I am applying for a NIST student undergraduate research fellowship (SURF). I am a sophomore math/physics double major at Cornell University. I've worked in a numerical micromagnetics research group at Cornell, studying spin-torque driven resonance in nanoscale ferromagnets. I have taken many courses that taught me applied math concepts. I am an independent problem-solver, and I am always thinking about how I can extend and generalize my knowledge. I think that my experience modeling magnetic materials, designing image-recognition models, and applying coursework to research problems makes me a good candidate for a NIST Student Undergraduate Research Fellowship with ITL/CTL.

I have taken a broad range of courses in applied math and physics. I've taken two courses in linear algebra, a course in numerical integration, a course in complex analysis, and a course in multivariable calculus. I am currently working on a research project with my Complex Analysis professor. In addition, I am familiar with using the calculus of variations to derive equations of motion, as well as other physics concepts, from courses in classical and wave mechanics.

I have relevant experience in computational science research in micromagnetics. In the summer of 2014, I worked as a research intern under John Phillip at Catholic University's Vitreous State Lab, designing micromagnetic simulations. The simulations broke a magnetic material into a mesh, and integrated the Landau-Lifschitz equation that describes the dynamics of a magnetic material. I varied integration parameters to make sure that the computational system did not diverge. I also designed a system to automate running simulations. This fall, I continued to work on micromagnetics with Prof. Dan Ralph's group at Cornell. After I took a Numerical Analysis course which covered fourier analysis, interpolation, and Runge-Kutta integration I noticed how these concepts were used in the micromagnetic software package. I was then able to implement my own model directly using the integrators, which I was able to adjust to clearly investigate the new problem.I began to write more complicated models, and implemented dynamics simulations myself, rather than using pre-existing packages. I've been very excited about getting insight into how magnets behave by simulating them.

I enjoy independently learning about computational and mathematical problems, and trying to solve them myself. For example, I've been interested in using neural networks to solve computer vision problems, and I've sought out a wide variety of papers and articles to learn how to build a functional neural network. Building neural networks has given me a space to use concepts that I've learned in linear algebra classes at Cornell. I've read Neural Networks for Pattern Recognition by Christopher Bishop, Neural Networks and Deep Learning by Michael Nielsen, and Herbert Jaeger's 2003 lecture series on implementing recurrent neural networks. The best feedforward neural network I've built reads handwritten digits with 98% accuracy. I am very excited to see that the Information and Communication Technology Laboratory researches mathematical modeling and image analysis. I would be eager to learn more about neural-network based computer vision, and I would be even more excited to learn more about the different methods of machine learning and where they can be applied to solve real problems.

I think that my experience modeling magnetic materials, designing image-recognition models, and applying coursework to research problems makes me a good candidate for a NIST Student Undergraduate Research Fellowship with the Information Technology/Communication Technology Lab. I want to work with the Information Technology/Communication Technology Laboratory (ITL/CTL), because I want hands-on experience in computational sciences and applied mathematics. I am interested in the ITL/CTL research on mathematical modeling and image analysis. I think that working among experienced researchers would help me refine and extend my knowledge of simulating nonlinear dynamics. I am very interested in using computational science and applied mathematics to solve real world problems, and I'm excited about the chance to acquire some of the expertise that resides at NIST ITL/CTL. I would benefit tremendously from working with experienced mentors and learning from their intuition and expertise. I would have interesting problems to work on, and a place to apply the concepts that I have learned in the classroom to solve real-world problems. My experience learning concepts, seeking out information, and using it to implement solutions makes me a good candidate for the NIST SURF internship.