SET09119 Physics-Based Animation

Assessment 1: Rigid-Bodies

Learning Outcomes Covered:	L01, L02, L03, L04
Assessment Type:	Practical Assessment / Demonstration
Overall module assessment	40% Assessment 1, 60% Assessment 2
For this assessment:	40%
Assessment Limits:	25 hours
Submission Date:	Monday, 08 April 2024
Submission Time:	17:00
Submission Method:	Via Moodle
Turnitin:	Not Applicable
Module leader:	Babis Koniaris
Tutor with Direct Responsibility:	

- You are advised to keep a copy of your assessment solutions.
- Please note regulation Section B5.3.b regards component weighting.
- Late submissions will be penalised following the University guidelines as follows: Choose an item.
- Extensions to the submission date may only be given by the Module Leader for exceptional circumstances. – by submitting appropriate request form from Extenuating circumstances.
- Feedback on submissions will normally be provided within three working weeks from the submission date.

The University rules on Academic Integrity will apply to all submissions. The student academic integrity regulations contain a detailed definition of academic integrity breaches which includes use of commissioned material; knowingly permitting another student to copy all or part of his/her own work

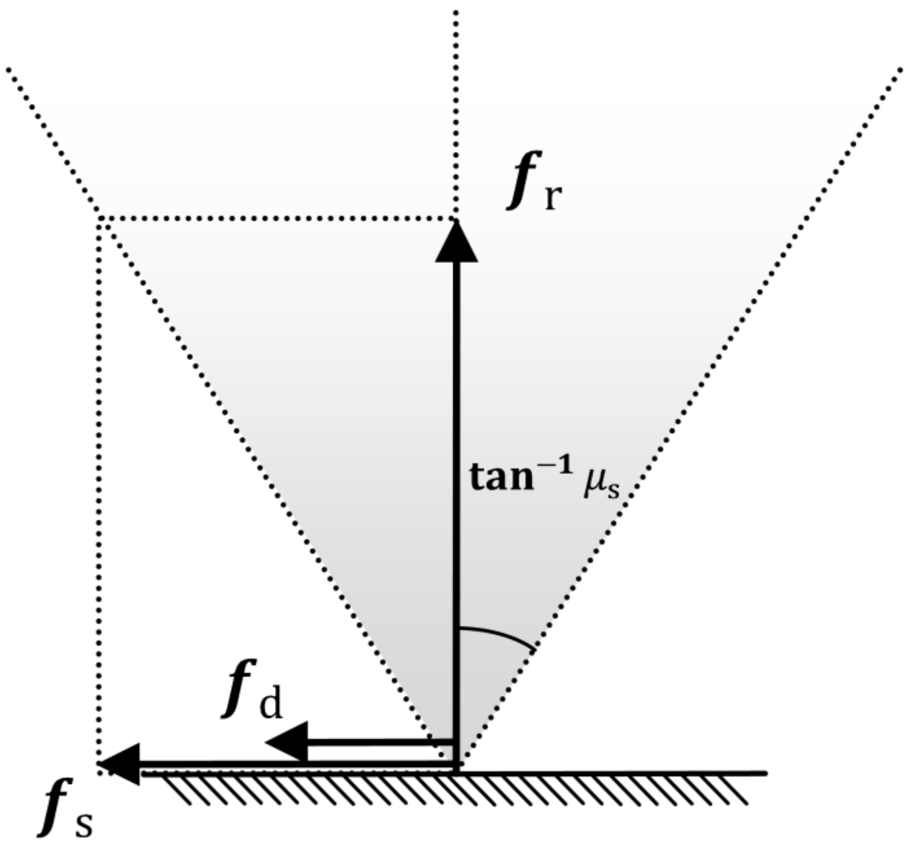
You must not share your work with other students - this includes posting any of your work in any repository that is accessible to others (such as GitHub) and applies also after you have completed the course. You must not ask coursework-related questions in online for a (such as Stackoverflow) and you must not use ChatGPT or other generative AI tools – this would constitute academic misconduct as it would be commissioning material.

By submitting the report, you are confirming that:

- It is your own work except where explicit reference is made to the contribution of others.
- It has not been submitted for any module or programme degree at Edinburgh Napier University or any other institution.
- It has not been made with the assistance of Artificial Intelligence (AI) tools.

Assessment 1: Rigid Bodies

Babis Koniaris



Introduction

The goal of this assessment is to deliver a working rigid body simulation that includes the following features:

- Works for a solid cuboid
- Collision detection with a horizontal plane
- Impulse-based collision response
- Simulates friction with a horizontal plane

Tasks

Task 1: Application of an impulse

For this task and all subsequent tasks, create a default cubic rigid body scale it by a factor of **3 along the y axis**. You will end up with a cuboid that has a width of 2, a height of 6 and a depth of 2. Assign a **mass of 2** to it.

- Output the inverse inertia matrix of the rigid body on the console [1]
- Assign an initial velocity of (2,0,0) and initial angular velocity of (0,0,0) to the solid. Do not assign any force to it. After 2 seconds, apply a single impulse to the solid so that its center of mass comes to a stop and the solid starts spinning clockwise.

Task 2: Collision detection

Task 2: Detect which vertex or vertices of a cuboid collide with the ground plane

To demonstrate your solution, output the following information to the console when a collision is detected:

- Coordinates of all colliding vertices [2]

[1] Note that you can display any glm object as a string using glm::to_string, which is part of the glm/ext.hpp library

[2] 1 if the collision is with a vertex, 2 if it's with an edge and 4 if it's with a face

- Average of all colliding coordinates [3]

Task 3: Collision response

Task 3: Simulate the collision between a rigid body (cuboid) and the ground plane using impulse-based collision response

Here are the specific simulations you will demonstrate:

- Assign an angular velocity of (0,0,0.5) to the solid and an elasticity of 1 [4]
- Assign an angular velocity of (0.1,0.1,0.1) to the solid and an elasticity of 0.7

You are welcome to demonstrate other cases too.

Task 4: Friction

Task 4: Add a model of friction to your simulation and any other operations of your own design that will make the solid stop in a realistic fashion.

The focus of this task should be to achieve a realistic simulation for an elasticity of around 0.6. You should aim to make the solid stop translating and rotating realistically. Use the theory *liberally* and *creatively* to achieve your goal.

Deliverables

Marking scheme

Here's a summary of what you need to deliver and allocated marks:

- **Task 1: Impulse application: 5 marks**
- **Task 2: Collision detection: 6 marks**
- **Task 3: Collision response (no friction): 9 marks**

[3]Hopefully you will have figured out in last week's practical that this information is mandatory to implement the collision response!

[4]this refers to the elasticity value used in the collision response impulse

- **Task 4: Collision response (w/ friction): 5 marks**

Submission details

You must submit your work using the relevant Moodle assignment by the deadline specified on Moodle. Please submit your zipped code and executable.