COLLOQUIUM Fall 2017

Ivan V. Andronov

Department of Computational Physics

St. Petersburg University

Russia

Parabolic Equation Method for the Problems of Diffraction by a Strongly Elongated Spheroid

Thursday, September 7, EMCS 240, 1:50–2:50 pm.

Abstract. The parabolic equation method had been used since 1940-s to study high-frequency diffraction by smooth convex bodies. However, for too much elongated bodies that classical approach requires for its applicability the frequency to be very high. The modification of the parabolic equation method proposed in 2009 significantly improves the applicability of the approximation. In this talk we justify some formal steps of that parabolic equation method at the level typical for the general PDE theory. In particular, we prove that a formal solution of the parabolic equation is actually the classical solution. We prove its uniqueness. We use various asymptotic properties of the Whittaker functions M and W, in particular we study the location of the zeros of W with respect to the first index.

This talk may be appropriate for graduate students with an interest in Partial Differential Equations and their applications.

COLLOQUIUM Fall 2017

Vasileios Maroulas

Department of Mathematics and Department of Business Analytics and Statistics

University of Tennessee at Knoxville

Classification on the space of persistence diagrams

Friday, September 29, EMCS 422, 3:00–3:50 pm.

Abstract. In this talk, we consider the problem of signal classification by considering their associated persistence diagrams. We endow the data space of persistence diagrams with a new metric. In contrast with the Wasserstein distance, this metric accounts for changes in small persistence and changes in cardinality. Pulling back to the space of signals, this corresponds to detecting differences in a signals periodicity, underlying noise, and geometry. The metric space of persistence diagrams is proved to admit statistical structure in the form of Frchet means and variances. The new classification method using this distance is benchmarked on both synthetic data and real acoustic signals.

This talk may be appropriate for graduate students with an interest in Statistics, Data Science and Machine Learning.

COLLOQUIUM Fall 2017

Lakmali Weerasena

Department of Mathematics

University of Tennessee at Chattanooga

A Local-search Algorithm and a Tolerance Function for Multi-objective Combinatorial Optimization Problems

Friday, October 20, EMCS 422, 2:00–2:50 pm.

Abstract. A multi-objective combinatorial optimization (MOCO) problem consists a solution set, known as Pareto set, due to the conflicting nature of the objective functions. In the literature variety of methods have been developed to find representations for Pareto sets of NP-hard MOCO problems and many of them do not provide error-bounds for the representation. In this study, a local-search algorithm is proposed to find representations for the class of 0-1 MOCO problems. In addition, a tolerance function is defined to identify the maximum error of the representation and is derived for the proposed algorithm. It is shown that the tolerance function depends on the characteristics of the objective functions of the MOCO problem and the initial solutions. Further, the performance of the algorithm is examined using some well-known MOCO problems.

This talk may be appropriate for undergraduate and graduate students with an interest in operations research and applications.

COLLOQUIUM Fall 2017

Ben Webb

Department of Mathematics

Brigham Young University

Isospectral Graph Reductions and Improved Estimates of Matrices' Spectra

Friday, November 17, EMCS 422, 3:15–4:05 pm.

Abstract. Via an isospectral graph reduction the adjacency matrix of a graph can be reduced to a smaller matrix while essentially preserving the matrix' set of eigenvalues. It is then possible to estimate the spectrum of the original matrix by considering Gershgorin-like estimates associated with the reduced matrix. Our main result is that the eigenvalue estimates associated with Gershgorin, Brauer, and Brualdi improve as the matrix is reduced. Given that such estimates improve with each successive reduction, it is also possible to estimate the eigenvalues of a matrix with increasing accuracy by repeated use this isospectral reduction process.

COLLOQUIUM Fall 2017

Heng Xiao

Kevin T. Crofton Department of Aerospace and Ocean Engineering

Virginia Tech

Friday, October 27, EMCS 422, 2:00–2:50 pm.

A Data-Driven, Physics-Informed Approach for Predictive Turbulence Modeling: From Data Assimilation to Machine Learning

Abstract. Many complex systems are characterized by physics at a wide range of scales, for which first-principle-based high-fidelity models resolving all the scales are prohibitively expensive to run. Consequently, practical simulations have primarily relied on low-fidelity models with approximate closure models, which introduce large model-form uncertainties and diminish their predictive capabilities. Turbulent flows are a classical example of such complex physical systems, where numerical solvers with turbulence closure models are widely used in industrial flow simulations. In light of the decades-long stagnation in traditional turbulence modeling, data-driven methods have been proposed as a promising alternative. We present a comprehensive framework for using data to reduce model uncertainties in turbulent flow simulations. With online, continuously streamed monitoring data, we use data assimilation and Bayesian inference techniques to reduce model-form uncertainties; With offline data from a database of flows, we proposed a physics-informed machine learning approach. While the focus is on turbulent flows, the framework is general enough for other complex physical systems.
More information: www.aoe.vt.edu/people/faculty/hengxiao/decml/publications0.html

This talk may be appropriate for undergraduate and graduate students who are interested in machine learning, data and computational engineering.

COLLOQUIUM Fall 2017

Boris Belinskiy

Department of Mathematics

University of Tennessee at Chattanooga

and

David Kotval

Middle Tennessee State University

Optimizing Forms Resulting from A Sturm-Liouville Problem on an Interval and a Graph

Friday, November 10, EMCS 422, 3:15–4:05 pm.

Abstract. We derive an optimal design of a structure that is described by a Sturm-Liouville problem with boundary conditions that contain the spectral parameter linearly. In terms of Mechanics, we determine necessary conditions for a minimum-mass design with the specified natural frequency for a rod of non-constant cross-section and density subject to the boundary conditions in which the frequency (squared) occurs linearly. By virtue of the generality in which the problem is considered other applications are possible. We also consider a similar optimization problem on a complete bipartite graph including the limiting case when the number of leaves is increasing indefinitely.

This talk is appropriate for all graduate students and the undergraduate students who have taken Analysis I.

COLLOQUIUM Fall 2017

Douglas White

Math and Physics major

University of Tennessee at Chattanooga

in co-authorship with

Boris Belinskiy

University of Tennessee at Chattanooga

Time Optimization of a Draining Tank and Similar Optimization Problems on Graphs

Friday, November 17, EMCS 422, 3:15–4:05 pm.

Abstract. We consider a tank containing a given volume of liquid and suppose that the liquid drains under the influence of gravity through a small hole at the bottom. The liquid's viscosity and friction at the hole are assumed to be negligible. The velocity of the exiting liquid is given by Torricelli's law, which states that the height of the liquid affects the velocity of the exiting liquid. Given the volume, we vary the shape of the tank to optimize the time taken for a tank to drain. After exploring the results of a few tank shapes, we prove the existence of a certain class of tanks for which the draining time can be made to hold any positive draining time. We also consider the dual problem and find that a tank with a given draining time can be begin with any positive volume of liquid. We then look at similar optimization problems for physical models in which Torricelli's law has to be modified as well as related optimization problems from graph theory.

This talk is appropriate for all graduate students and the undergraduate students who have taken Analysis I.

COLLOQUIUM Fall 2017

Benjamin Z. Webb

Brigham Young University

Provo, Utah

Isospectral Graph Reductions and Improved Estimates of Matrices' Spectra

Friday, November 17, EMCS 422, 2:00–2:50 pm.

Abstract. Via an isospectral graph reduction the adjacency matrix of a graph can be reduced to a smaller matrix while essentially preserving the matrix' set of eigenvalues. It is then possible to estimate the spectrum of the original matrix by considering Gershgorin-like estimates associated with the reduced matrix. Our main result is that the eigenvalue estimates associated with Gershgorin, Brauer, and Brualdi improve as the matrix is reduced. Given that such estimates improve with each successive reduction, it is also possible to estimate the eigenvalues of a matrix with increasing accuracy by repeated use this isospectral reduction process. This talk is quite visual and should be accessible to anyone who has had a first course in Linear Algebra.

This talk is appropriate for all students majoring in Math.

COLLOQUIUM Spring 2018

Sumith Gunasekera

University of Tennessee at Chattanooga

Chattanooga, TN

Inference for the Burr XII Reliability under Progressive Censoring with Uniformly Distributed Random Removals

Friday, February 16, EMCS 422, 2:00-2:50

Abstract. The inference about the reliability function of Burr XII distribution using the concept of generalized variable method, based on progressively type II censoring with uniformly distributed random removals, is proposed. As assessed by simulation, the coverage probabilities of the proposed approach are found to be very close to the nominal level even for small samples. The proposed new approaches are computationally simple and are easy to use. The method is illustrated with the aid of two examples.

Key words: Burr XII distribution, Generalized variable method, Progressively type II censored sample, Uniformly distributed random removals, Reliability function

Related research paper: Gunasekera, S. (2018). Inference for the Burr XII Reliability under Progressive Censoring with Random Removals. Mathematics and Computers in Simulation 144, 182–195. Crossref DOI link: https://doi.org/10.1016/j.matcom.2017.07.011 (Received on December 21, 2015; Revised on December 13, 2016; Accepted on July 31, 2017; Published online on August 18, 2017).

This talk may be appropriate for graduate students with an interest in Statistics, Reliability, Censored Data, Computational and Simulation Statistics, and Data Science.

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Michelle Rigler, Director
Disability Resource Center
423-425-4008
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COLLOQUIUM Spring 2018

Jin Wang

University of Tennessee at Chattanooga

Chattanooga, TN

Modeling and Simulating Tumor Growth Under Treatment

Friday, March 2, EMCS 422, 2:00-2:50

Abstract. We present a mathematical modeling framework for the study of tumor growth, where free boundary problems are formulated based on nonlinear partial differential equations. Our models incorporate several tumor treatment options that include resection, radiotherapy, chemotherapy, and virotherapy. We conduct extensive numerical simulation to examine tumor development under a range of biological settings, and discuss possible improvement on the efficacy of these tumor treatments. We particularly emphasize the multiple interactions among tumor cells, oncolytic viruses, and immune systems that shape the complex pattern of tumor growth.

This talk is appropriate for all graduate students and upper-level undergraduate students who are interested in the application of mathematics to biomedical sciences.

COLLOQUIUM Spring 2018

Xuemin Tu

University of Kansas

Lawrence, KS

Implicit Sampling for Data Assimilation

Friday, March 23, EMCS 422, 2:00-2:50

Abstract. Applications of filtering and data assimilation arise in engineering, geosciences, weather forecasting, and many other areas where one has to make estimations or predictions based on uncertain models supplemented by a stream of data with noise. For nonlinear problems, filtering can be very expensive since the number of the particles required can grow catastrophically. We will present a particle-based nonlinear filtering scheme. This algorithm is based on implicit sampling, a sampling technique related to chainless Monte Carlo method. This sampling strategy generates a particle (sample) beam which is focused towards on the high probability region of the target pdf and the focusing makes the number of particles required manageable even if the state dimension is large. Several examples will be given.

This talk is appropriate for all graduate and undergraduate students.

COLLOQUIUM Spring 2018

Xiu Yang

Pacific Northwest National Laboratory

Richland, WA

Uncertainty Quantification Using Limited Data

Thursday, March 29, EMCS 232, 1:40-2:30

Abstract. Realistic analysis and design of complex engineering systems require not only a fine understanding of the underlying physics, but also a significant recognition of uncertainties and their influences on the quantities of interest. Intrinsic variabilities and lack of knowledge about system parameters or governing physical models often considerably affect quantities of interest and decision-making processes. For complex systems, the available data for quantifying uncertainties or analyzing sensitivities are usually limited because the cost of conducting a large number of experiments or running many large-scale simulations can be prohibitive. Efficient approaches of representing uncertainties using limited data are critical for such problems. I will introduce a modified compressive sensing method, which exploits low-dimensional structures in the parameter space and solves an optimization problem to construct the surrogate model. I will demonstrate the efficiency of this method in applications including PDE with random parameters, solvation free energy calculation and stability analysis of power grid system.

This talk is appropriate for all graduate and undergraduate students.

COLLOQUIUM Spring 2018

Michael "Hardie" Chambers

University of Tennessee at Chattanooga

Chattanooga, TN

Standards, Technology, and Student Engagement in an Evolving World

Friday, March 20, EMCS 422, 2:00-2:50

Abstract. In this talk, we discuss the ever-changing world of K-12 mathematics education with respect to standards, technology and student engagement. The world we live in is full of constantly evolving technology and this results in the need for new approaches to use technology to enhance student learning. Teacher preparation does not always keep up with the various demands for improved curriculum via effective technology integration. Advanced preparation of teachers will increase student learning and engagement alongside the technology changes. As a result, we see the means of student engagement in math education to be a continual topic of importance for student learning with respect to effective use of instructional technology applications.

This talk is appropriate for undergraduate students, graduate students, and faculty with any interest in teaching, specific implications in secondary mathematics.