NSF Award: Leveraging Environmental Monitoring UAS (Unmanned Aerial System) in Rainforests

The U.S. National Science Foundation recently announced that a grant for over $1.2M has been awarded to a four-year collaborative research project among Texas A&M University, University of Nebraska – Lincoln and Iowa State University. Principal Investigators are Dr. Gretchen Miller (Texas A&M University), Drs. Brittany Duncan and Carrick Detweiler (University of Nebraska), and Dr. Josh Peschel (Iowa State University). This research project will be using the existing facilities at the **Soltis Center for Research and Education** in San Isidro, Costa Rica. The facility has a 42-meter canopy tower and sensors, along with the field experience of Dr. Miller and colleagues who have conducted research in the rainforest of the Center for more than five years. Here is an abstract of the project:

Rainforest canopies are important ecosystems for diverse plant and animal life, however validating predictions for scientific decisions about these environments is difficult due to a lack of efficient data collection methods. Access is limited due to remoteness, dense foliage, and venomous wildlife, which constrain research to trails and vegetation near the forest floor. Currently, most data is collected within 50 meters of trails and 5 meters from the ground due to these limitations. Unmanned Aerial Systems (UASs) have been used for sensor deployment and monitoring, but only recently has the ability to collect soil samples at precise locations in the ground been developed by the project team. The proposed work will contribute transformative soil, water, and leaf sampling technologies as part of a UAS sampling system to expand the reach of scientists in challenging environments. It will increase the perception abilities of the robots in challenging terrains and the ability for people to interact with and control the UASs. This effort has the potential to benefit a range of organizations that monitor sensitive environmental regions by providing complementary technologies that fulfill a gap through capabilities to sample previously inaccessible areas at a resolution not previously possible while reducing risk to both humans and the environment.

This proposal presents a vision aimed at advancing heterogeneous multi-UAS technologies, practices, and understanding to increase the reach of human sensing in challenging, hard-to-access environments. The proposed work will advance the NRI 2.0 Co-Robotic agenda by focusing on scalability of both systems and teams, inspired in the context of UAS-based forest canopy monitoring. The vision addresses key goals in co-robotic system development with regards to the available attention of the humans involved, site selection for complementary sampling, and improvements in robot design and decision making for sample collection. These goals will be developed in local, well-understood environments before being refined in yearly tests in the harsh, cluttered forest contexts, all while contributing to progress in fundamental co-robotic challenges. The proposed activities will result in: 1) Timing rules and motion-based communications for conveying multi-UAS intention and knowledge to end-users, 2) Perception algorithms that map the environmental knowledge and domain expertise of a scientist into a fleet of vehicles to support semi-autonomous collection of samples above and below the canopy, 3) Platform innovations to improve mechanisms and algorithms for sample collection in new contexts, and 4) Improved data collection in forest canopies to advance the science of plant hydraulics and streamflow generation.

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