Title: I downloaded *OpenSim* – NOW WHAT?

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Additional Mentors: Student members of GCMAS who are skilled users of *OpenSim* will be recruited to assist participants during the hands-on portion of the course.

Purpose:

OpenSim (http://opensim.stanford.edu/) is a freely-available software package for visualizing musculoskeletal structures and generating computer simulations of walking and other movements. This practical, hands-on tutorial will introduce participants to *OpenSim's* features, file formats, and documentation using clinically-relevant examples.

Intended Audience:

The tutorial is designed for GCMAS attendees (scientists, clinicians, and students) who are curious about the capabilities of *OpenSim*, but who have not previously used the software.

Prerequisite Knowledge:

Participants will be asked to bring (or share with a colleague) a laptop PC with a mouse and with *OpenSim* and *Notepad++* installed. Instructions for installing and getting started with these programs (both freely available) will be emailed to participants prior to the tutorial. To complete the hands-on exercises, participants must be comfortable navigating to files and managing multiple windows on their laptops. Participants will work in small teams at their own pace (guided by instructors), so exercises will be accessible to participants with varying backgrounds.

Abstract:

Computer simulation has emerged as a powerful method to investigate the actions of muscles during movement, to identify factors that contribute to movement disorders, and to evaluate the consequences of possible treatments. *OpenSim* (http://opensim.stanford.edu/) is freely-available software for developing and analyzing such simulations. Given measured external reaction forces and motion capture data, *OpenSim* allows users to visualize models of the musculoskeletal system, estimate internal forces, run analyses, and plot results. Since *OpenSim* was first released in 2007, the number of worldwide users has grown dramatically (> 60,000 unique downloads). What features of *OpenSim* explain its popularity? Would *OpenSim* be useful in my lab? What are some good ways to get started? This practical, hands-on tutorial will help answer such questions. Participants will be introduced to *OpenSim's* features, file formats, and documentation using clinically-relevant examples.

Learning Objectives:

1. Identify components of a musculoskeletal model in *OpenSim* and in the model's XML file.
2. Load a model in *OpenSim* and animate it using measured joint angles and/or marker trajectories.
3. Use an *OpenSim* model to examine whether muscle force- or moment-generating capacity changes substantially following a simulated surgery.
4. Describe the steps needed to process motion capture and GRF data for input into *OpenSim*.
5. List three limitations of existing *OpenSim* tools and three features to watch for in upcoming releases.
6. Locate *OpenSim* online resources, documentation and examples for further exploration.

Content:		*Minutes*
I.	Overview and Objectives – What is *OpenSim* and what can the software do? – What will this tutorial cover?	10
II.	Components of a Musculoskeletal Model *(hands on)* – How are models loaded, viewed, and edited in the *OpenSim* GUI? – How are bodies, joints, and muscles defined in an *OpenSim* XML file?	10
III.	Animating and Plotting *(hands on)* – How do I animate a model based on measured joint angles? – How do I take snapshots and save movies? – How do I plot useful data?	10
IV.	Scaling and Inverse Kinematics – How do I scale and animate a model based on marker trajectories?	15
	BREAK	10
V.	Guided Exploration *(hands on):* – In small teams, participants will use *OpenSim* to analyze the biomechanical consequences of a simulated tendon transfer surgery. Sample exercises, involving models of both the upper and lower extremity, will be provided.	45
VI.	Processing Experimental Data – What's involved in converting my own experimental data into the file formats used by *OpenSim*?	10
VII.	Limitations, New Developments, and Next Steps	10