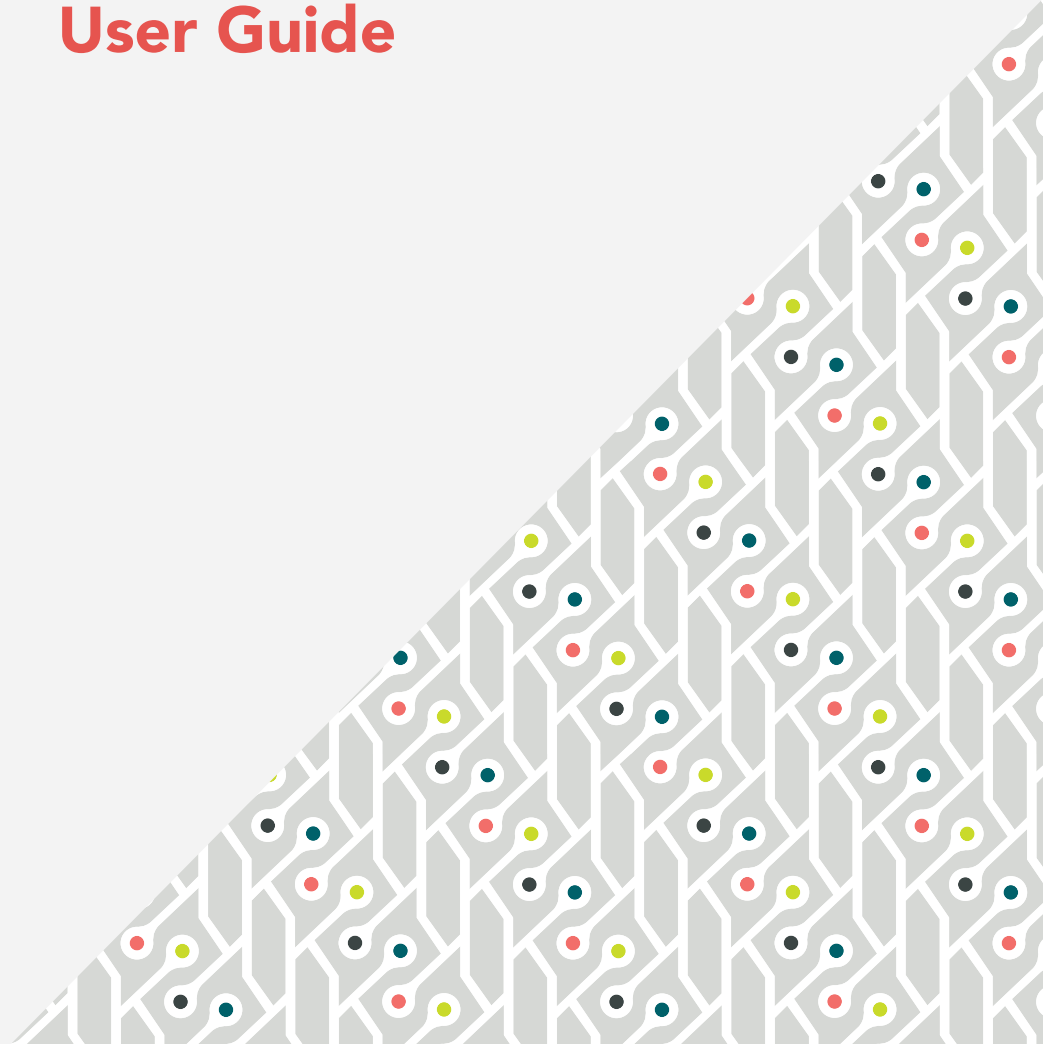


# Kinarm Analysis Scripts 3.1

## User Guide





When installed in accordance with this manual and verified by a BKIN technician, the equipment described in this guide is in conformity with the relevant Essential Health and Safety Requirements of the following Directives:

- 2004/108/EC (relating to electromagnetic compatibility)
- 2006/95/EC (relating to electrical equipment designed for use with certain voltage limits)
- 2006/42/EC (on machinery)

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# 1 Revision History

**Table 1-1: Revision History**

Revision	Description	Date	Approved By
1	Initial release (for Kinarm Analysis Scripts v3.0)	10-Jul-18	IEB
2	Logo Update	3-Dec-19	IEB
3	Conversion to DITA, Updating for version 3.1.0	23-Mar-21	IEB

## 2 Read This First

### 2.1 Conventions

The user information that accompanies the product uses typographical conventions to assist you in finding and understanding information.

- All procedures are numbered and all sub-procedures are lettered. You must complete the steps in the sequence in which they are presented to ensure success.
- Bulleted lists indicate general information and choices related to a function or procedure. They do not imply a sequential procedure.
- Control names and menu items or titles are spelled as they are on the system and they appear in highlighted text.
- Click or select means to move the pointer to an object or menu item and press the primary mouse button.
- Right-click means to point at an item and then press and immediately release the right mouse button without moving the mouse.

**NOTE:** Notes bring your attention to important information that will help you operate the product more effectively.

**ATTENTION:** These notes bring your attention to critical information that will help you operate the product more safely and effectively.

**CAUTION:** Cautions highlight ways you could injure yourself or the subject or damage your product and consequently void your warranty or service contract.

**WARNING:** Warnings highlight information vital to the safety of you, the operator, and the subject.

### 2.2 Audience

This information identifies the audience for the guide. These audience definitions are general in nature.

#### 2.2.1 Researcher

This individual is responsible for creating, running, and analyzing custom task programs. This individual may also be responsible for interpreting the results of standard tests for research purposes.

## 2.3 Customer Comments

If you have questions about the user documentation, or to report an error in the documentation, contact us at:

- support@kinarm.com

Use the term “Documentation” in the subject line and include as much information as possible in the description included in your message.

## 2.4 Customer Service

If you encounter problems with your Kinarm Lab, contact **Kinarm Support** at:

- support@kinarm.com

Software downloads for your Kinarm Lab can be found at:

- <https://www.kinarm.com/support/software-downloads/>

## 3 In This Guide

This guide provides a brief description of the various functions that can be used to load, manage, and analyze Kinarm data in MATLAB.

This document is intended for those users of Dexterit-E™ who wish to analyze their data using MATLAB®. It provides a brief summary of the functions available to assist with Kinarm data analysis. It assumes that the user is familiar with MATLAB. The current version of this library is intended to help load and analyze data collected with Dexterit-E 3.0 and later. Data collected using older versions of Dexterit-E should be imported into Dexterit-E Explorer™ and then re-exported in the Dexterit-E format, or an older version of the Kinarm Analysis Scripts should be used.

## 4 Kinarm Analysis Scripts

A set of basic MATLAB scripts to load Kinarm data into MATLAB for custom analysis is provided on the Kinarm Support website.

### 4.1 Install Kinarm Analysis Scripts

1. Download the Kinarm Analysis scripts from the Kinarm Support website. These are found under the MATLAB section of Software Downloads page.
2. In Windows Explorer navigate to **Documents** -> **MATLAB**.
3. In the MATLAB folder create a new folder called **Kinarm Analysis Scripts**.
4. Unzip and copy the contents of the Kinarm Analysis Scripts ZIP file into the **Kinarm Analysis scripts** folder you just created.
5. In MATLAB select **Set Path**.
6. Add the **Kinarm Analysis Scripts** folder you created to the MATLAB path.



## 5 Summary of Kinarm Analysis Scripts

The various functions that are provided by Kinarm have been grouped according to their purpose. Each function has detailed usage information embedded in the function.

To access the embedded information, at the MATLAB prompt, type:

```
help <function_name>
```

### 5.1 Load Data Into MATLAB

Table 5-1: Primary Function to Load Data

Name	Purpose
<code>zip_load</code>	This function is used to load Kinarm data into MATLAB. It can be used to load a single data file or multiple data files and can accept various arguments to control which files are loaded and from where. This function can be used to load both ZIP files (generated by Dexterit-E 3.8 and earlier) and KINARM format exam files (generated by Dexterit-E 3.9 and later).
<code>exam_load</code>	This function is identical to <code>zip_load</code> . This version of the function was created to help recognize that some exam files are ZIP files and some are KINARM files.

### 5.2 Derive Further Kinematics/Informatics

Table 5-2: Functions to Add/Modify Data (Sheet 1 of 2)

Name	Purpose
<code>add_video_latency</code>	Add estimates of minimum and maximum video latency based on the recorded times of visual stimuli, send commands and acknowledgements, display latency, and also on constraints imposed by the display's refresh rate.
<code>filter_double_pass</code> (previously <code>c3d_filter_dblpass</code> )	Filter all floating-point data. These data include all kinematic data, as well as analog channels. Integer data will not be filtered.
<code>KINARM_add_COP</code>	Add center of pressure position and velocity to the data structure for Kinarm End-Point (EP) Labs with force-plates.

**Table 5-2: Functions to Add/Modify Data (Continued) (Sheet 2 of 2)**

Name	Purpose
<code>KINARM_add_friction</code>	Add estimates of Kinarm friction. This function should be called PRIOR to filtering data. When present, these friction estimates will be used by <code>KINARM_add_torques</code> (i.e. to calculate the forces applied to a subject and the intramuscular torques).
<code>KINARM_add_hand_kinematics</code>	Add the hand velocities, accelerations, and commanded forces (in global coordinates) to the data structure. These values are calculated from the joint-based versions that are automatically saved as part of the data.
<code>KINARM_add_sho_elb</code>	Adds angles, velocities and accelerations for the shoulder and elbow in a local frame of reference. This function does nothing with Kinarm End-Point Lab data.
<code>KINARM_add_subject_inertia</code>	Add estimates of the subject arm inertia to the data structure (for Kinarm exoskeleton robots). When present, these estimates will be used by <code>KINARM_add_torques</code> to calculate the intramuscular torques.
<code>KINARM_add_torques</code>	Calculate intramuscular and applied torques (for Kinarm exoskeleton robots) or applied forces at the hand (for Kinarm end-point (EP) robots), and add these to the data structure. Because the equations to calculate these parameters utilize acceleration, the data should be filtered PRIOR to using this function.
<code>KINARM_add_trough_inertia</code>	<p>Add estimates of arm trough inertia to the data structure (for Kinarm exoskeleton robots). When present, these estimates will be used by <code>KINARM_add_torques</code> to calculate the intramuscular torques. This function requires an arm trough database (e.g. created by <code>KINARM_create_trough_database</code>) and uses <code>KINARM_combine_inertias</code>.</p> <p><b>NOTE:</b> This function can also be used to add extra inertia for a Kinarm end-point (EP) robot (e.g. a custom handle).</p>

## 5.3 Utility Functions

**Table 5-3: General Utility Functions**

Name	Purpose
<code>KINARM_combine_inertias</code>	Combine two inertias (e.g. hand trough and forearm trough for a Kinarm exoskeleton robot) into a single inertia that can be used by <code>KINARM_add_torque</code> .
<code>KINARM_create_trough_database</code>	Create a sample database of trough inertias (which is required to use to the <code>KINARM_add_trough_inertia</code> function). <b>NOTE:</b> This function can be used as a template to create a custom database (e.g. for a custom Kinarm end-point (EP) handle).
<code>sort_trials</code>	Sort the trials according to various options. <b>NOTE:</b> This function is called by <code>zip_load</code> to sort the trials by execution order.
<code>suptitle</code>	Create a "super title" for a figure that contains multiple sub-plots (this function is utilized by the sample scripts).

## 5.4 Sample Scripts

**Table 5-4: Sample MATLAB Scripts**

Name	Purpose
<code>demo_calc_im_torques</code>	This script shows the steps required to calculate intra-muscular torques when data is collected with a Kinarm Exoskeleton style lab.
<code>demo_calc_visual_stimulus_time</code>	This function demonstrates how to calculate the actual time that a visual stimulus was presented to the subject.
<code>demo_zip_load</code>	Sample code that demonstrates some of the basic functionality of the Kinarm Analysis Scripts.

## 6 Deprecated MATLAB Functions

Various functions have been deprecated and are no longer supported. Do not attempt to call these functions.

**Table 6-1: Deprecated Functions**

Name	Purpose
<code>c3d_add_video_latency</code>	Renamed <code>add_video_latency</code> .
<code>c3d_filter_dblpass</code>	Renamed <code>filter_double_pass</code> .
<code>c3d_load</code>	This function was previously called by <code>zip_load</code> . It is now embedded in <code>zip_load</code> .
<code>c3d_load_single_file</code>	This function was previously called by <code>c3d_load</code> . It is now embedded in <code>zip_load</code> .
<code>correctXTorque</code>	This function was previously called by <code>zip_load</code> . It is now embedded in <code>zip_load</code> .