Fall 2013

2013 (Fall)

University of Dayton. Department of Mathematics

Abstracts of the Colloquium talks: Fall 2013

Date	Speaker and Title	Time/Location
Thursday, Sep 12	Dan Ren, University of Dayton Optimal stopping time for the last passage time and last maximum time	3:00 PM, SC 323
Thursday, Sep 19	Lynne Yengulalp, University of Dayton Topological completeness	3:00 PM, SC 323
Thursday, Sep 26	Amanda Keck Criner, University of Dayton Research Institute Thermal nondestructive evaluation of porous materials	3:00 PM, SC 323
Thursday, Oct 3	Paul Eloe, University of Dayton A solution algorithm for three term linear fractional difference equations with constant coefficients	3:00 PM, SC 323
Monday, Oct 14	**Electro-Optics and Mathematics Joint Seminar** Willy Hereman, Colorado School of Mines Symbolic computation of conservation laws of nonlinear partial differential equations	**3:00 PM, SC 114**
Thursday, Oct 17	Catherine Kublik, University of Dayton Coarsening in high order, discrete, ill-posed diffusion equations	3:00 PM, SC 323
Thursday, Oct 24	Richard Kublik, Materials Resources LLC An Algorithm for Locally Adaptive Time Stepping	3:00 PM, SC 323
Thursday, Oct 31	Michael Radin, Rochester Institute of Technology Eventually periodic solutions & patterns of unbounded solutions of a second order delayed max-type difference equation	3:00 PM, SC 323
Thursday, Nov 7	David Freeman, University of Cincinnati Invertible Carnot Groups	3:00 PM, SC 323
Thursday, Nov 14	Asmaa Alharbi and Hadiah Esmaiel, University of Dayton Exponential Smoothing	3:00 PM, SC 323
Thursday, Nov 21	Nujud Alshehri, University of Dayton Forced Monotone Methods	3:00 PM, SC 323
Thursday, Nov 21	Ahmad Alhamad, University of Dayton Multivariate Time Series Models	**3:30 PM, SC 323**
Tuesday, Nov 26	Yulong Liu, University of Dayton Pricing an American put option in a jump model	3:00 PM, SC 323
Tuesday, Dec 3	Abdulmohsen Alruwaili, University of Dayton Boundedness and Decay of Solution in Delay Difference Equation with Unbounded Forcing Terms	3:00 PM, SC 323
Tuesday, Dec 3	Norah Alnami, University of Dayton Asymptotically Stable Solutions of a System of Coupled Nonlinear Differential Equations	**3:30 PM, SC 323**
Thursday, Dec 5	Salah Alsahafi and Abdualrazaq Sanbo, University of Dayton	3:00 PM, SC 323

	Boundedness of Solutions in Volterra Systems of Difference Equations	
Thursday, Dec 5	Pei Zhang, University of Dayton Idiosyncratic Risk and the Cross-Section of Expected Stock Return: A Threshold Regress Approach	**3:30 PM, SC 323**

Optimal stopping time for the last passage time and last maximum time
Dan Ren
Abstract: Given any transient diffusion process X, this paper considers the last passage time when X passes level l, and the (last) time when X reaches the maximum. For each random time, the paper solves the optimization problem $inf_\tau\ E[\lambda(\tau - \rho) + + (1 - \lambda)(\rho - \tau)+]$ over all stopping times τ in the set $T\rho^\lambda := \{\tau \in T \mid E\ [(\lambda\tau - \rho)+] < \infty\}$. The optimal stopping time of the passage time is given as $\tau * = inf\{t \in R + |X_t \leq \kappa\}$, where κ is the solution of an explicit defined equation. The optimal stopping time of the (last) maximum time is given as $\tau * = inf\{t \in R + |X_t \leq \varphi * (S_t)\}$, where the supreme process $St := sup 0 \leq s \leq t\ X_s$ and the function $\varphi *$ is the maximal solution (if exists) lying below the line $s \rightarrow \lambda s$ of a first-order ordinary differential equation.

Topological completeness
Lynne Yengulalp
Abstract: I will start by reviewing the Baire Category Theorem for complete metric spaces. I will then talk about other classes of topological spaces for which the Baire Category Theorem holds. Such spaces have various "generalized" completeness properties extending from the familiar local compactness property to the relatively new property of domain representability.

Thermal nondestructive evaluation of porous materials
Dr. Amanda Keck Criner
Abstract: Nondestructive evaluation is often used to identify damage in structures, including components of aircraft, spacecraft, automobiles, trains and piping, as they age beyond their design life. Many nondestructive evaluation techniques (acoustic, eddy-current, etc) detect and characterize damages through differences in observed physical parameters on homogeneous domains. I will present results of our investigation of the behavior of a model derived from homogenization theory as the model solution in parameter estimation procedures for simulated data for heat flow in a porous medium. We considered data simulated from a model on a perforated domain with isotropic flow and data simulated from a model on a homogeneous domain with anisotropic flow. We use ordinary least squares parameter estimation procedure along with a method of maps to detect damage using a hypothesis test and to characterize elliptical damage.

A solution algorithm for three term linear fractional difference equations with constant coefficients
Paul Eloe
Abstract: We consider a linear fractional difference equation of the form

$$D^{\propto}u(t) + aD^{\beta u(t)} + bu(t) = 0, t = 1,2, \ldots$$

Operators $(D^\gamma + cI)$ and $(D^\delta\ + dI)$, where I denotes the identity operator, do not commute and so, usual methods from sophomore level ordinary differential equations have not been modified to

construct solution algorithms. Zi Ouyang (BS, mathematics and physics, UD 2013) proposed a solution algorithm based on a transform method. Sufficient conditions in a and b are given that imply the convergence of the algorithm. A new series representation for 2^t is presented and analyzed. Sufficient background material from sophomore level ordinary differential equations is provided so that the talk is self-contained.

Symbolic Computation of Conservation Laws of Nonlinear Partial Differential Equations

Dr. Willy Hereman

Abstract A method will be presented for the symbolic computation of conservation laws of nonlinear partial differential equations (PDEs) involving multiple space variables and time. Using the scaling symmetries of the PDE, the conserved densities are constructed as linear combinations of scaling homogeneous terms with undetermined coefficients. The variational derivative is used to compute the undetermined coefficients. The homotopy operator is used to invert the divergence operator, leading to the analytic expression of the flux vector. The method is algorithmic and has been implemented in the syntax of the computer algebra system Mathematica. The software is being used to compute conservation laws of nonlinear PDEs occurring in the applied sciences and engineering. The software package will be demonstrated for PDEs that model shallow water waves, ion-acoustic waves in plasmas, sound waves in nonlinear media, and transonic gas flow. The featured equations include the Korteweg-deVries, Kadomtsev-Petviashvili, ZakharovKuznetsov, and Khoklov-Zabolotskaya equations.

Biographical sketch: Dr. Willy Hereman is Professor and Chair of Mathematical and Computer Sciences at the Colorado School of Mines. He received his BS, MS and PhD in Applied Mathematics from the University of Ghent, Belgium, in 1974, 1976 and 1982, respectively. Prior to the School of Mines, he was with the ECE department at the University of Iowa under a NATO Research Fellowship, and with the Mathematics department at the University of Wisconsin as a Visiting Assistant Professor. He has published over 100 research papers in acousto-optics, scattering theory, soliton theory, nonlinear wave phenomena, wavelets, and symbolic methods for nonlinear partial differential equations and lattices. His work has been mainly supported by the NSF. He is a laureate of the Royal Academy of Sciences of Belgium and a member of several professional organizations including ASEE, AMS, and SIAM.

Coarsening in high order, discrete, ill-posed diffusion equations

Catherine Kublik

Abstract: We study the discrete version of a family of ill-posed, nonlinear diffusion equations of order $2n$. The fourth order $(n = 2)$ version of these equations constitutes our main motivation, as it appears prominently in image processing and computer vision literature. It was proposed by You and Kaveh as a model for denoising images while maintaining sharp object boundaries (edges). The second order equation $(n = 1)$ corresponds to another famous model from image processing, namely Perona and Malik's anisotropic diffusion, and was studied previously. The equations presented in this talk are high order analogues of the Perona-Malik equation. We follow a recent technique by Kohn and Otto to establish rigorous upper bounds on the coarsening rate of the discrete versions of these high order equations, in any space dimension and for a large class of diffusivities.

An Algorithm for Locally Adaptive Time Stepping

Richard Kublik

Abstract: Simulations in computational neuroscience often involve large complex computational domains that display localized activity. In this talk, I will present an algorithm for locally adapting time stepping (LATS) that takes advantage of this localization of activity to reduce the computational cost associated with the simulation. With the LATS method, the computational cost is independent of the physical size of the domain, and scales with the amount of activity in the system.

Eventually Periodic Solutions & Patterns of unbounded solutions of a second order and delayed max-type difference equation

Michael Radin

ABSTRACT: We investigate the history of max-type equations from piece-wise linear functions (3X+1 Conjecture & Tent Map). In addition, we will discover the necessary conditions for every solution to be eventually periodic and for every solution to be unbounded. Furthermore, we will discover the patterns of eventually periodic solutions and patterns of unbounded solutions; in particular, how many subsequences go to infinity and how many subsequences go to 0.

Invertible Carnot Groups

David Freeman

Abstract: In this talk we will investigate properties of homogeneous metric spaces that can be "metrically inverted." A metric inversion generalizes the usual notion of a Mobius inversion in Euclidean space. In particular, we will characterize Carnot groups that admit a metric inversion.

Exponential Smoothing

Asmaa Alharbi and Hadiah Esmaiel

Abstract: The main purpose of this work is to illustrate the exponential smoothing as a technique of filtering time series data and forecasting. We are going to study three types of exponential smoothing models, these are, Simple Exponential Smoothing (SES), Linear Exponential Smoothing (LES), and Holt-Winters method. Additionally, a comparison will be established between the three mentioned types and the ARIMA models as well as forecasting. Also, theoretical proofs of the equivalence will be given. Three software packages (Excel, SAS, and JMP) were used to analyze the data and to verify the equivalency between some Exponential Smoothing models the corresponding ARIMA models.

Forced Monotone Methods

Nujud Alshehri

Abstract: We consider a boundary value problem of the form

$$y''(t) = f\big(t, y(t), y'(t)\big), a < t < b, y(a) = A, y(b) = B, \qquad (1)$$

Where $a < b, f$ is continuous a continuous map and A and B are real. The method of upper and lower solutions, coupled with monotone methods, is useful if f is independent of y'. If the conjugate conditions, $y(a) = A, y\,(b) = B$, are replaced by right focal conditions $y(a) = A, y'(b) = B$, then the method of upper and lower solutions, coupled with monotone methods, is useful in the case that f depends on y and on y'. In this talk, we construct a boundary value problem of the form

$$y''(t) = f\big(t, y(t), y'(t)\big), a < t < b, y(a) = A, y(b) = g(y, y'),$$

which is equivalent to (1) and obtain seek sufficient conditions on f and on g such that the method of upper and lower solutions, coupled with monotone methods, is useful.

Multivariate Time Series Models

Ahmad Alhamad

Abstract: In many forecasting problems, it may be the case that there is more than one variable to consider for our response y. Multivariate time series models involve several variables that are not only serially but also cross-correlated. Vector ARIMA models can often be used successfully to forecast multivariate time series, as it is in the uni-variate case.

Analyzing the auto-correlation function and cross-correlation function for a multivariate time series suggests the appropriate ARIMA model to be used.

Analyses of the residuals and the parameter estimates suggest if our model is appropriate to fit the data.

Pricing an American put option in a jump model

Yulong Liu

Abstract: In this talk, we price an American put option in a jump diffusion model. Using Monte Carlo Simulation, we apply a Least-Square regression algorithm to Kou's Jump Diffusion Model. Numerical results are compared to benchmark results obtained by the Binomial Tree Method. CPU time is also compared and a new method to reduce memory storage is analyzed.

Boundedness and Decay of Solution in Delay Difference Equation with Unbounded Forcing Terms

Abdulmohsen Alruwaili

Abstract: We use Lyapunov functionals to obtain sufficient conditions that guarantee the boundedness of all solutions of the delay difference equation

$$x(t+1) = a(t)x(t) + b(t)x(t-h) + f(t)$$

The highlight of the paper is relaxing the condition $|a(t)| < 1$. Criteria for the unboundedness of the solutions are obtained. Moreover, we will provide an example in which we show that our theorems provide an improvement of some of the recent literature.

Idiosyncratic Risk and the Cross-Section of Expected Stock Return: A Threshold Regress Approach

Pei Zhang

Abstract: Modern portfolio theory indicates that idiosyncratic risk should not bear a relationship with expected stock returns because it can be eliminated by holding a well-diversified portfolio of stocks. However in reality, investors may not hold such perfectly diversified portfolio. This research employs a new method threshold regression model to uncover the underlying relationship between idiosyncratic risk and the cross-section of expected stock returns. We hypothesize that investor behavior will differ significantly in normal market and extremely negative market. There will be a positive relation in normal market due to incomplete information where Investors need risk premium to compensate for idiosyncratic risk. While a negative relation exists if the market is extreme pessimistic, because High idiosyncratic risk are often related to financially distress firms and pessimistic markets exacerbate financial distress effect expectations.