THE UNIVERSITY OF TEXAS AT DALLAS SPRING 2013 COLLOQUIA ARCHIVE

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David Lehotzky	3/22/2013	Stabilization of the turning process via digital feedback control
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Revised: 5/29/2013



MATHEMATICS COLLOQUIUM

by Dr. Robert Kirby Associate Professor **Department of Mathematics** Baylor University

Metanumerical computing for partial differential equations

The last decade has seen the rapid growth in the expressiveness and power of software for the finite element method for the numerical solution of partial differential equations. Codes such as FEniCS and the Sundance project allow users to express the weak form of their problem in high-level syntax that the software uses to efficiently build algebraic operators and hence utilize high performance libraries to obtain numerical solutions.

In this talk, I will discuss the mathematical underpinnings of the Sundance project, showing how a framework based on Frechet differentiation allows us to reason about and process notation for variational forms. As an application of Sundance's capabilities for coupled multiphysics problems, I will also discuss current research on block-structured preconditioners for the Benard convection problem of incompressible flow.

- Date: Friday, January 25, 2013
- Time: 2:00 3:00 PM Coffee will be served in FO 2.610F at 1:30 PM

Room: FN 2.102

Public Invited



STATISTICS COLLOQUIUM

by Dr. Sherry Wang, Associate Professor Department of Statistical Science, Southern Methodist University

Epigenetic Change Detection and Pattern Recognition via Bayesian Hierarchical Hidden Markov Models

Epigenetics is the study of changes to the genome that can switch genes on or off and determine which proteins are transcribed without altering the DNA sequence. Recently, epigenetic changes have been linked to the development and progression of disease such as psychiatric disorders. High-throughput epigenetic experiments have enabled researchers to measure genome-wide epigenetic profiles, and yield data consisting of intensity ratios of immunoprecipitation (IP) versus reference samples. The intensity ratios can provide a view of genomic regions where protein binding occurs under one experimental condition, and further allow us to detect epigenetic alterations through comparison between two different conditions. However, such experiments can be expensive, with only a few replicates available. Moreover, epigenetic data are often spatially correlated with high noise levels. In this paper, we develop a Bayesian hierarchical model, combined with hidden Markov processes (HMP) with four states for modeling spatial dependence, to detect genomic sites with epigenetic changes from two-sample experiments with paired internal control. One attractive feature of the proposed method is that the four states of the HMPs have well-defined biological meanings, and allow us to directly call the change patterns based on the corresponding posterior probabilities. In contrast, none of existing methods can offer this advantage. In addition, the proposed method offers great power in statistical inference by spatial smoothing (via hidden Markov modeling) and information pooling (via hierarchical modeling). Both simulation studies and real data analysis in a cocaine addiction study illustrate the reliability and success of this method.

Date: Friday, February 1, 2013

Time: 2:00 - 3:00 PM Coffee will be served in FO 2.610F at 1:30 PM.

Room: FN 2.102

Public Invited



THE UNIVERSITY OF TEXAS AT DALLAS MATHEMATICS COLLOQUIUM

by

Dr. Gleb V.Nosovskiy Associate Professor, Department of Differential Geometry and Applications Faculty of Mechanics and Mathematics Moscow State University

Computer Gluing of 2D Projective Images

The problem of gluing of 2D projective images obtained from different points in the space is well-known in computer geometry. This problem spits in two steps: tracking and finding fast and robust algorithm for determination the projective mapping from the tracking results. A new tracking method is presented based on a general approach to recognize similar fragments in perturbed sets of objects which was suggested by A.T.Fomenko and the author.

For the second step, error estimate for the direct algorithm of determination of the projective mapping is presented. This estimate suggests that the direct algorithm of projective mapping calculation is much more accurate and robust than commonly used linear algorithms.

Keywords: Computer geometry, Multiple view computer geometry, Computer vision, Computer graphics, Projective geometry, Pattern recognition, Stereophotogrammetry, **Projective mappings**

Date: Wednesday, February 6, 2013

Time: 1:00 - 2:00 PM Coffee will be served in FO 2.610F at 12:30 PM.

Room: FN 2.102

Public Invited



MATHEMATICS COLLOQUIUM

by Dr. Igor Zelenko, Assistant Professor, Department of Mathematics, Texas A&M University,

Geometry of vector distributions: from Cartan to Tanaka and beyond

Vector distributions (subbundles of tangent bundles) appear naturally in Geometric Control Theory as sets of admissible velocities for control systems linear with respect to control parameters and Geometric Theory of Differential Equations as natural distributions on submanifolds of jet spaces. I am interested in the equivalence problem for such structures, i.e. in determining whether one such structure can be transformed to another one by the natural action of the group of diffeomorphisms of the ambient manifold. Apart of several cases of distributions of small rank and corank this equivalence problem is non-trivial, i.e. have functional differential invariants. Often it is extremely difficult to compute such invariants and to interpret them geometrically.

The general way to solve such equivalence problems is to assign to a geometric structure the (co)frame (or the structure of absolute parallelism) on some (fiber) bundle over the ambient manifold in a canonical way. The goal of this colloquium talk is to give a survey of the classical and recent developments in this equivalence problem, making special emphasis to the algebraic version of Cartan's method of equivalence developed by N. Tanaka in 1970s. The central object in the Tanaka approach is the notion of a symbol of a distributions at a point, which is a graded nilpotent Lie algebra. The prolongation procedure (i.e. the procedure of getting a canonical frame) can be described in terms of natural algebraic operation in the category of graded Lie algebras. However, the applicability of this machinery is restricted due to the impossibility to clasify all graded nilpotent Lie algebras and the presence of moduli in the space of such algebras.

Through this survey I will motivate the recent approach of B. Doubrov and myself to this problem reducing the original equivalence problem to the problems of equivalence of curves of symplectic flags. Our approach extends significantly the set of distributions for which the canonical frame can be constructed in a uniform way. This approach will be described in more details in my following talk in the Geometry seminar.

Date:Friday, February 8, 2013Time:2:00 - 3:00 PM
Coffee will be served in FO 2.610F at 1:30 PM.

Room: FN 2.102

Public Invited





Department of Mathematical Sciences

Colloquium

by

Dr. Shuying Sun

Assistant Professor Case Comprehensive Cancer Center and Department of Epidemiology and Biostatistics Case Westeran Reserve University

HMM-Fisher: A Hidden Markov Model Based Method For Identifying Differential Methylation

Abstract: DNA methylation is a common and important molecular change that plays a key regulatory role in both normal and diseased cells. It is significant to study DNA methylation, especially differential methylation patterns between two groups of samples (e.g., normal individuals vs. patients). With next generation sequencing (NGS) technologies, it is now possible to study methylation patterns by considering methylation at all CG sites in an entire genome. However, it is challenging to analyze large and complex NGS data. In order to address this problem, we have developed a new statistical approach named HMM-Fisher, which uses a hidden Markov model and the Fisher's exact test. In particular, we first use a hidden Markov chain to model the methylation signals by inferring the methylation state as No-methylation (N), Partial-methylation (P), or Full-methylated CG sites. The advantages of HMM-Fisher are that it can incorporate neighboring CG site methylation information and reduce the impact of sequencing errors. In this poster, we show our HMM-Fisher method and compare it with the two-sample T-test using a publicly available data set.

Date:	Monday, February 11 ¹¹¹ , 2013
Time:	2:00 - 3:00 PM Coffee will be served in FO 2.610F at 1:30 PM.
Room:	CN 1.120

+h

Public Invited

NOTE: Please contact Lorre Antoine at lantoine@utdallas.edu or (972)883-2161 or by FAX at (972)883-6622 for up-to-date colloquium information if you want to receive E-mail notices.

MATHEMATICS COLLOQUIUM

by Dr. Min Chen, Assistant Professor, Co Division of Biostatistics, Department of Clinical Sciences, University of Texas Southwestern Medical Center

Graphical Modeling of Biological Pathways in Genome-wide Association Studies

In genome-wide association studies (GWAS) researchers examine a large number of markers to identify their associations with disease, or to prioritize markers for follow-up studies. In most published studies the search is limited to single markers. However, this approach may lack adequate statistical power for true discoveries. We propose to incorporate biological pathway information in GWAS by a Markov Random Field model. This is motivated by the observation that genes interact with each other and multiple genetic markers may jointly affect the disease risk. Besides, a large amount of knowledge about biological pathways and gene-gene interactions has been accumulated from past biological and bioinformatics studies. Unlike most existing methods that treat genes in a pathway as an exchangeable gene list, our approach takes into account functional relationships among those genes. We show that the conditional distribution of our MRF model takes on a simple form, and propose an iterated conditional modes algorithm as well as a decision theoretic approach for statistical inference of each gene's association with disease.

Thursday, February 14, 2013 Date:

Time: 2:00 - 3:00 PM Coffee will be served in FO 2.610F at 1:30 PM.

Room: CB3 1.312

Public Invited



MATHEMATICS COLLOQUIUM

by Dr. Borislav Gajic Associate Research Professor Mathematical Institute SANU

Rigid-body dynamics and algebraic geometry

Rigid-body dynamics serves for centuries as a significant laboratory for development and examination of the most recent theoretical mechanical considerations and their applications. We will use it to illustrate a modern method of algebro-geometric integration of integrable and close to integrable PDEs and ODEs. The method of finite-gap integration creates a fruitful two-way interaction between some classes of nonlinear equations and the geometry of algebraic curves, the Jacobian and the Prym varieties. We will focus on the four-dimensional systems we have constructed, the Lagrange bitop and the systems of Hess-Appel'rot type, and we will show that the integration in the theta-functions leads to a dynamical version of the Mumford relation on the theta-divisors of the Prym varieties and the rigid-body dynamics in an ideal fluid. Related Kirchhoff equations are studied using both algebro-geometric and symbolic-computational techniques.

Date: Monday, Feb 25, 2013

Time: 2:00 - 3:00 PM Coffee will be served in FO 2.610F at 1:30 PM.

Room: FO 2.702

Public Invited

THE UNIVERSITY OF TEXAS AT DALLAS MATHEMATICS COLLOQUIUM

by

Dr. S.I. Agafonov Department of Mathematics Universidade Estadual Paulista S.J. Rio Preto, Brazil

Singular symmetric flat 3-webs and Frobenius 3-folds

The theory of Frobenius manifolds, having its origin in theoretical physics, has deep interrelations with apparently very different areas of mathematics: Witten-Gromov invariants and quantum cohomology, deformation of flat connections, integrable systems, singularity theory etc. We discuss a new aspect of this fruitful and fast developing theory: its relations with the classical chapter of differential geometry, namely the web theory.

Using the structure of a given semi-simple Frobenius 3-fold, we construct a 3-web in the plane. This web enjoys the following properties:

1) it is flat,

2) it admits at least one-dimensional symmetry algebra and

3) its Chern connection remains holomorphic in singular points, where at least 2 web directions coincide.

We present a classification of singularities of 3- webs with such properties and show that any such web is obtained by the presented construction. We give also a geometrical interpretation of the associativity equation, describing the corresponding Frobenius 3-fold.

Date: Thursday, February 28, 2013

Time: 2:00 - 3:00 PM Coffee will be served in FO 2.610F at 1:30 PM.

Room: CB3 1.312

Public Invited



THE UNIVERSITY OF TEXAS AT DALLAS STATISTICS COLLOQUIUM

by

Dr. Yulia Gel Associate Professor Department of Statistics and Actuarial Science, University of Waterloo, Waterloo, Ontario, Canada

Regularized prediction for the same-realization of time series

In this talk we discuss how modern regularization procedures can be employed for estimation and forecasting of the same-realization of time series, which can be viewed as a "large \$p\$-small \$n\$" problem in a time series framework. In particular, we show that banding enables us to employ an approximating model of a much higher order than typically suggested by AIC, while controlling how many parameters are to be estimated precisely and the level of accuracy. We present results on asymptotic consistency of banded autocovariance matrices under the Frobenius norm and provide a theoretical justification on optimal band selection using V-fold crossvalidation, which can be viewed as an alternative model selection criterion for the same-realization prediction. Our numerical studies show that the banded prediction yields a substantially lower predictive root mean squared error than forecasting methods that are based on classical model selection criteria. We also illustrate our procedure by application to forecating sea surface temperature. This is a joint work with Peter Bickel, University of California, Berkeley.

Date:	Monday, March 4, 2013
Time:	2:00 - 3:00 PM
	Coffee will be served in FO 2.610F at 1:30 PM.

Room: FO 2.702

Public Invited



THE UNIVERSITY OF TEXAS AT DALLAS APPLIED MATHEMATICS COLLOQUIUM

by

Dr. Anna Zemlyanova Visiting Assistant Professor Department of Mathematics Texas A&M University

Curvature-dependent surface tension in modeling of fracture

A new model of fracture mechanics which takes into account interfacial effects due to a curvaturedependent surface tension will be considered. This model is based on a physically valid assumption that the behavior of molecules near a surface of a material is significantly different from those in the bulk and depends on the local curvature of the material surface. The theory will be presented through three examples: a curvilinear non-interface crack, a straight interface crack and contact problems for a rigid stamp indentation into an elastic half-plane. It will be shown that the incorporation of surface effects on the crack boundary will eliminate the power and oscillating singularities at the crack tips which are predicted by linear elastic fracture mechanics. The mechanical problems will be reduced to the systems of singular integro-di erential equations. The regularization and numerical solution of these systems will be addressed and numerical examples will be presented. Potential direction for future resarch and connections with experimental results will be discussed.

- **Date:** Thursday, March 7, 2013
- **Time:** 2:00 3:00 PM Coffee will be served in FO 2.610F at 1:30 PM.

Room: CB3 1.312

Public Invited

NOTE: Please visit our webpage at http://www.utdallas.edu/math/news/ for up-to-date colloquia information.



THE UNIVERSITY OF TEXAS AT DALLAS mathematics colloquium

by Dr. Paul Bruillard Dept. of Mathematics Texas A&M University

Topological Quantum Computation Arithmetic Properties of Modular Categories

A physical system is said to be in topological phase if at low energies and long wavelength the physical observables are invariant under smooth deformations. These physical systems have applications in a wide range of disciplines, especially in quantum information science. Quantum computers based on such systems are topologically protected from decoherence. This fault-tolerance removes the need for the expensive error--correcting codes required by the qubit model. Topological phases of matter can be studied through their algebraic manifestations, modular categories. Thus, a complete classification of these categories would provide a taxonomy of admissible topological phases.

In this talk, we will review the connections between topological phases of matter and modular categories and discuss the classification program for such categories. We will then consider recent foundational work on the classification program as well as deep connections between these categories and number theory which make classification a tractable problem. In particular, we will consider how contemporary number theoretic techniques can be used to prove rank finiteness of modular categories. This analysis leads to intriguing primality conditions on modular categories, which are related to classical questions regarding the infinitude of Sophie Germain and Fermat primes. Time permitting, we will discuss how these techniques can be practically applied to extend the rank classification of modular categories.

- Date: Friday, March 8, 2013
- Time:
 2:00 3:00 PM

 Coffee will be served in FO 2.610F at 1:30 PM.

Room: FN 2.102

Public Invited



STATISTICS COLLOQUIUM

by Dr. Cristina Gorrostieta, Postdoctoral Fellow Statistics Department University of California at Irvine

Modeling dependence in multivariate time series

I will present extensions of two classical techniques for modeling dependence in multivariate time series, namely vector autoregressive model (VAR) and coherence analysis. These techniques are applied in describing brain signals dependencies.

To generalize the vector autoregressive model, I embedded this model in a mixed effects framework to account for between unit variability. This model is used for exploring multi subject fMRI brain connectivity and identifying connectivity structures with high variability between subjects.

To extend the notion of dual frequency coherence developed in the signal processing literature, I will establish the concepts of evolutionary and lagged dual frequency coherence. These concepts were developed with the aim to investigate time dependent brain oscillatory activity between different frequencies and were motivated by empirical evidence that point out how brain processes and mental disorders can be described by interactions between oscillatory neuronal activity at different frequencies

Date: Monday, March 18, 2013

Time: 2:00 - 3:00 PM Coffee will be served in <u>FO 2.610F</u> at 1:30 PM.

Room: <u>CB3 1.312</u>

Public Invited

MATHEMATICS COLLOQUIUM

by Dr. Semyon Tsynkov, Professor, Department of Mathematics, North Carolina State University

Quasi-lacunae of Maxwell's equations

We will discuss the Huygens' principle as it applies to Maxwellian electrodynamics, and show how it can be exploited for the design of numerical methods with particular advantageous properties. Theoretical developments will be corroborated by numerical simulations, including those performed using third party software.

Collaborators: V. Ryaben'kii, V. Turchaninov, S. Petropavlovsky, and Computational Sciences, LLC

Funding: NSF, AFOSR, ARO

Date: Wednesday, March 20, 2013

Time: 2:00 - 3:00 PM Coffee will be served in <u>FO 2.610F</u> at 1:30 PM.

Room: <u>FN 2.102</u>

Public Invited

APPLIED MATHEMATICS COLLOQUIUM

by

Mr. David Lehotzky, Visiting Research Guest, Mathematical Sciences Department, The University of Texas at Dallas

Stabilization of the turning process via digital feedback control

Regenerative chatter limits productivity and quality in high speed machining. To increase the material removal rate without losing stability of the process an active digital control strategy is investigated. The governing equation of the controlled mechanical systeml is a nonlinear DDE with two delays, one delay is constant the other one is piecewise linear and time periodic at the sampling period of the controller.

The stability of the linearized system is discussed. First the stability properties of the uncontrolled system is shown, then two methods for the selection of control parameters are presented. The first method approximates the infinite dimensional problem with a finite dimensional system by using semi-discretization. The second method applies a condition for stability equivalence in order to transform the equation to a DDE with point delays.

Date: Friday, March 22, 2013

Time: 2:00 - 3:00 PM Coffee will be served in <u>FO 2.610F</u> at 1:30 PM.

Room: <u>FN 2.102</u>

Public Invited

STATISTICS COLLOQUIUM

by Dr. Jin Liu, Postdoctoral Associate Department of Biostatistics School of Public Health Yale University

Integrative Analysis of Prognosis Data on Multiple Cancer Subtypes Using Compound Group Bridge

In cancer research, profiling studies have been extensively conducted, searching for genes/SNPs associated with prognosis. Examining the similarity and difference in the genetic basis of multiple subtypes of the same cancer can lead to better understanding of their connections and distinctions. Integrative analysis approaches analyze the raw data on multiple subtypes simultaneously. In this study, prognosis data on multiple subtypes of the same cancer are analyzed. An AFT model is adopted to describe survival. The genetic basis of multiple subtypes is described using the heterogeneity model, which allows a gene/SNP to be associated with the prognosis of some subtypes but not the others. A compound penalization approach is developed to conduct gene-level analysis and identify genes that contain important SNPs associated with prognosis. The proposed approach has an intuitive formulation and can be realized using an iterative algorithm. Asymptotic properties are rigorously established. Simulation shows that the proposed approach has satisfactory performance. An NHL (non-Hodgkin lymphoma) prognosis study with SNP measurements is analyzed.

Date: Monday, March 25, 2013

Time: 2:00 - 3:00 PM Coffee will be served in <u>FO 2.610F</u> at 1:30 PM.

Room: <u>CB3 1.312</u>

Public Invited

MATHEMATICS COLLOQUIUM

by Dr. Mohammad Akbar, Senior Lecturer Department of Mathematical Sciences The University of Texas at Dallas

New Ricci-flat Metrics and Ricci Solitons from Einstein-Scalar Field Theory

Ricci-flat metrics are one of three categories of Einstein metrics and in Lorentzian signature they are the vacuum solutions of the Einstein equations. The first part of the talk will present a recent method of generating a one-parameter family of Ricci-flat metrics from old ones in the presence of two commuting hypersurface-orthogonal Killing vector fields (know as static axially symmetric solutions in relativity) as well as present various warped form of the famous Minkowski and other flat metrics in arbitrary dimensions. The second part of the talk will present a family of solitonic solutions (i.e. self-similar) of the Ricci flow equations that can be generated from solutions of the Einstein equations with scalar-matter sources in one less dimension.

 Date: Thursday, March 28, 2013
 Time: 2:00 - 3:00 PM Coffee will be served in <u>FO 2.610F</u> at 1:30 PM.

Room: CB3 1.312

Public Invited

STATISTICS COLLOQUIUM

by

Dr. Haipeng Shen, Department of Statistics, The Wharton School, University of Pennsylvania Department of Statistics and Operations Research, University of North Carolina at Chapel Hill

Color Independent Component Analysis with Application to Brain Imaging Analysis

Independent component analysis (ICA) has been a powerful data-driven method for blind source separation. Most existing ICA procedures rely solely on marginal distribution information. However, in many applications, correlation structures within each source also play an important role. One important such example is fMRI or EEG brain imaging analysis where the brain-function-related signals are temporally correlated. We develop a frequency-domain ICA method within the framework of Whittle likelihood. Specifically, we propose to estimate the spectral density functions of the source signals instead of their marginal density functions. Our methodology allows the colored sources to have possibly mixed spectra, i.e. a mixture of line spectra and spectral density functions. Model parameters for the spectral density and the corresponding mixing matrix are then estimated via maximum Whittle likelihood. The proposed method is shown to outperform several popular existing methods through simulation studies and real applications.

Date: Friday, March 29, 2013

Time: 2:00 - 3:00 PM Coffee will be served in <u>FO 2.610F</u> at 1:30 PM.

Room: <u>FN 2.102</u>

Public Invited

ACTUARIAL SCIENCE COLLOQUIUM

by Dr. Chanho Lee, Assistant Vice President, Head of Life and Enterprise Economic Capital & Quantitative Risk Analytics, The Hartford Hartford, Connecticut

ECONOMIC CAPITAL: Economic Capital Modeling & its Applications

The speaker would like to provide a general description of Economic capital modeling and relate to the training for actuarial science students to have them better prepared for everchanging industry needs.

 Date: Friday, April 5th, 2013
 Time: 11:30 AM - 12:30 PM Coffee will be served in FO 2.610F at 11:00 AM

Room: FO 2.604

Public Invited

MATHEMATICS COLLOQUIUM

by

Dr. Vladimir Dragović, Professor of Mathematics Department of Mathematical Sciences The University of Texas at Dallas

Pseudo-integrable billiards: topological properties and arithmetic dynamics

We introduce a class of nonconvex billiards with a boundary composed of arcs of confocal conics which contain reflex angles. We present their basic topological and arithmetic properties. We study their periodic orbits and establish a local Poncelet porism. The connection with interval exchange transformation is established together with the Keanetype conditions for minimality.

Date: Friday, April 5, 2013

Time: 2:00 - 3:00 PM Coffee will be served in <u>FO 2.610F</u> at 1:30 PM.

Room: <u>FN 2.102</u>

Public Invited

ACTUARIAL SCIENCES COLLOQUIUM

by Dr. Ronald Dearing, Adjunct Professor, University of North Texas Adjunct Professor, Southern Methodist University

The Virtual Insurance Company

Dr. Dearing will discuss an alternative to the traditional brick and mortar facility we know as an insurance company. A case study, based on what is generally considered to be the world's first "virtual" insurance company, will present the business problem, the business solution, the parties involved, the economics, and the structure of the virtual company. Dr. Dearing was one of the early proponents of the virtual concept and he'll describe how the virtual enterprise came about and where it is today.

Date: Wednesday, April 10, 2013

Time: 1:00 - 2:00 PM Coffee will be served in <u>FO 2.610F</u> at 12:30 PM.

Room: <u>FN 2.102</u>

Public Invited

THE UNIVERSITY OF TEXAS AT DALLAS APPLIED MATHEMATICS COLLOQUIUM

by Dr. Bernard Hanzon, Department of Mathematics, University College Cork

2-EPT Levy Processes and Financial Option Pricing

The class of probability density functions on the real line with strictly proper rational characteristic functions are considered. On the positive half-line as well as on the negative half-line these probability density functions are Exponential-Polynomial-Trigonometric (EPT) functions. We refer to these probability density functions as 2-EPT densities. EPT density functions on the positive half-line can be represented as f(x)=c.exp(Ax).b, where ``A" is a stable square matrix, ``b" a column vector and ``c" a row vector and exp(Ax) stands for the matrix exponential of the matrix Ax. On the negative half line a similar representation holds, but now with "A" an anti-stable square matrix. The triple (A,b,c) is called a realization of the EPT function c.exp(Ax).b.

The more general class of probability measures on R with (proper) rational characteristic function have densities corresponding to mixtures of the point mass at zero (``delta distribution") and 2-EPT densities.

The Variance Gamma density which is well-known in Financial Mathematics is shown to be a 2-EPT density under a certain parameter restriction. Variance Gamma processes are Levy processes. We give conditions under which a 2-EPT distribution is infinitely divisible and hence gives rise to a Levy process. Here we make use of recent results on sufficient conditions for an EPT function to be non-negative (cf [1],[2]). In the presentation we will spend some time on explaining our results on how to determine the number of sign changes of an EPT function on a given finite interval using a generalized Budan-Fourier approach, which is possible for any EPT function.

The infinitely divisible 2-EPT densities give rise to a rich class of Levy processes for which there are closed form formulae for many option price problems and their corresponding Greeks. Value-at-Risk computations are also straightforward in this framework.

[1] B. Hanzon, F. Holland, "Non-negativity Analysis for Exponential-Polynomial-Trigonometric Functions on [0,infinity)," Arendt, Wolfgang (ed.) et al., Spectral theory, mathematical system theory, evolution equations, differential and difference equations. Basel: Birkhäuser. Operator Theory: Advances and Applications 221, 399-412 (2012). An earlier version of the paper can be downloaded from www.edgeworth.biz

[2] B. Hanzon, F. Holland, "Non-negativity of Exponential Polynomial Trigonometric Functions-a Budan Fourier sequence approach", Poster 429 presented at the Bachelier Finance Society Congress, Toronto, 2010; available on-line at web address http://euclid.ucc.ie/sta /hanzon/BFSTorontoPosterHanzonHollandFinal.pdf

Papers and software also available at <u>www.2-ept.com</u>.

(joint work with H.C. Sexton (Barclays London), F. Holland (Dept Mathematics, UCC))

Date: Friday, April 12, 2013

Time: 2:00 - 3:00 PM Coffee will be served in <u>FO 2.610F</u> at 1:30 PM.

Room: <u>FN 2.102</u>

Public Invited

APPLIED MATHEMATICS COLLOQUIUM

by Dr. Oleg Makarenkov Researcher, Leader of Dynamical Systems Research Line Basque Center for Applied Mathematics (BCAM)

Bifurcations in nonsmooth systems

An increasing interest in nonsmooth dynamical systems is motivated by multiple applications in control theory, thermodynamics, medicine and fluid dynamics. We discuss our recent contributions in the field focusing on bifurcations. We adopt the classical bifurcation function (usually attributed to Melnikov) and investigate bifurcations of resonance oscillations in differential equations with nondifferentiable Lipschitz righthand-sides. It turns out that the relevant Poincare map can be expandable in Taylor series despite of the above-mentioned nondifferentiability. The landscape changes completely in the case where the right-hand-sides are just continuous and more than one solution can share same initial condition (i.e. the Poincare map is not necessary defined). A geometric approach has been used to discover Melnikov type bifurcations here. For differential equations with piecewise smooth discontinuous right-hand-sides, we introduce the phenomenon of border-splitting bifurcation of closed orbits which occurs when the number of smooth pieces increases. An analogous phenomenon of grazing bifurcation is discussed in the context of piecewise smooth discrete-time dynamical systems that govern dispersing billiards. We clarify how generic this phenomenon is.

Date: Monday, April 29, 2013

Time: 2:00 - 3:00 PM Coffee will be served in FO 2.610F at 1:30 PM.

Room: <u>FO 2.702</u>

Public Invited

ACTUARIAL SCIENCES COLLOQUIUM

by Douglas Eckley, PhD., FSA, CPA, Independent Consultant and Adjunct Professor Northern Virginia Community College, Alexandria, VA.

Is Social Insurance a Ponzi Scheme?

In the 1920s, Charles Ponzi thought he had an arbitrage opportunity involving the Italian and American postal systems. He was wrong. But he told everyone that his scheme was working. When new investors came in, he used their money to pay back the earlier investors. Eventually, he did not have enough new investors to pay back old investors, and his scheme fell apart.

Today, we have from the website of the Social Security Administration: "It would be most accurate to describe Social Security as a transfer payment--transferring income from the generation of workers to the generation of retirees--with the promise that when current workers retire, there will be another generation of workers behind them who will be the source of their Social Security retirement payments."

Date: Friday, May 3, 2013

Time: 2:00 - 3:00 PM Coffee will be served in FO 2.610F at 1:30 PM.

Room: FO 2.702

Public Invited

ACTUARIAL SCIENCES COLLOQUIUM

by Dr. Joshua Zhu FSA, CERA, MAAA Director of Financial Modeling Aviva USA West Des Moines, Iowa

Actuary and Financial Modeling

Actuaries use mathematics, statistics, and financial theory to assess the risk that an event will occur and to help businesses and clients develop policies that minimize the cost of that risk. They are essential to insurance and reinsurance industry, either as staff employees or as consultants. There is a significant increase of demand for actuaries in the next decade due to the global economy growth and more insurance industry regulations. In this presentation, the speaker is intended to provide a unique view on this professional with his own working experience in the life insurance industry as an actuary. Different working areas of actuaries are discussed and how to become an actuary is illustrated. In addition, a financial modeling project based on speaker's experience is presented as an example of actuarial work in the real world. The speaker will give an introduction to the market consistent embedded value and discuss how to calculate this value with actuarial approaches.

Date: Monday, May 13, 2013

Time: 11:00 AM - 12:00 PM Coffee will be served in <u>FO 2.610F</u> at 10:30 AM.

Room: FO 2. 604

Public Invited