Python Script for Overarm Motion Analysis Using 3D Motion Capture Data

Human movement kinematics is an important focus within biomechanics with diverse purposes and applications. Due to functional complexity, large computational demands and diversity in protocols, the collaboration of software tools is important to help progress the understanding of human movement through biomechanics. Although the field has a large open-source community with software tools that help visualize human movement, there is a lack of open-source tools that analyze human movement. 3-dimensional upper extremity movements specifically lack open-source software that analyzes complex functional movement such as overarm throwing. Therefore, the goal of this project is to develop a script that performs upper extremity analysis of motion capture data. The motion capture data used is from an open-source study that had individuals with no prior overarm throwing experience throw over several sessions. Each participant completed 15 dominant and 15 nondominant hand throws with a baseball with a goal of throwing as fast as possible. The motion capture was taken with 10 Vicon infrared cameras (T-10, T-40, Oxford Metrics Ltd., UK) and the data are exported as csv files. The script is developed using Python along with libraries that aid data analysis and visualizing the data. Pandas, matplotlib and numpy are the major modules that the script uses to interact with the motion capture data. The code will calculate individual upper extremity segment angles to calculate the joint angles, visualize segment angles, visualize joint angles and visualize the segment angles changing over time by combining the segments on a figure. This software will be used for basic overarm throwing analysis and will allow the user to get a summary of the motion. Coaches and researchers that are interested in overarm throwing would find it useful because it visualizes and calculates throwing metric data, which will allow for a deeper understanding of the individual’s throwing biomechanics.