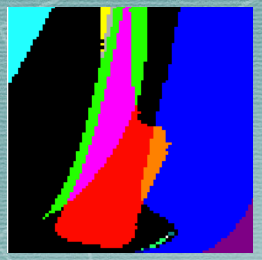
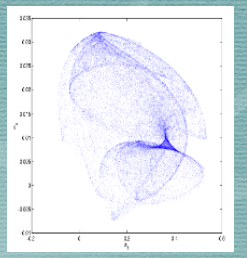


Workshop on "Computational math and applications"



Thursday Dec 15, 9.30-5pm, Hill 705

Organizers: Lisa Carbone, Shaun Harker and Linda Ness

Schedule, speakers and abstracts:

9.30am Konstantin Mischaikow: Computational Dynamics: Analysis, Lattices, Algebraic Topology, Algebraic Geometry

Abstract: I will give a high level talk that tries to show that

1) Understanding nonlinear systems requires computation

and

2) The types of computational tools span much of mathematics.

10.30pm - 11am Coffee

11am ***Shaun Harker: Computing Conley Indices and Connection Matrices for Spaces of Braids***

Abstract: The Conley-Morse approach to dynamics considers a Morse graph -- the Hasse diagram of a flow-defined partial order of isolating neighborhoods -- labelled with an invariant called Conley index. Nontrivial Conley indices indicate non-empty invariant sets. Additional information, taking the form of a connection matrix, relates the Conley indices between isolating neighborhoods. We exhibit the Conley-Morse approach to dynamical systems, along with connection matrix theory, on a computational example due to Ghrist, Van Den Berg, and Vandervorst where one can prove solution forcing results for a class of parabolic PDEs by applying Conley-Morse theory to systems of disentangling braids.

12pm - 1.30pm Lunch

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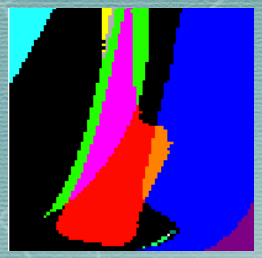

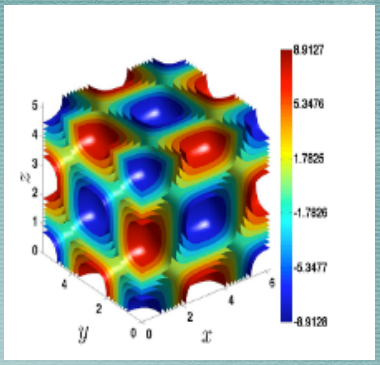

1.30pm ***Rachel Levanger: Studying fluid dynamics with persistent homology***

Abstract: Persistent homology is a very powerful tool used in the field of topological data analysis. With it, we are able to encode the geometry of complex and high-dimensional objects, such as images and point clouds, into a collection of points on the Euclidean plane, providing both a geometric summary and a great deal of dimensionality reduction. In this talk, we will discuss the basics of persistent homology and then explore its utility by looking at some applications to the study of fluid flows.

2.30 ***Scott Murray: Symbolic computer algebra, computer algebra systems, and applications***

Abstract: I will discuss algorithms for symbolic computation in algebra (ie, computations that don't involve numerical approximation). I will put this in the context of the development of integrated computer algebra systems such as Maple, Mathematica, Magma, GAP, and Sage. I will illustrate some of the basic techniques with examples of methods for computing with rings, groups and Lie algebras.

3.30pm - 4pm Coffee

4pm ***Doron Zeilberger: How to teach your computer to do research all on its own?***

Abstract: I will discuss several examples of deep research done by my computer (and collaborator), Shalosh B. Ekhad, using the Computer Algebra System Maple.

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