Physics-based Animation - SET09119

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1 Introduction

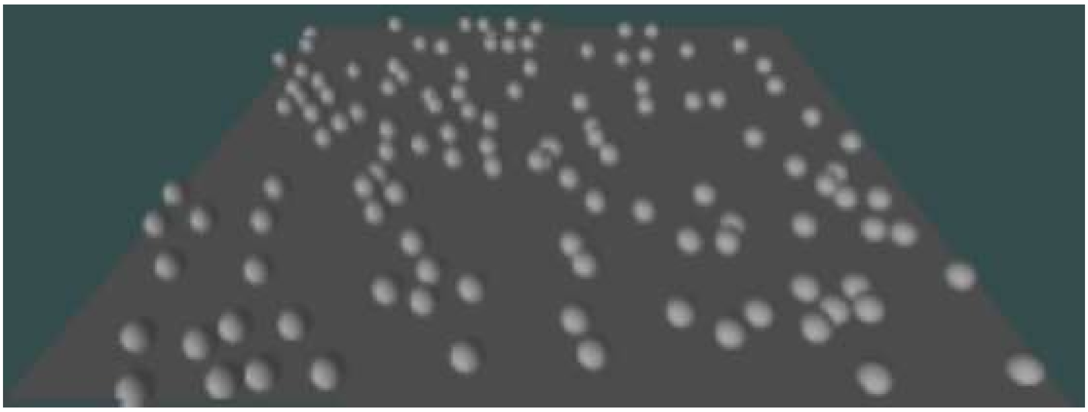
The goal of this project is to enable you to expand your practical understanding of physics-based animation techniques. The emphasis of this assignment is on the following topics:

- Collision detection
- Rigid bodies

2 Brief

This assessment can give you a total of 35 marks, distributed as 25 marks for the implementation and 10 marks for the report.

2.1 Spheres on the plane



In this project, you will create a simulation with interacting spheres moving on a table surface. The requirements are as follows:

- The spheres have a radius of 1m, and a mass of 1kg.

- The spheres use the model file resources/models/sphere.obj, which is centered at the origin and has a radius of 1.
- Simulate a number of spheres, between 10 and 30 (hint: everything can test against everything and still get smooth framerate)
- The table has dimensions of 30m $\times$ 30m.
- The table uses the model file resources/models/cube.obj, which is centered at the origin and the length of its sides is 1.
- The spheres start at random positions, as long as they are within the table's limits and on the table, and do not intersect with each other at their initial positions.
- There is an invisible wall surrounding the table, that the spheres can bounce off.
- The spheres start at random initial velocities, between -20 and 20 m/sec for each of the x and z axes.
- The delta time is 1/60 of a second
- There is no friction between the spheres and the table, and there is no friction between the spheres and the wall either.
- Only simulate positions (no rotations)
- **Extension 1** distribute randomly 3 types of spheres, the red, the green and the blue, with masses 1kg, 2kg and 3kg respectively. Simulate more than 100 (hint: use broad phase collision detection) and increase the table as needed up to ten times more.
- **Extension 2** when pressing "S", a sphere (of a random type, if extension 1 is implemented) should drop from a random XYZ position above the table. The sphere should correctly collide with the table all other spheres, and behave in a physically plausible way. Pay attention to the collision normals as they might not be parallel to the XZ plane anymore.
- **Extension 3** the 3 types of spheres in extension 1 should have have different radii: 1, 2 and 3 respectively. As above, pay attention to the collision normals.

2.1.1 Marking scheme

- The setup is correct: table and spheres with correct starting position and velocity [2 marks]
- Spheres collide correctly with wall [3 marks]
- Spheres collide correctly with each other [5 marks]
- Extension 1 (different sphere types) is simulated correctly [5 marks]

- Extension 2 (dropping spheres) is simulated correctly [5 marks]
- Extension 3 (different sphere sizes) is simulated correctly [5 marks]

2.2 Report

All the work you will complete for this project may not be apparent by running your submitted executable, and the techniques you have used won't be either. You are therefore required to document your project appropriately: present the research you have conducted and the approach(es) you have considered, chosen and implemented. Many experiments you have undertaken won't be visible in your final simulation, so make sure your report does justice to all the work you've done behind the scenes. Your report should also demonstrate your ability to reflect on your achievement in relation to concepts and techniques covered in lectures and/or researched independently. Your report should be written with LaTeXusing the Napier template available here

Your report can get you a maximum of 10 marks, out of the total of 35.

3 Collaboration and Plagiarism

This is an individual piece of assessment and the work submitted should be entirely your own. You are not allowed to collaborate with other people or to copy the work of other people.

Your coursework will be electronically checked against all other submissions. If any plagiarism is detected your coursework will not be marked. In the event of any doubt about authorship, you will be interviewed by the School of Computing Academic Conduct Officer and may be asked questions about any aspect of the work.

4 Submission

Your work will be assessed based on the following deliverables:

- Working executables
- Source code of your project
- Report

You should submit your assignment via Moodle. The assignment deliverable needs to contain the source code and everything else needed (e.g. CMakeLists.txt file) to build the project and generate an executable, including the executable. Please name your files as SET09119_<your-matric-number>.zip (rar/7z are also fine). The report should be similarly named and submitted to Turnitin separately.