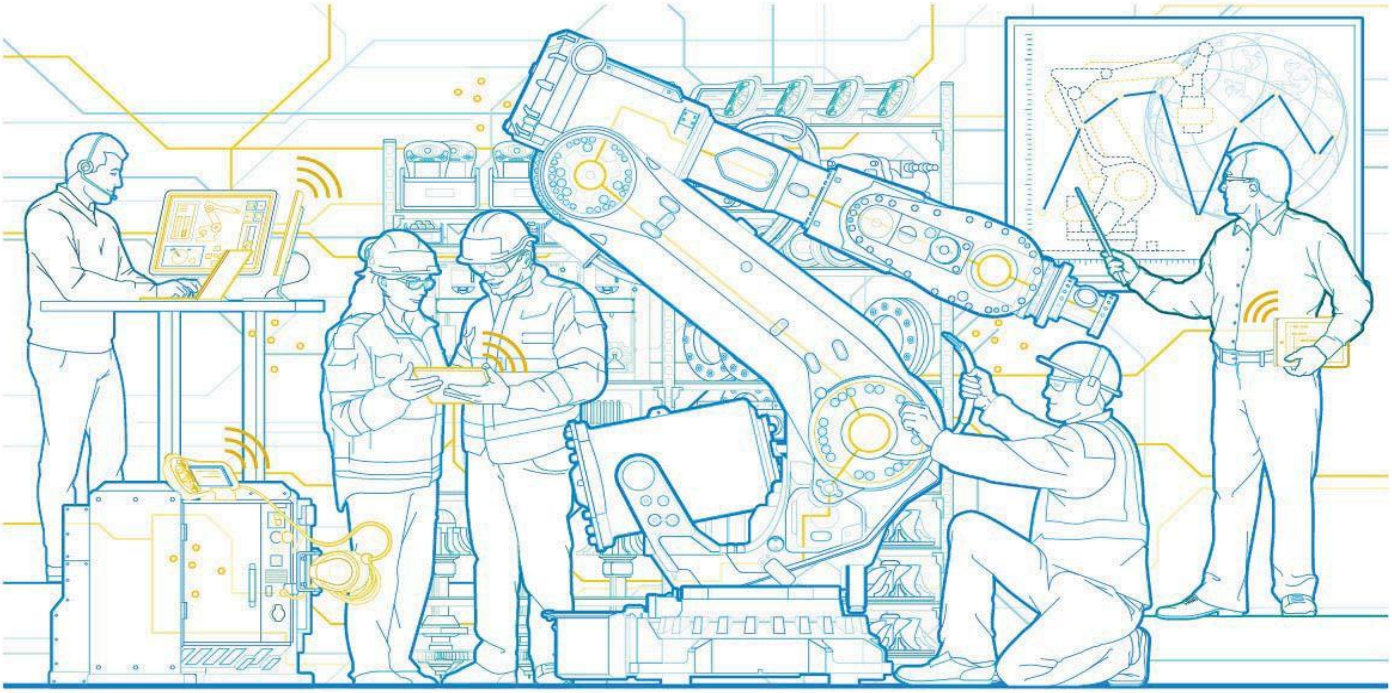


RobotStudio^{tm} 6.08

MultiMove

ABB AB
Robotics Products
SE-721 68
Västerås Sweden

2017-07-10 ABB

1. MultiMove 4

1.1. Building the MultiMove station.....5
1.2. Programming MultiMove systems 11
1.3. Changing the MultiMove motion behavior 17

1. MultiMove

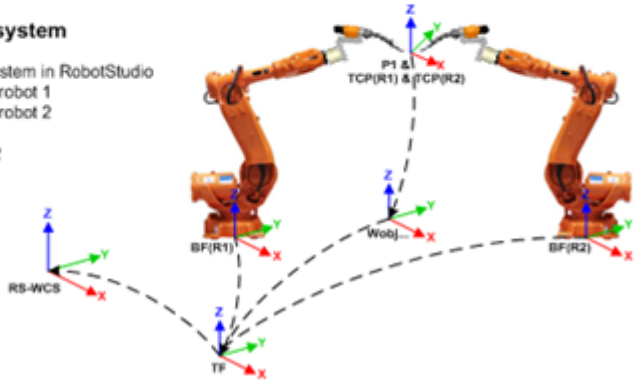
Definition

Definition!

The MultiMove functions helps you create and optimize programs for MultiMove systems where one robot or positioner holds the work piece and other robots operate on it.

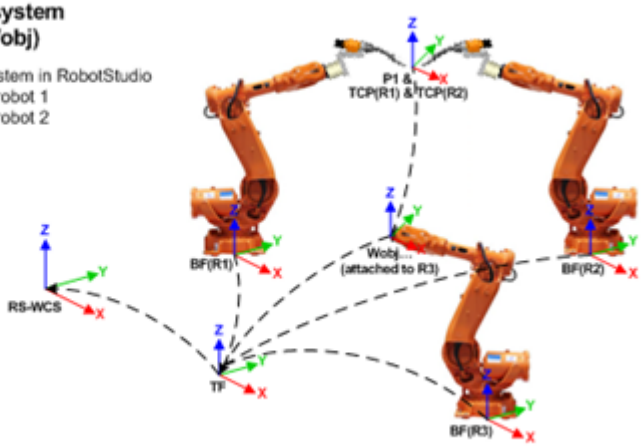
Coordinated MultiMove system

RS-WCS: World Coordinate System in RobotStudio
TCP(R1): Tool Center Point of robot 1
TCP(R2): Tool Center Point of robot 2
BF(R1): Baseframe of robot 1
BF(R2): Baseframe of robot 2
P1: Robot target #1
TF: Taskframe
Wobj: Workobject



Coordinated MultiMove system (one robot holding the Wobj)

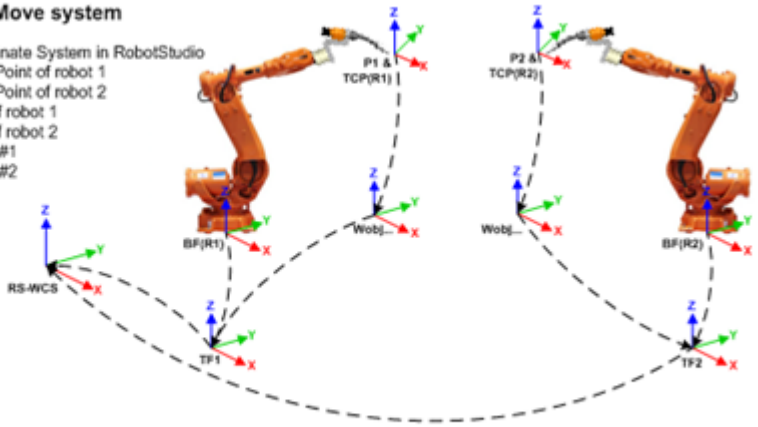
RS-WCS: World Coordinate System in RobotStudio
TCP(R1): Tool Center Point of robot 1
TCP(R2): Tool Center Point of robot 2
BF(R1): Baseframe of robot 1
BF(R2): Baseframe of robot 2
BF(R3): Baseframe of robot 2
P1: Robot target #1
TF: Taskframe
Wobj: Workobject



A specific kind of such systems is an *Independent MultiMove* system, in which robots can operate simultaneously and independently while being controlled by one controller.

Independent MultiMove system

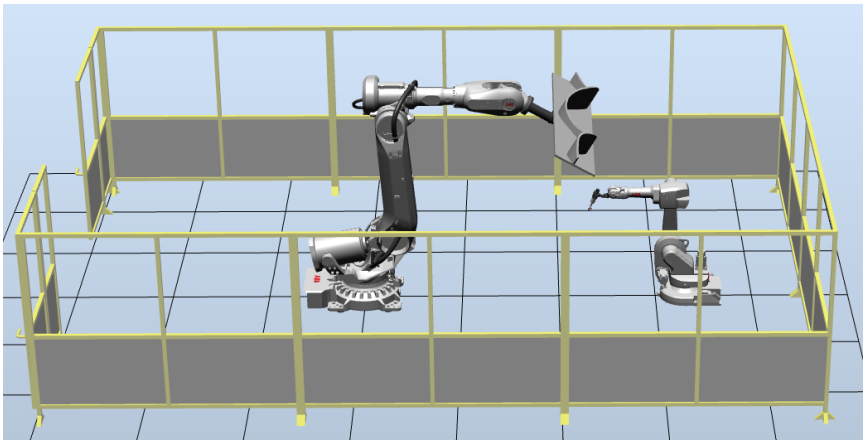
RS-WCS: World Coordinate System in RobotStudio
TCP(R1): Tool Center Point of robot 1
TCP(R2): Tool Center Point of robot 2
BF(R1): Baseframe of robot 1
BF(R2): Baseframe of robot 2
P1: Robot target #1
P2: Robot target #2
TF1: Taskframe 1
TF2: Taskframe 2
Wobj: Workobject



1.1. Building the MultiMove station

Overview

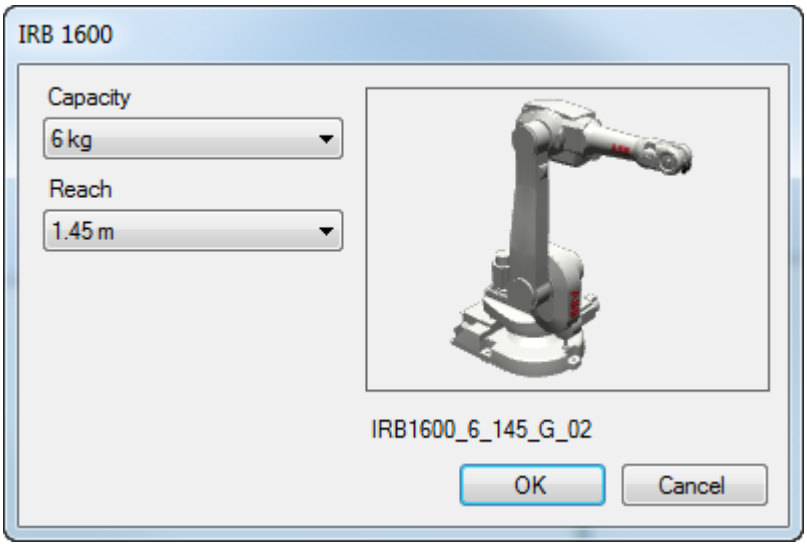
Before we start with **MultiMove** programming we will build a station with two robots and create a **MultiMove** system. We will also create a workobject and a path to use in the next exercise.



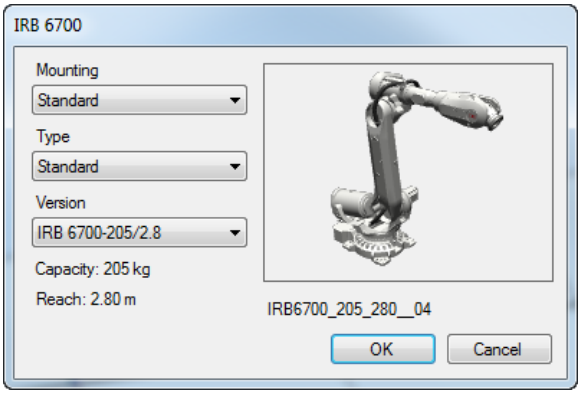
In order to better understand the **BaseFrame** and **TaskFrame** concepts in **MultiMove** system, see the definition on the previous page.

Import and place objects

1. Create a new **Solution with Empty Station**.
2. Name the solution *myMultiMoveSolution* and set the location to *courseware\solutions\Module_9\myMultiMoveSolution***.**
3. On the **Home** tab click the **ABB library** button and select **IRB 1600** and then the 6kg and 1.45m model.

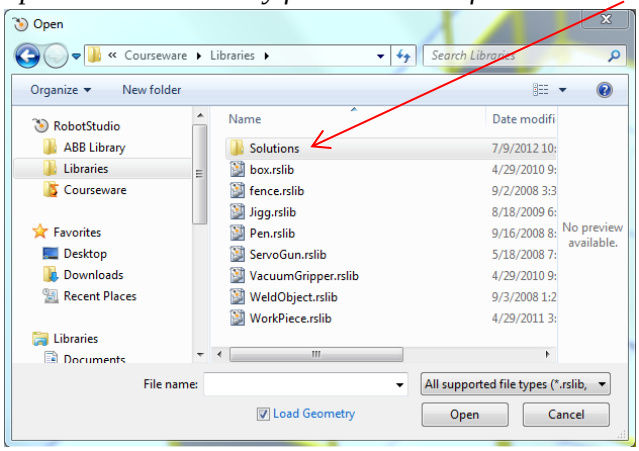


4. In the **Layout** browser right click the *IRB1600_6_145__01* robot and select **Position>Set Position**.
5. In the **Set Position** dialog verify that *World* reference is selected.
6. In the **Position** boxes enter **X = 3300**, **Y = 0**, **Z = 0**.
7. In the **Orientation** boxes enter **X = 0**, **Y = 0**, **Z = 180**, then click **Apply** and **Close**.
8. On the **Home** tab click the **ABB library** button and select **IRB 6700** and then the 205kg and 2.8m model.

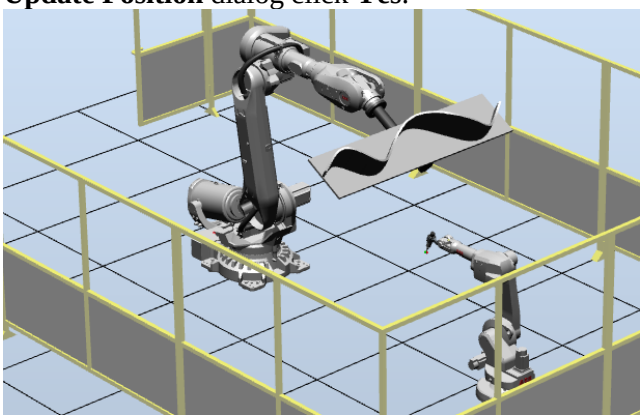


9. On the **Home** tab click the **Import Library** button.
10. In the **Open** dialog browse to the folder *Courseware\Libraries* and while pressing [**ctrl**] select the *Fence* and *mySpintecTool* libraries, and then click **Open**.

Note: mySpintecTool was created in the Learning the Basics Module. If the tool is not present in the Library folder it can be found in the Solutions folder.



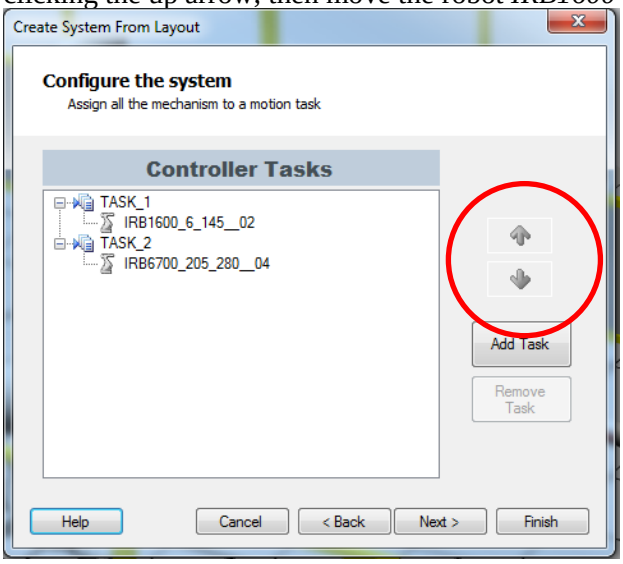
11. In the **Layout** browser drag the *mySpintecTool* tool to the *IRB1600* robot.
12. In the **Update Position** dialog click **Yes**.
13. On the **Home** tab click the **Import geometry** button.
14. In the **Open** dialog browse to the folder *Courseware\Geometry* and select the geometry *training_part1*, then click **Open**.
15. In the **Layout** browser drag the *training_part1* to the robot *IRB6700* robot and in the **Update Position** dialog click **Yes**.

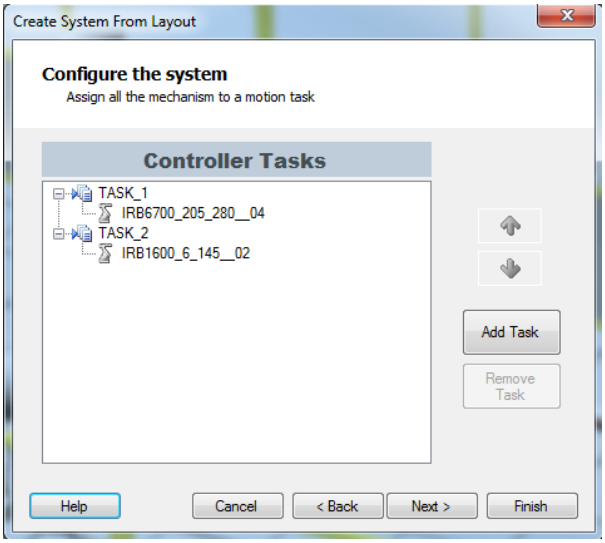


16. Save the station as *courseware\Module_9\myMultiMoveSolution\Stations\myMultiMoveLayout.*

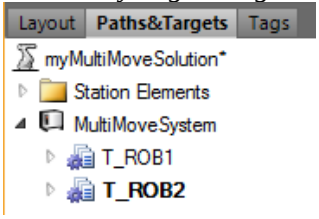
Create System from Layout

1. On the **Home** tab click the **Robot System** button and select **From Layout…**.
   This starts the **Create System From Layout** wizard.
2. In the **System Name and Location** page enter the name *MultiMoveSystem* then click **Next**.
3. In the **Select Mechanisms for the System** page make sure that both robots are selected.
4. In the **Configure the System page** select the robot *IRB6700* and move it up to *Task1 by* clicking the up arrow, then move the robot *IRB1600* down to *Task 2*.





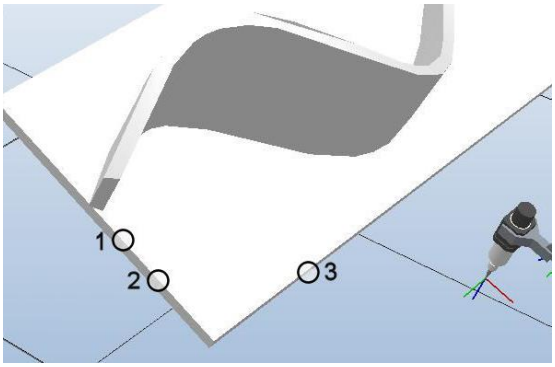
5. Click **Next**.
6. In the **System Option** page click **Finish**.
   Wait until you get the green confirmation in the down right corner.



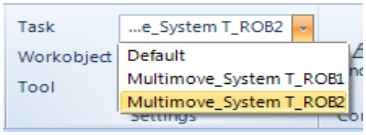
*In the **Paths&Targets** browser you can see that a system with two tasks has been created.*

Create a workobject

1. In the Graphics window set the Selection Level and Snap Mode to **Surface Selection** and **Snap Edge**.
2. Zoom the *training_part1* so that you can see the left side of its front as in the picture below.



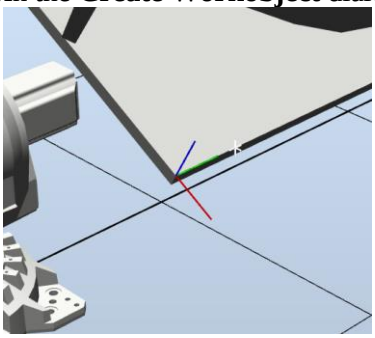
3. On the **Home** tab, in the **Task** box select the task *MultimoveSystem T_ROB2*.



(You can also in the **Paths&Targets** browser expand the node for the Virtual Controller *MultimoveSystem*, right click the task *T_ROB2* and then select **Set as active**).

4. On the **Home** tab, in the **Tool** box select the *tSpintec* tool.

5. On the **Home** tab click the **Other** button and select **Create Workobject**.
6. In the **Create Workobject** dialog, in the **Name** box enter *obWorkpiece*.
7. In the **User Frame** field click in the **Frame by points** box, then click the arrow.
8. In the **Frame by points** dialog, select **Three-point**.
9. Click the **First point on X axis** and in the Graphics click on point **1** as in the picture.
10. Click the **Second point on X axis** and in the Graphics click on point **2** as in the picture.
    The order of the first two points determines the direction of the X axis.
11. Click the **Point on Y axis** and in the Graphics click on point **3** as in the picture.
    This determines the positive Y direction and also the intersection which determines where the workobject will be created.
12. Click the **Accept** button.
13. In the **Create Workobject** dialog click **Create**.

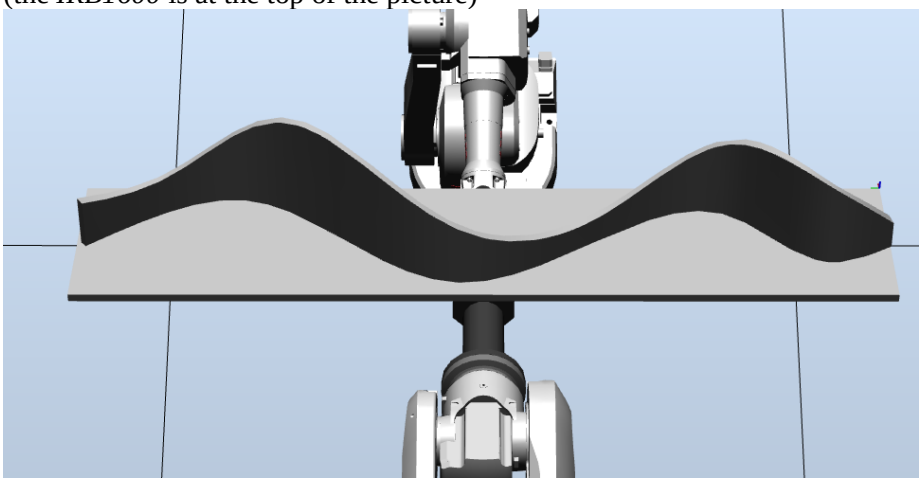


14. In the **Paths&Targets** browser right click the *obWorkpiece* workobject and then point to **Attach to** and select *IRB6700*.
15. In the **Update Position** dialog click **No**.
16. Confirm that the workobject will be moved by the robot by clicking **OK**.

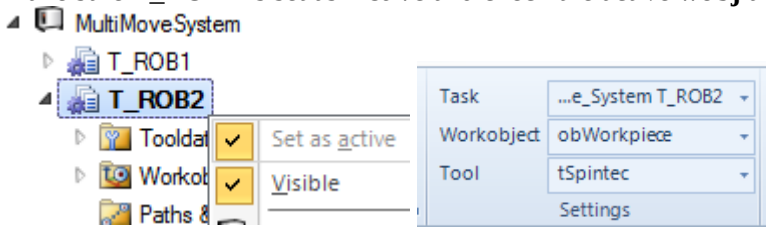
Create a path

Now we want to create a path following the upper edge of the bending body of the workpiece.

1. Zoom so that you can see the *training_part1* from above as in the picture below.
   (the *IRB1600* is at the top of the picture)

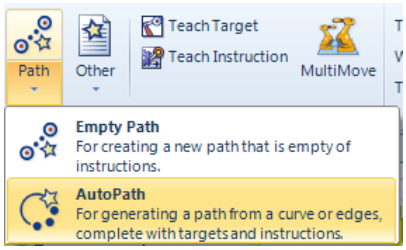


2. Make sure T_ROB2 is set as **Active** and check the active **wobj** and **tooldata**.



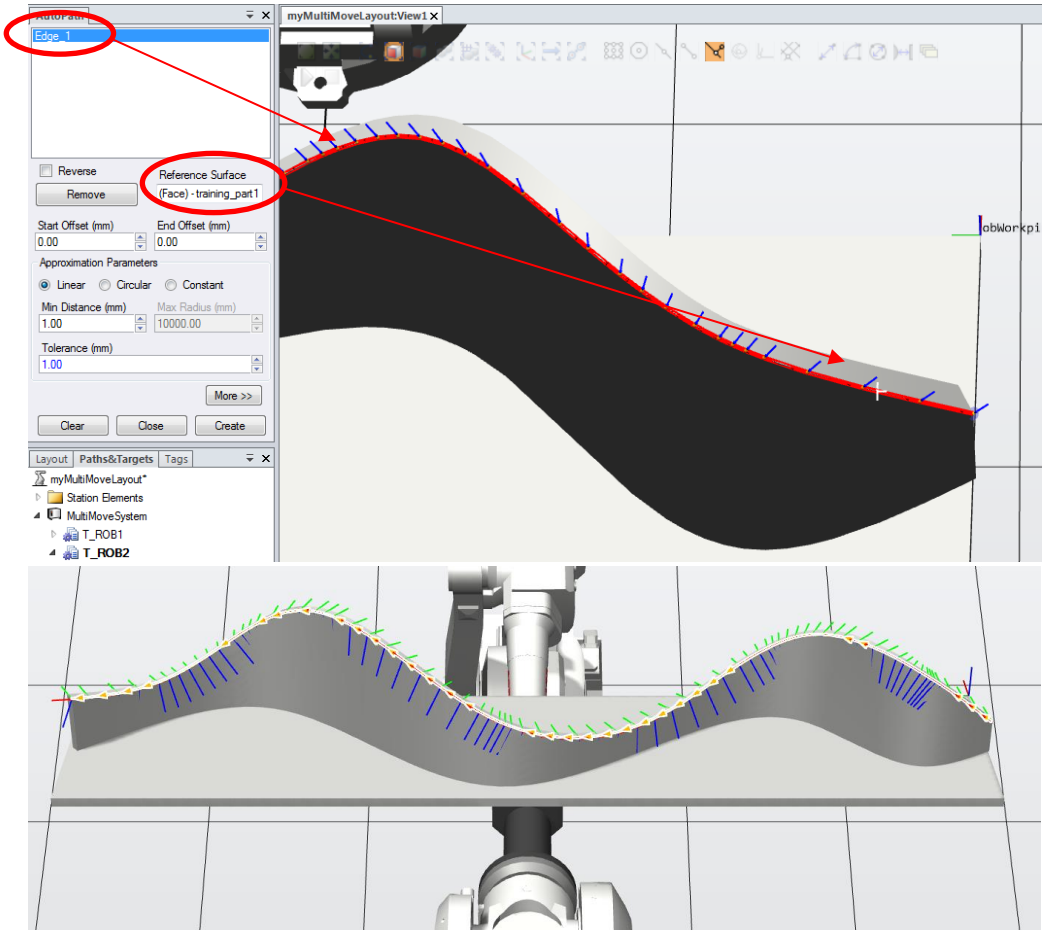
3. In the Task bar set the template to *MoveL,v200 and z1*

4. On the **Home** tab click the **AutoPath** button.



5. In the Graphics window select the selection level **Surface** and snap mode **Edge**.

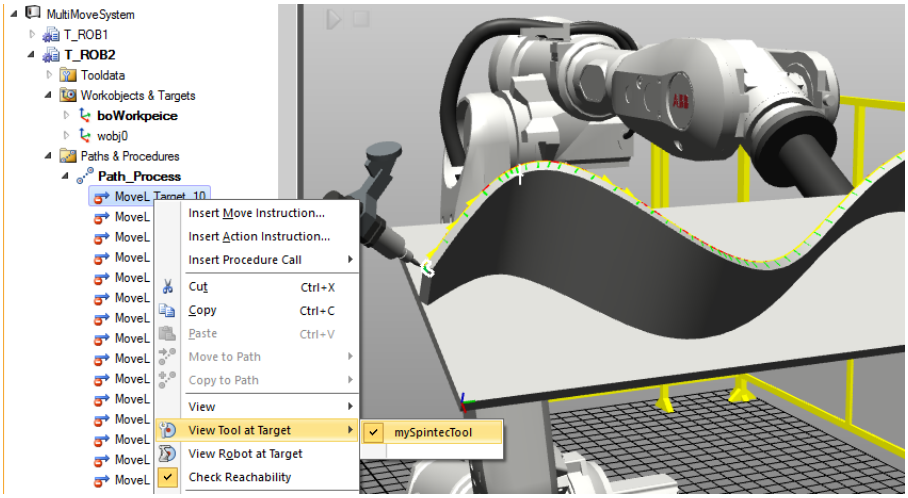
6. Click the top surface (as shown in red) for the reference surface and the edge as shown close to the corner below. Set **Tolerance** to 1.0mm



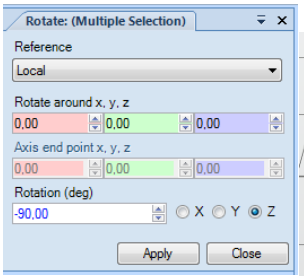
7. Click **Create**.
8. In the **Paths&Targets** browser rename the new path to *Path_Process*.

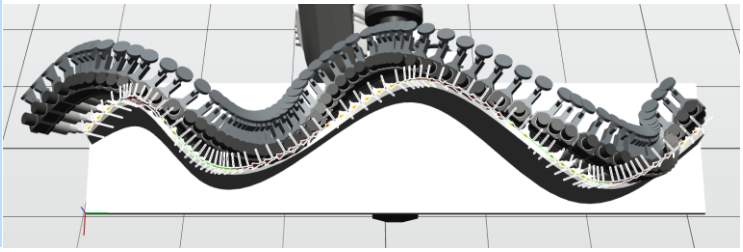
Change the target orientations

1. Expand the node of the *Path_Process* path and right click the first instruction, then select **View Tool at Target > mySpintecTool**.
   The tool reaches the curve from the side in an orientation that is not suitable for the IRB1600 to reach.

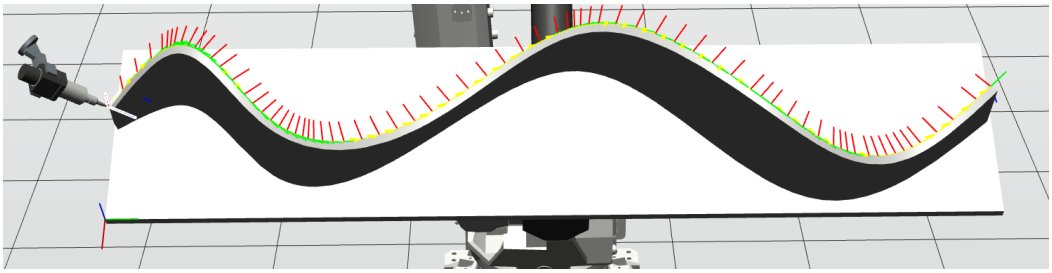


2. Again right click the first instruction and select **Locate Target**.
3. Multi select all targets under the workobject *obWorkpiece*.
4. When the targets are selected, on the **Modify** tab click the **Rotate** button.
5. Rotate the targets -90 degrees around Z.





6. De-activate **View Tool at Target**.



7. **Save** the station as *courseware\Module_9\myMultiMoveSolution\Stations\myMultiMoveBasicPath.*

1.2. Programming MultiMove systems

Overview

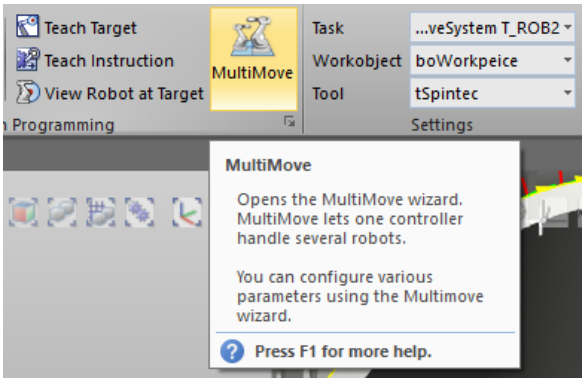
In this exercise we will create a **MultiMove** program that contains both synchronized and unsynchronized motions.

Creating a synchronized MultiMove program

We will use synchronized MultiMove for our process path so that the work piece robot continuously positions the work piece to facilitate for the tool robot. Synchronized programs are created with the MultiMove function.

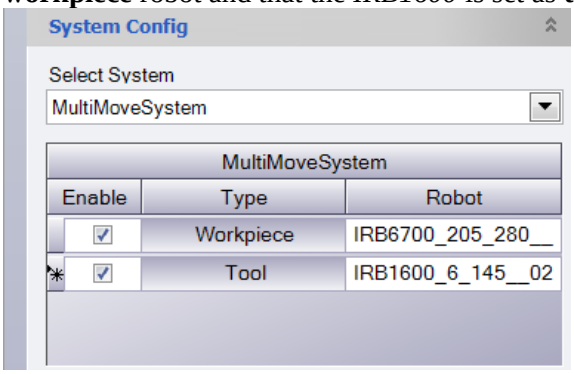
1. Open the station *myMultiMoveBasicPath* unless it is already open.

2. On the **Home** tab click the **MultiMove** button.

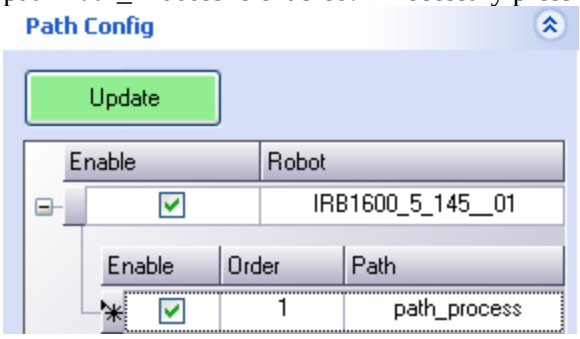


3. In the **MultiMove** window click the **Setup** button if the **Setup** page it is not already visible.

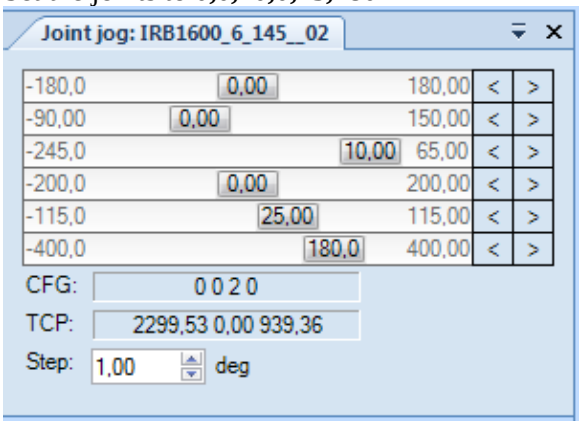
4. In the **System Config** group, in the **Select System** box select the system *MultiMoveSystem*. Make sure that both robots are enabled and that the *IRB6700* is set as **workpiece** robot and that the *IRB1600* is set as **tool** robot.



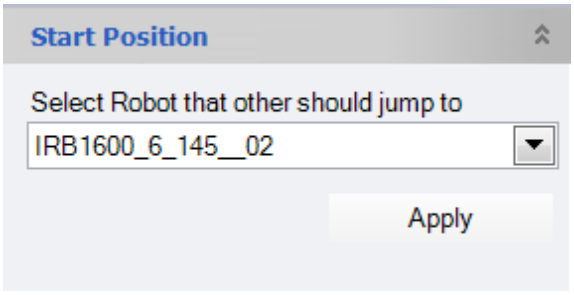
5. In the **Path Config** group expand the node for the robot *IRB1600* to make sure that the path *Path_Process* is enabled. If necessary press the Update button.



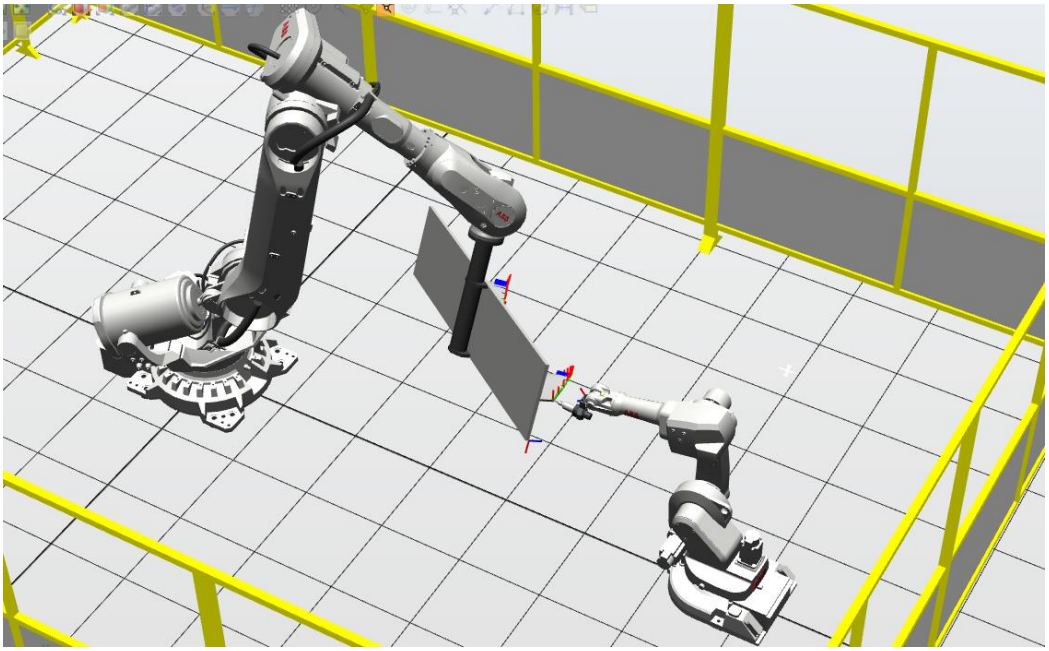
6. In the **Paths&Targets** browser right click *T_ROB2* and select **Mechanism Joint Jog**.
7. Set the joints to **0,0,10,0,25,180**



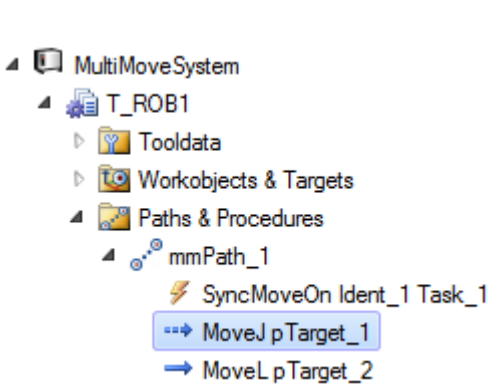
8. Expand the **Start position** group, and in the **Select Robot that other should jump to** box select the *IRB1600* and click **Apply**.

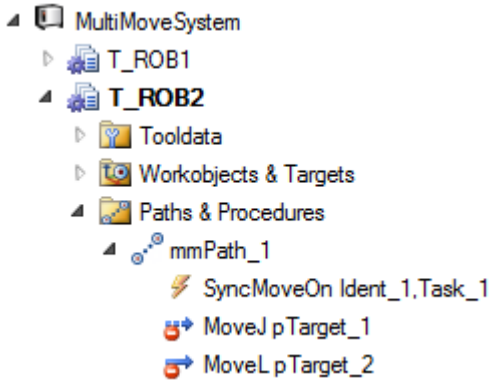


This moves the large robot so that the first target in its path is moved to the TCP of the small robot.



9. At the bottom of the **MultiMove** window, in the **Test** page click **Play**.
   *The robots now starts moving and synchronized paths for the robots are created. When finished, the message **Calculation OK** appears in the status box*
10. In the **MultiMove** window click the **Create Paths** button.
11. On the **Create Paths** page scroll down to the **Generate Paths** group and click **Create Paths**.
    Synchronized paths for the tool robot and the workpiece robot are now created in the **Paths&Targets** browser.
12. For each of the two mmPath_1 change the first motion instruction to Joint move.
    The warnings for targets that cannot be reached in T_ROB2 can be ignored, as they are calculated from obWorkpiece's current position.

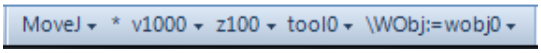




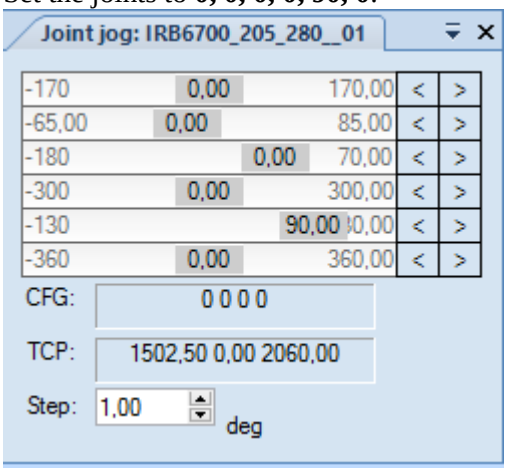
Adding unsynchronized instructions to the program

We will now add unsynchronized instructions to the paths, where the robots move to home positions independently of each other. First we will create three joint targets and then we will add them to the paths.

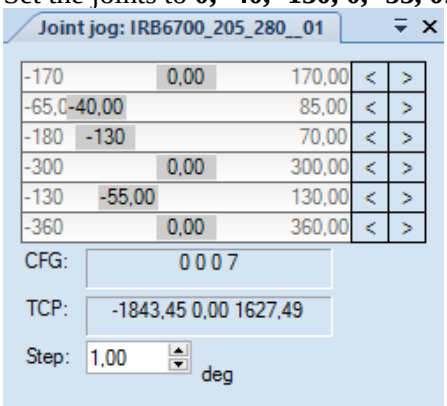
1. In the **Paths&Targets** browser right click the task *T_ROB1* and select **Set as active**.
2. In the Task bar set the template to MoveJ



3. In the **Paths&Targets** browser right click *T_ROB1* and select **Mechanism Joint Jog**.
4. Set the joints to **0, 0, 0, 0, 90, 0**.



5. On the **Home** tab click the **Teach Target** button.
   If you get a warning click yes.
6. Under *T_ROB1* expand the workobject and rename the new target (Target_10) to *p6700_Home*.
7. Set the joints to **0, -40, -130, 0, -55, 0**.



8. On the **Home** tab click the **Target** button and select **Teach Target**.
   If you get a warning click yes.
9. Under *T_ROB1* expand the workobject and rename the new target (Target_10) to *pChange*.

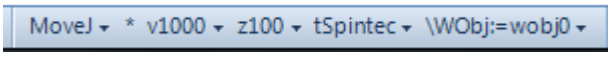
   We will now add the targets to the IRB 6700 path in this order;
   home – multimove – home – change.

10. Right click *p6700_Home* and select **Add to Path > mmPath1 > First**.
    If you get a warning click yes.

11. Right click *p6700_Home* and select **Add to Path > mmPath1 > Last**.
12. Right click *pChange* and select **Add to Path > mmPath1 > Last**.

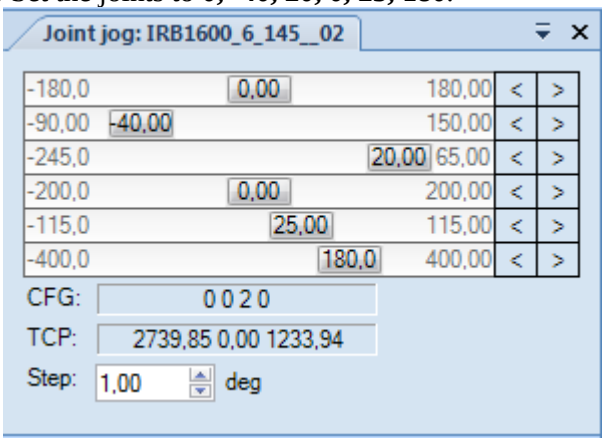
Now we will add a home position for the other robot.

13. In the **Paths&Targets** browser right click the task *T_ROB2* and select **Set as active**.
14. In the Task bar set the template to ***MoveJ*** and workobject to ***wobj0*.**



If the targets where created in the other workobject they would be dependent.

15. In the **Paths&Targets** browser right click *T_ROB2* and select **Mechanism Joint Jog**.
16. Set the joints to **0, -40, 20, 0, 25, 180**.

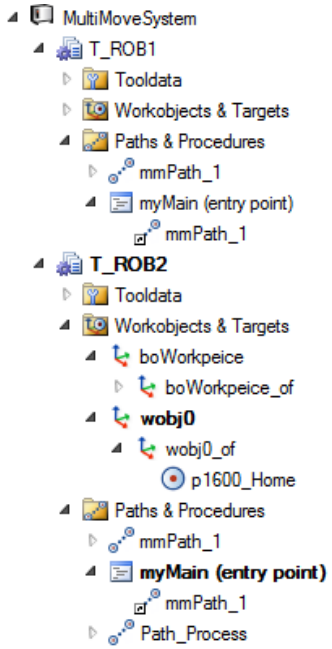


17. On the **Home** tab click the **Target** button and select **Teach Target**.
    If you get a warning click yes.
18. Under *T_ROB2* expand wobj0 and rename the new target to *p1600_Home*.
19. Right click *p1600_Home* and select **Add to Path > mmPath1 > First**.
    If you get a warning click yes.
20. Right click *p1600_Home* and select **Add to Path > mmPath1 > Last**.

Test the program

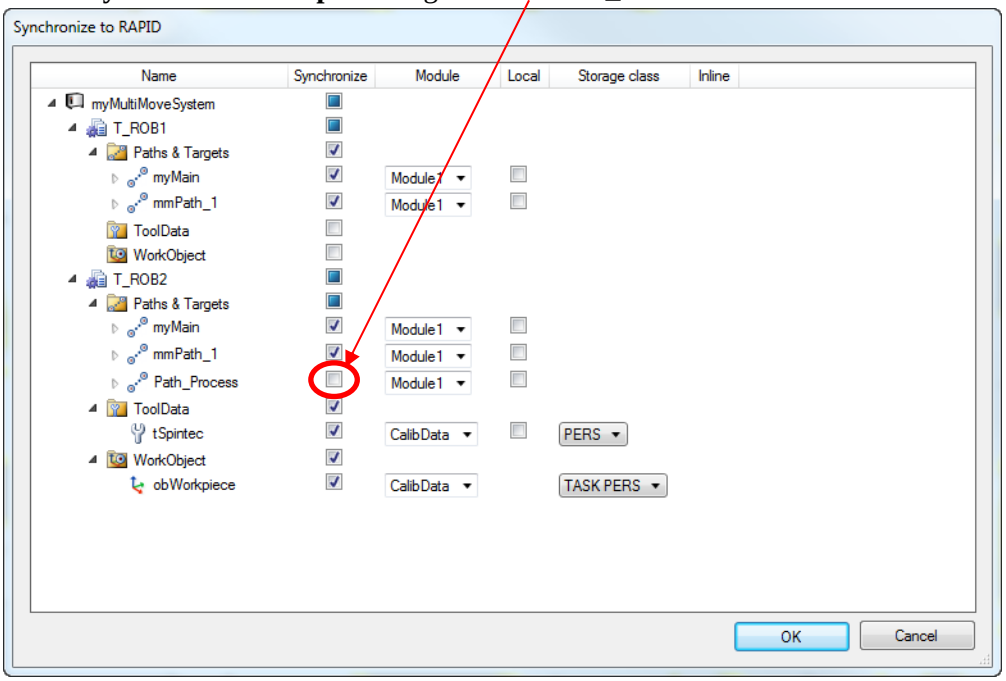
We will now synchronize the station to the virtual controller and run a simulation.

1. Create an empty path in each robot, rename it *myMain* set it to *Simulation entry point* and add the mmPath_1 to each.



2. On the **Rapid** tab click the **Synchronize to RAPID** button.

3. In the **Synchronize to Rapid** dialog uncheck *Path_Process* and then click **OK**.



This path was only needed for the basis of the creation of the coordinated MultiMove paths and is not required in order to execute the robot programs.

4. On the **Simulation** tab click the **Play** button.
   The robots now execute the paths.
5. Save the station as
   courseware\Module_9\myMultiMoveSolution\Stations\myMultiMoveSimulation.

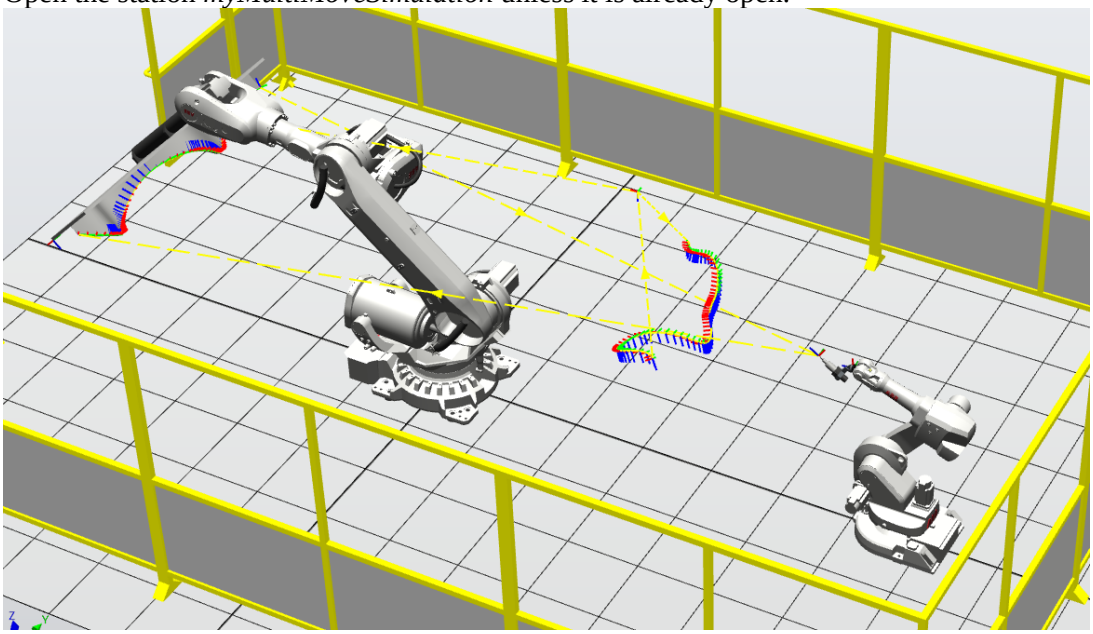
1.3. Changing the MultiMove motion behavior

Overview

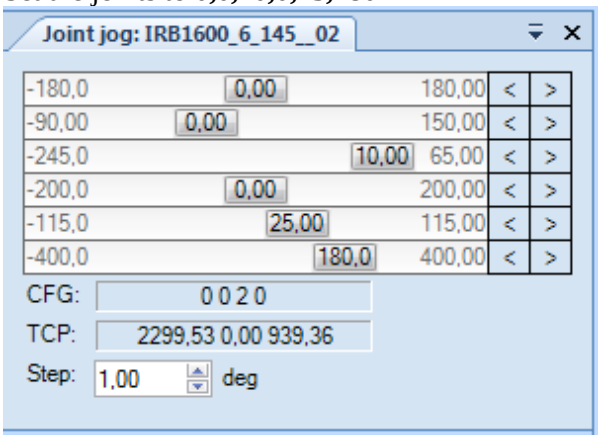
In this exercise we will learn how to use some of the motion behavior features in MultiMove. We will specify constraints and rules for how the robots shall move relative to each other. The default setting is no constraints, which results in the fewest joint movements. Note that some of the tests below will result in a path where the work piece will move below the floor.

Examine the default behavior

1. Open the station *myMultiMoveSimulation* unless it is already open.

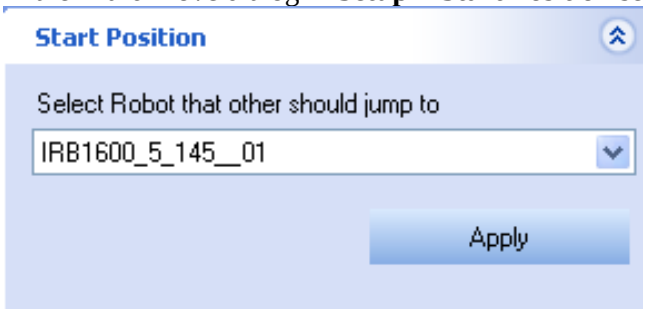


2. In the **Paths&Targets** browser right click *T_ROB2* and select **Mechanism Joint Jog**.
3. Set the joints to **0,0,10,0,25,180**



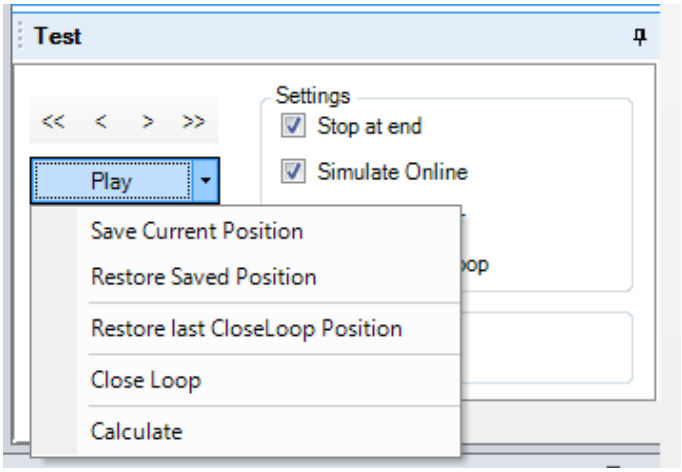
4. On the **Home** tab click the **MultiMove** button.

5. In the **MultiMove** dialog in **Setup > Start Position** select the IRB1600 and click **Apply**.



This moves the large robot so that the first target in its path is moved to the TCP of the small robot.

6. In the **Test** area click **Play** and then **Use Current Robot position**.
Note how the motion looks; if necessary run play again.
7. When the simulation is completed, on the **Play** button drop-down menu first select **Restore last CloseLoop Position** and then **Save Current Position**.



Changing the start position for the path

We will now jog the robots to new positions and see how that affects the generated path.

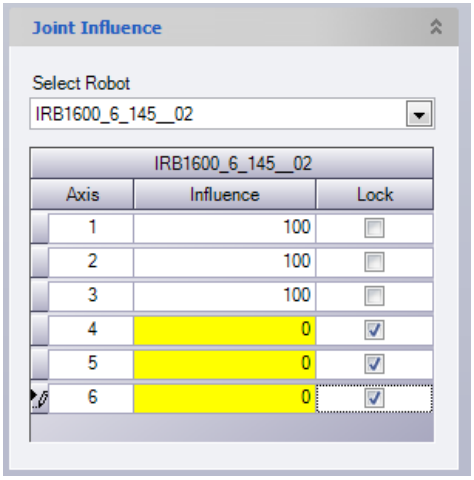
1. In the **Layout** browser select the *IRB 1600* robot.
2. On the **Modify** tab click the **Mechanism Joint Jog** button.
3. In the **Joint Jog** dialog click the slider for axis 4, type **-90** and press [**Enter**].
4. In MultiMove **Test** window click **Play**.
5. In the **Select Start Position** dialog select **Use current robot positions**.
This dialog is displayed since the current start position is not the same as the last used one. Note how the robots move differently than they did with the previous start position.

Locking joint influence

The Joint influence controls the balance of how much the robots will use their joints. We will use it to lock the motion of axis 4, 5 and 6 on the tool robot.

1. On the **Play** drop-down menu select **Restore saved position**.
2. In MultiMove navigation pane click the **Motion behavior** button.
3. On the **Motion behavior** page expand the **Joint Influence** group.
4. In the **Select robot** list select *IRB1600*.

5. In the robot axis grid, on the **Axis 4**, **5** and **6** rows check the **Lock** check box. Make sure that the **Influence** is set to **0** which locks the axes completely.

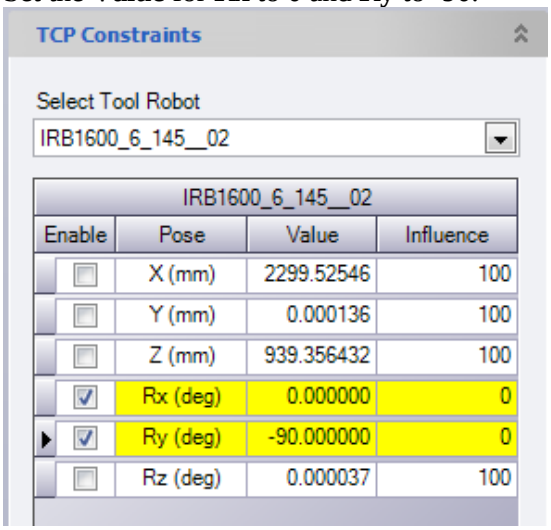


6. In MultiMove **Test** window click **Play**.
7. **Use manually saved position**.
   Note that the robots move differently now as compared to the default behavior. Also, notice that the locked axes do not change in the **Joint jog** dialog.
8. When the simulation is completed uncheck the check boxes that restrict the axes of the tool robot.

Setting TCP Constraints

The TCP constraints control the position and orientation of the tool. We will now create paths where the tool always is in a horizontal position.

1. On the **Motion behavior** page expand the **TCP Constraints** group.
2. In the **Select tool robot** list select *IRB1600*
3. Check the **Enable** check boxes for **Rx** and **Ry** constraints.
4. Set the **Value** for **Rx** to **0** and **Ry** to **-90**.

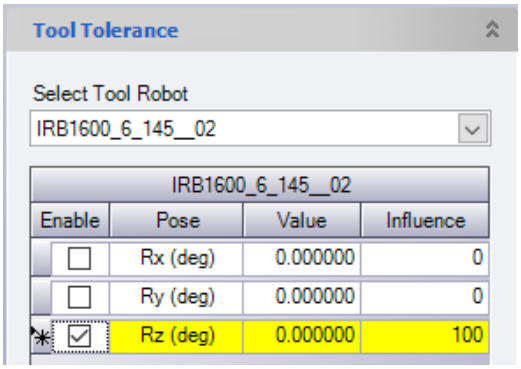


5. In MultiMove **Test** window click **Play** and .
6. **Use current robot position**.
   Note that the tool is kept in a horizontal position during the entire simulation.
7. When the simulation has completed, uncheck the check boxes that set the constraints.

Setting tool tolerances

Tool tolerances allow the tool to deviate from the path.

1. On the **Motion Behavior** page, in the **Tool Tolerance** group select *IRB1600* as tool robot and then enable the tool tolerance for **Rz**.
   This allows the tool to be reoriented around the Z axis when reaching the targets.

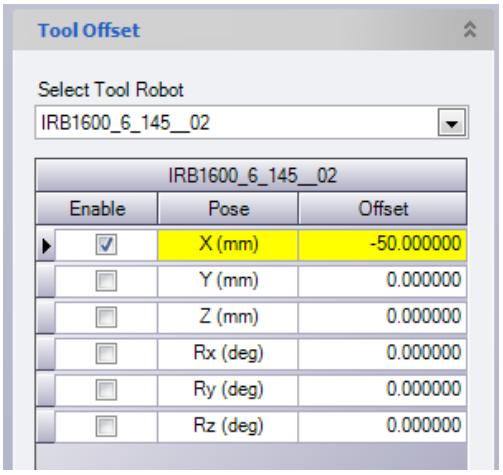


2. In MultiMove **Test** window, click **Play** and start from the **manually saved position**.
3. Uncheck the check box that sets the tolerance.

Setting tool offset

Tool offset creates an offset between the target and the tool.

1. In the **Tool Offset** group select *IRB1600* as tool robot, enable the tool offset for **X** and then enter the value **-50**.



2. In MultiMove **Test** window click **Play** and start from the **manually saved position**.
3. Note that the tool now runs 50 mm above the path.
4. Uncheck the checkbox.
5. Save the station as *courseware\Module_9\myMultiMoveSolution\Stations\myMultiMoveBehavior*.

Learn more

Click the **Help** button in the top right corner of RobotStudio.

See the help on section	for information about
Programming MultiMove Systems Overview	prerequisites and workflow for MultiMove programming

ABB AB
Robotics Products
SE-721 68 Västerås
Sweden