University of Alabama at Birmingham*)

Since the space of all cubic polynomials is (complex) two-dimensional and thus too difficult to comprehend, we study a one-dimensional slice of it: the space of all cubic symmetric polynomials of the form $f(z) = z^3 + \lambda^2 z$. Thurston has built a topological model for the space of quadratic polynomials $f(z) = z^2 + c$ by introducing the notion of quadratic invariant laminations. In the spirit of Thurston's work, we parametrize the space of cubic symmetric laminations and create a model for the space of cubic symmetric polynomials. This is a joint work with Alexander Blokh, Lex Oversteegen, Vladlen Timorin, and Sandeep Vejandla.

Breaking everything to cohere everything

Hiro Tanaka (*Texas State University*)

I will discuss how a better understanding of Morse theory on a point allows us to construct a roadmap to create stronger invariants in symplectic geometry, Morse theory, and Gromov-Witten theory. This is joint work with Jacob Lurie.

Leighton's Property of $X_{m,n}$

Maya Verma (*University of Oklahoma*)

In 1982, Leighton proved that any two finite graphs with a common cover admits a finite sheeted common cover. In this talk, I will introduce the combinatorial model $X_{m,n}$ for Baumslag-Solitar group $BS(m, n)$, and classify for which pairs of integers (m, n) the Leighton's theorem can be extended to the orbit space of covering actions on $X_{m,n}$.

Mapping class group of low complexity subshifts

Kitty Yang (*UNC Asheville*)

Given a subshift (X, σ), the mapping class group $\mathcal{M}(\sigma)$ is the group of self-flow equivalences of (X, σ), up to isotopy. For a minimal shift, there is an embedding $\mathrm{Aut}(X)/\langle\sigma\rangle \hookrightarrow \mathcal{M}(\sigma)$, where $\mathrm{Aut}(X)$ is the group of automorphisms.

If (X, σ) is conjugate to a primitive substitutive shift, then $\mathcal{M}(\sigma)$ is a finite extension of $\mathbb{Z}$, and under mild conditions, this finite group is precisely $\mathrm{Aut}(X)/\langle\sigma\rangle$.

We discuss more the general case when (X, σ) is a minimal subshift of linear complexity, subject to a technical condition, and give some examples.

This is joint work with Scott Schmieding.

Workshops & Panels

Panel: The future of topology and dynamics meetings and publications

Steven Clontz (*ScholarLattice*)

A panel of community members serving on the steering committees and editorial boards of the Spring Topology and Dynamics Conference series, the Summer Conference on Topology and its Applications series, and Topology Proceedings will discuss the state of their organizations and potential futures for our shared research infrastructure and community.

Workshop: Modeling topology research using the pi-Base

Steven Clontz (*University of South Alabama*)

To paraphrase Mary Ellen Rudin's review of Steen & Seebach's Counterexamples in Topology, topology is a dense forest of counterexamples, and a usable map of the forest is a fine thing. The pi-Base community database of topological spaces is an open-source database and web application that allows students and researchers to explore topological spaces, properties, and the theorems that connect them. Participants in this workshop will learn how to contribute to the pi-Base; in particular, students and their mentors are encouraged to join us to learn how engagement with the pi-Base community can reveal questions appropriate for student projects in general topology.

Workshop: Lean for topological spaces and manifolds

Jim Fowler (*The Ohio State University*)

Lean is a platform for writing proofs in a formal language that can be machine-checked for correctness. Mathlib is a library that contains a vast collection of mathematical theorems and definitions, including topological spaces and manifolds. Perhaps in the coming years, math papers will be expected to include formal proofs of their correctness. As a glimpse into this possible future, this talk includes a demonstration of Lean and will focus on examples drawn from topology. Participants interested in learning more will receive practical next steps.

Continuum Theory

Accessible points of arc-like continua

Andrea Ammerlaan (*Nipissing University*)

This talk will discuss the Nadler-Quinn problem. Posed in 1972, the problem asks if, given any arc-like continuum X and any point $x \in X$, we can embed X in the plane with x accessible. In 2001, Minc constructed a particularly simple example of an arc-like continuum X and point $p \in X$ for which it was not known whether p could be made accessible in a plane embedding of X. In 2020, Anusic proved that X can, in fact, be embedded with p accessible. I will give an overview of this proof and briefly introduce a more recent approach to the problem.

New embeddings of Knaster continuum in the plane

Ana Anusic (*Nipissing University*)

Given $n \in \mathbb{N}$, we show that there exists a planar embedding of Knaster continuum with n (fully) accessible composants. This answers a question of Debski and Tymchatin from 1993.

This is a joint work with Logan Hoehn.

Chaos and mixing homeomorphisms on fans

Goran Erceg (*University of Split*)

Mahavier products can be used to construct dynamical systems (X,f)(X,f)(X,f) where fff is a topologically mixing homeomorphism. Furthermore, for a given dynamical system (X,f)(X,f)(X,f) we define an equivalence relation on XXX and study quotients of dynamical systems. Using those results we produce on the Lelek fan and the Cantor fan a mixing homeomorphism as well as a mixing mapping, which is not a homeomorphism. And finally, an uncountable family of pairwise non-homeomorphic smooth fans that admit mixing homeomorphisms is constructed.

End-point-generated smooth fans

Rene Gril Rogina (*University of Maribor*)

We define end-point-generated smooth fans and give known examples. We also define combs and use them to answer previously open problems about specific Mahavier products and endpoint-generated smooth fans as well as construct an uncountable family of such fans. This is joint work with Will Brian of UNC Charlotte.

Hyperspaces of exactly n points

Alejandro Illanes (*Universidad Nacional Autonoma de Mexico*)

Given a topological space and a positive integer n, we consider the hyperspace $[X]^n$ of subsets of X with exactly n points. In this talk we discuss results we have obtained about the topological properties of $[X]^n$, such as: connectedness, arcwise connectedness, contractibility, existence of selections, spaces $[[0,1]]^n$, etc.

Inverse limits with Markov set-valued functions

Teja Kac (*University of Maribor*)

We introduce a new concept of Markov-type set-valued functions on trees allowing the graphs to be 222-dimensional. Additionally, we present Markov set-valued functions on compact metric spaces. We establish the conditions under which two inverse limits of inverse sequences of trees or compact metric spaces are homeomorphic. This is joint work with Iztok Banič and Matevž Črepnjak, both University of Maribor.

Cantor Sets and Topological Entropy for Set-valued Functions on Countable Domains

James Kelly (*Christopher Newport University*)

We characterize when an inverse limit of a set-valued function is a Cantor set. Given a set-valued function $F\colon X \to 2^X$, we define the set $D(F) = \bigcap_{n=1}^{\infty} F^n(X)$. It is known that $\varprojlim F = \varprojlim F|_{D(F)}$, so we only need to consider the $F|_{D(F)}$. When $D(F)$ is finite, $\varprojlim F$ is a shift of finite type, so we focus on the case where $D(F)$ is infinite, and we give a characterization for $\varprojlim F$ to be a Cantor set for this context. We go on to examine the entropy of a set-valued function on a countable domain and how that relates to the inverse limit being a Cantor set.

This includes joint work with L. Alvin and S. Greenwood.

Dendrites and path-homotopies

Curtis Kent (*Brigham Young University*)

In a one-dimensional space, any nullhomotopic loop factors through a dendrite. Analogously, we can say that two paths f and g, with the same endpoints, are equivalent if $f * \overline{g}$ factors through a loop in a dendrite, where $\overline{g}$ is the path g traversed backwards. We will show that the equivalence relation generated by this relation is the same as the path-homotopy and discuss its consequences.

This is joint work with Greg Conner, Jeremy Brazas, and Paul Fabel.

A class of 1-dimensional continua: Shape Theory meets Dynamics

Krystyna Kuperberg (*Auburn University*)

The notion of movability was introduced by K. Borsuk in 1967 as one of the basic notions in shape theory. A compactum X embedded in an absolute neighborhood retract (ANR), such as the Hilbert cube or the Euclidean space, is movable if for any neighborhood U of X there is a smaller neighborhood V of X such that V can be moved by a homotopy within U into any neighborhood W of X. Movability does not depend on the choice of the ANR or the embedding.

A continuum that is locally homeomorphic to the Cartesian product of the Cantor set and an open interval is called a lamination. In this talk we consider movable and non-movable laminations appearing as invariant sets in aperiodic continuous dynamical systems, as well as the flow around them and the larger 1-dimensional invariant compacta containing the laminations. A non-movable invariant lamination in a 3-dimensional Euclidean space is often contained in an invariant compactum that is movable.

Buried points of plane continua

David Lipham (*College of Coastal Georgia*)

Sets on the boundary of a complementary component of a continuum in the plane have been of interest since the early 1920's. Curry and Mayer defined the buried points of a plane continuum to be the points in the continuum which were not on the boundary of any complementary component. Motivated by their investigations of Julia sets, they asked what happens if the set of buried points is totally disconnected and non-empty. Curry, Mayer and Tymchatyn showed that in that case the continuum is Suslinian, i.e. it does not contain an uncountable collection of non-degenerate pairwise disjoint subcontinua. In an answer to a question of Curry et al, van Mill and Tuncali constructed a plane continuum whose buried point set was totally disconnected, non-empty and one-dimensional at each point of a countably infinite set. In this talk I will present proof that the van Mill-Tuncali example was the best possible in the sense that whenever the buried set is totally disconnected, it is one-dimensional at each of at most countably many points. I will also discuss a few related problems about plane continua and endpoints of dendroids.

This talk is based on joint work with Jan van Mill, Murat Tuncali, Ed Tymchatyn, and Kirsten Valkenburg.

Gehman Dendrite G_4 as Generalized Inverse Limit Spaces of Upper Semi Continuous Bonding Functions on $[0,1]$

Faruq Mena (*Soran University*)

In this talk we prove that the Gehman dendrite G_4 can be obtained as a generalized inverse limit space with a single upper semi-continuous bonding function on $[0,1]$. This answers a question of Farhan and Mena. Moreover, we find an uncountable family of inverse sequences on $[0,1]$ whose inverse limit spaces are homeomorphic to the Gehman dendrite G_4.

Commuting Maps of the Interval

Christopher Mouron (*Rhodes University*)

Let $f, g : [0,1] \longrightarrow [0,1]$. We say that f and g commute if $f(g(x)) = g(f(x))$ for all $x \in [0,1]$. Maps f, g that strongly commute when $f^{-1} \circ g = g \circ f^{-1}$. In this talk, I will discuss questions and solutions about strongly commuting maps of the interval $[0,1]$. From here, I will discuss applications of this to entropy and fixed point theory.

On open and monotone mappings

Lex Oversteegen (*University of Alabam at Birmingham*)

In 1972 A.R. Stralka asked if every open and monotone retraction from a dendroid to an arc is the identity map. In this talk we will review some old results, including a solution to this problem, and connect these results to more recent developments.

Inverse Limits of Finite Path Graphs

Hayley Pavlis (*Auburn University*)

The author defines the graph topology for finite graphs. We discuss the properties of a continuous map between graphs and properties of a traditional inverse limit of graphs. Most importantly, that a traditional inverse limit of finite path graphs is non-Hausdorff. We introduce a generalized inverse limit, where the first space is a metric arc and all other spaces are finite path graphs. Using the Bucket Handle continuum as an example, a technique is shown for constructing a generalized inverse limit, where the first space is a metric arc and the others are finite path graphs, that is homeomorphic to a traditional inverse limit of Hausdorff arcs.

Using crooked chains, we construct and analyze a non-Hausdorff hereditarily indecomposable continuum. This continuum has some interesting properties, which will be discussed. Ongoing research is discussed and open problems stated.

Projective Fraïssé limits of trees with confluent epimorphisms

Robert Roe (*Missouri University of Science & Technology*)

An earlier version of this article had a error in the proof that monotone epimorphisms of finite trees amalgamated. In this talk we will show an example of finite trees that do not amalgamate with monotone epimorphisms. Further, we show how we can use a subfamilies of the family of monotone epimorphisms, that we call simple-monotone and simple*-monotone, to obtain results similar to those in the original paper. We also show the new result that the topological realization of the projective Fraïssé limit of the family of finite trees with simple*-confluent epimorphisms is the Mohler-Nikiel dendroid.

This is joint work with W.J. Charatonik, A. Kwiatkowska, and S. Yang.

Non-metric Hereditarily Indecomposable Continua

Michel Smith (*Auburn University*)

The author has shown techniques for producing non-metric hereditarily indecomposable continua. Examples are presented. However, attempts to generalize metric construction techniques yield situations in which hereditary indecomposability implies metrizability. We review the author's recent results regarding such situations. Open problems in the area are stated.

The hyperspace of non-cut subcontinua of graphs and dendrites

Jorge Vega (*Benemérita Universidad Autónoma de Puebla*)

We give conditions under which the Vietoris hyperspace of non-cut subcontinua is compact, connected, locally connected or totally disconnected for graphs and dendrites. Also, we show that for a dendrite whose set of endpoints is dense this hyperspace is homeomorphic to the Baire space of irrational numbers.

Dynamical Systems

Fixed point portraits for laminations of the unit disc

Md Abdul Aziz (*University of Alabama at Birmingham*)

Laminations are a combinatorial and topological model for studying the Julia sets of complex polynomials. Every complex polynomial of degree d has d fixed points, counted with multiplicity. From the point of view of laminations, at most d-1, of these fixed points are peripheral (approachable from outside the Julia set of the polynomial). Hence, at least one of the d fixed points is "hidden" from the laminational point of view. The purpose of this study is to identify, classify and count the possible fixed point portraits for any lamination of degree d. We will identify the "simplest" lamination for a given fixed point portrait and will show that there are polynomials that have these simplest laminations. An application of fixed point portraits is to establish a correspondence between locally unicritical laminations and locally maximally critical laminations with rotational polygons. This application is a joint work with Brittany E. Burdette.

Realisation of Choquet simplices on manifolds

Sejal Babel (*Jagiellonian University*)

It is well known that the set of invariant measures of a topological dynamical system is a non-empty metrisable Choquet simplex. In 1991, Downarowicz proved that all such simplices arise as the sets of invariant measures of a class of minimal subshifts. Hence, one can ask the following question: which non-empty Choquet simplices can be realised as the sets of invariant measures for minimal homeomorphisms on manifolds? In the case of one-dimensional manifolds, we observe that the geometry of manifolds restricts the available dynamics. In my talk, I will discuss which measurable dynamical system can be realised as a minimal homeomorphism on a manifold. This will answer the question of realisation of Choquet simplex on manifolds of higher dimension.

I will also talk about necessary and sufficient conditions for an ergodic measure in Choquet simplex to have a discrete spectrum. The criterion is imposed on generic points of such a measure.

The talk is based on the results obtained in joint works with Melih Emin Can, Jernej Činč, Till Hauser, Dominik Kwietniak, and Piotr Oprocha.

Forcing among mixing patterns of triods

Sourav Bhattacharya (*VNIT Nagpur*)

We use rotation theory to deduce an order among periods of mixing patterns of some maps of triods.

Dynamics of rotated odometers

Henk Bruin (*University of Vienna*)

We study a family of infinite interval exchange transformations on the unit interval emerging from compositions of the Von Neumann-Kakutani map (dyadic odometer) with rational rotations (or more generally permutations of equal-length intervals. Hence the name "rotated odometers". By means of renormalization (similar to Rauzy-Veech induction) we cam translate the problem into one on symbolic substitutions, and determine the dynamic and ergodic structure of these rotated odometers.

This is joint work with Olga Lukina

Laminations to Julia Sets

Brittany Burdette (*Lander University*)

This talk will discuss a method of finding Julia sets from particular laminations. We use Mathematica and Matlab to model and solve a system of equations that represent the lamination in order to find the unique corresponding Julia set. Issues surrounding this method will also be discussed.

Interval maps with dense periodicity

Jernej Cinc (*ICTP Trieste & University of Maribor*)

This talk is based on a recent study of the class of interval maps with dense set of periodic points CP and its closure $\overline{CP}$ equipped with the metric of uniform convergence where we proved the following results:

1. $\overline{CP}$ is dynamically characterized as the set of interval maps for which every point is chain-recurrent.

2. Topological exactness (or leo property) is attained on the open dense set of maps in CP.

3. Every second category set in both CP and $\overline{CP}$ contains uncountably many conjugacy classes.

Based on a joint work with Jozef Bobok (CVUT Prague), Piotr Oprocha (AGH Krakow) and Serge Troubetzkoy (Aix Marseille).

Adic systems associated to multivariable polynomials

Sarah Frick (*Furman University*)

In this talk we will discuss adic systems on Bratteli diagrams associated to multivariable polynomials. While these diagrams are not stationary, they exhibit a self-similar structure that can be used to understand any resulting adic system. In particular, the structure alone implies the diagram is inherently expansive. Further, any diagram with multivariable polynomial shape will also be inherently expansive.

Counting Preimage Laminations

Forrest Hilton (*University of Alabama at Birmingham*)

A lamination L is a closed set of chords of the unit disk so that no two chords intersect in the open disk. A lamination is d-invariant under the degree d covering map $\sigma_d : S \to S$ of the unit circle if it is forward invariant (for any chord ab in L the chord $\sigma(a)\sigma(b)$ is also in L). In this talk we will discuss properties of d-invariant laminations that all contain a given forward invariant subset P of chords (for example a given periodic chord).

We count possible preimage laminations for n steps. i.e. the number of laminations that have a particular P as their σ_d^n image. In contrast to most laminations research, we do not specify critical cords (i.e., chords ab so that $\sigma(a) = \sigma(b)$).

We define what laminations should be included in our count. Particularly, we exclude critical and degenerate leaves from our laminations because they make the count immediately infinite. We also insist that each of the counted laminations are maximal, to avoid confluence, and have adequately many chords with the same image.

This class of laminations has the added advantage that they are all realized by complex polynomials of degree d, giving us some hope that we can use our combinatorial model to assemble a model of polynomial parameter space. It is clear in the degree 2 case that the laminations which we generate in our count correspond to limbs outside the molecule of the connectedness locus, with exactly one exception for each n.

Metrical limit theorems for maximal digits in complex continued fraction expansions

Maxim Kirsebom (*Universtiy of Hamburg*)

Continued fractions have long been an object of interest to both number theorists and dynamicists. In the 1970's and 80's great progress was made on understanding metrical properties of continued fractions, i.e. measure-theoretic properties. A particular focus was on the the maximal digits of continued fractions and their properties. In this talk I will discuss some of these results including an extreme value law proved by Galambos and a Poisson Law by Iosifescu. I will also discuss some recent developments in the field, primarily generalisations of these results to complex continued fractions.

Amorphic complexity and tameness of automatic systems

Elzbieta Krawczyk (*Jagiellonian University*)

Amorphic complexity is a relatively new invariant of dynamical systems useful in the study of aperiodic order and low complexity dynamics. Tameness is a well-studied notion defined in terms of the size of the Ellis semigroup of the system. In the talk we will study amorphic complexity and tameness in the class of automatic systems (systems arising from constant length substitutions). We will present a closed formula for the complexity of any automatic system and show that tameness of automatic systems can be succinctly characterised using amorphic complexity: an automatic system is tame if and only if its amorphic complexity is one. The talk is based on a joint work with Maik Gröger.

Uniform enveloping semigroupoids

Henrik Kreidler (*University of Wuppertal*)

Enveloping semigroups, introduced by Robert Ellis, are a useful tool in topological dynamics which allows to describe the behavior of systems (equicontinuity, distality, ...) in terms of properties of a topological-algebraic structure. Based on this idea, we discuss ”enveloping semigroupoids” in this talk and how they can be used to study structured extensions in topological dynamics and ergodic theory. This is based on joint work with Nikolai Edeko, Patrick Hermle and Asgar Jamneshan.

The conjugacy problem for Cantor minimal systems

Phillipp Kunde (*Jagiellonian University*)

A fundamental theme in dynamics is the classification of systems up to appropriate equivalence relations. For instance, the equivalence relation of topological conjugacy preserves the qualitative behavior of topological dynamical systems. Smale's celebrated program proposes to classify topological or smooth dynamical systems up to topological conjugacy.

These classification problems not only turn out to be hard but sometimes even to be impossible. In joint work with Deka, Garcia-Ramos, Kasprzak, and Kwietniak, we show that the equivalence relation generated by topological conjugacy of minimal homeomorphisms on a Cantor space is not a Borel set. This implies that Cantor minimal systems cannot be classified using inherently countable techniques.

Types and typesets in the classification of actions of non-commutative groups

Olga Lukina (*Leiden University*)

The notion of the type and typeset were introduced by Baer in 1937 in order to develop a classification of rank n subgroups of $\mathbb{Q}^n$. In this talk, we will introduce the notion of the type and typeset for minimal equicontinuous actions of non-abelian groups. In particular, we show that the commensurable class of the typeset is an invariant of the return equivalence class of such an action.

Endpoints and Branchpoints in Inverse Limits of Dendrites

Jonathan Meddaugh (*Baylor University*)

In this talk we will use symbolic systems developed by Baldwin to analyze the structure of inverse limits of certain unimodal maps on dendrites. In particular, we will characterize the endpoints and branchpoints of such an inverse limit in terms of the kneading sequence associated with the map.

Dynamics of the shift action on linear sequence spaces over groups beyond $\mathbb{Z}$

Sergei Miles (*UNC Charlotte*)

In linear dynamics, bounded linear operators over infinite-dimensional Banach spaces have been shown to be able to exhibit interesting characteristics including topological transitivity, topological mixing, and even chaos in the sense of Devaney. This talk will examine weighted ℓ^p sequence spaces together with the shift action as the operator. In the case the shift action is over the semi-group $\mathbb{N}$, the above topological properties have been characterized by conditions on the weight sequence associated with a given ℓ^p space. In this talk I will present recent results for new characterizations of these properties when we instead consider the group action over a countable group. I will also highlight other open questions.

This is a joint work with Kevin McGoff and William Brian.

Quasi-uniform entropy vs topological entropy

Olivier Olela Otafudu (*University of Limpopo*)

In 2023 Haihambo and Olela Otafudu introduced and studied the notion of quasi-uniform entropy $h_{QU}(\psi)$ for a uniformly continuous self-map ψ of a quasi-metric or a quasi-uniform space X. In this talk, we discuss the connection between the topological entropy functions h, h_f and the quasi-uniform entropy function h_{QU} on a quasi-uniform space X, where h and h_f are the topological entropy functions defined using compact sets and finite open covers, respectively. In particular, we have shown that for a uniformly continuous self-map ψ of a T_0-quasi-uniform space $(X,\mathcal{U})$ we have $h(\psi) \leq h_{QU}(\psi)$ when X is compact and $h_{QU}(\psi) \leq h_f(\psi)$ with equality if X is a compact T_2 space.

On block gluing property in Hom shifts

Piotr Oprocha (*AGH University*)

Hom shifts form a class of multidimensional shifts of finite type (SFT) where adjacent symbols must be neighbors in a fixed finite undirected simple graph G. This talk is about gluing distance in Hom shifts: given two nxn admissible partial blocks, how far do they need to be so that we can glue them together (i.e embed) in a larger admissible block.

The gluing gap measures how far any two square patterns of size n can be glued, which has a clear analogy with gap fo specification property in one-dimensional subshifts. We prove that the gluing gap either depends linearly on n or is dominated by $log(n)$. It is clear that there are Hom shift, where gluing gap is bounded by constant, thus independent of n. To support our results, we find a Hom shift with gap $\Theta(log(n))$, infirming a conjecture formulated by R. Pavlov and M. Schraudner.

This talk is based on a joint work with Silvere Gangloff and Benjamin Hellouin de Menibus.

Minimal zero entropy subshifts are unrestricted along a sparse set

Ronnie Pavlov (*University of Denver*)

A recent polynomial version of the celebrated Sarnak's conjecture asked whether, given a nonlinear polynomial $p \in \mathbb{Z}[x]$, zero entropy minimal topological dynamical system (X, T), $f \in C(X)$, and $x_0 \in X$, the sequence $f(T^{p(x)}x_0)$ is uncorrelated with the Mobius function μ.

This conjecture is false, and has been refuted in two recent works with interesting and somewhat difficult constructions. However, we can use a simple symbolic construction to prove the following: when (k_n) has zero Banach density, then not only may the sequence $f(T^{k_n}x_0)$ be correlated with μ, there are actually no restrictions on the sequence whatsoever.

Rigidity for Toeplitz and Enumeration Systems

Silvia Radinger (*University of Vienna*)

In this talk we will study measure-theoretical rigidity and partial rigidity for classes of Cantor dynamical systems including Toeplitz systems and enumeration systems. With the use of Bratteli-Vershik dynamical systems we can control invariant measures. Their structure in the Bratteli diagram leads us to find systems with the desired properties. Among other things, we will analyse different Toeplitz systems for their rigidity and show that there exist Toeplitz systems which have zero entropy and are not partially measure theoretically rigid with respect to any of its invariant measures. Further we show varying rigidity in the family of enumeration systems defined by a linear recursion.

This talk is based on joint work with Henk Bruin, Olena Karpel and Piotr Oprocha.

Scaling properties of (generalised) Thue-Morse measures

Tanja Schindler (*Jagiellonian University*)

The Thue-Morse measure and its generalisations are diffraction measures of simple aperiodic systems. Besides that, they are paradigmatic examples of purely singular continuous probability measures on the unit interval given as an infinite Riesz product. To study their scaling behaviour a classical method, the thermodynamic formalism can be used - which however has to be adapted to an unbounded potential. We will in particular see how one has to meaningfully define the topological and variational pressure in this setting. Besides seeing this method, we will also see how quantitatively the Birkhoff and dimension spectrum changes depending on the point of the singularity. This is joint work with M. Baake, P. Gohlke, and M. Kesseböhmer.

Dynamics of a General Non-autonomous Discrete Dynamical System

Puneet Sharma (*Indian Institute of Technology Jodhpur*)

In this talk, we discuss the dynamics of a general non-autonomous dynamical system. In particular, we discuss notions like equicontinuity, minimality and various notions of mixing and sensitivities for a general discrete non-autonomous system. We also discuss the case when the dynamics is generated by a uniformly convergent sequence of maps. We prove that if the system is generated by a commutative family converging at a "sufficiently fast rate" then many dynamical notions for non-autonomous system can be characterized by the limiting (autonomous) system.

The Critical Strip Lemma for σ_d-Symmetric Laminations of the Unit Disc - a Generalization of Thurston's Central Strip Lemma for σ_2 Laminations.

Thomas Sirna (*University of Alabama at Birmingham*)

Every complex polynomial with a locally connected Julia set generates a lamination of the unit disc — a closed set of non-crossing chords inside $\mathbb{D}$ whose endpoints on $\mathbb{S}$ are allowed to touch. This was a tool developed and explored by Thurston in order to study degree 2 complex polynomials, their Julia sets, and the parameter space of LC polynomials, the Mandelbrot set. The dimension of the corresponding 'multi-brot' sets increases in higher dimension so one usually restricts themselves to studying slices of the parameter space.

The restriction we make in this talk is to focus on symmetric polynomials, which we define as a degree d complex polynomial whose locally connected Julia set — and therefore, whose lamination — has $\frac{2\pi}{d-1}$ rotational symmetry. It turns out that this leads to behavior very similar to the degree 2 case.

Thurston utilized the Central Strip Lemma to help prove two main results in the degree 2 case — the No Wandering Triangles theorem (NWT) and the No Identity Return Triangles theorem (NIRT). The symmetric degree d case has an analogous result, which we call the Critical Strip Lemma. In this talk we prove the Critical Strip Lemma, which puts restrictions on the placement of leaves in σ_d-symmetric laminations. We will then outline how it's used to prove that in the σ_d-symmetric case, the NWT and NIRT theorems still hold.

On extending Cantor subsystems on dendrites

Jakub Tomaszewski (*AGH University*)

Submitting author: Jakub Tomaszewski, AGH University

Abstract During the talk we will focus on surjective Cantor systems. Each such system can be easily embedded in the Gehman dendrite, as its set of endpoints is a Cantor set. We will show that for each such embedding there exists a mixing map of the dendrite such that the endpoints' subsystem is conjugate to the Cantor system of choice. The main tool to obtain this result follows from Shimomura's method of approximating the dynamics on zero dimensional systems by analysing the dynamics of coverings of the underlying space. We will discuss the dynamical properties of the constructed map.

The talk is based on joint work with Dominik Kwietniak and Piotr Oprocha.

Some Dynamical Notions for Non-autonomous Systems

Sushmita Yadav (*Indian Institute of Technology Jodhpur*)

In this talk, we discuss the topological dynamics of a general non autonomous dynamical system. In particular, we discuss various dynamical properties such as equicontinuity, minimality, almost periodicity, proximality. We introduce the notion of orbital hull in non-autonomous dynamical systems and relate it with the dynamics of the system. We give a necessary and sufficient condition for the system to be minimal in terms of orbital hull. We also relate almost periodicity of the orbital hull of a point to equicontinuity of the non-autonomous dynamical system. We show that any minimal system generated by commutative family is either equicontinuous or has a dense set of sensitive points. We also discuss weakly mixing and proximality fo non-autonomous systems. We generalize some results for autonomous system to non-autonomous setting. We also discuss some counter-examples for the case when result cannot be extended to a non-autonomous setting.

Geometric Group Theory

Mapping Class Groups of Surfaces with Noncompact Boundary

Ryan Dickmann (*Georgia Institute of Technology*)

We will talk about the widely unknown classification of general surfaces due to Brown and Messer. Then we will discuss how the classification was used to get general results about the mapping class groups of orientable surfaces. In particular, we classified the automatically continuous pure mapping class groups over all orientable surfaces.

Surface Houghton Groups

George Domat (*Rice University*)

Surface Houghton groups are a generalization of Houghton groups to the surface setting. They are defined as groups of asymptotically rigid mapping classes of an infinite-type surface. We will give commensurability and isomorphism classication results for this class of groups. Some time will be spent motivating these groups as "medium" mapping class groups that live somewhere between the world of mapping class groups of finite-type surfaces and those of infinite-type surfaces. This is joint work with Javier Aramayona and Christopher Leininger.

Separable homology of graphs and the Whitehead complex

Becky Eastham (*University of Wisconsin, Madison*)

We introduce a 1-complex $\mathrm{Wh}(\Gamma)$ associated with a finite regular cover Γ of the rose which is connected if and only if the fundamental group of the associated cover is generated by elements in a proper free factor of the free group. When the associated cover represents a characteristic subgroup of the free group, the complex admits an action of $\mathrm{Out}(F_n)$ by isometries. We then explore the coarse geometry of $\mathrm{Wh}(\Gamma)$. Every component of $\mathrm{Wh}(\Gamma)$ has infinite diameter, and the complex $\mathrm{Wh}(\mathbf{R}_n)$ associated with the rose is nonhyperbolic. As corollaries, we obtain that the Cayley graph of the free group with the infinite generating set consisting of all primitive elements has infinite diameter and is nonhyperbolic.

On horofunction boundaries of homogeneous groups

Nate Fisher (*University of Wisconsin, Madison*)

In this talk, I will define and motivate the use of horofunction boundaries to study groups. I will discuss some examples which demonstrate interesting properties of the horofunction boundary and share new results about the horofunction boundaries of homogeneous groups.

CAT(0) and cubulated Shephard groups

Katherine Goldman (*Ohio State University*)

Shephard groups are common generalizations of Coxeter groups, Artin groups, graph products of cyclic groups, and (certain) complex reflection groups. We extend a well-known result that Coxeter groups are CAT(0) to a class of Shephard groups that have “enough” finite parabolic subgroups. We also show that in this setting, if the underlying Coxeter diagram is type FC, then the Shephard group is (cocompactly) cubulated. Our method of proof combines the works of Charney-Davis on the Deligne complex for an Artin group and of Coxeter on the classification and properties of the regular complex polytopes.

Hyperbolicity and relative hyperbolicity of free extensions of free groups

Funda Gültepe (*University of Toledo*)

The interest in the geometry of group extensions started with the geometrization theorem of Thurston for compact irreducible atoroidal 3-manifolds. We will talk about the geometry of group extensions and the motivations behind such studies in the cases of closed surface groups and free groups. More specifically, we will talk about the most general case so far and, we will give necessary and sufficient conditions for a free extension of a (non-Abelian) free group given by a subgroup of the outer automorphism group of the free group ($Out(F_n)$) to be hyperbolic and relatively hyperbolic. Joint work with Pritam Ghosh.

Random walks on groups and superlinear divergent geodesics

Vivian He (*University of Toronto*)

The central limit theorem of random walks answers the question "how quickly does the random walk drift away from the origin". Historically, it has been proven (under some assumptions) for free groups, hyperbolic groups, and various generalizations of hyperbolic groups. We proved this for one generalization of hyperbolic groups: groups containing superlinear divergent quasi-geodesics. The advantage of this setting compared to previous versions of CLT is that it is invariant under quasi-isometry.

In this talk, I will delve into the superlinear divergence property, as well as its geometric consequences that led to the theory of random walks on groups containing superlinear divergent quasi-geodesics. This talk is based on joint work with Kunal Chawla, Inhyeok Choi, and Kasra Rafi.

Decision problem for groups as equivalence relations

Turbo Ho (*California State University, Northridge*)

In 1911, Dehn proposed three decision problems for finitely presented groups: word problem, conjugacy problem, and isomorphism problem. These problems have been central to both group theory and logic, and were each proven to be undecidable in the 50s. There is much current research studying the decidability of these problems in classes of groups. Although these problems are classically studied as decision problems, each of them is naturally an equivalence relation. In this talk, we study them as equivalence relations and compare them using computable reductions. This leads to a more refined measure of their complexity and brings new results and questions.

Homological Representations of Low Genus Mapping Class Groups

Trent Lucas (*Brown University*)

The mapping class group $\mathrm{Mod}(S)$ of a surface S acts on the homology $H_1(S)$, yielding the well-studied symplectic representation $\mathrm{Mod}(S) \to \mathrm{Sp}(2g, \mathbb{Z})$. In this talk, we discuss an equivariant refinement of the symplectic representation. Namely, given a finite group G acting on S, the symplectic representation restricts to a map from the centralizer of G in $\mathrm{Mod}(S)$ to the centralizer of G in $\mathrm{Sp}(2g, \mathbb{Z})$. The image of this restriction has been studied by many authors and is generally difficult to understand. We discuss our result that the image of this restriction is arithmetic when S has genus at most 3.

Quasi-isometric rigidity of commensurated subgroups

Alex Margolis (*The Ohio State University*)

A finitely generated group can be thought of as a metric space when equipped with the word metric with respect to a finite generating set. This metric space is well-defined up to quasi-isometry. A major program in geometric group theory, initiated by Gromov, is determining to what extent the coarse geometry of a group determines its algebra. In this talk, we investigate when normal and commensurated subgroups, and their associated quotient groups and spaces, are preserved by quasi-isometries.

Random Bowditch Boundaries for Free Groups

Aaron Messerla (*University of Illinois at Chicago*)

The topology of the Bowditch boundary of a relatively hyperbolic group pair gives information about relative splittings of the group. It is therefore interesting to ask if there is generic behavior of this boundary. In this talk I plan to describe previously known results about the Bowditch boundary of a free group with cyclic peripheral structure, and discuss why there is no generic case when the peripheral structure is produced randomly.

The Second Rational Homology of the Torelli group

Daniel Minahan (*Georgia Institute of Technology*)

The Torelli group of a surface is the kernel of the action of the mapping class group on the first homology of the surface. It is a longstanding open problem to determine whether or not the Torelli group is finitely presented for closed oriented surfaces of genus at least 3. We will discuss some recent work of the author that rules out the simplest obstruction to the Torelli group being finitely presented. In particular, we will show that the second rational homology of the Torelli group is finite dimensional for all surfaces of sufficiently large genus.

Girth Dichotomy Arising from the Ping-Pong Dynamics in HNN Extensions

Pratyush Mishra (*Wake Forest University*)

The notion of a girth was first introduced by S. Schleimer in 2003. Later, a substantial amount of work on the girth of finitely generated groups was done by A. Akhmedov, where he introduced the so-called Girth Alternative and proved it for certain classes of groups, e.g. hyperbolic, linear, one-relator, $PL_+(I)$ etc. Girth Alternative is similar to the well-known Tits Alternative in spirit, therefore it is natural to study it for classes of groups for which Titis Alternative has been investigated. In this talk, we will explore the girth of HNN extensions of finitely generated groups in its broadest sense by considering cases where the underlying subgroups are either full or proper subgroups. We will present a sub-class for which Girth Alternative holds. We will also produce counterexamples to show that beyond our class, the alternative fails in general. Recently, we extended one of the main results proving the Girth Alternative for HNN extensions of word hyperbolic groups (instead of HNN extensions of free groups). The talk will be based on joint work with Azer Akhmedov.

Free product quotients acting on CAT(0) cube complexes

Thomas Ng (*Brandeis University*)

Quotients of free products are natural combinations of groups that have been exploited to study embedding problems. These groups have seen a resurgence of attention from a more geometric point of view following celebrated work of Haglund–Wise and Agol. I will discuss a geometric model for studying quotients of free products. We will use this model to adapt ideas from Gromov's density model to this new class of quotients, their actions on CAT(0) cube complexes, and combination theorems for residual finiteness. Results discussed will be based on ongoing work with Einstein, Krishna MS, Montee, and Steenbock.

Hyperfiniteness of boundary actions of acylindrically hyperbolic groups

Koichi Oyakawa (*Vanderbilt University*)

A Borel equivalence relation on a Polish space is called hyperfinite if it can be approximated by Borel equivalence relations with finite classes. This notion has long been studied in descriptive set theory to measure complexity of Borel equivalence relations. Although group actions on hyperbolic spaces don't always induce hyperfinite orbit equivalence relations on the Gromov boundary, some natural boundary actions were recently found to be hyperfinite. Examples of such actions include actions of hyperbolic groups and relatively hyperbolic groups on their Gromov boundary, actions of mapping class groups on arc graphs and curve graphs, and acylindrical group actions on trees. In this talk, I will show that any acylindrically hyperbolic group admits a non-elementary acylindrical action on a hyperbolic space with hyperfinite boundary action.

Incoherence for right-angled Coxeter groups on surfaces

Lorenzo Ruffoni (*Tufts University*)

A group is "coherent" if every finitely generated subgroup is finitely presented. In a certain sense, coherence is a low-dimensional phenomenon. For instance, 3-manifold groups and one-relator groups are coherent. In this talk we consider Coxeter groups defined by a graph that is a flag triangulation of a surface of genus g. For each g¿0, we construct a Coxeter group that is right-angled, hyperbolic, and incoherent. In these examples the witness to incoherence is always the fiber in a virtual algebraic fibration. This provides positive evidence towards a variation on Singer's Conjecture for right-angled Coxeter groups proposed by Davis-Okun. This is joint work with G. Walsh.

Non-hyperbolicity of single-isotopy-class fine curve graphs

Roberta Shapiro (*Georgia Institute of Technology*)

The fine curve graph of a surface is a graph whose vertices are essential simple closed curves in the surface and whose edges connect disjoint curves. Following a rich history of hyperbolicity in various graphs based on surfaces, the fine curve was shown to be hyperbolic by Bowden–Hensel–Webb. Given how well-studied the curve graph and the case of "up to isotopy" is, we ask: what about the part of the fine curve graph not captured by isotopy classes? In this talk, we introduce the result that the subgraph of the fine curve graph spanned by curves in a single isotopy class is not hyperbolic; indeed, it contains a flat of EVERY dimension. Joint work with Ryan Dickmann.

Combinations of parabolically geometrically finite groups

Brian Udall (*Rice University*)

We consider the collection of parabolically geometrically finite (PGF) subgroups of mapping class groups, which were defined by Dowdall-Durham-Leininger-Sisto. These are generalizations of convex cocompact groups, and the class of PGF groups contains all finitely generated Veech groups as well as certain free products of multitwist groups. We will see some basic motivations and properties of these groups, as well as discuss a combination theorem for PGF groups generalizing the combination theorem of Leininger-Reid for Veech groups. This allows one to build many more examples of PGF groups, including Leininger-Reid surface groups.

Minimal surface entropy for asymptotically cusped metrics in 3-manifolds

Franco Vargas Pallete (*Yale University*)

In this talk we will discuss how the minimal area of almost Fuchsian subgroups (more precisely, their asymptotic growth) of a Kleinian group detects the hyperbolic metric under pinched curvature conditions. This is based on upcoming joint work with Ruojing Jiang.

Leighton's property for $X_{m,n}$

Maya Verma (*University of Oklahoma*)

In 1982, Leighton proved that any two finite graphs with a common cover admit a finite sheeted common cover. In this talk, I will introduce the combinatorial model $X_{m,n}$ for the Baumslag-Solitar group $BS(m, n)$, and classify for which pairs of integers (m, n) Leighton's theorem can be extended to the orbit space of covering actions on $X_{m,n}$

Deciding when two curves are of the same type

Hanh Vo (*Arizona State University*)

Let S be a compact orientable connected surface with negative Euler characteristic. Two closed curves on S are of the same type if their corresponding free homotopy classes differ by a mapping class of S. Given two closed curves on S, we propose an algorithm to detect whether they are of the same type or not. This is joint work with Juan Souto.

Geometric Topology

Coarse bottlenecking and coarse skeletons of graphs

Michael Bruner (*University of Montana*)

We introduce the concept of (coarse) n-point bottlenecking in graphs and study the coarse geometry of graphs in terms of bottlenecking in their coarse skeletons. We examine the connections of bottlenecking with coarse planarity. This is joint work with Atish Mitra and Heidi Steiger.

Computability of Immersions

Daniel Epelbaum (*UC Santa Barbara*)

Suppose we are handed a map of smooth manifolds and would like to know if it is homotopic to an immersion. In general this problem is undecidable, indeed even immersibility of an arbitrary manifold into $\mathbb{R}^n$ is undecidable. In this talk we will see how to use techniques from rational homotopy theory, and the h-principle of Hirsch and Smale to provide an algorithm for this problem whenever the codimension of the manifolds is odd.

On Gromov's Conjecture for Right-Angled Artin Groups

Satyanath Howladar (*University of Florida*)

Gromov defined Macroscopic Dimension for manifolds as a measure of largeness, in order to study topology of manifolds admitting Positive Scalar Curvature metric. He conjectured universal cover $\tilde{M}$, of closed n-manifold M admitting Positive Scalar Curvature metric, should have $\dim_{mc}\tilde{M} \leq n-2$, for the metric on $\tilde{M}$ lifted from M. This conjecture heavily depends on $\pi_1(M)$. Recently, we could prove the conjecture for closed spin n-manifolds M, having $\pi_1(M) \in RAAG$. We will try to see a brief history of this conjecture and an overview of our proof method.

Complex Hyperbolic Gromov-Thurston Metrics

Barry Minemyer (*Commonwealth University, Bloomsburg*)

In 1987 Gromov and Thurston developed the first Riemannian manifolds that are not homotopy equivalent to a hyperbolic manifold but admit a Riemannian metric that is ϵ-pinched for any given $\epsilon > 0$. The manifolds that they construct are branched covers of hyperbolic manifolds, and to construct the metric they perform a sort of "geometric surgery" about the ramification locus. In 2022 Stover and Toledo proved the existence of similar branched cover manifolds built out of complex hyperbolic manifolds, and via a result of Zheng these manifolds admit a negatively curved Kahler metric. In this talk we will discuss how to construct a (not Kahler) Riemanain metric on these Stover-Toledo manifolds which is ϵ-close to being 1/4-pinched for any prescribed $\epsilon > 0$. These provide the first known examples of Kahler manifolds that are not homotopy equivalent to a complex hyperbolic manifold but admit a Riemannian metric that is ϵ-close to being 1/4-pinched.

Geometric Embeddings of Spaces of Persistence Diagrams with Explicit Distortions

Atish Mitra (*Montana Tech*)

Let n be a positive integer. We provide an explicit geometrically motivated 1-Lipschitz map from the space of persistence diagrams on n points (equipped with the Bottleneck distance) into Hilbert space. Such maps are a crucial step in topological data analysis, allowing the use of statistics (and thus data analysis) on collections of persistence diagrams. The main advantage of our maps as compared to most of the other such transformations is that they are coarse and uniform embeddings with explicit distortion functions. Furthermore, we provide an explicit 1-Lipschitz map from the space of persistence diagrams on nnn points on a bounded domain into a Euclidean space with an explicit distortion function. Our ideas come from geometric topology and dimension theory, and our methods are best described as quantitative dimension theory. This is joint work with Ziga Virk.

Rectangles inscribed in plane sets as a consequence of the non-embeddability of certain cones in $\mathbb{R}^3$

Ulises Morales-Fuentes (*CINC - UAEM, Morelos, Mexico*)

A plane set admits an inscribed rectangle if every homeomorphic copy of it in $\mathbb{R}^2$ contains the 4 vertices of at least one Euclidean rectangle. Vaughan proved that S^1 admits an inscribed rectangle by reducing the problem to the non-embeddability of the projective plane in $\mathbb{R}^3$ (it is not known if S^1 admits an inscribed rectangle of aspect ratio 1:1 i.e. a square). In this talk, using the non-embeddability of the $\mathrm{Cone}(K_5)$ and the $\mathrm{Cone}(K_{3,3})$ in $\mathbb{R}^3$ we classify plane compact connected locally-connected sets that admit inscribed rectangles. Using similar topological techniques, we also present a one-dimensional non-connected set such that every copy of it in $\mathbb{R}^2$ admits an inscribed rectangle with at least one vertex in each component.

The Maximum Cardinality of Essential Families in Normal or Regular Spaces

Leonard Rubin (*University of Oklahoma*)

Essential families can be used to provide a simple characterization of the dimension of a normal space (and with a small adjustment, also for a regular space). For example, a normal space X has dimension $n \in \mathbb{N}$ if and only if it has an essential family of cardinality n and for all $m > n$, it has no essential family of cardinality m. A space is *strongly infinite-dimensional* if it has a countably infinite essential family. The Hilbert cube, I^∞, is strongly infinite-dimensional; however, one might wonder if it has an uncountable essential family. Going even further, can a separable metrizable space have an uncountable essential family?

In this talk we will define essential families as they are used in this setting and then present the following theorem which establishes an upper bound on the cardinality of essential families in normal or regular (T_1 not required) spaces.

Theorem. Let X be a regular or normal space of infinite weight and $\mathcal{C}$ be an essential family in X. $\mathrm{card}\,\mathcal{C} \leq \mathrm{wt}X$.

We employ a proof by contradiction in which we assume that there is an essential family of higher cardinality than the weight of the given space and then by a transfinite construction, which we will not try to present, arrive at a contradiction. But we will give a clue as to how one can "finesse" this supposedly essential family in order to detect that it is not essential.

Bilinear pairings on two-dimensional cobordisms and generalizations of the Deligne category

Radmila Sazdanovic (*NC State University*)

The Deligne category of symmetric groups is the additive Karoubi closure of the partition category. It is semisimple for generic values of the parameter t while producing categories of representations of the symmetric group when modded out by the ideal of negligible morphisms when t is a non-negative integer. The partition category may be interpreted, following Comes, via a particular linearization of the category of two-dimensional oriented cobordisms. The Deligne category and its semisimple quotients admit similar interpretations. This viewpoint coupled to the universal construction of two-dimensional topological theories leads to multi-parameter monoidal generalizations of the partition and the Deligne categories, one for each rational function in one variable.

Holomorphic maps to blowups of projective space

Philip Tosteson (*UNC Chapel Hill*)

Let C be a compact Riemann surface, and X be smooth projective variety. We will consider the space of holomorphic maps $C \to X$.

When $X = \mathbb{P}^n$, Segal demonstrated a remarkable stabilization phenomenon: as d increases, the homology of the component of degree d holomorphic maps converges to homology of the component of degree d continuous maps $C \to X$. Ellenberg-Venkatesh and others have observed that this phenomenon is related to arithmetic conjectures about rational points on Fano varieties due to Batyrev and Manin. This suggests that this stabilization phenomenon may hold more generally.

I will talk about joint work with Ronno Das using the Vassiliev method to study the case of blowups of projective space at finitely many points (in particular del Pezzo surfaces).

What do 3-Manifolds Look Like?

Steve Trettel (*University of San Francisco*)

The Geometrization Theorem of Thurston and Perelman provides a roadmap to understanding topology in dimension 3 via geometric means. Specifically, it states that every closed 3-manifold has a decomposition into geometric pieces, and the zoo of these geometric pieces is quite constrained: each is built from one of eight homogeneous 3-dimensional Riemannian model spaces (called the Thurston geometries).

In this talk, we will approach the question of "what does a 3-manifold look like" from the perspective of geometrization. Through animations of simple examples in dimensions 2 and 3 we review what it means to put a (complete, homogeneous) geometric structure on a manifold, and construct an example admitting each of the Thurston geometries.

Using software written in collaboration with Remi Coulon, Sabetta Matsumoto and Henry Segerman, we will explore these manifolds "from the inside" - that is, simulating the view one would have in such a space by raytracing along geodesics. Finally we will explore the re-assembly of these geometric pieces and understand an "inside view" of general 3-manifolds.

Mapping class group actions on 3-manifolds

Bena Tshishiku (*Brown University*)

For a surface S, Thurston asked if the natural surjection $\mathrm{Homeo}(S) \to \pi_0\mathrm{Homeo}(S)$ splits, i.e. if there a natural action of the mapping class group $\mathrm{Mod}(S) := \pi_0\mathrm{Homeo}(S)$ on S. Markovic showed that no such action exists. On the other hand, there is a natural action of $\mathrm{Mod}(S)$ on the unit tangent bundle of S. More generally, for a 3-manifold M that fibers as a circle bundle over S, there is natural surjection $\mathrm{Homeo}(M) \to \mathrm{Mod}(S)$. We study when this surjection splits. This is joint work with Lei Chen and Alina al Beaini.

Corks for exotic diffeomorphisms

Terrin Warren (*University of Georgia*)

In dimension 4, there exist simply-connected manifolds which are homeomorphic but not diffeomorphic; the difference between the distinct smooth structures can be localized using corks. Similarly, there exist diffeomorphisms of simply-connected 4-manifolds which are topologically but not smoothly isotopic. In this talk, I will discuss some preliminary results towards an analogous localization of this phenomena using corks for diffeomorphisms. This project is joint work with Slava Krushkal, Anubhav Mukherjee, and Mark Powell.

The Alexander Polynomial and Gordian Distance

Ana Wright (*Davidson College*)

We call a knot K a complete Alexander neighbor if every possible Alexander polynomial is realized by a knot one crossing change away from K. It is unknown whether there exists a complete Alexander neighbor with nontrivial Alexander polynomial. I will discuss how to eliminate infinite families of knots with nontrivial Alexander polynomial from having this property and possible strategies for unresolved cases. I will also discuss how a related condition on determinants of knots one crossing change away from unknotting number one knots gives an obstruction to unknotting number one. This obstruction appears similar to an obstruction introduced by Lickorish, but Lickorish's obstruction does not subsume the obstruction coming from the condition on determinants.

"Shake slice conjecture" and "Smooth 4-D Poincaré conjecture"

Eylem Yildiz (*Duke University*)

In this talk, we will address two conjectures. Firstly, we will present the proof of "0-shake slice knots are slice", which was a collaborative effort with Selman Akbulut. Secondly, we will discuss how the progress made in the first problem can assist in tackling the "Smooth 4-D Poincaré conjecture". If time allows, we will delve into this further.

Set-Theoretic Topology

Recent results about proximal and semi-proximal spaces

Khulod Almontashery (*York University*)

We consider the class of proximal and semi-proximal spaces defined by Jocelyn Bell and introduce a strengthening of this class by examining the proximal game defined on totally bounded uniformities. We also discuss recent results about proximal and semi-proximal spaces. Joint work with Paul Szeptycki.

Maximal quotients of extremally disconnected flows via discrete group actions with respect to coarser group topology

Dana Bartosova (*University of Florida*)

We describe how to obtain a maximal quotient flow of a flow of a discrete group on an extremally disconnected space when we equip the group with a non-discrete topology. This generalized such description previously done for special types of flows, namely the greatest ambit and the Samuel compactification.

Playing Topological Games with Insights from Gruenhage

Jocelyn Bell (*Hobart and William Smith Colleges*)

In 1976, Gary Gruenhage introduced what he described as "a simple two-person infinite game," now sometimes called the neighborhood-point game. Among other things, he used this game to prove results about the preservation of topological properties in products. This infinite game was the inspiration for another game, called the proximal infinite game, which, not coincidentally, has also been used to prove results on products. We will discuss these games, certain modifications, and some results obtained by playing these games. Along the way we highlight parallels with Gruenhage's work.

A bound for the density of any Hausdorff space

Nathan Carlson (*California Lutheran University*)

We show, in a certain specific sense, that both the density and the cardinality of a Hausdorff space are related to the "degree" to which the space is nonregular. It was shown by Sapirovskii that $d(X) \leq \pi\chi(X)^{c(X)}$ for a regular space X and the speaker observed this holds if the space is only quasiregular. We generalize this result to the class of all Hausdorff spaces by introducing the nonquasiregularity degree $nq(X)$, which is countable when X is quasiregular, and showing $d(X) \leq \pi\chi(X)^{c(X)nq(X)}$ for any Hausdorff space X. This demonstrates that the degree to which a space is nonquasiregular has a fundamental and direct connection to its density and, ultimately, its cardinality. Importantly, if X is Hausdorff then $nq(X)$ is "small" in the sense that $nq(X) \leq \min\{\psi_c(X), L(X), pct(X)\}$. This results in a unified proof of both Sapirovskii's density bound for regular spaces and Sun's bound $\pi\chi(X)^{c(X)\psi_c(X)}$ for the cardinality of a Hausdorff space X. A consequence is an improved bound for the cardinality of a Hausdorff space. We give an example of a compact, Hausdorff space for which this new bound is a strict improvement over Sun's bound.

Applications and Limitations of Strategic Translation in Selection Principles

Christopher Caruvana (*Indiana University Kokomo*)

We review various applications of strategic translations in topological selection games and also discuss some particular cases where direct applications fail.

High dimensional sequential compactness

Cesar Corral (*York University*)

We will introduce high dimensional versions of sequential compactness for every ordinal $\alpha < \omega_1$. This will generalize a previous notion introduced by W. Kubis and P. Szeptycki for $\alpha \in \omega$. We then extend some known results in the finite case to the infinite case, exhibit some conditions that imply sequential compactness for higher dimensions and analyze the impact of some cardinal invariants in these classes of spaces. We will close with some remarks and applications.

More Trivial and non-Trivial autohomeomorphisms of $\mathbb{N}^*$

Alan Dow (*UNC Charlotte*)

We investigate the situation regarding autohomeomorphisms of $\mathbb{N}^*$, primarily in the Mathias model.

On Uniformly Continuous Surjections Between Function Spaces

Ali Emre Eysen (*Trakya University*)

Joint work with V. Valov

We consider uniformly continuous surjections between $C_p(X)$ and $C_p(Y)$ (resp, $C_p^*(X)$ and $C_p^*(Y)$) and show that if X has some dimensional-like properties, then so does Y. In particular, we prove that if $T : C_p^*(X) \to C_p^*(Y)$ is a continuous linear surjection, then $\dim Y = 0$ provided $\dim X = 0$. This provides a partial answer to a question raised by Kawamura-Leiderman.

The Tukey Representation of Directed Sets of Topology and its Applications

Ziqin Feng (*Auburn University*)

Directed sets are common in topology and in a variety of contexts. We show that every directed set can be represented, up to Tukey equivalence, by such a topological directed set. in the opposite direction we show that any totally bounded uniformity is Tukey equivalent to $[\kappa]^{<\omega}$, the collection of all finite subsets of κ, the cofinality of the uniformity - all other Tukey types are 'rejected'. Some applications of these results will be discussed in the talk. This is a joint work with Paul Gartside.

Refining and dominating families at the uncountable

Vera Fischer (*University of Vienna*)

We will discuss some recent results, including ZFC inequalities, concerning the higher Baire spaces analogues of some of the classical combinatorial cardinal characteristics of the continuum. Of special interest for the talk will be the generalized bounding, splitting, refining and dominating numbers.

On Arhangel'skiĭ's inequality

Ivan Gotchev (*Central Connecticut State University*)

In 1969, Arhangel'skiĭproved that if X is a Hausdorff space, then $|X| \leq 2^{\chi(X)L(X)}$, where $\chi(X)$ is the character and $L(X)$ is the Lindelöf degree of X. Since then it has been an open question if his inequality is true for every T_1-space X. In 2013, we proved that if X is a T_1-space, then $|X| \leq nh(X)^{\chi(X)L(X)}$, where $nh(X)$ is the non-Hausdorff number of X. In that way we were able to positively answer this question for every T_1-space for which $nh(X) \leq 2^{\chi(X)L(X)}$, and, in particular, when $nh(X)$ is not greater than the cardinality of the continuum. A simple example shows that our inequality is not always true for T_0-spaces.

Arhangel'skiĭand Šapirovskiĭstrengthened Arhangel'skiĭ's inequality in 1974 by showing that if X is a Hausdorff space, then $|X| \leq 2^{t(X)\psi(X)L(X)}$, where $t(X)$ is the tightness and $\psi(X)$ is the pseudocharacter of X.

In this talk we will show how Arhangel'skiĭ–Šapirovskiĭ's inequality, and therefore, Arhangel'skiĭ's inequality, could be extended to be valid for all topological spaces.

Riemann integral on a space with a fractal structure

José F. Gálvez-Rodríguez (*University of Almería*)

Joint work with Miguel A. Sánchez-Granero and Cristina Martín-Aguado.

In this work we start developing a Riemann-type integration theory on spaces which are equipped with a fractal structure. These topological structures have a recursive nature, which allows us to guarantee a good approximation to the true value of a certain integral with respect to some measure defined on the Borel σ-algebra of the space. We give the notion of Darboux sums and lower and upper Riemann integrals of a bounded function when given a measure and a fractal structure. Furthermore, we give the notion of a Riemann-integrable function in this context and prove that each μ-measurable function is Riemann-integrable with respect to μ. Moreover, if μ is the Lebesgue measure, then the Lebesgue integral on a bounded set of $\mathbb{R}^n$ meets the Riemann integral with respect to the Lebesgue measure in the context of measures and fractal structures. Finally, we give some examples showing that we can calculate improper integrals and integrals on fractal sets.

Clustering Properties of Convex-Valued Upper Semicontinuous (CUSCO) Functions

Jared Holshouser (*Norwich University*)

We establish relationships between various topological selection games involving the space of minimal cusco maps into the real line and the underlying domain of those maps. These connections occur across different topologies, including the topology of pointwise convergence and the topology of uniform convergence on compacta. Full and limited-information strategies are investigated. The primary games we consider are Rothberger-like games, generalized point-open games, strong fan-tightness games, Tkachuk's closed discrete selection game, and Gruenhage's (W)-games.

Adding a continuous map by forcing

Akira Iwasa (*Howard College*)

We discuss in what circumstances forcing adds new continuous maps. We prove that if X is scattered compact Hausdorff and Y is discrete, then forcing does not add any continuous maps from X to Y. On the other hand, if X is not a zero-dimensional scattered pseudocompact space and Y has more than one point, then ccc forcing adds a continuous map from X to Y.

The Class $C(\omega_1)$and Countable Net Weight

Istvan Juhasz (*HUN-REN Alfred Renyi Institute of Mathematics*)

Hart and Kunen and, independently, Ríos-Herrejón defined and studied the class $C(\omega_1)$ of topological spaces X having the property that for every neighborhood assignment $\{U(y) : y \in Y\}$ with $Y \in [X]^{\omega_1}$ there is $Z \in [Y]^{\omega_1}$ such that $Z \subset \bigcap\{U(z) : z \in Z\}$. It is obvious that spaces of countable net weight, i.e. having a countable network, belong to this class. We present several independence results concerning the relationships of these two and several other natural classes that are sandwiched between them.

In particular, we prove that the continuum hypothesis, in fact a weaker combinatorial principle called super stick, implies that every regular space in $C(\omega_1)$ has countable net weight, answering a question that was raised by Hart and Kunen.

These results are joint with L. Soukup and Z. Szentmiklossy.

Some examples concerning $L\Sigma(\leq \omega)$ and metrizably fibered compacta

Mikolaj Krupski (*University of Murcia and University of Warsaw*)

The class of $L\Sigma(\leq \omega)$-spaces was introduced in 2006 by Kubiś, Okunev and Szeptycki as a natural refinement of the classical and important notion of Lindelof Σ-spaces. Compact $L\Sigma(\leq \omega)$-spaces were considered earlier, under different names, in the works of Tkachuk and Tkachenko in relation to metrizably fibered compacta. In this talk we will present counterexamples to several open questions about compact $L\Sigma(\leq \omega)$-spaces that are scattered in the literature. Among other things, we refute a conjecture of Kubiś, Okunev and Szeptycki by constructing a separable Rosenthal compactum which is not an $L\Sigma(\leq \omega)$-space. We also give insight to the structure of first-countable $(K)L\Sigma(\leq \omega)$-compacta. The talk is based on a joint work with Antonio Aviles.

DL-closures and $2-3$ closures applied to the ring $C^1(R)$

Robert Raphael (*Concordia University*)

Joint work with W. D. Burgess

In joint work with Barr and Kennison it was shown that commutative semiprime rings have a DL-closure and a $2-3$ closure and that the ring of continuously differentiable real-valued functons is not closed in either sense. Our work is devoted to trying to describe the two closures of this ring. The methods are analytic often using basic ideas from calculus. A useful example sent by Alan Dow is presented.

Topological WWW-groups and Corson compact spaces

Vladimir Tkachuk (*Universidad Autonoma Metropolitana, Mexico City, Mexico*)

We will present several new characterizations of the fact that a given compact space K is Corson compact. Some of them will be in terms of embeddings of K in function spaces, another ones in terms of dense subspaces of $C_p(K)$ and even one characterization in terms of embedding K in a topological group.

Square-catcher subsets

Cristina Villanueva-Segovia (*Centro de Ciencias Matemáticas, UNAM, Morelia, Mexico*)

We say that a subset of the plane is a *square-catcher* if it contains at least one vertex of each square of the plane. In this talk, motivated by the square peg problem —does every Jordan curve contains the four vertices of a euclidean square?—, we will present some properties of square-catchers. In particular, we will look at minimal elements, with respect to the subset relation, of the family of square-catchers.

Dynamical Ideals of Topological Spaces

Justin Young (*University of Florida*)

Joint work with J. Zapletal

A dynamical ideal consists of a group acting on a set, along with an ideal that is invariant under the group action, and we can use dynamical ideals to obtain models of choiceless set theory. We focus on dynamical ideals where the underlying set is taken to be a topological space and the acting group is the group of homeomorphisms and look at how dynamical properties of the space correspond to fragments of AC in the associated model of set theory, along with particular examples.

Deciding when two curves are of the same type

Hanh Vo (*Arizona State University*)

Let S be a compact orientable connected surface with negative Euler characteristic. Two closed curves on S are of the same type if their corresponding free homotopy classes differ by a mapping class of S. Given two closed curves on S, we propose an algorithm to detect whether they are of the same type or not. This is joint work with Juan Souto.