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# A human body model for movement analysis using optoelectronic system

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Human motion analysis asks frequently for determination of kinetic and kinematic data. This work proposes method to model human body as a linkage of rigid segments and to compute so called body segment parameters (BSP). Calculated BSP combined with 3D optoelectronic (kinematic) system data allow also kinetic analysis of human motion. Proposed body model is based on Helen-Hayes protocol. Modifications are introduced which makes it more robust to analyze movements where ASIS markers are usually hidden from camera, such as running, jumping etc. Moreover, alternative way of computing anthropometric measurements, needed for computation of BSP, is suggested via additional marker set. It is believed that these extra markers are acceptable compromise which in turn saves preparation time for patient in comparison where anthropometric measurements are obtained with various tape measures and calipers.

Ultimate accuracy of inverse dynamic values is highly dependent on accuracy of BSP and 3D reconstruction. The later one is in turn greatly influenced by system calibration, i.e. cameras parameters computation. Another part of this work brings up the issue of calibration. A method to calibrate 3D optoelectronic system was proposed which exploits certain geometric entities defined within it, i.e. it takes advantage of orthogonal calibration tools. Proposed method simplifies typical camera calibration procedure of 3D kinematic systems.

Validation of proposed body model has been successfully undertaken by comparing results with widely accepted model which uses Helen-Hayes protocol. Additionally validation is preformed through check of segments power calculation in two different ways: direct computation and derivation of total segment energies.

Validation of proposed camera calibration has been carried out through reconstruction and analysis of points in space which position, i.e. mutual distance was known with high degree of accuracy in advance. Obtained accuracy is quite comparable, if not even better, with commercially available 3D kinematic systems.