Fall 2025

MTS-417

Intro to Robotics

Topic: Homogenous Transformation

DE – 44 MTS

Weightage: 02% out of 100 of Lab

Max Marks: 30

Deadline: 05th October 2025

Name – Reg No. : _____

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TASK # 1

In this task you will experimentally verify the property of homogeneous transformations using two different simulation setups.

$$^{0}T_{2} = ^{0}T_{1} \cdot ^{1}T_{2}$$

Setup:

- Create three dummy objects: R0, R1, R2.
- R1 is a child of R0.
- R2 is a child of R1.

Simulation Setup No. 1: (10)

1. Rotate R1 about the Z-axis by **45°**.
2. Translate R1 along the X-axis by a distance equal to the **first three digits of your leader registration number (in cm, converted to meters)**.
    - Example: Reg. No. = 123456 → Translation = 0.123 m.
3. Define a new transformation for R2 with respect to R1:
    - Rotate R2 about the Y-axis by **54°**.
    - Translate R2 along the Z-axis by a distance equal to the **last three digits of your leader registration number (in cm, converted to meters)**.
    - Example: Reg. No. = 123456 → Translation = 0.456 m.
4. Apply this transformation to R2 using sim.setObjectMatrix(R2, R1, …).

At this stage, the simulator has placed R2 indirectly through R1.

Simulation Setup No. 2: (10)

Using your known matrices from simulation setup No. 1, Find the transformation matrices.

➔ Multiply these transformation matrices to get transformation of frame R2 with respect to R0. (for example, 0T2 = 0T1 * 1T2)

➔ Apply this transformation to R2 using sim.setObjectMatrix(R2, R0, …).

Findings to write in report:

- Lua code used for Part A and Part B.
- Hand-calculated derivation of $0T2 = 0T1 * 1T2$.

- Screenshots of **both scenes**, showing that R2 ends up in the same physical position.
- A short discussion on why chaining transformations through an intermediate frame is equivalent to applying the composite transformation directly.

TASK # 2

You have two frames: R0 (world) and R1 (child of R0).

- Initially, R1 is rotated **45° about the Z-axis** with respect to R0.
- You then run the following Lua snippet:

```
A = Matrix3x3():rotz(math.pi/4)

B = Vector3({0.1, 0.1, 0.1})

T1 = Matrix4x4():fromrt(A,B)

sim.setObjectMatrix(R1, R0, T1:data())
```

- After running this code, what is the orientation of R1 with respect to R0? Choose one: (5)
  - 90°
  - 45°
  - 0°
- Explain **why your answer is correct**, considering how sim.setObjectMatrix behaves in CoppeliaSim. (5)

Note:

- Plagiarism from another group is strictly Prohibited.
- You can use ChatGPT or any AI tool for this report, but clear **reference** should be provided in the end.
- Lab Report to be submitted in a group of 2 or 3 students.
- **Per day late submission will have 25% penalty**. You have time till 05th October 2025 (11:00pm), try to submit at least one day earlier to avoid any issue.
- Only one person per group should submit the **PDF file (PDF only)** and **"CoppeliaSim EDU scene"** on LMS.
- Compile your data in **a single PDF file** named as **"LR1_Name1_Name2_Name3_SYN"**