

# *PROGRAM & ABSTRACTS*

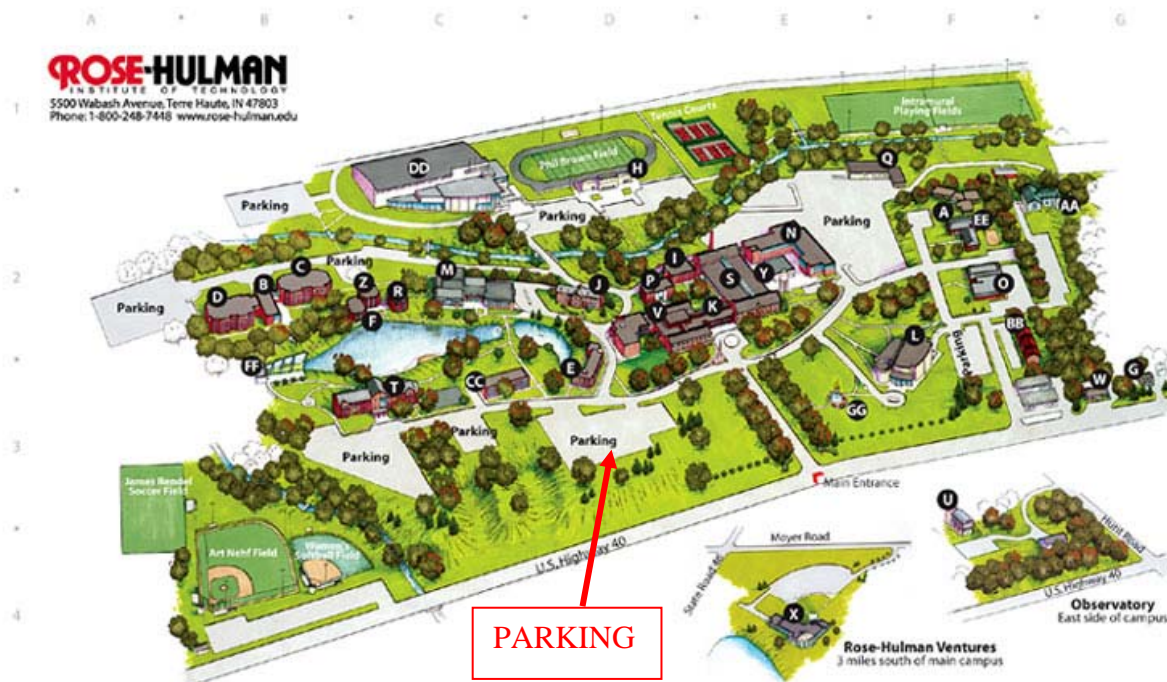
## *Indiana Section of the Mathematical Association of America*



*Fall Meeting  
at  
Rose-Hulman Institute of Technology  
October 25<sup>th</sup>, 2008*



## CAMPUS MAP



A. Alpha Tau Omega Fraternity (F2)	N. John T. Myers Center for Technological Research with Industry (E2)
B. Apartment Commons (B2)	O. Lambda Chi Alpha Fraternity (F2)
C. Apartment East (residence) (B2)	P. Logan Library (D2) (Learning Center in lower level)
D. Apartment West (residence) (B2)	Q. Facilities Operations (F1)
E. Baur-Sames-Bogart (BSB) Hall (residence) (D3)	R. Mees Hall (residence) (C2)
F. Blumberg Hall (residence) (C2)	S. Moench Hall (classrooms, labs) (E2)
G. Chi Omega Sorority (G3)	T. Percopo Hall (residence) (C3)
H. Cook Stadium/Phil Brown Field (D1)	U. Oakley Observatory (G4)
I. Crapo Hall (D2) (classrooms, computer center)	V. Olin Hall & Olin Advanced Learning Center (classrooms, laboratories) (D2)
J. Deming Hall (Residence) (D2)	W. Public Safety Office (G3)
K. Hadley Hall (E2) (reception/information desk, admissions, Financial aid, president, dean of faculty, institutional assessment)	X. Rose-Hulman Ventures (E4)
L. Hatfield Hall (F2) (auditorium, alumni, development, public relations)	Y. Rotz Mechanical Engineering Lab (E2)
M. Hulman Memorial Union (C2) (food service, bookstore, student affairs, health services, career services, student activities)	Z. Scharpenberg Hall (residence) (C2)
	AA. Sigma Nu Fraternity (G2)
	BB. Skinner Hall (residence) (F2)
	CC. Speed Hall (residence) (C3)
	DD. Sports and Recreation Center (C1)
	EE. Triangle Fraternity (F2)
	FF. White Chapel (B3)
	GG. Flame of Millennium (E3)

The conference is mainly being held in Olin Hall (V) on the Map. Though, the GM Room, where the invited talks are being given, is in Moench Hall (S). It is never necessary to go outside while in the main academic buildings, just ask and some one from Rose-Hulman will be able to direct you. Lunch is in the Hulman Memorial Union (M).

## PROGRAM of FALL MEETING

- 8:00–8:45      Registration in Olin Lobby
- 8:30—2:30      MAA Book Sale in Olin xxx
- 8:45–9:00      Welcome by *Art Western*, Dean of the Faculty, Vice President of  
GM Room      Academic Affairs, Rose-Hulman Institute of Technology
- 9:00–10:00      **Asymmetric Rhythms and Tiling Canons**  
GM Room      *Rachel Hall*, St. Joseph's University

Room	<i>Olin xxx</i>	<i>Olin xxx</i>	<i>Olin xxx</i>
10:15–10:40	<b>Math in Your Hands: The Use of Tablet PCs and Computer Algebra Systems in a Calculus Classroom</b>  <i>Joshua Holden</i> Rose-Hulman	<b>Graphs and Radio Channels</b>  <i>Zsuzsanna Szaniszló</i> Valparaiso University	<b>Linearized Active Contours Without Gradient Model</b>  <i>John M. Cochran</i> University of Louisville
10:45–11:10	<b>Integrating Numerical Methods/Analysis into Undergraduate Math Courses</b>  <i>Jerome Heaven</i> Indiana Tech	<b>Covers of Models</b>  <i>Daniel Kiteck</i> Indiana Wesleyan University	<b>Epidemiological Approach to the South Korean Beef Protests with a Hidden Agenda</b>  <i>Young Lee</i> Manchester College
11:15–11:45	<b>Classroom Demonstrations that Work (at least for me)</b>  <i>Elton Graves</i> Rose-Hulman	<b>Jeeps Crossing a Desert</b>  <i>Herb Bailey</i> Rose-Hulman	<b>A Novel Viable Solution to the Schrödinger Radial Equation</b>  <i>Jonathan O. Brooks</i> Ivy Tech

12:00–1:00      Lunch Kahn Room in Hulman Union  
Hulman Union

Room	<i>Olin xxx</i>	<i>Olin xxx</i>
1:15–1:40	<b>Sudoku and Orthogonality</b>  John Lorch Ball State University	<b>Zeros of the Partial Sums of <math>\cos(z)</math> and <math>\sin(z)</math></b>  Amos Carpenter Butler University

1:45–2:45      **A French Secret Applied to Invariant Manifolds**  
GM Room      *Mike Jolly*, Indiana University

## ABSTRACTS of INVITED TALKS

TIME: 9:00 am-10:00 am, in the GM Room  
TITLE: **Asymmetric Rhythms and Tiling Canons**  
SPEAKER: *Rachel W. Hall*, Saint Joseph's University  
This represents joint work with Paul Klingsberg (Saint Joseph's University).

ABSTRACT: Anyone who listens to rock music is familiar with the repeated drumbeat — one, two, three, four — based on a four-beat measure. However, other popular music (jazz, Latin, African) has different characteristic rhythms. Although much of this music is based on the four-beat measure, some instruments play repeated patterns that are not synchronized with the beat, creating *syncopation*—an exciting tension between different components of the rhythm. This paper is concerned with classifying and counting rhythms that are maximally syncopated in the sense that, even when shifted, they cannot be synchronized with the division of a measure into two parts. In addition, we discuss rhythms that cannot be aligned with other even divisions of the measure. Our results have a surprising application to rhythmic canons. A *canon* is a musical figure produced when two or more voices play the same melody, with each voice starting at a different time; in a *rhythmic canon*, rhythms, and not necessarily melodies, are duplicated by each voice. A rhythmic canon *tiles* if there is exactly one note onset in some voice on each beat. Upon mapping beats to integers, a rhythm forms a tiling canon if and only if its rhythmic motif and sequence of voice entries correspond to sets  $A$  and  $B$  forming a *tiling of the integers* — that is, a finite set  $A$  of integers (the tile) together with an infinite set of integer translations  $B$  such that every integer may be written in a unique way as an element of  $A$  plus an element of  $B$ . Although many have studied this problem, the complete classification of such tilings is an open question.

BIOGRAPHY: Rachel W. Hall received a BA in Ancient Greek from Haverford College and a PhD in mathematics from the Pennsylvania State University. Her research interests are mathematical music theory and ethnomathematics. She is on the editorial boards of *Music Theory Spectrum*, *Journal of Mathematics and Music*, and *Journal of Mathematics and the Arts*. As a member of the folk trio Simple Gifts since 1995, she has toured throughout the Mid-Atlantic and released three albums. She plays the English concertina, piano, and (occasionally) tabla.

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TIME: 1:45pm to 2:45pm, in the GM Room  
TITLE: **A French Secret Applied to Invariant Manifolds**  
SPEAKER: *Mike Jolly*, Indiana University Bloomington  
This is joint work with John Lowengrub (UC Irvine) and Sharon Ulery (Bowdoin College).

ABSTRACT: In this self-contained talk we will start by explaining what invariant manifolds are, and how they can make the world a better place. We will then run through a brief survey of how to compute them. We will finish with a "new" method which uses some neat stuff from vector calculus (where the secret is revealed).

BIOGRAPHY: Mike Jolly received a B.S. in Mathematics from the University of Michigan, and a Ph.D. in Mathematics from the University of Minnesota. He held a post-doctoral position at Princeton University in Applied Mathematics and Chemical Engineering before joining the faculty at Indiana University. His research interests include the mathematical treatment of turbulence and invariant manifolds. His musical talents are pretty much limited to playing the radio.

## ABSTRACTS of CONTRIBUTED TALKS

### 10:15–10:40 in Olin Room xxx

*Joshua Holden*, Rose-Hulman Institute of Technology

#### **Math in Your Hands: The Use of Tablet PCs and Computer Algebra Systems in a Calculus Classroom**

In the Fall Quarter of 2008 we explored the use of Tablet PCs in calculus classes in order to foster student engagement by incorporating active learning and collaborative activities. The use of tablets can make many improvements in a classroom, but mathematics classes pose special challenges which have not yet been systematically explored at Rose-Hulman. The most difficult of these from a technical perspective is the integration of computer algebra systems such as Maple with other Tablet PC software. This project explores ways to achieve this integration as well as other pedagogical improvements which the use of Tablet PCs could bring to mathematics classrooms. We will report on the reactions of students as well as the impressions of the professor.

### 10:15–10:40 in Olin Room xxx

*Zsuzsanna Szaniszló*, Valparaiso University

#### **Graphs and Radio Channels**

Engineers need to assign frequencies to radio towers in a way that the broadcasts do not interfere. This Channel Assignment Problem is modeled in mathematics by labeling the vertices of different graphs. We will present an overview of the history of the problem and talk about some new results.

### 10:15–10:40 in Olin Room xxx

*John M. Cochran*, University of Louisville

#### **Linearized Active Contours Without Gradient Model**

One of the major models currently in mathematical imaging is the active contours without gradient model developed by Tony Chan and Luminita Vese. The model successfully detects objects that are not defined by gradient and is robust in the presence of noise. A linearized version of the model will be presented which inherits many of the beneficial properties present in the nonlinear model with the added benefit of fast convergence - at least for simple images.

Suggestions for possible undergraduate research will also be presented along with several examples of the model in action.

### 10:45–11:10 in Olin Room xxx

*Jerome Heaven*, Indiana Tech

#### **Integrating Numerical Methods/Analysis Into Undergraduate Math Courses**

The speaker will discuss ways he has integrated numerical methods/analysis into several undergraduate math courses serving the needs of a major in software engineering, which is highly project-based.

### 10:45-11:10 in Olin Room xxx

*Daniel Kiteck*, Indiana Wesleyan University

#### **Covers of Models**

Covers are a type of approximation generalizing concepts from homological algebra. Models (from mathematical logic) can be used to define algebraic objects. This talk presents an introductory example of a cover of a model.

**10:45-11:10 in Olin Room xxx**

*Young Lee, Manchester College*

**Epidemiological Approach to the South Korean Beef Protests with a Hidden Agenda**

Hundreds of thousands of South Korean protesters have staged candlelight vigils and demonstrations against US beef imports. The problems, however, go far beyond that of beef imports. The political party veterans, who lost the presidential election, exploit labor unions that are discontent with the economy and ideological student groups to weaken the majority party. In this study, an epidemiological model is constructed with a system of three nonlinear differential equations. The model seeks to examine the dynamics of the system through stability analysis. Two threshold parameters that spread the protests are identified. The results are also explored by deterministic simulations.

**11:15-11:45 in Olin Room xxx**

*Elton Graves, Rose-Hulman Institute of Technology*

**Classroom Demonstrations that Work (at least for me)**

This talk will consist of actual demonstrations (not computer simulations) that are used by the speaker to motivate and illustrate the mathematics that is being taught in the class. The demonstrations will include the cycloid & brachistochrone problem, directional derivatives and Lagrange multipliers, spring-mass systems, and Newton's Law of Cooling, and others as time permits. Audience participation will be requested.

**11:15-11:45 in Olin Room xxx**

*Herb Bailey, Rose-Hulman Institute of Technology*

**Jeeps crossing a desert**

One of several Jeeps is to penetrate a desert as far as possible with the others returning to base camp at the edge of the desert. They share fuel along the way. Previous solutions have tacitly assumed that they all leave base camp together. We show that in a hostile desert they can penetrate further if some remain behind and come out later to help the returning Jeeps. A simple version of the problem was a recent 'puzzler' on Car Talk.

**11:15-11:45 in Olin Room xxx**

*Jonathan O. Brooks, Ivy Tech*

**A Novel Viable Solution to the Schrödinger Radial Equation**

A Bessel function in cylindrical coordinates can be shown to be in correspondence to the Schrödinger equation. The Bessel function defines both the charge densities and radii of any orbital of all atoms of the Periodic Table. The time average portion being zero allows definition of charge density in the form of a quadratic which is a form developed by Euler and d'Alembert in the mid 1700's from a consideration of the Lagrangian. Radii stem from dual solutions to the Bessel function, one for the atomic case and another for the solar case. Since the solar case diverges, the only way to get an increase in atomic orbiting electrons is to do a Lesbegue summation of the converging solution. This is convenient because electrons at greater distance from the center travel faster; and, planets travel slower. It was necessary to invert Schrödinger's radial variable in a variable of a Taylor series to get compliance.

**1:15-1:40 in Olin Room xxx**

*John Lorch, Ball State University*

**Sudoku and Orthogonality**

Since a sudoku solution is simply a special type of latin square, it is natural to transfer questions about latin squares, including those about counting and orthogonality, to the setting of sudoku. In the talk we will focus on methods for producing orthogonal pairs of sudoku solutions as well as results concerning maximal orthogonal families of 'linear' sudoku solutions.

**1:15-1:40 in Olin Room xxx**

*Amos Carpenter*, Butler University

**Zeros of the Partial Sums of  $\cos(z)$  and  $\sin(z)$**

In this talk, we give new extensions of results by Szego on the interrelationships between the zeros of the partial sums of  $e^z$ , and those of the partial sums of  $\cos(z)$  and  $\sin(z)$ . We also include numerical results and figures which illustrate our new results.

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The Mathematics Department at Rose-Hulman Institute of Technology is pleased to host the 52<sup>nd</sup> Fall Meeting of the Indiana Section of the Mathematical Association of America, counting from 1957 when the Section started having an annual Fall Meeting and an annual Spring Meeting, and the 139<sup>th</sup> meeting of the Indiana Section of the Mathematical Association of America, since the first meeting of the Section occurred on October 16, 1924. For more information on the history of the meetings, ask Steve Carlson, the Historian of the Section or visit the INMAA Website.

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**From the Brief History of Rose-Hulman Institute of Technology**

One central purpose has guided Rose-Hulman Institute of Technology since its founding more than a century ago. In the words of President Samuel F. Hulbert, "the Institute's fundamental objective is to develop students academically, culturally, physically, and socially so that they can make significant contributions to the nation's economy, the resolution of social problems, and the welfare of human race."

This objective reflects the purposes and philosophy of the founder, Chauncey Rose, a Connecticut native of Scottish descent who came to western Indiana in 1817. A businessman, entrepreneur, builder of railroads, leading citizen and philanthropist, Rose and nine of his friends on September 10, 1874, established a corporation and articles of association aimed at creating and maintaining "The Terre Haute School of Industrial Science," an institution chartered under the laws of the State of Indiana "for the intellectual and practical education of young men." A Board of Managers consisting of Mr. Rose and his associates administered the school.

