Real-Time Motion Tracking and Data Analytics for Live Insects Using Three-Wheeled Servosphere Robot

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Tetherless motion tracking is an essential technique for studying insect behavior, allowing for precise recreation and analysis of insect pathing trajectories. One potential application of these trajectories is in machine learning, where an insect's recorded motion can be used to determine its traits, e.g., species, sex, and health, making subject analysis more efficient and accurate than manual classification. Last year's work developed a prototype servosphere tracking system, and this project extends that work with three contributions: enhancing the system using an error-reduced design and multithreaded software capable of recording insect trajectories, performing stimulus experiments with seven naturally-obtained ants, and applying collected motion data to machine learning using a CNN classification model. The experimental results were two-fold: how well the system performed in live motion tracking experiments, and how well the recorded data trained the model. Five of the seven subjects were stimulated with 50g of sweetened honey and were 112% faster than the unstimulated subjects, corroborating expected results and demonstrating the system's robustness with stimulated motion. The average experimental error was 3.23mm along an ideal path, demonstrating the system's precision. The developed CNN model aimed to classify segmented trajectories based on their direction, and the system-produced trajectories yielded a model accuracy of 64%, establishing a proof-of-concept for applying tetherless motion tracking to machine learning. In the future, tetherless motion tracking can be used in other experiments, such as connecting neural activity to pathfinding, and machine learning can be used to analyze insects in larger numbers than previously allowed.

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