**Personal Background:**

I grew up taking fans from old power supplies to make frisbee hoverboards, drilling holes in my nerf gun dampers to make them shoot faster, and designing theater stages. When I was in elementary school, my parents would take me to an Engineering Day every year at UT Arlington.

When I was eight years old, I was finally able to compete in the Lego Mindstorm car race. In an old, repurposed chemistry lab, I was introduced to gear ratios for the first time. Our car raced ahead of the competition, zooming past the tape so fast that the color sensor couldn't see the finish line, sending it careening down the hall and into the brick wall. I learned about more than building cars, I built a system that percieved its world, made a decision, and acted on it.

When I was 15 years old, I woke up to find my mom dead at the kitchen table. I called 911 as I watched my dad give her CPR on the kitchen floor. Years of first aid training, survival kits, and emergency food rations, yet there was nothing we could do. When seconds count, help is minutes away. I want to build systems that bring help to crises faster.[1]

When I was 17 and volunteering at the state level for the Order of the Arrow, I had an advisor suggest I apply to a backpacking scholarship. I always went to Scouting Summer Camp because I sold the popcorn and coupon cards to pay for it. and because of that generosity I had the chance to climb the same mountains as my dad. I spent my first undergraduate summer working as a Conservation Foreman for Philmont Scout Ranch with the Order of the Arrow Trail Crew program. Over the summer, I led 40 teenagers to complete more than 2000 man-hours of conservation work to cut new trail at 12,000 feet in a burn scar left by a wildfire. A wildfire that scorched 36,740 acres and took 604 trained personnel nearly three weeks to contain. A wildfire that could have been prevented if the rural fire departments had access to higher quality mapping to contain the fire before it grew. It was only after the devastation that the local forestry groups received state funding for manually piloted response drones. Years later, leading trail crews through burn scars of that same wildfire, I saw firsthand how the lack of access to modern systems delayed fire containment. When seconds mattered, the hardware was hundreds of miles away. I want to develop autonomous systems that can save lives when human response alone can't keep pace.

In autonomy, triage, and disaster response, seconds count. My mission is to develop rapid, robust trajectory generation methods for autonomous vehicles operating in hazardous environments, empowering disaster mapping and emergency response.

**Intellectual Merit:**

At Texas A&M, I entered the Interdisciplinary Engineering Program to develop and pursue a custom Robotics and Controls Engineering degree program. Through this program, I researched college of engineering degree plans, authored my own degree plan to reach ABET accreditation, and combined the system-aware dynamics and control from mechanical engineering, signal processing, circuit analysis and modeling from electrical engineering, and the data structures and analysis of algorithms from computer science to create a single symbiotic robotics degree plan preparing for work across the localization, path planning, trajectory generation, and controls system architecture of modern autonomous vehicles. I have coordinated with advisors and department leadership from seven different offices, spoken to prospective students on a dozen occasions about the opportunities of the program, and even represented A&M's interdisciplinary engineering program to department chairs for interdisciplinary engineering programs across the country including at Purdue, Texas Tech, and Colorado School of Mines. Through the flexibility offered by the degree, I have been able to leverage special topics courses taught by world-leading researchers including those in autonomous aerospace vehicles and science communications.

Outside of academics, I joined TURTLE Robotics to get hands-on experience building robots. Through TURTLE, I competed in the Hatchling Program and Competition my first semester, then pitched and founded the Disaster Response Observation Network (DRON) project**.** DRON is a student project for rapid structual fire scene assessment, meant to aide first responders in disaster response. As project lead, I oversaw the design of a custom airframe, selection and integration of sensors, onboard computer, and flight contoller, development of system autonomy using MAVROS and PX4, implementation of multimodal perception and mapping pipelines using OpenCV and Unity, and validation trials in field tests. Through multiple design reviews, DRON has taught nearly 25 students skills in UAV design.

In my second semester, I joined the Human Empowering Robotics and Controls (HERC) Lab in the Mechanical Engineering Department, where I contributed to the design of a soft-testbed for human impedance control on lower-limb exoprosthesis for safe human–robot interaction studies. My primary role involved developing the bill of materials and validation plan for a silicone leg-analog testbed, ensuring that the platform could safely replicate the compliance and dynamics of a human limb. I worked to study silicone casting and hardness, fusion deposition modeling (FDM) printed thermoplastic polyurethane (TPU) geometries to observe anisotropic compliance, and human muscular anatomy to create a shelf-stable leg analog for testing.

I spent my second and final undergraduate summer working in the Aerial Autonomy group in the Army Research Lab through the National Summer Scholars Internship Program focusing on autonomous drone wire-perching and optical-flow-based perception calibration. My work centered on developing and deploying software for real-time perception pipelines for UAVs integrated through PX4 and ROS 2, while verifying our results using Gazebo Software-in-the-loop (SITL) simulation. I implemented methods for onboard wire detection and depth estimation in GPS-denied environments, optimizing data throughput across ROS 2 topics and validating systems in controlled flight trials. **Our group of three interns delivered field validation with 90% success rate in testing for wire perching three weeks ahead of schedule.** We then pursued individual projects, where I worked on calibration methods for optical flow inertial depth mapping. The aerial autonomy intern group of seven students presented at the University of Maryland (UMD) Joint Research Labs (JRL) Summer Symposium, and received best oral presentation out of ~15 presenting groups.

While at ARL, I also competed in an intern research proposal pitch competition to propose new research projects to representatives from funding agencies at the Army Research Office. I pitched the Swarm Coordination for Reconnaissance & Autonomous Mapping (SCRAM) concept of operations and software architecture, which outlined how a single mothership UAV could deploy and coordinate multiple micro-UAVs for efficient RF-denied large area mapping. In the competition, I tied for first with the SCRAM pitch.

I am currently designing a senior capstone project with the Department of Subsea Engineering to spec, model, and construct a Remotely Operated Vehicle (ROV) for offshore inspection. My contributions include both hardware characterization and controls development. I developed a motor testbed comparing three electronic speed controllers (ESCs) to evaluate thrust efficiency, informing the vehicle's propulsion system design. **I developed the electrical diagram and authored the bill of materials to balance cost and performance, and derived the control basis for gimbaled and ungimbaled thruster configurations for control authority and efficiency.** I also performed thruster placement optimization to maximize control authority while minimizing hydrodynamic coupling. This project applies theory of control systems into functional system design to extend my autonomy work from aerial to subsea environments, reinforcing a unified approach to robust autonomous vehicle system design.

I am also completing an Undergraduate Research Scholars (URS) Thesis under Dr. Jason O'Kane with the Aggie Autonomous Robotics Research Group (AARRG), applying reinforcement learning and trajectory generation to flipper-driven autonomous underwater vehicles (AUVs). My project involves (1) tuning a simulation environment to accurately model dynamic motion using a Physically Informed Neural Network (PINN), then (2) implementing trajectory generation and an RL hybrid mid-level trajectory controller while planning under uncertainty.[4] **I have delivered refined simulator parameters we intend to share with the manufacturer to improve SITL simulation for other research groups.** I am implementing and comparing model-based controllers with reinforcement learning policies to evaluate stability, convergence, and portability to real-world systems.

**Broader Impacts**

Developing robust trajectory generation methods for autonomous vehicles operating in hazardous environments provides direct benefit society by advancing UAVs deployed in disaster response. Reliable autonomy can help to save lives without risking more**,** enabling first responders, researchers, expanding operable range and decreasing deployment speed to reach more emergencies faster.[3] As mobile robots are deployed and integrated into everyday life, these systems must (1) estimate where they are, (2) decide where to go, and (3) act safely *under uncertainty.*[3] The ability of these systems to autonomously operate with confidence will define the next generation of autonomous system deployment. **My long-term goal is to make these systems more adaptive, robust, and efficient in supporting humanitarian and environmental missions.**

I believe in standing on the shoulders of giants, and that the single greatest thing one person can do is pave the way for another to achieve more. **As Secretary of the ASME Student Chapter, I expanded communications from 196 to 672 A&M students, and as President, I have grown the expanded again from 672 to 1,055.** I strengthened our national presence by sending 10 officers to a conference, and legitimized chapter operations through new documentation for our programs. As Internal Vice President of TURTLE Robotics, I helped publish the resources for our "Hatchling" training curriculum for new members and secured the organization's largest recurring sponsorship to ensure its sustainability. As the Project Manager for NASA's L'SPACE Mission Concept Academy (MCA), I led a team of 20 scientists and engineers through a 12 week conceptual mission design, culminating in a NASA Preliminary Design Review (PDR) delivery and presentation.

With the backing of the NSF Graduate Research Fellowship, I would be able to utilize my time in graduate school to develop faster, robust autonomous systems for emergency response. The GRFP will support my research in probabilistic trajectory generation and control, and enable me to design and build the tools for the generation of engineers that will aide communities across the world.

**Future Goals:**

I want to build drones that can respond to crises faster and more effectively bring data into the hands of first responders. I am pursuing graduate research across autonomous system development to develop path planning, trajectory generation, and trajectory control systems that are adaptive and robust to localization uncertainties. Through my research, I aim to advance scientific understanding of uncertainty-aware autonomy. I intend to explore how robots can plan and act safely with incomplete information. My research asks how autonomous vehicles can generate safe, dynamically feasible trajectories when localization is uncertain. This work will broadly benefit society by enabling faster, safer disaster-response robotics to improve response time and success rate during emergencies.

My educational plan is to pursue a Ph.D. in Robotics Engineering for probabilistic trajectory generation on autonomous systems. I intend to professionally develop aerial and subsea autonomous systems in emergency response, defense, commercial inspection. Graduate study will prepare me for this career by allowing me to pioneer novel methodologies in planning, trajectory generation, and autonomous system deployment. Graduate research will provide a rigorous training in research design while allowing me to apply and integrate perception, planning, and control methodologies to relevant projects.

Professionally, I intend to apply this foundation to develop autonomous aerial and underwater vehicles that can operate safely in uncertain environments.

**References:**

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