Personal, Background, and Future Goals Statement

Background

In my childhood, I have always found myself sketching out new comic book ideas, my hands racing to keep up with the flow of characters bubbling up from my mind's eye. I remember nights when I'd be hunched over my drawing table, consumed by the stories and personalities I was breathing life into. For me, it wasn't just about creation; it was about authenticity. I wanted to make each character as real as possible, often gifting them with fragments of my own experiences and emotions. It felt like every new creation was not just a figment of my imagination, but an extension of myself. This early fascination with the nuances of what makes someone who they are eventually intertwined with my passion for mathematics and engineering. As I delved into the realm of robotic control, it was like revisiting those early days of character creation. Here, I wasn't just sketching characters on paper but shaping them through mathematical logic and design, aiming to create robots that not only functioned but also 'felt' — with personalities and decision-making abilities that made them resonate more closely with the human experience. Every control algorithm I craft carries a touch of me just like my characters, be it the way I process information or some of my personal ethics. That's why in my career, I aim to research decision-making processes in autonomous robotic controls, striving to better their skills and build a logic that's more in tune with how a person thinks and acts.

I want to pursue graduate school because I aim to be a researcher. I'm deeply passionate about delving into the unknown, and the thrill of consecutive research discoveries has captivated me. My primary focus is to investigate decision-making processes within autonomous robotic controls, preferably in a national lab or academic setting. Beyond the allure of discovery, my motivation to pursue research and advanced studies comes from my desire to become an expert in the robotics field. I aim to be among the top experts in controls. Furthermore, I hope people can lean on my expertise, along with having a hand in shaping how robotic controls are integrated into our society and establishing the foundational principles of this field. Hopefully one day in the future, my contributions will become so significant that I might be recognized as a cornerstone figure in robotic control. While I aspire to do grand things, I also believe that the ethics of my contributions are even more significant. I want to use my voice to speak up and push for meaningful policy shifts. One of the things I believe is crucial is the development of safety measures in robotic controls, especially when they are used in combat. I want to advocate for requiring an integration of a robust ethical framework in the controls of any robot designed for combat. My goal is to advocate for policies that not only ensure the safety of robotics but also alleviate any potential negative consequences.

Intellectual Merit

My experiences in college have helped me understand that the best path forward for me in achieving my goal of becoming a researcher and a significant figure in my field has been through lab work, particularly in an academic context. Driven by my desire to contribute to robotics, I joined Peter Adamczyk's research group which specializes in robotic prosthetics. There, I focus on low-level controls, establishing ROS architecture, electrical prototyping, and analysis of related experiments for a semi-automatic robotic ankle. My expertise in this field has been recognized, as I have had the honor of presenting my research findings as a second author at the UW Madison First Wisconsin Robotics Symposium. I also have the distinction of being the second author on a paper related to this topic, which is currently in the works.

The most vital realization for me, and what leads me to graduate school, is the chain of research discoveries that underlie these iterative successes. While working on the semi-automatic robotic ankle, I noticed substantial inefficiencies in the experimental setup, including an excessively long setup time. The two hour-long equipment setups for mere 15-minute trials seemed disproportionate, especially given that any minor malfunction would extend this setup time by at least three hours. One particular challenge was setting walking thresholds based on angular acceleration from the IMU to count steps. I found the process for setting them to be inefficient and believed that there must be an algorithm that could self-adjust those thresholds to detect initial foot contact and lift-off. However, a review of the current literature revealed a

gap in this area – there were no algorithms that utilized IMU data, capable of self-adjusting detection thresholds for Toes-off and Initial Contact events that were specifically tailored for the lower foot.

Motivated to address this issue, I embarked on designing my own solution. I created a testing apparatus with a Seeed board, an IMU, and two FSR sensors. The trial involving 10 participants showed that my results were similar to the success of other non-adjusting threshold algorithms in the literature. I presented my findings as first author at the UW Madison Undergraduate Symposium and the 4th Great Plains Biomechanics Conference. Interacting with fellow scientists at these events helped me recognize ways to further improve my algorithm. Though my initial results were promising, I felt that the algorithm could adapt to even more complicated tasks, like maneuvering stairs or turning. Determined to refine it, I re-evaluated my initial approach. By recognizing consistent and reliable walking signal patterns, I formulated a new algorithm that eliminated the inconsistencies of the previous one. Moreover, to ensure clarity and maintainability, the new version was simpler and better commented. This iteration surpassed its predecessor in efficiency and fueled my aspiration to publish a technical paper detailing these advancements in the upcoming fall semester.

While my final destination is to be a primary investigator in a research laboratory, I also recognize the mutually beneficial contacts between private industry and academia through personal experience working in both areas. Through working in the automotive industry at Oshkosh Corp, I have been deeply involved in autonomous simulation testing. I used DSPACE's Simulink to interpret autonomous control signals that I used to create my tests in SIMPHERA. I made these tests according to DARPA requirements. I delved deeply into existing literature to align those tests with prevailing views on what DARPA specifications should encompass. Moreover, being the first in my company to utilize this platform, I naturally became the primary expert and bore significant responsibility in collaborating with DSPACE to pinpoint and address bugs. This task gave me the freedom to define the basic functionalities that an autonomous vehicle should have and learn to write them into simulation-based tests.

I also had to prototype the process of converting OpenDrive maps to Lanelet2, an endeavor not commonly pursued in the industry. The only tool available for this is a TUM's CommonRoad, but it has flaws. I collaborated closely with its developers, pinpointing errors and crafting solutions to rectify them. One specific challenge involved addressing overlapping points in the Lanelet2 map; these points were in near-identical locations but were distinct, causing Lanelet2 to misinterpret the continuity of the road. I also introduced a latitude and longitude adjustment mechanism, ensuring that a map centered at zero latitude and longitude doesn't inadvertently shift into the adjacent MGRS grid. This project bridged the gap between academia and industry, challenging and sharpening both my research and collaborative skills.

Beyond simulation and software, I also have an extensive embedded background. As an Electrical Engineering Intern at Collins Aerospace, I delved deep into the intricacies of circuit design and testing. My responsibilities encompassed crafting and assessing circuits with a diverse array of components, from sound I/O and op-amps to ADCs, DACs, and power resistors, among others. A highlight of my experience was prototyping electrical systems for devices, specifically Slaves/Masters using Raspberry Pi, which communicated via I2C. My versatility was further demonstrated as I aided in reverse engineering products, rigorously tested hardware and communication buses utilizing oscilloscopes, and engaged with foundational hardware designs on Xilinx FPGAs. In NorthStar Medical Radioisotopes, I played a pivotal role in refining the software for ozone-generating state machines that were previously failing in the field. Since my involvement, the improved code has been successfully integrated into the actual product. I also crafted electrical fixtures, software, and interfaces for testing, leveraged tools like serial communication, python, arduino, pyside2, and pyqt5. Additionally, I honed my skills in sensor calibration, engaging directly with manufacturers for troubleshooting. My ability to seamlessly integrate and analyze data was evident in my use of SQL and python to sift through and upload essential information to databases.

Broader Impacts

I am a first-generation immigrant from Russia. My journey has been shaped by economic challenges and the complexities of growing up in an abusive household. I intimately understand the

burden of being one's sole support system, both financially and emotionally. The stress of ensuring financial independence, managing tuition fees, and avoiding a return to a toxic home environment has been a lived experience for me. As I embark on my graduate studies, I am passionate about supporting students in similar situations. Drawing from personal experiences and resources that have been invaluable to me, I aim to create a supportive community for such students. Recognizing the weight of self-financing one's education, I am committed to fostering an environment that acknowledges and supports students navigating these challenges.

Moreover, navigating the fields of Electrical Engineering and Computer Science as a woman has given me unique insights. While I've been fortunate to find a supportive community in this predominantly male field, I've also experienced sexism. As I progress in my academic journey, I hope to be a representation of someone who is a woman and an expert in robotic controls. My aim is not only to listen but also to actively advocate for them, ensuring their voices are heard and their concerns addressed. Additionally, in graduate school, I hope to organize or join robotic clubs for elementary and middle school students, with a specific focus on introducing robotics to minority groups. I'm convinced that such initiatives play a crucial role in promoting equity, building confidence in kids and showing that they belong in the field of robotics. Research in controls would not only enhance my teaching skills but would also deepen my understanding of robotics, equipping me to create comprehensive teaching plans and projects. Moreover, graduate school will provide me with a deeper understanding of academia and connect me with invaluable networks. These enhanced perspectives and connections will strengthen my ability to encourage those students to pursue academia and assist them through their academic journey, should they decide to follow that path.

Because of the challenges I faced, I've always found myself gravitating towards leadership roles. From my days in middle school and high school, whether it was pioneering new clubs or volunteering for decision-making positions, I felt a drive to ensure that everyone's voice was heard and to create positive change within my community. This drive, I believe, comes from my experiences as an immigrant from Russia. Growing up in a place where bullying was predominant, the inclusivity I observed in the U.S. was a refreshing change. My ambition has always been to foster environments where everyone feels at home and included.

This desire is evident in my roles as Vice President in both the IEEE Eta Kappa Nu and the UW Madison Fencing club. At IEEE Eta Kappa Nu, I've taken proactive steps to ensure inclusivity through leading faculty panel discussions and meetings, and initiating HKN members. My time as the vice president of the UW Madison Fencing club faced challenges posed by the COVID-19 pandemic. Thus, our focus was to create online events where members could continue to connect and feel a sense of belonging, even in the midst of global uncertainty.

While I thrived in both leadership and academics, I faced several significant challenges that I found difficult to navigate alone. I've been fortunate to encounter exceptional mentors throughout my journey, individuals who have guided me onto the path I’m on today. A particularly pivotal moment was during my circuits class. Despite feeling well-prepared, I failed my first exam to the point where attaining an A was impossible. What scared me the most was my false confidence in my readiness. After the exam, my TA pointedly identified gaps in my knowledge and areas needing improvement. This feedback compelled me to confront my misconceptions, which helped me to manage securing a B by the course's end. Without his intervention, I might have continued in a pattern of oversight, jeopardizing my graduation by overestimating the depth of my understanding and overlooking essential details.

Inspired by him, I wanted to give back to my community in the same way. I chose to become a undergrad TA in one of UW Madison's most challenging course: ECE 532 - Intro to Machine Learning. Given its foundation in mathematics and linear algebra, many of my peers struggled or even withdrew from the course. As an undergrad TA, my approach has been to highlight potential knowledge gaps while emphasizing the core concepts. I aim to digest complex ideas into simpler terms. My efforts have resonated with many students, as evident from the rapport I have with them. They often seek my assistance exclusively among the available student aids, which showcases the impact of my mentorship approach.