Abstracts of Student Talks

Mathematical Association of America
Allegheny Mountain Section Meeting
University of Pittsburgh at Johnstown,
Friday April 9th, 2010

Krebs Hall, Room 200

7:30-7:45

Ashley Enstrom & Deanna Leandro, Edinboro University
Calculating π

We explore two well-known techniques for representing the number π. The oldest technique, attributed to Leibniz, evolves from the infinite series for the arctangent function. The second technique discusses the development of John Wallis' infinite product.

7:50-8:05

Richard Ligo, Westminster College
The Search for Extremal Graphs

Let G be a graph with v vertices. What is the maximum number of edges G may contain, while still containing no 3-cycle or 4-cycle as a subgraph? We have used computers to algorithmically search for the answer to this question, and in some cases have found graphs which improve the known lower bounds. We will give an introduction to the problem, describe what is known, including our preliminary results, and touch on some directions for future work.

8:10-8:25

Aron Siegel, Clarion University
Real Numbers Under Alternative Arithmetic

In this talk we will explore various properties that arise when the definitions of multiplication and addition are changed for the real numbers. This talk will explore identities, inverses, exponents, and determine how to define subtraction and division.

8:30-8:45

Emily Cunningham & Josh Fitzgerald, Clarion University
More Alternative Arithmetic

In a continuation of the "Circle Arithmetic" presentation, we will explore what positive and negative numbers become. We will also examine factoring under this alternative arithmetic, as well as look at the "circle" quadratic formula.

8:50-9:05

Shunika Hamilton, Washington & Jefferson College
The Number-Theoretic Function σ

For an integer $n \geq 1$, $\sigma(n)$ denotes the sum of all the divisors of n including n. This number-theoretic function, $\sigma(n)$, is related to several mathematic topics: perfect numbers, abundant numbers, deficient numbers, and amicable pairs of numbers. In this talk we use the number-theoretic function to define and describe the properties of these types of numbers. Moreover, this function is related to some well-known mathematicians, such as Pythagoras, Euclid, Euler, Mariano R. Garcia Jr., and Thabit ibn Qurra.

Krebs Hall, Room 201

7:30-7:45

Kevin Penner, University of Pittsburgh
The Role of Anti-Inflammatories in Chemotaxis Models

We describe a novel way to model inflammation. We examine the role anti-inflammatories play when added to a chemotaxis model containing macorphages and chemoattractant. The addition of anti-inflammatories allows for moving rash patterns, whereas the current literature largely focuses on stationary patterns.

7:50-8:05

Helen Parks, University of Pittsburgh
Recruitment Waves in a Periodically Forced Bistable Array

Psychophysical and neurophysiological experiments have demonstrated that retinal cells in 1:2 phase-locking with a forcing stimulus can recruit each other to different firing cycles over time to form a traveling wave. Counterintuitively, simulations show recruitment and traveling waves even when the model appears highly symmetric. Using numerics, analysis, and asymptotics, we examine a discrete model and its continuum limit to derive a recruitment condition and explain how the traveling wave velocity depends on parameters.

8:10-8:25

Mary Comerford, University of Pittsburgh at Johnstown
Three Normal Mixture and its Application

This talk will discuss the modality issues of a two and three normal mixture. It will explore the properties of these mixtures as well as develop a use for the three normal mixture. The three normal mixture will be used to determine the false positive and false negative results in high throughput screening drug test.

8:30-8:45

Marissa Goldrich, University of Pittsburgh
Human Immune Response to Influenza A Virus

Influenza A is a contagious acute respiratory disease that attacks healthy epithelial cells in the respiratory tract and infects them. The virus is suppressed by the immune system of the host which consists of multiple components that act at variable stages of the virus reproduction. I have modified a published mathematical model of the host immune responses to the Influenza A virus to account for the possibility of death of the organism due to the virus. I will discuss the benefits and shortcomings of each type of immune response, based on the variation of the reproductive capacity of the virus. Multiple outcomes are possible for certain ranges of reproductive capacity and I will discuss how the threshold for survival depends on the immune response.

8:50-9:05

Abigail Snyder, University of Pittsburgh
Understanding Synchrony in an Uncoupled Four Cell Model of Visual Oscillations

Experimental observations indicate that, in the presence of gamma oscillations and in response to a presented stimulus, neurons in the visual cortex tend synchronize to varying degrees as well as fire action potentials in a more oscillatory fashion. In particular, it is found that certain cells, which we refer to as Hub cells, tend to synchronize more strongly with both Hub and Non-Hub cells, regardless of the orientation preference of the cell, and, also, tend to exhibit stronger oscillations in firing patterns. Conversely, Non-Hub cells have weaker oscillations and tend to synchronize strongly only with cells of the same orientation preference or other Hub cells.

Using two Hub cells and two Non-Hub cells in an uncoupled 4-cell model, based on both leaky and quadratic integrate-and-fire neuronal dynamics, we demonstrate that the combination of Poisson distributed excitatory synapticinputs and varying strengths of coherent oscillatory synaptic inhibitory inputs can explain many aspects of the experimental results.

Krebs Hall, Room 220

7:30-7:45

Shane Mosier, Penn State Erie, The Behrend College
Statistical Analysis of College Football Betting Lines

I am exploring the impact of opening and closing spreads of the college football season in tracking winners and losers on a "straight-up" and "spread-factor" basis.

.

7:50-8:05

Dennis Pace, Slippery Rock University
Can Vampires Play Baseball?

This talk explores the physical interactions between supernatural beings and real-world scenarios that they are often placed in. Typical fiction, such as the "Twilight" series, tends to ignore external physical laws when describing feats of superhuman speed and strength. By modeling such events we will show that ignoring these physical laws has very unexpected consequences

8:10-8:25

Nicole Buckle, Allegheny College
An Exploration of the Mathematics of Google's PageRank

Google is one of the best known search engines, used by millions of people every day. We will begin by taking a brief look at the history of the well known search engine and its famous PageRank system. Then, we will create our own web example and explore the linear algebra and main theorems behind the workings of PageRank.

8:30-8:45

Kristen M. Hendershot, West Liberty University
Exploration of Level Sequences in Labyrinths

We will discuss labyrinths and a specific type of maze. Counting these is generally (famous and) quite difficult. However, a particular collection I considered was tractable, interesting, and may shed light on the general problem.

8:50-9:05

Robert Immendorf
Interesting Results With Dickson Polynomials

We take a look at Reverse Dickson Polynomials and look at their congruences mod p. We then focus on Permutation Polynomials and look to eliminate certain classes. I will present three theorems and proofs that we found during our research that eliminates some classes of Non-Permutation Polynomials.

Krebs Hall, Room 221

7:30-7:45

Austin Anuta-Darling, West Virginia University
Signatures of Chaos in Traveling-Wave Electrophoresis

Traveling-wave electrophoresis (TWE) is a method of ion separation and mobilization which utilizes longitudinal electric field waves traveling through a stationary fluid medium. In this research a 2-dimensional computer model of TWE is studied in order to determine the existence and properties of chaos which occurs in particle motions. The use of Lyapunov exponents plays a large role in this research as they distinguish between periodicity and chaos. Graphs of particle average velocities are found to contain devil's staircase structures that reveal a correspondence between map winding numbers and average velocities. This correspondence implies the existence of quasi-periodic states which are neither periodic nor chaotic.

7:50-8:05

Jeffrey Vargson & Nadia Man, Indiana University of Pennsylvania
Image Deblurring

The process of deblurring an image is just one example of the difficult task of attempting to solve an ill-conditioned inverse problem. In a time when digital imaging becomes increasingly popular, the demand for clearer images also grows. The goal of this study was to use MATLAB programming to apply two deblurring methods to a blurred image. Both the Tikhonov regularization method and the Truncated SVD method had successful, but imperfect, results.

8:10-8:25

Matt Kosko, University of Pittsburgh
Ants on Pheromone Trails

My research involved employing differential equations to model the movement of ants along chemical trails. I considered a simple "concentration difference model," whereby the ant's movement along a trail is governed by the concentration difference that the ant senses between her two antennae. The programs XPP and Matlab were used to model the ants on the trails. I concluded that ants have certain "critical velocities," the speeds at which the ant can move to stay on the trail, that are dependent on factors such as bending in an otherwise linear trail and the length and width of the ant's antennae. The research has larger implications in the design of objects that move through sensing changes in the environment."

8:30-8:45

Amanda Sgroi, Duquesne University
Mathematical Grain Boundary Detection Algorithms for Varying Polycrystalline Materials

Image segmentation, the separation of data into distinct components or objects, is a widely explored problem in image processing. However, the problem of determining object boundaries in real images such as the grain boundaries of polycrystalline materials as detected by scanning electron microscopes (SEM), is an increasingly difficult problem. Due to the varying qualities of individual metals, various algorithms for determining the grain boundaries, or skeletons, have been explored.

Initially, we found the boundaries for aluminum grains by combing the gradient of various anisotropically smoothed SEM images and then applied morphological operations. We then attempted to find copper boundaries using the same methodology and discovered some unique challenges when applying these mathematical segmentation techniques to different polycrystalline materials. Currently we are exploring the determination of platinum grain boundaries.

We have explored two different forms of platinum images with varying visibility, leading to variations in the algorithms needed for each set. In this talk we will discuss the evolution of our mathematical grain boundary detection algorithm and how the algorithm must be adapted to account for different metals.