DRISI

CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

TRANSFORMING IDEAS INTO SOLUTIONS

Research Notes

TPF-5(494) Tethered Unmanned Aerial System (sUAS) for Situational Awareness and Emergency Response Pilot and Evaluation

Improving an incident responder's monitoring capabilities

Rural

MAY 2025

Project Title:

Tethered Unmanned Aerial System (sUAS) for Situational Awareness and Emergency Response Pilot and Evaluation

Task Number: 4289

Start Date: February 1, 2023

Completion Date: June 30, 2025

Task Manager:

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WHAT IS THE NEED?

Understanding situational awareness during an incident is crucial to providing a safe operating environment for our response teams. Using a drone (sUAS) to autonomously transmit both high resolution and thermal imaging video to operators at the District Transportation Management Centers and Headquarters Emergency Operations Center is a novel way to provide valuable, realtime crucial information to decision-makers. By providing drone video via Caltrans Mobile Satellite services enables another critical path toward reliability and redundancy in emergency response events. A key problem with conventional drones is the limitation of flight time due to battery constraints. Battery management is a critical component of drone flight and often requires multiple, very expensive battery sets to keep a drone in the air for long durations. The operational flight time for a drone is up to 40 minutes and the drone must come down for a battery changeout. During this battery changeout, information is not sent to the command centers and situational awareness is degraded. The proposed drone used in this pilot project is tethered to the ground. By tethering the drone, power, and control can be provided from a ground base station. This enables a longduration, non-interrupted flight and eliminates frequent information outages to the operation centers Additional key advantages to tethered drones are that they can extend up to 150 feet, are in a very portable, lightweight suitcase format, and can accept a variety of power sources including a utility wall socket, portable solar panels, a small generator, battery inverter or an onsite vehicle.

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WHAT ARE WE DOING?

Drone technology and its capabilities will be included in the upcoming FHWA's Every Day Counts 7 (2023 – 2024) Innovations in the Next Generation TIM: Technology for Saving Lives category. This pilot/evaluation will allow both Caltrans and Washington State DOT to provide additional insight to others in our industry using this highly capable system.

WHAT IS OUR GOAL?

The Western States Rural Transportation Consortium (WSRTC) TPF-5(241)/TPF-5(494) has and continues to perform numerous task orders that have been very successful and useful to Caltrans and the motoring public. Partnering with D2, D3, the Office of Radio Communications Engineering, and the Washington State DOT/WSRTC will allow a robust set of operating environments, deployment situations, and personnel to evaluate and test the equipment. Ultimately, this evaluation will determine the suitability of enterprise-wide deployment of this evolving technology in multiple transportation departments nationwide.

WHAT IS THE BENEFIT?

Should the Fotokite tethered UAS prove cost-effective and maintainable, it will be considered for addition to Caltrans' Standard Plans and Specifications. A successful system could significantly improve Incident Responder's monitoring capabilities with a corresponding improvement in situational awareness, effectiveness, and safety. These benefits would be achieved without the current problem of short UAS battery life and flight time.

WHAT IS THE PROGRESS TO DATE?

UC Davis AHMCT research team has been selected by the technical advisory panel to perform the work.

- A kickoff meeting was conducted to review the scope of work from AHMCT
- Because of very tight budget deadlines, procurement of five Fotokite Tethered UAS systems and the supporting piece parts was made immediately.
- AHMCT received five Fotokite systems. Two were registered and shipped to Washington State DOT (WSDOT), and three were registered and deployed at DRISI, D2, and Maintenance Telecom.
- Training has been provided to both Caltrans and WSDOT by the vendor
- Each Fotokite system being evaluated has a log to record usage of the UAS.
- The Caltrans team is working with our Aeronautics program to develop usage guidelines for tethered drones.
- One of the drones had a motor fail during flight which caused it to crash. Root-cause was identified as motor controller failure. Three of the remaining four were identified as also having the faulty controller and were sent back for pre-emptive repair.
- One of the drones in WSDOT experienced camera lens condensation when flown during rainy conditions. It too has been repaired.
- Caltrans D6 has a Caltrans-approved drone pilot, as such, D6 was provided with one of the 3 drones for evaluation.
- No-cost extension extended to June 30th, 2025.
- Two of the 5 drones (D6 drone included) experienced frequent battery overheating which caused pre-mature landing and have been sent back to manufacturer for repair. One of the remaining 3 drones has experienced infrequent battery overheating. It, along with the remining 2 drones will be monitored for battery complications.
- Remote ID was enabled on all 5 drones to meet FAA requirements. This firmware upgrade introduced a bug which causes the application on the tablet to lose connectivity/control of the drone for tens of seconds. Control if eventually re-established. The drone does not land itself under these conditions. A firmware patch has not been released.
- Alternative ways to establish communication with the drones were explored as a response to limited cell coverage with the built in cellular SIM.

- Communication was established with an external, Caltrans owned and managed, cellular modem. This method has the added advantage of allowing Caltrans to pull video feed directly to HQ video servers.
- Communication was established using Starlink's antennas.
- Communication was established by swapping out the onboard SIM with a Verizon APN SIM owned and paid for by Caltrans. This has the added advantage of keeping the drone on our private network.
- All 5 drones in the project have experienced issue that have required shipping the units to Fotokite for repair.

IMAGES

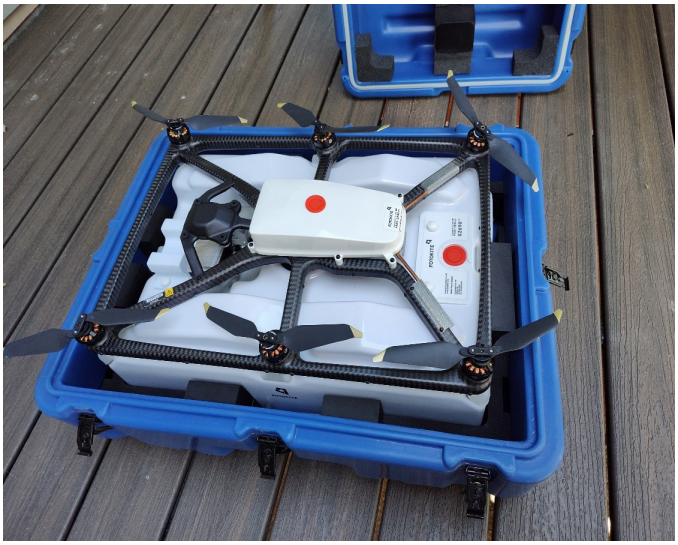

Image 1: Fotokite Sigma Drone and Portable Transport Case

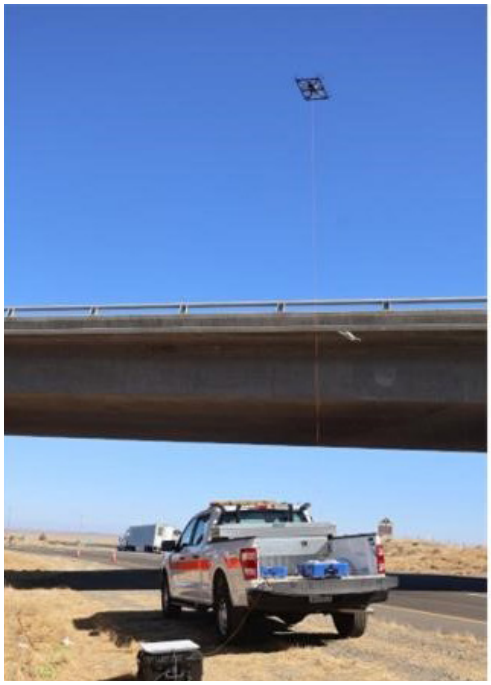

Image 2: Fotokite Sigma Drone on a Mission Connected via Starlink Antenna