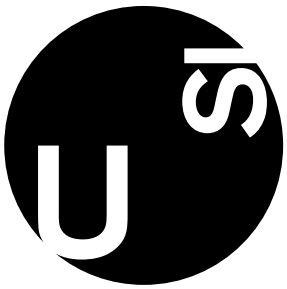

Università
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Bachelor Thesis

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From flying balls to colliding polygons

2D Physics Engine: Rigid Body Simulation

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Abstract

Physics engines are a fun and interesting way to learn about a lot of different subjects. First the theoretical concepts, such as the equations that dictate the motion of the objects, together with their components, need to be thoroughly understood. Then there is the necessity of finding a way to represent all of those concepts in a given programming language and to make them as efficient as possible so that the simulation runs fluidly. The task to be completed here was to extend an already existing physics engine that only made circles bounce off each other. The extension was focused on having the ability to generate some arbitrary polygons and make them bounce off each other in a physically accurate way. The main issues that rose up during the development of the extension: determining the inertia of a arbitrary polygon, which is important for realistic impacts; having an accurate collision detection system, which allows the engine to know when to make two polygons bounce off each other. Once those aspects were worked on and polished, the rest of the implementation went smoothly.

Advisor
Prof. Antonio Carzaniga

Advisor's approval (Prof. Antonio Carzaniga): Date:

Contents

1 Introduction

1.1 Goal of the project

The goal of the project was to extend an existing physics engine called "flying-balls"[1] by Prof. Antonio Carzaniga. This physics engine simulated the interactions between circles in a two-dimensional space. These circles appear in the window with a random position, together with a random initial velocity vector. The simulation would then just calculate the position of each circle in the following frame and draw it in its new state. If two circles were to collide with each other, the engine would detect it and make those circles bounce off each other. The resulting position and speed would be decided by the physics equations that govern the motion of such objects.

The extension this project was asked to bring is the possibility to have more complex shapes interact with each other, such as polygons. The polygons would have to be arbitrary and bounce off other polygons present in the scene.

1.2 State of the art

There are a lot of 2D physiques engines across the internet. The purpose of this project was not to bring something new to the already existing landscape, but rather learn how to complete every step of the process (polygons generation, collision detection, kinematics resolution) from scratch, simply having a pre-existing way to represent the shapes on the screen.

2 Technical Background

The technical background is all the research related to the programming part of this bachelor project. The programming language used in this project is a mixture of C and C++, for this part, the course of Systems Programming taught by Prof. Carzaniga during the third semester. Then came the study of the starting point of the project, which was divided in the logic itself and the framework used to display the state of the simulation on the screen.

2.1 Original project

Before starting to write any code, it was necessary to study carefully the original project. The starting point of chosen for this specific project was the last commit on the `c++-port` branch. The reason for this choice is that the project originally started fully in C (which is still the case for the `main` branch) and C++ offers more functionalities that help for a smoother development process.

[1] The state of the project before the extension can be found at `https://github.com/carzaniga/flying-balls/tree/c++-port`