1 Summary of Goals and Objectives

1.1 Technical Area

My grand objectives are to work in the area of multi-robot systems (MRS), especially those operating in a space environment (such as planetary exploration, near-earth, and deep space operations). I believe this is a highly challenging and relevant area, with secondary applications that can benefit humanity far into the future and in many aspects of society. This leverages the skills and knowledge base offered to me by my field of study, Computer Systems Engineering, and provides me a path with which to shape my future career and educational plans.

This area spans across many domains including: robotics, control systems, computer science, software engineering, computer networks, mechanical design, and artificial intelligence. Pursuing it will require skills and knowledge in many, if not all, of those domains, as well as a solid feeling for the application and domain of the specific problems to be pursued. More specific skills I will need include:

- Strong knowledge of C++ and Python
- Experience with computing systems operating in harsh environments (e.g., deep space) and including fallback software systems, RAD hardened processors, etc.
- Autonomous decision making (artificial intelligence, machine learning, adaptive control systems)
- Strong experiences working on interdisciplinary teams

These skills will be obtained through my projects (including FURI and capstone), focus of topics in my senior year and graduate school, internships, and work experiences.

1.2 Goals and Objectives

I will be earning my B.S.E in Computer Systems Engineering in May of 2019. I am set to then pursue my Masters in Computer Engineering (Computer Systems concentration) with an emphasis on Autonomous Systems and Robotics. This will be through the 4+1 accelerated masters at ASU, with my graduation date set for May of 2020. In the long-term, I would like to pursue a PhD in this area, Computer Systems Engineering, or a complementary field. The knowledge required for this area, especially when operating with the challenges of space exploration, will likely be best tackled in the research environment of a PhD. My current and future coursework is being carefully selected to target this specialty. Included are courses in artificial intelligence, linear and multivariable control systems, and graph theory. For my senior capstone project, I am working with the
NASA Psyche mission to develop a system to help classify the bulk composition of iron meteorite samples, collecting data that will be used later in the mission. I intend to use this experience to enhance my skills working on interdisciplinary teams, C++ programming, and developing systems that serve one part of a greater goal.

For the next several years I plan to work in industry after obtaining my masters degree. I plan to focus my search in the aerospace industry and other companies specializing in robotics. Aerospace has a strong relationship with my interests with its work on devices such as survey spacecraft, planetary rovers, and planetary science. Possible companies I will focus on include NASA, SpaceX, Ball Aerospace, and Southwest Research Institute. I value companies with challenging work, a strong work-life balance, enriching work environment. I believe that time in industry will provide me with grounded, real-world experience working on problems. Additionally, I think it will help to provide me greater perspective and domain knowledge that would complement that I have and would receive in academia.

I eventually plan to return to obtain my PhD and conduct research in MRS. Arizona State University, Georgia Institute of Technology, UC Berkeley, and University of Pennsylvania are strong candidates for this endeavor. This long-term plan is contingent on many factors: whether industry has equally interesting opportunities available to me, money, location, family, and the state of research in the area. I may prefer remain in the industry for longer if circumstances are not favorable for me to pursue a PhD immediately or I am able to achieve my goals there.

2 Current Status

2.1 Relevant Coursework Completed

My coursework completed to date follows the major map of the Computer (Systems) Engineering B.S.E. degree at ASU. It spans specialty areas of both computer science and electrical engineering. It has provided me a strong technical and theoretical background in programming, algorithm design, embedded systems, circuit analysis, mathematics, and physics. This background will be essential for more advanced topics in these areas.

- Microeconomic and Macroeconomic Principles
- Calculus: I, II, III
- Discrete Math Structures
- Modern Differential Equations
- Probability and Statics for Engineering Problem Solving
- Applied Linear Algebra
- Physics: Classical Mechanics, Electricity and Magnetism
- General Chemistry I
- Digital Design Fundamentals
• Computer Organization and Assembly Language
• Programming for Computer Engineering
• Data Structures and Algorithms
• Design and Synthesis of Digital Hardware
• Embedded Microprocessor Systems
• Operating Systems
• Intro to Software Engineering
• Circuits: I, II

2.2 Current Relevant Coursework

• CSE423 Systems Capstone Project
• CSE434 Computer Networks
• EEE203 Signals and Systems
• CSE408 Multimedia Information Systems
• CSE471 Introduction to Artificial Intelligence

2.3 Professional Preparation

I have prepared very well in the areas of resume construction, development of my writing and presentation skills, critical thinking, technical communication, and team communication. This has been accomplished through numerous resume review session, team projects in and outside of classes, the ASAP FSE394 class, the Fulton Undergraduate Research Initiative, and senior capstone design. Improvements can be made in the area of planning, mentoring, and leadership. I plan to tackle these in the coming years by simply taking proactive steps toward improving them. This will include increasing my volunteering and involvement with clubs and groups on campus, seeking more mentoring from others, and taking on leadership roles I otherwise would not plan to make time for.

3 Education

3.1 Future Relevant Coursework

Spring 2019

CSE424 Systems Capstone Project
CSE520 Computer Architecture II
MAT416 Introduction to Graph Theory
Research/Project Experience

Research is crucially important because it allows one to explore their interests, direct their own learning, and offers another avenue for applying knowledge gained in the classroom in a way that has positive external effects on society. Moreover, it encourages one to think of the big picture significance of the work being done in an area. Continually asking the question: "What is the significance of my research?" greatly stimulates this.

My long-term research focus is in the area of multi-robot systems, particularly in aerospace or space applications. This is an area I believe is filled with challenges and relevance to a wide range of industries and fields. It is well supported by the academic community, with numerous universities and professors dedicating resources to multi-robot systems.

I am currently involved in a FURI project designing an intelligent campus guide robot. This research utilizes vision processing of markers that mark a path to facilitate navigation between locations on campus. It leverages skills I have gained from classes as well as technologies learned from internship experience. This research serves as a stepping stone to future research, providing a basis on which to expand into a system of multiple robots and/or explore their application in hostile environments such as disaster zones and planetary exploration. This research can be continued on as the focus of a masters’ thesis in Computer Systems, as well as the focus of a doctoral thesis in Computer Systems or Planetary Exploration Systems. Several fellowships are relevant to the research I am interested in conducting and I will be considering applying to them. Two that I am familiar with are the NASA Space Grant and National Science Foundation Fellowship. Many more exist, and I will be exploring those that are relevant.

Industrial/Work Experience

Industrial experience offers a different insight into my technical areas of interest and a different set of experiences compared to academic research. Industry is more often focused on creating solutions that are commercially viable and will have an immediate impact on their customers. Additionally, as with research, the results can still be of benefit to the general public and advance the state of industry or technology at large. However, the level of advancement in the state of technology may not be as great as with more academic research. Opportunities are numerous, with competitive pay, but the quality of such opportunities is difficult to assess. Additionally, a degree of autonomy is lost when working in industry as your interests must work toward those of the company and the direction of the projects you work on may not be entirely your own. Overall, certainly early in my career, I believe industry experience is vitally important in discovering and targeting specific interests. Industry experience in autonomous systems, space science (such as satellites), and embedded systems (such as flight software and flight controllers) would most appeal
to me and provide what I hope are exactly the types of experiences that will contribute the most to my overall goals. Possible industry groups include:

- NASA (Jet Propulsion Laboratory, Marshall Space Flight Center) – Both of these NASA centers specialize heavily in space robotics. They are two of the leading industry experts in planetary rovers and deep-space satellite control systems.

- Southwest Research Institute – A non-profit research organization that works in a wide variety of areas ranging from space sciences, sensors, and instrumentation to autonomous vehicles and robotics.

5.1 Prior Experience

To date, I have worked as an intern at NASA’s Marshall Space Flight Center for the summer term of 2017 in its Control Systems Design and Analysis Branch (EV-41). There, I was able to gain experience working with the Robot Operating System, a very commonly used and powerful software framework for robotics. Additionally, I was able to gain a first look into the field of control systems, an integral part of robotics. The experience also offered an opportunity to write a final paper, create a poster, and present my work.

In the summer of 2018, I secured an internship with Ball Aerospace in Boulder, Colorado. I was a part of their Software Engineering division working with a sizeable interdisciplinary team on a project. There, I worked to help design visualization methods for a Robot Operating System enabled complex mechanism. I was able to learn much about complex mechanism design, systems engineering, as well as how an aerospace contractor operates on these kinds of systems.

5.2 Future Plans

My current future plans are to return to Ball Aerospace this coming summer before the start of my final Masters degree semesters. There I hope to gain experience in a different or new area of software within the aerospace industry.

6 Community Service

Community service is an excellent avenue for building one’s network, connecting with causes that could be the driving inspiration for research, and assist in developing leadership and teamwork skills.

In the past I have been involved with volunteering for robotics competitions such as FIRST and Vex as a judge. I would like to be more heavily involved, potentially mentoring a team or taking on more involved roles in helping to coordinate events. I have also sought relevant volunteer opportunities on campus at ASU. Through my involvement with the Micro Air Vehicles club, I have participated in a few events engaging with younger students and peers. My future involvement with this club will bring more opportunities. FURI provides the opportunity for me to volunteer in helping others with research, writing proposals, sharing my experiences, and defining their problem areas. Through the ASAP program I have been afforded the opportunity to connect with and mentor younger students from community colleges and those incoming transfers to ASU. This is definitely an area I am interested in developing my leadership skills with.
6.1 Leadership Skills

I plan to build leadership skills through continued involvement mentoring others in the ASAP program. Continued involvement in clubs on campus such as the MAV club and ASU Linux User's Group will also provide opportunities to do this through leadership roles, knowledge sharing, and campus involvement. As I continue forward in my career, building leadership skills in the form of mentoring and teaching others and being a driving force behind projects will become even more important.

7 Personal Mentoring Plan

7.1 Importance of Mentoring

Mentoring is essential to helping fully define my future career path and determining how to navigate my fields of interest and connect them to their utility in society.

I currently turn to Dr. Rodriguez, a professor at ASU with a background in control systems with interests in intelligent autonomous systems. I have worked with him on both of my FURI projects, sought advice about graduate school, and plan to have him involved as part of my Master's thesis.

I had previously been in contact with a mechanical engineering professor at ASU specializing in Multi-Robot Systems. From the computer science arena, there are other professors that also conduct research in the areas of artificial intelligence and multi-robot systems. I plan on contacting them soon to seek mentorship and discuss my future plans.

8 Economic and Financial Goals

In five years, my goal is to have finished my education and be several years into my career earning a competitive salary for the industry. More importantly, I hope to have properly invested and handled those earnings, holding a minimum 6-month emergency fund and significant investments. By that time, I will be fully independent from my parents and hope to be helping them financially if necessary. My career prospects in industry are very supportive of these goals, offering reasonable salaries as mentioned and excellent benefit and investment plans.

9 Graduate School

9.1 Importance of Graduate School

My intention in pursuing graduate school is to gain an extra level of knowledge and experience in my area that will secure my future, enable me to pursue more exciting opportunities in my career, and further enable life-long learning. I have received much advice pushing me to pursue

9.2 Preparation Plans

I have already applied and been accepted to ASU's 4+1 MS program in Computer Engineering (Computer Systems). My current plans to pay for graduate school are to apply for Teaching Assistant or Research Assistant positions. In addition, I will apply for any relevant scholarship or fellowship opportunities available.
9.3 MS Thesis and Committee
I am currently planning to pursue an MS Thesis focusing on task allocation strategies for multi-
robot systems in a coordinated construction task. I believe this path will enable me to gain much
more out of my MS degree. I have several professors in mind that I feel would be good to serve on
my committee. In order to finish my thesis, I plan to begin work in the coming Spring semester
and carry through some work over the summer.

9.4 PhD in Engineering
I have considered pursuing a PhD in engineering, researching a topic similar to that I am pursing
for my MS thesis. My plans have shifted and I have decided to delay that pursuit to later in my life.
This is a choice motivated by many factors including my perceived ability to fully carry through
and invest in the program. I intend to keep the possibility of pursuing a PhD open in the long-term.

10 Long-Term Professional Goals

10.1 Job Description
My ideal job is a position designing and implementing software in robotic or intelligent systems.
This could include robotic spacecraft, ground vehicles, flight software, or other software. I value
company environment very highly. My position must emphasis personal development and flexibility
in choosing responsibilities. My expectations are realistic, as often there will be projects that do
not fully align with my interests, but some degree of self-direction is not uncommon in industry.

11 Life-Long Learning

11.1 Professional Development Plan
My professional development plan is simple. I plan to finish my Bachelor of Science in Engineering,
then complete my Masters, with thesis option. To develop my professional and mentoring skills, I
plan to work as a Teaching Assistant or tutor during my Master’s degree. I have already worked
during internships in the aerospace industry, building my skills and knowledge there.

In the long term, I will continuously prepare for opportunities in higher positions, such as
management and systems engineering, and those positions on projects which are of interest to me.
This will ensure I am constantly challenged and moving toward my future goals.

11.2 Personal Development Plan
In the short term I plan to develop myself using the opportunities that will be provided to me by
continued research during my Masters degree. Working closely with others on research will allow
me to further develop my interpersonal skills. I plan to involve myself on campus more than I have
been during my undergraduate semesters. In the long term, I will continue this type of thinking,
involving myself in the community at the company I will be working at and the community I will
be living in.

11.3 Nurturing Specific Skills and Hobbies
As I transition out of school I expect to be drawn into honing a specific set of knowledge and skills
needed for my work, but plan to supplement those with projects in my spare time. In software,
having personal projects is a common way to develop new skills that will be useful in your career or to keep previously developed software skills sharp.

11.4 Future Education Plans
Aside from continued personal projects, I plan to explore the possibility of obtaining supplemental degrees and education that will be useful to me in industry. Systems Engineering is often called for in industry as a way for an engineer to be beneficial on large projects or in a management role.

12 Family Planning

13 Travel Plans
I have done very little traveling outside of the US and would be interested in having the opportunity to do so in the future. I feel traveling can provide you some perspective on your own life and the issues that you as an engineer are capable of solving. There is plenty of opportunity to do so when I am working in industry or even while I am completing my education, solo or with my family.

I am not particularly interested in living overseas. However, I know the only way to truly experience a country is to live in it and be fully immersed in the culture.

14 Investment Plans
I plan to start seriously planning for my retirement this coming calendar year. My plan is to contribute to a ROTH IRA and personal investment portfolio. Once I reach industry, I will have many more options available to me in terms of 401k plans, stock purchase plans, and profit sharing plans.

15 Contingency Plans
There are many opportunities available for me to fall back on if my long term plans fall through. Many of my goals can be delayed, postponed, or modified to accommodate changes in circumstance or difficulties in execution. I feel an industry job is a highly accessible fallback for not immediately pursuing a PhD or even a Master’s degree. It will still provide challenges and opportunities while not actively preventing advancement in education, as many industry companies are supportive of employees obtaining advanced degrees after employment.

16 Philosophy of Life
Contributing to the advancement of mankind is my primary motivator in life. The work or research I do must have tangible effects on society. This is part of my reasons for studying engineering instead of a more theoretical field like the hard sciences or math.

17 Other Issues