Predicting Joint Angles During Locomotion In Drosophila

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How animals, including humans, navigate their environment with agility and precision is a long-standing question in neuroscience research. Turning towards or away from an object is a fundamental aspect of locomotor control exhibited by all animals, from insects to humans. Given that insects like Drosophila (fruit-fly) have evolved to walk on the same terrestrial environment as humans, understanding how their brains control walking is directly relevant for both biomedical and robotics applications. We therefore, use the fly as a model-system to understand neural underpinnings of walking and turning.

Joint angles are integral to understanding walking and turning through quantifiable measures. We record joint angle data, as well as velocities using an exhaustive eight camera setup that surrounds a fly walking on a spherical treadmill. By creating a model to predict joint angles based on treadmill velocities, we aim to shorten the time and resources needed to accumulate joint angle data. Deep learning architectures perform well in time-series prediction tasks, and with modifications and fine-tuning, one or a combination of them may prove to be effective. Preliminary results show that when trained on 600-frame kinematic trials, models that undergo unsupervised training on inputs and are later fine-tuned with outputs have success in accurately predicting joint angles during turning.

This work will result in developing a tool that will allow using just the treadmill velocities to infer leg joint angles across all the legs of the animal. This tool will be extremely impactful to the broader scientific community given it will now be possible for anyone with a simple fly-on-treadmill setup to estimate leg kinematics, without having to build a complex multi-camera recording setup. It will also make it easier for us and others to correlate neural activity to leg kinematics.

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