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Marker-less human motion tracking - opportunities for field testing in sports

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Marker-based kinematic data collection is subject to marker placement errors, skin movement artifacts or marker occlusion. Outdoors the use of markers is limited. Free-form surface patches to estimate segment orientations [1] and global/local morphing techniques [2] were proposed for marker-less tracking. Advanced segmentation methods, dynamic occlusion handling and kinematic chains of higher complexity were presented [4].
The aim of this study was to apply marker-less and marker-based tracking simultaneously to full body movements in sports. Resulting joint kinematics were compared between methods.
A four camera system was used (Basler A602f, 180 Hz). Tests were carried out on an outdoor sports field. On top of a full-body suite grey markers were placed on anatomical landmarks [3]. Marker data was tracked semi-automatically using SIMI (Motion 7.0). Joint motion was calculated using a customized Matlab script. Marker-less tracking consists of three steps: segmentation, correspondence estimation and pose estimation [4]. Several movements were investigated to compare both tracking systems.
Average differences between joint angles of the upper extremity were less than 2.0° for flexion-extension, while lower extremity values varied up to 3.4°.
Differences between the two methods were in the range of repeatability measures for marker-based collection systems [5]. Based on the present data it can not be determined which systems better represents true skeletal motion. However, it was concluded that the proposed method gives comparable results to marker-based analyses. The resulting kinematics were of sufficient quality for technical analyses or energy calculations in sports movements.

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