

BOOK OF ABSTRACTS

Invited Lectures

Convergence analysis of approximation hierarchies for polynomial optimization

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We consider the polynomial optimization problem, which asks to minimize a multivariate polynomial f over a compact semi-algebraic set K . Equivalently, this is asking to find a measure with positive density function, which minimizes the expected value of f over K . This is a hard problem, which has spurred a booming research activity in the past two decades, starting with seminal works by Lasserre and Parrilo in 2000 and onward. In a nutshell, results from real algebraic geometry about positive polynomials and from functional analysis about moments of measures are used to construct hierarchies of bounds that converge to the global minimum of f over K . These bounds are based on using sums-of-squares positivity certificates. While testing positivity of a polynomial is a hard computational problem, the key fact is that there exist efficient algorithms to search for sums of squares of polynomials.

In this lecture we will focus on hierarchies of upper bounds, that are obtained by selecting sums-of-squares density functions with growing degrees d . We will discuss several recent results about the convergence rate of these hierarchies. For general convex bodies K we can show a convergence rate in $O(1/d)$ and, for simpler sets like the hypercube, we can show a stronger convergence rate in $O(1/d^2)$. In addition this convergence analysis is tight, which relies on establishing links to orthogonal polynomials and their extremal roots.

This lecture is based on joint work with Etienne de Klerk.

Algebra and geometry in the study of enzymatic cascades

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In recent years, techniques from computational and real algebraic geometry have been successfully used to address mathematical challenges in systems biology. The algebraic theory of chemical reaction systems aims to understand their dynamic behavior by taking advantage of the inherent algebraic structure in the kinetic equations, and does not need a priori determination of the parameters, which can be theoretically or practically impossible.

I will give a gentle introduction to general results based on the network structure. In particular, I will describe a general framework for biological systems, called MESSI systems, that describe Modifications of type Enzyme-Substrate or Swap with Intermediates, and include many post-translational modification networks. I will also outline recent methods to address the important question of multi-stationarity, in particular in the study of enzymatic cascades, and will point out some of the mathematical challenges that arise from this application.

Reaction-diffusion equations, population and gender dynamics

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Reaction-diffusion models have been widely used to study fundamental questions in population dynamics. This type of partial differential equations provide a way to translate local assumptions regarding the movement, growth and interactions of the individuals of a species, into global features of the population giving us a theoretical framework for questions such as the persistence of a species, invasions, coexistence of competing populations. Different mathematical tools from nonlinear analysis and dynamical systems can be used to study the consequences of varying different population characteristics have in the long term dynamics.

In this talk we will study competitive reaction-diffusion systems of the form:

$$\begin{cases} \frac{\partial u}{\partial t} = Lu + u(m(x) - u - bv) & \text{in } \Omega, t > 0, \\ \frac{\partial v}{\partial t} = Mv + v(m(x) - cu - v) & \text{in } \Omega, t > 0, \\ \nabla \frac{u}{m} \cdot \hat{n} = \nabla v \cdot \hat{n} = 0 & \text{on } \partial\Omega, t > 0, \end{cases}$$

with u, v representing the densities of two competing populations in an isolated habitat Ω , $a(x)$ the space dependent per-capita growth rate, $b, c > 0$ accounting for competition coefficients, and L and M elliptic operators accounting for the dispersal strategies of each species. In particular, we will discuss how the relationship between population dispersal and competition affects the persistence, dispersal and coexistence of the species.

In this talk we will also explore some issues related to the persistence and dispersal of women in STEM in an environment where they account for less than 17% of the population. I will share how

we have been able to significantly grow and thrive through the formation and strengthening of networks and alliances. In particular, we will discuss the process that led to the creation of the Direction for Diversity and Gender, the first in a Faculty of Sciences, Math, and Engineering in Chile, which I currently lead.

Revisiting the Contact Process

Maria Eulalia Vares¹

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Introduced by T. Harris more than forty years ago, the classical contact process is a simple stochastic model to describe the propagation of an infection in a population, where the individuals sit on the vertices of a graph, also called sites. It can be thought as a Markov process on the space of subsets of the set of all sites, identifying the state "infected" or "healthy" of each individual. Its description is simple and in the most natural examples the model shows interesting features, like dynamical phase transition and metastability, which have been precisely described. This process can be described through paths in a random space-time graph, also called Harris system. Several variations have been considered recently, including the case where the sites are given by the vertices of a random graph, or the contact process with two types of individuals. In this talk I would like to describe another variation, where one loses the Markov property but for which the investigation of phase transition, thought in terms of percolation properties, remains interesting. This is based on joint work with L.R. Fontes, D. Marchetti, and T. Mountford. If time allows I would like to discuss features of the metastable behavior of a contact process with two types of individuals, and which is work done by my PhD student at UFRJ, Mariela P. Machado.

Why Mathematics is changing the world

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Mathematics has always been key to help understanding the world in which we live. But it is becoming more and more one of the key technologies to change and improve it, and to foster innovation. Mathematics is behind most of the important recent technological developments. This is due to the increasing complexity of the processes that need to be described and understood. The use of sophisticated mathematics together with advanced algorithms lead to efficient and robust methods to solve problems that would be out or reach otherwise. This lecture will be devoted to the presentation of examples showing the strength of the mathematical technologies behind this immense success.

Mathematical Posters

C_6 -decomposition of the tensor product of complete graphs

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Let G be a simple and finite graph. A graph is decomposed into subgraphs H_1 and H_2 , if G is the edge disjoint union of H_1 and H_2 . If G is decomposed into H_1, H_2, \dots, H_k , where H_1, H_2, \dots, H_k are all isomorphic to H , then G is said to be H -decomposable. Furthermore, if H is a cycle of length m then G is C_m -decomposable. In this work, we prove the necessary conditions for the existence of C_6 -decomposition of $K_m \times K_n$ are sufficient. We infer from these conditions that every even regular complete multipartite graph is C_6 -decomposable if the number of edges of G is divisible by 6.

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A topological lower bound for the energy of a unit vector field on a closed hypersurface of the Euclidean space

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For a unit vector field on a closed immersed Euclidean hypersurface M^{2n+1} , $n \geq 1$, we exhibit a nontrivial lower bound for its energy which depends on the degree of the Gauss map of the immersion. When the hypersurface is the unit sphere \mathbb{S}^{2n+1} , immersed with degree one, this lower bound corresponds to a well established value from the literature. We introduce a list of functionals \mathcal{B}_k on a compact Riemannian manifold M^m , $1 \leq k \leq m$, and show that, when the underlying manifold is a closed hypersurface, these functionals possess similar properties regarding the degree of the immersion. In addition, in the original paper, we prove that Hopf flows minimize \mathcal{B}_n on \mathbb{S}^{2n+1} .

We notice that the aforementioned lower bound for the energy for a unit vector field on a closed oriented Euclidean hypersurface M^{2n+1} is

$$E(\vec{\nu}) \geq C(n) \frac{|\deg(\nu)| \text{vol}(\mathbb{S}^{2n+1})}{S^{[2n-1]}} + \frac{2n+1}{2} \text{vol}(M^{2n+1}),$$

where $S^{[2n-1]}$ and $C(n)$ are constants depending on the immersion of M and on n .

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On representation and character varieties of some one-relator groups

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Let $G = \langle x_1, x_2, \dots, x_g \rangle$ be a finitely generated group and K be an algebraically closed field with zero characteristic. The set of homomorphisms $\text{Hom}(G, GL_n(K))$ has a natural structure of an affine K -variety and is denoted by $R_n(G)$. It is called the representation variety of the group G . The group $GL_n(K)$ acts on $R_n(G)$ by conjugation and the corresponding category factor $R_n(G)/G$ is denoted by $X_n(G)$ and called the character variety of the group G .

Let p, q, g, h be integers such that $p > |q| \geq 1, g \geq 3, h \geq 2$ and let $W(x_1, \dots, x_s)$ be an arbitrary word on generators x_1, \dots, x_s . We consider the groups with the following presentations:

$$\begin{aligned} G_1 &= \langle (x_1, x_2, \dots, x_g, t) \mid t(x_1^2 x_2^2 \dots x_g^2)^p t^{-1} = (x_1^2 x_2^2 \dots x_g^2)^q \rangle \\ G_2 &= \langle (x_1, \dots, x_s, y_1, \dots, y_h, z_1, \dots, z_h, t) \mid \\ &\quad t([y_1, z_1] \dots [y_h, z_h] W(x_1, \dots, x_s))^p t^{-1} = \\ &\quad = ([y_1, z_1] \dots [y_h, z_h] W(x_1, \dots, x_s))^q \rangle, \end{aligned}$$

The description is given for representation varieties $R_n(G_1), R_n(G_2)$ and character varieties $X_n(G_1), X_n(G_2)$. Their irreducible components are described and their dimensions are calculated.

Kingman's theorem for uniquely ergodic systems

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In 1931, Birkhoff proved one of the most important theorems of the ergodic theory [1]. Namely, given an ergodic system (X, μ, T) , the time average, or the average along a trajectory, exists almost everywhere. That is

$$\lim_{n \rightarrow \infty} \frac{f(x) + f(Tx) + \cdots + f(T^{n-1}x)}{n} = \int_X f(x) d\mu(x),$$

for any integrable function $f : X \rightarrow \mathbb{R}$. This result is known as *pointwise ergodic theorem*. When (X, μ, T) is a *uniquely ergodic system* the convergence is uniform on X , see [4].

In 1968, Kingman showed his *subadditive ergodic theorem* [2], that asserts that, given any subadditive sequence $\{f_n\}$ in $L^1(X, \mu)$, the sequence $\{\frac{f_n}{n}\}$ converges to a constant $L(f)$, for almost all x .

A natural question is: is there an analogous result for Kingman's theorem? That is, if we consider a unique ergodic system (X, μ, T) , we have uniform convergence in Kingman's Theorem? Answer that question was the work proposed by Furstenberg to Furman [3].

The main objective of this work is to show the results obtained by Furman in [3]. That is, obtain a version of Kingman's theorem for the case of uniquely ergodic systems.

More precisely,

Theorem 1 (Furman, 1997). *Let (X, μ, T) be a compact uniquely ergodic system and let $\{f_n\}$ be a sequence of continuous subadditive functions on X . Then, for every $x \in X$*

$$\limsup_{n \rightarrow \infty} \frac{1}{n} f_n(x) \leq L(f)$$

uniformly on X . However, for any F_σ set E with $\mu(E) = 0$, there exist a continuous subadditive sequence $\{f_n\}$, such that

$$\limsup_{n \rightarrow \infty} \frac{1}{n} f_n(x) < L(f).$$

Several consequences of Furman's theorem will be presented.

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On the sum of powers of terms of a linear recurrence sequence

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Let $(F_n)_{n \geq 0}$ be the Fibonacci sequence given by $F_{n+2} = F_{n+1} + F_n$, for $n \geq 0$, where $F_0 = 0$ and $F_1 = 1$. There are several interesting identities involving this sequence such as $F_n^2 + F_{n+1}^2 = F_{2n+1}$, for all $n \geq 0$. In a paper of 2011, Luca and Oyono proved that if $F_n^s + F_{n+1}^s$ is a Fibonacci number, with $s \geq 3$, then $n = 0$ or 1 . In this work, we will prove, in particular, that if $(G_m)_m$ is a linear recurrence sequence (under weak assumptions) and $G_n^s + \dots + G_{n+k}^s \in (G_m)_m$, for infinitely many positive integers n , then s is bounded by an effectively computable constant depending only on k and the parameters of G_m .

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Flowers in Geometry

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In the poster I will present different kinds of curves and surfaces in mathematics that look like flowers in nature. There will be given geometric characteristics of rose curves and surfaces, as well as some others that have shape like a flower. The construction of such surfaces is inspired by nature, and it has application in design and architecture. Some examples will be visualised.

References

- [1] HERE YOU PUT THE NAME OF THE AUTHORS , *the title of your reference* , the journal's name

Bounds for maximal operators arising from a geometric problem

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A problem recently studied in [1] and [2] is the relation between sizes of sets $B, S \subseteq \mathbb{R}^2$ when B contains the boundary of a square with center in every point of S and sides parallel to the axis. By size, we mean Lebesgue measure and some fractal dimensions. More generally, in higher dimensions the sets consider are $B, S \subseteq \mathbb{R}^n$ when B contains the k -skeleton of an n -dimensional cube around every point of S .

This type of problems have associated a maximal operator. In this work we study a possible maximal operator and present results about its behaviour from $L^p \rightarrow L^q$, for $1 \leq p \leq q < \infty$. Also we consider some weighted inequalities. With this bounds we recover several results for the sizes of sets B .

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Multistationarity Analysis of the Earth's Pre-industrial Carbon Cycle Models using Chemical Reaction Network Theory

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ABSTRACT

Chemical reaction networks (CRNs) provide a language for representing systems of interacting entities. In this paper, the pre-industrial carbon cycle models of Schmitz (2002) and Anderies et al. (2013) are viewed and analyzed using CRNs. In this framework, we assess the models' capacity for multiple steady states or multistationarity via Chemical Reaction Network Theory – an approach that associates the topological structure of the CRN to the dynamical behavior of the network. The findings obtained here enhance the results established in the recent papers submitted by Fortun et al., which characterized the steady states of the aforementioned pre-industrial carbon cycle models.

An eigenvalue optimization problem

Anisa M. H. Chorwadwala and Souvik Roy

December 7, 2017

Abstract

We deal with the following eigenvalue optimization problem: Given a bounded open disk B in a plane, how to place an obstacle P of fixed shape and size within B so as to maximize or minimize the fundamental eigenvalue λ_1 of the Dirichlet Laplacian on $B \setminus P$. This means that we want to extremize the function $\rho \rightarrow \lambda_1(B \setminus \rho(P))$, where ρ runs over the set of rigid motions such that $\rho(P) \subset B$. We answer this problem in the case where P is invariant under the action of a dihedral group D_{2n} , and where the distance from the center of the obstacle P to the boundary is monotonous as a function of the argument between two axes of symmetry. The extremal configurations correspond to the cases where the axes of symmetry of P coincide with a diameter of B . The maximizing and the minimizing configurations are identified.

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Finite-time boundedness and dissipativity analysis of discrete-time repeated scalar nonlinear systems

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In this paper, finite-time boundedness and dissipativity analysis for a class of discrete-time repeated scalar nonlinear systems with time-varying delays is investigated. Based on the Lyapunov-Krasovskii stability theory and linear matrix inequality (LMI) approach, we propose the sufficient conditions for the considered system to be finite time bounded and finite-time dissipative. Finally, the LMI based conditions are validated for a marketing-production system.

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On a boundary value problem with a natural condition

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This talk concerns the existence of solutions for a nonlinear higher order fractional differential equation involving both the left Riemann-Liouville and the right Caputo fractional derivatives with a natural boundary condition. The study is based on the upper and lower solutions method.

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The Nielsen fixed point theory for 2-valued maps on the Klein-bottle

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The problem treated in this work is if a space has the Wecken property for n -valued maps. Analogous as to the classic theory for single valued function and similarly the Wecken property holds for compact triangulable manifolds of dimension at least three. For compact surfaces J. Guaschi and D. L. Gonçalves developed in [GG1] an algebraic criterion in terms of braid groups, using the fixed point theory of maps between the surface X and its configuration spaces. We use this approach to study the fixed point theory of 2-valued maps on the Klein bottle.

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P-Chain Codes

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Let P be a partially ordered set on the set of ordered coordinate positions of \mathbb{F}_q^n . A P -linear code C is a vector subspace of the metric space (\mathbb{F}_q^n, d_P) which we refer to as an $[n, k]_q$ P -code if $\dim C = k$. The P -weight of a subspace $D \subseteq \mathbb{F}_q^n$ is defined as $w_P(D) := |\langle \text{supp} D \rangle_P|$ and the r -th minimal generalized P -weight of an $[n, k]_q$ P -code C as

$$d_r^P(C) = \min\{w_P(D) \mid D \subseteq C, \dim D = r\}.$$

An $[n, k]_q$ P -code C is said to be a P -chain code if there is a sequence of linear subspaces $\{0\} = D_0 \subseteq D_1 \subseteq \dots \subseteq D_k = C$ such that $w_P(D_r) = d_r^P(C)$ and $\dim D_r = r$ for every $r \in \{1, 2, \dots, k\}$. In this work, we present some sufficient conditions for a P -code to be a P -chain code based on the previous work by Moura and Firer.

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On the discriminator of Lucas sequences

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The *discriminator* of a sequence $\mathbf{a} = \{a_n\}_{n \geq 1}$ of distinct integers is the sequence given by

$$\mathcal{D}_{\mathbf{a}}(n) = \min\{m : a_0, \dots, a_{n-1} \text{ are pairwise distinct modulo } m\}.$$

In other words, $\mathcal{D}_{\mathbf{a}}(n)$ is the smallest integer m that allows one to discriminate (tell apart) the integers a_0, \dots, a_{n-1} on reducing modulo m .

The main problem is to give an easy description or characterization of the discriminator (in many cases such a characterization does not seem to exist). The discriminator was named and introduced by Arnold, Benkoski and McCabe. They considered the sequence \mathbf{u} with terms $u_j = j^2$.

In this paper we study the discriminator problem for Lucas sequences. We consider the family of Lucas sequences uniquely determined by $U_{n+2}(k) = (4k+2)U_{n+1}(k) - U_n(k)$, with initial values $U_0(k) = 0$ and $U_1(k) = 1$ and $k \geq 1$ an arbitrary integer. For any integer $n \geq 1$ the discriminator function $\mathcal{D}_k(n)$ of $U_n(k)$ is defined as the smallest integer m such that $U_0(k), U_1(k), \dots, U_{n-1}(k)$ are pairwise incongruent modulo m . Numerical work of Shallit on $\mathcal{D}_k(n)$ suggests that it has a relatively simple characterization. In this paper we will prove that this is indeed the case by showing that for every $k \geq 1$ there is a constant n_k such that $\mathcal{D}_k(n)$ has a simple characterization for every $n \geq n_k$. The case $k = 1$ turns out to be fundamentally different from the case $k > 1$.

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Insensitizing Controls for a Phase Change Model

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In this work it is treated a insensitizing problem for a phase transition model introduced in [2] and treated by Hoffman & Jiang in [3] and Barbu in [1]. In this paper, a nonlinear parabolic system modeling phase field phenomena is considered. This system consists of two coupled parabolic equations, the first one describes the temperature of the material and the second one describes a phase field function. Under small perturbations of the initial data, we study the existence of controls insensitizing the phase field function and acting only on the temperature equation. This problem is equivalent to the null controllability of a parabolic system, which is studied by means of duality arguments, Carleman estimates, and fixed point theorems.

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**Self-similar measures: asymptotic bounds for the dimension and
Fourier decay of smooth images**

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R. Kaufman and M. Tsujii proved that the Fourier transform of self-similar measures has a power decay outside of a sparse set of frequencies. We present a version of this result for homogeneous self-similar measures, with quantitative estimates, and derive several applications: (1) non-linear smooth images of homogeneous self-similar measures have a power Fourier decay, (2) convolving with a homogeneous self-similar measure increases correlation dimension by a quantitative amount, (3) the dimension and Frostman exponent of (biased) Bernoulli convolutions tend to 1 as the contraction ratio tends to 1, at an explicit quantitative rate.

The results are based on a joint work with Pablo Shmerkin.

A Tale of Two Cones

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Abstract. The relationship between the cone of positive semidefinite (psd) real forms and its subcone of sum of squares (sos) of forms is of fundamental importance in real algebraic geometry and optimization, and has been studied extensively. The study of this relationship goes back to the 1888 seminal paper of Hilbert [3], where he gave a complete characterisation of the pairs $(n, 2d)$ for which a psd n -ary $2d$ -ic form can be written as sos. This poster will show how this relationship changes under the additional assumptions of symmetry on the given form; it will present our recent results [1, 2] giving the analogues of Hilbert's characterisation for symmetric and even symmetric forms respectively.

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Existence and symmetries for an elliptic equations with multipolar potentials and polyharmonic operators

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Differential equations with multipolar potentials appear in various areas of physics; for example, in molecular physics models and quantum mechanics [1, 3, 4]. We analyzed existence and symmetry of solutions for the following equation:

$$\begin{cases} (-\Delta)^m u = u|u|^{p-1} + V(x)u + f, & \text{in } \mathbb{R}^n, \\ u \rightarrow 0 & \text{as } |x| \rightarrow \infty, \end{cases} \quad (1)$$

with $m \in \mathbb{N}$, $n > 2m$, and $p > \frac{n}{n-2m}$. Note that the condition taken on p covers the critical and supercritical variational cases.

This study was developed in $\mathcal{H}_{k,\vec{\alpha}}$ -spaces, which are a sum of weighted spaces, and seem to be a minimal framework for the potential profile of interest. We investigate a concept of symmetry for solutions which extends radial symmetry and carries out an idea of invariance around singularities. Our results were published in [2].

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Toda Lattices and Orthogonal Polynomials in Two Variables

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We explore the connection between an infinite system of particles in \mathbb{R}^2 described by a bi-dimensional version of the Toda equations with the theory of orthogonal polynomials in two variables. We define a 2D Toda lattice in the sense that we consider only one time variable and two space variables describing a mesh of interacting particles over the plane. We show that this 2D Toda lattice is related with the matrix coefficients of the three term relations of bivariate orthogonal polynomials associated with an exponential modification of a positive measure. Moreover, block Lax pairs for 2D Toda lattices are deduced.

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Homological Tools in Dynamical Systems

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Our goal is to present a topological context fruitful in obtaining information on the behaviour of a wide range of dynamical systems. The overarching idea is to define an appropriate filtered chain complex which captures connections between the invariant sets of the system. We consider as our major algebraic apparatus a spectral sequence of the given complex. The unfolding of the spectral sequence exhibits a rich algebraic procedure and provides much insight into dynamical properties of a continuation of the dynamical systems being studied, such as bifurcation phenomena due the cancellation of singularities.

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Fluid Limit for the aggregation phase of condensing zero range process.

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In this work we prove that the first phase of coarsening in the condensing zero range process on a finite number of sites with N particles, as N tends to infinity, is described by a fluid limit, when time is appropriately rescaled. According to this limit, in a finite time determined by the initial distribution of particles, the process reaches a state in which mass concentrates at the sites having maximal weight under the invariant measure of the underlying random walk.

CODIMENSION ONE PARTIALLY UMBILIC SINGULARITIES OF HYPERSURFACES OF \mathbb{R}^4

D. LOPES, J. SOTOMAYOR AND R. GARCIA

This talk is about the mutually orthogonal one dimensional singular foliations, in oriented three dimensional manifolds M^3 , whose leaves are the integral curves of the principal curvature direction fields associated to immersions $\alpha : M^3 \rightarrow \mathbb{R}^4$. We focus on behavior of these foliations around singularities defined by the points, called partially umbilic, where at least two principal curvature coincide. It will be described the generic behavior of the foliations in the neighborhood of partially umbilic points of codimension one. These are the singularities which appear generically in one parameter families of hypersurfaces. We express the codimension one condition by minimally weakening the genericity condition given by R. Garcia, D. Lopes e J. Sotomayor in Partially Umbilic Singularities of Hypersurfaces of \mathbb{R}^4 . Bulletin des Sciences Mathematiques (Paris. 1885), v. 139, p. 431-472, (2015)

Riesz Bases of Exponentials on Unbounded Multi-Tiles

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Let $\Omega \subset \mathbb{R}^d$ be a set of positive and finite measure and Γ be a discrete set of \mathbb{R}^d . The existence of bases of exponentials of the form $E(\Gamma) = \{e^{2\pi i\gamma \cdot \omega} : \gamma \in \Gamma\}$ in the space $L^2(\Omega)$ is a very well studied problem.

Recently, Grepstad and Lev, and later Kolountzakis, showed that if Ω is a *bounded* set such that k -tiles the space by translations along a full lattice $\Lambda \subset \mathbb{R}^d$, then there exist vectors $a_1, \dots, a_k \in \mathbb{R}^d$ such that the system $E(H, a_1, \dots, a_k) := \{e^{2\pi i(h+a_j) \cdot \omega} : h \in H, j = 1, \dots, k\}$ is a Riesz basis of exponentials of $L^2(\Omega)$, where H is the dual lattice of Λ . Here, by k -tile we mean that for almost every $\omega \in \mathbb{R}^d$,

$$\sum_{\lambda \in \Lambda} \chi_{\Omega}(\omega + \lambda) = k.$$

However, this result is not true if Ω is not bounded. In this poster I will present a recent result in joint work with Carlos Cabrelli where sufficient conditions for Ω , of positive and finite measure, *not necessarily bounded*, are found to admit a Riesz basis of exponentials of the form $E(H, a_1, \dots, a_k)$ of $L^2(\Omega)$.

Optimal distributed control for the oscillation processes described by Fredholm integro-differential equations

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We consider the optimization problem in which it is required to minimize the integral functional

$$J[u(t, x)] = \int_Q \{[V(T, x) - \xi_1(x)]^2 + [V_t(T, x) - \xi_2(x)]^2\} dx + \\ + \beta \int_0^T \int_Q p^2[t, x, u(t, x)] dx dt, \quad \beta > 0, \quad (1)$$

on the set of solutions to boundary value problem

$$V_{tt} - AV = \lambda \int_0^T K(t, \tau) V(\tau, x) d\tau + f[t, x, u(t, x)], \\ x \in Q \subset R^n, \quad 0 < t \leq T, \\ V(0, x) = \psi_1(x), \quad V_t(0, x) = \psi_2(x), \quad x \in Q, \quad (2) \\ \Gamma V(t, x) \equiv \sum_{i,j=1,n}^n a_{ij}(x) V_{x_j}(t, x) \cos(\delta, x_i) + a(x) V(t, x) = 0, \\ x \in \gamma, \quad 0 < t \leq T.$$

Here A is the elliptic operator, δ is a normal vector, emanating from the point $x \in \gamma$; $K(t, \tau)$ is a given function defined in the region $D = \{0 \leq t \leq T, \quad 0 \leq \tau \leq T\}$ and satisfying the condition

$$\int_0^T \int_0^T K^2(t, \tau) d\tau dt = K_0 < \infty,$$

$\psi_1(x) \in H_1(Q)$, $\psi_2(x) \in H(Q)$, $\xi_1(x) \in H_1(Q)$, $\xi_2(x) \in H(Q)$, $p[t, x, u(t, x)] \in H(Q_T)$ are given functions; the function external source $f[t, x, u(t, x)] \in H(Q_T)$ depends nonlinearly from the control

function $u(t, x) \in H(Q_T)$ and $f_u[t, x, u(t, x)] \neq 0$, $\forall (t, x) \in Q_T$; λ is a parameter, T is a fixed moment of time and $\alpha > 0$ is a constant.

Algorithm for constructing of the solutions of nonlinear optimization problems was developed. The developed method of solving nonlinear optimization is constructive and scientific results can be used in applications.

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Mathematics and Image decomposition

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Grayscale images can be realized as a graph of a discrete function $f : \Omega \subset \mathbb{R}^2 \rightarrow \mathbb{R}$, that consists of discrete pixels, which, for mathematical analysis, is expected to be an $L^2(\Omega)$ function. The image degradations are due, firstly to the sensor and secondly to the shooting conditions. The problem of obtaining the “clean/clear” image U from an observed image f is an ill-posed problem, leading to image decomposition. In this work, we present a decomposition of an image, into a sum $u+v$, where the first component u is the structure part and the second component v represents the strongly oscillating part of the image (texture and noise), in order to achieve the restoration of a degraded image f . Motivated by the fact that the bounded variation $(BV; L^1)$ decomposition is more suitable for extracting local scale-space features than $(BV; L^2)$, we propose a new approach for an integro differential model, depending on modifications to the curvature term. Our approach combines a model proposed by Tadmor et al (2011), using an integro differential equation and a projection residual technique on a Banach space to preserve textures by making use of a technique due to Nouri et al (2016). For validation of the our theoretical study, a numerical technique based on a finite element scheme is used and numerical results are presented.

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Multi-type repulsion models and their applications

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We consider a class of models from Statistical Mechanics generalizing the well-known Widom-Rowlinson model. Our models are set on a triangular lattice in 2D and an FCC lattice in 3D. There are q types of particles characterized by (Euclidean) exclusion distances. We study the structure of extreme periodic Gibbs measures and their connections with the ground states. Based on the theoretical results, a Markov process is constructed, in the space of admissible configurations.

We also present an application of our results in a mathematical biology context where particles are interpreted as cells and the introduced stochastic dynamics covers cell birth, death, migration and mutation. Numerical simulations have been conducted and their results used in a number of applied domains, including tumor growth modelling. We will demonstrate degrees of agreement with biological experiments conducted with various co-cultures of healthy and cancer cells focusing on different aspects of cancer spread phenomena.

Shadowing and topological entropy of induced Morse-Smale diffeomorphisms

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It is well known that every map $f : X \rightarrow X$ on a continuum space X induces of a natural way, the induced map $C(f) : C(X) \rightarrow C(X)$ on the hyperspace of all nonempty and subcontinuum of X , defined as $C(f)(A) = f(A)$ for all $A \in C(X)$. We study relationships between f and its induced map $C(f)$, mainly shadowing and topological entropy.

In 2016, Good and Fernández showed that if the continuum map $C(f)$ has the shadowing property then f has shadowing too. The Morse-Smale diffeomorphisms on S^1 are examples of dynamical systems with the shadowing property and we show the following:

Theorem A. Let $f : S^1 \rightarrow S^1$ be a Morse-Smale diffeomorphism. Then the continuum map $C(f)$ does not have the shadowing property.

In 1975, Bauer and Sigmund showed that if f has positive topological entropy then the induced map $C(f)$ has positive entropy too. We show that dynamical systems with zero topological entropy could generate positive topological entropy on the hyperspace as we can see in the following:

Theorem B. Let $f : M \rightarrow M$ be a Morse-Smale diffeomorphism then the topological entropy of its induced map $C(f)$ is zero or infinite.

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Statistical Analysis of Impact of Micro Hydro on the Status of Women in the Households of Renewable Energy Users - with examples from Nepal

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For sustaining the rapid pace of development, energy is needed. But depleting supply of natural reserves of fossil fuels has compelled us to search for alternative and renewable source of energy. In countries like Nepal women spend several hours in the collection of firewood and in kitchens with firewood stoves. Micro hydro project is a source of renewable energy where the current in the natural rivers emerging out of the Himalayan ranges is utilized for electricity generation. A data based study of the extent of financial benefits and health benefits from the use of renewable energy to women in particular and family in general is done here using statistical methods. Family dynamics in general and the role of women in particular in this energy consumption landscape is minutely analyzed. Such results are of great significance to policy makers and planners for making appropriate decisions.

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On Crossing Piecewise Linear Vector Fields

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A large number of problems from mechanics, electrical engineering and the theory of control are described by piecewise smooth systems, [1]. It is well known that planar linear systems can have at most 10 distinct phase portraits and no limit cycles. However, it is not true for piecewise linear system, [2, 3, 4]. Motivated by this, we obtain normal forms for crossing piecewise linear systems on \mathbb{R}^2 having a straight line as the set of discontinuity and we sketch the bifurcation diagrams for the particular case when both systems have the origin as an isolated equilibrium point.

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Some results on generalized Hartshorne's conjecture and local cohomology modules

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Let \mathfrak{a} denote an ideal of a commutative Noetherian ring R . Let M and N be two R -modules. In this poster, we give partial answers on the extension of Hartshorne's conjecture about the cofiniteness of torsion and extension functors.

For this purpose, we study the cofiniteness of the generalized local cohomology module $H_{\mathfrak{a}}^i(M, N)$ for a new class of modules, called \mathfrak{a} -weakly finite modules, in the local and non-local case.

On fluid–structure interactions with the Coulomb friction law boundary condition

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We propose a new model in a fluid–structure interaction system composed by a rigid body and a viscous incompressible fluid using a boundary condition governed by the Coulomb friction law. With this boundary condition, the fluid can slip on the boundary if the tangential component of the stress tensor is too large. In the opposite case, we recover the standard Dirichlet boundary condition. The governing equations are the Navier–Stokes system for the fluid and the Newton laws for the rigid body. The corresponding coupled system can be written as a variational inequality. We prove that there exists a weak solution of this system.

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Color Symmetry Groups of Philippine Indigenous Textiles

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The Philippine archipelago is home to various indigenous communities, some of which have distinct weaving cultures. The poster will provide a mathematical analysis of woven multicolored textiles by indigenous communities in Northern Luzon, Muslim Mindanao and non-Muslim Mindanao. Our analysis involves studying the color group associated with a colored design or pattern in textile. The color group consists of the symmetries of the uncolored design or pattern that effect a permutation of the colors. A summary of the symmetry groups and color groups of a sampling of planar and frieze patterns and finite designs in textiles will be given. The sampling is obtained from well-known museums in Philippines, existing literature on Philippine textiles, and collections of scholars. The woven textiles studied result from three weaving techniques employed by the indigenous communities, namely, the decorative dyeing, decorative weaving and supplementary thread techniques.

The tendency of a particular symmetry to be more or less common than another can indicate relationships between the color symmetries, the culture that produced the textile and the weaving technique. For instance, the Tbolis from non-Muslim Mindanao use three shades of colors manifesting their dreams, myths and beliefs through their T'nalak cloth. On the other hand, the Tinguians from Northern Luzon use two shades of color to create optical patterns to ward off bad spirits. Moreover, the Yakans and Tausugs from Muslim Mindanao use colorful multicolored motifs to create highly color symmetric repeated patterns in celebration of bravery in battle and joy in marriage rituals.

Singular Hyperbolicity and Sectional Lyapunov Exponents of Various Orders

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We propose notions of singular hyperbolicity and sectional Lyapunov exponents of orders beyond the classical ones, namely, other dimensions besides the dimension 2 and the full dimension of the central subbundle of the singular hyperbolic set. It is obtained a characterization of dominated splittings, partial and singular hyperbolicity in this broad sense, by using Lyapunov exponents and the notion of infinitesimal Lyapunov functions . Furthermore, it is given alternative requirements to obtain singular hyperbolicity. As an application we obtain some results related to singular hyperbolic sets for flows.

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Lattices applied to communication problems

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Inside the area of Information Theory, started with Claude Shannon in 1948, lies the study of codes in the context of lattices and other discrete constellations for applications in coding, decoding and quantization. In this sense, the idea of this talk is to present a special construction of lattices and constellations based on the known *Construction C* and to explore lattice decoding in distributed network systems.

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Wind-tree dynamics

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The set of all possible configurations of the Ehrenfest wind-tree model endowed with the Hausdorff topology is a compact metric space. For a typical configuration we show that the wind-tree has interesting dynamics: it is minimal, ergodic and has infinite ergodic index in almost every direction. In particular some ergodic theorems can be applied to show that if we start with a large number of initially parallel particles their directions decorrelate as the dynamics evolve answering the question posed by the Ehrenfests.

Multiobjective approaches for Cutting & Packing problems

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The decisions associated to cutting and packing problems (C&P) are taken considering a set of conflicting objectives and in general, there is not a single solution that attends all of them. In contrast to the monoobjective version, the multiobjective C&P has received little attention in the literature. In this talk, we review current research addressing the problem from the multiobjective perspective. We also present recent results of a branch-cut-and-price approach to solve the biobjective two-dimensional cutting stock problem.

A Posteriori Error Analysis of Mixed Finite Elements for Degenerate Elliptic Problems

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Let $\Omega \in \mathbb{R}^n$ be a bounded Lipschitz polytope and a be a non-negative measurable function. Given $g \in L^2(\Omega)$. We consider:

$$\begin{cases} -\operatorname{div}(a\nabla u) = g & \text{in } \Omega \\ u = 0 & \text{on } \partial\Omega \end{cases}$$

We are interested in degenerate problems in the sense that the coefficient a can become infinite or zero in subsets of $\bar{\Omega}$.

Assuming that a belongs to the Muckenhoupt class A_2 , we generalize to the degenerate case the work by M. Vohralik [2] for uniform elliptic problems. In this way we introduce and analyze a posteriori error estimators for the Raviart-Thomas approximation [1].

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Decay rates for a plate equation with a fractional dissipative memory term

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We consider the asymptotic behavior of a linear plate equation with effects of a rotational inertia and an intermediary damping in the memory term. The fractional damping depends on a parameter θ that satisfies $0 \leq \theta \leq 1$. We show the explicit decay rate of the solution and also that the decay rate is optimal.

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Bounds for the number of \mathbb{F}_q -rational points of

$$aX^nY^n - X^n - Y^n + b = 0$$

and chords of an affinely regular polygon inscribed in a hyperbola

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Let \mathcal{G} be the projective plane curve defined over \mathbb{F}_q , with affine equation given by

$$aX^nY^n - X^n - Y^n + b = 0,$$

and for each $s \in \{2, \dots, n-1\}$, let $\mathcal{D}_s^{P_1, P_2}$ be the base-point-free linear series cut out on \mathcal{G} by the linear system of all curves of degree s passing through the singular points $P_1 = (1 : 0 : 0)$ and $P_2 = (0 : 1 : 0)$ of \mathcal{G} . The present work determines an upper bound for the number $N_q(\mathcal{G})$ of \mathbb{F}_q -rational points on the nonsingular model of \mathcal{G} in cases where $\mathcal{D}_s^{P_1, P_2}$ is \mathbb{F}_q -Frobenius classical. As a consequence, when \mathbb{F}_q is a prime field, the bound obtained for $N_q(\mathcal{G})$ improves in several cases the known bounds for the number n_P of chords of an affinely regular polygon inscribed in a hyperbola passing through a given point P distinct from its vertices.

Ideals of Leavitt Path Algebras

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During the 2015 CIMPA Research School in Turkey on “Leavitt path algebras and graph C^* -algebras”, Astrid an Huef raised the question whether the statement: *For a given graph E , every (closed) ideal I of $C^*(E)$ is the intersection of all the primitive/prime ideals containing I .*

is true for ideals of Leavitt path algebras.

We first construct examples showing that this statement does not hold in general for Leavitt path algebras, and then prove that, every ideal of the Leavitt path algebra is an intersection of primitive/prime ideals if and only if the graph E satisfies Condition (K).

We examine the uniqueness of factorizing a graded ideal as a product of prime ideals. If I is a graded ideal and $I = P_1 \cdots P_n$ is a factorization of I as an irredundant product of prime ideals P_i , then necessarily all the ideals P_i must be graded ideals and $I = P_1 \cap \dots \cap P_n$. We get a weaker version of this result for non-graded ideals.

Finally, powers of an ideal I are studied. While $I^2 = I$ for any graded ideal I , for a non-graded ideal I , all I^n are non-graded and distinct, but $\bigcap_{n=1}^{\infty} I^n$ is a graded ideal which is the largest graded ideal contained in I . Hence, $\bigcap_{n=1}^{\infty} I^n = 0$ if and only if I contains no vertices.

Unbounded Compactness in Locally Solid Vector Lattices

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Many papers are devoted to concept of unbounded convergence. Notion of uo -convergence was proposed firstly in [2]. Notion of un -convergence was introduced in [7] and further investigated in [3, 5]. Unbounded convergent nets in terms of weak convergence, called uaw -convergence, was introduced by Zabeti and investigated in [8]. All these notions are defined on Banach lattices.

Unbounded topology is considered on a locally solid vector lattice. The pair (X, τ) stands for a locally solid vector lattice, whereas the pair (Y, τ') denotes a generic locally convex space. In [4], we write $x_\alpha \xrightarrow{u\tau} x$ for a net (x_α) in the locally solid vector lattice (X, τ) if $|x_\alpha - x| \wedge w \xrightarrow{\tau} 0$ for all $w \in X_+$. We say that the net (x_α) is unbounded τ -convergent to x whenever $x_\alpha \xrightarrow{u\tau} x$. For more expositions on this notion and the related topics, see [4, 6].

In the poster, the concepts of unbounded compact operators are studied and some properties of them are investigated.

The small part of this work is the joint work with Omid Zabeti and Niyazi Anil Gezer [1].

Keywords: $u\tau$ -convergence, uaw -convergence, un -convergence, u -compact operator.

Mathematics Subject Classification: Primary 46B42, 54A20; Secondary 46B40.

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Lyapunov-type Inequality for a Conformable Boundary Value Problem

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We consider a boundary value problem involving conformable derivative of order $0 < \alpha \leq 1$, and Dirichlet conditions. To prove the existence of solutions, we apply the method of upper and lower solutions together with Schauders fixed-point theorem. Furthermore, we give the Lyapunov inequality for the corresponding problem.

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Shadowing for Discontinuous Linear piecewise Maps

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The shadowing property was introduced by Anosov, and is closely related to the stability property of dynamic systems. In 1988, Coven, Kan and Yorke provided necessary and sufficient conditions for an application to have the shadowing property. Chen, in 1991, generalized this result for continuous piecewise linear applications.

In this talk we will cover the shadowing property for discontinuous linear parts. We will study the points at which such application is not monotonous, or it is discontinuous, and we will prove that the shadowing property for these applications is completely determined by the dynamics of these points. This result generalizes Chen's.

Abstract linear second order differential equations with depending on time operators

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In a real Hilbert space H consider the following perturbed Cauchy problem

$$\begin{cases} \varepsilon u''_{\varepsilon\delta}(t) + \delta u'_{\varepsilon\delta}(t) + A(t)u_{\varepsilon\delta}(t) = f(t), & t \in (0, T), \\ u_{\varepsilon\delta}(0) = u_0, & u'_{\varepsilon\delta}(0) = u_1, \end{cases}$$

where $A(t) : V \subset H \rightarrow H$, $t \in [0, \infty)$, is a family of linear self-adjoint operators, $u_0, u_1 \in H$, $f : [0, T] \mapsto H$ and ε, δ are two small parameters.

We study the behavior of solutions $u_{\varepsilon\delta}$ in two different cases:

- (i) when $\varepsilon \rightarrow 0$ and $\delta \geq \delta_0 > 0$, relative to solutions to the following unperturbed problem:

$$\begin{cases} \delta l'_\delta(t) + A(t)l_\delta(t) = f(t), & t \in (0, T), \\ l_\delta(0) = u_0, \end{cases}$$

- (ii) when $\varepsilon \rightarrow 0$ and $\delta \rightarrow 0$, relative to solutions to the following unperturbed system:

$$\begin{cases} A(t)v(t) = f(t), & t \in (0, T), \\ v(0) = A^{-1}(0)f(0). \end{cases}$$

We obtain some *a priori* estimates of solutions to the perturbed problem, which are uniform with respect to parameters, and a relationship between solutions to both problems. We establish that the solution to the unperturbed problem has a singular behavior, relative to the parameters, in the neighbourhood of $t = 0$. We show the boundary layer and boundary layer function in both cases.

Refinements of majorization, Favard and Berwald-type inequalities via Abel-Gontscharoff interpolation

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In this talk, I will present some interesting results related to the refinements of the majorization-type inequalities via Abel-Gontscharoff interpolating polynomial as well as the refinements of the Favard-Berwald type inequalities.

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Applications of binomial sequences to cryptography^{*}

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Different binary sequence generators produce sequences whose period is a power of two [1, 3, 4, 5]. Although these sequences exhibit good cryptographic properties, such sequences can be obtained as output sequences from simple linear structures. More precisely, every one of these sequences is a particular solution of a linear difference equation with binary coefficients [2]. Moreover, it can be shown that all these binary sequences can be obtained by XORing a finite number of binomial sequences [2] that correspond to the diagonals of the Pascal's triangle reduced modulo 2. Consequently, such a linearity makes the generators that produce the previous sequences vulnerable against cryptanalysis and makes them not suitable as part of more complex cryptographic structures.

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A model for the thermoregulation response on sweating in human males and females' body

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Abstract

The human bodies have to stay their normal temperature because the enzyme that causes reaction in the body functions are best at normal temperature. The study deals comparative study of thermoregulation activities of human males and females under hot zone due to sweating. The solution is presented on the basis of variation finite element method for one and two dimensional steady and transient cases. Sweating is one of the effective thermoregulatory processes when the body is in hot condition of heat strain caused by hot ambient conditions or a high metabolic rate. Sweating is considered as a loss of heat from the body by evaporation of water inside body. The sweating rate for male is calculated by the relation [Hoppe, 1993]:

$$E = 8.47 \times 10^{-5} \{ (0.1 T_{sk} + 0.9 T_b) - 36^{\circ}C \} \text{ [kg/m}^2\text{/sec]}$$

Where, $T_{sk} = T_0$ (Outer skin surface temperature), $T_b = 37^{\circ}C$ (Body core temperature). The rate of sweating in females is less compared to males due to the lower density of sweat gland and hormonal pattern in females. So, coefficient of T_b is considered as 0.7 instead of 0.9 in above relation for females [Hoppe, 1993 and Wyndham, 1965]. The analysis sought out that tissue temperature in males is slightly higher as compared to females when atmospheric temperature T_{∞} is less than body core temperature. But the females tissue temperature is higher when T_{∞} exceeds above $37^{\circ}C$. The steady state nodal temperature is achieved earlier in case of males in comparison to females.

Keywords: thermoregulation, finite element method, sweating

Beurling-Hörmander's theorem related to Bessel-Struve transform

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We deal with uncertainty principle related to Bessel-Struve transform \mathcal{F}_{BS}^α and we show an analogous of Beurling-Hörmander's theorem for each $\alpha > -\frac{1}{2}$. More precisely, we determine the form of nonzero functions satisfying weaken condition of Beurling-Hörmander's theorem which differ from α half integer or nonhalf integer. As applications, we obtain a Gelfand-Shilov theorem, Cowling-Price type theorem and analogous of Hardy's theorem.

Ramblings about a circular billiard

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The circular billiard problem consists in the free motion of a point particle inside a circle, making elastic collisions at the impacts with the boundary.

It defines a 2-dimensional integrable conservative dynamical system, which dynamics is easily destroyed by perturbations. We will show several different dynamics obtained by small perturbations of the circle.

As the definition of billiard only depend on free motion and elastic collision it is easily extended to riemannian surfaces. We will show that the geodesic circular billiard is also a 2-dimensional integrable conservative dynamical system on surfaces of constant curvature and on those whose metric is defined by an index of reflection.

And address the question: is there any surface where the geodesic circular billiard is not integrable?

Asymptotic stability and stabilization of a class of non-autonomous fractional order neural network with delay

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Due to wide applications of fractional differential equations in many physical systems from various fields of science and engineering, analyzing their stability in order to control such systems at equilibrium is very crucial. In this paper, we consider a non-autonomous Caputo fractional-order neural network model described the following equation:

$${}_C D_t^\alpha x_i(t) = -a_i x_i(t) + \sum_{j=1}^m b_{ij}(t) f_j(x_j(t)) + \sum_{j=1}^m c_{ij}(t) f_j(x_j(t - \tau)) + I_i(t), \quad (1)$$

$$x_i^{(k)}(0) = \phi_k, \quad t \in [-\tau, 0], \quad \tau > 0, \quad i = 1, 2, \dots, m. \quad (2)$$

For $1 < \alpha < 2$, we derive sufficient conditions for local and global asymptotic stability of the considered system. We demonstrate the stabilization of the system with suitable examples, which validate the effectiveness of the proposed results. The techniques used are Laplace transform, Mittag-Leffler function and generalized Gronwall inequality.

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Rauzy Fractals and its properties

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Let A be an alphabet over 3 letters and A^* be the set of finite and non-empty words over A . A *substitution* σ is a map from A to A^* . It is known that to any substitution we can associate a shift symbolic dynamical system. It is known that for a large class of substitutions σ , the associated dynamical system is measure theoretically isomorphic to an exchange of pieces over a compact set \mathcal{K}_σ of \mathbb{R}^2 . This set is called Rauzy Fractal and has many beautiful properties. In particular \mathcal{K}_σ induces a periodic tiling of the plane and moreover its boundary is fractal. In this work, I will present some geometrical and dynamical properties of the Rauzy fractal and its boundary. .

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Deficient and multiple points of maps from a complex into a manifold

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Let S^n be the unitary sphere in \mathbb{R}^{n+1} . The classical Borsuk-Ulam Theorem asserts that for every continuous map $f : S^n \rightarrow \mathbb{R}^n$ there is $x \in S^n$ such that $f(x) = f(-x)$. Consequently, there is no injective continuous map $S^n \rightarrow \mathbb{R}^n$.

Given a continuous map $f : X \rightarrow Y$, a point $x \in X$ is called a multiple point of f if $f^{-1}(f(x)) \neq \{x\}$. Otherwise, it is called a single point.

For continuous maps from S^n into \mathbb{R}^n , although there is no injective continuous map, one may ask “how big” could be the set of single points of a such map, also about the set of multiple points.

In a general study about multiple points of continuous maps between manifolds of the same dimension, D. L. Gonçalves gave the following classification:

Theorem 1 ([3]). *Let M, N be manifolds of the same dimension, with M closed. Let $[f]$ denote the homotopy class of a continuous map $f : M \rightarrow N$.*

- a) *If the Hopf's absolute degree of f is 1, then there is a map $g \in [f]$ such that the set of multiple points is not dense in M .*
- b) *If the map f has Hopf's absolute degree different from 1 then the set of multiple points of any map $g \in [f]$ is dense.*

And S. Orevkov provided an example of a continuous map $f : S^2 \rightarrow \mathbb{R}^2$ such that the set of single points is dense, but does not contain any open set.

In another direction, but also related, there is the following result of P. T. Church and J. G. Timourian.

Theorem 2 ([1]) Suppose M and N are connected n -manifolds and $f : M \rightarrow N$ is a proper map with Hopf's absolute degree $A(f) \neq 0$. Let Δ_f be the set of points $y \in N$ for which $f^{-1}(y)$ has less than $|A(f)|$ points.

- (1) Then $\dim \Delta_f \leq n - 1$ and Δ_f contains no closed (in N) subset of dimension $n - 1$.
- (2) If f is discrete (i.e., each $f^{-1}(y)$ is discrete), then $\dim \overline{\Delta_f} \leq n - 2$.

In this work, we extend the notion of Hopf's absolute degree to proper maps from a connected, locally path-connected, locally compact n -dimensional space into a n -manifold. The domain also requires to satisfy a certain cohomological condition. Then, we are able to prove a similar result to the Theorem 2, where M is not assumed to be a manifold.

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New developments in classical approximation theory and its applications

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K-functionals, moduli of smoothness and rate of approximation of average operators play an important role in classical approximation theory since they express intrinsic properties related to the smoothness of a function.

Since 2013, in a technique developed in Jordão, Menegatto & Sun (2014), those tools have been used in order to improve results in functional analysis concerning about to get sharp estimates for the eigenvalue sequences of certain integral operators on spaces of complex valuable functions on the unit sphere. Research on estimates for the eigenvalue sequences as mentioned here has the last big contribution at 80's. Since there it has been staked until 2013, that is why the technique developed in Jordão & Sun (2014) figures as an important contribution in this research area.

It is intended to present new developments on approximation theory and its consequences in the study of eigenvalues sequences of integral operators on a general setting, namely homogeneous spaces of rank 1. The main reference is Jordão & Carrijo (2017).

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Self-inversive polynomials with all zeros on the unit circle

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We consider the sequence of polynomials that satisfy the following three term recurrence relation

$$Q_{m+1}(z) = (z - \beta_{m+1})Q_m(z) - \alpha_{m+1}zQ_{m-1}(z), \quad m = 1, 2, \dots, \quad (1)$$

with $Q_0 = 1$ and $Q_1(z) = z + \beta_1$, where the complex numbers α_{m+1} and β_m , $m = 1, 2, \dots$, are non zero.

If $\alpha_{m+1} > 0$ and $\beta_m > 0$, $m = 1, 2, \dots$, it was known that the corresponding polynomials satisfy the orthogonality property

$$\int t^{-m+s} Q_m(t) d\phi(t) = 0, \quad s = 0, 1, \dots, m-1,$$

where $d\phi$ is a strong positive measure defined on the positive real axis for which all the strong moments $\mu_m = \int t^m d\phi(t)$, $m \in \mathbb{Z}$, exist. In this case, the zeros of Q_m are real, simple, they are all on the positive real line and they interlaces with the zeros of Q_{m-1} . If $\alpha_{m+1} < 0$ and $\beta_m < 0$ or $\alpha_{m+1} > 0$ and $\beta_m > 0$, $m = 1, 2, \dots$, the zeros of Q_m are real and simple. From classical bibliography references, it is possible to see that these properties easily follow from the recurrence relation.

The goal of this work is show that the sequence of polynomials obtained from (1) and from the Möbius transformation that maps the real line onto the unit circle, named transformed sequence of polynomials, are classes of self-inversive polynomials with all the zeros on the unit circle. Furthermore, we explore the properties of these new classes of self-inversing polynomials.

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On the existence of solution for a nonlinear model in periodic Sobolev spaces

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Abstract

In this work, we study the existence of solution for a nonlinear model about optics in Periodic Sobolev Spaces. We use the Banach Fixed Point Theorem to prove the existence of an attractor point which will be the solution to the problem. We finally analyze the good behavior of this solution with respect to the initial data.

Keywords: Existence of Solution, Periodic Distribution, Fourier Theory, Groups and Semigroups Theory, nonlinear model of optics.

2010 Mathematics Subject Classification: 35G25, 35Q55, 35Q60, 47D03, 35B99

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Positive bounded solutions for nonlinear polyharmonic problems in the unit ball

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In this paper, we study the existence of positive solutions for the following nonlinear polyharmonic equation $(-\Delta)^m u + \lambda f(x, u) = 0$ in B , subject to some boundary conditions, where m is a positive integer, λ is a nonnegative constant and B is the unit ball of \mathbb{R}^n ($n \geq 2$). Under some appropriate assumptions on the nonnegative nonlinearity term $f(x, u)$ and by using the Schauder fixed point theorem, the existence of positive solutions is obtained. At last, examples are given for illustration.

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Forcing Connected Domination Number of Graphs Under Some Birony Operation

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TBA

Thematic
posters on
women in
mathematics

Womens committee of the Iranian Mathematical Society (IMS)

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Abstract

In this poster, we introduce the Women's Committee of The Iranian Mathematical Society. We, in particular, present programs and activities of this committee since its establishment.

Mulheres na Matemática

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Neste poster, vamos apresentar várias das ações do projeto de extensão “Mulheres na Matemática” desenvolvido na Universidade Federal Fluminense. Uma das ações é a criação do site: <http://mulheresnamatematica.sites.uff.br/>, que é o primeiro site brasileiro com o objetivo de trazer ao conhecimento da comunidade científica, em particular da comunidade matemática, a trajetória acadêmico-científica de mulheres na matemática, com seus desafios e conquistas. Entrevistas, vídeos e estatísticas são apresentadas no site. Uma outra ação importante do projeto é “Vamos à escola!”, onde realizamos atividades com meninas do Ensino Fundamental e Ensino Médio, com a finalidade de estimulá-las a seguir a carreira de matemática ou áreas afins, como engenharia e computação. Historicamente, no âmbito mundial, a Matemática é uma profissão masculina [1]. No caso do Brasil, de acordo com o Instituto Nacional de Estudos e Pesquisa (Inep), nos últimos dez anos houve um aumento de cerca de 54% no número de mulheres brasileiras que se formaram em engenharia eletrônica, 45% nas formadas em engenharia de produção e 30% em engenharia química e engenharia civil. Mas quando olhamos para os números mais de perto, vemos que a parcela de mulheres nas chamadas ‘ciências duras’ ainda está longe de se equiparar à de homens. Se, nas ciências em geral, as mulheres já são 50% dos pesquisadores em atividade no Brasil, nas áreas exatas são apenas 30% e, nas engenharias, 26%, de acordo com o Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)[2]. O número reduzido de mulheres nas Ciências Exatas e da Terra, em particular na Matemática, ajuda a perpetuar a diferença entre o número de homens e mulheres cientistas e implica numa perda inestimável de possíveis talentos. Assim, esperamos que nosso projeto colabore de alguma forma para reverter esta situação.

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About the II Meeting for Women in Math in Latinamerica.

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The II Meeting for Women in Math in Latinamerica was held between January 22 and 26, 2018, in Valdivia-Chile. The organization was in charge of "Colectivo de Mujeres Matemáticas en Chile".

In this poster we aim to give an overview of this activity. We will describe the activities that were carried out, the feedback we received from the participants and what we learned in the organizational experience.

Women in STEM, progress and prospects; the case of a Ghanaian University

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The problems posed by paucity of women in STEM careers in Ghana is not different from what exists in other countries. Women are grossly under-represented in science and technology and this is more evident in the physical than the biosciences. Ghana has ten public universities, eight technical universities, 74 private universities, proportion of female enrolment remains low and this is worse at the postgraduate level, especially in the physical sciences. This study considers postgraduate enrollment into STEM programmes in KNUST from 1997 and 2017. Trends show an increased enrolment in life sciences while Engineering and Mathematics related programmes lag behind.

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The Role of Women Mathematicians in Indonesia

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In this paper, we described the role of women mathematicians in Indonesia for improving their capacity on their contribution to society. As stated by Allyn Jackson in her paper at 2004 entitled "Has the women-in-mathematics problem been solved", there is a statement that women do mathematics differently from men, especially in how they deal with competition and criticism. Furthermore, in daily life, Indonesian women mathematicians introduce and teach the topic of mathematics to the children or the student using so many different culture at each region in big country of Indonesia. So mathematics can be combined with culture as we called ethnomathematics as part of ethnoscience. We gave some example of using ethnomathematics for elementary school in Indonesia.

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The influence of the environmental factors on some famous female mathematicians success

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In recent years, women's participation in mathematics has increased, but the number of male mathematicians is still more than of women. It is indeed clear that women's participation in advanced mathematics is the benefit of societies. Despite the real barriers for women in sciences, history has witnessed influential women in mathematics. Hypatia (born c. 350-370; died 415 AD) is probably the first female mathematician who we know about. Hypatia lived in Ancient Greece in Alexandria. She was the daughter of Theon who was a philosopher and mathematician. After Hypatia, many famous female mathematicians have recorded in history such as Sophie Germain, Sofia Kovalevskaya, Emmy Noether,....

In 2014, Maryam Mirzakhani, an Iranian mathematician and a professor of mathematics at Stanford University who was the first and only woman to win the Fields medal in mathematics. The aim of this study is to investigate biography of some famous women in mathematics and determine the influence of environmental factors such as cultural, economic status, political on their success.

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Female Mathematicians in Turkey

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There is a huge difference between numbers of female professors and male professors in Mathematics in Turkey. This difference is not so noticeable at the level of undergraduate/graduate education and even at the early stages of the academic career in Mathematics. Another point is, there are national and international conferences held in Turkey and there are very few female invited speakers when compared with the male invited speakers. I will try to give these statistics in our country, Turkey. These surprising and sad facts motivated us to establish the Association for Turkish Women in Mathematics (TKMD) in 2012. In the Association, we are trying to provide a platform where female mathematicians can express themselves both professionally and socially. There are 4 events that are organized by our Association every year and are open to both national and international speakers and participants. I will try to give general information about these activities, also present what we had done since 2012 and our future activities as well.

CONTINUED FRACTION FOR PATRIARCHAL PRACTICES IN NIGERIA

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Patriarchy refers to a system of social relations that describes the position of the father as the head of the household. The supremacy of men over women led to the running of homes and most societal institutions by men. This is due to a few factors like religion, cultural norms and practices, gender-role socialization, marriage institution, that reinforce the subordinate status of women, Durosaro (2016). This has been the case in every part of the world especially Nigeria. Patriarchal attitude has affected some sectors of human development in Nigeria like education and politics. The effects of patriarchal attitudes on human development in Nigeria using continued fraction are analysed in this work. The result shows how women have been seen as incompetent as men.

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Actions to reduce the gender gap taken by the Equality and Gender Commission of the Mexican Mathematical Society

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In this poster we will highlight the diverse actions performed in Mexico in order to reduce the gender gap, since the creation of the Equality and Gender Commission (CEG) of the Mexican Mathematical Society (SMM), in November of 2013. We also describe briefly the current situation as for the inclusion of women in maths in our country.

In representation of the CEG we have attended and organized a plethora of events concerning this matters both nationally and internationally. In particular, our experience in Latin America provides evidence that the factors underlying the underrepresentation of women in math are similar for most of the south of the continent.

We've witnessed that some substantial progress has been achieved in raising awareness about the gender gap in mathematics in the last four years. As such, we believe that it is time to discuss further initiatives and actions to promote the closing of this gap.

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Femmes et mathématiques

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”Femmes et mathématiques” is a French association founded in 1987 which works with other such forces in and out of the country to promote gender equality in Mathematics in France. Through diverse programmes it aims at supporting professional women mathematicians and encouraging young women to study mathematics. This poster will present some indications of our aims and actions.

<http://www.femmes-et-maths.fr/>

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AWM ADVANCES!

Kristin Lauter, Microsoft Research and Magnhild Lien*, California State University Northridge

<https://awmadvance.org>

We describe the objectives, activities and achievements of the 5-year AWM NSF Advance Grant: “Supporting Careers for Women in Mathematics through Research-focused Networks.”

The goal of this grant is to advance careers for women in the mathematical sciences by building strong research-based networks. A guiding principle is that systemic change occurs at the community level rather than through the accumulation of one-by-one individual changes. Thus we focus on building community and advancing women in a given research area as a whole. Individual members should benefit from participation in the network, but we measure impact by integrating over the whole. Our primary goal is to increase the percentage of women’s participation in the mathematics research community from roughly 10% to 30% within 10 to 15 years. Representation can be measured in many ways, for example by examining the percent of women among tenure stream faculty at research universities; participants in research programs at the NSF Math Institutes; PIs on NSF grants; invited speakers at major research conferences, and editorial board positions at leading research journals.

Built on the model of the successful Women In Numbers (WIN), a research network for women in number theory, in existence since 2006, the AWM ADVANCE Project has fostered eight new research networks to date. An additional eight research networks are in formation, thus spanning a total of 17 different research areas. Activities include Research Collaboration Conferences for Women follow-up activities at AWM workshops at national math meetings, & AWM Research Symposia and proceedings in the AWM Springer Series.

A social scientist is conducting a study of how participation in these research networks influences women’s careers and their representation and visible leadership in the research areas. Results from survey-based assessments of network activities and interactions, in addition to preliminary results based on archival data will be presented.

A PORTRAIT GALLERY OF AFRICAN WOMEN MATHEMATICIANS

Marie Françoise Ouedraogo

Abstract: The poster is a presentation of a booklet of portraits of African Women Mathematicians. It is a project of AWMA aiming to create and update a database of role models of African Women Mathematicians for the AWMA website. This portal will aim at motivating and stimulating young girls for mathematical careers.

An invitation to the ‘hall of fame’. On the trails of women among ICM speakers

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Ever since its inaugural celebration in 1897, the International Congress of Mathematicians (ICM) has signified the greatest effort of the mathematical community to establish international communication and connection across all mathematical topics. Through history, the ICMs have hosted some of the most prominent mathematicians of their time. Needless to say, receiving an invitation to present a talk at an ICM is a matter of high international reputation, often compared with the entrance into a “hall of fame for mathematics”.

Women mathematicians attended the ICMs from the start. With the invitation of Laura Pisati to present a lecture in 1908 in Rome and the plenary talk of Emmy Noether in 1932 in Zurich, they entered the grand international stage of their field. At the ICM in 2014 in Seoul, Maryam Mirzakhani became the first woman to be awarded the Fields Medal, the most prestigious award in mathematics. In our poster we dive into assorted data sources to follow the footprints of women among the invited speakers, visualizing their demographics and topic distributions, and providing glimpses into their diverse biographies.

Women in mathematics in the Netherlands

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The poster depicts the most recent information (2014) on the number of women in the mathematical departments in the Netherlands. It also offers a summary of the number of women across all sciences in the country in 2017. Last, it lists some current actions to promote diversity on a national level, and some past and future activities of the local association of female mathematicians.