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Comparison of Methods for Analyzing Mouse Locomotion with Free Software

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INTRODUCTION: Mouse locomotion is commonly studied in models of human musculoskeletal disease and exercise physiology. Traditional methods for tracking joint movements for the study of locomotor kinematics is labor intensive and requires expensive hardware. We sought to speed up the process with Deep Learning using free software and consumer grade hardware.

METHODS: Nine mice were filmed prior to and after one week of voluntary wheel locomotion. We filmed 174 trials using two GoPro cameras operating at 120 FPS. Trials were digitized separately for each camera using both DeepLabCut (Deep Learning) and DLTdv8 (manual). Cameras were 3D calibrated and coordinates tracked for 6 lower limb landmarks. We compared rigid body error by digitizing a wand of known length and compared locomotor kinematics after 1 week of wheel access.

RESULTS: DeepLabCut has significant hardware requirements compared to DLTdv8, and setup for the former is more challenging in comparison. Once configured, DeepLabCut was efficient in video processing and accurate in marker tracking (50% lower mean error). We found significant kinematic differences after one week of wheel activity, including increased mean speed, stride frequency, stride length as well as lower duty factor.

CONCLUSION: We found that consumer grade hardware and free software is a viable solution to the challenges of studying locomotor kinematics in mice. Inexpensive hardware coupled with deep learning yields both increases in video throughput and marker accuracy. Finally, we found significant locomotor differences after only one week of wheel acclimation, suggesting a non-invasive approach to altering gait kinematics.