Project Title	Markerless pose estimation to study the locomotion of load-carrying leaf cutter ants
Supervisor	Dr David Labonte
Themes	Biomechanics and Mechanobiology

Project Description

Imagine, instead of driving your car to the nearest supermarket, you would have to carry your cars weight in groceries over your head while doing parkour during rush hour in the middle of a crowded city for twelve hours every day. What sounds insane to a human is the daily life of a leaf-cutter ant. It is widely known that ants are capable of carrying loads greater than twenty times of their own body weight when transporting food back to their colony. As they live in symbiosis with a fungus they grow, the colonies survival and growth depend on the workers ability to harvest substantial amounts of plant material to feed the fungus.

- What enables these tiny creatures to move freely under the weight of the cut leaf fragments?
- How does the additional load on their joints influence their locomotion?

These questions are to be investigated in this project.

Instead of relying on manual evaluation of video data, you will train a deep neural network architecture based on DeepLabCut to perform pose estimation of ants, carrying different loads. This approach enables us to automate the extraction of tracking data when comparing the influence of load on workers of different sizes and potentially different species.

You will also be involved in the design of a multi-camera setup to record individual workers from various angles synchronously, in order to create 3D reconstructions of the recorded gait cycles.

Due to the proposed methodology, prior experience in machine learning and computer vision, as well as mechanics are required for this project. You will gain insights into the use and implementation of deep neural networks, creation and challenges of labelled training data sets, 3D reconstruction of tracking data, and the biomechanics of insect locomotion.

For more info on the group: http://evo-biomech.ic.ac.uk

Recommended Literature:
1. Mathis, A. et al. DeepLabCut: Markerless pose estimation of user-defined body parts with deep learning. Nat. Neurosci. 21, 12811289 (2018).
2. Zollikofer, C. P. E. Stepping patterns in ants. J. exp. Biol. 127, 119127 (1994).
3. Wilson, E. O. Caste and division of labor in leaf-cutter ants I. Overall Pattern in A. sexdens. Behav. Ecol. Sociobiol. 7, 143156 (1980).
4. Moll, K., Roces, F. & Federle, W. How Load-Carrying Ants Avoid Falling Over: Mechanical Stability during Foraging in Atta vollenweideri Grass-Cutting Ants. PLoS One 8, e52816 (2013).