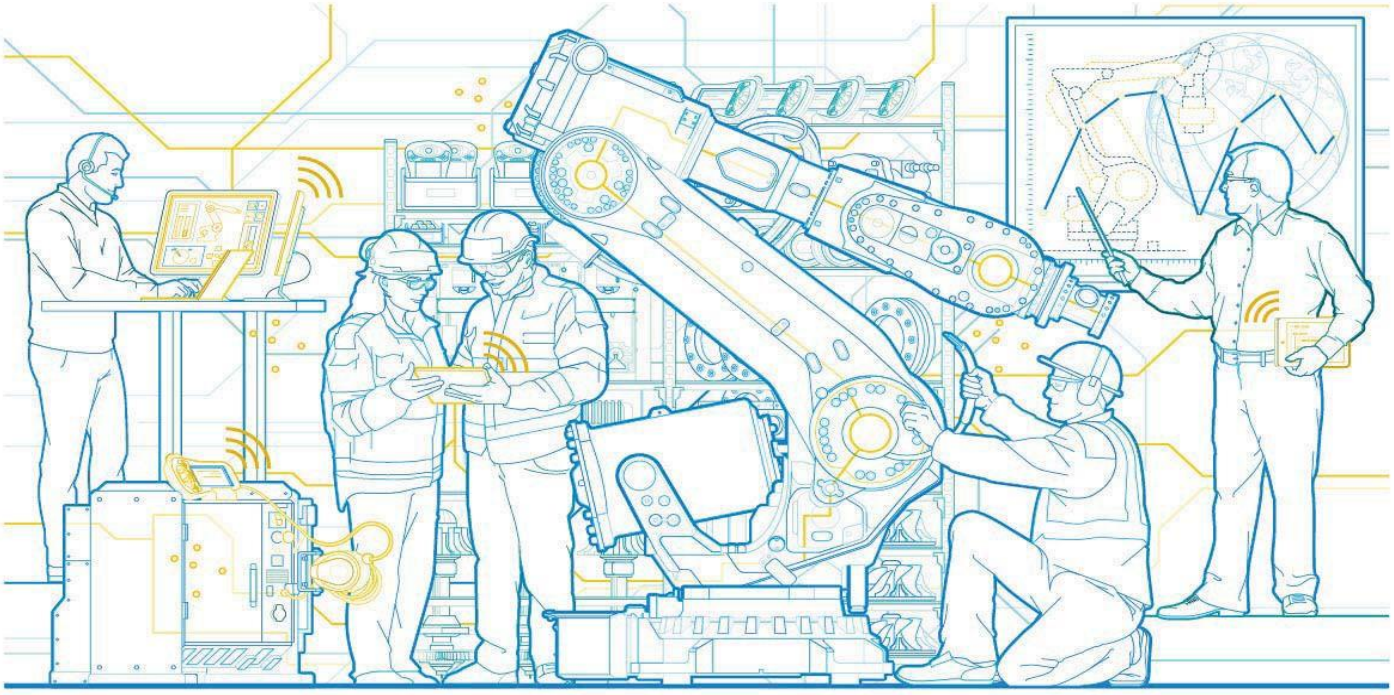


RobotStudio^{tm} 6.08

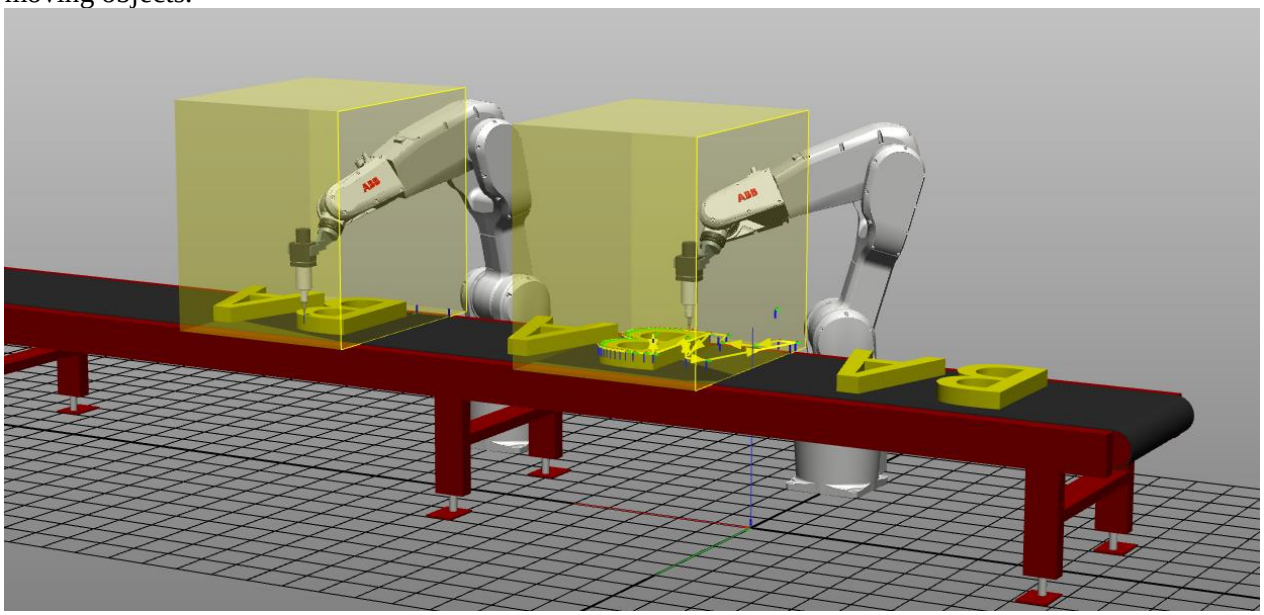
Conveyor Tracking

ABB AB
Robotics Products
SE-721 68
Västerås Sweden

2017-07-11 ABB

Overview

In this module we will learn how to set up and program robots that use **Conveyor Tracking** to work with moving objects.



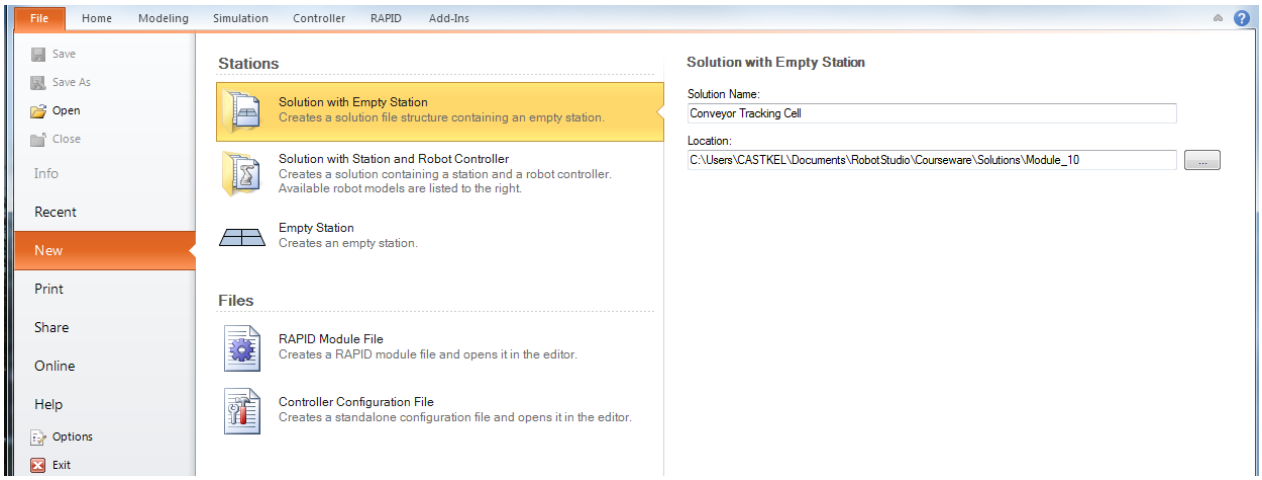
1. Prepare the Station

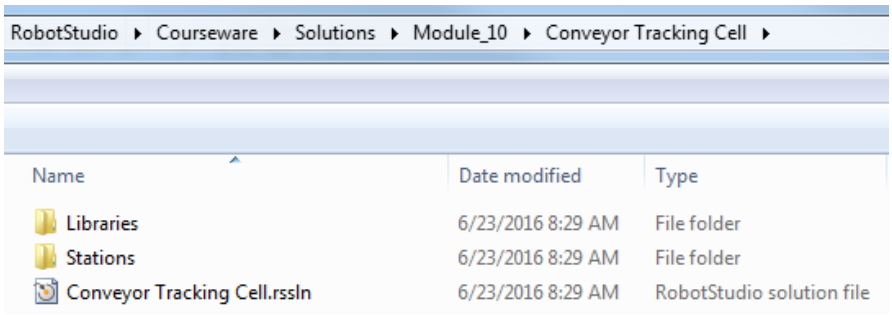
1.1. Create a Solution

Overview

We will start with creating a solution for the exercise. A solution is a file structure that helps the user to keep all the files belonging to a RobotStudio project in a good structure. A solution can contain one or more station files plus other related files.

1. On the **File** tab, select **New>Solution with Empty Station**. Name the solution *Conveyor Tracking Cell* and set the location to *courseware\solutions\Module_10* and click **Create**.

2. 

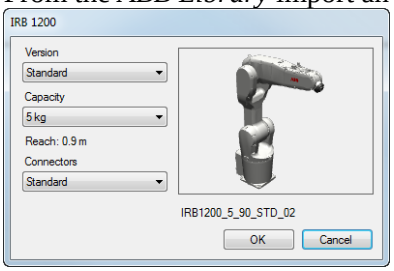


1.2. Prepare the Station Layout

Overview

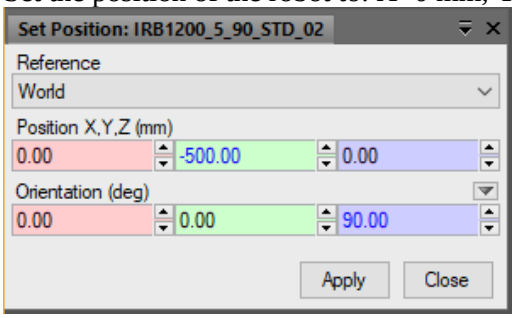
Now we will prepare the station layout with one robot and one conveyor.

1. Import the library file *\Courseware\Libraries\Belt conveyor.rslib*.
2. Disconnect the *Belt Conveyor* from library.
3. From the *ABB Library* import an *IRB1200 5kg* robot with standard connectors.



4. Import the library file *\Courseware\Libraries\SpindleTool.rslib*.
5. Attach the *SpindleTool* to the robot.

6. Set the position of the robot to: X=0 mm, Y= -500 mm, Z=0 mm, RX=0, RY=0, RZ= 90.



7. Save the station.

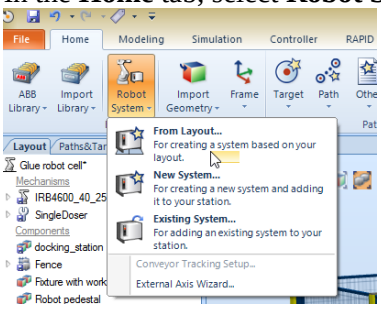
***Note*:** When the solution was created, an empty station was saved to the solutions sub folder *\Stations*. Now when save is pressed, that station will be overwritten.

1.3. Create a System

Overview

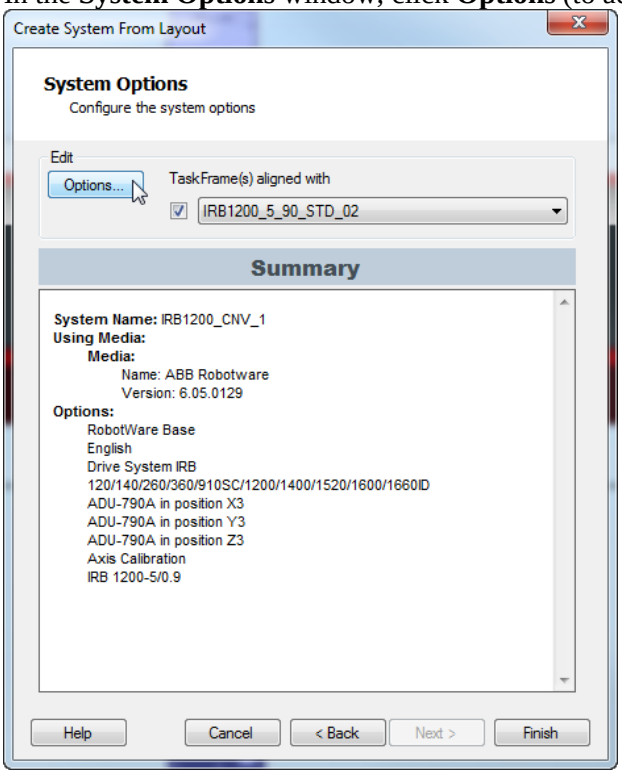
A system used with conveyor tracking must have the software option *606-1 Conveyor Tracking* included.

1. In the **Home** tab, select **Robot System>From Layout**…

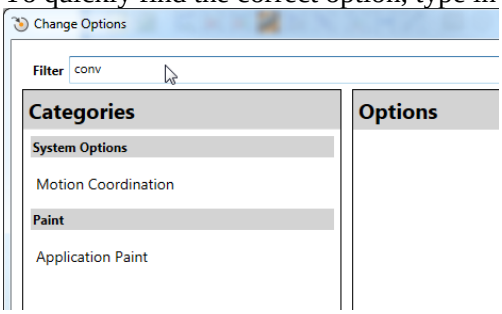


2. Name the system *IRB1200_CNV_1*. The system will be placed in the solutions sub folder *\Systems*. Select the newest RobotWare you have installed on your computer (the latest version of RobotWare is automatically installed with RobotStudio).
3. Click **Next** twice.

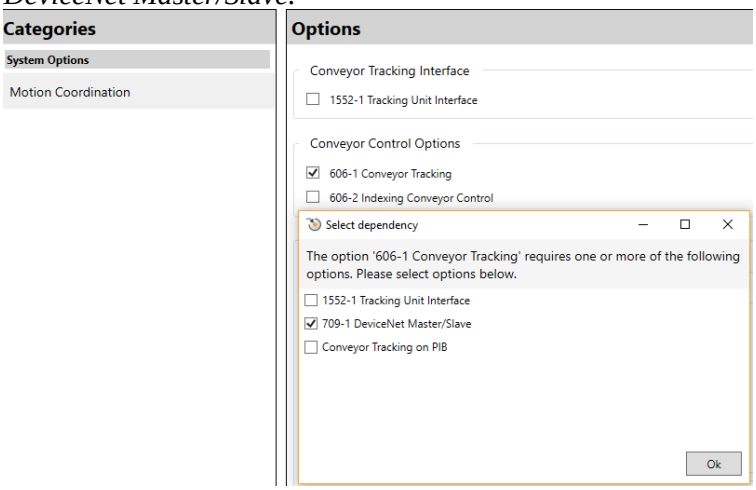
4. In the **System Options** window, click **Options** (to add the Conveyor Tracking option).



5. To quickly find the correct option, type in *conv* in the **Filter** field.

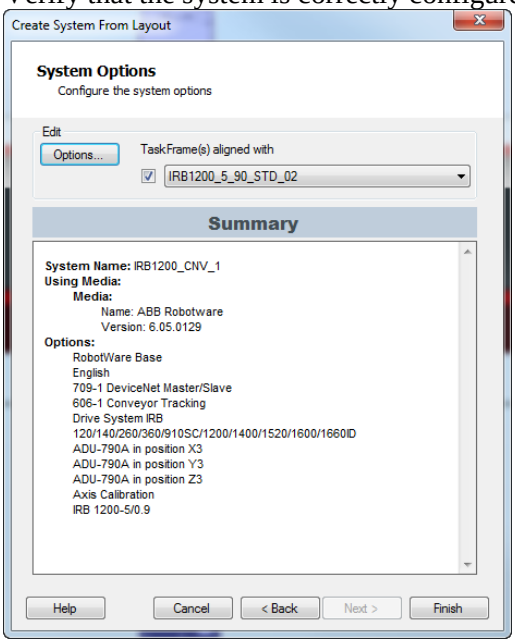


6. Select **Motion Coordination** and the option *606-1 Conveyor Tracking* and the dependency chain *709-1 DeviceNet Master/Slave*.

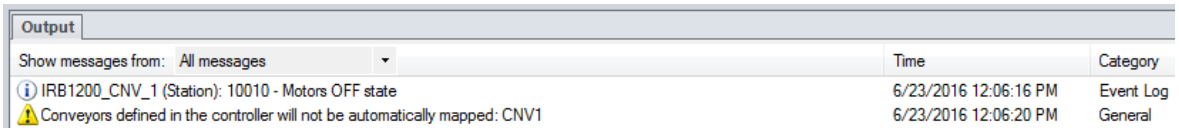


7. Click **Ok** to close the options window.

8. Verify that the system is correctly configured, then click **Finish** to start the system.



Note: When the system starts you will get a warning about the conveyor not being mapped in the Output Window. We will fix that once we have a conveyor defined in our station.

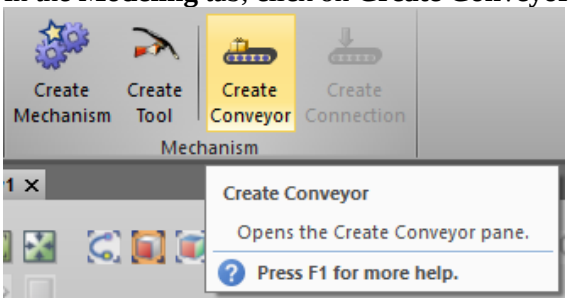


1.4. Create a Conveyor Mechanism

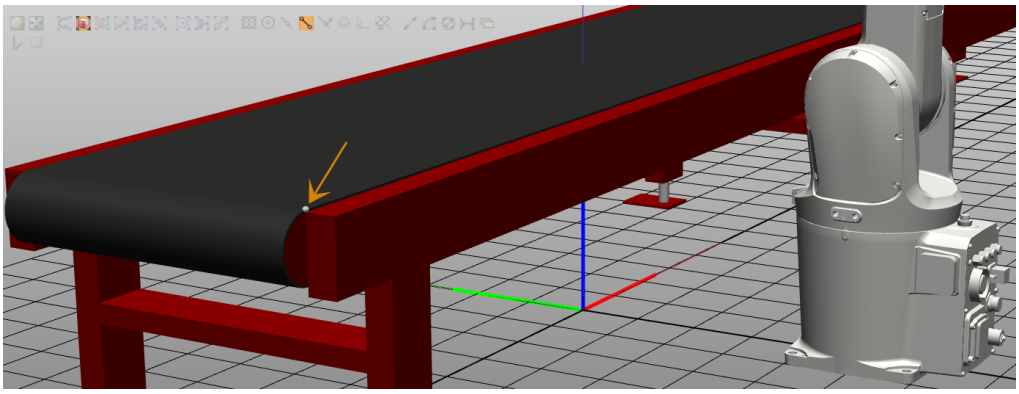
Overview

In order to simulate conveyor tracking in RobotStudio we need a **Conveyor Mechanism.** This mechanism will move objects that can be tracked by one or more robots in a station.

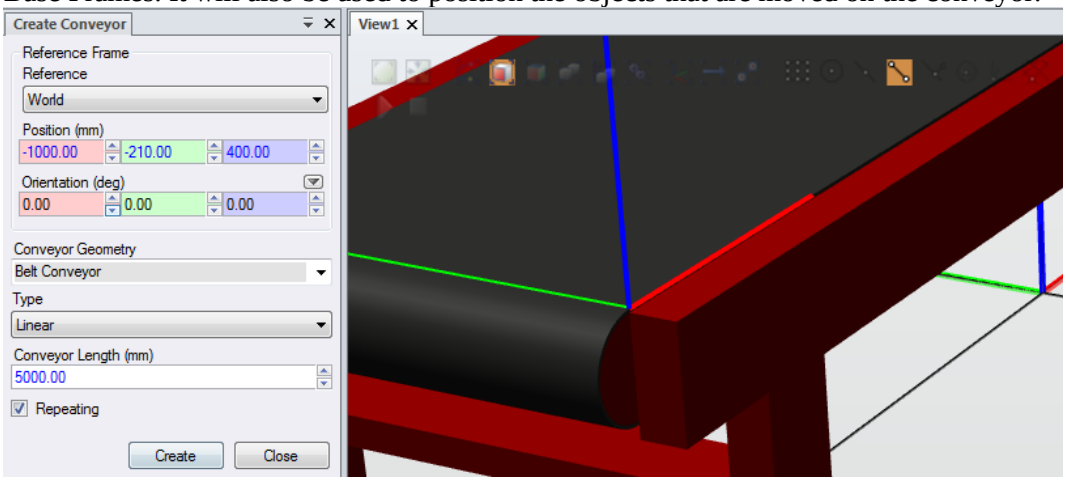
1. In the **Modeling** tab, click on **Create Conveyor**.



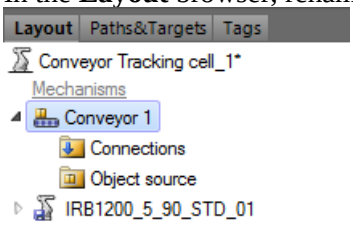
2. Select Selection Level **Surface** and Snap Mode **End**. In the **Create Conveyor** window, ensure the reference is set to **World** and then place the cursor in any of the **Positions** fields. Click in the corner of the conveyors top surface as on the picture below.



This **Position** will be the *Conveyor Reference Frame* that will later be used to calculate the system's Base Frames. It will also be used to position the objects that are moved on the conveyor.



3. In the **Conveyor Geometry** list, select *Belt Conveyor* (if the *Belt Conveyor* not is disconnected from library (Step 1.2.2), it will not be visible in the list).
   It is not necessary to select a **Conveyor Geometry**, but it's a good practice to have a part associated with the conveyor. After the conveyor is created, the *Belt Conveyor* will be embedded in the conveyor mechanism and will not be visible in the browser anymore.
4. In the **Conveyor Length** field, enter the value 5000 mm. This means that the object(s) moving on the conveyor will move 5000 mm, and then be deleted from the station.
5. Keep the check box **Repeating** checked. This means that an endless stream of objects will be created and moved on the conveyor during simulation.
6. Click **Create**.
7. In the **Layout** browser, rename the conveyor to *Conveyor 1*.

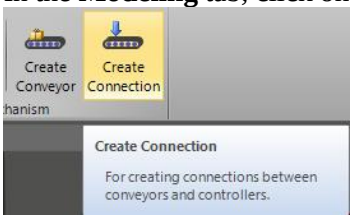


1.5. Create Connection

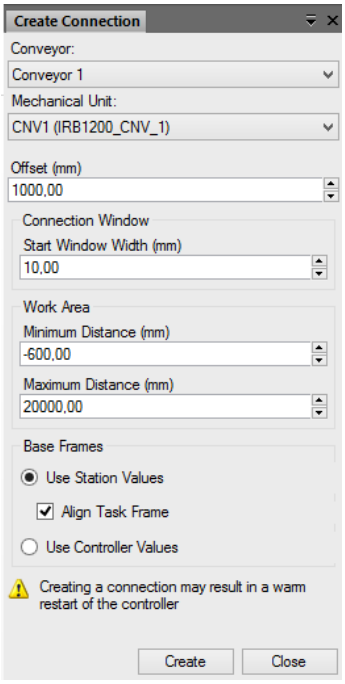
Overview

A *Conveyor Connection* must be created in order for the system to track a moving workobject. Creating this connection creates a correctly configured workobject.

1. In the **Modeling** tab, click on **Create Connection**.



2. In the **Create Connection** window we can see that there are preset values in all parameter fields.



Conveyor
The name of the conveyor mechanism. In this exercise our conveyor *Conveyor 1*.

Mechanical Unit
The system mechanical unit that should be simulated. In this exercise *CNV1* in the system *IRB1200_CNV_1*.

Offset
The connection will be created along the x-axis of the *Conveyor Reference Frame* with the specified *Offset*. The preset value in *Offset* will place the connection in front of the robot mechanism.

Connection Window – Start Window Width
The allowed *Start Window* for the robot. For more information regarding this, please check the Conveyor Tracking option manual.

Work Area – Minimum Distance
The allowed *Minimum Distance* for the robot. For more information regarding this, please check the Conveyor Tracking option manual.

Work Area – Maximum Distance
The allowed *Maximum Distance* for the robot. For more information regarding this, please check the Conveyor Tracking option manual.

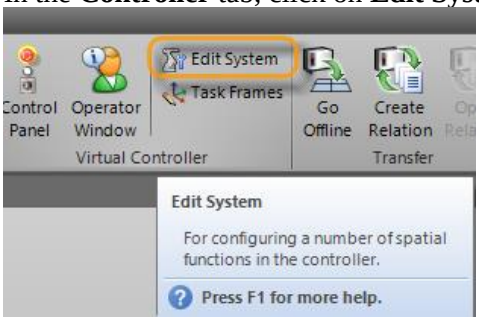
Base Frames
Depending on the situation you may want to change the setting in the *Base Frames* option group. A guiding principle is that the conveyor itself will never be moved by creating or modifying a connection.

Base Frames – Use Station Values
The station layout will be kept and the *Base Frame* values in the system will be changed to match the station layout.

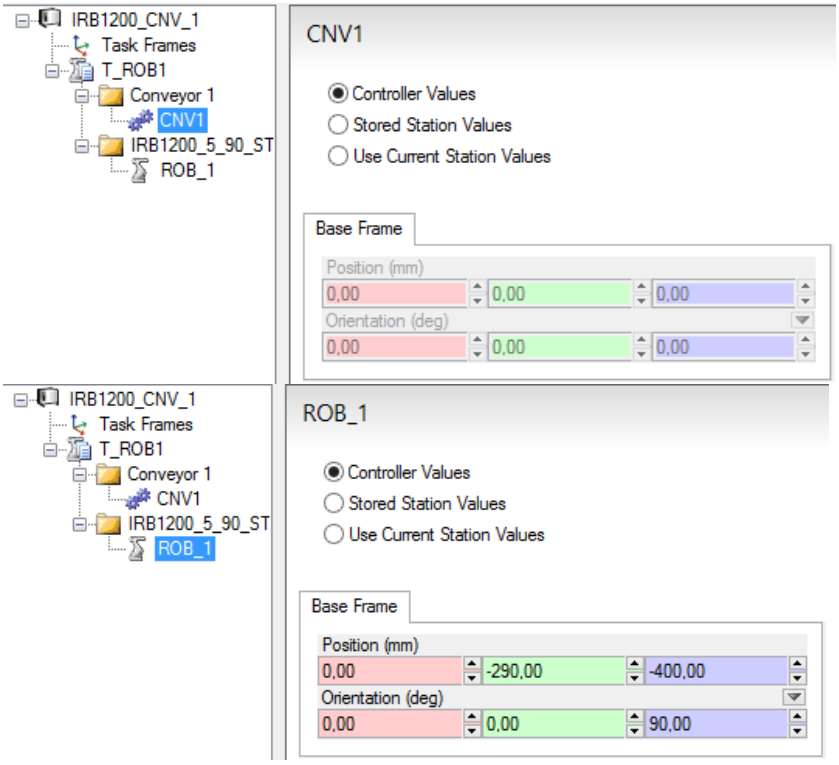
Base Frames – Use Controller Values
The system's *Base Frame* values will be kept and the station layout will be aligned to them.

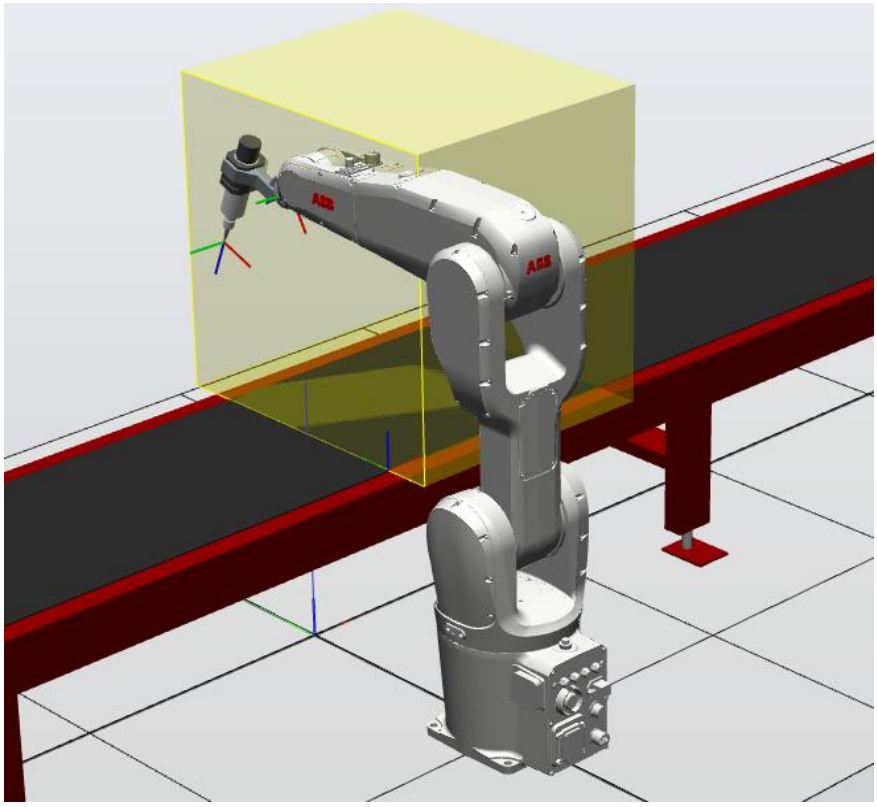
Base Frames – Align Task Frame
Only used with *Use Station Values*. The systems *Task Frame* will be aligned with the conveyor connection, which means that the conveyor (CNV1) *Base Frame* will be zero in position and orientation.

3. Change the **Start Window Width** to 500 mm.
4. Click **Create**. Note that the system is restarted for updating the **Start Window**.
5. Click **Close**.
6. In the **Controller** tab, click on **Edit System**.



7. Verify that the *Base Frames* values are as expected; that is the conveyor base frame has a definition of zero, and the base frame of the robot is displaced from that position. Click **OK**.





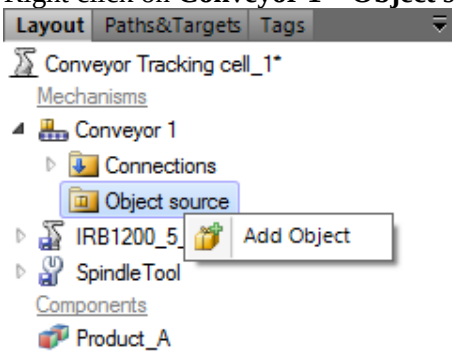
8. In the **File** tab, click **Save Station As** and then **Save**. The station will be saved in a new file with '_1' added as a suffix to the filename.

1.6. Add an Object to the Object Source

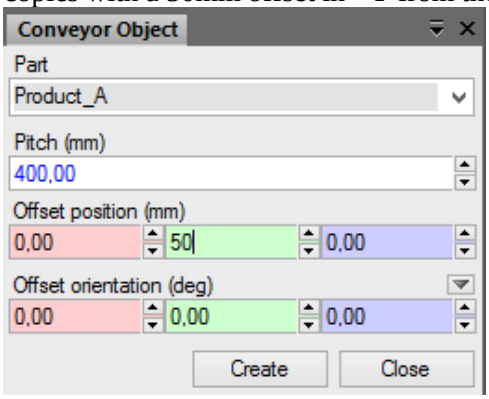
Overview

The objects moving on the conveyor during simulation are generated from the conveyor's **Object source**. A list with multiple objects can be added to the source.

1. Import the geometry *\Courseware\Geometry\Product_A*.
2. Right click on **Conveyor 1 – Object source** and select **Add Object**.



3. In the **Part** drop down, select *Product_A*. This will be the object that the **Object source** creates copies of, and that will be moved on the conveyor.
4. Set the **Pitch** value to 400mm. This is the distance the conveyor must travel before the next object is created.
5. Set the **Offset position** to X=0, Y=50, Z=0. Don´t change the **Offset orientation**. This will create the copies with a 50mm offset in +Y from the *Conveyor Reference Frame*.



6. Click **Create** and then **Close**. Note that *Product_A* will be invisible when **Create** was clicked.
7. Save the station with **Save Station As**.

2. Program the Robot

Overview

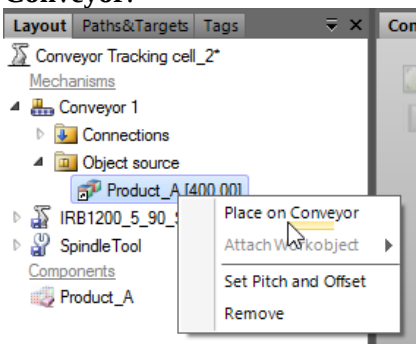
Now that we have the station and system prepared we can program the robot. Most of the operations used for programming with conveyor tracking are initiated from the **Layout** browser.

2.1. Place an Object on the Conveyor

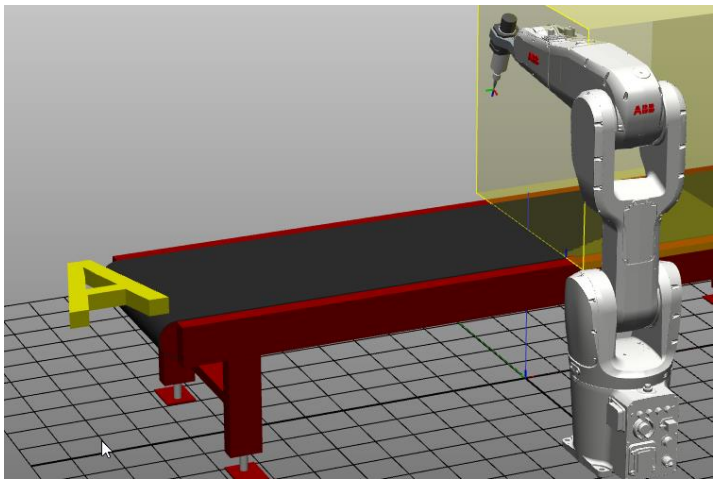
Overview

To be able to create targets and paths on the object *Product_A* it must be placed on the conveyor and jogged to the correct position in front of the robot.

1. In the **Object Source** in the **Layout** browser, right click on *Product_A* and then click on **Place on Conveyor**.

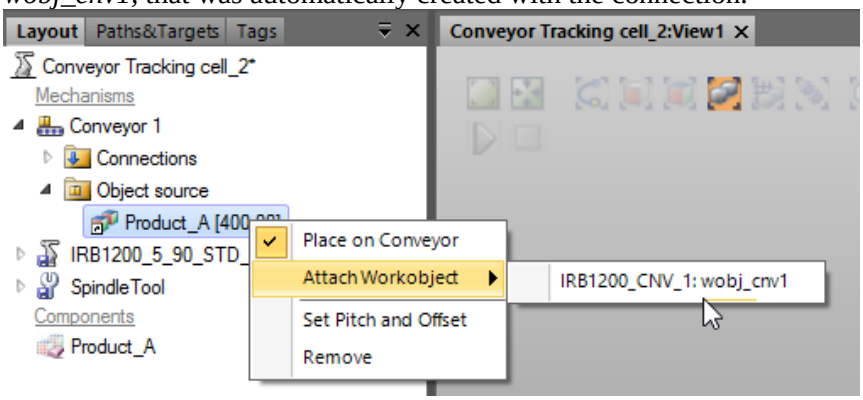


Now *Product_A* should be visible on the conveyor positioned with its *Local Origin* placed with an offset of +Y 50mm (that we defined in the *Conveyor Connection*) from the *Conveyor Reference Frame*.



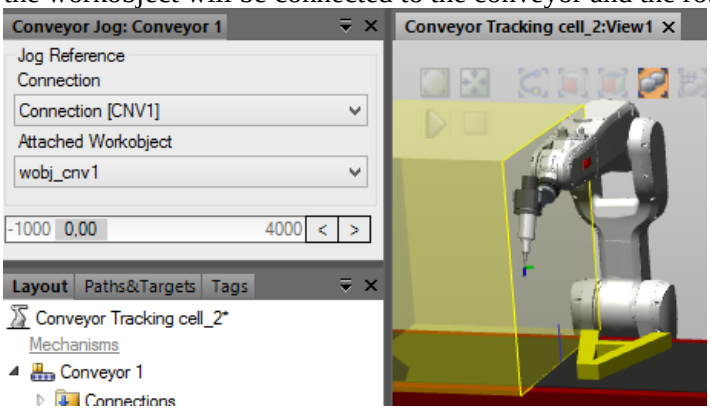
2. Before we jog the conveyor into position *Product_A* in front of the robot, it must be attached to the workobject that should be used.
   In the **Layout** browser, right click on *Product_A*, then click on **Attach Workobject** and select

wobj_cnv1, that was automatically created with the connection.



3. In the **Layout** browser, right click on *Conveyor 1* and then click on **Jog** in the context menu. Alternatively, left click on *Conveyor 1* and then click on **Conveyor Tools –Modify,** and then **Jog**.

4. Select **Connection** *Connection [CNV1]* and jog the conveyor to position 0. This is the position where the workobject will be connected to the conveyor and the robot will start tracking the workobject.

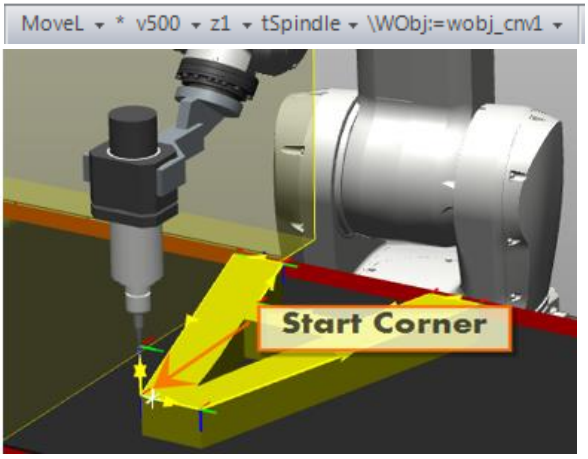


2.2. Create Targets and a Path

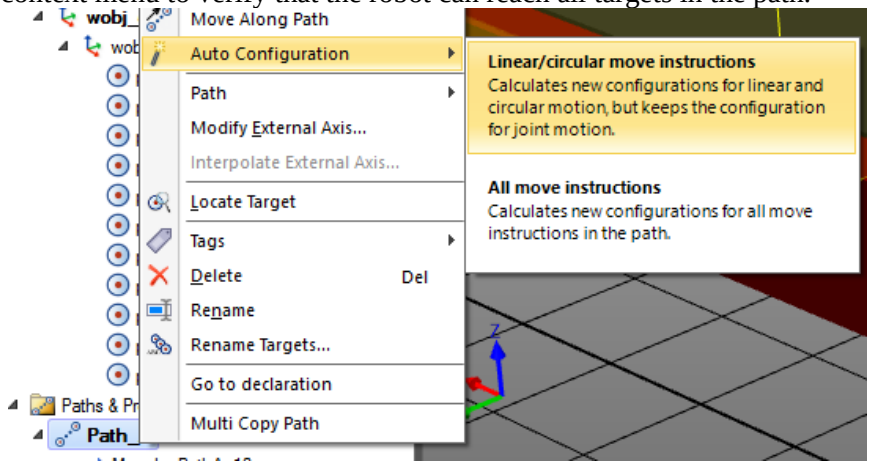
Overview

When creating targets and paths involving conveyor tracking, the same tools are used as for programming in a static workobject. For more information regarding this, please check the *Basic* and *Graphical Programming* modules.

1. With the tool *tSpindle* and workobject *wobj_cnv1* active, create a path that goes around the outer rim of *Product_A*. The path should start in the right corner away from the robot (see picture below) use linear motion, and have an approach and depart target 50mm above the first/last target on the surface. Use speed *v500* and *z1* for the zone.

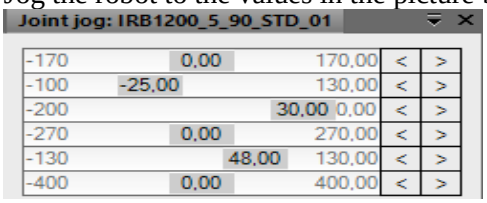


2. Rename the path to *Product_A*.
3. Rename the targets in the path by adding the prefix *pProdA_*.
4. Right click on *Product_A* and select **Auto Configuration – Linear/circular move instructions** in the context menu to verify that the robot can reach all targets in the path.



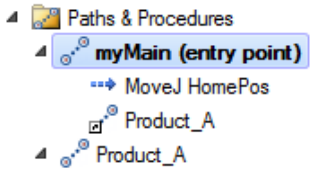
5. Create a new empty path and name it *myMain*. Right-click on *myMain* and set as **Simulation Entry Point**.

6. Jog the robot to the values in the picture below.



7. Set *wobj0* as active workobject.
8. With *myMain* as active path, teach an instruction with the following template, speed and zone selected:

9. Rename the taught target to *HomePos*.
10. Add a procedure call in *myMain* to *Product_A*.



11. Synchronize the two paths to RAPID.
12. Save the station with **Save Station As**.

2.3. Finalize the Program in the RAPID Editor

Overview

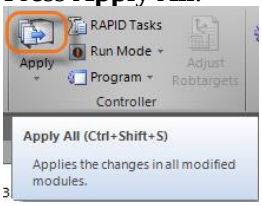
For everything to work we need to add some RAPID commands, this we will do from the RAPID Editor. For more information regarding the editor, please check the *Programming and simulating IOs* module.

1. In the **RAPID** tab, double click on *Module1* to open up the **Rapid Editor**.
2. Edit the *myMain* procedure to add instructions in the sequence as shown below.

```
PROC myMain()
    MoveJ HomePos,v5000,fine,tSpindle\WObj:=wobj0;
    ActUnit CNV1;
    ConfL\Off;
    WHILE TRUE DO
        WaitWObj wobj_cnv1;
        Product_A;
        MoveJ HomePos,v5000,fine,tSpindle\WObj:=wobj0;
        DropWObj wobj_cnv1;
    ENDWHILE
ENDPROC
```

To find information about a RAPID instruction, left click on the instruction and then press **F1**, this will open the RAPID Reference manual and display information for that specific instruction.

3. Press **Apply All**.



3. Running the Simulation

Overview

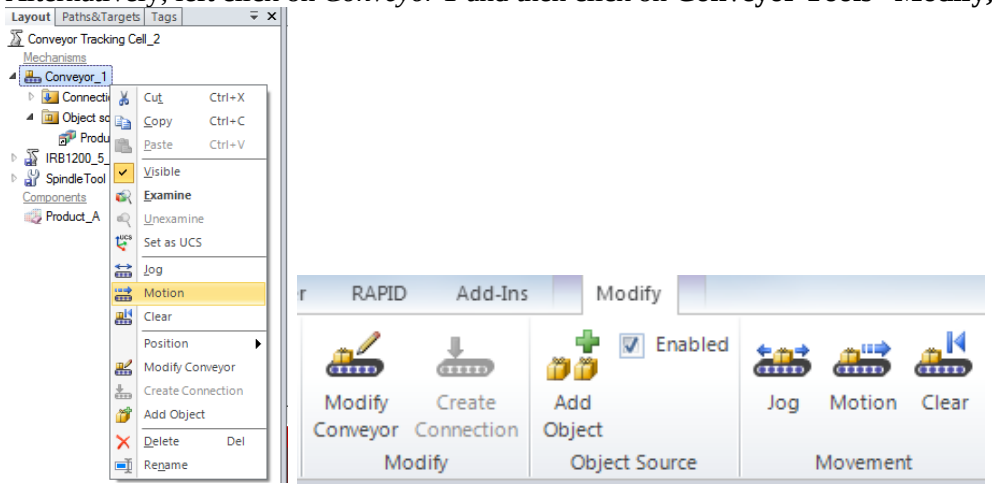
Now that we have a program in the robot, we can run a simulation and test different scenarios.

3.1. Set the Conveyor Speed

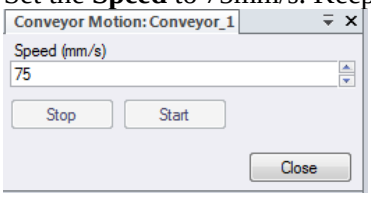
Overview

During simulation the conveyor speed can be changed. This makes it possible to test different conveyor speeds to verify if the robot has had time to finish the path on the active object before the next object in queue passes the connection point.

1. In the **Layout** browser, right click on *Conveyor 1* and select **Motion**.
   Alternatively, left click on *Conveyor 1* and then click on **Conveyor Tools –Modify,** and then **Motion**.

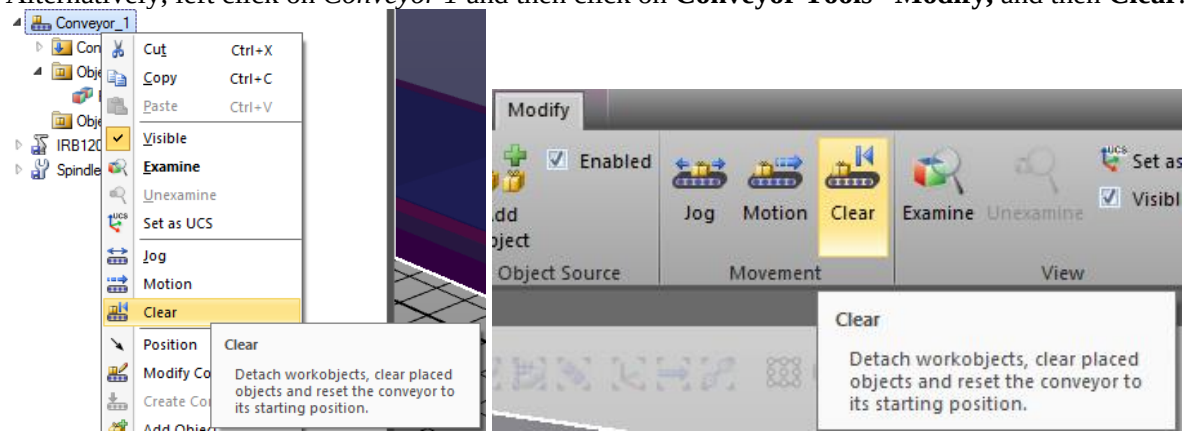


2. Set the **Speed** to 75mm/s. Keep the **Conveyor Motion** window open.

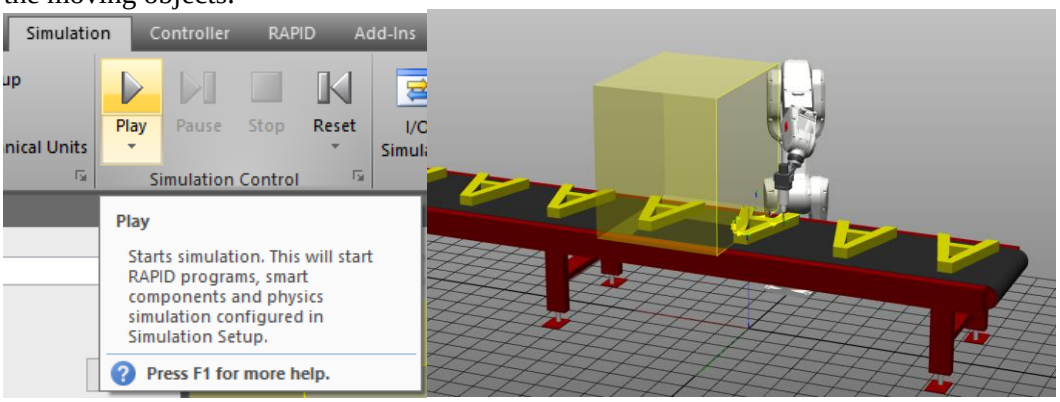


3. In the **Layout** browser, right click on *Conveyor 1* and select **Clear** to reset the conveyor to the start position.

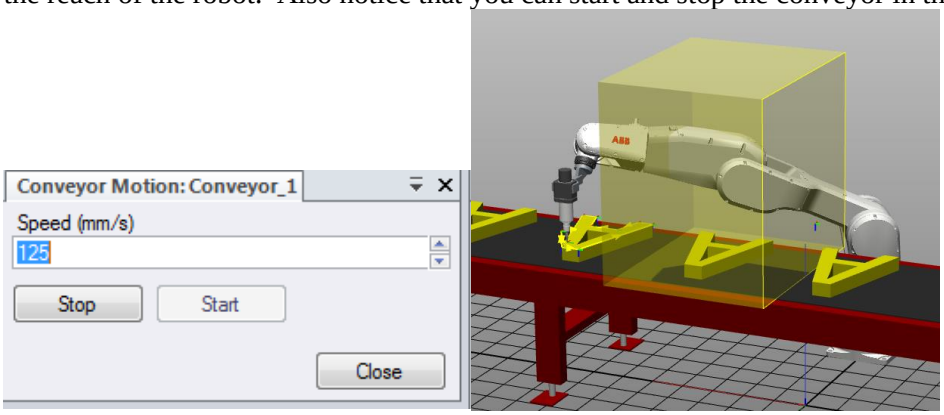
Alternatively, left click on *Conveyor 1* and then click on **Conveyor Tools –Modify,** and then **Clear**.



4. In the **Simulation** tab, click **Simulation Play** and verify that robot can execute the program and track the moving objects.



5. Increase the **Conveyor Speed** to 125mm/s, now the robot will not finish the path on the active object before the next object in queue passes the connection point. After a while the positions will be outside the reach of the robot. Also notice that you can start and stop the conveyor in the motion dialog box.



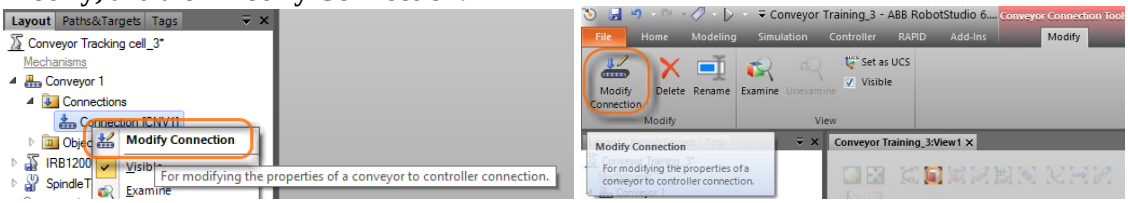
Change the Start Window

Overview

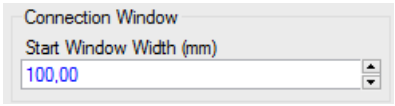
The **Start Window** is the window on the conveyor where the moving object must be for the robot to connect to it. If the object has passed the window, the robot will skip that object and wait for the next object in queue.

In RobotStudio the **Start Window** is displayed as a yellow box. To hide this box, uncheck **Visible** on the **Connection**.

1. Keep the **Conveyor Speed** at 125mm/s.
2. In the **Layout** browser, right click on *Connection [CNV1]* and select **Modify Connection**. Alternatively, left click on *Connection [CNV1]* and then click on **Conveyor Connection Tools – Modify,** and then **Modify Connection**.



3. Change the **Start Window** to 100mm and press **Apply and Close**, then wait until the controller have restarted.



4. Reset the conveyor to the start position (Step 3.1.3).
5. Click **Simulation Play**. Note that after a while the robot will ignore objects that have passed the **Start Window**. This will avoid the robot going outside of its reach.
6. Stop and reset the simulation.
7. Change the **Conveyor Speed** back to 75mm/.
8. Save the station as *Conveyor Tracking cell one robot one conveyor*.
9. Create a **Pack and Go** file of the station in the *\Solutions\Conveyor Tracking cell\Stations* folder.

4. Add a Second Robot to the Station

Overview

Now we will add a second robot to the station that will work on the same conveyor.

4.1. Prepare the Second Robot System

1. Import another *IRB1200* robot of the same variant as the first one.
2. Set its position as: X=1000 mm, Y= -500 mm, Z=0 mm, RX=0, RY=0, RZ= 90.
3. Import the library file *\Courseware\Libraries\SpindleTool.rslib* and attach it to the new robot.
4. Create a new system with the name *IRB1200_CNV_2* and with the same options as the first robot.

4.2. Add a Second Conveyor Connection

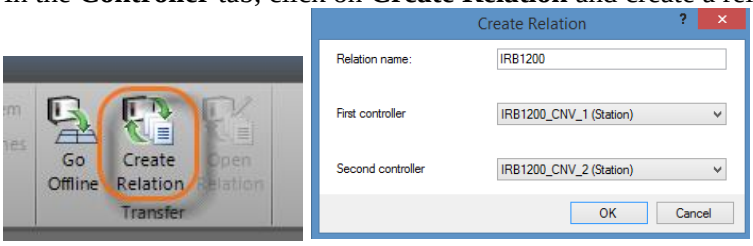
1. In the **Layout** browser, create a new **Connection** to *Conveyor 1* for the **Mechanical Unit** *CNV1* in *IRB1200_CNV_2*.
2. In the **Create Connection** window, change the **Start Window Width** to 500mm before you click **Create**.

4.3. Transfer the RAPID Program to the Second Robot

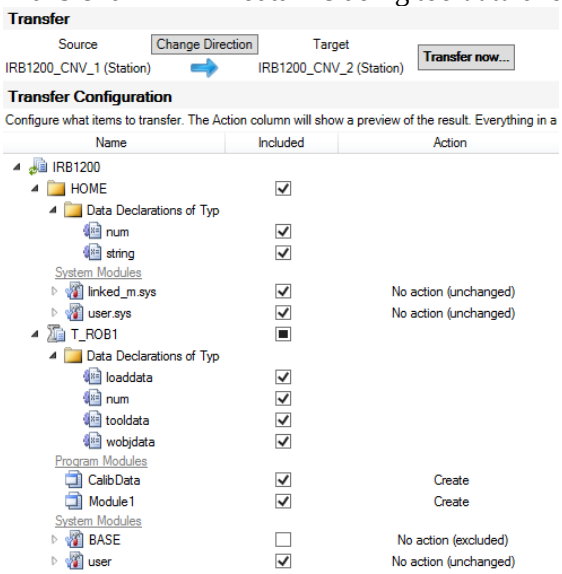
Overview

To copy the RAPID program from the first to the second robot, we will use the **Transfer** tool.
For more information regarding **Transfer**, please check the *Transfer* module.

1. In the **Controller** tab, click on **Create Relation** and create a relation between the two robots.

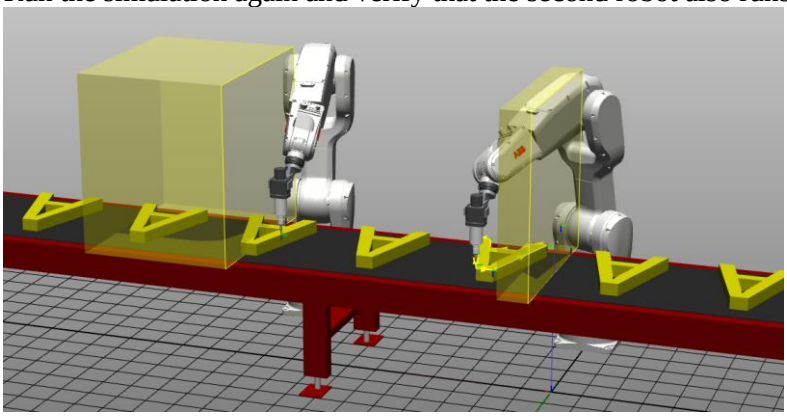


2. Transfer all RAPID data including *tooldata* and *wobjdata* from *IRB1200_CNV_1* to *IRB1200_CNV_2*.



3. Set the **Simulation Entry Point** to *myMain*.
4. Clear the conveyor to the start position. (Step 3.1.3).

5. Run the simulation again and verify that the second robot also runs the program for *Product_A*.

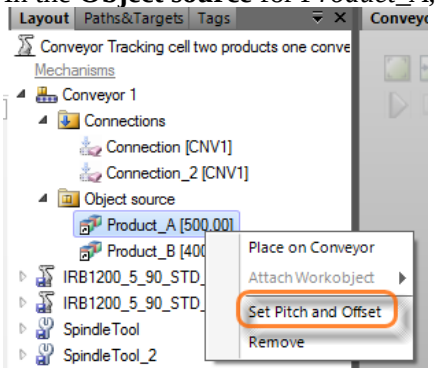


6. Stop the simulation, reset the conveyor and save the station as *Conveyor Tracking cell two robots one conveyor*.
7. Create a **Pack and Go** file of the station in the *\Solutions\Conveyor Tracking cell\Stations* folder.

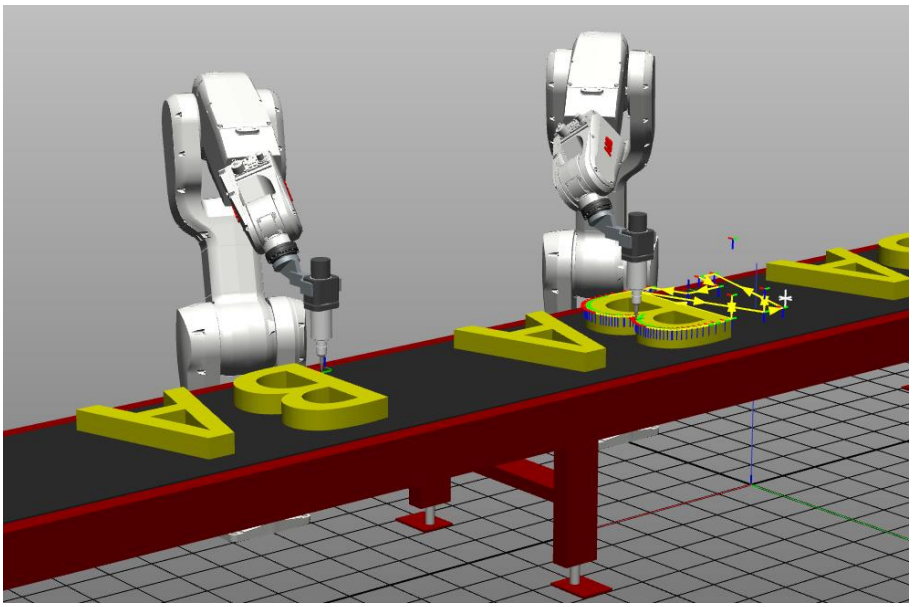
Challenge 1

Add *Product_B* to the conveyor simulation.

- Import the geometry*\Courseware\Geometry\Product_B*.
- Add *Product_B* to the **Conveyor 1 - Object source**. Set the **Pitch** to 400mm and the **Offset** to +Y 50mm.
- In the **Object source** for *Product_A*, change the **Pitch** to 500mm.



- Create a path that goes around the outer edge of *Product_B*.
- Include the new path to the RAPID program for the first robot.
- Transfer the program to the second robot (*IRB1200_CNV_2*).
- Run the simulation again and verify that the robots run the programs for *Product_A* and *Product_B*.
- Save the station as *Conveyor Tracking cell two products one conveyor*.
- Create a **Pack and Go** file of the station in the *...\Solutions\Conveyor Tracking cell\Stations* folder.



Challenge 2

Add a second Conveyor to the station.

- Create a new **Conveyor Mechanism** (*Conveyor 2*). **Position** and **Conveyor Length** should be the same as for *Conveyor 1*, but keep the **Conveyor Geometry** field empty.
- In *Conveyor_1*, delete the **Connection** for the second robot.
- Create a **Connection** in the new conveyor for the second robot (*IRB1200_CNV_2*).
- Remove *Product_B* from the **Object source** in *Conveyor 1* and add it to the **Object source** in the new conveyor. Set the **Pitch** to 400mm and the **Offset** to +Y 50mm.
- Change the **Pitch** back to 400mm for *Product_A*.
- Modify the RAPID programs so the first robot runs the path for *Product_A*, and the second robot runs the path for *Product_B*.
- Set the **Speed** for *Conveyor 2* to 75mm/s so both conveyors run with the same speed.
- Run the simulation again and verify that the first robot run the path for *Product_A*, and the second robot run the program for *Product_B*.
- Save the station as *Conveyor Tracking cell two products two conveyors*.
- Create a **Pack and Go** file of the station in the …*\Solutions\Conveyor Tracking cell\Stations* folder.

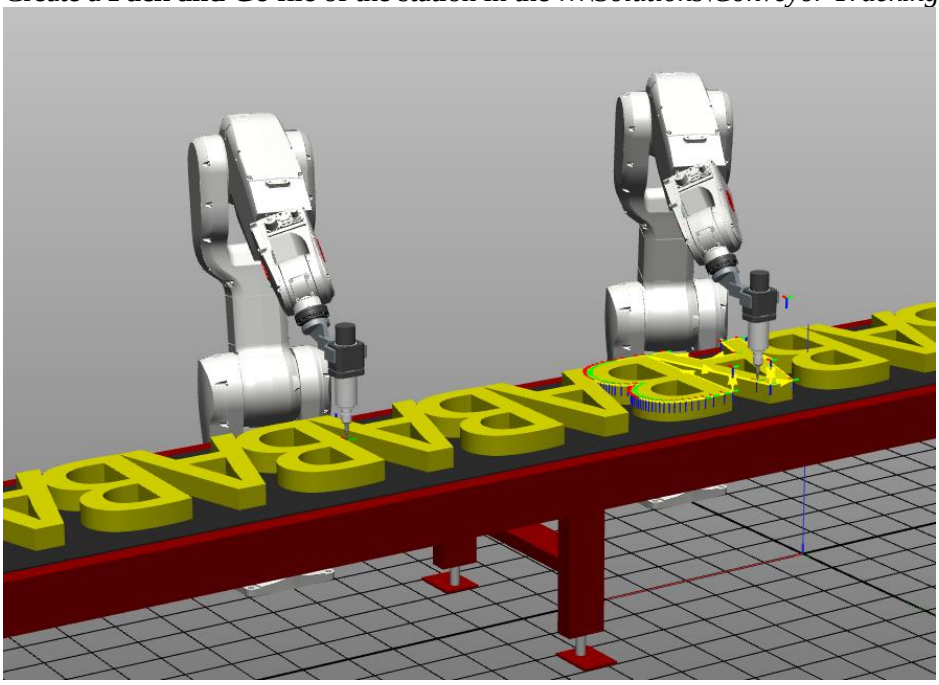


ABB AB
Robotics Products
SE-721 68 Västerås
Sweden