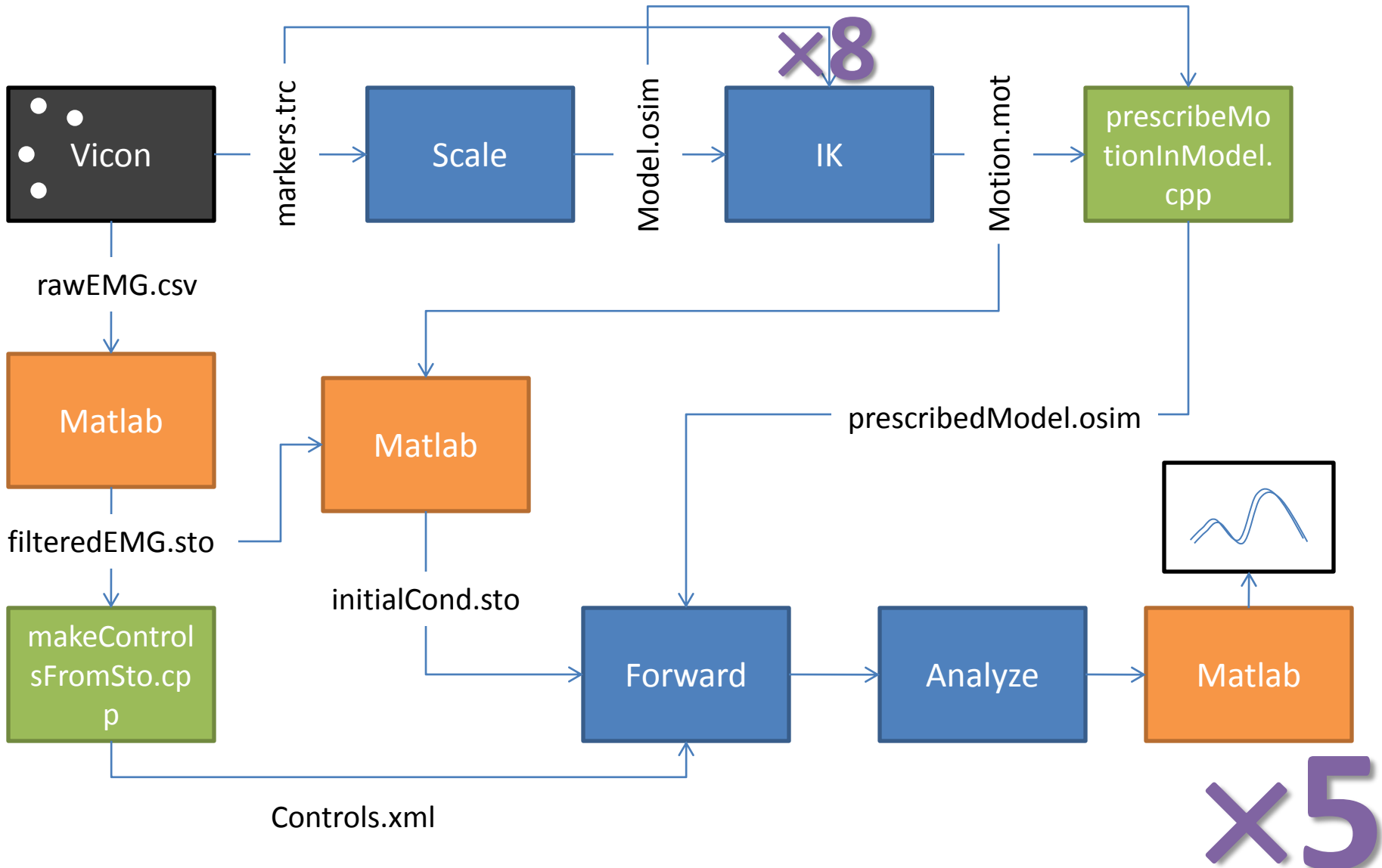




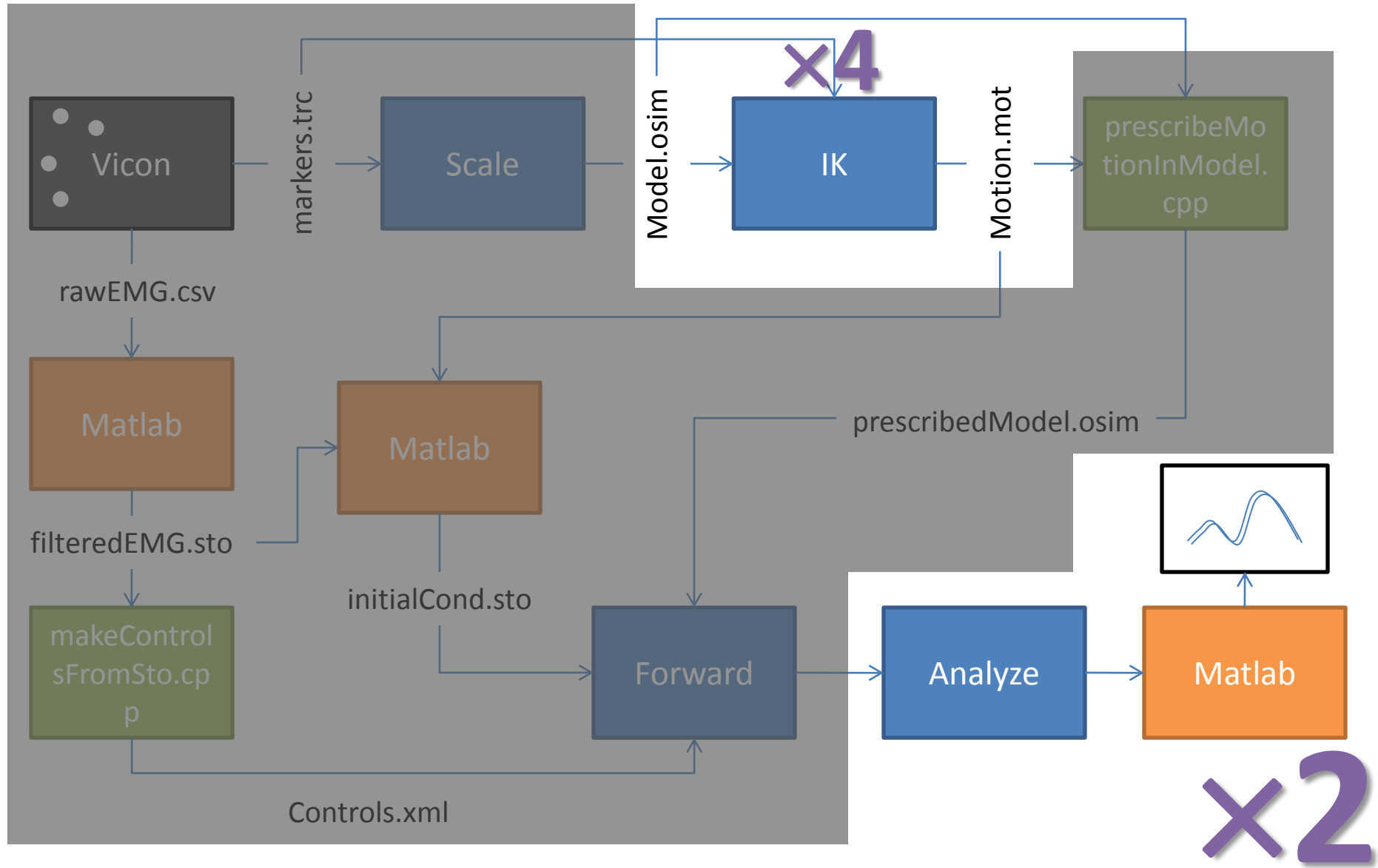
# Modeling and Simulation in Bulk

OpenSim Advanced Users Workshop  
August 16, 2011

# My Motivation



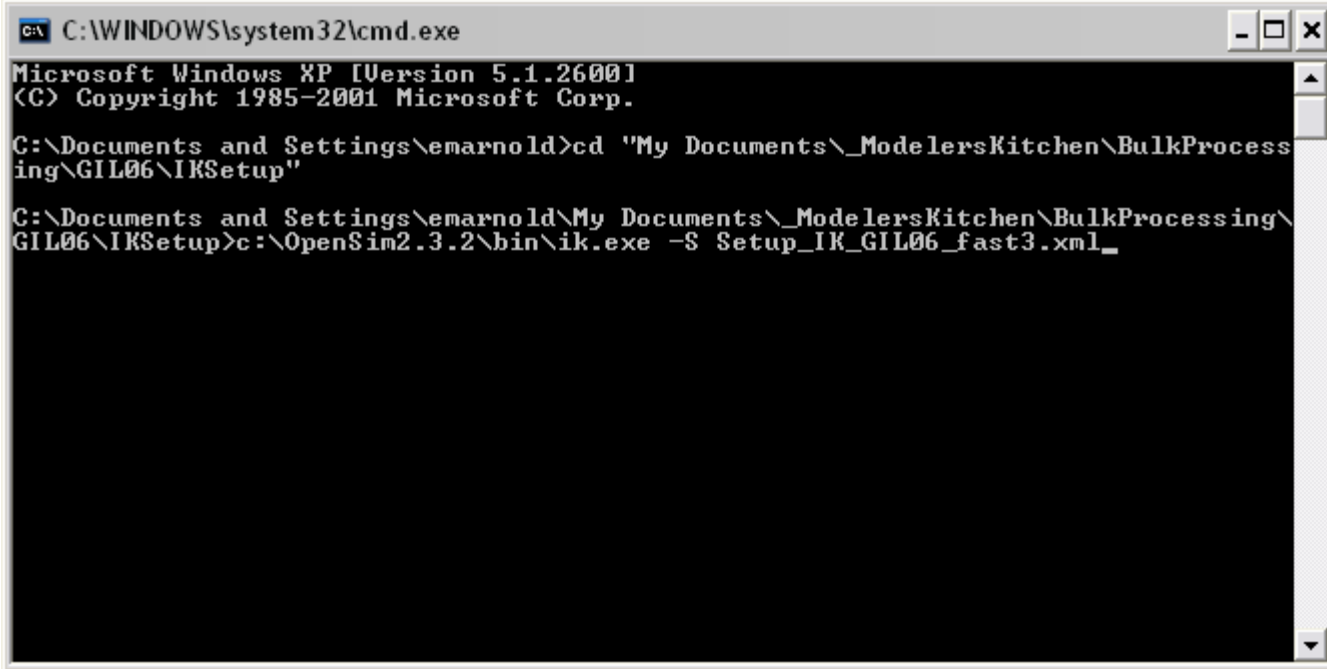
# Today's Example



# You will need

- Matlab
- BatchOpenSimInMatlab.zip
  - Workshop Project Page

# Tools in the Command Line



```
C:\WINDOWS\system32\cmd.exe
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\emarnold>cd "My Documents\_ModelersKitchen\BulkProcessing\GIL06\IKSetup"

C:\Documents and Settings\emarnold\My Documents\_ModelersKitchen\BulkProcessing\GIL06\IKSetup>c:\OpenSim2.3.2\bin\ik.exe -S Setup_IK_GIL06_fast3.xml_
```

C:\OpenSim2.3.2\bin\ik.exe -S Setup\_File.xml

Path to OpenSim tool you  
want to use  
(ik.exe, analyze.exe, etc)

-S for setup

Setup File Name

# Output

```
C:\WINDOWS\system32\cmd.exe
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\emarnold>cd "My Documents\_ModelersKitchen\BulkProcessing\GIL06\IKSetup"

C:\Documents and Settings\emarnold\My Documents\_ModelersKitchen\BulkProcessing\GIL06\IKSetup>c:\OpenSim2.3.2\bin\ik.exe -S Setup_IK_GIL06_fast3.xml

This program includes software developed by the
Apache Software Foundation (http://www.apache.org/).

-----
Constructing tool from setup file Setup_IK_GIL06_fast3.xml.

Loaded model GIL06 from file ../GIL06_gait2392_simbody_v23.osim
  MODEL: GIL06
  forces: 92
  analyses: 0
  bodies: 13
  joints: 12
  markers: 39
Running tool GIL06_fast3.
Loaded marker file C:\Documents and Settings\emarnold\My Documents\_ModelersKitchen\BulkProcessing\GIL06\MarkerData\GIL06_fast3.trc (37 markers, 114 frames)
Frame 1 (t=0.125003): total squared error = 0.0223747, marker error: RMS=0.0245911, max=0.0602543 (toe_r)
Frame 2 (t=0.133337): total squared error = 0.0227277, marker error: RMS=0.0247843, max=0.0582712 (toe_r)
...
Frame 111 (t=1.04167): total squared error = 0.0299058, marker error: RMS=0.02843, max=0.0641389 (thighwand_r)
Frame 112 (t=1.05): total squared error = 0.0221762, marker error: RMS=0.0244818, max=0.0614205 (thighwand_r)
InverseKinematicsTool: 112 frames in 4.047s

IK compute time = 5063ms

C:\Documents and Settings\emarnold\My Documents\_ModelersKitchen\BulkProcessing\GIL06\IKSetup>
```



captured in  
out.log

# Moving to Matlab

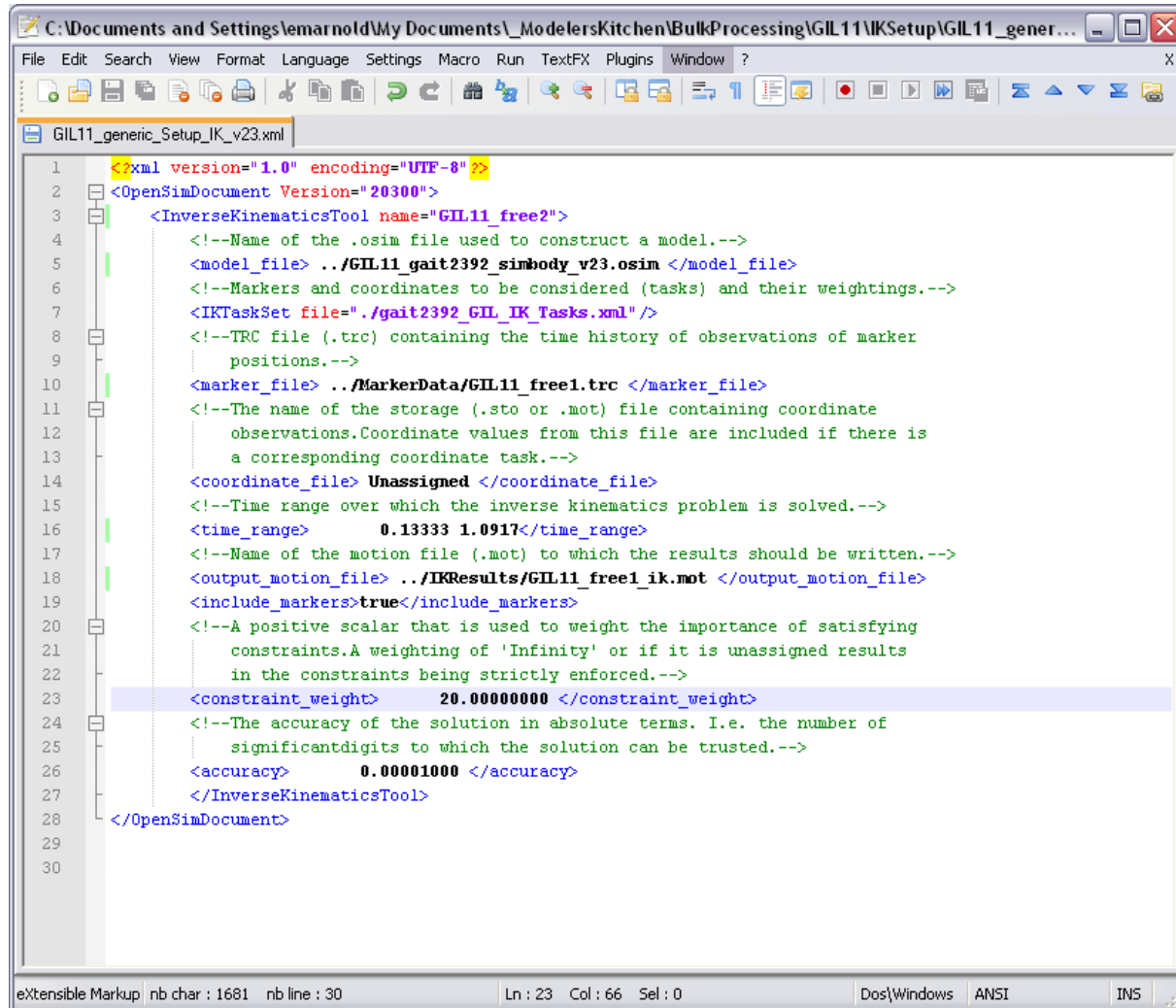
% write a string to send to the command line

```
Command = 'c:/OpenSim2.3.2/bin/ik.exe -S  
Setup_File.xml';
```

% send it to the command line

```
system(Command);
```

# Setup Files in Matlab



```
C:\Documents and Settings\lemarnold\My Documents\ModelersKitchen\BulkProcessing\GIL11\IKSetup\GIL11_gener...
File Edit Search View Format Language Settings Macro Run TextFX Plugins Window ?
GIL11_generic_Setup_IK_v23.xml
1 <?xml version="1.0" encoding="UTF-8" ?>
2 <OpenSimDocument Version="20300">
3   <InverseKinematicsTool name="GIL11_free2">
4     <!--Name of the .osim file used to construct a model.-->
5     <model_file> ../GIL11_gait2392_simbody_v23.osim </model_file>
6     <!--Markers and coordinates to be considered (tasks) and their weightings.-->
7     <IKTaskSet file="./gait2392_GIL_IK_Tasks.xml" />
8     <!--TRC file (.trc) containing the time history of observations of marker
9     positions.-->
10    <marker_file> ../MarkerData/GIL11_free1.trc </marker_file>
11    <!--The name of the storage (.sto or .mot) file containing coordinate
12    observations.Coordinate values from this file are included if there is
13    a corresponding coordinate task.-->
14    <coordinate_file> Unassigned </coordinate_file>
15    <!--Time range over which the inverse kinematics problem is solved.-->
16    <time_range> 0.13333 1.0917</time_range>
17    <!--Name of the motion file (.mot) to which the results should be written.-->
18    <output_motion_file> ../IKResults/GIL11_free1_ik.mot </output_motion_file>
19    <include_markers>true</include_markers>
20    <!--A positive scalar that is used to weight the importance of satisfying
21    constraints.A weighting of 'Infinity' or if it is unassigned results
22    in the constraints being strictly enforced.-->
23    <constraint_weight> 20.00000000 </constraint_weight>
24    <!--The accuracy of the solution in absolute terms, I.e. the number of
25    significantdigits to which the solution can be trusted.-->
26    <accuracy> 0.00001000 </accuracy>
27  </InverseKinematicsTool>
28 </OpenSimDocument>
29
30
eXtensible Markup nb char : 1681 nb line : 30 Ln: 23 Col: 66 Sel: 0 Dos\Windows ANSI INS
```

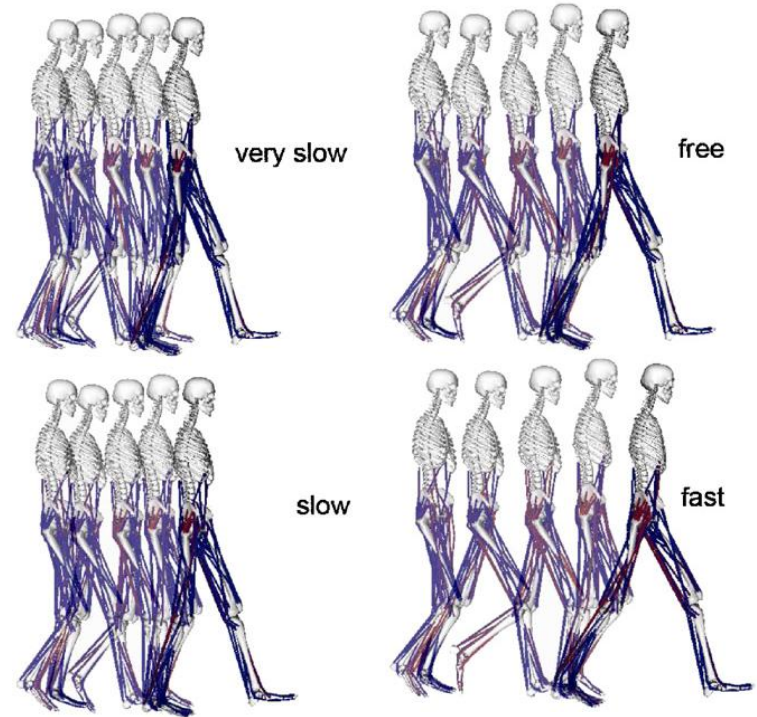


# Setup Files in Matlab

- `xmlread`
  - Parse an xml file and turn it into a document object model
- Get and Set to interact with attributes
  - `getElementsByTagName`
  - `getFirstChild`
  - `setNodeValue`
  - `getAttributes`
- `xmlwrite`
  - Write object back out to an xml file

# Batch Example

- 2 Subjects
- 4 Gait Speeds
  - xslow, slow, free, fast
- Inverse Kinematics
- Muscle Analysis
- Plot results



Liu, M.Q., Anderson, F.C., Schwartz, M.H. and Delp, S.L., Muscle contributions to support and progression over a range of walking speeds, *Journal of Biomechanics*, Nov 2008, 41(15):3243-3252.(2008)

# Tips

- Give gait trials meaningful, consistent names during data collection.
  - ex. Run\_200\_02.trc not trial1.trc
- Avoid spaces in file and folder names
- Adopt regular folder structure for all subjects
- Use values and text from inputfiles rather than hard coding in matlab
- Verify input/output file conventions when moving between versions
- Use sendmail to automate updates

# Following up...



The screenshot shows a web browser window with the address bar displaying <https://simtk.org/home/modelerskitchen>. The page features a navigation menu with links for Home, About Simtk.org, and How to Contribute. A search bar is present, and the user is logged in as Edith Arnold. The main content area is titled 'The Musculoskeletal Modeler's Kitchen Project Overview'. It includes a sidebar with navigation links such as Overview, Team, Downloads, Documents, Wiki, Publications, and Advanced. The main text describes the project's focus on making musculoskeletal models and simulations, using a metaphor of cooking. A photograph of a burnt pizza is included. The page also lists project leads, related projects, and a section for sharing tips and feedback.

**Simtk.org: The Musculoskeletal**

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## The Musculoskeletal Modeler's Kitchen Project Overview

**Overview**  
Update  
Statistics  
Geography of use

**Team**

**Downloads**

**Documents**

**Wiki**

**Publications**

**Advanced**

**Downloads & Source Code**  
[OpenSim API Programs](#)  
[Plots to Share](#)  
[Tools in Other Program](#)

This projects does not store source code in Simtk's Subversion repository.

**Description:** Making musculoskeletal models and simulations is a lot like cooking. Anything complicated is going to take a while to get just right and there will probably be a few failed attempts along the way. Unfortunately, in research we only see the tasty, beautifully presented, dish served at the fancy party (the paper in a journal) and not the burnt, over-salted, misshapen disasters that preceded it (all those failed simulations and ideas that didn't pan out). But there's a lot of great stuff in those failed attempts and we should document it somewhere.



Did you spend 2 weeks debugging something that was fixed with one line of code? Share it!

Do you have a simulation that you need help with? Ask for help here!

Did someone give you a great time saving tip? Pass it on!

Did you make something cool but unpublishable? Brag about it!

Have strong opinions about modeling and simulation? Climb on that soapbox!

Fail proudly.

**Available Downloads and Their Potential Uses:** Anything goes.  
Most stuff will happen in the Wiki and Forum.

**Project Lead**  
  
[Edith Arnold](#)  
[Contact](#)

**Driving Biological Problems**  
This project is part of [Neuromuscular Biomechanics](#)

**Related Projects**  
[OpenSim](#)  
[Neuromuscular Models Library](#)  
[Lower Limb Model 2010](#)

# ...contribute to the Wiki!



The screenshot shows a web browser window displaying the Simtk Wiki page for "Successful Simulations". The browser's address bar shows the URL "wiki.simtk.org/modelerskitchen/SuccessfulSimulations". The page features a navigation menu with links for Home, About Simtk.org, How to Contribute, Search Simtk.org, emarnold Preferences, News, Log Out, Create Project, and My Page. The main content area is titled "Successful Simulations" and includes a "Table of Contents" with links to "Running OpenSim in the Command Line", "Running OpenSim out of Matlab", "Creating and Using Plug-ins in OpenSim", "Inverse Kinematics", "Inverse Dynamics", "Residual Reduction algorithm", and "Computed Muscle Control". The page also has a "Running OpenSim in the Command Line" section with introductory text.

SuccessfulSimulations - modeler x

wiki.simtk.org/modelerskitchen/SuccessfulSimulations

Home About Simtk.org How to Contribute Search Simtk.org emarnold Preferences News Log Out Create Project My Page

Simtk Wiki - modelerskitchen SuccessfulSimulations

Overview Team Downloads Documents Wiki Publications Advanced

Downloads & Source Code

- OpenSim API Programs
- Plots to Share
- Tools in Other Program

This project does not store source code in Simtk's Subversion repository.

FrontPage RecentChanges FindPage HelpContents **SuccessfulSimulations**

Edit (Text) Info Subscribe Add Link Attachments More Actions:

## Successful Simulations

This page is for topics related to running tools such as inverse kinematics, inverse dynamics, RRA, CMC, etc in C data into Open Sim or doing something with your results, see [PreProcessing](#) and [PostProcessing](#), respectively. T spirit of optimism and preference for alliteration.

### Table of Contents

- [Running OpenSim in the Command Line](#)
- [Running OpenSim out of Matlab](#)
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- [Residual Reduction algorithm](#)
- [Computed Muscle Control](#)

### Running OpenSim in the Command Line

Many people get started with OpenSim in the GUI, but using the command line can be more efficient for rapid iter debugging. If your simulations are crashing the GUI and you don't know why, using the command line instead mea