Department of Mathematics and Statistics Colloquia

Student Research Presentations

(Monday, December 7 at 3:45 pm in Roop 103, refreshments at 3:30)

Title: *A Study of a Straight Rod under Twist and Tension with Different Constitutive Relations*

Speaker: Vicky Kelley (Faculty advisor: Eva Strawbridge)

Abstract: Starting with a straight rod under tension, we are studying the perturbations in twist and bend using the Kirchhoff Rod Model. Additionally, we can include the effects of drag approximated by resisted force theory. Finally, this model can inform us about the response of internal forces compared to external ones. This work has applications to the study of worm locomotion, bacterial flagella, and DNA.

Title: *Analyzing Multistationarity in Chemical Reaction Networks Using the Determinant Optimization Method*

Speaker: Zev Woodstock (Faculty advisor: Paul Warne)

Abstract: Multistationary chemical reaction networks are of interest to scientists and mathematicians alike. While some criteria for existence of multistationarity exist, obtaining explicit reaction rates and steady states that exhibit multistationarity for a given network — in order to check nondegeneracy or determine stability of the steady states, for instance — is nontrivial. Nonetheless, we accomplish this task for a certain family of sequestration networks using a generalization of Craicun and Feinberg's Determinant Optimization Method.

Title: *The Critical and Smith Groups of the Rook's Graph and Its Complement*

Speaker: Jonathan Gerhard and Noah Watson (Faculty advisor: Joshua Ducey)

Abstract: A major algebraic invariant of graphs is the critical group, which can be understood both algebraically and combinatorially. Given a graph G on n vertices, we can view its Laplacian as a map L from $\mathbb{Z}^n$ to $\mathbb{Z}^n$. The critical group $K(G)$ is defined to be the torsion subgroup of $\mathbb{Z}^n/\mathrm{Im}(L)$. Critical groups are known for only a few families of graphs. Combinatorially, we can think about playing a chip-firing game on our graph G. We begin by placing a non-negative number of chips on every vertex of our graph except for one that we will call the bank. The bank has the negation of the sum of the chips on the other vertices, so that the total sum of all vertices is zero. This set-up is called a configuration of the graph. If a vertex has more chips than its degree, it can "fire" by sending one chip to each adjacent vertex, with the bank firing only when no other vertices can. Two configurations are considered equivalent if one can be reached from the other through chip-firing. A configuration is called critical if no vertices but the bank can fire and we can get back to it through chip-firing.