JACOSOFT - User guide

kinova

V1.4.1

ABOUT THIS DOCUMENT

This document was written for the 3.2.5.3 version of Jacosoft but may be used for the previous and subsequent versions.

 Read all instructions before using this product.

 Keep these instructions for future reference.

This document contains information regarding the use of Jacosoft, a program devoted to facilitate the configuration and maintenance of Kinova's JACO arm. This document is intended for:

- JACO users;
- Field service, customer support and sales employees of authorized distributor of JACO.

Symbols, definitions and acronyms

 Important information regarding the safety of Kinova's products and their operator.

 Tip on the maintenance, operation and manipulation of Kinova's products.

General Information

Jacosoft is a software programming tool that can edit, read, write and store the JACO arm configuration parameters and help troubleshoot problems with the JACO arm.

Jacosoft can only be used if the computer on which it is installed is connected to the JACO arm with the USB cable provided by Kinova.

This document contains detailed information on the installation and the use of Jacosoft.

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SOFTWARE INSTALLATION

To be ready to use Jacosoft on your computer, you must:

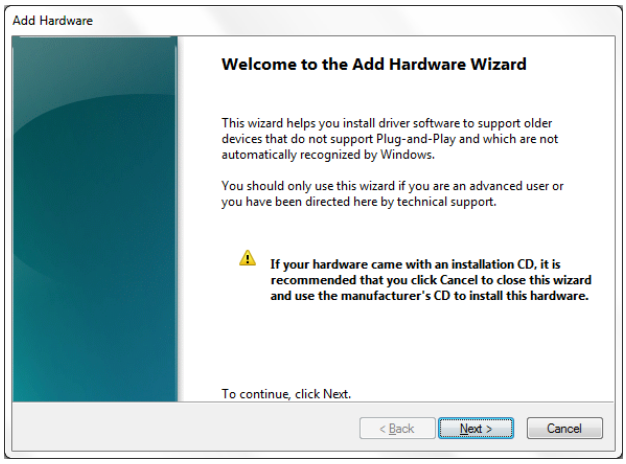
1. Install the driver;
2. Install the software;
3. Enter the licence.

If you want to update the software, please refer to the Software update section (p. 7).

The figures and terms used in this document are dependant of the computer's operating system and version. The terms you will encounter may differ of what is presented in this document.

Driver installation

1. Plug your JACO arm in your computer using the USB cable provided by Kinova. The following window should appear:

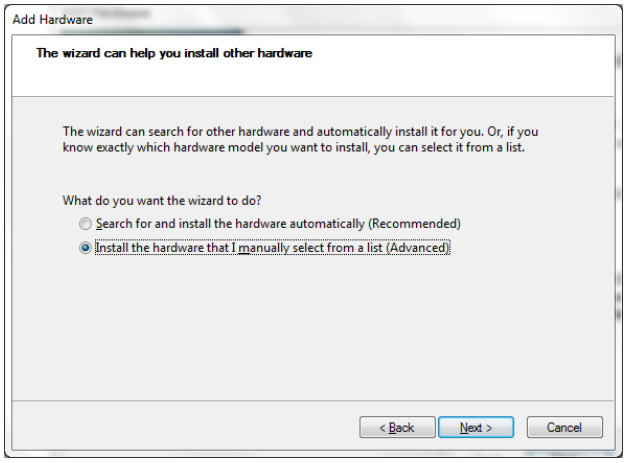


If this window doesn't appear :

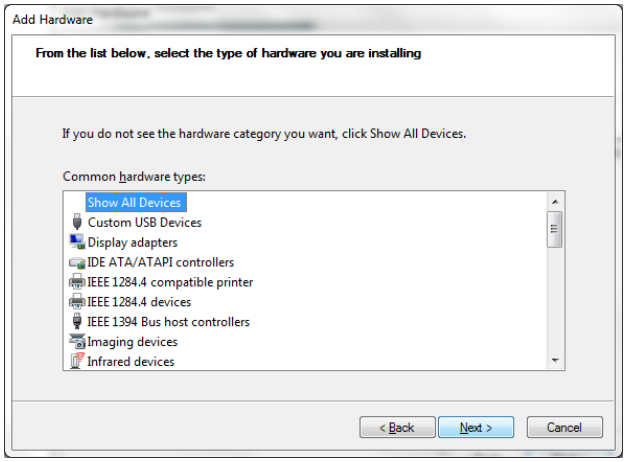
a. Go on the Start menu, choose: program/ accessories / command prompt.
b. Enter the following command: **hdwwiz**.

The previous window should appear.

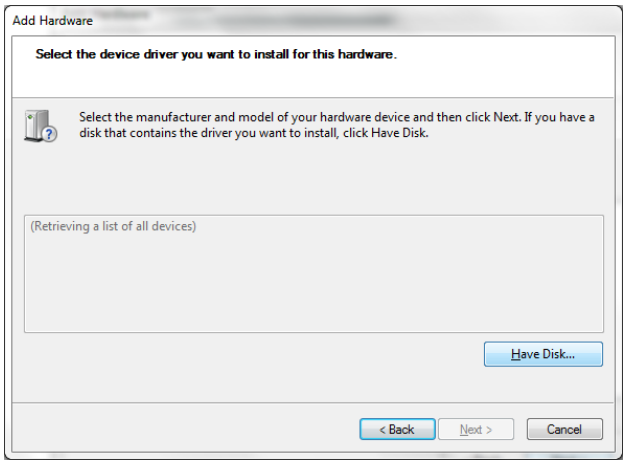
2. Click on **Next**. The following window should appear:



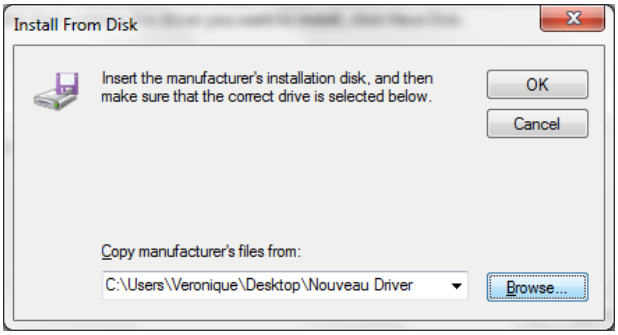
3. Choose "**Install the hardware that I manually select from a list**".
4. Click on **Next**. The following window should appear:



5. Choose "**Show All Devices**".
6. Click on **Next**. The following window should appear:



7. Click on **Have Disk…** The following window should appear:



8. Click on **Browse** and get the JACO driver in the specified folder.
   - The folder should be called "**1 - JACO Drivers**" and found in the Jacosoft package.
9. Click on **OK**.

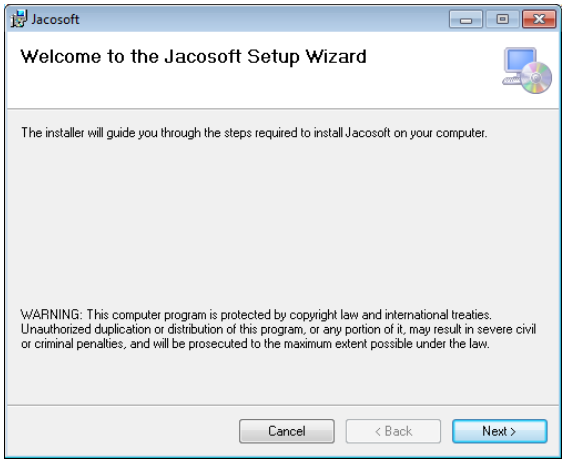
The driver has been installed.
You must now install the Jacosoft software.

Software installation

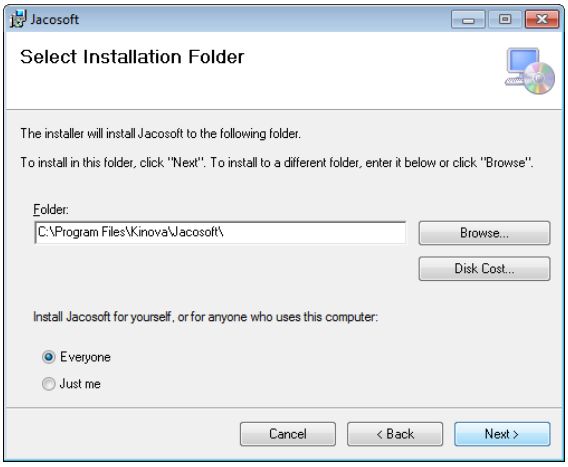
1. Open the folder called "**2 – Jacosoft [X.X.X.X]**"

The [X.X.X.X] represent the Jacosoft version of the Jacosoft package.

2. Double-click on the "**JacosoftInstaller**" item. The following window should appear:



3. Click on **Next**. The following window should appear :



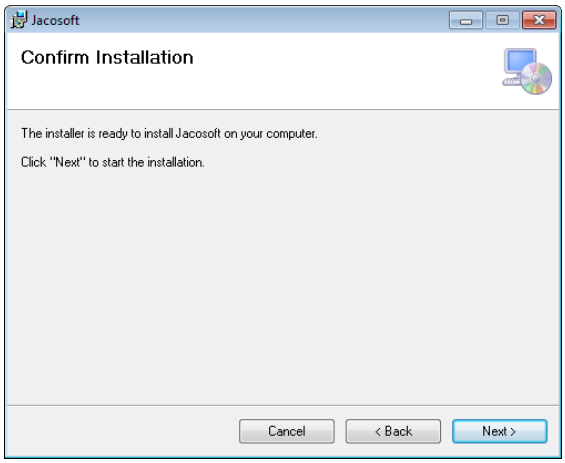
FOR THE ADMINISTRATOR ACCOUNT

4. Be sure the chosen folder is located on the disk C:\
5. Select **Everyone**.

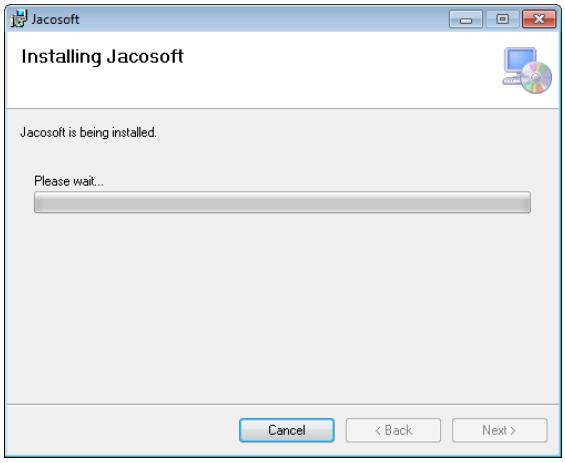
FOR ANY OTHER USER ACCOUNTS

4. Windows will ask to indicate the path to the installation (.msi) folder. This folder is located in the folder specified in step 1.
5. Windows will ask the administrator password to proceed with the installation. You must provide it.

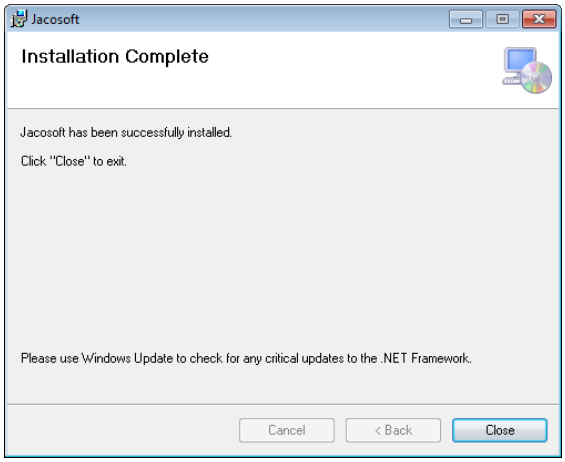
6. Click on **Next**. The following window should appear :



7. Click on **Next**. The following window should appear:



8. Wait until the installation is complete.
9. Click on **Next**. The following window should appear:



10. Click on **Close**.

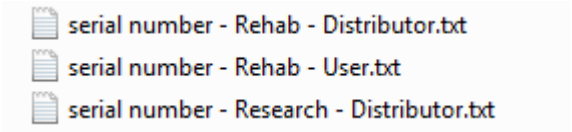
The software installation is completed.

In order to use the software, you must install the licence.

Licence

1. Find your Jacosoft licence.

   - The Jacosoft licence is included in the Jacosoft package and is presented as a ".txt" file. The licence can take one of the following forms:



2. Double-click on the text file. A text file with the licence will open.

The licence is a 6x5 alphanumeric code that will define the access you'll have of the tab menu.

3. Copy the entire 30 digits of the licence.

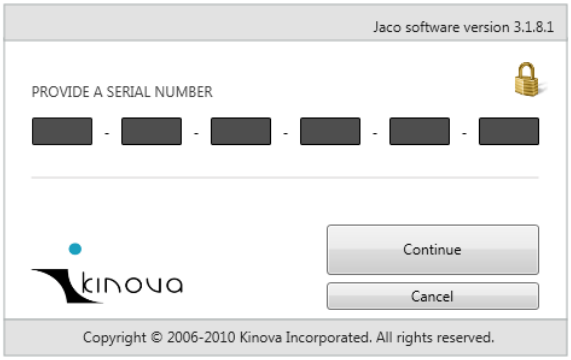
You may copy the entire licence by following those two simple steps:

a. Simultaneously hold the Ctrl + A buttons;

b. Simultaneously hold the Ctlr + C buttons.

4. Open Jacosoft by clicking on the following icon. This icon should be available on your desktop.

- When opening the software for the first time, the following window should appear:



5. Copy the licence number by holding the Ctrl + V button simultaneously.
6. Click on **Continue**.

The installation process is over and Jacosoft is now ready to be used.

You should verify the connection of the software with JACO.

a. Power your JACO;

b. Connect JACO to the PC with the USB cable provided;

The communication status light should turn to green.

Software update

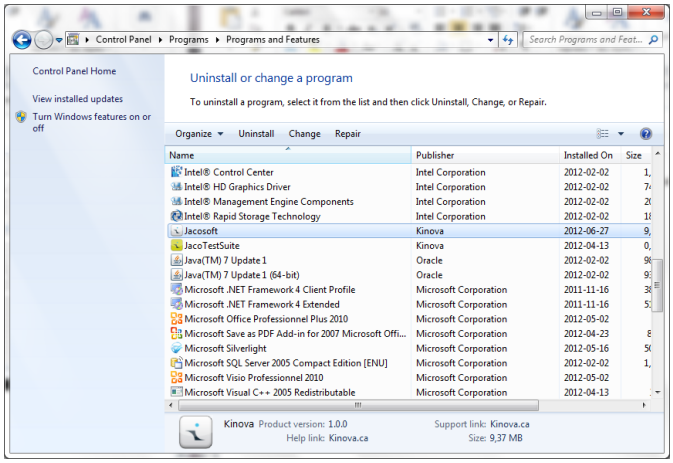
To install a new version of Jacosoft, you must:

1. Uninstall the software;
2. Erase the licence;
3. Proceed with the new Jacosoft version and licence installation.

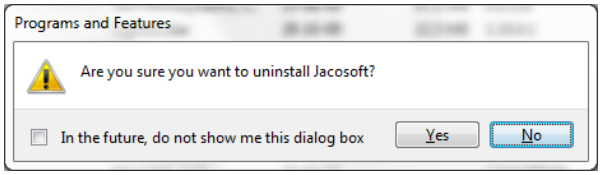
The driver does not need any modification.

UNINSTALL JACOSOFT

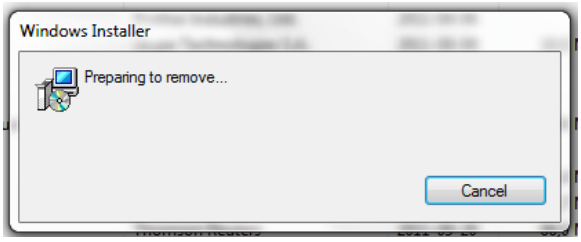
1. Go in the Start menu of the computer and choose “Control Panel/Programs/Uninstall a program”. The following window should appear:



2. Double-click on the **Jacosoft** item. The following window should appear:



3. Click on **Yes**. The following window should appear:



Jacosoft has been uninstalled.

You must now erase the licence.

ERASE THE LICENCE

You must manually erase the folder [Licences] and all of its content in:

- The administrator account
- Every other user account

1. With the Explorer, open the folder in which are located the Jacosoft licences

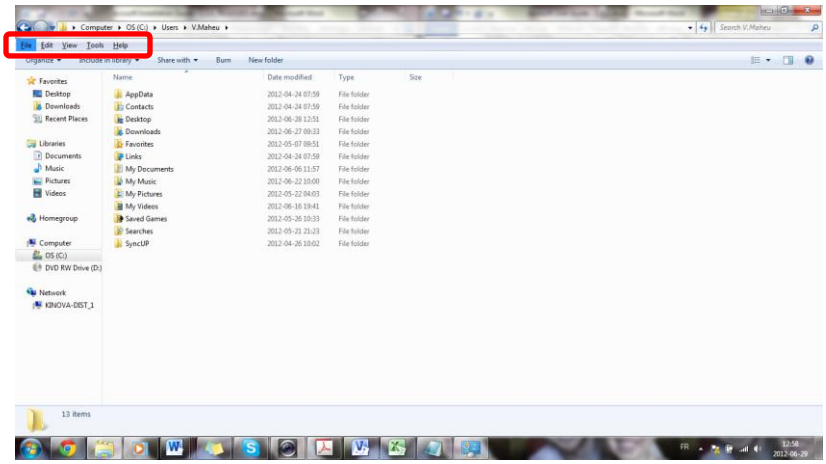
   - For WINDOWS XP and VISTA
     C:\Documents and Settings\YourUserName\Application Data\Kinova\Products\Licenses\.

   - For WINDOWS 7
     C:\YourUserName\App Data\Roaming\Kinova\Products\Licences\.

The folder **App Data** is a hidden folder. It may not appear automatically in the explorer window. To access the **App Data** folder, you must:

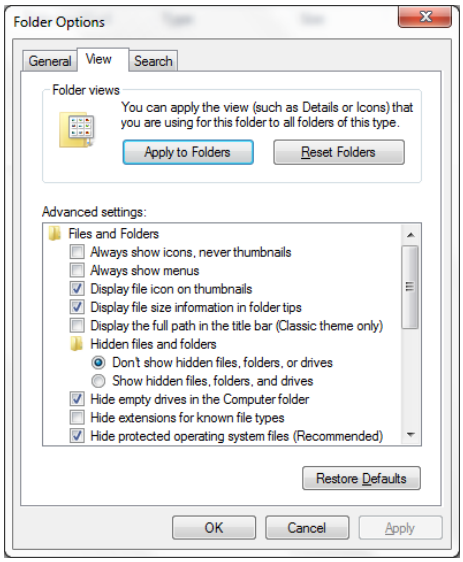
a. Access the **User** folder (YourUserName) as defined in the preceding path;

b. Press the Alt button. The following menu (red square) should apprear:



c. Select **Tools/Folder options**.

d. Click on the **View** tab. The following window should appear:



e. Select "**Show hidden files, folder and drives**".

The **App Data** folder should now appear.

2. Select all the items of this folder.

3. Erase the items by simultaneously clicking on the Ctrl + Alt + Del buttons.

JACOSOFT – OVERVIEW

When the JACO arm is powered, there may be a delay before the communication with the software is established.

Anytime you change the information, you must press on the **SEND** button. If you change tab without saving the information, they will be lost.

Licence and access

The access to the different tabs is defined by the licence type. The following figure presents the tab to which each licence gives access.

	ACADEMIC	REHAB	USER
Main menu	✓	✓	✓
General Information	✓	✓	
Configurations	✓	✓	
Protection zones	✓	✓	
Trajectory	✓		
Diagnosis	✓	✓	✓

JACOSOFT MAIN MENU

File

The **File/Profile** menu will allow you to proceed with the following actions:

- Load : Import a previously « saved » configuration;
- Save : Save a configuration in a hidden folder and give a name to that configuration;
- Import : Import a previously « exported » configuration;
- Export : Save a configuration in a specified folder.

You must “Save” a profile in order to give it a name before exporting it. You cannot “Export” a profile and name it.

Options

The **Options/Advance/Restore Factory Default** will allow resetting the default configurations (factory parameters) to the JACO arm.

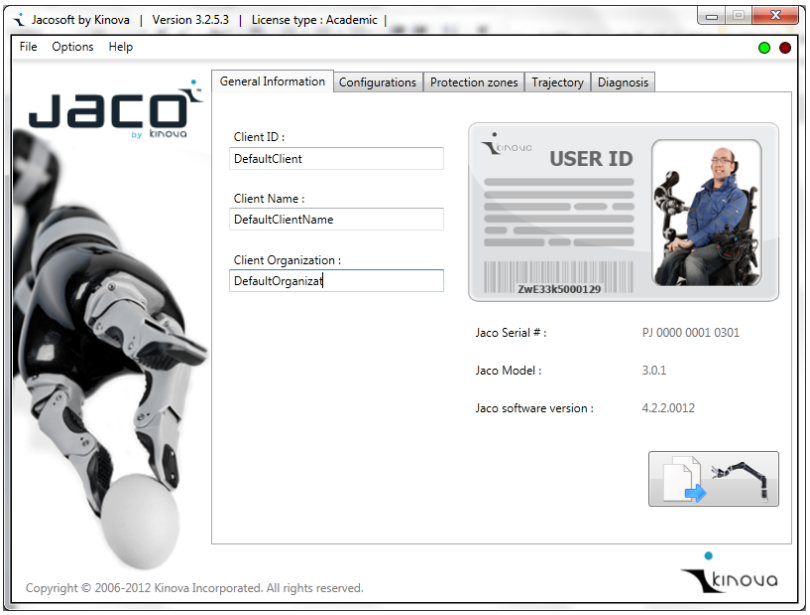
The default configurations will reset the protection zones.

The JACO arm is right handed in its default configuration.

The mapping will also be reset to its default configuration.

GENERAL INFORMATION TAB

The following figure shows the General Information tab:



In the General information tab, you may enter the following information on the JACO arm user:

- Client ID : the client/user's identification;
- Client Name : the client/user's name;
- Client Organisation : the client/user's organization.

In this tab, you will also find important information concerning JACO:

- Jaco Serial # : JACO's serial number;
- Jaco Model : JACO's model version;
- Jaco Software Version : JACO's software version.

You may not modify that information as it is permanent and necessary to your JACO identification.

Don't forget to save your information by pressing on the **SEND** button. If you change tab before pressing the **SEND** button, the newly change data will be lost.

CONFIGURATIONS TAB

The Configurations tab contains two sub tabs which will be explained in the following sections:

- Positioning tab;
- Control tab (including Mapping info).

Configurations/Positioning tab

The following figure shows the Configurations/Positioning tab.

The Positioning tab allows you to configure the following parameters:

- Laterality : the JACO arm laterality (left- or right-handedness);
- Retracted angle : the retracted angle of the RETRACT position[1] of JACO (Retract Positioning (simple mode));
- Retracted trajectory : the HOME position, the RETRACT position and the trajectory between those positions (Retract Positioning (advance mode)).

[1] The RETRACT position refers to the position occupied by the JACO arm when it is not in use. The RETRACT position allows minimizing the physical volume occupied by the JACO arm and its electrical consumption.

Don't forget to save your information by pressing on the **SEND** button. If you change tab before pressing the **SEND** button, the newly changed data will be lost.

LATERALITY

The JACO arm laterality is defined by the position of the arm in reference to its user.

The default configuration of the JACO arm is right-handed. When the JACO arm is bought as left-handed, the fingers #2 and #3 are inverted to perform an effective grip. In this case, the option: **Fingers #2 and #3 inverted** must be selected. It is important to do this selection if you want to conserve all of JACO's functionality.

The selection of **Fingers #2 and #3 inverted** is a software modification which allows JACO's thumb (Finger #1) to move in accordance with Finger #3 instead of Finger #2.

The physical shift of Finger #1 must be done for the grip to perform.

RETRACT POSITIONING SIMPLE (SIMPLE MODE)

The RETRACT position angle may be selected by pressing either one of the following arrows  . The JACO figure will move accordingly to your choice.

You may save the information by pressing the **SEND** button and try the RETRACT position by accessing the HOME/RETRACT function (see the JACO User Guide).

The RETRACT position configuration may interfere with the protection zones. If the arm won't move from the RETRACT position after its configuration, you must reconfigure it.

RETRACT POSITIONING (ADVANCE MODE)

The configuration of the RETRACT position with the advance mode will allow defining a sequence of positions (RETRACT trajectory) that will be reached by the JACO arm (see the JACO User Guide for more details).

To configure an advance RETRACT position, you will need to move the JACO arm with the controller. You may choose to control the arm using Cartesian or Angular mode.

- The Cartesian mode refers to the movements of JACO through normal control (see User Guide).
- The Angular operation mode will allow reaching some non-conventional positions. The control is achieved by moving each axis independently with the controller. To achieve an Angular control, please press on the Angular button.

The Angular operation mode will disable all the security elements inherent to the control of the JACO arm.

The Angular operation mode should only be used by experimented technicians.

To configure an advance RETRACT position, please go through the following steps:

1. Enable the advance RETRACT mode by selecting the **Enable** case.
2. Bring the JACO arm in its desired RETRACT position with the controller.
3. Press on the **Add** button.
4. Repeat steps #2 and #3 for all the positions you wish to integrate in the RETRACT trajectory.
5. Save the information with the **SEND** button.

The RETRACT position is the first position to be added when configuring a retraction trajectory (RETRACT Position – Advanced).

If some positions need to be moved up or down in the retraction trajectory, you may click on the position and move it accordingly with the following arrows .

The RETRACT position configuration may interfere with the protection zones. If the arm won't move from the RETRACT position after its configuration, please reconfigure it.

Configurations/Control tab

The following figure shows the Configurations/Control tab.

In the **Control** tab, you may configure the following parameters:

- Sensitivity : Kinova's joystick sensitivity
- Permitted speed [4-15 cm] : the maximal linear speed of JACO's movements
- Drinking mode : the drinking mode parameters

Don't forget to save your information by pressing on the **SEND** button. If you change tab before pressing the **SEND** button, the newly change data will be lost.

SENSITIVITY

The Sensitivity parameter allows you to increase/decrease Kinova's joystick sensitivity in relation to JACO's movement.

The sensitivity is adjusted by moving the pointer towards the right (increase sensitivity) or the left (decrease sensitivity). If the sensitivity is minimal (100%), the controller responds with great proportionality. If the sensitivity is maximal (1000%), the controller responds with no proportionality.

The SENSITIVITY parameter is only effective for the Kinova joystick.

PERMITTED MAX SPEED

The speed parameter is related to the linear displacement of the JACO arm's hand and is defined in centimeters per second (cm/s).

The maximum speed is adjusted by entering a number going from 4 to 15, 15 being the maximum speed permitted by JACO. For this setting, please follow the following advices:

- Increment the speed with the user's experiment with the JACO arm;
- For a non-experimented user, set a maximal speed of 4 to 7 cm/s;
- For an experimented user who's control lack of dexterity or proportionality, set a maximal speed of 10 to 12 cm/s;
- Only use a maximal speed of 15 cm/s with users who have experience, a proportional and dexterous control over the JACO arm.

DRINKING

The drinking mode shifts in height (Height of the glass) and in distance (Radius of the glass) the center of rotation of the wrist[2]. It compensate when the user drinks directly from a glass or a bottle.

- Height of the glass : refers to the height of the bottle/glass neck in reference to JACO's hand.
- Radius of the glass : refers to the glass/bottle radius.

The DRINKING parameters must be set for a precise glass or bottle. Once those parameters are set, the user should always use the same glass and grip it from the same place (height).

Configurations/Control/Mapping Info tab

In the Mapping info tab, you may configure many aspect of the controller used to operate the JACO arm. The Mapping info tab refers to many aspect of the control that will be explained in the following sections. Appendix 1 presents a step-by-step example for configuration of the mapping.

The Mapping info tab may be accessed by the **Mapping info** button located on the right side of the window. After pressing on **Mapping info** button, the following window should appear:

[2] Please refer to the JACO User Guide for detailed information on the drinking mode.

To configure the JACO control parameters, you must:

1. Choose the interface that is used in the **Charts** menu;
2. Define the quantity of control modes that will be used and classify them under the available mode lists (List A and List B);
3. For each control mode (**Modes**), you must define the functionalities associated with the controller events (**Control Stick Events**) and controller push buttons (**Control Buttons Events**).

Don't forget to save your information by pressing on the **SEND** button. If you change tab before pressing the **SEND** button, the newly change data will be lost.

CHARTS

The Charts tab will allow you to choose the interface used[3] by the user. The following list of interface is available:

- Joystick 3-Axis : refers to Kinova's joystick, used in 3-Axis operation mode.
- Joystick 2-Axis : refers to Kinova's joystick, used in 2-Axis operation mode.
- API Interface[4] : refers to the programming interface of the JACO arm.
- Easy Rider Interface : refers to a multiple control system available on some wheelchairs and distributed by HMC.
- Universal Interface : refers to the electronic box distributed by Kinova and used to control the JACO arm through the wheelchair controller (See the Universal Interface User Guide).

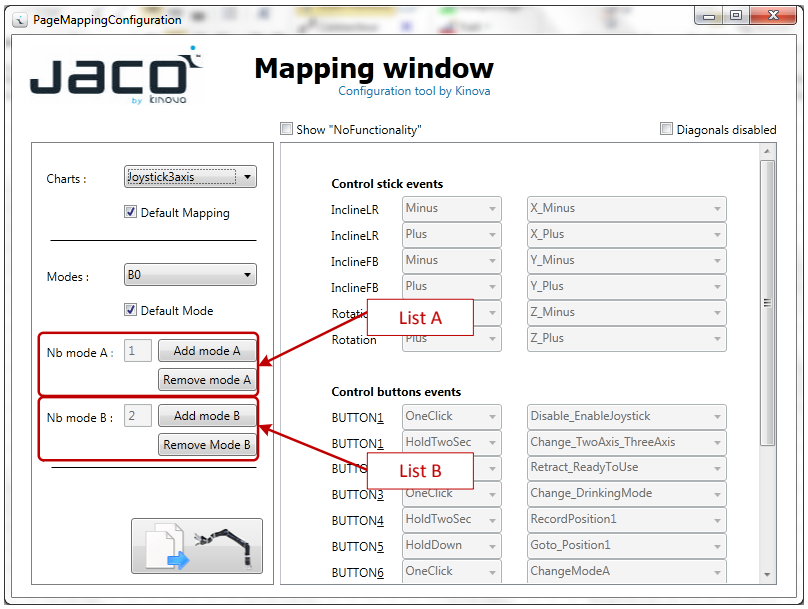
The **Default Mapping** option is used to indicate that the interface (Charts) chosen will be the one accessible at JACO start-up. Only one Chart may be chosen for **Default Mapping.**

MODES

The control modes (**Modes**) defined for the control of the JACO arm may be classified into two independent lists (**List A** and **List B**). For each list, you may enable and configure a maximum of 6 different control modes. Therefore, a maximum of 12 control modes may be used to operate the JACO arm. The following figure shows the location of the two lists.

[3] If you can't decide which interface is used, please contact Kinova for technical support at Support@KinovaRobotics.com

[4] The "API Interface" chart is not available to the rehabilitation market.



The **Add mode A** and **Remove mode A** buttons are used to, respectively, add and remove operation modes in List A while the **Add mode B** and **Remove mode B** buttons are used to, respectively, add and remove operation modes in List B.

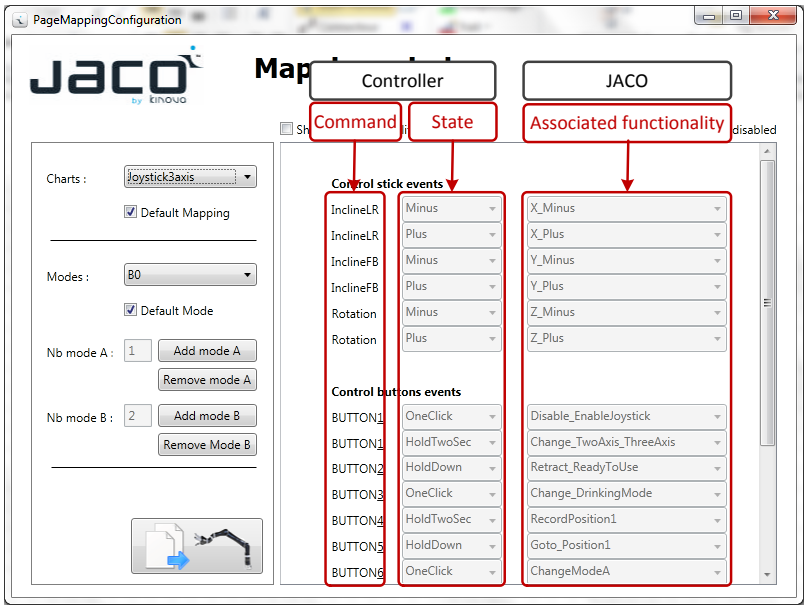
The **Default Mode** option is used to indicate that the control mode chosen will be the one accessible at JACO start-up. Only one Mode may be chosen for **Default Mode.**

The **Retract_ReadyToUse** function must be available in the **Default Mode**.

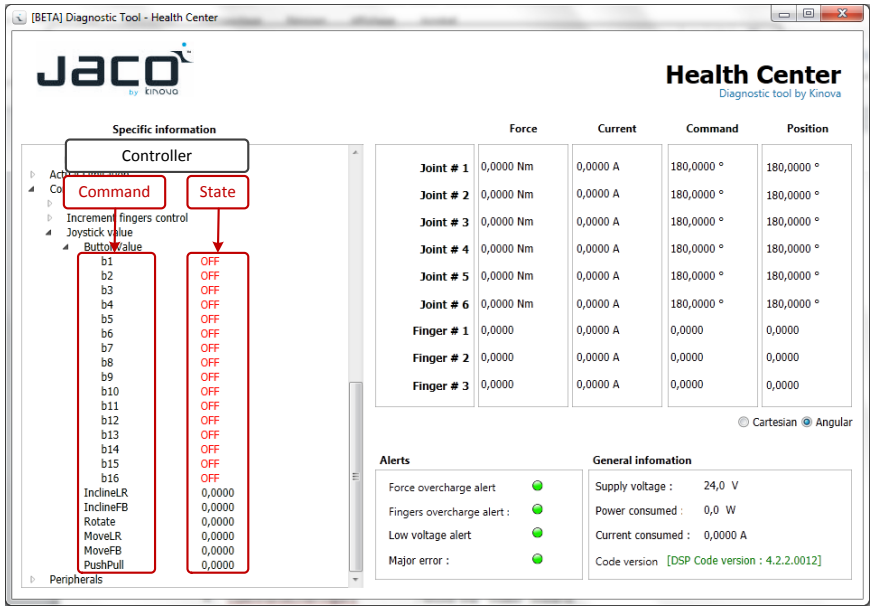
CONTROLLER FUNCTIONALITIES

The control over JACO is divided into three categories:

- The controller's command
- The controller's state
- The JACO associated functionalities



To define your controller's associated **Commands** and **States**, please refer to the Health Center (Diagnosis tab) under the Control/Joystick Value menu as shown in the following figure. The **Commands** and **States** associated with Kinova's joystick and Universal Interface are respectively defined in Appendix 2 and 3.



CONTROL STICK EVENTS

Only the following JACO's basic movements[5] may be associated with the Control Stick Events:

PREFIXE	PLUS	MINUS
X_	Right translation of the hand	Left translation of the hand
Y_	Front translation of the hand	Back translation of the hand
Z_	Up translation of the hand	Down translation of the hand
Xteta_	Left lateral orientation of the hand	Right lateral orientation of the hand
Yteta_	Top vertical orientation of the hand	Bottom vertical orientation of the hand
Zteta_	Rotation of the wrist	Rotation of the wrist

- OpenHandOneFingers : Move the "index" outward.
- CloseHandOneFingers : Move the "index" inward.
- OpenHandTwoFingers : Move Finger #1 and the "index" outward.
- CloseHandTwoFingers : Move Finger #1 and the "index" inward.
- OpenHandThreeFingers : Move three fingers outward.
- CloseHandThreeFingers : Move three fingers inward.

Those functionalities may not be associated with the values read in the JACO Health Center.

Please note that Jacosoft was designed to configure the totality of the control parameters. However, your JACO version may not support those functionalities. If the configuration you are trying to save won't work, please contact Kinova for technical support.

CONTROL BUTTONS EVENTS

The 6 following states can be associated to each buttons:

- OneClick : Push and release the button.
- HoldOneSec : Push on the button for a whole second.
- HoldTwoSec : Push on the button for two seconds.

[5] For a complementary list on the JACO Functionalities, please refer to the JACO User Guide.

- HoldThreeSec : Push on the button for three seconds.
- HoldFourSec : Push on the button for four seconds.
- HoldDown : Push on the button until the desired position is reached or when the functionality has ended.

If the "HoldDown" state is configured for a button, no other state may be configured for this button.

The **JACO Functionalities** associated to the button **Commands** are the JACO movements (defined above) and the following additional functions:

- Disable_Enable_Joystick : Enable or disable the controller.
- Retract_ReadyToUse : Reach the HOME or the RETRACT position.
- Change_TwoAxis_ThreeAxis[6] : Toggle between the 2- or 3-Axis operation modes.
- Change_DrinkingMode : Enable or disable the drinking mode.
- ChangeModeA[7] : Toggle between the modes of list A.
- ChangeModeB[8] : Toggle between the modes of list B.
- DecreaseSpeed : Decrease the JACO arm speed to its minimum (4 cm/s).
- IncreaseSpeed : Increase the JACO arm speed to its maximum permitted speed (defined in the Configurations/Control tab).
- Goto_PositionX[9] : Go to the previously recorded predefined position X.
- RecordPositionX : Record the predefined position X.

Please note that Jacosoft was designed to configure the totality of the control parameters. However, your JACO version may not support those functionalities. If the configuration you are trying to save won't work, please contact Kinova for technical support.

DIAGONALS

To disable the diagonal movements of the controller, select the Diagonals Disabled option.

[6] Only available with the Kinova joystick.
[7] ChangeModeA was listed as ChangeMode_Left in Jacosoft's older versions.
[8] ChangeModeB was listed as ChangeMode_Right in Jacosoft's older versions.
[9] Only use with "HoldDown".

Diagonals should be disabled for finger movements.

Diagonals should be disabled when 2 movements that can't be controlled simultaneously are joined in the same operation mode.

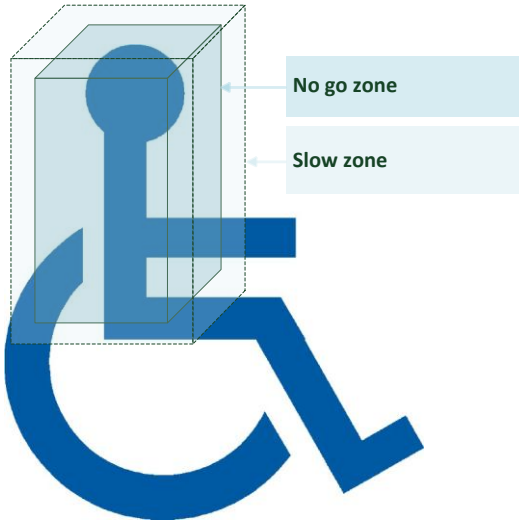
NO FUNCTIONALITY

To show the totality of the configurable commands, check the Show ''No Functionality'' box.

PROTECTION ZONES TAB

The following figure shows the Protection Zones tab.

The Protection Zones tab allows you to configure a protection zone around the user. There are two specific zones that may be configured: the No Go and the Slow zones.



The protection zone represents a compromise between the user's mobility and the possibility of JACO to access the area near his/her head. Once the protection zone is set, it should be validated thoroughly by the user to make sure it suits his/her daily needs.

Don't forget to save your information by pressing on the **SEND** button. If you change tab before pressing the **SEND** button, the newly change data will be lost.

No Go Zone

No parts of the JACO arm are allowed to enter the No Go Zone. To configure the No Go Zone, you must follow the following directives:

1. Bring the JACO arm's fingertip near the user's mouth.

The "Mouth Position" should always be reached by a qualified technician using Kinova's joystick.

2. Press on the 

button to determine the No Go Zone front limit.

There exist an approximate shift of 4 cm between the position where the No Go Zone is set and where it actually begins.

To set a No Go Zone that begins at the user's face, you may open the fingers to their maximum opening range and surround the user's mouth with the hand before pressing the GET ACTUAL POSITION button.

3. Measure the distance of elements 1, 2, 3 et 4 :

   - Element #1 refers to the user's head diameter in cm.
   - Element #2 refers to the user's face height in cm.
   - Element #3 refers to the distance between the user's chin and hips in cm.
   - Element #4 refers to the user's shoulders in cm.

The No Go Zone is extremely important for the user's safety. The user should never use the JACO arm if this zone is not configured.

Slow Zone

The Slow Zone refers to a virtual border located around the No Go Zone. The JACO arm will slow its movements when entering the Slow Zone and will stop at the No Go Zone. To configure the Slow Zone, you must:

1. Define the Slow Zone thickness :

   - Move the cursor toward the left (decrease thickness) or the right (increase thickness).
   - The Slow Zone thickness will be displayed in cm.

2. Define the Slow Zone speed :

   - Move the cursor toward the left (decrease speed) or the right (increase speed).
   - The Slow Zone speed will be displayed according to a % referring to the fraction of the maximum speed configured in the Control tab[10].

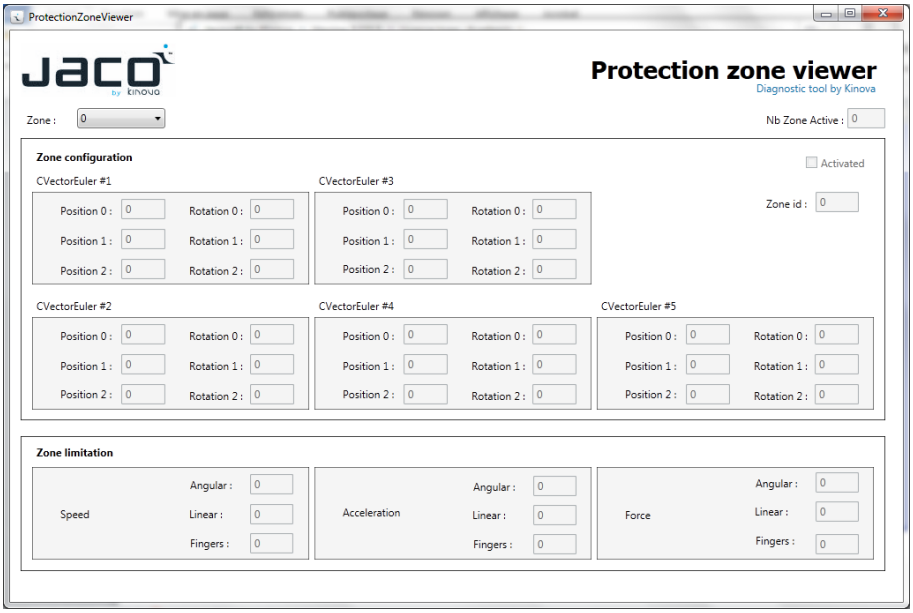
Delete all zones

The Delete all zones button allows you to erase all the information saved in the JACO arm concerning the protection zones.

The Protection Zones must be deleted before being changed.

Show Viewer

The Show Viewer button allows you to display the following window. This windows shows the data saved concenring the protection zones.

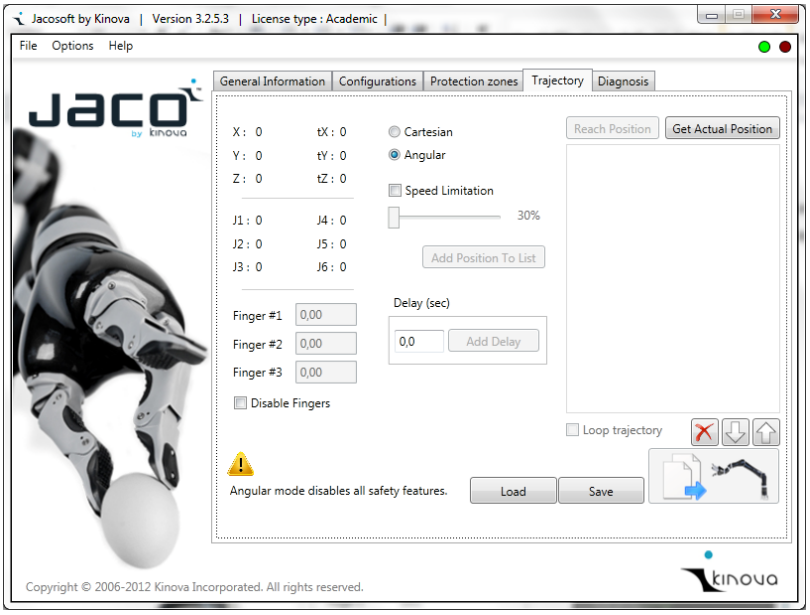


[10] For example: 100% refers to the normal speed of the JACO arm (Permitted max speed). If you choose 26%, the JACO arm will move at 26% of the Permitted Max Speed when entering the Slow Zone.

TRAJECTORY TAB

The Trajectory tab is only available with the Academic licence.

The Trajectory tab allows you to configure, save and load a specific trajectory. The following figure shows the Trajectory tab.



A trajectory may be constituted of the following elements:

- Position (either reached by Cartesian or Angular control) with or without a Speed limitation;
- Delay (in seconds);

Positions

To **add a position** to a trajectory, you must:

1. Reach a position with JACO.
2. Click on the Get Actual Position button.
3. If you wish to add a speed limitation when reaching this position, select the Speed limitation item and select the % of speed limitation that will be affected to this position.
4. If you wish to add this position, click on the Add Position To List button.

Delays

To **add a delay** to a trajectory, you must:

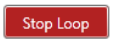
1. Enter a number (delay in seconds) under the Delay box.
2. Click on the 

button.

Trajectory

At any time, you may move an item in the trajectory up or down the list using the arrows  . You may also delete the item by using the  button or reach the item by using the 

button.

To **start the trajectory**, you must click on the  button. You may also loop the trajectory by selecting the Loop Trajectory box. Once the Loop Trajectory box is selected, a 

button will appear to allow you to stop the trajectory.

You may also Save the newly configured trajectory or Load an old one by using the following buttons 

.

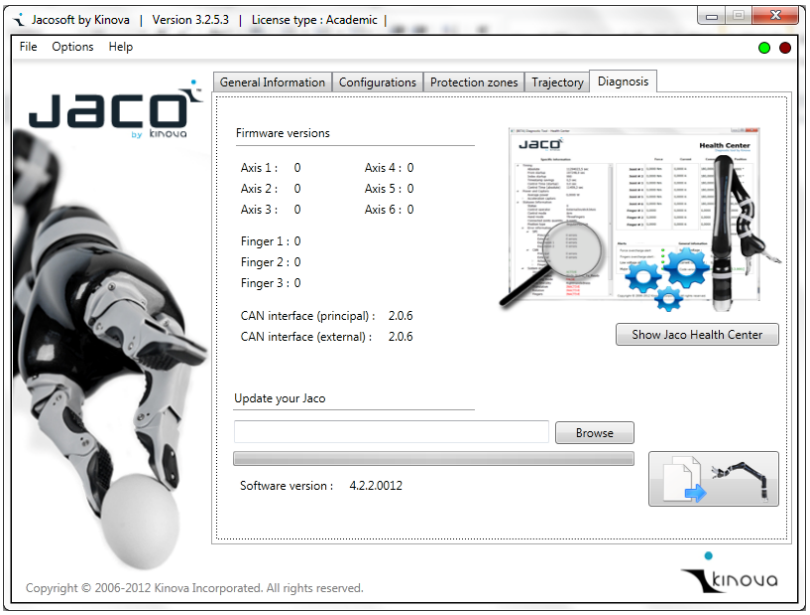
To erase a trajectory, you must select every event independently and erase them all.

DIAGNOSIS TAB

The Diagnosis tab hides a powerful diagnostic tool dedicated to help a Kinova representative assist you with any technical issue occurring with the JACO arm. In the Diagnosis tab, you may:

- Main window : display the firmware version of JACO's basic components;
- Update your Jaco : actualize the internal programs (DSP version) of the JACO arm.
- Jaco Health Center : display the diagnosis tool;

The following figure presents the Diagnosis tab**.**



Update your JACO

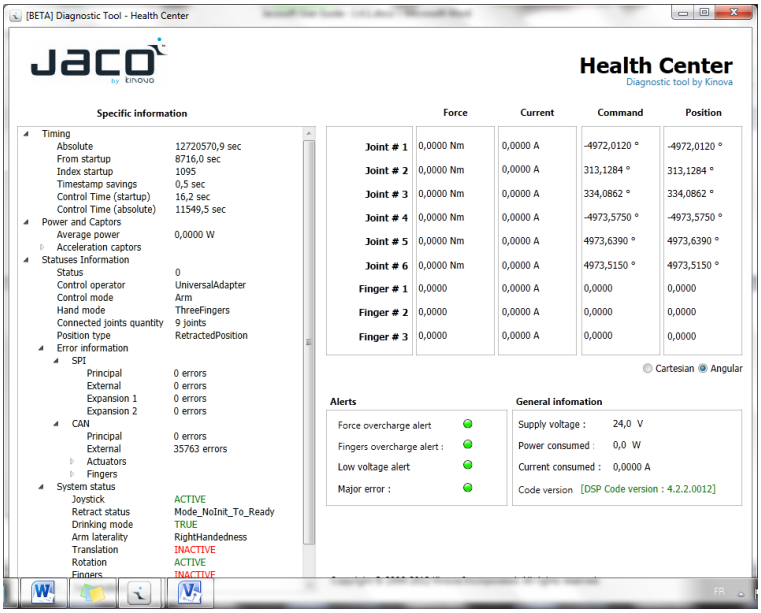
This function allows you to reprogram your JACO using the adequate .hex file provided by Kinova.

JACO Health Center

The JACO Health Center is a real time information center. The data may help to detect a technical problem with the JACO arm, define the actual temperature of each joint, determine the usage of the JACO arm, and many more.

If any problem should occur with your JACO arm, please communicate with a Kinova representative who'll help you through this section.

The following window should appear after pressing on the Show Jaco Health Center button.



SPECIFIC INFORMATION

On the left side of the window, you have access to a menu from which you may choose the element you would like to analyze. On the right side, you may see the information available for the chosen elements.

CONTACTING SUPPORT

If you need help or have any questions about this product, this guide or the information detailed in it, please contact a Kinova representative at:

- Support@KinovaRobotics.com.

We value your comments!

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APPENDIX 1: STEP-BY-STEP EXAMPLE FOR MAPPING CONFIGURATION

The following section describes a step-by-step approach to help configure the mapping of two fictive client cases. The information on the client's control method, mobility and needs have to be acquired before configuring the mapping.

For an adequate configuration of the mapping, there are 18 functions to assure, one of which (Change Mode) must be assured in every mode. For easiness of mapping schematics, the following abbreviations will be used:

FUNCTIONS	ABBREVIATIONS
X_Minus	X-
X_Plus	X+
Y_Minus	Y-
Y_Plus	Y+
Z_Minus	Z-
Z_Plus	Z+
Xteta_Minus	XΘ-
Xteta_Plus	XΘ+
Yteta_Minus	YΘ-
Yteta_Plus	YΘ+
Zteta_Minus	ZΘ-
Zteta_Plus	ZΘ+
Open Hand Three Fingers	OF3
Close Hand Three Fingers	CF3
Open Hand Two Fingers	OF2
Close Hand Two Fingers	CF2
Retract_ReadyToUse (HOME/RETRACT)	H/R
Change Mode	C.M.

Here are the main steps of the mapping configuration:

1) With the JACO Health Center, Control/Joystick Value and Button Value menu, find out which buttons and which joystick movements relate to which command and states;
2) Define how much modes will be needed;
3) Define in which list they will be placed;
4) Assign the functions in the modes in the most intuitive way possible;
5) Disable the diagonals when needed;
6) Place the Retract_ReadyToUse (H/R) function in default mode in order to be able to set the arm in its ready position at JACO's onset;
7) Decide the methods for switching between modes.

Case #1: 4 d.o.f. control interface, 1 external button possibility

CLIENT'S INFORMATION

- Client drives all his wheelchair functions through a 4 functions (4 d.o.f.) sip and puff device.
- Client has space and mobility for 1 additional push button only.

CHARTS USED

- Controlling JACO through the wheelchair control interface may only be achieved through the Universal Interface.

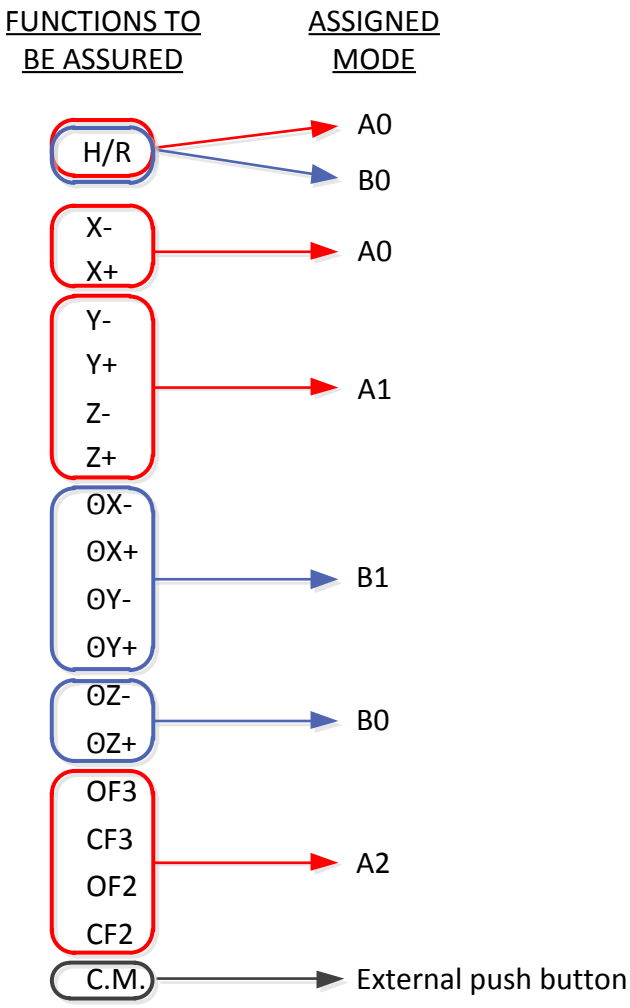
MAPPING CONFIGURATION NECESSITY

1) With the JACO Health Center, Control/Joystick Value and Button Value menu, find out which buttons and which joystick movements relate to which command and states.
2) Define how much modes will be needed
   - Change Mode (C.M.) assured by external push button;
   - 4 d.o.f. control interface;
   - 17 functions to assure.
   - ➢ Equation used: $\frac{17 \text{ functions}}{4\ d.o.f.} > 4\ modes = 5\ modes.$
3) Define in which list the modes will be placed
   - There are 2 lists;
   - Each list may incorporate up to 6 modes;

- Separating the modes into 2 different lists will allow changing modes in a more intuitive way.

➢ 3 modes in list A
➢ 2 modes in list B

4) Assign the functions and movements in the modes



5) Disable the diagonals when needed

- Disable diagonals in following modes:
  - A0
  - A2
  - B0

6) Place the Retract_ReadyToUse (H/R) function in default mode in order to be able to set the arm in its ready position at JACO's onset.
   - Either B0 or A0 may be set as default mode.
7) Decide the methods for switching between modes
   - The external push button will be used to change between mode;
   - There are 2 lists;
   - HoldTwoSec will be used to access list A in all of the modes assigned in list B;
   - OneClick will be used to toggle into list A in all of the modes assigned in list A;
   - HoldTwoSec will be used to access list B in all of the modes assigned in list A;
   - OneClick will be used to toggle into list B in all of the modes assigned in list B.

Case #2: 3 way controller (cephalic joystick), no external button

CLIENT'S INFORMATION

- Client drives all his wheelchair functions through a 3 functions (3 d.o.f.) cephalic device.
- Client has neither space nor mobility for additional push button.

CHARTS USED

- Controlling JACO through the wheelchair control interface may only be achieved through the Universal Interface.

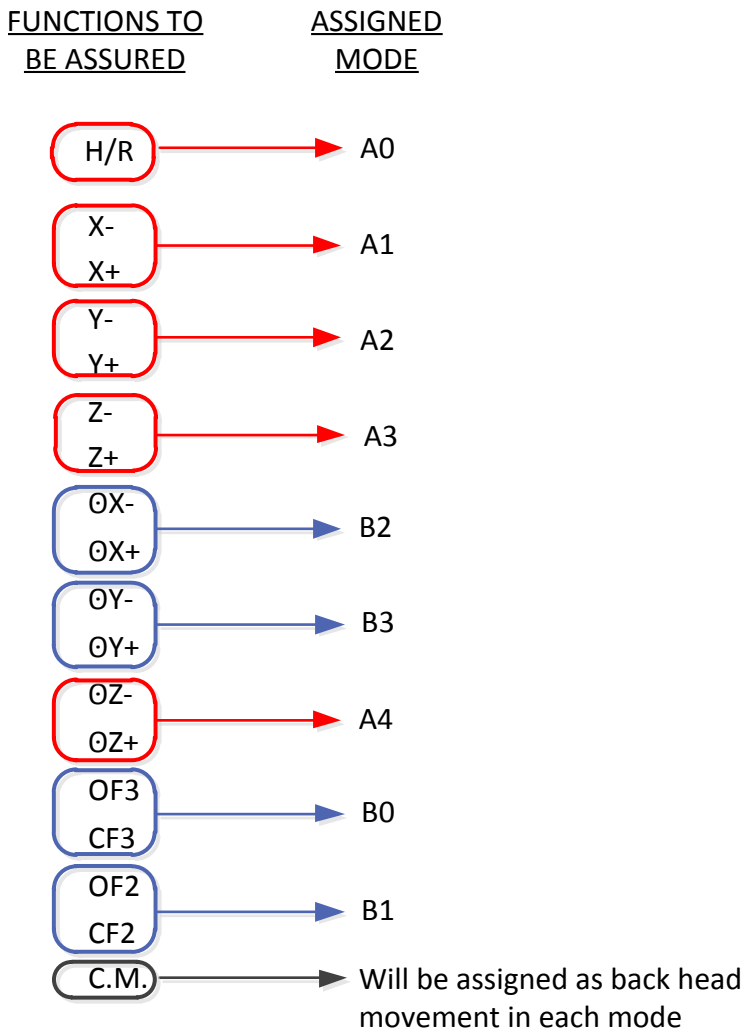
MAPPING CONFIGURATION NECESSITY

1) With the JACO Health Center, Control/Joystick Value and Button Value menu, find out which buttons and which joystick movements relate to which command and states.
2) Define how much modes will be needed
   - 3 d.o.f. control interface minus 1 that will be used in each mode for Change Mode (C.M.) $\rightarrow$ 2 d.o.f.
   - 17 functions to assure.
   - ➢ Equation used: $\frac{17 \text{ functions}}{2\ d.o.f.} > 8\ modes = 9\ modes.$
3) Define in which list the will be placed
   - There are 2 lists;
   - Each list may incorporate up to 6 modes;

- Separating the modes into 2 different lists will allow changing modes in a more intuitive way.

  - 5 modes in list A
  - 4 modes in list B

4) Assign the functions and movements in the modes



5) Disable the diagonals when needed

- Disable diagonals in all the modes.

6) Place the Retract_ReadyToUse (H/R) function in default mode in order to be able to set the arm in its ready position at JACO's onset.

- A0 must be set as default mode.

7) Decide the methods for switching between modes

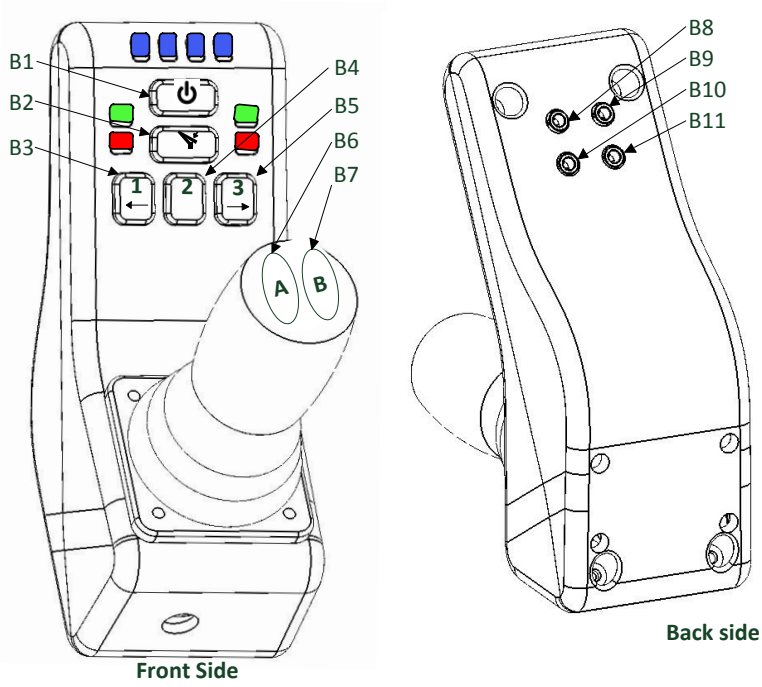
- Change Mode (C.M.) will be assigned to the back head movement in each mode.
- There are 2 lists;
- HoldOneSec will be used to access list A in all of the modes assigned in list B.
- OneClick will be used to toggle into list A in all of the modes assigned in list A.
- HoldOneSec will be used to access list B in all of the modes assigned in list A.
- OneClick will be used to toggle into list B in all of the modes assigned in list B.

APPENDIX 2: KINOVA'S JOYSTICK ASSOCIATED COMMAND AND STATES

The Kinova joystick associated Commands and States are defined in the following figure. If you are using another controller, please refer to the Health Center (Diagnosis tab) under the Control/Joystick Value menu to define the controller Commands and States.

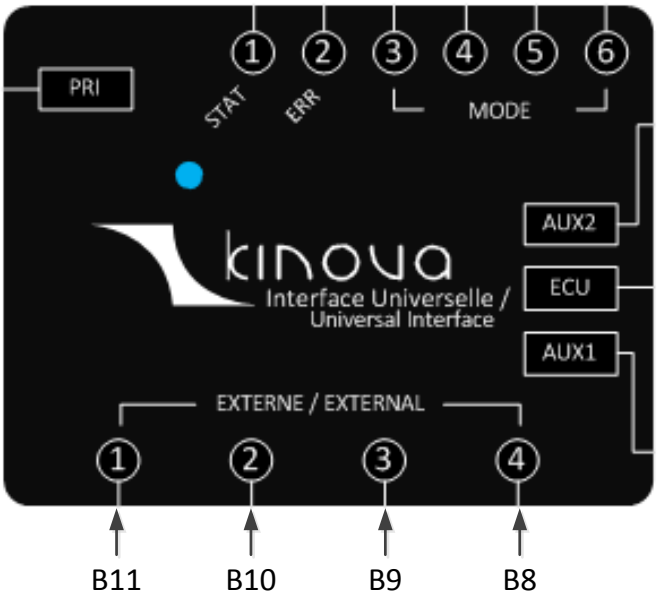
COMMAND	STATES « PLUS »	STATES « MINUS »
InclineLR	Right inclination of the lever	Left inclination of the lever
InclineFB	Front inclination of the lever	Back inclination of the lever
Rotation	Clockwise rotation of the lever	Counter clockwise rotation of the lever
MoveLB	No functionality	
MoveFB	No functionality	
Push	No functionality	

The buttons **Command** and **States** associated to Kinova's joystick are defined in the following figure:



APPENDIX 3: UNIVERSAL INTERFACE ASSOCIATED COMMANDS AND STATES

The buttons associated to the Kinova Universal Adapter are defined in the following figure:



CONTROL BUTTON EVENTS

B1 to B4 are associated to controller's movements which allow, for example, special functions as Retract_ReadyToUse to be associated with joystick movements.

These special functions may not be associated with controller's movement when JACO is controlled with Kinova's joystick.