DRISI
CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION
TRANSFORMING IDEAS INTO SOLUTIONS

Research Notes

Use of Small Unmanned Aerial Systems (UAS) for Rural Communications Tower Inspection

Using drones to efficiently monitor our microwave tower network infrastructure.

Rural

MAY 2025

Project Title:
Innovation and Deployment of Small Unmanned Aerial Systems (sUAS) in Rural Environments

Task Number: 4298

Start Date: February 26, 2025

Completion Date: April 10, 2026

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WHAT IS THE NEED?

Rural Intelligent Transportation Systems (ITS) systems that utilize microwave communication systems (MCS) have been installed for over 15 years in some parts of California. For the systems to work properly, preventative maintenance must occur on the MCS towers and in between towers to ensure a quality communication network. Currently, tower inspections are performed by workers who must put themselves in high-risk situations as they access the remote sights and ascend the tower for inspection. UAS are currently utilized by Caltrans to inspect infrastructure such as bridges and can be utilized for MCS tower inspections. A quality MCS also requires an unobstructed Fresnel zone. The Fresnel Zone is calculated during design, and the towers are positioned to avoid obstructions. However, as the installation ages, the vegetation will continue to grow and may impact the MCS. Utilizing a UAS, the Fresnel zone can be inspected, and vegetation can be marked for removal as needed. Through these UAS operations, the MCS can be maintained ensuring the infrastructure can function in the rural areas.

WHAT ARE WE DOING?

The research aims to provide a detailed analysis of the feasibility of UAS to inspect MCS towers and the Fresnel zone between those towers and reflectors. The project will develop a guide to utilizing UAS for MCS tower inspection, RF analysis, and Fresnel zone inspections based on AHMCT's past experiences and Caltrans' current UAS inspection activities. The project will target MCS links that have problematic performance and evaluate the Fresnel zones in those areas as well as the MCS towers at those locations.

Caltrans

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WHAT IS OUR GOAL?

Through this project, the feasibility and use cases of UAS-based inspection of MCS infrastructure will be studied, and results will be presented to Caltrans. The results will also include a guide to utilizing UAS for MCS tower inspection, RF analysis, and Fresnel zone inspections. AHMCT has the required prior experiences in this domain, and Caltrans' current UAS inspection activities will serve as a benchmark to identify the limitations and advantages of UAS-based systems. The guide will target MCS links that have problematic performance and focus on the evaluation of the Fresnel zones as well as the MCS towers at such locations. This work will ensure that the MCS will continue to provide a reliable network for Caltrans and other users of the MCS infrastructure. Finally, an adoption feasibility cost-benefit analysis will be completed.

WHAT IS THE BENEFIT?

Conventional tower inspection relies on workers to ascend, inspect, and descend towers one by one, a slow and hazardous process. Adopting UAS for inspection will open the possibility of faster, safer, and, hence, more frequent inspections. The proposed research will increase worker safety while conducting tower inspections and develop a novel Fresnel zone preventative maintenance method. Such methodologies initially focus on MCS infrastructure but can be extended to similar inspection tasks. If successful, the methods and guidelines developed as part of this research will be adopted by others relying on microwave communication, the inspection industry, and the other DOTs nationwide.

WHAT IS THE PROGRESS TO DATE?

- UC Davis AHMCT has been selected by the technical advisory panel and the research team.
- A scope of work is being reviewed, and the procurement process is underway. The anticipated start date is first quarter 2025.
- Contract was executed May 5, 2025.
- Drone manufacturer and model has been selected. It will be the Skydio X10 drone for its ability to fly without the need for GPS and in close quarters surrounded by metal beams.