Fall 2025

MTS-417

Intro to Robotics

Topic: Introduction to CoppeliaSim EDU Software

DE – 44 MTS

Weightage: 03% out of 100 of Lab

Deadline: 28th September 2025

Name – Reg No. : _____

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Registration Number based Cuboid Motion and Goal Alignment Analysis in CoppeliaSim EDU

Objective:

To implement a personalized Cuboid motion in CoppeliaSim EDU based on the student's registration number and to compute vector alignment with respect to a fixed goal using dot and cross products.

- **Create a Cuboid object** in CoppeliaSim EDU.
- Write and attach a **non-threaded Lua child script** to the Cuboid.
- The Cuboid must move along **registration number dependent parametric equations**:

$$x(t) = (d_1 + 1)\,\sin\left(\frac{t}{d_2 + 1}\right), \quad y(t) = (d_3 + 1)\,\cos\left(\frac{t}{d_4 + 1}\right)$$

where d1, d2, d3, d4 are digits taken from your registration number (e.g., last 4 digits).

$$(x_g, y_g) = (2, 2)$$

At each simulation step, compute and print in the console:

- **Euclidean distance** between Cuboid and goal:

$$d = \sqrt{(x_g - x)^2 + (y_g - y)^2}$$

- **Dot product** between motion direction vector (Vx,Vy) and goal direction vector (dx,dy)
- **Cross product** between motion direction and goal vector.
- **Heading error angle**:

$$\phi = \arctan 2(\text{cross}, \text{dot})$$

At simulation start, your script must print your **Registration Number, Path Equations, and Goal Coordinates** to ensure uniqueness.

ASSESSMENT REQUIREMENTS

- **Step 1:** Write group leader **registration number digits** and add the personalized equations for x(t) and y(t) on CoppeliaSim EDU script only (NO need to write on paper or word file)
- **Step 2:** Paste the **Lua script** with proper comments.
- **Step 3:** Provide **simulation screenshots** showing Cuboid trajectory and console outputs (REG no., live dot/cross values).
- **Step 4: Discussion & Analysis:**
    - Explain the meaning of dot, cross, and ϕ in relation to the goal.
    - Relate the signs of dot and cross products to motion alignment (toward goal, away from goal, left/right deviation).

Hint:

Motion Direction vectors are given as follows:

$$v_x(t) = \frac{d_1 + 1}{d_2 + 1} \cos\left(\frac{t}{d_2+1}\right)$$

$$v_y(t) = -\frac{d_3 + 1}{d_4 + 1} \sin\left(\frac{t}{d_4+1}\right)$$

Remember **Dot product** between motion direction vector (Vx,Vy) and goal direction vector (dx,dy) is

$$\text{dot} = v_x \cdot dx + v_y \cdot dy$$

And cross product is

$$\text{cross} = v_x \cdot dy - v_y \cdot dx$$

Where

$$dx = x_g - x(t), \quad dy = y_g - y(t)$$

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 28th Sept 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"**