Research Statement

Leigh L. Noble

http://www.leighnoble.org/ noble@leighnoble.org

USMA, MADN-MATH, 646 Swift Rd, West Point NY 10996 (845) 938-2413
http://www.math.usma.edu/people/Noble/ leigh.noble@usma.edu

Loosely speaking, my specialty is mechanics of materials, which is a discipline on the cusp of math, mechanics, and materials science. I am interested in inverse problems in mechanics. I view my research interests as having four major regions. The first three are my dissertation research, extensions to it, and my fellowship research. The fourth area contains topics which capture my curiosity but for which I have not yet developed research projects.

My dissertation research focused on recovering the crystallographic texture coefficients through the thickness of certain sheet metals. This is an inverse problem for if we know the texture coefficients we can predict the mechanical properties, but it is the mechanical properties which we can directly measure and the texture coefficients we desire. During the manufacture of sheet metals, the mechanical action of rolling imparts a preferred orientation of crystallites in the sheet. This crystallographic texture affects the mechanical properties (such as strength or hardness) and is of interest to industry. When the texture is represented as an infinite series of generalized spherical functions, certain coefficients can be used to predict various mechanical properties of the sheet. My work demonstrated a nondestructive method to determine texture coefficients as a function of depth and showed existence and uniqueness of the solution to the associated PDE. I am interested in continuing this research by becoming better at the quantitative nondestructive measurement at the heart of my work and strengthening the mathematical results by investigating regularity.

I am currently involved in extending this research with Chi-Sing Man at the University of Kentucky. We are building on previous work of Man, Cai, Donohue, and Fei[1] on attenuation and combining it with my work on texture. This combination allows us to determine how internal friction present in sheet metals may affect the texture coefficients calculated using the method from my dissertation work. We expect to submit a publication shortly describing the case with homogeneous attenuation. Ultimately I would like to include inhomogeneity in both attenuation and texture; additional existence, uniqueness, and regularity results deserve exploration as well. This is a rich vein of work.

My fellowship investigates cracking of advanced ceramics under conditions of high strain rate and high compressive stress. My general goal is to better understand the reasons

[1] C.-S. Man, Z. Cai, K.D. Donohue, P. Fei, "Anisotropic Ultrasonic Attenuation in an AA 5754 Aluminum Hot Band." *Aluminum Wrought Products for Automotive, Packaging, and Other Applications*, pp. 35–43, TMS (The Minerals, Metals, and Materials Society), 2006.

why this cracking occurs and attempt to predict when or how it will happen. More specifically, I wish to determine some relationship between microstructure, specifically texture, and cracking. I am also looking at the relationship between the distribution of internal stresses immediately prior to the onset of cracking. An attempt to ascertain a relationship between the microstructure and the internal stress distribution is also desired.

My training has been focused broadly on the applied math disciplines with a healthy appreciation for pure mathematics and an understanding that all branches of math can become necessary when investigating problems involving the physical world. I am interested in many topics, including numerical computation, neural networks, and neuroscience. It is my hope that I will have an opportunity to explore math during my career and share my discoveries with others.