

MTRN4230 Lab 01

1. Aim

Lab 1 aims to (1) set up your Virtual Machine (VM) working environment, (2) familiarise yourself with the UR5e robot and Polyscope – the Universal Robotics programming and control interface, and (3) write and test basic Polyscope programs in the VM environment. If you complete the Safety Demonstration for the ROBOT-1 assessment, you can run your programs on the real robots during this lab session.

2. Pre-lab

You must complete the read through the risk assessment form and safe working procedure, aim to complete Modules 1-8 of the online e-series core track learning course and install the VM ([Refer to the MTRN4230 Lab 0](#) document). Completing the online components of the ROBOT-1 assessment is encouraged but not required.

Pre-lab checklist:

- Complete Modules 1-8 of the [e-series core track](#).
- Follow the VM installation guide on Moodle. Make sure you install version 5.11.10.
- Remember to wear enclosed footwear.
- Remember to bring your student ID card to the lab.

3. Lab Activities

During the lab you should work through the set of installation and programming tasks listed below on the Universal Robotics Polyscope Simulation application – URSim in the VM. Refer to the UR5e resources on Moodle for guidance on completing the tasks.

[You may try to complete any outstanding pre-demonstration tasks required for the ROBOT-1 assessment so that you can perform the demonstration component of the ROBOT-1 assessment early if time permits.](#)

Once completed, your demonstrator will give you permission to operate the robot and test your programs on real hardware once you have verified the correctness of your program in URSim first.

3.1. Installation Tasks

- Add a safety password to URSim (this is required to modify the safety settings).
- Add a safety plane to reduce the speed of movement when the Tool Centre Point (TCP) is within 100mm of the table plane.
- Adjust the Robot Limits, using the Factory Pre-sets, so that the tool speed is a maximum of 750mm/s.
- Set a new Home position for the robot. Choose a random configuration.
- Save the installation as `lab01-z.installation`, eg. `lab01-z5010101.installation`.

- Note that this will override the default safety installation provided. When working on future labs and assessments tasks you must use the default safety installation we provided.

3.2. Movement tasks:

- Move the robot to the 'Home' position.
- Move the robot so that all joint positions are 0°.
- Move the robot so that the TCP pose is all 0.
 - Is this possible? If not, what is the minimum number of non-zero values required?
- Move the robot so the TCP position is fixed at and the end effector rotates about the x axis.
 - Can you make the full motion? If not, what happens and why?

3.3. Programming Tasks:

- Write a sub-program that moves the robot from its current position to the 'Home' position.
- Write a sub-program that loops through 3 well-spaced waypoints with a moveJ motions.
 - Repeat with the same 3 waypoints but with moveL motions.
 - Repeat again, but with moveP motions.
 - What is the difference? When may each motion be most appropriate?
- Write a program that calls the Home sub-program, followed by the MoveJ sub-program, then continue for Home, MoveL, Home, MoveP, Home.
- Save the program as `lab01- z.urp` for example `lab01-z5010101.urp`.
- Experiment with more advanced programs

4. Post-lab

- Complete Modules 5-8 of the e-series core track and prepare for your ROBOT-1 assessment in week 2.
- Work through the hazards listed on the RMF and with reference to AS4024.3302 (2017) Sections 4.4 and 4.5, identify whether each risk control is an 'Elimination', 'Safeguarding' or 'Supplementary protective' measure
- You may want to get started on looking through the documentation provided for the RTDE and RVC Toolboxes. These toolboxes can be used for the ROBOT-2 assessment which will be used in week 2. So, getting a head start on understanding how to use it will be beneficial.

5. Where to get help

VM:

- Start with the VirtualBox forums: <https://forums.virtualbox.org/>

UR5e Robot + URSim

- Check the UR5e Manual v5.10 on Moodle
- Check the Universal Robotics Forums: <https://forum.universal-robots.com/>
- Refer to the online Universal Robotics resources such as the e-series core track module

