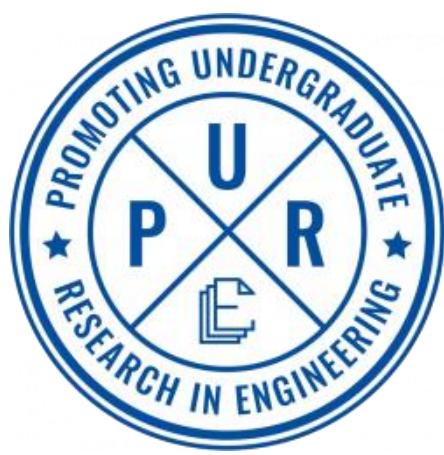


Pulley Driven Spider-Bot For Acoustic Datasets

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MOTIVATION

- Traditional acoustic data sets vary significantly due to motion from human subjects
- Quiet, precise robots offer **controlled movement** for acoustic payloads enabling repeatable system for acoustic researchers
- Near-silent operation to **minimize acoustic interference**

BACKGROUND

- Parallel-cable driven robot** designed to maneuver payload along specified trajectory within 3D-region
- Eight modules control payload movement
- Payload is intended to be **acoustic instrument** (microphone, speaker)

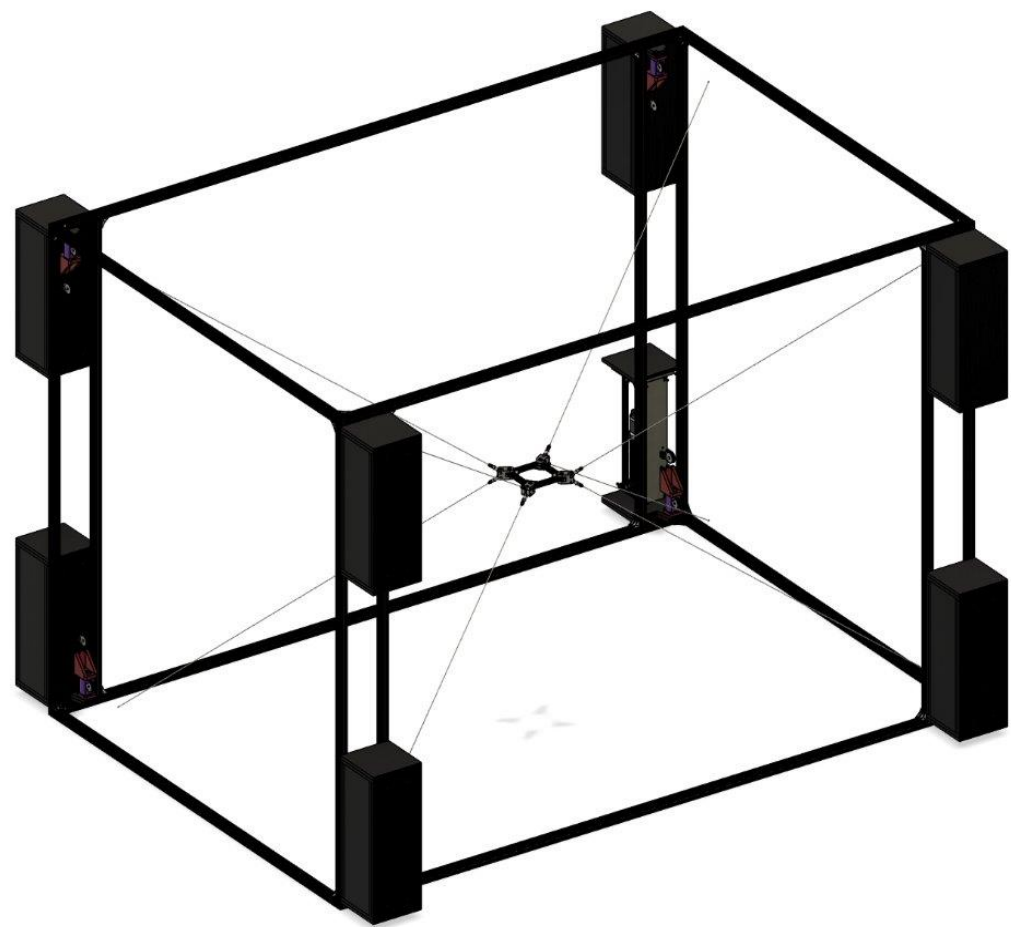


Figure 1: Spider-Bot CAD visualization (eight modules)

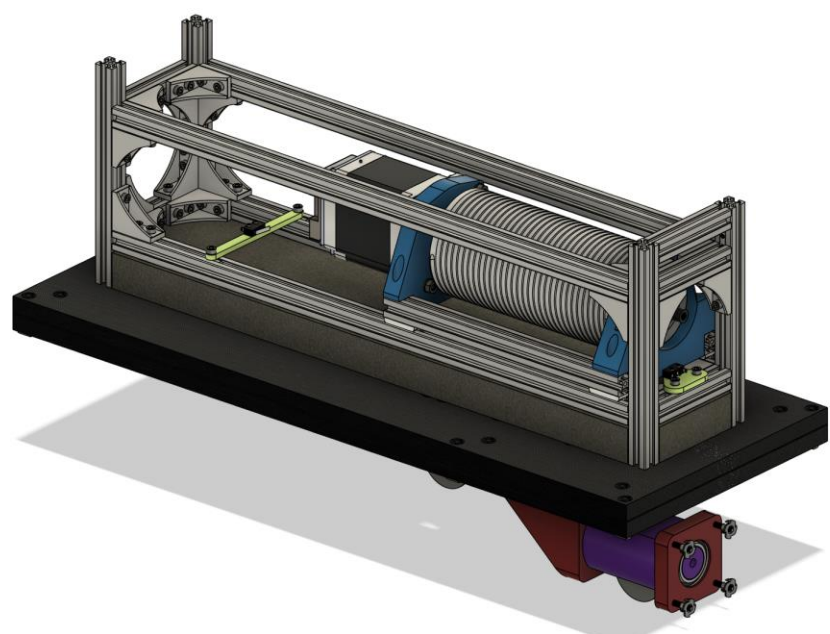


Figure 2: Single module CAD visualization

RESEARCH GOAL

- Assemble Spider-Bot through secure mounting of modules and wire brake systems for precise operation
- Develop individual control of modules through CAN
- Characterize acoustic data** and noise levels produced by module under various conditions

PREVIOUS DESIGNS

- Unstable module fastening resulted in significant acoustic interference
- Unproven motor control due to ROS latency [2]
- Acoustic interference from high voltage power source

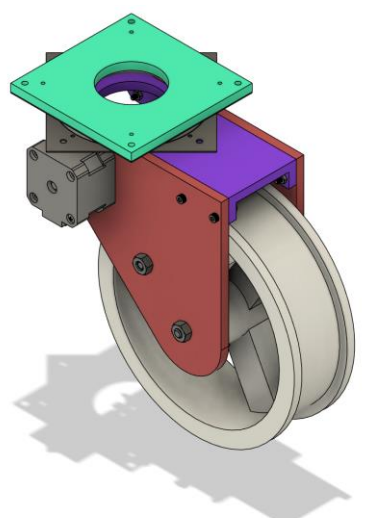


Figure 3: First Spider-Bot design with four modules

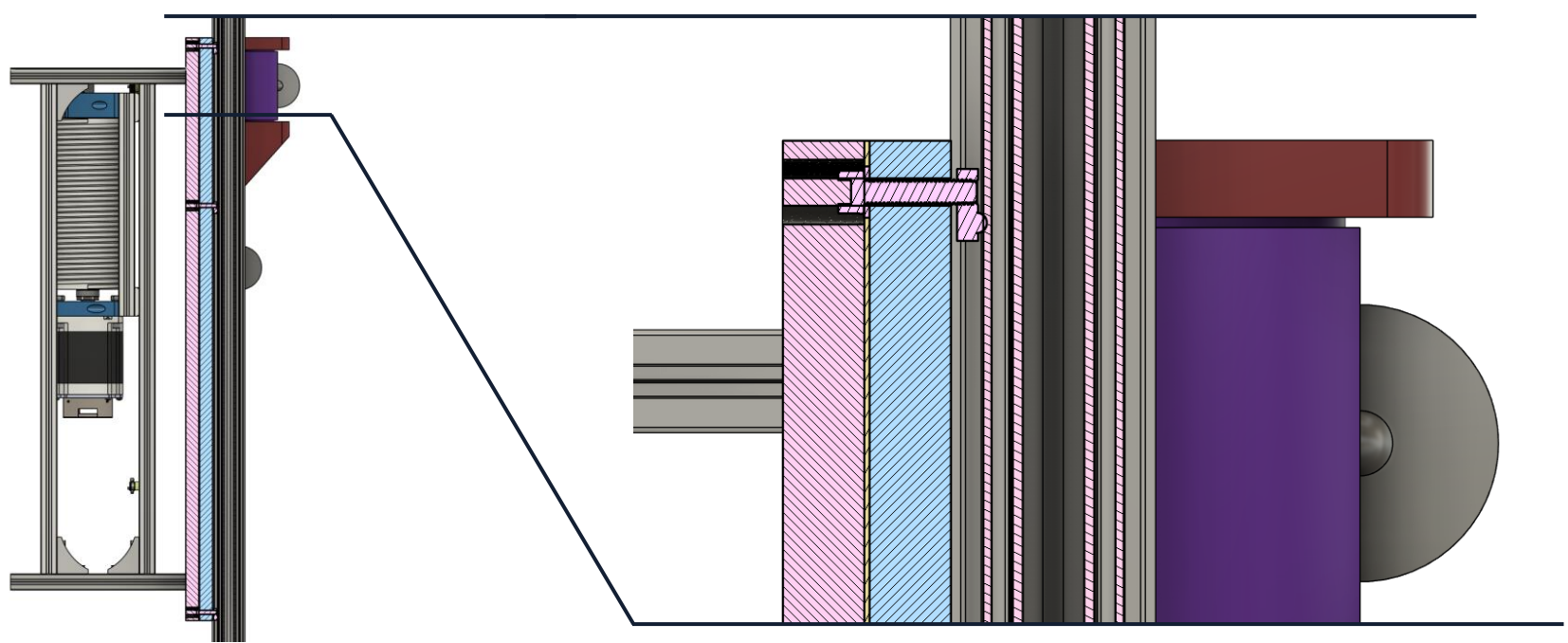


Figure 4: Unreliable mounting system

PROGRESS

- Used CAN for motor control due to its **effective precision timing** for real-time control systems [3]
- Attached wood paneling for acoustic dampening
- Designed more **secure module mounts**
- Measured acoustic data in various module conditions

PROGRESS (CONTINUED)

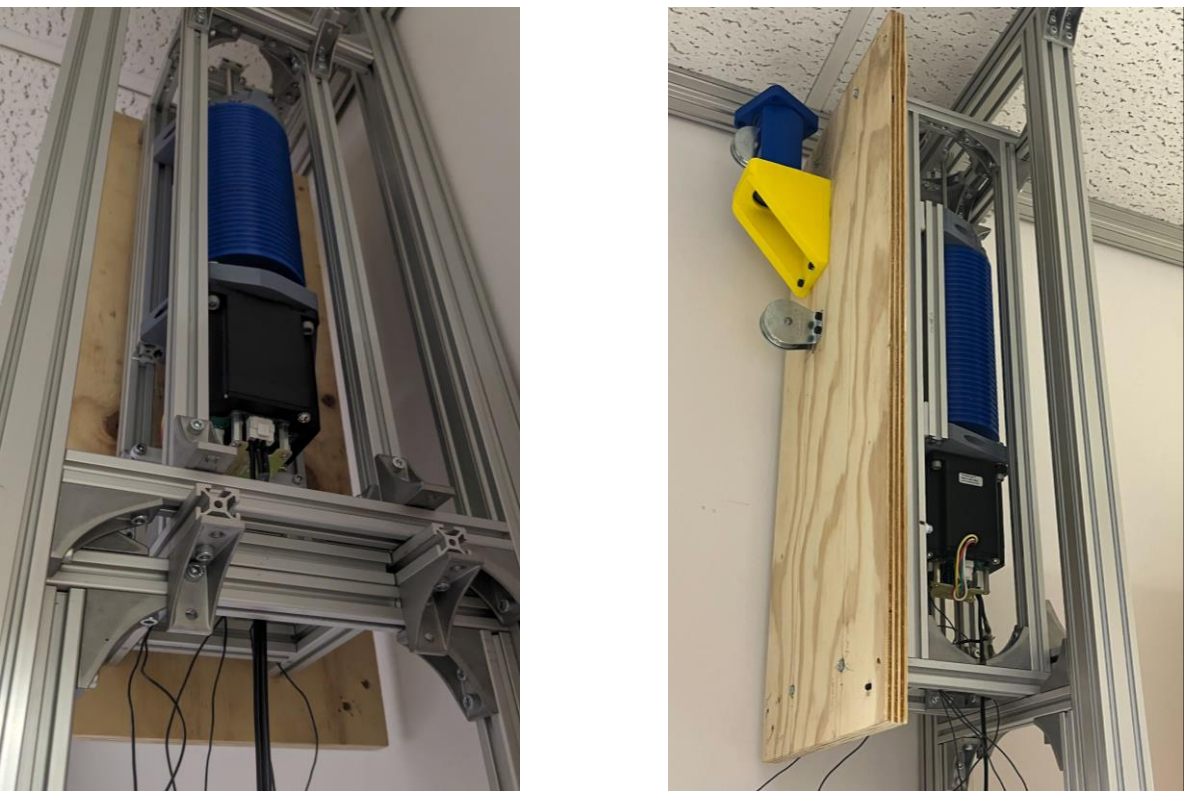


Figure 5: Mounted module with more stable supports and wood paneling.

RESULTS



Figure 6: Experimental setup

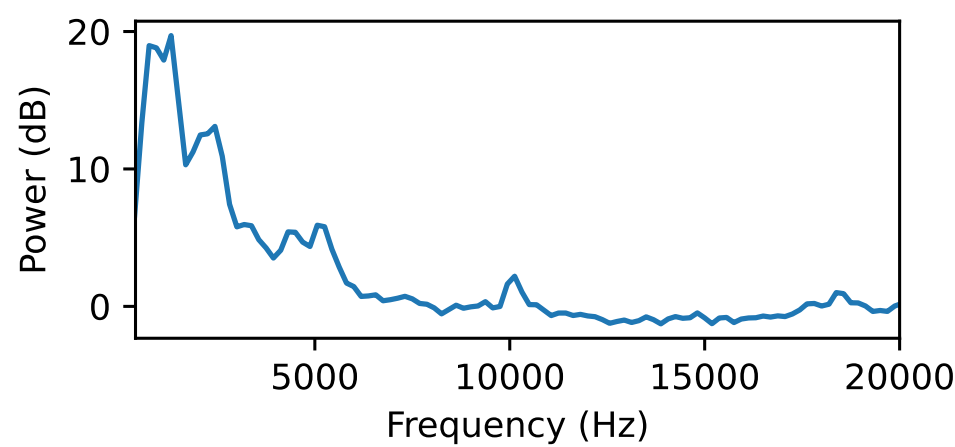


Figure 7: Power spectrum of power supply

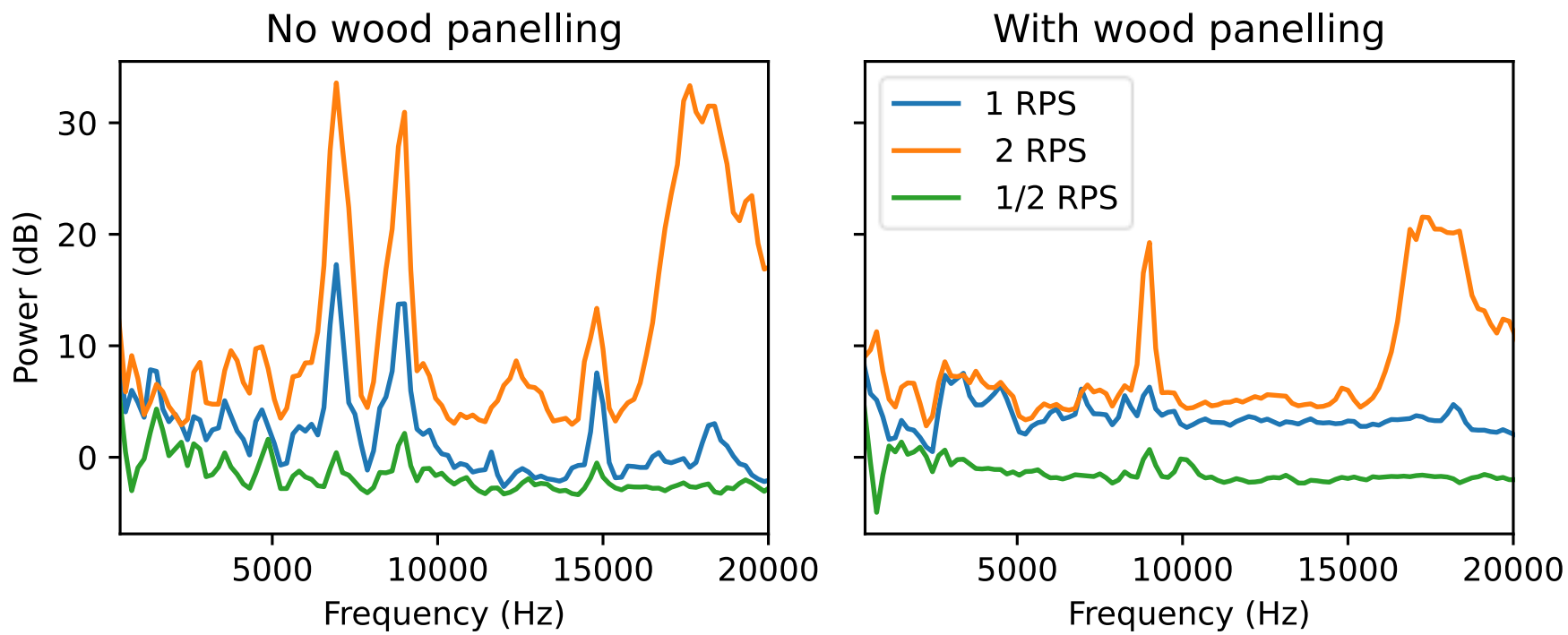


Figure 8: Averaged periodograms of the motor module in various configurations and speeds.

ANALYSIS

- Adding wood dampens unwanted noise
- Harmonic noise increases with greater motor speeds
- Running the motors at moderate speeds (0.5 - 1RPS) and utilizing additional wooden dampers would further minimize background noise

FUTURE DIRECTION

- Minimize the noise from the power source
- Develop control scheme for entire Spider-Bot with acoustic payload
- Find alternative lighter and non-flammable materials to wood for acoustic dampening

REFERENCES

- [1] A. Lu et al., "Mechatronic Generation of Datasets for Acoustics Research," 2022 International Workshop on Acoustic Signal Enhancement (IWAENC), Bamberg, Germany, 2022, pp. 1-5, doi: 10.1109/IWAENC53105.2022.9914771.
- [2] Y. Maruyama, S. Kato and T. Azumi, "Exploring the performance of ROS2," 2016 International Conference on Embedded Software (EMSOFT), Pittsburgh, PA, USA, 2016, pp. 1-10, doi: 10.1145/2968478.2968502.
- [3] G Leen, D Heffernan, TTCAN: a new time-triggered controller area network, Microprocessors and Microsystems, Volume 26, Issue 2, 2002, Pages 77-94, ISSN 0141-9331, [https://doi.org/10.1016/S0141-9331\(01\)00148-X](https://doi.org/10.1016/S0141-9331(01)00148-X).



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