Emergence of dispersive shock waves and rarefaction waves in dimer granular crystals Madeleine Généreux, 2019

This summer, I studied the mathematics behind granular crystals. This combined my academic interests because the equations I worked with and derived are based in physics and the applications of studying shocks propagating in granular chains are rooted in engineering.

A granular crystal is a chain of materials that interact with one another. For this research, it is useful to look at a

make it possible to look at the behavior of shocks in chains, we can better understand how to design a material that could eventually absorb shocks. Similarly, another application is energy harvesting. It is interesting to understand how being able to capture shocks traveling through a material could help transform mechanical energy into other forms of energy.

My role specifically in this research project was to derive a Partial Differential Equation (PDE) to represent strain in a dimer lattice. Strain is defined as the difference in displacement between two adjacent masses and a dimer lattice is a chain in which the masses are not identical. Most previous research has focused on monomer chains, chains in which the masses are identical, and it is a good starting point to derive new equations. After having derived a possible equation, it was important to visualize the solution. Using MATLAB, it is possible to compute a solution to the problem and gain new insights. For example, I visualized the strain as a function of particle index at different times (left) and a space-time contour plot strain (right) for a dimer lattice with a mass ratio of .7.



Faculty Mentor: Professor Chong

Funded by the Student Faculty Research Grant Fellowship supported by my National Science Foundation grant titled "Strongly Nonlinear Dynamics of Lattice Networks: From Analysis to Application."