Mathfest 2002
Burlington, VT

MAA and Pi Mu Epsilon
Student Paper Sessions
August 1 – 2, 2002

PI MU EPSILON

Pi Mu Epsilon is a national mathematics honor society with over 275 chapters throughout the nation. Established in 1914, Pi Mu Epsilon is a non-secret organization whose purpose is the promotion of scholarly activity in mathematics among students in academic institutions and among staffs of qualified non-academic institutions. It seeks to do this by electing members on an honorary basis according to their proficiency in mathematics and by engaging in activities designed to provide for the mathematical and scholarly development of its members.

Pi Mu Epsilon regularly engages students in scholarly activity through its *Journal* which has published student and faculty articles since 1949. In addition, the society awards monetary prizes for mathematics contests and awards established by chapters.

Since 1952, Pi Mu Epsilon has been holding its annual National Meeting in conjunction with the summer meetings of the Mathematical Association of America (MAA).

MAA Student Chapters

The MAA Student Chapters program was launched in January 1989 to encourage students to continue study in the mathematical sciences, provide opportunities to meet with other students interested in mathematics at national meetings, and provide career information in the mathematical sciences. The primary criterion for membership in an MAA Student Chapter is "interest in the mathematical sciences." Thus, the Student Chapter program supplements, but does not compete with, the chapters of Pi Mu Epsilon. Currently there are approximately 225 active Student Chapters on college and university campuses nationwide. Students are also members of the MAA Sections in their geographic region. Many of the MAA Sections provide special activities for students at their regularly scheduled meetings.

J. Sutherland Frame Lecture

Friday, August 2, 2002
8:00 - 8:50 pm
Emerald Grand Ballroom, Sheraton

SOAP BUBBLES: OPEN PROBLEMS

Frank Morgan

Williams College

Despite much recent progress by many mathematicians, including undergraduates, many simple open problems remain. This presentation will also include a little contest with demonstrations, explanations, and prizes. No prerequisites.

The J. Sutherland Frame Lecture is named in honor of the ninth President of Pi Mu Epsilon, who served from 1957 to 1966 and passed away on February 27, 1997. In 1952, Sud Frame initiated the student paper sessions at the annual Pi Mu Epsilon meeting, which is held at the Summer Mathfests. He continually offered insight and inspiration to student mathematicians at these summer meetings.

Student Activities
Schedule of Events

Wednesday, July 31

5:30 pm - 6:30 pm	MAA/PME Student Reception	Courtyard, Sheraton

Thursday, August 1

9:00 am - 5:00 pm	Student Hospitality Center	Exhibit Hall, Sheraton
1:00 pm - 2:57 pm	MAA Session #1	Kingsland Room
1:00 pm - 2:55 pm	PME Session #1	Willsboro Room
1:00 pm - 2:57 pm	MAA Session #2	Shelburne Room
1:00 pm - 2:55 pm	PME Session #2	Meeting Room 12
3:00 pm - 4:57 pm	MAA Session #3	Kingsland Room
3:00 pm - 4:35 pm	PME Session #3	Willsboro Room
3:00 pm - 4:57 pm	MAA Session #4	Shelburne Room
3:00 pm - 4:35 pm	PME Session #4	Meeting Room 12
5:30 pm - 6:20 pm	MAA Modeling Contest Winners	Amphitheater, Sheraton

Friday, August 2

9:00 am - 5:00 pm	Student Hospitality Center	Exhibit Hall, Sheraton
1:00 pm - 2:57 pm	MAA Session #5	Kingsland Room
1:00 pm - 2:35 pm	PME Session #5	Willsboro Room
1:00 pm - 2:57 pm	MAA Session #6	Shelburne Room
1:00 pm - 2:35 pm	PME Session #6	Meeting Room 12
3:00 pm - 5:15 pm	MAA Session #7	Kingsland Room
3:00 pm - 4:35 pm	PME Session #7	Willsboro Room
3:00 pm - 5:15 pm	MAA Session #8	Shelburne Room
3:00 pm - 4:35 pm	PME Session #8	Meeting Room 12
6:15 pm - 7:45 pm	PME Banquet	Diamond Ballroom
8:00 pm - 8:50 pm	J. Suthlerland Frame Lecture **Frank Morgan**, Williams College *Soap Bubbles: Open Problems*	Emerald Grand Ballroom

Saturday, August 3

9:00 am - 3:00 pm	Student Hospitality Center	Exhibit Hall, Sheraton
1:00 pm - 2:50 pm	MAA Student Workshop **Patti Frazer Lock**, St. Lawrence University *Topics in Graph Theory*	Emerald Ballroom I
3:00 pm - 3:50 pm	MAA Student Lecture **Colin Adams**, Williams College *"Blown Away: What Knot to do When Sailing" by Sir Randolph "Skipper" Bacon*	Emerald Ballroom III
4:00 pm - 4:50 pm	Student Problem Solving Competition	Shelburne Room

MAA Session #1

Kingsland Room (Burlington Sheraton Hotel) 1:00 P.M. – 2:57 P.M.

The first four speakers in this session are students of Professor Frank Morgan and the last three of Professor Cesar Silva in the REU Program at Williams College.

1:00-1:15 A HUNT FOR THE OCTAGON-SQUARE AND SOME OTHER NASTY COMPETITORS

Eric Schoenfeld
Williams College

The notorious octagon square tiling is the most efficient way to enclose and separate two areas on the two-dimensional torus. We hope to expose it for the fraud it truly is. Some other questionable characters arise already in $\mathbf{R}^2$ if bubbles are allowed to overlap themselves.

1:17-1:32 DOUBLE BUBBLES IN SPHERICAL AND HYPERBOLIC 3-SPACE

George Lee, Jr.
Harvard University

The double bubble problem seeks the least-area way to enclose two regions of prescribed volume. We suspect that the solution in spherical and hyperbolic three-space is similar to a familiar double soap bubble. One major difficulty in proving this is showing that no volume is split into multiple components.

1:34-1:49 BUBBLES ON CONES

Tracy Borawski
Williams College

The most efficient way to enclose a single area on the surface of a cone is a circle about the vertex. We seek the most efficient way to enclose and separate two areas. Numerous possibilities are reduced to two: a variation of the standard double bubble and something new.

1:51-2:06 SYMMETRIES AND COMPARISONS OF MINIMIZING DOUBLE BUBBLES

Robert Lopez
Williams College

The Double Bubble problem seeks to find the least-perimeter way to fence off two areas. On certain surfaces many types of minimizing double bubbles appear. This is a relatively new finding and can lead to some rather interesting solutions to the double bubble problem.

2:08-2:23 DYNAMICAL SYSTEMS AND THEIR EIGENFUNCTIONS

Brian Katz
Williams College

Here is a functional relationship between the study of dynamical systems and their eigenfunctions: Many of the seemingly purely dynamical questions have a precise rewording as eigenvalue questions. I will illuminate this relationship in the finite measure case and introduce some of the issues in the infinite measure case.

2:25-2:40 THE DYNAMICS OF $\mathbf{R}^2$ ACTIONS

Sarah Iams
Williams College

We will examine group actions in $\mathbf{R}^2$ on the measure space and define some dynamical properties of these systems. Our $\mathbf{R}^2$ examples will lead to an understanding of tilings as dynamical systems.

2:42-2:57 ON DYNAMICS OF $\mathbf{R}^2$ ACTIONS AND TILINGS

Kirsten Wicklegren
Harvard University

Given a finite set of tiles, the space of all tilings of the plane can be viewed as a dynamical system. We will investigate the dynamical properties of tiling spaces, a particular example of an $\mathbf{R}^2$ action.

PME Session #1

Willsboro Room (Burlington Sheraton Hotel) **1:00 P.M. – 2:55 P.M.**

1:00-1:15

FACTORIZATION AND $PSL_2(13)$

Tom Wakefield

Youngstown State University - Ohio Xi

The group G is factorizable if $G = HK$, where H and K are nontrivial subgroups. Although trivial examples of non-factorizable groups are easy to generate, it is more difficult to prove that nontrivial groups do not factor. An overview of the proof that $PSL_2(13)$ is not factorizable will be presented.

1:20-1:35

CARRY GROUPS

Lorne Fairbairn

SUNY Potsdam – New York Phi

A carry group $G\overset{x}{\circ}H$ is defined on $G \times H$ with x in the center of G. The group's operation is given by $(g_1,h_1) \bullet (g_2,h_2) = (g_1g_2x^i, h_1h_2)$ where $i = 0$ or 1 depending on h_1 and h_2. The x^i can be thought of as i carries of x from H into G. This method of joining groups allows for a distinct way of seeing isomorphisms.

This is joint work with Michael Tsiang, UC Santa Cruz, and Grant Clifford, Harvey Mudd College. All are students of Professor Blair Madore in the REU program at SUNY Potsdam.

1:40-1:55

THE EVOLUTION HOMOMORPHISMS AND CLASSIFICATION OF CELLULAR AUTOMATA

Nicole Miller

Salisbury University – Maryland Zeta

This paper describes cellular automata generated by group multiplication. We discuss conjectures pertaining to long-term effects of finite cellular automata where time evolution induces a homomorphism of the underlying automata into itself. Partitioning the state transition diagram modulo the kernel of this homomorphism into cosets produces a quotient machine.

2:00-2:15

SEARCH FOR CONSTRUCTIONS OF PARTIAL DIFFERENCE SETS

Ed Kenney

University of Richmond – Virginia Alpha

We investigate the connection between partial difference sets and projective planes of several different orders in an effort to locate a family of partial difference sets in new groups. We first show several Galois Ring constructions, and then describe work utilizing quadratic forms and Mathon-constructed maximal arcs to provide insight into their geometry and structure. (Preliminary report.)

2:20-2:35

HOW TO COLOR A GRAPH

Eric C. Polley

St. John's University – Minnesota Delta

Complete edge-colored graphs with loops that have the geometric property of 2-point homogeneity provide a natural generalization of distance transitive graphs. Several of my results display the relationship between the direct product and the wreath product of these graphs. The long-term goal of this research is to classify finite two-point homogeneous graphs, up to isomorphism.

2:40-2:55

ANALYSIS OF THE CLOSURE AND INTERIOR OF TOPOLOGICAL SPACES

Christopher Jones

Youngstown State University – Ohio Xi

The closure operator, and its dual, the interior, are concepts fundamental to topological spaces. For a set A in a topological space X, let $\alpha(A)$ be the number of sets produced using the closure and interior operators on A, and let $\overline{\alpha}(X)$ be the maximum number of sets that can be produced in the space. An upper bound is known for $\overline{\alpha}(X)$; in this talk, that upper bound and other values for $\overline{\alpha}$ will be presented, along with other results on this topic. These results build primarily on the work of Kuratowski in the 1920s.

MAA Session #2

Shelburne Room (Burlington Sheraton Hotel) 1:00 P.M. – 2:57 P.M.

The speakers in this session are students of Professor Robert Strikhartz in the REU Program at Cornell University.

1:00-1:15

THE FINITE ELEMENT METHOD ON FRACTALS

Kevin Coletta

Rensselear Polytechnic Institute

The finite element method is a powerful tool for approximating solutions to differential equations. An analogous method has been developed on the Sierpinski gasket and other fractals. I will discuss some refinements of this method, as well as applications to the wave equation on fractals.

1:17-1:32

FOURIER SERIES METHODS ON FRACTALS

Kealey Dias

SUNY Stony Brook

Ordinary Fourier series may be thought of as eigenfunction expansions for the Laplacian (2nd derivative) on an interval. There is an analogous expansion on certain fractals, including the Sierpinski gasket, based on the Laplacian defined by Kigami. I will discuss this type of expansion and some applications.

1:34-1:49

POLYNOMIAL TYPE FUNCTIONS ON FRACTALS

Jonathan Needleman

Oberlin College

On certain fractals, including the Sierpinski gasket, Kigami has defined the analog of the Laplacian. Functions annihilated by a power of the Laplacian are analogous to polynomials on the line. I will discuss properties of these polynomial type functions.

1:51-2:06

POWER SERIES ON FRACTALS

Po-lam Yung

Chinese University of Hong Kong

Power series provide a powerful tool for understanding functions defined on the line. On certain fractals, including the Sierpinski gasket, it is possible to define the analog of power series. I will discuss properties of this type of expansion.

2:08-2:23

CONSTRUCTING A P-LAPLACIAN ON THE SIERPINSKI GASKET

Carto Wong

Chinese University of Hong Kong

I will discuss the construction of a non-linear differential operator on the Sierpinski gasket. This construction is the analog of the p-Laplacian on Euclidean space.

2:25-2:40

PDE'S ON THE OCTAGASKET FRACTAL

Daniel G. Treat

University of Missouri-Rolla

The study of PDE's on fractals provides interesting examples of phenomena that run counter to intuition. In this talk, the various properties of electrical resistance on the octagasket fractal will be discussed, along with their implications in PDE fractal theory.

2:42-2:57

MOCK FOURIER SERIES FOR THE STANDARD CANTOR MEASURE

Matthew Hirn

Cornell University

Jorgensen and Pedersen show that orthonormal bases of exponential functions exist for certain special Cantor measures, but not for the usual one-third Cantor measure. In the talk I will describe a weaker kind of basis of exponential functions that has some of the properties in common with ordinary Fourier series.

PME Session #2

Meeting Room 12 (Burlington Sheraton Hotel) **1:00 P.M. – 2:55 P.M.**

1:00-1:15 IMPLEMENTATION OF ERROR CORRECTING CODES

Conrad Miller

Southwestern University – Texas Pi

Through the use of the Pentium/8086 assembly language, we show how it is possible to implement a Hamming error correcting/detecting code by using the most basic functions of the computer's architecture.

1:20-1:35 CHECK, PLEASE!

James Sloan

Southwestern University – Texas Pi

I will discuss the IBM, Verhoeff, and ISBN check digit schemes, and their implementation in Java.

1:40-1:55 THE ILLUSTRATED ANALYST: GRAPHING FUNCTIONS, CONVOLUTIONS, AND FOURIER TRANSFORMS

Michael B. Henry

Augustana College – Illinois Eta

This project develops interactive software in OpenGL and Java to visualize theorems in analysis pertaining to signal processing. It will help you understand how the transform of a convolution is the product of the transforms.

This project was developed at the NSF-VIGRE supported REU program, illiMath2002, at the University of Illinois, under the leadership of Professor George Francis.

2:00-2:15 BINARIZING TEXT IMAGES, AND RELATED ISSUES

Elizabeth Fite

Hendrix College – Arkansas Beta

Image processing has a wide variety of applications; one such application is the retrieval of textual data from paper sources for input into a database. This presentation will focus on the issues associated with preparing text images for use by an OCR.

2:20-2:35 MATHEMATICS OF HIGH PERFORMANCE COMPUTER GRAPHICS

Igor Crk

Carthage College – Wisconsin Epsilon

We will be presenting the results of our summer research on high performance computer graphics.

2:40-2:55 MATHEMATICAL ANALYSIS OF COMPUTING ALGORITHMS

Noorie Hanum

San Angelo State University – Texas Zeta

We analyze the basic computing algorithms using mathematical tools, such as the Big O notation, to evaluate their efficiency in computing. Some of the algorithms studied are Quick Sort, Heap Sort, Selection Sort, Binary Search and Sequential Search. Mathematics is used to determine the time taken by these algorithms and to rate and compare them. The use of mathematics as an essential tool in mathematics is established.

MAA Session #3

Kingsland Room (Burlington Sheraton Hotel) **3:00 P.M. – 4:57 P.M.**

3:00-3:15

CHAOS IN THE SOLAR SYSTEM
Carolyn Staples
Claremont McKenna College

It is known that Hyperion, one of the satellites of Saturn, does not follow the standard behavior of all satellites. I will discuss the chaotic behavior of Hyperion and compare it to the chaotic behavior of a forced pendulum.

3:17-3:32

SARAH HUGHES COMES FROM NOWHERE?
Thomas Breunig
University of Wisconsin Oshkosh

Many articles claimed that Sarah Hughes pulled off a huge upset to win the 2002 Women's Olympic Figure Skating Gold Medal. I will explain and model the method used by the Olympic Committee to calculate the medal rankings as a social welfare procedure, and examine some of the oddities that occur from this procedure.

3:34-3:49

WHERE TO PARK?
Sarah Grove
Youngstown State University

After touring several different parking lots of various sizes, the ultimate question of where to park the car is randomly decided. Once all of the available spots are filled, the spatial distribution of spaces with and without cars is noted. Interesting correlations to real world problems are explored.

3:51-4:06

HIGH PERFORMANCE SHOELACE TIGHTENING
Michael Piatek
Duquesne University

A shoelace with ends connected is one example of a mathematical knot. An evolving problem in knot theory is optimizing conformations with respect to different definitions of complexity such as rope length. In this introductory talk, we will investigate complexity measures and methods of speeding up associated computational optimization tasks.

4:08-4:23

MTBI PROJECT: MATHEMATICS AND BIOLOGY
Thela Morales
Mesa State College

A presentation of some of work performed at Cornell University's 2002 Summer Mathematical and Theoretical Biology Institute.

4:24-4:40

BENFORD'S LAW: THE SURPRISING DISTRIBUTION
Abigail Fleming
Mesa State College

When looking at the first digits of a set of numbers, it would seem natural that the probability of any given first digit would be one in nine. However, the occurrence usually follows a different pattern: Benford's Law. We will look at characteristics of Benford's Law as well as its history, applications and an overview of its proof.

4:42-4:57

BALANCING THE BALANCE
Tammy Bastion
St. Norbert College

Let n be a positive integer. Using a balance scale and masses of known weights, you want to be able to weigh an object of weight 1, 2, 3, …, n. What is the minimum number m of known masses , and what are their weights, that will allow you to do this?

PME Session #3

Willsboro Room (Burlington Sheraton Hotel)

3:00 P.M. – 4:35 P.M.

3:00-3:15

RECURSIVE METHOD FOR SOLVING THE MANY-BODY QUANTUM PROBLEM

Jonathan Moussa
Worcester Polytechnic Institute -- Massachusetts Alpha

The quantum many-body problem in the Born-Oppenheimer approximation is recast in a recursive form. The electrons are added into the system sequentially, where the n^{th} electron is solved in terms of a basis consisting of the $(n-1)$-electron and single electron wave functions. When compared to the configuration-interaction method, this method is computationally more favorable. Costly Slater determinants are not needed for anti-symmetrization, and the basis size needed to represent the same n-electron space is exponentially reduced. As an example, the energy eigenvalues of multiple electrons in a one-dimensional infinite square well are calculated.

3:20-3:35

KICKING THE SYSTEM: THE EFFECT OF 4:1 FORCING ON STABLE PULSE LENGTH

Ben Blaiszik
Elmhurst College – Illinois Iota

In systems that exhibit a bistability between a nonlinear (nonzero) state and the basic (zero) state, fronts can form connecting these two states. Furthermore, two fronts can bind to create a pulse. The Ginzburg-Landau equation is used as a mathematical model to investigate this behavior in travelling waves. A differential equation is obtained describing the length of a pulse, and a phase line analysis is used to determine stability. Recent work by Crawford and Riecke has shown that periodically forcing the system at twice the natural frequency of the waves can result in stable pulses. We investigate the effect of additionally forcing the system at four times the natural frequency. We find that there is a critical value for the amplitude of the 4:1 forcing where the behavior of the stable pulse length changes.

3:40-3:55

DELAYED RESONANCE

Valerie Kunde
Aquinas College – Michigan Lambda

A second order differential equation build to display resonance in its solution can have a surprising solution curve: The amplitude decreases before it increases. In this talk we will explore why this happens and discuss the model interpretation which reflects this phenomenon.

4:00- 4:15

DYNAMICS OF POPULATION MODELING

Joel Lepak
Youngstown State University – Ohio Xi

Modeling populations using differential equations can in many cases accurately describe systems found in nature, such as species competing for resources, or species feeding off each other. Advantages and drawbacks of various modeling techniques will be discussed, as well as some important features found in population models.

4:20-4:35

NUMERICAL SOLUTIONS OF PDES

Robert Shuttleworth
Youngstown State University – Ohio Xi

Partial differential equations are a valuable tool for modeling many physical problems in today's changing world. However many PDEs cannot be easily solved analytically. One remedy is to use finite difference methods to approximate the solutions. The Forward, Backward, and Central Difference Methods provide means for approximation, but with either poor orders of convergence or horrendous stability concerns. The Crank Nicholson Method is one method with a good rate of convergence but without concerns relating to stability. With this in mind, the Crank Nicholson was expanded to cover solutions of two-dimensional PDEs. One application is to provide insight into solutions of the Black-Scholes Equation, which is used to price options in the financial world.

MAA Session #4

Shelburne Room (Burlington Sheraton Hotel) 3:00 P.M. – 4:57 P.M.

All speakers in this session are from REU Programs: the 1st speaker a student of Professor Jody Sorenson at Grand Valley State University, speakers 2 – 4 of Professor Warren Weckesser at Cornell, speaker 5 of Professors Donal O'Shea & Alan Durfee at Mt. Holyoke, and speakers 6 - 7 of Professors Joel Foisy and Laura Person, respectively, at SUNY Potsdam.

3:00-3:15

BIFURCATIONS IN ONE-DIMENSIONAL DYNAMICAL SYSTEMS

Jonathan Armel

Oberlin College

Dynamical systems is the study of the behavior of functions under iteration. We discuss the dynamics of families of one-dimensional functions with a single parameter. While there are only two generic types of changes (called bifurcations), many atypical (non-generic) bifurcations can also occur.

3:17-3:32

BIFURCATIONS OF THE FORCED VAN DER POL EQUATION

Chris Lipa

North Carolina State University

Chaos was first discovered in the forced van der Pol equation more than 50 years ago, but bifurcations in the full equation are still poorly understood. In this presentation we explore how the flow of the forced van der Pol equation changes as we change the forcing parameters.

3:34-3:49

ANALYSIS OF DYNAMICS IN SYSTEMS WITH MULTIPLE TIME SCALES

Sabyasachi Guharay

Princeton University

Studying the forced van der Pol equation led to one of the first discoveries of "chaos." We use the van der Pol equation to study the bifurcations that occur in dynamical systems with multiple time scales. We show both analytic and computational results.

3:51-4:06

EXAMINING BIFURCATIONS OF THE FORCED VAN DER POL EQUATION

Katherine A. Bold

University of Texas at Austin

The forced van der Pol equation models biological and physical systems. Slight changes in parameters lead to drastically different behavior of solutions. A small parameter in the system results in the phenomena of multiple time scales. We investigate dynamics and bifurcations of the singularly perturbed system.

4:08-4:23

RATIONAL POLYNOMIAL REPRESENTATIONS OF KNOTS

Craig Philips

Rutgers University

It can be shown that any knot can be parameterized using polynomial functions. We have explored methods of transforming these parameterizations into rational parameterizations and the behavior of the representations thus obtained.

4:25-4:40

THREE COMPONENT LINKING IN EMBEDDED GRAPHS

Garry Bowlin

Clarkson University

A 3 component link is a union of 3 circles embedded in $\mathbf{R}^3$. If none of these components can be isolated in a sphere, then they are said to be non-split. This talk conveys the idea of creating three component links out of disjoint cycles such that in any spatial embedding of a graph, a non-split 3 component link will be formed.

4:42-4:57

ON WHEN COLORINGS OF KNOTS AND LINKS NECESSITATE MANY COLORS

Jodi Denino[1], Michael Dunne[1], Brandy Guntel[2], and Lisa M. Smith[3]

[1]SUNY Potsdam, [2]Indiana University, [3]Clarkson University

Lou Kauffman has conjectured that given a reduced alternating knot or link diagram K with the determinant of K a prime number p, any coloring of the diagram K from $\mathbf{Z}_p$ will have exactly as many colors as there are crossings in the diagram. We prove a connection between the colors used in an alternating diagram K and the determinant of K for a certain class of alternating diagrams. Our result implies Kaufman's Conjecture for this class of alternating diagrams.

PME Session #4

Meeting Room 12 (Burlington Sheraton Hotel)

3:00 P.M. – 4:35 P.M.

3:00-3:15

DRIVING MIS-CODING

Amanda Milby
Southwestern University – Texas Pi

I will discuss different methods of assigning driver's license numbers, including the use of computer sequential numbers, error-detecting check digits, the encoding of personal information, and hypothetical repercussions of 9/11.

3:20-3:35

ERROR-CORRECTING CODES AND ABSTRACT ALGEBRA

Philip Busse
St. Norbert College – Wisconsin Delta

There is a surprisingly large amount of abstract algebra involved with the theory of error-correcting codes for the transmission of binary data. We will present an elementary introduction to error-detecting and error-correcting codes, emphasizing the algebraic aspects. We will then extend the results to study of the transmission of ternary data.

3:40-3:55

A HAMMING CODE BY ANY OTHER NAME…

Casey Douglas
Southwestern University – Texas Pi

Which permutations of a Hamming (8,4) codeword will constitute a valid hamming code under another scheme?

4:00-4:15

NEW PRIMALITY TESTING

Christian Jason Maier
Alfred University

For very small numbers *N*, it is easy to determine whether *N* is prime or composite. The task becomes more difficult as *N* increases, and mathematicians use computers to implement tests of compositeness which may be based on one of several different mathematical concepts. With all such tests, however, there is the unfortunate possibility of finding a pseudo-prime, or a composite number that acts like a prime. It has been my goal to provide an algorithm that returns fewer pseudo-primes, by implementing primality tests based on two different mathematical concepts. My presentation will discuss the latest outcomes of my research.

4:20-4:35

UNIFORMLY SWEEPING OUT FOR MEASURE PRESERVING GROUP ACTIONS

Brian Street
University of Virginia – Virginia Kappa

Many properties in ergodic theory are equivalent to what subsets of the group "sweep out", that is, the subset acting on any set of positive measure is the whole space. We present some of the properties that follow if this sweeping out happens uniformly in the size of the subset.

MAA Session #5

Kingsland Room (Burlington Sheraton Hotel) **1:00 P.M. – 2:57 P.M.**

The first three speakers and fifth speaker in this session are students of Professors Edward Aboufadel, Steven Schlicker, William Dickinson, and Clark Wells, respectively, in the REU Program at Grand Valley State University.

1:00-1:15

APPLYING WAVELETS TO STEGANOGRAPHY

Lisa Driskell, Central Michigan University

Wavelet – based steganography is the embedding of coded messages into the insignificant wavelet coefficients of a decomposed or transformed signal or image. The signal or image is then recomposed and becomes a stego-object. We will demonstrate wavelet-based steganography with univariate and bivariate wavelets.

1:17-1:32

THE GEOMETRY OF $\mathbf{H}(\mathbf{R}^n)$

Audrey L. Powers, Agnes Scott College

In this talk we discuss the geometry of the space whose points are the nonempty compact subsets of $\mathbf{R}^n$. Among the geometric concepts we will discuss in this space are parallel and intersecting lines and the characterization of circles and disks.

1:34-1:49

SPHERICAL TRIANGLE THEOREMS

Ryan M. Koesterer, Grand Valley State University

Spherical geometry and Euclidean geometry differ in many respects. In particular, there are 11 classes of "triangles" on the sphere. We will present a classification of the different types of "triangles" and discuss how the traditional triangle theorems from Euclidean geometry (SAS, ASA, etc) extend to spherical geometry.

1:51-2:06

LINEAR PROGRAMMING

Joseph Dethrow, Southern Illinois University Edwardsville

Linear programming is a multifaceted subtopic of optimization theory. In this field, we view an objective function subject to a system of constraints. We will discuss three methods of solution for a Linear Program: the Geometric Method, the Algebraic Method, and the Simplex Tableau Method.

2:08-2:23

ON ROTATIONS IN 3-SPACE

Noah Delong, Taylor University, **& Emily Fagerstrom,** Willamette University

Inspired by a chemistry animation program, we examined 3 x 3 rotation matrices, specifically, the rotation matrix $R = \lim_{n\to\infty}(R_z(\gamma/n)R_y(\beta/n)R_x(\alpha/n))^n$ where $R_\omega(\theta)$ is a rotation of θ about the ω–axis. This rotation has a surprisingly simple form and interesting properties, and we investigate what underlying structure could be responsible for them.

2:25-2:40

HOW FEW RADII?

Irma Servatius, Worcester Polytechnic Institute

The wedge obtained from a quarter circle by cutting off the isosceles right triangle is filled with circles, tangent to the chord, the original circle, and the other adjacent circles. Their radii are compared to the circles inscribed in the subdivided isosceles right triangle. A geometric gem emerges.

2:42-2:57

CARRY FUNCTIONS

Grant Clifford, UC Santa Cruz, **& Michael Tsiang**, Harvey Mudd College

Let H be a group and f a map from $H \times H$ into the integers **Z**. If f satisfies $f(a, b) + f(ab, c) = f(a, bc) + f(b, c)$ we call it a carry function. Carry functions can be used in forming group extensions by cyclic groups. We conjecture that if β and h are elements of H that commute then $f(\beta, h) = f(h, \beta)$. We will show conditions under which this is true.

Note: This presentation is the result of work at the Clarkson-Potsdam REU with Lorne Fairbarn, SUNY Potsdam under the direction of Dr. Blair Madore, SUNY Potsdam.

PME Session #5

Willsboro Room (Burlington Sheraton Hotel) **1:00 P.M. – 2:55 P.M.**

1:00-1:15

TOPOLOGICAL GRAPH THEORY
Catharine Wright
University of Maine – Maine Alpha

Kasimir Kuratowski presented a proof of the sufficient and necessary conditions for planarity of a graph. In this paper, I discuss the general concepts that Kuratowski used and compare them to more modern proofs of his theorem. In particular, I look at proofs by Carsten Thomassen, Yury Markarychev and Frank Bernhart. I also briefly address applications of the theorem.

1:20-1:35

MAXIMUM CHROMATIC STATUS OF A GRAPH
Elizabeth Donovan
Worcester Polytechnic Institute – Massachusetts Alpha

The maximum chromatic status of a graph G is the maximum attainable sum of all the distances between vertices of distinct colors over all possible colorings of G. We compute this parameter for various families of graphs, and obtain bounds for more general results.

1:40-1:55

A LOOK AT TRIANGLES WITH GRAFFITI.PC
Kelly Wroblewski
University of Houston – Downtown – Texas Nu

This presentation includes the resolution of some conjectures of Graffiti.pc, a program written by Emmelinda DeLaVina. The conjectures are bounds on the graph invariant, *number of triangles*. Results of this research are related to a problem addressed by Robert Cowen and William Emerson in their paper, "On Finding k_4 ($k_{3 \leq x}$)".

2:00-2:15

GRAPHS THAT COUNT: GENERALIZED CATALAN NUMBERS
Anupam Bhatnagar and Borislav Mezhericher
Queen's College – New York Alpha Alpha

In this talk we show how graph theoretical techniques can be effectively employed to obtain a closed form for the generating function of the Catalan numbers. We generalize this approach to obtain formulae for higher dimensional Catalan numbers; in particular, we explore graphs related to three-dimensional Catalan numbers..

2:20-2:35

ILLI-TANTRIX: NEW WAYS OF LOOKING AT KNOTS
Yana Malysheva
University of Illinois – Illinois Alpha

This real-time interactive computer visualization of the tangent indicatrix of a knot animates the work of Colin Adams on counting the number of crossings in continuously varying knot-projections.

This project is represents joint work with Amit Chatwani, Princeton University. The software was written in OpenGL and Java at the illiMath2002 NSF-VIGRE supported REU at the University of Illinois, under the leadership of Professor George Francis.

2:40-2:55

INTRINSICALLY CHIRAL GRAPHS
Eman Kunz and Quincy Loney
SUNY Potsdam – New York Phi

A graph is said to be intrinsically chiral if every tame spatial embedding of the graph cannot be deformed onto its mirror image. This talk will include an introduction to some known results about intrinsically chiral graphs and a discussion of some open problems and new results concerning the intrinsic chirality of graphs in the generalized Petersen family.

This paper represents joint work with Garry Bowlin of Clarkson University.

MAA Session #6

Shelburne Room (Burlington Sheraton Hotel) **1:00 P.M. – 2:57 P.M.**

1:00-1:15

THE SUPPORT OF A PROBABILITY DENSITY FUNCTION

Andrew Boettcher
Augustana College

We consider probability density functions of one real variable with support contained in an interval. We show how the endpoints of the interval can be found by looking at the behavior of (natural log of) the corresponding moment-generating function in the large.

1:17-1:32

PHILOSOPHICAL CONSIDERATIONS OF INFINITY

Nate Marchese
Augustana College

A short history of the idea of infinity will be presented. The quasi-empirical nature of mathematics raises questions in the philosophy of mathematics, in particular about infinity. Metaphysics is particularly relevant to issues of certainty in mathematics.

1:34-1:49

A POSTER FOR S_4

Kathleen Reif
Augustana College

A poster for the symmetric group on 4 elements, which has order 24, will be presented. The poster includes the conjugacy classes of S_4 and the lattice of the subgroups of S_4 with conjugate subgroups noted.

1:51-2:06

AN INFINITE CLASS OF GENEALOGY GRAPHS

Susan Struck
Augustana College

We consider family trees where parents have two children, one male and one female. After several generations, we ask if it is possible that each descendant in the last generation is equally related to each person in the starting generation. We answer by giving an infinite class of such trees.

2:08-2:23

MEASURING ECONOMIC INEQUALITY

Michael Sula
Augustana College

Economists use many different functions to assess inequality in the distribution of wealth, including the coefficient of variation, the interquartile range coefficient, and a one parameter family known as Atkinson's index. We will present, compare, and contrast these.

2:25-2:40

MODELING GENETIC ERROR CORRECTION ON THE MOLECULAR LEVEL

Daniel P. Morris
Southwestern University

An algorithmic approach to detecting and correcting errors affecting the central dogma of genetics: transcription, translation, and replication.

2:42-2:57

UNORDERED MASTERMIND

Scott Nickleach
Slippery Rock University

Following a brief overview of the original game of deductive reasoning, we consider a variation: In the original, code-breakers determine a code that involves four colors where order is considered, while in this variation, only the group of colors need be determined. We conclude with a comparison of strategies for each game.

PME Session #6

Meeting Room 12 (Burlington Sheraton Hotel) **1:00 P.M. – 2:35 P.M.**

1:00-1:15 THE MATHEMATICS OF SOCCER

David Gohlke
Youngstown State University – Ohio Xi

The purpose of my presentation is to analyze certain aspects of soccer. I will use geometry to calculate the relative difficulty of different shots. I will also plot a graph of level curves in order to graphically explain my results. I will then use these results to show how to defend against the shots.

1:20-1:35 GOD KNOWS MARKOV

John Angelis
Youngstown State University – Ohio Xi

Bible Quiz is a competition similar to Jeopardy or Prep Bowl where teams of quizzers compete against each other. A quizzer must exit the match after getting a certain number of questions correct or incorrect. Therefore they must estimate the amount of risk they are willing to accept to answer a given question. In this talk I will propose several strategies that yield optimal results under this uncertainty.

1:40-1:55 THE ASSUMPTIONS AND STRATEGIES OF REPEATED GAMES

Teresa Selee
Youngstown State University – Ohio Xi

Economists assume that companies playing an infinitely repeated game will hold payoffs constant for the length of the game. Unfortunately, these payoffs are what determine how players act. The validity of this assumption will be examined using various strategies and applications from game-theoretical concepts in order to determine if companies are making the right decisions.

2:00-2:15 GAME STRATEGY DEVELOPMENT

Brian Wyman
University of Richmond – Virginia Alpha

From the time that we are children, we are taught to develop strategies that will optimize our performance in sports and games. Similarly, as mathematicians, we must develop techniques that allow us to attack problems in game theory. Our project develops both computational and analytical methods to devise game strategies for a game of sticks, and we examine the implications and possible further applications of our findings.

2:20-2:35 CAN REDUCING THE LOSERS' PENALTY RETRENCH ESCALATING BEHAVIOR IN THE DOLLAR AUCTION?

Tricia Hemmesch
College of St. Benedict – Minnesota Delta

The Dollar Auction has been studied to model escalating social interaction. The players bid for the same prize and have equal and fixed bankrolls. The highest bidder wins the prize minus the bid, while the other players pay their highest bid to the auctioneer and receive nothing. O'Neill's Theorem (1986) suggests optimal strategies for rational play under an added assumption called the conservative convention. Suppose the dollar auction is altered so that the losers pay instead $1/p$ of their highest bid, where p is a positive integer. The idea of the proof of O'Neill's Theorem then needs to be modified. This talk will describe the series and patterns resulting from the losers' penalty modification. In particular, I will show that as p approaches infinity, the importance of the players' bankrolls is minimized.

MAA Session #7

Kingsland Room (Burlington Sheraton Hotel) **3:00 P.M. – 5:15 P.M.**

The last three speakers in this session are students of Prof. Margaret Robinson in the REU Program at Mt. Holyoke College.

3:00-3:15

THE TOWER OF POWERS

James Zou, Ohio State University

Let k, a_1, a_2, a_3, ... be arbitrary positive integers. We prove that the sequence of infinite towers of exponents modulo k, $\{(a_1 n)^{(a_2 n)^{(a_3 n)^{\cdots}}} \pmod k \mid n = 1,2,3,\ldots\}$ is eventually periodic and we determine its minimal period $L(k, a_1, a_2, \ldots)$. We also investigate what values this sequence takes on and how often they appear.

3:17-3:32

GIVE ME A BOOST: UPS & DOWNS IN LEARNING MONOTONIC BOOLEAN FUNCTIONS

Amy C. Ulinski, Duquesne University

Can monotone Boolean functions be approximately learned using uniformly distributed random examples? We apply Fourier analysis to develop a heuristic learning algorithm that exploits interesting properties of this function class. Empirical testing of this algorithm has led to further insight into monotone Boolean functions and finding their approximations.

3:34-3:49

THINNING OUT DIVERGENT SERIES

Elisa Golfinopoulos and **Ryan McCarthy**, Hamilton College

If the harmonic series is divided into two parts, one containing all terms with a 9 in the denominator and one with all terms that do not have a 9, then the first sub-series converges and the second diverges (Kempner, 1914). We will generalize this thinning process to divergent series.

3:51-4:06

ON A CLASS OF THUE-MORSE TYPE SEQUENCES

Ricardo Astudillo, University of Illinois at Urbana-Champaign

We study a class of binary sequences defined in terms of digital expansions, which generalize the famous Thue – Morse sequence. In particular, we investigate the occurrences of arbitrarily long palindromes in these sequences, and we generalize a recent result of Allouche and Shallit in this connection.

4:08-4:23

ASSOCIATED PRIMES OF MONOMIAL IDEALS

Katherine Pavelek, Gustavus Adolphus College

We will expand previous results regarding associated primes of powers of ideals generated by square free monomials of degree two. Such ideals can be represented as edge ideals of graphs. We will examine the two classes of monomial ideal; those generated in degree two and path ideals of graphs.

4:25-4:40

GENERALIZED EXPONENTIAL SUMS AND IGUSA LOCAL ZETA FUNCTIONS

Thomas Wright, Bowdoin College

For any polynomial in n variables with coefficients in Z_p (the p-adic integers), we define the Igusa Local Zeta function (ILZF) as $Z(\theta) = \int_{Z_p} | f(x_1 x_2 \ldots x_n)_p^{\theta} | dx_1 dx_2 .. dx_n$ (for Re (θ) >2), while Weil's function is $F^*(i^*) = \int_{Z_p} \psi(i^* f(x_1 x_2 \ldots x_n)) dx_1 dx_2 .. dx_n$.
In my talk, we will explore the link between these two functions.

4:42-4:57

NEWTON POLYHEDRA AND THE IGUSA LOCAL ZETA FUNCTION

Annalee Wiswell, Scripps College

In certain cases we can calculate the Igusa Local Zeta Function $Z_f(s)$ associated to a polynomial f in several variables over the p-adic numbers by studying the Newton Polyhedron $\Gamma(f)$ of the polynomial. We introduce $Z_f(s)$ and $\Gamma(f)$, and study the poles of $Z_f(s)$ and their orders.

5:00-5:15

NATURAL BOUNDARIES OF IGUSA LOCAL ZETA FUNCTIONS

John Gonzalez, Massachusetts Institute of Technology

The Igusa Local Zeta Function (ILZF) of a polynomial $f \in Z_p[x_1, \ldots, x_n]$ is $Z(s) = \int_{Z_p^n} | f(\vec{x})_p^s | dx_1 \ldots dx_n$ and is defined for Re(s)>0.
Igusa showed that these are rational functions of p^{-s}. For certain polynomials, we form an Euler product of ILZF and discuss its natural boundary.

PME Session #7

Willsboro Room (Burlington Sheraton Hotel) **3:00 P.M. – 4:35 P.M.**

3:00-3:15 ANALYSIS OF SHOCKS IN GRANULAR MATERIAL FLOWS

Nathan A. Lewallen
North Carolina State University – North Carolina Gamma

I will discuss properties of conservation equations describing the flows of granular materials. One of these properties, having important consequences for the deformation of materials, is the formation of shock waves. The talk will cover both mathematical analysis and scientific computation in understanding shock waves arising from granular material flows.

3:20-3:35 RECIPROCITY GAP AND GENERAL LINEAR "CRACK" IDENTIFICATION

F. Ronald Ogborne
SUNY Fredonia – New York Pi

Andrieux and Ben Abda detail a method for identifying the position of a linear "crack" in the steady-state case of a 2-D object when the crack completely blocks the flow of heat. In this talk, we extend their theory to cover more general linear cracks. We will also explore methods for recovering information about the temperature jump across the crack and the function that governs the heat flow across the crack in a non-destructive manner.

This research is being conducted as part of an NSF-sponsored REU program at Rose-Hulman Institute of Technology under the supervision of Professor Kurt Bryan.

3:40-3:55 MODELING TRICHOLORETHYLENE

Lara Stroud
Meredith College – North Carolina Mu

Tricholorethylene (TCE) is a lipophilic, nonflammable, colorless liquid used mostly by factories as a solvent to remove grease from metal parts. Inhaled TCE is broken down by the body into other toxic chemicals. This presentation will describe a physiologically based pharmacokinetic model (PBPK) for the inhalation and exhalation of TCE in laboratory rats using a system of ordinary differential equations. The model has been used to simulate a variety of exposure scenarios.

4:00-4:15 THE MATHEMATICAL PROPERTIES AND UNDERLYING STRUCTURE OF FAST-SPIKING CELL AND NETWORKED CELL MODELS

Carrie Diaz Eaton
University of Maine – Maine Alpha

Fast-spiking (FS) interneurons are inhibitory neurons found in the somatosensory cortex. FS cell networks exhibit highly rhythmic activity. We will investigate an FS cell model inspired by Erisir, et al. (1999), analyze the underlying structure of the model and the behavior of networked models, and discuss the biological interpretations.

4:20-4:35 A NUMERICAL STUDY OF THE BETA INSULIN GLUCOSE MODEL OF DIABETES

Joseph Boley
University of Houston – Downtown – Texas Nu

Mathematical models have been developed to describe the dynamics of the factors contributing to diabetes, and from this, deduce a pathway to the disease. Diabetes is characterized by abnormal beta-cell mass, reduced insulin secretion, and a reduced effectiveness of insulin. The Beta Insulin Glucose (BetaIG) model, a system of non-linear ordinary differential equations, was developed by Topp et al. in 2000 to couple established methods of modeling insulin and glucose dynamics with beta-cell mass dynamics. We have studied the behavior of the BetaIG system given specific initial values for beta-cell mass, blood insulin concentrations, and blood glucose concentrations. One result of our study was the demonstration of the convergent point found by Topp et al. This study was directed by Dr. Bin Hu, Keio University, Japan, and Dr. Chenyi Hu, University of Houston-Downtown.

MAA Session #8

Shelburne Room (Burlington Sheraton Hotel) 3:00 P.M. – 5:15 P.M.
The first four speakers in this session are students of Professor Gary Lawlor and the second four of Professor Janine Wittwer in the REU Program at Williams College.

3:00-3:15 THE STEINER PROBLEM ON A SEMICIRCLE AND A HIGHWAY
Mark Burkhardt
Williams College

We will discuss the cheapest way to connect towns on a semicircle to a highway through its endpoints.

3:17-3:32 MINIMAL SPANNING TREES AND THE STEINER PROBLEM
Aaron Magid
Williams College

For a finite set of points in a plane, finding the minimal spanning tree is usually a much easier task than finding the Steiner minimal network. We'll explore some properties of minimal spanning trees for points on a circle and other conics.

3:34-3:49 STEINER PROBLEM I
Joseph Rabinoff
Harvard University

We will discuss an algebraic approach to the Steiner problem.

3:51-4:06 STEINER PROBLEM II
Neil Hoffman
Williams College

We will discuss conic sections and the Steiner problem.

4:08-4:23 4-ADIC SQUARE FUNCTIONS
Edvard Major
Williams College

I will talk about a square function of a Daubechies-4 wavelet and a square function of a 4-adic analog to the dyadic Haar function.

4:25-4:40 A FUNCTION CALLED "SQUARE"
Phillipa Charters
Williams College

A generalization of the useful Square Function to n-adic intervals

4:42-4:57 SQUARE FUNCTIONS AND WEIGHTS ON VARIOUS INTERVALS
Lisa DeKevkelaere
Colby College

What happens when some intervals are more important than others? The use of weights is a way to alter the significance of certain pieces of an interval. Here we will discuss the use of weights in relation to the square function on different intervals.

5:00-5:15 THE N-ADIC SQUARE FUNCTION
Anna Elisabeth Todd
Missouri Baptist

We will discuss some thoughts on extending the square function operator to the new and exciting world of n-adic intervals.

PME Session #8

Meeting Room 12 (Burlington Sheraton Hotel)

3:00 P.M. – 4:35 P.M.

3:00-3:15

A SMART MEASUREBOT

Fei Sun

Moravian College – Pennsylvania Omicron

A robot starts from a random spot and travels around the room. It goes straight forward, bumps on the walls, makes turns, and goes on. By recording the distances it has covered and the turns it has made, the robot is eventually able to measure the areas of the room and display the number on its LCD screen. The robot is capable of measuring a room of rectangular shape or any polygon surrounded by walls. The measurebot is build with Lego Mindstorms RIS 2.0.

3:20-3:35

CENTROIDS ARE CENTRAL

Amanda Szymanski

Aquinas College – Michigan Lambda

When a suitable region in the first quadrant is rotated around the y-axis, the generated solid has a volume that can be found using various methods. Suppose we wanted to find α such that the same region rotated around $x = \alpha$ gives the same volume or some multiple of that volume. When we solve the problem using the usual solid of revolution formulas, we recover the definition of the centroid of the region. This causes us to recall Pappus' Theorem for such volumes and we find the easiest way to solve problems of this type.

3:40-3:55

THE INDETERMINATE CASE [0/0] – A CLOSER LOOK

Hai He

Hunter College – New York Beta

The indeterminate case [0/0] can be unpredictable since it depends on the functions in the numerator and the denominator. We will examine how to deal with problems of this sort when they get more complicated, i.e., those where you cannot use L'Hospital's Rule.

4:00-4:15

LAW OF COSINES IN N-DIMENSIONS

Mehrdad Khosravi

University of Central Florida – Florida Alpha Mu

I will start with the basic geometric ideas of vectors and angles in two dimensions. Then I will introduce some concepts and tools that can be of use in higher dimensional spaces. One of these tools is the idea of the wedge product, which is simply a generalization of the cross product. For a group of vectors in N-dimensional space, the wedge product generates results "similar" to those of the cross product applied to vectors in a two- or three-dimensional space. I will then introduce a law of cosines for N-simplices, using the concept of oriented volume.

4:20-4:35

MONTE CARLO INTEGRATION

Nicole J. Munden

Southern Illinois University at Edwardsville – Illinois Zeta

Monte Carlo integration is used to approximate the area under a curve by two methods. Corresponding variances are found, so the relative efficiency, which shows one method can be more efficient as an approximation to the area under the function being evaluated, can be established.

MAA Student Lectures

2002	Colin Adams	*"Blown Away: What Knot to do When Sailing" by Sir Randolph "Skipper" Bacon III*
2002	M. Elisabeth Pate-Cornell	*Finding and Fixing Systems' Weaknesses: The Art and Science of Engineering Risk Analysis*
2001	Rhonda Htcher	*Ranking College Football Teams*
2001	Ralph Keeney	*Building and Using Mathematical Models to Guide Decision Making*
2000	Michael O'Fallon	*Attributable Risk Estimation: A Tale of Mathematical/Statistical Modeling*
2000	Thomas Banchoff	*Interactive Geometry on the Internet*
1999	Edward G. Dunne	*Pianos and Continued Fractions*
1999	Dan Kalman	*A Square Pie for the Simpsons and Other Mathematical Diversions*
1998	Ross Honsberger	*Some Mathematical Morsels*
1998	Roger Howe	*Some New and Old Results in Euclidean Geometry*
1997	Aparna Higgins	*Demonic Graphs and Undergraduate Research*
1997	Edward Schaefer	*When is an Integer the Product of Two and Three Consecutive Integers?*
1996	Kenneth Ross	*The Mathematics of Card Shuffling*
1996	Richard Tapia	*Mathematics Education and National Concerns*
1995	David Bressoud	*Cauchy, Abel, Dirichlet and the Birth of Real Analysis*
1995	William Dunham	*Newton's (Original) Method - or - Though This Be Method, Yet There is Madness*
1994	Gail Nelson	*What is Really in the Cantor Set?*
1994	Brent Morris	*Magic Tricks, Card Shuffling and Dynamic Computer Memories*
1993	Richard Guy	*The Unity of Combinatorics*
1993	Joseph Gallian	*Touring a Torus*
1992	Peter Hilton	*Another Look at Fibonacci and Lucas Numbers*
1992	Caroline Mahoney	*Contemporary Problems in Graph Theory*
1991	Lester Lange	*Desirable Scientific Habits of Mind Learned from George Polya*

J. Suthlerland Frame Lectures

2002	Frank Morgan	*Soap Bubbles: Open Problems*
2001	Thomas F. Banchoff	*Twice as Old, Again, and Other Found Problems*
2000	John H. Ewing	*The Mathematics of Computers*
1999	V. Frederick Rickey	*The Creation of the Calculus: Who, What, When, Where, Why*
1998	Joseph A. Gallian	*Breaking Drivers' License Codes*
1997	Philip D. Straffin, Jr.	*Excursions in the Geometry of Voting*
1996	J. Kevin Colligan	*Webs, Sieves and Money*
1995	Marjorie Senechal	*Tilings as Differential Gratings*
1994	Colin Adams	*Cheating Your Way to the Knot Merit Badge*
1993	George Andrews	*Ramanujan for Students*
1992	Underwood Dudley	*Angle Trisectors*
1991	Henry Pollack	*Some Mathematics of Baseball*
1990	Ronald L. Graham	*Combinatorics and Computers*
1989	Jean Cronin Scanlon	*Entrainment of Frequency*
1988	Doris Schattschneider	*You Too Can Tile the Conway Way*
1987	Clayton W. Dodge	*Reflections of a Problems Editor*
1986	Paul Halmos	*Problems I Cannot Solve*
1985	Ernst Snapper	*The Philosophy of Mathematics*
1984	John L. Kelley	*The Concept of Plane Area*
1983	Henry Alder	*How to Discover and Prove Theorems*
1982	Israel Halperin	*The Changing Face of Mathematics*
1981	E. P. Miles, Jr.	*The Beauties of Mathematics*
1980	Richard P. Askey	*Ramanujan and Some Extensions of the Gamma and Beta Functions*
1979	H. Jerome Keisler	*Infinitesimals: Where They Come From and What They Can Do*
1978	Herbert E. Robbins	*The Statistics of Incidents and Accidents*
1977	Ivan Niven	*Techniques of Solving Extremal Problems*
1976	H. S. M. Coxeter	*The Pappus Configuration and Its Groups*
1975	J. Sutherland Frame	*Matrix Functions: A Powerful Tool*