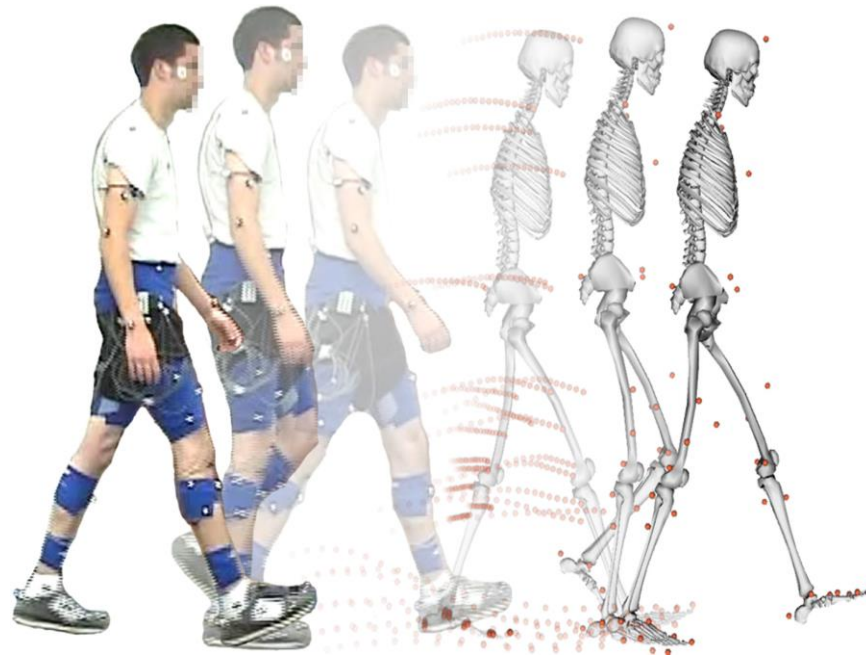


Loading Data in OpenSim

OpenSim Workshop

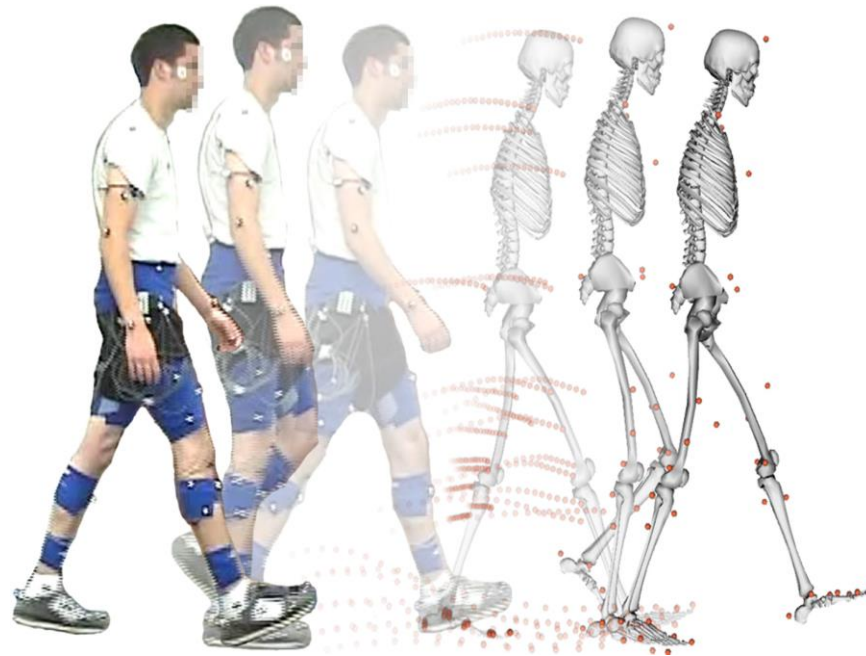
The bad news....

- Pre-processing experimental data is **not** trivial
- Details may be data-specific, model-specific, and application-specific



The good news...

- Some pre-processing tools are available
- Pre-processing additional subjects and files gets easier after you've done it once



Data import: file formats

- Import file format:
 - .trc
 - .mot
 - .sto
 - setup files (xml)

Marker Files (.trc)

Microsoft Excel - subject01_walk1.trc

File Edit View Insert Format Tools Data Window Help Adobe PDF

Type a question for help

100%

Arial

10

A1	PathFileType													
	A	B	C	D	E	F	G	H	I	J	K	L	M	
1	PathFileType	4	(X/Y/Z)	subject01_walk1.trc										
2	DataRate	CameraRate	NumFrames	NumMarkers	Units	OrigDataRate	OrigDataStart	OrigNumFrames						
3	60	60	900	41	mm	60	1	900						
4	Frame#	Time	R.ASIS			L.ASIS			V.Sacral	R.Thigh.Upper				
5			X1	Y1	Z1	Z2	Y2	Z2	X3	Y3	Z3	X4	Y4	
6														
7	1	0	617.24762	1055.27502	170.782	639.60638	1044.25842	-88.9098	430.8698	1051.265	29.96675	517.3327	741.096	
8	2	0.017	617.99811	1053.21753	168.5132	641.23621	1042.27856	-90.9321	432.3406	1050.237	26.84679	516.6138	740.4259	
9	3	0.033	620.29224	1051.77124	165.8594	643.59692	1041.06079	-94.3072	434.0994	1049.341	23.81936	517.7789	739.6809	
10	4	0.05	621.54041	1050.55212	163.5325	646.75104	1040.35681	-96.8619	436.2799	1048.707	20.95202	519.1975	739.3258	
11	5	0.067	624.58844	1050.92834	161.2461	649.25415	1041.42517	-98.4846	438.8279	1048.451	18.27267	522.1685	738.2791	
12	6	0.083	628.15863	1051.42017	158.449	652.04126	1043.04651	-101.857	441.5721	1048.661	15.77033	526.8028	738.1261	
13	7	0.1	630.80774	1051.99683	155.2827	654.94336	1045.55249	-104.843	444.3065	1049.388	13.38743	535.1032	738.0898	
14		0.117	634.3573	1053.58888	151.4853	656.46411	1048.43481	-108.355	446.8308	1050.622	11.01402	544.723	738.2121	

subject01_walk1

Ready

NUM

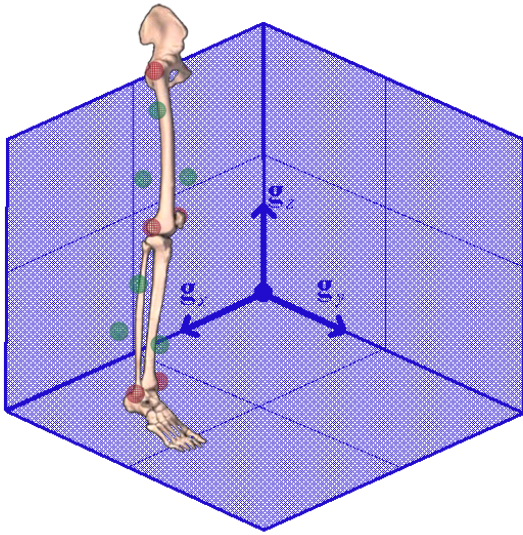
The **.trc** file format specifies the position of markers from a motion capture trial

- First 3 Lines: **Header specifying trial info**
- 4th Line: Column labels containing the **marker names**
- 5th Line: Identifies **component and marker number**

They can be opened and modified using Excel, Mokka, BTK, etc.

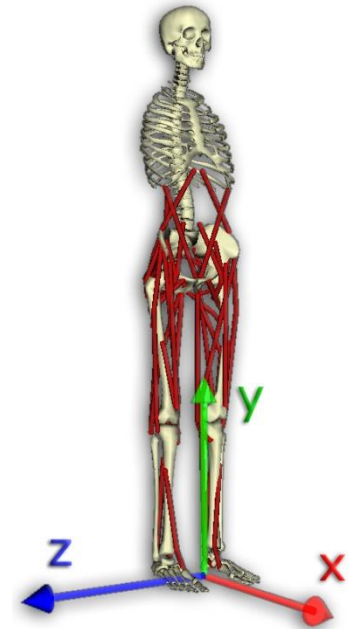
Coordinate Systems

Measure Markers in Lab Coordinate System



coordinate frame g

OpenSim Model Coordinate System

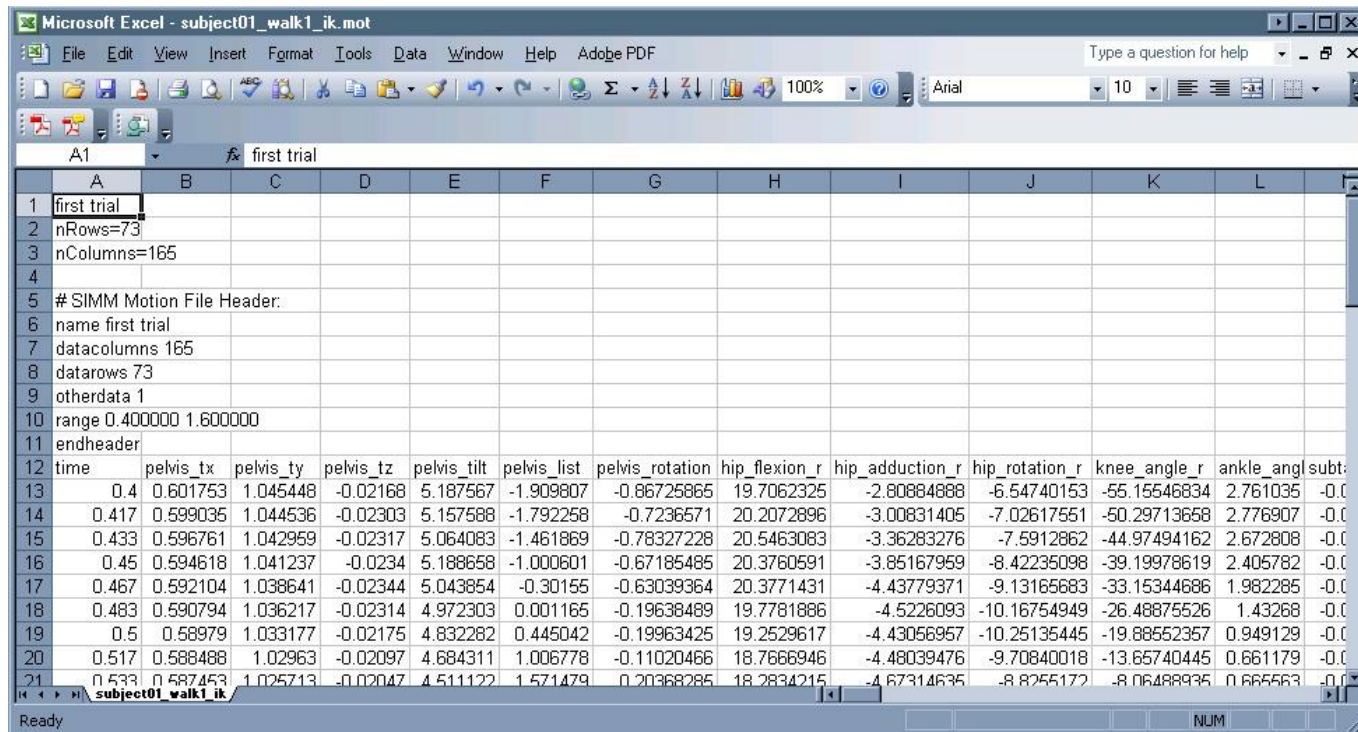


coordinate frame O

Rotation Matrix

$${}^A\mathbf{R}^B = \begin{bmatrix} r_{xx} & r_{xy} & r_{xz} \\ r_{yx} & r_{yy} & r_{yz} \\ r_{zx} & r_{zy} & r_{zz} \end{bmatrix}$$

Motion (.mot) & Storage (.sto) Files



The screenshot shows a Microsoft Excel window titled "subject01_walk1_ik.mot". The spreadsheet contains a header section and a data table. The header section includes fields for "first trial", "nRows=73", "nColumns=165", "# SIMM Motion File Header:", "name first trial", "datacolumns 165", "datarows 73", "otherdata 1", "range 0.400000 1.600000", and "endheader". The data table has 16 columns: "time", "pelvis_tx", "pelvis_ty", "pelvis_tz", "pelvis_tilt", "pelvis_list", "pelvis_rotation", "hip_flexion_r", "hip_adduction_r", "hip_rotation_r", "knee_angle_r", "ankle_angle_r", "ankle_angle_l", "ankle_angle_r", "ankle_angle_l", and "ankle_angle_r". The data rows show numerical values for each column, starting from 0.4 for time and various joint angles and positions.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	time	pelvis_tx	pelvis_ty	pelvis_tz	pelvis_tilt	pelvis_list	pelvis_rotation	hip_flexion_r	hip_adduction_r	hip_rotation_r	knee_angle_r	ankle_angle_r	ankle_angle_l	ankle_angle_r	ankle_angle_l
1	0.4	0.601753	1.045448	-0.02168	5.187567	-1.909807	-0.86725865	19.7062325	-2.80884888	-6.54740153	-55.15546834	2.761035	-0.0	-0.0	-0.0
2	0.417	0.599035	1.044536	-0.02303	5.157588	-1.792258	-0.7236571	20.2072896	-3.00831405	-7.02617551	-50.29713658	2.776907	-0.0	-0.0	-0.0
3	0.433	0.596761	1.042959	-0.02317	5.064083	-1.461869	-0.78327228	20.5463083	-3.36283276	-7.5912862	-44.97494162	2.672808	-0.0	-0.0	-0.0
4	0.45	0.594618	1.041237	-0.0234	5.188658	-1.000601	-0.67185485	20.3760591	-3.85167959	-8.42235098	-39.19978619	2.405782	-0.0	-0.0	-0.0
5	0.467	0.592104	1.038641	-0.02344	5.043854	-0.30155	-0.63039364	20.3771431	-4.43779371	-9.13165683	-33.15344686	1.982285	-0.0	-0.0	-0.0
6	0.483	0.590794	1.036217	-0.02314	4.972303	0.001165	-0.19638489	19.7781886	-4.5226093	-10.16754949	-26.48875526	1.43268	-0.0	-0.0	-0.0
7	0.5	0.58979	1.033177	-0.02175	4.832282	0.445042	-0.19963425	19.2529617	-4.43056957	-10.25135445	-19.88552357	0.949129	-0.0	-0.0	-0.0
8	0.517	0.588488	1.02963	-0.02097	4.684311	1.006778	-0.11020466	18.7666946	-4.48039476	-9.70840018	-13.65740445	0.661179	-0.0	-0.0	-0.0
9	0.533	0.587453	1.025713	-0.02047	4.511122	1.571479	-0.20368285	18.2834215	-4.67314635	-8.8755172	-8.06488935	0.665563	-0.0	-0.0	-0.0

The **.mot** & **.sto** file formats contain **many** different types of data, including joint angles and moments, excitations, activations, and forces.

- Motion files (**.mot**) require uniform time spacing
- Column labels can be ambiguous (i.e., be aware of what file you are viewing)
- All units are SI (i.e., meters, Newtons, etc...)

Ground Reaction Force Data

	A	B	C	D	E	F	G	H
1	name subject01_walk1_grf.mot							
2	datacolumns 19							
3	datarows 9009							
4	range 0.000000 15.013300							
5	endheader							
6		ground_force_vx	ground_force_vy	ground_force_vz	ground_force_px	ground_force_py	ground_force_pz	ground_force_vx
7	0	101.5119767	745.4881142	-47.44070554	0.37030205	-0.0075	0.12774652	17.26936127
8	0.0017	103.2043876	743.0973413	-46.86966548	0.37809513	-0.0075	0.12810137	18.91380164
9	0.0033	104.8844976	740.7135492	-46.28801443	0.37719739	-0.0075	0.12845514	20.50537239
10	0.005	106.5399203	738.2996154	-45.70129774	0.37628513	-0.0075	0.1288046	21.99210933
11	0.0067	108.1584244	735.8401938	-45.10743176	0.37535383	-0.0075	0.12914662	23.32367317
12	0.0083	109.7278112	733.3196148	-44.50479585	0.37439896	-0.0075	0.12947833	24.45219084
13	0.01	111.2361372	730.7218514	-43.8924258	0.37341601	-0.0075	0.12979706	25.33324305
14	0.0117	112.6717298	728.0304566	-43.27004355	0.37240058	-0.0075	0.1301005	25.92666846
15	0.0133	114.0235159	725.2286088	-42.63818276	0.37134841	-0.0075	0.13038667	26.1974759
16	0.015	115.2810839	722.2991605	-41.99815198	0.37025539	-0.0075	0.13065393	26.11679042








Force data must be represented in a **very specific order**:

BODY 1 FORCE (x , y , z)	BODY 1 COP (x , y , z)	BODY 2 FORCE (x , y , z)	BODY 2 COP (x , y , z)	BODY 1 TORQUE (x , y , z)	BODY 2 TORQUE (x , y , z)
------------------------------------	----------------------------------	------------------------------------	----------------------------------	-------------------------------------	-------------------------------------

NOTE: Column labels must be **exactly** as shown!


OpenSim Utilities (from confluence website)

- “Tools for preparing motion data” section

Package		Brief Description	Platform	Authors	License	Included Materials	Last Updated
MOToNMS		MOToNMS is a Matlab toolbox able to read motion data stored in C3D files and process markers trajectories, ground reaction forces, and EMG signals for OpenSim and CEINMS.	Matlab	Alice, Mantoan, Monica Reggiani	GNU General Public License	Extensive online documentation, example data	Ongoing
GaitExtractToolbox171		Matlab toolbox to assist in extracting kinematic, kinetic, and EMG information directly from a C3D file for use in OpenSim. The scripts can be configured for any laboratory configuration.	Matlab	Tim Dorn	MIT License	PDF Instructions and Example data	Jan, 2011
Matlab_Opensim_Tools_v2		Folder containing a number of functions for processing data from C3D files to OpenSim format and for generating setup files and running scale/ik/id from the matlab command line.	Matlab	Glen Lichtwark, Ayman Habib, Rod Barrett	MIT License	Readme instructions and example data	August, 2013
OpenSMAC1.0		This project contains a utility program (OpenSMAC) that converts motion files from a Motion Analysis Corp. system (TRB and ANB files) into a format supported by OpenSim (TRC/MOT). It can also convert C3D files if you have a valid license and hardware key for SIMM and the Motion Module.	Motion Labs C++ plugin	Peter Loan	Custom	PDF Instructions	Dec, 2009
Lee-Son's Toolbox		This toolbox converts VICON motion capture data into OpenSim inputs. Converts data into *.trc (marker trajectories) and *.mot (force plate data) files.	Binary (.exe) files	Sangjun Lee and Jinkyoun Son	MIT license	Manual, Example data	Sep, 2013
Preprocessing Utilities or Download here		A set of matlab scripts for preprocessing experimental data to put it in format expected by OpenSim. These scripts were developed by Ajay Seth to process C3D from Gillette Children's Specialty Healthcare.	Matlab	Ajay Seth	Custom		Aug, 2008
External load Utilities or Download here		A Matlab script, with examples, to generate GRF .mot files and an external loads setup file compatible with OpenSim 2.4. The script works with standard gait lab GRF data from pre-2.0. A README file with instructions is included with the download.	Matlab	Sam Hamner	Custom		Jan, 2012


OpenSim Utilities (from SimTK website)

- <https://simtk.org/projects/opensim-utils>







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OpenSim Utilities



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About

The purpose of this umbrella project is to provide a central repository of user-contributed OpenSim utilities and extensions.

Download Latest Releases ▾

License: [Neuromusculoskeletal Builder](#)

This collection is no longer being maintained through this project. To find OpenSim utilities, you now have two options:

- 1) Visit the summary table on the OpenSim documentation pages (<http://simtk-confluence.stanford.edu:8080/display/OpenSim/Tools+for+Preparing+Motion+Data>)
- 2) Conduct a search on SimTK. Click here (https://simtk.org/search/search.php?srch=opensim&type_of_search=soft) and then narrow your search to "Scripts, Plug-Ins, and Other Utilities" by checking the box on the left.


A repository of tools written by members of the OpenSim community to support their usage of the

1,883
downloads

3
forum posts

Last updated
Mar 21, 2017

Project Statistics



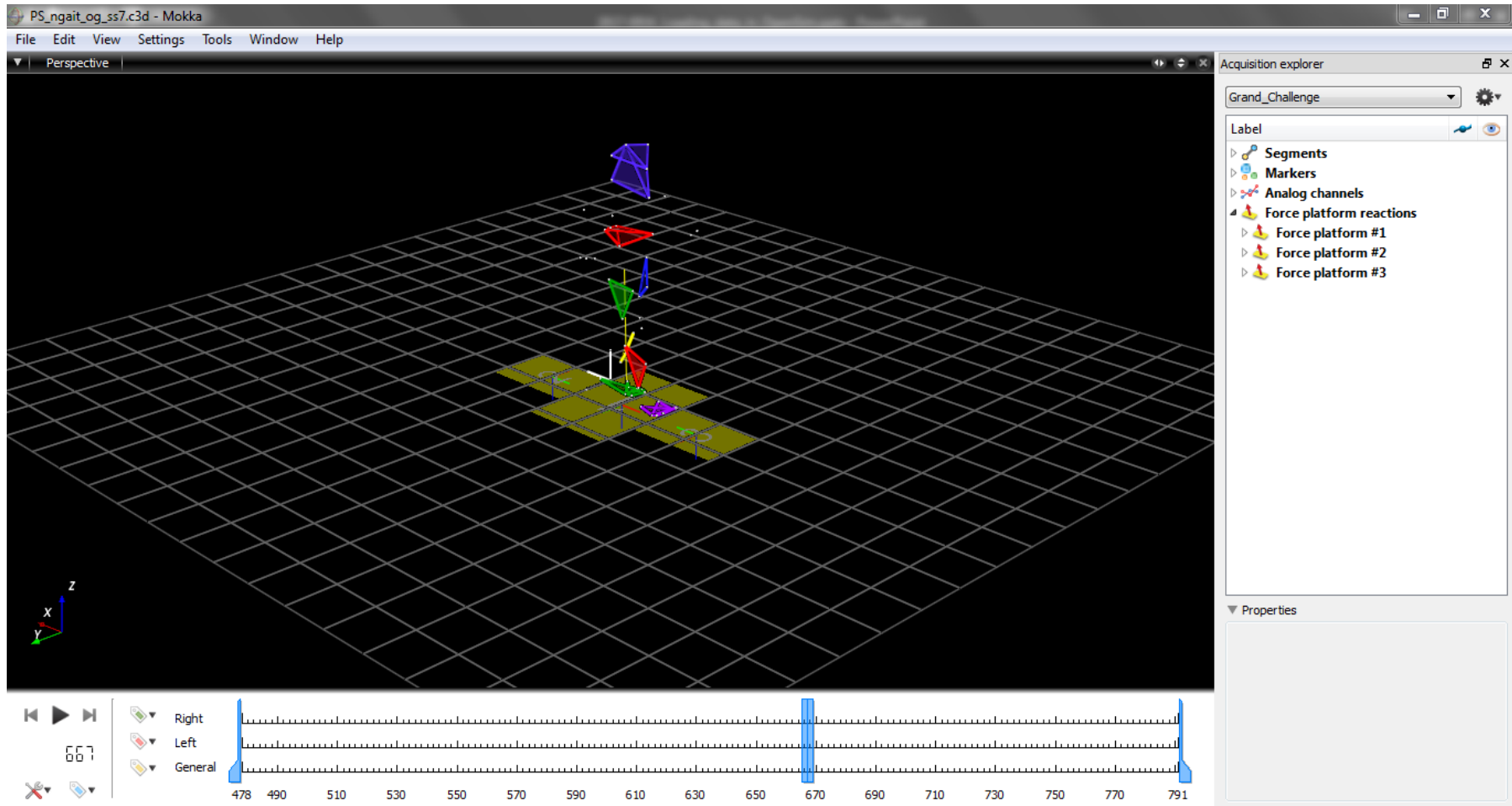
Jennifer Hicks

BTK libraries/Mokka tool



<http://biomechanical-toolkit.github.io>

- Several toolboxes use BTK functions.



Barre' et al. Comp Meth Prog Med, 2014

BTK and MOKKA online resources

- MOKKA is available from:
<http://biomechanical-toolkit.github.io/mokka/>
- BTK is available from:
<https://code.google.com/archive/p/b-tk/> and
packages from
<https://code.google.com/archive/p/b-tk/downloads>
- New project refactoring BTK is on the way:
<http://www.openma.org>

Demo of use of MOKKA to prepare .trc files

- Example: use of MOKKA to save trc files and OpenSim to apply transformations to marker data
- Example: Matlab script for batch processing c3d files using BTK

