COLLOQUIUM Fall 2001

Yongzhi Steve Xu

Department of Mathematics,
University of Tennessee at Chattanooga

Thursday, October 18, Room 212, 3:00pm.

Inverse Problems of Underwater Acoustics

Abstract. Inverse problems of underwater acoustics have applications in many areas, including ocean exploration and medical imaging. Two applications will be discussed in this talk:

(1) Imaging a floating objects from undersea.

(2) Evaluation of osteoporosis.

The oceans cover more than half of the earth's surface. With more and more human activities on the sea surface and under the sea, it has been an urgent issue to be able to effectively observe floating objects from undersea. Sound wave is the only energy form that can propagate effectively in water. Our research is using mathematical and computational approaches to study properties of acoustic waves scattering in an ocean, and developing new methods for effective acoustic imaging. This talk presents new results of imaging floating objects from underwater by the generalized dual space indicator method.

The methodology we developed for sound waves in an ocean may also be applied to a medical application.

Today, the methods of reference for the evaluation of osteoporosis rely on the absorption of X-rays by the bone tissue. An alternative, which has been proposed during the last fifteen years, makes use of ultrasound techniques, which are non-ionizing, easier to employ, and less costly.

As bone is known to be poroelastic in structure, we consider modeling it using Biot's formulation. In this talk we present some new results in our ongoing research on the reflection and transmission of ultrasonic wave in bovine cancelous bone. We investigate the relations among reflecting waves, transmission waves and Biot coefficients. We also consider the determination of the parameters of cancelous bone.

This talk will be suitable for **undergraduate students** who love Physics and have had a bit of Differential Equations and Linear Algebra.

COLLOQUIUM Fall 2001

Harry Miller

Department of Mathematics,
University of Tennessee at Chattanooga

Thursday, November 1, Room 212, 3:00pm.

Problems of Sierpi$\grave{n}$ski and Erd$\ddot{o}$s - Comments and Open Questions

Abstract. I will present some of my results (old and brand new) in this area and give you a broad background of these kinds of problems. Several open questions will also be presented.

This talk will be of interest to students with an advanced mathematics background (certainly all past and present Math 350 students). A problem, suitable for students, will be presented.

COLLOQUIUM Fall 2001

Jason Hall Moore

Department of Molecular Physiology and Biophysics,

Program in Human Genetics

Vanderbilt University Medical School

Tuesday, November 6, Room 212, 2:00pm.

NEW PARADIGMS FOR THE ANALYSIS OF HIGH-DIMENSIONAL GENETIC DATA

Abstract. I

COLLOQUIUM Fall 2001

Aniekan Ebiefung

Department of Mathematics,

University of Tennessee at Chattanooga

Thursday, November 15, Room 300, 3:00pm.

An Alternative Formulation of the Leontief Input-Output Pollution System

Abstract. In 1970 Wassily Leontief, who won the 1973 Noble Price in Economic Science for his model of input-output economics, extended his input-output system to include pollution related activities. The Leontiefs model can be used to choose different environmental friendly technologies for the economy by solving systems of linear equations. This paper provides an alternative formulation of the Leontief input-output pollution system, which requires less data than the classical model. The presentation will be accessible to everybody and will provide a good application of elementary linear algebra.

COLLOQUIUM Fall 2001

Mary E. Edgerton, M.D., Ph.D.

Vanderbilt-Ingram Cancer Center, Biomedical Informatics Core

Vanderbilt University Medical Center

Monday, November 26, Room 207, 2:00pm.

USING MATHEMATICAL MODELLING TO UNDERSTAND THE MECHANISMS AFFECTING THE SPREAD OF DUCTAL CARCINOMA IN-SITU, THE PRECURSOR TO BREAST CANCER

Abstract. Breast cancer affects approximately one in nine women in the United States. Noninvasive breast cancer, or breast cancer that lacks the ability to spread throughout the body, has long been recognized. Noninvasive breast cancer may develop into invasive breast cancer, which has acquired the ability to metastasize or spread to other parts of the body. Noninvasive breast cancer is being diagnosed at an increasing rate. Cure can be achieved by local removal. It recurs if not completely removed, and, as stated above, may eventually develop into invasive breast cancer.

It is known that noninvasive breast cancer spreads through ducts in the breast. Sometimes, in the microscopic examination of breast biopsy material, cancer cells can be seen interspersed in otherwise normal ducts in the vicinity of noninvasive breast cancer. It is not known how to use this finding to predict the spread of noninvasive breast cancer. In this study, we will study breast biopsies to determine whether the microscopic observation of cancer cells interspersed in otherwise normal ducts has any implications for the spread of noninvasive breast cancer.

A cell automata model of ductal carcinoma in situ will be developed. Simulations will be performed with a range of cell motility, cell proliferation, and cell death parameters. The patterns of spread of neoplastic cells in the simulated images obtained from the model results will be compared with actual histological images. The simulation patterns will be compared with the histological patterns as follows. The model will include grid elements occupied by normal ductal cells, neoplastic ductal cells, or space within the duct. The starting outline for a grid will be a simple linear two-dimensional duct. based on images of duct morphology obtained from actual cases. Rules for cell motion will be start at a simple level and evolve as needed to match istological patterns observed in practice. This evolution will be discussed. In this proposal the simplest possible model to describe the spread of in situ neoplasia will be simulated for comparison with the histological images. Future directions for the model may include the progression to invasive disease or the presence of multiple foci of invasion. Although it would be beyond the scope of the current work, a future step would be to test the statistical significance of any relationship between these functional variables and patient outcomes. Ultimately, it is expected that the results of this study will help us to recognize when a woman is at higher risk for increased spread and more extensive noninvasive breast cancer.

BLUE CROSS - BLUE SHIELD OF TENNESSEE

BETTY ANNE NEAL, VICE PRESIDENT

Wednesday, November 28, Room 207, 3:00pm.

THE ACTUARIAL PROFESSION AND OPPORTUNITIES AT BLUE CROSS - BLUE SHIELD OF TENNESSEE

COLLOQUIUM Spring 2002

Qin Shao

Department of Statistics, The University of Georgia

January 30, Wednesday, Room 207, 2:00pm.

Parsimonious Periodic Time Series Modeling

Abstract. Time series with periodic means and autocovariances frequently arise in climatology, economics, hydrology, electrical engineering, etc. Modeling methods for periodic series focus on the class of periodic autoregressive moving-average (PARMA) models as the PARMA second moment structure is indeed periodic. A ubiquitous problem in fitting a PARMA model to a periodic series, however, lies with parsimony. Even very simple PARMA models can have an inordinately large number of parameters–typically far more than is necessary for an adequate statistical description of the series. This talk presents results aimed at parsimonious PARMA model development through the analysis of a daily temperature series from Griffin, Georgia.

Qin Shao is a candidate for a tenure track position at our Department.

COLLOQUIUM Spring 2002

Ranee Thiagarajah

Lincoln National Reassurance Company

Ft. Wayne, Indiana

February 15, Friday, Room 207, 2:00pm.

LIKELIHOOD BASED INTERVAL ESTIMATIONS

FOR WEIBULL MODEL WITH CENSORED DATA

Abstract. We consider various likelihood based confidence intervals for the parameters of Weibull distribution with censored data. Large sample methods based on the asymptotic normal distribution of the MLEs are in general inaccurate even though they are easy to apply in most situations. For obtaining interval estimations for the weibull parameters under censoring, we derive procedures based on the likelihood ratio statistics (LR), modified LR statistics, and bias - skewness corrected score statistics. The behaviour of these confidence intervals are examined by conducting Monte Carlo studies under various degrees of censoring.

Ranee Thiagarajah is a candidate for a tenure track position at our Department.

COLLOQUIUM Spring 2002

Christine Cheng

**Institute for Mathematics and Its Application,
University of Minnesota**

February 18, Monday, Room 207, 1:00pm.

From Discrepancy to Declustering:

Near-optimal multidimensional declustering strategies for range queries

Abstract. With improvements in computer processing speed and storage capabilities, disk I/O (input/output) has become the bottleneck for many modern data-intensive applications. As such, the use of multi-disk systems together with declustering schemes has been suggested. Declustering schemes allocate data blocks among multiple disks to enable parallel retrieval.

Given a declustering scheme D, its response time with respect to a query Q, $rt(Q)$, is defined to be the maximum number of disk blocks of the query stored by the scheme in any one of the disks. If $|Q|$ is the number of tiles in Q and M is the number of disks then $rt(Q)$ is at least $\lceil |Q|/M \rceil$. One way to evaluate the performance of D with respect to range queries is to measure its additive error - the maximum difference between $rt(Q)$ and $|Q|/M$ over all range queries Q.

In this talk, I will present two declustering schemes for uniform multidimensional data arranged in a d-dimensional grid. These schemes are the first known declustering schemes whose asymptotic additive errors with respect to range queries are near optimal.

Christine Cheng is a candidate for a tenure track position at our Department.

COLLOQUIUM Spring 2002

Sharon Brueggeman

Department of Mathematics,

Ohio State University

February 21, Thursday, Room 161, 2:30pm.

Nonsolvable number fields ramified at only one small prime

Abstract. In this talk, I will discuss the search for a finite extension of Q which has nonsolvable Galois group and is ramified only at a prime l where $l \leq 7$. Ideas for constructing such an extension can be taken from the theories of modular forms, elliptic curves and Galois representations. For many $l > 7$, the division points on an elliptic curve can be used to construct extensions. For $l \leq 7$, Serre's conjecture on Galois representations shows where not to look. Dick Gross has shown that these extensions should exist by using the notion of Hilbert modular forms. I plan to present some of the methods involved in trying to find them.

COLLOQUIUM Spring 2002

Ramon Figueroa-Centeno

Department of Mathematics,

Pittsburg State University

February 22, Friday, Room 207, 2:00pm.

Erdős, Bertrand's Postulate and Magical Product Labelings

Abstract. In 1932 nineteen year old Paul Erdős published his first paper in which he gave a short and elegant proof to Bertrand's Postulate, which states that given an integer $n \geq 2$ there exists at least one prime number between n and $2n$. Moreover, from his proof one can glean that if $n \geq 6$ then there are at least two distinct prime numbers in that interval. In this talk we will use these results to show how one can completely characterize some families of graphs that admit labelings which are inspired by magic squares.

Now, A graph G of size q is defined to be product magic if there is a labeling from $E(G)$ onto $\{1, 2, \ldots, q\}$ such that, at each vertex v, the product of the labels on the edges incident with v is the same while it is called product antimagic if all products are different. Similarly, a (p, q) graph G is defined to be product edge-magic if there is a labeling f from $V(G) \cup E(G)$ onto $\{1, 2, \ldots, p + q\}$ with the property that $f(u) \cdot f(v) \cdot f(uv) = k$ is a constant, where k is called the valence, for any edge uv of G. On the other hand, it is said to be product edge-antimagic if all valences are distinct. We use Bertrand's postulate to completely characterize product magic graphs and product edge-magic graphs without isolated vertices. Several classes of graphs are shown to be product antimagic and results involving joins and corona products of graphs are discussed. Finally, we provide a characterization of product edge-antimagic graphs.

Ramon Figueroa-Centeno is a candidate for a tenure track position at our Department.

COLLOQUIUM Spring 2002

Dr. Ken Senior

Time Service Department–Clock Development,

U.S. Naval Observatory

February 22, Friday, Room ???, 3:15pm.

Accuracy and Precision of Global Positioning System geodetic clock estimates using the Carrier-Phase signal as well as the modulated codes

Abstract. The accuracy of GPSS-based clock estimates is determined by the pseudorange data. For 24-hour arcs of global data sampled at 5-minute intervals, the formal errors for the clock estimates are typically about 115 ps. An internal test of the actual time transfer measurement accuracy has been made by comparing clock estimates at the boundaries between successive analysis arcs for receivers equipped with very stable oscillators, using the combined daily clock estimates provided by the International GPSS Service (IGS). During the period 29 October 2000 to 28 July 2001, the observed day-boundary discontinuities for individual IGS stations have distributions well described as zero-mean and Gaussian. However, the variances among the 23 stations span a wide range, from RMS values of about 170 ps to 1200 ps, implying time transfer accuracies ranging from about equal to the formal errors to nearly an order of magnitude greater. For a few stations, the performance changes dramatically with time. Since the same receiver and antenna models are common for many stations, it is likely that the dominant site-dependent effects are related more to local factors affecting data quality than to specific hardware choices. The ALGO and NRC1 stations display notable temporal variations that might be seasonal. We find that a portion of the variability is caused by sensitivities to long-term temperature changes, with coefficients of -101 ps/ °C and 156 ps/ °C . Smaller, less significant temperature-dependent effects are seen at some of the other stations. After allowing for temperature-dependent effects, much larger day-boundary jumps remain for ALGO and NRC1 during winter 2000/2001, possibly due to signal reflection off snow-covered surfaces near the antennas. Temporal changes in time transfer accuracy at HOB2 are probably related to damage to the antenna cable. The causes for similar changes at MATE and briefly at NYAL/NYA1 have not been identified. Using our thermal sensitivity results for USNO, where the cable and receiver systems are well isolated from environmental changes, we have extended our previous study of diurnal temperature effects on AOA Dorne Margolin choke-ring antennas to put an upper limit of 10.1 ps/ °C on any possible pseudorange-induced long-term variations due to this type of antenna. The precision of clock estimates within a given analysis arc is usually assumed to be better than indicated by the formal errors or the accuracy measures because the relative clock estimates are determined mostly by the carrier phase observations. We confirm this for intervals shorter than about 1 day, the analysis arc length. Average Allan deviations are well correlated with the day-boundary accuracy measures and imply a stability floor for carrier phase time transfer up to 1 day of $2 \times 10^{-13}\tau^{-0.44}$, consistent within measurement errors with a random walk process. For longer intervals we expect the stability to improve as τ^{-1} but this cannot be tested until more stable station clocks are available.

COLLOQUIUM Spring 2002

Jamylle Carter

Institute for Mathematics and its Applications (IMA),

University of Minnesota

February 25, Monday, Room 207, 1:00pm.

Dual Methods for Total Variation-Based Image Restoration

Abstract. This talk will describe a computational method for the inverse problem of edge-preserving image restoration. Total Variation (TV) regularization removes noise from an image while retaining its edges. We solve an equivalent dual version of the TV problem. Images restored using this dual approach will have crisp edges (discontinuities), whereas images recovered under earlier primal methods may contain blurred edges. Joint work with Tony Chan, Pep Mulet,and Lieven Vandenberghe.

Jamylle Carter is a candidate for a tenure track position at our Department.

COLLOQUIUM Spring 2002

Dr. Ken Senior

Time Service Department–Clock Development,

U.S. Naval Observatory

February 22, Friday, Room ???, 3:15pm.

Accuracy and Precision of Global Positioning System geodetic clock estimates using the Carrier-Phase signal as well as the modulated codes

Abstract. The accuracy of GPSS-based clock estimates is determined by the pseudorange data. For 24-hour arcs of global data sampled at 5-minute intervals, the formal errors for the clock estimates are typically about 115 ps. An internal test of the actual time transfer measurement accuracy has been made by comparing clock estimates at the boundaries between successive analysis arcs for receivers equipped with very stable oscillators, using the combined daily clock estimates provided by the International GPSS Service (IGS). During the period 29 October 2000 to 28 July 2001, the observed day-boundary discontinuities for individual IGS stations have distributions well described as zero-mean and Gaussian. However, the variances among the 23 stations span a wide range, from RMS values of about 170 ps to 1200 ps, implying time transfer accuracies ranging from about equal to the formal errors to nearly an order of magnitude greater. For a few stations, the performance changes dramatically with time. Since the same receiver and antenna models are common for many stations, it is likely that the dominant site-dependent effects are related more to local factors affecting data quality than to specific hardware choices. The ALGO and NRC1 stations display notable temporal variations that might be seasonal. We find that a portion of the variability is caused by sensitivities to long-term temperature changes, with coefficients of -101 ps/ °C and 156 ps/ °C . Smaller, less significant temperature-dependent effects are seen at some of the other stations. After allowing for temperature-dependent effects, much larger day-boundary jumps remain for ALGO and NRC1 during winter 2000/2001, possibly due to signal reflection off snow-covered surfaces near the antennas. Temporal changes in time transfer accuracy at HOB2 are probably related to damage to the antenna cable. The causes for similar changes at MATE and briefly at NYAL/NYA1 have not been identified. Using our thermal sensitivity results for USNO, where the cable and receiver systems are well isolated from environmental changes, we have extended our previous study of diurnal temperature effects on AOA Dorne Margolin choke-ring antennas to put an upper limit of 10.1 ps/ °C on any possible pseudorange-induced long-term variations due to this type of antenna. The precision of clock estimates within a given analysis arc is usually assumed to be better than indicated by the formal errors or the accuracy measures because the relative clock estimates are determined mostly by the carrier phase observations. We confirm this for intervals shorter than about 1 day, the analysis arc length. Average Allan deviations are well correlated with the day-boundary accuracy measures and imply a stability floor for carrier phase time transfer up to 1 day of $2 \times 10^{-13}\tau^{-0.44}$, consistent within measurement errors with a random walk process. For longer intervals we expect the stability to improve as τ^{-1} but this cannot be tested until more stable station clocks are available.

COLLOQUIUM Spring 2002

Professor Bogdan Vernescu

Worcester Polytechnic Institute

A Vertically Integrated Industrial Mathematics Program

March 5, Tuesday, Room 207, 3:00pm.

Abstract. WPI has a long tradition of project-based undergraduate education and an applications oriented graduate education. Since 1997, the Center for Industrial Mathematics and Statistics (CIMS) at WPI has developed industrial mathematics projects with over twenty five industrial partners for both graduate and undergraduate students. The industrial partners sponsor senior year undergraduate projects, summer undergraduate research projects, graduate projects for students in the new Professional M.S. programs in Industrial Mathematics and Financial Mathematics, Ph.D. projects and summer internships. The speaker will give a brief outline of the vertically integrated industrial program and discuss various aspects of the industrial interactions.

COLLOQUIUM Spring 2002

Ms. Meg Kiessling

Department of Mathematics

University of Tennessee at Chattanooga

Electronic Design Engineer, Network Administrator, Mathematics Instructor: Different Fields with Shared Fundamentals

April 9, Tuesday, Room 161, 2:00 pm.

Abstract. A discussion of the common elements found in the differing fields of electronic engineering, computer network administration and mathematical education. In particular, how the experiences of working within each field present problems unique to that field, but also how the common tools of communication, observation, and problem solving can be used successfully to develop the required results. The parallels between these fields are closely related to the problem solving techniques which lie at the core of many mathematics classes.

Meg Kiessling is a candidate for a position at our Department.

COLLOQUIUM Spring 2002

Marc Loizeaux

Department of Statistics,
Florida State University

Bayesian Inference for a Spatial Cluster Model

Using Perfect Sampling

April 10, Wednesday, Room 207, 1:00pm.

Abstract. We will look at a Bayesian spatial point process model in which observations are assumed to cluster around a finite collection of underlying points. The prior and likelihood are modeled as locally stable point processes. With additional mild conditions on the likelihood, we show that the posterior is locally stable on its support. This implies that perfect sampling from the posterior may be feasible using an algorithm of Kendall and Moller. The Neuman-Scott model is used in several applications.

COLLOQUIUM Spring 2002

Professor Johnny Henderson

Department of Mathematics, Auburn University

Differential Inequality Methods for Solutions of Boundary Value Problems for Ordinary Differential Equations

April 12, Friday, Room 207, 2:00pm.

Abstract. Employing upper and lower solutions methods to obtain solutions of boundary value problems for ordinary differential equations enjoys quite a history. In particular, if β is an upper solution and α is a lower solution, respectively, of $y'' = f(x, y, y')$ on $[a, b]$, (i.e., $\beta''(x) \leq f(x, \beta(x), \beta'(x))$ and $\alpha''(x) \geq f(x, \alpha(x), \alpha'(x))$), with $\alpha(x) \leq \beta(x)$ on $[a, b]$, conditions are sought for f such that, for each $\alpha(a) \leq A \leq \beta(a)$ and $\alpha(b) \leq B \leq \beta(b)$, there is a solution, y, of $y'' = f(x, y, y')$ satisfying $y(a) = A$, $y(b) = B$, and $\alpha(x) \leq y(x) \leq \beta(x)$ on $[a, b]$.

Extensions of upper and lower solutions methods will also be discussed for certain elliptic boundary value problems as well as for higher order problems.

COLLOQUIUM Spring 2002

Dr. Roozbeh Vakil

Benedict College, Columbia, SC

Investigating the Properties of a Parabola

April 22, Monday, Room 161, 1:00pm.

Abstract. In my talk I will explain some of the difficulties students experience when they begin to learn algebra from a theoretical point of view. I will then discuss an active way of presenting such topics. I will try to make it interesting both for faculty and students.

COLLOQUIUM Spring 2002

Dr. Pablo Tarazaga

Department of Mathematics, University of Puerto Rico
Mayaguez, Puerto Rico

Euclidean Distance Matrices

April 19, Friday, Room ?, 2:00pm.

Abstract. We will introduce the cone of Euclidean Distance Matrices (EDMs), and discuss some results about the structure of this set. Some interesting subclasses of EDMs will be presented and characterized. We will mention some applications and the optimization problems associated with this model.

COLLOQUIUM Spring 2002

Mayme Kay Banasiak

Department of Mathematics,
University of Tennessee at Chattanooga

MATHEMATICS AND THE COLLEGE-BOUND STUDENT

April 23, Tuesday, Room 161, 1:30pm.

Abstract. Everyone wants to be successful. What do students "pack" to "bridge" from their present status to college mathematics? What does it take to be successful in your college mathematics course? What mathematical skills are needed? What study skills are needed? What time management skills are needed?

The speaker is a candidate for a position of the Director of the Developmental Mathematics.

COLLOQUIUM Spring 2002

Ali Arman

Riverdale High School
Murphreesboro, TN

A Development of the Exact Values of Sine and Cosine of $3, 6, 9, 12, ...87$ Degrees

April 29, Monday, Room 207, 1:10pm.

Abstract. This presentation involves expressing the side of a regular decagon in terms of the radius of the circumscribed circle and shows how this leads to finding the exact value of, say the $\sin 18°$. Then, using known exact values of sine and cosine, with the exact value of $\sin 18°$ one can develop a list of all of the exact values for sine and cosine from $0°$ to $90°$ with iterative incrementation of $3°$. For example the exact value of the $\sin 54° = (\sqrt{5}+1)/4$.

COLLOQUIUM Spring 2002

Yong S. Colen

Mathematics Chair,

Hawken Middle and Upper Schools

Gates Mill, Ohio

Pathways to Eureka Moments

May 21, Tuesday, Room 161, 11:30 am.

Abstract. Providing positive learning experience for innumerate students is the key to modifying their misperceived potential. Several "constructive" approaches to mathematics learning will illustrate how students can begin an arduous and yet fulfilling journey to discovery.

COLLOQUIUM Spring 2002

Dr. Lucas Van der Merwe

Department of Mathematics,

Northeast State Community College

3-Domination Critical Graphs with Arbitrary Independent Domination Numbers

June 4, Tuesday, Room 159, 11:45 am.

Abstract. Sumner and Blitch conjectured in 1983 that for any $k-$ domination critical graph G with $k \geq 3$, $\gamma(G) = i(G) = k$. This conjecture was disproved in 1996 for $k \geq 4$ by Ao, Cockayne, MacGillivray and Mynhardt, leaving the conjecture open only for $k = 3$. We show that there exists a connected 3-domination critical graph G with $i(G) = k$ for each $k \geq 3$, thus settling the conjecture.