Plenary Speakers

On Expansive Systems

Alexander Arbieto- TYAN Member (Federal University of Rio de Janeiro, Brazil)
Rio de Janeiro, Brazil

Abstract

In this talk we will present the theory of expansiveness for dynamical systems. We will show how the theory is well developed for homeomorphisms and diffeomorphisms, and we will relate it with the concept of entropy. We will show the advances for flows and explain how the theory still has open questions for flows with singularities. If the time allows, we will talk about some recent results for group actions.

Plenary talk 6:

Tuesday (November, 08), $14:30 - 15:30$

The unbalancing lights problem

Daniel Pellegrino - TYAN Member (Federal University of Paraíba)
João Pessoa, Brazil[1]

Abstract

The unbalancing lights problem (sometimes called Gale-Berlekamp switching game) consists of an $n \times n$ square matrix of light bulbs set up at an initial configuration Θ_n. The board (matrix) has n row and n column switches, which invert the on-off state of each bulb (on to off and off to on) in the corresponding row or column. Let $i(\Theta_n)$ denote the smallest final number of on-lights achievable by row and column switches starting from Θ_n. The goal is to find

$$R_n := \max\{i(\Theta_n) : \Theta_n \in \mathcal{P}\},$$

where $\mathcal{P}$ is the set of all 2^{n^2} initial configurations. We investigate upper and lower estimates for R_n. This talk is based in joint works with A. Raposo, J. Silva and E. Teixeira.

Plenary talk 8:

Tuesday (November, 09), $11:30 - 12:30$

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Sublinear type elliptic PDEs

Ederson Moreira dos Santos - Bas Member (ICMC/ University of São Paulo)
São Carlos, Brazil

Abstract

In this lecture I will address some questions regarding existence, uniqueness, qualitative properties and characterization of special solutions of elliptic PDEs, namely least energy solutions and least energy nodal solutions. I will be more focused on our recent contributions about sublinear type elliptic PDEs and show that some of these results can be set on a general framework on critical point theory.

Plenary talk 7:

Tuesday (November, 09), $10 : 30 - 11 : 30$

Understanding the regularity mechanism of nonlinear diffusion processes

Eduardo Teixeira -TYAN Member (University of Central Florida)
United States

Abstract

Nonlinear diffusion processes drive a plethora of fundamental phenomena in Nature, ranging from physics, to chemistry, biology and finances. A key feature of such models is that their corresponding regularity mechanisms are relatively mild in comparison to their linear counterparts. The mathematical manifestation of such a deficiency is the eventual lack of differentiability of solutions. In this talk, I will discuss a necessary condition on the " diffusion resistance" of the model as to attain C^1 regularity of solutions. Since C^1-estimate is a borderline regularity case, this is notoriously more difficult and the analysis requires several new ingredients, which will be discussed by geometric means.

Plenary talk 10:

Tuesday (November, 10), $14:30 - 15:30$

Survey of isospectral homogeneous Riemannian manifolds

Emílio Lauret (Instituto de Matemática de Bahía Blanca)
Argentina

Abstract

We will review several results on inverse spectral geometry in the setting of homogeneous Riemannian manifolds. Some key points will be Schueth's examples of continuous curves of isospectral left-invariant metrics on compact Lie groups, Sutton's construction of isospectral compact homogeneous Riemannian manifolds (as a generalization of Sunada-Pesce's method), and spectral isolation/uniqueness problems among $G-$invariant metrics on a fixed homogeneous space G/K.

Plenary talk 5:

Tuesday (November, 8), $13:30 - 14:30$

Self-organization at the origin of artificial life

Ernesto Lupercio - BYAN Member (Centro de Investigación y de Estudios Avanzados Del IPN)
Mexico

Abstract

In this talk, aimed at a general audience, we will do a very brief review of the fields of artificial life and self-organized criticality and finally see how the second informs the first, enhancing our understanding of biological systems. This talk is based on joint work with Kalinin and Shkolnikov, and with Cruz, Muñoz, Tabares, and Viafara.

Plenary talk 2:

Tuesday (November, 7), $13:30 - 14:30$

Decay of solutions to the Navier-Stokes equations

Gabriela Planas (Estadual University of Campinas)
Campinas, Brazil

Abstract

The Navier-Stokes equations describe the time evolution of the velocity of an incompressible fluid. The Fourier Splitting Method is the main tool for proving the energy decay of the solutions. In this talk, we will present some ideas behind this study and discuss recent results in critical Sobolev spaces.

Plenary talk 11:

Tuesday (November, 11), $14:30 - 15:30$

Transport theory and applications to fluid dynamics

Helena Nussenzveig Lopes - TWAS Award 2022 (Federal University of Rio de Janeiro)
Rio de Janeiro, Brazil

Abstract

The underpinning of classical theory of ODEs and transport equations is smooth vector fields. In seminal work, published in 1989, Ron DiPerna and Pierre-Louis Lions provided an extension of this theory to vector fields with Sobolev regularity. This was motivated in great part by problems in kinetic theory and in turbulence.

In this lecture we will introduce some of the main ideas and results from the DiPerna-Lions transport theory. We will then present and discuss applications in incompressible fluid dynamics connected to the mathematical modeling of turbulence.

Brief introduction to functional differential equations, dynamic equations on time scales and generalized ODEs

Jaqueline Godoy Mesquita - TYAN Member (University of Brazilia)
Brazilia, Brazil

Abstract

In this talk, I will give a brief introduction of functional differential equations, dynamic equations on time scales and generalized ODEs, as well as to present some applications that can be addressed using these equations.

Plenary talk 3:

Tuesday (November, 7), $14:30 - 15:30$

Geometric Bäcklund Transformations and Superposition Formulae for the hyperbolic and elliptic sine-Gordon and sinh-Gordon equations

Keti Tenenblat - TWAS Member (University of Brazilia)
Brazilia, Brazil

Abstract

We present a unified approach for the six cases of Bäcklund-type theorems for space-like or time-like surfaces, in the $3-$dimensional pseudo-Euclidean space. In each case, the surfaces have constant negative or positive Gaussian curvature and they correspond to solutions of the hyperbolic or elliptic sine-Gordon or sinh-Gordon equations. We discuss Bäcklund transformations and obtain superposition formulae for these equations. This procedure provides infinitely many solutions of the differential equations and it shows an unusual property for the elliptic equations. The Bäcklund transformation alternates solutions of the elliptic sinh-Gordon equation with those of the elliptic sine-Gordon equation and the superposition formula provides solutions of the same elliptic equation. Explicit examples and illustrations are included and the singularities of the solutions are briefly discussed. This talk is based on recent papers in collaboration with Filipe Kelmer and Luciana A. Rodrigues.

Plenary talk 1:

Tuesday (November, 7), $11:30 - 12:30$

The Borel map and the algebra of smooth solutions in locally integrable structures

Paulo Cordaro - TWAS Member (IME/University of São Paulo)
São Paulo, Brazil

Abstract

In this talk we shall present the concept of a locally integrable structure, the associate algebra of solutions, its Borel map and show how the algebraic properties of the Borel map induce analytic properties of the solutions. This is a long term research project developed in collaboration with B. Lamel (Qatar) and G. DellaSala (Lebanon).

Plenary talk 9:

Tuesday (November, 10), $11:30 - 12:30$

On packing of circles and spheres

Yoshiko Wakabayashi - BAS Member (IME/University of São Paulo)
São Paulo, Brazil

Abstract

Problems on packing of circles and spheres have attracted great attention of mathematicians and have been investigated for many centuries.

One of the oldest and most famous packing problems concerns a question on the densest possible arrangement of unit spheres in the 3-dimensional Euclidean space. A solution to this problem was conjectured by Kepler in 1611, but proved only in 2005 by Hales.

Except for the dimension 2 (solved by Fejes-Tóth, 1942), the corresponding problems in other dimensions remained open until 2017, when Maryna Viazovska, one of the Fields Medal winners 2022, solved in dimension 8. This breakthrough contributed to a solution in dimension 24 (Cohn, Kumar, Miller, Radchenko and Viazovska, 2017).

Many other types of packing problems have been considered in the literature. Some of them have attracted more attention of computer scientists, interested both in theoretical issues concerning their computational complexity, as well as more practical issues concerning the design of algorithms to solve them.

Most classical packing problems are NP-hard, and therefore unlikely to be solvable in polynomial time. In this talk we focus on one such problem: given a finite set of circles of different sizes, pack them into a smallest possible number of unit bins. We present an asymptotic polynomial-time approximation scheme for this problem (that can be extended to packing of spheres into cubes, and other related cases).

This is joint work with Flávio K. Miyazawa (Unicamp), Lehilton L.C. Pedrosa (Unicamp), Rafael C.S. Schouery (Unicamp) and Maxim Sviridenko (Yahoo Research).

Plenary talk 4:

Tuesday (November, 8), $11:30 - 12:30$