Abstracts of talks

Pierre Albin, University of Illinois at Urbana-Champaign
Hodge Theory of Pseudomanifolds
Abstract: Singular spaces show up in geometry all of the time, for example as algebraic varieties, orbit spaces of group actions, and moduli spaces of geometric structures. When we study these spaces traditional analytic and topological tools for smooth manifolds need to be modified to take into account the presence of singularities. I will report on joint work with several collaborators in which we develop analytic tools on pseudomanifolds, apply them to Hodge theory, and obtain extensions of topological invariants from closed manifolds such as the signature and higher signatures.

John Bryant, Florida State University
Some Counterexamples to the Bing-Borsuk Conjecture
Abstract: A topological space X is *homogeneous* if, for every two points $x, y \in X$, there is a homeomorphism $h\colon X \to X$ such that $h(x) = y$. In 1965 Bing and Borsuk proved that, in dimensions 1 and 2, every locally compact, locally contractible homogeneous space is a topological manifold, and a conjecture arose that this should be true in higher dimensions as well. I will discuss the relationship of this conjecture to the topological classification of higher dimensional euclidean space resulting from work of R. Edwards, F. Quinn, and Bryant-Ferry-Mio-Weinberger and report on recent results of B. and Ferry showing that the Bing-Borsuk conjecture is false in dimensions ≥ 6. In particular there are "nice" homogeneous spaces that are homotopy equivalent to the n-sphere ($n \geq 6$) that are nowhere locally euclidean.

Robin Deeley, University of Colorado Boulder
From Atiyah-Singer to the Analytic Surgery Exact Sequence via Geometric K-Homology
Abstract: The Atiyah-Singer index theorem represents a landmark in 20th century mathematics. Since its proof in the 1960s, index theory has developed in many directions and found many applications. Understanding the index theorem is still nontrivial. However, there are a number of useful frameworks which make the Atiyah-Singer index theorem somewhat more intuitive.

One such framework is K-homology. Our first main goal is to view the Atiyah-Singer index theorem as a corollary of the isomorphism between geometric and analytic K-homology following the work of Baum and Douglas. This will be followed by a discussion of joint work with Magnus Goffeng in which geometric K-homology is used to study secondary invariants using the surgery exact sequence of Higson and Roe.

Sherry Gong, University of California, Los Angeles

Results on Spectral Sequences for Singular Instanton Floer Homology

Abstract: We introduce a version of Khovanov homology for alternating links with marking data, ω, inspired by instanton theory. We show that the analogue of the spectral sequence from Khovanov homology to singular instanton homology (Kronheimer and Mrowka, *Khovanov homology is an unknot-detector*) collapses on the E_2 page for alternating links. We moreover show that the Khovanov homology we introduce for alternating links does not depend on ω; thus, the instanton homology also does not depend on ω for alternating links.

Craig Guilbault, University of Wisconsin - Milwaukee

Infinite Boundary Connected Sums with Applications to Universal Covers of Manifolds

Abstract: A *boundary connected sum* $Q_1 \Diamond Q_2$ of n-manifolds is obtained by gluing Q_1 to Q_2 along $(n-1)$-balls in their respective boundaries. Under mild hypotheses, this gives a well-defined operation that is commutative, associative, and has an identity element. As a result (under those hypotheses) the boundary connected sum $\Diamond_{i=1}^{k} Q_i$ of a finite collection of n-manifolds is also well-defined. This observation fails spectacularly when we generalize to countably infinite collections. In this talk I will discuss a pair of reasonable (and useful) substitutes for a well-definedness theorem for infinite boundary connected sums. An application of interest in both manifold topology and geometric group theory examines the universal covers of certain aspherical manifolds. We will describe examples different from those found in the classical papers by Davis and Davis-Januszkiewicz. Much of this work is joint with Ric Ancel and Pete Sparks.

Jo Nelson, Rice University

Contact Invariants and Reeb Dynamics

Abstract: Contact geometry is the study of certain geometric structures on odd dimensional smooth manifolds. A contact structure is a hyperplane field specified by a one form which satisfies a maximum nondegeneracy condition called complete non-integrability. The associated one form is called a contact form and uniquely determines a Hamiltonian-like vector field called the Reeb vector field on the manifold. I will give some background on this subject, including motivation from classical mechanics. I will also explain how to make use of J-holomorphic curves to obtain a Floer theoretic contact invariant, contact homology, whose chain complex is generated by closed Reeb orbits. This talk will feature numerous graphics to acclimate people to the realm of contact geometry.

Marco Radeschi, University of Notre Dame

Simply-Connected Odd Dimensional Besse Orbifolds Are Manifolds

Abstract: Riemannian orbifolds enjoy most properties of Riemannian manifolds, and in particular the existence of geodesics. When all geodesics can be extended indefinitely and are all periodic, we say that the orbifold is a Besse orbifold. The goal of this talk is to show that, if a simply connected Besse orbifold has odd dimension, it must be a manifold, and in fact a sphere. This is a joint work with Manuel Amann and Christian Lange.

Ravi Shankar, University of Oklahoma

Recent Developments in Non-negative Sectional Curvature

Abstract: In this talk we will present some recent progress in the study of non-negatively curved manifolds. We begin with a survey of some of the main theorems and obstructions in the least several decades as well as statements of some open problems and conjectures. This includes the seminal theorems of Gromov on the total Betti number, the Soul theorem of Cheeger and Gromoll for open manifolds as well as the Bott conjecture on the rational ellipticity of non-negatively curved manifolds. We then present results on recent progress in constructing non-negatively curved manifolds beginning with the work of Grove and Ziller in 2000. We conclude with a recent generalization of the Grove-Ziller construction as well as related results.