Please describe in general scientific terms your academic research program (thesis) and your professional goals in 500 words or less. Preference will be given to those candidates who can demonstrate a well-defined research program. Clearly demonstrate how the Ph.D./doctoral research program is directly related to aerospace engineering/space sciences. (500 words)

A mile of highway will take you one mile, but a mile of runway will take you anywhere in the world. My flight instructor used to tell me this while running through the pre-flight checklist and readying the Cessna-172 Skyhawk for lessons every weekend. Even cruising at 10,000 feet, the sky is the limit for Skyhawks; my sights are set much higher. As the gates to deep space open and humanity takes its next “giant leap,” the missions defining the accomplishments of my generation require advances in space infrastructure and robotics to enable safe interplanetary exploration. As a graduate researcher in space robotics, I apply to the Amelia Earhart Fellowship to garner the support I need to lead the development of technologies that will accelerate humanity’s evolution into a space-faring civilization and redefine the meaning of “humanly possible.”

My thesis work develops semantic mapping capabilities that will enable autonomous caretaking in future space habitats such as Gateway and the Artemis Base Camp. Space-inhabiting robots must be endowed with human-comparable visual perception to perform inspection and caretaking of human habitats. Robots caring for the International Space Station (ISS), like the Astrobee free-flying robot, must be able to identify the types of objects (e.g., "Power Cable") and specific instances of these objects (e.g., "PC-001") from raw images to gain actionable information about the status of the spacecraft. This sensor information could be used to construct a higher-level semantic map representation of the environment, including information like the types and locations of visible objects, how objects are related to each other, and other details about their state like the position of subassemblies or the status of indicator lights. My work creates an instance-aware semantic map of the ISS power and communications network for autonomous caretaking by performing per-instance segmentation and localization of power and ethernet cables from Astrobee raw imagery, integrating this information into a scene segmentation framework, and developing a database of prior knowledge against which to compare the current sensed map for fault detection. This capability enables robots like Astrobee to detect unplugged wires, loose cables, and incorrect cable routing on the ISS and work with crew or manipulation robots to resolve these anomalies.

Long-term, I dream of operating robots for environmental research in Antarctica, operating exploration rovers on the moon or Mars, operating robots for extravehicular maintenance of space research stations, and of answering the question, “so what will this technology do for humanity?” Completing a Ph.D. in aerospace engineering at UIUC supported by an Amelia Earhart Fellowship will help me answer this question while helping the aerospace community tackle some of humanity’s most difficult challenges in robot autonomy. I am excited to enter an academic setting after completing my doctoral degree and to devote my career to developing new technologies that enable the continuous presence of thousands of people in space. I fully intend to extend our reach beyond this world. I hope Zonta International can help these dreams take flight.

Other activities (please give a description of your non-scholastic activities, volunteer work, and cultural interests.):

Activity 1 (40 words):

In my free time during the Ph.D. degree, I enjoy learning languages. I currently study Russian and Mandarin Chinese. I am a Space Cooperation delegate in the Stanford U.S.-Russia forum and I conduct research with Taiwanese engineering partners.

Activity 2 (40 words):

I love scuba diving. Diving reminds me that Earth is as wondrous as space, and it has shown me patience and serenity. It inspires me with reflection and gratitude on all that this short life has to offer.

Activity 3 (40 words):

Before the pandemic, I was an avid clarinetist. I performed as principal clarinetist of the Stanford Symphony Orchestra, in addition to performing with the Stanford Wind Quintet and the Stanford University Ragtime Ensemble.

Activity 4 (40 words):

I enjoy mentoring and tutoring undergraduate and high school students. I find that mentoring others and exposing my own gaps in knowledge provides a mutual growth opportunity. I love sharing "A-HA!" moments with students!

Publications:

Publication 1:

K. Yonehara, R. Abrams, H. Dinkel, B. Freemire, and R. Johnson. ”Gas Filled RF Resonator Hadron Beam Monitor for Intense Neutrino Beam Experiments”. International Conference on Particle Accelerator Physics, 2016.

Publication 2:

H. Dinkel, T. Bretl, B. Coltin, T. Smith, and M. Moreira. ”Conditional Variational Autoencoders on Astrobee RGB-D Imagery”. National Aeronautics and Space Administration Summer Intern Poster Symposium, 2020.

Publication 3:

J. Cornelius, H.Dinkel, and A. Kurgan. “U.S. and Russian Strategies in the Privatization of Space”. International Astronautical Federation Global Space Exploration Conference, 2021.