

Project Title	Design of an Actively Powered Omni Directional Insect Treadmill
Supervisor	Dr David Labonte
Theme(s)	Biomechanics and Mechanobiology Computational and Theoretical Modelling
Project Description	<p>Insects are the undisputed champions of legged locomotion, having mastered walking, running, and climbing on virtually any surface, often on steep inclines or even upside down. Therefore, insects have become the inspiration for the design of hexapod robots.</p> <p>To understand which adaptations, allow insects to perform these incredible feats, we can use deep learning-based markerless pose estimation to study their locomotion from video recordings. However, this process requires not only intricate camera setups and extensively trained machine learning models but also large numbers of recorded gait cycles, which are both difficult and stressful to obtain - not only for the experimenter but especially the studied animal. In the past, conventional treadmills have been miniaturised and used for these applications, which come with the caveat of requiring the animal to walk a straight line and with external stimulation, potentially provoking flight responses instead of a natural gait.</p> <p>To this end, this project aims to design and build an actively powered omnidirectional insect treadmill that allows for the automated recording of freely walking insects. The goal is for the setup to automatically track the insect walking on the treadmill in real-time and control the motor speeds accordingly, so the insect can move in any direction at will while being kept in the centre of the surrounding recording setup.</p> <p>As we aim to investigate the locomotion of a broad range of species walking on different substrates, the belts of the treadmill will need to be interchangeable to enable the use of various materials. As the project encompasses designing and building an omnidirectional treadmill as well as implementing its control loop, experience in Computer-Aided Design, rapid prototyping, and programming are required.</p> <p><u>For some design inspiration / suggested literature of large omnidirectional treadmills:</u> Pyo, S., Lee, H. and Yoon, J. (2021) 'Development of a Novel Omnidirectional Treadmill-Based Locomotion Interface Device with Running Capability', Applied Sciences, 11(9), p. 4223. doi: 10.3390/app11094223.</p> <p>Souman, J. L., Giordano, P. R., Schwaiger, M., Frissen, I., Thümmel, T., Ulbrich, H., De Luca, A., Bühlhoff, H. H. and Ernst, M. O. (2011) 'CyberWalk: Enabling unconstrained omnidirectional walking through virtual environments', ACM Transactions on Applied Perception, 8(4). doi: 10.1145/2043603.2043607.</p>