Title and abstracts of contributed talks

Minicourse on Singularities in Geometry and Dynamics

Hasselt, 22-23 November 2021

Marcelo Alves (Universiteit Antwerpen)

Hofer's geometry and braid stability

Abstract: A central object in the study of Hamiltonian diffeomorphisms on a symplectic manifold is Hofer's metric dH, a bi-invariant metric on the group of Hamiltonian diffeomorphisms that displays rigidity features that are special for those diffeomorphisms.

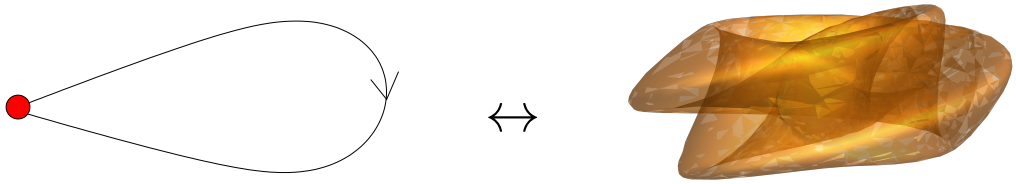
In my talk I will discuss a result stating that, under certain conditions, the braid type of a set of periodic orbits of Hamiltonian diffeomorphisms on surfaces is stable under perturbations that are sufficiently small with respect to Hofer's metric. This can be applied to obtain stability properties of topological entropy. For example, we show that for any non-degenerate Hamiltonian diffeomorphism ϕ on a closed surface the topological entropy is lower semi-continuous at ϕ with respect to the Hofer metric dH. A similar result is valid for compactly supported Hamiltonian diffeomorphisms of the two-dimensional disk. All this is joint work with Matthias Meiwes.

Yannick Gullentops (Universiteit Antwerpen)

From hyberbolic-regular leafs to directed graphs

Abstract: Completely integrable systems, systems with a maximum amount of conservation laws, have always been of interest in the study of dynamics. This allows us to reduce the problem to lower dimensional sets. In particular the case where some of the conservation laws generate effective $\mathbb{S}^1-$actions a lot of work has been done already. *Toric systems*, where all conservation laws generate effective $\mathbb{S}^1-$actions, were classified by Delzant in 1988. *Semitoric systems*, where we only have one effective $\mathbb{S}^1-$action and have restricted the types of singularities that can appear, have been classified in 2009-2011 by Pelayo & Vũ Ngọc. Because these systems do not contain degenerate and hyperbolic components they are slightly less interesting than *hypersemitoric systems* and *proper* $\mathbb{S}^1$ *systems* which both allow hyperbolic components.

In this presentation we will study the hyperbolic-regular leafs of proper $\mathbb{S}$ systems. We will show a one to one correspondence between hyperbolic-regular leafs and a subset of the weakly connected, directed graphs which we will call the generalized bouquets.



(a) Graphs (b) Fiber

The first part of our talk will talk about the local behaviour of the singular points, as the above correspondence is strongly determined by the $\mathbb{S}^1$ period of the singular points. Afterwards we will discuss the connection with graph theory and why we are interested in these graphs.

Sandor Hajdu (Universiteit Antwerpen)

Nonlinear splittings and Finsler functions

Abstract: We revise the notion of a Finsler manifold and that of a nonlinear splitting. We discuss how a Finsler function induces a nonlinear splitting, and we investigate how certain properties of the splitting relates to the dynamics of the underlying Finsler manifolds.

Maikel Bosschaert (Universiteit Hasselt)

Chaotic RG Flow and the Doom of Universality in Tensor Models

Abstract: We study a bi-antisymmetric tensor quantum field theory with $O(m) \times O(M)$ symmetry. Working in $4 - \epsilon$ dimensions, we calculate the beta functions up to second loop order and analyze the Renormalization Group (RG) flow and its fixed points. We allow the parameters m and M to assume general real values, which results in them functioning as bifurcation parameters. We find a fold-Hopf bifurcation point from which Shilnikov homoclinic solutions emanate. In this talk we will demonstrate how to locate and continue the homoclinic bifurcation curves in the 8 dimensional system.

Melvin Yeung (Universiteit Hasselt)

Geometry of Stokes phenomenon and the 16th problem of Hilbert

Abstract: It is already long since known that an analytic function inside its domain of analyticity can at worst be polynomially small, it is after all what it means to be fully determined by their Taylor series at that point. Now what happens if instead of taking a point inside the region of analyticity, we take a point at the edge of the region of analyticity?

We will discuss the work of Ilyashenko on finiteness of limit cycles in this context. We will also discuss what extra information Stokes phenomenon for this function give and we apply this to the transit map of a semihyperbolic saddle. Then we will sketch how this argument fits into the finiteness proof.

Karandeep Singh (KU Leuven)
Stability of singular points of Lie (bi)algebroids

Abstract: Given a structure which induces a singular foliation on a manifold M such as a Lie algebra action, a Poisson structure or more generally, a Lie algebroid and a leaf L of this singular foliation, a natural question is when L remains a leaf under small perturbations of the structure. I will give an overview of the results in this direction by M. Crainic and R. Fernandes for zero-dimensional leaves, as well as the results by J. P. Dufour and A. Wade for higher order singularities, which all state that the vanishing of some cohomology group implies a positive answer to the question. I will then describe the cohomology group whose vanishing implies the stability of a singular point under perturbing within the subclass of Lie algebroids A compatible with a fixed Lie algebroid structure on the dual vector bundle A^*.

Lars Swijsen (KU Leuven)
Tensor completion using geodesics on Segre manifolds

Abstract: We propose a Riemannian conjugate gradient optimization method for finding low rank approximations of incomplete tensors. This algorithm explicitly uses the geodesics on the Segre manifold. We apply our method to movie rating predictions in a recommender system for the MovieLens dataset, and identification of pure fluorophores via fluorescent spectroscopy with missing data.

Aldo Witte (KU Leuven)
Regularisation of log-contact structures

Abstract: In this talk we will study geometric structures with so called log (or b-) singularities, with main examples contact and symplectic forms. These are differential forms on M which have simple poles along a real hypersurface Z. One deals with these singularities by replacing the tangent bundle by a certain Lie algebroid, called the log-tangent bundle, which has as sections vector fields tangent to Z. We will describe a procedure, called regularisation, which allows one to transport a log-geometric structure on M to a foliated geometric structure on a manifold of one-dimension higher. Using this procedure we can use known results for foliated structures to prove statements about log structures. We will apply this philosophy to the Weinstein conjecture for log-contact forms. Joint work in progress with A. del Pino Gomez