

Agenda

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|----------------------|---|
| 14:00 – 14:15 | Welcome and goals of workshop
– <i>Jen Hicks</i> |
| 14:15 – 14:35 | Inverse dynamics and static optimization: how it works, exercises, & practice
– <i>Jeff Reinbolt</i> |
| 14:35 – 15:00 | Guided analyses and exploration on your own
– <i>Jeff Reinbolt & You</i> |
| 15:00 – 15:20 | Forward dynamics simulation: how it works, exercises, & practice
– <i>Jeff Reinbolt</i> |
| 15:20 – 15:45 | Guided simulation and exploration on your own
– <i>Jeff Reinbolt & You</i> |
| 15:45 – 16:05 | Interfacing OpenSim models with MATLAB/Simulink
– <i>Jeff Reinbolt</i> |
| 16:05 – 16:55 | Guided control system design and exploration on your own
– <i>Jeff Reinbolt & You</i> |
| 16:55 – 17:00 | Closing remarks
– <i>Jen Hicks</i> |

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<https://simtk.org/home/opensim>

<http://opensim.stanford.edu>

Purpose of modeling and simulation

Visualize
complex
movement
patterns

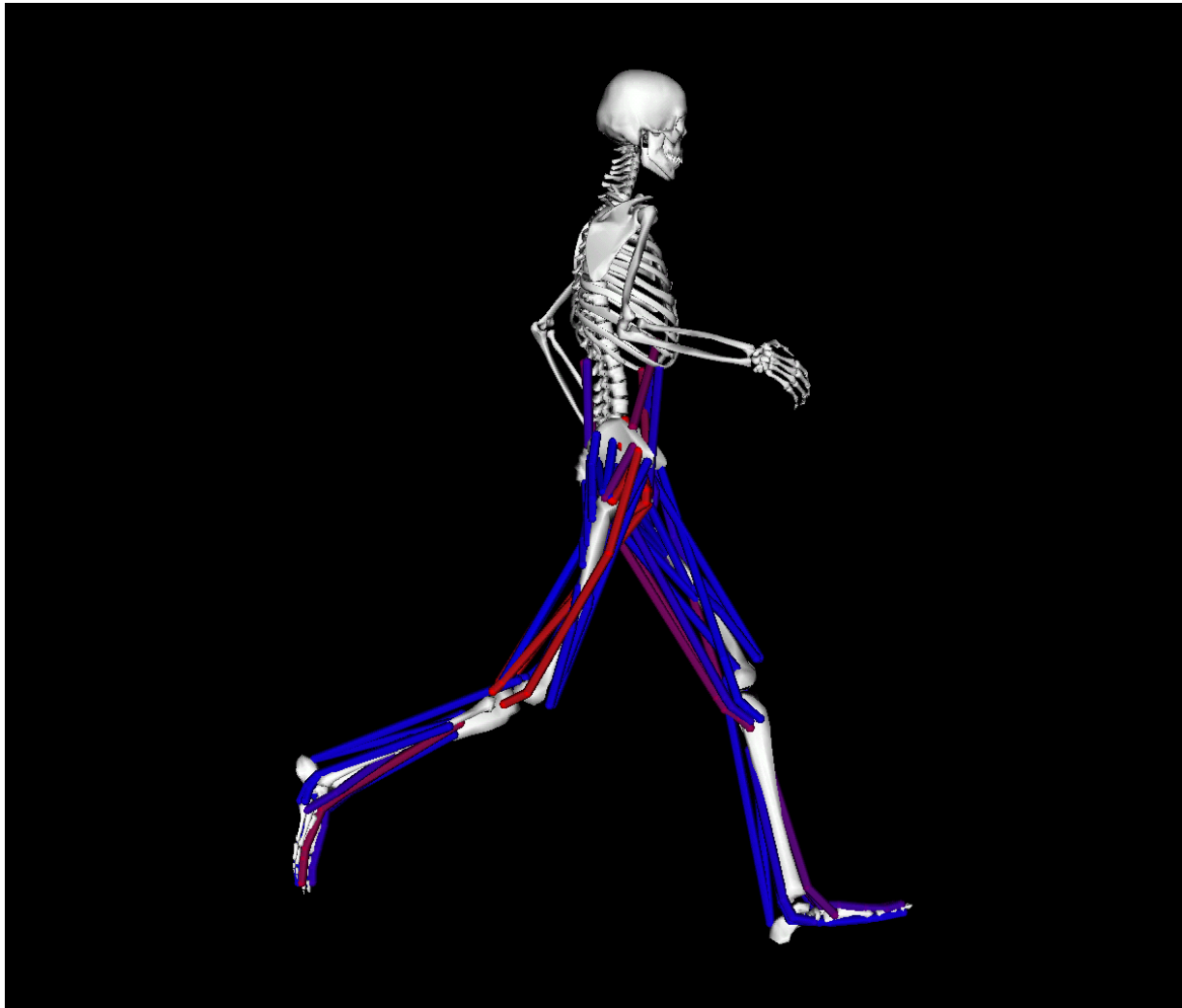
Probe
parameters
that
are difficult
to measure



Perform
“what if”
studies

Identify
cause-effect
relationships

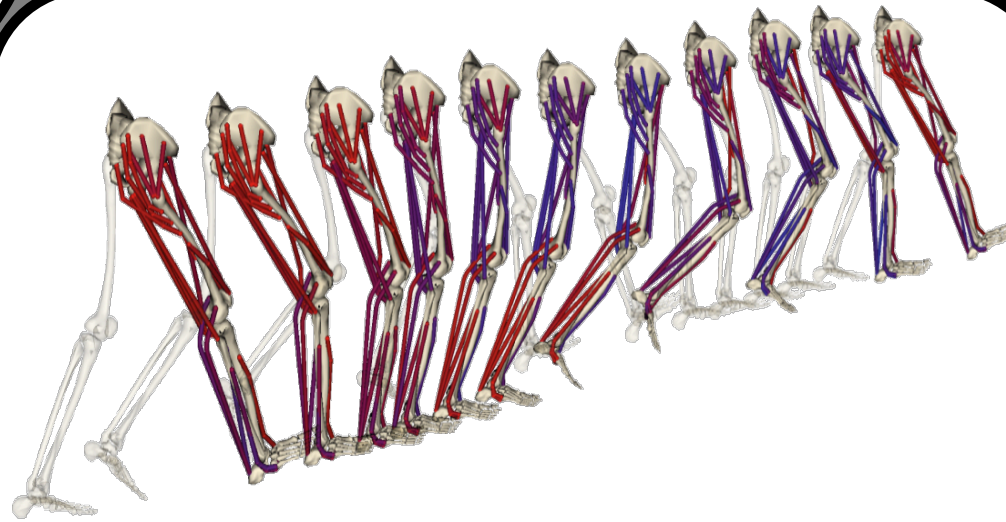
Visualize human running in detail



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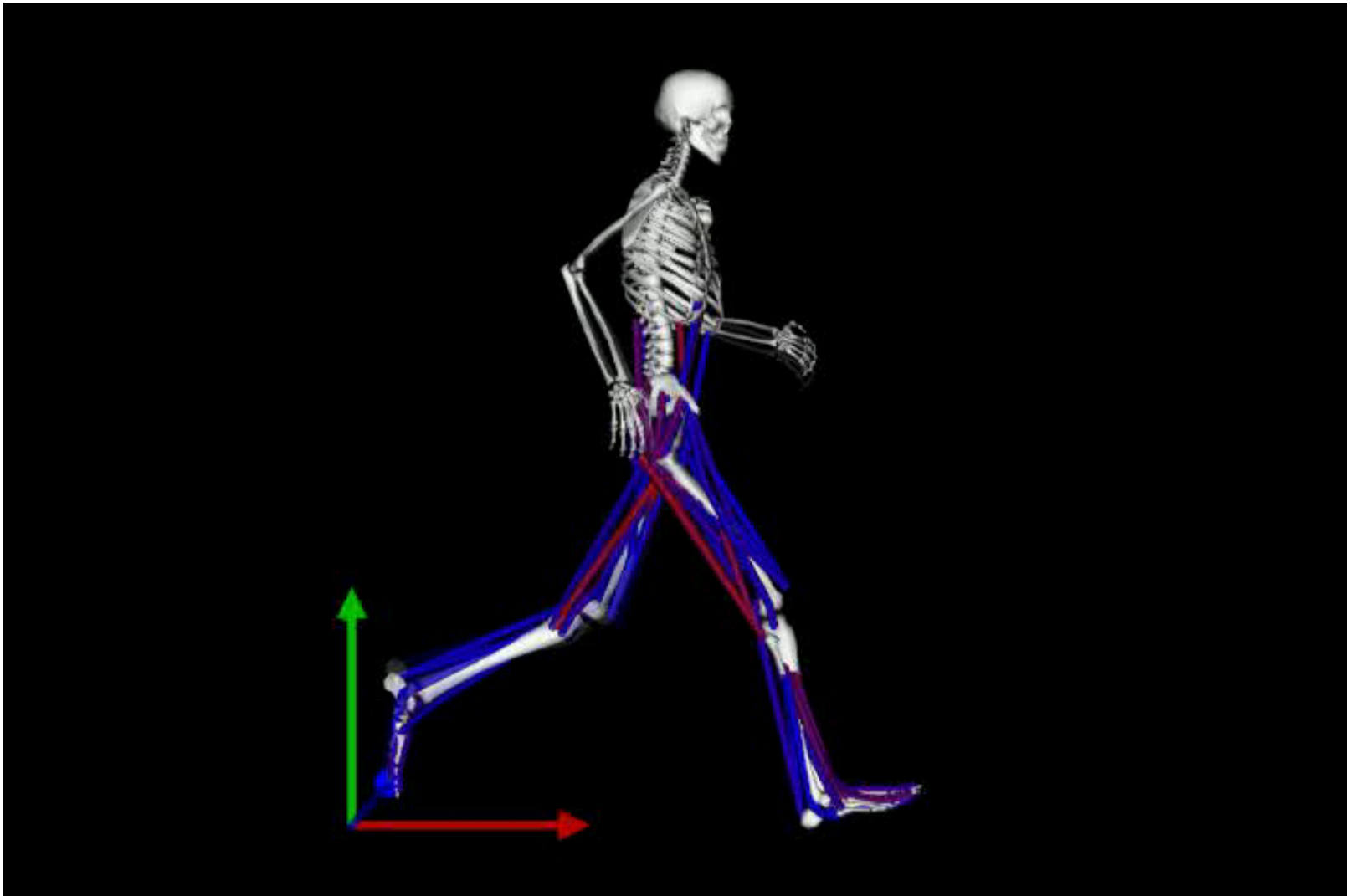
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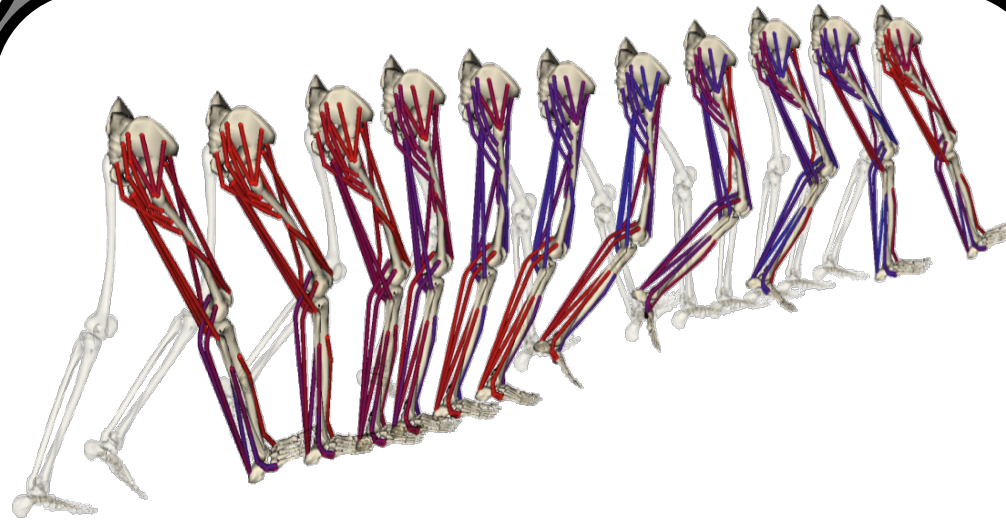
Probe the function of a muscle



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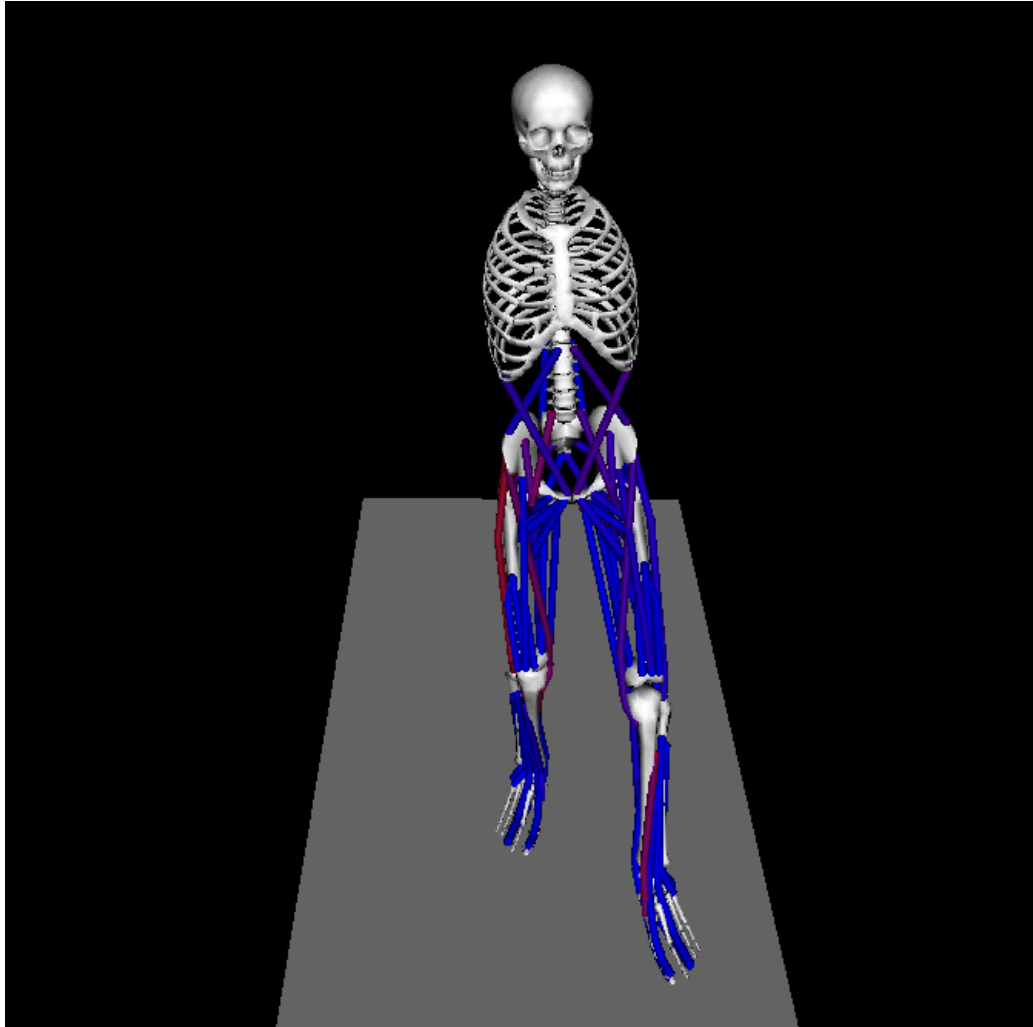
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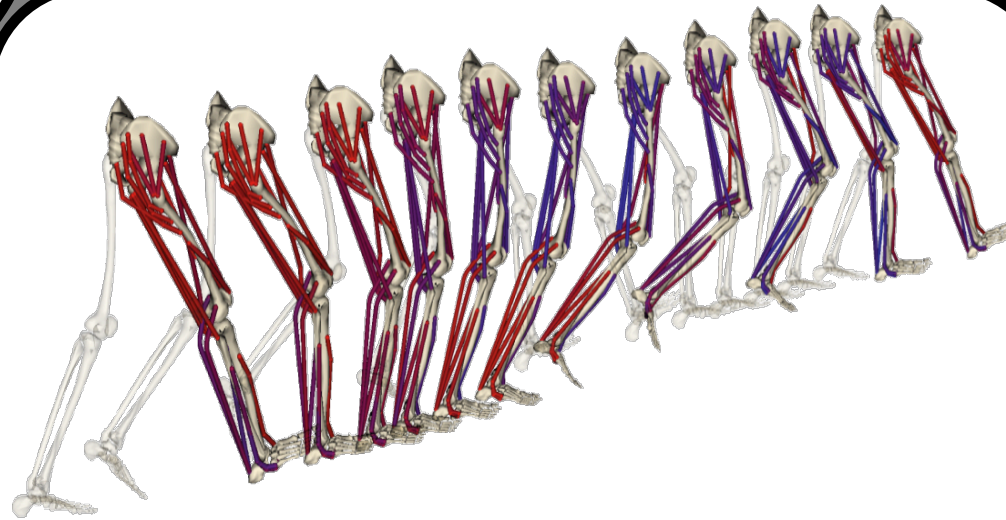
Examine causes of crouch gait



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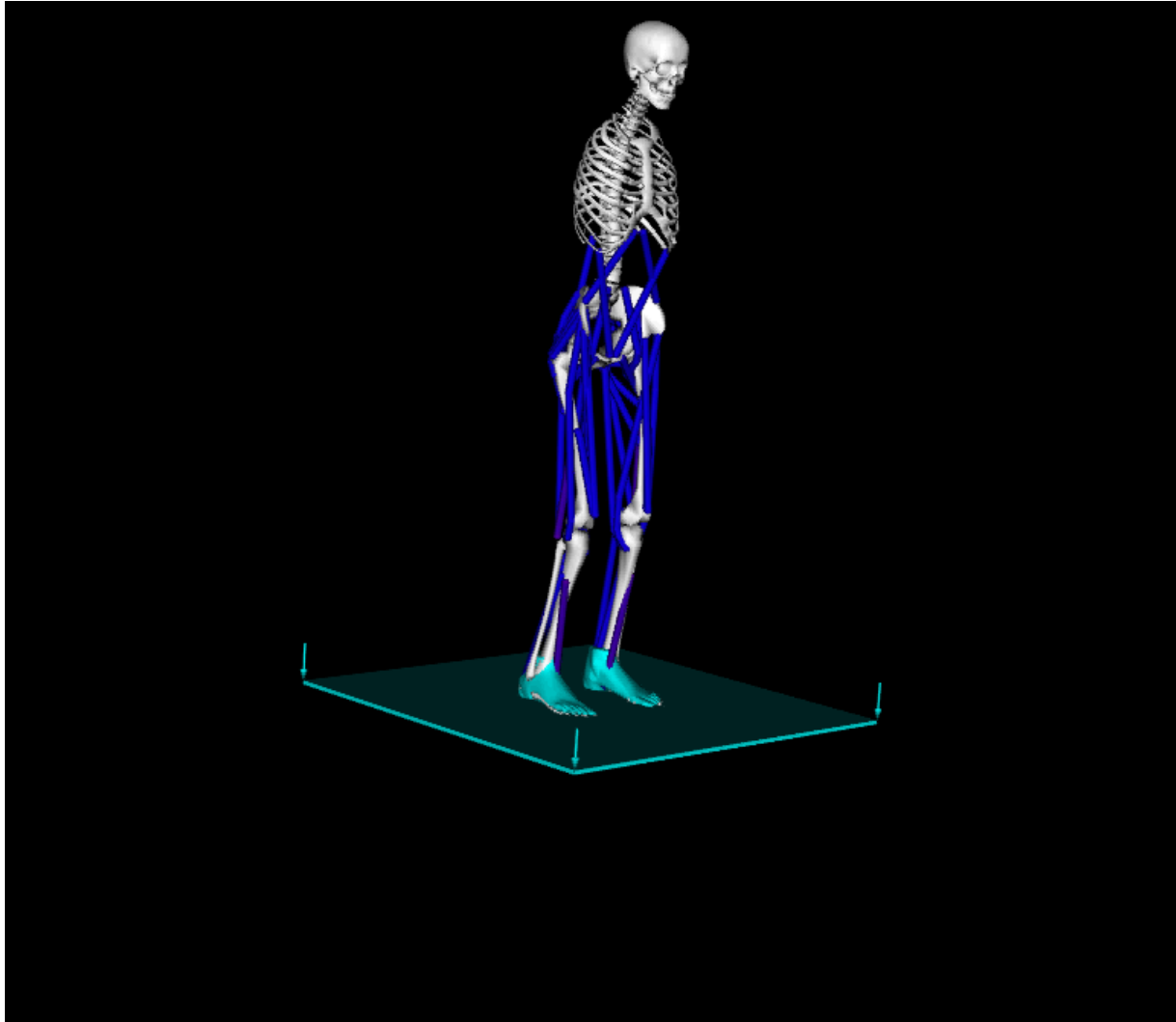
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What happens if the floor drops?



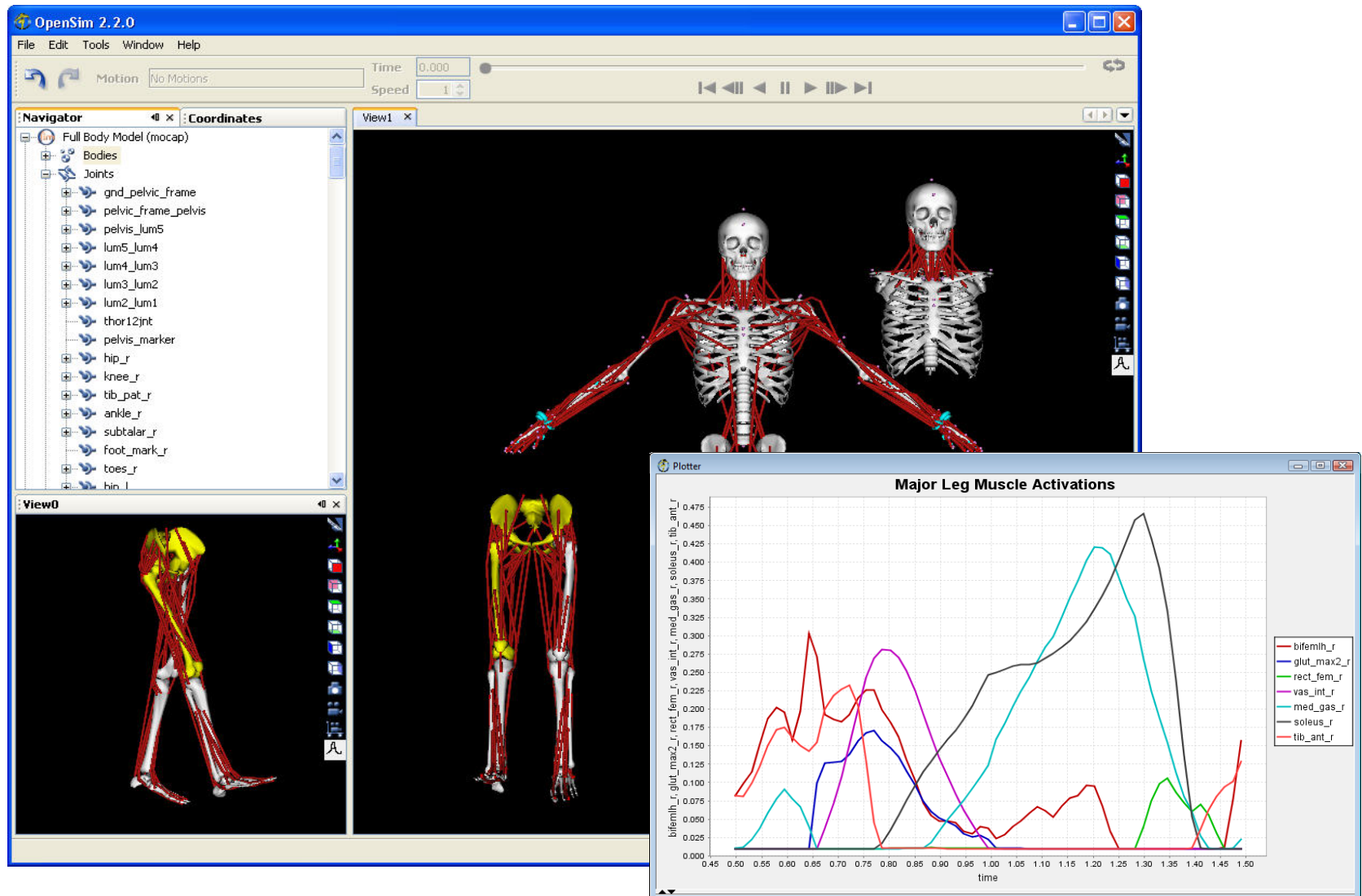
Problems with current paradigm

- 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

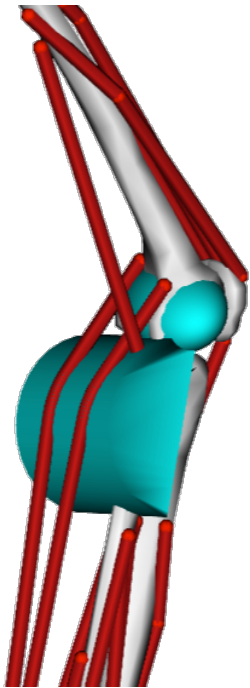
What does OpenSim provide?

- 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

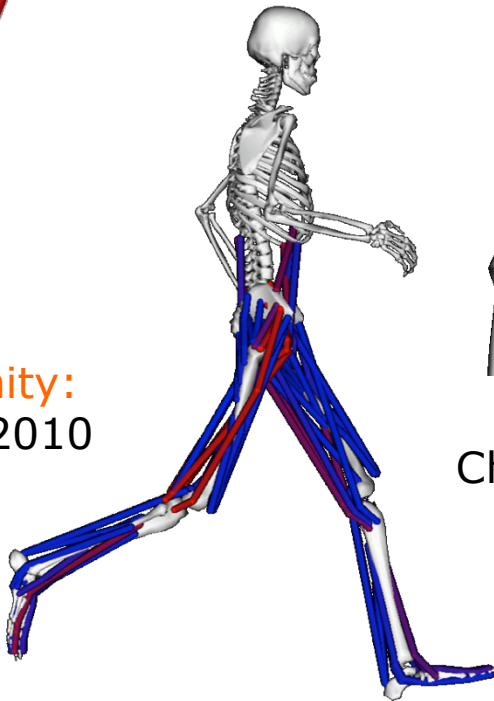
OpenSim is an application



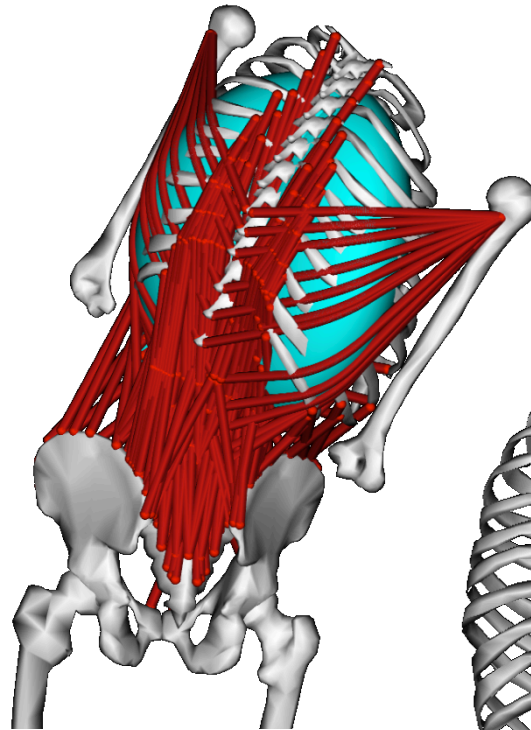
OpenSim is a repository of models, data, & tools



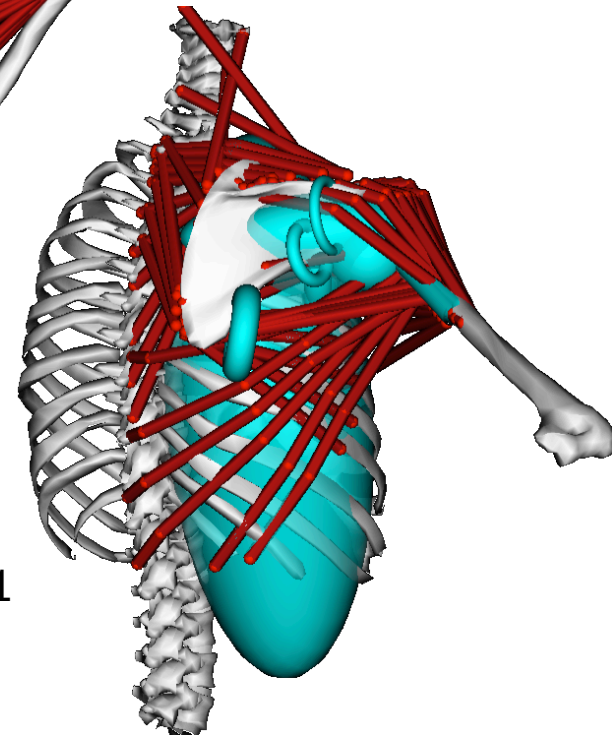
Lower-extremity:
Arnold et al, 2010



Running: Hamner et al, 2010



Lumbar-spine:
Christophy et al, 2011



Shoulder:
Matias et al, in prep.

OpenSim is a repository of models, data, & tools



Objectives for the Workshop

- Discuss the need for simulations to understand the complex neuromusculoskeletal system
- Perform inverse dynamics to determine joint torques from joint motion
- Perform forward dynamics to determine joint motion from muscle excitations
- Edit muscle excitations in a forward dynamics simulation to understand muscle actions
- Interface OpenSim models with MATLAB/Simulink to create closed-loop control systems

Getting the most out of the workshop:

- Work in groups and help each other
- Use your resources: lectures, handout, and online materials
- Ask questions
- Have fun and take breaks

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