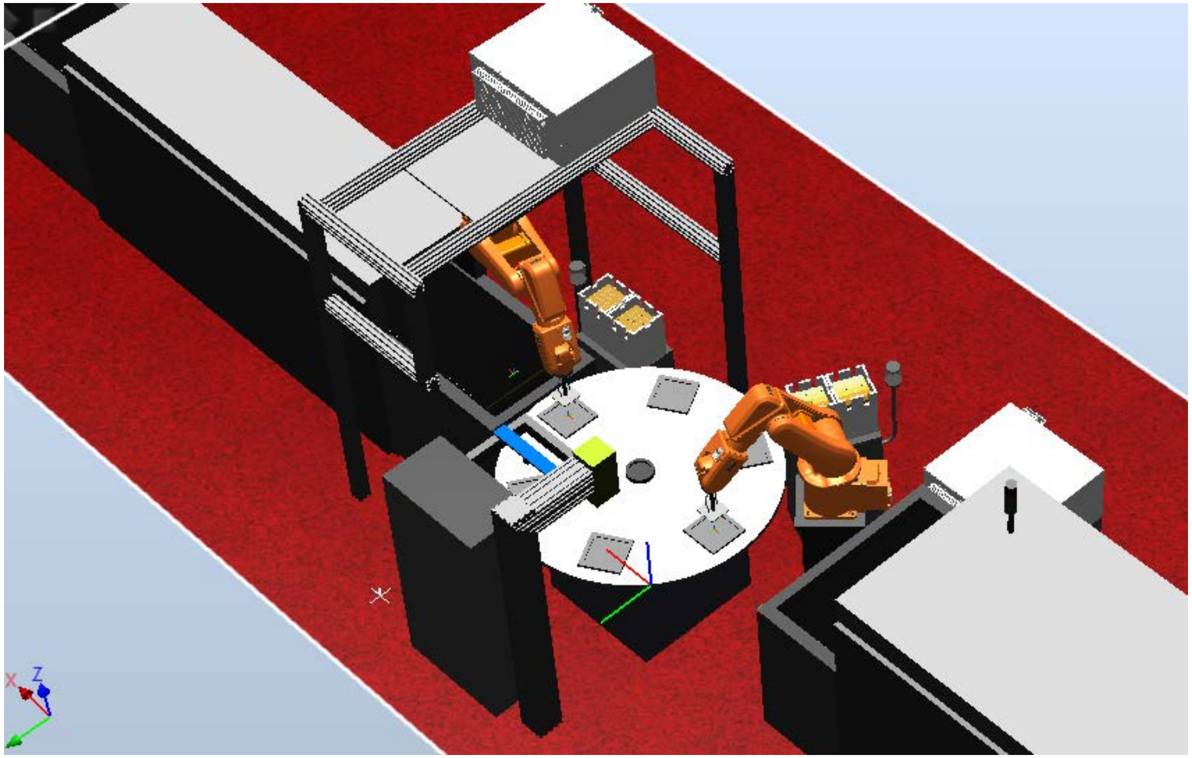
Robotstudio

Offline Visual Programming & Simulation Tool



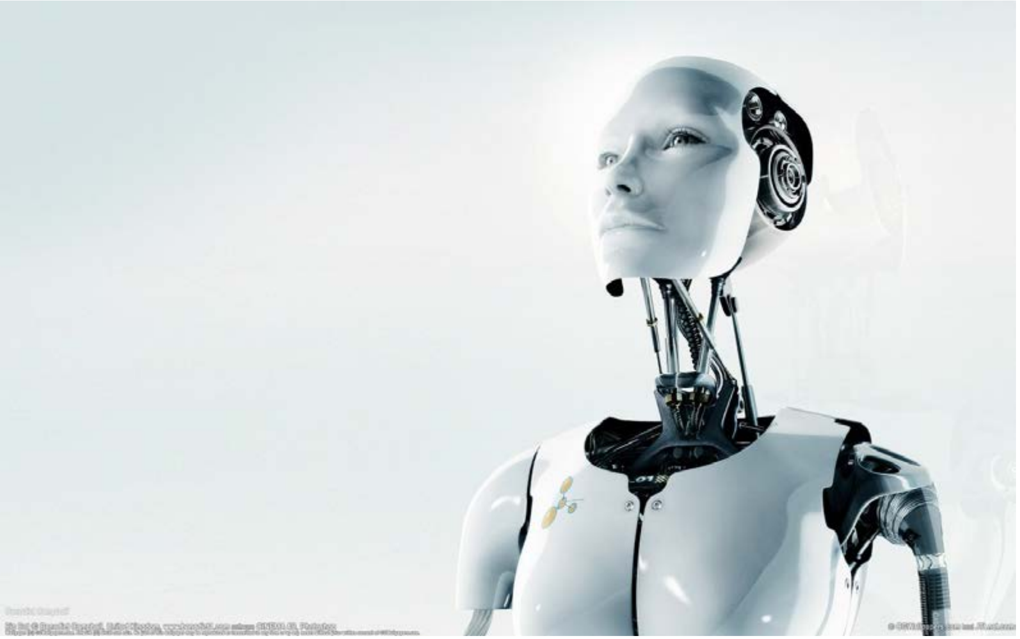
Akbar F. Moghaddam (Shahab)

Norsk Titanium
Components

ROBOTICA OSLOENSIS

- M.Sc. Of Robotics & Intelligent Systems ROBIN, UiO
- Robot Engineer, Norsk Titanium Components
- Chairman, Robotica Osloensis

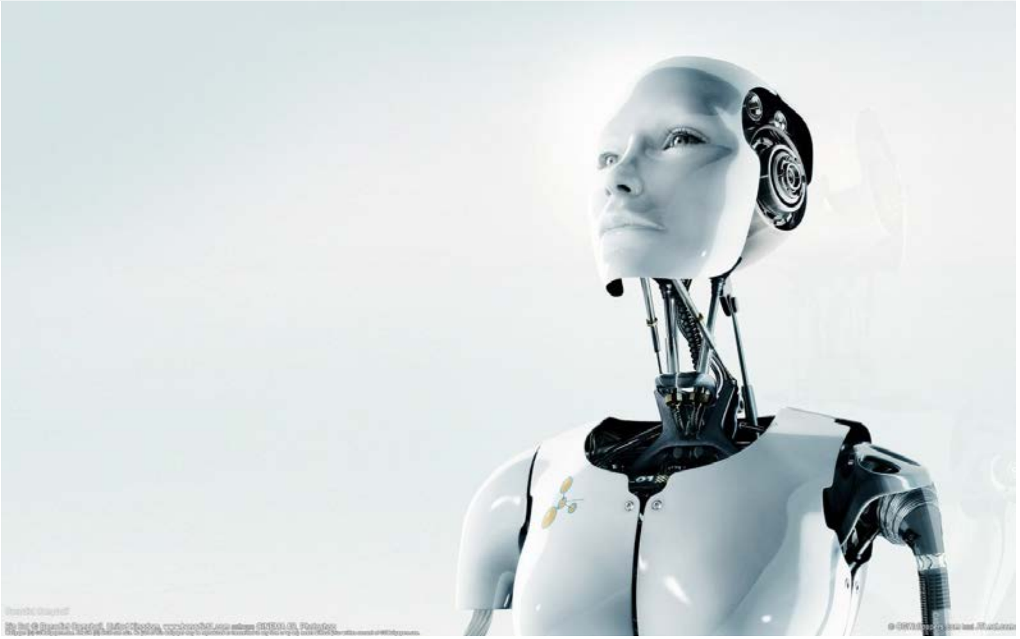
What kind of Robots?



NOT this kind

What kind of Robots?

This kind

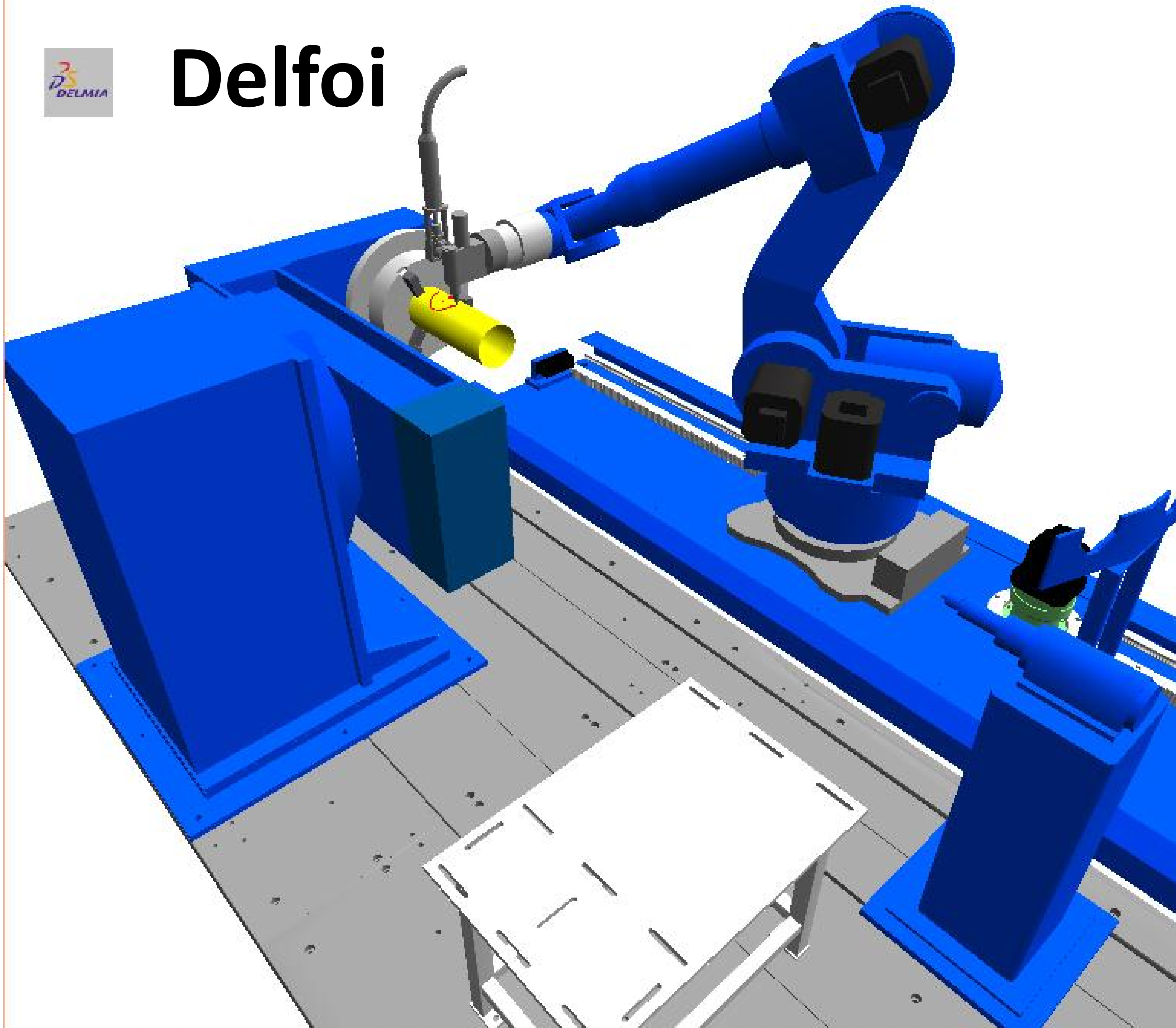


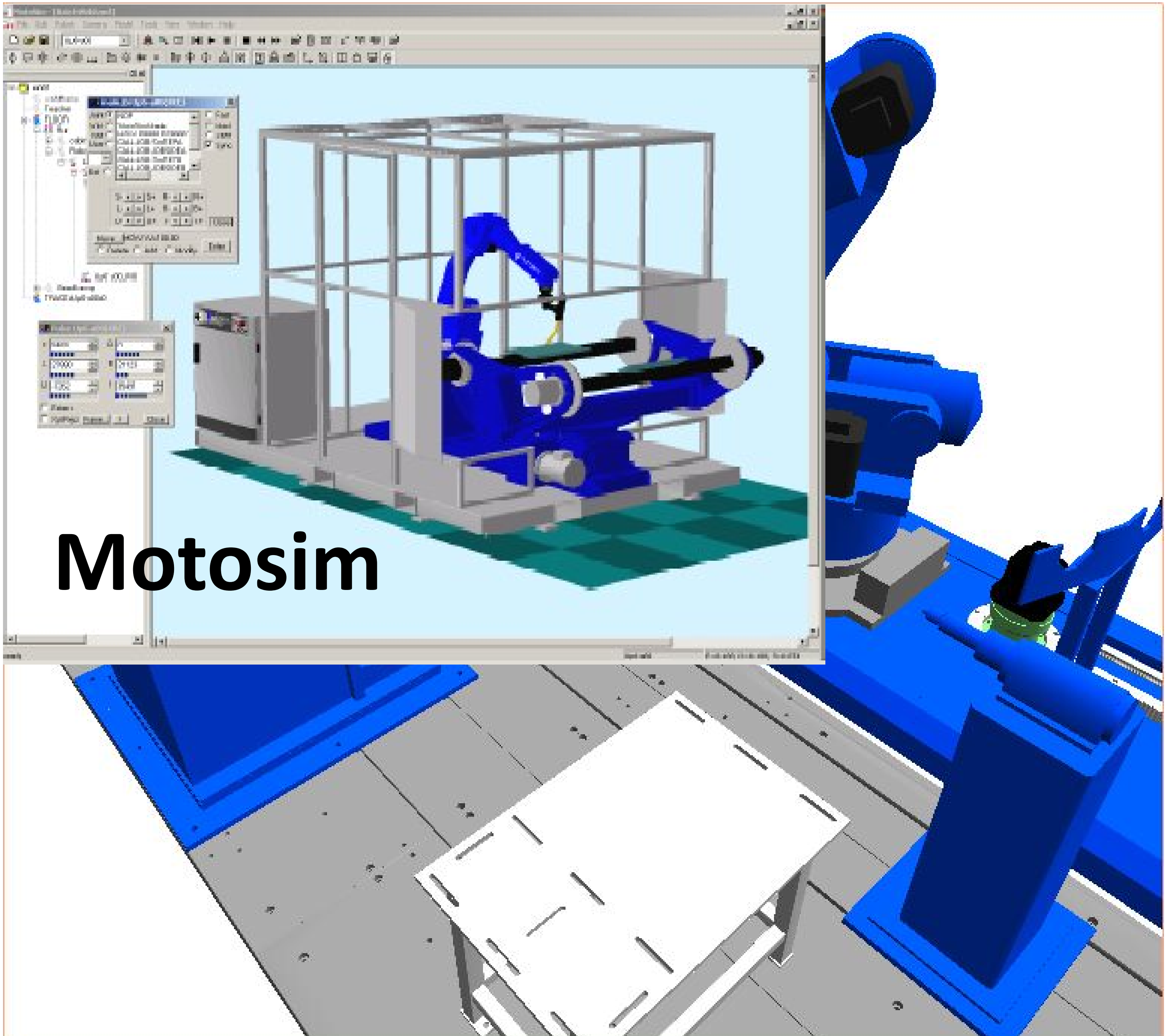
NOT this kind

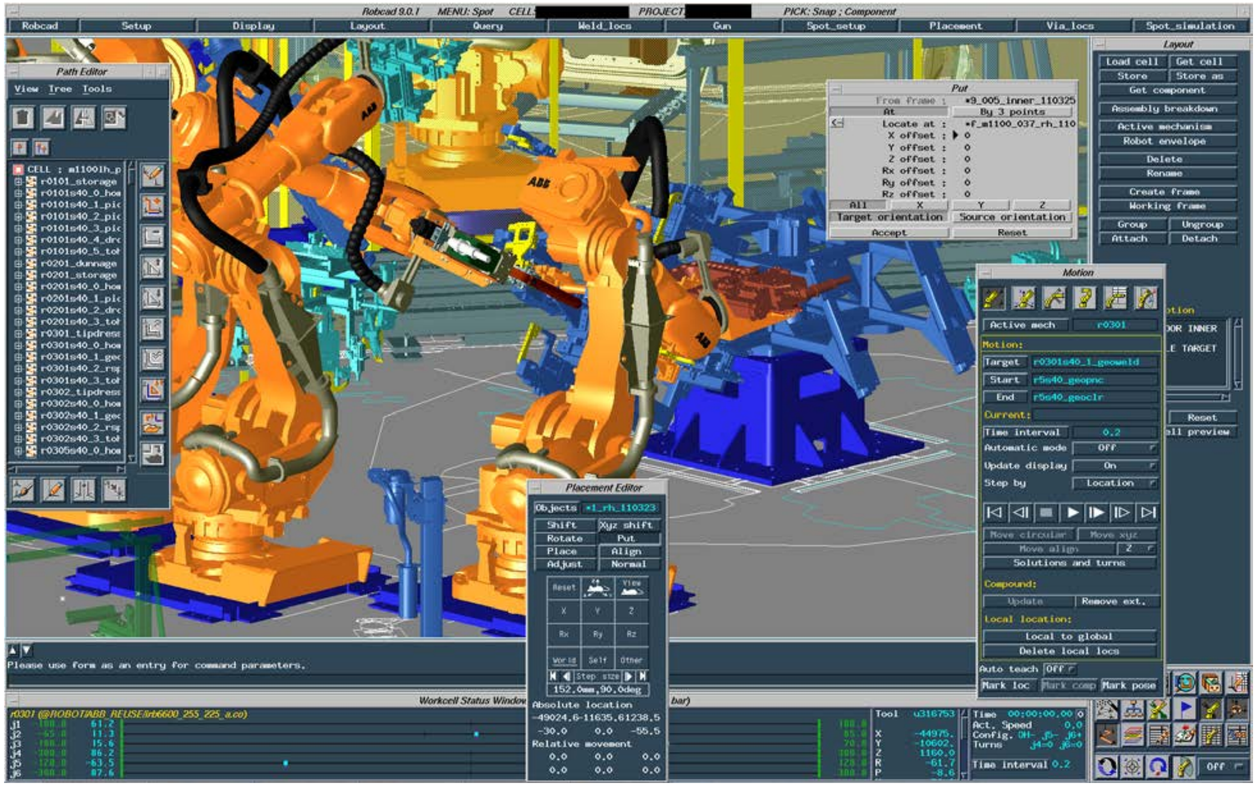

FlexPicker
ABB
ABB
ABB

Off-Line Programming (OLP)
Visual Programming Language (VPL)
Simulation

Delfoi



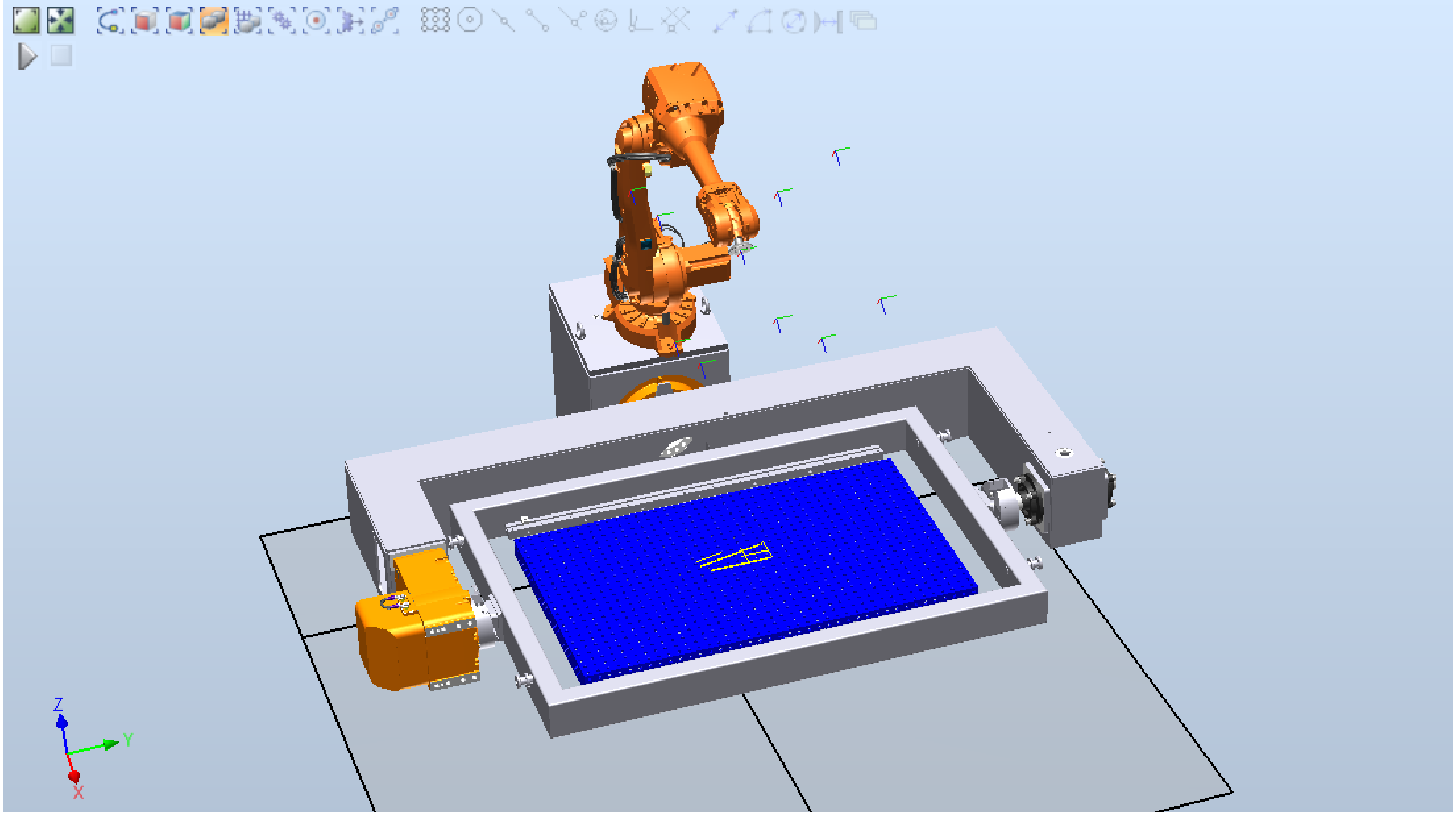

Motosim



Robcad 9.0.1 MENU: Spot CELL: [redacted] PROJECT: [redacted] PICK: Snap ; Component
Robcad
Setup
Display
Layout
Query
Weld_locs
Gun
Spot_setup
Placement
Via_locs
Spot_simulation
Path Editor
Put
Layout
Motion
Placement Editor
Please use form as an entry for command parameters.

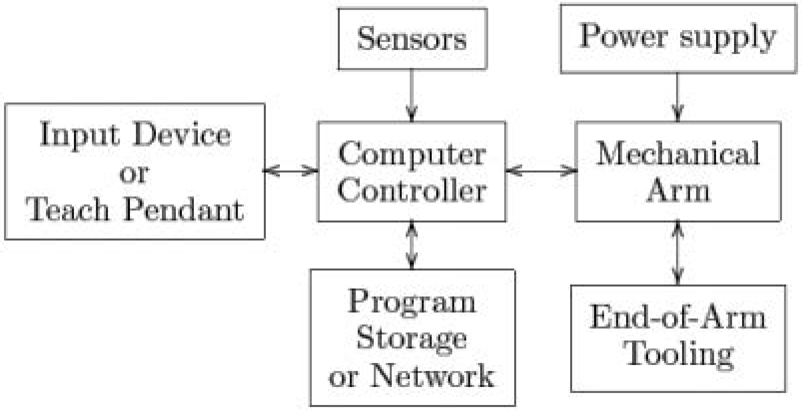
RoboCAD

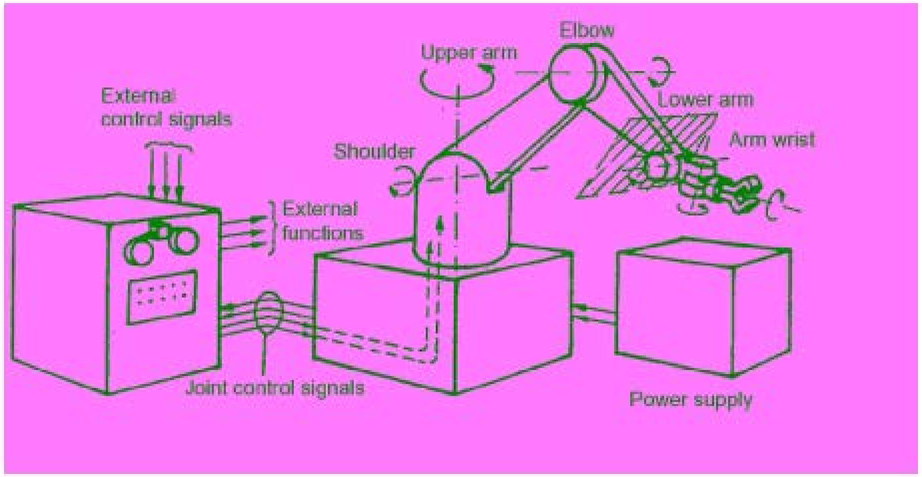
Robotstudio



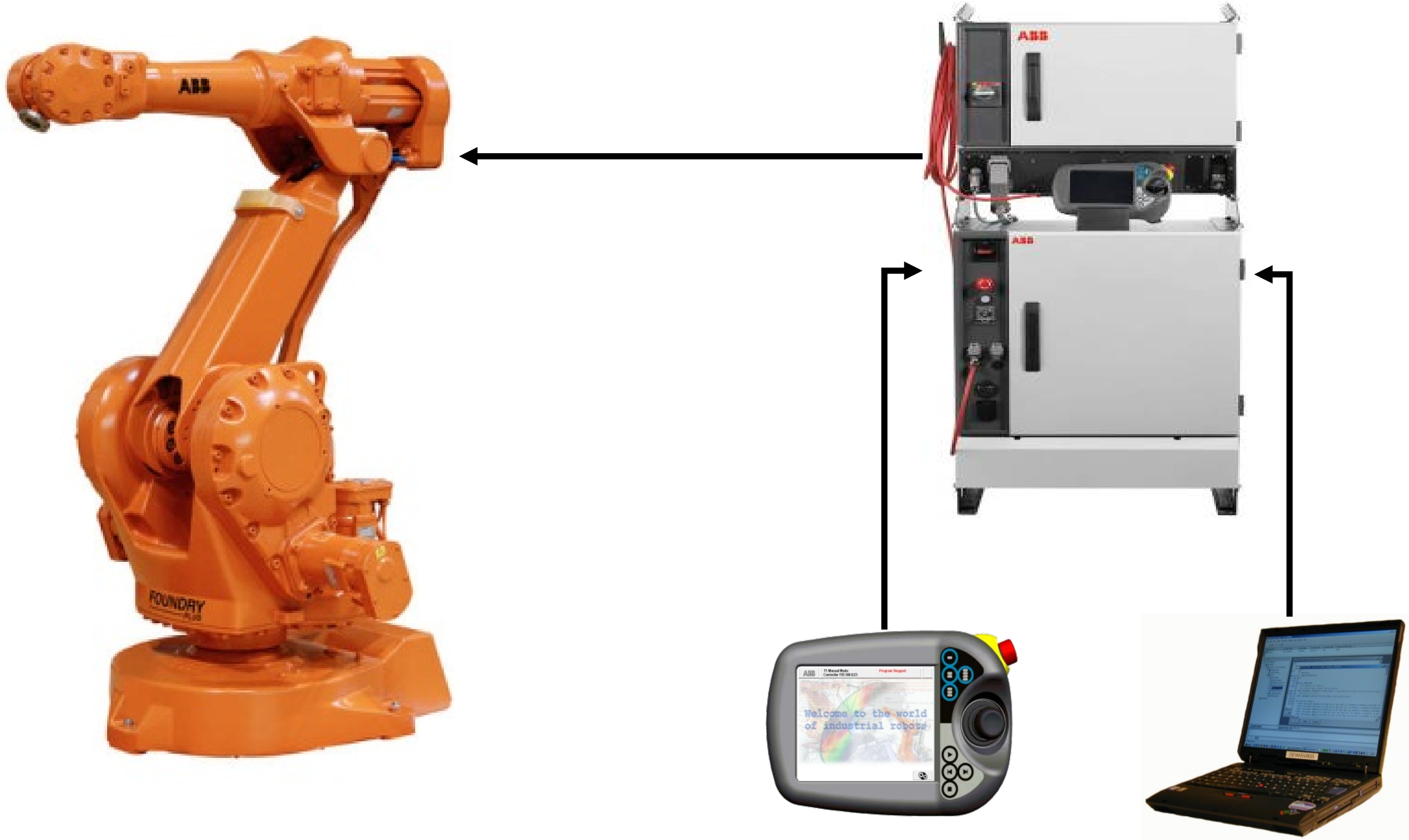
Robotstudio

Industrial Manipulators



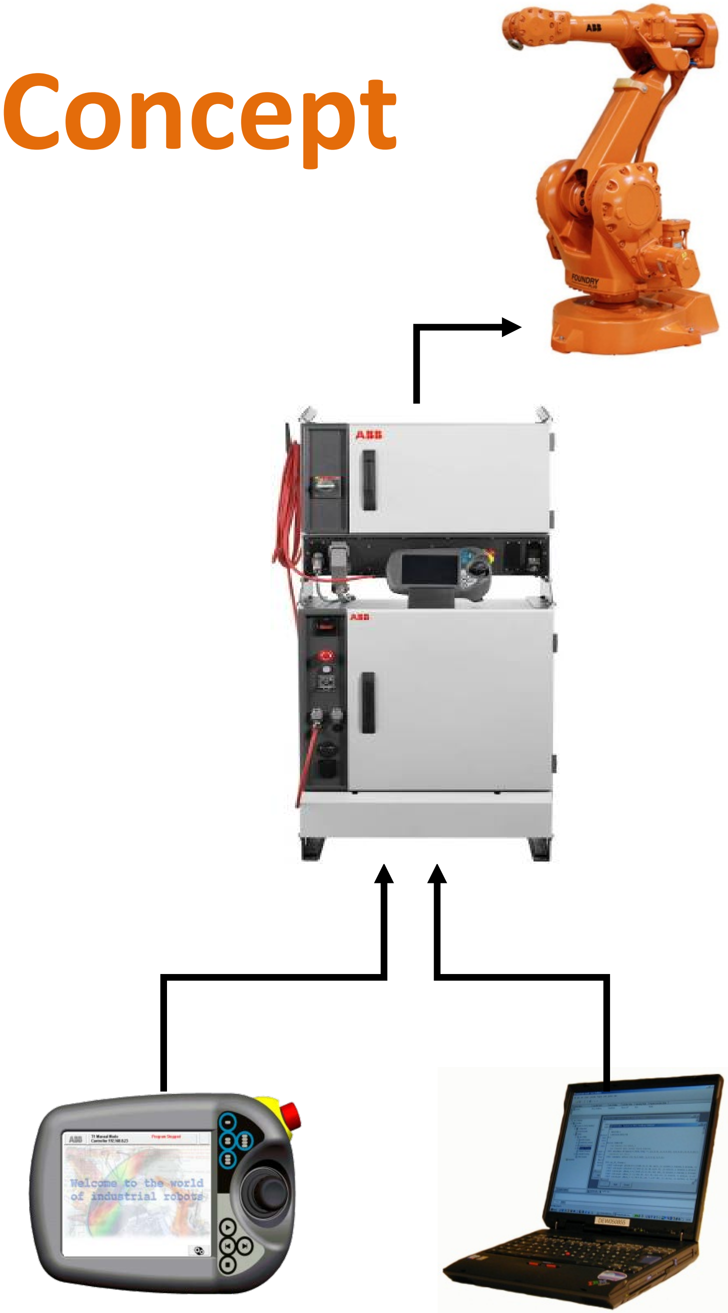


IRC5 Operator Concept



IRC5 Operator Concept

- The FlexPendant and RobotStudio$^{\text{Online}}$ work together
- Same accessibility of data on FlexPendant as on RobotStudio$^{\text{Online}}$
  - Configuration of System Parameters only available through RobotStudio
- Select the most optimal point of entry to perform efficiently
  - Example: Keyboard entry
- Allow for future growth with different pendant concepts
  - Example: Cutting Pendant



Easy to use

- Intel Strong ARM Processor
- Independant Computer
- (load-) indepedant from the main robot control computer
- „Hot-Plug“ option:
  Connect and disconnect the FlexPendant at any time even during production
- OP system Windows CE .NET
- Develop adapted user interfaces in Microsoft Visual Studio .NET
- Swap HMI language without restart including asian characters
- Easy swapping between applications

VirtualRobot™ Technology

- Virtual Robot is the exact copy of ABB controllers in the control cabinets
- All the parameters and configurations are available on the virtual controller and could easily be transfered to the real world robot from the PC.

VirtualRobot™ Technology → True Offline Programming

VirtualRobot™ Technology

- VirtualRobot is an exact copy of the S4 controller
- Robot programs and configuration parameters can easily be transferred between robots and PC

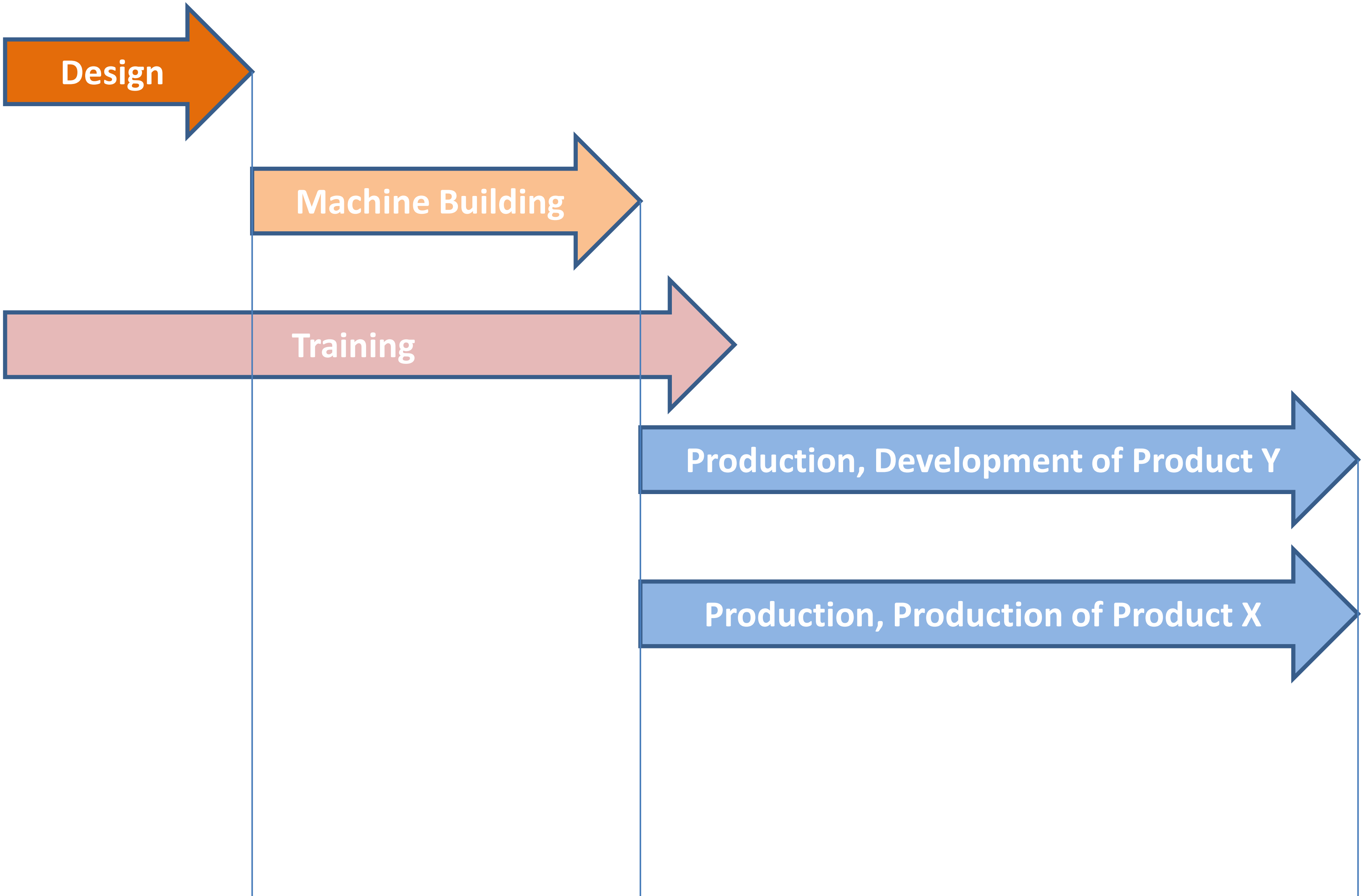
WYSIWYG

VirtualRobot™ Technology ➡ True Offline Programming

Areas of Application

- Machine Design phase (Development)
- Machine building phase (Development)
- Training phase
- Production Phase – Development of product Y
- Production Phase – Production of product X

Areas of Application



Steps in using Robotstudio

Design

↓

Define Path

↓

Generate Program

↓

Simulate Graphically & Verify

↓

Optimize

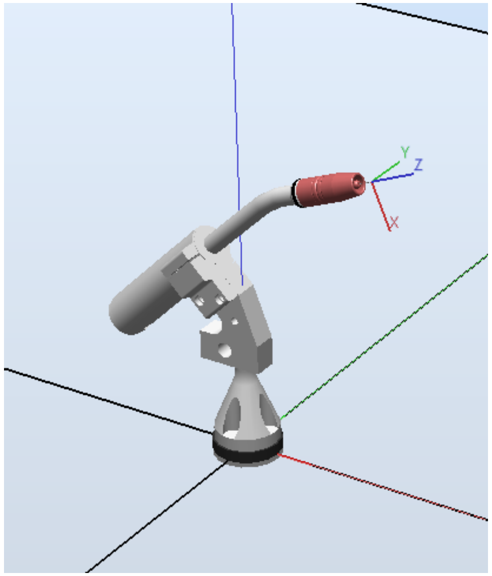
Design Libraries

- Complete library of all ABB robots and manipulators
- Set of standard equipment from ABB
- Ability to design CAD models
- Ability to import CAD designs

Design Libraries

Similarly we have to assemble the tool onto the robot during the design phase

Tool | **Robot** | **Robot with Tool**



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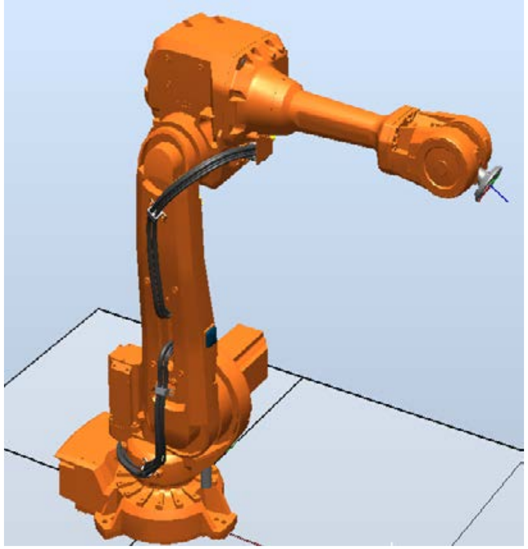

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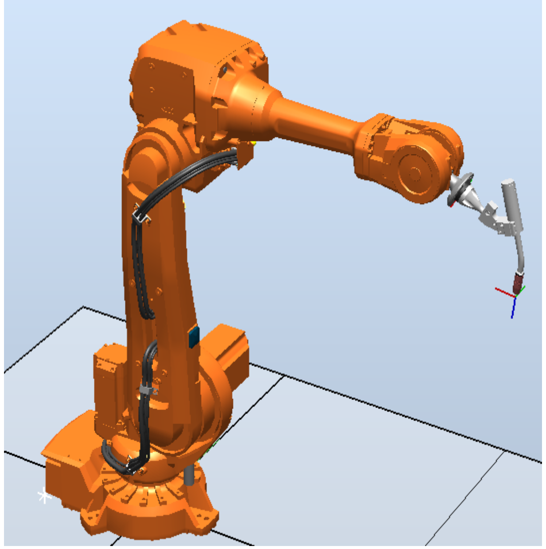


Designing in Robotstudio

Customer defined objects could be :

- Designed in any standard CAD application and import the drawing in RobotStudio.
- RobotStudio contains a built CAD application that could be used to design objects

Improved comprehension

- Build new solutions quickly:
  - Evaluate alternatives
  - Initial feasibility studies
  - Initial cycle-time calculations (production time)
- Visualize solutions:
  - Share a proposed solution with users on all levels
  - Address problem areas at an early stage (workspace issues, etc)
- Include 3D simulations in quotations

Risk reduction

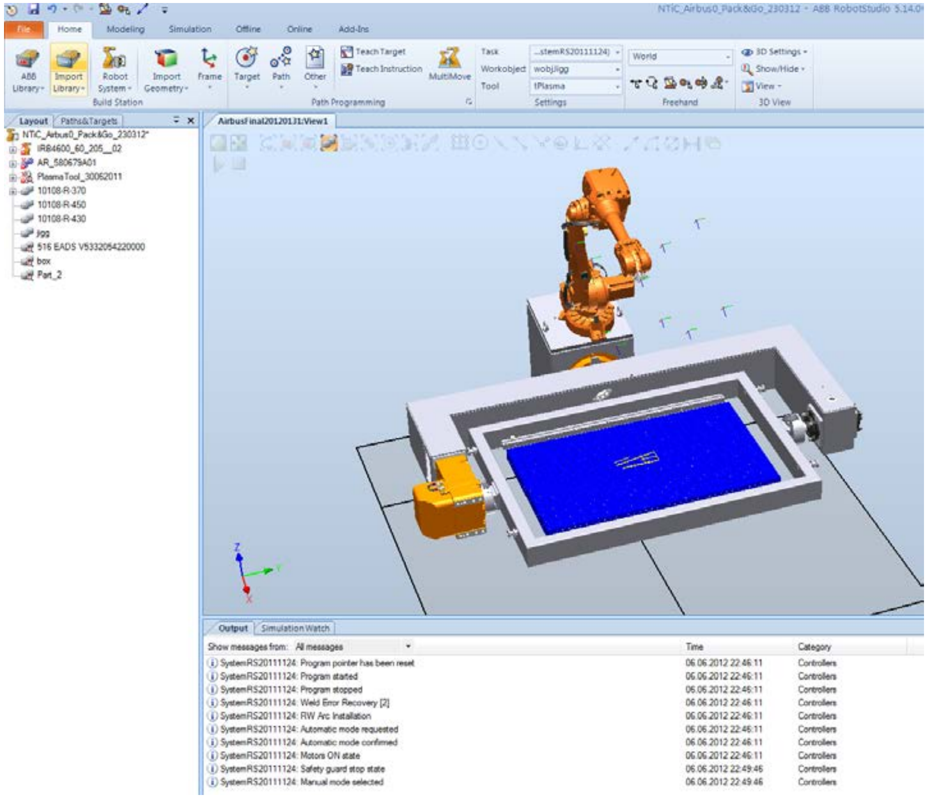
- Verify new designs quickly:
  - Check reachability
  - Avoid collisions
  - Detect singularity issues
- Secure project feasibility and success

Industrial IT

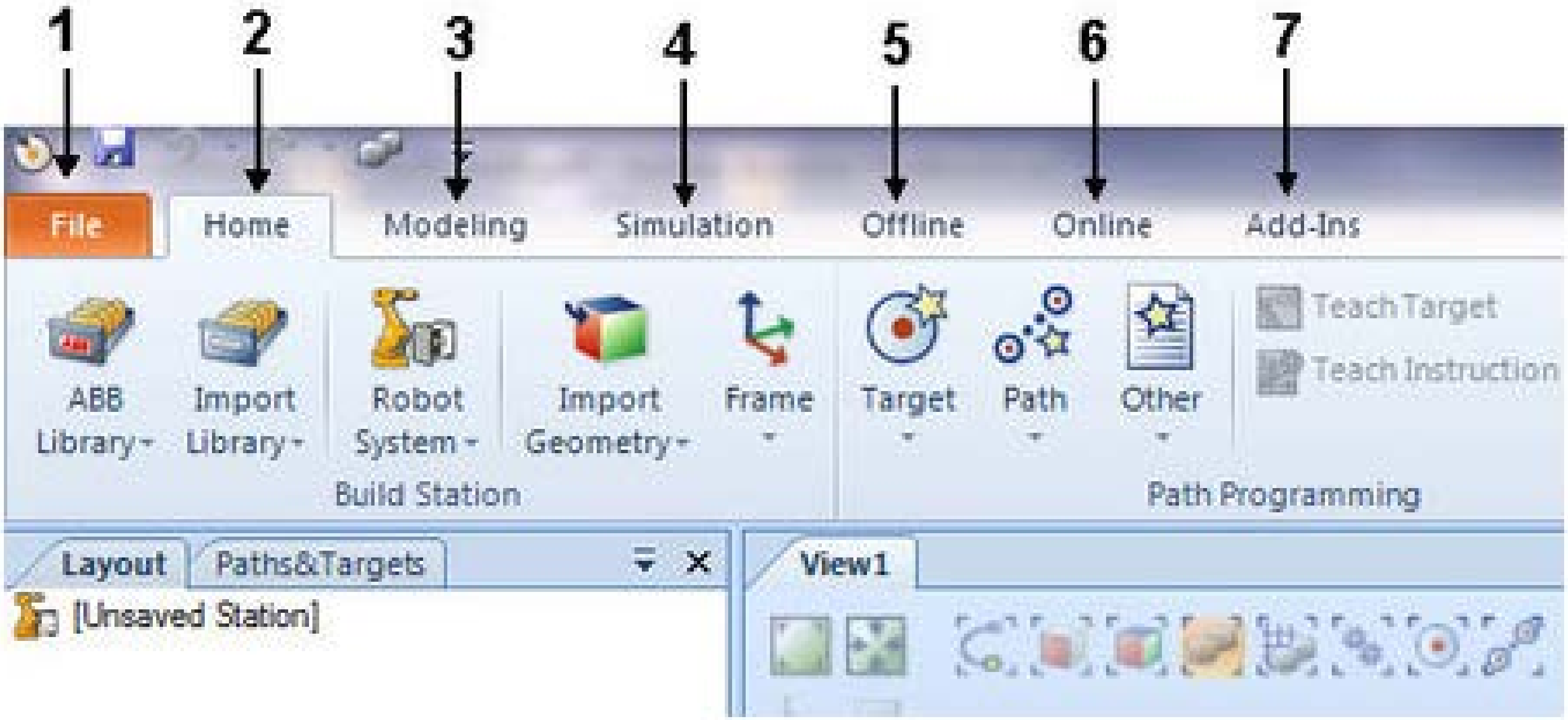
Industrial IT
...the *Next* Way of Thinking

Robotstudio

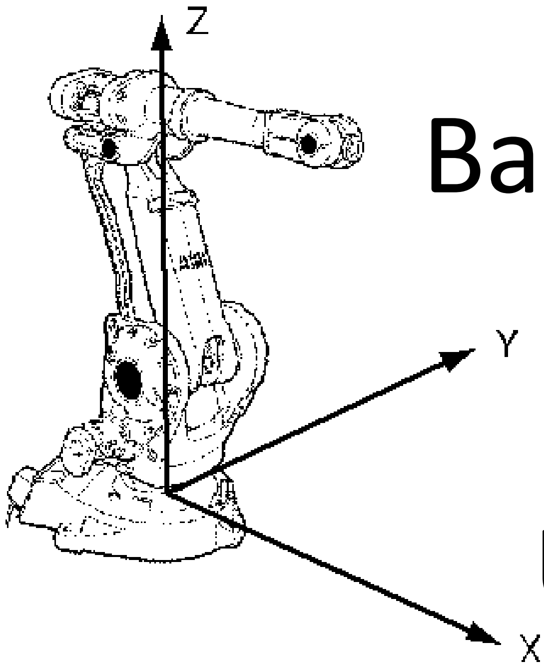
part 2



Graphic User Interface

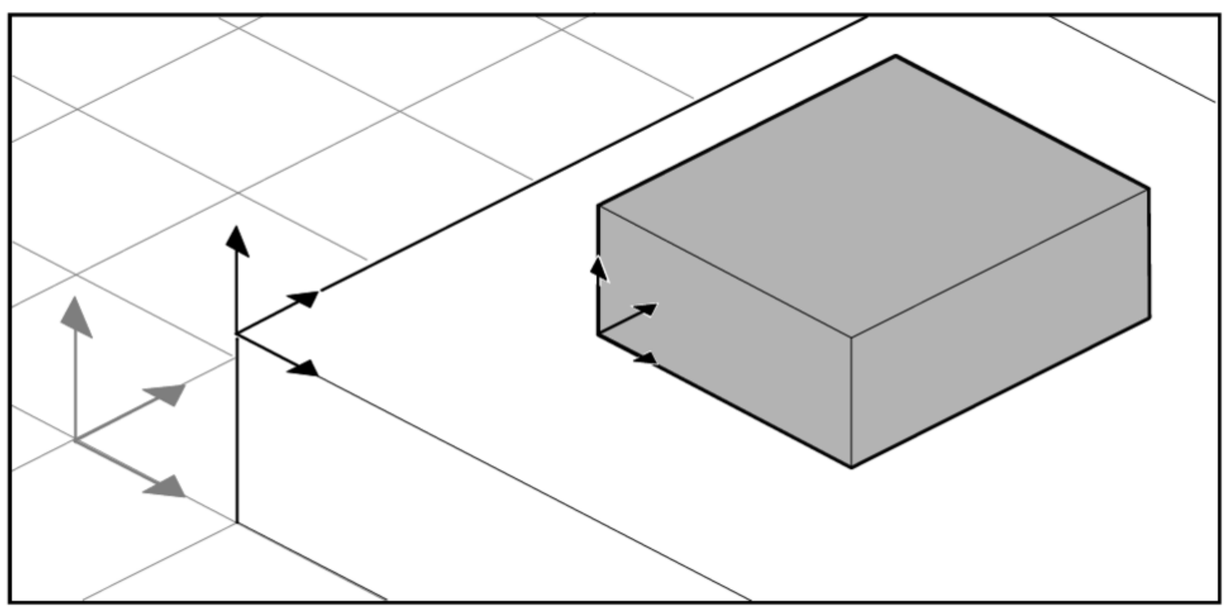


Flexpendant

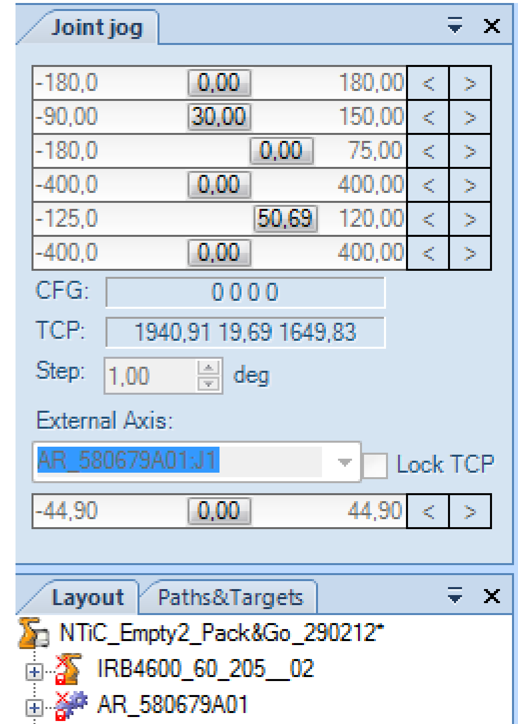


Base Coordinate System

UCS & Workobjects



Joint angles / Joint Jog



Three coordinate frames: (0) (1) (2)

Positions:

$$\begin{bmatrix} x_1 \\ y_1 \end{bmatrix} = \begin{bmatrix} a_1\cos(\theta_1) \\ a_1\sin(\theta_1) \end{bmatrix}$$

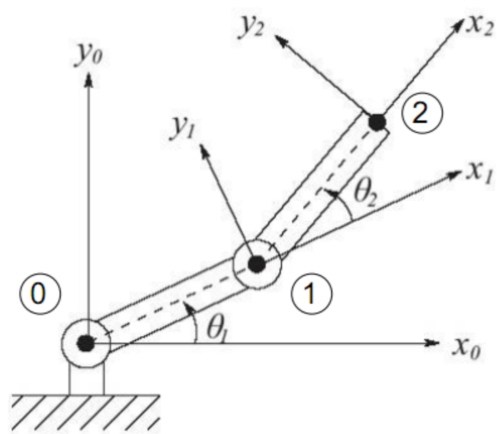
$$\begin{bmatrix} x_2 \\ y_2 \end{bmatrix} = \begin{bmatrix} a_1\cos(\theta_1)+a_2\cos(\theta_1+\theta_2) \\ a_1\sin(\theta_1)+a_2\sin(\theta_1+\theta_2) \end{bmatrix} \equiv \begin{bmatrix} x \\ y \end{bmatrix}_t$$

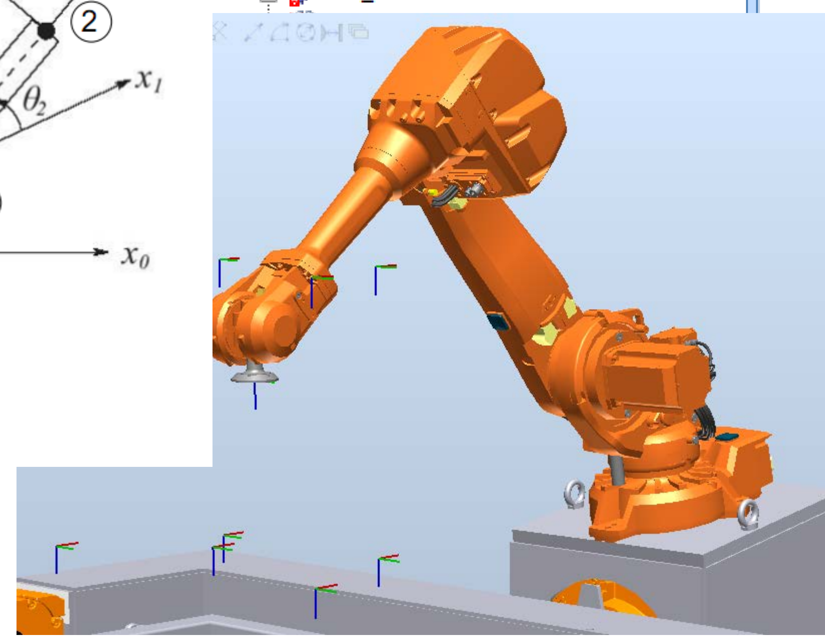
$$\hat{x}_0 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}, \hat{y}_0 = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

Orientation of the tool frame:

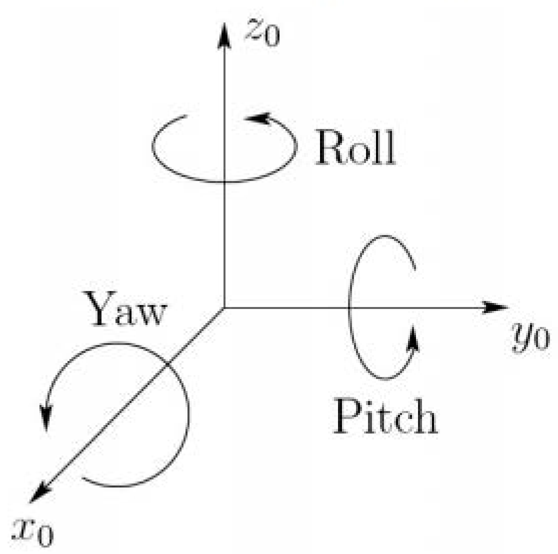
$$\hat{x}_2 = \begin{bmatrix} \cos(\theta_1+\theta_2) \\ \sin(\theta_1+\theta_2) \end{bmatrix}, \hat{y}_2 = \begin{bmatrix} -\sin(\theta_1+\theta_2) \\ \cos(\theta_1+\theta_2) \end{bmatrix}$$

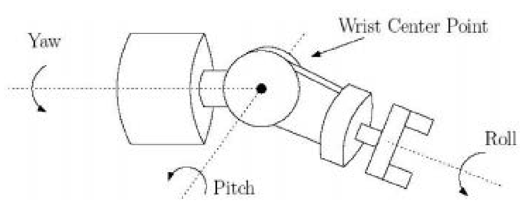
$$R_2^0 = \begin{bmatrix} \hat{x}_2\cdot\hat{x}_0 & \hat{y}_2\cdot\hat{x}_0 \\ \hat{x}_2\cdot\hat{y}_0 & \hat{y}_2\cdot\hat{y}_0 \end{bmatrix} = \begin{bmatrix} \cos(\theta_1+\theta_2) & -\sin(\theta_1+\theta_2) \\ \sin(\theta_1+\theta_2) & \cos(\theta_1+\theta_2) \end{bmatrix}$$

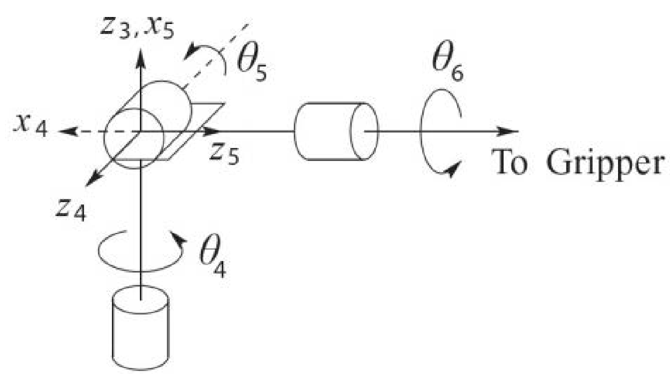


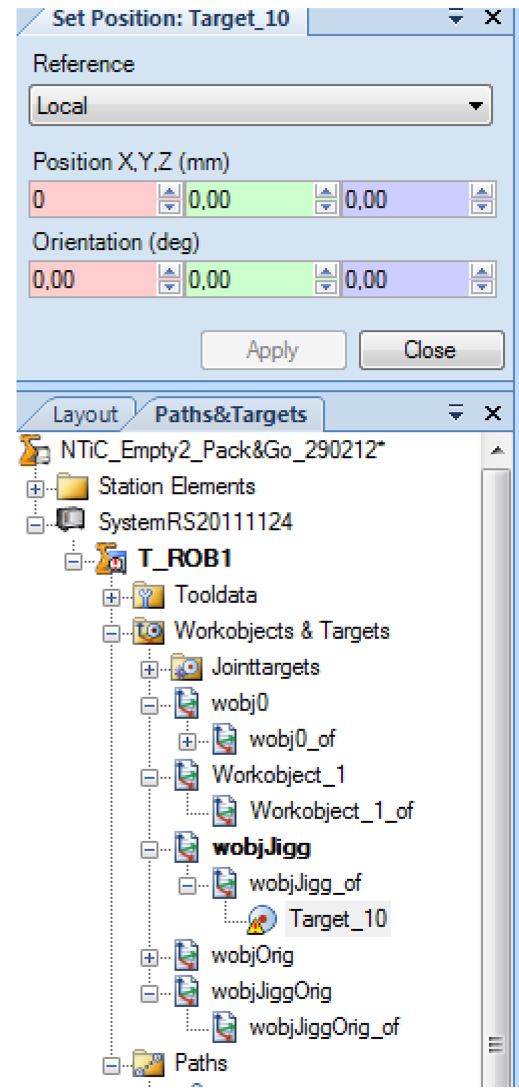


Euler angles
Rx,Ry,Rz

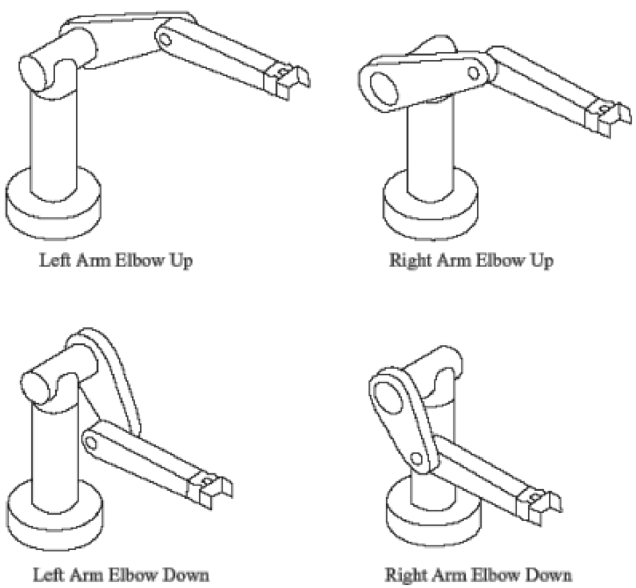


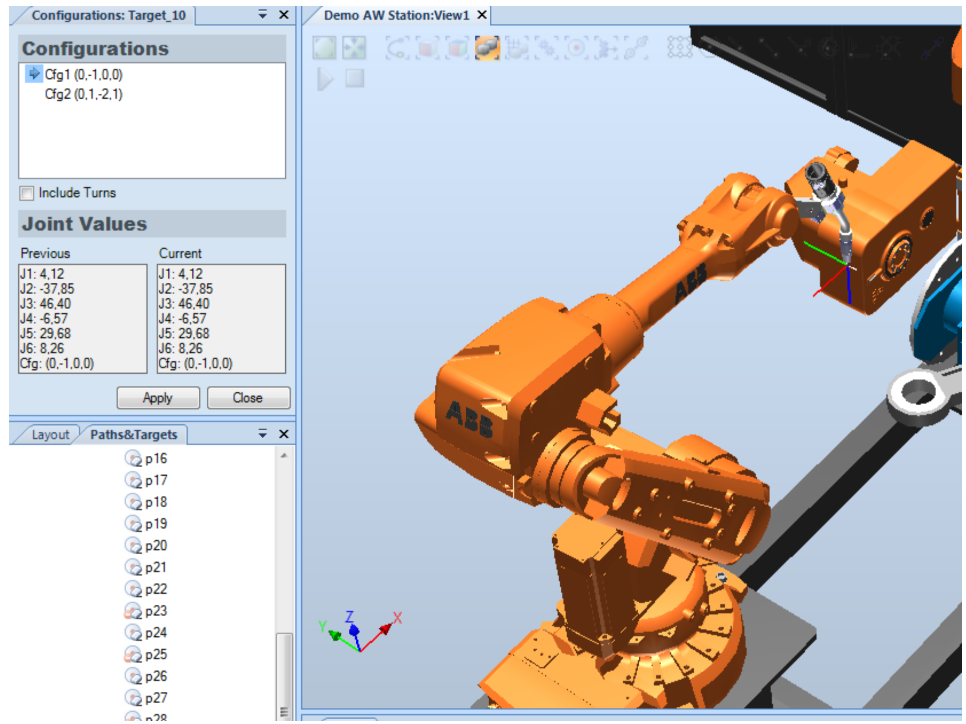




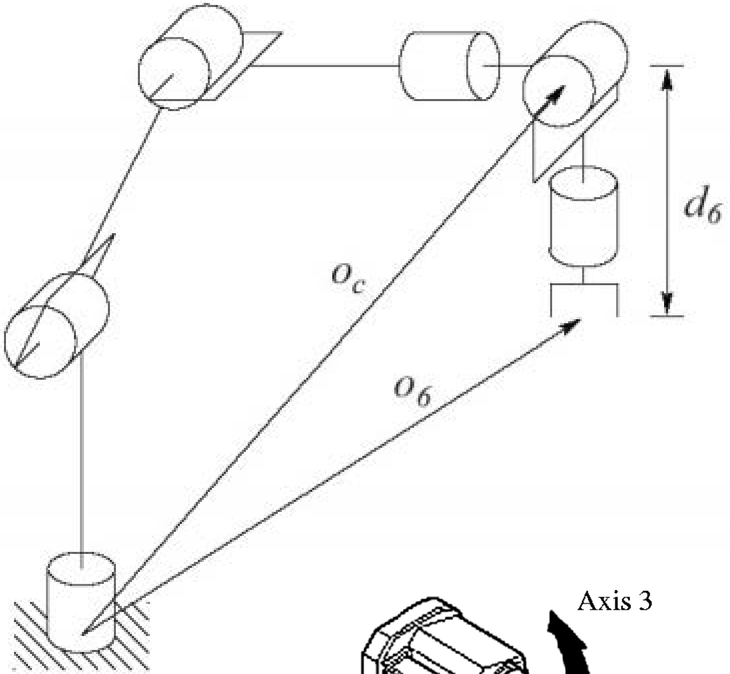


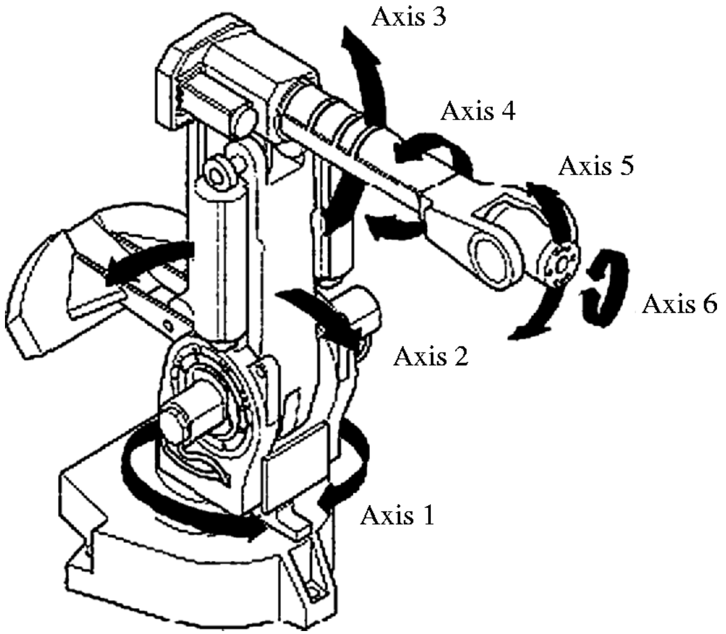
Arm Configurations

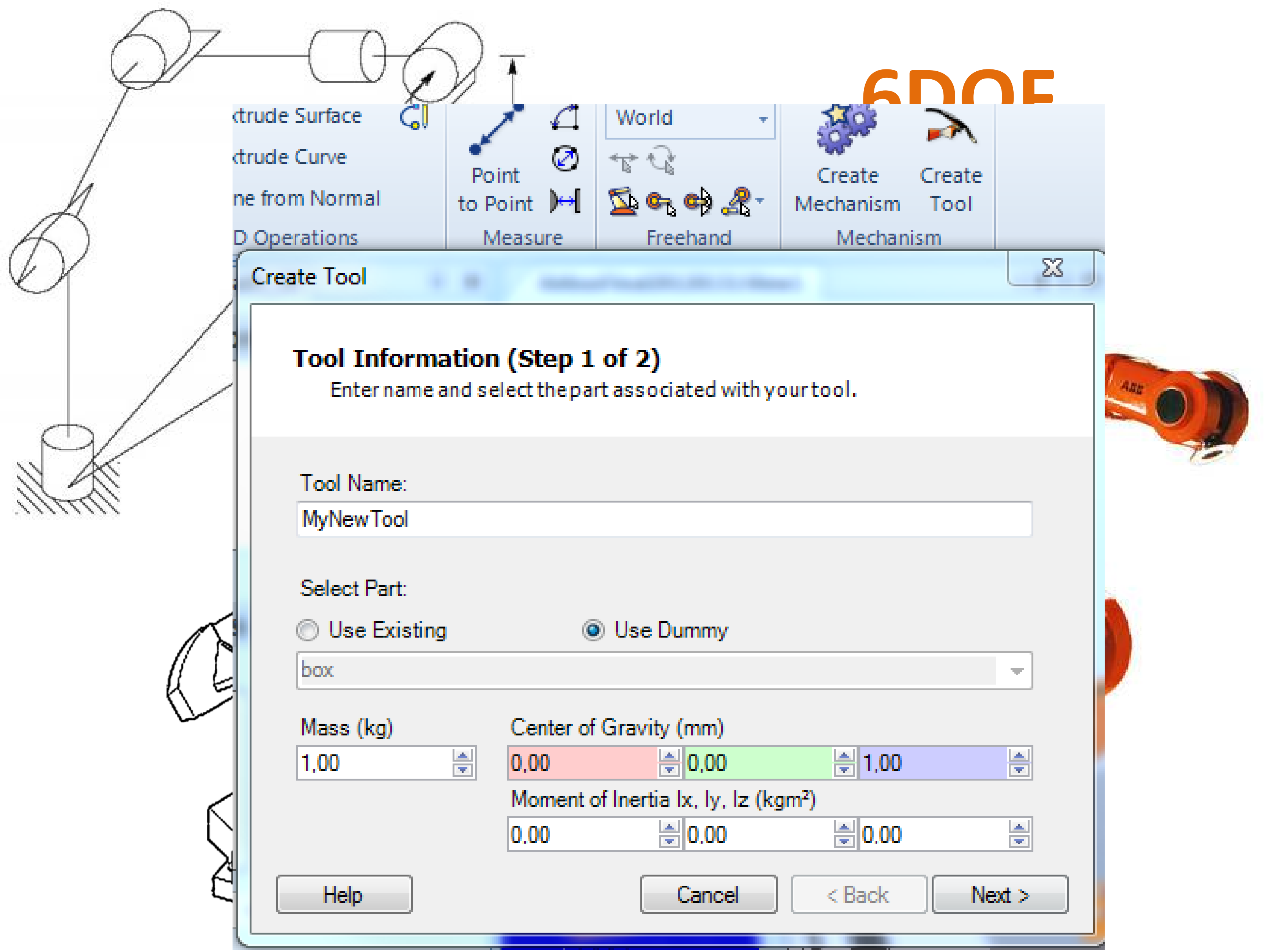




6DOF

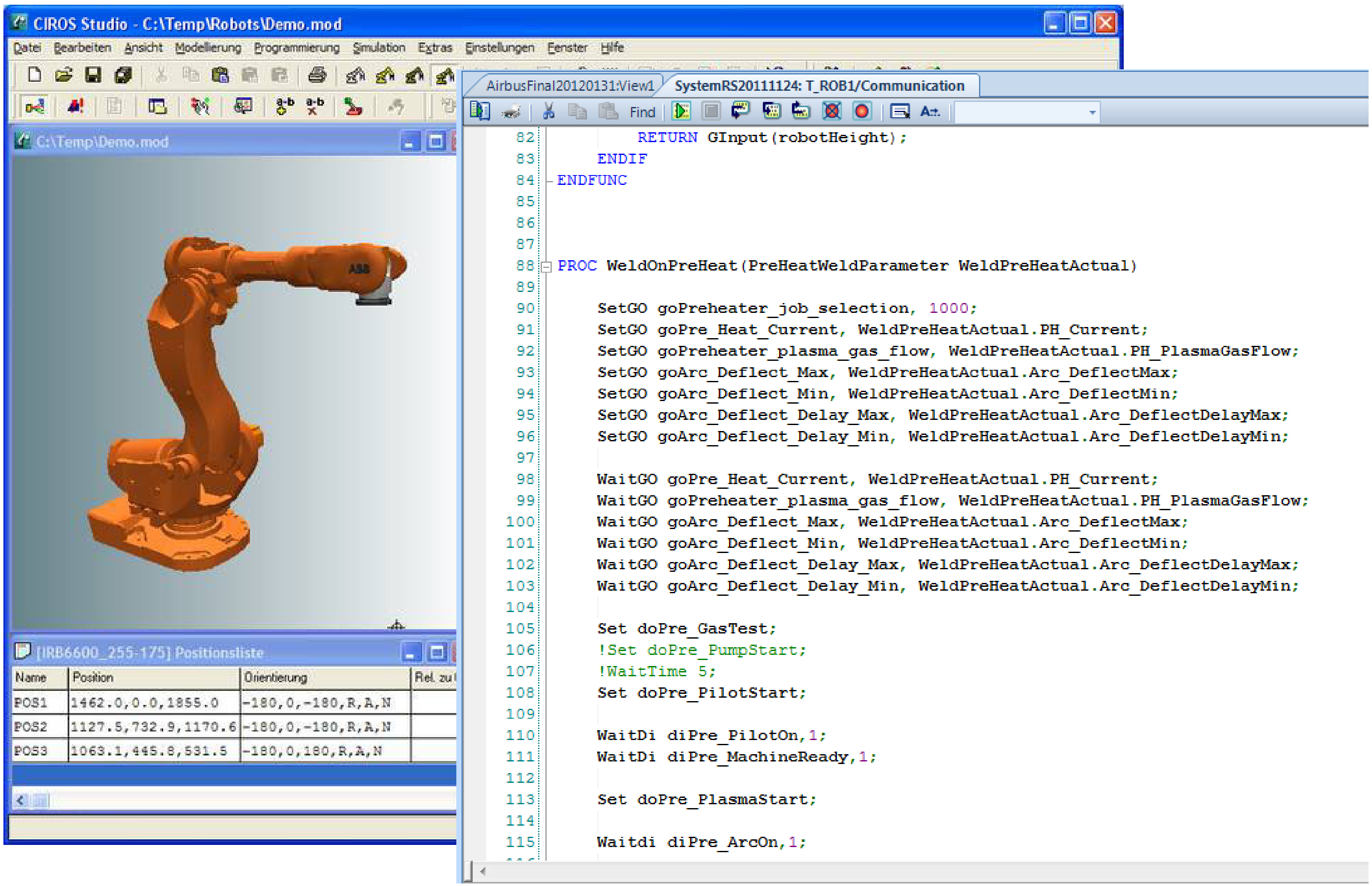





xtrude Surface
xtrude Curve
ne from Normal
D Operations
Point
to Point
Measure
World
Freehand
Create
Mechanism
Create
Tool
Mechanism
Create Tool
Tool Information (Step 1 of 2)
Enter name and select the part associated with your tool.
Tool Name:
MyNewTool
Select Part:
Use Existing
Use Dummy
box
Mass (kg)
1,00
Center of Gravity (mm)
0,00
0,00
1,00
Moment of Inertia Ix, Iy, Iz (kgm²)
0,00
0,00
0,00
Help
Cancel
< Back
Next >

RAPID Programming Language

Part 3



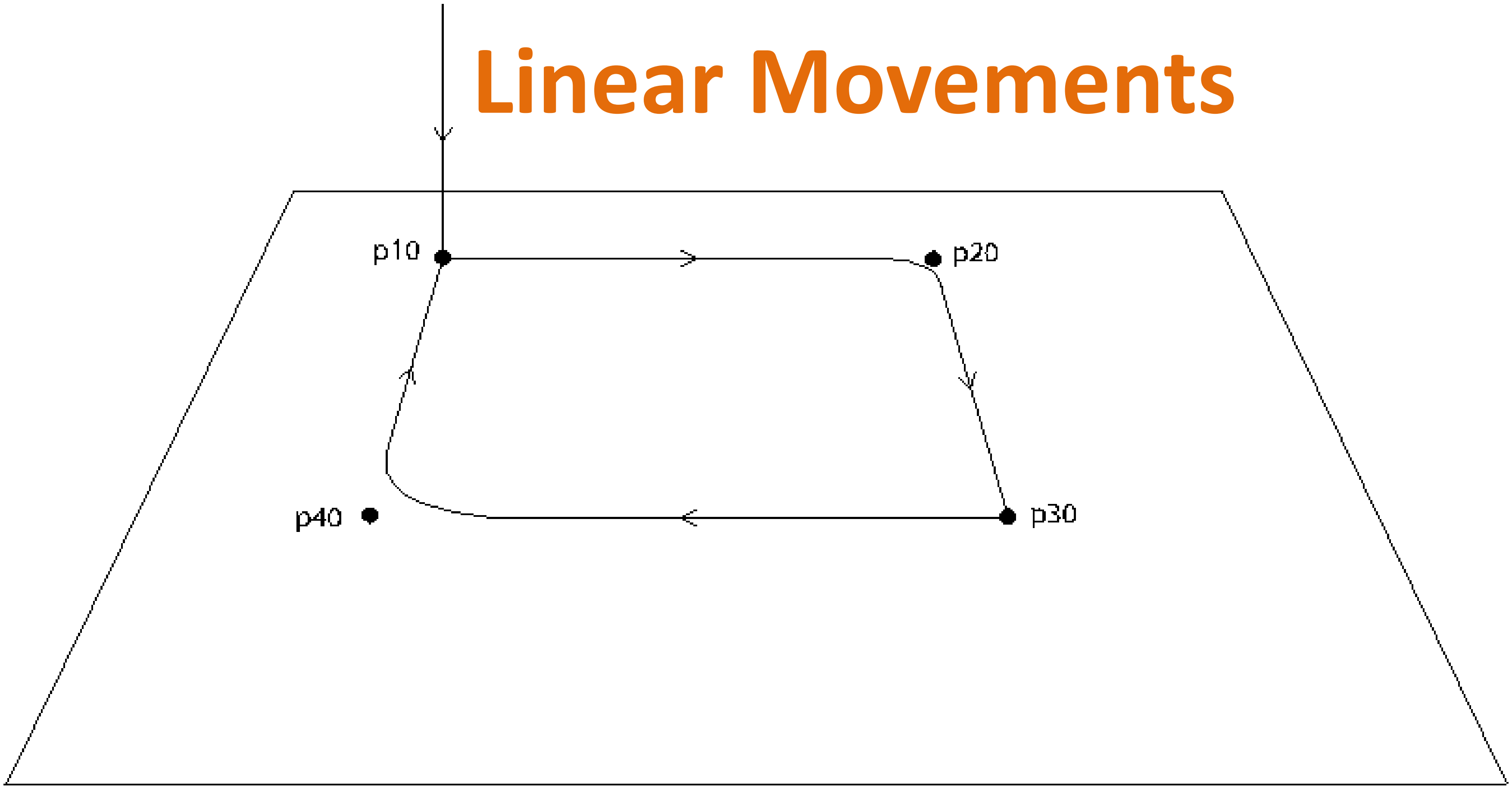
RAPID

High-level programming language

Features in the language include:

- Routine parameters:
  - Procedures
  - Functions
  - Routines - a means of responding to interrupts.
- Arithmetic and logical expressions
- Automatic error handling
- Modular programs
- Multi tasking

Linear Movements

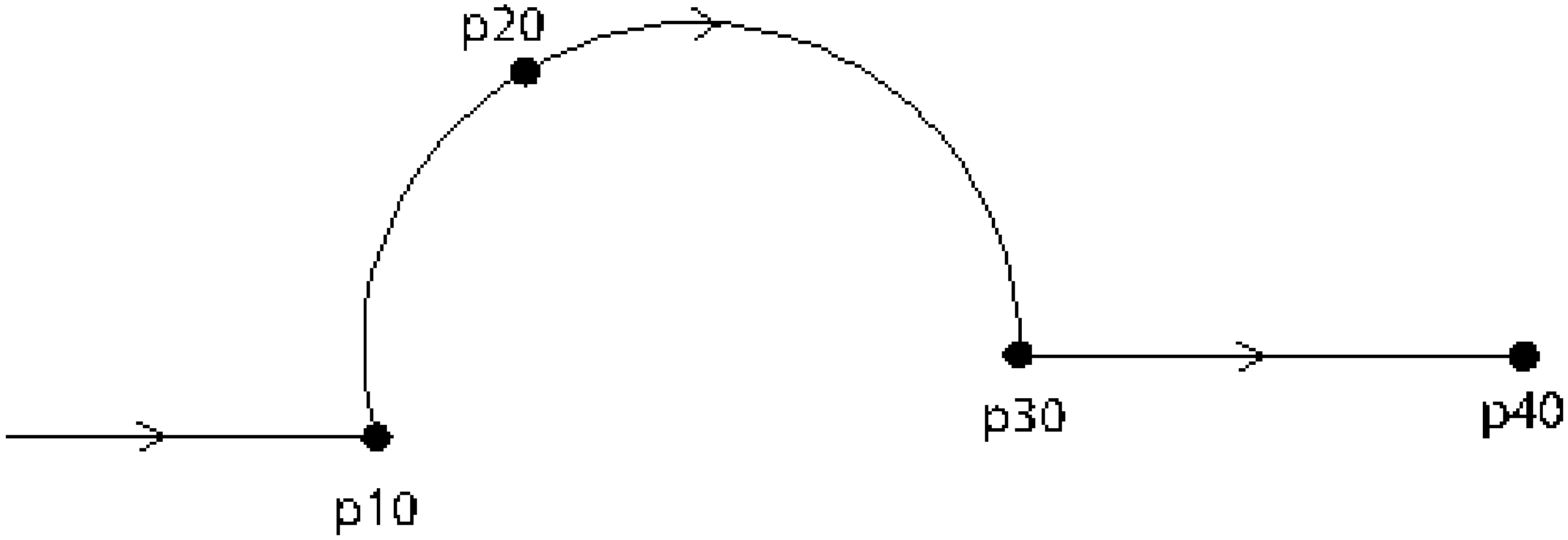



```
VAR tooldata tPen := ...
...
VAR robtarget p40 := ...
PROC main()
   MoveL p10, v200, fine, tPen;
   MoveL p20, v200, z20, tPen;
   MoveL p30, v200, fine, tPen;
   MoveL p40, v200, z50, tPen;
   MoveL p10, v200, fine, tPen;
ENDPROC
```

Non Linear Movements

Example

```
MoveL p10, v500, fine, tPen;
MoveC p20, p30, v500, fine, tPen;
MoveL p40, v500, fine, tPen;
```



PC SDK

The PC SDK (Software Development Kit) enables IRC5 customers to operate one or many robot controllers from a tailored application on a PC (MS .Net).

PC SDK is bundled with RobotStudio and is free.