Young Topoplogy Meeting UK
Imperial College London
25-26. April 2013

Abstracts

Self-transverse immersions of manifolds

Alexander Longdon

Given a self-transverse immersion of a smooth, compact, closed manifold M into real space, we can ask interesting geometric questions such as "how many times does the immersed manifold intersect itself?" This sort of geometric question can be translated to problems in homotopy theory using the Pontrjagin-Thom construction. In this talk, we shall explore this method and see how it can be applied to give back information about geometry using methods from algebraic topology.

Three-dimensional spherical orbifolds

Andrea Seppi

Every spherical three-dimensional orbifold arises as the quotient of the three-sphere by the action of a finite subgroup of SO(4). Such subgroups were classified in an algebraic way; on the other hand, the spherical quotient orbifold often inherits a fibration from the three-sphere. In this work, a correspondence between the two points of view was completed. We will introduce the objects of interest and discuss the geometric and algebraic information arisen from the research.

Chebyshev's miracle after Frohman and Gelca

Hoel Queffelec
Joint work with Heather Russel (University of Southern California, Los Angeles)

The skein module provides a diagrammatic re-interpretation of the Jones polynomial, that can be extended to knots in any 3-manifold. In the case of thickened surfaces, this module may be endowed with an algebra structure, called Jones-Kauffman algebra. Frohman and Gelca studied in the late 90's the case of the thickened torus, giving a basis of its module which behaves very well under skein product. The basis elements are built over simple curves with the help of Chebyshev polynomials of the first kind.
In a joint work with Heather Russel, we propose a new proof for this formula, that enlightens the role of the Chebychev polynomials as change of basis. This leads us to define a notion of oriented skein module, which naturally generalizes to other surfaces and proves to be a funny invariant as well.

Fundamental groups of 3-manifolds and products of trees — Alessandro Sisto

Quasi-isometric embeddings in products of trees have applications to the Novikov conjecture and in theoretical computer science. I will indicate how to prove that "most" fundamental groups of 3-manifolds quasi-isometrically embed in a product of at most 8 trees. Based on joint works with David Hume and John MacKay.

Spin structures on low-dimensional manifolds — Andrew Donald

A spin structure on a manifold is a piece of additional geometric data that can be associated with the manifold. I will discuss a couple of ways in which spin structures arise in the study of three and four-manifolds.

Smooth structures on nonorientable 4-manifolds and involutions — Rafael Torres

We describe how to construct inequivalent smooth structures for every closed non-orientable 4-manifold with fundamental group of order two that admits a Pin+-structure. A study of the smooth structure on the universal cover of the manifolds constructed yield examples of exotic involutions. These results serve as a good excuse to review and exemplify the process of unveiling exotic smooth structures.

Products of manifolds as branched covers — Christoforos Neofytidis

The existence of a non-zero degree map defines a transitive relation, called domination, on the homotopy types of closed oriented manifolds. The realization of manifolds as domains for such maps, most notably as branched covers, has been a long-standing topic in topology. We show that certain non-trivial products can be realized as branched double covers for large classes of manifolds. We then apply our constructions to study domination by products for low-dimensional and for simply connected targets.

Collision-free motions of robots on graphs — Marjan Safi Samghabadi

We consider a fixed metric graph G and 2 robots as metric balls that are allowed to move on G without collisions. All centres (x,y) of non-colliding robots form the configuration space of 2 robots on G. We present an algorithm to determine if such a configuration space is path-connected, namely whether 2 robots can move without collisions between two given configurations.

Existence of an undominated strategy in normal form game — Alena Chernikava

One of the fundamental results widely used in the game theory is the theorem that states the existence of an undominated strategy of a player in a normal form game under the assumption that the set of his strategies is compact and his utility function is continuous.
The theorem is explicitly stated in "Theorie des jeux pour l'economie et la politique" by Moulin, but essentially it is contained in many papers on game theory. The result was proven for compact metric spaces, using a non-trivial argument. We give another, elementary and topology-based proof of the existence of an undominated strategy of the i-th player in a normal form game of n persons in case that the set of strategies of the i-th player is an almost compact (and not necessarily Hausdorff) topological space and the utility function of the i-th player is continuous.

Legendrian θ-graphs — Danielle O'Donnol

We investigate Legendrian θ-graphs in R^3 with the standard contact structure. We define the invariants Thurston- Bennequin number, tb, and rotation number, rot, for Legendrian graphs. We determine which Thurston-Bennequin number and rotation number can be realized for a Legendrian θ-graphs that is topologically planar. We investigate whether these invariants determine the graph up to Legendrian isotopy.

Knot Concordance — Lukas Lewark

A knot is slice if it bounds a disc in the four-space. Isotopy classes of knots, quotiented by slice knots, form the knot concordance group C, an infinitely generated abelian group.
Slice-torus invariants, which are an interesting class of real-valued homomorphism from C, may detect the subtle difference between smooth and topological sliceness. In particular they allow to show that the subgroup of C consisting of topologically slice knots has free abelian summands.

The HOMFLYPT knot invariant and some moduli spaces — Andrew Lobb

We discuss a instance of the coming together of two seemingly distinct approaches to invariants in low-dimensional topology.

The L2-Alexander invariant detects the unknot — Fathi Ben Aribi

The L2-Alexander invariant is an L2 invariant for knots constructed in a similar way as the classical Alexander polynomial, only by looking at operators on the L2 Hilbert space of the knot group instead of finite dimensional matrices. This invariant takes a knot and gives a function on the positive real numbers. I will present its construction and its main properties, among which the fact that it caracterizes the trivial knot.

Dehn surgery on hyperbolic knots — Fionntan Roukema

A knot in the 3-sphere whose complement admits a hyperbolic structure is called a hyperbolic knot. The process of gluing a solid torus to the boundary component of the exterior of a knot is called Dehn surgery. A well known result, due to Thurston, states that a surgery on a hyperbolic knot that produces a non-hyperbolic 3-manifold is, in some sense, exceptional. In this talk we will describe a classification of the exceptional surgeries on the minimally twisted 5-chain link. We will then use this classification to describe hyperbolic knots with exceptional surgeries at ``maximal'' distance.

The Maslov Index, Algebraic Eta Invariants and Signature Additivity — Chris Palmer

This talk examines the role of the Kashiwara-Wall index and complex structures in finding the signature of a manifold. In the first part we interpret the signature defect in Wall's non-additivity theorem as the Kashiwara-Wall index of a particular triple of Lagrangians. Ranicki's real signature is a modified definition of the ordinary signature of a manifold with a correction term given by the algebraic eta invariant of a pair of Lagrangians. Using a relationship between the Kashiwara-Wall index and the algebraic eta invariant we show that the real signature is additive. We conclude by introducing the related problem of finding the signature of a triangulated manifold via the use of dual cells.

The sense and (abstract) nonsense of triangulated categories — Jeroen Maes

Triangulated categories play a central role in many branches of mathematics, such as algebra, geometry, topology and mathematical physics. By providing examples we discuss two sides of a coin: one side being the triangulated structures, the other one model structures. As an outlook we hint at to what extent the coin can be flipped, transfering model structures into triangulated structures, and how far these structures are apart from each other.

TQFT and quantum representations — Julien Korinman

A TQFT can be described as a functor from a cobordism category to a vector space one. Taking its origins in the originals ideas of E.Witten making connection between topology and Quantum Field Theory, those objects give rise to topological tools such as invariants for knots, for 3-manifolds and representations of mapping class group.

SK-groups and the multiplicativity of the signature of fiber bundles — Carmen Rovi

I will talk about the multiplicativity of the signature of fiber bundles: I will give examples of non-multiplicativity and will discuss the conditions that we need to impose on a fiber bundle to guarantee the multiplicativity of the signature. To what extent can we make these conditions be weaker?
I will also relate these ideas to the SK-groups. These SK-groups arise from cutting and pasting operations on manifolds, and they have interesting connections to the problem of the multiplicativity of the signature as well as to TQFTs as invariants of the partition functions of a TQFT.

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Day	Time	Speaker	Title
Thursday 25. April 2013	14.00 - 14.30	Registration and Snacks	
	14.30 - 14.55	Alexander Longdon	Self-transverse immersions of manifolds
	14.55 - 15.20	Andrea Seppi	Three-dimensional spherical orbifolds
	15.20 – 15.45	Hoel Queffelec	Chebyshev's miracle after Frohman and Gelca
	15.45 – 16.15	Tea and Coffee Break	
	16.15 – 16.40	Alessandro Sisto	Fundamental groups of 3-manifolds and products of trees
	16.40 – 17.05	Andrew Donald	Spin structures on low-dimensional manifolds
	17.05 – 17.30	Rafael Torres	Smooth structures on nonorientable 4-manifolds and involutions
	17.30 – 18.00	Tea and Coffee Break	
	18.00 – 18.25	Christoforos Neofytidis	Products of manifolds as branched covers
	18.25 – 18.50	Marjan Safi Samghabadi	Collision-free motions of robots on graphs
	18.50 – 19.15	Alena Chernikava	Existence of an undominated strategy in normal form game

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Day	Time	Speaker	Title
Friday 26. April 2013	9.55 – 10.20	Danielle O'Donnol	Legendrian theta-graphs
	10.20 – 10.45	Lukas Lewark	Knot Concordance
	10.45 – 11.15	Tea and Coffee Break	
	11.15 – 12.25	Andrew Lobb	The HOMFLYPT knot invariant and some moduli spaces
	12.25 – 12.50	Fathi Ben Aribi	The L2-Alexander invariant detects the unknot
	12.50 – 14.30	Lunch Break	
	14.30 - 14.55	Fionntan Roukema	Dehn surgery on hyperbolic knots
	14.55 - 15.20	Chris Palmer	The Maslov Index, Algebraic Eta Invariants and Signature Additivity
	15.20 – 15.45	Jeroen Maes	The sense and (abstract) nonsense of triangulated categories
	15.45 – 16.15	Tea and Coffee Break	
	16.15 – 16.40	Carmen Rovi	SK-groups and the multiplicativity of the signature of fiber bundles
	16.40 – 17.05	Julien Korinman	TQFT and quantum representations