SWACSM Abstract

Joint Angle Calculations using Motion Capture and Deep Learning Pose Estimation while Running

LUKE VANKEERSBILCK, ISAAC HEDENGREN, MCGYVER CLARK, JOHN HEDENGREN, & IAIN HUNTER

Running Mechanics Lab; Exercise Sciences; Brigham Young University; Provo, UT

Category: Masters

Advisor / Mentor: Hunter, Iain (iain_hunter@byu.edu)

ABSTRACT

Marker based motion capture is currently the most accurate method of measuring human kinematics; however, it is expensive and is often limited to lab environments making it unsuitable for many applications. Two-dimensional methods are available through open source code, but it is unclear which of these methods provides the greatest accuracy. **PURPOSE**: The purpose of this study is to quantify the accuracy of pose estimation from a monocular electro-optical sensor with deep learning to infer segment end points and pose estimation utilizing two open-source code approaches. **METHODS**: One subject ran at 6.5 m/s for 15 s while being recorded with Vicon Nexus and an iPhone both running at 240 Hz. Visual 3D computed joint angles from the marker data. The iPhone view was placed perpendicular to the sagittal plane. Deep learning algorithms produced 2D pose information that was translated into hip, knee, and ankle sagittal plane joint angles. Pearson r correlations compared MediaPipe and OpenPose joint angle estimations through 15 s of running to the motion capture data. **RESULTS:** Markerless methods showed correlation values compared with Visual 3D of hip (MediaPipe = 0.968, OpenPose = 0.975), knee (MediaPipe = 0.983, OpenPose = 0.964), and ankle (MediaPipe = 0.928, OpenPose = 0.904). Both markerless methods showed limitations on predicting maximum flexion and extension angles. Although the correlation values were high, in practice these differences in maximum range of motion may impact any future interpretation of data. **CONCLUSION**: Care should be taken when utilizing extreme joint angles when using deep learning algorithms. Although at this point the open source methods are not as accurate as marker based motion capture they could enable the collection of data from a larger population of people given the ease of data collection, this could facilitate crowd sourced data collection with much larger sample sizes than are traditionally feasible.