

Tutorial on Using ITRI Robot Arm

2018/11/25

Outline

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

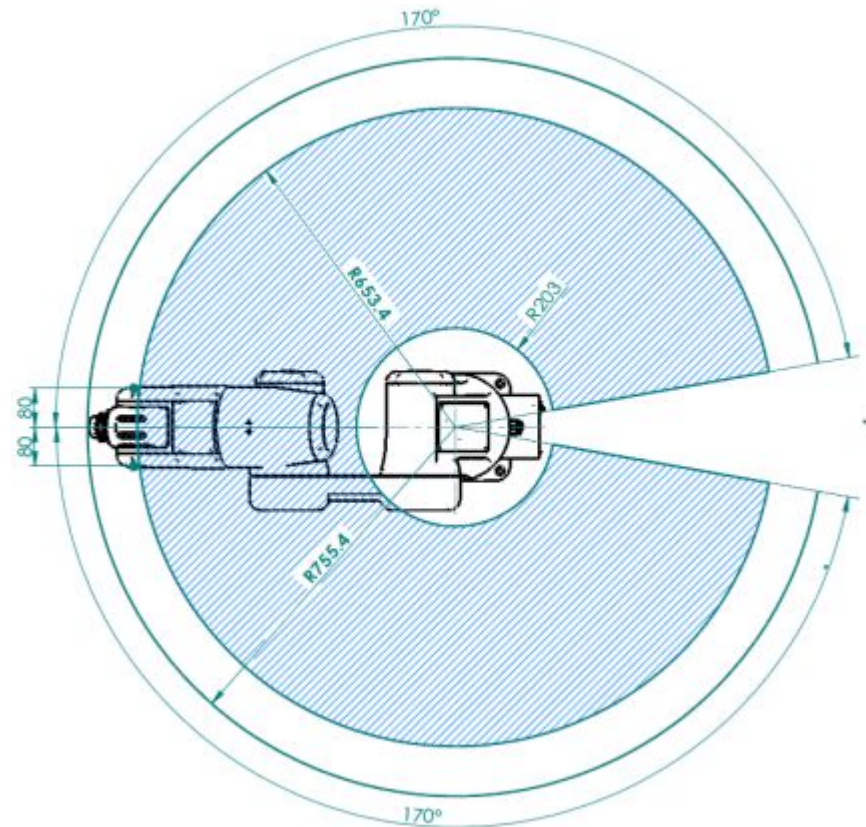
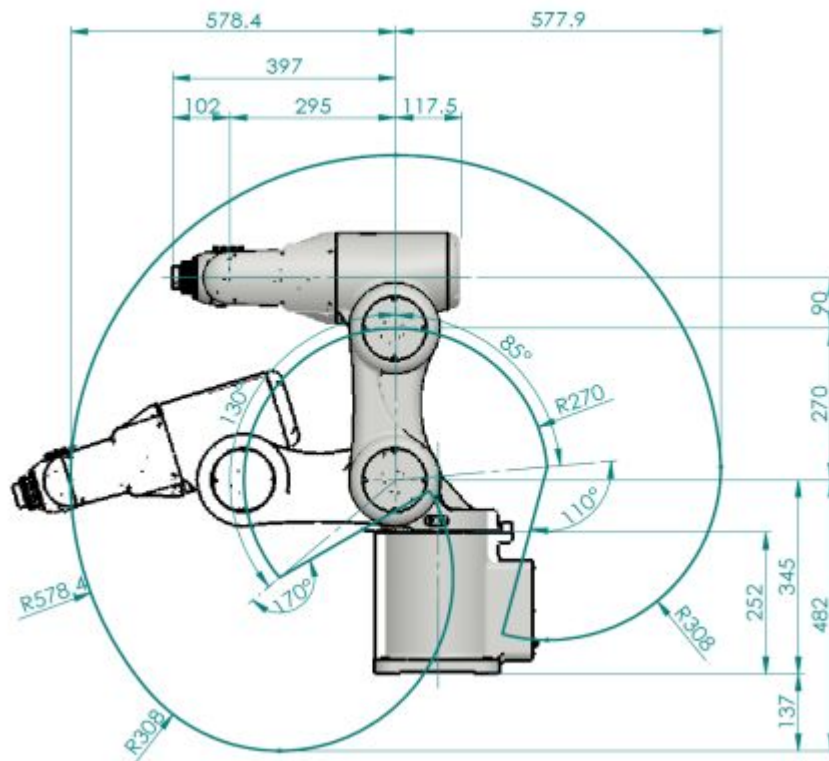
Arm

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



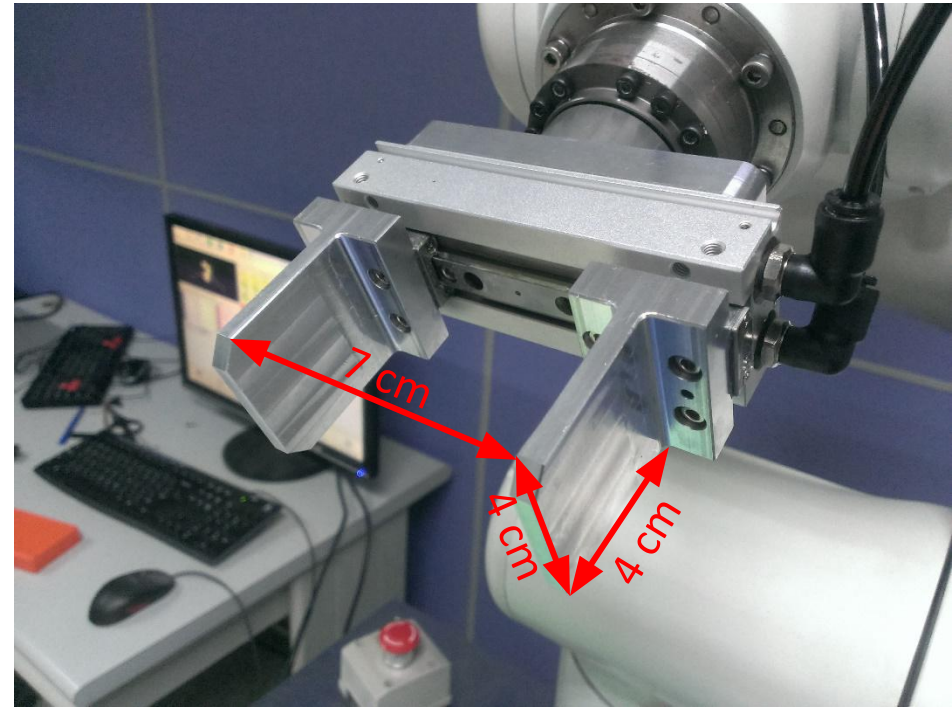
Arm

- 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.



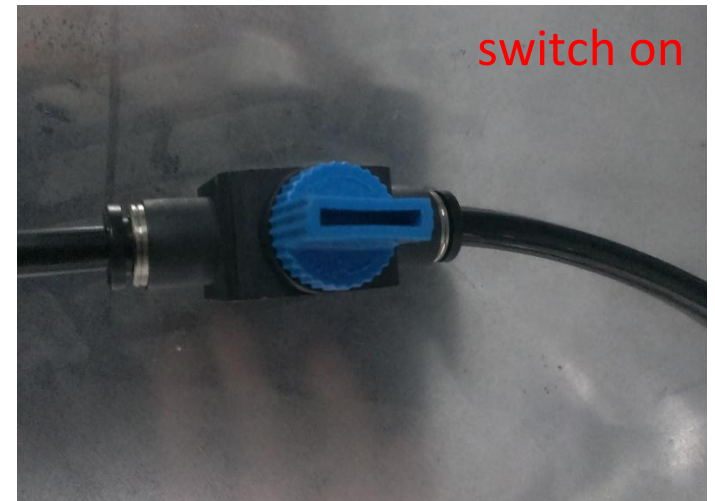
Air Pump

- 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.



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 displays a robotic software interface. At the top, a status bar shows '實機連線-停止' (Real Machine Connection - Stop) and '系統正常' (System Normal) in a green box. Below this is a toolbar with icons for '建新專案' (New Project), '開啟專案' (Open Project), '儲存專案' (Save Project), '執行 F5' (Execute F5), '暫停 F6' (Pause F6), '停止 F7' (Stop F7), and '單步執行' (Single Step Execution). The main area is divided into a table on the left and a 3D model on the right. The table has three columns: target angles, angles from encoder, and Cartesian position and orientation. The 3D model shows a robot arm with 'Base Frame' (red) and 'Tool Frame' (green) coordinate systems. At the bottom, a 'Dashboard' bar contains icons for '運轉畫面' (Operation View), '程式撰寫' (Program Writing), '運動控制' (Motion Control), 'I/O設定' (I/O Settings), '視覺模組' (Vision Module), '通訊模組' (Communication Module), and '系統/異常處理' (System/Exception Handling).

編號	名稱	種類	數值	字串	J1	J2	J3
1			0				
2			45				
3			-45				
4			0				
5			-45				
6			0.01				

Left column: target angles
Middle column: angles from encoder
Right column: Cartesian position and orientation

Dashboard

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

J (Joint): rotate each joint

單軸模式 **位置模式** **工具模式** F1:切換鍵盤操作模式

J1	J2	J3	J4	J5	J6	PtP Speed	Speed Rate
0.0000	45.000	-45.00	0.0000	-45.00	0.0100	1.0000	100.00

座標設定 **刪除** **快速移動到點** **移動到Home點**
座標點 **新增/覆寫** **直線移動到點** **移到自定義點**

編號	名稱	種類	數值	字串	J1	J2	J3
1	0	0	X	0			
2	45	45	Y	251.20606			
3	-45	-45	Z	208.79394			
4	0	0	A	89.985858			
5	-45	-45	B	-45			
6	0.01	0.01	C	-179.99			

運動控制 **I/O設定** **視覺模組** **通訊模組** **系統/異常處理**

J1-J6 (Joint 1 to Joint 6)
 Hold the arrow button to rotate the joint.

Adjust the rotating angular velocity.

- PtP Speed: percentage of max motor rotation speed. Please keep it less than 5.
- Speed Rate: Do not alter it.

Software

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

The screenshot displays the ITRI Robot Software interface. At the top, a status bar shows '實機連線-停止' (Real machine connection - stop) and '系統正常' (System normal). Below this, a toolbar contains icons for file operations and execution. The main window is divided into several sections:

- Left Panel:** A 3D visualization of a robotic arm in a Cartesian coordinate system.
- Top Center:** Mode selection buttons: '單軸模式' (Single axis mode), '位置模式' (Position mode, highlighted with a red box), and '工具模式' (Tool mode).
- Center:** A grid of controls for X, Y, Z, Rx, Ry, and Rz. Each control has up/down arrows and a numerical display. The 'Line Speed' and 'Speed Rate' controls are highlighted with a red box.
- Right Panel:** A sidebar with various system parameters and sliders, including '教導介面 PnP Speed', '教導介面 Line Speed', '系統 Speed Rate', '系統 Acc Time', and '系統 Dec Time'.
- Bottom Left:** A table showing the current program's coordinates and joint angles.
- Bottom Center:** A table for defining coordinate points.
- Bottom Right:** A row of icons for different software functions: '運動畫面' (Motion screen), '程式撰寫' (Program editing), '運動控制' (Motion control, highlighted with a red box), 'I/O設定' (I/O settings), '視覺模組' (Vision module), '通訊模組' (Communication module), and '系統/異常處理' (System/Exception handling).

Table 1: Program Coordinates and Joint Angles

Line	X	Y	Z	A	B	C
1	0	0	0			
2	45	45				
3	-45	-45				
4	0	0				
5	-45	-45				
6	0	0	0.02			

Table 2: Coordinate Points

編號	名稱	種類	數值	字串	J1	J2	J3

Motion control

X Y Z: translations in X, Y and Z direction.
Rx Ry Rz: rotations in X, Y and Z direction.

Adjust the translational velocity.

- Line Speed (mm/s): keep it less than 20.
- Speed Rate: Do not alter it.

Software

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

The screenshot displays the ITRI Robot Software interface. At the top, a toolbar contains icons for file operations and execution. Below this, a status bar shows '實機連線-停止' (Real machine connection - stop) and '系統正常' (System normal). The main window is divided into several sections. On the left, a 3D model of a robotic arm is shown. In the center, the 'T 工具模式' (T Tool mode) is selected, displaying a grid of buttons for translation (TX, TY, TZ) and rotation (TRx, TRy, TRz). To the right of this grid are buttons for 'Line Speed' and 'Speed Rate'. Further right, a sidebar contains various system parameters and settings. At the bottom, a 'Motion control' section is highlighted with a red box, containing icons for '運動畫面' (Motion screen), '程式撰寫' (Program writing), '運動控制' (Motion control), 'I/O設定' (I/O settings), '視覺模組' (Vision module), '通訊模組' (Communication module), and '系統/異常處理' (System/Exception handling).

實機連線-停止
系統正常

單軸模式 位置模式 **T 工具模式** F1:切換鍵盤操作模式

TX TY TZ TRx TRy TRz

Line Speed Speed Rate

座標設定 刪除 快速移動到點 移動到Home點

座標點 新增/刪除 直線移動到點 移到自定原點

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.

運動畫面 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

實機連線-停止

插值錯誤

單軸模式 位置模式 工具模式 F1:切換鍵盤操作模式

X Y Z Rx Ry Rz Line Speed Speed Rate

-0.000 350.66 286.61 - - - 20.000 100.00

座標設定 刪除 快速移動到點 移動到Home點

座標點 新增/覆寫 直線移動到點 移到自定原點

編號	名稱	種類	數值	字串	J1	J2	J3
1	0	0	X	0			
2	28.41	28.41	Y	350.6666			
3	-34.28	-34.28	Z	286.61992			
4	4.54	4.52	A	95.094829			
5	0.13	0.13	B	-84.22944			
6	-5.06	-5.04	C	174.92326			

2013/12/7 21:17 插值錯誤

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

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

Software

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

實機連線-停止 2013.12.7 21:14

插值錯誤

版本編號: 3.0.2.3 0: Robot系統基本參數 存檔重啟 模擬重啟 實機重啟

異常復歸 清除記錄

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

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.

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

實機連線-停止 2015.11.30 13:19:45

系統正常

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

輸入點(input) 輸出點(output) To test the gripper, select the "output" tab.

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 displays the ITRI Robot Software interface. At the top, there is a toolbar with icons for file operations and execution. Below the toolbar, the main window is divided into several sections. On the left, there is a table showing robot coordinates and joint positions. In the center, there is a status bar with '實機連線' (Real Machine Connection) and '系統正常' (System Normal). On the right, there is a communication module settings panel. This panel is highlighted with a red box and contains the following information:

- 1: [Ethernet Client] 命令通訊模式
- 位址: 127.0.0.1
- 接口: 4000
- ==== 未連線 =====
- 連線 (button)
- 送出 (button)

Below the communication module settings, there is a large yellow area with the following text:

To connect this software to your program, click this “連線” (connect) button. The red dot will become green if you connect successfully.

At the bottom of the interface, there is a navigation bar with icons for various functions. The '通訊模組' (Communication Module) icon is highlighted with a red box.

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 (11/25).
- Demo: before 12/16, Report due: 12/16
- 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/1WBYIJ35CEMCyl_5tKj4NAW8koNyH_XdN4VMP-rvGTmE/edit#gid=0
 - Read the reservation rules carefully.
- Once you have completed your program, make an appointment with TAs before 12/16 to demonstrate it.