



# Inferring UAV Position Relative to Smartphone Sensors Based on Acoustic Characteristics

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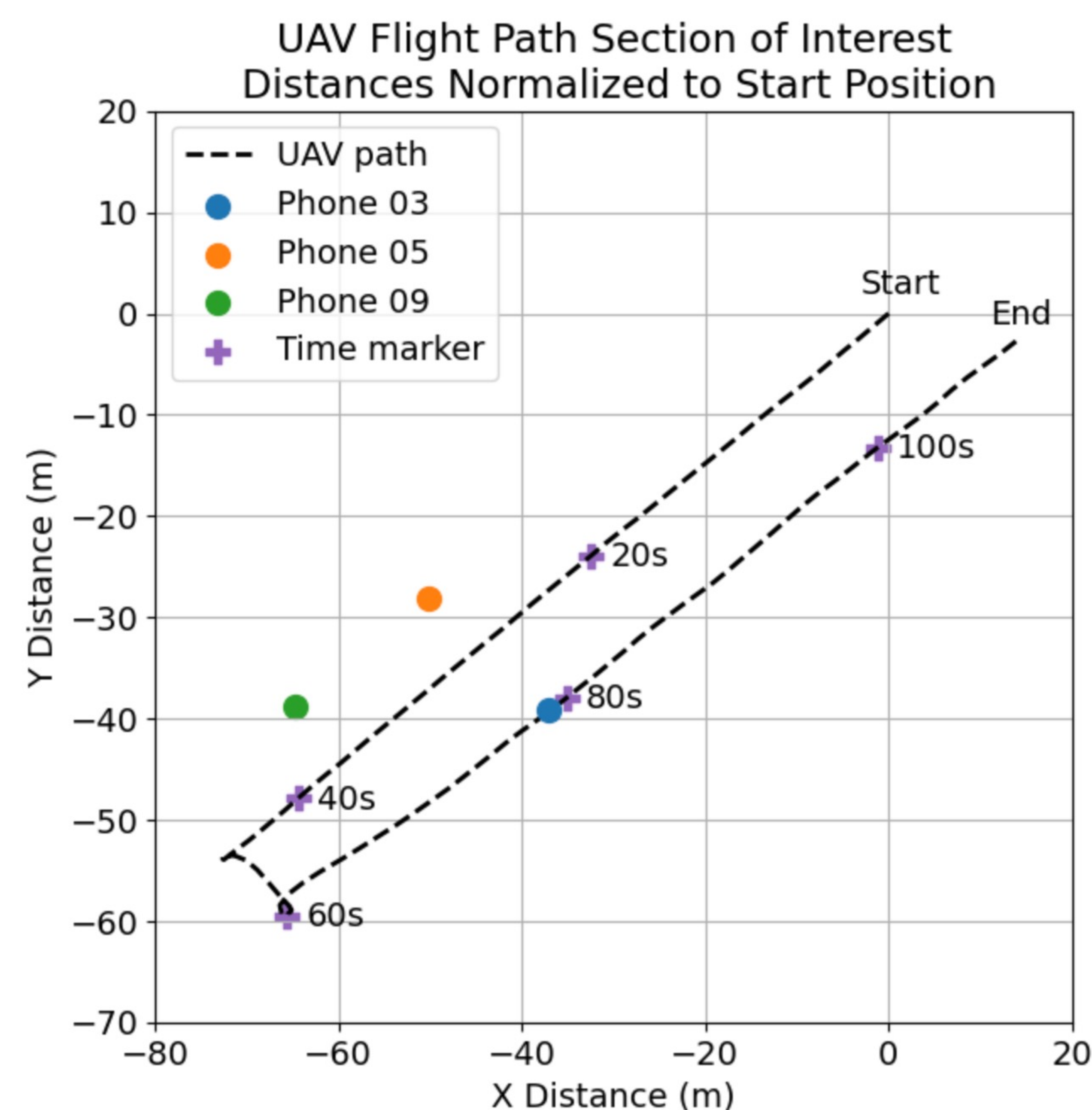
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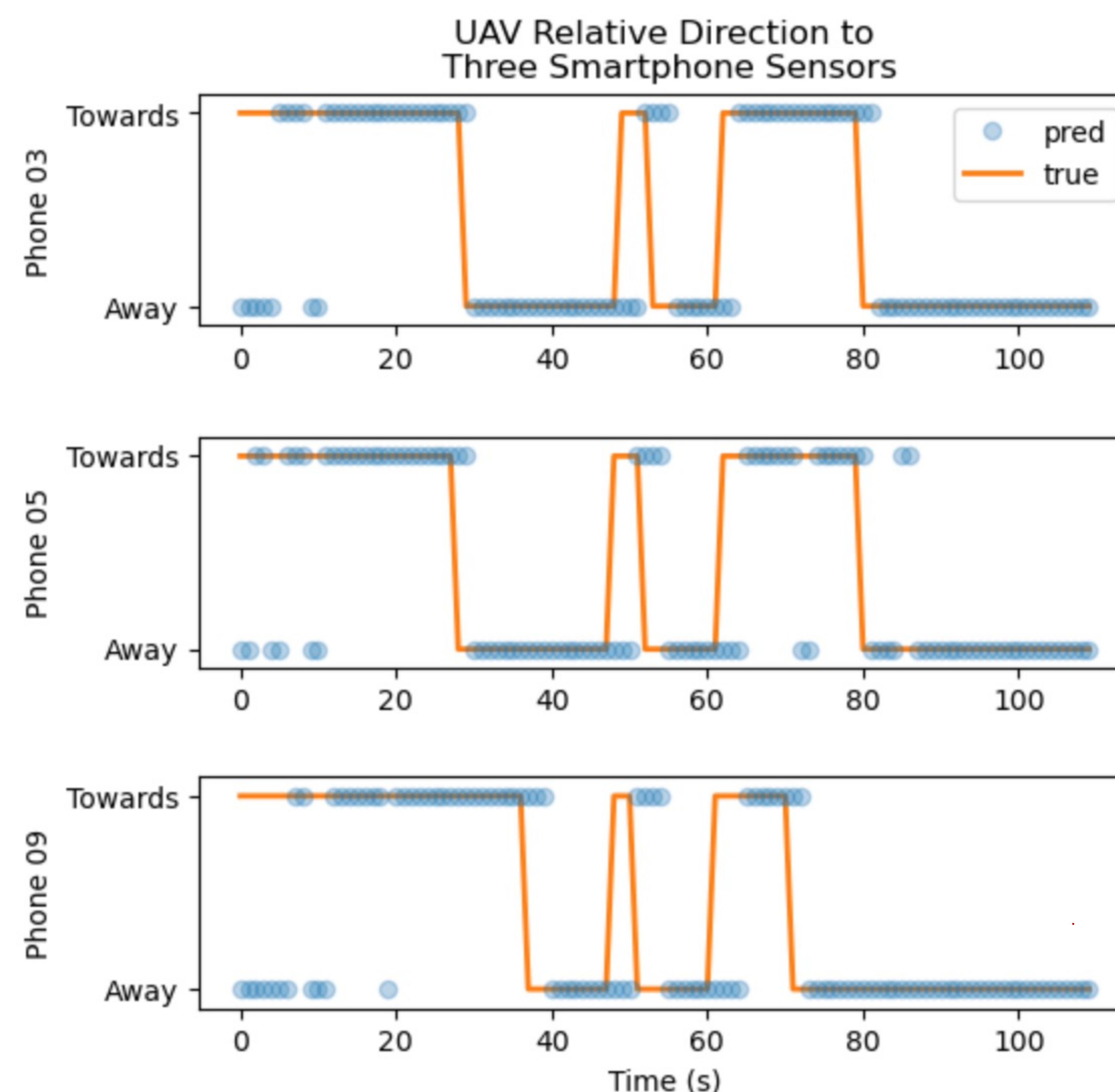
## Introduction and Motivation

- Unmanned Aerial Vehicles (UAVs) pose concerns to nuclear non-proliferation efforts due transport, delivery, and reconnaissance capabilities
- Utilizing commercial-off-the-shelf systems, such as smartphones, to both collect and assess data will augment geophysical sensing systems
- With a single device or distributed network of devices, knowledge of the signal source direction is invaluable
- In conjunction with INL, flight tests of a DJI Matrice 600 were conducted using smartphones as acoustic sensors



## Technical Approach and Results

- Short-time Fourier transforms (STFTs) were generated for 30s long waveforms and were recalculated every one second to simulate the arrival of new data
- From the STFT output, the max values in two targeted frequency bands (100-125 and 200-250 Hz) were extracted for each time bin
- An 8-degree polynomial was fit to max value vs time curve for each band
- The final four seconds of each polynomial was used to estimate the slope of each curve
- The slopes were used to determine whether the UAV is heading towards or away from a sensor



## Conclusion and Next Steps

- Inferring UAV direction based on spectral characteristics of acoustic signals is a viable method for relative source positioning in relation to a smartphone sensor
- To increase reactivity, additional fine tuning and improvement of slope analysis is necessary
- Implement Kalman or particle filter to more efficiently and effectively assess direction

## Mission Relevance

- The impact of this work is continued demonstration of the viability of smartphone acoustic sensors
- This work contributes to non-proliferation efforts by developing methods for acoustic source detection and characterization

## MTV Impact

- MTV has provided an avenue for collaboration between UH Manoa and INL on this work
- Further collaboration between UH Manoa and INL is planned with upcoming data collections and experiments



This work was funded in-part by the Consortium for Monitoring, Technology, and Verification under Department of Energy National Nuclear Security Administration award number DE-NA0003920

