COLLOQUIUM Fall 2004

Valery Gaiko

Department of Mathematics

Belarusian State University
of Informatics and Radioelectronics

Minsk, Belarus

Wednesday, July 14, EMCS 422, 2:30 pm.

On Global Bifurcation Theory of Polynomial Dynamical Systems

Abstract.
Two–dimensional polynomial dynamical systems are considered and the main problem of qualitative theory of such systems is discussed: Hilbert's sixteenth problem on the maximum number and relative position of limit cycles.

COLLOQUIUM Fall 2004

Jeff Brueggeman,

PhD in Mathematics from University of Illinois

(formerly of Nationwide Insurance)

Thursday, October 21, EMCS 422, 3:00 pm.

Risk of Ruin For Positive Expectation Games

Abstract.
In this talk, we will discuss Risk of Ruin in gambling. First we will make basic comparisons to risk in investment theory. Then we will present examples and formulas for games whose results are close to being normally distributed. Finally we will breakdown games with more skewed outcomes, present an alternate formula for their risk of ruin and provide examples.

COLLOQUIUM Fall 2004

Sharon Brueggeman,

Department of Mathematics

UTC

Thursday, October 28, EMCS 422, 3:00 pm.

The nonexistence of certain Galois extensions with small ramification

Abstract.
In the integers, we define a prime number as a number that factors only in trivial ways. We can also define prime ideals as ideals that do not factor. When we view these numbers and ideals in finite extensions of the rationals, they often will factor. Ramification is the term for describing "bad" factorizations. In this talk, we will discuss methods of trying to find a finite Galois extension which has only one ramified prime.

COLLOQUIUM Fall 2004

Pierre A. Gremaud,

Department of Mathematics

North Carolina State University
with Chris Kuster, the same school

Thursday, November 4, EMCS 422, 3:00 pm.

Numerical Methods for Stationary Hamilton-Jacobi Equations

Abstract.
The Hamilton-Jacobi equations find their origin in Classical Mechanics. They appear naturally in wave propagation problems, optimal Control, level set formulations and countless other problems. In short, they are ubiquitous in modern Applied Mathematics. Hamilton-Jacobi equations are well understood theoretically (at least in the multidimensional scalar case).
In this talk, we will start by briefly reviewing the history, range of application and analysis of Hamilton-Jacobi equations. We will then turn to numerical methods for such equations. Even though the underlying problems maybe ones of propagation, discretized Hamilton-Jacobi equations do not naturally lead to explicit methods (unlike hyperbolic conservation laws for instance). Instead, discretization leads to "general" nonlinear systems. While traditional nonlinear solvers (Newton like methods) can always be used, in many cases "one pass" algorithms can be designed and implemented, leading to tremendous savings. We will review two such methods, Fast Marching and Fast Sweeping, present generalizations of those methods to problems with obstacles and discuss the relative performance of those algorithms.
The talk will be elementary in nature and aimed at the non experts.

COLLOQUIUM Fall 2004

Lucas van der Merwe and Marc Loizeaux

Department of Mathematics

University of Tennessee at Chattanooga

Thursday, November 18, EMCS 422, 3:00 pm.

4_t- Critical Graphs with Maximum Diameter

Abstract.
Let $\gamma_t(G)$ denote the total domination number of the graph G. A graph 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 in $E(\overline{G})$. We show that, for 4_t- critical graphs G, that is, γ_t- critical graphs with $\gamma_t(G) = 4$, the diameter of G is either 2, 3 or 4. Further, we characterize structurally the 4_t- critical graphs G with $diamG = 4$.

Significant portions of this talk will be appropriate for students.

COLLOQUIUM Spring 2005

Betsy Darken

Department of Mathematics

University of Tennessee at Chattanooga

Tuesday, January 18, EMCS 422, 3:00 pm.

From 0 to 60 in 15 Weeks: What Should and Can be Accomplished in Mathematics Courses for Future K-8 Teachers

Abstract.
This presentation will include:
(a) a brief overview of national recommendations for mathematics content courses for future teachers;
(b) results of a pretest/posttest study of future teachers' mathematical knowledge; and
(c) a discussion of a course that develops a deeper understanding of the mathematics that these students will soon teach.

COLLOQUIUM Spring 2005

Binggen Zhang

Department of Mathematics

Ocean University of China

Qingdao, Peoples Republic of China

Friday, January 28, EMCS 422, 2:00 pm.

On the Oscillation of Delay Partial Difference Equations

Abstract.
Professor Zhang is visiting John Graef at the Math Department. He will discuss the modern trends in the theory of partial differential equations, including equations with delay.

We strongly recommend this lecture to the students majoring in Math.

COLLOQUIUM Spring 2005

Dr. Peter Groves

Department of Physics, Geology, and Astronomy

University of Tennessee at Chattanooga

Wednesday, February 2, EMCS (218), 3:00 pm.

Use of the Covariant Derivative in Physics

Abstract.
In calculus, you learn about "total derivatives" and "partial derivatives". It turns out that the partial derivative is very important in describing phenomena in everyday physics. In Einstein's General Relativity (GR), however, one deals with "curved space", and one must learn how to define a derivative on such a curved space. Once defined, this derivative is called the "covariant derivative", and is essential to the understanding of GR, as well as the understanding of even more general theories (for instance, theories that attempt to unify gravitation and quantum mechanics).
A relatively low level introduction will be given to curvature, and then the form of the covariant derivative (of a vector) will be derived. This lecture will be most interesting to math and physics students who have some knowledge or experience with calculus. As a matter of fact, since the method of curved spaces has also been applied to material science, engineering students who have had some calculus could also benefit from the talk.
All students majoring in Math, Physics, and Engineering, as well as faculty who use methods of Calculus in their courses, are invited.

COLLOQUIUM Spring 2005

Dr. Ronald Smith

Department of Mathematics

University of Tennessee at Chattanooga

Friday, February 4, EMCS 422, 2:00 pm.

Closure of Matrix Classes under Schur Complementation

Abstract. The Schur complement M/A of the square partitioned matrix $M = [A, B; C, D]$ in which A is nonsingular is given by:

$$M/A = D - CA^{-1}B.$$

It is well known that the Schur complement of a positive definite matrix is itself positive definite. That is, the class of positive definite matrices are closed under Schur complementation. Often, it is problematic to determine whether a class of matrices is closed under Schur complementation. In this talk we present a general approach for determining whether a given class of matrices is closed under Schur complementation. A number of classes are then examined for such closure.

We strongly recommend the students majoring.....

COLLOQUIUM Spring 2005

Kumer Pial Das

Graduate Teaching Assistant

Department of Mathematics and Statistics

Auburn University, Alabama

Thirsday, February 10, EMCS 422, 3:00 pm.

Ruin Estimates Under Interest Force: A Martingale Approach

Abstract. Risk theory considers stochastic models that may be used to study the risk of a risk enterprise, where the nature of the operation is such that expenditures may exceed receipts during some accounting periods in the normal course of operation. This paper studies in details the surplus process of an insurance portfolio. Martingale technique has been used to derive results concerning the probability of ruin, given that ruin occurs.

Kumer Pial Das is a candidate for a position at our Department.

COLLOQUIUM Spring 2005

Changki Kim

Mathematics Department

The University of Texas at Austin

Thirsday, February 17, EMCS 422, 3:00 pm.

Modeling Surrender/Lapse Rates and Valuing Surrender Options in Interest Indexed Annuities

Abstract. I present surrender rate models with explanatory variables such as the difference between reference rates and crediting rates, policy age since issue, financial crises, unemployment rates, economy growth rates, and seasonal effects. I use the logit function and the complementary log-log function in modeling surrender rates. I show that the logit model and the complementary log-log model are generally better than the existing surrender rate models such as arctangent model. I also show that the surrender rate models are different according to insurance policy types and find proper surrender rate models for the four insurance groups: protection plans, education plans, endowment, and annuities. With the logit surrender rate model, I calculate the value of interest indexed annuities, and the value of the surrender options in interest indexed annuities. I also investigate the surrender rate impacts on the value, the duration, and the convexity of interest indexed annuities.

Changki Kim is a candidate for a position at our Department.

COLLOQUIUM Spring 2005

Leigh J. Halliwell,

FCAS, MAAA

Monday, February 21, EMCS 422, 2:00 pm.

Maximum Likelihood and Medical-Malpractice Claims: An Actuarial Analysis

Abstract. The severity a medical malpractice claim is Insurance companies is an important component of the price of medical malpractice insurance. To a sample of two hundred Tennessee claims from 1991 to 2004 Mr. Halliwell will fit by maximum likelihood a gamma distribution whose scale parameter varies by year. The average claim severity is proportional to the scale parameter. A graph suggests that the severity is tending to increase; but maximum likelihood allows us to test the significance of the trend. Most actuarial work is less technical than this; but the exercise shows that casualty actuaries have the training and the opportunity to apply mathematical and statistical theory to business problems.

Mr. Halliwell is a self-employed consulting actuary in Chattanooga. He has worked in many different insurance fields both in the US and abroad, and frequently publishes in journals and speaks at seminars. Time permitting, he will answer questions about the actuarial profession.

COLLOQUIUM Spring 2005

Lingju Kong

Department of Mathematical Sciences

Northern Illinois University

Tuesday, March 1, EMCS 422, 3:00 pm.

Nonlinear Boundary Value Problems

Abstract. Presented in this talk are results on nonlinear multi-point boundary value problems with emphasis on those consisting of the equation

$$u'' + f(t, u, u') = 0, t \in (0, 1),$$

and one of the two-parameter boundary conditions

$$u'(0) = \lambda_1,\ u(1) - \sum_{i=1}^{m} b_i u(t_i) = \lambda_2$$

and

$$u(0) - \sum_{i=1}^{m} a_i u(t_i) = \lambda_1,\ u(1) - \sum_{i=1}^{m} b_i u(t_i) = \lambda_2$$

Sufficient conditions are found for the existence of solutions of the above problems based on the existence of a pair of lower and upper solutions. For each of the two problems, under some assumptions, explicit ranges of values of λ_1 and λ_2 are obtained such that the problem has a solution, has a positive solution, and has no solution, respectively. Furthermore, the theoretical structure of the (λ_1, λ_2) plane is characterized, more precisely, it is proved that (λ_1, λ_2) plane can be divided by some continuous curve Γ into two disjoint connected regions Λ^E and Λ^N such that the problem has a solution for $(\lambda_1, \lambda_2) \in \Lambda^E$ and has no solution for $(\lambda_1, \lambda_2) \in \Lambda^N$. Existence of solutions for $(\lambda_1, \lambda_2) \in \Gamma$ is also discussed. Some work on higher even order boundary value problems will also be addressed.

Lingju Kong is a candidate for a position at our Department.

COLLOQUIUM Spring 2005

David Ashe

Department of Mathematical

University of Tennessee at Chattanooga

Wednesday, March 2, EMCS 233, 2:00 pm.

Graph Decompositions

Abstract. Theorem: Let R be a disjoint 2-regular subgraph in the complete graph K_n. There exists a 8-cycle system of $G = K_n - E(R)$ where $E(R)$ are the edges in R if and only if:
1) all vertices in R have even degree,
2) $|E(K_n - E(R))|$ is divisible by 8, and
3) n is odd.

Showing that the 3 conditions are necessary is straight forward, however showing that they are sufficient is more involved. The approach taken is inductive. The following Lemma is required.

Lemma: Let n be odd and let R be a 2-regular subgraph of the complete graph K_n. The number of edges in $K_n - E(R)$ where $E(R)$ is the number of edges in R is divisible by 8 if and only if n and $I(R)$ where $I(R)$ is the number of vertices not in R (isolated vertices) are related as shown below.

$n(mod 16)$	1	3	5	7	9	11	13	15
$I(R)(mod 8)$	1	0	3	2	5	4	7	6

Vertices are selected wisely and partitioned from K_n such that $I(R)$ and the number of vertices remaining in this modified graph call it H fall into the same category in the table above. The lemma is then used to show the number of edges in H and not in R are divisible by 8 and can be partitioned into 8-cycles.

The next step is to partition the edges incident with H and incident with the removed vertices from K_n (those not in H) into 8-cycles. Sotteau's theorem accomplishes this. There is a more general version. It is stated here for 8-cycles specifically.

Sotteau's Theorem: There exists a 8-cycle system of $K_{a,b}$ if and only if:

1) a and b are even
2) 8 divides a or b, and
3) $\min\{a, b\} \geq 4$.

Unfortunately, Sotteau's theorem does not partition all of the remaining edges into 8-cycles. They have to be found by hand, trial and error, brute force, etc In actuality, these 8-cycles (the widget) must be found first keeping in mind that Sotteau's theorem and the lemma will be used later.

This is a general summary of the proof, however there are many cases that had to be considered and this process was applied to each of them.

COLLOQUIUM Spring 2005

Jianlong Han

Department of Mathematics

Michigan State University

Tuesday, March 15, EMCS 422, 3:00 pm.

Nonlocal evolution equations

Abstract. An interesting phenomenon is observed when one takes a molten binary alloy and quenches it, i.e., rapidly lowers the temperature so that it becomes solid. Immediately after the quench one observes that the sample becomes inhomogeneous very quickly,decomposing into a very fine-grained structure - two concentration phases, one rich in one component and one rich in the other component. As time passes, the fine-grained structure becomes more coarse with large particles growing and smaller particles tending to dissolve. The sudden appearance of a fine grained structure is called spinodal decomposition. The coarsening process is called Ostwald Ripening.

The first half of the talk will describe some detailed mathematical models (nonlocal Cahn-Hilliard equations and nonlocal phase field systems) to predict spinodal decomposition and Ostwald ripening. Then I will give results about the existence, uniqueness and continuous dependence on initial data of the solution to the equation and system. Also I will give a nonlinear version of the Poincare inequality which is used to show the existence of an absorbing set in each constant mass affine space. Finally, I will discuss the numerical simulation for the nonlocal Cahn-Hilliard equation.

Jianlong Han is a candidate for a position at our Department.

COLLOQUIUM Spring 2005

Leigh J. Halliwell,

FCAS, MAAA

Monday, March 28, EMCS 422, 2:00 pm.

Regression Models and Loss Reserving

Abstract. Though insured losses may take many years to settle, actuaries must long beforehand estimate the amount and timing of these losses so that insurers may reserve for them. For decades actuaries have used simple, deterministic reserving methods; but recently they have begun to use stochastic models, especially regression models. This session will show how stochastic reserving relates to and moves beyond deterministic reserving, the progress made to date in applying regression models to loss reserving, and what progress remains to be made. Estimating the loss reserve of a workers' compensation self-insurance fund will serve to illustrate the theory.

Mr. Halliwell is a self-employed consulting actuary in Chattanooga. He has worked in many different insurance fields both in the US and abroad, and frequently publishes in journals and speaks at seminars. Time permitting, he will answer questions about the actuarial profession.

Boris P Belinskiy * **and John R Graef** *

Department of Mathematics

University of Tennessee at Chattanooga

On the Stability of a Wing in a Flow: A Nonlinear Sturm-Liouville Problem

Monday, April 11, EMCS 422, 3:00 pm.

Abstract. We consider a nonlinear Sturm-Liouville problem that arises from the study of the problem of the torsion of a wing in a flow. We derive an approximate equation of torsion that, along with boundary conditions, forms a non-linear Sturm-Liouville problem with the Mach number as the spectral parameter. The main result of the paper is the description of the conditions under which there exists a unique solution of the problem and characterization of the corresponding (lowest) Mach number.

The material of this presentation is available for students majoring in Math or Engineering; the minimum of Math 245 is required.

* The authors were supported by the Center of Excellence in Computer Applications.

COLLOQUIUM Spring 2005

Cammey E. Cole

Department of Mathematics and Computer Science

Meredith College
Raleigh, NC

Modeling 4-Methylimidazole: The Effects of Acute and Chronic Exposure

Monday, May 9, EMCS 422, 3:30 pm.

Abstract. The chemical 4-Methylimidazole (4MI) is used in the manufacture of a variety of pharmaceuticals as well as photographic and agricultural chemicals. The National Toxicology Program is currently investigating the toxicity of 4MI. In support of this study, a physiologically based pharmacokinetic model of the uptake and disposition of 4MI in rats and mice was developed, using a system of nonlinear differential equations, to predict the tissue doses of 4MI resulting from intravenous and oral exposure. The study investigated the effects of both acute and chronic exposure to 4MI. An inverse problem was formulated to determine model parameters that are not available in the literature. The model results are compared to the toxicokinetic data from acute exposure studies and to the data from chronic exposure studies. Numerical results from this work will be presented.

COLLOQUIUM Spring 2005

Francesco Barlioli

School of Mathematics and Statistics

Carleton University
Ottawa, Canada

Inverse Eigenvalue Problem and Minimum Rank Problem for Qualitative Classes of Matrices

Tuesday, May 10, EMCS 422, 3:30 pm.

Abstract. Spectral Graph Theory is the study of the eigenvalues of various structured matrices associated with graphs. This subject lies at the crossroads of Linear Algebra and Graph Theory, and has become a prominent area of study for both disciplines. Of particular interest here is the so-called "inverse eigenvalue problem." Essentially, the goal is to construct a certain type of matrix from some specified spectral information. In our case part of this spectral information will be contained in an underlying graph. The main problem of interest can be summarized as follows: "Given a graph G, describe or characterize all possible sets of eigenvalues that can be realized by symmetric matrices whose graph is G. This problem is still unresolved even in the simple case of acyclic graphs (trees). In this talk we present the complete solution of the inverse eigenvalue problem for generalized and double generalized stars. A strictly related problem is the "minimum rank problem", namely, the minimum rank among matrices within a given class of matrices. In particular, matrices with a given prescribed graph. We will then present some recent results, like the characterization of minimum rank for unicyclic graphs and decomposable graphs.

Short bibliography
[1] F. Barioli and S. M. Fallat, On the eigenvalues of generalized and double generalized stars, To appear in Lin. Mult. Algebra.
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[5] C.R. Johnson and A. Leal Duarte, The maximum multiplicity of an eigenvalue in a matrix whose graph is a tree, Lin. Mult. Algebra, 46 (1999), 139–144.

COLLOQUIUM Spring 2005

Miroslav Bartusek

Department of Mathematics

Masaryk University

Brno, The Czech Republic

On oscillatory properties of second order differential equations with p-Laplacian

Tuesday, May 17, EMCS 422, 3:30 pm.

Abstract. An asymptotic representation of solutions of second order quasilinear differential equations is presented. It generalizes Prufer transformation. We state a condition under that it is possible to give the necessary and sufficient conditions for the differential equation being oscillatory, nonoscillatory or having both oscillatory and nonoscillatory solutions, respectively.

COLLOQUIUM Spring 2005

John V. Matthews, III

Department of Mathematics

University of Tennessee at Chattanooga

Different Granular Flow Models in Various Hopper Geometries

Tuesday, May 24, EMCS 422, 3:30 pm.

Abstract. Continuum modeling of granular flows has, to date, been built upon ad hoc constitutive relations describing the relationships among the properties of stress, velocity, plasticity, and friction.

In this work two granular material constitutive models will be considered, von Mises and Matsuoka-Nakai, in gravity-driven flows through converging pyramidal domains. The domains presented in this talk approximate hopper geometries used in industrial applications: a hopper with a square cross-section and a rectangular nozzle with semicircular ends. The discretization of the problem through a spectral collocation method yields a nonlinear problem which is then solved numerically. Differences in the nature of the computed flows, including the appearance of circulation, will be demonstrated.

Additionally, the quality of mass flow, i.e. flow in which the entire granular material is mobilized, and the cessation of mass flow as frictional properties are changed will be explored. Finally, some recent experimental work has provided a unique opportunity for comparison with the mathematical models, and initial promising results from this collaboration will be presented.

COLLOQUIUM Spring 2005

Liancheng Wang

Department of Mathematics

Kennesaw State University, GA

Mathematical Analysis of An SEIR Model with Simple Mass Incidence Action Form

Friday, June 24, EMCS 422, 3:30 pm.

Abstract. In this research, an SEIR model with a simple mass action incidence form is studied and the mathematical analysis is carried out. The threshold phenomena is established for some parameter values and questions are posed at the end of the talk.