

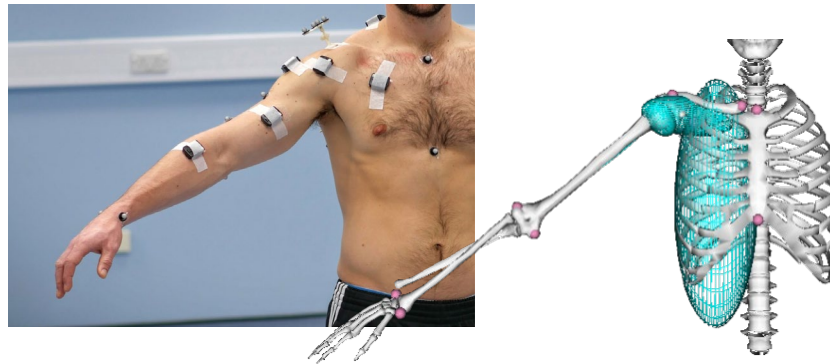


Data import – Market set setup

OpenSim Workshop 2018

Importing experimental data

- Import file format:
 - .trc
 - .mot
 - setup files (xml)
- Pre-processing experimental data is not trivial
- But:
 - Some pre-processing tools are available
 - Pre-processing gets easier after you've done it once



Importing experimental data

- Tip #1: Collect high-quality data suitable for simulation

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OpenSim Documentation / OpenSim Support / User's Guide

Preparing Your Data

Created by Jennifer Hicks, last modified on Aug 27, 2012

This chapter describes the formats for data files that can be imported into OpenSim. Generally, you must input the following types of data into OpenSim to generate simulations:

1. Marker trajectories
2. Ground reaction forces and moments and centers of pressure

You may also import joint angles to provide additional kinematic data. Marker trajectories must be specified in .trc files, and ground reaction and center of pressure data must be specified in .sto or .mot files. Joint angles must be specified in .sto or .mot files. The .sto file format, which is similar to the .mot file format, is described below. EMG data may also be imported using .sto or .mot files, for example, to compare experimental EMG data to muscle excitations obtained from a simulation. This section covers:

- [Collecting Experimental Data](#)
- [Coordinate Systems](#)
- [Marker \(.trc\) Files](#)
- [Motion \(.mot\) Files](#)
- [Storage \(.sto\) Files](#)
- [Tools for Preparing Motion Data](#)

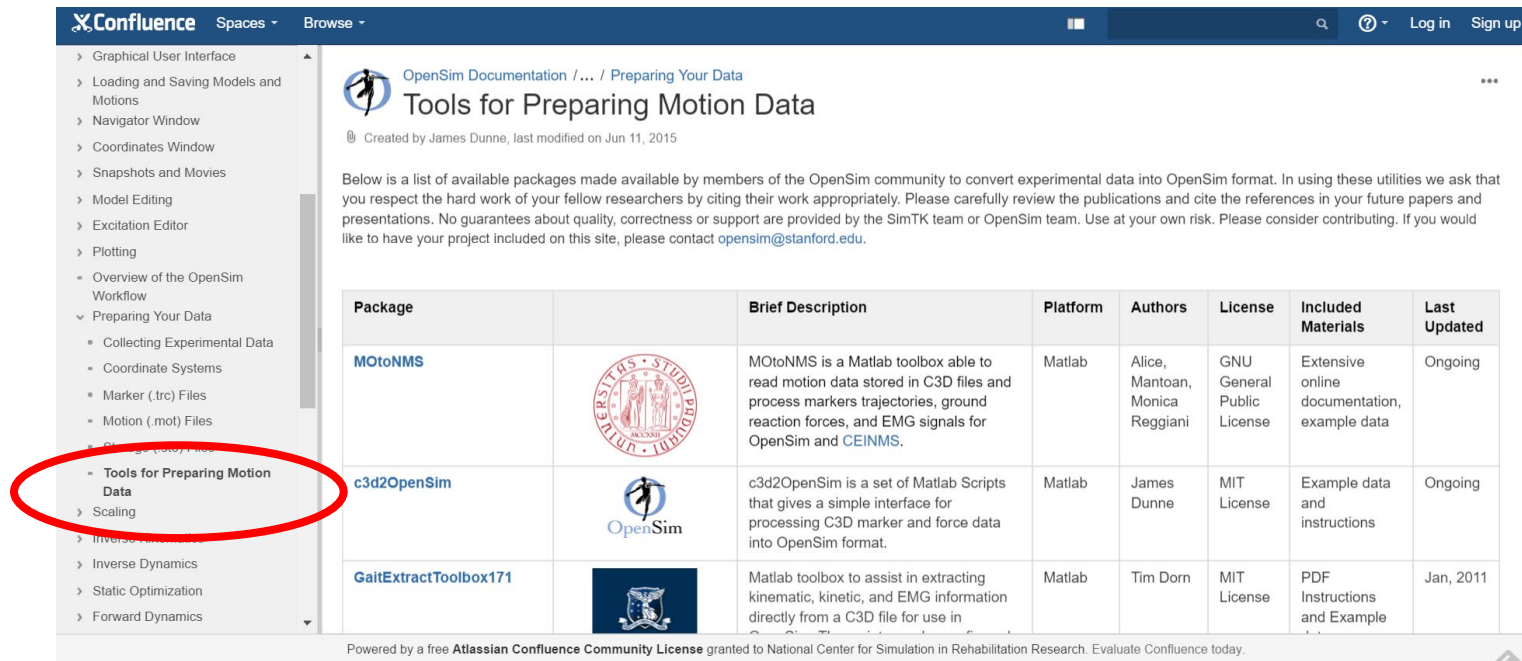
Next: [Coordinate Systems](#)

No labels




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Importing experimental data

- Tip #1: Collect high-quality data suitable for simulation
- Tip #2: Assess whether existing pre-processing tools meet your needs



The screenshot shows the OpenSim Documentation page for 'Tools for Preparing Motion Data'. The left sidebar contains a navigation menu with the following items: Graphical User Interface, Loading and Saving Models and Motions, Navigator Window, Coordinates Window, Snapshots and Movies, Model Editing, Excitation Editor, Plotting, Overview of the OpenSim Workflow, Preparing Your Data (highlighted with a red circle), Collecting Experimental Data, Coordinate Systems, Marker (.trc) Files, Motion (.mot) Files, Tools for Preparing Motion Data (highlighted with a red circle), Scaling, Inverse Kinematics, Inverse Dynamics, Static Optimization, and Forward Dynamics. The main content area features a table of available packages for converting experimental data into OpenSim format.

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
c3d2OpenSim		c3d2OpenSim is a set of Matlab Scripts that gives a simple interface for processing C3D marker and force data into OpenSim format.	Matlab	James Dunne	MIT License	Example data and instructions	Ongoing
GaitExtractToolbox171		Matlab toolbox to assist in extracting kinematic, kinetic, and EMG information directly from a C3D file for use in	Matlab	Tim Dorn	MIT License	PDF Instructions and Example	Jan, 2011

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Importing experimental data

- Tip #1: Collect high-quality data suitable for simulation
- Tip #2: Assess whether existing pre-processing tools meet your needs

Also: [Biomechanical ToolKit](http://biomechanical-toolkit.github.io/), an open-source framework to visualize and process biomechanical data
(<http://biomechanical-toolkit.github.io/>)

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

PathFileType

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									
5			X1	Y1	Z1	X2	Y2	Z2	X3	Y3	Z3	X4	Y4	Z4
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	8	0.117	634.3573	1053.59898	151.4853	656.46411	1048.43481	-108.355	446.8308	1050.622	11.01402	544.723	738.2121	

subject01_walk1

Ready

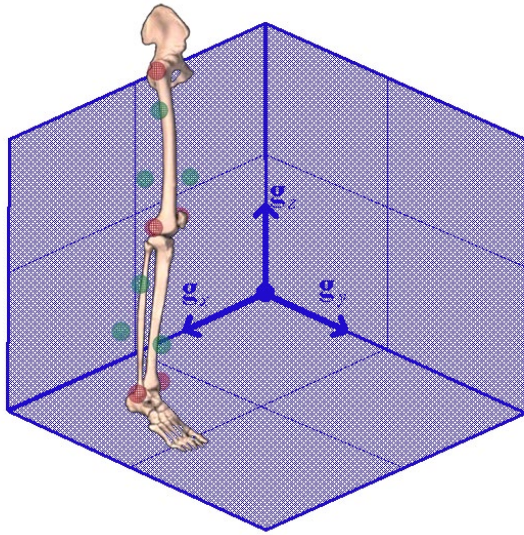
NUM

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

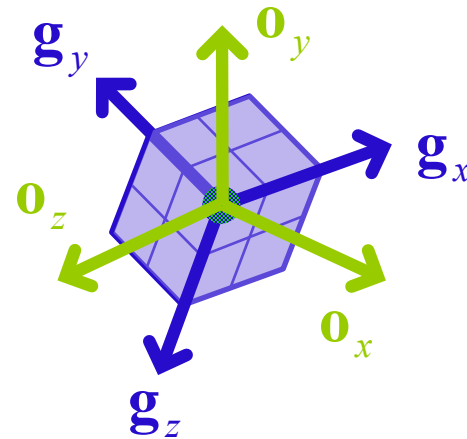
- First 3 Lines: **Header specifying trial info**
- 4th Line: Column labels containing the **marker names**
- 5th Line: Identifies **component and marker number**

Coordinate Systems

Measure Markers in Lab Coordinate System



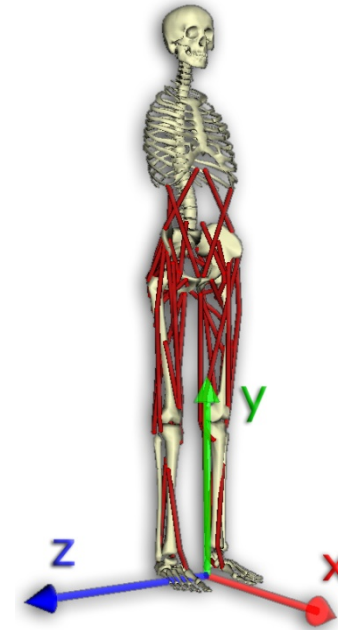
coordinate frame g



Rotation Matrix

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

OpenSim Model Coordinate System



coordinate frame o

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

Microsoft Excel - subject01_walk1_ik.mot

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Type a question for help

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first trial

	A	B	C	D	E	F	G	H	I	J	K	L	
1	first trial												
2	nRows=73												
3	nColumns=165												
4													
5	# SIMM Motion File Header:												
6	name first trial												
7	datacolumns 165												
8	datarows 73												
9	otherdata 1												
10	range 0.400000 1.600000												
11	endheader												
12	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	subt...
13	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
14	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
15	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
16	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
17	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
18	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
19	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
20	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
21	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

subject01_walk1_ik

Ready NUM

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	745.4661142	-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	BODY 1 COP	BODY 2 FORCE	BODY 2 COP	BODY 1 TORQUE	BODY 2 TORQUE
(x , y , z)	(x , y , z)	(x , y , z)	(x , y , z)	(x , y , z)	(x , y , z)

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

Demo of Data Previewer

