Summer 2008

Friday, June 27, 3:00-4:00 pm.

- Place: EMCS 422
- Speaker: Bo Yang, Department of Mathematics, Kennesaw State University, Kennesaw, GA, USA
- Title: Estimates for Positive Solutions to a Fourth Order Boundary Value Problem
- Abstract: We consider positive solutions to the fourth order boundary value problem:
  $$u''''(t)=f(t,u(t)),\;0<t<1,\eqno(1)$$
  $$u(0)=u''(0)=u''(1)=u(1)=0.\eqno{(2)}$$
  The fourth order equation (1) is a model for the deformation of an elastic beam. The boundary conditions mean that the beam is simply supported at both ends $t=0$ and $t=1.$ We show that if f is a nonnegative function, then positive solutions of the problem (1)-(2) satisfy a set of {\it a priori} upper and lower estimates. These estimates can help understand how the beam bends under forces, and can help us to establish existence and nonexistence results for positive solutions of the problem (1)-(2).

Thursday, June 12, 3:00-4:00 pm

- Place: EMCS 422
- Speaker: John R. Graef, Department of Mathematics, University of Tennessee at Chattanooga, Tennessee, USA
- Title: A Nonlinear Boundary Value Problem for a Wing in an Air Flow
  OR
  Why Engineers Should Use Nonlinear Analysis
- Abstract: We consider the problem of modeling the torsion of a wing in an air flow. An approximate equation for the torsion is derived. Along with the boundary conditions, this forms a non-linear Sturm-Liouville problem with the Mach number as the spectral parameter. Conditions under which a unique solution of the problem exists are presented and a characterization of the corresponding (smallest) Mach number is given. This smallest eigenvalue, which

leads to the failure of the wing, is estimated by using a cubic approximation. The techniques used here also allow the calculation of the exact value for dry air. For some values of the parameters, these are both found to be significantly smaller than the value obtained using standard linear approximation techniques. (This talk is based on joint work with B. P. Belinskiy of the UTC Mathematics Department and R. E. Melnik of the UT SimCenter at Chattanooga.)

Thursday, May 29, 2:45-3:45 pm.

- Place: EMCS 422
- Speaker: Vincent Charles Betro, PhD GA,
  University of Tennessee SimCenter @ Chattanooga
  Adjunct Instructor, Department of Mathematics, University of Tennessee at Chattanooga, Tennessee, USA
- Title: A Parallel Algorithm for Optimization-Based Smoothing of Unstructured 3-D Meshes
- Abstract: Serial optimization-based smoothing algorithms are computationally expensive. Using Metis (or ParMetis) to partition the mesh, the parallel algorithm moves (or does not move) a processor's internal nodes based on a cost function derived from the Jacobians and condition numbers of surrounding elements. Ghost nodes are used to communicate new positions, the owning processor on a boundary uses new information to move boundary nodes, and the process repeats. The result is a ready-to-use decomposed mesh.

Thursday, May 22, 2:45-3:45 pm.

- Place: EMCS 422
- Speaker: Betsy Darken, Department of Mathematics, University of Tennessee at Chattanooga, Tennessee, USA
- Title: The 2008 Presidential Report on Mathematics Education: Iplications for Quantitative Reasoning
- Abstract: In March 2008, a panel appointed by the President of the United States issued its final report regarding ways to improve American mathematics education. I will discuss the recommendations of this National Mathematics Advisory Panel and

focus on one problem identified by the Panel as needing particular attention. This is the problem of students' difficulties with rational numbers, ratios, and proportionality. I will present research on the pervasiveness of this problem even among college students and suggest actions that can be taken to improve the situation.

Thursday, May 15, 2:45-3:45pm.

- Place: EMCS 422
- Speaker: Miroslav Bartusek, Department of Mathematics, Masaryk Univ., Brno, Czech Republic
- Title: Existence of Global Solutions for Systems of Second-Order Functional-Differential Equations
- Abstract: Sufficient conditions for the existence of continuable solutions for the system of second-order functional-differential equations with p-Laplacian are given. The results are applied to the n-th order differential equation.

Monday, May 12, 2:45-3:45pm.

- Place: EMCS 422
- Speaker: Ronald L. Smith, Department of Mathematics, University of Tennessee at Chattanooga, Tennessee, USA
- Title: Schur Complements and Eigenvalue Inequalities
- Abstract: The Cauchy interlacing theorem states that the eigenvalues of a Hermitian matrix H are interlaced by the eigenvalues of any principal submatrix $A.$ The converse was proved by Fan and Pall. Here, we discuss necessary conditions for the eigenvalues of $H/A,$ the Schur complement of A in $H,$ to interlace the eigenvalues of H and also discuss the interlacing relationship between H and H/A in general. An analog of the converse to the Cauchy interlacing theorem, obtained in joint work with S.-A. Hu, is also provided as well as extensions due to C. K. Li and R. Mathias. A minimum principle for Schur complements of positive definite Hermitian matrices obtained by J. Liu and L. Zhu is discussed as well as extremal characterizations due to Li and Mathias. These results lead to a number of eigenvalue/singular value inequalities.

Thursday, May 8, 2:45-3:45

- Place: EMCS 422
- Speaker: Lucas van der Merwe, Marc Loizeaux, and Francesco Barioli, Department of Mathematics, University of Tennessee at Chattanooga, Tennessee, USA
- Title: A Family of 4-Critical Graphs with Diameter Three
- Abstract: Let $\gamma_t(G)$ denote the total domination number of the graph G. G is said to be total domination edge critical, or simply γ_t-critical, if $\gamma_t(G+e) < \gamma_t(G)$ for each edge $e\in E(\overline{G}).$ In this paper we study a family $\cal H$ of 4-critical graphs with diameter three, in which every vertex is a diametrical vertex, and every diametrical pair dominates the graph. We also generalize the self-complementary graphs, and show that these graphs provide a special case of the family $\cal H$.

Spring 2008

Thursday, May 1, 10:30-11:30

- Place: EMCS 422
- Speaker: Weixing Cai, Department of Mathematics, Syracuse University, New York, USA
- Title: Testing and Selecting among k Multivariate Normal Populations for Equivalence with Respect to a Standard Vector
- Abstract: We will explain how the formulation comes out by starting with single hypothesis testing in univariate normal distribution. Generalization to multivariate normal and more than one population will be followed. Definition of good or bad multivariate normal populations is given according to their Mahalanobis distances from a desired standard vector as being small or large. Applications in multiple target detection in signal processing, multivariate bioequivalence and biometric will be mentioned. In the presentation, our goal is to select an acceptable (not bad) population whenever there is at least one good population, and to select nothing whenever all populations are bad. We establish the

weak equivalence between selecting and a modified global testing: selecting no population is equivalent to failing to reject the global null hypothesis, while selecting an acceptable population means rejecting the global null hypothesis. The problems on the generalized power and type I error are discussed after a procedure is given. I will use a real data example show how to use the procedure. Finally, connection to discriminant analysis and future research directions may be mentioned depending on time.

- Note: Weixing Cai is a candidate for a position at our Department.

Monday, April 14, 12:00-1:00.

- Place: EMCS 239
- Speaker: Mrs. Yu-Juan Jien, Department of Mathematics, Purdue University, West Lafayette, Indiana, USA
- Title: Stochastic Differential Equations Driven by Fractional Brownian Motion
- Abstract: It has become more popular to use fractional Brownian motion (fBM) B^H to model the input of a system due to its self-similarity and long-range dependence. But since it is neither a Markov process nor a semi-martingale when H is not 1/2, the usual stochastic calculus does not apply to the stochastic differential equations (SDEs) driven by fBM. In this talk we will study a class of SDEs driven by fBM with arbitrary index H in the Skorohod sense. The SDEs have linear and random diffusion coefficients, which can be anticipating exceptionally, and globally Lipschitz drift coefficients. The technique used for this goal is to consider the anticipating Girsanov transformation on fractional Wiener space. Then by applying this transformation, we are able to study the existence and uniqueness of the original SDE by solving a simpler one.
- Note: Yu-Juan Jien is a candidate for a visiting position at our Department.

Wednesday, April 9, 10:00-11:00 am.

- Place: EMCS 239
- Speaker: Dr. Sergei Avdonin, Department of Mathematics and Statistics, University of Alaska, Fairbanks, Alaska, USA
- Title: The Boundary Control Approach to Inverse Problems and Signal Processing
- Abstract: The goal of this talk is to describe connections between non-harmonic Fourier series, control theory, inverse problems of mathematical physics, and signal processing. In particular, we describe an approach to inverse problems (the so-called Boundary Control Method) which is based on deep connections between controllability and identification problems and is applicable to a wide range of linear systems. As an example of the approach, we consider control and inverse problems for differential equations on graphs. We suppose that on each edge of the graph, the wave (or heat, or Schr\"odinger) equation is defined, and that standard compatibility conditions are satisfied at the internal vertices. We prove that the system is exactly controllable if the graph is a tree and the control is applied to all (or to all but one) boundary vertices. Otherwise the system is not generally exactly controllable but may be spectrally controllable. We show how to recover a tree (its connectivity and the lengths of the edges together with coefficients of the equation) from a given response operator or Weyl matrix function. We demonstrate effectiveness of the Boundary Control Method on a classical problem of signal processing --- the spectral estimation problem. The boundary control approach to sampling and interpolation of band-limited and multi-band signals will also be discussed.
- Note: Dr. Avdonin is a candidate for the position of Chair of Excellence in Applied Mathematics.

Monday, April 7, 12:00-1:00

- Place: EMCS 239
- Speaker: Shaobai Kan, Department of Mathematics, Wayne State University, Detroit, Michigan
- Title: Identification of Systems With Regime Switching and Unmodeled Dynamics
- Abstract: This paper is concerned with persistent identification of systems that involve deterministic unmodeled dynamics and stochastic observation disturbances, and whose unknown parameters switch values (possibly large sizes) that can be represented by a Markov chain. Two classes of problems are considered. In the first class, the switching parameters are stochastic processes modeled by irreducible and aperiodic Markov chains with rates of state transitions sufficiently higher than adaptation rates of identification algorithms. We show that an averaged behavior of the parameter process can be derived from the stationary measure of the Markov chain and can be estimated with periodic inputs and least-squares type algorithms. Upper and lower error bounds are established that explicitly show impact of unmodeled dynamics. In contrast, the second class of problems represents systems whose state transitions occur infrequently. An adaptive algorithm with variable step sizes is introduced for tracking the time-varying parameters. Convergence and error bounds are derived. Numerical results are presented to illustrate the performance of the algorithm.
- Note: Shaobai Kan is a candidate for a position in our Department.

Thursday, April 3, 3:00-4:00 pm.

- Place: EMCS 422
- Speaker: **Dr. Johnny Henderson**, Department of Mathematics, Baylor University, Waco, Texas
- Title: Uniqueness Implies Existence and Uniqueness Criterion for Certain Nonlocal Boundary Value Problems for Third Order Ordinary Differential Equations
- Abstract: For the third order ordinary differential equation, $y'''=f(x,y,y',y'')$, we consider uniqueness implies existence

arguments for solutions satisfying the nonlocal 4-point boundary conditions, $y(x_1)=y_1,\;y(x_2)=y_2,\;y(x_3)-y(x_4)=y_3$. Uniqueness of solutions of such boundary value problems are intimately related to solutions of the third order equation satisfying certain 3-point boundary conditions. These relationships will be discussed as well. Finally, in the case when f is Lipschitz, optimal interval lengths will be determined, in terms of the Lipschitz coefficients, on which solutions are unique (hence exist), for the 4-point nonlocal boundary value problems.

- Note: Dr. Henderson is a candidate for the position of Chair of Excellence in Applied Mathematics.

Monday, March 31, 12:00-1:00

- Place: EMCS **239**
- Speaker: Dr. Daniela Szatmari-Voicu, Texas Environmental Studies & Analysis, LLC
- Title: Minimax Bias L-estimators of Scale Parameter
- Abstract: We derive the best non-symmetrized and symmetrized L-estimators of scale with respect to their asymptotic bias, under e - contamination neighborhood centered at a known error distribution F_0 which is symmetric and unimodal, by first performing a study on the maximum asymptotic bias curves of the non-symmetrized and symmetrized interquantile ranges from which the L-estimators considered arise. For F_0symmetric and unimodal and making use of the generalized method of moment spaces, the solutions to the minimax- bias problems are shown to be convex combinations of at most two interquantile ranges. Sufficient conditions are also found such that the solutions are just one interquantile range.
- Note: Dr. Szatmari-Voicu is a candidate for a tenure-track position in our Department.

Wednesday, March 19, 12:00-1:00 pm.

- Place: EMCS **239**
- Speaker: **Dr. Ravi Agarwal**, Department of Mathematics, Florida Institute of Technology, Melbourne, Florida
- Title: Singular Integral Equations With Real World Applications

- Abstract: We shall provide easily verifiable sufficient conditions which guarantee the existence of solutions to some singular integral equations. The motivation of these problems comes from real world applications, particularly, in communications theory, and the Homann flow.
- Note: Dr. Agarwal is a candidate for the position of the Chair of Excellence in Applied Mathematics.

Tuesday, March 4, 3:05 pm.

- Place: EMCS 422
- Speaker: Boris Belinskiy*, Department of Mathematics, University of Tennessee at Chattanooga
- Title: Stochastic Wave Equation Driven by a Fractional Brownian Motion
- Abstract: We consider a linear stochastic wave equation driven by fractional-in-time noise. We prove the existence and uniqueness of the weak solution. We also study the expected energy associated with wave equation and improve our previous results on that matter. Specifically, we find the iff condition of the convergence of the series representing the expected energy using physically natural objects. We discuss the smoothness of the solution. We consider both cases $H>1/2$ and $H<1/2$ for the Hurst parameter.
- Note: The presentation would be of interest to Math students who are majoring in any area of Applied Math.
- Note: * Research of this author was supported in part by the University of Tennessee at Chattanooga Faculty Research Grant.

Tuesday, February 19, EMCS 422, 3:05 pm.

- Place: EMCS 422
- Speaker: Meg Kiessling, Department of Mathematics, University of Tennessee at Chattanooga
- Title: The Use of Projects in Math 136 (Calculus for Management, Life, and Social Sciences), Math 215 (Math for Elementary School Teachers), and Math 123 (Mathematics in Our Modern World)
- Abstract: Over the past three years, I have incorporated projects in all of these classes. I will present information on the types of

projects I have used, the expectations I had for these projects, the students' response and performance in completing the projects, sources for project ideas and methods used for grading the projects.
- Note: All are welcome to attend this talk, especially those considering incorporating projects into these or similar courses.

Thursday, January 24, 3:05-4:00 pm.

- Place: EMCS 422
- Speaker: Aniekan Ebiefung , Department of Mathematics, University of Tennessee at Chattanooga
- Title: Disjunctive Programming and Generalized Leontief Input-Output Model
- Abstract: This paper considers a generalization of the Leontief input-output model that is useful in modeling the concept of choice of technology. It is shown that a disjunctive programming problem, together with its dual problem, may be used to effectively solve the new input-output model.
- Note: This is a modeling paper that will be of interest to students and the general public.

Thursday, January 10, 3:05 pm.

- Place: EMCS 422
- Speaker: Marat Akhmet, Department of Mathematics, Middle East Technical Univ., Ankara, Turkey
- Title: Differential Equations with Piecewise Argument of Generalized Type: a New Theory for 25-year-old Equations
- Abstract: Differential equations with an argument of a solution as the greatest integer function were introduced at the beginning of 1980s by K. Cooke and co-authors. Significant theoretical results concerning oscillations, boundary value problems, positive solutions have been obtained. The only method of investigation for these systems has been the reduction of the equations to systems of discrete equations, which involves only the values of solutions at integers or their multiples. Thus, many common questions for all types of differential equations: existence and uniqueness of

solutions, dependence of solutions on parameters, stability, existence of integral manifolds and almost periodic solutions, etc., have not been investigated fully. In a few last papers, we have proposed a new approach, which allows us to create a theory of these systems very similar to that of ODE despite the equations considered by us have deviating arguments. In the report, we discuss the results obtained last 2-3 years. The phenomenon of bifurcation and chaos for these equations and applications to certain problems of population dynamics will also be considered.

Fall 2007

Thursday, November 8, 3:30 pm.

- Place: EMCS 423
- Speaker: Matt Mathews, Department of Mathematics, University of Tennessee at Chattanooga
- Title: Granular Flows Around Hopper Inserts
- Abstract: It is common to use corrective inserts to encourage better flow patterns in granular material moving through a converging hopper. One model of a steady state granular flow around such an insert leads to a set of hyperbolic conservation laws for the components of the stress tensor and two components of velocity. A Runge-Kutta discontinuous Galerkin (RKDG) method is applied and the resulting flow fields are computed.
- Note: Students who have completed a differential equations course, with linear algebra, will find much of the mathematics accessible. Students who have completed a numerical analysis course will see many familiar concepts.

Thursday, October 11, 3:00 pm.

- Place: EMCS 422
- Speaker: Lingju Kong, Department of Mathematics, University of Tennessee at Chattanooga
- Title: New Existence Results for Higher Order Multi-point Boundary Value Problems
- Abstract: We consider a certain higher order multi-point boundary value problem. We provide sufficient conditions for the existence of a solution of this problem based on the existence of higher order lower and upper solutions. Explicit conditions are also found for the existence of a solution of the problem. The differential equation has nonlinear dependence on all lower order derivatives of the unknown function and the boundary condition covers many multi-point boundary conditions studied in the literature. Schauder's fixed point theorem and appropriate Nagumo conditions are employed in the analysis. Examples are included to illustrate the results.
- Note: These results are joint work with John R. Graef and Qingkai Kong.
- Note: Students who have had an introduction to ordinary differential equations will find the subject matter of interest.

Thursday, September 13, 3:00 pm.

- Place: EMCS 422
- Speaker: Qingkai Kong, Department of Mathematical Science, Northern Illinois University
- Title: Use Time Scales to Study Impulsive Functional Differential Equations
- Abstract: We explore connections between certain impulsive differential equations and corresponding dynamic equations on time scales. More specifically, for a given impulsive differential equation, we construct a ``counterpart'' as an equation defined on a time scale which has the same qualitative behavior. By doing so, we can simply ``translate'' any results for the equation on time scale to the impulsive differential equations. As applications of this result, we obtain oscillation criteria for two linear impulsive differential equations with delays by applying existing results for equations on time scales. Our work shows that this method provides a new approach for the general impulsive differential equations and can be used to some equations which are difficult to deal with by the traditional ways.
- Note: Students who have had an introduction to ordinary differential equations will find the subject matter of interest.