

Analysis of Adaptive Passive Technologies for the Locomotion and Inspection with Autonomous Robots in Unstructured Environments



Robert Stevenson¹

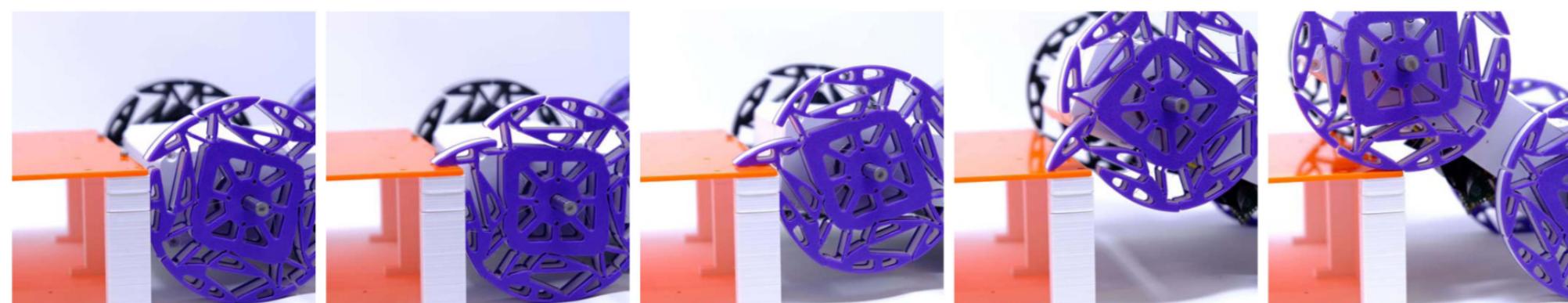
¹ University of Lincoln

UNIVERSITY OF LINCOLN

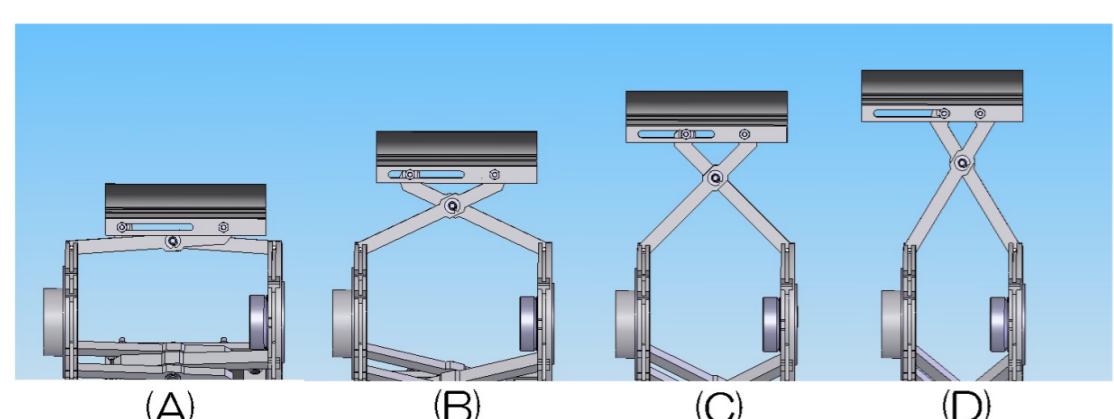
Introduction

- Not all industry sectors have well-structured, predictable environments and instead might have more unstructured environments.
- Robots can suffer from inefficiencies and slower movements from exerting more effort to navigate the challenging unstructured terrain.
- This work explores how passive technologies could apply for traversing uneven environments more efficiently.

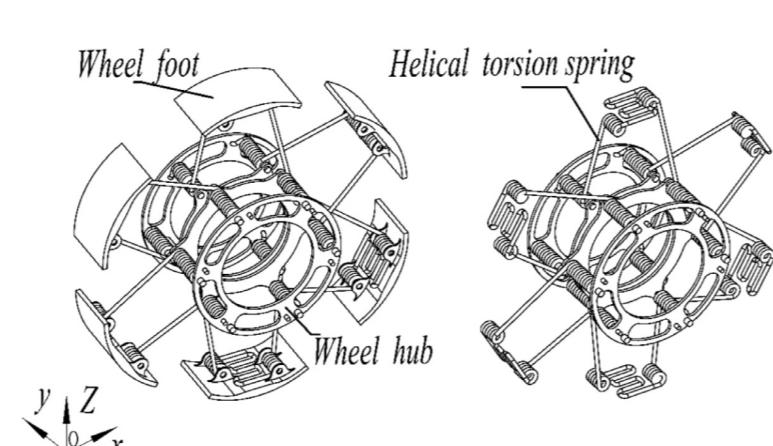
Existing Literature



PaTS-Wheel during traversal (Godden et al., 2024)



Compliant variable-diameter mechanism for lunar rovers (Zeng et al., 2018)



variable-wheel for the search and rescue robots (Nagatani, Kuze, and Yoshida, 2007)

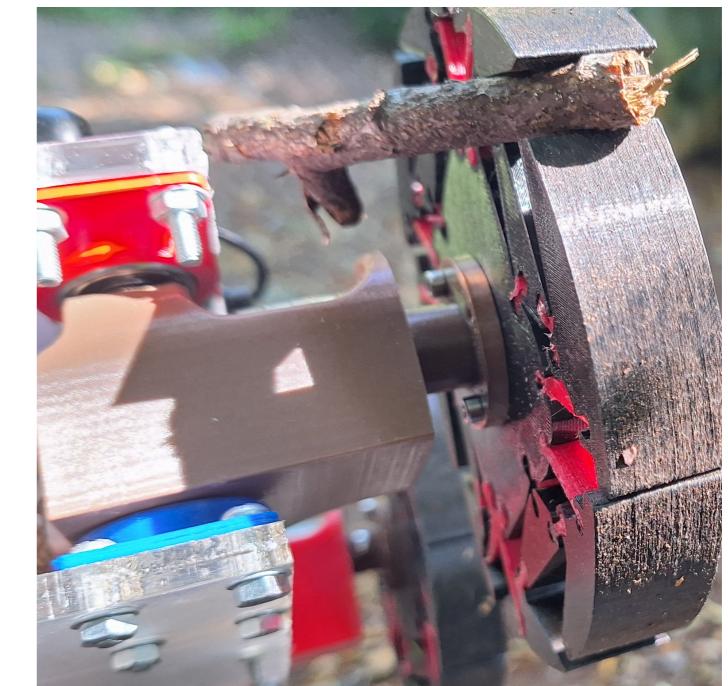
Aims

- Investigate efficiency and vibrations during traversal of real challenging environments, identifying deployment limitations and benefits for this concept technology.
- Iterate to the design concept while maintaining and enhancing its capabilities where possible.

Test Environment



Range of debris from test area 2

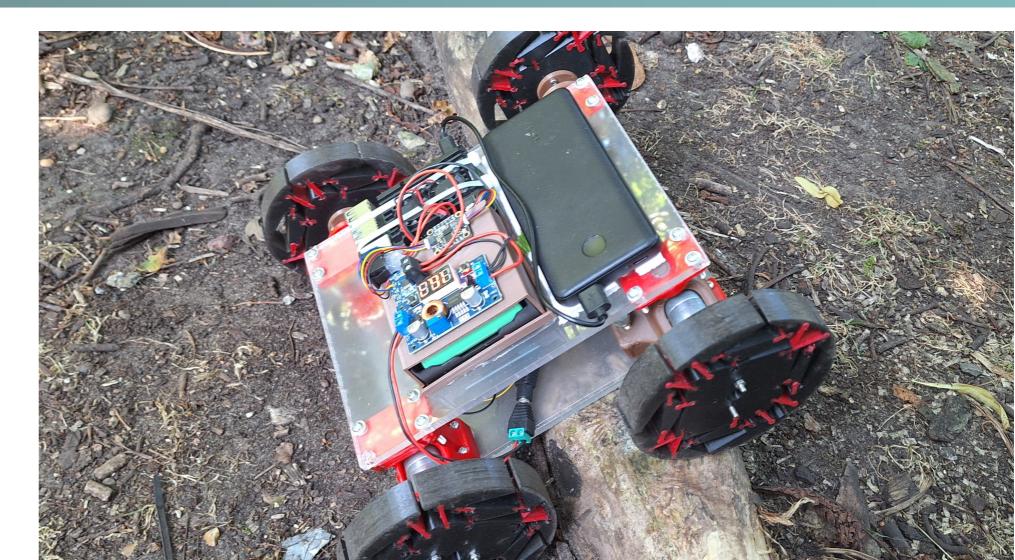


Environment debris jammed in a DogBone PaTS-Wheel

Implementation

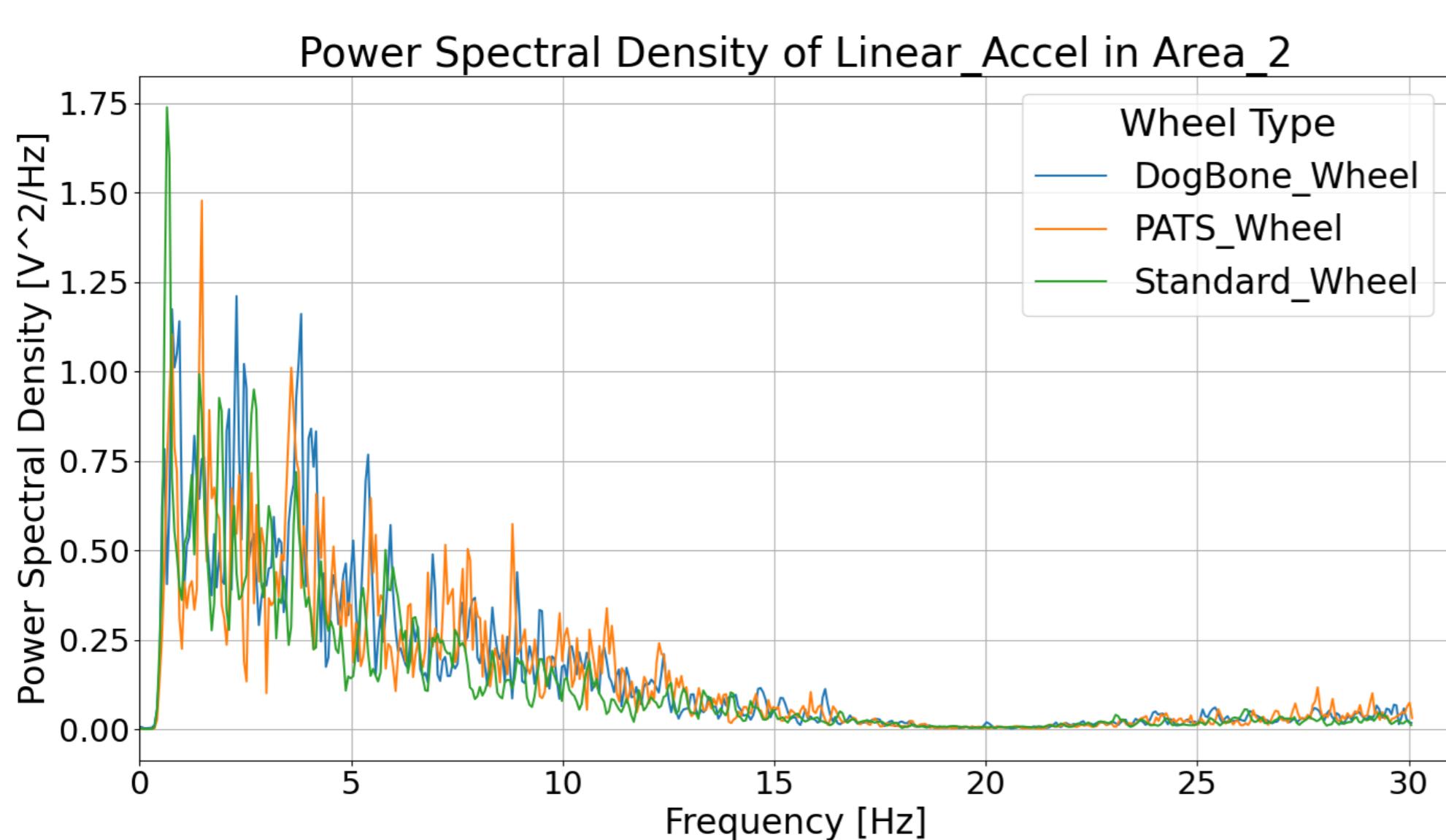


DogBone PaTS-Wheel

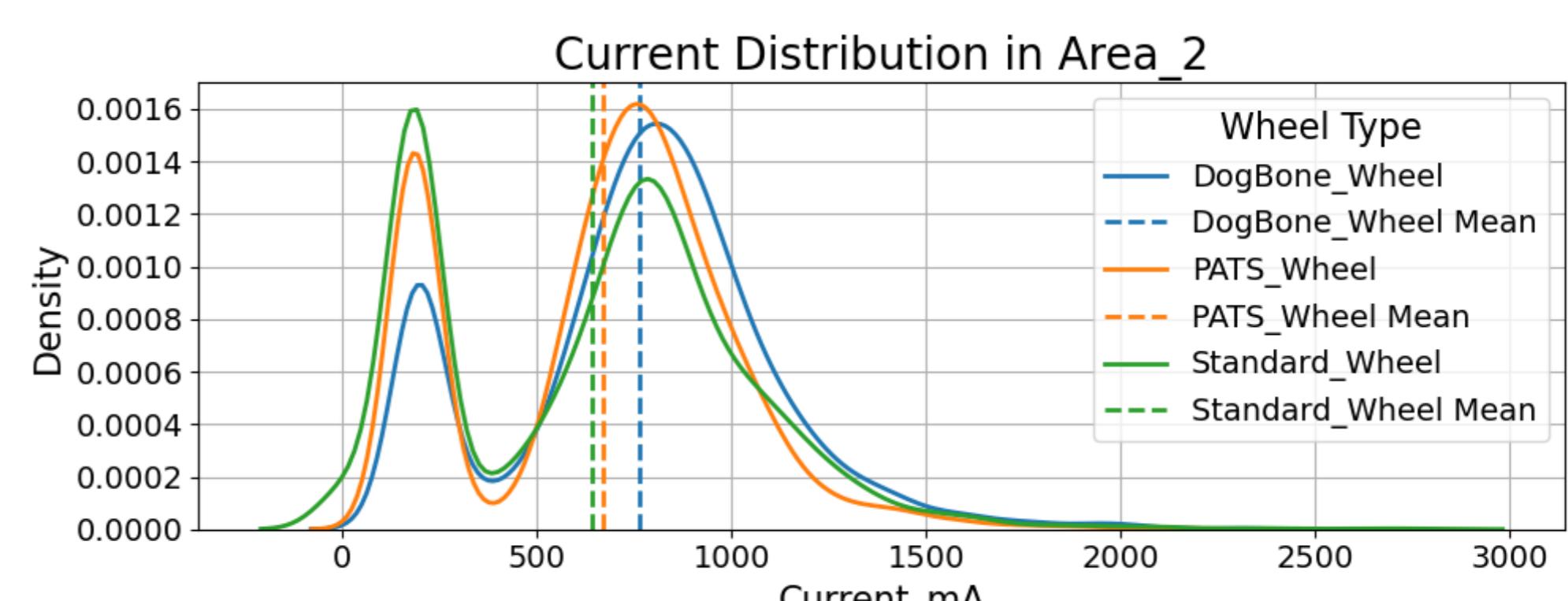


Test platform traversing a fallen log in test area

Results (WIP)



Power spectral density of linear acceleration magnitude of Area 2



Current draw distributions of the wheel types in Area 2

- Godden, T. et al. (2024). "PaTS-Wheel: A Passively-Transformable Single-Part Wheel for Mobile Robot Navigation on Unstructured Terrain". In: *IEEE Robotics and Automation Letters* 9.6, pp. 5512–5519.
- Nagatani, K., M. Kuze, and K. Yoshida (2007). "Development of a Transformable Mobile Robot with a Variable Wheel Diameter". In: *Journal of Robotics and Mechatronics* 19.3, pp. 252–257.
- Zeng, W. et al. (2018). "Design and analysis of a compliant variable-diameter mechanism used in variable-diameter wheels for lunar rover". In: *Mechanism and Machine Theory* 125, pp. 240–258. ISSN: 0094-114X.

