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Initial development of an autonomous UAV for underwater data acquisition

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VoR (Version of Record)

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REPOSITORY RECORD

Lloyd, Steven D., Paul A. Lepper, and Simon C. Pomeroy. 2019. "Initial Development of an Autonomous UAV for Underwater Data Acquisition". figshare. <https://hdl.handle.net/2134/23347>.

Initial Development of an Autonomous UAV for Underwater Data Acquisition

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Loughborough
University

Problem Identification

- ▶ Current methods of Acoustic Surveying
 - Drifting
 - Vessel Based Deployment
 - Dipping Hydrophone (military)
- ▶ Limitations
 - Re-deployment Rate
 - Risk Involved
 - Cost Involved

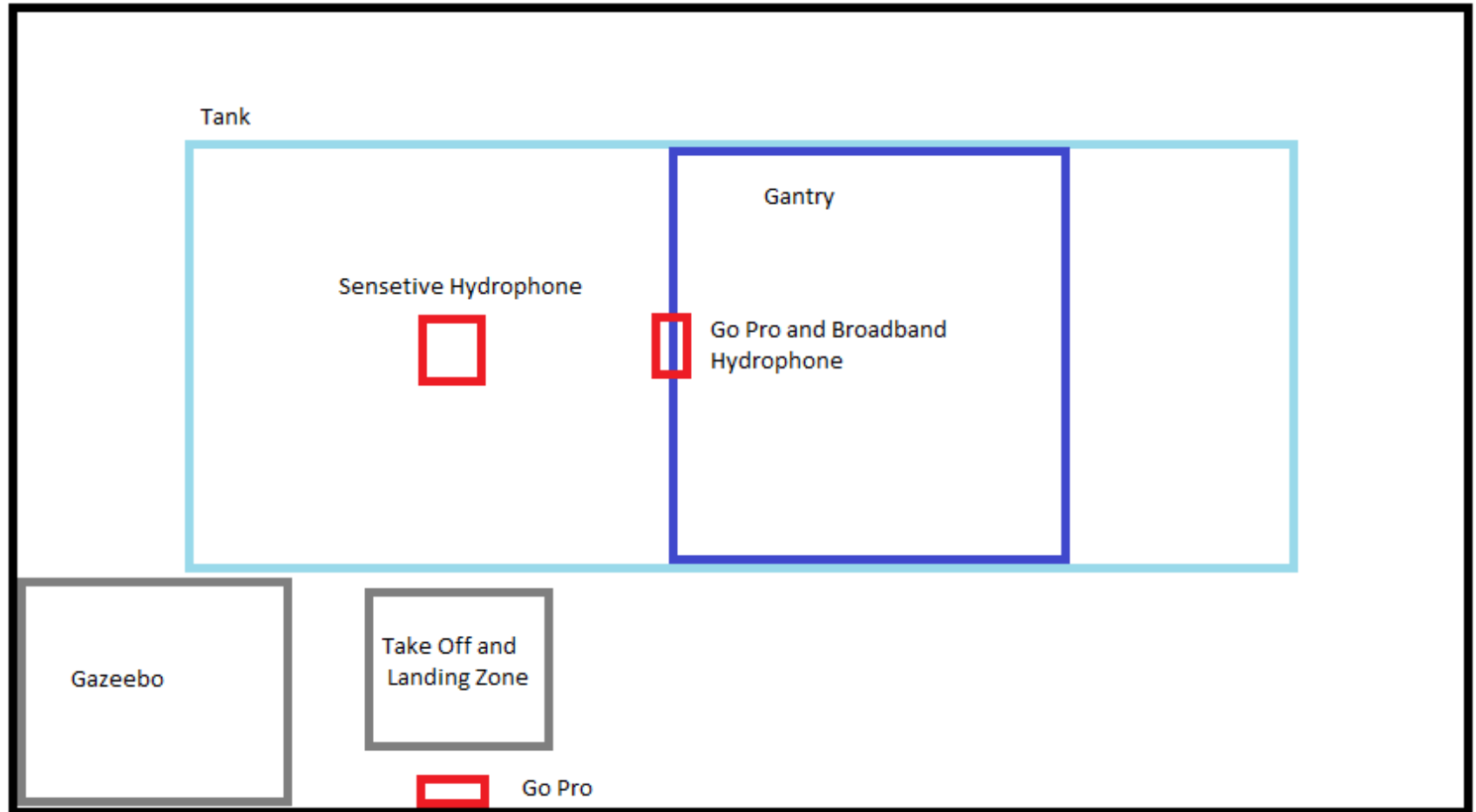


Solution and Application

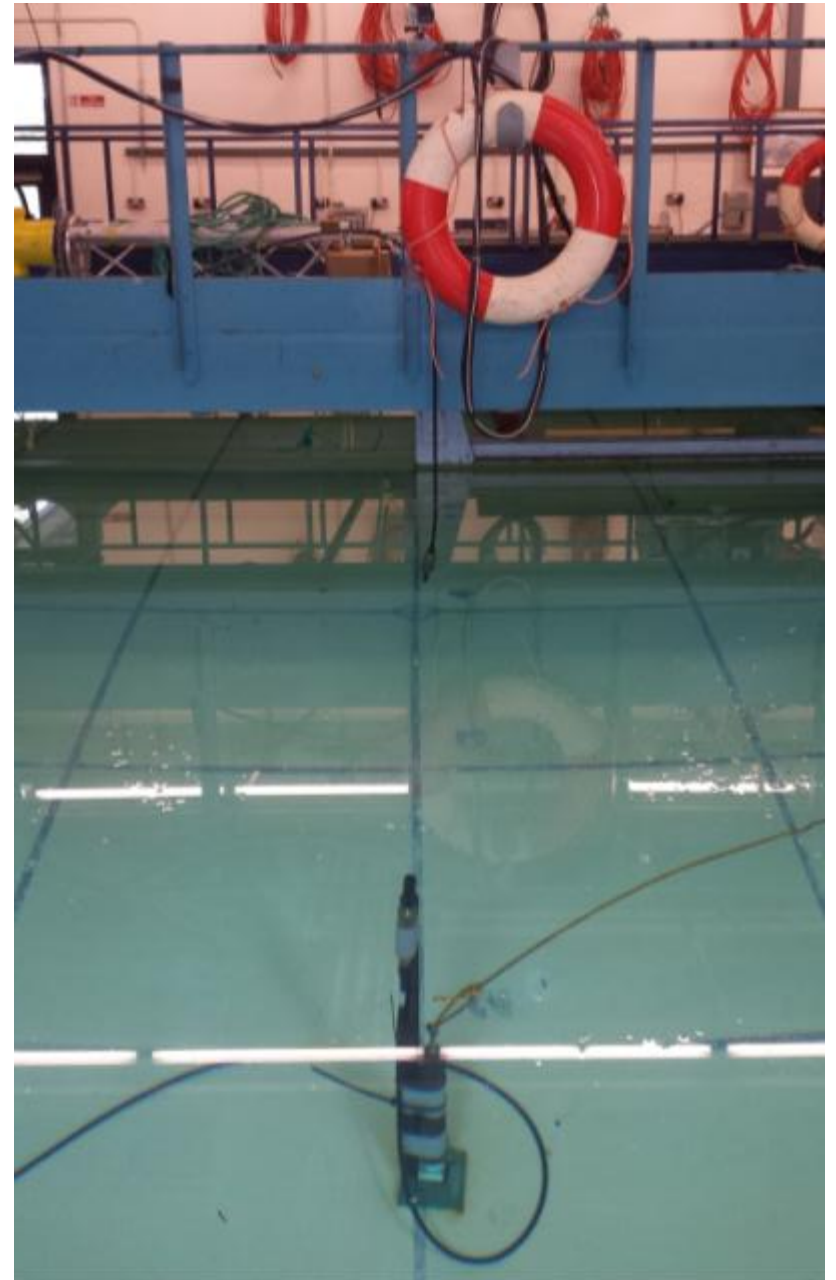
- ▶ Using Unmanned Aerial Vehicles for Acoustic Surveying
- ▶ Applications
 - Acoustic surveys
 - Offshore construction
 - Piling
 - Environmental Monitoring
- ▶ Presentation of Current state of research
 - Effect of UAV on environment
 - Lack of data, mainly visual



Test Plan



Test Plan

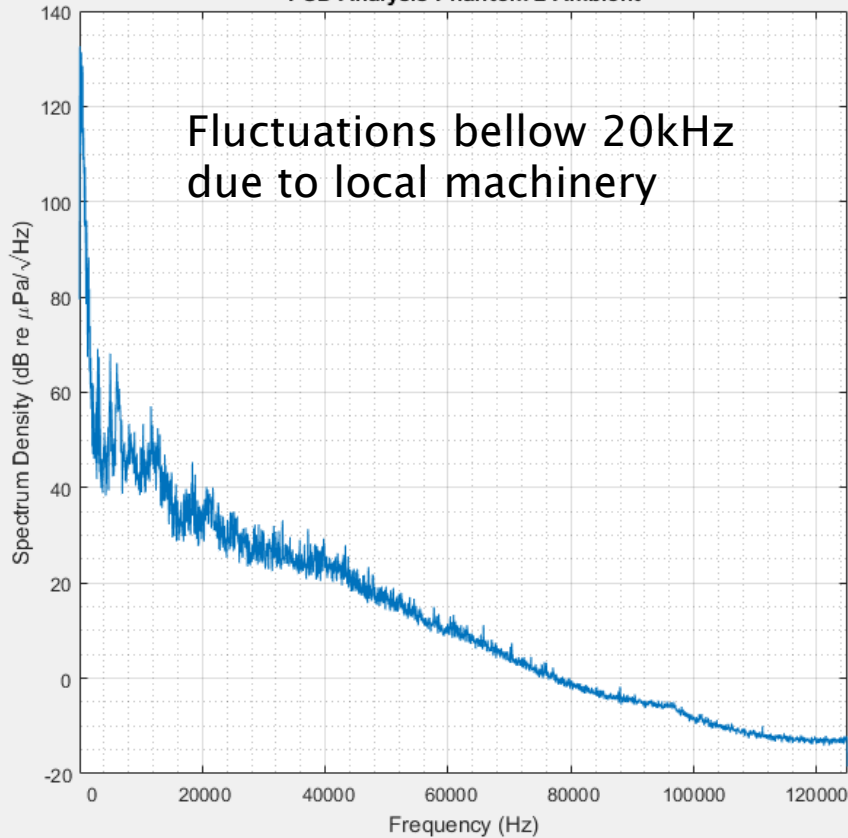


Presentation of results

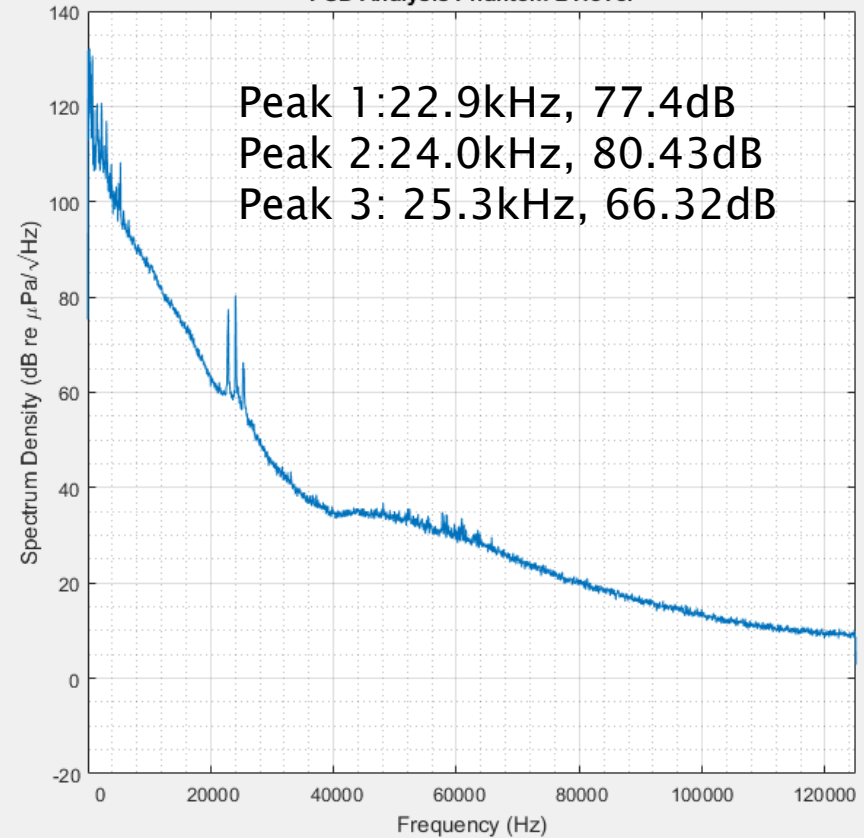
- ▶ Power spectral density–Allows comparison
- ▶ Comparing results
 - Same FFT Size
 - Same window used (Hanning)
 - Same Hydrophone used (Reson 4032,5–120,000Hz)
- ▶ Same time frame of 9 seconds analysed regardless of sample rate (unless stated)
- ▶ All dB re $1 \mu\text{Pa}/\sqrt{\text{Hz}}$

Results: Phantom 2 Hover

PSD Analysis Phantom 2 Ambient



PSD Analysis Phantom 2 Hover

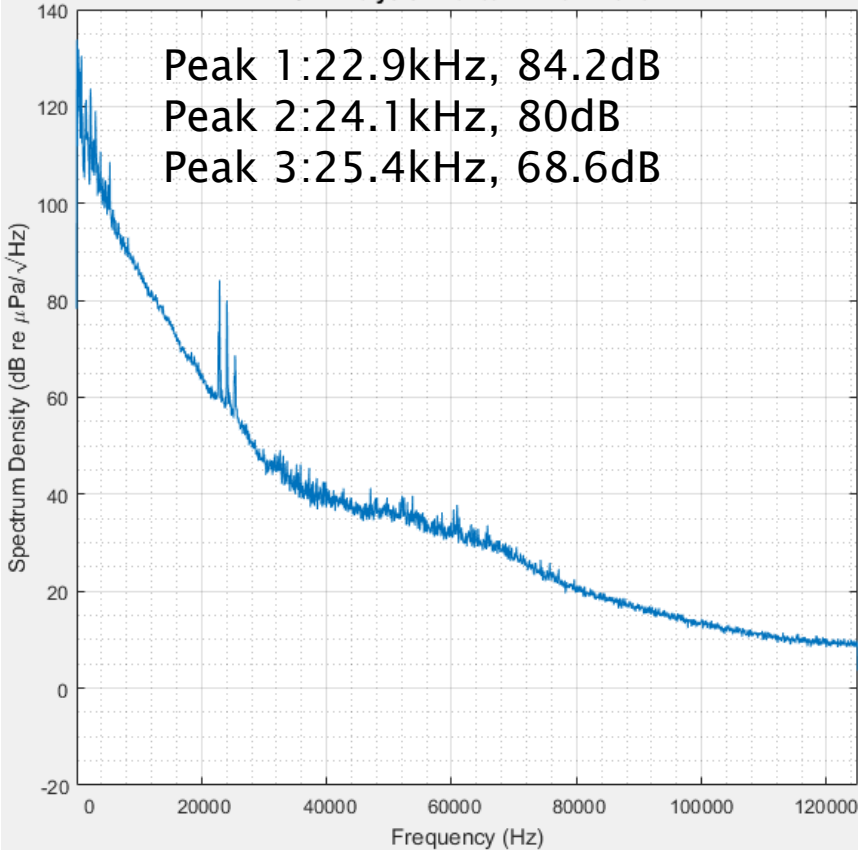


Ambient: 100Hz up to 50kHz bandpass filter +50dB gain

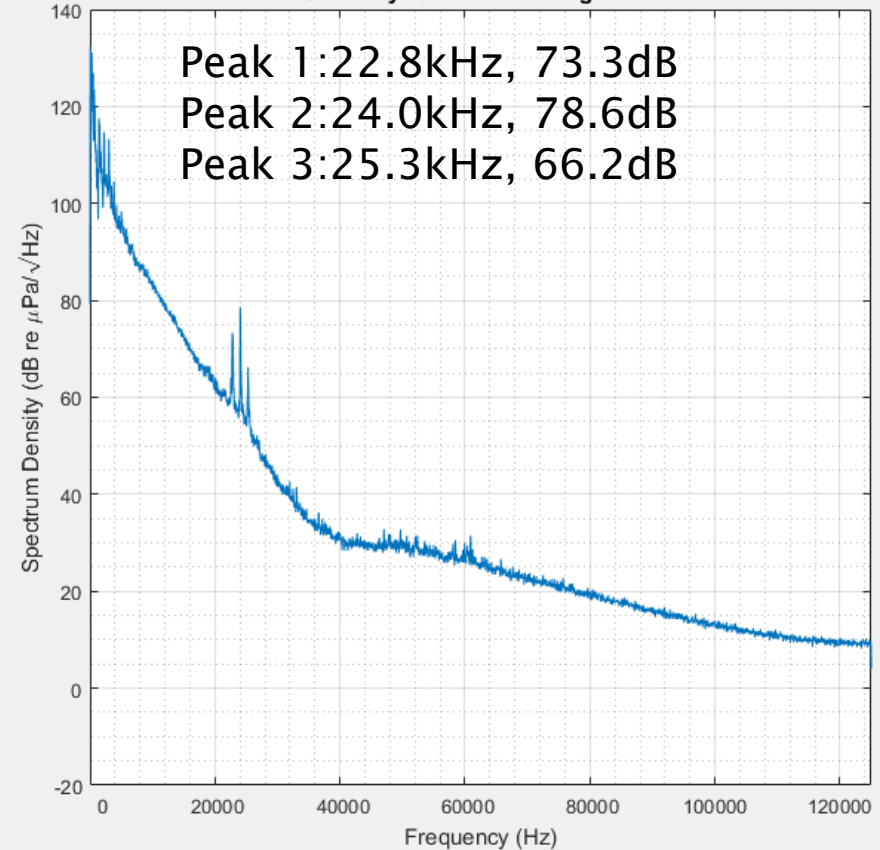
UAV Hover: 100Hz up to 100kHz bandpass filter +50dB gain

Results: Phantom 2 Altitude

PSD Analysis Phantom 2 Low Hover

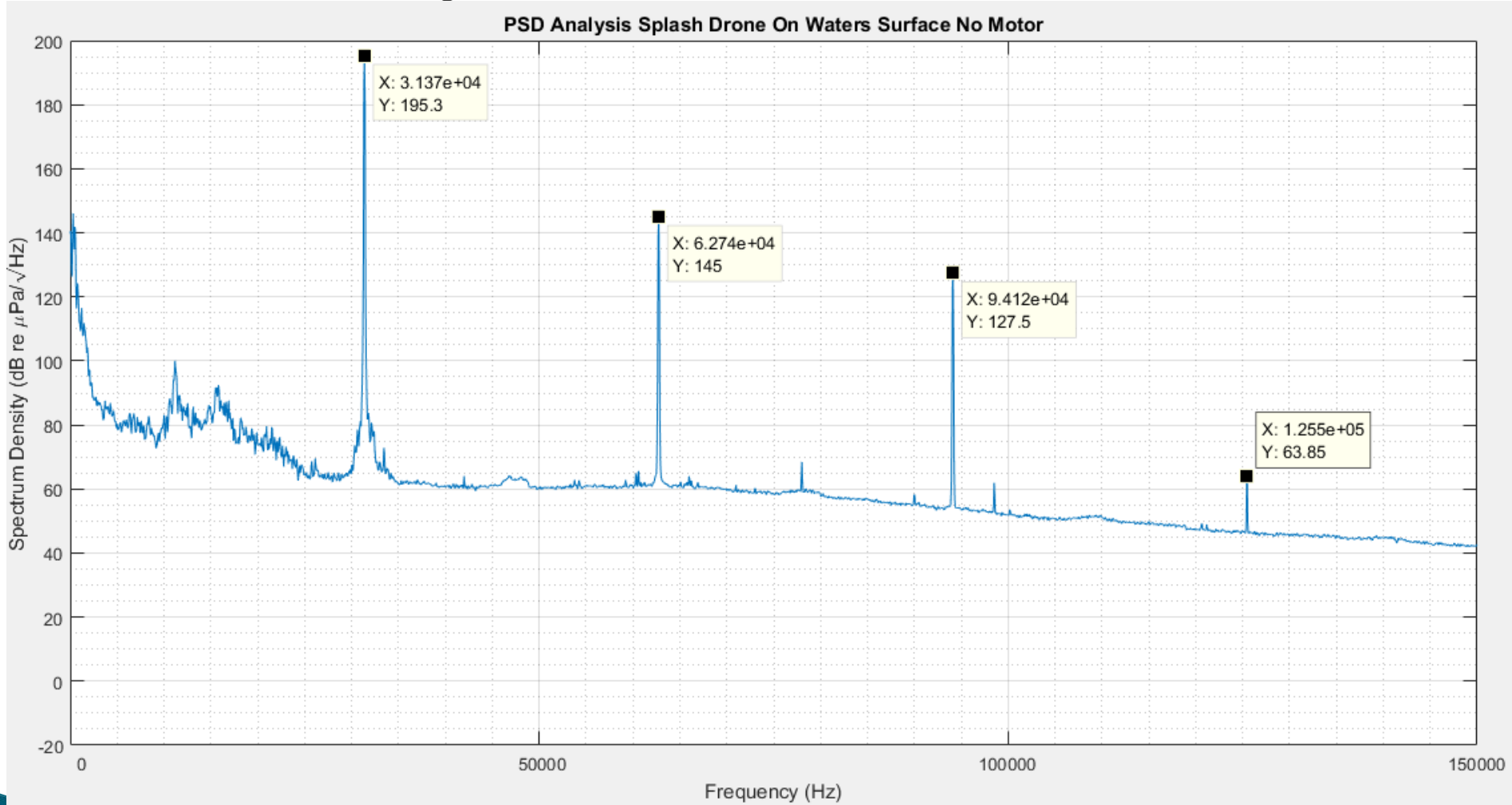


PSD Analysis Phantom 2 High Hover



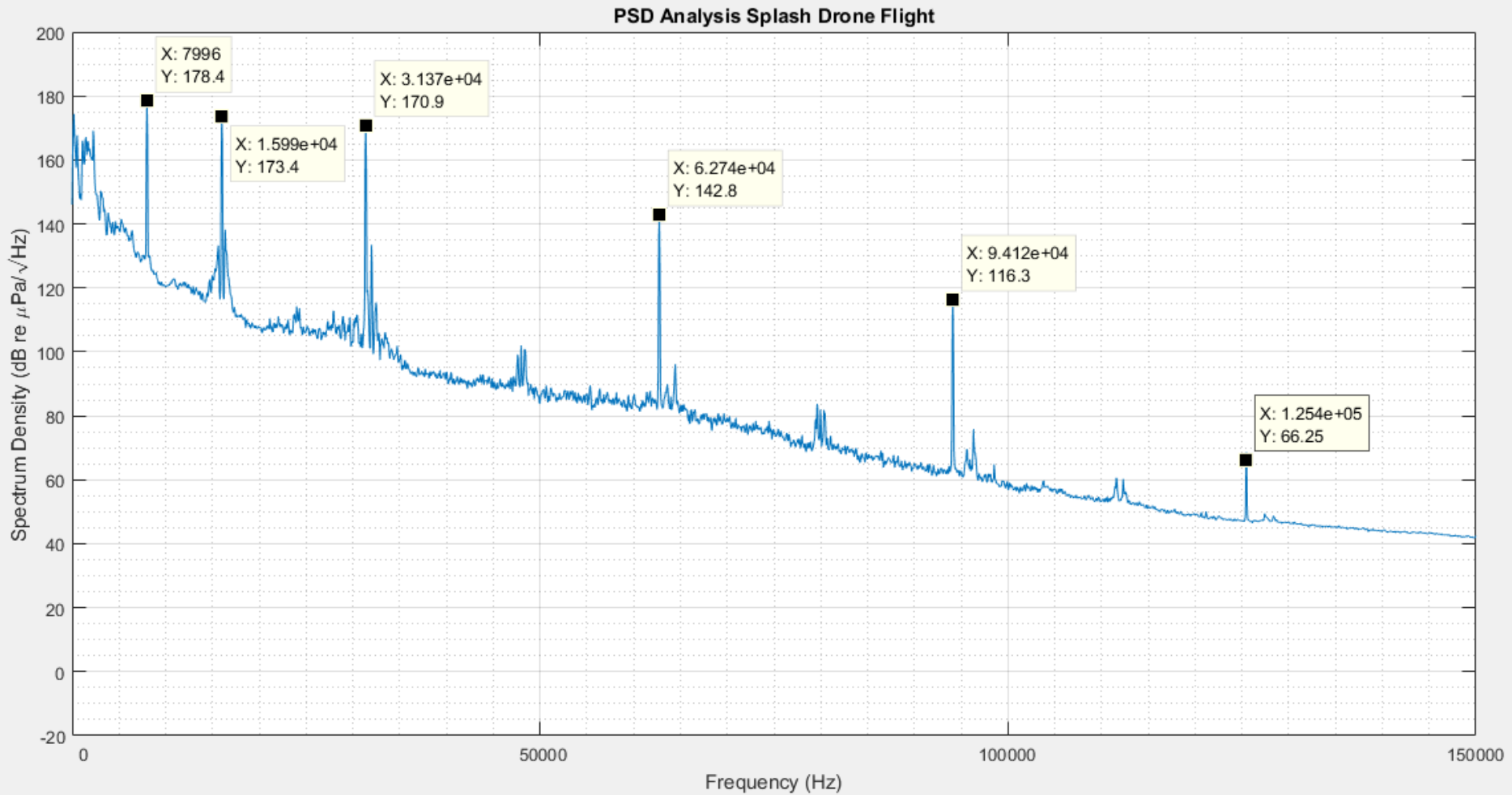
Both Tests: 100Hz up to 100kHz bandpass filter +50dB gain
Hover Low @ 1.5m above surface, Hover high @ 5m above surface
All Units of dB re 1 $\mu\text{Pa}/\text{root Hz}$ (RMS)

Results Splash drone on surface



Tested: 100Hz up to 100kHz bandpass filter +20dB gain 500kS/s

Results Splash Drone Flight



Tested: 100Hz up to 100kHz bandpass filter +20dB gain 500kS/s
PSD of all data from flight (~25seconds)

Limitations of Current Tests

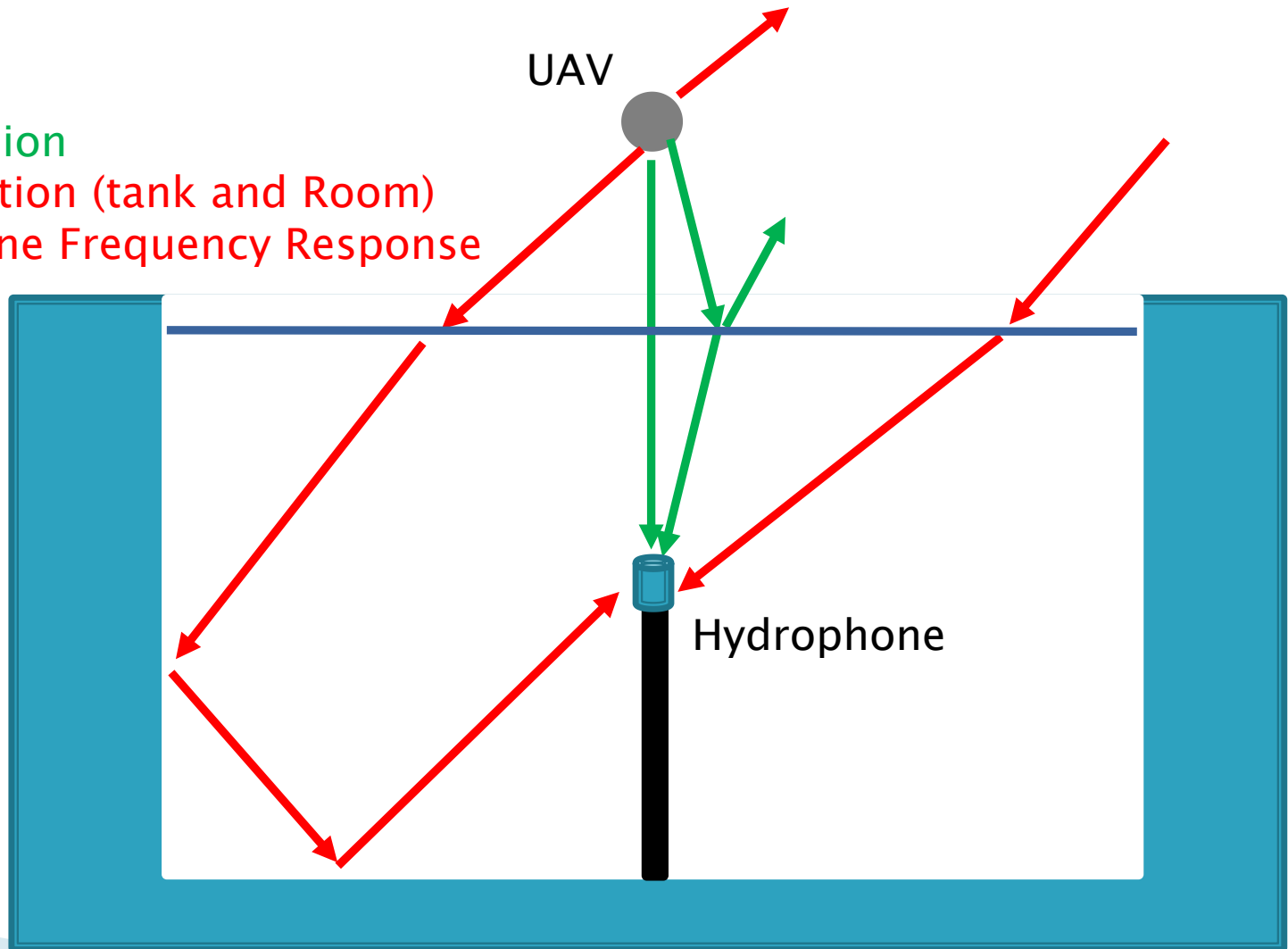
Refraction

Reflection

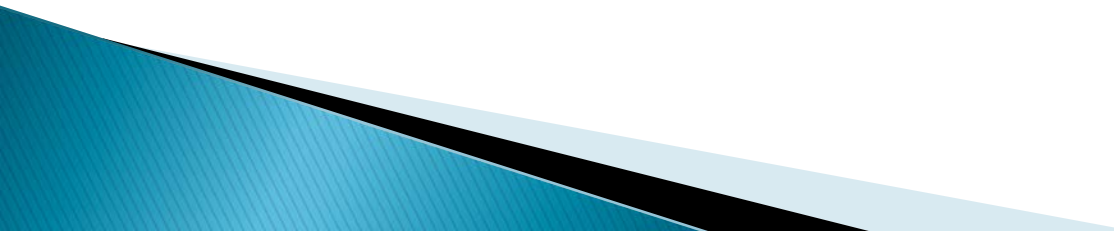
Transmission

Reverberation (tank and Room)

Hydrophone Frequency Response



Conclusions

- ▶ UAVs offer potential for underwater acoustic environmental monitoring
 - ▶ UAVs tested emit ultrasonic frequencies that can be detected underwater
 - ▶ Further investigation into non motor related frequency components
 - ▶ Potential for noise friendly UAV development
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Future Work

- ▶ Analysis of splash drone acoustics in air
- ▶ Creation of testing rig (repeatability)
- ▶ Free field testing (reverberation Removal)
- ▶ Flight with Hydrophone attached
- ▶ Validate ultrasonic frequency's observed
- ▶ Development of an on-board data logging system in order to relate motor RPM/chassis vibration to acoustic frequencies observed

