WORKSHOP OPENSIM

19 octobre 2017

Welcome!
Bienvenue!

Sofamea

SB

INSTITUT de BIOMÉCANIQUE HUMAINE GEORGES CHARPAK

ARTS ET MÉTIERS ParisTech

Agenda

8:30 – 9:30	**Reception and check OpenSim installation** Accueil des participants et vérification des configurations matérielles
9:30 – 9:45	**Introducing workshop** Discours d'ouverture du Workshop *Florent Moissenet*
9:45 – 10:00	**Musculoskeletal modeling in OpenSim** Presentation du project OpenSim *Luca Modenese*
10:00 – 10:30	**Participants' presentations and objectives** Attentes de chacun & objectifs du workshop *Florent Moissenet*
10:45 – 11:00	*Coffee Break*
11:00 – 12:00	**Presentation of OpenSim software** Présentation du logiciel Opensim *Luca Modenese & Clément Favier*
12:00 – 13.00	*Lunch*

Agenda

13:00 – 13.45	**Tutorial 1: import data in OpenSim** Tutoriel 1 : Importation des données dans Opensim
13:45 – 14.30	**Tutorial 2: model marker set and scaling** Tutoriel 2 : Jeu de marqueurs du modèle et mise à l'échelle
14:30 – 14.45	*Coffee Break*
14:45 – 15.30	**Tutorial 3: Inverse Kinematics** Tutoriel 3 : Cinématique inverse
15:30 – 16.15	**Tutorial 4: Introduction to muscle analysis** Tutoriel 4 : Introduction à l'analyse musculaire
16:15 – 17.00	**Validation, best practices and assistance on personal projects** Validation, bonne pratique et assistance aux projets personnels
17:00 – 17.15	**Closing presentation** Discours de clôture du Workshop

OpenSim

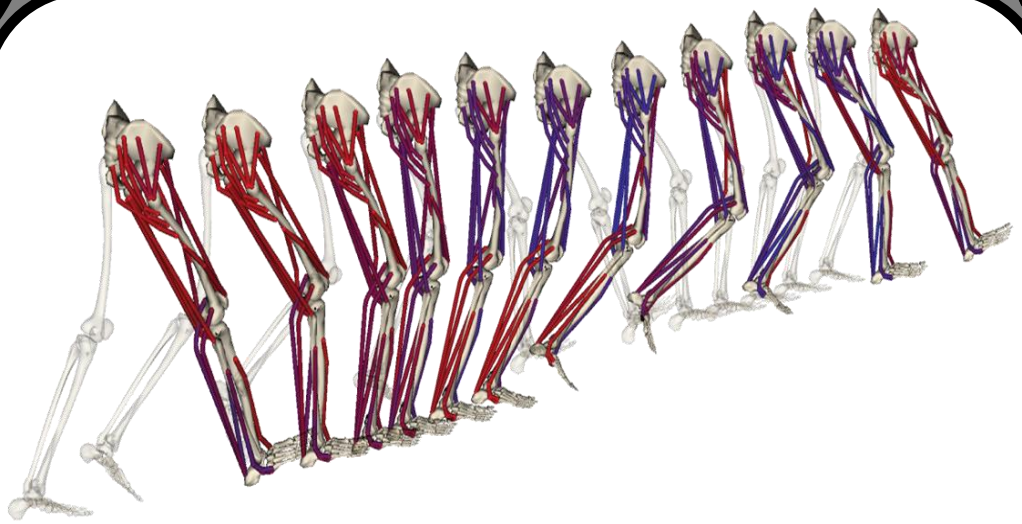
https://simtk.org/home/opensim

http://opensim.stanford.edu

Purpose of modeling and simulation

Visualize complex movement patterns

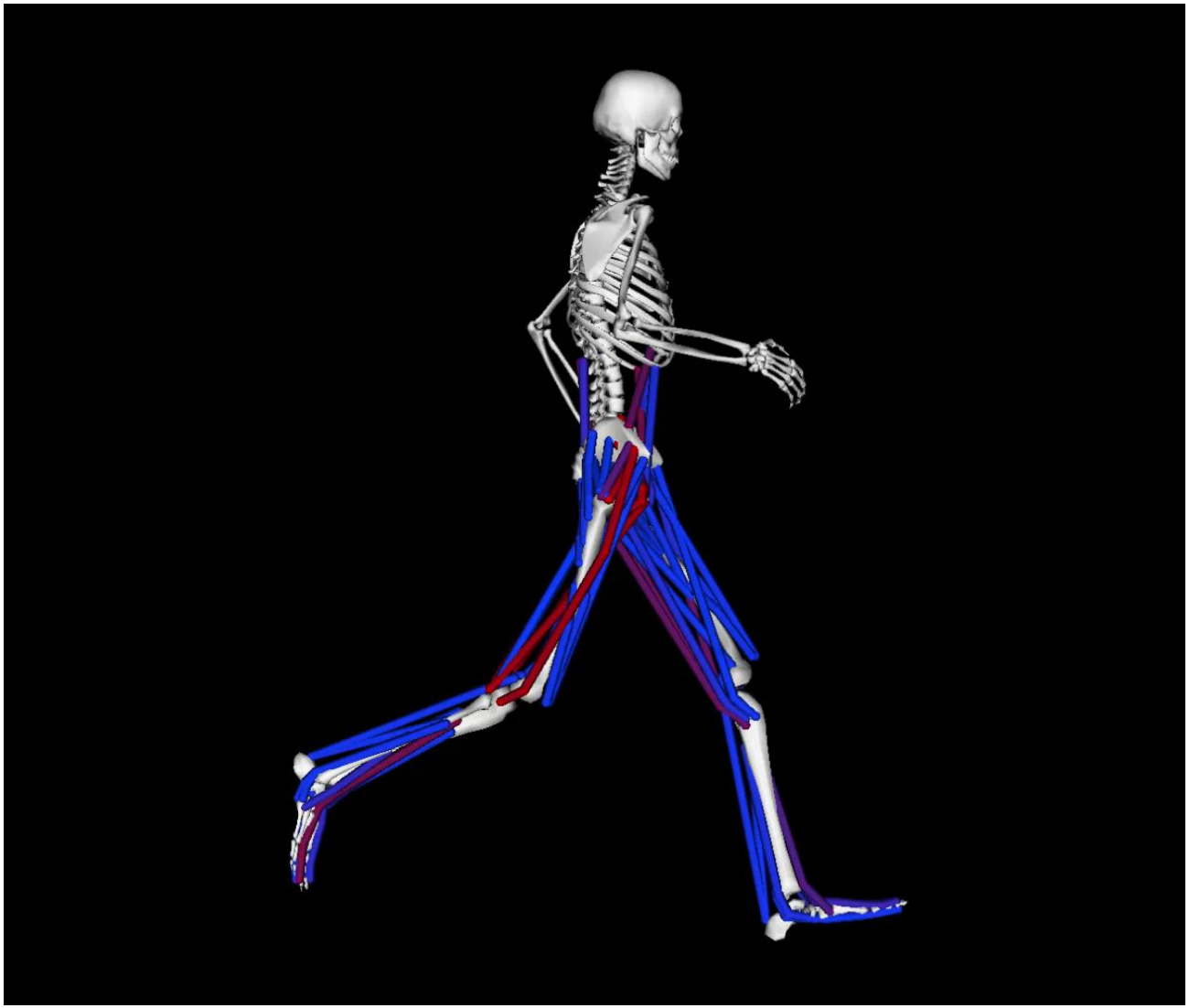
Probe parameters that are difficult to measure



Perform “what if” studies

Identify cause-effect relationships

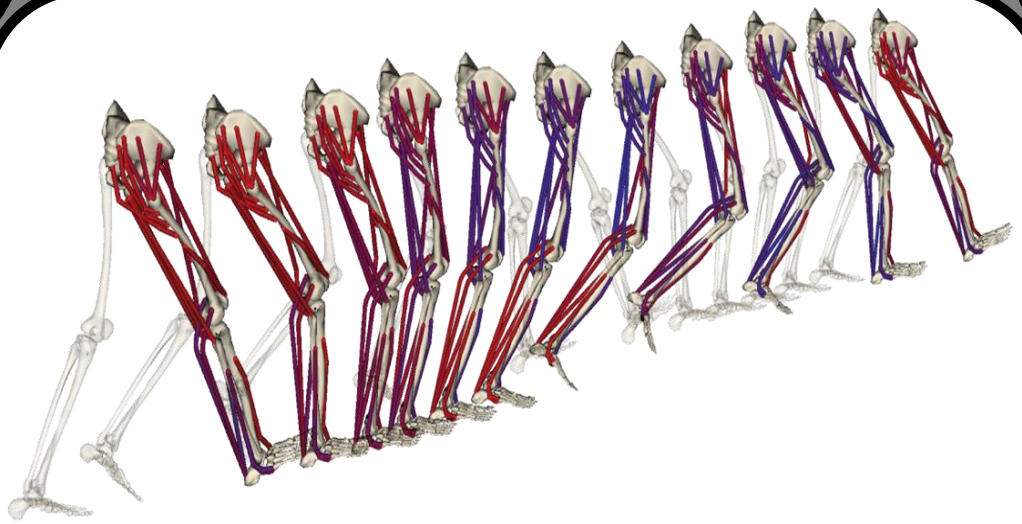
Visualize human running in detail



Purpose of modeling and simulation

Visualize complex movement patterns

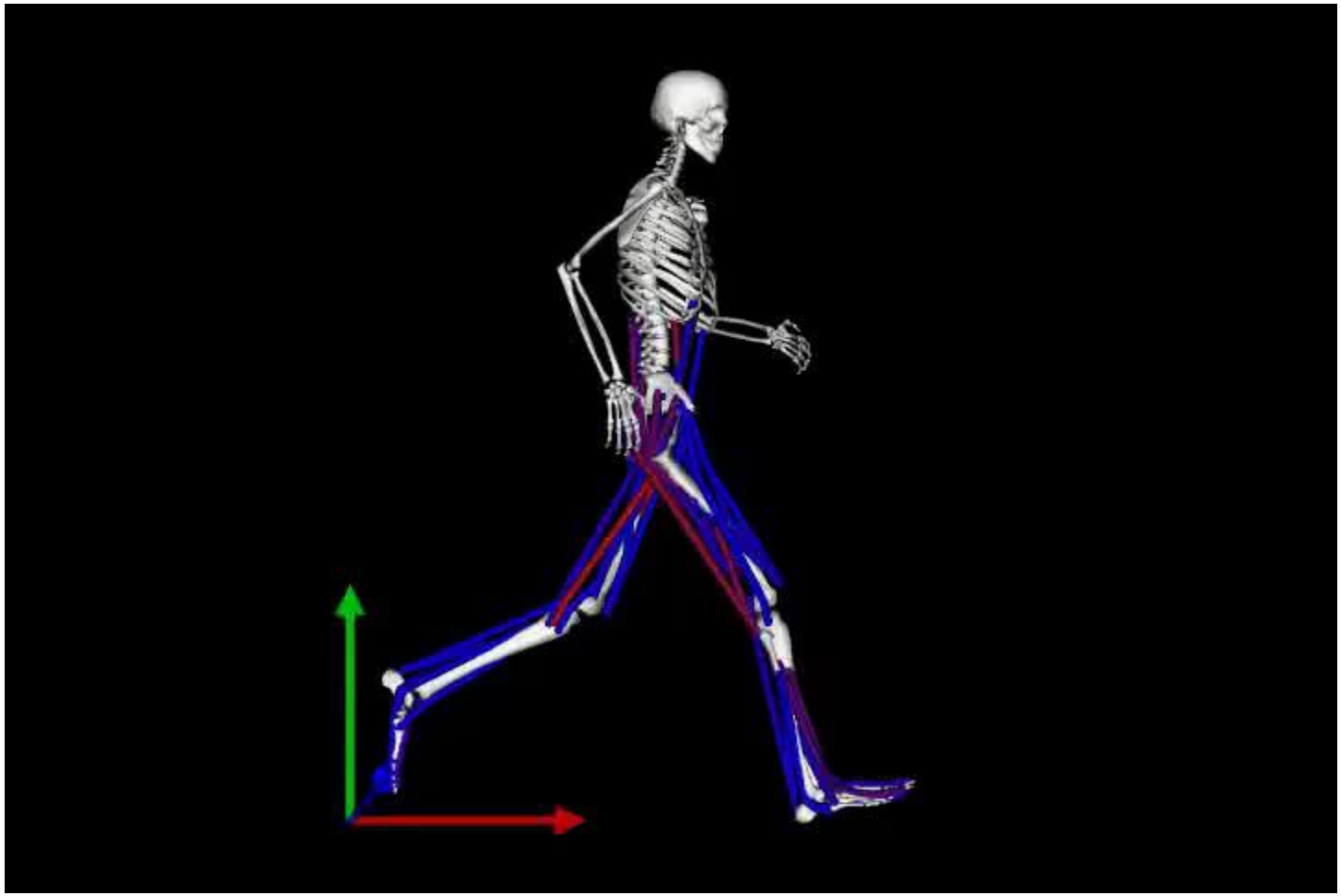
Probe parameters that are difficult to measure



Perform “what if” studies

Identify cause-effect relationships

Probe the function of a muscle



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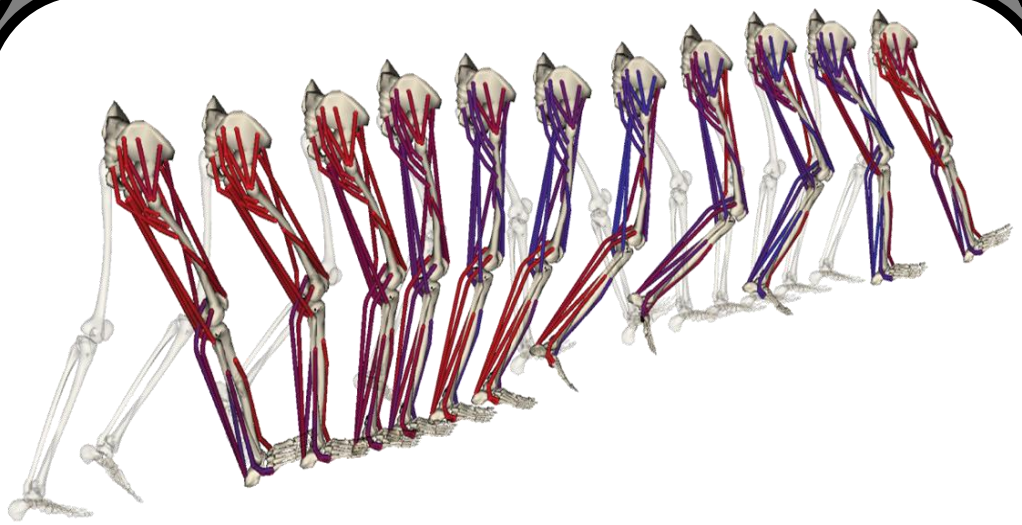
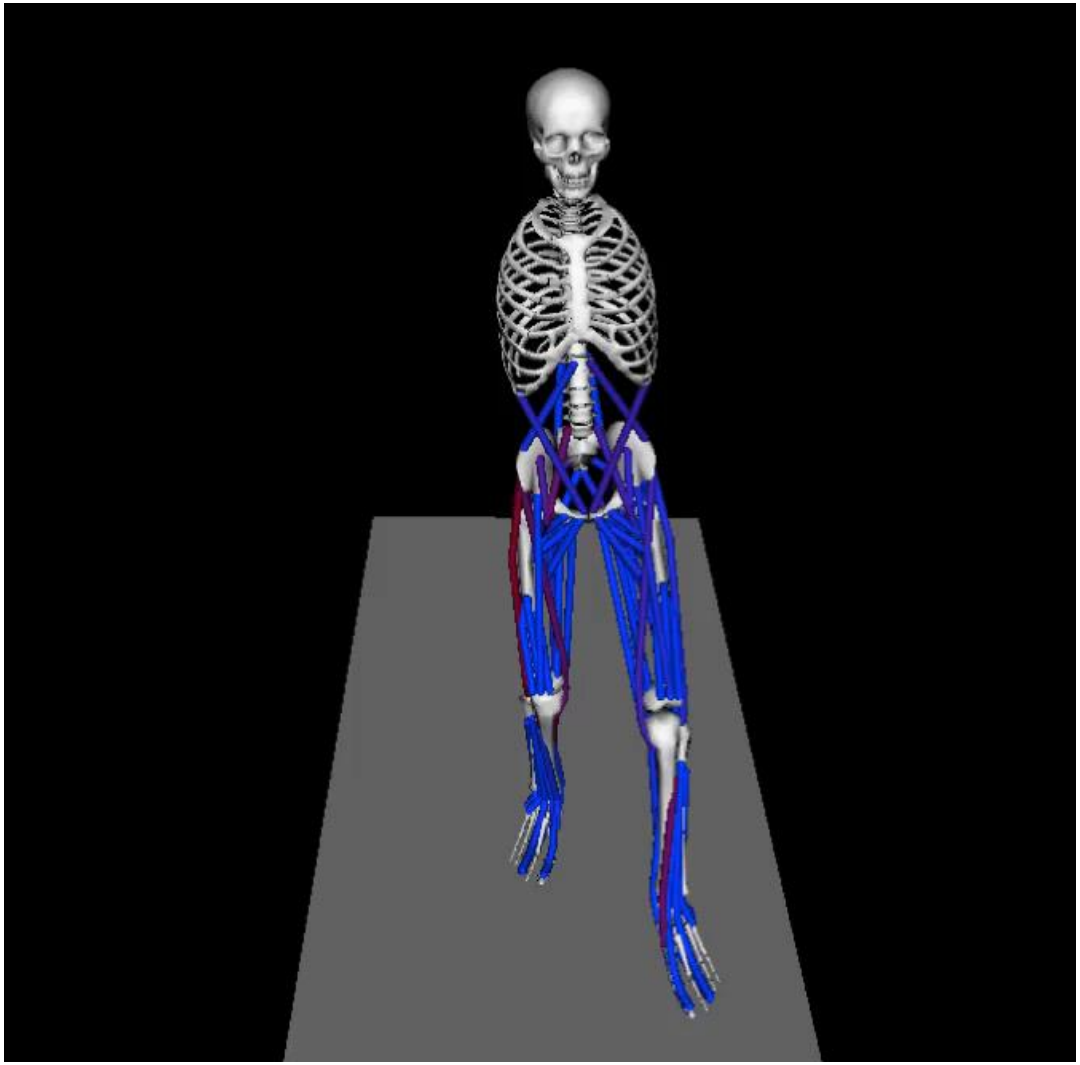


Perform “what if” studies

Identify cause-effect relationships

Examine causes of crouch gait



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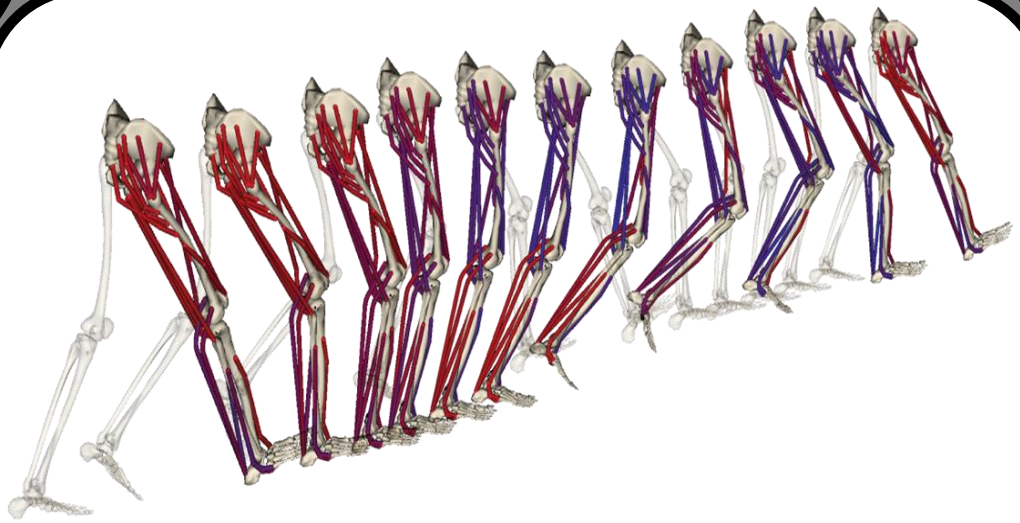
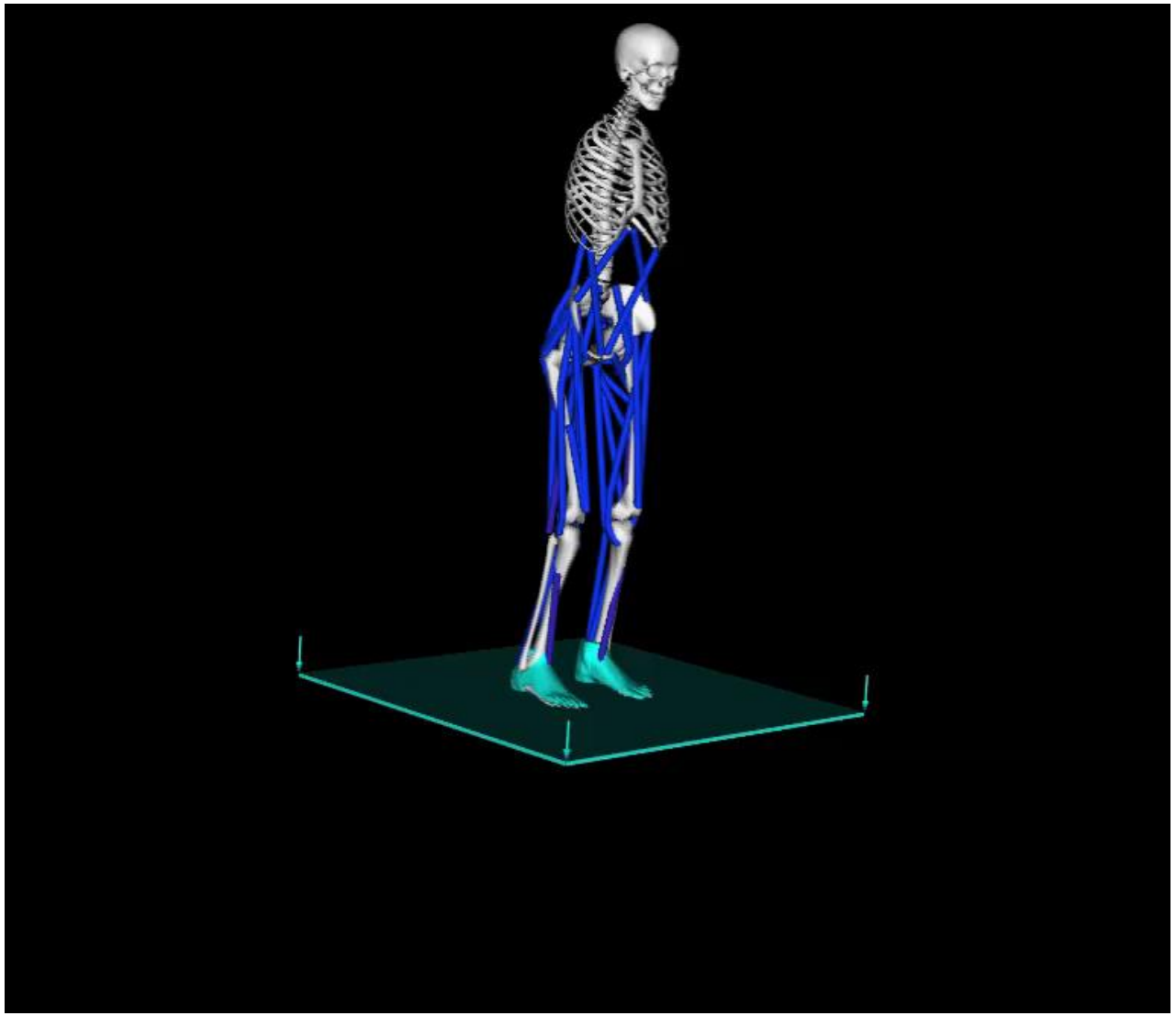


Perform “what if” studies

Identify cause-effect relationships

What happens if the floor drops?



Problems with current paradigm

- Difficult to reproduce results of published papers
- Commercial codes valuable but not extensible
- Cost of commercial code limits use in teaching
- Building your own code is a challenge
- Difficult to bring your innovations to the world
- Continuity is lost when students graduate
- Isolation

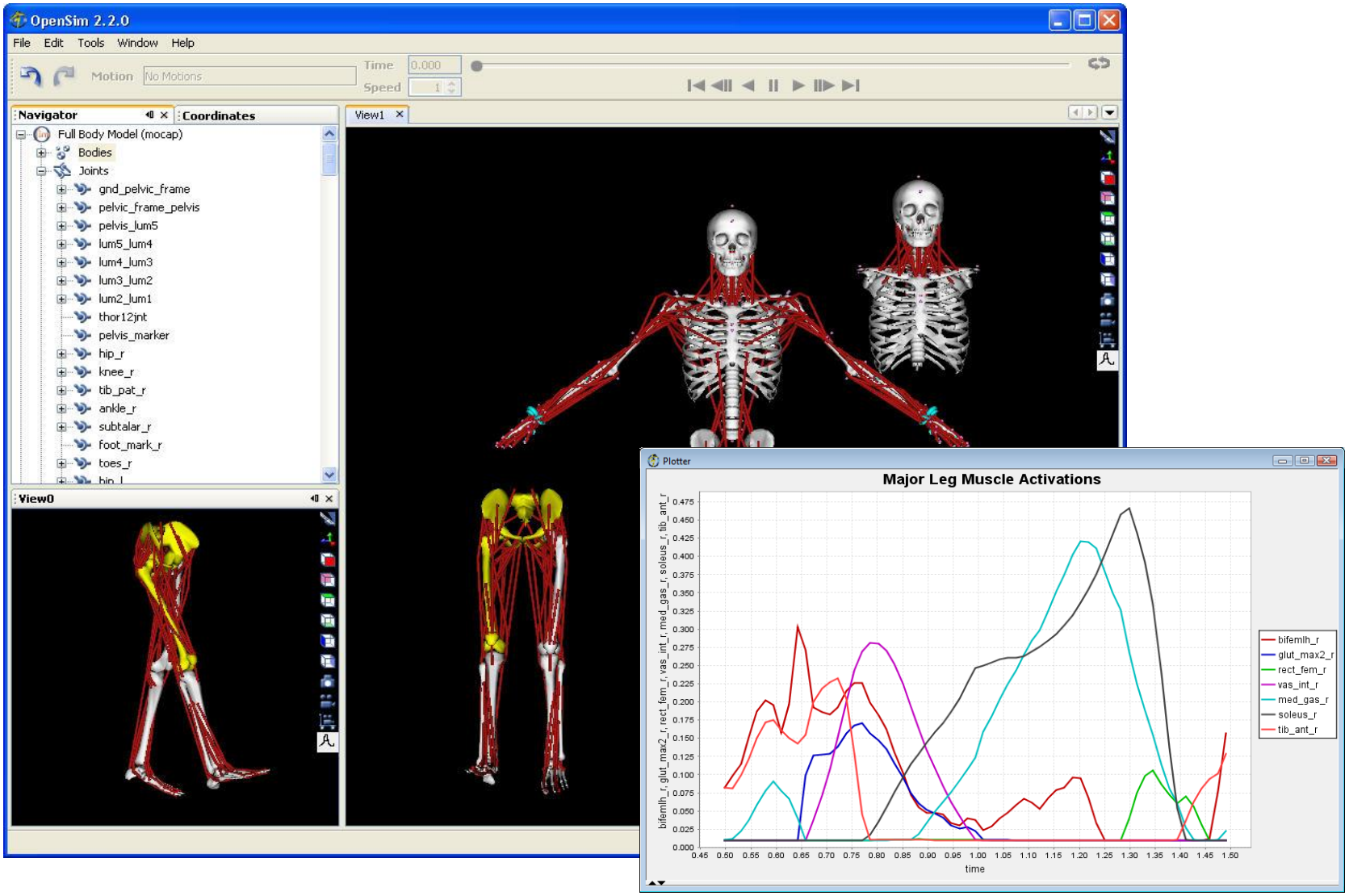
What does OpenSim provide?

- Open access - results can be reproduced
- Extensible - you can add your own features
- Widely available - bring your innovations to the world
- Free - teaching materials
- Access - a community of experts
- Continuity - for your lab

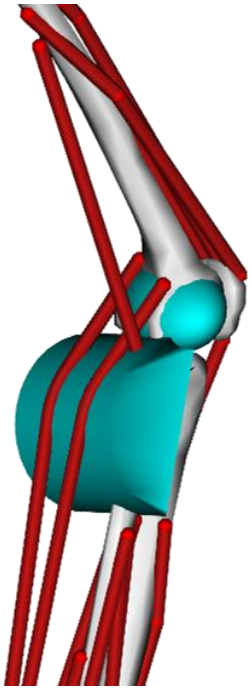
Some OpenSim features

- Standard format for exchanging models
- General purpose inverse dynamics
- Optimization to estimate muscle and joint forces
- Methods to create simulations from motion capture
- Tools to analyze simulations
- A fast and open dynamics engine

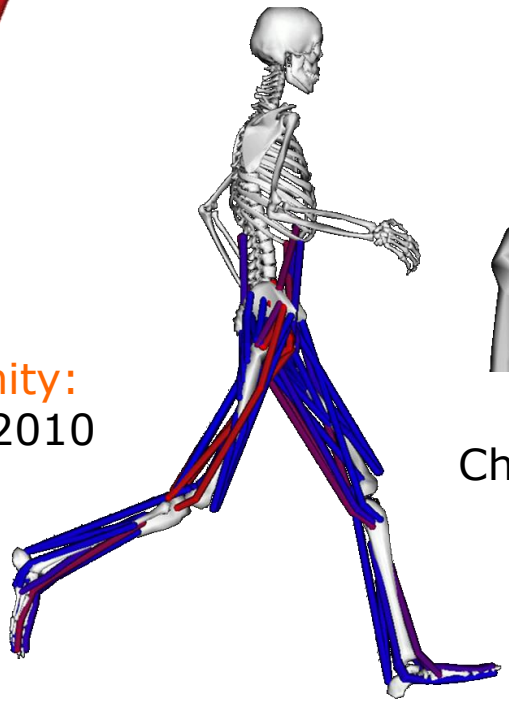
OpenSim is an application



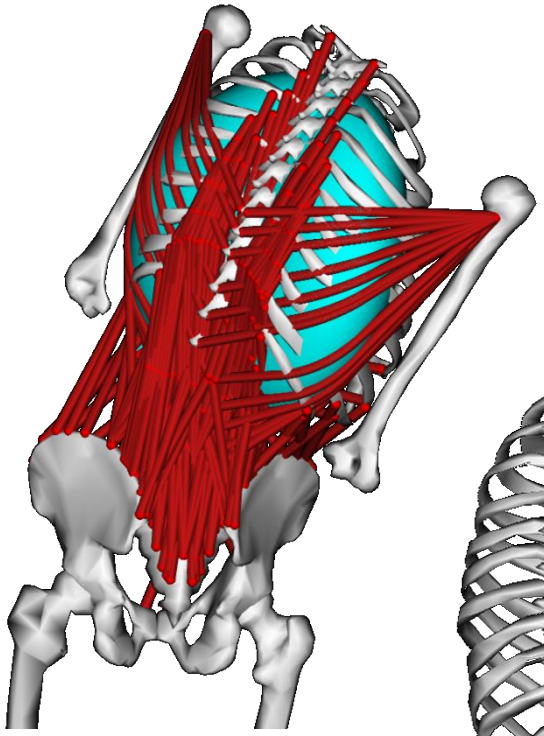
OpenSim is a repository of models



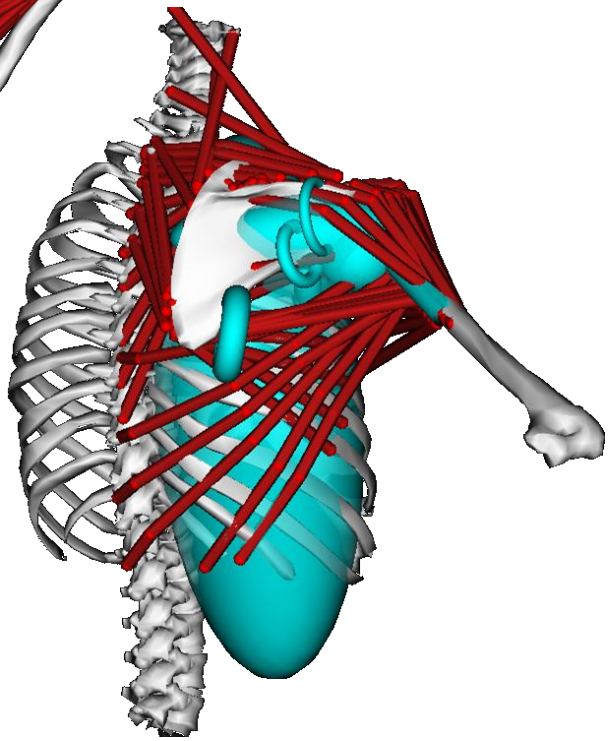
Lower-extremity:
Arnold et al, 2010



Running: Hamner et al, 2010



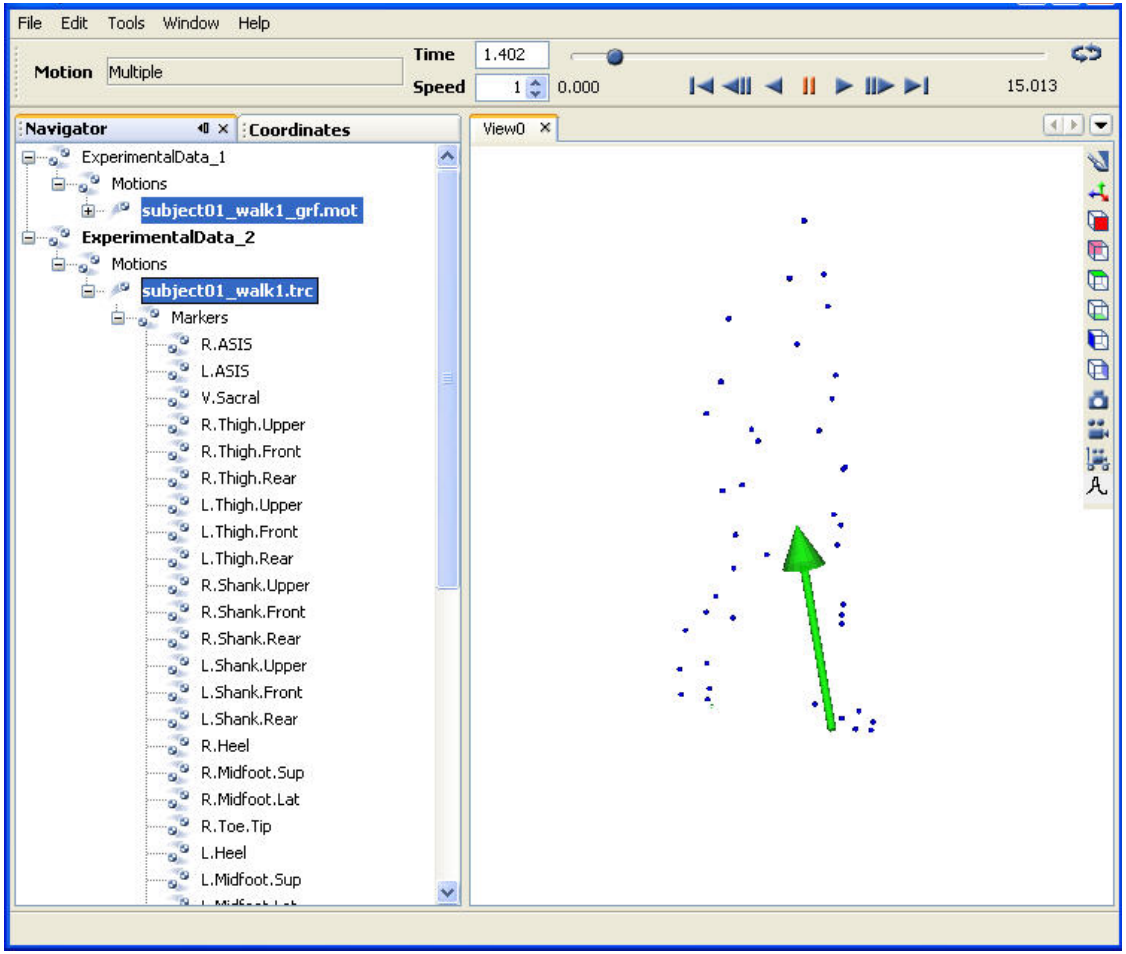
Lumbar-spine:
Christophy et al, 2011



Shoulder:
Matias et al, 2016

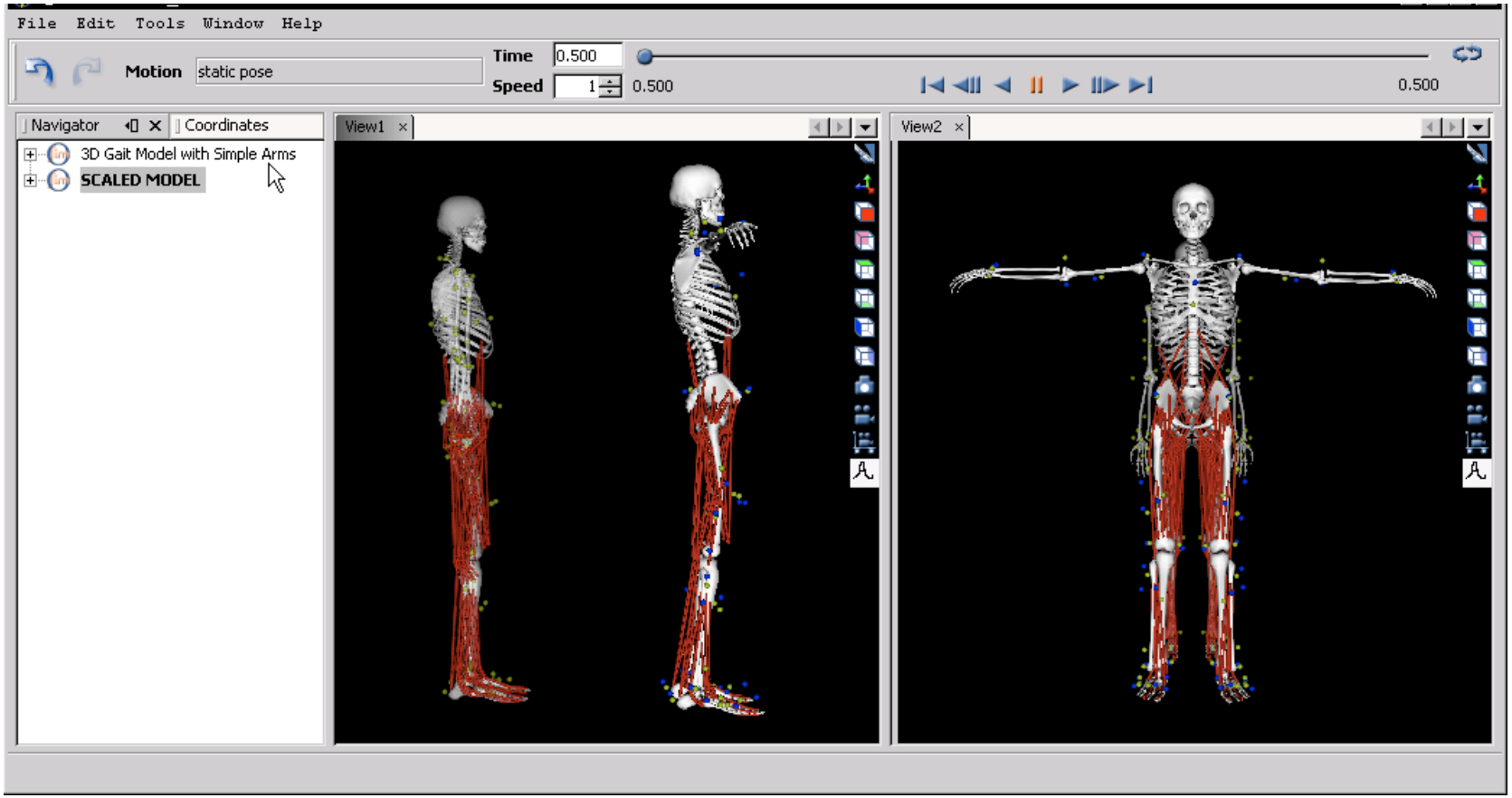
OpenSim is a set of tools

Importing and Previewing Motion Data



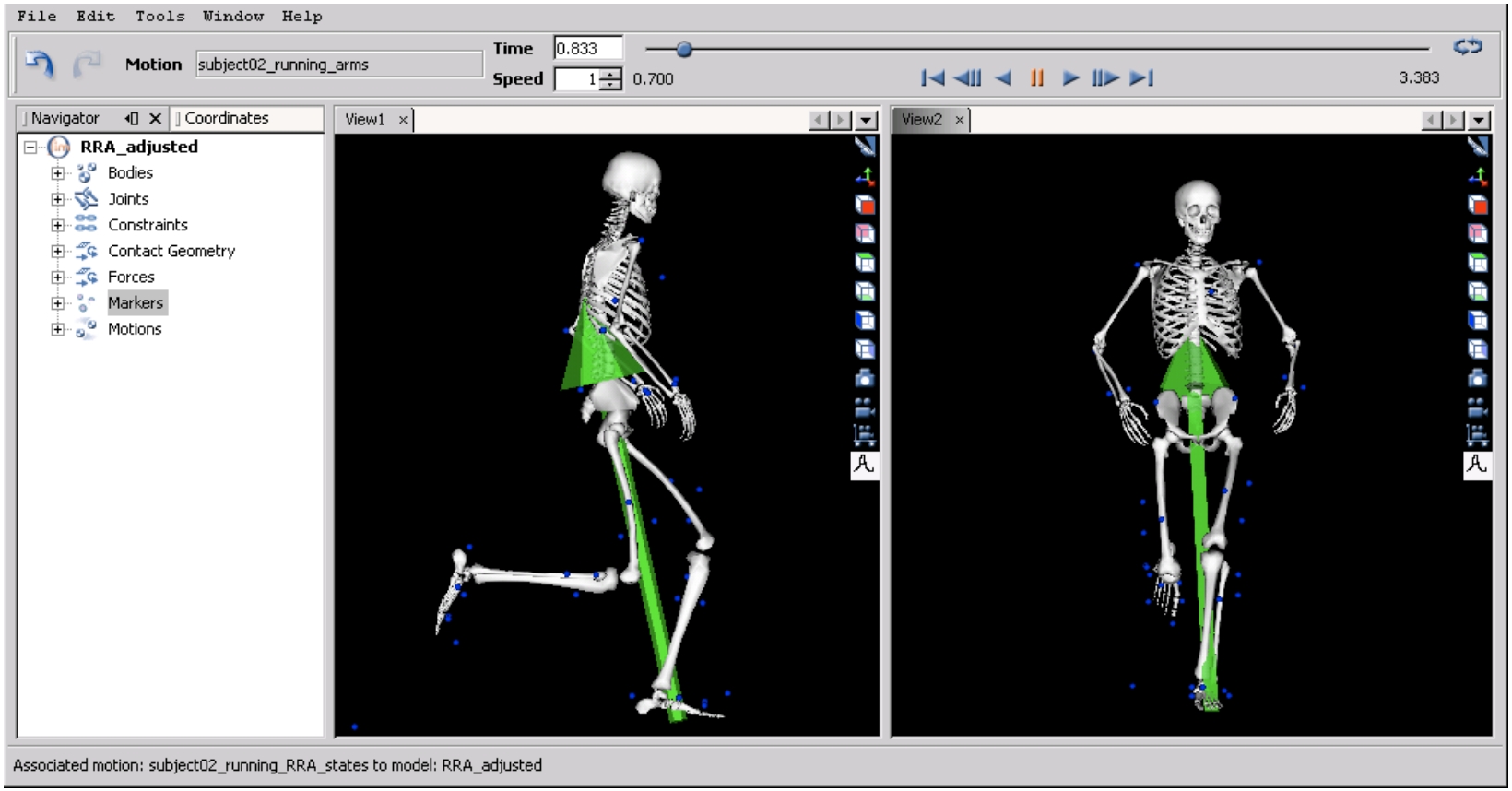
OpenSim is a set of tools

Scaling Musculoskeletal Models



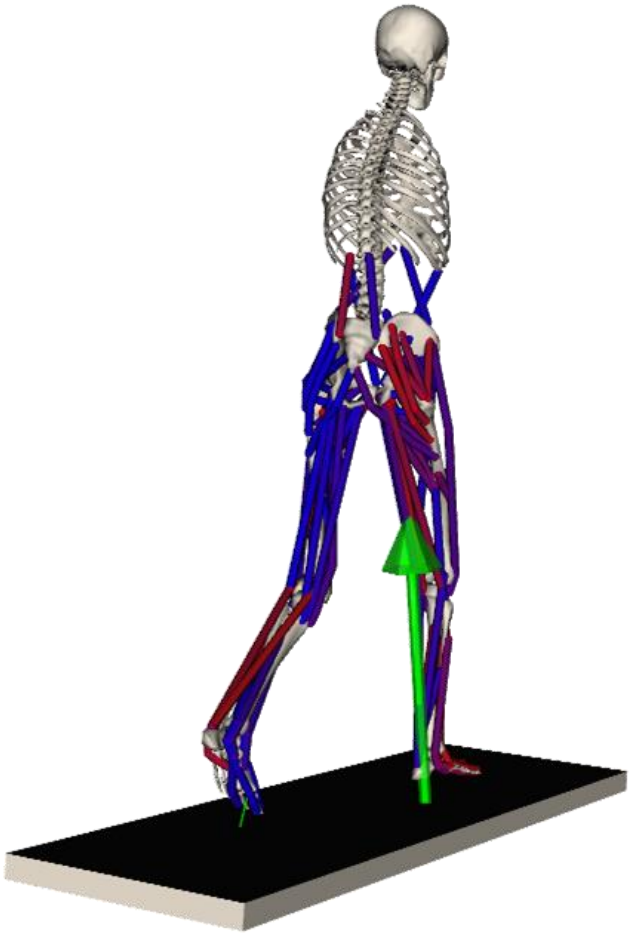
OpenSim is a set of tools

Inverse Kinematics and Inverse Dynamics



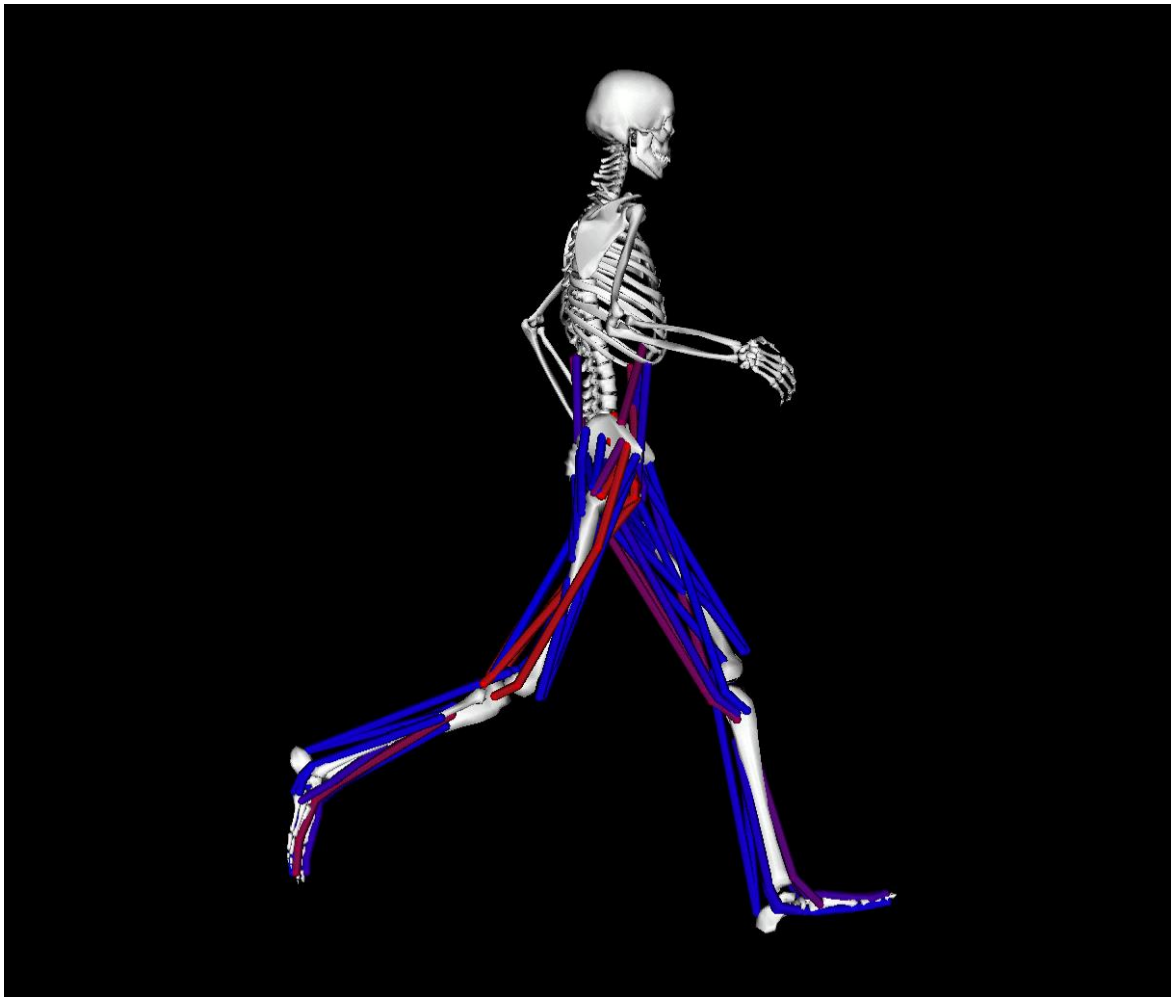
OpenSim is a set of tools

Estimation of Muscle Forces:
Static Optimization and Computed Muscle Control



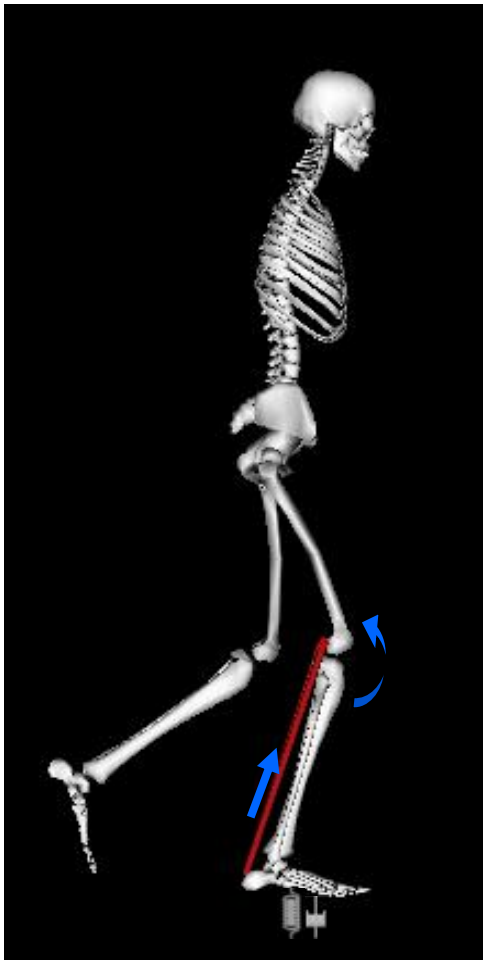
OpenSim is a set of tools

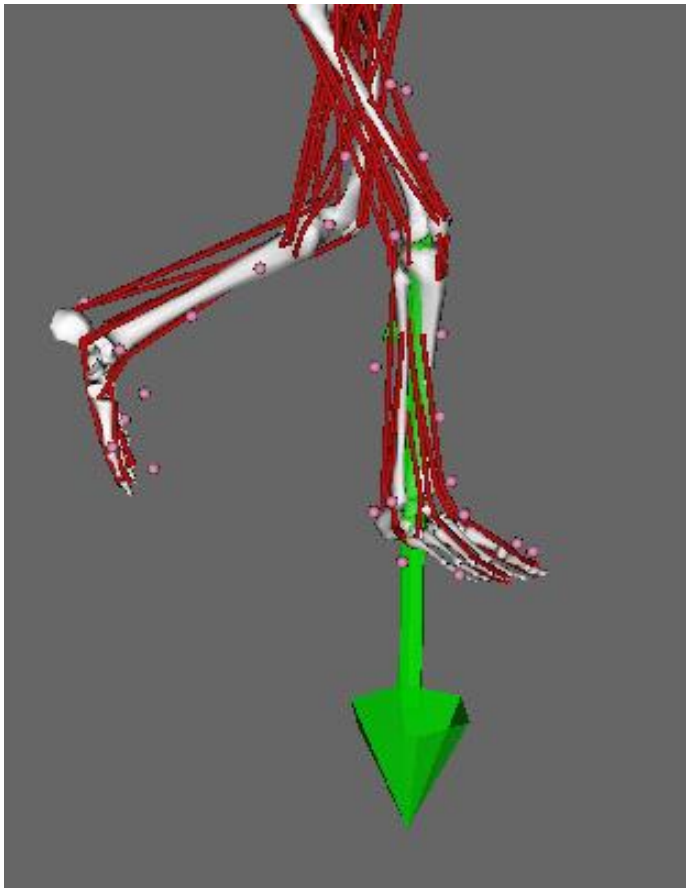
Forward Dynamics



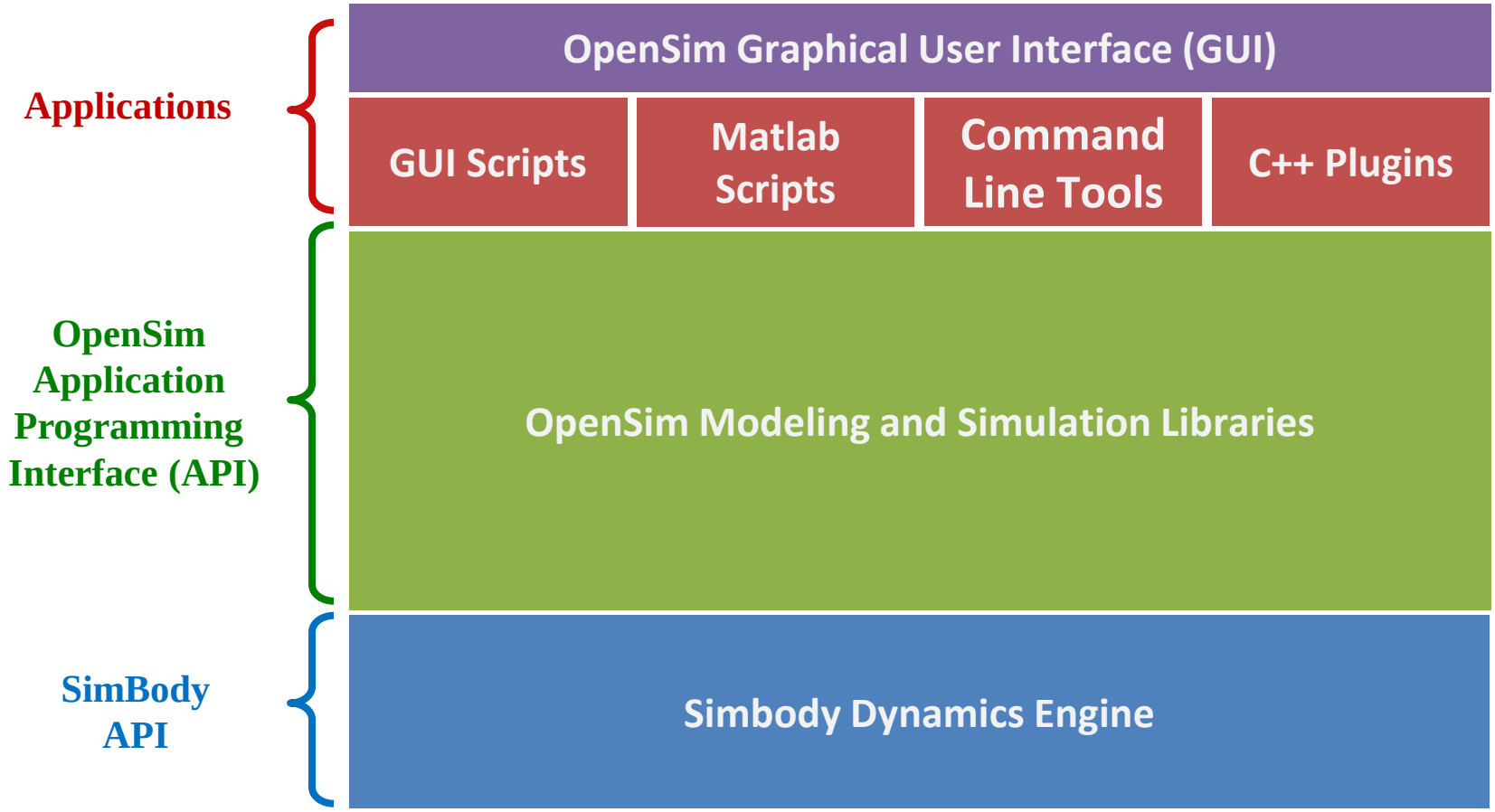
OpenSim is a set of tools

Analyses: Induced Accelerations and Joint Reactions





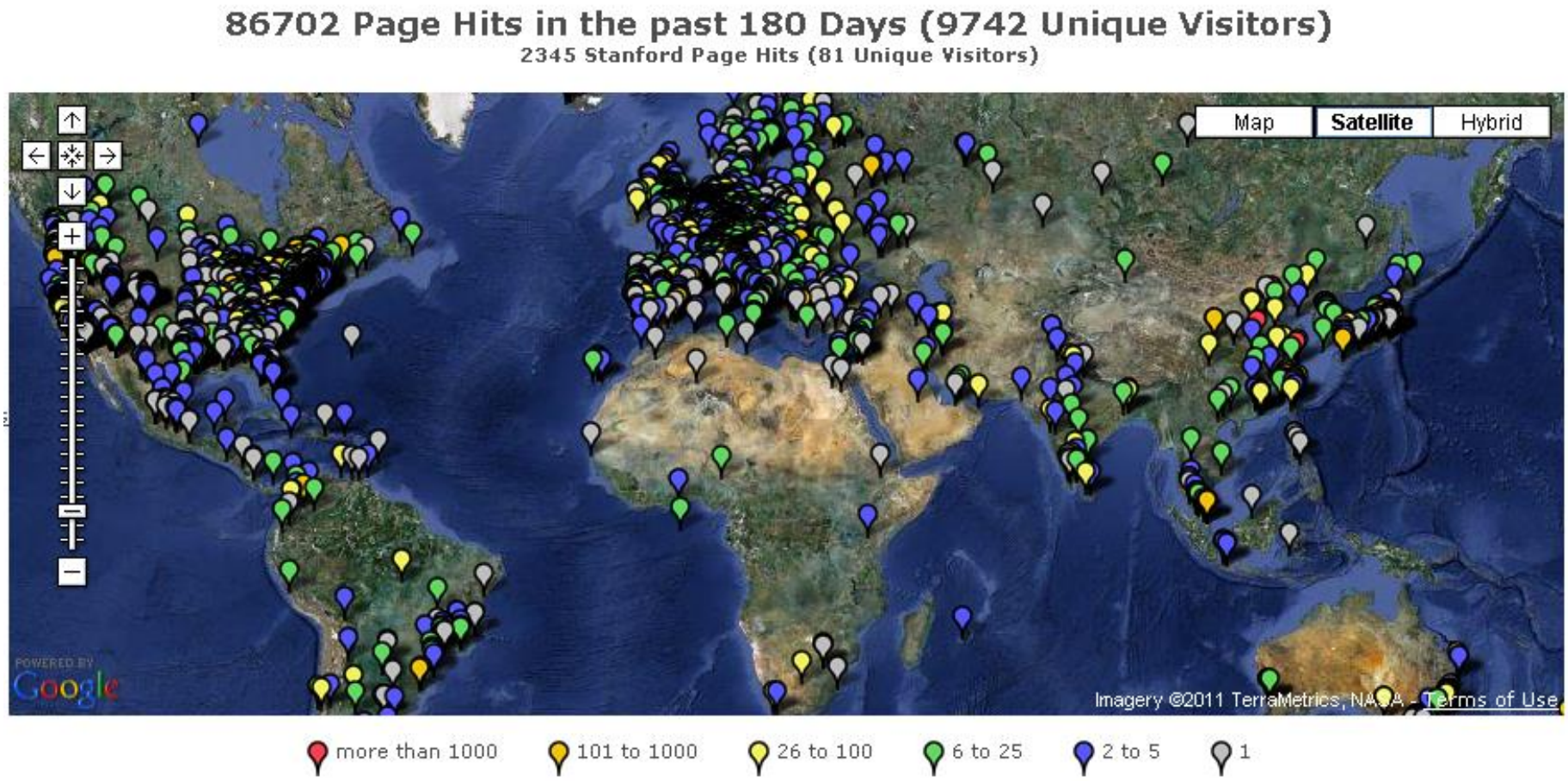
OpenSim is an extensible software framework



OpenSim is a resource

http://opensim.stanford.edu

OpenSim is a worldwide community



OpenSim is a team of contributors:


Scott Delp


Ayman Habib


Jennifer Hicks


Jeff Reinbolt


Ajay Seth


Michael Sherman


Edith Arnold


Matt DeMers


Sam Hamner


Chand John


Kat Steele


Melanie Fox


Peter Eastman


Clay Anderson


Allison Arnold


Eran Guendelman


May Liu


Peter Loan


Darryl Thelen


You!

Objectives for the Workshop

- Familiarize with the OpenSim software
- Gain more insight in the Opensim workflow using the provided motion capture data:
  - Learn how to pre-process the data
  - Learn how to prepare your models
  - Learn the underlying theory, best practices, and trouble shooting tips for scaling, inverse kinematics and muscle analysis through hands-on practice
- Have clear directions about where to look for help and resources if needed

The Workshop Software

- OpenSim 3.3

Getting the most out of the workshop:

- Feel free of interrupting me at any time with questions
- Help each other
- Consult the online resources
- Still need help? Online forum (simtk website)
- Be patient, have fun and take breaks!

How we hope you will respond:

- Continue to use OpenSim in your research
- Develop musculoskeletal models and simulations, and contribute them to the biomechanics community
- Use OpenSim in your teaching and contribute new teaching materials
- Add features to the software and share with others

Disclaimers

- This workshop materials and simulations have been developed for educational and training purposes, not to be used in research.

- Used data are from the Grand Challenge competition 5, you can find more data at https://simtk.org/projects/kneeloads

- Some material has been adapted from a previous workshop, held at GCMAS 2015. We acknowledge the authors of that original material, available at https://simtk-confluence.stanford.edu/display/OpenSim/GCMAS+Tutorial+2015

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Faculty introduction

Sofamea

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INSTITUT de BIOMÉCANIQUE HUMAINE GEORGES CHARPAK

ARTS ET MÉTIERS ParisTech

Luca Modenese

Research Fellow
Imperial College/University of Sheffield

2013: PhD in Biomechanics (Imperial College London)
2013: Visiting Scholar Stanford University
2013-2017 PostDoc at Griffith University and Sheffield University
2017 Imperial College Research Fellow

Research Interest:
Musculoskeletal models of the lower limb for clinical applications.

Applications relate to:
Cerebral palsy, juvenile idiopathic arthritis, knee osteoarthritis.

Goal is to:
Improve clinical practice through pathology identification, discrimination and outcome prediction.

Clément Favier

PhD student
Imperial College London

2014: Diplôme d'Ingénieur Mécanique (Polytech Montpellier)
2015: MSc Biomedical Engineering (ENSAM Paris)
2015-2017: PhD at Imperial College London

Research Interest:
Musculoskeletal and finite elements modelling of the spine.

Applications relate to:
Lower back pain treatments, study of balance recovery.

Goal is to:
Understand how different activities can influence the loadings applied to the structures of the spine and lead to back pain.

Florent Moissenet

Ingénieur en biomécanique (PhD)

Centre National de Rééducation Fonctionnelle et de Réadaptation - Rehazenter, Luxembourg

2008: Diplôme d'Ingénieur Mécanique (IFMA, Clermont-Ferrand)
2011: PhD in Biomechanics (LBMC, Université Lyon 1)
2011-current: Research and clinical supervision of the Rehazenter's gait lab

Research Interest:
Musculoskeletal models of the lower limb for clinical applications

Applications relate to:
Stroke, Cerebral palsy

Goal is to:
Better identify the contribution of each clinical impairment to gait abnormalities