MATHEMATICS DEPARTMENT SEMINAR SCHEDULE
February 24 – February 28, 2003

All seminars are held in Boyd Graduate Studies unless otherwise noted

MONDAY, February 24, 2003

VIGRE Research Group
10:30-12:30, Room 524
Speaker: Ivan Cheltsov, University of Georgia
Title of talk: *"Birational geometry of 3-folds"*

Group Representation and Cohomology
2:30p.m., Room 410
Speaker: Graham Matthews/Jon Carlson, University of Georgia
Title of talk: *Projective Resolutions/Stable Categories*

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

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

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 of talk: *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.

TUESDAY, February 25, 2003

VIGRE
2:00-3:15 p.m., Room 304
Speaker: Brian Conrad, University of Michigan
Title of talk: *Prime values of polynomials*
Abstract: Classical probabilistic heuristics due to Hardy and Littlewood (and really Gauss) predict how often one expects an irreducible polynomial over the integers to take on prime values, including the case of several polynomials at once. There are some basic obstructions one must take into account, all of which are local. No cases of such heuristics have ever been proven beyond the case of a single linear polynomial in one variable (essentially the prime number theorem and Dirichlet's theorem), nor have likely counterexamples ever been found.

Despite our complete ignorance, one can ask for more. In one direction, one can ask about polynomials in several variables. This turns out to be relatively straightfoward to formulate, except that to make sense of a certain infinite product factor in the asymptotic one needs to use Deligne's generalization of the Riemann Hypothesis for varieties over finite fields. But more interesting phenomena lie just around the corner: there are fruitful analogies between the ring of ordinary integers and the ring of polynomials in one variable over a finite field (the "function field case"), so one can ask whether the classical unproven heuristics have analogues in this setting. Rather amazingly, we'll see that the classical heuristics are not only provably false (for interesting reasons!) in the function field case, but they can be plausibly salvaged in a manner which involves a mixture of algebra and geometry, and required proving some surprising periodicity phenomena with no known classical analogues.

It turns out that the correct conjecture in the function field case involves obstructions which are global and not just local (in contrast to the classical case in integers), and the case of characteristic 2 is particularly vexing. Many illustrative numerical examples will be given, and several concrete open questions will be stated at the end.

No knowledge of algebraic geometry or number theory will be assumed. This is joint work with Keith Conrad and Robert Gross.

Student Number Theory

3:30 p.m., Room 222
Speaker: TBA
Title of talk: *TBA*

WEDNESDAY, February 26, 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
No Meeting this week

Algebraic Geometry
2:30 p.m., Room 303
Speaker: Igor Dolgachev, University of Michigan
Title of talk: *Abstract configurations in algebraic geometry*
Abstract: (v_k,w_l) configuration is a pair of finite sets of cardinalities v and w with a relation on the product of the sets such that each element of the first set is related to the same number k of elements from the second set and, conversely, each element of the second set is related to the same number l of elements in the first set. An example of an abstract configuration is a finite geometry. In this talk we discuss some examples of abstract configurations and, in particular finite geometries, which one encounters in algebraic

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

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.

Numerical Analysis
3:30 p.m., Room 410
No Meeting this week

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

Arithmetic Geometry/Number Theory
3:30 p.m., Room 304
No Meeting this week

THURSDAY, February 27, 2003

Special Talk
11:00 a.m., Room 304
Speaker: Cristian Popescu, John Hopkins University
Title of talk: *1-Motives, Etale Cohomology and Equivariant Iwasawa Theory*
Abstract: The classical conjectures of Gross and Brumer-Stark seem to describe two completely unrelated deep properties of special values of equivariant L-functions of Stickelberger type. In this talk, we will develop a general Equivariant Main Conjecture in Iwasawa Theory, which captures the Brumer-Stark and Gross phenomena simultaneously and works equally well in characteristics 0 and p. The characteristic p side of the theory draws its main ideas from Deligne's construction of 1-motives associated to smooth projective curves over finite fields. The characteristic 0 side of the theory is based on a new construction of number field analogues of the l-adic realizations of Deligne's 1-motives and is deeply rooted in earlier work of Tate and Ritter-Weiss on Multiplicative Galois Module Structure. Time permitting, we will also provide evidence in support of this new Equivariant Iwasawa Theoretic statement and discuss its links to p-adic refinements of Rubin-Stark-type conjectures "over Z".

FRIDAY, February 28, 2003

Geometry
2:20 p.m., Room 322
Speaker: Elizabeth Denne, **University of Illinois**
Title of talk: *Alternating Quadrisecants of Knots*

Abstract: In 1994 Kuperberg showed that if K is a non-trivial tame knot in $\mathbb{R}^3$, then K has a quadrisecant. It is interesting to compare the linear ordering of the intersection points along the quadrisecant with the cyclic ordering of the intersection points along the knot. There are three possible orderings called simple, flipped and alternating. I will show that alternating quadrisecants exist for non-trivial tame knots and then indicate some of the applications of this result to geometric properties of knots such as ropelength.

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Upcoming Events

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MONDAY, March 3, 2003

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

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

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

Mathematics and Engineering Colloquium
3:30 p.m., Bldg. 1140, Forestry, Rm. 100
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.