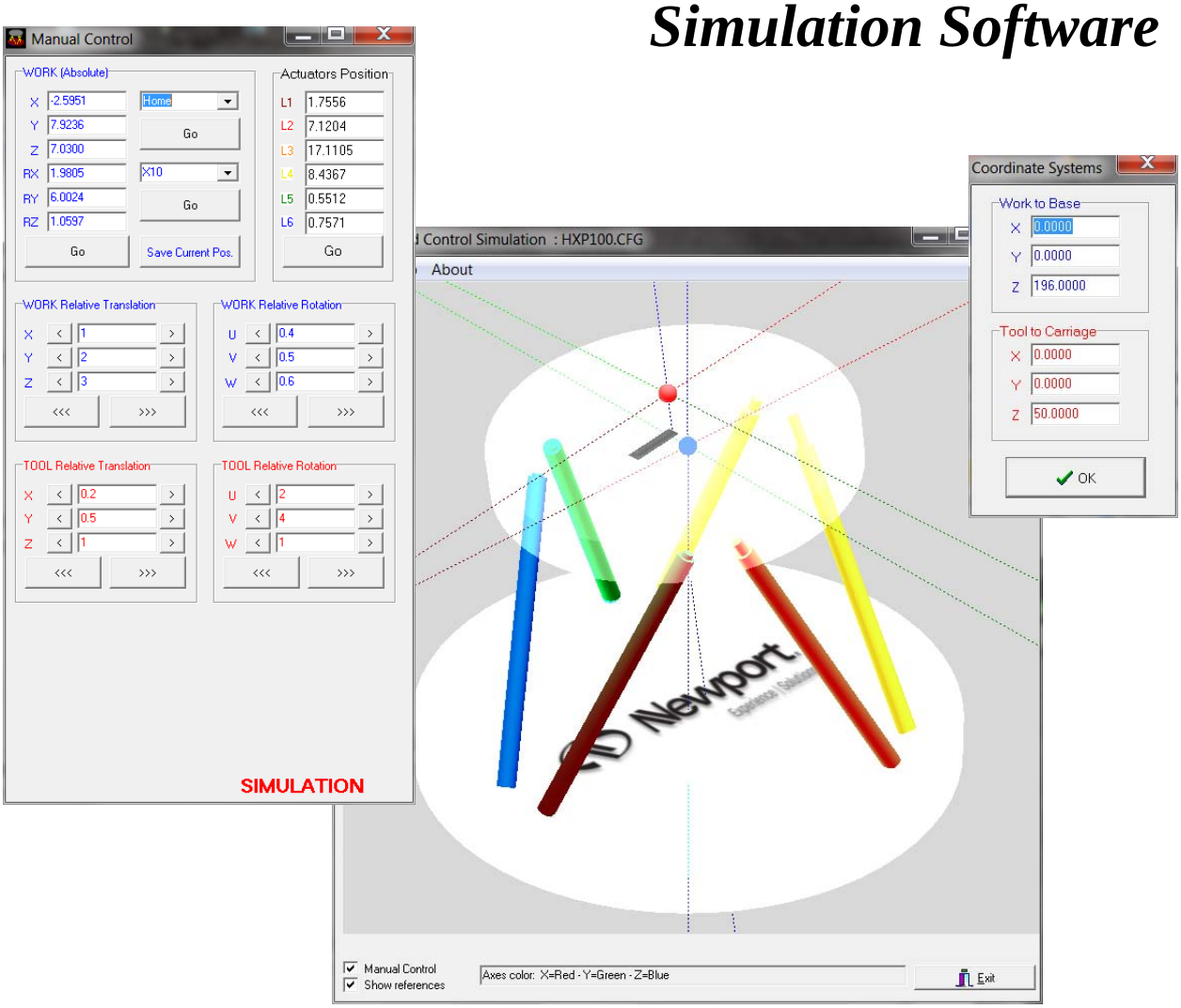
Simul_Hexapod

Hexapod Control Simulation Software



User's Manual

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Preface

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Table of Contents

Preface ii
Confidentiality & Proprietary Rights ii

1.0 Simul_Hexapod Windows Description 1

2.0 Newport Hexapod Conventions 2

3.0 Simul-Hexapod Software Installation 5

4.0 Starting Simul-Hexapod 6

5.0 Using Simul-Hexapod 7
5.1 Virtual Hexapod Display 7
5.1.1 Virtual hexapod conventions 7
5.1.2 Mouse control and features 7
5.2 Main Menu 8
5.2.1 File 8
5.2.2 Setup menu 8
5.2.3 About Menu 11
5.3 Setting the Hexapod's Coordinates 12
5.4 Hexapod Displacement Control 13
5.4.1 Absolute positioning in Work coordinates 13
5.4.2 Relative positioning in Work coordinates 13
5.4.3 Relative positioning in Tool coordinates 15
5.4.4 Actuator Positioning 15

Simul_Hexapod
Hexapod Control Simulation Software

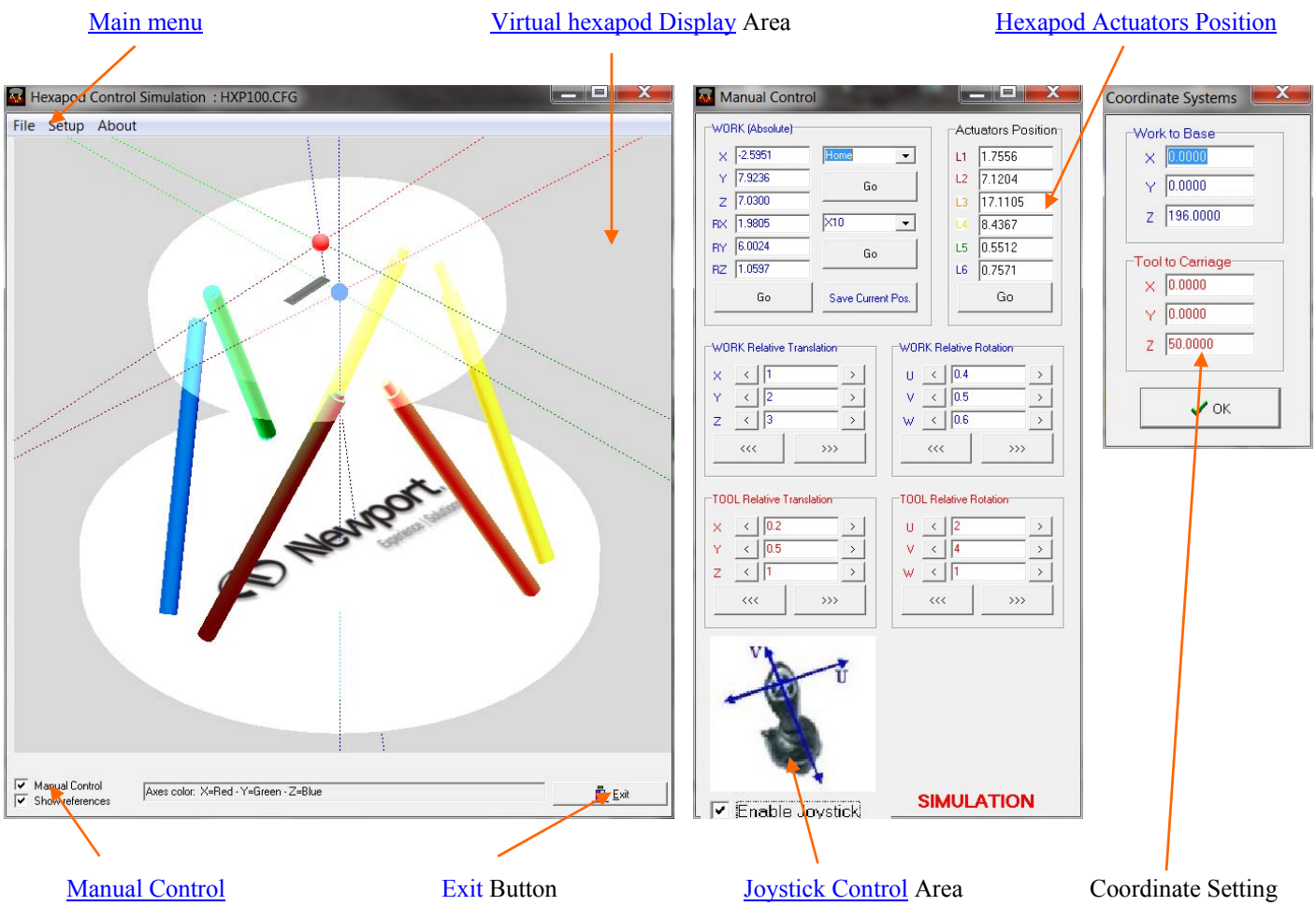
1.0 Simul_Hexapod Windows Description

Simul_Hexapod software includes 3 main windows:

- A Virtual Hexapod display window
- A Manual Control window
- A reference setting window

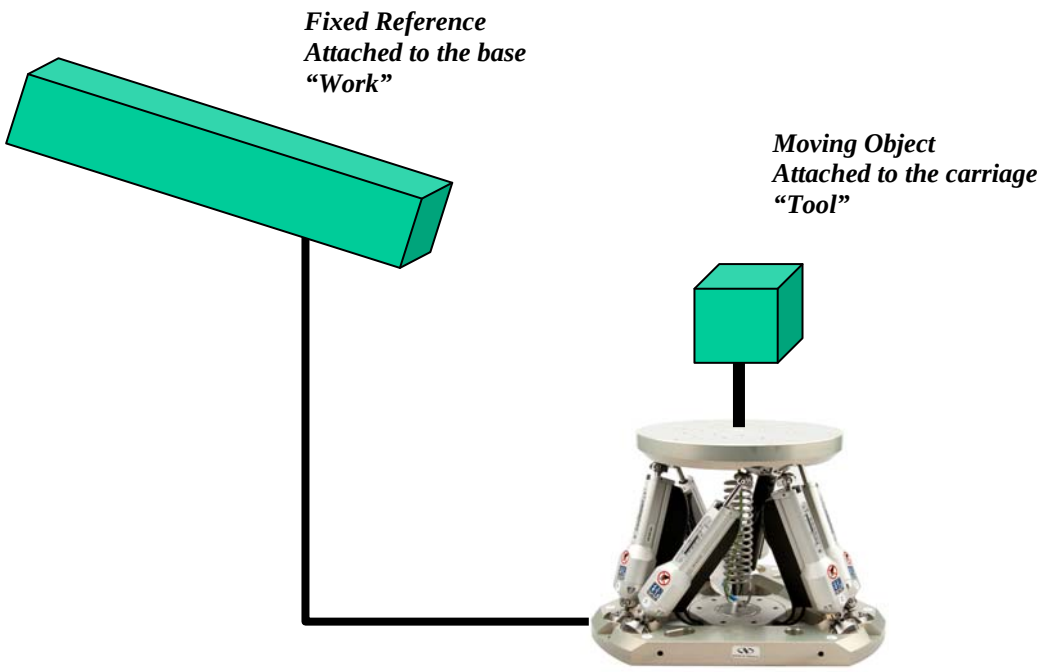
The Manual control window can be displayed or hidden by checking the "Manual Control" Box located at the bottom right of the Virtual hexapod display window.

Virtual hexapod display **Manual Control**
Coordinates

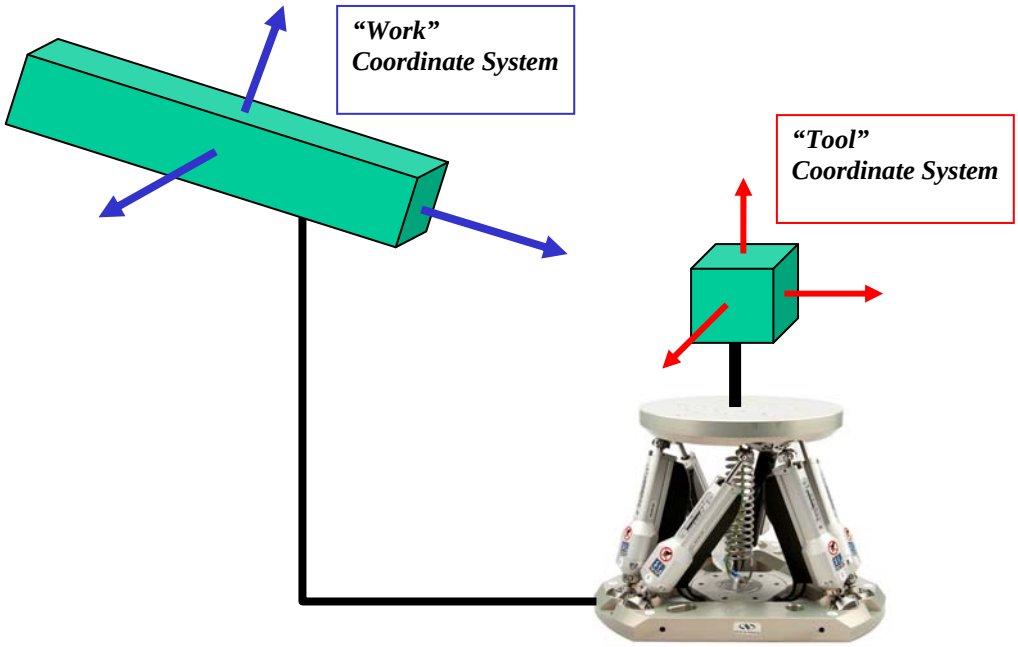


2.0 Newport Hexapod Conventions

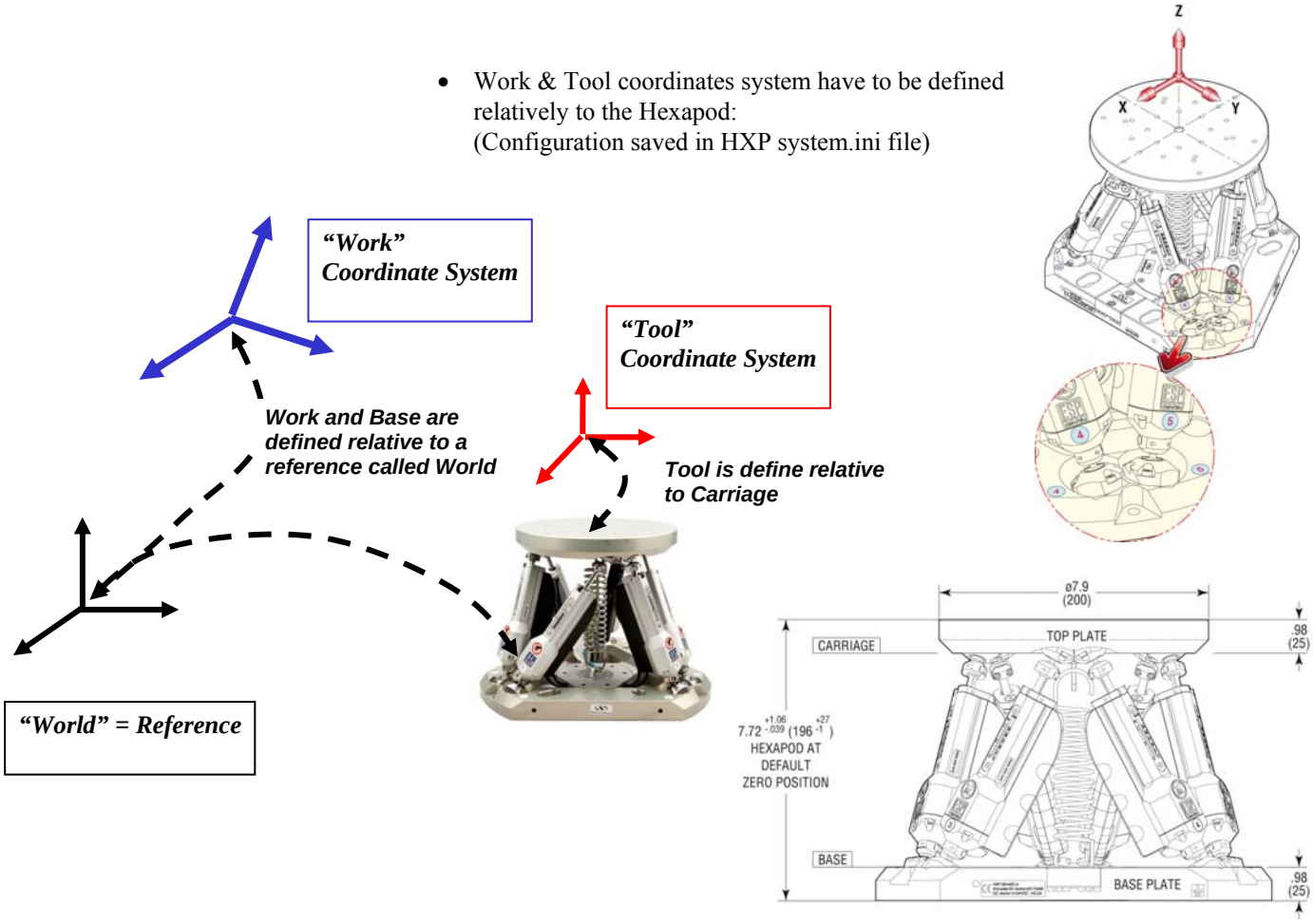
- Hexapod is used to move an object relatively to another:



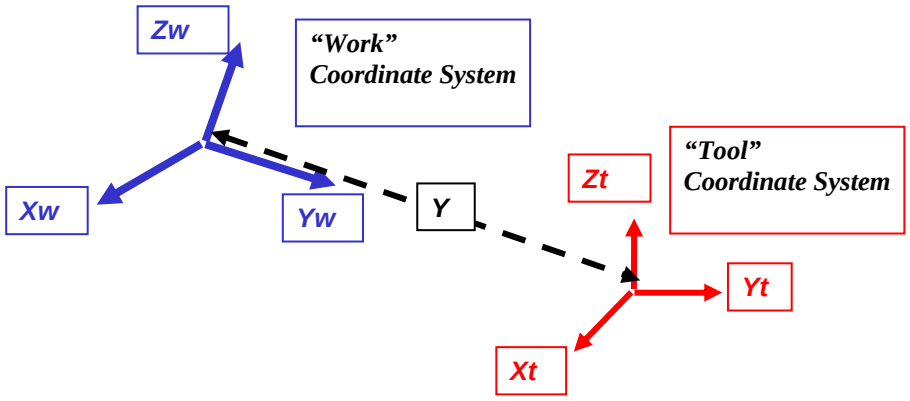
- Position and orientation of fixed object (Work) and moving object (Tool) are defined by coordinates systems linked to them:



- Work & Tool coordinates system have to be defined relatively to the Hexapod:
  (Configuration saved in HXP system.ini file)

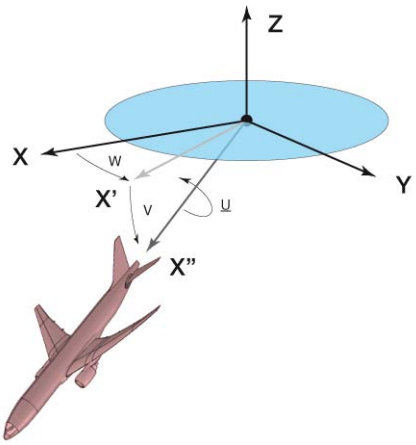


- Hexapod Position (X,Y,Z,U,V,W) = Position & Orientation of Tool in Work:



X, Y, Z = Coordinates of the origin of Tool in Xw, Yw, Zw
U, V, W = Orientation of Xt, Yt, Zt directions relative to Xw,Yw,Zw directions (Bryant Angles)

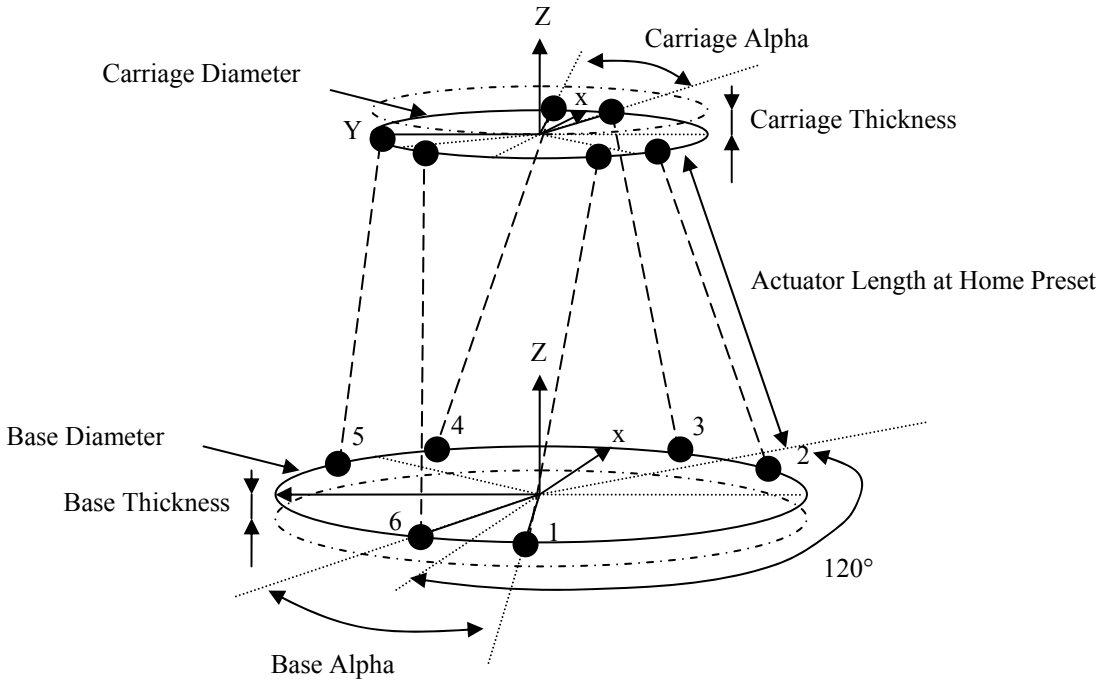
Hexapod Absolute Move = Motion to Hexapod Absolute Position



- Orientation U, V, W = Bryant angles :
  - Clockwise rotation about the Z-axis by the Yaw angle W
  - Clockwise rotation about the New Y-axis "Y" by the Pitch angle V
  - Clockwise rotation about the new X-axis "X" by the Roll angle U

- Hexapod construction parameter definitions:

  The schematic below describes the standard conventions (actuator number, axes definitions, and planes) of Newport hexapods.



NOTE

Black points represent the theoretical positions of the twelve joints of a hexapod. Plain circular lines represent the hexapod planes (passing through the joints) and dotted circular lines represent the hexapod reference planes (upper side of the carriage and lower side of the base)

- Newport Hexapod HPX 100 dimensions:
  - Base and Carriage thickness: 25 mm
  - Actuator length: 166 to 192 mm
  - Distance between the reference planes of the joints when actuators are at 166 mm: 144, 23 mm

3.0 Simul-Hexapod Software Installation

Insert the **Simul_Hexapod** CD into your CD or DVD-ROM drive. Proceed as follows:

- Click Start on the Windows taskbar
- Select Run from the Start menu
- Click Browse and locate your CD or DVD-ROM drive to view the files in the CD
- Find the installer program named SETUP.EXE and double click this file, then click OK in the Run dialog
- Follow on-screen instructions to install **Simul_Hexapod** software.

The following directories will be automatically created:

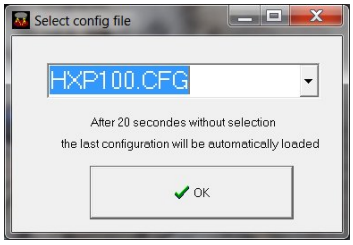
- C:/…/Simul_Hexapod: containing following files
  - Simul_hexapod.exe
  - Simul_hexapod.exe-shortcut
  - Simul_hexapod.ini
  - Simul_hexapod_LANGUAGE_1.ini
  - Simul_hexapod_LANGUAGE_2.ini
- C:/…/Simul_Hexapod/CFG: containing following files
  - HXP100.CFG
  - HXP1000.CFG

In the “C:/…/Simul_Hexapod “ directory, click and drag the “simul_hexapod.exe-shortcut” to your desktop.

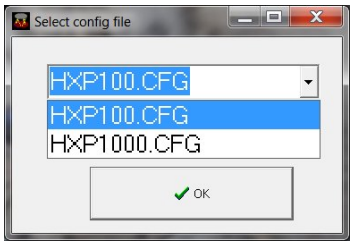
4.0 Starting Simul-Hexapod

On your desktop, double-click on “simul_hexapod.exe-shortcut.

A message appears prompting the user to select the hexapod configuration to be loaded.



A pull-down list displays the available configurations.



NOTE

Newport standard hexapods (HXP100, HXP1000, etc.) are default. Other configurations can be defined and saved by the user. (See Save Current Configuration chapter)

Click “**OK**” to launch Simul-Hexapod with the selected configuration.

NOTE

If not selection is made within 20 seconds, the last saved configuration will be automatically loaded.

5.0 Using Simul-Hexapod

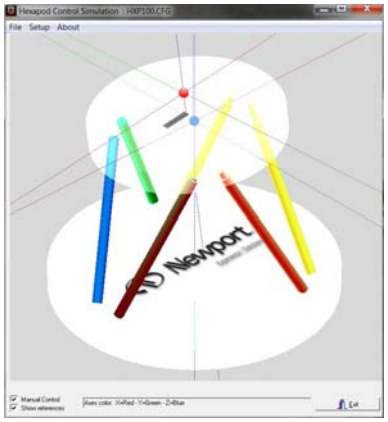
The main window opens up and displays the virtual Hexapod using parameters from the selected configuration file. (Window Size, position, Hexapod size, position, orientation, etc…).

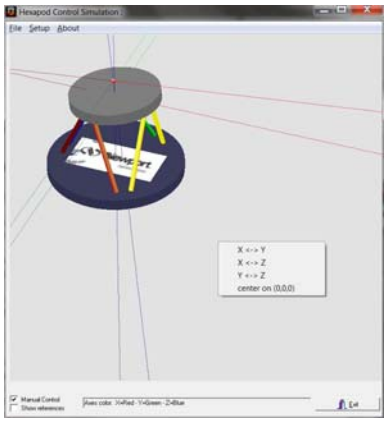
The manual control window may also be displayed if it was enabled in the configuration file.

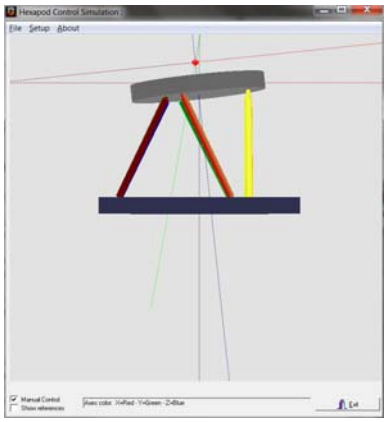
The user can perform the following actions:

- Set the Virtual hexapod display parameters
- Access Main menu functions
- Set Coordinates origin point
- Move the virtual hexapod

5.1 Virtual Hexapod Display







The virtual hexapod is displayed and can be controlled as described below:

5.1.1 Virtual hexapod conventions

- Axes colors : X: Red, Y: Green, Z: Blue , U (Rx): around Red axis, V (Ry): around Green axis, W (Rz): around Blue axis
- Red point : The Tool Coordinate System's origin is defined in the "Hexapod Coordinates Setting" window, "Tool to Carriage" panel
- Blue point : The Work Coordinate System's origin is defined in XYZ in the "Hexapod Coordinates Setting" window, "Work to Base" panel

5.1.2 Mouse control and features

- Mouse scroll up or down (anywhere in the screen): zoom in or out
- Mouse left click (anywhere) and drag: rotates the virtual hexapod (2 directions)
- Mouse left double-click on a point: re-center this point in the screen
- Mouse right click (anywhere) and drag: moves the virtual hexapod left/right-Up/down
- Mouse right click (anywhere) and release: displays the menu:
  - X<->Y, X<->Z or Y<->Z : click one for a 2D view of the hexapod.
  - "Center on 0,0,0": places the Hexapod Base (0,0,0 world coordinates) in center of the screen

5.2 Main Menu

5.2.1 File

This menu allows:

Text files **Editing** through a text editor

Exiting Simul-Hexapod software

5.2.2 Setup menu

This menu allows setting all Simul-Hexapod software parameters using 5 commands:

5.2.2.1 Hexapod

This sub-menu opens up a window to set all mechanical parameters (HXP100 parameters, as an example):

Work to Base panel: to define the Work Coordinate origin location (X, Y &Z, relative to the Base centre).

Tool to Carriage panel: to define the Tool coordinate origin location (X, Y &Z, relative to the Carriage centre).

NOTE

These settings are also accessible through the Hexapod Coordinates Setting window.

Height: Distance between joints reference planes when actuators are at their minimum position

Carriage panel: to define the positions of the carriage end of the actuator joints

Base panel: to define the positions of the base end actuator joints positions

---

NOTE

Joint positions can be defined using XY or polar coordinates. (In case of Polar coordinates, the "Calculate" button must be pressed after entering angles to update the XY coordinates

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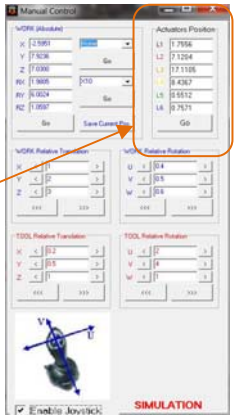
Actuators panel: to define the actuators' length and travel range

5.2.2.2 Display

This sub-menu allows setting of the following parameters:

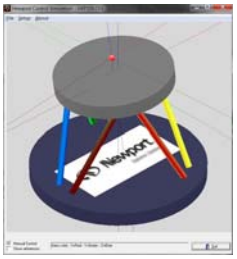


- **Number of digits** displayed in the "Actuators position" panel of the Manual control window

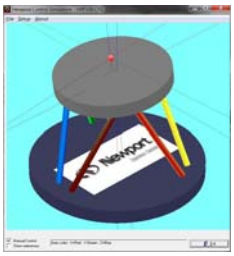
NOTE

Change will take effect after saving the configuration and restarting Simul-Hexapod

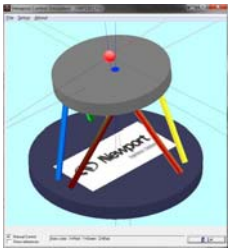
- **Transparent plates**: when checked, the bottom and upper plates are transparent instead of plain grey (carriage) and purple (base). Effect is immediate.



- **Background color** can be selected through a new window. ("Define custom colors button" allows wider color selection). Effect is immediate.

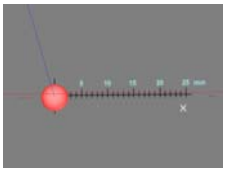


- **Nodes size**: to set the sizes of the red (Tool coordinate origin) and blue points (Work coordinate origin) size. Effect is immediate.



NOTE

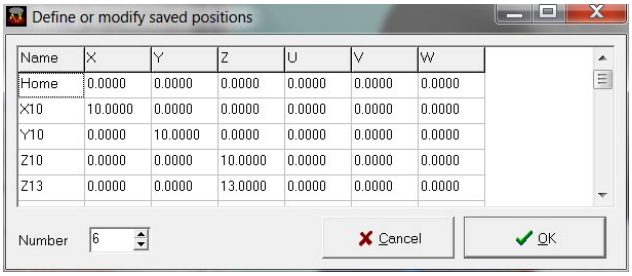
The top of the carriage includes a ruler



5.2.2.3 Displacements

Saved positions

This sub-menu allows defining or modifying specific positions through a dedicated window:



Each saved position includes a name and the 6 virtual position values.

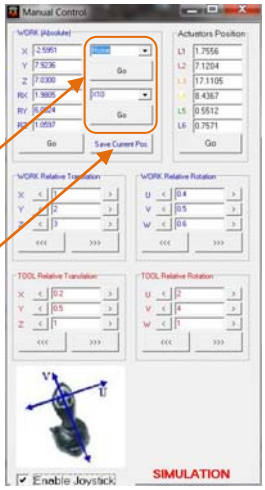
Saved position parameters (name, X, Y, Z, U, V & W positions) can be simply edited and then saved by clicking "**OK**" to close the window.

A position can be added (to the bottom of the list) by increasing the **Number**. (Reducing the **number** deletes the last position)

"**Cancel**" button closes the window disregarding any change

The virtual hexapod can be moved to such position through the "**Go**" buttons of the Manual control window.

In the manual control window, the **"Save current position"** button automatically creates and saves the new position at the bottom of the list.



5.2.2.4 Language

Hexapod software supports French and English languages.

All displayed menus and messages are saved in text files:

- Hexapdo_simul_LANGUAGE_1) for French
- Hexapdo_simul_LANGUAGE_1) for English.

NOTE

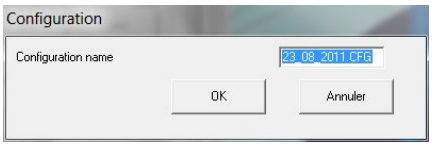
These text files can be modified to accommodate another language.

5.2.2.5 Save Current Configuration

This sub-menu allows saving all current **Hexapod_Simul** parameters such as:

- Hexapod mechanical configuration
- Virtual Hexapod current position, orientation, colors, zooms, etc.
- Manual control enabling state and control values
- Windows positions and sizes
- Etc.

When saving the configuration, a default name (current date) is proposed with the "*.CFG: extension.



The user can enter another name and click OK to save this new configuration in the "C:/…/Simul_Hexapod/CFG" directory.

WARNING

An existing configuration file will be overwritten!

It is recommended to save other configurations with a unique file name.

5.2.3 About Menu

This menu provides software information through the following commands:

5.2.3.1 About

This menu provides information on current software version and designers.

5.2.3.2 Help File

Provides access to this document ("*.pdf" format)

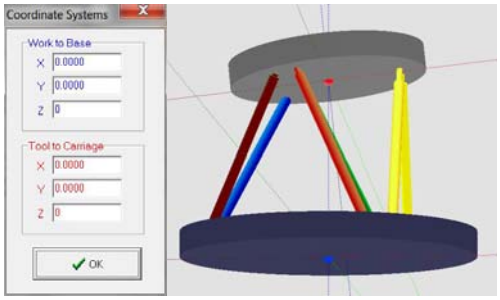
5.3 Setting the Hexapod's Coordinates

Three coordinates systems are defined to allow easy positioning of the virtual hexapod:

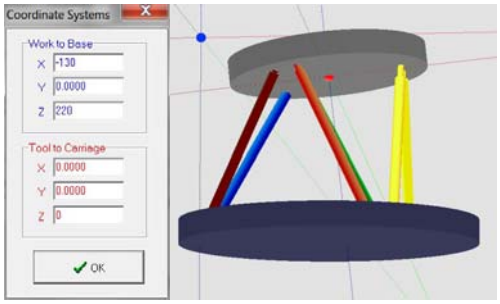
- Base Coordinate System: Its origin is located at the center of the bottom side of the hexapod base and cannot be modified.
- Work Coordinate System: Its origin can be set in relation to the base coordinate's origin. It is represented by a blue sphere.
- Tool Coordinate System: Its origin point can be set in relation to the center of the lower side of the carriage. It is represented by a blue sphere.

Work and Tool Coordinate System SETUP:

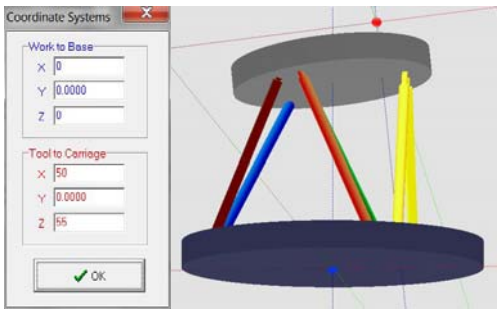
- Work = Base
  &
  Tool = Carriage



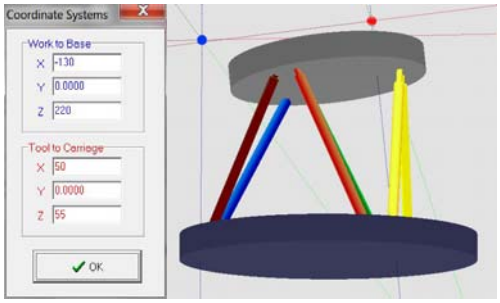
- Work ≠ Base
  &
  Tool = Carriage



- Work = Base
  &
  Tool ≠ Carriage



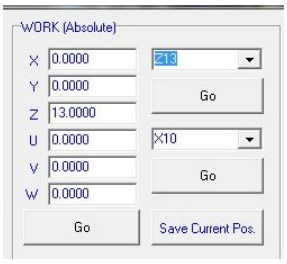
- Work ≠ Base
  &
  Tool ≠ Carriage



5.4 Hexapod Displacement Control

Simul_Hexapod software offers four ways to position the virtual hexapod

5.4.1 Absolute positioning in Work coordinates



The "**Work (Absolute)**" panel of the manual control window has 2 ways to position the virtual hexapod:

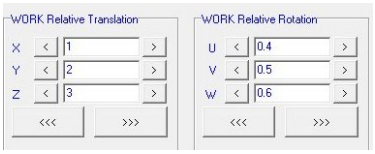
1. By setting each axis position value and then pressing the "Go" button below
2. By selecting a Saved position in one of the two drop-down lists and then pressing the corresponding "Go" button below

NOTE

"Save current position" button automatically creates and saves the new position at the bottom of the saved position list.

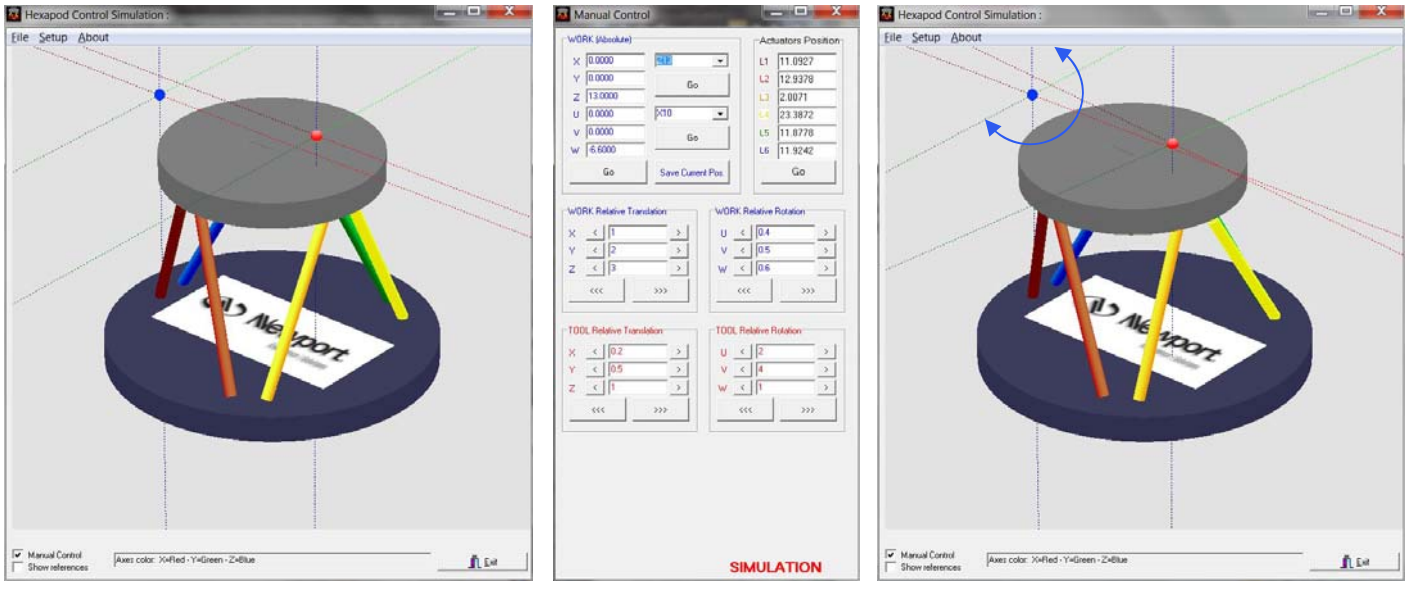
5.4.2 Relative positioning in Work coordinates

5.4.2.1 Through push-buttons



"**Work Relative Translation** and **Rotation**" panels of the manual control window offer 2 ways to position the virtual hexapod: Axis by axis or three axes at a time.

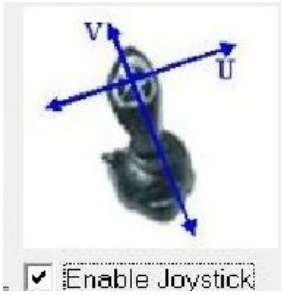
Enter each axis value and click on an arrow button (Left for negative motion and right for positive motion)



Example: "W" rotation in Work coordinates.

NOTE

When using multiple axes control buttons (3 arrows) the theory of commutativity does not apply, so hexapod will not return to the starting position after a positive move followed by a negative move of the same distance. Refer to the HXP Users manual for a more detailed discussion of combined motion of multiple axes.

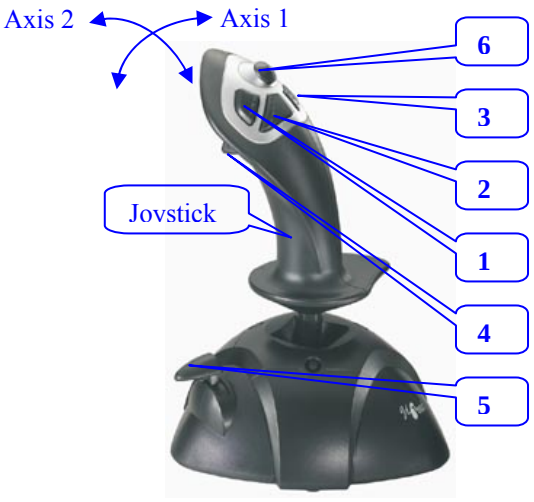


5.4.2.2 Through Joystick

Simul_Hexapod automatically detects any "joystick" connected to a USB port and recognized by Windows. Once detected, the image to the right appears at the bottom left of the screen.

Checking the "Enable Joystick" box enables the following actions:

- Button **1** (fire): toggle (up) virtual machine display and joystick 2 axes control: X-Z, Y-Z, U-V, W, X-Y
- button **2** fire): toggle (down) virtual machine display and joystick 2 axes control: X-Y, W, U-V, Y-Z, X-Z
- Button **3** (fire): not used
- Button **4** (trigger fire): to enable joystick (2 directions)
- Button **5** (throttle): to adjust Joystick speed
- Button **6** (8 directions): to position virtual camera (does not work in X-Z mode

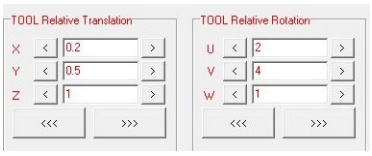


I.E. X-733U Joystick

NOTE

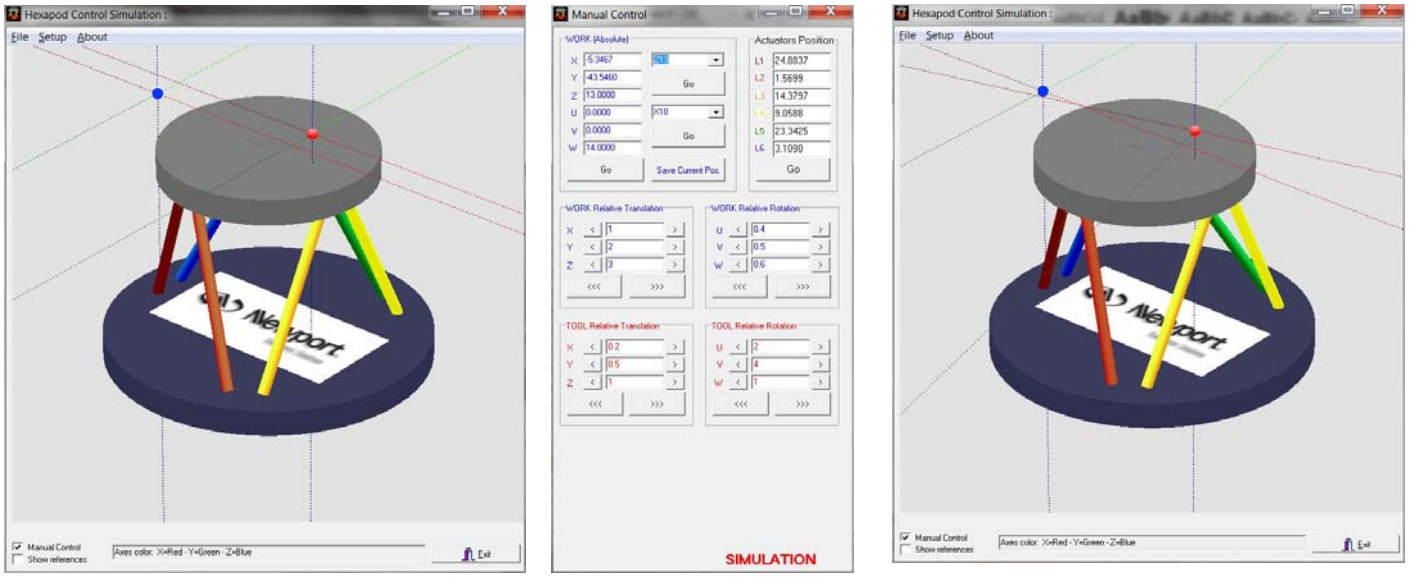
Other USB compatible joysticks may have different action button assignments.

5.4.3 Relative positioning in Tool coordinates



"**Tool Relative Translation** and **Rotation**" panels of the manual control window offer 2 ways to position the virtual hexapod: Axis by axis or three axes at a time.

Enter each axis value and click on an arrow button (Left for negative motion and right for positive motion)



Example: "W" rotation in Tool coordinates.

NOTE

When using multiple axes control buttons (3 arrows) the theory of commutativity does not apply. Refer to the HXP Users manual for a detailed discussion of combined motions of multiple axes.

5.4.4 Actuator Positioning

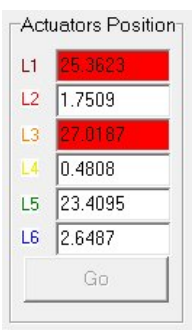
The hexapod actuators corresponding theoretical positions are calculated based upon the current position of the virtual axes.

The reverse function can be used by changing the actuator positions and pressing the "**Go**" button.

Virtual hexapod display will reflect the corresponding position.

NOTE

Whenever an actuator position is out of the range defined in the "Actuator" panel of the Hexapod Mechanical Parameters the background color turns red.



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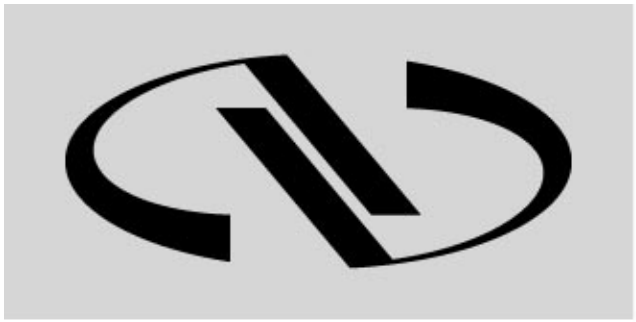

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