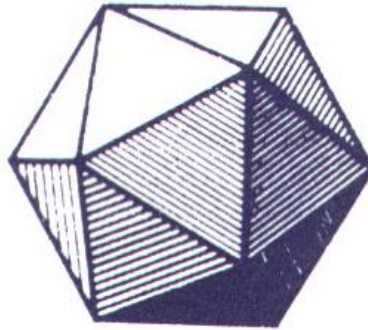


North Central Section

**Mathematical
Association of America**



Fall Meeting • October 20-21, 2017
University of Minnesota – Morris
Morris, Minnesota

Friday, October 20, 2017

7:00 – 8:30 **Registration** – Science Atrium
\$15 (Free for Students and Invited Speakers)

7:00 – 8:00 **Book Sales**, Science 2185
Internet access: connect to eduroam

Evening Session – Science 1020, Dr. Mark Logan, Presiding

8:00 – 8:05 **Welcome** – **Dr. Peh Ng**, Division of Science & Mathematics, **UM - Morris**
8:05 – 9:00 **Doug Anderson, Concordia College**
Proportional Derivatives: What They Are and How They Might Relate to
Fractional Calculus

9:00 – 10:00 **Reception** – UMM Student Center Alumni Room

Saturday, October 21, 2017

8:30 – 11:00 **Registration** – Science Atrium

8:30 – 11:00, 12:00-2:00 **Book Sales** – Science 2185

Morning Session – Science 1020, Dr. Peh Ng, Presiding

9:00 – 9:05 **Greetings: Dr. Michelle Behr**, Chancellor, University of Minnesota - Morris

9:10 – 10:00 **Section NExT Invited Speaker**

Kaisa Taipale, University of Minnesota – Twin Cities

Color Me Combinatorial: Beauty from Statistical Mechanics

Morning Concurrent Session I – Science 2190, Dr. Barry McQuarrie, Presiding

10:05 – 10:55 **Section NExT Activity**

Su Dorée, Augsburg University

Turning Routine Exercises into Activities that Teach Mathematical Inquiry

Morning Concurrent Session II – Science 2200, Dr. Dave Roberts, Presiding

10:05 – 10:25 **Jeremiah Bartz, University of North Dakota,**

Nu-gap Balancing Numbers

10:30 – 10:50 **Thomas Q. Sibley, College of St. Benedict & St. John's University**

Magic Groups

Invited Lecture – Science 1020, Dr. Peh Ng, Presiding

11:00 – 11:50 **Michael Pearson, MAA Executive Director**

Solving Problems: MAA American Mathematics Competitions and Evolving Views of Mathematics Education

12:00 – 1:00 **Luncheon** – Student Center Alumni Room

1:10 – 1:40 **Business Meeting** – Science 1020, Dr. Namyong Lee, Section President

Presiding

Afternoon Concurrent Session I – Science 2190, Dr. Chris Atkinson, Presiding

- 1:45 – 2:05 **Kristin Heysse, Macalester College**
Building Forests and Making Weekend Plans
- 2:10 – 2:30 **Joel Iiams, University of North Dakota,**
The Rumor Conjectures
- 2:35 – 2:55 **Nathan McClanahan*, Nicholas Stegmeier, Leon Yonan, Jung-Han Kimn,**
South Dakota State University
Parallel Simulations of Biofilms Based on the Cahn-Hilliard Equation
- 3:00 – 3:20 **Wook Kim, Minnesota State University - Mankato**
On Certain Group Representations in Number Theory

Afternoon Concurrent Session II – Science 2200, Dr. Merc Chasman, Presiding

- 1:45 – 2:05 **Hans Musgrave* (graduate), Paige Relling**
Extending Homotopy Perturbation Method to Recurrence Relations
- 2:10 – 2:30 **Julie Yuan (undergraduate), University of Minnesota – Twin Cities**
Geometric Representations of Polynomial Roots over Finite Fields
- 2:35 – 2:55 **Patrick Blee (undergraduate), University of Minnesota – Twin Cities**
Dice: Interesting and Unexpected Properties
- 3:00 – 3:20 **Namyong Lee, Minnesota State University - Mankato**
PIC Math Program Experience at Minnesota State University, Mankato

Local Organizing Committee:

Peh Ng (chair), Chris Atkinson, Merc Chasman, Harris Ismail, Mark Logan, Barry McQuarrie, Dave Roberts, Courtney Cook (math student rep).

Abstracts

Invited Addresses

- **Doug Anderson**, Concordia College, **Proportional Derivatives: What They Are and How They Might Relate to Fractional Calculus**

My colleague Darin Ulness from Concordia's chemistry department and I introduced proportional derivatives in 2015, which are motivated by proportional-derivative controllers in control theory. Their definition and properties will be explored, particularly the kind of calculus that they generate. A possible connection to the new Caputo-Fabrizio definition of fractional derivatives without singular kernel (2015, 2017) will also be briefly mentioned.

- **Michael Person**, MAA – Executive Director, **Solving Problems: MAA American Mathematics Competitions and Evolving Views of Mathematics Education**

Through its years as the American High School Mathematics Examination and now as the AMC, MAA competitions programs illustrate the evolving views of what constitutes effective mathematical problem solving, as well as identifying and cultivating mathematical talent. We'll take a leisurely tour through more than a half-century of the Association's efforts to advance mathematics through competitions.

- **Kaisa Taipale**, University of Minnesota – Twin Cities, **Color Me Combinatorial: Beauty from Statistical Mechanics**

It's easy for students to think that math is dead — nothing new since Euler, right? Totally symmetric self-complementary plane partitions (TSSCPPs), fully packed loop (FPLs), and domino tilings of Aztec diamonds say otherwise. These mathematical objects come up at the intersection of probability, combinatorics, algebra — and coloring! These very visual and frankly fascinating objects draw in mathematicians and non-mathematicians alike. In this talk, I want to tell a story of modern math research that brings together beauty, computers, and a number of Midwestern mathematicians. Come for the colors, stay for the math!

Section NExT Workshop

- **Su Dorée**, Augsburg University, **Turning Routine Exercises into Activities that Teach Mathematical Inquiry**

Asking questions, checking examples, making conjectures, and constructing counterexamples are part of any mathematician's toolkit and important skills for our students to learn. The MAA CUPM curriculum guide agrees, calling us to “include activities designed to promote student's progress in learning to . . . assess the correctness of solutions, create and explore examples, carry out mathematical experiments, and devise and test conjectures” with the goal that “students should develop mathematical independence and experience open-ended inquiry.” How do we help students develop inquiry skills and ignite their curiosity about mathematics? In this professional development workshop we explore some practical strategies you can use to transform routine textbook exercises emphasizing procedural fluency and basic conceptual understanding into activities that teach inquiry. Come ready to try your hand at creating inquiry-based activities.

Contributed Talks

- **Jeremiah Bartz**, University of North Dakota, **Nu-gap Balancing Numbers**

Gap balancing numbers were introduced by Panda and Rout as certain positive integers related to when the sum of two triangular numbers is a triangular number. In this talk, we give an alternative definition of gap balancing numbers motivated by geometric considerations. Using this viewpoint, several results are presented regarding classes of gap balancing numbers and related sequences. This is joint work with Bruce Dearden and Joel Iiams.

- **Patrick Blee (undergraduate)**, University of Minnesota – Twin Cities, **Dice: Interesting and Unexpected Properties**

Let's talk about dice! Are they always transitive? Is the distribution of the sum of two standard dice unique to them, or can we make crazy dice that together simulate their sum but individually look strange? You don't have to roll the dice and make guesses for these questions, we'll see how to answer them. Along the way we'll also see how dice bring together probability and algebra and how using dice when teaching probability can provide effective motivation.

- **Kristin Heysse**, Macalester College, **Building Forests and Making Weekend Plans**

Consider the following process on a simple graph without isolated vertices: Order the edges randomly and keep an edge if and only if it contains a vertex which is not contained in some preceding edge. The resulting set of edges forms a spanning forest of the graph. We explore the probabilities of this process forming k components and how this relates to a group of friends making plans for the weekend.

- **Joel Iiams**, University of North Dakota, **The Rumor Conjectures**

A running modulus recurrence (rumor) is a recurrence relation where z_0 , the initial seed, is any positive integer and successive terms are given by the formula $z_n = b \cdot z_{n-1} + c \pmod{n+k}$, where $b \geq 2$ and $k \geq 0$. We will discuss the genesis of the study of rumors, connections with the work of others, and progress on the rumor conjectures.

- **Wook Kim**, Minnesota State University – Mankato, **On certain group representations in number theory**

Group representations are ubiquitous in number theory but disguised in different forms. We shall discuss a few aspects of representations of algebraic groups of smaller rank such as GL_2 or GL_3 with a general view point. The goal is to introduce a well-known intertwining operator for induced representations in a concrete way.

- **Namyong Lee**, Minnesota State University - Mankato, **PIC Math Program Experience at Minnesota State University, Mankato**

PIC Math is a new program supported by MAA and SIAM and funded by NSF. It aims to increase awareness among mathematics faculty about non-academic career options for students, prepare undergraduate students for careers in industry, and provide research experience for students through a course in which students work on research problems from industry. In this talk, we present our own PIC Math program experience, including how we designed the course over the existing course, how students and instructor have engaged in this active learning class, what are some unexpected gains and losses through the project, and how students changed their perspective in learning mathematics, through the four group projects we got from industry.

- **Nathan McClanahan***, **Nicholas Stegmeier**, **Leon Yonan**, **Jung-Han Kimn**, South Dakota State University, **Parallel Simulations of Biofilms Based on the Cahn-Hilliard Equation**

Biofilms are attached microbial communities made of many different components. Biofilms are found throughout nature as well as industrial and medical settings. Understanding how biofilms spread is important in prevention and treatment of diseases and contamination. To model a biofilm we used an energy based model based on the Cahn-Hilliard equation and the Flory-Huggins equation. We will give a brief description of the background of these equations. We will discuss the numerical methods and the use of the Portable Extensible Toolkit for Scientific Computing (PETSc) developed at Argonne National Laboratory. Results consistent with observations in nature will be discussed.

- **Hans Musgrave* (graduate)**, **Paige Relling**, University of North Dakota, **Extending a Homotopy Perturbation Method to Recurrence Relations**

In this talk, a homotopy perturbation method (HPM) for solving integro-differential equations is extended to recurrence relations. The technique yields closed-form solutions for various linear recurrence relations including multivariate examples. Additionally, the method has applicability for equations with variable coefficients. This study demonstrates that the extended HPM is a powerful and efficient tool for solving recurrence relations.

- **Thomas Q. Sibley**, St. John's University and the College of St. Benedict, **Magic Groups**

Magic squares have fascinated people for ages. We'll explore some new twists: What if the elements to put in the spaces come from a group? And why should we be confined to the plane? How about magic cubes or magic hypercubes?

- **Julie Yuan (undergraduate)**, University of Minnesota – Twin Cities, **Geometric Representations of Polynomial Roots over Finite Fields**

The algebraic structure known as a finite field is a classic example of abstract mathematics with concrete applications. In this talk, we will exploit the existence of an isomorphism between finite fields of prime power order and vector spaces over finite fields to visualize polynomials as collections of points in affine space. In doing so, we will identify two distinct subsets of "line-containing" polynomials, developing criteria to determine whether a polynomial contains a line and if so, how many such lines.