

COLLOQUIUM Fall 2006

Charles R. Johnson

Department of Mathematics
College of William & Mary

Williamsburg, Virginia

Friday, September 8, EMCS 422, 1:00 pm.

**Bounded Ratios of Products of Principal Minors:
The Positive Definite Toeplitz Case**

Abstract. This will be an informal blackboard talk about very recent work on the problem of determining which ratios of products of principal minors are bounded among all positive definite Toeplitz matrices. Comparison with other classes of matrices (such as general positive definite) will be given. The Toeplitz case leads to some remarkable facts and questions about this historically very well studied class of matrices.

This talk will be appropriate for students who have had the first course in Linear Algebra.

COLLOQUIUM Fall 2006

Don C. Warrington

Editor/Consultant, Pile Buck, Inc., Vero Beach, Florida
MS, Registered Professional Engineer at Tennessee and Ohio
Member of the American Society of Civil Engineers

Tuesday, September 26, EMCS 422, 3:00 pm.

**Development of a Parameter Selection Method
for Vibratory Pile Driver Design with Hammer Suspension**

Abstract. This paper details the mathematical modeling of vibratory pile driving systems using a linear model with the objective of obtaining a closed form solution to estimate either the power requirement of the machine, the torque requirement of the motor driving the eccentrics, or both. It begins by reviewing the system model for the system without a suspension, which is used to enable connection of the vibrating machine with a crane, a mast of a dedicated machine, or an excavator. It proceeds to solve the equations of motion for a system with a suspension, using Laplace transforms and solving the inverse transform using residues and complex integration. The model indicates that, under certain conditions, both the amplitude and the power consumption of the system increase with a suspension, but the results make the practical implications of the result uncertain. Finally a simple set of equations is developed for actual vibratory design which result in the suspension being ignored and the necessary torque of the driving motor computed.

Additional information may be found at <http://www.vulcanhammer.net/vibro/>

Students who have had an introduction to ordinary differential equations, Laplace transforms and very basic complex analysis will find the subject matter of interest.

COLLOQUIUM Fall 2006

Betsy Darken

Department of Mathematics
University of Tennessee at Chattanooga

Tuesday, October 3, EMCS 238, 3:05 pm.

**Mathematical Ignorance:
Do We Brag About It or Can We Do Something About It?**

Abstract. These days, everyone from the President of the United States to the Chancellor of UTC is concerned about the need to improve mathematics education in this country. Yet this is also a country where many citizens complacently remark that I cant do math. Can our own UTC students do mathematics? In this presentation, I will discuss the results of a study investigating how well UTC students can answer elementary mathematical questions such as the following. What fraction is equivalent to $33\frac{1}{3}\%$? How much time has elapsed between 10 : 47 am and 6 : 19 pm? Why is it impossible to divide by 0? I will also compare the performance of future teachers to other students and discuss what UTC can do to help break the pandemic of mathematical ignorance in this country. Perhaps some day our citizens will be no more likely to brag that I cant do math than they will say that I cant read.

All are welcome to attend this talk, especially those who want their children to be able to do mathematics better than their parents.

COLLOQUIUM Fall 2006

Yongzhi Xu

Department of Mathematics
University of Louisville, KY

Monday, October 9, EMCS 238, 1:00 pm.

**Heat Equation and its Applications
in Imaging Processing and Mathematical Biology**

Abstract. Heat equation, or diffusion equation, describes how heat diffuses from a place to nearby area. Heat equation and its variations have applications in many areas, including some areas that may look very unrelated.

In this talk, we start with formulations of heat equation based on Fick's law and based on random walk process. Then we discuss applications of heat equation that are applied to image processing such as computer vision and medical imaging. Applications of heat equation to biological models, including cancer models and other spatial ecological models will be discussed.

This is a general introduction talk. It is accessible to undergraduate students with some knowledge of calculus.

COLLOQUIUM Fall 2006

Boris Belinskiy

**Department of Mathematics
University of Tennessee at Chattanooga**

Friday, November 3, EMCS 422, 1:00 pm.

**Some Problems of Stability, Controllability, and Stochastic Oscillations
of Mechanical Systems**

Abstract. This talk represents the preliminary report on the Faculty Research Grant. The speaker will briefly outline the topics of his research supported by the University of Tennessee at Chattanooga Faculty Research Grant, Fall 2006 - Spring 2007. The following topics will be discussed.

- a. Problems of control for the systems with time - dependent parameters.
- b. Gevray's and trace regularity of a semigroup associated with beam equation.
- c. Energy of stochastic wave equation driven by fractional Gaussian noise.
- d. Energy of a nonlinear beam excited by additive random noise.

The presentation may be of interest to students who are thinking about graduate studies in Applied Mathematics.

COLLOQUIUM Spring 2007

Sharon Brueggeman

Department of Mathematics,
University of Tennessee at Chattanooga
Chattanooga, TN

Tuesday, November 28, EMCS 422, 3:00 pm.

Group Learning in Math 145

Abstract. Over 50 years of educational research has shown that active learning is better than passive watching. Group learning has been shown to be effective at both promoting active learning and increasing student satisfaction. In Spring 2006, I replaced weekly quizzes with group learning worksheets in my sections of Math 145. In this talk, I will discuss my methodology and worksheet content. I will compare data with another semester and share my conclusions.

COLLOQUIUM Fall 2006

**Aniekan A. Ebiefung,
U. C. Foundation Professor**

Department of Mathematics

**University of Tennessee at Chattanooga
Monday, December 4, 233 EMCS , 1:00-2:00 pm.**

On Existence Theory for the Vertical Linear Complementarity Problem

Abstract. Existence of solutions for the vertical linear complementary problem is characterized in terms of representative sub-matrices of the system.

The presentation would be of interest to Math students who are majoring in any area of applied math or to any body who has interest in the application of linear algebra.

COLLOQUIUM Fall 2006

Shaun Micheal Fallat

Department of Mathematics

University of Regina, Canada

Tuesday, December 5, 232 EMCS , 2:00-3:00 pm.

On the Minimum Rank of Graphs

Abstract. For a given undirected graph G , the minimum rank of G is defined to be the smallest possible rank over all real symmetric matrices A whose (i, j) th entry is nonzero whenever $i \neq j$ and $\{i, j\}$ is an edge in G . In the case of trees, minimum rank has been characterized and can be described in terms of the so-called path cover number. For more general graphs only sporadic results are known. In this talk I intend to survey known results for graphs with cut-vertices, unicyclic graphs and co-graphs. If time permits, I will include a brief history and outline some possible future directions.

The presentation would be of interest to Math students who are majoring in any area of Applied Math.

COLLOQUIUM Spring 2007

Lingju Kong* and Qingkai Kong**

*Department of Mathematics

University of Tennessee at Chattanooga

**Department of Mathematics

Northern Illinois University, DeKalb, IL

Tuesday, January 23, 422 EMCS, 3:00-4:00 pm.

Asymptotic Formulas for Right-Indefinite Half-linear Sturm-Liouville Problems

Abstract. We study the regular half-linear Sturm-Liouville equation

$$-(p\phi_r(y)) + q\phi_r(y) = \lambda w\phi_r(y) \quad \text{on } J = (a, b),$$

where $\phi_r(u) = |u|^{r-1}u$, $r > 0$, $p^{-\frac{1}{r}}, q, w \in L(a, b)$, and $p > 0$ a.e. on J . Let $N(\lambda)$ denote the number of zeros in J of a nontrivial solution of the equation. Asymptotic formulas are found for $N(\lambda)$ when $w \geq 0$ a.e. and w changes sign, respectively. As a consequence, the existence and asymptotics of real eigenvalues are established for the half-linear Sturm-Liouville problem consisting of the above equation and a separated boundary condition when w changes sign.

Our results cover Atkinson and Mingarelli's work on second order linear equations as a special case. The generalized Prüfer transformation plays a key role in the proofs.

*The speaker

COLLOQUIUM Spring 2007

Melissa J. Laeser

Hamilton County Department of Education

Chattanooga, TN

Thursday, January 25, 422 EMCS, 3:30-4:30 pm.

Some Remarks on Discrete Probability Distributions

Abstract. We discuss the way the Normal distribution and Poisson distribution should be presented in the low level Statistics classes.

COLLOQUIUM Spring 2007

Marc Loizeaux and Lucas van der Merwe *

Department of Mathematics,
University of Tennessee at Chattanooga
Chattanooga, TN

Thursday, February 15, EMCS 422, 3:05 pm.

4-Critical Graphs with Diameter 3

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 4-critical graphs with diameter three.

* The speaker.

Students are welcome to attend this talk.

COLLOQUIUM Spring 2007

Marc Loizeaux* and Lucas van der Merwe

Department of Mathematics,
University of Tennessee at Chattanooga
Chattanooga, TN

Monday, March 1, EMCS 422, 3:05 pm.

**Diameter 3, 4-critical graphs
with a diametrical vertex of degree $n - 4$**

Abstract. The degree of any vertex in a connected graph which has total domination number k is at most $n - k$. Let F be the family of 4-critical graphs with diameter three such that, G is in F if G has a diametrical vertex u with degree $n - 4$. We characterize a subfamily of F in which every vertex in G is on a diametrical path starting from u .

* The speaker.

Students are welcome to attend this talk.

COLLOQUIUM Spring 2007

Oleksiy Ignatyev

Department of Mathematical Sciences,
Kent State University,
Kent, OH

Tuesday, March 6, EMCS 422, 3:00 pm.

On the Partial Asymptotic Stability in Nonautonomous Differential Equations

Abstract. The main method for investigating the stability and asymptotic stability of the zero solution of the system

$$\frac{dx}{dt} = X(t, x), \quad X(t, 0) \equiv 0 \quad (1)$$

is Lyapunov's Direct (or Second) Method. Lyapunov's initial results, and the initial work involving Lyapunov vector-functions pertained to finite-dimensional dynamical systems determined by ordinary differential equations.

With the emergence of the Second Method of Lyapunov as an indispensable tool in science, engineering, and applied mathematics, several interesting and important variants to Lyapunov's original concepts of stability were proposed. One of these involves the notion of partial stability. This type of stability is of interest, e.g., in applications where only the asymptotic behavior of certain prespecified components of a motion is of interest, and in applications where stability with respect to only certain variables of the motion is in fact true.

In applications, for research of asymptotic stability, it is possible to create a function $V(t, x)$ which is positive definite with respect to part of variables whose derivative is not negative definite but nonpositive. For stability investigation in such cases, the mathematical tool was created in the form of theorems of Barbashin-Krasovskii type in the assumption that right hand sides of differential equations do not depend on t or are periodic or almost periodic functions of t .

In this paper, we obtain the criteria of the asymptotic stability of the zero solution of system (1) if system (1) is, in general, nonautonomous in the assumption that dV/dt does not change its sign, provided that $\sum_{i=1}^j V_i^2$ is positive definite with respect to part of studying variables. Here $V_1 = dV/dt, V_i = dV_{i-1}/dt, i = 2, \dots, j; j$ is some positive integer.

COLLOQUIUM Spring 2007

Sergei Lapin

**Department of Mathematics,
University of Houston, TX**

Thursday, March 8, EMCS 422, 3:00 pm.

**A Boundary Lagrange Multiplier Based Domain Decomposition Method
for Wave Propagation in Heterogeneous Media**

Abstract. The main goal of this talk is to address the numerical solution of a wave equation with discontinuous coefficients by a finite element method using domain decomposition and semimatching grids.

A wave equation with absorbing boundary conditions is considered, the coefficients in the equation essentially differ in the subdomains. The problem is approximated by an explicit in time finite difference scheme combined with a piecewise linear finite element method in the space variables on a semimatching grids. The matching condition on the interface is taken into account by means of Lagrange multipliers. The resulting system of linear equations of the saddle-point form is solved by a conjugate gradient method.

COLLOQUIUM Spring 2007

Ronald Smith

Department of Mathematics,
University of Tennessee at Chattanooga
Chattanooga, TN

Tuesday, March 20, EMCS 422, 3:15-4:15 pm.

Eventually Inverse M-matrices

Abstract. Those nonnegative matrices, some Hadamard power of which are inverse M-matrices are characterized. This requires a refinement of the strict path product necessary condition for an inverse M-matrix. The smallest such Hadamard power may be arbitrarily large. It is also shown that, beyond some threshold, all continuous Hadamard powers of an inverse M-matrix are inverse M. In the process, several new results about inverse M-matrices are given.

Most of the talk should be accessible to students who have completed Math 212.

COLLOQUIUM Spring 2007

Jason R. Morris

Department of Mathematics,
University of Alabama at Birmingham

Wednesday, March 21, EMCS 422, 3:00-4:00 pm.

Nonlinear differential equations posed on an infinite interval

Abstract. The topological degree for Fredholm operators is used to prove the existence of solutions for differential equations that are posed on an infinite interval. I will discuss both boundary value problems (ordinary differential equations) on the half-line, and also semi-linear parabolic partial differential equations on a semi-infinite cylinder. In both cases, the solutions exist for all positive times, and are shown to have particular asymptotic properties. In this talk, I will review the finite-dimensional (Brouwer) topological degree, in order to motivate the topological degree for Fredholm operators. I will then indicate the assumptions that are made in order to meet the abstract requirements of the degree argument. Finally, I will give examples of problems to which the results apply.

COLLOQUIUM Spring 2007

Sharon Brueggeman

Department of Mathematics,
University of Tennessee at Chattanooga
Chattanooga, TN

Thursday, March 29, EMCS ?, 3:00 pm.

Ramification Targets

Abstract. An unsolved problem in algebraic number theory is to explicitly describe a number field having both nonsolvable Galois group and discriminant $+/- p^n$ where p is 2, 3, 5, or 7. In prior colloquia, I have described the derivation and application of discriminant bounds to eliminate possible cases. In this talk, I will describe targeted finite search methods to locate such a number field in cases not eliminated by bounding.

COLLOQUIUM Spring 2007

Terry Walters and Stephen Kuhn

Department of Mathematics,
University of Tennessee at Chattanooga
Chattanooga, TN

Monday, April 9, EMCS 239, 3:30 pm.

Customized Web Homework

Abstract. "If students would only do homework and do it on time they'd do well in my course!" How to get students to do their part, not overwhelm faculty with grading, communicate with students electronically via formatted mathematics, and have complete control over textbook-independent problem sets? The authors, using a system developed at the University of Kentucky, have several years of data from precalculus and calculus courses suggesting that one answer is web homework with hard deadlines. Many faculty use this same open, free, collaborative system in a variety of mathematics courses but it is also used for students at the University of Kentucky in first year Spanish and can be used in a variety of other disciplines.

Students are welcome to attend this talk.

This research was supported by NSF grant DUE-0127007.

COLLOQUIUM Spring 2007

Tom Kozubowski

**Department of Mathematics,
University of Nevada - Reno**

Thursday, April 19, EMCS 422, 3:05-4:00 pm.

**The Laplace distribution and generalizations:
Fundamental properties, applications, and recent developments**

Abstract. In his memoir in 1774, P.S. Laplace introduced an error distribution that now bears his name. Since then, for many years the popularity of the Laplace distribution in stochastic modeling has been by far less than that of its four-years-older "sibling" - the second law of Laplace, better known as the Gaussian (normal) distribution. It is only in recent years that this distribution, together with its various generalizations, has been revived, and is now being used in a variety of fields, including archaeology, biology, biostatistics, climatology, economics, environmental science, finance, geosciences, and physics.

In this talk, we will review fundamental properties of the Laplace and related distributions, discuss their applications, and present some recent developments in this area.

COLLOQUIUM Spring 2007

Jeff Webb *

Department of Mathematics,
University of Glasgow, Scotland

and Gennaro Infante

Department of Mathematics,
University of Salabria, Italy

Tuesday, June 5, EMCS 422, 1:30-2:30 pm.

Loss of Positivity in a Nonlinear Scalar Heat Equation

Abstract. Nonzero solutions of an ordinary differential equation that models a thermostat are studied. There is a controller at one end of a heated bar which adds or removes heat according to the temperature detected by a sensor at some point along the bar. This is therefore a nonlocal boundary value problem.

For certain values of a parameter positive solutions can exist, but as the parameter decreases towards zero, positivity is lost. We investigate this loss of positivity and show that solutions exist which are positive on an interval which decreases in length as the parameter decreases.

We study the problem via an integral equation where the kernel changes sign. The main tool used is the fixed point index of compact maps.

* The speaker

COLLOQUIUM Spring 2007

Gennaro Infante

Department of Mathematics,
University of Salabria, Italy

Tuesday, June 5, EMCS 422, 3:00-4:00 pm.

Positive Solutions of Perturbed Hammerstein Integral Equations

Abstract. We discuss the existence of positive solutions of some perturbed Hammerstein integral equations by means of fixed point index theory. We apply our results to some nonlocal BVPs that arise in some heat flow problems to prove the existence of multiple positive solutions under suitable conditions.

COLLOQUIUM Spring 2007

Miroslav Bartusek

Department of Mathematics,
Masaryk University, Brno, Czech Republic

Friday, June 8, EMCS 422, 1:30-2:30 pm.

On the Distribution of Zeros of Solutions
of a System of Differential Inequalities

Abstract. In this talk, a system of differential inequalities is considered. It is shown that for an oscillatory solution, the zeros of all components are simple, and the zeros of consecutive components are separated from each other. A special energy function is used to investigate the properties of the zeros.