

Rural

MAY 2026

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

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DRISI provides solutions and knowledge that improves California's transportation system.

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

Using drones to efficiently monitor our microwave tower network infrastructure.

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 the Advanced Highway Maintenance and Construction Technology's (AHMCT) 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.

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, radio frequency (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?

Reviewed research on UAS-based inspections for communication towers. Findings show UAS significantly reduces costs and safety risks compared to manual climbing. Key challenges include navigation, obstacle avoidance, and operating in complex tower environments.

Compared UAS inspections with current practices. UAS improves safety, reduces crew size, enables faster repeat inspections, and produces detailed 3D models for better damage detection and long-term monitoring. Challenges include RF interference near towers and wind limitations; mitigation strategies (e.g., RF shielding, redundancy) are under evaluation.

Conducted market assessment of drone solutions. Selected Skydio X10 with VT300-L camera based on performance, compliance, and usability, supported by Skydio Scan software for automated inspections.

Developed initial UAS inspection guidelines based on FAA Part 107 and prior experience. Communication tower-specific protocols will be refined during field trials. Evaluated multiple photogrammetry software tools for data processing.

Currently awaiting delivery of the UAV from the vendor, with shipment expected to begin in mid-May 2026 and delivery anticipated by late May 2026 to begin field deployment and testing.