University of Lincoln Assessment Framework
Assessment Briefing Template 2024-2025

Module Code & Title: ELE3005M – Robotics and Automation

Contribution to Final Module Mark: 30%

Coursework Title: Assignment

Description of Assessment Task and Purpose:

Sections 1 and 2 of this assessment evaluate the understanding of the basic concepts in robotics covered in this module. The questions will guide you towards writing a technical report addressing the key aspects involved in the automation of a typical manipulation task using articulated robots. The questions include theoretical discussions to show understanding and mathematical calculations.

Learning Outcomes Assessed:

1. Select and evaluate technical literature and other sources of information to address problems in the robotics and automation field and its underlying principles.
2. Select, evaluate and apply key control principles, quantitative science and robot programming tools in the design of robotics systems and problems
3. Select and apply appropriate computational and analytical techniques to model typical robotics applications in automation problems and recognise the limitations of the techniques employed
4. Understand and evaluate the operation and application of a range of sensory systems in robotics and demonstrate principles of secure data storage and analysis
5. Communicate effectively on complex engineering matters with technical and non-technical audiences

Knowledge & Skills Assessed:

1. Subject Specific Knowledge, Skills and Understanding: automation using robots, manipulation and teleoperation, forward and inverse kinematics, robot types, configurations and applications
2. Professional Graduate Skills: independence and personal responsibility, written communication, literature search, and solving engineering problems

Assessment Submission Instructions:

This submission is individual work.

You will find the submission link via ELE3005M Blackboard Module Site under Assessments.

All work should be submitted by the deadline stated above. Any late submissions will be subject to a lateness penalty in line with the University policy.

The method of submission described above should be used in the first instance however, in cases of technical issues please email your assessment to: soesubmissions@lincoln.ac.uk by the above deadline. Please include the module code and coursework title in the email subject.

All work will be subject to plagiarism and academic integrity checks. In submitting your assessment you are claiming that it is your own original work; if standard checks suggest otherwise, Academic Misconduct Regulations will be applied.

Date for Return of Feedback:

2 weeks after hand-in

Format for Assessment:

A report in pdf format submitted individually via turn-it-in with clearly labelled question numbers.

Marking Criteria for Assessment:

90-100%: a range of marks consistent with a first where the work is exceptional in all areas.

80-89%: a range of marks consistent with a first where the work is exceptional in most areas.

70-79%: a range of marks consistent with a first. Work which shows excellent content, organisation and presentation, reasoning and originality; evidence of independent reading and thinking and a clear and authoritative grasp of theoretical positions; ability to sustain an argument, to think analytically and/or critically and to synthesise material effectively.

60-69%: a range of marks consistent with an upper second. Well-organised and lucid coverage of the main points in an answer; intelligent interpretation and confident use of evidence, examples and references; clear evidence of critical judgement in selecting, ordering and analysing content; demonstrates some ability to synthesise material and to construct responses, which reveal insight and may offer some originality.

50-59%: a range of marks consistent with lower second; shows a grasp of the main issues and uses relevant materials in a generally business-like approach, restricted evidence of additional reading; possible unevenness in structure of answers and failure to understand the more subtle points: some critical analysis and a modest degree of insight should be present.

40-49%: a range of marks which is consistent with third class; demonstrates limited understanding with no enrichment of the basic course material presented in classes; superficial lines of argument and muddled presentation; little or no attempt to relate issues to a broader framework; lower end of the range equates to a minimum or threshold pass.

35-39%: achieves many of the learning outcomes required for a mark of 40% but falls short in one or more areas.

30-34%: a fail; may achieve some learning outcomes but falls short in most areas; shows considerable lack of understanding of basic course material and little evidence of research.

0-29%: a fail; basic factual errors of considerable magnitude showing little understanding of basic course material; falls substantially short of the learning outcomes for compensation.

Marks will be allocated for appropriate structure and format of the report, demonstration of an understanding of the context and theoretical background to the work, use of an appropriate range of references and effective use of results to support any conclusions made.

Please note that all work is assessed according to the University of Lincoln Management of Assessment Policy and that marks awarded are provisional on Examination Board decisions (which take place at the end of the Academic Year.

Feedback Format:

Annotation and marking grid added to the submitted report

Additional Information for Completion of Assessment:

1. Please make sure any supporting figures you include are clear and show detailed steps for any calculations made.
2. Refer to the given question notes for additional question-specific guidelines.
3. Avoid copying over all questions with your submitted answers to avoid false high similarity scores on turn-it-in.

Assessment Support Information:

Please email any questions to SaLiu@lincoln.ac.uk

Important Information on Academic Integrity:

The use of AI tools is Not permitted

All work will be subject to plagiarism and academic integrity checks. In submitting your assessment, you are certifying that this is entirely your own work, without input from either commercial or non-commercial writers or editors or advanced technologies such as artificial intelligence services unless explicitly allowed and referenced. If standard checks suggest otherwise, Academic Misconduct Regulations will be applied.

Nowadays, it is common to see large numbers of robots in factories automating highly repetitive tasks such as packing, painting, welding, assembling, and many other labour-intensive tasks, in order to keep up with the increasing demands of our growing population. Research an example task of your choice that has been previously automated in factories using **robotic manipulators** to speed up the production rate and discuss the following:

1. [5 marks] What are the main types of robotic systems? What tasks can they perform?

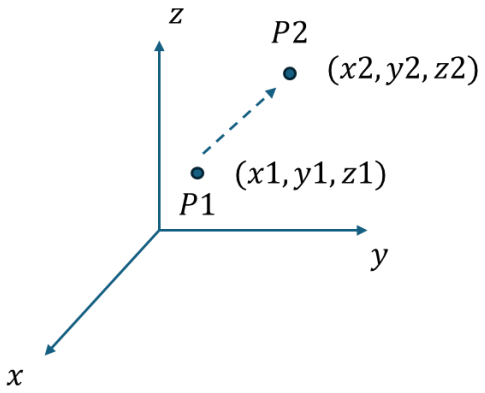
2. [5 marks] What are the types of joints in a robot? What motions can they provide?

3. [5 marks] What are the differences between forward kinematics and inverse kinematics?

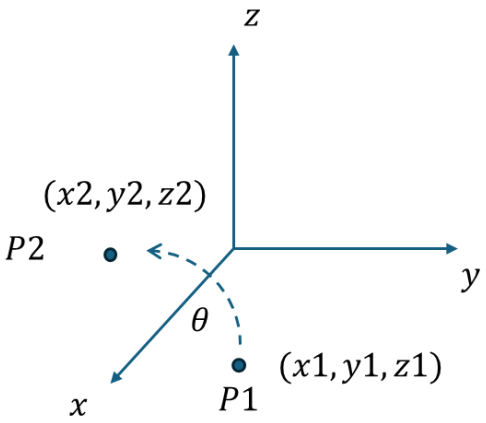
4. [5 marks] What are the common sensors in a typical robotic system?

   Note: *Your answer to each question should be no more than 150 words in length. Remember to reference any sources you use appropriately. Please use IEEE style.*

5. [15 marks, 5 marks each] (1) Determine the homogeneous transformation matrix (4 × 4) to translate P1 to P2 as shown in below figure (along x, y, z axes for distance lx, ly, lz). (2) If $lx = 1, ly = 2, lz = 3, x1 = 1, y1 = 1, z1 = 1$, calculate $x2, y2, z2$. (3) Do the calculations in MATLAB and use rigiBody to visualise (both P1 and P2). Show your code (copy and paste here) and result (save as figure the insert here, not screen capture).

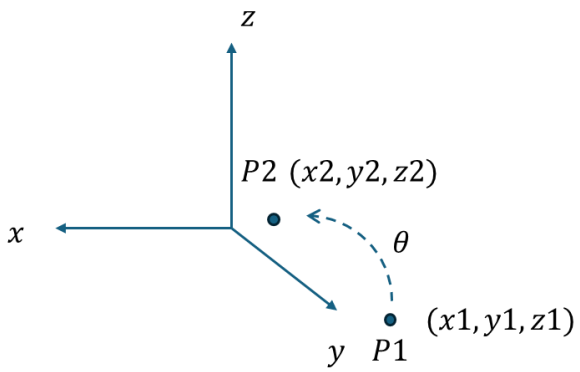


6. [15 marks, 5 marks each] (1) Determine the homogeneous transformation matrix (4 × 4) to rotate P1 to P2 around axis x for angle θ as shown in below figure. (2) if $\theta = 30°$ and $x1 = 1, y1 = 1, z1 = 1$, calculate $x2, y2, z2$. (3) Do the calculations in MATLAB and use rigiBody to visualise (both P1 and P2). Show your code (copy and paste here) and result (save as figure the insert here, not screen capture).

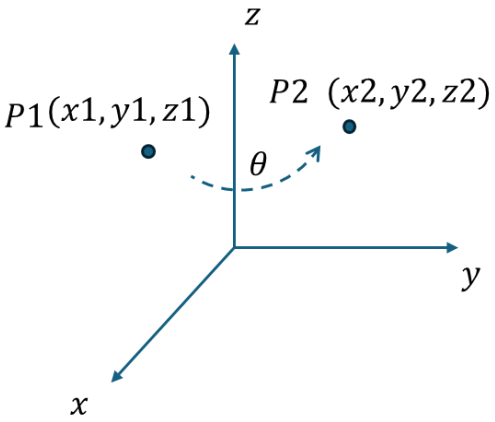


7. [15 marks, 5 marks each] (1) Determine the homogeneous transformation matrix (4 × 4) to rotate P1 to P2 around axis y for angle θ as shown in below figure. (2) if $\theta = 45°$ and $x1 = 1, y1 = 1, z1 = 1$,

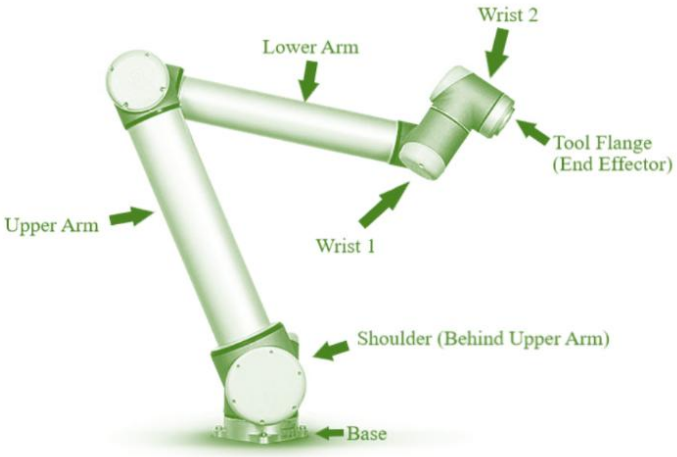
calculate $x2, y2, z2$. (3) Do the calculations in MATLAB and use rigiBody to visualise (both P1 and P2). Show your code (copy and paste here) and result (save as figure the insert here, not screen capture).

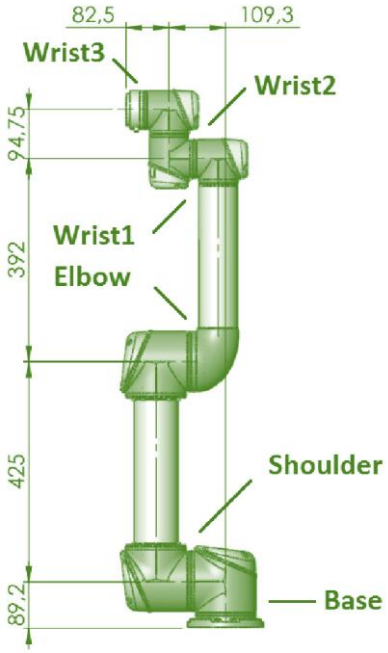


8. [15 marks, 5 marks each] (1) Determine the homogeneous transformation matrix (4 × 4) to rotate P1 to P2 around axis z for angle θ as shown in below figure. (2) if $\theta = 60°$ and $x1 = 1, y1 = 1, z1 = 1$, calculate $x2, y2, z2$. (3) Do the calculations in MATLAB and use rigiBody to visualise (both P1 and P2). Show your code (copy and paste here) and result (save as figure the insert here, not screen capture).



9. In some cases, the kinematic model of a robot might not be available, and you would need to derive this yourself. The figure below shows the dimensions for a six-degrees-of-freedom robotic manipulator to be modelled.





1) [5 marks] Assign appropriate frames to the given robot (on the given figure or your own sketch).

   Note: It is sufficient to show only 2 axes for each frame since the third axis can be deduced. Briefly comment on how you assigned the frames.

2) [10 marks] Now that you have assigned appropriate frames, model this robot in MATLAB, show your code (copy and paste here) and result (save as figure the insert here, not screen capture).

3) [5 marks] Assign a random configuration (angles) to this robot, using MATLAB, show your code (copy and paste here) and result (save as figure the insert here, not screen capture).

   Note: You can use other programming language such as Python/C/C++.

This is the end of the assessment