"Paint the walls orange. Make the floors green. People need to stand out from the background."

Wrapping up my final presentation as an MIT Lincoln Laboratory intern, I recommended this unusual décor to as an immediate way to improve the performance of automatic video surveillance systems. Though I hardly expect airports and embassies to become eyesores, I wanted to illustrate the difficulty motion detection algorithms have distinguishing people dressed in dark attire from the shadowy backgrounds found in many secure facilities. My nine-week project on multi-camera tracking resulted in several conclusions like this one identifying the bottlenecks associated with processing real-world security footage. After my presentation, I was approached by a full-time lab researcher who wanted to share my results with security officials the next week. I will never forget how rewarding it was to know that surveillance decision-makers actively sought the knowledge I had battled for all summer. In that cathartic moment, I knew I could make an exciting and meaningful career in application-driven computing research.

My passion for technical research was first inspired by the power of formal mathematics. As a rising junior, I tackled a summer team project at a UCLA REU sponsored by Microsoft Research Asia (MSRA). Trying to characterize the stable structures that can arise from ad-hoc network formation, I saw how elegant concepts like symmetry could be harnessed to prove our sponsor's conjectures about connectivity. My teammates and I were so excited about our results we snapped a team photo in front of our equation-ridden whiteboard. Discovering the power of formalism inspired me to pursue further research grounded in mathematics. In later reflections, however, I realized I was unsatisfied that all I had to show for months of effort was a few elegant proofs. I resolved to find ways to deploy mathematics to solve problems that originated in the everyday lives of people outside of academia.

This desire led me to work at Lincoln Laboratory, where I investigated automating multi-camera tracking. In this project I could easily satisfy my appetite for formal analysis by fitting Gaussian mixtures to model a scene's static background or inferring the average visitor's transition time between cameras via cross-correlation. Unlike my previous work, though, this elegance had obvious real-world purpose behind it. Moreover, in pursuing that purpose I discovered an additional research interest: designing evaluation procedures and metrics that assess whether a software system achieves its objective. Based on my Lincoln Labs experience, I know that I thrive in projects merging formalism and experimentalism. Multi-camera tracking offers an excellent opportunity to apply both skills toward meaningful impact for national security, and I cannot wait to tackle long-term research in this area.

As a leader of several long-term student research teams, I know what it takes to sit in the driver's seat of technical investigations and guide projects from exploratory stages to publishable results. Olin's learn-by-doing curriculum has seen me complete self-driven team projects in every semester. My track record includes a wirelessly-controlled hovercraft and an emulation of the Apollo Guidance Computer. Furthermore, as Project Manager of my team at UCLA, I led an international team of American and Chinese students from initial cluelessness about game theory to a competitive conference submission (see previous research statement). In this role I learned how to build cohesion and momentum within a diverse team and prioritize our collective efforts to achieve sponsor objectives. Eager to build further skills in leadership, I currently serve as Project Manager of my undergraduate capstone engineering project. I establish the technical checkpoints necessary to keep the project on track and coordinate reviews of our progress with our liason, an IBM Fellow. My experience-forged competencies in leadership, teamwork, and technical achievement will allow me to hit the ground running in graduate school and immediately contribute to impact-driven research.

Graduate school offers an ideal setting for the in-depth investigation of video surveillance research I propose. First, my current theoretical knowledge must be bolstered by intense study of topics such as Bayesian reasoning and computer vision for my project to succeed. Additionally, achieving progress on a multi-camera tracking system, especially empirical evaluation, will demand huge investments of time and devotion that I would not be able to commit outside of a scholarly environment. Joining the CSAIL computer vision group at MIT appears to be an excellent match of my research interests and would keep me institutionally connected to work at Lincoln Laboratory. Graduate research here will provide me with the flexible, collaborative work atmosphere Olin has raised me to thrive in.

After graduation from a PhD program, I hope to join the full-time staff at Lincoln Laboratory to pursue further video surveillance research. Armed with expert knowledge from a successful graduate investigation, I look forward to returning to a setting that offers regular opportunities to make recommendations to practitioners and achieve tangible impacts. I hope to spend several years here improving the algorithms and evaluation metrics used for multi-camera tracking systems and communicating results to practicing security decision-makers. As my work develops, I hope to transition to a university professorship where I can continue research but also devote time to my other passion: technical education.

Inspired by the first-class instruction and mentorship received throughout my life, I want to become an educator that enables students of all backgrounds to solve meaningful technical problems. At Olin I lead a service project called Engineering Discovery in its charge to make science and engineering accessible, relevant, and fun for a younger audience. I will never forget the day I brought a "see your own DNA" lesson to a primarily black group of 5th graders at an underprivileged school in Dorchester, MA. Sequan, the most rambunctious of the bunch, couldn't contain his excitement after his concoction of cheek swab, Gatorade, and dish soap produced the spider-web-like threads of his own DNA. When I asked what he thought of biology, he replied, "It's better than cool. It's *ill*!" This experience showed me that hands-on curriculum can motivate students from all backgrounds to find science engaging and relevant. Now as Engineering Discovery's curriculum director I am continually amazed at what students can do within an open-ended design challenge. During a recent workshop, I saw 4th graders design rockets with innovative fin shapes that launched far higher than the simple models I had built. Providing students with open-ended hands-on projects appears to me the ideal way to expand technical endeavors beyond their traditional audience and spark a lasting passion for science and engineering.

I fully expect to continue my commitment to hands-on, open-ended learning as a university professor. As a product of Olin's project-based curriculum I have seen firsthand how valuable these pedagogical techniques are for maintaining motivation and achieving learning outcomes as an undergraduate. As a future professor I hope to pay forward to my students the quality of instruction and personal attention I received at key stages of my college education. Through design challenge-based course projects and mentoring undergraduate research efforts, I hope to introduce all my undergraduate students (especially those from underrepresented groups) to the thrill of open-ended technical research.

My greatest ambitions in life are to leverage the power of mathematics and computing to solve meaningful problems and communicate the excitement and relevance of these techniques to a broader audience. The NSF Fellowship would provide me with flexibility to pursue both goals in my immediate future and establish a productive career as an impact-driven researcher and educator.