Personal Statement: UIUC ISE PhD

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Since middle school, I have always been interested in mathematics and its applications in computer science. I initially entered Department of Computer Science and Technology, Tsinghua University with a silver medal in CMO’14 and a first prize in NOIP’13, and from middle school I am especially interested in geometry and combinatorics, which has built up a preliminary background for my current interests. At that time I said, while contests of MO and OI are quite different from each other, the fields of math and computer science are like the rain and the sunshine; when standing hand in hand, they will form into a wide and rainbow-colored world.

I entered IIIS in Spring 2016. The early times in Department of CST helped me strengthen my fundamental understanding in computer science; after entering IIIS, as I decided to take more courses than required to make more variety in my knowledge background, I found myself doing better in courses in connection with mathematics than those about coding, and then gradually developed my research interest in the general direction: whatever combines mathematics and computer science, especially in computational geometry, computer graphics/vision/robotics and learning theory.

In Spring 2018, on the visiting program to UT Austin, I did research in the field of data-driven topological reconstruction under the supervision of Qixing Huang and Chandrajit Bajaj. During the visiting program, my supervisors let me learn by exploring instead of lead my way, so I gained much understanding about dictionary learning, information theory, non-convex optimization and etc. Although I came across much difficulty and did not achieve substantial results, it did make an unusual experience and provided me with understandings of scientific research as my first experience as a researcher.

After coming back, I did research on dynamic scene SLAM in the Graphics Lab of Tsinghua, under the supervision of Shi-Min Hu. In that project, I observed a fact that landmarks on a rigid body has constant pairwise distances, and contributed in the concept of motion similarity matrix and rigidity constraints for clustering, which improved both the accuracy and efficiency of the state-of-the-art semantic clustering algorithm. The paper, *ClusterSLAM: A SLAM Backend for Simultaneous Rigid Body Clustering and Motion Estimation*, has been accepted for ICCV 2019. Inspired of the fancy effects and potential of rigidity properties, I finished my Bachelor Thesis *Noise-Stable Rigid Graphs for Euclidean Embedding*, which got an A grade.

From Fall 2019, I have been seeking for opportunities to find real-world applications of the computational geometry and optimization in a wide range of areas, and now I am on an internship in the MSC lab of UC Berkeley, doing research on point-cloud-based mapping and localization, which can contribute to the autonomous driving system. I am still working on this project, trying to develop a robust algorithm that combines GPS and IMU/Lidar data and realizes robust and accurate real-time localization. During the experiments, I am confronted with an issue that while practical navigation usually need global maps, large-scale point cloud maps take huge memory spaces and have poor time efficiency. Thus, I came up with an idea to replace the global map with an Atlas of local maps with topological connections and do online inter-map relocalization on edges of them, which I am still working on.

With research experiences in a wide range of fields, I have gained opportunities to look into computer vision from different perspectives, and get convinced that it is inherently a geometric and algorithmic problem. In my view, the eventual goal of vision problems is to gather information from partial noisy observations and infer the underlying geometric structures, with an algorithm economical with resources of samples, storage and computational power. While the current trend of deep learning makes competent tools for data-driven optimization, the black-box system in turn needs more explanation and optimization itself. In my belief, we need to incorporate tools of computational geometry, information theory, learning theory and algorithm design to achieve a “closed-form solution” to computer vision problems. Although such a revolutionary progress is probably beyond the reach at this moment, I would enthusiastically expand my horizons and do more solid research to close the gap.

As I have made a good foundation for academic research during the first two years in college, I am currently making my way and getting fulfilling progress for academic research. As a future PhD student at UIUC ISE, I am interested in, but not restricted to, the fields of computer graphics, vision and autonomous driving. I would love to cherish the opportunity to enter the new field of Operations Research under the supervision of Professor **Yuan Zhou** and learn more solid knowledge on optimization, while contribute in fields with both practical value and mathematical aesthetics with new inspiring methods, with my eventual dream to combine different fields, and make creative work with new inspiring perspectives towards those areas we have always been concerned on.