

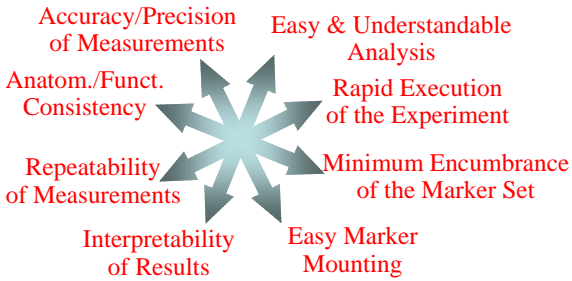
Designing experimental protocols for routine *clinical gait analysis*: exemplary cases on Lower Limb and Foot Multi-segmental analysis



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Criteria for the Design:



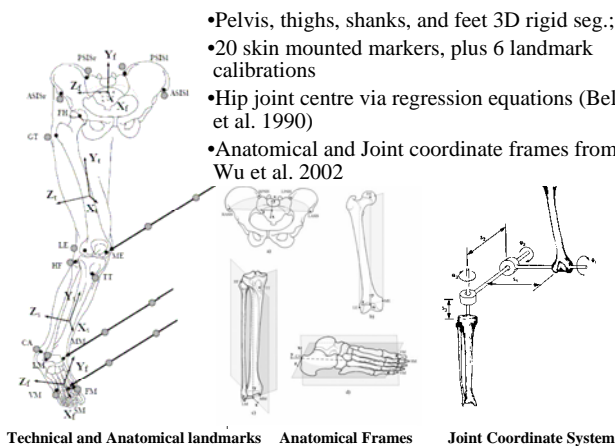
Steps for a Rationale Design:

- a) Identification of the Clinical Question/Issue
- b) Definition of the Relevant Quantities/Variables
- c) Selection of Appropriate Anatomical/Functional References
- d) Association btw Internal > External References
- e) Design of the Marker-Set
- f) Analysis of Feasibility/Usability, and of Errors

the Lower Limb protocol

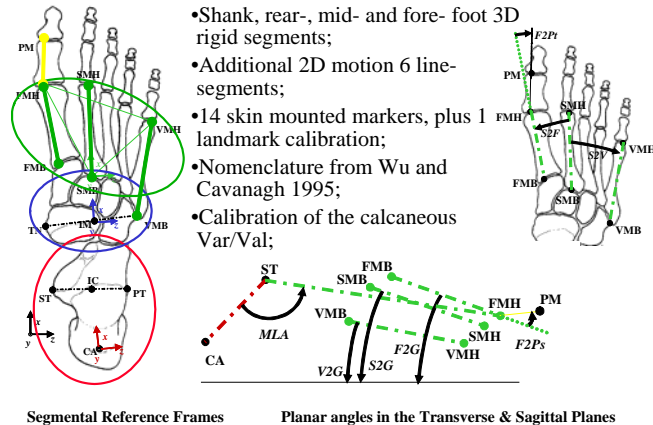
the models

- Pelvis, thighs, shanks, and feet 3D rigid seg.;
- 20 skin mounted markers, plus 6 landmark calibrations
- Hip joint centre via regression equations (Bell et al. 1990)
- Anatomical and Joint coordinate frames from Wu et al. 2002

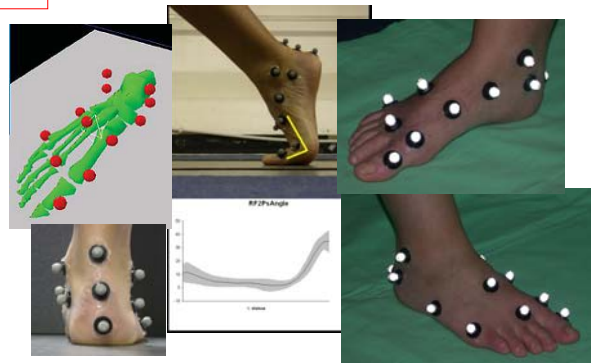
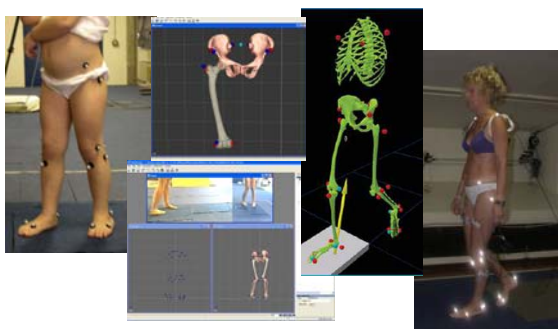


the Multi-Segment Foot protocol

- Shank, rear-, mid- and fore- foot 3D rigid segments;
- Additional 2D motion 6 line-segments;
- 14 skin mounted markers, plus 1 landmark calibration;
- Nomenclature from Wu and Cavanagh 1995;
- Calibration of the calcaneus Var/Val;



the mrk-sets



the main features

- ☞ It is anatomical-based, i.e. definitions embedded on bony landmarks;
- ☞ Calibrations viable also by a simple single marker in correspondence in a static acquisition, rather than the traditional instrumented pointer;
- ☞ Quick patient preparation and repeatable marker mounting;
- ☞ No need of additional anthropometric measurements or alignment devices;
- ☞ ISB recommended bony segment reference frames, mutually independent;
- ☞ Three-planar kinematics & kinetics of trunk, pelvis, hip, knee and ankle;
- ☞ Possible extension to a much larger number of landmarks to be tracked;
- ☞ Terminology according to current practice (Fl/Ex, Ab/Ad (Ev/Inv), In/Ex);
- ☞ Consistency with the results of the traditional protocols (JEGM '06);
- ☞ Validation also via comparison with known underlying joint motion.

- ☞ Markers all tracked with standard 8 TV camera configuration typical of full-body gait analysis (same time of standard lower limb protocols);
- ☞ Independent analysis of rotations in the transverse and sagittal planes of the IMPJ, 1st 2nd and 5th metatarsal, and medial longitudinal arch;
- ☞ All via anatomical landmarks > easy training;
- ☞ Minimum artefactual effects for tendon elevation;
- ☞ Consistent patterns over a normal population, also for small joint motion;
- ☞ Terminology according to current practice (Do/Pl, Ev/Inv, Ab/Ad);
- ☞ Validation via elementary exercises.