UC|UP MATH PhD Program

Research Seminar Program

UC|UP Joint PhD Program in Mathematics

Date: April 5th, 2019

Place: Room *17 de Abril*, Department of Mathematics, University of Coimbra

Program

11h00 - Reception

11h15 - Willian Ribeiro[1]: *Weak exponentiability in categories of lax algebras*

Abstract: We start this talk by recalling, motivating, and formalizing in categorical terms the concept of exponentials. Then moving to the particular case of the category Top of topological spaces and continuous functions, we comment on the alternatives to the non-existence of arbitrary exponentials. Weak exponentials are one of these alternatives, and using the (T,V) setting introduced by Clementino and Tholen, these objects are proven to exist not only in Top, but also in many other categories from Analysis and Topology, as (probabilistic) metric spaces, bitopological spaces, approach spaces, and multi-ordered spaces, which are all topological over the category Set of sets and maps.

12h00 - Carla Dias[2]: *Gibbs-Markov-Young structures and stochastic stability*

Abstract: In the 1960's, Sinai and Bowen showed that all smooth uniformly hyperbolic dynamical systems admit a finite Markov partition. Sinai, Ruelle and Bowen then used this remarkable geometric structure, and the associated symbolic coding of the system, to study ergodic properties such as the rate of decay of correlations. Some years ago, L.-S. Young proposed an alternative geometric structure, which we call Gibbs-Markov-Young (GMY) structure, as a way of studying the ergodic properties of certain dynamical systems. In this talk, we discuss the relation between GMY structure, Lyapunov exponents and stochastic stability in the setting of random perturbations. This is a joint work with J.F. Alves and H. Vilarinho.

Lunch Break

14h15 - Diogo Lobo[3]: *Image Restoration Models through Backpropagation on Medical Imaging*

Abstract: The use of neural networks for image processing tasks in the previous decade has set the pace of current research in this area. However, the general intrinsic "black box" nature of such algorithms is a drawback

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[2]Carla Dias is a post-doc researcher of CMUP, working at the University of Porto, in Dynamical Systems.

[3]Diogo Lobo is a PhD student of the Joint PhD Program UC|UP, working at the University of Coimbra, in Numerical Analysis, under the supervision of Professor Sílvia Barbeiro.

in the context of medical applications. We propose the use of deep learning techniques on already established non-linear diffusion schemes in order to optimize the parameters for each specific task. Consequently, we obtain improved image restoration models with good mathematical foundations. The learning framework and resulting models are presented along with related numerical results and image comparisons.

15h00 - Ahmed Elshafei[4]: *Geodesic completeness for Pseudo-Riemannian manifolds*

Abstract: We study geodesic completeness of pseudo-Riemannian Lie groups by applying techniques from complex dynamics. We recall that, for a semi-simple Lie group, a geodesic corresponds to an integral curve in the Lie algebra of the Euler-Arnold vector field. These vector fields are algebraic and homogeneous of degree 2 thus amenable to be studied by techniques from complex dynamical systems. We present a complete study for SL(2,R) and give some indication on the further application of the techniques to SL(2,C).

[4]Ahmed Elshafei is a PhD student of the Joint PhD Program UC|UP, working at the University of Porto, in Geometry, under the supervision of Professor Helena Reis.