



v.1.5.1

Lee-Son's Toolbox

User Manual



Human-Centered CAD Laboratory
Department of Mechanical and Aerospace Engineering
Seoul National University

Written by

Lee, Sang Jun (skylsj@snu.ac.kr)

Jinkyoun Son (flyingj@snu.ac.kr)

Downloads and other informations are available at

<https://simtk.org/home/lee-son>

<http://hccl.snu.ac.kr/>

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1. Introduction

This toolbox converts VICON motion capture data into OpenSim input. With this toolbox, the user can easily and quickly obtain *.trc (marker trajectories) and *.mot (force plate data) files, which can be used directly in OpenSim.

This toolbox automatically adapts to the number of markers, the name of the markers, and the number of force plates that are used. Also, the user can choose any experimental coordinate system as an option. At this point, only AMTI force plates are available, but Kistler force plates will also be available soon. (If the user uses Kistler force plates, they can send in the *.csv files.)

Lee-Son's toolbox and several examples are available at the SimTK community page (<https://simtk.org/home/lee-son/>) and at the lab homepage (<http://hcc1.snu.ac.kr/>). **This toolbox is free and comes with no warranty, but we do ask for acknowledgement if used in publications.** For any questions that arise, we can be reached by e-mail or public forums. (Figure 1)

The screenshot shows the SimTK community page for Lee-Son's toolbox. The page has a blue header with the SimTK logo and navigation links: Home, About Simtk.org, How to Contribute, Search Simtk.org, News, Log Out, Create Project, and My Page. The main content area is titled "Lee-Son's Toolbox: a Toolbox that Converts VICON Mocap Data into OpenSim Inputs" and includes a "Project Overview" section. The overview section contains a description of the toolbox, a list of available downloads and their potential uses, and a purpose/synopsis. The NEXUS and OpenSim logos are prominently displayed in the center. The page also features a sidebar with links to Overview, Team, Downloads, Documents, and Advanced, as well as a "Driving Biological Problems" section.

[Figure 1] the SimTK community page: Lee-Son's toolbox

This manual is based on VICON NEXUS 1.7.0 and Lee-Son's toolbox 1.5.1. This manual may not change when there are only minor changes in any new version of the toolbox.

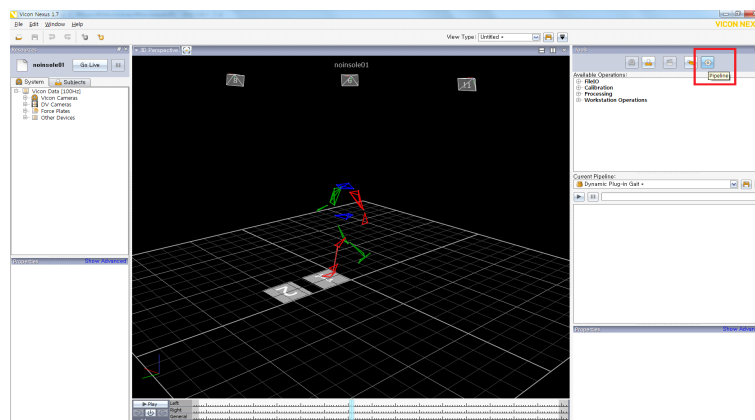
2. How to Use

2.1. Requirements

- ① VICON NEXUS (and its license)
- ② Motion capture data for static/dynamic trials (read in VICON NEXUS)
 - marker trajectories (should be previously labeled)
 - force plate data (at this point, only AMTI force plates are available)
- ③ Lee-Son's toolbox

2.2. Exporting *.csv files in VICON NEXUS

First, motion capture data should be exported as *.csv (comma-separated variables) files using VICON NEXUS. After labeling all markers and setting the time region of interest, click the **[Pipeline]** button in the **[Tools]** panel. (Figure 2)

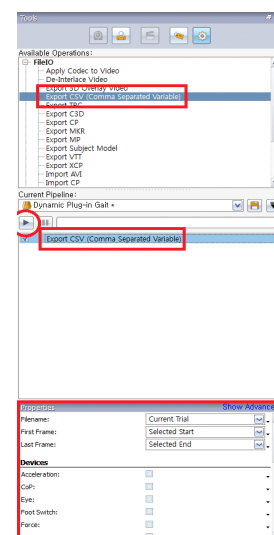



[Figure 2] VICON NEXUS and the [Pipeline] button

Next, double-click **[FileIO] > [Export CSV (Comma Separated Variables)]** in the **[Available Operations]** box. The **[Export CSV (Comma Separated Variables)]** check-box will then appear in the **[Current Pipeline]** box. If this check-box is clicked and activated, a number of additional options will appear in the **[Properties]** panel below. Only these four options should be checked:

[Devices] > [CoP], [Reaction Force], [Reaction Moment]
[Trajectories] > [Components].

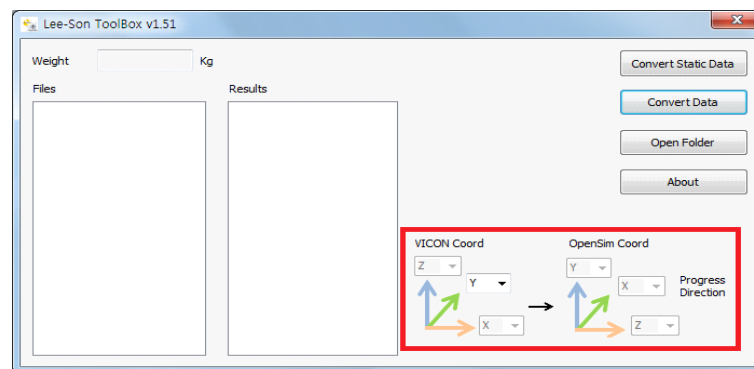
Additional operations can be added, such as a filtering routine before the **[Export CSV (Comma Separated Variables)]** check-box. Saving these settings as a pre-defined pipeline configuration will reduce the necessary time and effort next time this routine is used.



Finally, click  to run the pipeline. A *.csv file for the trial will then appear in the current directory.

2.3. Setting the experimental coordinate system

Before converting the motion capture data into OpenSim input, the experimental coordinate system must be set. The options for the coordinate system are in the bottom-right area of the toolbox. (Figure 3)



[Figure 3] the options for the coordinate system

In OpenSim, the recommended coordinate system is shown below.

X axis: the progressional direction of the subject
Y axis: the upward direction
Z axis: defined from the X and Y axes

In the VICON motion capture system, however, when setting the coordinate system using the calibration wand, the upward direction becomes the Z axis automatically. Therefore, only the coordinate transforms in the toolbox are possible in this case. In this toolbox, once the progressional direction of the subject is chosen, the other axes are defined automatically. (four options: X/-X/Y/-Y, default option: Y)

In fact, this process is not critical to the OpenSim analysis; moreover it is possible to change the coordinate system again in OpenSim. Therefore, if the progressional direction is not clear, the default option is likely the best choice.

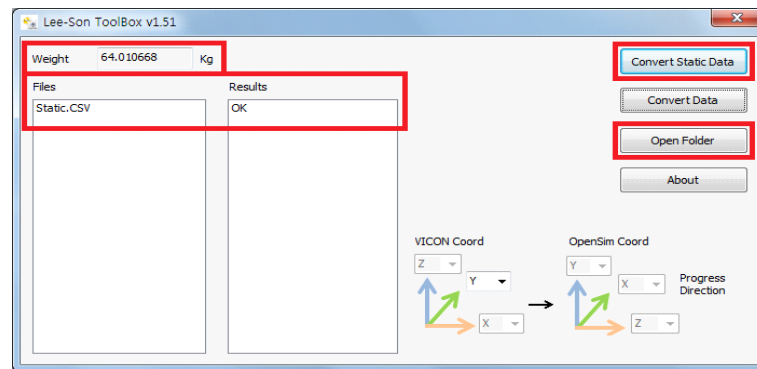
2.4. Converting data from static trials

To scale the OpenSim musculo-skeletal model, a *.trc (marker trajectories) file is required for a static trial. The *.trc file can be obtained from the *.csv file using the **[Convert Static Data]** button on the toolbox.

When executing the toolbox and clicking the **[Convert Static Data]** button, a file-selection window is opened. After selecting the *.csv file from the static trial and

clicking **[open]**, the result will appear in the toolbox. If the result is “OK”, the *.trc file for the static trial will appear in the same directory. Clicking the **[Open Folder]** button after the conversion opens the directory.

If the subject was on force plates during the static trial, the subject’s weight will also appear in the toolbox simultaneously. This is calculated as the time-average of the sum of the vertical forces of all force plates. (Figure 4)

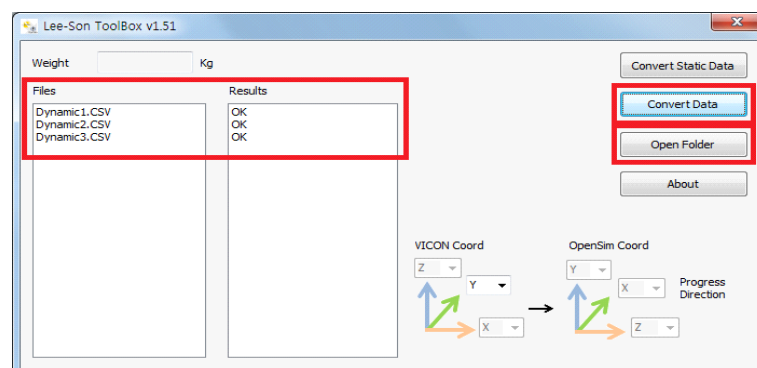


[Figure 4] converting data from static trials

2.5. Converting data from dynamic trials

To analyze the motion capture data in OpenSim, *.trc (marker trajectories) and *.mot (force plate data) files are necessary for a dynamic trial. The *.trc and *.mot files can be obtained from the *.csv file using the **[Convert Data]** button on the toolbox.

When executing the toolbox and clicking the **[Convert Data]** button, a file-selection window is opened. After selecting the *.csv file from the dynamic trial and clicking **[open]**, the result will appear in the toolbox. Multiple *.csv files can be chosen simultaneously. If the result is “OK”, the *.trc and *.mot files for the static trial will appear in the same directory. Clicking the **[Open Folder]** button after the conversion opens the directory. (Figure 5)



[Figure 5] converting data from dynamic trials

2.6. Solving errors during conversions

Occasionally the result will not be “OK”. In this case, follow the instructions below.

① “△△ marker is duplicated”

This occurs because there are duplicated marker names in the input *.csv file. This is a type of error that occurs when the *.csv file is exported in VICON NEXUS (not in this toolbox). In this case, please re-export the *.csv file in VICON NEXUS and check the result again.

② “File read error”

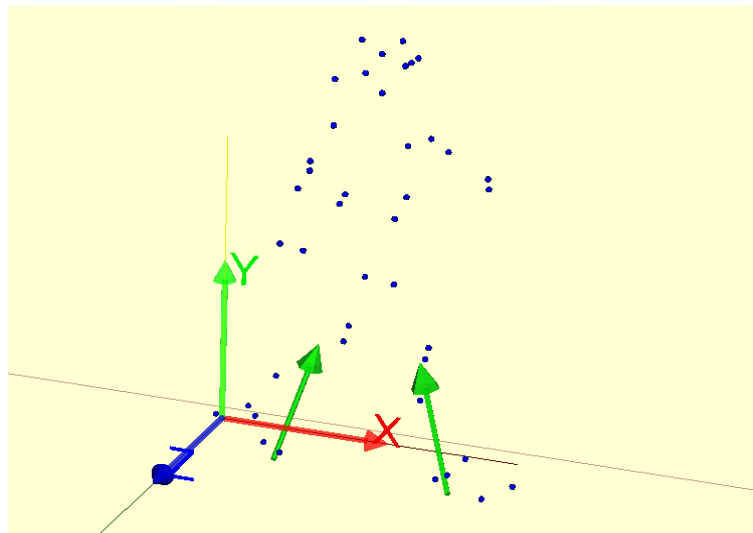
This error arises when the input *.csv file is open and being edited manually. In this case, please close the program used to edit the *.csv files (such as Excel, or Notepad) and try again.

③ “File write error”

This error arises when the output *.trc and/or *.mot file(s) are open and being edited manually. In this case, please close the program used to edit the *.trc and *.mot files (such as Excel, or Notepad) and try again.

2.7. Previewing converted data in OpenSim

It is possible to preview the created *.trc and *.mot files in OpenSim. To do this, please refer to OpenSim User’s Guide - 24.7 Previewing Motion Capture (Mocap) Data. (Figure 6)



[Figure 6] previewing converted data in OpenSim

3. Examples

3.1. An example for static trials

Several example files can be downloaded from the SimTK community page and from the lab homepage. “Static.CSV” is an example of a static trial. This static trial was captured on force plates, allowing the user to see the subject’s weight in the toolbox simultaneously. The marker set is a simplified version of the full-body model by Samuel Hamner *et al.* (<https://simtk.org/home/runningsim/>)

3.2. Examples for dynamic trials

“Dynamic1.CSV”, “Dynamic2.CSV”, and “Dynamic3.CSV” are some of the examples for dynamic trials. These are gait trials of the same subject with “Static.CSV”, and each of them has two AMTI force plates.

4. Related Projects and References

- ① “Theories and Practices of Motion Analysis”
<http://www.kwon3d.com/theory/prac.html> by Young-Hoo Kwon
- ② “OpenSim”
<https://simtk.org/home/opensim> by Scott Delp *et al.*
- ③ “C3D Extraction Toolbox”
<https://simtk.org/home/c3dtoolbox> by Tim Dorn
- ④ “OpenSMAC: Utility for importing Motion Analysis data (TRB, ANB) into OpenSim”
<https://simtk.org/home/opensmac> by Peter Loan
- ⑤ “An Investigation and Expansion of Musculoskeletal Modeling and Analysis Techniques”
by John Wade Kelly