Horário	Segunda-feira	Terça-feira	Quarta-feira	Quinta-feira	Sexta-feira
11:30-12:30 h	C1 Sala Esmeralda	C4 Sala Safira C5 Sala Turmalina C6 Sala Ametista	C9 Sala Ametista C10 Sala Turmalina		C16 Sala Ametista C17 Sala Turmalina
16:30-17:30 h	C2 Sala Safira C3 Sala Esmeralda	C7 Sala Ametista C8 Sala Turmalina	C11 Sala Ametista C12 Sala Turmalina C13 Sala Safira	C14 Sala Ametista C15 Sala Turmalina	

C1 Otimização em estruturas eletrônicas

José Mário Martinez
IMECC- Unicamp

Segunda-feira **Coordenador: Geraldo Nunes Silva** **Sala Esmeralda**
11:30-12:30 h

O Cálculo de Estruturas eletrônicas é um tema desafiante da matemática aplicada que envolve a resolução de problemas com enorme número de variáveis. Diversas técnicas de otimização são usadas para a resolução deste problema. Nesta palestra faremos uma revisão das técnicas mais bem sucedidas e relataremos nossas experiências na área.

C2 The navier-stokes, euler and other related equations

Edriss Saleh Titi
U.C.Irvine and Weizmann Institute, Israel

Segunda-feira **Coordenador: Milton da Costa Lopes Filho** **Sala Safira**
16:30-17:30 h

In this talk I will survey the status of, and the most recent advances concerning, the questions of global regularity of solutions to the three-dimensional Navier-Stokes and Euler equations of incompressible uids. Furthermore, I will also present recent global regularity results concerning certain three-dimensional geophysical ows, including the three-dimensional viscous \primitive equations" of oceanic and atmospheric dynamics.

C3 Diretrizes do programa espacial brasileiro e a matemática aplicada no Brasil

Jose Raimundo B. Coelho
Presidente da Agência Espacial Brasileira (AEB)

Segunda-feira **Coordenador: Geraldo Nunes Silva** **Sala Esmeralda**
16:30-17:30 h

C4 Transfer orbits in the planar restricted three-body problem

Antonio Fernando Bertachini de Almeida Prado
INPE

Terça-feira **Coordenador: Paulo F. de Arruda Mancera** **Sala Safira**
11:30-12:30 h

In this research, the goal is to find transfer orbits for a spacecraft from one celestial body back to the same celestial body or to the Lagrangian points of that system. The mathematical model for the system is the planar restricted three-body problem. To avoid numerical problems during close approaches, the version of the model that has the global Lamaître regularization is used. First of all, attention is given to the family of transfer orbits involving no more than one revolution of the spacecraft. The systems under study are the ones with more important practical applications: the Earth-Sun and the Earth-Moon systems.

Five families of transfer orbits are found in the region studied and the results are plotted in terms of the true anomaly. The same plots also show the evolution of the Jacobian constant. A special effort is made to find transfer orbits with small *V.

After that, the problem of sending a spacecraft from the Earth to the Lagrangian points L4 and L5 is treated as a natural extension of the problem of sending a spacecraft from one body back to the same body. Two transfer orbits from the Earth to L4 and two transfer orbits from the Earth to L5 are found. Next, the numerical integration is extended beyond the desired Lagrangian point and it is found that, for all four orbits, the spacecraft passes near the Lagrangian points L3, L4 and L5 and comes back to the neighborhood of the Earth. Integration after this first close approach with the Earth has different results for each of the orbits studied, and it is necessary to describe them separately. In general, the orbits found here can be applied to:

i) Transfer a spacecraft between any two points in the group formed by the Earth and the Lagrangian points L3, L4, L5 (in the Earth-Sun system) with near-zero *V;

ii) Make a tour to the Lagrangian points for reconnaissance purposes with near-zero *V for the entire tour. The small relative velocities during the close approaches are ideal for the data acquisition phase or for a rendezvous with another spacecraft. There is also a possibility to recover the spacecraft after the tour (for re utilization and/or study), since it returns to the Earth's neighborhood;

iii) Build a cycler transportation system linking all the points involved or only two of them (as the two options for a cycler transportation system between the Earth and L5 or L4, that is shown in the present paper). In a system like that, a heavy spacecraft can stay in one of the orbits showed here and a small spacecraft can make a "taxi service" and rendezvous with the heavy vehicle to transport persons and/or materials to/from it. The "swing-by" with the Earth plays a very important role in these systems and will be explained in detail in the present paper.

C5 Algoritmos iterativos para solução de problemas matemáticos desafiadores na sociedade contemporânea

Antonio C. G. Leitão
UFSC

Terça-feira **Coordenador: Sandra Mara Cardoso Malta** **Sala Turmalina**
11:30-12:30 h

Na primeira parte da palestra será apresentada, por meio de exemplos, uma família de problemas matemáticos que se caracterizam por objetivar a determinação de um parâmetro em um sistema de equações (algébricas, diferenciais, integrais, etc). Tais problemas, denominados problemas inversos, oferecem os seguintes desafios:

i) as medições disponíveis do parâmetro desconhecido são indiretas e inexatas;

ii) o operador matemático que mapeia o parâmetro nos dados observados é instável (isto é, mal-posto).

Uma vez apresentados os problemas de interesse, a palestra será focada na discussão de 2 famílias de algoritmos iterativos que visam obter soluções aproximadas dos mesmos, a saber:

i) métodos tipo gradiente;

ii) métodos tipo Newton.

A análise de convergência desses métodos será apresentada de forma didática: Que perguntas devem ser respondidas para que se possa determinar e/ou quantificar a eficiência de um método iterativo para resolver problemas mal-condicionados?

C6 Quantificação da incerteza de soluções de problemas numéricos com parâmetros aleatórios

Jose Eduardo Souza de Cursi
INSA de Rouen

Terça-feira **Coordenador: Rubens Sampaio** **Sala Ametista**
11:30-12:30 h

Os problemas práticos envolvem parâmetros que devem ser estimados a partir de testes, observações ou experimentos et que são, portanto, incertos ou, no mínimo afetados por erros e variabilidade. Por exemplo, os parâmetros físicos de uma estrutura ou de um material, assim como os parâmetros de modelos econômicos sofrem de diferentes variabilidades causadas por condições operacionais e do meio ambiente. Tais variabilidades introduzem incertezas no funcionamento do sistema, de modo que é importante quantificá-las por razões de segurança. De maneira análoga, a variabilidade das condições futuras faz com que as predições da resposta do sistema contenham incertezas cuja quantificação é indispensável para uma avaliação correta dos riscos.

Na prática, a quantificação dos riscos resulta de uma análise da distribuição de probabilidades das soluções das equações de um modelo ou da otimização de um critério. Assim, é necessário determinar – de uma forma cuja utilização prática seja simples – a distribuição de probabilidades das variáveis e interesse.

Esta conferencia apresenta, de forma os principais métodos de determinação numérica de tais distribuições de probabilidade, com ilustrações em situações simples, mas significativas e exemplos de aplicações práticas.

C7 Dual-tree complex wavelets - their key properties and a range of image-processing applications

Nick Kingsbury
University of Cambridge

Terça-feira **Coordenador: Messias Meneguetti Junior** **Sala Ametista**
16:30-17:30 h

We will describe the Dual-Tree Complex Wavelet Transform (DT CWT), a form of discrete wavelet transform which generates complex coefficients by using two trees of wavelet filters in parallel to obtain their real and imaginary parts. This introduces limited redundancy (2^m : 1 for m-dimensional signals) and the Hilbert-pair property is designed into the two wavelet bases such that the transform provides approximate shift invariance and directionally selective filters (properties lacking in the traditional wavelet transform), while preserving the usual properties of perfect reconstruction and computational efficiency with good well-balanced frequency responses. Energy is preserved in the Q-shift wavelet filters, resulting in tight-frame properties too. In the decade since the dual tree was first proposed, it has been applied to images and 3D datasets and has been shown to outperform traditional wavelets in a range of applications, which will be summarized.

C8 Resonance in low-temperature oxidation waves for porous media

Alexei Mailybaev
IMPA

Terça-feira **Coordenador: Maria Cristina Cunha** **Sala Turmalina**
16:30-17:30 h

We analyze traveling wave profiles possessing an internal resonance point for a class of systems of partial differential equations describing oxidation and vaporization of liquid fuel in a porous medium when an oxidizer (air) is injected. It is shown that the resonance is characterized by a saddle point of an associated vector field defined on a folded surface in state space.

We prove existence and uniqueness of this singularity for an open set of parameters. The singularity yields an extra restriction on wave parameters. This restriction is found explicitly in the physically relevant case of a small ratio of reaction/vaporization rates. We find the general large time asymptotic solutions of the problem as a sequence of waves, and show that resonance waves play a key role in determining these solutions. Efficiency of the resonant regime for oil recovery process is discussed.

C9 Constrained intervals, interval spaces, and optimization under generalized uncertainty

Weldon A. Lodwick
Univ. Colorado

Quarta-feira **Coordenador: Geraldo Nunes Silva** **Sala Ametista**
11:30-12:30 h

Constrained intervals, intervals as a mapping from [0,1] to linear functions with non-negative slopes, and arithmetic on constrained intervals [1], generate a space that turns out to be a cancellative abelian monoid albeit with a richer set of properties than the usual (standard) interval arithmetic. This means that not only do we have the classical embedding as developed by H. Radström [3] and S. Markov [2] but the properties of these polynomials. We study a little of the geometry of the embedding of intervals into a quasi-linear vector space and some of the properties of the mapping of constrained intervals into a space of polynomials. Thus, there are three parts to this talk. (1) The representation of intervals as linear polynomials with non-negative slopes. (2) The algebraic structure of this new representation. (3) The link between (constrained) intervals and generalized uncertainty as they are used in optimization. The theoretical reason for considering a new representation of intervals is to have a formalization in (a subset of) polynomial space with the view to evaluate expressions (functions) of intervals. The theoretical reason for considering the algebraic structure of the embedding into a space with inverses is to solve equations and optimization problems.

C10 Multidimensional projection for visualizing and interacting with high-dimensional data

Luis G. Nonato
ICMC

Quarta-feira **Coordenador: José Alberto Cuminato** **Sala Turmalina**
11:30-12:30 h

Interactive visualization has become a central component of most massive data analysis and exploration systems. However, enabling simple, intuitive and effective interactive visual resources is not a straightforward task, mainly when dealing with complex high-dimensional data. In this talk we will present the recent mathematical and computational tools we have developed towards manipulating large high-dimensional data sets. Much of our research relies on multidimensional projection methods

designed to map high-dimensional instances of data onto low-dimensional visual spaces so as to preserve neighborhood structures as much as possible. The flexibility and usefulness of our framework will be demonstrated through a variety of applications such as interactive summarization of document collection, image colorization, vector field visualization, music playlist construction, visualization of web search results, among others. Challenges and future directions of this stimulating research field will also be discussed.

C11 Mathematical modeling of large deformation in salt tectonics

I-Shih Liu
Instituto de Matemática - UFRJ

Quarta-feira **Coordenador: Mauro Rincon** **Sala Ametista**
16:30-17:30 h

We consider instability of a two-layered solid body of a denser material on top of a lighter one. This problem is widely known to geoscientist in sediment-salt migration as salt diapirism. In the literature, this problem has often been treated as Rayleigh-Taylor instability in viscous fluids instead of solid bodies.

To treat problems of large deformation, we propose a new algorithm for large deformation of solid bodies in general. It is a successive incremental linear approximation based on the well-known idea of small deformation superposed on large deformation at every numerical step. Numerical example for bending of a rectangular block into a circular section is presented for comparision with the exact solution.

Modeling sediment-salt as elastic-viscoelastic solid body, the proposed method is used for numerical simulation of salt tectonics showing the formation of salt diapirs. Experimental varification of material models is also shown.

C12 Generalized statistical complexity measure: a new tool for dynamical systems

Osvaldo A. Rosso
UFAL

Quarta-feira **Coordenador: Alejandro César Frery Orgambide** **Sala Turmalina**
16:30-17:30 h

López-Ruiz, Mancini and Calbet have proposed a statistical complexity measure, based on the notion of "disequilibrium", as a quantifier of the degree of physical structure in a time series Given a probability distribution P and its associate information measure I[P], an amount of "disorder" associated to the state of a system, the LMC-statistical complexity, is the product of a normalized entropy H (normalized Shannon-entropy) times the disequilibrium Q, given by the Euclidean "distance" from P to the uniform distribution Pe. The statistical complexity vanishes both for a totally random process and for a purely periodic one. Martín, Plastino and Rosso improved on this measure by suitably modifying the distance-component (in the concomitant probability space). The obtained MPR-statistical complexity is (i) able to grasp essential details of the dynamics, (ii) an intensive quantity, and (iii) capable of discerning among different degrees of periodicity and chaos. The MPR-statistical complexity can be viewed as a functional that characterizes the probability distribution P associated to the time series generated by the dynamical system under study. It quantifies not only randomness but also the presence of correlational structures. In this seminar, selection of the information measure I and generalized disorder, as well as, election of distance D and generalized disequilibrium are reviewed. Evaluation of the probability distribution P associated to a dynamical system or time series under study is a physical problem. Additional improvements can be expected if the underlying probability distribution is "extracted" by more appropriate consideration regarding causal effects in the system's dynamics. Several well-known modelgenerated time series, usually regarded as being of either stochastic or chaotic nature, are analyzed. The main achievement of this approach is the possibility of clearly distinguishing between them in the H x MPR-Complexity representation space, something that is rather difficult otherwise. In addition, recent applications to time series from biological (epileptic EEG records, deformation of red blood cells, cancer progression, etc.) and physics systems (stochastic resonance, econophysics, literature, ENSO/El Niño, etc.) will be reviewer.

C13 The steiner tree problem for the n-cube and extensions to mathematical biology

Leslei Richard Foulds (Les Foulds)
Universidade federal de Goiás

Quarta-feira **Coordenador: Maria do Socorro N. Rangel** **Sala Safira**
16:30-17:30 h

For a metric space (S, d), define a weighted graph G= G(S, d) with vertex set S so that each edge {s, t} has weight d(s, t). For a finite subset X of S, a minimum spanning tree T(X) for X is a tree (that is, a connected, acyclic subgraph) with vertex set X such that the sum of the weights of T(X) is a minimum. A Steiner minimal tree S(X) for X is a tree having the minimum possible length over all trees in G that contain X in their vertex sets.

For a fixed alphabet A = {0, 1} and a fixed positive integer N, let d denote the Hamming distance on AN, that is, d((a1,...,aN), (a1',...,aN')) is equal to the number of indices i such that ai ≠ ai'. Denote AN by QN.. The graph G = G(QN, d) is the 1-skeleton of the N-cube. We establish that the complexity of finding a Steiner minimal tree for QN is NP-complete.

We also discuss the extension of the above problem to the case where A has a given, finite number of symbols. For this more general problem, we discuss approaches for tree construction, the question of tree minimality and a tree comparison metric.

Finally, we mention how the results may be useful in the task of constructing evolutionary trees from molecular databases.

C14 How wavelets are used to study turbulent transport in fluid and plasma flows

Marie Farge
ENS- Paris

Quinta-feira **Coordenador: Margarete Oliveira Domingues** **Sala Ametista**
16:30-17:30 h

We will review wavelet methods to study fluid and plasma flows in the fully-developed turbulent regime for bounded and unbounded geometries. We will present new results concerning the emergence of dissipative structures in fluid and plasma turbulence. We will present a wavelet denoising method that we will apply to videos taken with a fast camera implemented in the tokamak Tore-Supra to study coherent structures observed in edge plasma. We will discuss perspectives concerning the use of wavelets to study turbulent transport in confined fluid and plasma flows and conjecture the existence of non viscous and non resistive dissipative structures in the fully-developed turbulent regime.

This work is done in collaboration with Romain Nguyen van yen (Freie Universität, Berlin) and Kai Schneider, Université de Provence, Marseille. It is financed by the Fédération de Recherche Fusion par Confinement Magnétique-ITER. It was published in Phys. Rev. Lett. (106, 184502, 2011) and in Nucl. Fusion (52, 013005, 2012). These papers can be downloaded from http://wavelets.ens.fr in 'Publications'.

C15 Concepções do projeto Klein de matemática em português e suas ações

Yuriko Yamamoto Baldin
Departamento de Matemática da UFSCar

Quinta-feira **Coordenador: José Antonio Salvador** **Sala Turmalina**
16:30-17:30 h

A palestra irá apresentar os princípios e os objetivos do Projeto Klein de Matemática em Português, um projeto com apoio da SBM, SBEM,SBMAC, SBHMat,OBMEP e apoio financeiro da CAPES. Um relato das suas ações, sua relação com o Projeto Internacional da ICMI-IMU, e o significado das Oficinas dirigidas para professores do Ensno Básico e das licenciaturas será feito. Espera-se que possamos divulgar as possibilidades deste projeto para ações futuras mais duradouras que poderão contribuir para a melhoria da formação de professores e do ensino básico de matemática.

C16 Processamento de alto desempenho: papel, serviços e futuro

Pedro Leite da Silva Dias
LNCC

Sexta-feira **Coordenador: Fábio Borges de Oliveira** **Sala Ametista**
11:30-12:30 h

A modelagem computacional é usada para compreender, analisar e resolver problemas científicos e tecnológicos e constitui-se numa grande área de pesquisa interdisciplinar. Ë baseada no desenvolvimento de modelos matemáticos, algorítimos e técnicas de processamento computacional para simular, testar hipóteses e prever a evolução de fenômenos e processos. Tem aplicações nas áreas de saúde, engenharias, ciências da terra, física, química, biologia e nas ciências humanas. A dimensão dos problemas tipicamente abordados na modelagem computacional cresceu substancialmente nas últimas décadas em função os seguintes aspectos: (a) capacidade de processamento (aumento da ordem de mil vezes entre 1997 e 2008, (b) capacidade de armazenamento (um milhão de vezes no mesmo período) e (c) avanço das tecnologias de informação e computação (redes mutiGigabit). O Brasil esteve razoavelmente bem colocado no ranking internacional no final dos anos 90 mas hoje está bem longe do desempenho computacional disponível nos demais países do BRIC. Mas existem "ilhas" no Brasil, como no caso da Previsão de Tempo e Clima (CPTEC) e na Petrobras. Serão discutidos alguns exemplos de aplicações de computação, de alto desempenho no Brasil, as necessidades atuais e perspectivas futuras do SINAPAD (Sistema Nacional de Processamento de Alto Desempenho).

C17 On multivariate orthogonal polynomials

Teresa E. Pérez
Universidade de Granada

Sexta-feira **Coordenador: Cleonice Fátima Bracciali** **Sala Turmalina**
11:30-12:30 h

Classical orthogonal polynomials in one variable can be defined as orthogonal polynomials associated to a moment functional satisfying a Pearson differential equation. We extend this concept to several variables defining classical multivariate orthogonal polynomials as those associated to a moment functional satisfying a matrix analogue of the Pearson differential equation ([2]). In this talk, we present old and new results on classical multivariate orthogonal polynomials. In particular, classical multivariate orthogonal polynomials on the unit ball and some useful modifications will be studied. We will present the so–called Krall modification ([3]) obtained by adding a finite set of equally spaced mass points on the border of the unit ball, and some Sobolev modifications ([1], [4]), obtained by adding to the ball functional the evaluation of the gradients in one or several points. Sobolev orthogonal polynomials in several variables appears for the first time in [5] in a problem related to dwell time for polishing tools in fabricating optical surfaces.