

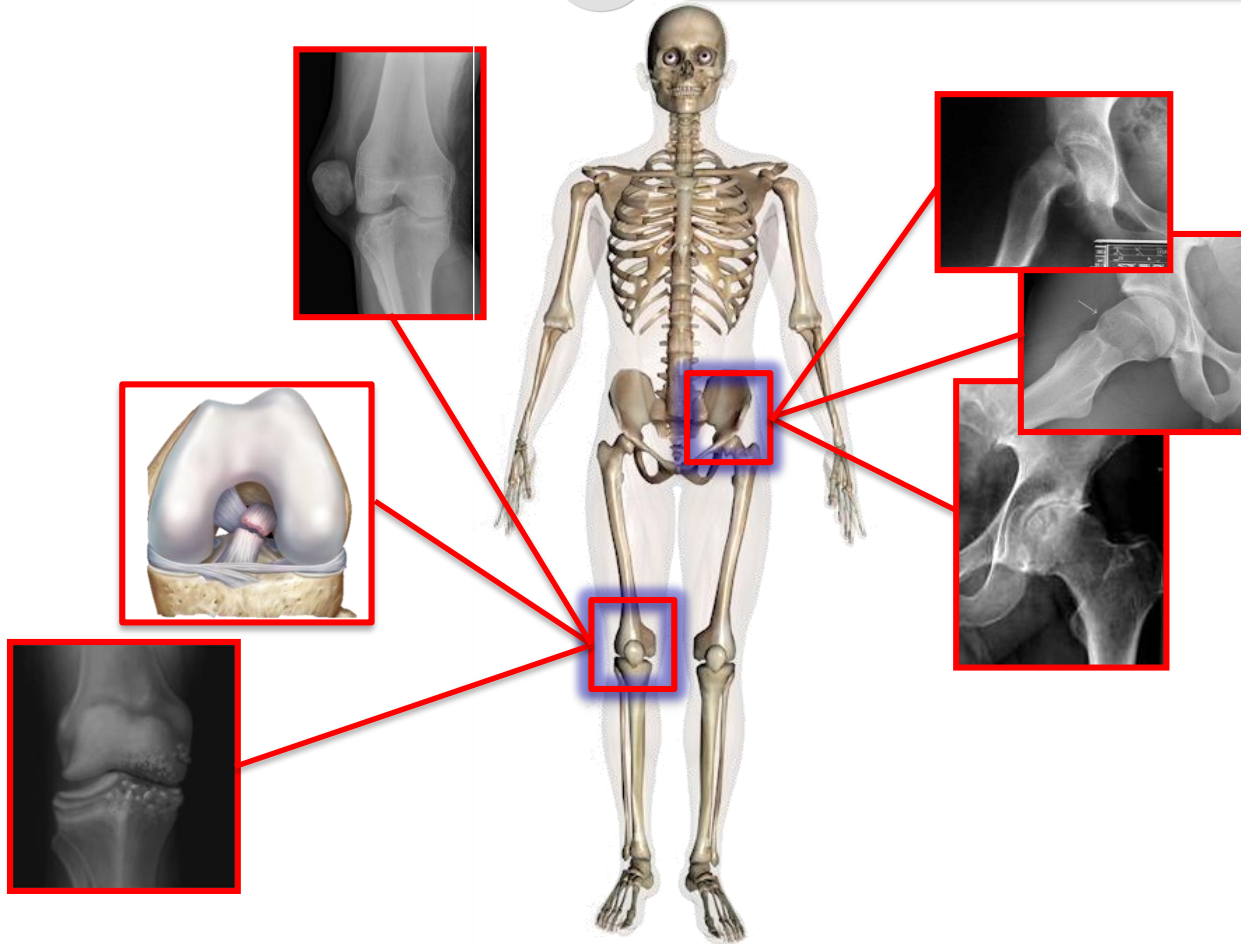
The Personalised Digital Human: Personalising Computational Models to Manage Neuromusculoskeletal Conditions

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Creating & Using Personalised Computational Models

1. Create person's model to directly encompass

- » *Form*, e.g. medical imaging
- » *Function*, e.g. motion capture...

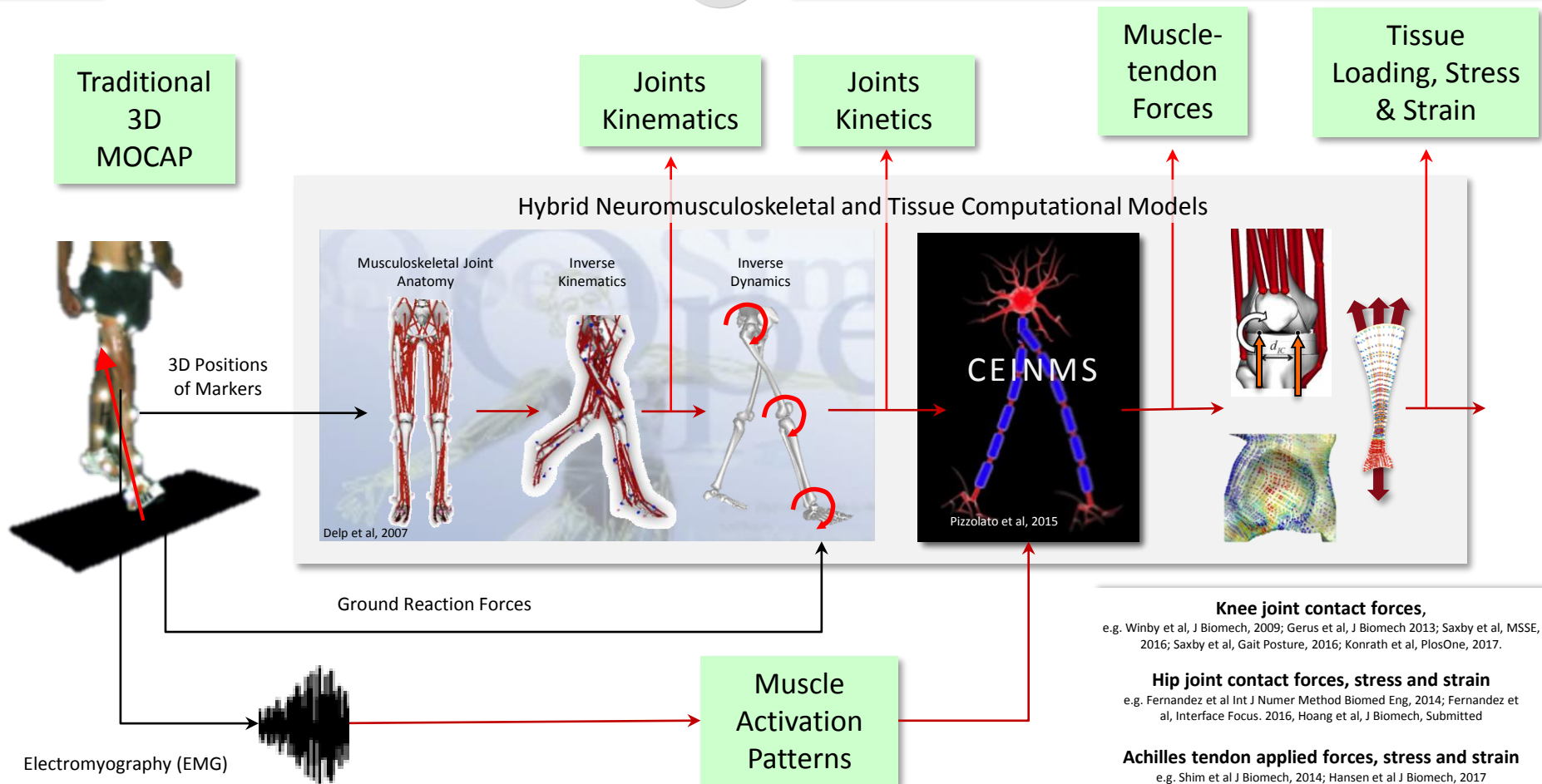
2. Calibrate or tune model parameters to

- » Measured experimental data
- » Literature data
- » Population or atlas data



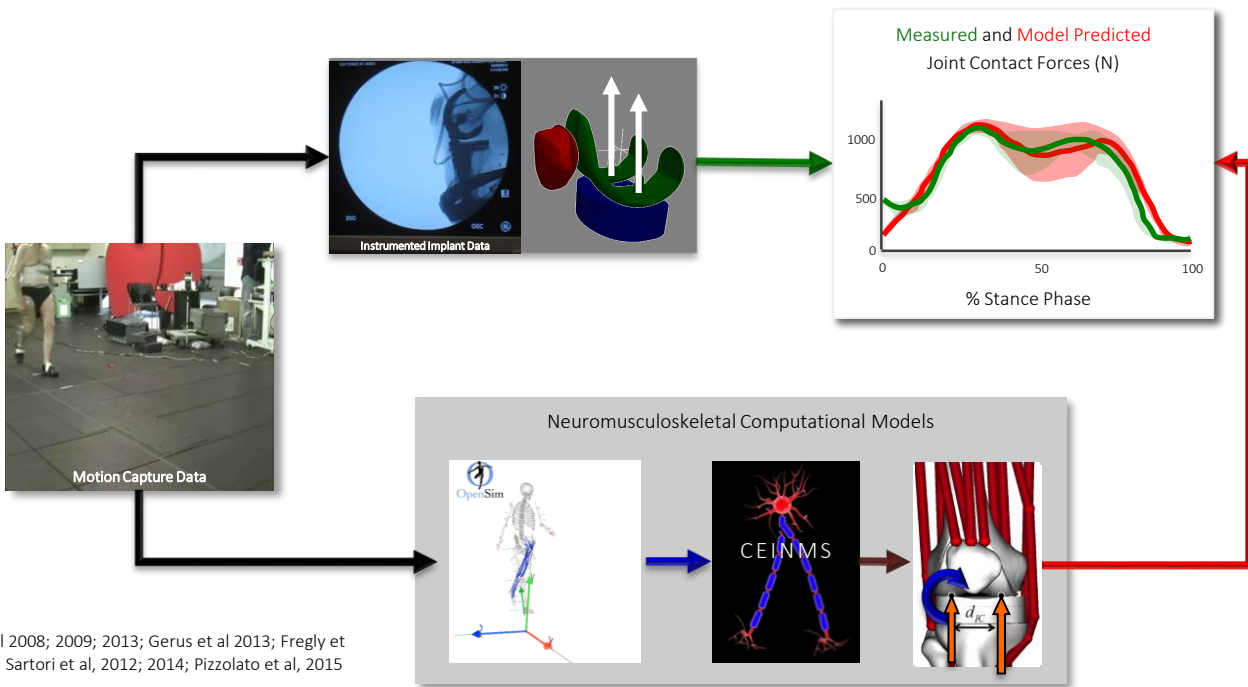
- Musculotendon
- Neural excitation dynamics
- Bone geometry
- Joint geometry
- Tissue material properties

3. Drive the model with experimental data



Scaled-generic vs

Subject-specific

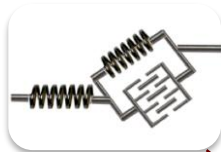


Winby et al 2008; 2009; 2013; Gerus et al 2013; Fregly et al, 2012; Sartori et al, 2012; 2014; Pizzolato et al, 2015

Subject-specificity needs to encompass...

Musculotendon Physiological Properties

(e.g. Gerus et al J Biomech, 2013)



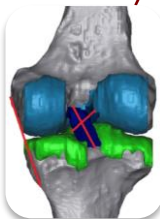
Musculotendon Anatomy

(e.g. Gerus et al J Biomech, 2013;
Marra et al J Biomech Eng, 2015)



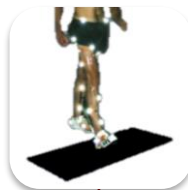
Joint Mechanics

(e.g. Gerus et al J Biomech, 2013)

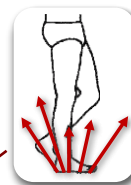


Neuromusculoskeletal System

Movement

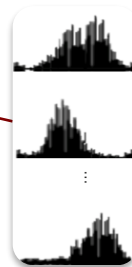


External Loading



Muscle Activation Patterns

(e.g. Winby et al J Biomech, 2009,
Walter et al, J Biomech Eng, 2014)



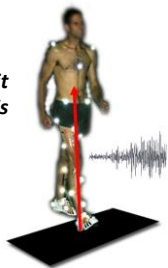
Skeletal and Segmental Anatomy

(e.g. Kainz et al J Biomech, 2016;
Marra et al J Biomech Eng, 2015)



Medical Imaging + MOCAP → Personalised NMSK Models

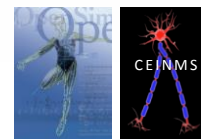
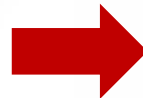
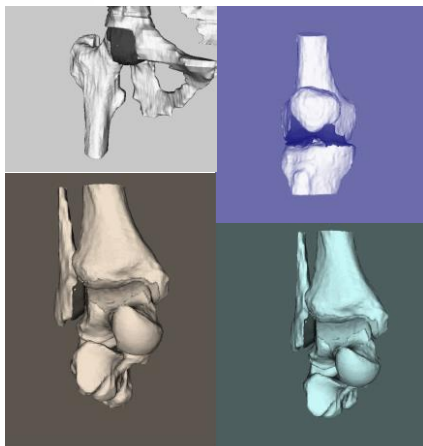
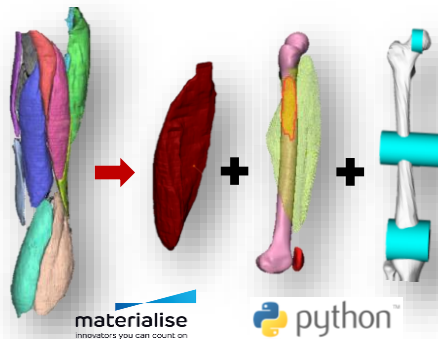
Gait Analysis



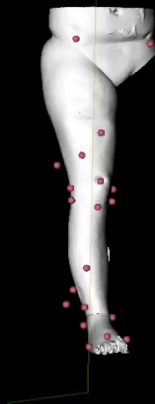
Lower Limb MRIs



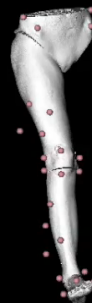
Statistical Shape Models



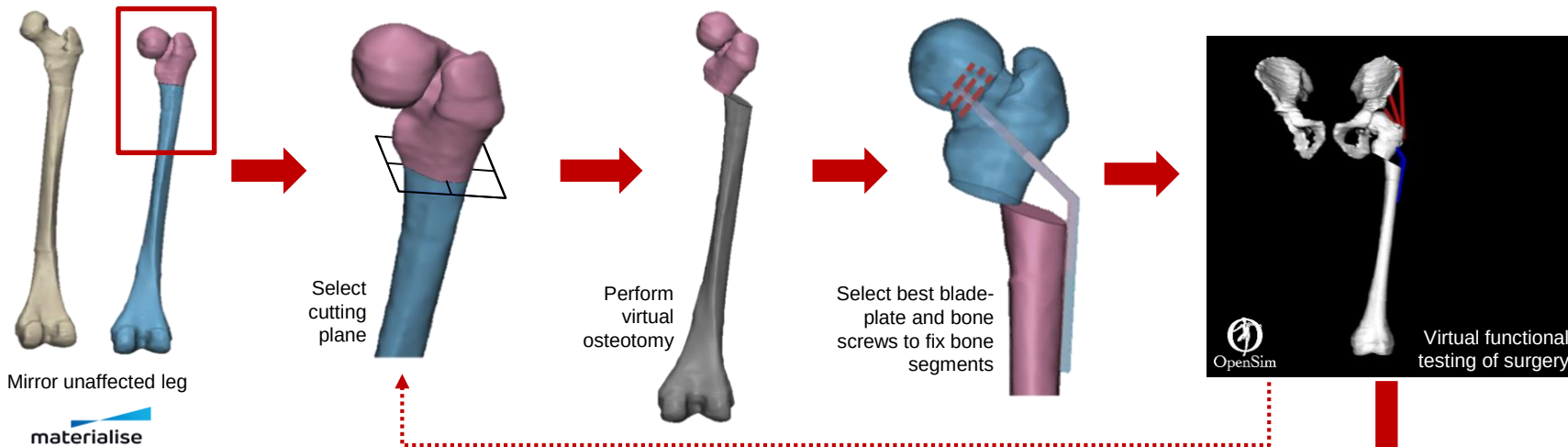
Patellar Dislocator



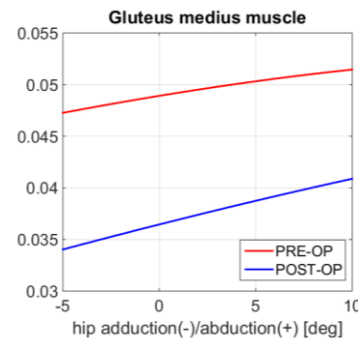
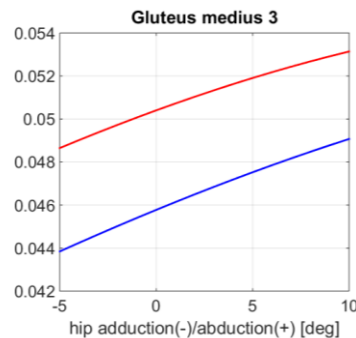
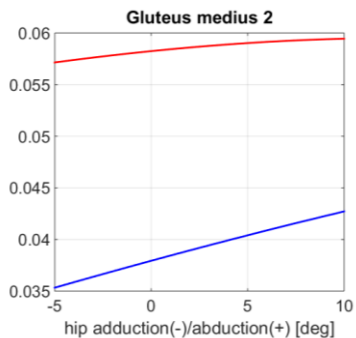
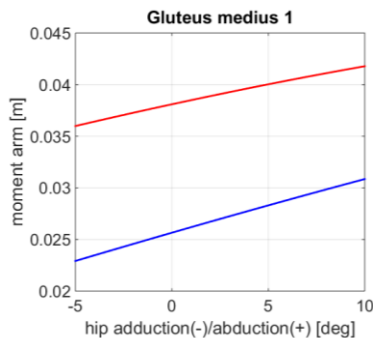
Control Participant



(Barzan et al, J Biomech, In Preparation)



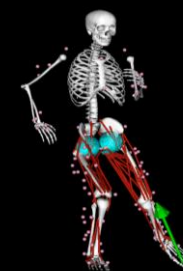
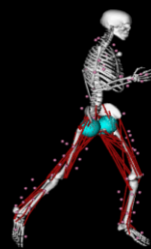
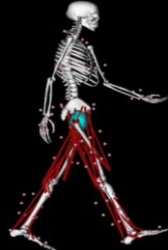
materialise
innovators you can count on



blade plate



(Saxby et al, *MSSE*, 2016;
Saxby et al, *Gait Posture*, 2016;
Konrath et al, *PlosOne*, 2017)



Tested 104 ACL Reconstruction & 60 Controls

- 18-43 years
- Semitendinosus + gracilis autograft
- Reconstruction $\leq$ 6 months ACL rupture
- Tested 2-3 years post-ACL Reconstruction

