# Rose-Hulman Conference

# on

# Undergraduate Mathematics

**April 19 - April 20, 2013**

**Rose-Hulman Institute of Technology**
**Department of Mathematics**
**Terre Haute, Indiana**

# Welcome

Welcome to the 30th annual Rose-Hulman Conference on Undergraduate Mathematics. We approached this year's conference with the resolve to have an event worthy of the three decade hallmark that this conference has achieved. Working toward this milestone has spawned some new amenities due to the financial support of several industrial partners. The Mathematical Association of American (MAA) has sponsored our conference for years through a grant from the National Science Foundation, and while this support is the cornerstone of our monetary resources, this year's conference has further benefited from the gracious support of Maplesoft, MIT Lincoln Laboratory, Metron Scientific Solutions, and Sandia National Laboratories. These robust resources have allowed us to forego a registration fee and have permitted us to work with a conference hotel, which has nicely given us a venue to network throughout the conference. Beyond financial support, many of our new industrial partners have joined us to introduce themselves to our talented conference participants, and we will have a panel on mathematically oriented industrial careers. Combined with our panel on graduate school, these sessions showcase avenues beyond the undergraduate curriculum. We sincerely hope that everyone enjoys the added features of this year's conference and finds themselves enriched, welcomed, and nurtured.

The plenary theme of this year's conference is the mathematics of computation and computational biology, and we are excited to have three superb plenary speakers. The conference begins with the CEO of Metron Scientific, Dr. Thomas Mifflin, showing how a computational probability model was used to locate the wreckage of Air France flight 447. Friday evening's plenary by Dr. Tony Nance, an associate director of the Mathematical Biosciences Institute, explains the critical and symbiotic role being played by mathematics in the advancement of the life and medical sciences. Saturday's plenary by Dr. Janet Best on modeling sleep promises to pique our interests as we prepare to recover from the conference's excitement. Additionally, we have convened a new plenary this year exemplifying the undergraduate research that we have all come to celebrate, and in this venue three selected presenters will compete for the title of *Best Presentation*.

The conference's success rests on the shoulders of many, and we are indebted and thankful to everyone who has provided assistance, including:

| | |
|---|---|
| President Robert Coons | Introductory Comments |
| Devon Hardman, Katie Ross, Ellen Snelling, Helen Ritchey Kathyrn Yochman, Arnold Yim | Registration |
| Chase Mathison, Jason Sauppe | Graduate Panel |
| Drs. Bowling, Pudwell, Stickles | Competition Committee |
| The Men of Pike | Refreshments |
| Pi Mu Epsilon | Student Party |
| Michelle Prather | Administrative Assistance |
| Leanne Holder | Friday's Dinner |
| Heidi Isaia | Faculty Party |
| Kevin Hewerdine, Career Services | Dinner Sponsorship |
| Drs. Broughton, Bryan, DeVasher, Eichholz, McSweeney, Shibberu | RHIT Representatives |
| Nick Crawford | Software Support |

Moreover, we further appreciate the Rose-Hulman ethos, which has provided an environment of helpful and kind assistance. To the entire campus, thanks for being receptive to the requests that we have made. This conference has gained much from your willingness to help.

Finally, we are thankful for your research efforts and participation; after all, we are here to highlight and celebrate your achievements. Without you the conference wouldn't exist. The success of this year's conference proves that undergraduate research is thriving, and we are thankful for your mathematical intrigue, your perseverance, and your fondness of mathematics.

In heartfelt appreciation:

Allen Holder, co-organizer
Vin Isaia, co-organizer
Allen Broughton, department head

## Sponsors

The conference received support and gifts from the following partners, and we are honored by their gracious backing.

**Mathematics Association of America***

**Sandia National Laboratories**

**Metron Scientific Solutions**

**MIT Lincoln Laboratory**

**Maplesoft: Mathematics, Modeling, Simulation**

Support from these partners has allowed us to forego a registration fee, support accommodations for 40 attendees, sponsor a conference dinner, give a monetary award for the *Best Presentation Competition*, and give prizes at the undergraduate party. Please keep these associations and companies in mind as you continue your mathematical journey.

* Funds provided through MAA NSF-RUMC, NSF #DMS-0846477.

## Rose-Hulman Undergraduate Math Journal

The Rose-Hulman Undergraduate Mathematics Journal is devoted entirely to papers written by undergraduates on topics related to mathematics. Although the authors need not be undergraduates at the time of submission or publication, the work must have been completed before graduation. The journal will be distributed freely in an electronic format (PDF) from the journal's web site.

In order to maintain a high level of exposition, each paper must be sponsored by a mathematician familiar with the student's work and each paper will be refereed. The editor-in-chief will make the final decision for publication.

Should you want to consider publishing your research in the Rose-Hulman Undergraduate Math Journal, please contact:

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*The RHIT Undergraduate Math Journal is sponsored by the Mathematics Department at Rose-Hulman Institute of Technology.*

# Program At-A-Glance

| | Track A<br>Room O157 | Track B<br>Room O159 | Track C<br>Room O257 | Track D<br>Room O259 | Track E<br>Room O169 |
|---|---|---|---|---|---|
| 01:35 PM - 01:40 PM<br>Friday 04/19/2013 | Moench Hall E104, Opening Remarks<br>President Robert Coons | | | | |
| 01:40 PM - 02:25 PM<br>Friday 04/19/2013 | Moench Hall E104, Plenary Talk<br>Dr. Thomas Mifflin, Metron | | | | |
| 02:55 PM - 03:15 PM<br>Friday 04/19/2013 | Foulkes, James<br><br>Computational Electronics | MacGillivray, Michael<br><br>Robust Analysis of Metabolic Pathways | Solyst, Wiliam<br>Southworth, Justin<br><br>Voronoi Iteration as a Dynamical System | | Hettinger, Elizabeth<br><br>Technology in the Elementary Classroom |
| 03:25 PM - 03:45 PM<br>Friday 04/19/2013 | Uppal, Ananya<br><br>Intersecting cylinders: From Archimedes and Zu Chongzhi to Steinmetz and beyond | Ross, Katie<br><br>An Investigation of Boundary Conditions for the Yee Scheme in Complex Geometry | Yochman, Katy<br><br>The Hexagrammum Mysticum in the Finite Projective Plane | Folberth, James<br><br>Optimization and Fast Numerical Methods in Chromatography | Herrington, Weston<br><br>Analysis of the Impact of the ALEKS Learning Tool on Undergraduate Mathematics Students |
| 03:50 PM - 04:10 PM<br>Friday 04/19/2013 | Fene, Itelhomme<br><br>The Interlace Polynomial of the Wheel | Wei, Haining<br><br>Risk Management in Banking | Monaikul, Natawut<br><br>Do numbers play dice? Visualizing order and chaos in number theory through random walks | Hardman, Devon<br><br>A Semiparametric Model for Assessing the Efficacy of Media Types in Cell Culturing Studies | Lippelt, Christopher<br>Modi, Vismay<br><br>Determining Molecular Characteristics Based on their Intrinsic Geometries |
| 04:20 PM - 04:40 PM<br>Friday 04/19/2013 | Harris, Matthew<br><br>A Numerical Realization of the Carrier-Greenspan Transform for Tsunami Modeling | Rhoads, Anthony<br><br>Modeling dynamics of HIV recombination | Distler, Hilary<br><br>Runs with no winner in a Lottery | Weaver, Chelsea<br><br>A Spatial Analysis of Basketball Shot Chart | Simon, Jacqueline<br>Taylor, Jonathan<br><br>The Analysis of a Protein Alignment Algorithm with ROC-curves |
| 04:45 PM - 05:30 PM<br>Friday 04/19/2013 | Moench Hall E104, Panel Discussion<br>Panel on Careers | | | | |
| 05:45 PM - 06:45 PM<br>Friday 04/19/2013 | Hulman Union Faculty Dinning Room, Dinner<br>Dinner | | | | |
| 07:00 PM - 08:00 PM<br>Friday 04/19/2013 | Moench Hall E104, Plenary Talk<br>Dr. Tony Nance, NSF Mathematical Biosciences Institute | | | | |
| 08:30 PM - 10:00 PM<br>Friday 04/19/2013 | Student/Faculty Party, See Directions in Program | | | | |

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|---|---|---|---|---|---|
| 08:00 AM - 08:25 AM<br>Saturday 04/20/2013 | Ludington, Chase<br><br>The effect of risk taking behavior induced by treatment efficiency in epidemic models | Drobny, Jon<br><br>Hidden Markov Models and the Search for Extrasolar Planets | Houssou, Kodjo<br><br>Can CFA franc promote the trade between the WAEMU and its trading partners? | Pringle, Jack<br><br>Optimal Crop/Farm Assignment | Mathison, Chase<br><br>Determining Material Parameters Via Impedance Measurements |
| 08:30 AM - 08:55 AM<br>Saturday 04/20/2013 | Vrablik, Tim<br><br>Why Mathematics Matters in the Modern World | Hirsbrunner, Daniel<br>Lee, Moon<br>Sigalov, Maxim<br><br>Creative Blocking | Abbott, Luke<br><br>Generalizing of Complex Fractals | | Goodrich, Timothy<br><br>Characterizing Finite-Depth Stack-Sortable Permutations |
| 09:00 AM - 09:25 AM<br>Saturday 04/20/2013 | Vrablik, Tim<br><br>Why Mathematics Matters in the Modern World | Freidin, Brian<br>Halliday, Robert<br><br>Spherical Geometry in Space-Time | Al-ruhaimy, Ahmad<br><br>Approximation of the Trigonometric Functions Using Special Angles | Hommowun, Nicholas<br>Manary, Elizabeth<br>Schneider, Aaron<br><br>Covering the Square Lattice with Disjoint Unit Disks | Yuan, Ruyue<br><br>Enumerations of Sorting Permutations with a Finite-Depth Stack |
| 09:30 AM - 10:30 AM<br>Saturday 04/20/2013 | Moench Hall E104, Best Presentation Competition<br>Mr. Lkhamsuren, Samore, and L. Yuan | | | | |
| 10:40 AM - 11:30 AM<br>Saturday 04/20/2013 | Moench Hall E104, Panel Discussion<br>Panel on Graduate School | | | | |
| 11:40 AM - 12:30 PM<br>Saturday 04/20/2013 | Moench Hall E104, Plenary Talk<br>Dr. Janet Best | | | | |

# Program - Plenary Speakers

**Dr. Thomas Mifflin**
CEO of Metron Scientific Solutions
Room: Moench Hall E104
Time: 01:40 PM - 02:25 PM
Date: Friday 04/19/2013

### The Search for the Underwater Wreckage of Air France Flight 447

On the morning of June 1, 2009, Air France flight 447 fell into the depths of the Atlantic ocean during turbulent weather. One week later the mathematical and computational efforts conducted at Metron Scientific Solutions identified the approximate location where the wreckage would be found. We will present how probabilistic search models, along with knowledge of ocean currents and prior searches, lead to the successful outcome of finding the wreckage of flight 447.

### About Dr. Thomas Mifflin

Dr. Mifflin joined Metron in 1995 and became the lead for Metron's Advanced Mathematics Applications Division in 1997. In 2010 he became the Chief Executive Officer of Metron. His technical work has focused mainly on a series of DARPA projects including developing advanced scheduling algorithms for precision optics manufacturing processes, developing a decision support system for using commercial aircraft for Strategic Airlifts, developing advanced link discovery technology for the intelligence community and developing a theory of detection for random graphs.

From 1992 to 1995, Dr. Mifflin was employed by the FAA's Operations Research service where he was the principal investigator for the development of the Optiflow prototype which used integer programming to schedule aircraft departures for traffic management. Dr. Mifflin was the project leader for the Flight Schedule Monitor which is also deployed in the FAA's Command Center. He was the project leader for the FAA Airline Data Exchange (FADE) project which developed a prototype system for distributed, collaborative planning among the FAA and the airlines which later became the FAA's Collaborative Decision Making Program.

From 1986 to 1992, Dr. Mifflin was employed by the Naval Research Laboratory where he was the Section Head for the Decision Support and Force Level Planning Section. He was the principal investigator for NRL in the Spotlight ATD, a theater ASW prototype, and the Tactical ASW Battle Management System (TABS). Both of these projects extended the state-of-the-art for nonlinear tracking and correlation systems.

Dr. Mifflin was NRL's principal investigator for the Integrated Strike Planning System prototyping effort. He directed the weapon allocation and timeline generation prototypes for ISPS.

Dr. Mifflin was project leader for the Command Decision Support Project for ONR. He was project leader for the Situation Assessment module in the SDI Battle Management project at NRL. He was the principal investigator for the Afloat Correlation System tracker / correlator evaluation.

From 1978 to 1986, Dr. Mifflin worked at ORI Inc., where he developed force level effectiveness models for the Navy's ballistic missile program office. He developed models for Navy force mixtures in a START / SALT environment. He developed models that quantified the impact of reentry body inventories for the C4 and D5 strategic missiles.

From 1974 to 1978, Dr. Mifflin was employed by the Center for Naval Analyses where he performed statistical analyses and developed models for the Marine Corps. He developed a computer model that corrected correlation coefficients for the effects of multiple curtailment. He was the author of several CNA studies for Military Manpower.

**Dr. Tony Nance**
Associate Directory of the MBI
Room: Moench Hall E104
Time: 07:00 PM - 08:00 PM
Date: Friday 04/19/2013

**Interactions Between Mathematics, Biology, and Medicine: Advances All Around**

Interactions Between Mathematics, Biology, and Medicine: Advances All Around

Mathematics and physics have worked hand-in-hand for over 2000 years, each influencing and enriching the other. The same can be said for mathematics and chemistry over the last 200 years, but the work that mathematics and the life sciences have done with and for each other is best measured in decades. Why such a difference? What has changed to enable these two disciplines to work better together? And what is some of that work, anyhow? In this talk we will address these questions, highlight some of the exciting progress being made on important problems in biology and medicine, and discuss the role of the National Science Foundation's Mathematical Biosciences Institute.

**About Dr. Tony Nance**

During the customary job search after completing his PhD in Mathematics at Ohio State, Tony and his wife made what seemed to be a small decision - let's spend one more year in Columbus. As one more year has become sixteen more years, it's hard for him to imagine a better choice. In addition to enjoying the more-typical aspects of academic life at Ohio State, Tony feels fortunate to have had a wonderful array of uncommon experiences, including helping to create and direct Ohio's first distance education program in college mathematics; receiving two university-wide teaching awards; and serving as Director of the Mathematics & Statistics Learning Center. Tony feels most fortunate, though, to have been asked to join NSF's Mathematical Biosciences Institute in late 2003. His time at MBI has been the most fulfilling and eye-opening of his professional life, and he looks forward to the wonder and surprise the future holds. When away from MBI and OSU, Tony enjoys reading, sports, puzzles and games of all sorts, and above all spending time with his wife and children.

**Dr. Janet Best**
The Ohio State University, Mathematics
Room: Moench Hall E104
Time: 11:40 AM - 12:30 PM
Date: Saturday 04/20/2013

**The Dynamics of Sleep**

The Dynamics of Sleep

To sleep "like a baby" means to sleep peacefully and soundly. Yet parents often observe that their infant's sleep has frequent interruptions and perhaps a short sleep-wake cycle; statistical analysis confirms that infant sleep and adult sleep have different dynamical structures. Perhaps it is the prevalence of chronic sleep disorders that has adults looking back wistfully at sleeping babies. Compounding the difficulty of managing a sleep disorder is the news that disruptions in normal sleep-wake activity have been associated with many long-term health consequences. I will discuss what is known about the biological basis of sleep including controversies in the field. I will then show how mathematical models, both deterministic and random, help us to understand sleep-wake rhythms from newborns to adults while also yielding insights into some sleep disorders. The results are sure to change the way you think about sleep and will reveal opportunities to participate in uncovering the mathematical structures that arise in sleep and other state transitions.

**About Dr. Janet Best**

Janet Best joined the Mathematics Department at The Ohio State University in 2006, after three years as a postdoctoral fellow at the Mathematical Biosciences Institute on the OSU campus, where she continues to be a long-term visitor. Her research interests lie primarily in deterministic and random dynamical systems and mathematical neuroscience. Janet is fascinated by the workings of the brain and how mathematics can help us understand brain function in both health and disease, and she particularly enjoys exploring these issues in collaboration with undergraduates. Janet has received a CAREER Award from the National Science Foundation and was a 2010-2012 Alfred P. Sloan Foundation Research Fellow.

# Program - Best Presentation Award

Best Presentation Competition
Room: Moench Hall E104
Time: 09:30 AM - 10:30 AM
Date: Saturday 04/20/2013

**Random Points, Broken Sticks, and Triangles**
Luvsandondov Lkhamsuren, University of Illinois at Urbana-Champaign

If a stick is broken up at two randomly chosen points, what is the probability that the three pieces form a triangle? This question first appeared about 150 years ago in an examination at Cambridge University.

It attracted the interest of 19th century French probabilists, and more recently was popularized by Martin Gardner. The problem gives rise to the "broken stick model", an important probabilistic model that arises in areas ranging from biology to finance. The model has been shown to be a good match for a variety of real-world data sets, including intervals between twin births reported in the Champaign-Urbana, intervals between rainy days reported at the airport in North Bay, Ontario, Canada, and intervals between aircraft crashes of U.S. Carriers.

In this presentation, we report an research performed at the Illinois Geometry Lab (IGL), in which we considered generalizations of the original broken stick problem.

**Advanced Finite Difference Methods in a Chromatography Inverse Problem**
Ted Samore, Rose-Hulman Institute of Technology

The estrogen receptor protein exists in equilibrium between monomers and dimers. Size-exclusion chromatography was performed for the ligand-binding domain of the protein, in order to ascertain the rate parameters governing the dimerization reaction. Work by others indicates that accurate numerical simulation of the chromatography column may lead to more detailed parameter estimates. A numerical simulation of the chromatography column was developed, based on solving systems of partial differential equations. These equations included stiff nonlinear reaction, convection, diffusion, and absorption terms, describing behavior on several spatial and temporal scales. This type of problem is notoriously difficult to solve. Stable and accurate schemes were achieved via operator splitting, which allowed different model components to be treated with specialized numerical techniques. The PDE solvers were coupled to optimization routines and experimental data, allowing initial model parameter estimates to be iteratively refined so as to best approximate the data.

**The probability that a polynomial with integer coefficients has all real roots**
Lirong Yuan, Purdue Universtiy

It is natural to use polynomials with integer coefficients for examples and exercises in an algebra course. However, not all such polynomials have all real roots. We ask a question: what is the probability that a random polynomial with integer coefficients has all real roots? We use some tools from probability theory and complex analysis to reduce the problem to studying the roots of random polynomials with real-valued coefficients instead. We discover that the probability that a polynomial of degree n with integer coefficients has real roots is equal to the probability that a polynomial of degree n-1 over real coefficients has real roots. In certain cases this allows us to use calculus to obtain an exact answer.

# Program - Panel Sessions

### Panel on Mathematically Oriented Careers

Representatives from Metron, MIT Lincoln Lab, Maplesoft,
Sandia National Labs, Rose-Hulman Statistics
Room: Moench Hall E104
Time: 04:45 PM - 05:30 PM
Date: Friday 04/19/2013

Have you ever wondered what a mathematically oriented career is? Representatives from industry will speak about their career paths in industrial jobs in mathematics. In particular, the panel will present opportunities for summer work, internships, and scholarships as related to their host companies. Panel members are:

- Dr. Thomas Mifflin, Metron Scientific Solutions
- Mr. John Peach, MIT Lincoln Laboratory
- Mr. Tim Vrablik, Maplesoft
- Dr. Mark Inlow, Rose-Hulman Statistician

### Panel on Graduate School

Room: Moench Hall E104
Time: 10:40 AM - 11:30 AM
Date: Saturday 04/20/2013

This panel contains current graduate students in mathematics and mathematics related programs and student who have recently navigated the application process successfully. Combined, they provide a breadth of graduate school possibilities beyond the undergraduate curriculum. The members are

- Kathryn Yochman, Rose-Hulman Institute of Technology
- Chase Mathison, Rose-Hulman Institute of Technology
- Jason Sauppe, University of Illinios at Urbana-Champaign
- Arnold Yim, Purdue University

Please bring questions.

# Program - Undergraduate Talks

## Presentations from 2:55 - 3:15 pm, Friday, 4/19/2013

**Computational Electronics**
Foulkes, James, Rose-Hulman
Friday 04/19/2013 02:55 PM - 03:15 PM in Olin O157
Chair: Folberth, James

As electronic devices are getting smaller with time as dictated by Moore's Law the motion of charge carriers becomes more important. At these very small scales the conventional equations regarding carrier motion as described by James Clerk Maxwell become inaccurate; whereas, models used in hydrodynamic theory fit the empirical evidence quite closely. This talk presents a hypothesis of how spin glasses operate at these micro-scales using hydrodynamic models and continuum mechanics and describes several of the key implications regarding the transient response of the system.

**Robust Analysis of Metabolic Pathways**
MacGillivray, Michael, University of Notre Dame
Friday 04/19/2013 02:55 PM - 03:15 PM in Olin O159
Chair: Taylor, Jonathan

Flux Balance Analysis (FBA) is a widely used computational model for studying the metabolic pathways of cells and the role individual metabolites and reactions play in maintaining cell function. However, the successes of FBA have been limited by faulty biological assumptions and computational imperfections. We introduce Robust Analysis of Metabolic Pathways (RAMP) as a more theoretically sound and computationally accurate model of cellular metabolism. We will develop the traditional FBA model and describe the flaws in its modeling assumptions, and then introduce RAMP as a solution to these flaws. After a mathematical overview of RAMP, we will discuss its computational results and successes and the possibilities it opens for future work.

**Voronoi Iteration as a Dynamical System**
Solyst, Wiliam, Taylor University; Southworth, Justin, Taylor University
Friday 04/19/2013 02:55 PM - 03:15 PM in Olin O257
Chair: Yochman, Katy

A dynamical system known as the Voronoi Iteration is explored. A Voronoi Tessellation comes divides up the plane into regions nearest to each member out of a set of generator points. The Voronoi Iteration takes the vertices of the Voronoi Tessellation as generators and builds a new Voronoi Iteration. Computers simulation is utilized to examine the results of iteration. Properties of Voronoi Iteration examined include growth and expansion rate. Period points in uniform lattice are explored. A special type of point set which keeps the same number of generators across all iterations is detailed. This special case looks nearly periodic (when scaled) and tends to expand exponentially in diameter but appears to have a cocircular limit.

**Technology in the Elementary Classroom**
Hettinger, Elizabeth, Saint Mary-of-the-Woods Collge
Friday 04/19/2013 02:55 PM - 03:15 PM in Olin O169
Chair: Lippelt, Christopher

Technology has been used in the classroom setting for hundreds of years. It has grown and evolved into the modern definition of technology. Technology plays a major part in differentiation and allows teachers to reach all learners. It is a valuable resource however it also presents many challenges. How is technology used in the classroom? How does it affect learning? We will explore the history technology and its uses in the classroom as well as some of the challenges presented to educators.

## Presentations from 3:25 - 3:45 pm, Friday, 4/19/2013

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**Intersecting cylinders: From Archimedes and Zu Chongzhi to Steinmetz and beyond**
Uppal, Ananya , University of Illinois at Urbana-Champaign
Friday 04/19/2013 03:25 PM - 03:45 PM in Olin O157
Chair: Foulkes, James

If two cylinders of radius 1 intersect at right angle, what is the volume of the region common to both cylinders? This problem goes back more than two thousand years to Archimedes and the Chinese mathematician Zu Chongzhi, who solved it using an ingenious geometric argument. In the early 20th century, Charles Steinmetz, a famous engineer of his time, studied this problem and also the analogous problem involving three perpendicular cylinders, and the regions of intersection of the cylinders have since been referred to as "Steinmetz solids". More recently, the problem has been popularized by Martin Gardner in his books and Scientific American articles, and by Steven Strogatz in his New York Times column.

In this presentation, we report on research performed at the Illinois Geometry Lab (IGL), in which we considered higher-dimensional versions of the Steinmetz solids.

**An Investigation of Boundary Conditions for the Yee Scheme in Complex Geometry**
Ross, Katie , Rose-Hulman Institute of Technology
Friday 04/19/2013 03:25 PM - 03:45 PM in Olin O159
Chair: Hawn, Derek

Numerical methods for solving Maxwell's equations will be investigated. In particular, embedded boundary methods will be used to address complex geometry, where the basic scheme uses a uniform grid everywhere except near the boundary. On the interior, the classical finite difference time domain scheme attributed to Yee may be used, and only the boundary terms need to be modified. Successful implementation of rigid translations of a rectangular domain in 2D, where the discrete sample points do not coalesce with the domain defined by the continuous problem, will be presented.

**The Hexagrammum Mysticum in the Finite Projective Plane**
Yochman, Katy, Rose-Hulman Institute of Technology
Friday 04/19/2013 03:25 PM - 03:45 PM in Olin O257
Chair: Pringle, Jack

The hexagrammum mysticum has been a presence in projective geometry since the times of Kepler, Pascal and Desargues. With the advent of computers, its become possible to visualize the figure and see intimate connections between the lines and points that form the mystic hexagram. We examine the effects of using a finite projective plane with fewer points and lines available than are required for the complete figure to be coordinatized. Specifically, the types and number of collapsings that occur in the projective plane of order 7 are discussed and explained.

**Optimization and Fast Numerical Methods in Chromatography**
Folberth, James, Rose-Hulman Institute of Technology
Friday 04/19/2013 03:25 PM - 03:45 PM in Olin O259
Chair: Samore, Ted

Size-exclusion chromatography is a method for separating molecules in solution based upon their sizes. An existing convection-diffusion-reaction PDE model of a size-exclusion chromatography column has been implemented to study the separation of monomer and dimer states of estrogen receptor proteins. Operator splitting and standard convection and diffusion finite difference methods were previously used in the numerical solution of the model. The use of an exact-time diffusion solver and separately solving stiff reaction ODEs led to a significant simulation speed improvement. The speed improvements allow us to (more easily) investigate optimization techniques to fit convection, diffusion, reaction, and other physical parameters to experimental data.

**Analysis of the Impact of the ALEKS Learning Tool on Undergraduate Mathematics Students**
Herrington, Weston, Southwest Baptist University
Friday 04/19/2013 03:25 PM - 03:45 PM in Olin O169
Chair: Hettinger, Elizabeth

For several years, the ALEKS online learning tool has been used as part of the curriculum for PreAlgebra courses at my university, but it had not yet been proven as to whether this was beneficial for the students. This semester, I analyzed the data that this professor and the ALEKS system had gathered about student behavior. Through this research, I was able to apply both correlation analysis and creation of statistical models to real world data in order to find the most important factors in student performance.

## Presentations from 3:50 - 4:10 pm, Friday, 4/19/2013

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**The Interlace Polynomial of the Wheel**
Fene, Itelhomme, University of Louisiana at Lafayette
Friday 04/19/2013 03:50 PM - 04:10 PM in Olin O157
Chair: Yochman, Katy

In this work we study the interlace polynomial of wheel graphs. Interlace polynomials are graph polynomials which give information about the structural properties of graphs. We give explicit formulas for the interlace polynomials of Wn, the wheel graph with n external edges, for certain n. We also give recursive formulas for interlace polynomial of some trees related to the wheel graphs. Since for any n the star graph Sn, where —E(Sn)— = n and the butterfly or bowtie graph B are both subgraphs of Wn, we have found recursive formulas for the interlace polynomial of these graphs. We believe these formulas will aid us in computing the interlace polynomial of the wheel graph. Our interest in the wheel graph comes from applications of the wheel graph to radio numbering, which is the assignment of radio station labels to the vertices of a graph.

**Risk Management in Banking**
Wei, Haining, Knox College
Friday 04/19/2013 03:50 PM - 04:10 PM in Olin O159
Chair: Distler, Hilary

It has been said 'to finance is to create'. From the boom of the railroads to the advent of the Internet, the financial markets have manifested the authenticity of this proverb for centuries. But it seems more reasonable to substitute this saying with 'to finance is to destroy' after such events as the financial cirsis in 2007 caused by mortgage loan mismanagement. Bankers misunderstood and misused the Gaussian copula function created by David Li to model credit risk so that they allowed themselves to be exposed to the dangers of risky loan portfolios. The talk will study this formula, and illustrate its potential dangers.

**Do numbers play dice? Visualizing order and chaos in number theory through random walks**
Monaikul, Natawut, University of Illinois at Urbana-Champaign
Friday 04/19/2013 03:50 PM - 04:10 PM in Olin O257
Chair: Foulkes, James

Many properties of the natural numbers can be encoded as sequences of 1's and -1's. On the surface, such sequences often show no obvious pattern and indeed seem to behave much like randomly generated sequences. In order to gain a deeper understanding of the "random-like" behavior of such sequences, we construct certain "random walks" in the plane formed with these sequences. These random walks provide a natural way to visualize the degree of randomness inherent in a sequence and to detect, and possibly explain, hidden patterns, but they can also open up new mysteries that defy explanation.

In this presentation, we report on the research we performed at the Illinois Geometry Lab (IGL) aimed at better understanding these number-theoretic random walks and unraveling some of their mysteries.

**A Semiparametric Model for Assessing the Efficacy of Media Types in Cell Culturing Studies**
Hardman, Devon, Rose-Hulman
Friday 04/19/2013 03:50 PM - 04:10 PM in Olin O259
Chair: Ross, Katie

Scientists are often trying to find the best media type for cell growth. However, the current method used for assessing this does not allow for formal inference on which media type is really the best. One of the problems currently is that the scientists assume a value for the unknown initial seeding density when modeling the growth of the cells, which may not be accurate. The scientists must periodically take a new sample and reseeding into new wells; they reseed by hand but still assume some unknown initial seeding density. We modeled the number of times the density in each well doubled over time by considering the idea of a semi-parametric model. Under this framework, we model the mean and variance. We can use the new model to find a confidence interval allowing us to determine which media type is the best for cell growth.

**Determining Molecular Characteristics Based on their Intrinsic Geometries**
Lippelt, Christopher, Rose-Hulman Institute of Technology; Modi, Vismay, Rose-Hulman
Friday 04/19/2013 03:50 PM - 04:10 PM in Olin O169
Chair: Simon, Jacqueline

As part of Rose-Hulmans Protein Atlas Project, it has become necessary to visually model the results of mathematical and biological findings. In this talk, we will introduce the mathematics for grouping proteins based on their intrinsic geometries, and then present visuals to support such groupings. To start, we construct a Smooth Contact Map based on the distances between each atom in the molecule. Then we create a matrix of eigenvalues for that molecule and match each atom in the molecule with an eigenvalue. Each atom is colored in PYMOL depending on the size of its eigenvalue. We use the trends we find from our graphical and mathematical representations of the molecule to determine characteristics of the protein. These characteristics allow us to visually confirm the accuracy of previously grouped proteins.

## Presentations from 4:20 - 4:40 pm, Friday, 4/19/2013

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**A Numerical Realization of the Carrier-Greenspan Transform for Tsunami Modeling**
Harris, Matthew, University of Evansville
Friday 04/19/2013 04:20 PM - 04:40 PM in Olin O157
Chair: Pringle, Jack

We are concerned with the run-up/run-down problem for the non-linear shallow water wave equation. In 1958, Carrier and Greenspan were able to linearize this problem for the case of a plane sloping beach. Their method has received much attention and is now referred to as the Carrier-Greenspan transform. In the 1990s, Pelinovsky et al. generalized it to consider parabolic bathymetry with constant slope. The main feature of these two situations is that the Carrier-Greenspan transform can be performed explicitly, producing analytical solutions to the run-up problem for these cases. This transform was recently extended by Rybkin-Pelinovsky-Didenkulova to inclined bathymetries of arbitrary cross sections. By using this transform the original non-linear water wave equation is reduced to a linear Klein-Gordon equation on a half-line. The resulting linear system does not, in general, have a d'Alembert solution. Thus numerical methods are required. We consider a sloping bathymetry with trapezoidal cross section, which is of particular interest, as many natural rivers and man-made canals have this shape. Even in this simple case the potential of the associated Klein-Gordon equation has a strong singularity at the endpoint, making standard numerical algorithms very unstable in the region of interest. In this paper, we are going to show how to deal with this complication and turn the Carrier-Greenspan transform into a fast, smoothly working numerical algorithm. Our method can be modified to model the run-up on bays of more complicated shapes and can be effectively used for numerical simulations of inundations caused by tsunamis for real bathymetries.

**Modeling dynamics of HIV recombination**
Rhoads, Anthony, McKendree University
Friday 04/19/2013 04:20 PM - 04:40 PM in Olin O159
Chair: Modi, Vismay

The ability of Human Immunodeficiency Virus (HIV) to persist in a host despite a strong immune response is thought to be driven by its high mutation rate and its potential to form new genetic sequences via recombination. In vitro recombination of HIV has been frequently observed, but the rate of HIV recombination in vivo remains poorly estimated. In approximately 20 percent of sexually transmitted HIV cases, the patients infection is initiated by two or more transmitted/founder (T/F) viruses, facilitating recombination. In this study, we examine the dynamics of recombination in several such patients. We develop mathematical models of different levels of complexity that predict HIV evolution via recombination and estimate parameters of these models using experimental data. In doing so, we investigate whether it is necessary to assume that recombinant viral variants possess an inherent fitness advantage over the T/F viral variants in order to match experimental data. We also examine the role of stochasticity in the dynamics of HIV recombination during the first months post-infection.

**Runs with no winner in a Lottery**
Distler, Hilary, Saint Mary-of-the-Woods College
Friday 04/19/2013 04:20 PM - 04:40 PM in Olin O257
Chair: Hardman, Devon

The lottery wants to design a game that will attract and sustain players. There is a balance between profits made as the jackpot increases and ticket sales, as well as drawings without a winner, which are called runs. The State of Oregon Lottery asked Richard Iltis to help them compute the likelihood of having long runs of drawings where there was no winner while keeping the players interest. Iltis develop uses two formulas to project the likelihood of this happening. The two models use the information from previous drawing and develop a prediction for future runs. One model represents the information well while the other does not incorporate vital information that should be taken into account. This allowed the lottery to make the most profitable decision. And though the models represented the data fairly well, there were still aspects that made the models less accurate. This talk will discuss the results in this article.

**A Spatial Analysis of Basketball Shot Chart**
Weaver, Chelsea, Saint Mary-of-the-Woods Collge
Friday 04/19/2013 04:20 PM - 04:40 PM in Olin O259
Chair: Crawford, Nick

Basketball coaches at all levels use shot charts to study shot location and outcomes for their own teams as well as upcoming opponents. Shot charts are simple plots of the location and result of each shot taken during a game. Although shot chart data are rapidly increasing in richness and availability, most coaches still use them as descriptive summaries. However, a teams ability to defend a certain player could potentially be improved by using shot data to make inferences about the players tendencies and abilities. This article develops a hierarchical spatial model for shot-chart data, which allow for spatially varying effects of covariates. The spatial models permit differential smoothing of the fitted surface in two spatial directions, which naturally correspond to polar coordinates: distance to the basket and angle from the line connecting the two baskets. This approach is illustrated using the 2003-2004 shot chart data for Minnesota Timberwolves guard Sam Cassell.

**The Analysis of a Protein Alignment Algorithm with ROC-curves**
Simon, Jacqueline, Rose-Hulman Institute of Technology; Taylor, Jonathan, Rose-Hulman Institute of Technology
Friday 04/19/2013 04:20 PM - 04:40 PM in Olin O169
Chair: Hawn, Derek

Proteins, the basic building blocks of many biological molecules, can be compared by three dimensional folds that dictate structure and function. Many efficient, accurate algorithms have been determined that take a mathematical description of a proteins folds and use dynamic programming to align its structure with that of other proteins. The parameters for one such algorithm were tuned using ROC curves.

## Presentations from 8:00 - 8:25 am, Saturday, 4/20/2013

**The effect of risk taking behavior induced by treatment efficiency in epidemic models**
Ludington, Chase , Valparaiso University
Saturday 04/20/2013 08:00 AM - 08:25 AM in Olin O157
Chair: Taylor, Jonathan

We study several epidemic models that incorporate risk taking behavior as a response to an effective treatment. We show that a risk-taking behavior that depends increasingly on the recovered individuals can induce bistability between a stable disease free state and an endemic one. In particular, we show that, if the treatment is implemented when the infected class is large enough, even a relatively small risk taking behavior response could cause the disease to persist.

**Hidden Markov Models and the Search for Extrasolar Planets**
Drobny, Jon, Rose-Hulman Institute of Technology
Saturday 04/20/2013 08:00 AM - 08:25 AM in Olin O159
Chair: Simon, Jacqueline

One of the most exciting topics in modern astronomy is the ongoing search for extrasolar planets. Hidden Markov Modeling is a recently developed statistical analysis tool developed for speech recognition that has been applied to fields as diverse as bioinformatics and economics. In this presentation, the basic theory of both the transit method of detecting extrasolar planets and Hidden Markov Model analysis is covered, and a state-duration, continuous hidden Markov Model is presented and used to analyze stellar light curves taken by the Kepler Space Telescope to detect and characterize transiting extrasolar planets.

**Can CFA franc promote the trade between the WAEMU and its trading partners?**
Houssou, Kodjo, University of Minnesota
Saturday 04/20/2013 08:00 AM - 08:25 AM in Olin O257
Chair: Ross, Katie

This paper discuss briefly the implications of the peg exchange rate CFA-Euro on the trade in the West African Economic and Monetary Union (WAEMU) based on the framework of SHANE-ROE-SOMWAPU, optimal control and the real business cycle theories. Hence, the study aims to show by econometrical estimation under the international market clearance condition, the effect of the exchange rate on the trade in WAEMU. It analyzes deeply the dynamic propagation mechanism of the rate of change of the exchange rate on the exportation volume, consumption, and foreign interest rate. Definitely, the exchange rate seems to be an important macroeconomic variable affecting the trade between WAEMU and its trading partners such the European Union, USA, China, etc. We find that the depreciation of the exchange rate will be effective if the real value of the exportation and the consumption is greater than one percent increase of the foreign interest rate. The results indicate also that under the peg exchange regime system with Euro, the exportation demand in WAEMU is an exponential function of the foreign interest rate, the import prices, and the consumption. The model suggests that a policy of pegging the CFA to the Euro may cause economic distortions in West African countries that effects their trade competitiveness in foreign markets.

**Optimal Crop/Farm Assignment**
Pringle, Jack, Rose-Hulman Institute of Technology
Saturday 04/20/2013 08:00 AM - 08:25 AM in Olin O259
Chair: MacGillivray, Michael

The model provides a list of crops suitable for a particular farm based on the climate, soil, nutrient, and pest conditions of the region. The optimal partition is found by an interior-point algorithm, which is particularly useful when designing crop lists because a strictly complementary solution to linear programming relaxation observes all possible optimal solutions to the original binary problem. The techniques developed rely on a continuous parametric analysis, and we show that the parameterization provides meaningful information about the structure of the optimal assignments.

**Determining Material Parameters Via Impedance Measurements**
Mathison, Chase, Rose-Hulman Institute of Technology
Saturday 04/20/2013 08:00 AM - 08:25 AM in Olin O169
Chair: Goodrich, Timothy

In certain situations it is useful to identify an unknown piece of metal without contact or visual inspection. We wish to do this by inducing a current in a coil and placing the metal object in the resulting magnetic

field. We have a well known model which gives the change in impedance of the coil (the coil's self impedance in free space minus the impedance in the coil with the metal present) based on the properties of the metal. From this model, we will analyze the inverse problem of finding the metal's properties by measuring the change in impedance for any given frequency of the alternating current in the coil.

## Presentations from 8:30 - 8:55 am, Saturday, 4/20/2013

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**Why Mathematics Matters in the Modern World**
Vrablik, Tim, Maplesoft
Saturday 04/20/2013 08:30 AM - 08:55 AM in Olin O157
Chair: Isaia, Vincenzo

The National Academy of Engineering (USA) previously published A Century of Innovation: Twenty Engineering Achievements that Transformed our Lives. This book celebrates the top twenty technological advances of the twentieth century that fundamentally changed society. Mathematics has played a major role in bringing these innovations to reality by helping scientists and engineers grapple with seemingly impossible tasks. Today, mathematical techniques reach even further into our society. In addition to making technology more efficient and effective, mathematical techniques help organizations deal with financial, manufacturing, and even marketing issues.

In this seminar, discover how you can utilize your degree in mathematics as a stepping stone to transform the modern world, just as scientists from the past have done. Case studies from a diverse range of industries and technical disciplines that are using Maplesoft solutions to solve difficult problems will be highlighted.

**Creative Blocking**

Hirsbrunner, Daniel, University of Illinois at UrbanaChampaign; Lee, Moon, University of Illinois at Urbana Champaign; Sigalov, Maxim , University of Illinois at Urbana-Champaign
Saturday 04/20/2013 08:30 AM - 08:55 AM in Olin O159
Chair: Mathison, Chase

We define *creative blocking*, which is a function $T$ that creates a new polygon from a given polygon $p$ in the following way: erect a square on each edge of $p$ and connect the vertices of these squares. Let $e_{n,k}(p)$ be the $k^{\text{th}}$ edge of $T^n(p)$ and let $A(n,p,f) = \sum_k f(e_{n,k}(p))$. Given a polygon $p$ and a function $f$, we show that if $f$ satisfies $f(z) = f(iz)$, then the following recurrence holds $4A(n,p,f) - A(n+2,p,f) + 2A(n+3,p,f) - A(n+4,p,f) = 0$. In particular, given a polygon $p$, the growth rate of the perimeter of $T^n(p)$ as $n$ goes to infinity is investigated. We also consider the sum of the squares of the lengths of the edges, which gives nice results. A few conjectures are also made.

This is joint work with Ilkyoo Choi, Jeremy Dejournett, Daniel Hirsbrunner, Moon Hwan Lee, Bruce Reznick, and Maxim Sigalov.

**Generalizing of Complex Fractals**

Abbott, Luke, Southwest Baptist University
Saturday 04/20/2013 08:30 AM - 08:55 AM in Olin O257
Chair: Drobny, Jon

The purpose of this presentation is to illustrate the generalizing of complex fractals, specifically the Mandelbrot Set, into hypercomplex space. This presentation will explain and illustrate how complex numbers in fractal expressions can be replaced with hypercomplex numbers (such as quaternions, bi-complex numbers, octonions, etc.) expanding the dimensions of the fractal far beyond the original two. Using dimensional slicing these hyper-dimensional shapes can be displayed in three-dimensional space, creating a wide variety of three-dimensional representations of any fractal. This generalization could very easily lead to the discovery of extraordinary hyper-dimensional fractals that have never before been encountered.

**Characterizing Finite-Depth Stack-Sortable Permutations**

Goodrich, Timothy, Valparaiso University
Saturday 04/20/2013 08:30 AM - 08:55 AM in Olin O169
Chair: Yochman, Katy

In his 1968 classic work, The Art of Computer Programming Volume 1, Donald Knuth introduced the notion of sorting permutations using infinite-depth stacks. Further, Knuth characterized which permutations are sortable using classical permutation patterns. Gener- alizing Knuths work, we explore sorting permutations multiple times through a finite-depth stack. Using an experimental mathematics approach, we seek to identify which patterns render small permutations unsortable, and then prove that the result holds for larger per- mutations. Particularly, we determine a complete characterization of which permutations are sortable when passed once through a finite-depth stack or when passed multiple times through a depth-2 stack. We conclude by examining the computational limits that this problem quickly approaches and possible directions for further research.

## Presentations from 9:00 - 9:25 am, Saturday, 4/20/2013

**Why Mathematics Matters in the Modern World**
Vrablik, Tim, Maplesoft
Saturday 04/20/2013 09:00 AM - 09:25 AM in Olin O157
Chair: Isaia, Vincenzo

The National Academy of Engineering (USA) previously published A Century of Innovation: Twenty Engineering Achievements that Transformed our Lives. This book celebrates the top twenty technological advances of the twentieth century that fundamentally changed society. Mathematics has played a major role in bringing these innovations to reality by helping scientists and engineers grapple with seemingly impossible tasks. Today, mathematical techniques reach even further into our society. In addition to making technology more efficient and effective, mathematical techniques help organizations deal with financial, manufacturing, and even marketing issues.

In this seminar, discover how you can utilize your degree in mathematics as a stepping stone to transform the modern world, just as scientists from the past have done. Case studies from a diverse range of industries and technical disciplines that are using Maplesoft solutions to solve difficult problems will be highlighted.

**Spherical Geometry in Space-Time**
Freidin, Brian, University of Illinois at Urbana-Champaign; Halliday, Robert, University Of Illinois-Urbana Champaign
Saturday 04/20/2013 09:00 AM - 09:25 AM in Olin O159
Chair: Samore, Ted

In classical geometry one studies the geometry of the sphere, including measure of length, angles, and central and stereographic projections. We start with Minkowski space-time, the setting for Einstein's theory of special relativity. In this space we defined the unit sphere, and created an interactive applet to visualize geodesics and measure lengths and angles. We also derived many analogues of results from classical spherical geometry in this new setting, and will discuss how we were aided by computational mathematics in our studies.

**Approximation of the Trigonometric Functions Using Special Angles**
Al-ruhaimy, Ahmad, King Fahd University of Petroleum & Minerals
Saturday 04/20/2013 09:00 AM - 09:25 AM in Olin O257
Chair: Folberth, James

In this note, we have shown how to construct a formula that can approximate trigonometric functions using well known special angles. Furthermore, we have illustrated with examples how this formulas work, and the error involved in the calculation.

**Covering the Square Lattice with Disjoint Unit Disks**

Hommowun, Nicholas , Illinois College; Manary, Elizabeth, Illinois College; Schneider, Aaron, Illinois College

Saturday 04/20/2013 09:00 AM - 09:25 AM in Olin O259

Chair: Modi, Vismay

In this talk we consider the following problem:

Consider the square lattice in the plane with inter-point distance $d$. For which positive numbers $d$ is it possible to cover every point of this lattice with closed disks of unit radius having pairwise-disjoint interiors?

This is a modification of a problem proposed by Peter Winkler in his Puzzled column in the Communications of the ACM. We show that for certain values of $d > 0$, such a disk covering is possible, and discuss some of the difficulties involved in approaching this problem.

**Enumerations of Sorting Permutations with a Finite-Depth Stack**

Yuan, Ruyue , Valparaiso University

Saturday 04/20/2013 09:00 AM - 09:25 AM in Olin O169

Chair: Crawford, Nick

In The Art of Computer Programming, Donald Knuth showed that the Catalan numbers count the permutations that are sortable after one pass through an infinite depth stack. We generalize this result by counting the permutations sortable after one or more passes through a finite depth stack. In particular we completely solve this enumeration problem for the case of one pass through a finite stack and the case of any number of passes through a depth 2 stack. We also count permutations that are sortable in a specified finite stack but not sortable in a shallower stack and enumerate the sequences.

# Conference Attendees

| | |
|---|---|
| Abbott, Luke | Southwest Baptist University |
| Al-ruhaimy, Ahmad | King Fahd University of Petroleum & Minerals |
| Alm, Jeremy | Illinois College |
| Auyeung, Shamuel | Calvin College |
| Best, Janet | The Ohio State University |
| Billingsley, Matt | Rose Hulman Institute of Technology |
| Black, Kirsten | Missouri Baptist University |
| Bowling, Stephen | Southwest Baptist University |
| Bowmaster, Brian | Rose Hulman Institute of Technology |
| Bryan, Kurt | Rose-Hulman Institute of Technology |
| Burrows, Andrew | IUPUI-Purdue School of Engineering |
| Bussmann, Sarah | Illinois Wesleyan University |
| Broughton, Allen | Rose-Hulman Institute of Technology |
| Carlisle, Sylvia | Rose-Hulman Institute of Technology |
| Carlson, Steve | Rose-Hulman Institute of Technology |
| Chandramouli, Ranjana | Rose-Hulman Institute of Technology |
| Cisse, Amadou | Missouri Baptist University |
| Cox, Angelica | Rose Hulman Institute of Technology |
| Crawford, Nick | Rose-Hulman Institute of Technology |
| Crocker, Christopher | Rose Hulman Institute of Technology |
| Distler, Hilary | Saint Mary-of-the-Woods College |
| Drobny, Jon | Rose-Hulman Institute of Technology |
| Edgar, Casey | Eastern Michigan University |
| Eichholz, Joe | Rose-Hulman Institute of Technology |
| Evans, Diane | Rose-Hulman Institute of Technology |
| Fene, Itelhomme | University of Louisiana at Lafayette |
| Folberth, James | Rose-Hulman Institute of Technology |
| Foulkes, James | Rose-Hulman Institute of Technology |
| Foutch, David | Southern Illinois University Carbondale |
| Freidin, Brian | University of Illinois at Urbana-Champaign |
| Goodrich, Timothy | Valparaiso University |
| Goulet, Dave | Rose Hulman Institute of Technology |
| Graves, Elton | Rose Hulman Institute of Technology |
| Grimaldi, Ralph | Rose-Hulman Institute of Technology |
| Grossman, Ryan | Ivy Tech Community College |
| Halliday, Robert | University Of Illinois-Urbana Champaign |
| Han, Juyeon | IUPUI-Purdue School of Science |
| Hardman, Devon | Rose-Hulman Institute of Technology |
| Harris, Matthew | University of Evansville |
| Hawn, Derek | Rose-Hulman Institute of Technology |
| Herrington, Weston | Southwest Baptist University |
| Hettinger, Elizabeth | Saint Mary-of-the-Woods Collge |
| Hiance, Jacob | Rose Hulman Institute of Technology |
| Hirsbrunner, Daniel | University of Illinois at UrbanaChampaign |
| Holden, Joshua | Rose-Hulman Institute of Technology |
| Holder, Allen | Rose-Hulman Institute of Technology |
| Holder, Leanne | Rose-Hulman Institute of Technology |
| Hommowun, Nicholas | Illinois College |
| Houssou, Kodjo | University of Minnesota |
| Isaia, Vincenzo | Rose-Hulman Institute of Technology |
| Jones, Edna | Rose-Hulman Institute of Technology |
| Kamperman, Amy | Rose Hulman Institute of Technology |
| Kliemann, Steve | Eastern Michigan University |
| Kunz, Elizabeth | University of Evansville |
| Lambert, Chris | Rose Hulman Institute of Technology |
| Langley, Thomas | Rose-Hulman Institute of Technology |
| Lautzenheiser, Roger | Rose-Hulman Institute of Technology |
| Lee, Moon | University of Illinois at Urbana Champaign |
| Lkhamsuren, Luvsandondov | University of Illinois at Urbana-Champaign |
| Lippelt, Christopher | Rose-Hulman Institute of Technology |
| Lubarski, Vaughn | Rose Hulman Institute of Technology |
| Ludington, Chase | Valparaiso University |
| MacGillivray, Michael | University of Notre Dame |
| Manary, Elizabeth | Illinois College |
| Mann, Abigail | Rose Hulman Institute of Technology |

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|---|---|
| Marks, Jessie | Central Methodist University |
| Mason, Ashley | IUPUI |
| Mathison, Chase | Rose-Hulman Institute of Technology |
| Maxin, Daniel | Valparaiso University |
| McSweeney, John | Rose-Hulman Institute of Technology |
| Melton, Lizzie | Rose Hulman Institute of Technology |
| Mi, Nan | Eastern Michigan University |
| Michael, Adam | Rose-Hulman Institute of Technology |
| Mifflin, Thomas | Metron Scientific Solutions |
| Modi, Vismay | Rose-Hulman Institute of Technology |
| Monaikul, Natawut | University of Illinois at Urbana-Champaign |
| Mulc, Thomas | Rose Hulman Institute of Technology |
| Nance, Tony | Mathematical Biosciences Institute |
| Orzech, Mitch | Rose Hulman Institute of Technology |
| Peach, Daniel | Bates College |
| Peach, John | MIT Lincoln Laboratory |
| Peterson, Jonathon | Purdue University |
| Phillips, Stetson | Central Methodist University |
| Priddy, Jerry | Central Methodist University |
| Pringle, Jack | Rose-Hulman Institute of Technology |
| Rader, Dave | Rose-Hulman Institute of Technology |
| Reed, Samantha | Saint Mary-of-the-Woods College |
| Reyes, Eric | Rose-Hulman Institute of Technology |
| Rhoads, Anthony | McKendree University |
| Rickert, John | Rose-Hulman Institute of Technology |
| Riley, Amanda | Valparaiso University |
| Ring, Rachel | Saint Mary-of-the-Woods College |
| Roberts, Dakota | University of Evansville |
| Ross, Katie | Rose-Hulman Institute of Technology |
| Ryan, Dennis | McKendree University |
| Salminen, Adam | University of Evansville |
| Samore, Ted | Rose-Hulman Institute of Technology |
| Say, Ann | Rose-Hulman Institute of Technology |
| Sanborn, Barbara | Rose-Hulman Institute of Technology |
| Schade, Erin | Eastern Michigan University |
| Schendt, Abby | Rose Hulman Institute of Technology |
| Schneider, Aaron | Illinois College |
| Selby, Christina | Rose-Hulman Institute of Technology |
| Shankar, Jay | Rose Hulman Institute of Technology |
| Shi, Yunhui | Rose Hulman Institute of Technology |
| Sigalov, Maxim | University of Illinois at Urbana-Champaign |
| Simon, Jackie | Rose-Hulman Institute of Technology |
| Smith, Zach | Rose Hulman Institute of Technology |
| Solyst, Wiliam | Taylor University |
| Southworth, Justin | Taylor University |
| Starr, Octavia | Metro State University |
| Tacchi, Leah | Illinois Wesleyan University |
| Tai, Wei-Cheun | Missouri Baptist University |
| Taylor, Jonathan | Rose-Hulman Institute of Technology |
| Tenerovich, Jacob | Eastern Michigan University |
| Uppal, Ananya | University of Illinois at Urbana-Champaign |
| James Valles | Saint Mary-of-the-Woods College |
| Vrablik, Tim | Maplesoft |
| Wang, Fei | University of Kentucky |
| Want, Yilin | Rose Hulman Institute of Technology |
| Watson, Guiliana | Rose Hulman Institute of Technology |
| Wei, Haining | Knox College |
| Weaver, Chelsea | Saint Mary-of-the-Woods College |
| Whiteley, Jake | Rose Hulman Institute of Technology |
| Witte, Michael | Missouri Baptist University |
| Xia, Xintong | Rose Hulman Institute of Technology |
| Yochman, Katy | Rose-Hulman Institute of Technology |
| Yuan, Lirong | Purdue University |
| Yuan, Ruyue | Valparaiso University |
| Yuk, Andrew | Rose Hulman Institute of Technology |
| Zeng, Xiaoxue | University of Kentucky |
| Zhang, David | Calvin College |
| Zhou, Pengzi | Rose Hulman Institute of Technology |