



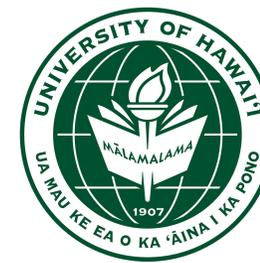
Rocket Ignition Detection Using Data Collected by Smartphones

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Consortium for Monitoring, Technology, and Verification (MTV)



Introduction

- Identify unique characteristics of acoustic rocket ignition signals
- Develop algorithms to detect near-real-time rocket ignition in audio data collected by smartphones

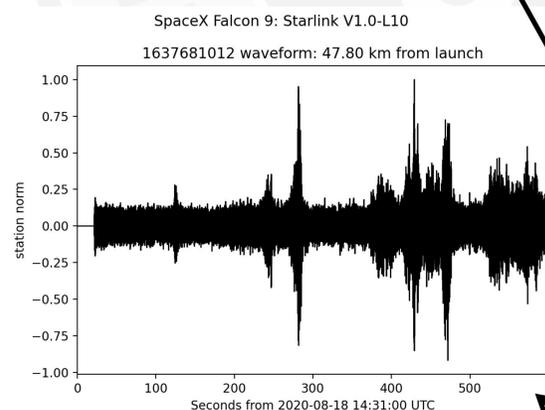
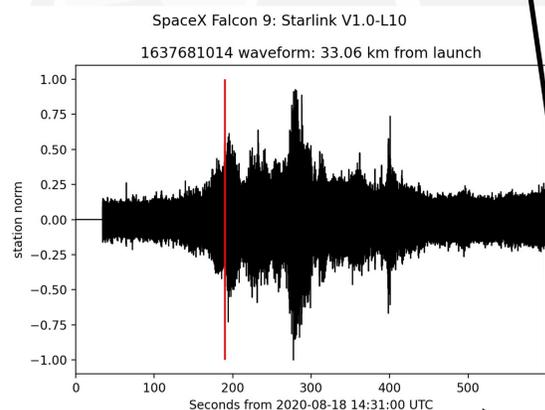
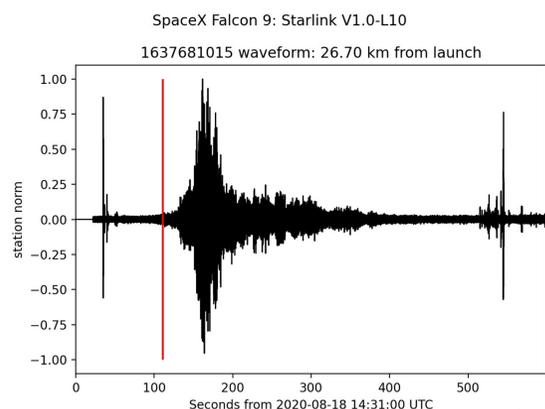
Mission Relevance

- Rocket launch monitoring with fast and accurate ignition detection capabilities valuable for nuclear non-proliferation monitoring

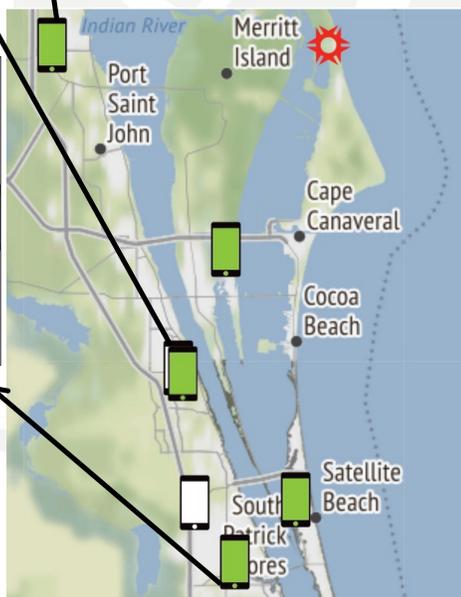
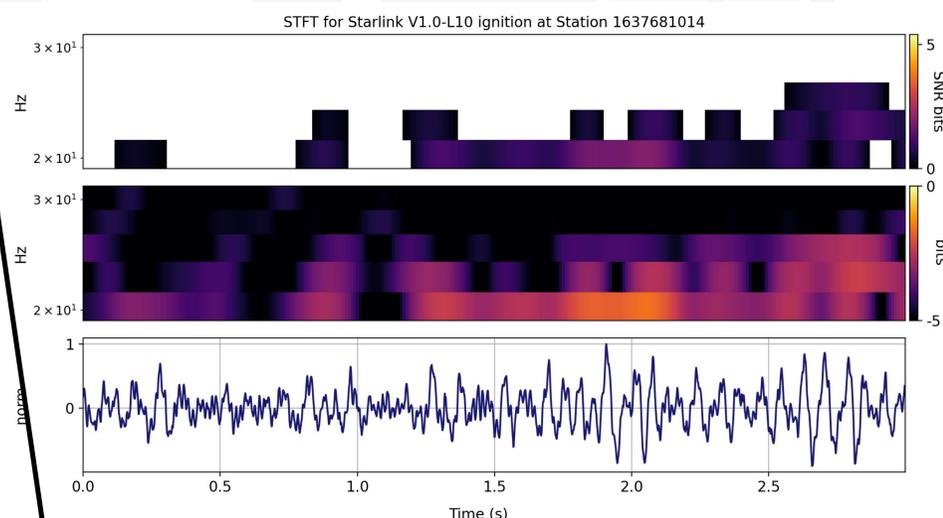
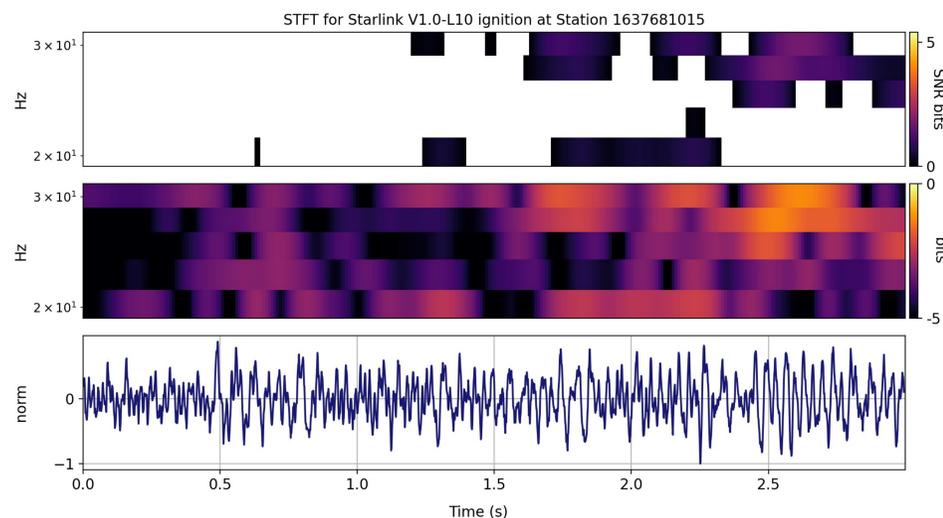
Technical Approach

- Audio data from 37 SpaceX Falcon 9 and ULA Atlas V rocket launches were collected, annotated, and aggregated into a curated dataset
- The data were collected at 10-100 km ranges by a network of smartphones with a sampling rate of 800Hz
- Time-frequency analysis was performed to identify and label ignition signals for each launch and smartphone
- Unique characteristics of the ignition signals were used to construct a preliminary algorithm for near-real-time acoustic detection of rocket ignition

Results



The algorithm fails to detect rocket ignition at this location.



Range	Ignition accuracy	Launch accuracy
30 km	82%	92%
40 km	59%	76%
50 km	52%	72%

Expected Impact

- Improvements in rocket launch detection and early warning capabilities

MTV Impact

- This work is relevant for important MTV research areas such as supersonic and hypersonic shock and delivery systems

Conclusion

- Acoustic signatures of rocket ignition can be detected up to 60 km from launch
- At 30 km range, accuracy is high, but false positives can occur
- At greater range, accuracy drops quickly
- Algorithm can detect second stage ignition and first stage entry burn if SNR is high

Next Steps

- Aggregation and curation of rocket launch data
- Application of domain expertise and machine learning methods to ignition and launch detection

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