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Reconstruction of Human Skeletal Movement in the 3-D Virtual Space

AURELIO CAPPOZZO

Dept. of Human Movement & Sport Sciences (LabLAB)
Università degli Studi di Roma - Foro Italico
Piazza Lauro de Bosis 6
00194 Rome
ITALY

aurelio.cappozzo@iusm.it

The question is : "how does a healthy or diseased joint move in the activities of daily life ?". To contribute to this problem the following issues must be tackled : 1) optimal estimation of the instantaneous pose of bones in a laboratory system of reference during the execution of a physical exercise using the instantaneous position of point skin markers or pose of 3-D skin markers ; 2) optimal estimation of the subject-specific bone morphology and determination of relevant anatomical axes. The first issue entails the development of an estimator that incorporates a mathematical model of the displacement of the markers relative to the underlying bone identified using a non-invasive, subject-specific, approach. At present, when subject-specific bioimages are not available, anatomical data are obtained through a low-resolution anatomical calibration that entails the determination, through stereophotogrammetry, of the position of the few bony landmarks that are identifiable through palpation. This procedure, although universally used, supplies totally unsatisfactory results. Thus, the second issue calls for the development of a procedure that allows for an estimate of subject-specific bone digital models and their registration with the movement data. This talk presents the background, the present and prospective state of the art of knowledge regarding the above-mentioned issues.