RobotStudio Courseware 5.60

Learning the Basics



The information in this manual is subject to change without notice and should not be construed as a commitment by ABB. ABB assumes no responsibility for any errors that may appear in this manual.

Except as may be expressly stated anywhere in this manual, nothing herein shall be construed as any kind of guarantee or warranty by ABB for losses, damages to persons or property, fitness for a specific purpose or the like.

In no event shall ABB be liable for incidental or consequential damages arising from use of this manual and products described herein.

This manual and parts thereof must not be reproduced or copied without ABB's written permission, and contents thereof must not be imparted to a third party nor be used for any unauthorized purpose. Contravention will be prosecuted.

Additional copies of this manual may be obtained from ABB at its then current charge.

© Copyright 2012 ABB All right reserved. ABB AB Robotics Products SE-721 68 Västerås Sweden

2014-04-08 ABB

1. Courseware	4
1.1. Courseware files	4
2. Learning the basics	6
2.1. RobotStudio Overview	6
2.1.1. Exploring RobotStudio	6
2.1.2. Navigating the Graphics window using the mouse	10
2.1.3. Managing document folders	11
2.2. Creating a basic station	13
2.2.1. Creating a new station	13
2.2.2. Adding a tool	14
2.2.3. Importing the controller cabinet	16
2.2.4. Moving the controller cabinet	16
2.2.5. Importing CAD files	17
2.2.6. Positioning the table	18
2.2.7. Placing the box	19
2.3. Programming the basic station	21
2.3.1. Jogging the robot	21
2.3.2. Creating a Workobject	23
2.3.3. Programming the motions	25
2.3.4. Running the Simulation	30
2.3.5. Adding a start and home position	32
2.3.6. Using the Rapid Editor for basic adjustments	36
2.3.7. Simulation settings	39
2.3.8. Saving the robot program	
2.4. Local Origin	40
2.5. Creating a tool	45
2.6. Task Frame	51

1. Courseware

1.1. Courseware files

Overview

In this exercise we will unpack the courseware files and set the default RobotStudio folder.

Extracting the Courseware folder

Along with the RobotStudio Courseware you have received a *RobotStudio Courseware.exe* file.

- 1. Double click the RobotStudio Courseware.exe file.
- 2. In the **Zip Self-Extractor** dialog, browse to where you have your **My Documents** folder and select the **RobotStudio** folder.

	7-Zip self-extracting archive
	Extract to: er\Courseware\RobotStudio 5.14 Courseware v110419\
Browse For Folder	
Specify a location for extracted files.	Extract Cancel
 RobotStudio Backups Code Snippets Geometry Instruction Templates Libraries Libraries My ScreenMaker Projects ScreeenMaker Templates Stations Systems Systems VSTA SametimeFileTransfers SametimeTranscripts 	Cancel

3. Click the Unzip/Extract button.

Setting the RobotStudio User Project Folder

4. On the File tab click Options.

Doptions

- 5. In the **Options** dialog select **Files & Folders**.
- 6. In the **User Project Folder** click the browse [...] button.
- 7. Browse to the *Courseware* folder that you just extracted and click the **OK** button.

Browse For Folder
Specify a location for extracted files.
🔺 🚺 RobotStudio 🔺
Backups
Description of the second s
Courseware
Decometry
Libraries
RAPID Programs
Stations
Systems
Geometry
lnstruction Templates
Libraries
Mu SereenhAsker Dreinste
Make New Folder OK Cancel

8. Click OK.

By setting the User Project Folder you have now created a shortcut that will appear in all open, import load and save dialogs. For example:

🁏 Open		×
🚱 🗢 🔋 🕨 Jahnberg, Anders	My Documents RobotStudio Courseware	✓ 4y Search Courseware
Organize 🔻 New folder		≣ ▾ 🔞
 RobotStudio Stations Courseware Favorites Desktop Downloads Recent Places Libraries Documents Music Flotures Videos 	Name Geometry Libraries RAPID Programs Stations Systems	Select a file to preview.
File <u>n</u> ame:	V Load Geon	Station files (*.rsstn)
		,

Here we can see the Courseware button in the Open dialog

Challenge

If you have an internet connection you can visit the RobotStudio community. Go to $\underline{http://www.abb.com/roboticssoftware}$.

2. Learning the basics

2.1. RobotStudio Overview

2.1.1. Exploring RobotStudio

Overview

Before starting with the actual exercises, we will take a quick look at RobotStudio and commonly used functions.

To open a demo station

Now we will open a demo station to play with. Do not save any changes to the station during this exercise.

- 1. On the **Start** menu select *All Programs* > *ABB Industrial IT* > *Robotics IT* > *RobotStudio* 5.60 > *RobotStudio* to start RobotStudio.
- 2. In the **File** tab, click Open.



3. Browse to the folder \Courseware\Stations and open the station Exploring.

Open			X
Stephen M. Kelly	 My Documents Robotstudio Coursewa 	re 🖡 Stations 🖡	Search Stations
Organize 🔻 New folder			:= - 🔞
3 RobotStudio	^ Name	Date modified	
Stations	Solutions	5/22/2012 2:25 AM	
🐚 Courseware	S Exploring.rsstn	4/19/2011 1:28 AM	
	SlueStation.rspag	9/13/2011 3:48 AM	
숨 Favorites	GlueStation_Analyze.rspa	g 6/9/2011 9:24 PM	
🧮 Desktop	IRB460_palletizing.rspag	9/11/2011 9:43 PM	
〕 Downloads	Reachability_start.rspag	9/8/2008 10:21 PM	
📃 Recent Places	ScreenMakerExercise .rsp	ag 5/31/2011 12:59 AM	
	StartLathe.rspag	4/28/2011 3:12 AM	
🥽 Libraries	🚮 TaskFrame.rspag	4/29/2011 4:00 AM	
Documents		Da	ate: 4/19/2011 1:28 AM
👌 Music		Siz	ze: 19.4 MB
Pictures		Au	uthor:
🛃 Videos		Tit	tler
🖳 Computer		Re	evision:
	•		
File name: Exp	lloring.rsstn		✓ All supported file types (*.rsstn, ▼
		Load Geometry	Open 🔫 Cancel

The main parts of RobotStudio window

The picture on the next page shows the main parts of RobotStudio:



1	Quick Access For quick acc toolbar, right arrow next to	s Toolbar ess to commonly used commands and settings. To add an item to the click the item and select Add to quick access toolbar or click the the toolbar and select Customize Commands .
2	Tabs The tabs conta according to t	ain collections of commands and setting items for different aims he following table:
	File	Opening, saving stations and options etc.
	Home	Building up stations, creating systems, creating paths with graphical programming.
	Modeling	Creating and grouping components, creating solids, curves and surfaces, measurements and CAD operations. This is also from where you create Smart Components and use the Mechanism Modeler .
	Simulation	Setting up, configuring, controlling, monitoring and recording simulations.
	Controller	For working with system parameters and configuration and setting up relationships to transfer programs, data etc. between controllers. (VC (Virtual Controller) or live controllers)

	RapidEditor for writing new and/or debugging existing Rapid programs.Add-InsPowerPacs and Add-Ins.ModifyThis is a contextual tab, which is only visible when an object is selected. It list specific commands for that object type.Layout and HargoutHargets browser Subjects with the objects, you either select them here or in the Supple subjects with the objects, you either select them here or in the Supple subjects with the objects of the station, such as robots and tagets browser displays the physical items of the station, such as robots and tagets browser displays the physical items of the station, such as robots and the Output with the objects, you either select them here or in the Supple subjects and targets.Output with HereSupple subjects with the objects subjects with the objects subject subjects with the objects subject					
	Add-Ins	PowerPacs and Add-Ins.				
	Modify	This is a contextual tab, which is only visible when an object is selected. It list specific commands for that object type.				
3	Layout and P The Layout b tools. When w Graphics wind The Paths&T data, work ob	Paths&Targets browser prowser displays the physical items of the station, such as robots and vorking with the objects, you either select them here or in the dow. Cargets browser displays programming data such as controllers, tool jects and targets.				
4	Output wind The Output w Controller. So information. In Simulation and IO signals Note: Depend	ow and Simulation Watch window displays messages from RobotStudio and the Virtual ome messages are active: by clicking on them you get more a Watch you will be able to monitor values of dynamic properties is in Smart Components. ling on main tab, different windows will show.				
5	Active Toolb Shows active are the default	ar templates and parameters such as speed data and zone data. These t settings that will be used when creating Move instructions.				
6	RobotStudio Here you will	Help menu find help on RobotStudio, Rapid, API etc.				
7	Documents M Allows you to possible to ad	Manager be easily search and browse for files to load into the station. It is also d references to files and folders or embed files into the station.				
8	Graphics win The Graphics and parts of o levels and sna correct selection the Graphics of	ndow window displays the objects in the station. Here you select objects bjects when building and programming stations. Icons for selection ap modes can be found at the top of the Graphics window. Using ton level and snap mode settings is important for successful work in window.				
9	Controller st A green light MANUAL m	atus bar indicates that the controller is in AUTO mode, yellow that it is ode, and red that it is not started.				

To explore selection levels and snap modes

1. In the Graphics window click the **Part Selection** icon.



The name of an icon appears as a ToolTip when holding the cursor over the icon.

2. In the Graphics window click the Snap Object icon.



This is a multi-snap mode, snapping to the closest center, edge or corner.

- 3. In the Graphics window click the fork lift. The entire fork lift is now highlighted red. You can also see the pick point as a white star that has snapped to the closest center/edge/corner.
- 4. On the **Home** tab, in the **Freehand** group click the **Move** button. A cross with arrows in the X, Y and Z directions now appear on the truck. Drag the arrows to move the object.



5. On the **Home** tab, in the **Freehand** group click the **Jog Joint** button and then select any joint on one of the robots. By pressing the left mouse button on one of the joints in the Graphics window you are able to jog it in any direction.



- 6. Continue exploring the selection levels and snap modes by snapping to corners, edges and center points of parts, tools, entities and surfaces etc.
- 7. Close the station without saving when you are done.

2.1.2. Navigating the Graphics window using the mouse

Navigating the Graphics window using the mouse

The table below shows how to navigate the Graphics window using the mouse:

То	Use the keyboard / mouse combination	Description
Select Items		Just click the item to select. To select multiple items, press the SHIFT key while clicking the new items.
Rotate the station	CTRL + SHIFT +	Press CTRL + SHIFT + the left mouse button while dragging the mouse to rotate the station. With a 3-button mouse you can use the left and middle buttons, instead of the keyboard combination.
	CTRL +	Press CTRL + the left mouse button while dragging the mouse to pan the station.
Zoom the station	CTRL +	Press CTRL + the right mouse button while dragging the mouse to the left to zoom out. Dragging to the right zooms in. With a 3-button mouse you can also use the middle button, instead of the keyboard combination.
Zoom using window	SHIFT +	Press SHIFT + the right mouse button while dragging the mouse across the area to zoom into.
Select using window	SHIFT +	Press SHIFT + the left mouse button while dragging the mouse across the area to select all items that match the current selection level.

2.1.3. Managing document folders

Create a gallery for frequently used documents

It is possible for the users to create a document gallery in order to easily access their frequently used documents. The galleries can be created using the **Documents** window, and are also placed in **Import Library** or **Import Geometry** menus in the **Home** tab.

1. On the Documents window, press on Locations in order to add and locate your galleries.

Docume	ents	3	×
Station	Search		
Browse	Locations		
Search	Q	•	≽

2. When the **Document Locations** dialogue box appears, click on **Add Location > File System**, as depicted in the picture below. By doing so, the **File System** dialogue box will pop up.

Oocument Lo	cations	6			~
Locations +	Add Location	Remove Edit			
Name	File Syster	n	Filter	Gall	Sear
ABB Library	File Syste	[Program Files (x86)]\ABB Industrial IT\	*.rslib	Flat	Yes
User Library	File Syste	[User Projects]\Libraries	*.rslib	Menu	Yes
Jser Geomet	try File Syste	[User Projects]\Geometry	*.sat;*.igs;	Menu	Yes
RobotApps	Online	https://robotapps.robotstudio.com/api/	*.rslib;*.zip	None	Yes
					Close Help

3. Now we want to create a gallery for the library objects located in the courseware folder. On the **File System** dialogue box, name the new location as Courseware. Then set the path to the Library folder located in the Courseware folder, and select *.rslib as a Filter from the dropdown menu. Set up the rest of parameters as shown in the following picture and press OK.

Location Name	Course	eware				
Path	C:\Us	ers\SEARKOO\Docu	ments\R	obotStudio\Cour	seware\Libraries	
Filter	•.rslib		•			
Cache files fro	m networ	k				
Directory						
Show as galler	y in the	Import Library	•	menu		
Style	Flat	Recursive				
Include when s	earching	all locations				

4. Now you can see the Courseware gallery added to the Document Locations list.

Document Locat	ions	1			>		
Locations - Ad	Id Location	- Remove Edit					
Name	Туре	URL	Filter	Gall	Sear		
ABB Library	File Syste	[Program Files (x86)]\ABB Industrial IT\	*.rslib	Flat	Yes		
User Library	File Syste	[User Projects]\Libraries	*.rslib	Menu	Yes		
User Geometry	File Syste	[User Projects]\Geometry	*.sat;*.igs;	Menu	Yes		
RobotApps	Online	https://robotapps.robotstudio.com/api/	*.rslib;*.zip	None	Yes		
Courseware	File Syste	[User Projects]\Courseware\Libraries	*.rslib	Flat	Yes		
l						 	_
					Close	Help	

5. Press **OK** in order to complete the task and add the gallery to the Import Library menu. The result will be the same as the below picture.



You can now create a gallery for **Import Geometries** following the above instruction. See the picture below for the settings in the **File System** dialogue box.

File System	
Location Name	Courseware
Path	C:\Users\SEARKOO\Documents\RobotStudio\Courseware\Geometry
Filter	*.sat;*.igs;*.stp;*.vda;*.modi 👻
Cache files from	network
Directory	
Show as gallery	in the Import Geometry
Style 🔘	Flat 🔘 Recursive
Include when sea	arching all locations
	OK Cancel Help

Searching a specific documents

Using the **Search** function in **Documents** window, you can search for a document by its name. The result will appear on the Documents window. Then you can double-click on the found item(s) in order to import it to the station. You can also use the **Browse** function in

order to browse to all available locations created in **Document Locations**. These functions provide an easy, quick access to your documents.



2.2. Creating a basic station

Goal of the chapter

In these exercises we will learn how to build a basic station containing a robot, a tool, a fixture and a work piece as shown in the picture. Later in the course we will program the robot to operate on the work piece.



2.2.1. Creating a new station

Overview

A new station can be created in three ways:

- With no system starting from scratch with an empty station and then add a new or existing system to it.
- With a template system this is the simplest way to create a new station with a robot and a link to a rudimentary system template.
- With an existing system this creates a new station containing one or more robots in accordance with an existing, built system.

In this exercise we will use the second alternative.

Creating the new station

- 1. In the File tab, click New and then select a new Station with Robot Controller.
- 2. By default, **template systems** are listed in the right pane of the window. Select *IRB1600* 6kg 1.2m and then click create.

<u>ک</u> بر او او	ABB RobotS	tudio 5.15.02
File Home	Modeling Simulation Controller RAPID Add-Ins	۵ 😯
🔛 Save 🔜 Save As	Create a new Station	Station with Robot Controller
Save As Popen Close Info Recent New Print Share Online Help Poptions Coptions Exit	Create a new Station Imply Station Creates an empty station. Station with Robot Controller Creates a station with a robot system. Available robot models are listed to the right. RobotStudio will automatically create a matching virtual controller. Imply Station with existing Robot Controller Creates a station and adds an existing Virtual Controller to it. Creates a new RAPID Module Imply RAPID Module File Creates a RAPID module file and opens it in the editor.	Station with Robot Controller Small Robots IRB1201 3kg 0.58m IRB120 3kg 0.58m IRB140 6kg 0.81m L. IRB1410 5kg 1.44m IRB160010 4kg 1.5m IRB1600 10kg 1.2m IRB160010 4kg 1.5m IRB1600 10kg 1.2m IRB160010 5kg 1.2m IRB1600 10kg 1.2m IRB160010 1kg 1.5m IRB1600 10kg 1.5m IRB160010 15kg 1.8m IRB260010 10kg 1.5m IRB260010 15kg 1.8m IRB260010 20kg 2.0m IRB260012 12kg 1.8m IRB2600 20kg 2.5m. IRB2600 12kg 1.9m IRB4600 60kg 2.5m. IRB2600 12kg 1.9m IRB4600 20kg 2.5m. IRB2600 12kg 1.9m IRB4600 60kg 2.5m. IRB4600 12kg 1.9m IRB4600 60kg 2.5m. IRB4600 12kg 2.5m. IRB4600 10kg 2.5m. IRB660 130kg 3.15m IRB660 20kg 2.5m. IRB6601 100kg 2.5m. IRB6600 105kg 2.2m IRB6640 100 10kg 2.5m. IRB6640 105kg 2.5m. IRB6640 100 20kg 2.5m. IRB6640 100 20kg 2.5m. IRB6640 100 10kg 2.7m. IRB6640 100 205kg
		Into /ouu sokg s im Into /ouu sokg 2.sm IRB /ouu 400kg 2.ss System Name: IRB 1600_6kg_1 2m Location: C:\Users\sefttallDocuments\RobotStudio\Systems Browse

- 3. In the **File** tab select **Save As**.
- 4. Browse to the folder \Courseware \Stations and save the station as MyStation_1.

Learn more

Click the **Help** button **(2)** in the top right corner of RobotStudio.

See the help section	for information about
Workflow for building a new station	Creating stations and systems.

2.2.2. Adding a tool

Overview

We will now import and attach a tool to the robot. This is done in two steps: first we import the tool to the station and then we attach it to the robot.

The tool that we will import is a library component, which means that it is a RobotStudio object that has been saved as a separate file. The library import creates a link from the station to the library file on the hard drive. Therefore, several stations can share the same library component. On the Home tab you can find the Import library button, it has two sections:

1. The upper button opens up a dialog where you can browse for libraries.



2. The lower part that opens up default RobotStudio libraries and personal galleries.

Importing the tool

- 1. Open the station from the last exercise (*Mystation_1*), unless it is already open.
- 2. In the **Home** tab click the **Import Library** button. Since you have already created the Courseware gallery to this menu, you can now easily select the needed library component from this gallery. Click the Courseware gallery and select *Pen*.



The tool will be imported to the station and placed at the origin of the world coordinate system, thus hidden inside the robot. However, in the Layout browser you can see that the tool has been imported.

Attaching the tool

1. Inside the Layout browser, drag the tool *Pen* and drop it on the robot *IRB1600*.



2. Answer the question "Do you want to update the position of Pen" with Yes.



*The tool is moved to the wrist of the robot.***Save** the station as *MyStation_2*.

2.2.3. Importing the controller cabinet

Overview

We will now import a model of the controller cabinets to the station. The controller model is for visual representation only, the Virtual Controller runs regardless if there is a cabinet or not.

Importing the controller cabinet

- 1. Open the station from the last exercise (*Mystation_2*), unless it is already open.
- 2. On the Home tab click the Import Library button (lower section).
- 3. In the **Equipment** folder, select the *IRC5_Control-Module* library.



The cabinet will be imported to the station and placed at the origin of the world coordinate system.

4. Save the station as *MyStation_3*.

2.2.4. Moving the controller cabinet

Overview

We will now move the controller to a more suitable position in the station. If not the exact position is important, **Freehand** move is an easy way to modify the position of objects. RobotStudio has several functions for moving objects, each suitable for different situations. In this exercise the exact position is not important as long as it is placed out of reach from the robot so we will use the **Freehand** move.

Moving the controller cabinet part

- 1. Open the station from the last exercise (*Mystation_3*), unless it is already open.
- 2. In the **Layout** browser select *IRC5_Control-Module* or use selection level **Part** to make the selection directly in the graphics window.
- 3. On the **Home** tab, in the **Freehand** group click the **Move** button.



4. Click and hold on the green arrow in the Freehand move cross, then drag the controller one floor square (about 1 meter) to the right of the robot (negative Y direction). Then click and hold on the red arrow and drag it one square backwards (negative X direction).



5. Save the station as *MyStation_4*.

2.2.5. Importing CAD files

Overview

You add work pieces and custom equipment, like fixtures or conveyors, by importing the CAD models of the objects. In this exercise we will import a table and box.

Importing the CAD files

- 1. Open the station from the last exercise (*Mystation_4*), unless it is already open.
- 2. On the Home tab click Import Geometry.
- 3. In the **Open** dialog browse to *Courseware**Geometry* then hold down the [CTRL] key and select the objects *Box.sat* and *Table.sat*.

4. Click the **Open** button.



5. Save the station as *MyStation_5*.

Learn more

Click the **Help** button **(2)** in the top right corner of RobotStudio.

See the help section	for information about
Libraries, geometries and CAD files	Supported CAD formats and import options
Troubleshooting and optimizing geometries	How to solve geometry problems like slow updates and invisible parts.

Challenge

The detail level of a model can be changed to increase the performance for large models. Open the **Options** dialog and go to **Graphics**>**Performance**.

To increase performance for large models, set the detail level to **Coarse**. This only affects the visual representation of the object, not the accuracy when generating curves and targets. To improve visual display and make it easier to select points in objects with many details, set the detail level to **Fine**.

When you are finished, change back to the default value, **Automatic**. RobotStudio will then determine which level to use based on the zoom factor in the station. This increases the file size of the station.

2.2.6. Positioning the table

Overview

The table will be moved 600 mm from the **Base Frame** of the robot in X direction, 100 mm in Y direction, and finally with a -30° rotation around Z. We will use the **Set Position** command for this movement.

Positioning the table

- 1. Open the station from the last exercise (*Mystation_5*), unless it is already open.
- 2. In the Layout browser right click the *Table* and select Set Position.

- 3. In the **Set position** dialog, in the **Reference** list select the **World** coordinate system.
- 4. In the **Position** fields enter these values **600**, **100**, **0**.
- 5. In the **Orientation** fields enter these values **0**, **0**, **-30**.

	Set Position	n: Lable			•
	Reference				
	World				~
	Position X,Y,Z (mm)			
	600.00	2 100.00) 🗘	0.00	1
	Orientation (deg))			
	0.00	\$ 0.00	*	-30.00	1
			Apply		Close
6. (Click Apply.				
				-	

7. Save the station as *MyStation_6*.

2.2.7. Placing the box

Overview

We will now place the box at one of the corners of the table. For placing an object relative another without knowing the exact coordinates, the **Place** commands are well suited. Now we will use the Place by two points command since we need to both move the box and change its orientation around one axis.

TIP!

When selecting a corner of an object, make sure to click inside the surface of the object, this to make sure the pick point will snap correctly.

Placing the box on the table

- 1. Open the station from the last exercise (*Mystation_6*), unless it is already open.
- 2. In the Graphics window select the Part Select level and the Snap End mode.



3. Rotate and zoom the station so you get a view similar to the one in the picture below. It is easier if you have a clear view of the box and the corners of the table.

- 4. In the Layout browser right click the box part, point to Place select Two Points.
- 5. When the text insertion point is positioned in any of the **Primary point From** boxes, click the corner of the box marked with **1** in the picture.
- 6. When the text insertion point is positioned in any of the **Primary point To** boxes, click the corner of the table marked with **2**.
- 7. When the text insertion point is positioned in any of the **Point on X-Axis -From** boxes, click the corner of the box marked with **3**.
- 8. When the text insertion point is positioned in any of the **Point on X-Axis -To** boxes, click the corner of the table marked with **4**.

Place Objec	t: F	Зох			₹ x			
Reference								
World					*			
Primary Point - From (mm)								
0.00	÷	1026.63~	÷	0.00	*			
Primary Point - To (mm)								
600.00	\$	100.00	\$	400.00	A V			
Point on X-Axis - From (mm)								
300.00	0.00	A V						
Point on X-Axis - To (mm)								
975.00	\$	749.52~	•	400.00	×			
Translate along	the	ese axes:						
▼X V		🔽 Z						
		Арр	ly		ose			

9. Click Apply.



The primary point on the box is now moved to the primary point on the table and the points on the X-Axis set the orientation of the box. 10.Save the station as Mystation_7.

2.3. Programming the basic station

2.3.1. Jogging the robot

Overview

Before programming the station, we will practice jogging the robot. Jogging the robot can be done in several ways but here will use the freehand functionality. Note that both **Mechanism Joint Jog** and **Mechanism Linear Jog** are available also from the **Modify** tab which is enabled when the robot is selected in the Layout browser.

-		-				
🁏 🖬 🤊 - 🔍 - 🗧 [Unsaved Sta	tion] - ABB R	obotStudio 5.15 (64-bit) Mecha	inism Tools			
File Home Modeling Simulat	ion Contr	oller RAPID Add-Ins M	lodify			
Yet Position C Rotate Place → Bace → Copy Orientation Al Set Local Origin Bapply Orientation	ttach Detach	Modify Mechanism	Mechanism Joint Jog	Save As Library	Examine Unexamine Set as UCS	 Visible Selectable in 3D View Show Work Envelope
Position		Modify	Motion	Library	View	
Layout Paths&Targets 🗧 🛪	View1 ×					
∑ [Unsaved Station]* Mechanisms () ∑ IRE1500_6_120_02 ▷ 20 Pen Components 20 Pen		C. II. II. <mark>2</mark> 2 2 0 2	₽. ₩0 \ %	VOLX	240H6	
IRC5_Control-Module						

Jogging the robot joint by joint

- 1. Open the station from the last exercise (*Mystation_7*), unless it is already open.
- 2. On the Home tab, in the Freehand group click Jog Joint.



3. In the Graphics window select one of the joints and move it by dragging the mouse.



Jogging the robot linearly

1. On the Home tab, in the Freehand group click Jog Linear.

```
☆ 🏹 💁 🚭 ♣ -
Freehand
```

2. In the Graphics window select the robot by clicking on it. A cross with red, green and blue arrows is now displayed at the Tool Center Point (TCP).



3. Click and drag the arrows to jog the robot. Use the red arrow for X direction, green for Y and blue for Z.

Reorienting the tool of the robot

- 1. On the Home tab, in the dropdown list of the Freehand group select Active Tool.
- 2. Click the button for **Jog Reorient**.



3. In the Graphics window select any part of the robot. Circular arrows are now displayed around the TCP.



4. Drag the arrows to reorient the tool around its current TCP position.

Jumping back to the neutral position

After finishing the jogging practice, jump back to the original neutral position.

1. In the **Layout** browser, open the context menu by right clicking the robot and then select **Jump Home**.

2.3.2. Creating a Workobject

Overview

The first thing we will do when programming the station is to create a workobject coordinate system. Workobjects are special coordinate systems in which the programmed positions are stored. Correctly used, workobjects facilitate calibration and modifications of the cell layout: if repositioning the work piece or the robot itself, you just reposition the workobject correspondingly, and the program is up-to-date again.

Programming a robot without having specific workobjects is possible, but not recommended. A default workobject, *Wobj0*, which always is fixed at the origin of the controller's world coordinate system, will be used in that case.



World coordinates

A workobject consist of two frames. The **User Frame** (User coordinate system) is referenced from the **World Coordinate System** and the **Object Frame** (Object coordinate system) is

referenced from the **User Frame**. See picture above where the position of two different parts located in the same fixture are described.

Creating the workobject

- 1. Open the station from the last exercise (*Mystation_7*), unless it is already open.
- 2. In the Graphics window select the **Part Select** selection level and the **Snap Object** snap mode.



3. Rotate and zoom the station till you get a clear view of the top of the box.



- 4. On the **Home** tab click on **Other** and select **Create Workobject** from the drop-down menu.
- 5. In the Create Workobject dialog, in the Name box enter *Wobj_Box*.

/	Create Workobject		×
⊿	Misc data		
	Name	Wobj_box	
	Robot holds workobject	False	
	Moved by mechanical unit		
	Programmed	True	
⊿	User Frame		
⊳	Position x, y, z	Values	
⊳	Rotation rx, ry, rz	Values	Ξ
	Frame by points		
⊿	Object Frame		
⊳	Position x, y, z	Values	
⊳	Rotation rx, ry, rz	Values	
	Frame by points		
⊿	Sync properties		
	Storage type	TASK PERS	
	Task	T_ROB1 (IRB1600_5kg_1.2m_typeA)	Ŧ
		Create Close	

- 6. In the **User Frame** group click the **Frame by points** box and then click the drop-down arrow.
- 7. In the **Frame by points** dialog select **Three-point** as method for defining the frame.
- 8. Set the insertion point in one of the **First point on X axis** boxes and then click the corner of the box marked as **1** in the picture above. The coordinates of the selected point are now inserted in the boxes and the insertion

The coordinates of the selected point are now inserted in the boxes and the insertion point moved to the **Second point on X** axis boxes.

9. Continue clicking in corners 2 and 3 in Second point on X axis and Point on Y axis, respectively.



10.Click Accept.

The Create frame by points dialog will close.

- 11.In the Create Workobject dialog click Create.
 - A workobject, displayed as a coordinate system, is now created on the box. You can also see the workobject in the **Paths&Targets** browser.



12. Save the station as *MyStation_8*.

Learn more

Click the **Help** button **(2)** in the top right corner of RobotStudio.

See the help section	for information about
About coordinate systems	Workobjects and other coordinate systems useful when programming a robot.

2.3.3. Programming motion

Overview

Paths are RobotStudio elements that contain the instructions for the robot. The order in which the instructions are stored in the path is the order in which they will be executed. We will create a path where the robot moves along the sides of the small box on top of the big one. This is done by 'graphical programming', i.e. by clicking in the graphics.

To get a working robot path, we need to go through a couple of different steps. First we will use the corner points of our graphical part to create targets. After this we will adjust the

orientation of the targets. Finally we will add these targets to a path and set appropriate axes configurations for each instruction.

Creating the targets

- 1. Open the station from the last exercise (*Mystation_8*), unless it is already open.
- 2. In the Graphics window select **Part Selection** level and **Snap End**.



3. Zoom and rotate the station so that you get a clear view of the tool and the small box.



- 4. On the Home tab click the Target drop-down and select Create Target.
- 5. In the Create Target dialog, make sure the pointer is set to the first Position box.



6. In the Graphics windows click the corners on the top surface in the same order as in the picture above.



The red stars show positions where targets will be created.

7. In the **Create Target** dialog click the **Create** button. Now 4 targets are created with default orientation (0,0,0).

Adjusting the target orientation

To get a good view on the current orientation of the targets we will use the function **View Tool at Target** which will give us a preview on how the tool will be oriented around the targets.

- 1. In the **Paths&Targets** browser select the first target (Target_10) and click the **Modify** tab.
- 2. In the View Tool at target drop-down, select Pen.

🍯 🔚 🌒 - 🔍 - 🤫	[Unsaved Station] - ABB	RobotStudio 5.15 (64-bit)	Target Tools	- Interne Taylore	-				
File Home M	Modeling Simulation Cor	troller RAPID Add-Ins	Modify						
to new path	🧑 Move to Workobject 🔹	🕥 Jump To Target	- 1	🔪 Set Position	🙏 Place 👻	Set Normal to Surface			💱 Set as UCS
	🙀 Convert Target to Workobject	View Tool at Target -	hility Configurations	🔥 Offset Position	Copy Orientation	Align Target Orientation	Evamina	Unavamina	Visible
ocopy to Workobject -		Pen it at Target	binty conigurations	🕑 Rotate	Apply Orientation	Modify External Axis	cxamme	Unexamine	Show Name
	Organize	Verify			Position			View	

As the orientation of our targets are zero and our TCP has Z pointing out from the tool, the preview of the tool will be hidden in the box. To be able to see this preview we need to make the box invisible

3. In Layout browser un-check Visible in the context menu of the box.



Next step is to set a suitable configuration on the first target and then re-use this orientation for the rest of our targets. If the exact orientation is known, it is easiest to manually type these values into the **Set Position** dialog. In this case when we have no exact values we will manually adjust the orientation of the first target.

4. In the Freehand group select reference Local in drop-down list. Then select Target_10 in **Paths&Targets** browser and then enable the **Rotate** button.

As a help to see if a target is reachable we will now enable the function **View Robot at Target**.

- 5. In the context menu of Target_10, select **View Robot at Target**. Now the robot will jump to the target as soon as it is possible to reach.
- 6. Rotate the target approximately +180 degrees around the Y axis by click&drag on the green arrow.
- 7. Rotate the target approximately +15 degrees around the Z axis by click&drag on the blue arrow.



Tip!

If you press the [f]-key while rotating, the rotation will execute in smaller steps.

8. In the context menu of Target_10, click **Modify Target>Set Position**.

9. Select **World** as reference and make the final adjustments to round off the angles as in pictures below. Press **Apply**.

Set Posit	ion: larget_10	-		* X	Set Posi	tion: Target_10			•
Reference					Reference				
World				-	World				
Position X.	Y,Z (mm)				Position X	Y,Z (mm)			
778.48~	202,24~	0	580.00		778,477	202,24~	0 5	80,00	
Orientation	(deg)				Orientation	n (deg)			
179,47~	€ 1,93~	4	164,65~	A	180,00	0.00	01	65,00	

- 10. In the context menu of Target_10, select **Copy Orientation**.
- 11. Multi-select the three remaining targets and click **Apply Orientation** from the context menu. Now all targets will have the same orientation.



- 12. Make the box visible again by checking Visible from the context menu.
- 13. Step through the targets and make sure they are all possible to reach. As **View Robot at Target** is activated the robot will automatically jump to the targets if possible.
- 14. Disable View Tool at Target, View Robot at Target.
- 15. Save the station as *MyStation_9*.

Adding the targets to a path

- 1. Open the station from the last exercise (Mystation_9), unless it is already open.
- 2. On the Home tab click Empty Path from the Path drop-down menu.



An empty path, Path_10, is now created and displayed in the Paths&Targets browser. 3. Right click the path, select **Rename** and change the name to *Path_Box*.

On the **Status Bar** down at the bottom of the interface you can see the active instruction template. These are the default settings that will be used when creating the Move instructions.

4. Change the parameters according to the picture below.



Path_Box

6. On the Modify tab click the Add to Path button and select Path_Box and First.

Tite Home Modeling Simulation Controller RAPID Add-Ins Modify %2 Add to new path @ Move to Workobjed - @ Convert Target to Workobjed @ Ump To Target @ View Robot at Target - @ View Robot at Target @ Set Position Le Place - % Offeet Position Add-Ins Movie to Workobjed - % Offeet Position Add-In	R C Vicible
32 Add to new path Work to Work objed - Work to Work objed -	Set as UCS
 CLISTO CLISTO	Unexamine Show Name View
Layout Paths&Targets = + X View1 X	
[Uneved Station] Solice Elements Solice Elements	

- 7. In the Paths&Targets browser select Target_10.
- 8. On the **Modify** tab click the **Add to Path** button and select **Path_Box** and **Last**. Now the loop is closed.



Tip!

You can also use drag&drop to create the instructions.

9. Select the path, and in the **Modify** tab select **Rename Targets**. Write *pBox*_ as target prefix and press **Apply**. This function also available from the context menu of the path.



10. Save the station as MyStation_10.

Setting axes configuration

Before we can setup and run a simulation we need to define what axes configurations the robot should have for each target. This can be done manually by stepping through each instruction and clicking **Configurations** from the context menu. In this way you will get a list of all available configurations. In cases where we have many instructions a more efficient way is to use **Auto Configuration**. In this way we will only set the start configuration and then RobotStudio will calculate the configuration for the rest of the instructions in order to get as smooth movements of the robot axes as possible.

- 1. Open the station from the last exercise (*Mystation_10*), unless it is already open.
- 2. Select Path_Box and click Auto Configuration from the Modify tab.



3. Select the first configuration in the list and press **Apply**. The robot will now run through all instructions and get valid configurations on all remaining.

Select Robot Configuration	
Configurations	
🗣 Cfg1 (0,-2,1.0)	
Cfg2 (0.01.1)	
Cfg3 (-2,0,1,6) Cfg4 (-2,-2,-1,7)	
org : (2, 2, 1,7)	
Include Turns	
Joint Values	
Previous Current	
J1: 23.74 J2: -6.33 J2: -6.33	
J3: 32.93 J3: 32.93 J4: -119.16	
J5: 45.78 J5: 45.78	
Cfg: (0,-2,1,0) Cfg: (0,-2,1,0)	
Apply Cancel	

4. Save the station as *MyStation_11*.

Tip!

Auto Configuration is also available from the path context menu.

Learn more

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

See the help section	for information about
About targets and paths	Targets, paths and move instructions.
Robot axis configurations	Axes configurations

2.3.4. Running the Simulation

Overview

Now we have completed all steps required to proceed creating a RAPID program. The strength with the virtual controller is that we use the same software as the real robot controller. This means that we are able to run a simulation where we get very close to the

same behavior as on a real robot controller. The robot program will be stored on the system running on the virtual controller, just as the program for a real robot is stored on its system.

Synchronize to the Virtual Controller

- 1. Open the station from the last exercise (Mystation_11), unless it is already open.
- 2. On the **Home** tab, click the **Synchronize** button.



3. In the **Synchronize to VC** dialog make sure all data are selected and then click **OK**.



All program data is now transferred from the RobotStudio station to the virtual controller.

4. To get a view of the result, expand the tree structure in the Rapid tab, and double click **Module1** as shown below.



Setup the Simulation

To be able to start a simulation we need to define where the robot should start the execution. This can be done by adding a main sequence directly in the Rapid Editor or we can use the Simulation Setup dialog where we get this done automatically.

1. On the **Simulation** tab click the **Simulation Setup** button.

🛌 Simulation Setup

2. Select *Path_Box* and click the arrow pointing to the left in order to add it to main procedure.

Program Sequence Simu	lation Scenari	DS			
Active Tasks		Sequence			
Select Active Tasks:	.2m_typ	Main Sequence T_ROB1:	\$ × • •	Available Procedures: Path_Box	
Continuous Single Cycle		Entry point			

- 3. Click the **OK** button.
- 4. Now go back to the Rapid editor to see the resulting main sequence.



5. In the Simulation tab click the **Play** button. The robot will now execute the RAPID program.

2.3.5. Adding a start and home position

Overview

To be sure that the robot can execute this linear path we will add a new target which we will use as an approach/depart target. As the path, so far, only consists of linear instructions problems will appear in situations where the actual position of the robot makes a linear movement to the first instruction impossible.

Adding an approach/depart target

- 1. In the **Paths&Targets** browser select copy from the **pBox_10** context menu. Then click Paste from the **Wobj_Box** context menu.
- 2. Rename the target to **Appr_Box**.
- 3. Select Appr_Box and click Set Position from the Modify tab.

🖌 Set Position

4. Set the reference to Local and move the target -150mm in the Z direction. Press Apply.



- 5. In the toolbar for active templates, change to **MoveJ** and set the parameters as below. MoveJ + * v300 + fine + Pen_TCP + \WObj:=Wobj_Box +
- 6. Select the target **Appr_Box** and then add it to the top of the path.



7. Change back to **MoveL** as active template.

MoveL + * v300 + fine + Pen_TCP + \WObj:=Wobj_Box +

8. Repeat step 6 but now add the instruction last in the path.

🗄 🚽 Pa	th_Box
	MoveJ Appr_Box
	MoveLpBox_10
	MoveL pBox_20
	MoveL pBox_30
	MoveL pBox_40
	MoveLpBox_10
<u>R</u>	MoveL Appr_Box

Note that the yellow triangle warning appears on the new instructions. This is because no axes configuration is set yet.

9. Select Path_Box and click Auto Configuration from the Modify tab.



10. Select the first configuration in the list and click **Apply**. The selected configuration will now be set to the first target and calculated for the others.

Select Robot Co	nfiguration
Configur	ations
🕈 Cfg1 (0,-2,1	.0)
Cfg2 (0,0,-1	.1)
Cfg3 (0,-1,0	0.2)
Cfg4 (0,1,2	.3)
Include Turr	15
Joint Va	lues
Previous	Current
J1: 23,74	J1: 23,74
J2: -12,87	J2: -12,87
J4: -102.82	J4: -102.82
J5: 39,93	J5: 39,93
J6: 106,53	J6: 106,53 Cfa: (0,2.1.0)
0.9. (0, 2, 1,0)	[0:g. (0, 2, 1, 0)
Apply	Cancel

Now we will also add a Home position that we will place in a separate path.

11. From Home tab, create a new empty path and rename it to Home.



- 12. In **Home** tab, select **Jump Home** from the context menu of the robot. The robot will now reset the axes to default values.
- 13. From the Modify tab, select Mechanism Joint Jog.

🔦 Mechanism Joint Jog

14. Jog the robot according to the screenshot below.

-180,0	50,00	180,00) <	>
-63,0 -30	.00	136,00) <	>
-235,0		20,00 5,00	<	>
-200,0	0,00	200,00) <	>
-115,0	30,00	115,00) <	>
-400,0	0.00	400,00) <	>
CFG:	0000			
TCP:	423,21 504,36 828,	57		
Step: 1	00000 🚔 dea			

Tip!

Click the separate boxes for each axis and press space on your keyboard. Now you will be able to write exact values.

- 15. Change active work object to **wobj0** from the **Settings** group in **Home** tab.
- 16. In the toolbar for active templates, change to **MoveJ** and set the parameters as below. MoveJ • * v300 • fine • Pen_TCP • \WObj:=wobj0 •
- 17. In **Path Programming group** of **Home** tab, click **Teach Instruction**.

A new target will now be created in **wobj0** and a **MoveJ** instruction will be added to the new Path. Press yes on the message that follows.

ABB Robo	otStudio 🛛 🕅
1	Default 'wobj0' is about to be used. It is recommended to change this value. Do you want to continue with the operation?
	Don't show message about this again.
	Yes No

- 18. Rename the new target to **HomePos**.
 - 🖕 🙀 wobj0 i≟...i≩ wobj0_of HomePos 🗄 🗟 Wobj_Box 🗄 📲 Wobj_Box_of • pBox 10 pBox_20 pBox_30 • pBox_40 . 💽 Appr_Box 🗄 浸 Paths Path Box - MoveJ Appr_Box MoveL pBox_10 MoveL pBox_20 MoveL pBox_30 MoveL pBox_40 MoveL pBox_10 MoveL Appr_Box Home -📷 MoveJ HomePos
- 19. To transfer the new instructions to the virtual controller, click **Synchronize to VC** from the **RAPID** tab.

S 3 4) + (2 + 2				
File Home Mode	ling Simulation Controller	RAPID	Add-In	15
Request Release Write Access Write Access	Synchronize	Snippet I	nstruction *	Ju
Access	Synchronize to VC	ns	ert	
Controller Files	For synchronizing an open static	on to a		
Current Station	virtual controller.		3 Su 3 Su	10
⊿ 🔲 IRB1600_5kg_1.2m_1	Synchronize to Station	ollerto	, es . *	5.0
M Configuration	an open station			

- 20. Make sure everything is selected and then click OK.
- 21. Save the station as *MyStation_12*.

Tip!

Note that synchronization can be done in several ways. The **Synchronize** button appears in both the **Home** and **Rapid** tabs. Alternatively right clicking on either the system or a particular path in the **Paths&Targets Browser** on the **Home** gives you this same option.



2.3.6. Using the Rapid Editor for basic adjustments

Overview

In this section we will look into how to use the Rapid Editor for basic adjustments of our program. We will also step through each instruction one by one. Later in the course we will learn how to use the more advanced features for debugging and editing.

Rapid Editor

- 1. Open the station from the last exercise (*Mystation_12*), unless it is already open.
- 2. In the **Rapid** tab, expand the tree structure and double click **Module1** as shown below.



3. Click in the main procedure and add a call to the Home.



Note the IntelliSense as you start to type. The return key will add the highlighted instruction/procedure.

- Change the speed to v1000 in the HomePos instruction. MoveJ HomePos, v1000, fine, Pen_TCP\WObj:=wobj0;
- 5. Click **Apply** changes.

Ir	15						
	Quick find 👻	<i>A</i>		🚡 RAPID Tasks	Î.	8	S
	Go to line	Eind /	Apply	🚺 Run Mode 🔻	Adjust	Start	Ş
	Jump To 👻	Replace +	- The second sec	🚺 Program 🔻	Robtargets	Start	Ģ
	Find			Controller			
	2m (Station) ×		Apply	changes			
			Ann	ies the changes to	the module in		
: :	pBox_10:=[[103. pBox_20:=[[72.5	44661437,	the p also	checks the program	the system and m.	192,0 92,0.	.99
:	pBox_30:=[[108.	824438228	,32.31	6617103,30],[0,-0.13052	6192,0	.99
	NRAV ////-11130	760375077	714 5		SOGTOD A O	u17/1/8	61

6. Confirm the change by clicking **YES**.



7. To be able to see both our graphical view and the program, click **New Vertical Tab Group** by right clicking the editor tab.

1		<u> </u>	-	/ restortimes *	Alton Mg Lin Ables #
T_ROB1/M	M	Close	<u> </u>	NO DO DYN <mark>N</mark> NYNYN DOYWAETS NUDHA	1 00001 Meaded 1 00001 Medded 1 00001 medded 2 00001 medded 3 00001 medded 4 00001 medded 5 00001 medded 6 00001 medded 6 00001 medded 9 0001 medded 9 0001 medded
2 📮		Rename Tab	[[103.44661437,17		00651 retraining to Appr. Best. (1200000 2007-200-5, 2012), 201- 00651 retraining to Appr. Best. (12044604437, 127.7782125797, 38 00657 retraining to Appr. Best. (1413-218090554, 584, 345212574, 82 1 (2940); Petty_Box()
3		New Horizontal Tab Group	[[72.510676622,16 [[108.824438228,3		 Breed, J. Ager, Jone, V. W., Line, J. Per, J. T. Weby (model), Sens. Breed, J. Hou, S. V. W., Line, K. P., 2019000 (model), Sens. Breed, J. Blow, J. H., V. Mark, J. M., 2019000 (model), Sens. Breed, J. Blow, J. M., V. Mark, J. Lee, 2019000 (model), Sens. Breed, J. Blow, J. M., V. Mark, J. Lee, J. 2019000 (model), Sens. Breed, J. Blow, J. M., V. Mark, J. Lee, J. 2019000 (model), Sens.
5		New Vertical Tab Group	[139.760375977,4	FT T	 Brunck, pilling, 24, u 1992, Plant, Pere, 207 (2016) (control (done)) Brunck, degrer (done, v 1992, Plant, Pere, 2027 (2016) (control (done)) Brunckey, Brunck, v 1992, Plant, Pere, 2027 (2016) (control (done)) Brunckey, Brunckey, Brun
6		Move to Previous Tab Group	=[[103.44661437,1 [[423.210991524.5		11 Norry 12 Febb, Norg 13 EXPECT 13 EXPECT 14 Contemporary 14 Contemporary 15 Contemp
8 📮	Ы	Move to Next Tab Group			
9		Full Screen	Pen_TCP\WObj:=Wob		23 Indexeduct
10		Close all editor windows	en_TCP\WObj:=Wobj	11	-
12	M	ovel pBox_30,v300,tine,F	en_TCP\WObj:=Wobj	/	

8. In the Virtual Controller group of the **Controller** tab, open **the Control Panel** and change to **AUTO** mode and push the **Motors Button**.



Tip!

Click the $\overline{}$ button up in the right corner to switch style of the **Control Panel**.

9. Back in the Rapid tab Set the program pointer to the main routine

Start Step over Test a	heck Pro ogram Poi	gram nter •	Breakpoint	RAPID Profiler •	
	₹ ⊏	Gol	To <u>P</u> rogram Po	pinter	
		Gol	To M <u>o</u> tion Poi	nter	
0/1-	 Image: A set of the set of the	<u>F</u> oll	ow Program P	ointer	
	Set	t Prog	ram Pointer		
		Set	Program Poin	ter to <u>M</u> ain i	n all tasks
		Set	Program Poin	ter to <u>C</u> urso	r
		Set	Program Poin	ter to <u>R</u> outir	ne
	_	se s	tep in		

10. Use the Step in (**F11**) function to step through the program.

As we now have done changes to the program directly in the virtual controller, we need to synchronize the changes back to the station.

11. While still in the **Rapid** tab, click the lower half of the **Synchronize** button to reveal the Synchronize to Station feature. Synchronize to the station.



12. In the dialog, check the top node so that everything get selected and press **OK**.



- 13. In **Simulation** tab, click the **Play** button. Note that the robot now first go to the Home position we added to the main procedure from the Rapid Editor.
 - \triangleright Play
- 14. Save the station as MyStation_13
- 15. Save the station as a Pack&Go from the Share section of the File tab. A Pack&Go file will include all data required to restore the station and system so this is the recommended way of saving a project when finished or when moving to another PC.



2.3.7. Simulation settings

Overview

In this section we will look into the RobotStudio options for simulation settings. The Simulation speed setting allow you to set the simulations speed relative the real time. This can be useful when having longer simulations where you want to save time running through the simulations.

RobotStudio Options

- 1. Open the station from the last exercise (*Mystation_13*), unless it is already open.
- 2. From the **File** tab, click **Options.**

😥 Options

3. Go to the Simulation section and click **Accuracy** and check **As fast as possible.** Then click **OK**.

Synchronization	Accuracy
Vechanism	
/irtual Controller	Simulation speed
Online	Simulation speed relative to real time.
Authentication	☑ As fast as possible
Ferminal	
Graphics	100%
lenderer	Simulation timesten
ppearance	Specify approximate simulation timestep. Exact step depends on
Performance	controller configuration.
Sehavior	24 ms
Seometry	E
Simulation	
Collision	
/irtual Time	
Accuracy	Apply Reset Default

- 4. Press **Play** from the **Simulation** tab to run the simulation again. Now note that it will run through the simulation in a much shorter time but the resulting process time will be the same.
- 5. Go back to **Options** and uncheck **As fast as possible** again.

Learn more

Click the **Help** button **(2)** in the top right corner of RobotStudio.

See the help section	for information about
Options	RobotStudio Options

2.3.8. Saving the robot program

Saving the robot program

1. In the **Rapid** browser, select **Save program As** from T_ROB1 context menu.

4	RAPID	
		Synchronize to <u>V</u> C
		Synchronize to Station
	🔺 🗐 M 🔁	Load Program
	· · · · · · · · · · · · · · · · · · ·	<u>Save Program As</u>
	* =	<u>R</u> ename Program
	Syster ×	D <u>e</u> lete Program
	퉳 в. 🚍	New Module
	🔏 u: 🔁	Load <u>M</u> odule
	Image: A start of the start	Active
	(Start Task
		Stop Task
		Go To <u>P</u> rogram Pointer
		Go To Motion Pointer
		<u>Follow Program Pointer</u>
		Paste Ctrl+V
	ų.	Adjust Robtargets

2. In the folder \Courseware\RAPID Programs save the program as BoxProgram_1.

Summary

Now we have created a robot program that can be loaded to a real robot. The saved modules can be viewed or edited using the Rapid editor or any text editor.

Basically, our program exists in three independent versions now:

- In RobotStudio, where the positions and motion properties are saved in the path.
- In the virtual controller, where it is stored in the controller's program memory just as on a real controller.
- As files on the hard drive, which we saved from the virtual controller through RobotStudio.

2.4. Local Origin

Overview

In the next three exercises we will work with the same station but with another tool and work piece loaded. The tool will be created from a CAD file using the tool wizard. We will also work with a new work piece which will require some changes to the station, concerning frames. We will start with looking into **Local origin**.

Each CAD file has its own local coordinate system called **Local origin**. In this exercise we will explain why this coordinate system has big impact on many operations in Robot Studio. We will import a CAD file for a tool that was saved in a way that we need to modify its coordinate system to be able to use it in our simulations.

Tool wizard

- 1. From the **Share** section in the **File** tab select **Unpack & Work** and unpack the file **TaskFrame.rspag** from *Courseware\Stations*.
- 2. In the **Select the directory where the files will be unpacked** field click the **Browse** button.

3. In the dialog browse to \MyDocuments\RobotStudio\Courseware\Stations\ click New Folder and name it myBasicStation.

Select Folder		23
😋 🔵 🗢 📗 « RobotStud	io > Courseware > Stations > - 47 Search Stations	م
Organize 🔻 New folder		:= • 🔞
*	Name	Date modified
🔆 Favorites	\mu myBasicStation	2011-05-05 08:53
Desktop		
Lownloads		
Dropbox		
Recent Places		
🥞 Libraries		
Documents		
J Music		
Network		
Protects		
Videos		
r Computer 👻	< III	P.
Folder:	myBasicStation	
	Select Folder	Cancel

4. Click the **Select Folder** button.

Inpack & Work
Select package
Select the Pack & Go file to unpack
Select the directory where the files will be unpacked
Toders (Documents (hoboticitudio (Lourseware (Stations Virybasicotation)
Help Cancel < Back Next >

- 5. Click the **Next** button.
- 6. Check the controller system dialog and click the **Next** button.
- 7. Click the **Finish** button.
- 8. When finished, click the **Close** button.
- 9. Import the geometry *SpintecTool.sat* from the Courseware folder.

۲		4	Ĩ	•	☆	Teach Target	<u> </u>	Task	5kg
In	nport	Frame	Target	Path	Other	reachinstruction	MultiMove	Tool	tool0
Geo	User G	eometry		Ť	Path F	Programming	G.	1001	Settin
L	Course	eware			Cours	eware			
	Locatio	ons				Box	ca	rfront	
	Browse	e for Geor	metry	Ctrl+G	_				
			-			InFeeder	pr	opeller	
						robot stand	Sp	intecTool	

A geometry representing the tool is now imported to the station and placed with its local origin in the zero point of the world coordinate system. As the local origin on this specific part is not placed in the attach point of the tool you will see the offset between the coordinate system and actual CAD part.



Attach to Robot

To show why this can be a problem we will attach the tool geometry to the robot.

1. In the **Layout** browser right click the *SpintecTool* and on the context menu point to **Attach to** and select the robot.

Tip!

Drag&drop is often easier when using the Attach command.

2. In the Update the position dialog click Yes.



Due to the definition of the local coordinate system of the part, you get an offset of the tool. This is what we now have to fix.

3. In the context menu of the *SpintecTool*, select **Detach**.

Setting the Local Origin

42

1. Make the robot invisible by un-checking Visible from the context menu.

2. In graphics, zoom so you get a good view of the tool.



3. Select Selection level Surface and Snap mode Center.

- 4. In the **Layout** browser right click the *SpintecTool* and select **Place**. In this case we will place the object by one point.
- 5. Make sure the pointer is in one of the Position boxes and then click the surface as in picture above.

Place Ob	oject: SpintecTo	ol	₹ ×		
Reference					
World			-		
Primary Po	pint - From (mm))			
500.00	500.00	0.00			
Primary Po	oint - To (mm)				
0.00	0.00	🚖 0.00			
Translate along these axes:					
	Appl	y a	ose		

Tip!

To avoid clicking on the floor, go into RS Options and make the floor invisible.

ignorhronization Back Wechanism 6 F Online 2 Color Suthentication Cereminal Graphics 2 F Renderer 9 E Grick Show 2 F Show 2 F Sho	sground color From color theme Ration color: From floor x V UCS Frame V Gradient Transparent V Gradient V Gradient V Gradient
Online Image: Color state stat	Rhow floor x v UCS rame V Grid
Graphics Renderer Appearance* ■ Grideren Grider	Frame I Grid
Appearance* Grid	X: (mm) Y: (mm)
renormance	i space 1000,00 👘 1000,00 👘
Behavior Sh Geometry Sh	ow coordinate system ow navigation and selection buttons
Simulation	

- 6. Click Apply. This will move the SpintecTool to RobotStudio world zero.
- 7. In the **Layout** browser right click the *SpintecTool* and select **Rotate.** In this case we will rotate the object about the world coordinate system by 90 degrees. Click **Apply**.

ointecTool	₹ x
	•
nd x, y, z	
0.00	.00 🚔
int x, y, z	
(⊉ 0.00	.00
g)	
🛓 🍥 X	🔘 Y 🔘 Z
Apply	Llose
	pintecTool nd x, y, z ★0.00 ★0 int x, y, z ★0.00 ★0 g) x Apply

At this point if we were to attach the tool to the robot it would still not go to the correct position as the attachment point reference is still the local coordinate system of the part.

In the next steps we will adjust the local coordinate system to match the position of the model.

8. In the **Layout** browser right click the *SpintecTool* and select **Set Local Origin.** You will notice in the dialog box the following values.

Set Lo	cal Origin: Spin	tecTool	∓ x
Reference	e		
World			•
Position	X,Y,Z (mm)		
-500	€ 0.00~	-500.00	
Orientati	on (deg)		
90.00	0.00	0.00	
	Ap	ply Cle	ose

We will now correct these values to coincide with the corrected CAD model by changing all values to zeros. Click **Apply**.

Set Lo	cal Origin: Spin	tecTool	∓ x
Reference	ce		
World			•
Position	X,Y,Z (mm)		
0.00	0.00	0.00	
Orientat	ion (deg)		
0.00	0.00	0.00	
	Apr		lose

The coordinate system is now moved to coincide with the actual position in the station which also happens to be the attachment point of our tool geometry.



- 9. Attach the tool geometry to the robot to see the difference. Now it should attach correctly.
- 10. Detach it again.

Exporting the Geometry

Now we will export the geometry with a new name for later use.

11. In the **Export** group of the **Modify** tab which is visible after selecting SpintecTool in the browser, click **Export Geometry**. (Also available from context menu.)



- 12. In the **Save As** dialog change the name to *mySpintecTool*.
- 13. Click the **Save** button.

Organize 🔻 New folder				III •
TobotStudio	Name	Date modified	Туре	Size
퉬 Geometry	Solutions	2010-06-07 12:42	File folder	
Courseware	Box.sat	2008-09-16 08:15	SAT File	16 KB
	carfront.sat	2008-09-05 13:45	SAT File	1 327 KB
🔆 Favorites	CurveTrainingPart.sat	2006-03-22 09:47	SAT File	18 KB
🧮 Desktop	InFeeder.sat	2010-04-29 21:53	SAT File	565 KB
🗼 Downloads	propeller.sat	2008-10-21 20:55	SAT File	3 523 KB
🔛 Recent Places	Rail.sat	2009-08-18 18:20	SAT File	16 KB
	robot stand.sat	2008-09-03 11:07	SAT File	38 KB
🥽 Libraries	SpintecTool.sat	2008-10-15 12:56	SAT File	184 KB
Documents	Table.sat	2008-09-16 08:15	SAT File	71 KB
👌 Music	test part.sat	2008-09-03 10:52	SAT File	9 797 KB
Pictures	training_part1.sat	2008-09-02 16:38	SAT File	494 KB
😸 Videos				
	×			
File <u>n</u> ame: mySpintecTo	ol.sat			
Save as type: ACIS R21 files	(*.sat)			

14. Make the robot visible again.

Learn more

Click the **Help** button **1** in the top right corner of RobotStudio.

See the help section	for information about
Introduction >Terms and Concepts >Libraries, geometries and CAD files	Definitions and overview of the geometry and library system in RobotStudio.

2.5. Creating a tool

Overview

In this exercise we will create a tool from the CAD file saved in previous exercise and save it as a library component. To do this we will import a geometry representing the tool. From this geometry we specify a **Tool Center Point** (TCP) and some other parameters. When the tool is finished we will save it as a library component and attach it to the robot.

Preparing the geometry

Note! After creating a tool the geometry will no longer be editable and cannot be used for creating tools again. This means that it is a good practice to make a copy or export the geometry to file before creating the tool, if you do not already have one.

- 1. Unpack the **Pack&Go** file **TaskFrame.rspag** from *Courseware\Stations* unless the station is still open.
- 2. Import the geometry my*SpintecTool.sat* from the Courseware folder unless it is already imported.

A geometry for the tool is now imported to the station and placed at the origin of the world coordinate system. Note that this is the geometry we fixed in the local origin exercise. If necessary there is a correct copy in the Solutions folder.

3. In the Layout browser right click the robot and uncheck Visible.



Click in the Graphics to remove the red marking and the robot will now be invisible and you can see the tool on the floor. In the Layout browser the node for the robot is marked with a magnifying glass $\frac{3}{2}$, indicating that it is not visible in the Graphics window

0 12 00 / 0

Creating a reference frame

To simplify the later TCP definition we will start by creating a reference frame.

1. Zoom and rotate the station so that you get a clear view of the tip of the tool. It is important that you see the circular front of the tip clearly.



2. On the Home tab click the Frame drop-down and select Create Frame.



- 3. In the Graphics window select **Surface Selection** level and **Snap Center**.
- 4. In the dialog click in the **Frame Position** field and then in the Graphics window click on the tip surface.



The snap goes to the center of the surface as our selection level and snap mode.

5. Click the **Create** button.



As we did not define an orientation it mimics the world coordinate system. Now we will use the graphics to get the angle of the tool.

6. In the Layout browser right click *Frame1* and select Set Normal to Surface.

e_1				
	*	Cu <u>t</u>	Ctrl+X	
		<u>С</u> ору	Ctrl+C	
		<u>V</u> iew		Þ
	¥.	Set as <u>U</u> CS		
	\mathbf{x}	Set Position		
	Ð	<u>R</u> otate		
	- k	Place	I	
	≛	Set Normal To Surface		

- 7. In the **Set Normal to Surface** dialog click the top field and then in the Graphics window click the tip surface.
- 8. Click the **Apply** button.

-- 🦕 Fram

Set Normal to Surface: Frame_1	₹	х
(Face) - mySpintecTool		•
Approach Direction		
⊙ X ⊙ Y		
⊙-X ⊙-Y ⊙-7		
Project Point on Surface		
Offset (mm)		
0.00	4	
Apply	ose	

Since the default definition of the approach direction is positive Z it points out of the surface.

Creating the new tool

Now that we have both graphics and frame we will use these to create a tool.

1. In the Mechanism group of the **Modeling** tab click the **Create Tool** button to start the wizard.



- 2. In the Create Tool wizard in the Tool Name field enter mySpintecTool.
- 3. To select a part click the **Use Existing** button and in the drop-down list select the *mySpintecTool* part.
- 4. Type in 3kg as mass.
- 5. In the Graphics window select Part Selection level and Snap Gravity.

|--|

6. In the **Create Tool** dialog click in the **Center of Gravity** field and then in the Graphics window click the tool graphics.

Create Tool				×		
Tool Information (Step 1 of 2) Enter name and select the part associated with your tool.						
Tool Name: mySpintecTool						
Select Part:	O	Use Dummy				
mySpintecTool				-		
Mass (kg)	Center of (Gravity (mm)				
3,00000	-47,19~	€ 0,00~	⊜ 73,19~			
	Moment of	Inertia Ix, Iy, Iz (kgn	n²)			
	0	0,00000	0,00000			
Help		Cancel	< Back	Next >		

Note that snap gravity assumes that the object is of the same density when calculating the center of gravity. You can also type in moment of Inertia but there is no RobotStudio functionality for this so you have to get the data externally.

- 7. Click the Next button.
- 8. In the **TCP Name** field enter *tSpintec*. *This is the name of the tooldata that will be used in RAPID*
- 9. In the Values from Target/Frame click the field and then on *Frame_1*.
- 10. Click the large arrow [->] button to add the TCP.

TCP Information (Step 2 of 2) Name and positionyour TCP(s).			
TCP Name:		TCP(s):	
tSpintec		tSpintec	
Values from Target/Frame			
Values from Target/Frame Frame_1	->		
Values from Target/Frame Frame_1 v Position (mm)	->		
Values from Target/Frame Frame_1 ← Position (mm) 31.79~ ⊕ 0.00 ⊕ 229,64~ ⊕	•		
Values from Target/Frame Frame_1 ← Position (mm) 31.79~ ⊕0.00 ⊕229,64~ ⊕ Orientation (deg)			
Values from Target/Frame Frame_1 Position (mm) 31.79~ 0.00 229,64~ 0.00 Orientation (deg) 0.00 0.00 0.00 0.00	· ->	Delete	Edit
Values from Target/Frame Frame_1	•	Delete	Edit

11. Click the **Done** button.



In the Layout window we can see that the geometry part has been replaced by the tool mechanism. But that the frame remains.

12. In the Layout browser right click the *Frame_1* frame and select Delete.

Saving the tool as a library component

Saving the tool as a library component makes it available for use in other stations as well. It also means that if you update the library then all stations using the library will be updated the next time you open them.

1. In the **Layout** browser right click the tool *mySpintecTool* and select **Save as Library** from the **Modify tab**.



2. In the **Save As** dialog enter *Courseware**Libraries**mySpintecTool*.

Note the small floppy disk that shows that the tool now is a library file.

Attaching the tool to a robot

- 1. Right click in the Graphics window and select **View All**. The station now zooms out so that all objects are visible.
- 2. In the Layout browser right click the robot and make it visible again.
- 3. Attach the tool to the robot.





4. In the Update the position dialog click Yes.

5. **Save** the station as *Courseware**Stations**MyStation_NewTool.rsstn*.

2.6. Task Frame

Overview

Now we have created a new tool that we will use when executing the path on the new work piece. Working in RobotStudio requires understanding about several different coordinate systems. In this chapter we will learn how to work with the Task Frame. As these concepts will follow through the whole training materiel, it is very important to understand the differences between these, as mentioned below.



Moving the TaskFrame

1. Open the station from the last exercise (*MyStation_NewTool.rsstn*), unless it is already open.



As we can easily see in this station, we will not be able to execute the path on top of the work piece without moving the robot. This can be done on two ways; either by moving the **BaseFrame** of the robot or moving the **TaskFrame** of our controller. To avoid **BaseFrame** values in the controller we will change the **TaskFrame** which is the recommended way. The recommendation is to only modify the **BaseFrame** values when required, such as in **MultiMove** Systems or working with external axes. Later in the course we will see situation where this is required.

- 2. Import the geometry **Stand.sat** from the *Courseware**Geometry* folder.
- 3. In the **Controller** tab select the system and click on the **Task Frames** button.
- 4. In the **Position XYZ** fields enter **0**, **0**, **600** with world as reference.

Modify	Task Frames : Il	RB1600_5kg_1.2	₹×	
Modify all Task Frames relative the RobotStudio Station world.				
Reference	•			
World				
Position >	(, Y, Z			
0,00	0,00	600,00		
Orientatio	'n			
0,00	0,00	0,00	▲ ▼	
		Apply Cl	ose	

- 5. Click on the **Apply** button.
- 6. As you do not want to have an offset to the **BaseFrame**, answer **Yes** on the question *"Do you also want to move the base frame(s)?"*

	J
ABB Robots	tudio 🛛 📉
?	Do you also want to move the Base Frame(s)?
	Yes <u>N</u> o

7. As a workobject including targets is pre-created in this station which we do not want to move the same distance, answer **Yes** on the question "*Do you want to keep the positioning of all stationary RAPID objects*?"



The robot is now moved up on the robot stand, with all target locations kept.



Making thefinal adjustments

Now we will make sure the robot can reach the targets and run auto configuration to set suitable axes configurations

1. Activate **View Robot at target** and step through all the targets in the workobject, *obWorkPiece*.



- 2. As all targets seems to be possible to reach, de-activate View Robot at target again.
- 3. Set MoveL as active template from the toolbar with parameters as below.

MoveL + * v300 + z1 + tSpintec + \WObj:=obWorkpiece +

4. Multi-select all targets and add them to a new path by clicking Add to new path from the **Modify** tab.

🞎 Add to new path

5. Add the Approach target also as first instruction. This time, set **MoveJ** as active template.

```
MoveJ + * v100 + z1 + tSpintec + \WObj:=obWorkpiece +
```

av :					
Appro	ach				
		Inline			
ath_10	+.0 0 4	Add to ne <u>w</u> path			
a MoveLt_ a MoveLt	÷.0	Add to <u>p</u> ath	►	Path_10 🕨	<first></first>
MoveLt_	`@ ```	Copy to Workobject	ł		<last></last>
。 [®] Path_	10				
	veJ	Approach			
- 🙀 Mo	veL	t_WorkPiece10			
🙀 Mo	veL	t_WorkPiece20			
🔂 Mo	veL	t_WorkPiece30			
	veL	t_WorkPiece40			
- 🙀 Mo	veL	t_WorkPiece50			
- 🙀 Mo	veL	t_WorkPiece60			
	veL	t_WorkPiece70			
- 🙀 Mo	veL	t_WorkPiece80			
Mo	veL	t_WorkPiece90			
- 🙀 Mo	veL	t_WorkPiece100			
- 🙀 Mo	veL	t_WorkPiece110			
- 🙀 Mo	veL	t_WorkPiece120			
🛛 🙀 Mo	veL	t_WorkPiece130			
🙀 Mo	veL	t_WorkPiece140			
Mo	veL	Approach			

6. Run Auto Configuration to set the axes configurations. Either from the context menu of the path or the **Modify** tab.



- 7. As configuration for the first target, select (0,0,-1,0). Press **Apply**. Now the configurations for the rest of the targets are calculated.
- 8. Now use your knowledge from earlier parts of this course, to setup and run a simulation. You need to first synchronize the path to the VC and then setup the simulation.
- 9. Save the station as *MyStation_NewPath.rsstn*.

Learn more

Click the **Help** button **2** in the top right corner of RobotStudio.

See the help section	for information about		
Coordinate Systems	The different coordinate system used		

© Copyright 2012 ABB All right reserved. ABB AB Robotics Products SE-721 68 Västerås Sweden



