Équipe Topologie-Dynamique
Journée de rentrée 2004

(jeudi 3 octobre, salle 2L8)

9:30 Abderrahim Mesbah. *On the Boundary of Convex Hyperbolic Manifolds*

10:10 pause café

10:40 Renata Turkes. *On the effectiveness of persistent homology*

11:20 Nina Otter. *Fractal dimensions at the crossroad between persistence and magnitude*

12:00 Samuel Lelièvre – Nguyen-Thi Dang. *Présentation de modèles mathématiques 3D*

12:30 déjeuner partagé (salle du conseil)

14:00 Sylvain Crovisier – Céline Gautier. *Présentation de l'équipe*

14:40 Dylan Cant. *Persistence and contact geometry*

15:20 pause thé

15:50 Daniele Cannarsa. *Equivalence between approximate and full controllability for bilinear systems*

Résumés

Abderrahim Mesbah. *On the Boundary of Convex Hyperbolic Manifolds*
Studying convex cocompact hyperbolic 3-manifolds through the data on their boundary has always been a significant area of research. Bers' double uniformization theorem states that there is a full correspondence between such manifolds and the conformal structure on their ideal boundary. Thurston conjectured that, in the case where the boundary is a pleated surface, there is a one-to-one correspondence between the bending locus and the deformation space of the 3-manifold. Through the work of Labourie and Schlenker, it has been shown that there exists a one-to-one correspondence between the induced metric on the boundary (when its Gaussian curvature is greater than -1) and the deformation space of the 3-manifold. In this talk, we will further explore the relationship between convex cocompact hyperbolic 3-manifolds and the induced data on their boundaries. We will also introduce globally hyperbolic anti-de Sitter manifolds and highlight the analogy between them and convex cocompact hyperbolic manifolds.

Renata Turkes. *On the effectiveness of persistent homology*
In this talk I will present the work from the paper "On the effectiveness of persistent homology",and some current follow-up work on generalised persistent homology transforms that are shown to be sufficient descriptors of shape. The talk is based on joint work with Guido Montúfar, Adi Onus and Nina Otter.

Nina Otter. *Fractal dimensions at the crossroad between persistence and magnitude*
Many physical processes or phenomena, such as eroded coastlines, snowflakes, fluid turbulence, human brain networks or blood vessels, are characterised by the repeating of similar patterns across different scales of resolution. One says that such phenomena exhibit self-similarity. One measure of the complexity of a self-similar phenomenon is its fractal dimension, which can be thought of as an extension of the usual topological notion of dimension beyond integers. Estimating the fractal dimension of data is an important and difficult problem in data analysis, which finds many applications, ranging from image compression to cancer detection.

In the past 20 years methods from the field of Topological Data Analysis (in particular, persistent Betti numbersand persistent homology), have successfully been used to develop estimations of fractal dimensions for metric spaces that have been shown to outperform existing methods. At the same time, in a distinct line of work, magnitude, a cardinality-like invariant of metric spaces introduced by Tom Leinster around 2010, has shown to be related to the Minkowski dimension of compact subsets of Euclidean space. More recently, through a connection established between the two fields, there have been new attempts to estimate fractal dimensions through the notion of persistent magnitude introduced by Govc-Hepworth.

In this talk I will first give an overview of the different approaches in TDA and magnitude theory to estimate fractal dimensions. I will then talk about the connection between the two fields and introduce persistent magnitude dimensions. Finally, I will discuss how these methods have the potential of helping address problems difficult to solve with more traditional approaches, such as the definition and estimation of fractal dimensions of relational models of data, such as network, hypergraphs or simplicial complexes.

The talk is partly based on joint work with Sara Kalisnik, Miguel OMalley, as well as Rayna Andreeva, Haydée Contreras-Peruyero, Sanjukta Krishnagopal, Maria Antonietta Pascali, Elizabeth Thompson.

Dylan Cant. *Persistence and contact geometry*
I will present an approach to obtaining persistence results for isotopies which preserve a contact structure. Applications include existence of fixed points in 1-parameter families. Most of the talk will be dedicated to a gentle introduction to the geometry of contact manifolds, and why contact isotopies are interesting and worthy of study.

Daniele Cannarsa. *Equivalence between approximate and full controllability for bilinear systems*
In this talk, I will explore a result where the study of orbit foliations associated with control systems leads to an equivalence between approximate controllability and full controllability. Specifically, I will discuss how this equivalence applies to bilinear control systems in $\mathbb{R}^n \setminus \{0\}$, providing insight into the controllability properties of such systems.This work was part of a collaboration with Mario Sigalotti and has been recently recognised in Systems & Control Letters.