My first foray into robotics was an online course, “Robotics: Aerial Vehicles” instructed by Professor Vijiay Kumar from UPenn GRASP Lab. I was struck by the mathematical beauty of the modeling, planning, and control, vital for the functioning of aerial robots. This course inspired in me a desire to pursue robotics as an academic field of study. I carried this excitement with me through my undergraduate years, and, as a graduate student, I would like to focus my studies upon the more specific branch of autonomy - algorithms for perception and planning.

As a Tsinghua University undergraduate in Mechanical Engineering, I have excelled in my major. I rank XXX out of the XXX students in my department. During my study abroad at UC Berkeley, I achieved a 4.0 GPA. My early exposure to robotics showed me the field’s interdisciplinary nature, and, for that reason, I minored in Computer Science. My major in Mechanical Engineering has provided me with a deep understanding of dynamics and control techniques, while my minor in Computer Science has armed me with a solid foundation in algorithms as well as software and hardware systems. By remaining knowledgeable of the latest open-source tools and robotics publications, I am working towards becoming a full-stack robotics researcher.

Robotics, I believe, is an experimental science. From my experience, robotics research involves both fundamental knowledge (theory) and proficiency in hardware platforms (experimentation). Consequently, I have prepared myself for graduate studies in two ways. First, I acquired a solid skillset in robotics experimentation. Through several projects, I have gained hands-on experience with STM32 and Pixhawk (embedded systems), PX4 (the open-source flight control software), ROS, caffe (a deep learning framework), SIMULINK, and many others. Familiarity with these tools helped me progress in projects and made me comfortable debugging with hardware. Secondly, I actively acquired robotics-related knowledge beyond my undergraduate curriculum. I gained extensive experience in computer vision and path planning through various research projects. During my undergraduate years, I also taught myself through several classic robotics-related textbooks, covering the topics of kinematics, optimal control, estimation, and reinforcement learning.

Ultimately, I want to build an autonomous flying vehicle, which I believe will be the solution to future transportation. There are, however, several key issues that need to be addressed around this goal. These issues form the foundation of my research interests. There is still a great deal of work to be done in localization, planning, and control for robots; they constitute a pipeline of what an intelligent agent should be doing while trying to locomote. In my journey to explore robotics, I have tried and endeavor to continue tackling interesting questions that occur along this pipeline.

My research at UC Berkeley focused on path planning. When I studied abroad at UC Berkeley, I completed an independent research project under the supervision of Professor XXX. We worked on a project entitled “Learning from Human Demonstration”. In this project, we utilized point set registration, a computer vision algorithm, to generate a reasonable path for robotic manipulators according to human lead-through teaching. Our work enabled robots to manipulate 2-D objects safely. I was very excited to be the primary author of a paper that we have submitted to XXX, the premiere robotics conference. From this experience, I learned the novel idea of *imitation* in path planning and began to understand how perception algorithms can play a key role in robotic planning and control.

I developed a deeper understanding of perception algorithms during my internship at Aptiv (formally known as Delphi Labs Silicon Valley), where I worked on lane detection for autonomous driving. In this project, I utilized neural networks, combined with classical computer vision algorithms, to localize the vehicle and feed lane information into the vehicle controller. My work achieved state-of-the-art performance for lane detection tasks, running at 50Hz. This exposure to industrial robotics application made me realize the importance of an effective algorithm's robustness and speed and implanted in me the determination to develop algorithms that can meet industrial standards.

Following the project at Aptiv, which leveraged machine learning for perception, I am now working on reinforcement learning for planning. In my current undergraduate thesis project, "Path Planning for Autonomous Vehicles at a Roundabout", I am exploring reinforcement learning in partially observable Markov decision processes; I seek to improve the outcome of reinforcement learning with a combination of model-based and modeless techniques. With these projects, I have begun to realize that while machine learning improves robots' capability to generalize, it is sometimes too erratic and cannot be properly explained. The integration of machine learning with classical algorithms in control and planning is one of the topics I wish to explore.

My research experience thus far has shown me that algorithms must be extremely robust and rapid in order to be eligible for industrial application. Therefore, I believe that experimental validation of ideas and algorithms is important, and I want to ensure that algorithms can run real-time in real-life scenarios on robotic test beds. In pursuit of my desire to develop a flying vehicle, I want to leverage aerial vehicles as the primary platform for research in my graduate studies. Doing so will aid me in addressing interesting questions in robotic perception and planning. My experience with flight control utilizing Pixhawk and PX4 familiarized me with this platform. Compared with other robotic systems, a UAV platform presents exciting possibilities with more degrees of freedom, a broader view, and relatively easy dynamics and control properties. In the meantime, it induces challenges like limited computing resources.

With these thoughts in mind, I am interested in two topics in particular for graduate research. First, I want to investigate fast and robust perception algorithms with a focus on visual input. I believe robotic systems that can be massively delivered need to be on a tight budget, both in terms of inexpensive sensors and limited computing resources. Professor Luca Carlone's research on resource-constrained perception algorithms resonates with me in this regard. The second question I want to address is high-level planning and decision-making algorithms. I wish to explore the integration of reinforcement learning algorithms with classical optimization techniques, with specific tasks of planning. Related to this topic, Professor Jonathan P. How's research on multi-agent reinforcement learning and Professor Nicholas Roy's research on path planning for micro UAVs are of particular interest.

I aspire to become a leading robotics researcher in industry and ultimately develop a flying vehicle for future transportation. I have laid a solid foundation for this goal through hard work in my undergraduate studies, and I wish to expand my knowledge and acquire additional independent research skills through graduate studies at XXX. XXX offers formidable research opportunities. To be a part of the robotics community and bring about technology that can potentially transform human society is the most exciting thing I could imagine. I am eager to join the group of researchers who will lead the future revolution, and I believe the training I can receive at XXX, along with my passion and skills, will allow me to make a difference to the world.