Introduction & Career Goals

My intention to pursue a PhD in computer science is driven by various and different experiences in life which have all played part in forming my belief in the ability of technology to enhance peoples' lives in countless ways. As such, my primary goal as a future researcher is to contribute toward solutions to the most important problems and questions facing our society. Also, because I believe that nothing good is fully experienced until it is shared with others, I aim to educate and inspire others just as I have been fortunate enough to continually be surrounded by those who've helped and inspired me.

I believe that I have an established track record of excelling both inside and outside of academia, an aptitude in mathematics that has certainly biased my path towards my current trajectory, and a passion for solving problems that contain the possibility of truly influencing people's lives in a meaningful way. Two broad classes of problems which I believe wholeheartedly to belong to that set are those of (1) space and planetary exploration, and (2) robotics and machine learning. The former of which is of critical importance to furthering our understanding and exploring possibilities beyond our own planet, and the latter which has shown exponential growth in terms of progress and its role in our everyday lives. I can think of no more important, prudent, and challenging area to work than at the intersection of the two.

Prior Experience

During my junior year of college while studying abroad in Germany, I was given the opportunity to work with Dr. Henry Brighton at the Max-Planck Institute for Human Development - Center for Adaptive Behavior and Cognition in Berlin (MPIB). Our main projects during my six months there involved training various machine learning algorithms to model heuristic decision-making in real world situations. Most notably, we were able to prune a major healthcare questionnaire down to less than 1/10th of its original size while sacrificing less than 5% of its predictive capabilities in regard to the future healthcare needs of the respondents. In practical terms, the result meant that what began as a lengthy mail questionnaire (60 questions), could now be administered orally by practitioners who could be confident in the survey's predictive capacity in terms of future health risks facing their patients.

After graduating I found a home for my intellectual curiosities at RPX Corporation in San Francisco. RPX was a young company looking to change and "de-militarize" the intellectual property landscape through widespread collaboration between the major developers of new technologies. I began working as part of the Data Science & Analytics team where the theme of my work was in analyzing large amounts of data to develop insights into the patent market. This included applying machine learning methods to model patent asset valuation and developing a multi-factor approach to predict the likelihood of future occurrence of an infringement lawsuit.

At the start of my second year, I was recruited into the Corporate Development group where I was given the opportunity to develop market strategies cohesive with our own research into modeling and analyzing the particular risks our client companies were facing. Examples include the development of a patent co-defendant insurance offering (built on our predictive infringement modeling) whereby companies could collaboratively take a stand against malicious entities in the patent market.

Graduate Work

Applying to graduate programs in computer science with my set of interests I was particularly interested in programs with significant focus on interdisciplinary research, which is what brought me to Rutgers University. Collaborations within Dr. Kostas Bekris' robotics group include ongoing work with the Psychology department studying human interpretability of robotic movements, human-robot interaction, and crowd simulation projects. Working with the vision groups of Dr. Ahmed Elgammal and Dr. Dimitris Metaxas, I've had opportunity to collaborate with members of the Center for Cognitive Science (RuCCS) on perception-related studies. The support of these groups and opportunities that they provide have been invaluable to me as a student.

During my first year, our group decided to compete in the Amazon Picking Challenge: a robotics competition with the goal of correctly identifying objects within a warehouse-like shelving unit, grasping a pre-determined but unknown selection of the objects, and placing them securely into an order bin. The project brings together elements of computer vision (perception of objects), motion planning, and mechanical engineering. On the perception task, I worked closely with Dr. Ferreira de Souza, a visiting professor from the Federal University of Espirito Santo. We began with an open-source version of the LINEMOD algorithm for 3D pose estimation and adapted the algorithm to fit the environmentally difficult shelf scenario, where we were able to significantly improve its object detection performance. Additionally, we compiled the largest RGBD database with 6 degree-of-freedom(DoF) ground truth object pose to date which we also freely offered to the community [1].

The challenge provided a unique opportunity to combine research and real-world engineering while building on and learning from the specific expertise of other students. Though the core teams consisted of PhD students in robotic motion planning, manipulation, and perception, the opportunity allowed our team to involve several masters students as well as a handful of undergraduates. All of these students had interest in robotics but no substantial previous experience, and many were able to directly contribute to and take pride in our team's final solution.

In my second year, my interest in complex robotic systems drew me towards a project with my advisor involving tensegrity robots. While our lab had been successful in the past employing efficient sampling-based motion planning algorithms to the high-dimensional challenge in a physics-based simulation, the problem of planning "blind" (i.e., beginning with no prior knowledge) in such a complex system was still very computationally demanding. Having been given the opportunity to spend the summer at NASA ARC, I decided to spend the time working towards more informed solutions to the motion planning problem using Bayesian optimization over previous trajectories. Though the results I was able to achieve were only preliminary, I believe that this direction shows tremendous promise and I was grateful for the opportunity to be able to learn from researchers working on similar problems, and to be able to present my results to them.

References

[1] C. Rennie, R. Shome, K. E. Bekris, and A. F. De Souza, "A dataset for improved rgbd-based object detection and pose estimation for warehouse pick-and-place," *IEEE Robotics and Automation Letters*, vol. 1, no. 2, pp. 1179–1185, 2016.