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Accuracy of joint angles using markerless silhouette-based tracking and hybrid tracking vs. traditional marker based tracking

Becker, L.1, Russ, Ph.2

1University of Magdeburg, 2Simi Reality Motion Systems

Introduction

Markerless tracking is seen as a potential method to make movement analysis quicker, simpler and better available in many different areas of biomechanical application. Since this technology is still new in the fields of sports, markerless systems have to be evaluated for sufficient accuracy to serve as a valid tool. Therefore, the aim of this study was to assess the accuracy of the new silhouette-based tracking software "Simi Shape" for markerless and hybrid tracking versus traditional marker based tracking.

Methods

Specific joint movements and complex sports movements have been analyzed simultaneously using marker, silhouette and hybrid tracking (silhouettes + markers). Angles of shoulder, elbow, hip, knee and ankle joint have been compared using the three different methods by means of Spearman correlation coefficient and standard deviation of angle difference. In case of insufficient results based solely on measurements with markerless tracking, hybrid tracking solutions have been assessed additionally.

Results

Markerless tracking shows highly accurate results for knee, ankle and shoulder movements in the sagittal plane ($r_s = >0,9$). Using hybrid tracking comparable results could be achieved for all angles in all planes. Reasons for accuracy problems based on markerless tracking have been identified to occur mainly if segment rotations do not cause the silhouette to change. In this case hybrid markersets have been provided to improve the accuracy of these segment rotations.

Discussion

The results of this study indicate markerless and hybrid tracking to be efficient methods in terms of accurate joint angle data assessment, which present a promising technology in areas of sports and medical motion analysis. As this study only compared markerless/hybrid data with marker data for one single subject, further research should provide more information about methodological difficulties concerning intra- and inter-tester reliability in-between and between days using the different methods. As no accurate marker placement is needed for markerless or hybrid tracking this method might be superior compared with marker based systems in terms of reliability.

Contact: philipp@simi.com

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