



Goal

Identify and annotate unique features of rocket launch, trajectory, and chronology to develop missile detection capabilities.

Data

Smartphones ≈25km from launch collected audio data at 800Hz.

Method

Peaks in data are used to identify events, which are classified as launch sequences or anomalies by their characteristics.

Discussion

Launch signatures of rocket types are similar but differentiable. Anomalies with high SNR are distinguishable.

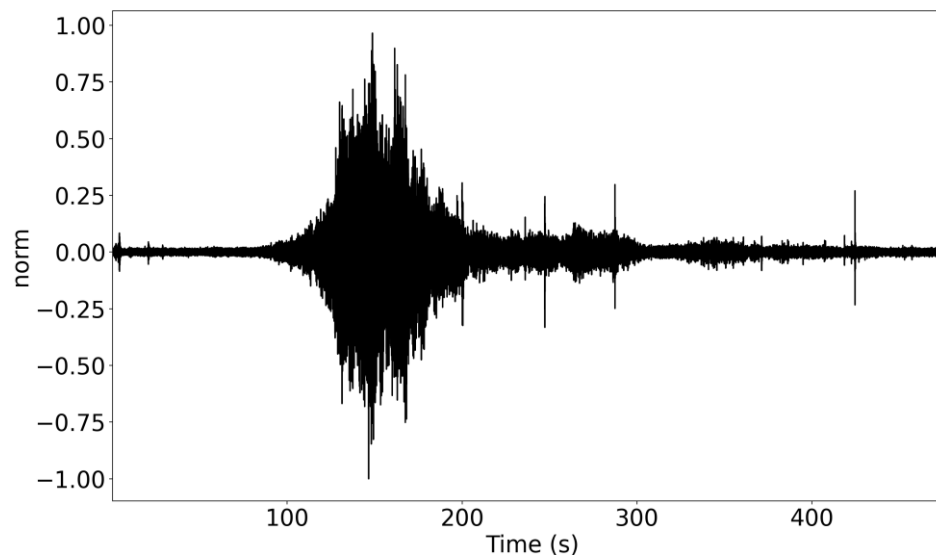
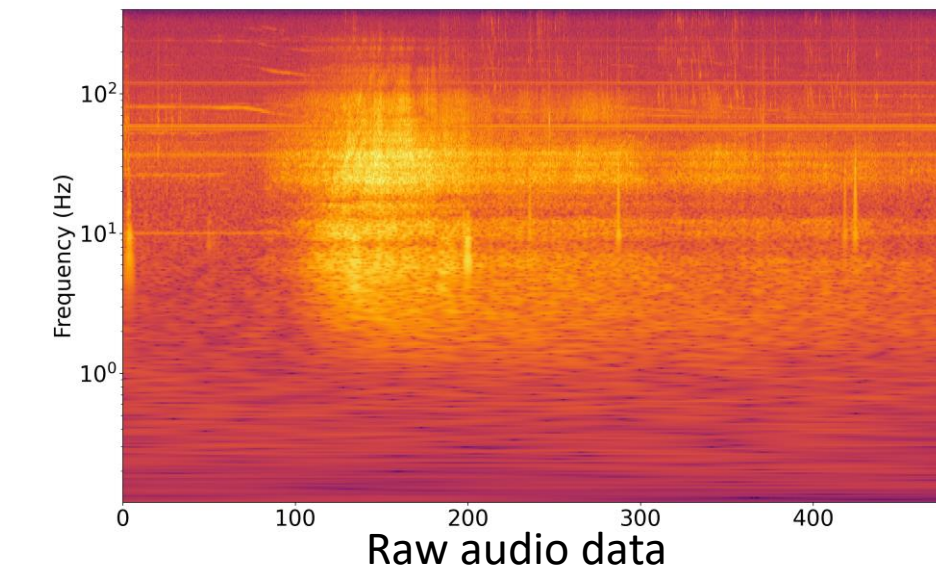
Future work

Identify and annotate features of launch and anomaly signatures in greater detail.

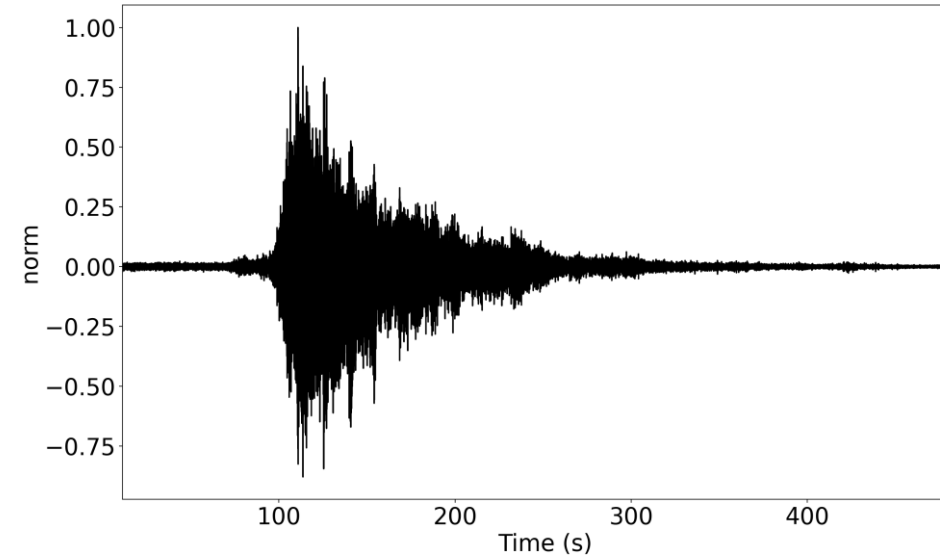
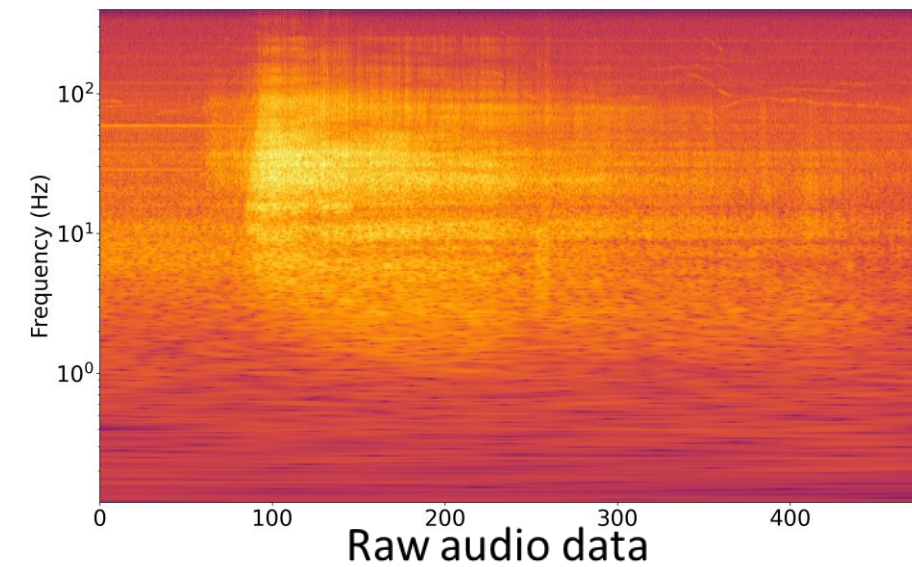
References

Garcés, Milton. Quantized Constant-Q Gabor Atoms for Sparse Binary Representations of Cyber-Physical Signatures. *Entropy*. 2020; 22(9):936.

Falcon 9 Starlink launch
CWT of audio data



Atlas V Perseverance launch
CWT of audio data





Investigation of Rocket Signatures Collected by Smartphones

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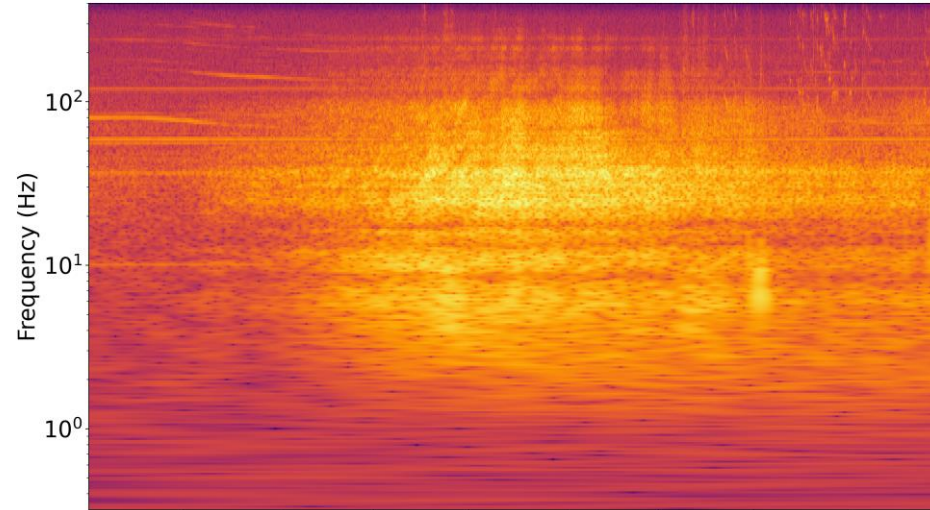
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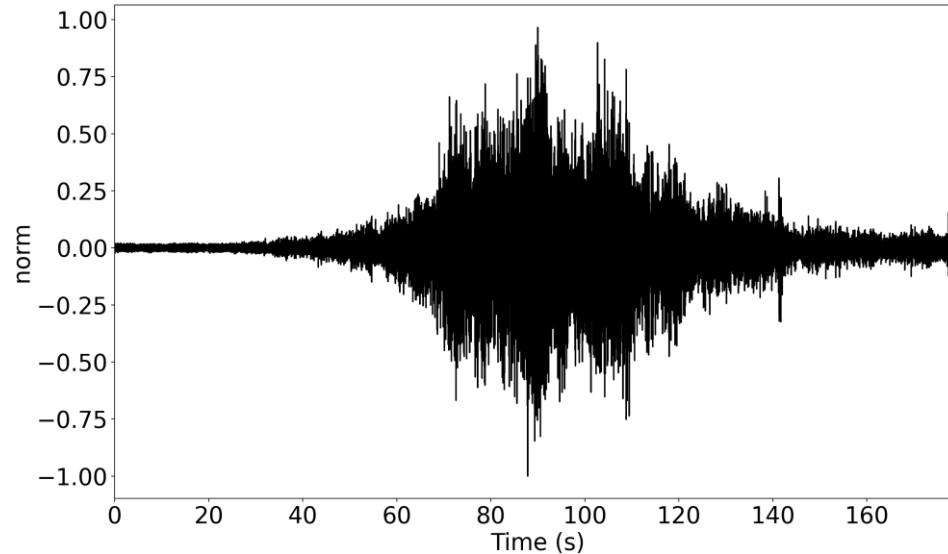
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Falcon 9 Starlink launch

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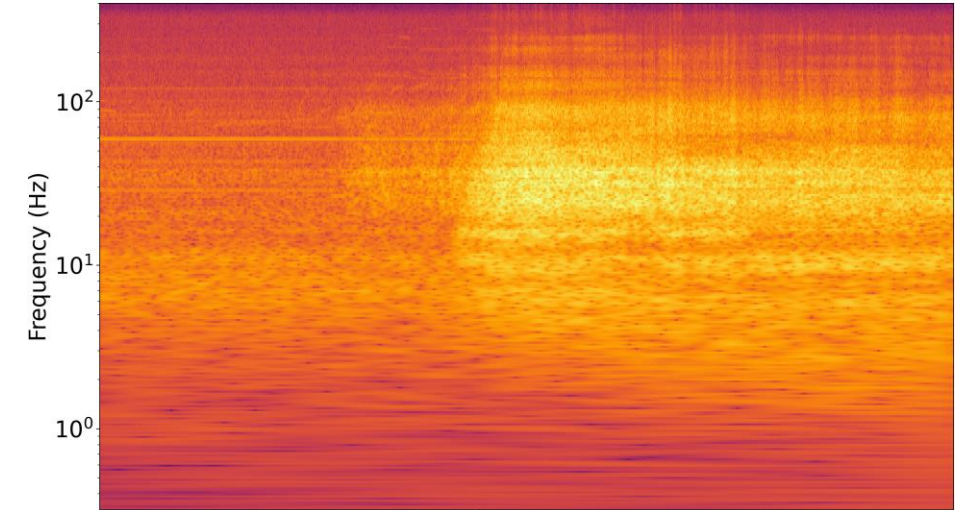


Raw audio data

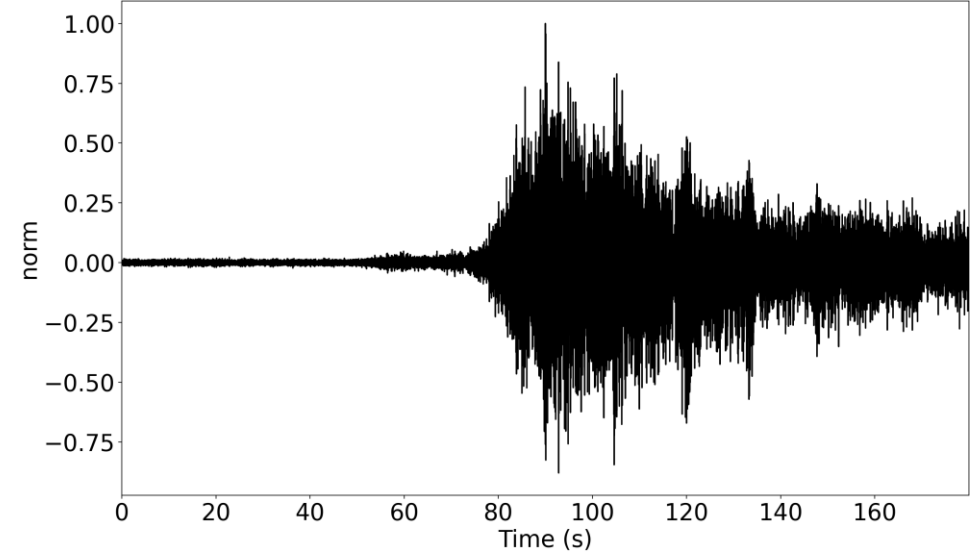


Atlas V Perseverance launch

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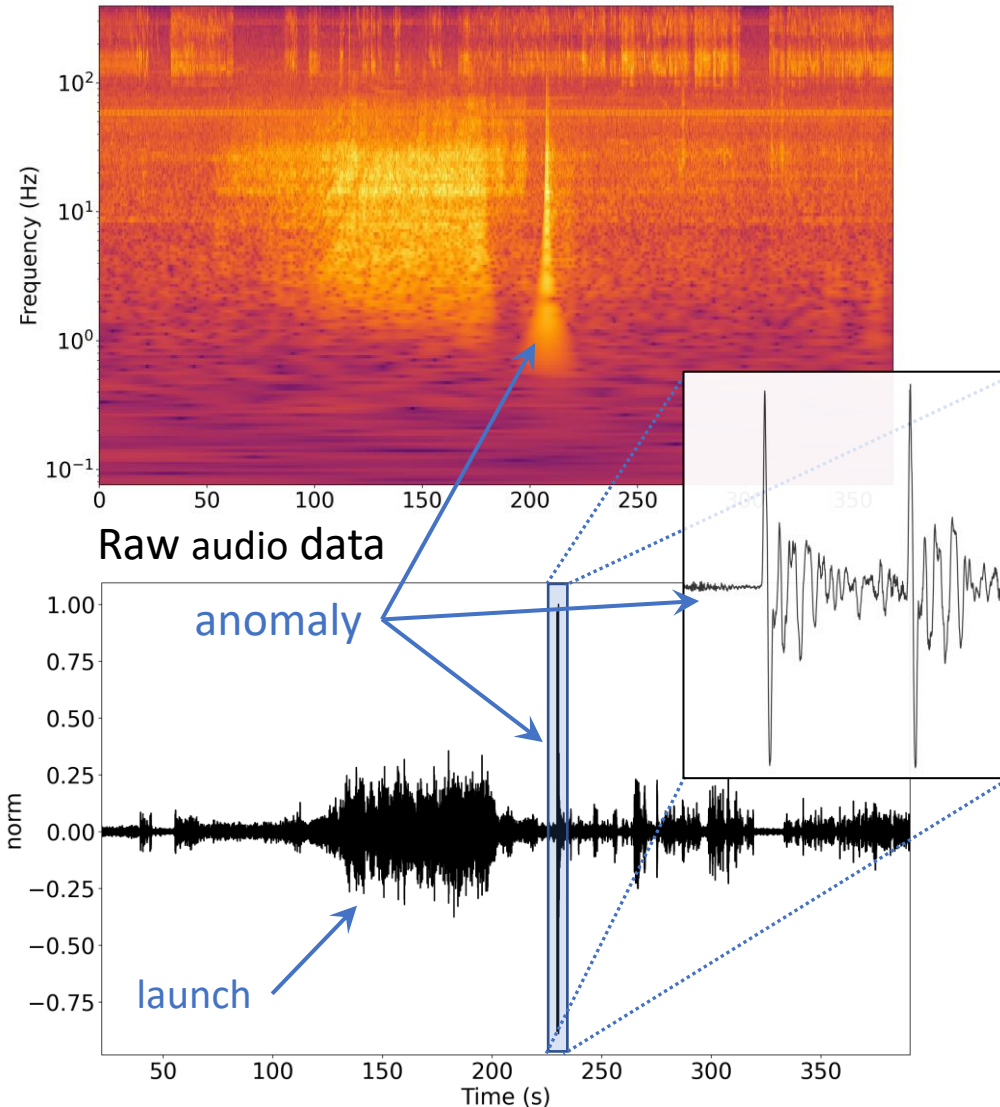
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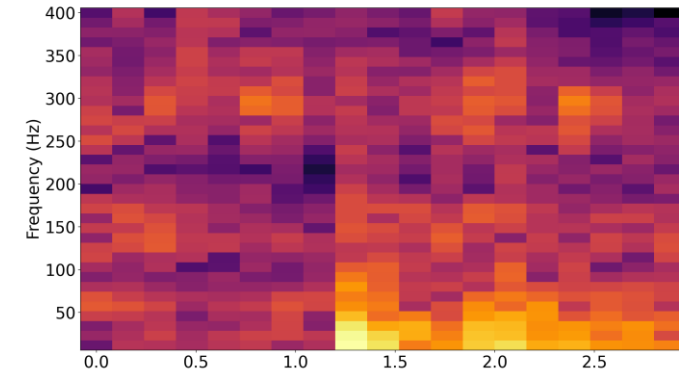
References

Garcés, Milton. Quantized Constant-Q Gabor Atoms for Sparse Binary Representations of Cyber-Physical Signatures. *Entropy*. 2020; 22(9):936.

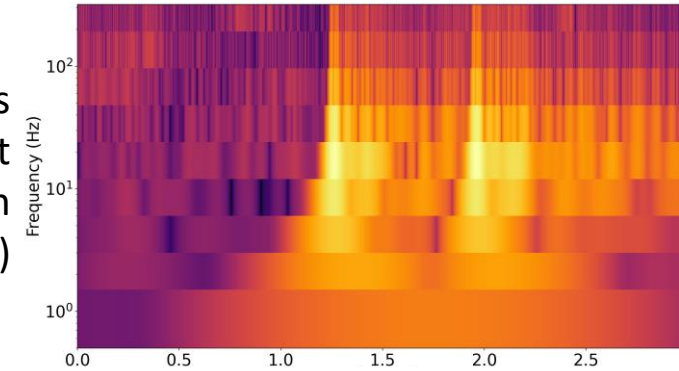
CWT of audio data



Short-time Fourier Transform (STFT)



Continuous Wavelet Transform (CWT)



Constant Q Transform (CQT)

