

Tutorial on Using ITRI Robot Arm

2018/11/19

Outline

- Equipment
 - Arm
 - Gripper
 - Pump
 - Valve
- Rules
- Software
- Assignment 4

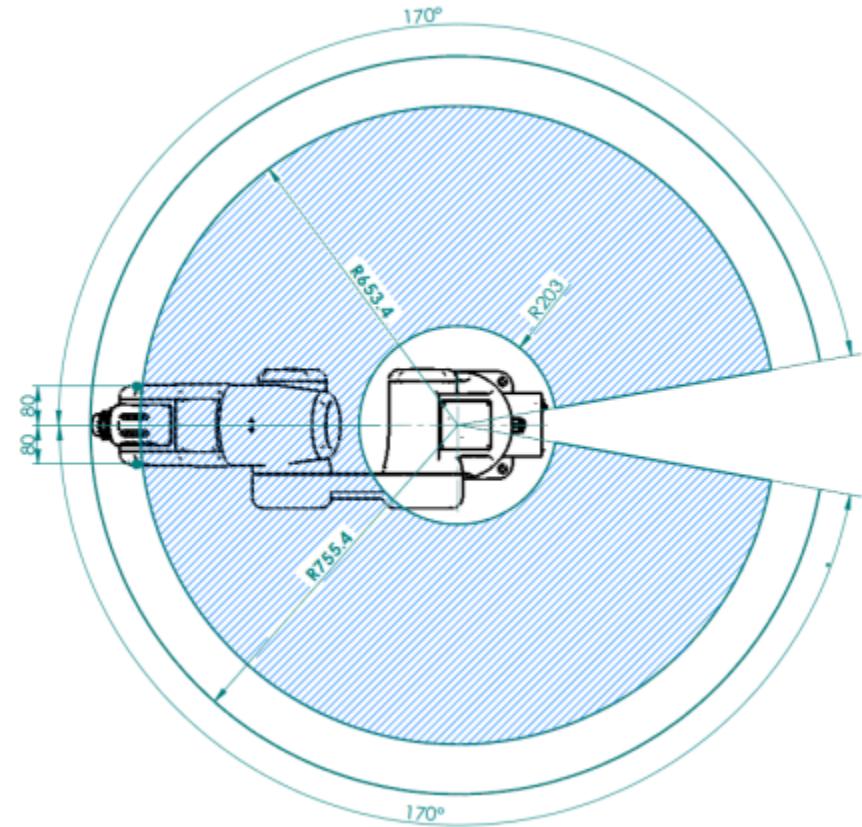
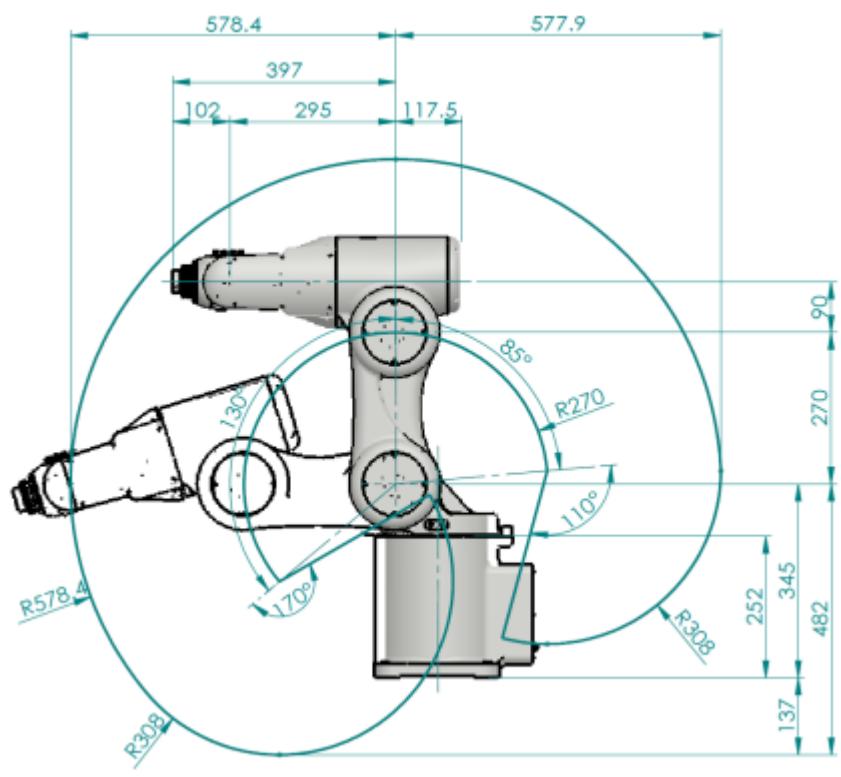
Arm

- Robot Arm
 - 6 DOF
 - Payload: 7 kg
 - Weight: 43 kg
 - AC Servo Motors



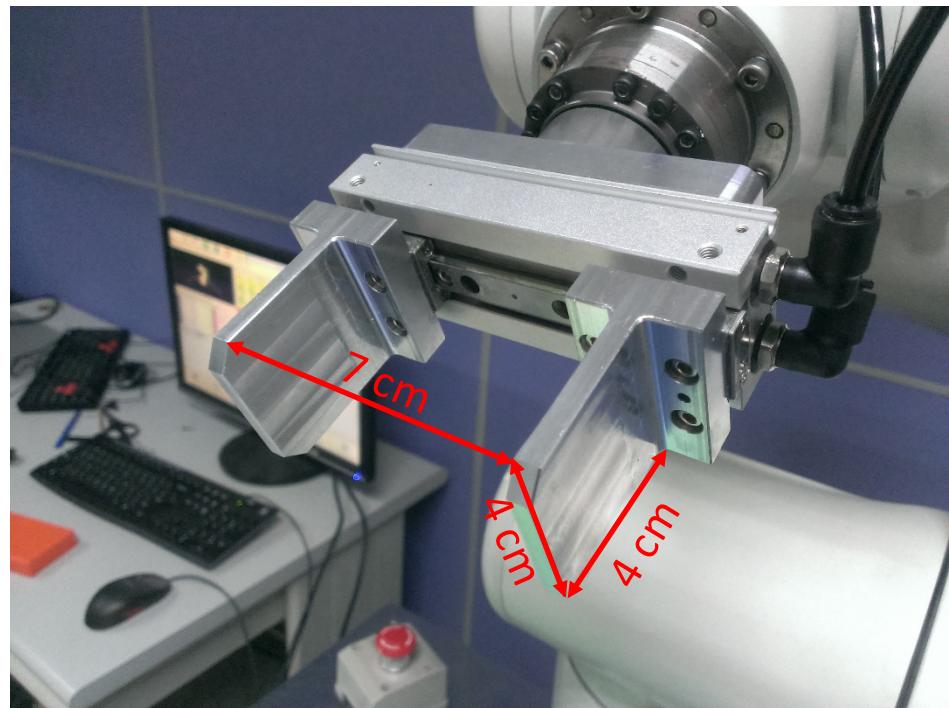
Arm

- Workspace
 - More details will be provided in assignment 4 file.



Gripper

- Gripper
 - Mounted on the joint 6 of the robot arm.
 - Spec: 7 cm * 4cm * 4cm
 - 2-finger parallel gripper
 - Pneumatic
 - Only open and close
 - Be careful when you grasp something fragile.



Air Pump

- Air pump
 - Plug it when you want to use the gripper.
 - It will automatically pump the air when the pressure is low.
 - Be sure to unplug it every time you finish using it.
 - Do not touch anything on the pump.

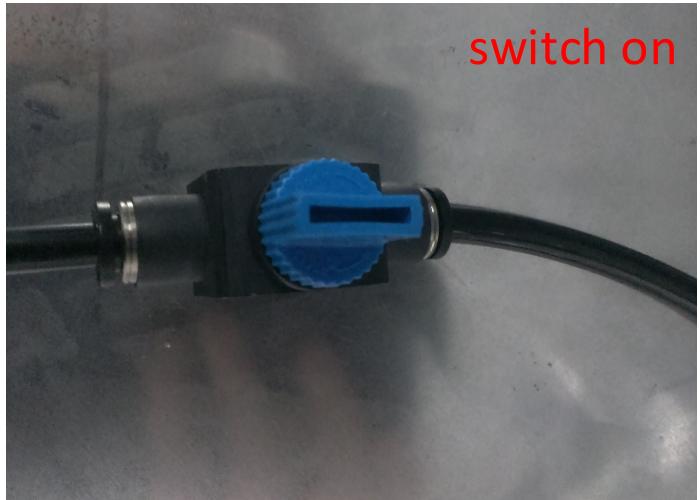


Air Valve

- Air valve
 - Connection between the pump and the arm.
 - Switch it on when you want to use the gripper.
 - **Switch it off when you don't need to use the gripper temporarily, and every time you leave the room.**



switch off



switch on

Rules

- For your own safety and everyone's convenience,
please follow the rules:
 - Never enter the workspace when the arm is operating.
 - Keep the emergency button handy.
 - Do not operate the arm alone.
 - If you want to increase the arm speed, do it gradually.
 - If you break the arm, be sure to tell us. Otherwise, you will be punished, HARD.
 - Don't be too loud, there is a lab next to the room.
 - If there is any question, contact us first. (Lab phone number: 02-33669885)

Rules

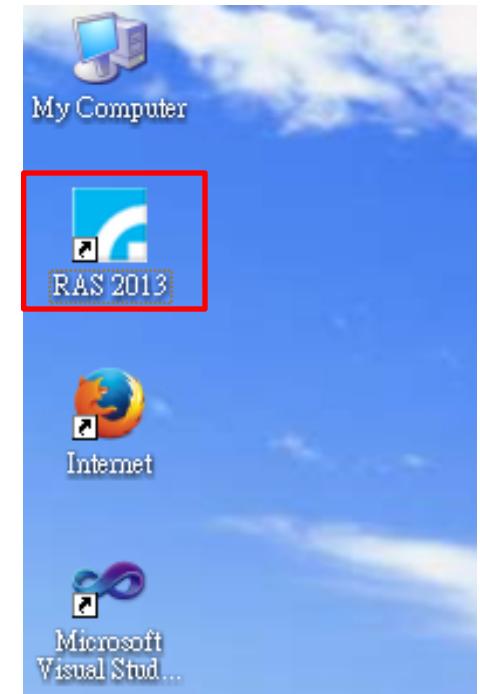
- Check these items before you leave the room.
 - Move the arm back to the home position.
 - Close the software and back to the desktop. (You don't need to shut down the computer.)
 - Switch off the valve and unplug the pump.
 - Take your personal belongings and do not leave any garbage.
 - Close the door.

Software

- Provided by the manufacturer to control or communicate with the arm.
- The software and manual are in Chinese.
 - We translated some important parts of the manual to English.

Software

- Where can I find the software?
 - On the desktop, RAS 2013.
 - You will hear a sound from the controller because the motor is automatically turned on when this program is executed.



Software

If this bar is green, everything is fine.
If this bar is red, some error happened.

The screenshot shows the ITRI Robot Software interface. At the top, there is a toolbar with various icons for file operations (New Project, Open Project, Save Project, Execute F5, Pause F6, Stop F7, Step Execution) and a status bar showing '實機連線-停止' (Machine Connection-Stop), the date '2018.12.3', and the time '20:56:38'. Below the toolbar, a message bar indicates '系統正常' (System Normal) in green. On the left, a table displays robot joint angles and Cartesian coordinates:

	目標角度	編碼器角度	座標
1	0	0	X: 0
2	45	45	Y: 251.20606
3	-45	-45	Z: 208.78394
4	0	0	A: 89.985858
5	-45	-45	B: -45
6	0.01	0.01	C: -179.99

Below the table, a 3D simulation window shows a yellow robotic arm with a tool frame attached. The simulation includes a grid floor and coordinate axes labeled X, Y, and Z. Labels 'Base Frame' and 'Tool Frame' are placed near the robot's base and tool respectively. At the bottom, there is a command display window with tabs for '命令顯示' (Command Display), '畫面視角' (View Angle), '路徑顯示' (Path Display), '教點顯示' (Teach Point Display), and '模型載入' (Model Load). The '命令顯示' tab is active.

Left column: target angles

Middle column: angles from encoder

Right column: Cartesian position and orientation

Dashboard

The dashboard features several functional buttons:

- 運轉畫面 (Operation View) - highlighted with a red box.
- 程式撰寫 (Program Writing)
- 運動控制 (Motion Control)
- I/O 設定 (I/O Setting)
- 視覺模組 (Vision Module)
- 通訊模組 (Communication Module)
- 系統/異常處理 (System/Error Handling)

Software

J (Joint): rotate each joint

The screenshot shows the ITRI Robot Software interface with the following components:

- Top Bar:** Includes icons for New Project, Open Project, Save Project, Execute F5, Pause F6, Stop F7, Step Execution, and a gear icon.
- Status Bar:** Displays "實機連線-停止" (Machine Connection - Stop), "系統正常" (System Normal), the date "2018.12.3", and time "20:58:21".
- Toolbars:** "J 單軸模式" (Single Axis Mode), "L 位置模式" (Position Mode), "T 工具模式" (Tool Mode), and "F1 切換鍵盤操作模式" (Switch Keyboard Operation Mode).
- Robot Simulation View:** Shows a 3D model of a 6-axis robotic arm with a green arrow indicating rotation.
- Table of Joint Parameters:**

	1	2	3	4	5	6
名稱	0	45	-45	0	-45	0.01
座標點	X	Y	Z	A	B	C
數值	0	251.20606	208.79394	89.985858	-45	-179.99
- Motion Control Panel:**
 - Buttons: 座標設定 (Coordinate Setting), 刪除 (Delete), 快速移動到點 (Quick Move to Point), 移動到Home點 (Move to Home Point), 新增/覆寫 (Add/New/Overwrite), 直線移動到點 (Linear Move to Point), 移到自定原點 (Move to Custom Origin).
 - Slider: 教導介面 PtP Speed (Teach Interface PtP Speed) at 1%.
 - Slider: 教導介面 Line Speed (Teach Interface Line Speed) at 1 mm/s.
 - Slider: 系統 Speed Rate (System Speed Rate) at 100%.
 - Slider: 系統 Acc Time (System Acc Time) at 200 ms.
 - Slider: 系統 Dec Time (System Dec Time) at 200 ms.
 - Text: 座標系統 (Coordinate System) set to 座標 0.
- Bottom Navigation Bar:**
 - Icons: 運轉畫面 (Run View), 程式撰寫 (Program Write), 運動控制 (Motion Control), I/O 設定 (I/O Setting), 視覺模組 (Vision Module), 通訊模組 (Communication Module), and 系統/異常處理 (System/Exception Handling).

Annotations:

- A red box highlights the "J 單軸模式" tab.
- A red arrow points from the "J 單軸模式" tab to the "J1-J6" row in the motion control panel.
- A red box highlights the "J1-J6" row in the motion control panel.
- A red arrow points from the "J1-J6" row to the "Adjust the rotating angular velocity." text.
- The text "J1-J6 (Joint 1 to Joint 6)" is displayed below the row.
- The text "Hold the arrow button to rotate the joint." is displayed below the row.
- The text "Adjust the rotating angular velocity." is displayed to the right of the row.
- The text "• PtP Speed: percentage of max motor rotation speed. Please keep it less than 5." is displayed below the "Speed Rate" slider.
- The text "• Speed Rate: Do not alter it." is displayed below the "Speed Rate" slider.
- A red box highlights the "運動控制" button in the bottom navigation bar.

Software

L (Line): Move the end-effector in Cartesian space.

The screenshot shows the iTRI Robot Software interface with the following key elements:

- Top Bar:** Includes icons for New Project, Open Project, Save Project, Execute F5, Pause F6, Stop F7, Single Step Execution, and a gear icon for settings. The status bar indicates "實機連線-停止" (Machine Connection - Stopped) and "系統正常" (System Normal).
- 3D Simulation View:** Shows a yellow robotic arm with a green laser pointer at its end-effector, positioned over a 3D grid.
- Motion Control Panel:** Features a red box around the "位置模式" (Position Mode) tab. It includes controls for X, Y, Z, Rx, Ry, Rz axes with numerical values (e.g., X: 0.0000, Y: 251.20, Z: 208.79), and two speed-related sliders: "Line Speed" (1.0000 mm/s) and "Speed Rate" (100.00%).
- Tool Buttons:** Includes buttons for "座標設定" (Coordinate Setting), "刪除" (Delete), "快速移動到點" (Quick Move to Point), "移動到Home點" (Move to Home Point), "新增/覆寫" (Add/New/Overwrite), "直線移動到點" (Move to Point), "移到自定原點" (Move to Custom Origin), and "座標系統" (Coordinate System).
- Table:** Displays a table of joint positions (J1-J6) and their corresponding X, Y, Z coordinates. The table rows are numbered 1 to 6.
- Bottom Navigation:** A menu bar with tabs: 運轉畫面 (Operation View), 程式撰寫 (Program Writing), 運動控制 (Motion Control), I/O設定 (I/O Setting), 視覺模組 (Vision Module), 通訊模組 (Communication Module), and 系統/異常處理 (System/Error Handling). The "運動控制" tab is highlighted with a red box.

Annotations:

- A red arrow points from the "位置模式" tab to the "Line Speed" and "Speed Rate" sliders.
- A red arrow points from the "座標系統" button to the coordinate table.
- Red text annotations provide instructions:
 - "X Y Z: translations in X, Y and Z direction." and "Adjust the translational velocity."
 - "Rx Ry Rz: rotations in X, Y and Z direction."
 - Two bullet points under "Adjust the translational velocity.": "Line Speed (mm/s): keep it less than 20." and "Speed Rate: Do not alter it."

Software

T (Tool): Move the end-effector relative to current pose.

The screenshot shows the TTRI Robot Software interface with the following components:

- Top Bar:** Includes icons for New Project, Open Project, Save Project, Execute F5, Pause F6, Stop F7, Single Step Execution, and System Status (Real Machine Connection - Stop, System Normal).
- 3D Simulation View:** Shows a yellow robotic arm with a tool frame attached, positioned over a 3D grid.
- Tool Mode Selection:** A tab bar at the top right includes 単軸模式 (Single Axis Mode), 位置模式 (Position Mode), and 工具模式 (Tool Mode). The Tool Mode tab is highlighted with a red box and arrow.
- Control Buttons:** A row of buttons for TX, TY, TZ, TRx, TRy, and TRz, each with up, down, and left/right arrows. To the right are Line Speed (1.0000) and Speed Rate (100.00) controls.
- Point Setting Options:** Buttons for 座標設定 (Coordinate Setting), 刪除 (Delete), 快速移動到點 (Quick Move to Point) with a checked checkbox, 移動到 Home 點 (Move to Home Point) with a checked checkbox, and other options like 新增 / 覆寫 (Add / Overwrite), 直線移動到點 (Linear Move to Point), and 移到自定原點 (Move to Custom Origin).
- System Parameters:** On the right, there are sliders for 教導介面 PtP Speed (1%), 教導介面 Line Speed (1 mm/s), 系統 Speed Rate (100 %), 系統 Acc Time (200 ms), 系統 Dec Time (200 ms), and 座標系統 (Coordinate System) set to 座標 0.
- Table:** A table showing coordinate values for joints 1 through 6. The first row is labeled with X, Y, Z, A, B, C respectively. The second row has values 0, 45, -45, 0, -45, 0. The third row has values 0, 45, -45, 0, -45, 0.02. The fourth row has values 0, 251.20606, 208.79394, 90, -45, 180.
- Log:** A log window at the bottom left shows the date and time: 2013/12/7 20:59:8, and the message: 運動教導器: 返回Home點 (Motion Guide: Return to Home Point).
- Motion Control Tab:** A tab labeled "Motion control" is highlighted with a red box and arrow.
- Bottom Navigation:** A toolbar with icons for 運轉畫面 (Operation View), 程式撰寫 (Program Write), 運動控制 (Motion Control), I/O 設定 (I/O Setting), 視覺模組 (Vision Module), 通訊模組 (Communication Module), and 系統/異常處理 (System/Error Handling). The Motion Control icon is highlighted with a red box and arrow.

Annotations:

- A red arrow points from the "Tool Mode" tab to the "Tool Mode" section of the controls.
- A red arrow points from the "Move to Home Point" checkbox to the "Move to Home Point" button.
- Red text annotations provide descriptions for the movement controls:
 - TX TY TZ: translations in X, Y and Z direction of tool frame.
 - Rx Ry Rz: rotations in X, Y and Z direction of tool frame.
 - Move the arm to home position.

Software

The screenshot shows a robotic control software interface. At the top, there is a toolbar with various icons: 新建專案 (New Project), 開啟專案 (Open Project), 儲存專案 (Save Project), 執行 F5 (Run F5), 暫停 F6 (Pause F6), 停止 F7 (Stop F7), and 單步執行 (Single Step). The main window displays a 3D simulation of a robotic arm on a grid. Below the toolbar, there is a message box with a red border and a red arrow pointing to it. The message box contains the text "插值錯誤" (Interpolation Error) and a gear icon. To the right of the message box, there is a status bar showing the date and time: 2018.12.3 21:12:23.

The control panel below the message box includes several buttons and sliders:

- Tool Mode buttons: 單軸模式 (Single Axis Mode), 位置模式 (Position Mode), 工具模式 (Tool Mode).
- Speed controls: 教導介面 PtP Speed (Teach Interface PtP Speed), 教導介面 Line Speed (Teach Interface Line Speed), 系統 Speed Rate (System Speed Rate), 系統 Acc Time (System Acc Time), 系統 Dec Time (System Dec Time).
- Coordinate controls: X, Y, Z, Rx, Ry, Rz, Line Speed, Speed Rate.
- Move buttons: 座標設定 (Coordinate Setting), 刪除 (Delete), 快速移動到點 (Quick Move to Point), 移動到 Home 點 (Move to Home Point), 新增/覆寫 (Add/Overwrite), 直線移動到點 (Linear Move to Point), 移到自定原點 (Move to Custom Origin).
- Coordinate table:

編號	名稱	種類	數值	字串	J1	J2	J3
1	0	X	0				
2	28.41	Y	350.6666				
3	-34.28	Z	286.61992				
4	4.54	A	95.094829				
5	0.18	B	-84.22944				
6	-5.06	C	174.92326				
- Message bar at the bottom: 2018/12/7 21:17 插值錯誤 (Interpolation Error on 2018/12/7 21:17).
- Bottom navigation icons: 運轉畫面 (Operation View), 程式撰寫 (Program Writing), 運動控制 (Motion Control), I/O 設定 (I/O Setting), 視覺模組 (Vision Module), 通訊模組 (Communication Module), 系統/異常處理 (System/Exception Handling).

A red sign like this indicates that some error happened. The arm is locked in this situation. Check the next slide for recovery.

Software

實機連線-停止 2013.12.7 21:14
插值錯誤

建新專案 開啟專案 儲存專案 執行 F5 暫停 F6 停止 F7 單步執行

版本編號: 2.0.2.3 異常復歸 清除記錄

錯誤列表 備註 1 2013/12/7 21:1:17 插值錯誤

1. Click “異常復歸” (error recovery) button.
2. Move the arm to home position.
3. Find the cause of the error (e.g., moving too fast, pose out of workspace, singular point, etc.), and contact us if it keeps happening.

0: Robot系統基本參數

參數名稱	數值
[Pixel Mode]	-1
[Auto Communication Mode]	0
[Auto Communication IP]	127.0.0.1
[Auto Communication Port]	4000
[Auto Communication Com]	1
[Auto Communication Type]	1
[Auto Communication Buffer Size]	20480
[Auto Load Project Name]	default

System/ Exception handling

運轉畫面 程式撰寫 運動控制 I/O設定 視覺模組 通訊模組 系統/異常處理

Software

To test the gripper, select the “output” tab.

實機連線-停止								2015.11.30	
建新專案	開啟專案	儲存專案	執行 F5	暫停 F6	停止 F7	單步執行		系統正常	18:18:45
輸入點(input)	輸出點(output)								
0 第1軸 Reset	1 第2軸 Reset	2 第3軸 Reset	3 第4軸 Reset	4 第5軸 Reset	5 第6軸 Reset	6 第7軸 Reset	7 第8軸 Reset		
8 第1軸 ABSM	9 第2軸 ABSM	10 第3軸 ABSM	11 第4軸 ABSM	12 第5軸 ABSM	13 第6軸 ABSM	14 第7軸 ABSM	15 第8軸 ABSM		
16 第1軸 ABSR	17 第2軸 ABSR	18 第3軸 ABSR	19 第4軸 ABSR	20 第5軸 ABSR	21 第6軸 ABSR	22 第7軸 ABSR	23 第8軸 ABSR		
24 第1軸 BRK	25 第2軸 BRK	26 第3軸 BRK	27 第4軸 BRK	28 第5軸 BRK	29 第6軸 BRK	30 第7軸 BRK	31 第8軸 BRK		
32 System Ready	33 Auto Mode	34 絕對值編碼器清除	35 Soft ON	36 Soft OFF	37 無	38 無	39 無		
40 無	41 無	42 無	43 無	44 無	45 無	46 無	47 無		
48 氣壓閥 1	49 氣壓閥 2	50 氣壓閥 3	51 氣壓閥 4	52 氣壓閥 5	53 氣壓閥 6	54 氣壓閥 7	55 氣壓閥 8		
56 無	57 無	58 無	59 無	60 無	61 無	62 無	63 無		

Click the “氣壓閥 1” (output 48) button, it will become green and the gripper will be closed. Click it again if you want to open the gripper.

Input/Output settings

運轉畫面 程式撰寫 運動控制 I/O 設定 視覺模組 通訊模組 系統/異常處理

Software

Connection type, address and port.
Do not alter this.

The screenshot shows the ITRI Robot Software interface. At the top, there is a toolbar with various icons: New Project, Open Project, Save Project, Execute (F5), Pause (F6), Stop (F7), Step Execution, and a gear icon for settings. To the right of the toolbar, the status bar displays "實機連線 - 停止" (Actual machine connection - stopped) and "系統正常" (System normal). The date and time are shown as 2013.12.3 21:25:58. Below the toolbar, there is a message area with the following text:
專案: C:/Program Files/ITRI/RobotSoftware/default/default.pir
主程式: C:/Program Files/ITRI/RobotSoftware/default/default.irb
副程式: C:/Program Files/ITRI/RobotSoftware/default/default_ex.irb
运动教导器: 返回Home點
2013/12/7 20:59:8 運動教導器: 返回Home點
2013/12/7 21:1:17 插值錯誤
2013/12/7 21:2:17 錯誤復歸
2013/12/7 21:2:40 運動教導器: 返回Home點
In the center, there is a communication module window titled "1: [Ethernet Client] 命令通訊模式". It shows the IP address as 127.0.0.1 and port as 4000. A red arrow points to the "連線" (Connect) button, which has a red dot indicating it is not connected. Below the communication module, the text reads:
To connect this software to your program, click this “連線” (connect) button. The red dot will become green if you connect successfully.

Communication module



Software

- The software is full-screen, press Alt+Tab to browse other windows.
- To exit, press ESC and click “確定”.
- Some Chinese words frequently seen:
 - 確定 = Yes/Affirmative
 - 取消 = Cancel
 - 系統正常 = The system is normal
 - 運動控制 = Motion control
 - 通訊模組 = Communication module
 - 連線 = Connect
 - 異常復歸 = Error Recovery

Assignment 4

- The Assignment 4 and the manual of robot arm will be released today (11/19).
- Demo: before 12/3, Report due: 12/3
- Reserve the arm to test your program.
 - The room is in B1 of CSIE building with an “ER7” sign on its door (next to B05).
- The first time you use the arm, TAs will give you a brief introduction. (about 15 minutes)

Assignment 4

- Equipment reservation (the same for final project)
 - Use Google Docs, and select “ITRI Arm”
 - https://docs.google.com/spreadsheets/d/1Awt2HEmD5-CWALZ2-poslQYiov3hnqfejH4TENsll_c/edit
 - Read the reservation rules carefully.
- Once you have completed your program, make an appointment with TAs before 12/03 to demonstrate it.