MATHEMATICS DEPARTMENT SEMINAR SCHEDULE

February 17 – February 21, 2003

All seminars are held in Boyd Graduate Studies unless otherwise noted

MONDAY, February 17, 2003

Group Representation and Cohomology
2:30p.m., Room 302
Speaker: Graham Matthews, University of Georgia
Title of talk: *Projective Resolutions, continued*

Topology
2:30p.m.Room 326
Speaker: Gordana Matic, University of Georgia
Title of talk: *Transverse contact structures in Seifert fibre spaces.*

Faculty and Graduate Social
3:00 p.m., Room 409
Coffee, Tea, Cookies

Colloquium
3:30 p.m., Room 304
Speaker: Jorge Cortés Monforte, University of Illinois
Title of talk: *Geometric Methods For Control and Coordination Of Autonomous Systems*
Abstract: In this talk we present recent progress on motion planning and control algorithms for single and multiple vehicle systems. This work is motivated by applications to autonomous robotic systems and mobile sensing networks. On the basis of our approach is the idea of exploiting the geometric structures behind the differential equations governing the evolution of mechanical control systems. For single-input systems, we present results on controllability, on series expansions describing the evolution of the trajectories, and on averaging under high amplitude and high frequency forcing. For multiple vehicle systems, we focus on decentralized control laws for the coordination of networks performing spatially distributed sensing tasks. The technical approach relies on a collection of tools from Nonlinear Control Theory, Geometric Mechanics, Nonsmooth Analysis and Distributed Algorithms.

CATS
4:40 p.m., Room 306 Boyd Graduate Studies
Speaker: Andreas Voigt, UGA Department of Physics and Astronomy
Title of talk: *How Feynman diagrams help to resolve mysteries in physics*
Abstract: The interacting fermion problem is of fundamental importance in a wide range of physics research areas. It includes fields as diverse as electronic structure theory of solids, strongly correlated electron physics, quantum chemistry and the theory of nuclear matter. Especially the strange and still unrevealed nature of the high temperature superconductors has attracted a great deal of attention and remains still unsolved.

I will give an introduction into the problem and an overview about the ongoing project to combine a Monte Carlo summation techniques with a self-consistent high-order Feynman diagram expansions. I will present the basics steps necessary to carry out the task: the formulation of the model Hamiltonians and the use of Feynman diagrams to calculate basic physical quantities like the self-energy. Some interesting results for the Anderson impurity model will be presented.

TUESDAY, February 18, 2003

VIGRE
2:00-3:15 p.m., Room 304
Speaker: Jon Conlon, University of Mississippi
Title of talk: *Simple asset price bubbles when everyone knows that everyone knows ... that the asset is worthless*
Abstract: A model of an asset price bubble (like the recent NASDAQ bubble) is presented, in which all agents know that the asset is worthless, all agents know that all agents know that the asset is worthless, ..., and (all agents know that)^n the asset is worthless. The bubble exists even though the market lasts only a finite number of periods. That is, everyone initially holds the asset even though everyone knows that the price will collapse in the near future. The model involves asymmetric information, so different people are working with different information. However, everyone is rational. Thus, asset price bubbles like the recent NASDAQ bubble are possible even if everyone is rational and everyone knows that they are in a bubble that will soon burst.

Student Number Theory
3:30 p.m., Room 222
Speaker: All
Title of talk: *Research Discussion (Continuation of perfect number ideas?)*

WEDNESDAY, February 19, 2003

Wavelet Analysis
10:10-11:10 a.m., Room 542
Speaker: Haipeng Liu, University of Georgia
Title of talk: *Regular compactly supported wavelets in sobolev spaces, continued*

Graduate Student Seminar
2:30 p.m., Room 302
Speaker: Tanya Cofer, University of Georgia
Title of talk: *Inflexible Knowledge and Teaching for Deep Structure*
Abstract: We will discuss the article "Inflexible Knowledge: The First Step to Expertise" by Daniel T. Willingham from American Educator Winter, 2002 (http://www.aft.org/american_educator/winter2002/CogSci.html). The author argues the difference between what is commonly referred to as "rote" or "superficial" knowledge and "inflexible" knowledge. Inflexible knowledge is meaningful, but narrow in scope and is often intimately tied to the context in which it was learned. Unlike rote knowledge, where the student simply parrots memorized patterns, inflexible knowledge is an essential part of the learning process. The author makes some suggestions for teachers on how to leverage understanding of inflexible knowledge in order to ultimately promote deep learning.

We will investigate the implications of inflexible knowledge in our own classrooms and discuss teaching strategies. Consider the following questions as you read the article:

1) Have you had trouble getting students to give deep, insightful answers to questions in your own class? If so, what is your intuition about why this is the case? Could inflexible knowledge be playing a role?

2) Can you find specific examples of your own students' demonstration of rote knowledge or inflexible knowledge in class, on homework, or on exams?

3) How could you alter your teaching practices to better accommodate the role that inflexible knowledge plays in student learning?

4) As mathematicians, we generally have strategies for gaining deeper understandings about difficult, abstract topics. What are some of your strategies?

Algebraic Geometry
2:30 p.m., Room 303
Speaker: Ivan Cheltsov**,** University of Georgia
Title of talk: *"Birational rigidity of a four-dimensional smooth complete intersection of a quadric and a quartic not containing a plane"*

Problem Solving Group
2:30 p.m., Room 322

Numerical Analysis
3:30 p.m., Room 410
Speaker: TBA
Title of talk: *TBA*

Lie Theory
3:30 p.m., Room 303
No Meeting this week

Arithmetic Geometry/Number Theory
3:30 p.m., Room 304
Speaker: Dino Lorenzini, University of Georgia
Title of talk: *From models of curves to models of jacobians*
Abstract: This is the last talk in a series of four lectures intended for graduate students in number theory and algebraic geometry. In this talk, we will discuss the relationships between the model of a curve and the model of its jacobian, following Raynaud. This talk will also serve as an introduction to Brian Conrad's talk on Monday 2/24, when he will discuss this circle of ideas in the context of the modular curve X_1(p).

Math Club Meeting
5:00 p.m., Room 304
Speaker: Dr. Malcolm Adams, University of Georgia
Title of talk: *"The Law of Large Numbers and the Measurement of Sets."*
Abstract: Jacob Bernoulli's law of large numbers says that if we flip a fair coin many times, then we should find roughly the same number of heads as tails. We will discuss how to translate this and related probabilistic questions into fundamental questions on the measurement of subsets of the real numbers. This sets the groundwork for proving that monkeys can type novels and that gamblers will end in the poorhouse.

Refreshments will be provided.

THURSDAY, February 20, 2003

Faculty and Graduate Social
3:00 p.m., Room 409
Coffee, Tea, Cookies

Colloquium
3:30 p.m., Room 304
Speaker: Pavel Lushnikov, Los Alamos National Laboratory
Title of talk: *Nonlinear Theory of the excitation of surface waves by wind due to the Kelvin-Helmholtz instability*
Abstract: The interface of two ideal fluids is unstable to linear perturbations if the relative speed (wind) of two fluids exceeds a threshold value, which depends on the surface tension and the acceleration of gravity, as was discovered by Kelvin and Helmholtz in 19th century. Does nonlinearity saturate the linear instability or cause a finite time singularity at the boundary surface? To answer that question a nonlinear theory of the Kelvin-Helmholtz instability is developed on a basis of the Hamiltonian description of a boundary surface of two ideal fluids. Perturbation theory exploits a

small-angle approximation of surface elevation. The basic nonlinear process is the wave-wind interaction which differs significantly from the nonlinear interaction in the absence of wind. It is shown that nonlinearity does not saturate the linear instability but, on the contrary, leads to an explosive growth of the amplitude. Near the instability threshold, the envelope of surface elevation is described by a nonlinear (2+1)-dimensional Klein-Gordon equation. An exact analytical proof of singularity formation in a finite time is given and depends on the initial condition for the nonlinear Klein-Gordon equation. Singularity formation allows one to explain satellite and airplane observations of the very sharp dependence of the fraction of sea surface covered by foam on the wind velocity. Implication of the proposed theory to recent year experimental observation of Kelvin-Helmholtz instability at the interface between superfluid 3He-A and superfluid 3He-B is discussed.

FRIDAY, February 21, 2003

Geometry
2:20 p.m., Room 322
Speaker: Sue Whitesides, School of Computer Science, McGill University, Montreal
Title of talk: *Embedding Problems for Paths and Cycles with Direction Constrained Edges*

Abstract: We determine the reachability properties of the embeddings in 3D of a directed path, in the graph theoretic sense, whose edges have each been assigned a desired direction (East, West, North, South, Up, or Down) but no length. We ask which points of
3D can be reached by the terminus of an embedding of such a path, by choosing appropriate positive lengths for the edges, if the embedded path starts at the origin, does not intersect itself and respects the directions assigned to its edges. Similarly, we ask which graph theoretic cycles have physical realizations, without self-intersections, that respect the given direction constraints.

These problems arise in the context of extending planar graph embedding techniques and VLSI rectilinear layout techniques from 2D to 3D. We give combinatorial characterizations that yield linear time recognition and layout algorithms.

All are welcome. No special background is assumed.

joint work with G. Di Battista (U. Roma III), G. Liotta (U. Perugia), and A. Lubiw (U. Waterloo)

****

Upcoming Events

****

MONDAY, February 24, 2003

Special Number Theory Seminar
3:30 p.m., Room 304
Speaker: Professor Brian Conrad, University of Michigan
Title of talk: *J_1(p) has connected fibers*
Abstract: We will begin with a "review" of some basic facts concerning arithmetic curves, and will study resolution of tame cyclic quotient singularities on arithmetic surfaces. This will be used to determine the structure of component groups of mod p reductions of modular curves intermediate between X_1(p) and X_0(p) (the case of X_0(p) is an old result due to Mazur-Rapoport, and the case of X_1(p) explains the title). This work also leads to evidence in favor or a conjectured formula for the order of the torsion subgroup of J_1(p)(Q), which we'll formulate.

This is joint work with S. Edixhoven and W. Stein.

Mathematics and Engineering Colloquium
3:30 p.m., Room 328
Speaker: Dr. M. K. Stephen Yeung, Department of Biomedical Engineering
Boston University
Title: *Reverse Engineering Gene Networks*
Abstract: We present a scheme to reverse-engineer gene networks on a genome-wide scale using a relatively small amount of gene expression data from microarray experiments. It uses singular value decomposition to construct a family of solutions and then identify the unique solution by robust regression. Our algorithm has O(log N) sampling complexity and O(N^4) computational complexity. We test and validate our approach in a series of numerical experiments on model gene networks.

WEDNESDAY, February 26, 2003

Faculty and Graduate Social
3:00 p.m., Room 409
Coffee, Tea, Cookies

Colloquium
3:30 p.m., Room 304
Speaker: Cristian Popescu, John Hopkins University
Title of talk: *Stark-type Conjectures "over Z"*
Abstract: In the 1970s and early 1980s Stark developed a remarkable conjecture aimed at interpreting the first non-vanishing derivative of an Artin L-function L_{K/k, S}(s, \chi) at s=0 in terms of the arithmetic properties of the Galois extension of global fields K/k. Work of Tate, Chinburg, and Stark himself has revealed far reaching applications of Stark's Conjecture to Hilbert's 12-th Problem and the theory of Galois module structure of groups of units and ideal-class groups. In his search for new examples of Euler Systems, Rubin has formulated in 1994 a strong version ("over Z", in Tate's terminology) of Stark's Conjecture for abelian L-functions of arbitrary order of vanishing at s=0. Our study of the functorial base-change behavior of Rubin's Conjecture led us to formulating a seemingly more natural Stark-type conjecture "over Z". We will discuss and provide evidence for this new statement, as well as briefly describe the main goals of the conjectural program initiated by Stark.

MONDAY, March 3, 2003

Mathematics and Engineering Colloquium
3:30pm, Room 328 Grad Studies Bldg.
Speaker: Professor MingQing Xiao Department of Mathematics Southern Illinois University
Title of talk: *Feedback Control Of Compression Systems*
Abstract: In recent years, control of compression systems has become a topic of much research interest to control engineers. One of the major challenges in the design and operation of compression systems is handling the instabilities that arise in the unsteady fluid structural dynamics. This is because when a turbo-machine, such as a jet engine, operates near its optimal operating point, the flow can become unstable. Two kinds of instability phenomena, rotating stall and surge, are of major concern in compression systems, as they can lead to undesirable reduction in performance and even damage to engine components during operations.

In this talk, I will present some of our recent results in controlling compression systems. I will first introduce the full-order compression system model, the so-called Moore-Greitzer model, and show that it is not (topologically) equivalent to its linearized version near the point where the pressure rise closes to its maximum. I will then show that the Moore-Greitzer model features a center manifold near this maximum pressure rise, which makes it possible to translate the study of the behavior of the local flow in the compressor into a study of the flow of two scalar ODE's on the center manifold. Using the normal form of a nonlinear system obtained through integral averaging, I will introduce a nonlinear state feedback controller, which accomplishes the tasks of preventing the closed-loop system from entering either rotating stall or surge and causing the closed-loop pressure rise coefficient to approach its maximum with the elimination

of hysteresis. I will close by presenting numerical simulations of open-loop and closed-loop models, to illustrate the analysis and the results.

THURSDAY, March 6, 2003

Mathematics and Engineering Colloquium
3:30 p.m., Room TBA
Speaker: Professor Weijiu Liu, Department of Mechanical Engineering
Massachusetts Institute of Technology
Title of talk: *Mixing in Chaotic Advection Flows and Feedback Flow*
Abstract: Why study mixing? Fluid mixing is often encountered in engineering applications and it is carried out in order to achieve good performance in some processes like the mixing of air and fuel in combustion engines. Persistent patterns in chaotic fluid mixing have been observed in experiments and numeric simulations but could not described mathematically. With the help of Floquet theory, we will present an answer to this open problem.

Why flow control? In engineering applications we often need to control a flow to behave in a desirable way. For instance, we need to design a control to stabilize a laminar flow which is preferred in engineering. In this talk we also show boundary feedback controls designed for 2D channel flow.