NASA Dataset Release Feedback Request: Moog S-250

Presented at the NASA Acoustics Technical Working Group Meeting at NASA Langley Research Center

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We Want to Hear from you

- What data is the most useful?
- Are processed spectra sufficient?
- Would the release of raw time histories be useful?
- What airfoil data is most relevant?
- Have we missed anything?

Moog S-250 Vehicle



- Research vehicle
- Octocopter with 4 sets of contra rotating blades

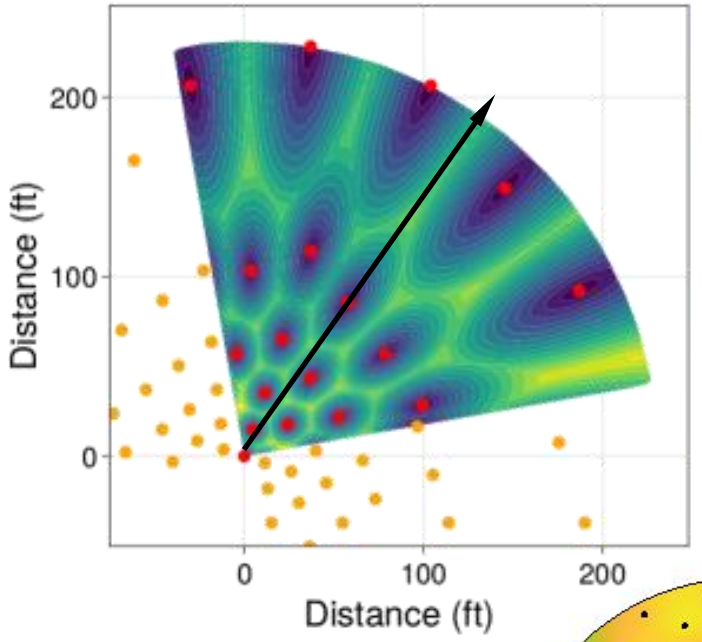
Overview of Test Campaign

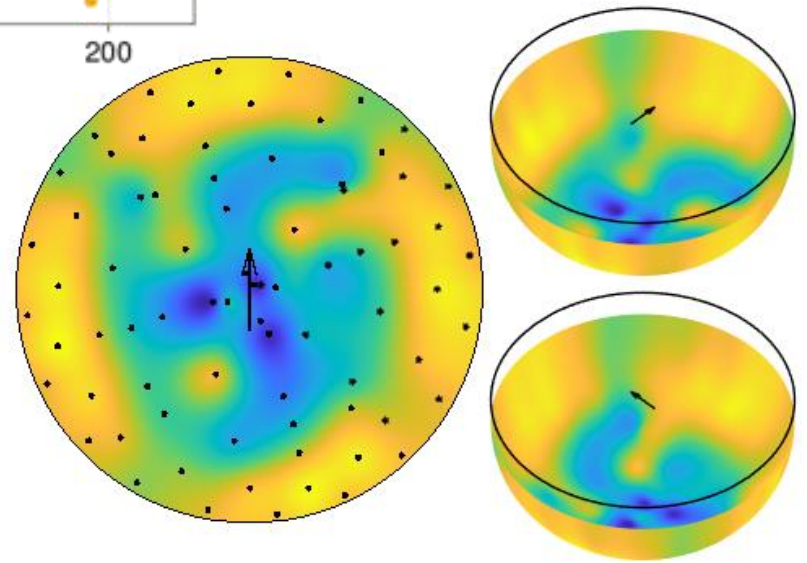
- Ground run-up – 11/06/2019
  - Objective: obtain initial sound levels for vehicle
- Electric motor noise – 08/20/2021
  - Objective: characterize motor noise
- 15’ hover – 06/29/2022
  - Objective: refine far-field estimate and obtain initial acoustic hover data
- 60’ hover – 07/21/2023
  - Objectives: quantify far-field, obtain data for the construction of noise hemispheres.



Microphone Array

- 18 microphones (red)
- Geodesic distribution projected to ground to evenly distribute microphones
- 90° array
  - Vehicle rotated in 90° increments to create four recordings
  - Records merged to create full hemisphere
  - Prevents cross correlations between microphones that do not share a quadrant
- Able to generate spectra at points 15° below horizon



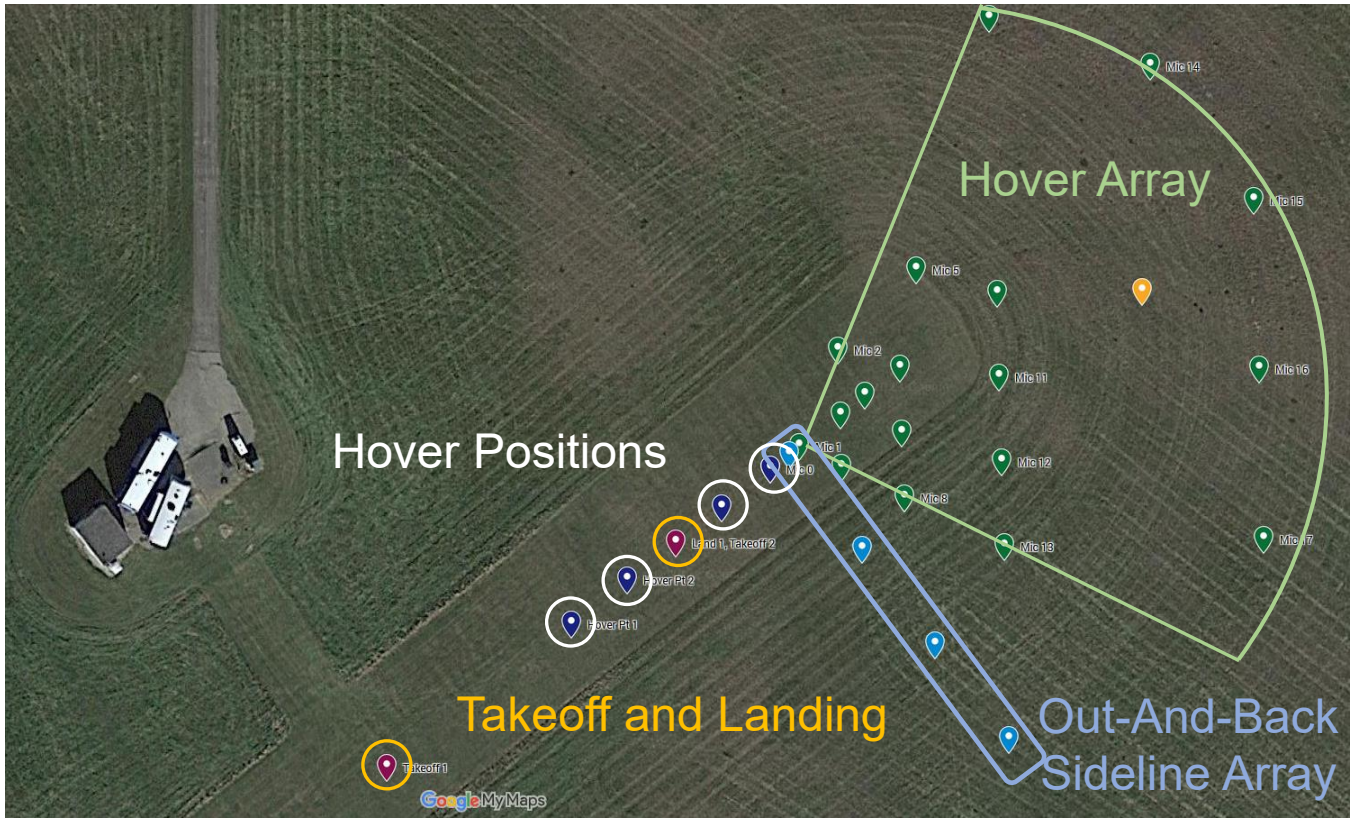


Hover Maneuvers

- S-250 vehicle was remotely piloted
- 60 ft above ground level – out of ground effect
- Four azimuths to capture directivity with the 90° quadrant array
- Aircraft held ~ 30 s at each heading,10+ s of data extracted and processed at each heading
- Vehicle telemetry indicated stable conditions of time window used for acoustic data processing

Test Location and Layout

- Testing performed at the Springfield-Beckley Municipal Airport, UAM development area
  - Active airfield
  - Little traffic, quiet space for acoustic work
- Microphone Arrays shown in Green. Additional data captured at locations indicated in figure



Telemetry and Atmospheric Data

GPS Timestamped telemetry

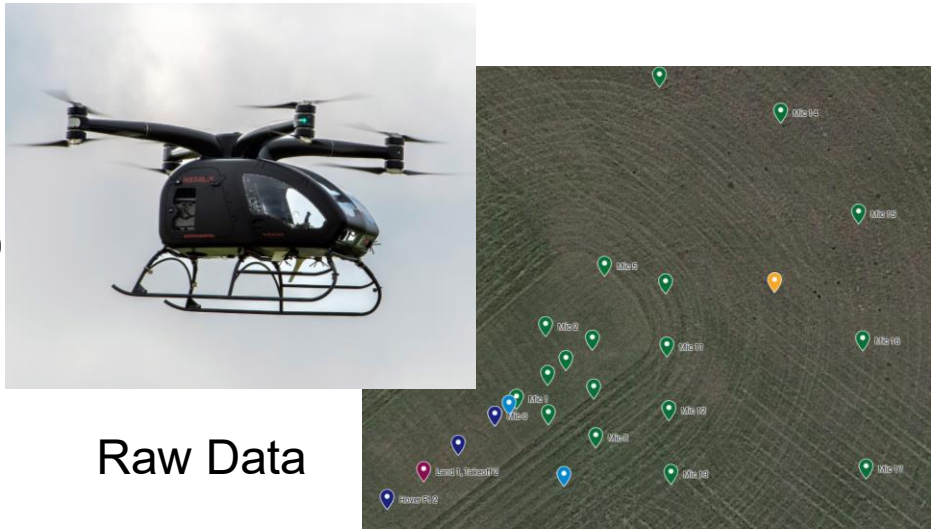
- Vehicle position (Lat/Lon Single Point Position)
- Vehicle altitude (Single Point Precision from GPS, higher accuracy from altimeter and radar systems)
- Position uncertainties
- RPM for each rotor (no once-per-rev)
- Vehicle Yaw
- Vehicle Pitch

Atmospheric Data at ~10ft

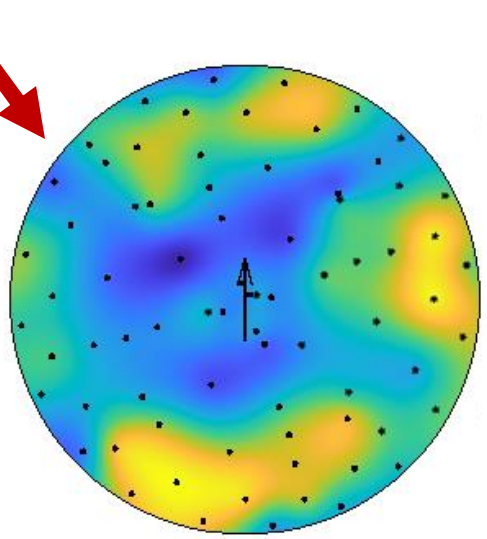
- Temperature
- Humidity
- Wind Speed
- Wind Direction
- Pressure (from airfield sensor)

Raw and Processed Acoustic Data

- GPS timestamped time history (Pa) for every microphone
  - 200 kHz sample rate
  - Microphone sensitivities applied
  - Raw microphone locations available (from RTK system)
- Processed data
  - FFT for each microphone
    - Coordinate transformation into vehicle reference frame
    - Time aligned (reception to emission)
    - FFT details available including time segments used in averaging
  - Data corrections included
    - Microphone frequency response
    - Background subtraction (5 dB threshold)
  - Acoustic depropagation to hemisphere equal to vehicle tip-to-tip diameter
    - Atmospheric attenuation removal
    - Spherical spreading effects



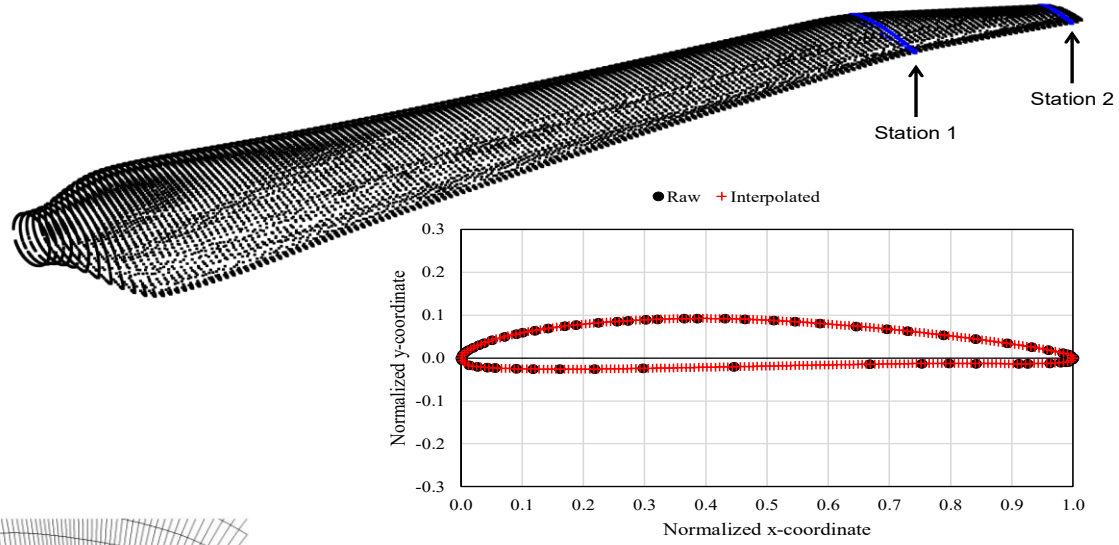
Raw Data



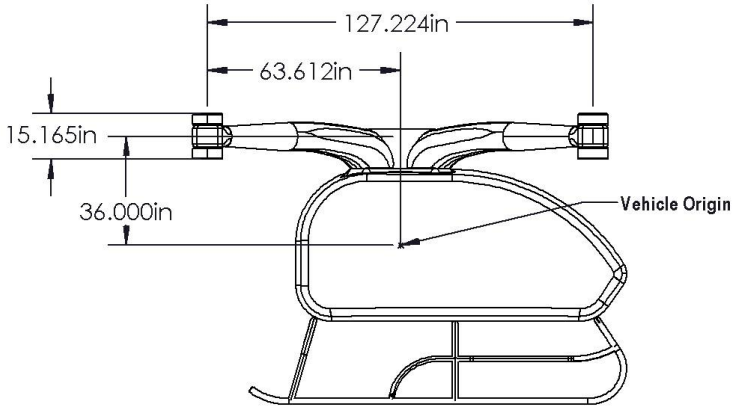
Processed Hemispheres

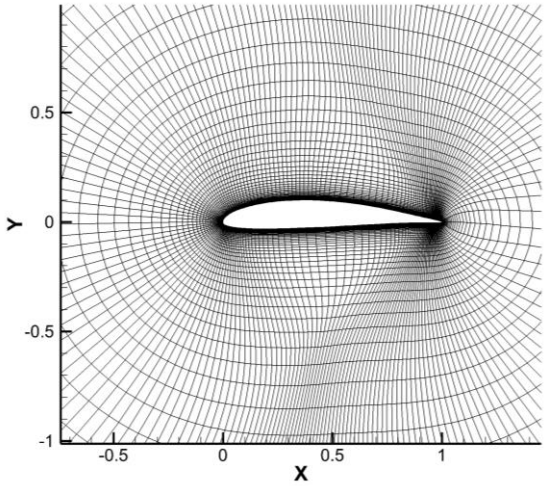
Vehicle Geometry Data Available

- 3D blade scan and airfoil data
- Airfoil data generated using AFTGen
- Vehicle geometry and center of mass data



Station 2





Conclusions

- The Moog S-250 dataset will be among the first fully open full-scale UAM acoustic measurements
- What data should be released?
  - Full time histories?
  - Is hemisphere processed acoustic data enough?
- Are airfoil tables useful or would the community prefer to calculate their own?
- Exploring data dissemination methods within NASA
  - Available without specific request (just download)
  - New repositories within NASA

Henderson, B. S., Cluts, J., Svetgoff, A. A., Jantzen, J., & Bennett, J., "Acoustic measurements for the Moog S-250 vehicle in hover," *30th AIAA/CEAS Aeroacoustics Conference,* AIAA 2024-3275, 2024.
doi: 10.2514/6.2024-3275

Thanks and Q&A

Feedback can be provided directly or via email to:

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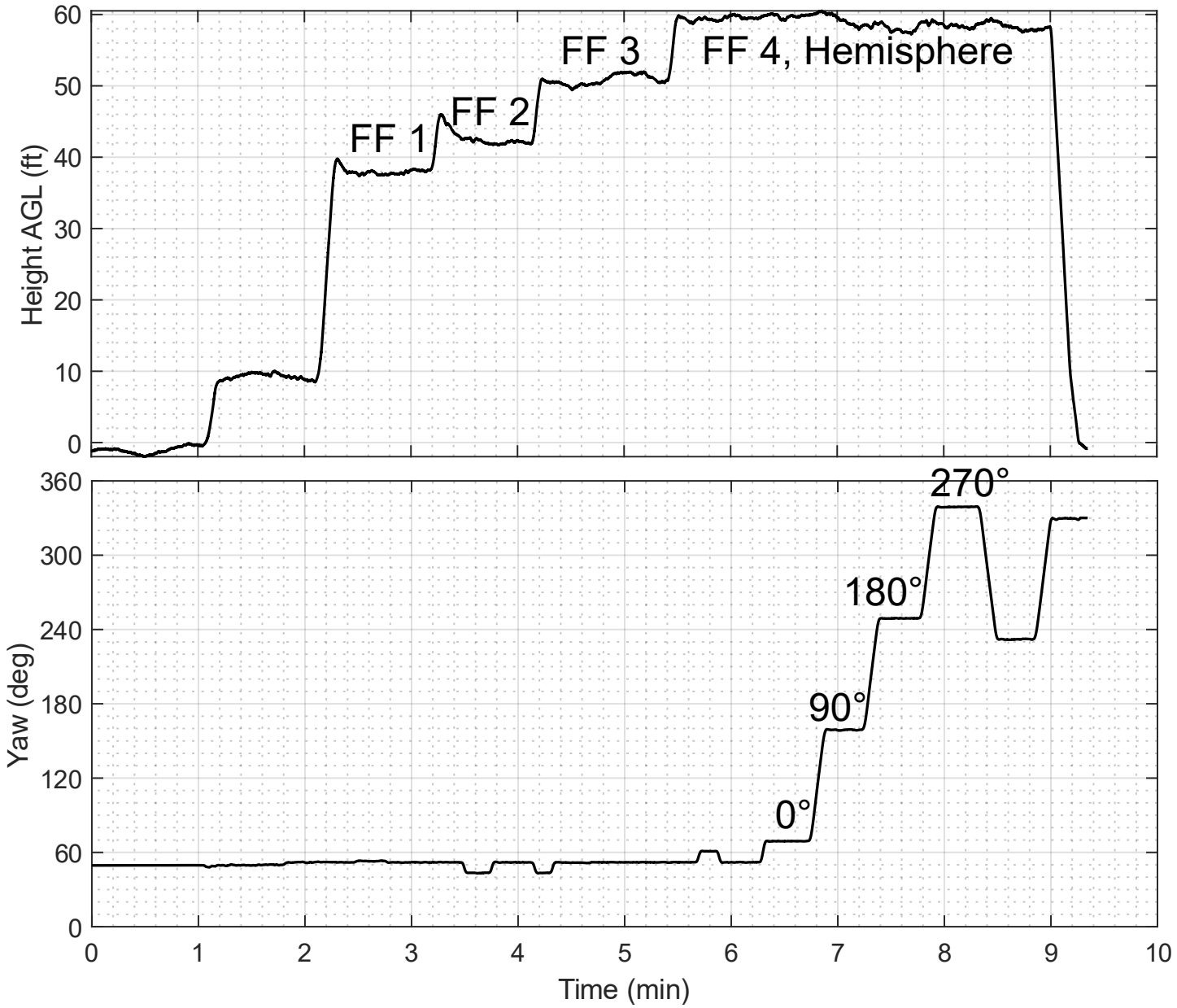
Extras

Telemetry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30
20
10
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FF 1
FF 2
FF 3
FF 4, Hemisphere
Yaw (deg)
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300
240
180
120
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Time (min)