

Introduction

Motion Capture Analysis & Plotting Assistant (MCAPA) is developed for analyzing upper limbs' joint angles captured by the Xsens¹ motion capture systems. The app has four different tabs, 'Load', 'Comparison', 'Control Group', and 'Table'. This is a run through of all the tabs and functionalities of the app.

Load

The app starts up on the 'Load' tab. This is where you import the data sets to be processed throughout the session.

There are two sections on this tab. To the left it's the loading window, and to the right it's a property input window for individual plots.

The screenshot displays the 'Open_MCAPA' application window with the 'Load' tab selected. The interface is divided into two main sections: a loading window on the left and a property input window on the right.

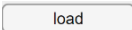
Loading Window (Left):

- At the top, there are tabs for 'Subject-1', 'Subject-2', 'Subject-3', 'Subject-4', 'Subject-5', and 'Old Stats'. 'Subject-2' is currently selected.
- Below the tabs, there are three trial entries:
 - Trial 1:** GMHM-1.mvnx
 - Trial 2:** GMHM-2.mvnx
 - Trial 3:** GMHM-3.mvnx
- A form for patient/control information is located below the trials, with fields for:
 - Anonymised Patient/Control ID:
 - Gender (Male/Female/Other/Prefer not to say):
 - Date of Birth (DD/MM/YYYY):
 - Dominant Arm (Right/Left):
 - Amputated Side (Right/Left):
 - Level of Amputation (Above-elbow/Below-elbow):
 - Prosthetic Type (Passive/Body-powered/Myoelectric/Externally-powered):
 - Terminal Device Type (Hook-shaped/Anthropomorphic):
 - Height (cm):
 - Weight (kg):
- To the right of the form is a 'Threshold Value' section with a text input field containing '10' and a unit dropdown set to 'mm'.
- Below the threshold section are four buttons: 'load', 'plot', 'table', and 'save'.

Property Input Window (Right):


- At the top, there is a 'Joint(s) to plot' dropdown menu set to 'All'.
- Below that is a 'Task Name' text input field.
- At the bottom, there are two checkboxes: 'Right Handed' (checked) and 'Left Handed' (unchecked).

Loading New Data


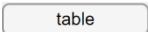
To load a new set of data, first, input a threshold value (in millimeters), which determines the initial and final valid frames (only frames in between the first and last frames to pass the threshold will be valid). And then choose one of the five subject tabs, and press the  button, and a file selection window will pop up. Select up to three *.mvnx² files to be imported (once loaded, you'll NOT be able to

add more files to the same subject without overwriting the previous import, so please select all desired files at once). Once imported, a notification will pop up displaying 'loading success', please do NOT try to carry out any other tasks in the app until then.

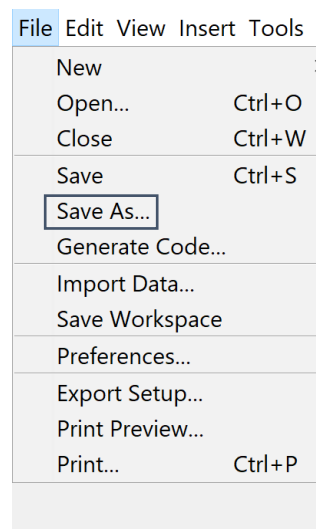
The note pad below is for entering basic information regarding the subject, the pre-existing texts are recommendations for what to record, and can be edited.

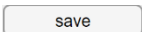
Once imported, the data set could be saved for later uses, either as old stats or a new control group profile. To save the data and the attached note pad, press the  button, and a file saving window will pop up, select a folder and enter an appropriate name. The data will be saved as a *.mat³ file, and the notes will be saved in a text file.

Plot and Data Table

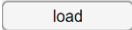
To generate a plot, first select the angle(s) to plot in the drop down to the right, this will not affect the data table. Then, enter the name of the task captured, this will show up in the title of the plot as well as the data table. Check the 'left handed' check box if the task was carried out with the left arm, if both 'left handed' and 'right handed' check boxes are unchecked, the task is processed for the right arm by default. Once the above properties have been entered, press the  button to generate a plot, or press the  button which will take you to the table tab of the app, listing the maximum, minimum angles and movement range for every degree of freedom.

To save a plot, go to 'File' in the manu bar, and select 'Save As...', saving as a *.jpg is recommended.



To save a data table, simply press the  button below the table, and a saving window will pop up. The table will be saved in a Microsoft® Excel file.

Loading Saved Data

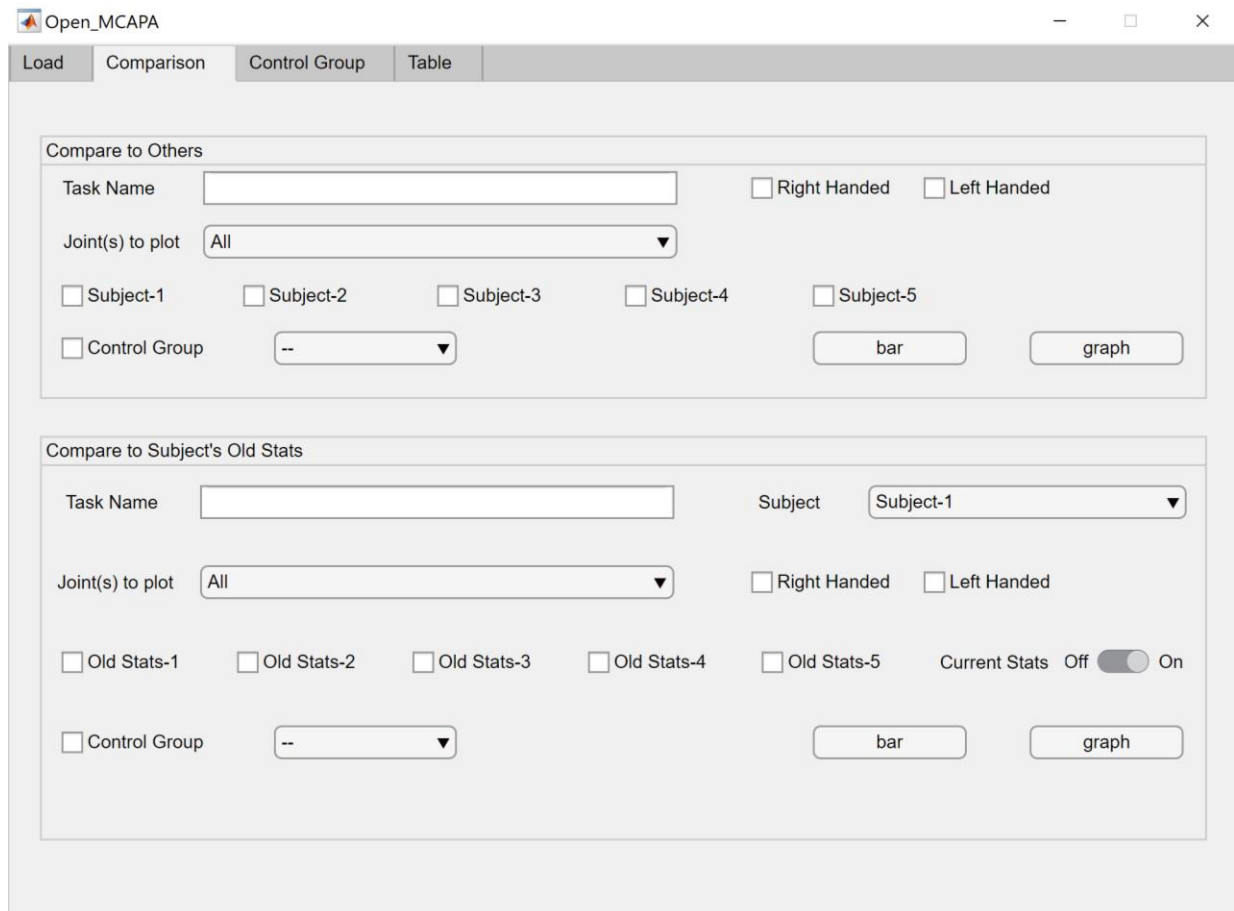
Previously saved *.mat files can be loaded as old stats for further comparison. To import the *.mat files, go to the 'Old Stats' tab where up to 5 old data sets can be loaded separately by pressing the  buttons.

Comparison

Before you start making comparisons, select the joint angle(s) to be plotted, enter the task name, and indicate whether it was a left-handed task.

Quantitative and qualitative comparisons could be done for:

1. Between subjects
2. Between a subject's recent and past captures
3. To a control group with non-amputees



The screenshot shows the 'Open_MCAPA' application window with the 'Comparison' tab selected. The interface is divided into two main sections: 'Compare to Others' and 'Compare to Subject's Old Stats'.


Compare to Others:

- Task Name:** A text input field.
- Joint(s) to plot:** A dropdown menu currently set to 'All'.
- Right Handed / Left Handed:** Two checkboxes, both currently unchecked.
- Subjects:** Five checkboxes labeled 'Subject-1' through 'Subject-5', all currently unchecked.
- Control Group:** An unchecked checkbox and a dropdown menu showing '--'.
- Buttons:** 'bar' and 'graph' buttons.

Compare to Subject's Old Stats:

- Task Name:** A text input field.
- Subject:** A dropdown menu currently set to 'Subject-1'.
- Joint(s) to plot:** A dropdown menu currently set to 'All'.
- Right Handed / Left Handed:** Two checkboxes, both currently unchecked.
- Old Stats:** Five checkboxes labeled 'Old Stats-1' through 'Old Stats-5', all currently unchecked.
- Current Stats:** A toggle switch currently set to 'Off'.
- Control Group:** An unchecked checkbox and a dropdown menu showing '--'.
- Buttons:** 'bar' and 'graph' buttons.

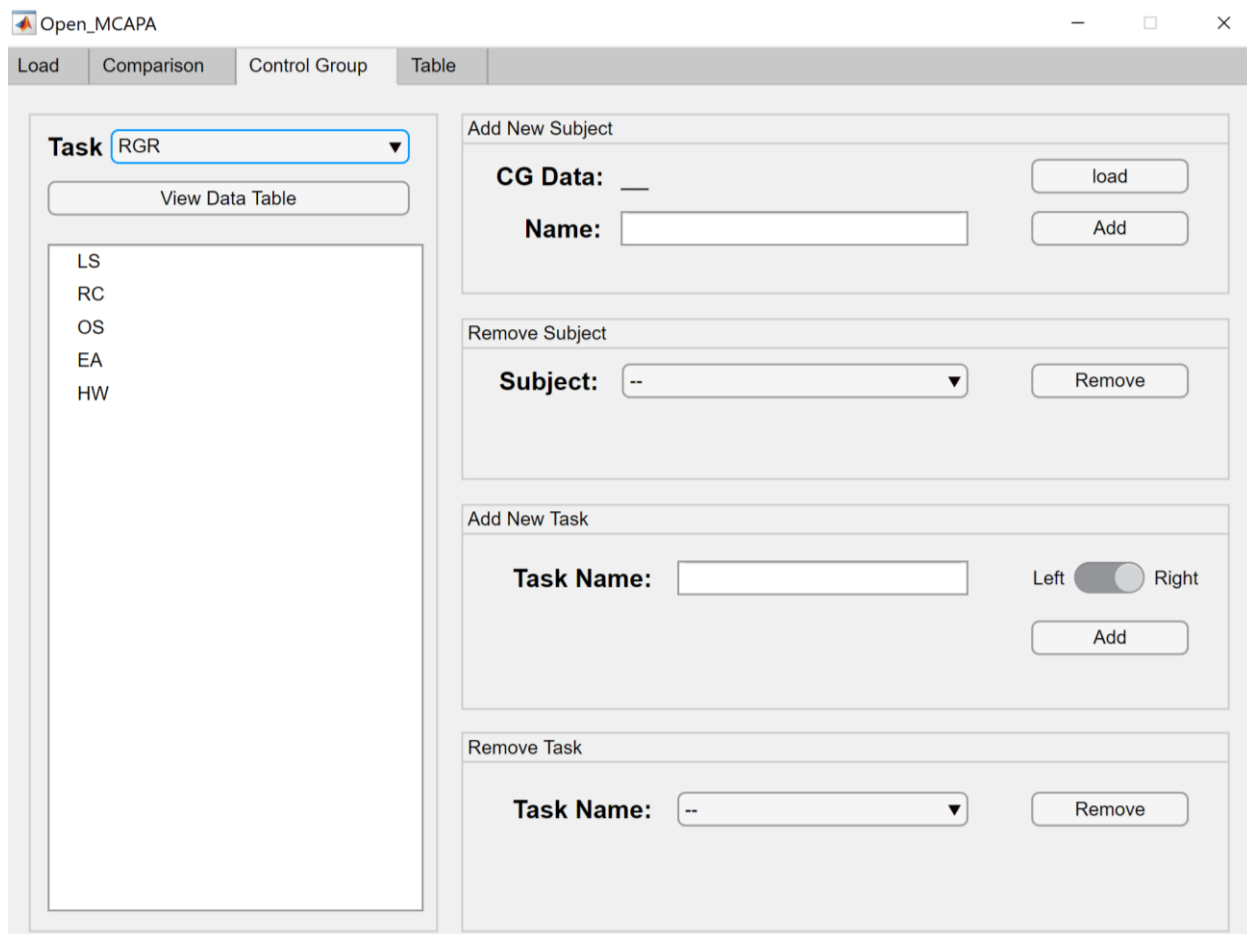
Tick all the data sets to be compared. For the control group (CG), select the task in the drop down next to the tick box. For comparisons between a subject's recent and past captures, select a subject from the 'Subject' drop down if the recent data is imported as one of the five subjects in the 'Load' tab.

Quantitative comparisons are done by pressing the  button, and it's presented as bar plots of maximum and minimum angles and ranges side by side. All joint angles cannot be plotted together for this type of comparison due to visibility issues.

Qualitative comparisons are done by pressing the  button, and it's presented as overlapping line plots of the joint movements.

Control Group

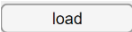
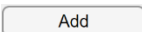
The 'Control Group' tab allows you to manage the control group profiles. You can add or remove subjects from the control group (CG) profiles and view CG angle tables for different tasks. To manage a CG profile, select a task from the 'Task' drop down, and indicate whether to edit the left-handed or the right-handed profile of the task. The list on the left shows all the subjects in the selected profile.



The screenshot shows the 'Open_MCAPA' application window with the 'Control Group' tab selected. The interface is divided into several sections:

- Task Selection:** A dropdown menu labeled 'Task' is set to 'RGR'. Below it is a 'View Data Table' button.
- Subject List:** A list of subjects is displayed: LS, RC, OS, EA, and HW.
- Add New Subject:** A section with a 'CG Data:' label, a 'Name:' input field, and 'load' and 'Add' buttons.
- Remove Subject:** A section with a 'Subject:' dropdown menu (currently showing '--') and a 'Remove' button.
- Add New Task:** A section with a 'Task Name:' input field, a 'Left' toggle switch (which is currently turned on), and a 'Right' label. There is also an 'Add' button.
- Remove Task:** A section with a 'Task Name:' dropdown menu (currently showing '--') and a 'Remove' button.

Adding New CG Subject

To add a subject, first save the data as a *.mat file in the 'Load' tab. Then, press the  button, and a file selection window will pop up. Import the *.mat file, give it an appropriate name and press the  button.

Removing a CG Subject

To remove a subject, select the subject to remove from the drop down, and press the

Remove

Adding New CG Task

To add a new task, enter the task name in the edit field, select the arm used to carry out the task (left/right), and then press the

Add

button. Once the task is added, add the subjects to it using the add new CG subject feature.

Removing a CG Task

To remove a task, select the task to remove from the drop down, and press the

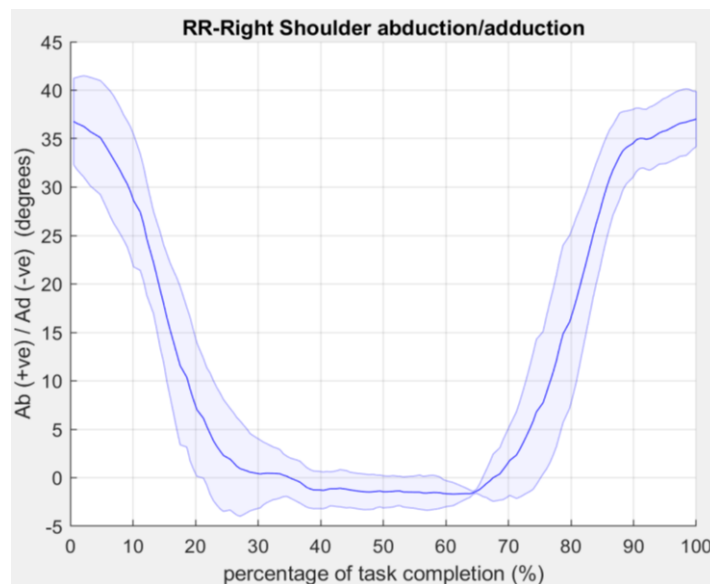
Remove

button.

Additional Info

Interpreting the Plots

For plots with more than one trials included, the solid line in the middle is the median, and the shaded area is the IQR.



Saving Files

When saving a file, make sure the file's name does not begin with a number or contain any symbols other than the underscore (_).

1. Xsens is a 3D motion tracking technology and products development company. Visit Xsens website at www.xsens.com
2. *.mvnx file type is developed by Xsens for their MVN Analyze software.
3. *.mat file type is developed by mathworks containing MATLAB® formatted data.