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CLINICAL WALKER-ASSISTED GAIT ANALYSIS: METHODOLOGICAL AND INSTRUMENTAL APPROACH

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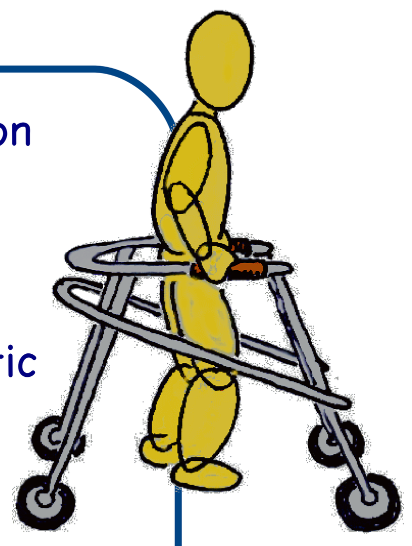
INTRODUCTION

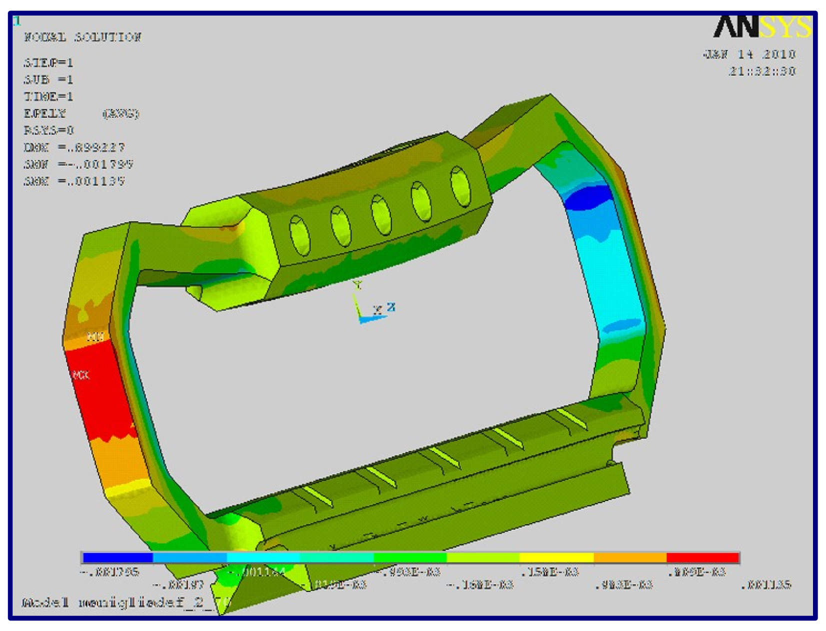


Instrumental clinical gait evaluations are mainly based on kinematic, kinetic and electromyographic measures.

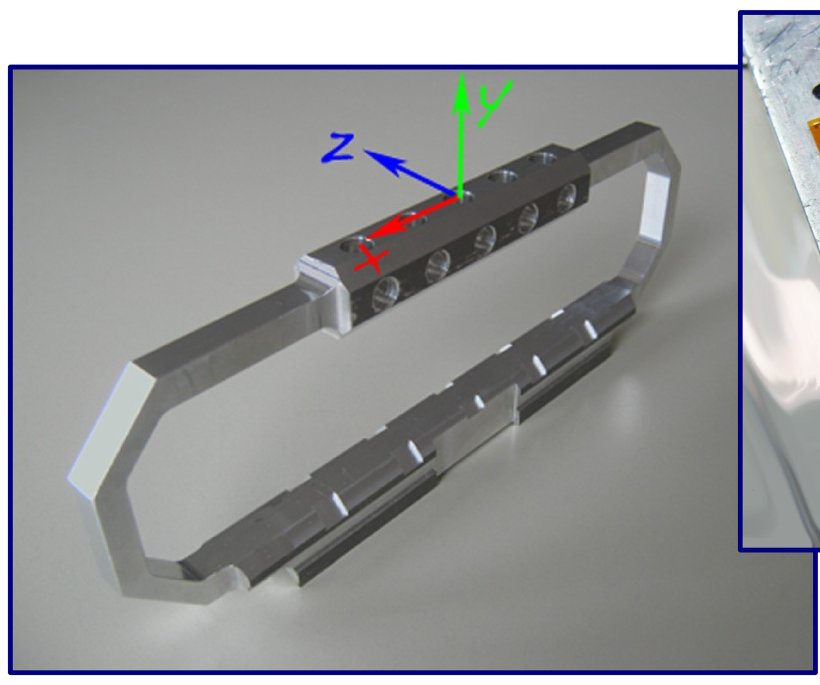
In patients forced to walk with **anterior or posterior walkers** loads on upper limbs are unknown [1] and kinetic measures are altered by walker wheels and forceplates interaction.
Loads can be measured by **load cells**.
Available commercial cells *(AMTI MCW-6-500, Watertown, MA, USA)* [2,3] are rigidly fixed to a particular walker model, therefore
it appeared a leading issue to develop **two load cells** that can be easily assembled and adapted to any walker to measure bilateral **6 DOF loads applied by the subject on his own walker.**

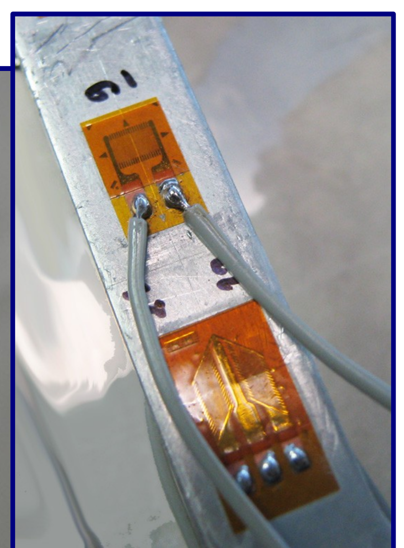
MATERIALS AND METHODS

Finite Element (FEM) Analysis to evaluate:
- static resistance
- best strain gage positioning
- magnitude of measurable strains



Two octagonal load cells were realized as 7075 T6 aluminium handles (total mass 0.270 Kg) instrumented with **strain gages.**

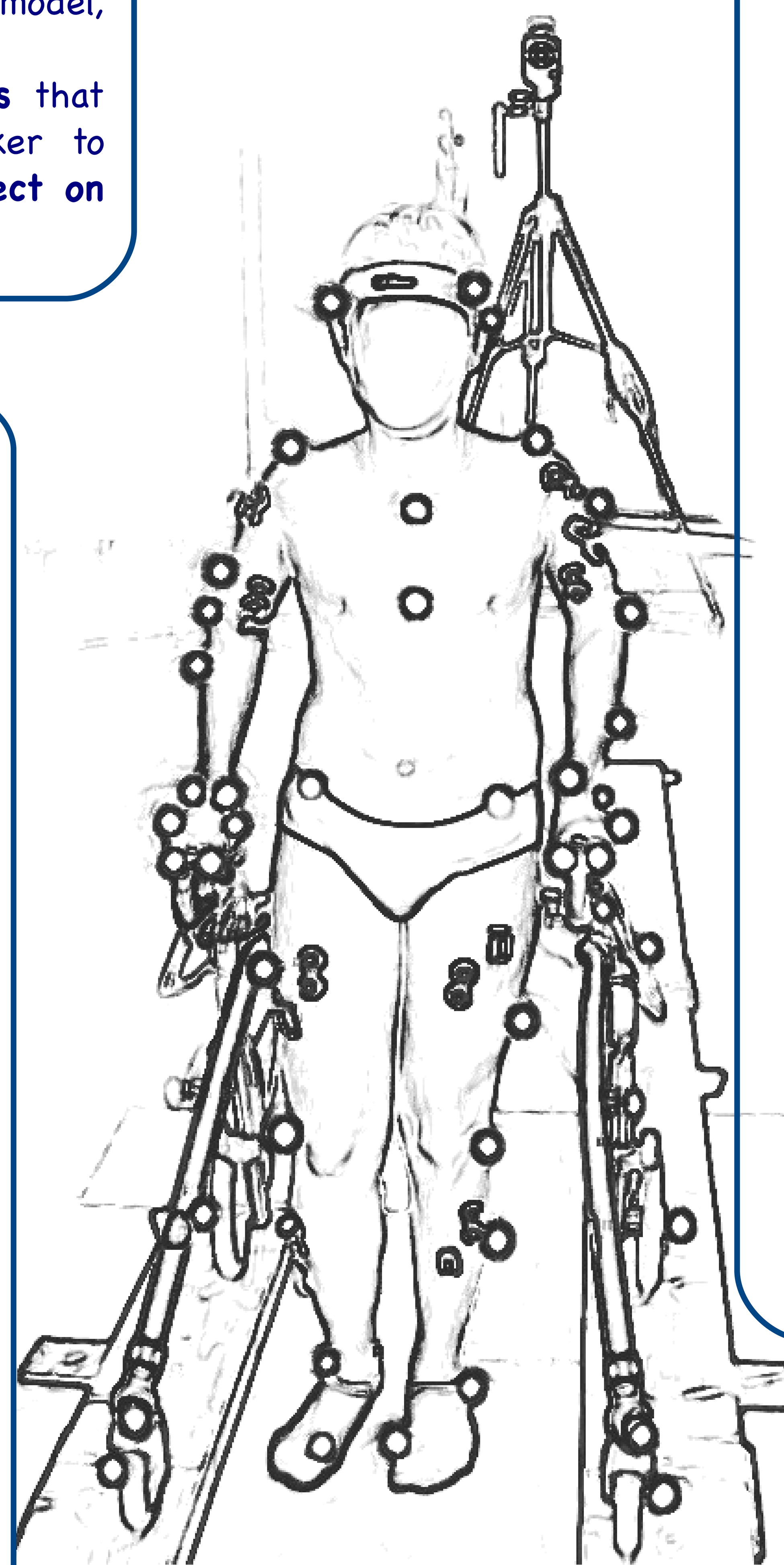




Handles are fixable to the tubes that form the handles of walkers with different sizes by mean of metal bands.

Loads are measured by full strain gage Wheatstone bridges.
Full scale values considered are:
Fx, Fz = 500 N
Fy = 1100 N
Mx, My, Mz = 20 Nm

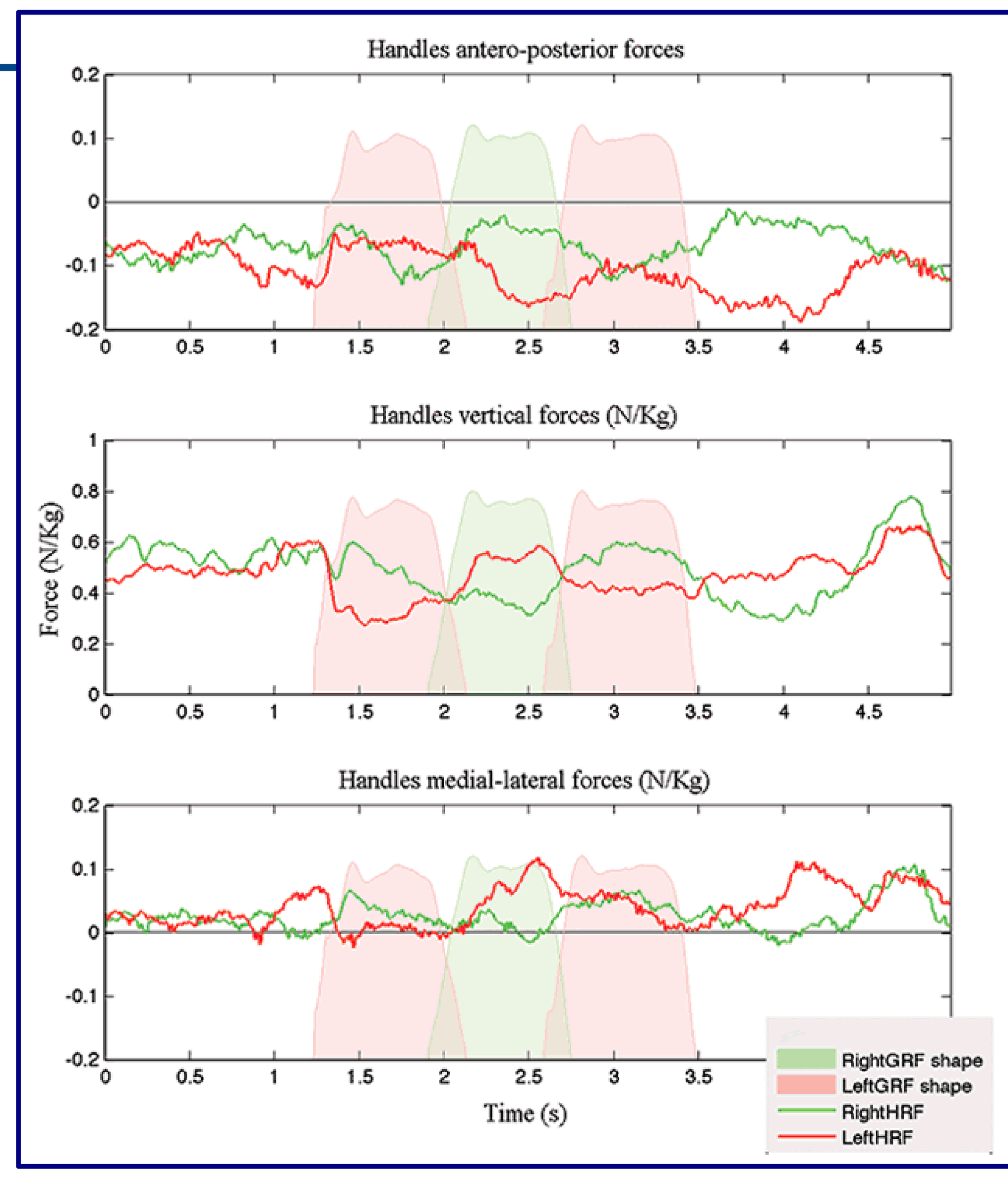
Signals are amplified and acquired synchronously with kinematic, kinetic and electromyographic data via a Vicon MX system (*OxfordMetrix, Oxford, UK*).



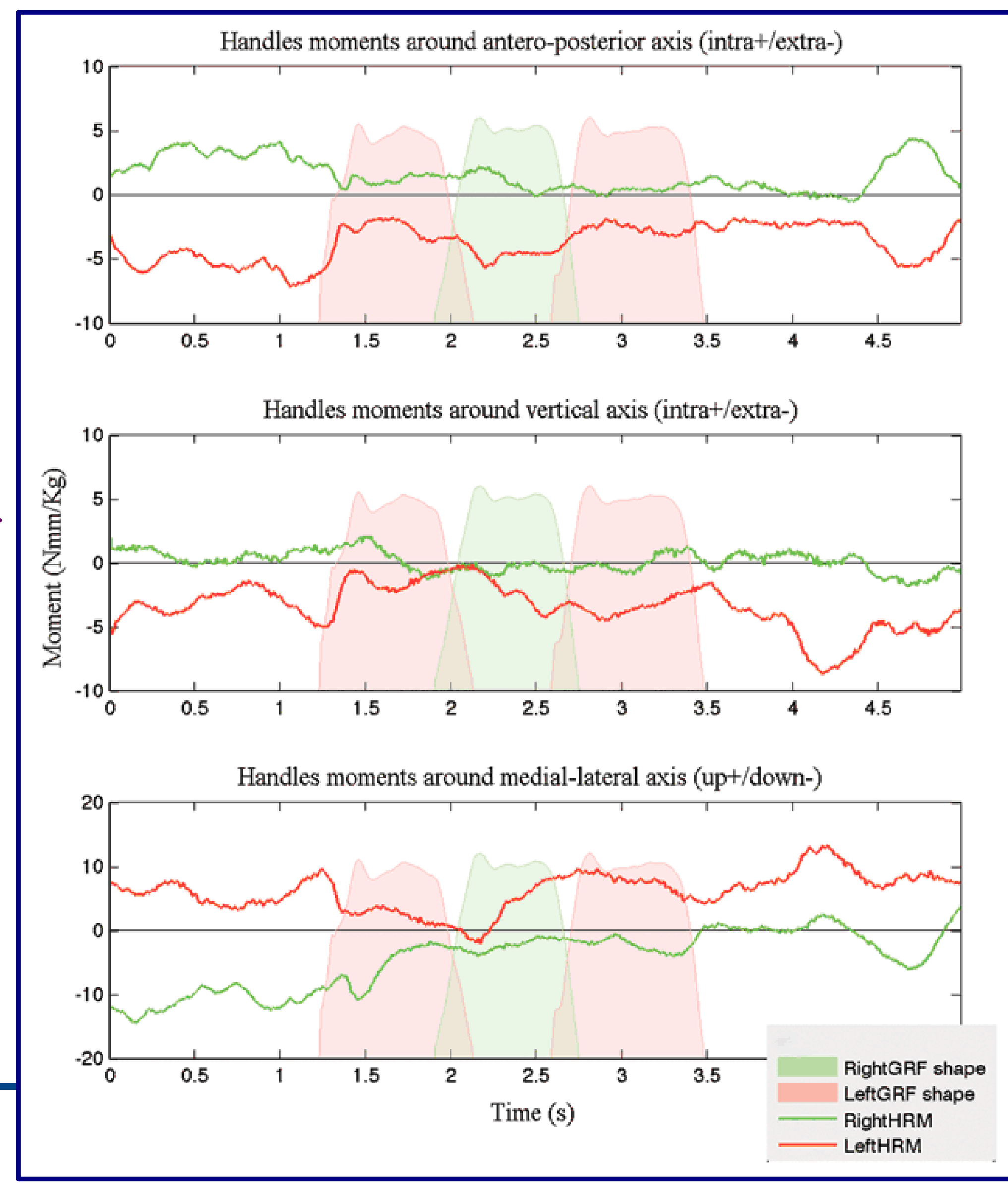
RESULTS

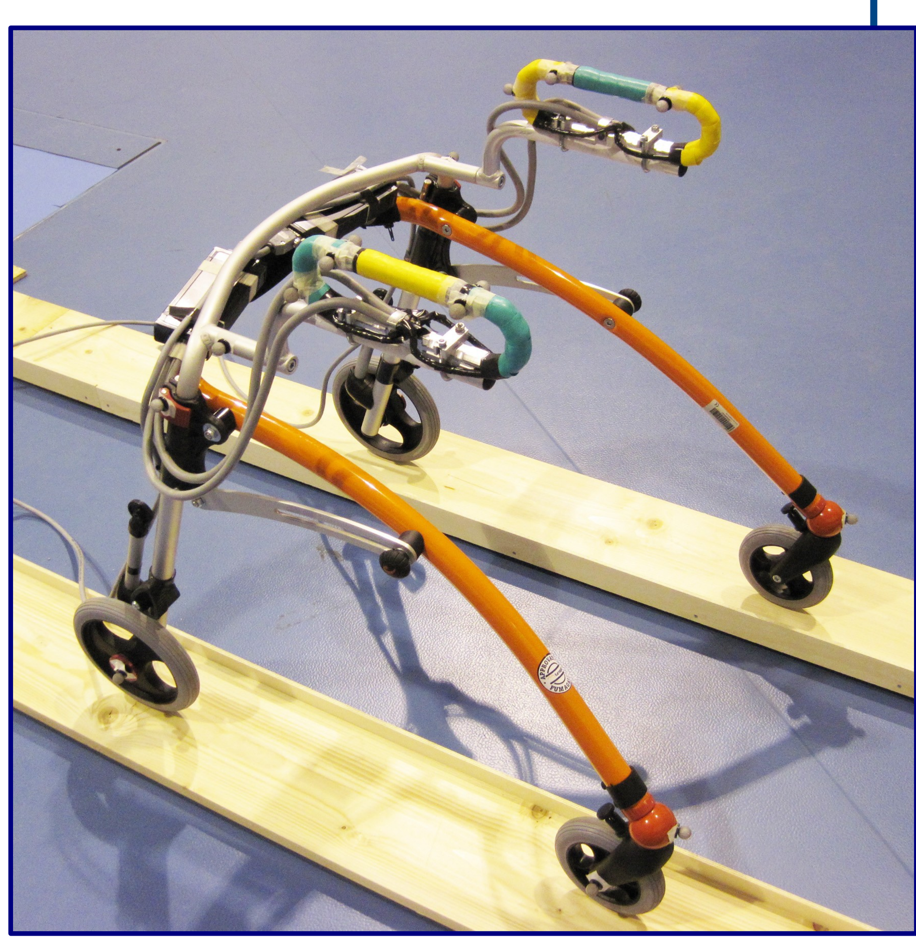
Static calibration process confirmed accurate cell sensitivity.
Crosstalk compensation obtained through the calibration matrix provides good uncoupling among different channels.

To avoid walker wheels interaction with force platforms, a couple of **rails slightly upraised from the ground** has been realized. Walker height has to be adjusted to compensate for increase caused by handles and rails.



Preliminary data *on a normal child while walking with a posterior walker.*
Graphs show Handle Reaction Forces (HRF) and Moments (HRM) components, as % of bodymass, along antero-posterior, vertical and medial-lateral axes for the right (green) and left (red) sides.
Vertical Ground Reaction Force (GRF) patterns are superposed to evidence gait cycle phases





Handles applied on a R82 walker, with rails over the force plates

DISCUSSION AND CONCLUSIONS

Two **prototype 6 DOF load cells** have been realized.

Calibration process demonstrated high sensitivity of the cell and good uncoupling among different channels.

Overall **accuracy** demonstrates lower performance compared to commercially available load cells [2], but lightness and adaptability of the handles realized will allow to have a versatile instrument, easily **usable for both research and clinical purposes**, adapting to subject's own walker.

Use of instrumented handles might then improve design and development of new walker models.

The system is now undergoing **dynamical validation** and a **full-body biomechanical model**, to perform upper and lower limb inverse dynamics, is being developed.

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