# BOOK OF ABSTRACTS

## CIMA - Centro de Investigação em Matemática e Aplicações
## Annual Meeting 2024

## Universidade da Madeira
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# CIMA Annual Meeting 2024

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February 2-3, 2024

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# Preface

We are delighted to present this collection of abstracts for the CIMA Annual Meeting 2024. This event celebrates the vibrant and dynamic community of researchers within CIMA. The Annual Meeting of CIMA is a significant event in our calendar, offering a platform for the exchange of ideas, the sharing of research, and the promotion of collaborations that transcend disciplinary boundaries. Each abstract included here provides a glimpse into the work carried out by our esteemed participants. The wide range of topics covered reflects the extensive impact of mathematical research on various fields. We hope that this compilation will inspire and serve as a reference for future works. We sincerely thank you for your participation in the CIMA Annual Meeting and for contributing to the ongoing tradition of excellence in mathematical research.

The Organizing Committee would like to thank Fundação para a Ciência e a Tecnologia (through project UID/MAT/04674/2020, https://doi.org/10.54499/UIDB/04674/2020), and Arditi (CIMA-Arditi) for their financial support. Special thanks are extended to the University of Madeira for its organizational support and to the Associação de Promoção da Madeira for providing materials to the participants of this meeting.

**Organizing Committee:**
José Luís da Silva
Maurício D. L. Reis
Marco Garapa

# Contents

# INCLUSION OF A SHARED FRAILTY IN GAP TIME MODELS

Ana M. Abreu (presenter), Ivo Sousa-Ferreira, Cristina Rocha

Assessing the impact of unobserved heterogeneity is important in the analysis of gap times between recurrent events. This aspect encourages the inclusion of a shared frailty (i.e., random effect) into the model, as it allows taking into account the within-subject correlation.

The aim of this talk is to present some recent contributions in recurrent event analysis, namely parametric gap time models with and without a shared frailty.

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# ALTERNATIVE APPROACHES TO PARAMETRIC 2-WAY ANOVA

Anabela Afonso (presenter), Dulce G. Pereira

Factorial ANOVA is commonly used in several fields such as ecology, biology, and social sciences. With real data, the ANOVA assumptions are easily violated. Additionally, for categorical data, parametric ANOVA may not be appropriate due to the non-metric nature of the data. Several alternative tests have been proposed to relax the assumptions of ANOVA. Nonparametric approaches are based on rank transform and aligned rank of the observations. The semiparametric approaches allow the relaxation of the homoscedasticity assumption. Permutation-based tests do not require the assumption of normality and can be used with small data samples.

In this presentation, we present the most popular alternative approaches to parametric 2-way ANOVA and compare their performance using discrete data (which can mimic ordinal data because ties can occur with positive probability) in balanced homoscedastic and heteroscedastic designs.

ON THE COMPLETE LIFTS TO TANGENT BUNDLES

Rui Albuquerque

We recall the theory of complete lifts of tensors to the tangent bundle of a given manifold $M$ and see some properties of the natural type (1,1) tensor over $TM$, which is analogous to the natural type (0,2) skew-symmetric tensor or the well-knowm symplectic structure on the cotangent bundle $T^*M$ of the same base.

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INVERSE CONDUCTIVITY PROBLEMS BASED ON VECTOR VARIATIONAL PRINCIPLES*

Luís Bandeira

Electrical impedance tomography and Calderón's problem [2] is being intensely studied in the last decades. Both from the perspective of theory and of applications, it is a challenging and appealing problem. The perspective of using vector variational techniques in inverse problems was initiated in [4] and its consequences for the numerical approximation explored in [3], followed by various variational variants examined in different contexts and frameworks through the years. In many cases, variational principles involved are in need of relaxation and this is usually achieved through homogenization. In [5] a different approach was followed, in the sense that a non-linear PDE system was the starting point to study a non-convex (non-quasiconvex) functional. Though its relaxation was computed quite explicitly, such information turned out to be irrelevant for the non-convex, original functional whose minimizing sequence would produce approximating solutions to the inverse conductivity problem. Our contribution here is placed in this line of variational perspectives on inverse problems, aiming to overcome some of the difficulties found in [5] from a practical viewpoint. We propose vector functionals that are polyconvex (the main sufficient condition to ensure existence of solutions for vector variational problems) so that they do not require relaxation; or simple functionals, that despite the fact of not being quasiconvex or polyconvex, yet its simplicity looks promising for numerical approximation.

*Joint work with Pablo Pedregal, UCLM, Spain

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# A BIORTHOGONAL APPROACH TO THE INFINITE DIMENSIONAL FRACTIONAL POISSON MEASURE

Jerome B. Bendong (presenter), Sheila M. Menchavez, José Luís da Silva

In this paper we use a biorthogonal approach (see [1, 4, 3]) to the analysis of the infinite dimensional fractional Poisson measure (fPm) $\pi_\sigma^\beta$ over $\mathcal{D}'$, the dual of the Schwartz test function space $\mathcal{D}$. The Hilbert space $L^2(\pi_\sigma^\beta)$ of complex-valued functions is described in terms of a system of generalized Appell polynomials $\mathbb{P}^{\sigma,\beta,\alpha}$ associated to the measure $\pi_\sigma^\beta$. The kernels $C_n^{\sigma,\beta}(\cdot)$, $n \in \mathbb{N}_0$, of the monomials may be expressed in terms of the Stirling operators of the first and second kind as well as the falling factorials in infinite dimensions, which were introduced recently in [2]. Associated to the system $\mathbb{P}^{\sigma,\beta,\alpha}$, there is a generalized dual Appell system $\mathbb{Q}^{\sigma,\beta,\alpha}$ that is biorthogonal to $\mathbb{P}^{\sigma,\beta,\alpha}$. The test and generalized function spaces associated to the measure $\pi_\sigma^\beta$ are completely characterized in terms of an integral transform, called the $S_{\pi_\sigma^\beta}$-transform. It turns out that all these spaces $(\mathcal{N})_{\pi_\sigma^\beta}^{\pm\kappa}$, $0 \le \kappa \le 1$, are universal in the sense that the $S_{\pi_\sigma^\beta}$-transform of their elements are entire functions (for $0 \le \kappa < 1$) or holomorphic functions ($\kappa = 1$) and independent of the measure $\pi_\sigma^\beta$.

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# ARITHMETIC VARIETIES OF NUMERICAL SEMIGROUPS

Manuel B. Branco

A *submonoid* of $(\mathbb{N},+)$ is a subset of $\mathbb{N}$ containing 0 that is closed under addition. A *numerical semigroup* is a submonoid $S$ of $(\mathbb{N},+)$ such that $\#(\mathbb{N}\setminus S)<\infty$, that is, $\mathbb{N}\setminus S$ has finite cardinality.

If $S$ is a numerical semigroup, then $\mathrm{m}(S)=\min(S\setminus\{0\}), \mathrm{F}(S)=\max(\mathbb{Z}\setminus S)$ and $\mathrm{g}(S)=\#(\mathbb{N}\setminus S)$ are relevant invariants of $S$ called *multiplicity*, *Frobenius number* and *genus of* $S$, respectively.

If $A$ is a non-empty subset of $\mathbb{N}$, then we write $\langle A\rangle$ for the submonoid of $(\mathbb{N},+)$ generated by $A$, that is,

$$\langle A\rangle=\{u_1a_1+\ldots+u_na_n \mid n\in\mathbb{N}\setminus\{0\}, \{a_1,\ldots,a_n\}\subseteq A \text{ and } \{u_1,\ldots,u_n\}\subset\mathbb{N}\}.$$

It is well known that $\langle A\rangle$ is a numerical semigroup if and only if $\gcd(A)=1$.

In this talk, we present the notion of arithmetic variety for numerical semigroups. We study various aspects related to these varieties such as the smallest arithmetic that contains a set of numerical semigroups and we exhibit the root three associated with an arithmetic variety. This tree is not locally finite; However, if the Frobenius number is fixed, the tree has many nodes and algorithms can be developed.

Joint work with:
Ignacio Ojeda (Universidad de Extremadura) and J.C.Rosales (Universidad de Granada)

# TESTING SOURCES OF VARIABILITY IN A HIERARCHICAL CLASS OF STOCHASTIC INDIVIDUAL GROWTH MODELS

Carlos A. Braumann (presenter),
Patrícia A. Filipe, Gonçalo Jacinto, Nelson T. Jamba

Consider $M$ individual animals (or plants) growing in a randomly fluctuating environment and let $X_i(t)$ be the size of the $i$-th individual ($i = 1, \ldots, M$) at age $t$. A general individual growth model class, proposed in [6], uses the stochastic differential equation (SDE)

$$dY_i(t) = \beta(\alpha - Y_i(t))\ dt + \sigma\ dW_i(t) \qquad (i = 1, \ldots, M), \tag{1}$$

where $Y_i = h(X_i)$ is a transformed size by an appropriate strictly monotonous $C^1$ function $h$, $\alpha = h(A)$ is the transformed value of the asymptotic size $A$, $\beta > 0$ is a growth parameter, $W_i(t)$ ($i = 1, \ldots, M$) are independent standard Wiener processes and $\sigma \geq 0$ is the strength of the effect of environmental fluctuations on growth. Parameter estimation, profit optimization in livestock production and many other issues concerning (1) were studied in [1, 2, 3, 4, 5, 7, 8].

However, different individuals may have different parameter values, $\alpha_i$ [and//or $\beta_i$] ($i = 1, \ldots, M$), varying randomly from individual to individual according to some distribution, leading to a mixed SDE model $dY_i(t) = \beta_i(\alpha_i - Y_i(t))\ dt + \sigma\ dW_i(t)$. We assume $\alpha_i = \mu + \sigma^* \varepsilon_i$, with $\varepsilon_i$ ($i = 1, \ldots, M$) i.i.d. standard Gaussian r.v. [and/or similarly for $\beta_i$]. For mixed models, parameter estimation by maximum likelihood often requires approximate methods since the integral involved in the likelihood function may not have an explicit expression. This team has developed the delta approximation method and compared this new method with existing ones in [9, 11].

Furthermore, as considered in [10], individual $i$ parameter values, say for example $\alpha_i$, may depend on some characteristic $g_i$ (e.g., a genetic value) of the individual, leading to more complex models. In this example, we have $\alpha_i = \mu + c\ g_i + \sigma^* \varepsilon_i$.

Using this hierarchy of models with increasing complexity, one can test the significance of the different sources of variability. For environmental variability effects, one tests the hypothesis $\sigma = 0$. If significant, the variability of parameter $\alpha$ among individuals can be tested through the hypothesis $\sigma^* = 0$ [similarly for $\beta$ variability]. If, for example, $\alpha$ variability is detected, one can test for the significance of a genetic value by testing the hypothesis $c = 0$.

The above-mentioned papers also applied the theoretical results to a large real dataset of bovines of the Mertolengo breed. Here, using the same dataset for illustration, we will briefly review the statistical methods to detect significant sources of variability and to estimate parameters.

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DETERMINATION OF THE SPACE-TIME SLIP DISTRIBUTION USING LINEAR PROGRAMMING TECHNIQUES

Vladimir Bushenkov (presenter), Bento Caldeira, Georgy Smirnov, Cristina Pimentel

A seismic data inversion method based on the linear programming (LP) model was used to reconstruct the kinematics of large earthquakes in the form of a space-time slip distribution on the fault plane. This approach can be used with various datasets, including strong ground motion data. The inversion matrix based on the concept of Green's functions calculated using a finite difference method and a 3D structural model of the earth. The proposed dual formulation of the LP problem allows increasing the stability of the computing process and using regularization conditions. An economic scheme was created to represent the data in the computer's memory. The results of numerical experiments are presented.

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VELOCITY AND ENERGY OF PERIODIC TRAVELLING INTERFACIAL WAVES

Filipe S. Cal

For a periodic travelling irrotational wave propagating at the interface between two homogeneous, incompressible and inviscid fluids, we generalise the Stokes definitions for the velocity of the wave propagation in a two-layer fluid framework. We prove, under certain monotonic conditions imposed on the horizontal velocity of the motion at the interface, that the mean horizontal velocity of propagation of the wave is greater than the generalised mean horizontal velocity of the mass of the fluid. We show that, for interfacial waves of small amplitude, the excess kinetic and potental energy densities of the fluid per horizontal unit area have the same magnitude, but different signs. For the nonlinear setting, we prove that the excess potential energy density is positive, whereas the kinetic is negative.

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COMPARISON OF EXTINCTION TIMES FOR STOCHASTIC LOGISTIC TYPE MODELS

Clara Carlos (presenter), Carlos A. Braumann, Nuno M. Brites

We have extended to populations with Allee effects (see [1]) a general stochastic differential equation growth model that incorporates the effect of random fluctuations on the *per capita* growth rate and studied it in [4] for non-harvested populations. For populations under constant effort sustainable harvesting, the specific cases of logistic growth (without Allee effects) and logistic-like growth with Allee effects were studied by [2]. Here, we will compare these models with and without harvesting.

By using the results from [3] for the first passage times and, more specifically, for the (realistic) extinction times, we can obtain the expressions for the mean and standard deviation of the extinction times for the specific models. We study the impact of Allee effects on extinction times, with or without harvesting. In addition, we study the impact of harvesting on extinction times for the models with and without Allee effects.

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ATTEMPT AND CAUSATION

José Carmo

Causation of a state of affairs, considering a set of simultaneous acts and considering sequences of sets of simultaneous acts. Agent's responsibility for some state of affairs (the result was caused intentionally or was caused by chance or as a result of unexpected events) and the concept of attempt. Use of modal logic to represent and characterize such concepts.

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# $2 \times 2$ NONLINEAR HYPERBOLIC SYSTEMS OF CONSERVATION LAWS

Joaquim M. C. Correia

After we review a few discontinuous solution issues intrinsic to first order hyperbolic systems of conservation laws we consider the case of the $2 \times 2$ systems and their diffusive-dispersive approximations.

RING WITHDRAWALS

Marco Garapa (presenter), Maurício Reis

One of the main contributions to the study of belief change is the AGM model, proposed by Alchourrón, Gärdenfors and Makinson, in 1985 [1]. In the AGM model several kinds of belief change operators are considered. One of those classes of operators is formed by the so-called *contraction operators*, which are defined as functions that satisfy a certain list of eight postulates. One of those postulates is *recovery*, which has been pointed out as an implausible property in several settings. Another kind of change operators, which are designated by *severe withdrawals* has been proposed by Rott and Pagnucco in [3]. These operators satisfy all the eight postulates that characterize AGM contractions except recovery. However, they satisfy another undesirable property, which is known as *expulsiveness*.

In this talk we present another class of change operators, which we designate by *Ring Withdrawals* and which do not satisfy recovery nor expulsiveness. We first present a constructive definition for these operators based on Groove's systems of spheres [2] and after that we identify a set of postulates which characterizes these operators. Additionally, we present the interrelations among Ring Withdrawals, AGM Contractions and Severe Withdrawals.

Joint work with Eduardo Fermé (University of Madeira) and Abhaya Nayak (Department of Computing, Macquarie University, Sydney, Australia).

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# STRUCTURAL BREAKS AND SEGMENTED REGRESSION ANALYSIS IN TIME SERIES

Dulce Gomes

In Public Health, particularly in the field of infectious diseases, it is extremely important to study the impact of adopting public policies for the control and elimination (or at least reduction up to the threshold established by the World Health Organization) of these diseases.

To this end, I intend to evaluate, through simulation studies, methods for testing (retrospectively) breaks or changes in structure in time series, at unknown moments of time, including determining the number of these breaks as well as the confidence intervals of break dates.

After identifying the breaks, a segmented regression analysis will be carried out assuming an ARIMA-type error correlation structure, as opposed to what is common used in various applications in the area of Public Health, where errors are considered to have only a first-order autoregressive structure (Prais-Winsten method).

Through this segmented regression, the annual percent change (APC) in each of the segments identified by the breaks will also be estimated, as well as the average percent change (annual-AAPC, monthly-MAPC or other) as a weighted average of the estimated APCs, using the lengths of the segments as weights.

This work was partially supported by Fundação para a Ciência e a Tecnologia (FCT) via project UIDB/04674/2020.

BIOLOGICAL NETWORKS SUPPORTED BY HYPERBOLIC GEOMETRY STRUCTURES

Clara Grácio

For many years, biological entities were represented as points in a low-dimensional Euclidean space, implicitly assuming the flat geometry of biological space, which leads to distortion of distances between biological objects. But in recent years we have seen the development of the use of hyperbolic geometry to model complex networks, so hyperbolic spaces have attracted a lot of attention for the analysis of biological data. The fundamental mathematical idea behind is to realize that the traditional Riemannian curvature can be reformulated in terms of the more primitive concept of distance.

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# PLSc-SEM TO EVALUATE THE FACETS OF BURNOUT IN LISBON AIRPORT BORDER OFFICERS

L. M. Grilo[a,h,i,j] (presenter), T. F. Braz[c,d], H. L. Grilo[b,c], J. P. Maidana[e,f] and M. Stehlík[e,f,g]

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Structural equation modeling (SEM) allows us to model and estimate complex relationships between multiple dependent and independent variables. With SEM, which is a multivariate statistical technique considered to be second generation, it is possible to analyze relationships between manifest variables (i.e., directly observed/measured) and latent variables/constructs (i.e., not directly observed), considering measurement errors in the manifest variables. Some of these powerful features are not found, in fact they are limitations, in first generation multivariate techniques, such as multiple regression or analysis of variance. Burnout syndrome has been studied in various professional activities through different questionnaires and in this study the Shirom-Melamed Burnout Measure (SMBM) was used, which is composed of three latent constructs (theoretical concepts not directly measured): “emotional exhaustion”, “cognitive fatigue” and “physical fatigue”. The 14 questions available in this reliable and internationally validated SMBM questionnaire correspond to observed variables that are measured on a Likert-type self-assessment scale, with seven categories. A theoretical structural reflective model consistent with the specialized literature and expressing a priori perceptions about the causal relationships between those latent constructs, where “physical fatigue” is the target latent construct. A survey was carried out among border officers at Lisbon airport, using a Portuguese version of the SMBM, and a non-random sample was then obtained. To estimate a model, the consistent Partial Least Squares (PLSc) estimator was applied and the bootstrap resampling method was considered to test the significance of the various PLSc-SEM results. The estimated model, supported by available data, gives us important indications of how the three dimensions that characterize burnout syndrome may be related: exogenous construct "emotional exhaustion" has a direct positive effect on the constructs "cognitive fatigue" and "physical fatigue", but also has an indirect effect on the latter through the mediating construct of "cognitive fatigue".

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TRAVELLING WAVES IN THE ROSENAU-KdV EQUATION

Michael Grinfeld

We consider the existence of monotone travelling waves in the Rosenau-KdV equation, which exhibits phenomena that cannot be seen in the well-known Burgers-KdV equation [1]. Many problems are still open.

This is joint work with N. Bedjaoui and G. Maypaokha (UPJV) and J. M. Correia (Évora).

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A NEW CLASS OF LOCATION INVARIANT VALUE-AT-RISK ESTIMATORS

Lígia Henriques-Rodrigues

In the field of statistical extreme value theory, risk is generally expressed either by the value at risk at a level $q$ ($\text{VaR}_q$), the size of the loss occurred with a fixed probability, $q$, the upper $(1-q)$-quantile of the loss function. The value of $q$ if often smaller than $1/n$, where $n$ denotes the size of the available sample, $\underline{\mathbf{X}}_n = (X_1, \ldots, X_n)$. We consider heavy-tailed models, i.e. Pareto-type underlying cumulative distribution functions, with a positive extreme value index (EVI), quite common in many areas of application. For these Pareto-type models, the classical EVI- estimators are the Hill estimators introduced in [3], the average of the $k$ log-excesses over a threshold $X_{n-k:n}$. The adequate estimation of the EVI is crucial for the semi-parametric estimation of the $\text{VaR}_q$. The Hill estimators are not location invariant, so we will use the PORT methodology introduced in [1], with PORT standing for Peaks Over a Random Threshold and a recent class of generalized mean (GM) of the EVI, the Lehmer's mean-of-order $p$ EVI-estimators introduced in [4] to derive the new class of PORT-$\text{L}_p$ VaR-estimators. A first approach to combine the PORT methodology and the use of GMs in VaR estimation was done in [2]. Under some restrictions on the underlying model, these estimators are consistent and asymptotically normal. The behaviour of the PORT-$\text{L}_p$ VaR-estimators is studied for finite samples through Monte-Carlo simulation. Joint work with Manuela Neves, Helena Penalva and M. Ivette Gomes.

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PERIODIC COUPLED SYSTEMS AND VAN DER POL OSCILLATORS

Feliz Minhós (presenter), Sara Perestrelo

This work contains an existence and localization result for periodic solutions of second-order non-linear coupled planar systems, without requiring periodicity for the non-linearities. The arguments for the existence tool are based on a variation of the Nagumo condition and the Topological Degree Theory.

The localization tool is based on a technique of orderless upper and lower solutions, that involves functions with translations.

The main result is applied to a system of two coupled Van der Pol oscillators with a forcing term.

**Acknowledgement** This research was supported by national funds through Fundação para a Ciência e Tecnologia, FCT, under the project
https://doi.org/10.54499/UIDB/04674/2020.

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DIRECTIONAL CURVATURES FOR IMPLICITLY DEFINED SUBSETS OF $\mathbb{R}^n$

Fátima Pereira

Let us fix a point on the boundary of a non-empty compact convex set in $\mathbb{R}^n$. Assuming that, near this point, the boundary of the set is given by an implicit equation, I will present an easy formula to calculate the curvature in the direction of any tangent vector.

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# STABILIZATION OF FLUID FLOW OLDROYD-B SIMULATIONS BASED ON EIGENVALUES OF CONFORMATION TENSOR

Marília Pires (presenter), Tomáš Bodnár

From a physical point of view, the molecular strain tensor can be represented at continuous level in viscoelastic fluids by the conformation tensor. This symmetric tensor should always be positive definite, however the positive-definiteness is sometimes lost in numerical simulations of non-Newtonian viscoelastic fluids flows at larger values of the Weissenberg number. This problem known as the High Weissenberg Number Problem (HWNP) and is characterized by the breakdown of numerical solutions. In some cases the HWNP can be avoided (or at least delayed) by adding a stress diffusion term to the transport equations for viscoelastic tensors [1, 2, 3, 4, 5]. In this work, numerical tests are presented, demonstrating the HWNP problem and its possible cure based on stabilization method employing local addition of an artificial stress diffusion term to the transport equations, in the regions of the computational domain where the positive-definiteness of the conformation tensor can be violated.

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EVOLUTIONARY DYNAMICS FOR CELLULAR AUTOMATA AND APPLICATIONS

C. Correia Ramos

We discuss evolutionary and genetic algorithms for cellular automata. We consider processes, such as mutation, replication recombination and assembly to transform families of cellular automata. We analyse evolving populations of cellular automata, and its main characteristics. Applications are discussed, namely to pseudo random number generators, simulation of natural phenomena and image processing.

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Project UIDB/04674/2020

# NUMERICAL STUDIES ON THE EFFECT OF SHEAR STRESS DURING THE METASTASIS PROCESS

José Alberto Rodrigues

The formation of a secondary tumor at a site distant from the the primary tumor is known as metastasis by a cancerous tumor. To initiate the metastatic spread of cancer through the bloodstream, tumor cells must transit through microenvironments of dramatically varying physical forces. Cancer cells are able to migrate through the stroma, intravasate through the endothelium into the blood or lymphatic vessels, to flow within the vessels, to extravasate from the vessel through the endothelium and colonize in tissue at a secondary site.

In soft tissues, cancer cells are exposed to mechanical forces due to fluid shear stress, hydrostatic pressure, tension and compression forces. Fluid shear stress is one of the most important forces that cells are exposed to, and its effects on blood cells, endothelial cells, smooth muscle cells, and others have been extensively studied. However, much less is known about fluid shear stress effects on tumor cells. Cancer cells experience two main kinds of fluid shear stress: stresses generated by blood flow in the vascular microenvironment, and those generated by interstitial flows in the tumor microenvironment.

Stresses generated by interstitial and blood flows could contribute to the metastatic process by enhancing tumor cell invasion and circulating tumor cell adhesion to blood vessels, respectively. However, it is difficult to predict tumor cell behavior to such forces and it is difficult to experimentally measure such flows in the tumor microenvironment

With this work we present different methodologies to numerically study the shear effect in two stages of the metastasis process: in the interstitial environment and in the blood vessel. In the blood vessel we are also interested in quantifying the platelet protection effect.

Using Isogeometric analysis, for modelling complex geometries, we numerically study the shear stress effect over the cancer cells into the blood vessel and quantify the platelets protection effect.

In the interstitial medium one uses a coupled Keller-Segel and Darcy–Brinkman model implemented in finite elements to obtain numerical results about the effect of shear stress on cancer cell proliferation.

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doi: 10.3390/mca25020019

# DEMYSTIFYING SOME RULES OF THUMB IN STATISTICS

Jorge Santos (presenter), Marília Pires, Russell Alpizar Jara

We address some issues that arise from the application of some well established rules of thumb in applied statistics. Specifically, we focus on the approximation of discrete distributions by the Gaussian distribution, and the skewness effect on the relationship among the arithmetic mean, median, and mode. In fact there are simple rules that are widely applied and taught on basic statistic courses, but should be more discussed and corrected, given the available counterexamples of what is being claimed.

# PERIOD INCREMENTING AND ATTRACTORS ON NONAUTONOMOUS FLAT TOP TENT MAPS

Luís Manuel Ferreira da Silva

In this work, we consider the family of non-autonomous dynamical systems obtained by iterating tent maps with a flat top of constant value $u$ introduced at instants $i$ such that $s_i = 0$, where $s$ is a binary sequence that we call the iteration pattern. We introduce symbolic dynamics and study the kneading invariants for these dynamical systems. More precisely, we define the kneading invariants $K(u, s)$ as symbolic sequences and study sufficient conditions for a symbolic sequence to be a kneading invariant $K(u, s)$ for some $u$, for each iteration pattern $s$. Finally, we describe the parameters $u$ for which there are Milnor attractors for iteration patterns $s$ such that $s_{np} = 0$ for all $n$, as limits of parameter sequences corresponding to local attractors, organized according to a period-incrementing structure.

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CIMA–ARDITI

DIFFUSION, DISPERSION, AND POLE DYNAMICS IN NONLINEAR PDEs

J.A.C. Weideman

Many model PDEs have the form $u_t + uu_x = L(u)$, where $L$ is some linear operator. For example, if $L(u) = u_{xx}$ (resp. $u_{xxx}$), then the PDE models the interplay between nonlinearity and diffusion (resp. dispersion). When the solutions are analytically continued from the real axis into the complex plane, the effects of diffusion and dispersion can be related to pole dynamics of these solutions. Diffusion pushes poles off to infinity in the imaginary direction (smoothing) whereas dispersion causes a drift along the real direction (oscillations); see [1]. In this talk we consider the situation (not covered in [1]) where both diffusion and dispersion are in competition with nonlinearity.

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**Meeting ID:** 194 966 149
**Meeting Passcode:** 353209

# Program

**Friday, February 2, 2024**

09h00 – 09h20: **Reception and registration of participants**

09h20 – 09h30: **Opening of the Meeting**

09h30 – 10h30: **Sessão 1** (Chair: José Luís da Silva)

- *Testing Sources of Variability in a Hierarchical Class of Stochastic Individual Growth Models*
  Carlos A. Braumann (presenter), Patrícia A. Filipe, Gonçalo Jacinto, Nelson T. Jamba

- *Comparison of Extinction Times for Stochastic Logistic Type Models*
  Clara Carlos (presenter), Carlos A. Braumann and Nuno M. Brites

10h30 – 11h00: **Coffee break**

11h00 – 12h30: **Sessão 2** (Chair: Joaquim Correia)

- *Periodic coupled systems and Van der Pol oscillators*
  Feliz Minhós (presenter) and Sara Perestrelo

- *Diffusion, Dispersion, and Pole Dynamics in Nonlinear PDEs*
  J.A.C. Weideman

- *Travelling waves in the Rosenau-KdV equation*
  Michael Grinfeld

12h30 – 14h00: **Lunch in Restaurante Tipografia - Castanheiro Boutique Hotel**

14h00 – 16h00: **Sessão 3** (Chair: Feliz Minhós)

- *2×2 Nonlinear hyperbolic systems of conservation laws*
  Joaquim M. C. Correia

- *Evolutionary dynamics for cellular automata and applications*
  C. Correia Ramos

- *Period incrementing and attractors on nonautonomous flat top tent maps*
  Luís Manuel Ferreira da Silva

- *Velocity and energy of periodic travelling interfacial waves*
  Filipe S. Cal

16h00 – 16h30: **Coffee break**

16h30 – 18h30: **Sessão 4** (Chair: Manuel Branco)

- *Numerical Studies on the Effect of Shear Stress During the Metastasis Process*
  José Alberto Rodrigues **Online**

- *Inverse conductivity problems based on vector variational principles*
  Luís Bandeira

- *Attempt and Causation*
  José Carmo

- *Biological networks supported by hyperbolic geometry structures*
  Clara Grácio

**Saturday, February 3, 2024**

09h00 – 10h30: **Sessão 5** (Chair: Carlos Ramos)

- *Arithmetic varieties of numerical semigroups*
  Manuel B. Branco

- *Ring Withdrawals*
  Marco Garapa (presenter) and Maurício Reis

- *On the complete lifts to tangent bundles*
  Rui Albuquerque

10h30 – 11h00: **Coffee break**

11h00 – 12h30: **Sessão 6** (Chair: Carlos Braumann)

- *Structural Breaks and Segmented Regression Analysis in Time Series*
  Dulce Gomes

- *Inclusion of a shared frailty in gap time models*
  A.M. Abreu (presenter), I. Sousa-Ferreira and C. Rocha

- *Demystifying some rules of thumbs in Statistics*
  Jorge Santos (presenter), Marilia Pires, Russell Alpizar Jara **Online**

12h30 – 14h00: **Lunch in Restaurante Tipografia - Castanheiro Boutique Hotel**

14h00 – 16h00: **Sessão 7** (Chair: Vladimir Bushenkov)

- *Alternative Approaches to Parametric 2-way ANOVA*
  Anabela Afonso (presenter), Dulce G. Pereira **Online**

- *A Biorthogonal Approach to the Infinite Dimensional Fractional Poisson Measure*
  Jerome B. Bendong (presenter), Sheila M. Menchavez, José Luís da Silva

- *Directional Curvatures for Implicitly Defined Subsets of* $\mathbb{R}^n$
  Fátima Pereira

- *Stabilization of Fluid Flow Oldroyd-B Simulations Based on Eigenvalues of Conformation Tensor*
  Marília Pires (presenter), Tomáš Bodnár

16h00 – 16h30: **Coffee break**

16h30 – 18h00: **Sessão 8** (Chair: Marília Pires)

- *Determination of the space-time slip distribution using linear programming techniques*
  Vladimir Bushenkov (presenter), Bento Caldeira, Georgy Smirnov, Cristina Pimentel

- *A New Class of Location Invariant Value-at-risk Estimators*
  Lígia Henriques-Rodrigues

- *PLSc-SEM to evaluate the facets of burnout in Lisbon airport border officers*
  L. M. Grilo (presenter), T. F. Braz, H. L. Grilo, J. P. Maidana and M. Stehlík

18h00 – 18h10: **Closing of the Meeting**

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