

Musculoskeletal Model Scaling using OpenSim

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- Needed to and process analyze experimental data
 - Can be used to validate the simulation
 - Can serve as intial guess to optimization for debugging
- Needed for my research

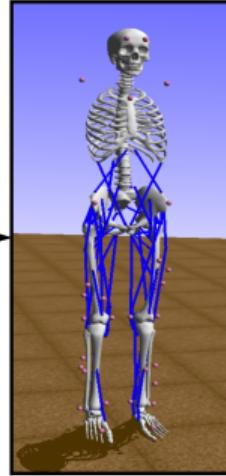
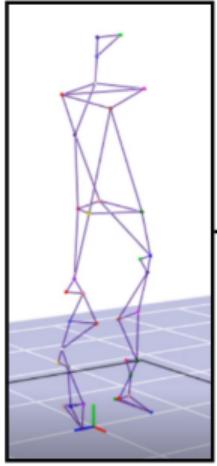
$$F \neq MA$$

$$F + Residual = MA$$

- Magnitude of Residual actuators is used to judge validity experimental results
- A good model scaling is needed for lower magnitude of residuals

Model Scaling

Static Trial



Scaled Model

▶ Video: Walking Animation

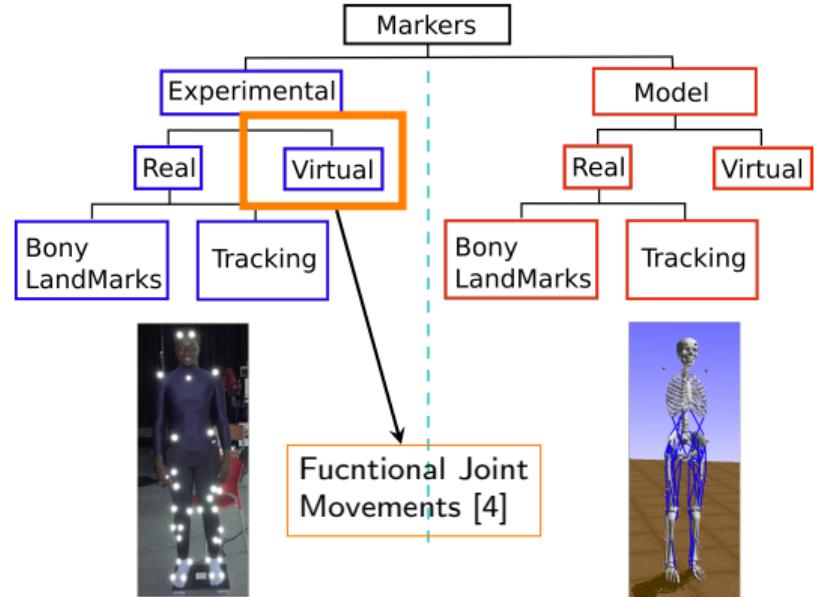
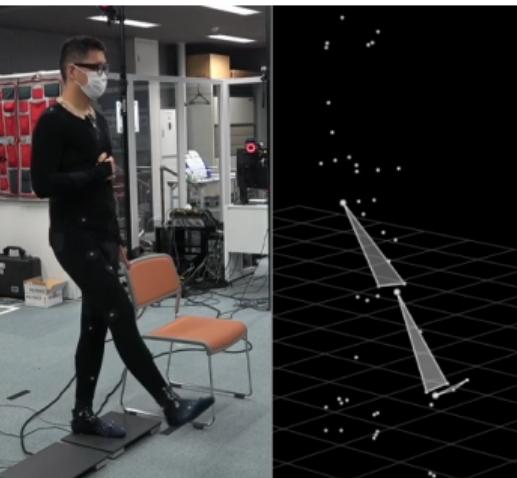


Table 1: Marker Errors After Scaling

- Implemented Algorithm to adjust markers for skin shear ([5])
- Implemented SCoRe Algorithm for center prediction ([2])



▶ Video: FJC Visualization

Recorded the following motions:

- Small Circles of Legs
- Large Circles of Legs
- Normal Cross Legs
- Large Cross Legs
- Normal Star Arc
- Exaggerated Star Arc

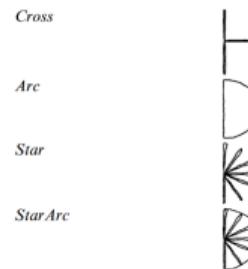


Figure 1: Motion Visualization [1]

Motion	Max Error
Star Arc	3.4cm
Normal Cross	3.5cm
Star Arc Exaggerated	4.1cm
Big Circle	4.1cm
Small Circle	4.3cm

Motion	Max Error
Star Arc	3.4cm
Normal Cross	3.5cm
Star Arc Exaggerated	4.1cm
Big Circle	4.1cm
Small Circle	4.3cm

Should be < 2cm [3]

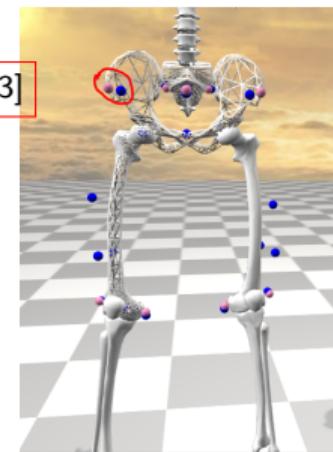


Figure 2: Error Visualization

- ① Bony landmark palpation training.
- ② Experiments
- ③ Evaluation

Thank you for your patience.

<https://jamboard.google.com/d/1Q3xu9pAiXgBtjg0vjr89Fg52SUvQBvTrE7zoqG14UGY/edit?usp=sharing>

References I

- [1] Valentina Camomilla et al. "An optimized protocol for hip joint centre determination using the functional method". In: *Journal of biomechanics* 39.6 (2006), pp. 1096–1106.
- [2] Rainald M Ehrig et al. "A survey of formal methods for determining the centre of rotation of ball joints". In: *Journal of biomechanics* 39.15 (2006), pp. 2798–2809.
- [3] *OpenSim: Best Practices*. URL: <https://simtk-confluence.stanford.edu/display/OpenSim/Simulation+with+OpenSim+-+Best+Practices>.
- [4] *OpenSim: Model Scaling Webinar*. URL: <https://www.youtube.com/watch?v=ZG7wzvQC6eU>.
- [5] Andrew J Stoddart, D Ewins, and D Hynd. "A computational method for hip joint centre location from optical markers". In: (1999).