KineMouse Wheel: A standardized turn-key open-source behavioral tracking system for head fixed rodents

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Current methodologies for quantifying 3D behavior of head-fixed mice are limited by expense and invasiveness, lack access to the bottom view of the mouse, and do not present a reliable system for calibrating cameras. While the study of neurons has witnessed impressive advancements that allow for an abundance of information regarding physiology, this information must be linked to behavior in a more reliable and systematic way. The proposed framework achieves end-to-end behavioral analysis through a setup composed of lightweight transparent treadmill, acquisition software for low-cost high-speed cameras arranged to access multiple perspectives on the body, a computational method to map movements with single digit precision in 3D space, and analysis to infer pattern from data. This framework provides users a reliable, standardized, and reproducible way to analyze behavior at high resolutions, allowing for access to fine behavioral features across a variety of laboratories and applications. Its usage is demonstrated in example settings of the head-fixed mice.