



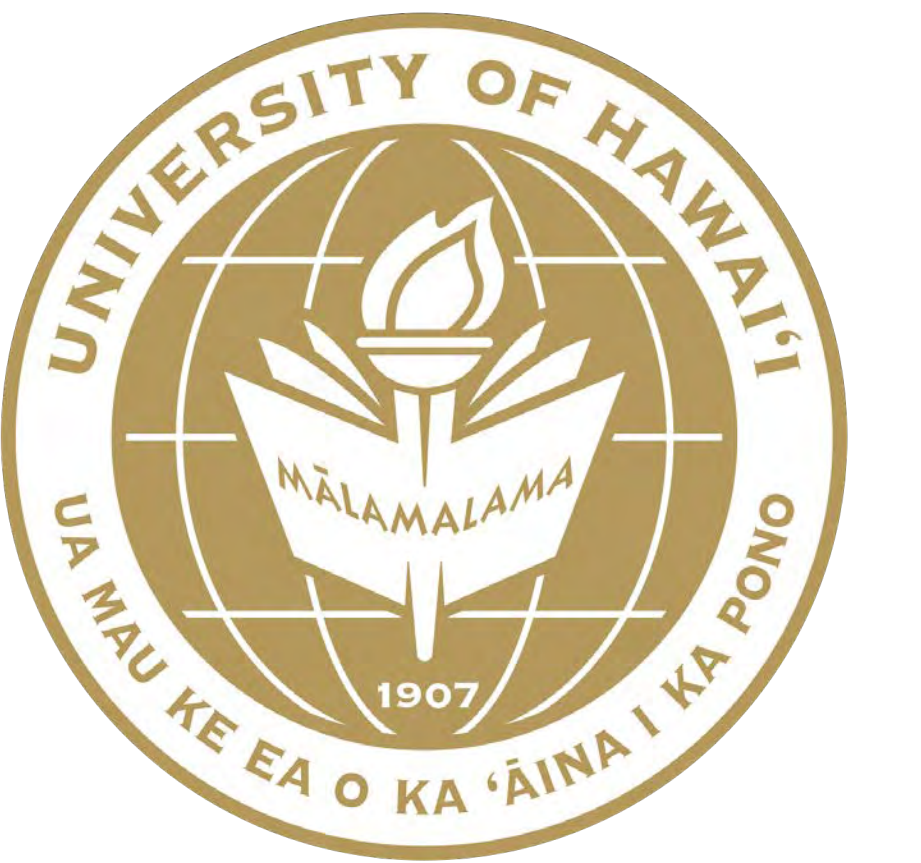
Data Collection and Analysis Procedures on Balloon Platforms

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Introduction and Motivation

- A Samsung Galaxy S10 slung from a balloon plummeted from a stratospheric height of 36 km (~119,000 feet).
- The RedVox app provided a complete record of its rapid descent and abrupt deceleration when it hit the ground.
- RedVox API and SDK in public repos facilitate access and reproducibility.
- Paper provides a guide on how to navigate and operate heterogeneous data collection platforms

Mission Relevance

- Demonstrate explosion monitoring capability from high altitude balloons.
- Development of easily available applications with open-source SDKs encourage flexibility and diversity of data collection and analysis.

Technical Approach

- A Galaxy S10 was in an enclosure box attached to a balloon was released at a height ~36km.
- The S10 internal sensors recorded the various stages of the descent.
- Data were processed using the RedVox SDK, the Redvox-Pandas, and the libquantum open-source frameworks.

Python SDK:

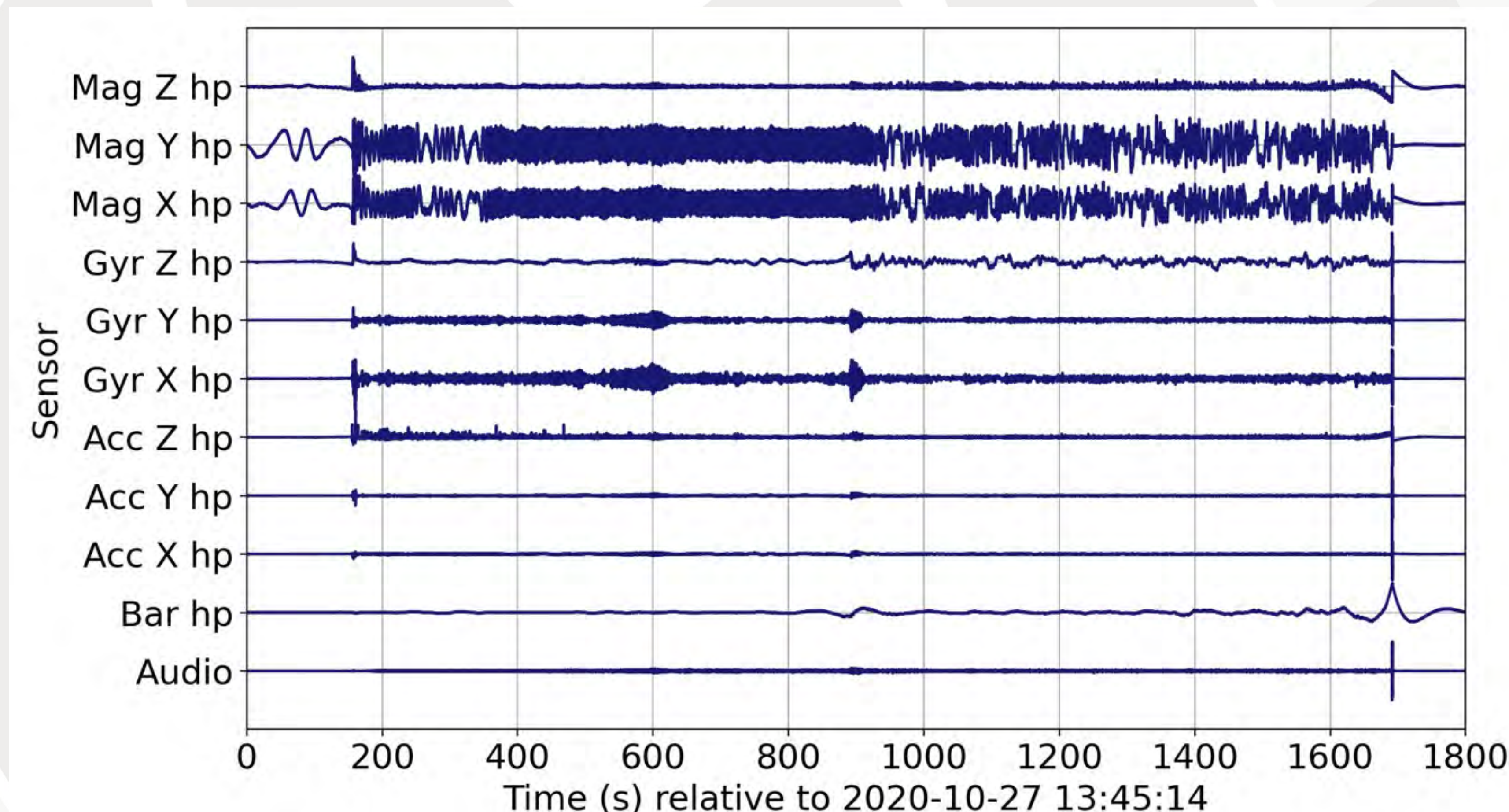
<https://pypi.org/project/redvox/>

RedPandas Pipeline:

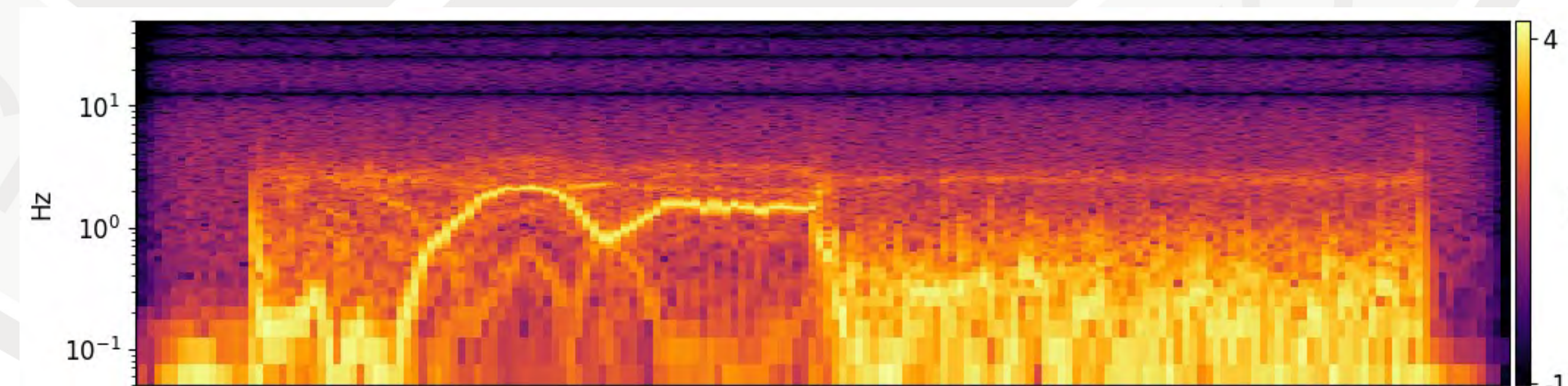
<https://pypi.org/project/redvox-pandas/>

Time-Frequency Representations:

<https://pypi.org/project/libquantum/>



High-pass filtered (hp) waveforms for sensors: audio, barometer (Bar), accelerometer (Acc), gyroscope (Gyr) and magnetometer (Mag).



Spectrogram for high-passed filtered horizontal component of the magnetometer showing the high flat spin frequency in the stratosphere

Results

- The S10 was deployed screen down within the payload enclosure, and its vertical (z) axis is positive down.
- At the beginning of the record, the balloon is ascending through the stratosphere with the payload slowly spinning about its vertical axis (flat spin).
- Skyfall begins with the cutting of the line and substantial movement and rotation along all axes.
- The first stage of the Skyfall event is the fall through the thin stratosphere, where the parachute is ineffective.
- The fastest (~90 m/s) descent occurred during the stratospheric freefall, reaching a peak “flat spin” frequency of ~2 Hz (120 rpm).
- The second stage corresponds to penetration into the troposphere and a reduction in the vertical and rotational motion of the payload enclosure.
- Skyfall terminates with impact on the ground, shown by high amplitudes on all channels. The final minutes of the record show the payload enclosure flipped upside down.

Conclusion

- Smartphones are viable airborne geophysical data collection platforms.

Skyfall Paper

Garcés, M. A., D. Bowman, A. Christe, T. Yoshiyama, B. Williams, M. Colet, J. Tobin, Samuel Takazawa, S. Popenhagen, K. McLin, C. Zeiler (2021, in internal review). Skyfall 2020: Smartphone data from a 36 km balloon drop. For submission to MDPI Sensors.

