

**DEPARTMENT OF MATHEMATICS**  
**Annual Report to the Board of Trustees of**  
**Rose-Hulman Institute of Technology**  
**1 June 02 - 31 May 2003**

1. Department Overview
2. Personnel Changes
3. Student and Alumni Highlights
4. Faculty and Staff Activities
  - a. Teaching, Curriculum Development, and Student Advising
  - b. Professional Development
  - c. Professional Service
  - d. Faculty Honors and Awards
  - e. Membership in Faculty Clusters
5. Grants and Continuing Grant Activities
6. Departmental Programs

## **1. Department Overview**

This was a very successful year for the department. In addition to very successful teaching, professional development and service programs on the part of the faculty here are some high points:

- Successful at hiring a statistician
- Successful implementation of curriculum review program
- 50% of incoming freshman have advanced math placements, Fast track calculus is over 10% of the freshman class
- the number of math majors, double majors and minors shows continuing growth

## **2. Personnel Changes**

- Dr. Mark Inlow was hired as an Assistant Professor in the area of statistics.
- Robert Lopez is retiring after 18 years as a professor in the Math Department. Will be Joining the Staff of Waterloo Maple Software (unsolicited offer)
- David Rader was granted tenure and promoted to Associate Professor.
- Gary Sherman was on sabbatical leave during the spring quarter to write a monograph on cwatsets for publication by the MAA or AMS
- Visiting Assistant Professor Aleksey Telyakovskiy was welcomed into the department for this school year.
- Systems Administrator Mike McLeish was a welcome addition to the Math and Computer Science Departments

### 3. Student and Alumni Highlights

**Pi Mu Epsilon Honorary Mathematics Fraternity** Thirty eight new members of the Rose-Hulman student body were inducted at the spring 2003 Initiation Banquet for the Indiana Gamma Chapter of Pi Mu Epsilon. The speaker was John Andersen, a 1978 Rose graduate who is employed by Eli Lilly as a statistician.

#### Mathematics Competitions

**1. 14th annual Alfred R. Schmidt Freshman Mathematics Competition** (advisor John Rickert) Twenty-six freshmen took part in the Thirteenth Annual ARS Competition. First place was awarded to **David Chambers**, 2<sup>nd</sup> place was awarded to **Stephen Galler and Stephen Schnelle**, and 3<sup>rd</sup> place was awarded to **James Baxter**.

**2. 24th Annual Virginia Tech Regional Mathematics Competition** (Advisor John Rickert) Sixteen Rose-Hulman students participated in this nation-wide mathematics problem solving competition held November 2002.

**3. 63rd Annual Putnam Competition** (Advisors Kurt Bryan and John Rickert) In the 63rd Annual William Lowell Putnam Mathematical Competition students **Michael Ewing, Logan Harper and Aaron Dubin** ranked in the top 500 out of 3,349 contestants. The team of **Michael Ewing, Guy Srinivasan and Kellan Wampler** was 43<sup>rd</sup> from the 476 colleges and universities represented.

**4. 19th Mathematical Contest in Modeling** (Advisor David Rader) Three teams from Rose-Hulman spent four days in February competing in this annual international modeling contest. The team of **Michael Ewing, Nick Trainor and Jeremy Groven** received Meritorious Performance Certificates. The team of **Chris Scribner, Guy Srinivasan and E. Kellan Wampler**, and the team of **Brian Barker, James Howard and Ronald Stanis** both received Successful Participant Certificates.

**5. 38th Indiana College Mathematics Competition** (Advisor John Rickert) **John Beety, Jungmin Choi, Krishna Ersson, Michael Ewing, Shawn Hymel, Curtis Katinas, Ryan Poplin, Dustin Schwenk, Guy Srinivasan, Adam Thompson, Nic Trainor, Geoff Ullman and Kellan Wampler** represented Rose-Hulman at the 2003 ICMC held at Butler University in March 2003.

#### Student Presentations

**Noor Martin** presented *Factoring Integers via Lenstra's Elliptic Curve Method*, Matthew Ford presented *Elliptic Curve Cryptography*, and **Alla Genkina** presented *de Castel'jau's Algorithm in Hyperbolic Space* as part of the 2002-2003 Math Colloquium series.

Rose-Hulman student **Kellan Wampler** presented *War: the Vicious Cycle* at the 2003 Undergraduate Math Conference held March 21 and 22, 2003.

## Student Awards

During the Spring Honors and Awards Banquet, **Michael Ewing** received the Clarence P. Sousley Award, presented to a senior mathematics major for exceptional performance in mathematics.

Freshmen **Aaron Dubin** and **Stephen Schnelle** received the Theodore Paine Palmer Award for demonstrating excellence in mathematics during the freshman year.

During the same ceremony, The team of **Michael Ewing**, **Nick Trainor** and **Jeremy Groven** were recognized for their Meritorious Performance in the 19th Mathematical Contest in Modeling. Also **Michael Ewing**, **Logan Harper**, **Aaron Dubin**, **Guy Srinivasan** and **Kellan Wampler** were recognized for their performance on the 63rd Annual Putnam Competition.

## Summer Internships and REU's

**Brian Barker** – Rose-Hulman – Cwatsets research

**Nic Trainor** – Rose-Hulman – Inverse Problems

**Kellan Wampler** – University of Kentucky

**Guy Srinivasan** - National Security Agency

**Scott Mollan**, Ohio State - statistics and biostatistics

## 4. Faculty and Staff Activities

### 4.a Teaching, Curriculum Development and Student Advising

**Departmental Level:** The faculty were organized into four self selected interest groups according to the four concentration of the degree program. Each group made significant improvements in the concentration areas: The groups are:

- traditional mathematics concentration –convener Jerry Muir
- discrete applied mathematics – convener David Rader
- continuous applied mathematics – convener David Finn
- statistics – convener Diane Evans

In addition, the coordination of courses with multiple sections was greatly improved, with almost all faculties now taking on the informal leadership role of course coordination.

The department initiated some assessment activities to analyze and validate the appropriateness of the placement and persistence programs of the department (Advanced Placement- Allen Broughton, Diagnostic Test – John Rickert)

### Course Development

- Diane Evans - continued development and coordination of Statistics courses
- Jerry Muir - taught Functional Analysis course he developed for a second time  
Complex analysis course notes were well-received by students, and is currently refining them and using them in the course for a second time
- Yosi Shibberu - Hidden Markov models motivated by work at Rose-Hulman Ventures

### **Student Advising and Support**

- Freshman Advisors: Elton Graves, David Finn, Roger Lautzenheiser, Robert Lopez, John Rickert,
- Sophomore Advisor: Tanya Leise
- Junior Advisor: David Finn
- Senior Advisor: Yosi Shibberu
- Statistics advisor: Diane Evans
- Double majors and minors: Allen Broughton
- Pi Mu Epsilon Advisor: Elton Graves
- Math contests: See section 3 above
- Actuarial Advisor – Jeffery Leader
- Conducted independent study courses for two math majors in graduate-level analysis topics, as part of preparation for graduate school – Jerry Muir
- RHIT Martial Arts Club Advisor: Jeffery Leader

## **4.b Faculty and Staff Professional Development**

### **Publications, Articles, and Writing**

Kurt Bryan

- “A Review of Selected Works on Crack Identification”, to be published in IMA Volume 137: Geometric Methods in Inverse Problems and PDE Control

Stephan Carlson, Invited by the editorial staff of Encyclopedia Britannica to write articles for publication in their hardcopy, CD-ROM, and on-line editions. Articles include:

- the major article on “Topology” including an associated bibliography.
- a major article on “Graph Theory.”
- eight other shorter articles on various mathematical topics

Diane Evans,

- “Algorithms for determining the distribution of order statistics from discrete populations” , accepted with revisions
- The Distribution of the Kolmogorov-Smirnov Statistic for Exponential Populations with Estimated Parameters”, submitted
- “Algorithms for Computing the Distributions of Convolutions of Discrete Random Variables”, submitted

David Finn,

- “Can a bicycle create a unicycle track?” College Math Journal, Vol 33 (4) 283-292 September 2002
- “Which way did you say that bicycle went?” submitted to the Mathematics Magazine

Joshua Holden,

- “Abelian varieties over finite fields with a specified characteristic polynomial modulo  $l$ ”, Journal de The'orie des Nombres de Bordeaux, accepted.
- “First-hit analysis of algorithms for computing quadratic irregularity”, Mathematics of Computation, accepted.

- “Notes on an analogue of the Fontaine-Mazur conjecture”, with Jeffrey D. Achter. *Journal de The'orie des Nombres de Bordeaux*, accepted.
- “New Conjectures and Results for Small Cycles of the Discrete Logarithm”, with Pieter Moree., to appear in: *High Primes and Misdemeanours: lectures in honour of the 60th birthday of Hugh Cowrie Williams* (refereed proceedings), accepted.

Thomas Langley,

- “Alternate transition matrices for Brenti's q-symmetric functions with extensions to the hyperoctahedral group” conference paper International Conference on Formal Power Series and Algebraic Combinatorics, July 2002, University of Melbourne, Melbourne, Australia.
- “The plethysm of two Schur functions at hook and near-hook shapes” (joint with J. Remmel) accepted for publication in the *Electronic Journal of Combinatorics*.

Jeffery Leader,

- “Acceleration of Data Collection Times in Static Gravimetric experiments Using a Modified LDF Approximation”, with Atanas Serbezov and Manish Lodaya, a chemical engineering graduate student. Paper presented by Atanas Serbezov at the AIChE National Meeting
- Submitted manuscript for Numerical Analysis textbook to Addison-Wesley for publication (target date, 15 Oct. 2003)

Tanya L. Leise,

- Tanya Leise and Jay R. Walton, “A method for solving dynamically accelerating crack problems in linear viscoelasticity”, to appear in *SIAM J. Applied Math*.
- Tanya Leise and Andrew Cohen, *Not Just Twiddling Our Thumbs*, submitted to *College Math Journal*.

Jerry Muir,

- “Linear fractional transformation methods in  $C^n$ ” appeared in *Complex Variables Theory and Application*.
- “Convex mappings of the ball in  $C^n$  that are half-plane mappings in one coordinate”, submitted.

David, Rader,

- “Maximizing the product of two linear functions in 0-1 variables”, *Optimization*, V. 51 no. 3 (2002), pp. 511-537. Joint work with P.L. Hammer, P. Hansen, and P.M. Pardalos.
- “The quadratic 0-1 knapsack problem with series-parallel support”, *Operations Research Letters*, V. 30 (2002), no. 3, pp. 159-166. Joint work with G. Woeginger

Aleksey Telyakovskiy ,

- “Numerical aspects of compositional modeling in porous media”, submitted to *Advances in Water Resources*

## Mathematical Sciences Technical Report Series (MSTR)

- MSTR 02-03 Hyperbolic Billiard Paths: Rebecca Lehman, Chad White
- MSTR 02-07 Pigeon-Holing Monodromy Groups: Niles G. Johnson
- MSTR 02-08 The Galois Correspondence for Branched Covering Spaces and its Relationship to Hecke Algebras: Matt Ong,
- MSTR 02-09 Applications of Graph Theory to Separability, Steve Young
- MSTR 02-10 Characterizing a Defect in a One-Dimensional Bar: Cynthia Gangi and Sameer Shah
- MSTR 02-11 A Review of Selected Works on Crack Identification: Kurt Bryan & Michael S. Vogelius
- MSTR 02-12 Fixed Point and Two-cycles of the Discrete Logarithm: Joshua Holden
- MSTR 02-13 Tilings of Low-Genus Surfaces by Quadrilaterals: John Gregoire and Isabel Averill

### Presentations

Stephan Carlson,

- Session on “Professional Service” at the Project NExT – IN meeting during the Fall 2002 Indiana Section Meeting.

Diane Evans,

- “A Probability Programming Language (APPL) for Student Use in Probability Courses” Spring Indiana section meeting of the MAA
- Invited speaker at the Annual Meeting of the Asphalt Pavement Association of Indiana about Contractor Acceptance-Volumetrics. The talk was entitled “A Risk Analysis Assessment for Specification Development.” RHIT statistics major, John Stoner, also gave a talk.

David Finn,

- Poster Session on CCLI grant at AMS-MAA National Meeting Baltimore 2003,
- Member of Panel Discussing Laptops in the Classroom, Baltimore 2003.

Joshua Holden,

- “Fixed points and Two-cycles of the Discrete Logarithm”, Algorithmic Number Theory Symposium V, University of Sydney, Australia, July 9, 2002
- “Counting Fontaine-Mazur-like function fields”, AMS Special Session on Number Theory and Arithmetic Geometry, AMS Eastern Section Meeting, Northeastern University, \ October 5, 2002.
- “Modular Arithmetic and Trap Door Ciphers”, Mathematics and Computer Science Colloquium, Wabash College, March 27, 2003
- “New Conjectures and Results for Small Cycles of the Discrete”, Conference in Number Theory in Honour of Professor H.C. Williams, The Banff Centre, Banff, Alberta, Canada, May 26, 2003

Thomas Langley,

- “Guessing Secrets” at Wabash College mathematics colloquium (March 2003)
- “The Combinatorics of Symmetric Functions” at the Indiana MAA section meeting at Butler University (March 2003)
- “Alternate transition matrices for Brenti's  $q$ -symmetric functions with extensions to the hyperoctahedral group” International Conference on Formal Power Series and Algebraic Combinatorics, July 2002, University of Melbourne, Melbourne, Australia

Tanya Leise,

- “Not Just Twiddling Our Thumbs”, January 19, 2003, Mathematical Modeling In and Out of the Classroom Session at 2003 AMS/MAA Joint Meetings, Baltimore.
- “A Dynamically Accelerating Crack in a Linearly Viscoelastic Material”, October 14, 2002, 2002 Meeting of the Society of Engineering Science, Penn State University.

Robert Lopez,

- CAS-Based Exercises in Engineering Math, ASEE, Montreal, June, 2002,
- Technology-Based Advanced Engineering Mathematics, Maple Summer Workshop, Waterloo, Ontario, Canada, July, 2002
- Invited Address: Technology throughout the Engineering Math Curriculum, Ecole de Technologie Superieure, Montreal, Quebec, Canada, June, 2002

Jerry Muir,

- Convex mappings of the ball in  $C^n$  that are half-plane mappings in one coordinate” the AMS/MAA Joint Mathematics meetings in Baltimore in January.

Gary Sherman,

- MAA minicourse on cwatsets at the AMS-MAA Joint Meetings in Baltimore

Aleksey Telyakovskiy,

- “Approximate Solutions to the Boussinesq Equation”, invited colloquium speaker at Cornell University:
- “Approximate Solutions to the Boussinesq Equation” presented at the AMS/MAA Joint Mathematics meetings in Baltimore in January 2003
- “Thermodynamical Calculations in Compositional Reservoir Modeling” presented at SIAM – Geosciences Conference in Austin, TX, in March 2003

## **Rose Math Seminar**

Allen Broughton,

- “Kaleidoscopic Tilings on Surfaces, this Time with the Groups” (2 talks)
- “Vanishing Cycles and Kaleidoscopic Quadrilateral Tilings”

Kurt Bryan,

- “An Inverse Problem Arising In Non-destructive Testing for Cracks”
- “Homogenization: It's Not Just for Dairy Products”

Diane Evans,

- “The Distribution of the Kolmogorov-Smirnov Statistic for Exponential Populations with Estimated Parameters”

David Finn,

- “Prescribing the Curvature of Level Curves”

Jeffery Leader,

- “Automatic Differentiation of Algorithms“ (2 talks)

Thomas Langley,

- “The Combinatorics of Symmetric Functions”

Aleksey Telyakovskiy ,

- ”Approximate solutions to the Boussinesq equation”

### **Conferences and Workshops attended**

Steve Carlson and Thomas Langley attended MathFest 2002 in Burlington, Vermont, in the summer of 2002

Thomas Langley and Jeffery Leader attended the SIAM Conference on Discrete Mathematics in San Diego, August 2002

Allen Broughton and Diane Evans attended the National Joint Statistical Meetings in August 2002

Allen Broughton, Stephan Carlson, Thomas Langley and David Rader Fall 2002 Meeting of the Indiana Section of the MAA at Indiana University Northwest in Gary, Indiana

Allen Broughton, Kurt Bryan, Stephan Carlson, Elton Graves, Ralph Grimaldi, Thomas Langley, Tanya Leise and Aleksey Telyakovskiy attended the Joint Mathematics Meetings of the AMS and MAA in Baltimore, Maryland in January 2003

Allen Broughton, Stephan Carlson, Diane Evans, David Finn, Elton Graves, Josh Holden, Thomas Langley, Roger Lautzenhesiser, David Rader and John Rickert attended the Spring 2003 Meeting of the Indiana Section of the MAA at Butler University in Indianapolis, March 2003

Ralph Grimaldi attended the 34<sup>th</sup> S.E. Combinatorics Conference in Boca Raton in March 2003

David Finn and Josh Holden attended the AMS Sectional Meeting at IU in April 2003

### **Other professional development activities**

Allen Broughton - Supervised a group of four REU students. They successfully completed three papers on tiling problems on Riemann surfaces

Kurt Bryan - Continued work with Lester Caudill on inverse problems related to the thermal imaging. Supervised a group of four REU students who successfully completed two papers on Inverse problems related to nondestructive testing. Reviewed two papers for the Journal, “Inverse Problems in Engineering”.

Diane Evans - Completed a year long consulting project with the Asphalt Pavement Association and the Indiana Department of Transportation on contractor acceptance-volumetrics. Indiana will now be one of the first states developing and incorporating into pavement contracts our recommended acceptance specifications. A RHIT statistics major, John Stoner, also worked on this project.

Yosi Shibberu - worked with two Rose-Hulman students on writing a hidden Markov modeling software package for a Rose-Hulman Ventures client during summer of 2002

Jerry Muir - Continued joint research with Ted Suffridge at the University of Kentucky, including a two month summer visit to that university in the summer

Elton Graves: As a part of a national assessment project on the effectiveness of CAS in teaching mathematics:

- Attended two workshops on assessment for NSF project I'm working on
- Writing a paper on assessment of reform calculus funded by NSF
- Member of an assessment panel discussion at MAA National meeting in Baltimore
- Member MAA subcommittee on mathematics across the curriculum

Jeff Leader - Continued research in computational biology with undergraduates through a MA495 courses

Robert Lopez - Invited visitor to Waterloo Maple, the week of June 16, 2002

## **4.c Faculty and Staff Professional Service**

### **RHIT Committee Chairs**

- Admissions and Standing Committee – Elton Graves
- Academic Computing Committee – Robert Lopez
- Academic Software Committee – Allen Broughton
- Curriculum Committee – Allen Broughton
- Graduate Studies Committee – Jeffery Leader
- Honors and Awards – David Rader
- Parallel Computing – Allen Broughton

### **Other Professional Service**

Allen Broughton- Refereed papers for several journals

Stephan Carlson - In June 2002, completed three year term as Governor of the Indiana Section of the Mathematical Association of America (MAA). Served as member of the national MAA Committee on Sections through January of 2003. Serving as member and chair of the national MAA Committee on SIGMAAs (Special Interest Groups of the MAA Organized and chaired two meetings associated with the MAA Committee on SIGMAAs and attended the meeting of the MAA Committee on sections

Diane Evans - Reviewer for a new mathematical statistics and probability textbook.

David Finn - Reviewed Differential Equations and Linear Algebra Textbook for McGraw-Hill, Reviewed proposal for new calculus book for W.H. Freeman,  
- Continued Reviewing Papers for Math Reviews  
- Reviewed for "College Mathematics Journal"  
- MAA department Liaison

Elton Graves - Indiana State Director AMC 8,10,12

- Regional Director of MATHCOUNTS
- Organizer of State MATHCOUNTS competition

Josh Holden - Co-organizer, AMS Special Session on Cryptography and Computational and Algorithmic Number Theory, AMS Central Section Meeting, Indiana University, April 4--6, 2003

- Refereed papers for the Journal of Online Mathematics and its Applications, the Rose-Hulman Undergraduate Mathematics Journal and "The Internet Encyclopedia", Hossein Bidgoli, Editor-in-Chief, John Wiley and Sons, to appear.

Roger Lautzenheiser - Reviewer for several mathematics journal papers.

Tanya Leise - Co-organizer of MAA Contributed Paper Session on Mathematical Modeling in the Classroom, Baltimore 2003 with Brian Winkel (US Military Academy--West Point) and Amy Radunskaya (Pomona College).

Jerry Muir – reviewer for Mathematical Reviews.

David Rader - - Continued to serve as the Indiana MAA Public Information Officer.

Rickert- Served as a coach and organizer of the teams representing the state of Indiana at the American Regions Math League meet to be held in May, and web-master for the American Regions Mathematics League historical web site.

- Coordinator for weekly mathematical problem solving sessions for area high school students.
- Will be working as tutor and teaching assistant coordinator at the Research Science Institute program during the summer of 2003.

Gary Sherman- Refereed papers for several journals

Aleksey Telyakovskiy – Reviewed papers for “Journal of Hydrology” and for “ASCE Journal of Hydrologic Engineering”

#### **4.d Faculty Honors and Awards**

Diane Evans -Selected as a NEXt Indiana fellow. attended Fall and Spring Indiana section meetings of the Mathematical Association of America (MAA) in which project fellows met for a day of conferencing.

- Nominated for the John M. Chambers Statistical Software Award for 2002-2003 through the American Statistical Association for the development of A Applied Programming Language (APPL).

Thomas Langley - Selected as 2002-2003 MAA Project NEXt fellow and attended related workshops at the MAA Mathfest summer meeting in Burlington, VT (August 2002) and at the AMS/MAA Joint Meetings in Baltimore (January 2003).

## 4.e Membership in Faculty Clusters

Imaging Systems Faculty: Allen Broughton David Finn, Jeff leader

Parallel Computing Users Group: Allen Broughton, Jeff Leader, Josh Holden

## 5. Grants and Continuing Grant activities

The Rose-Hulman NSF-Research Experience for Undergraduates Program will continue during the upcoming summer. This summer's program, which will be directed by **Allen Broughton** and **Kurt Bryan**, is the fifteenth consecutive year of the program.

**David Finn** will continue to administer NSF grant "Course, Curriculum and Laboratory Improvement (CCLI) for curriculum development in 3D geometry this summer. Three Rose-Hulman students will participate for six weeks this summer. The grant is for \$75,000 and will run for another year after this.

## 6. Departmental Programs

**Fast Track Calculus** 50 students, Director Elton Graves, Instructors: Elton Graves and Roger Lauzenheiser

**Rose-Hulman Undergraduate Mathematics Journal**, Editor Roger Lautzenheiser, Assistant editor David Rader, fall, 2002 issue - 5 papers with 6 authors; spring, 2003 issue - 7 papers with 15 authors.

**Rose-Hulman High School Mathematics Competition** (thirty-seventh annual). organizers Ralph Grimaldi and John Rickert, about 500 students.

**Rose-Hulman Undergraduate Mathematics Conference** (March 2003, 20'th annual), co-organizers, Stephan Carlson and Tom Langley, 12 student talks, about 60 conference.