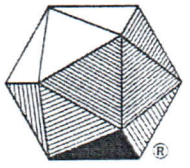
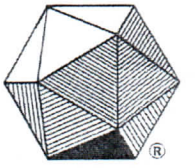


Mathematical Association of America
Golden Section (Northern California, Nevada and Hawaii)
Saturday, March 4, 2017
Santa Clara University
STUDENT POSTER SESSION ABSTRACTS



Title. *Generating classical multiplier sequences*

Authors. Summer Al-Hamdani and Alexandra Leon, California State University, Fresno

Faculty sponsor. Dr. Tamas Forgacs

Abstract. Inspired by two claims in "Multiplier sequences, classes of generalized Bessel functions and open problems" by Csordas and Forgcs, our main goal was to verify that two particular multiplier sequences can be generated using the methods of the above mentioned paper. We present proofs that certain Bessel-type functions generate multiplier sequences, whose generic terms are Cauchy-products of Laguerre polynomials and hypergeometric functions respectively. We also give possible ways to extend proofs to a large class of generating functions.

Title. *Locally linear embedding of chromatic clusterings in temporal and spatial domains*

Author. Linda Beverly, California State University, East Bay

Faculty sponsor. Dr. Shirley Yap

Abstract. The capability to identify chromatic groupings within video is an important application of video processing. In this poster we present an application of Locally Linear Embedding, a method of geometric dimensionality reduction, applied to identifying similar color regions over time within video. This technique preserves the underlying geometric information. Identifying similar regions of color may be used to preprocess information that may be used to prepare the information for video compression and psychovisual optimization.

Title. *Propagation of lead in the human body*

Author. Jordan Collignon, California State University, Monterey Bay

Faculty sponsor. Dr. Todd Kapitula (ICERM)

Abstract. Lead is a toxin that has well known side effects including fatigue, muscle pain, impaired kidney function, lower IQs for children, and brittle bones. Lead can be absorbed into the body through paint, air, water, and various other consumer products. Once ingested, blood transports lead throughout the body, where the vast majority of lead absorbed accumulates in the bone, particularly in the tougher cortical bone and the spongy trabecular bone. In this work, we explore a three-compartment dynamic ODE and PDE model for lead in blood, cortical bone and trabecular bone. Previous models have not fully explored the concept of nonlinearity and diffusion in the process of body lead propagation. Numerical solutions of the model equations allow us to compare our results with those from previous work and suggest that nonlinear interactions between compartments may play a significant role in the dynamics of lead propagation.

Title. *Geometry of ERGMs*

Authors. Rodolfo Garcia and Ha Nguyen, San Jose State University

Faculty sponsor. Dr. Elizabeth Gross

Abstract. Exponential random graph models (ERGMs) are families of distributions defined by a set of network statistics and, thus, give rise to interesting graph theoretic questions. Our research focuses on the ERGM where the edge, 2-path, and triangle counts are the sufficient statistics. These models are useful for modeling networks with a transitivity effect such as social networks. For statistical tests, given an observed network G, one would like to understand the set of simple graphs with the same edge, 2-path, and triangle counts G. This set is called the fiber of G and are the 0-1 points on an algebraic variety, which we refer to as the reference variety. The goal of this project is to understand the geometry of the reference variety. In particular, our poster focuses on understanding graphs that are singular points of the reference variety. This direction has leaded us to discover a connection between graph automorphisms and graphs with deficient Jacobian.

Title. *Ultrasound nerve segmentation*

Author. Rosa Garza, University of Southern California

Faculty sponsor. Dr. Neelesh V. Tiruviluamala

Abstract. Through machine learning and artificial intelligence, we developed a neural network to analyze ultrasound images, identify nerve cells, and locate their exact position. The data science competition, hosted by the online platform Kaggle and sponsored by Halyard Health, proposed a solution to post-surgical pain with the placement of catheters at the source of discomfort. For this procedure to be successful, my team and I tested different neural network model architectures to detect which would most accurately identify nerve cells in ultrasound images. We improved from an accuracy score of 0.51 to 0.54317 after implementing a U-net model. The significant increase in accuracy score showed with more improvement to the U-Net, our model's accuracy score could have continued to improve and help future researchers understand which techniques are better to analyze images with visual distortion.

Title. *Analyzing sexual transmission in the spread of the Zika virus in Colombia*

Author. Victoria Kelley, University of California, Davis

Faculty sponsor. Dr. Juan Cordovez (Universidad de los Andes) and Dr. Carlos Castillo-Chavez (Arizona State University)

Abstract. Zika has become a global concern for public health due to its devastating birth defects for pregnant women and its rapid spread through Latin America and the Caribbean. In Colombia the outbreak started in October 2015 and since then, 87,355 cases have been reported. The Zika virus is a vector borne disease transmitted through the bite of the female mosquito Aedes aegypti, however there is evidence of a sexual transmission route for this disease. Mathematical models are helpful to understand the diseases dynamics and to identify the most important infection routes. Using SIR models as tools, we developed a mathematical model to evaluate the role of sexual transmission in the spread of the disease. We evaluated the importance of this pathway for the current outbreak in Colombia.

Title. *Early undergraduates' emerging perceptions of proof and conviction*

Author. Ryan Pugh, California State University, Monterey Bay

Faculty sponsor. Dr. Alison Lynch

Abstract. Our project focuses on early undergraduates' beliefs surrounding conviction and proof. Specifically, we are interested in what these students believe is convincing, what they believe a proof is, and how these ideas are related. Through conducting interviews and performing data analysis, common features began to present themselves. In this poster, we will explore these features and their connections to our research questions.

Title. *Projective geometry and music*

Author. Kecia Sako, San Jose State University

Faculty sponsor. Dr. Jordan Schettler

Abstract. The cross ratio (involving 4 collinear points and distances between them) is a fundamental invariant in projective geometry. Lengths of line segments give rise to frequencies of vibrating strings, and the cross ratio can be interpreted as a measure of how those frequencies sound together. In particular, features of the cross ratio can be visualized on a fanned fret guitar or in major triad chords on a piano.

Title. *A quantitative survey of improvements to Cauchy and Pellet radii of matrix polynomials*

Author. Timothy Shur, Santa Clara University

Faculty sponsor. Dr. Aaron Melman

Abstract. This paper uses 37 real-world problems problems to quantitatively test two recent improvements to generalized Cauchy and Pellet radii of matrix polynomials to illustrate their practical effectiveness.

Title. *Finding classes of identifiable linear compartment models using graph theory*

Author. Jennifer Young, Santa Clara University

Faculty sponsor. Dr. Nicolette Meshkat

Abstract. The parameter identifiability problem in systems biology deals with the question of which unknown parameters of a model can be determined from given input-output data. If the parameters can take on an infinite number of values and yet yield the same input-output data, we say the model is unidentifiable. Linear compartment models are used to model the transfer of material between compartments, which can be related to the mathematical notion of a directed graph, where the vertices represent the compartments and the edges represent the rates of transfer. We use a program written in Mathematica to find all minimal configurations of inputs and outputs required for an identifiable model. We also examine classes of models with n compartments and n edges arranged in a cycle and investigate how many edges can be added without rendering the model unidentifiable.
