**Funded Research:**

I will characterize how photo-responsive dye-doped glassy polymer (PMMA) fibers, glued to paper, induce changes in the paper in response to UV light. This will include varying the parameters used to create the fibers, such as the amount of chain transfer agent used (controls the molecular weight of the polymers). Once the fibers are created, I will also vary the types of paper and types of glue used. The ultimate purpose of studying the characterization of these fibers is to create a large three-dimensional structure, like a satellite, that could be folded up into a practical structure for transport, then unfolded using the photomechanical response.

To characterize the photomechanical response, I am developing an imaging system to quantitatively measure the response. The topography of the fiber/paper will be characterized using an edge detection technique known as the “variance of the Laplacian” technique. The Laplacian operator measures the 2nd derivative of the image. Since the image's entries are (of course) not continuous functions, the Laplacian is implemented by convolving the image’s matrix with a Laplacian “kernel.” When I calculate the variance of the result, I find meaning in that value; a high variance indicates a wide spread of responses, both edge-like and non-edge like. These are qualities of an in-focus image. A low variance indicates there are few edges, indicating blurriness. My “twist” on the technique is that I am dividing the image into many sub-images and performing the operation on each sub-image. Thus, each variance I calculate is a direct indicator of the edges at each point in the image. Plotting these results with respect to their location in the image yields a three-dimensional reconstruction of the surface. The edges are of use because I can vary the distance of an intermediate lens to the focal plane. Any deviance from that (i.e. the fiber’s photomechanical response) can be quantitatively measured with my technique. The variance of a particular position is correlated with its height above the lab table. My other hope with this project is to be able to recover the depth of an object in this way, as that is something that could be used in almost every scientific field. For instance, a NASA rover could use this imaging technique to safely land on an unknown planetary object.

**How it will help in my future academic or career goals:**

This research will be (and has been) an invaluable experience for me. As one who would ultimately like to become a software engineer, the experience of working and collaborating in a group has many benefits. I am learning to communicate my ideas effectively. Additionally, working in a team is a vital component of a computer scientist’s job because of the collaboration involved. While it is fun to think and work independently on a project, I also highly value the input from everyone else. My project wouldn’t be as complete without the others’ help. The old phrase, “Two minds are better than one,” has never rung so true. Lastly, I am getting firsthand experience in the software development process. I am given instructions on what my software should do, but I am free to implement whichever design I choose. This mimics how actual software development occurs.

The research experience itself has taught me about receiving funding and what independent research is about. In the future, I will draw upon this experience. I’ve learned how to apply for research grants, how to carry out independent research, and (hopefully) how to present my findings.

Lastly, creating my imaging technique has given me crucial experience in coding in Python. Python is becoming an increasingly more important language in the industry. The sooner I get experience in it, the better my career prospects will be.