# Orbiter Simulator

## SSRMS Dialog Box Manual
## Version V1.0

**SSRMS, Rev A**
**August 9, 2014**

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# INTRODUCTION

## SSRMS Dialog Box Version 1.0
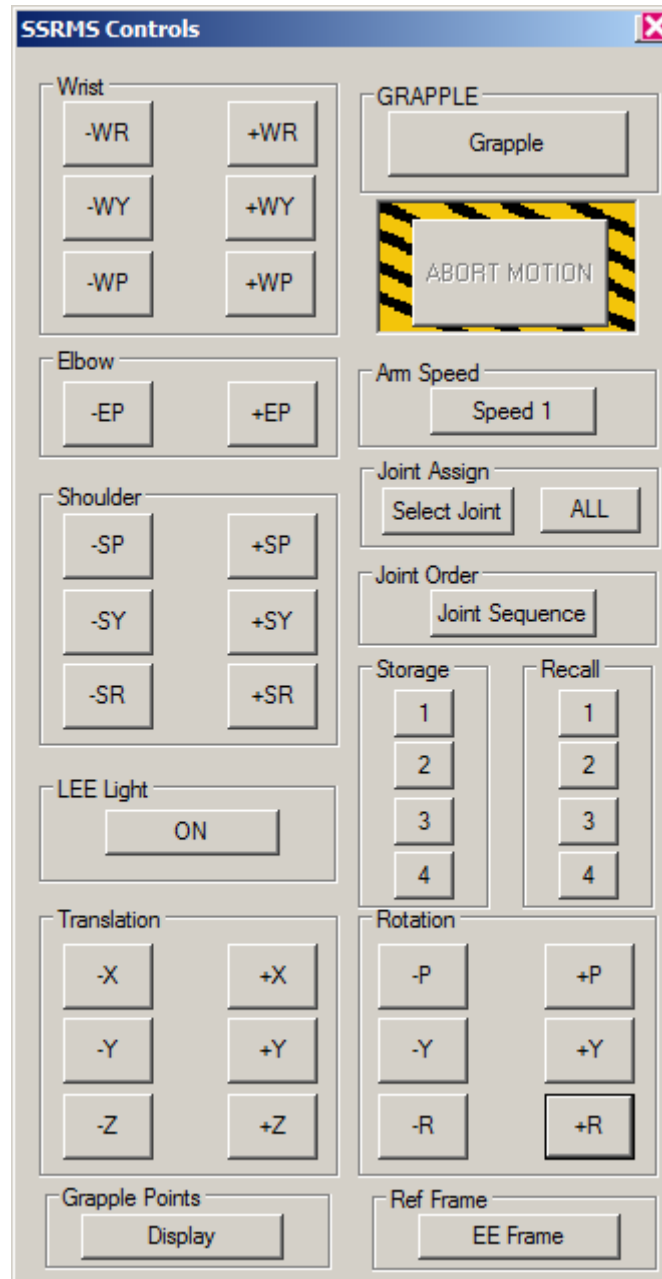


The SSRMS control dialog box can be opened with key sequence "CTRL+SPACEBAR" when the SSRMS is the focus vessel.

The advantage of using this control dialog is that it allows you to control the arm while it is NOT the selected focus vehicle. It can be opened and then moved to another screen (if you have a multi-screen setup) and is available whenever you wish to operate the arm whether the arm is still the focus vessel or not.

The following is a brief description of the various buttons on the dialog box, and what each button allows the user to perform.  Following this discussion, a simple scenario is presented to allow the user to experience the various advantages the dialog box provides.

**Joint individual controls**

Each of the seven joints is represented by a button that allows the user to individually control the various joint rotations.  The Wrist (the end effector nearest the grappled payload, or the free end that CAN grapple a payload) can be rotated in the roll, yaw and pitch direction (positive or negative) with the buttons "+WR, -WR, +WY, -WY, +WP, -WP".  Similarly, the Elbow ("+EP, -EP") and the shoulder joints ("+SP, -SP", etc.) can be individually controlled.

**LEE Light control**
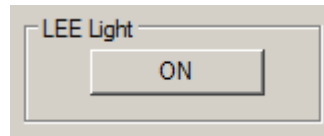


This button allows the user to turn on or off the light associated with the Latching End Effector (LEE) that is NOT attached to the base.  Very useful when moving in to grapple an item and the ISS is not in a sun-lit part of the orbit.  If the light is "ON", the button displays "ON", if the light is "OFF", the button displays "OFF".

**Grapple Points**
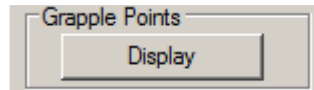


This button will turn on/off the display of grapple points when on an external view. Parent attachments are displayed as BLUE arrows, Child attachments are shown as RED arrows.

**Ref Frame**
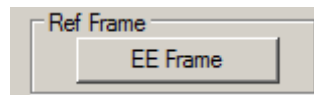


Allows the selection of the reference frame for the arm; if the end effector is the selected point the button will display "EE Frame", if the shoulder is selected the button will display "Shoulder Frame".

**Grapple**
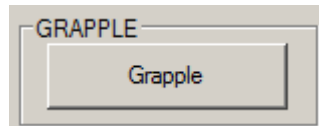


This button will allow for the grappling of an object when within proper range. If the object is within range, the button will be enabled for grappling, and once grappled the button will change to "Release" signifying that an object IS grappled.
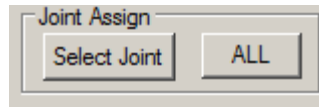
**ABORT MOTION**



If an auto-sequence move is in progress, the button is enabled. Depressing the button will halt any auto-sequence.
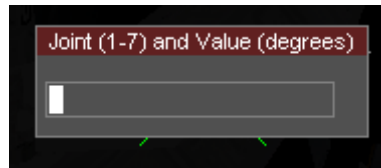
**Arm Speed**
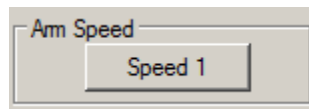


The Arm Speed button allows the toggling of the speed of the arm. The button will change its display showing the currently selected speed factor (i.e. speed 1, speed 2, speed 5 or speed 10).

**Joint Assign**



Depressing the "Select Joint" button will open an input dialog box:



The box allows for the individual setting of the target ("TGT") rotation of a single joint.

The joints are assigned as:

"1" is the Shoulder Roll ("SR")
"2" is the Shoulder Yaw ("SY")
"3" is the Shoulder Pitch ("SP")
"4" is the Elbow Pitch ("EP")
"5" is the Wrist Pitch ("WP")
"6" is the Wrist Yaw ("WY")
"7" is the Wrist Roll ("WR")

In the dialog box, the user enters a number corresponding to the joint first, and then the target rotation in degrees (- 270 to +270 degrees).

## The "ALL" Button under Joint Assign

If the "ALL" button is selected, a special input box will open:
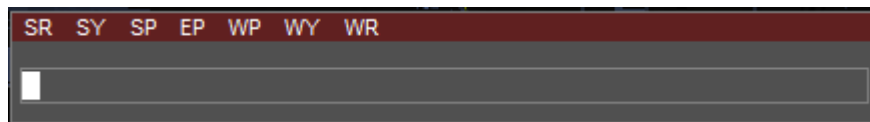


This box will allow for the entry of multiple joint values in the order listed in the title of the box. If you do not wish for the joint to move, then its current value must be entered until all desired joint changes are entered. Using this box is recommended from the HUD (internal) view, and then the appropriate joint values can be input correctly. Once all of the joints to be changed are entered the box can be closed by hitting the "ENTER" key, any subsequent joints not entered in the box will be left to their current value. When "ENTER" is chosen, the target values in the HUD display will update to the input values. Next the Joint Sequence can be entered and the individual joints will be moved (or, all joints will be moved if an "8" is entered; see the next button discussion.)

### Joint Order
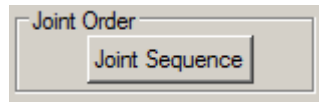


Depressing this button will open an input dialog box:



This input box allows the user to enter the order for the automatic movement of the arm. All or ANY of the joints can be moved to the target ("TGT") positions indicated on the HUD display. When the error ("ERR") for a given joint is zero, the next joint (if any) in the order entered is next moved until all of the joints in the order have reached their target positions. If only a partial joint movement is entered (in other words, if the sequence was only "43" signifying that only the elbow pitch AND THEN the shoulder pitch should move) then only those two joints would be moved to their target positions.

### Storage
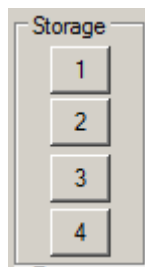


The Storage buttons allow the user to save the current configuration of the various joints for retrieval later in the simulation. If the storage position is not yet used, the associated Recall button is "greyed-out". Saving a configuration into an empty location will cause the associated recall button to become "alive". If a storage location is already used, it can be over-written by pressing the associated location's storage button again.

**Recall**

**The Recall buttons** are only active when there is actually a joint sequence stored in the associated storage location. If the arm is in a "zero-angle" configuration (e.g., all of the joints are at "0" degrees rotation) and that configuration is stored in a location, that location will be considered as empty and the associated Recall button will be "greyed-out" back to an empty configuration.

**Translation**
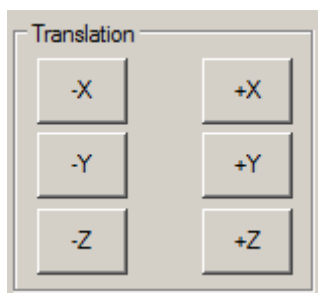
Allows for the inverse-kinematics translation control of the end effector in whichever frame of reference is selected.

**Rotation**
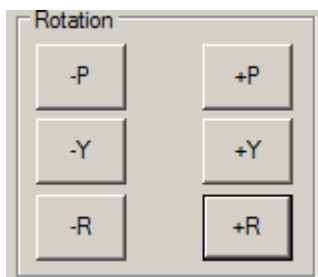
Allows for the inverse-kinematics rotation control of the end effector in whichever frame of reference is selected.

## UPDATES WITH THIS VERSION

**Version 1.0**

Initial release of the SSRMSD with a dialog box for control.

## Example scenarios

### Moving the arm using auto sequences

Begin by selecting any scenario using the arm ensuring that the arm "vessel" has the focus (using F3 dialog as necessary). Use the F1 key to move to the LEE camera view. In the upper portion of the HUD display, you'll see information relating to the arm's status:

```
   SR       SY       SP       EP       WP       WY       WR
  80.64   -37.05    10.56   106.70   117.45   -31.01   -66.98      (current)
   0.00     0.00     0.00     0.00     0.00     0.00     0.00      TGT
  80.64   -37.05    10.56   106.70   117.45   -31.01   -66.98      ERR


   X       Y      Z       Pitch    Yaw      Roll
 -422    -463    +25     -179.8   -45.1    -179.9
Rotation speed: 1 deg/sec
Translation speed: 1 ft/sec
Using EE frame
LEE2 - Open
LEE1 - BASE
```

Each of the arm's seven (7) joints is listed with its designator in order (e.g., Shoulder roll is "SR" or joint "1", the arm elbow joint is "EP" or number "4",etc.). Each joint's angular position is displayed; each joint can be rotated +/- 270 degrees along the line labeled "(current)". The next line is the target ("TGT") position stored in the auto sequence storage. The next line is the difference between the current position and the target position ("ERR"). Rotation speed is the arm speed; it begins the simulation always at speed "1". Various speeds can be selected by repeated selections on the Arm Speed button; it will cycle through all available speeds.

Let's begin with a simple movement, back to the zero arm position. First, the targets when the simulation is first started will always be the zero ("0.00") in the "TGT" locations.

The storage location targets are currently in the "TGT" position, and the "ERR" or error line shows the difference between the targets and the current, actual position.  Now to move the arm.

Depressing the "Joint Sequence" button will cause the following window will appear:



This window will allow us to tell the arm in what order to move the various joints.

For this example, we'll move the arm starting with the roll channel of the Wrist (item "7") backwards to the Shoulder roll channel (item "1") by entering "7654321" into the box.  If you only wanted to move one or two joints in the sequence that is possible by only entering the numbers for the joint you wish to move.  You should NOT enter more than 7 distinct numbers as the remainder will be ignored.
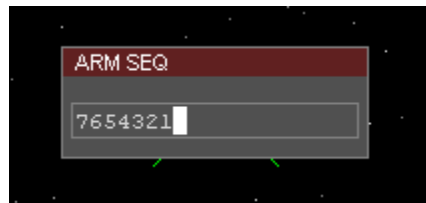


Once you hit enter, the system will process the order you have provided, and the arm will start to move.

During the arm movement, you can go to an external view using "F1"; additionally you can speed up the arm movement by cycling the arm speed button.

**NOTE**
At any time during an automatic sequence the motion can be aborted (stopped) by pressing the "ABORT MOTION" button.  The button is only active during automatic arm motion.  To restart the sequence the Joint Order button will have to be pressed and a new sequence again entered.

When the sequence cycle has completed, you'll see the arm in its "zero-angle" condition.  During movement, the difference line ("ERR") will "countdown" to zero as each joint moves towards the target position.

## Special Simultaneous Joint Sequence Case

One special case associated with automatic movement and the Joint Sequence is the simultaneous movement of all joints within the arm to the target position. This can be accomplished by inputting an Arm Sequence of "**8**". When entered, all of the non-zero error joints will begin to move towards their targets at the same time. This would also allow for moving just one or more individual joints first, then completing the movements with all joints moving together. As an example, if you wished to move the elbow pitch, then the shoulder pitch, and then all of the other joints together, you would enter an Arm Sequence of "**438**".

## Moving the arm using manual inputs into Sequence "TGT"

The "TGT" sequence always starts a scenario with default values stored in it until you move a previously stored sequence in "1" through "4" into it, however you can change the values stored in sequence "TGT" by using the "Joint Assign" button. When Joint Assign is used, a dialog box is called requesting a joint number (1 through 7) and a value for that joint in degrees (-270 to +270).
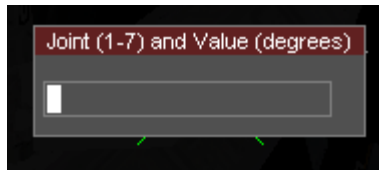


Enter the joint number first, a space, and then the value to set the joint to in degrees (decimals are allowed, so "-189.9" is acceptable). You can continue to use Joint Assign to enter all the relevant joint angles, then when you've finished the input, select the Joint Order button and the order for joint movements and the arm will reposition to those values you have input.



When you hit "enter" you should see the appropriate joint "TGT" value change to the value that you have input in the dialog box.

Now return the arm to its previous position by selecting key "1" for sequence "1", and you will see the stored position in "1" is transferred to the target storage. To move the arm in the auto sequence, again use the Joint Sequence key. This time for the sequence numbers enter "12567" only. Once the arm has stopped moving, again select Joint Sequence button, and enter "34" as the joint sequence. This exercise will demonstrate how you can enter just partial sequences.

**Moving Stored Sequences between scenario files**

If you wish to move a set of stored sequences from one scenario to another, open the scenario from which you wish to obtain the sequences.  Under the SSRMSD vessel heading in the scenario file, you will find something similar to this:

```
ARM_SET1 80.638937 -35.851380 10.367336 108.875364 123.103913 -34.889204 -62.354741
ARM_SET2 80.630426 -35.846889 10.445056 108.877249 117.581761 -35.426398 -62.353403
ARM_SET3 80.630426 -7.556453 30.264051 55.196736 -33.827419 -78.043901 96.010061
ARM_SET4 80.638937 -32.776855 12.599769 101.831997 118.604810 -28.122545 -69.678156
```

Each line contains the complete joint sequence for a given location, "ARM_SETx" where "x" is the storage location (1 through 4).  Any or all of the sequences can be copied and moved to another scenario file if desired, however only one entry per storage location is allowed.  The numbers can be edited as well for the individual joints if desired, the stored sequence is SR, SY SP, EP, WP, WY, WR.

**Credits**

Thanks to SiameseCat and Donamy for the original SSRMS add-on and for allowing me to add the dialog box to the code.  I sincerely hope in some small way I have improved on what was already an amazing add-on.