Task 1C

Design a Ball Balancing Platform

[*Last Updated on:* ***19th October 2020, 16:39 Hrs***]

Note: Before proceeding further, make sure you have gone through the videos provided in the CoppeliaSim Tutorials section.

Problem Statement

The aim of this task is to develop a **Ball Balancing Platform** having **two degrees of freedom (DOF** in CoppeliaSim **using the model files provided**.

Given

A set of **nine model files (.ttm)** for CoppeliaSim software as shown in the following Figure 1.

Figure 1: List of Model files

The maximum and minimum occurrences (quantity) of the mentioned model files **permitted** in the **Ball Balancing Platform** design are shown below in Table 1.

Model file	Maximum Occurrences Permitted	Minimum Occurrences Permitted	Use of each model
base_plate	**x1**	**x1**	Serves as the base platform of the design
connecting_rod	**x8**	**x1**	Connects the ***l_connector*** with the ***servo_fin***
l_connector	**x8**	**x1**	Connects the ***top_plate*** with the ***connecting_rod***
servo	**x8**	**x1**	Serves as the actuator in the design
servo_fin	**x8**	**x1**	Connects ***servo's*** shaft with the ***connecting_rod***
servo_holder	**x16**	**x1**	Serves as support for the ***servo*** in the design
top_plate	**x1**	**x1**	Serves as the top platform in the design

Model file	Maximum Occurrences Permitted	Minimum Occurrences Permitted	Use of each model
universal_joint	**x2**	**x1**	Together in combination with **2** ***yokes***, it helps to reduce the load on the servo motors
yoke	**x4**	**x2**	Together in combination with **1** ***universal joint***, it helps to reduce the load on the servo motors

Table 1: Maximum and Minimum occurrences permitted of the given model files

Getting Started

- Download the following zip file containing the above mentioned model files for CoppeliaSim. Right-click on the hyperlink and select **Save Link As...** option to download.
  - **task_1c_model_files.zip**

> **Note:** The browser might warn that the file can harm your PC, but it will not and you can safely download it.

- **Extract the downloaded zip file** and copy-paste the folder in the directory as per your machine's Operating System:
- Ubuntu OS - `CoppeliaSim_Edu_V4_0_0_Ubuntu18_04/models/`
- Windows OS - `C:\Program Files\CoppeliaRobotics\CoppeliaSimEdu\models\`
- Now open CoppeliaSim software in your machine. After opening the software, the model browser available generally on the top left corner of the screen should be as shown in the Figure 2.

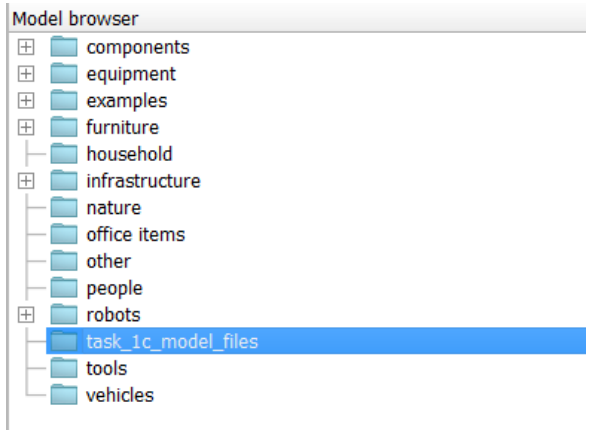

Figure 2: Model Browser of CoppeliaSim after extracting the zip file

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Note: If the model browser is not visible, go to the **Model browser** icon  on left pane of CoppeliaSim ***OR*** go to **Tools** menu and check the option for **Model browser**. If the **task_1c_model_files** folder is not visible, try restarting CoppeliaSim once.

- Now, read the following instructions carefully. **Any deviation from the listed instructions will result in poor evaluation and hence low marks**.

Instructions

- Teams **are not allowed** to use **any other model files apart from the ones given**.
- **Mass and Inertia** properties of provided models **must not** be changed.
- **Scaling** of the size of model files **is not** permitted.
- Make sure your design meets the **maximum** and **minimum** requirements of occurrences of the models as shown in Table 1.
- In the entire design, **only base_plate** should be set to ***static (non-dynamic)***. Refer **Task 1 Tutorial** videos in order to learn how to do the same.
- It is recommended to group the non-moving parts of the designs. This will help to reduce the complexity of the scene hierarchy. However, **make sure** that the **base_plate is not grouped** with any other object or model file.

- All joints should be configured to ***Torque/Force*** mode and ***Motor enabled*** option **should be unchecked** as shown in Figure 3 and Figure 4.

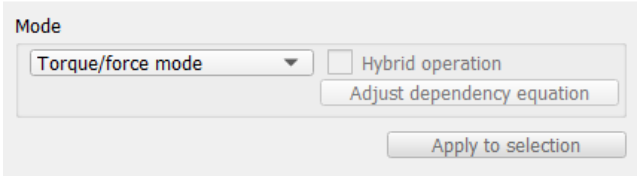

Figure 3: All joints should be configured in Torque/Force mode

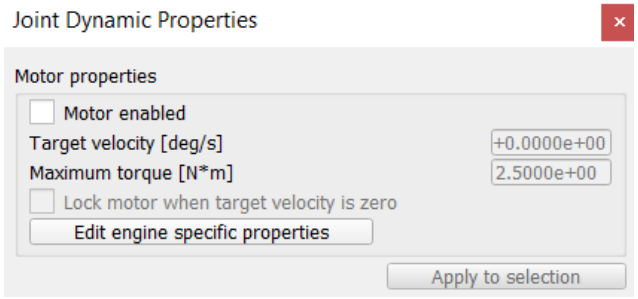

Figure 4: Make sure Motor enabled option is unchecked

- All the **respondable objects** in the design should have **'Body is respondable'** option **checke** as shown in Figure 5.

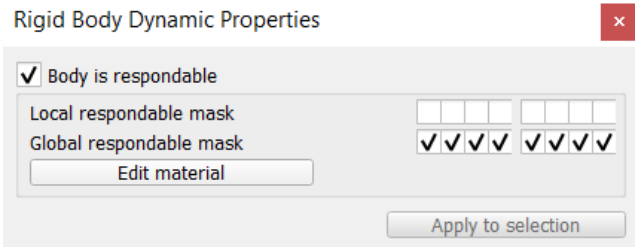

Figure 5: Make sure Body is respondable option is checked

- Naming convention **should be strictly followed** as per given in the following Table 2.

Object Type	No repeated occurrences	Repeated occurrences
respondables	**Insert** '_***1***'. e.g. *base_plate_respondable_1*	**Insert** '_***<quantity>***' after the name. e.g. *base_plate_respondable_1*, *base_plate_respondable_2* etc.

Object Type	No repeated occurrences	Repeated occurrences
visuals	**Insert** '_***1***'. e.g. *base_plate_visual_1*	**Insert** '_***<quantity>***' after the name. e.g. *base_plate_visual_1*, *base_plate_visual_2* etc.
force sensors	**Insert** '_***<1st Initial of parent and 1st Initial of child>_1***'. e.g. *force_sensor_by_1*	**Insert** '_***<1st Initial of parent and 1st Initial of child>_<quantity>***'. e.g. *force_sensor_by_1*, *force_sensor_by_2* etc.
joints (revolute, spherical etc.)	**Insert** '_***<1st Initial of parent and 1st Initial of child>_1***'. e.g. *revolute_joint_ss_1*	**Insert** '_***<1st Initial of parent and 1st Initial of child>_<quantity>***'. e.g. *revolute_joint_ss_1*, *revolute_joint_ss_2* etc.
dummies	**Insert** '_***1***'. e.g. *dummy_1*	**Insert** '_***<quantity>***' after the name. e.g. *dummy_1*, *dummy_2* etc.

Table 2: Naming convention for respondables, visuals, force sensors, joints and dummies

- To rename the objects, **double click on the name of the object** in the scene hierarchy.
- **Only small letters and numerals** are allowed.
- **Repeated occurrences** should only be used **if there are more than 1 occurrences** of the same object.

Expected Output

- In order to check the design make sure that the following points are in order **after you click the Play button**.
- Make sure all the respondables, force sensors and joints **have a tick mark** next to it as shown in the Figure 6. ***If any relationship set is incorrect, CoppeliaSim will through an error or display a warning symbol*** next to it as shown in Figure 7.

Figure 6: Tick mark next to force sensor

Figure 7: Warning symbol next to force sensor

- You will note that the ***top plate*** and the ***servo fins*** **tilt by certain degrees**. This is normal and due to the mass of the top plate.

> **Note:** The above two points do not guarantee that your design is correct. However, generally if the above two conditions are true, the design is correct.

- Proceed to the **Submitting Task 1C** section only when you are satisfied with the output.

Submitting Task 1C

There are **three files to be submitted** in this task. These are as follows:

1. **CoppeliaSim XML scene**:

   Follow the below steps to create a **XML file** of your **Ball Balancing Platform** design.

   - Go to ***File -> Save scene as -> CoppeliaSim XML scene -> Exhaustive***. Name the file as `task_1c_output` and select the directory where you want to save the **XML file**. A file by the name of `task_1c_output.simscene.xml` will be saved in the selected directory.
   - Make sure to rename this file as `task_1c_output.xml` .
   - Follow the gif given below in Figure 8 to understand the process better.

   

   Figure 8: Demonstration to save scene as XML file

2. **CoppeliaSim Model File**:

   Follow the below steps to create a **Model file (.ttm)** of your **Ball Balancing Platform** design.

   - Make sure that you **position the base plate** at **[0, 0, 0.0055]** and **orient it** at **[0, 270, 0 with respect to world frame**. Follow the gif given below in Figure 9 to add, position anc orient base plate.

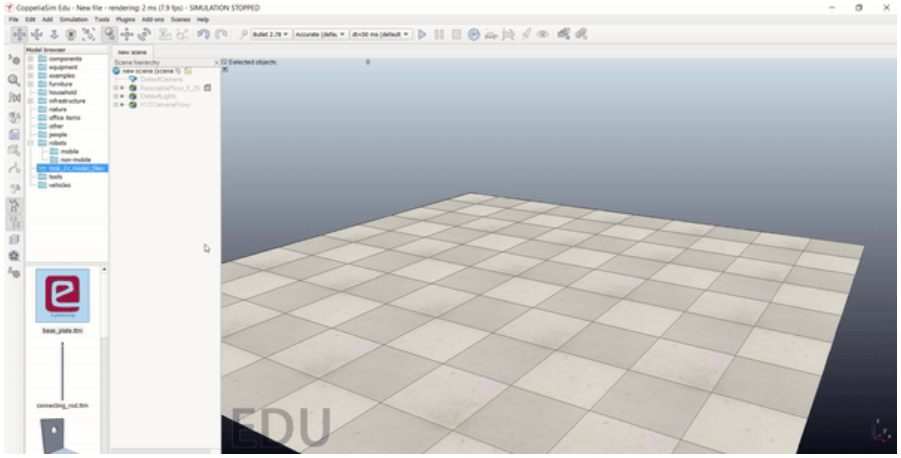

Figure 9: Demonstration to add, position and orient base plate

- Select **only the parent object** of the design that you have created. **Do not select** the objects that come by default in the scene such as '***DefaultCamera***', '***ResizableFloor***' etc. Make sure that the parent object is **positioned at x=0 and y=0**.
- Go to ***File -> Save model as -> CoppeliaSim model -> Click on OK*** when prompted ***-> Click on No*** when it asks for ***Model Thumbnail Image -> Configure the thumbnail's image -> Click on OK***.
- Name the file as `task_1c_bbp` and select the directory where you want to save the **mod (.ttm)** file.
- A file by the name of `task_1c_bbp.ttm` will be saved in the selected directory.
- Follow the gif given below in Figure 10 to understand the process better.

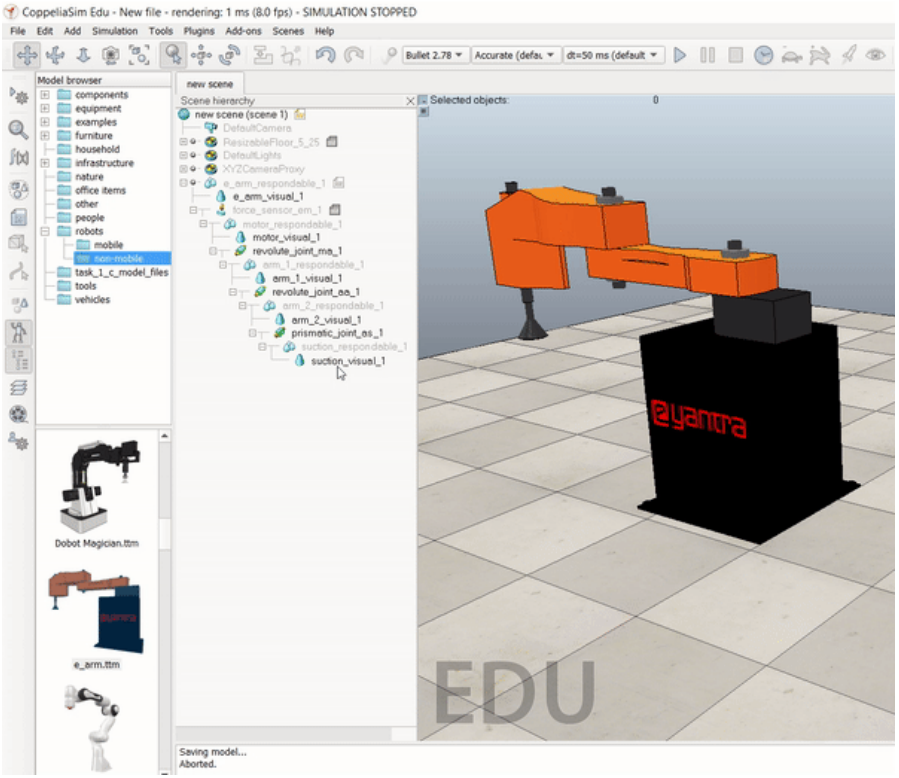

Figure 10: Demonstration to save model file

3. **CoppeliaSim Video Recording**:

   Follow the below steps to create a **Simulation Video recording** in **mp4** format of your **Ball Balancing Platform** design.

   - Make sure that the view on the screen captures **most of your model and scene hierarchy is visible**. For example, orient the screen as shown in the Figure 11.

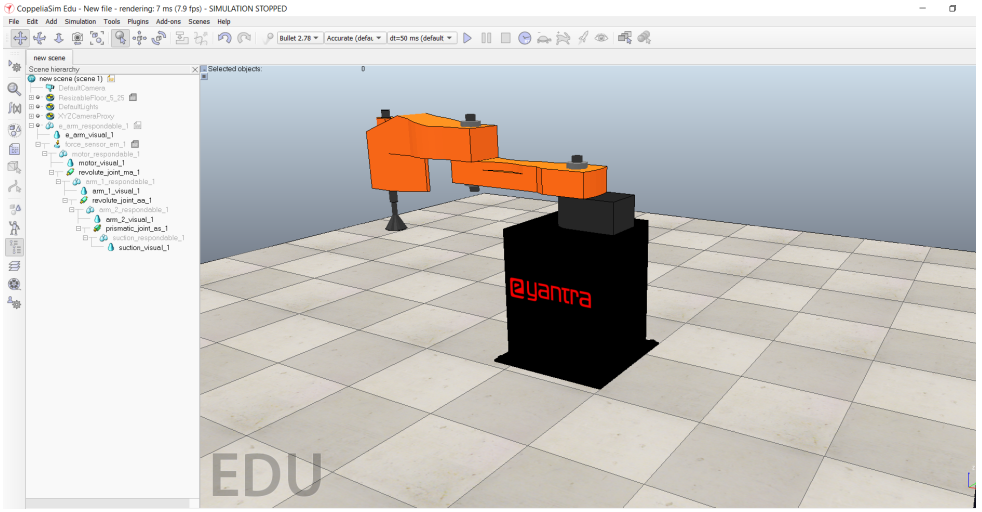

Figure 11: View before starting video recording

- Go to **Video recorder**  icon available in CoppeliaSim software.
- Check on the **Launch at next simulation start** tick box and uncheck **Hide information text** tick box.
- Select the **Output type** as **MP4/MPEG-4 part 2**. Select the directory where you want to save the file.
- The dialog box will look as shown in Figure 12 after completing the above steps.

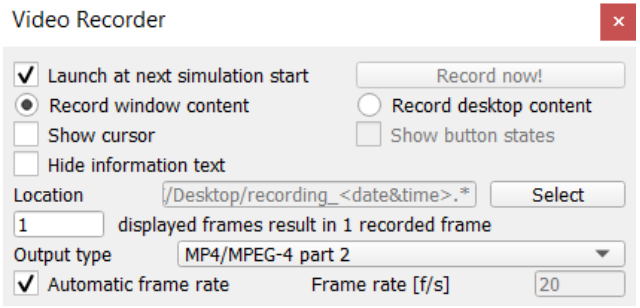

Figure 12: Video Recorder dialog box after completing the above mentioned steps

- Click the **Play** button to start the simulation and recording.
- Make sure that the **video recording length** is **less than 10 seconds**.

- To end the simulation and recording, click on the **Stop** button.
- Rename the file as `task_1c_simulation.mp4`.

Note: File names mentioned are case sensitive. Verify all the file names before creating the zip file.

- After you have saved all the files with the mentioned names in a directory / folder, rename the directory / folder as `NB_<Team-ID>_Task_1C`.
- Make sure these **three** files are present in the folder named `NB_<Team-ID>_Task_1C`:
  - `task_1c_bbp.ttm`
  - `task_1c_output.xml`
  - `task_1c_simulation.mp4`
- Compress this folder to **zip** file and rename the zip file as `NB_<Team-ID>_Task_1C.zip`.

NOTE: If your Team ID is **9999**, the folder name should be `NB_9999_Task_1C` and the zip file name should be `NB_9999_Task_1C.zip`.

- Upload the zip file on the portal after selecting the radio-button as **Task 1C** as shown in Figure 13.

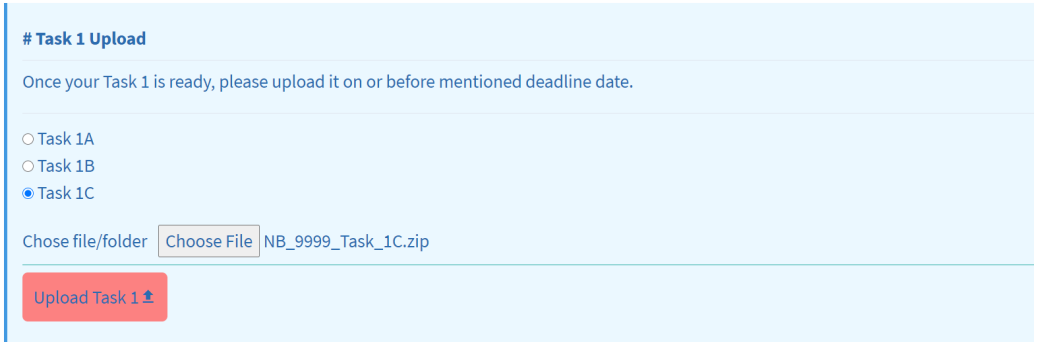

Figure 13: Submission of **NB_9999_Task_1C.zip** file on eYRC portal

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ALL THE BEST !!

Note: While asking doubts on Piazza forum, make sure you do not disclose the design of your Ball Balancing Platform.
