Developing a Physics Problem Simulation Engine

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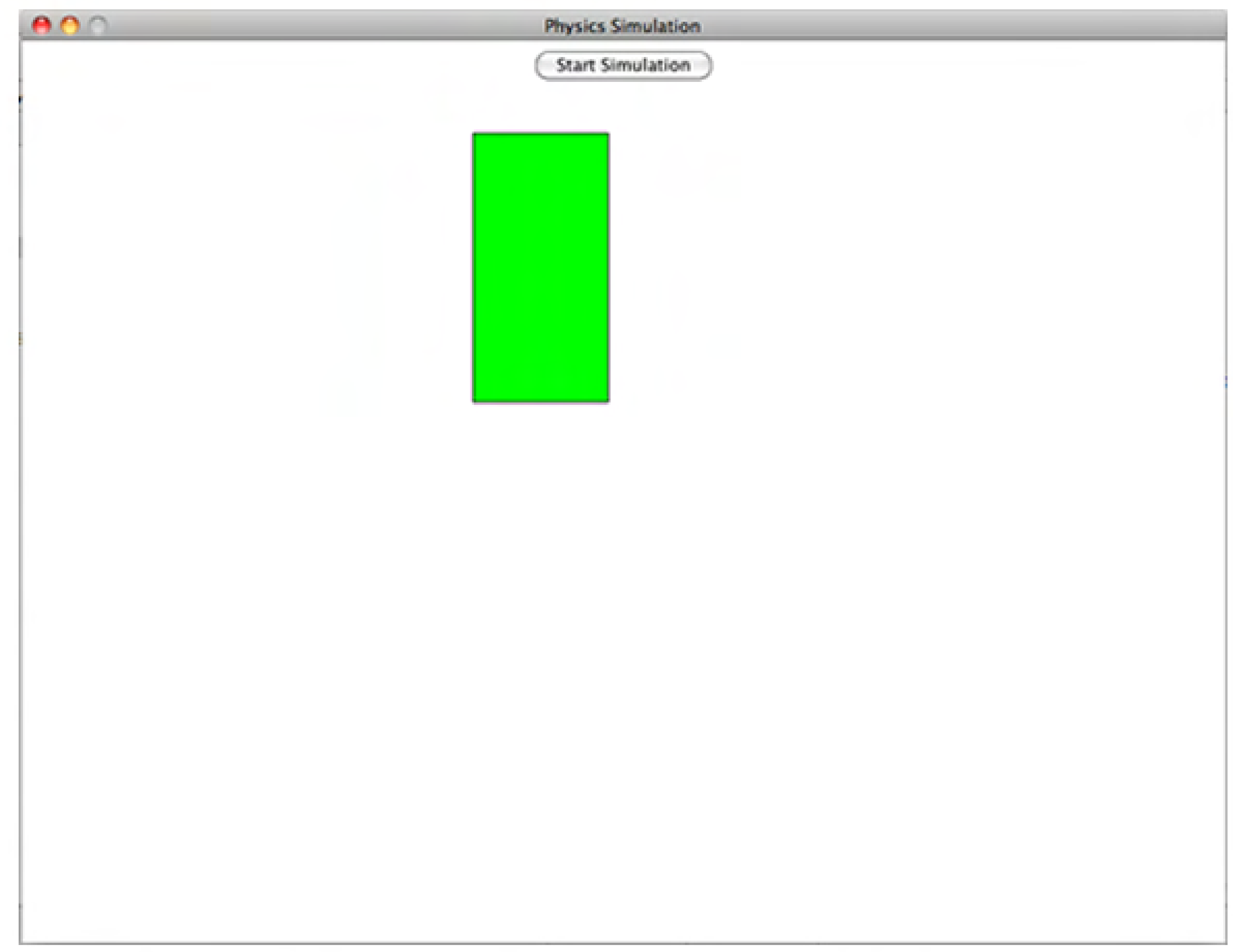
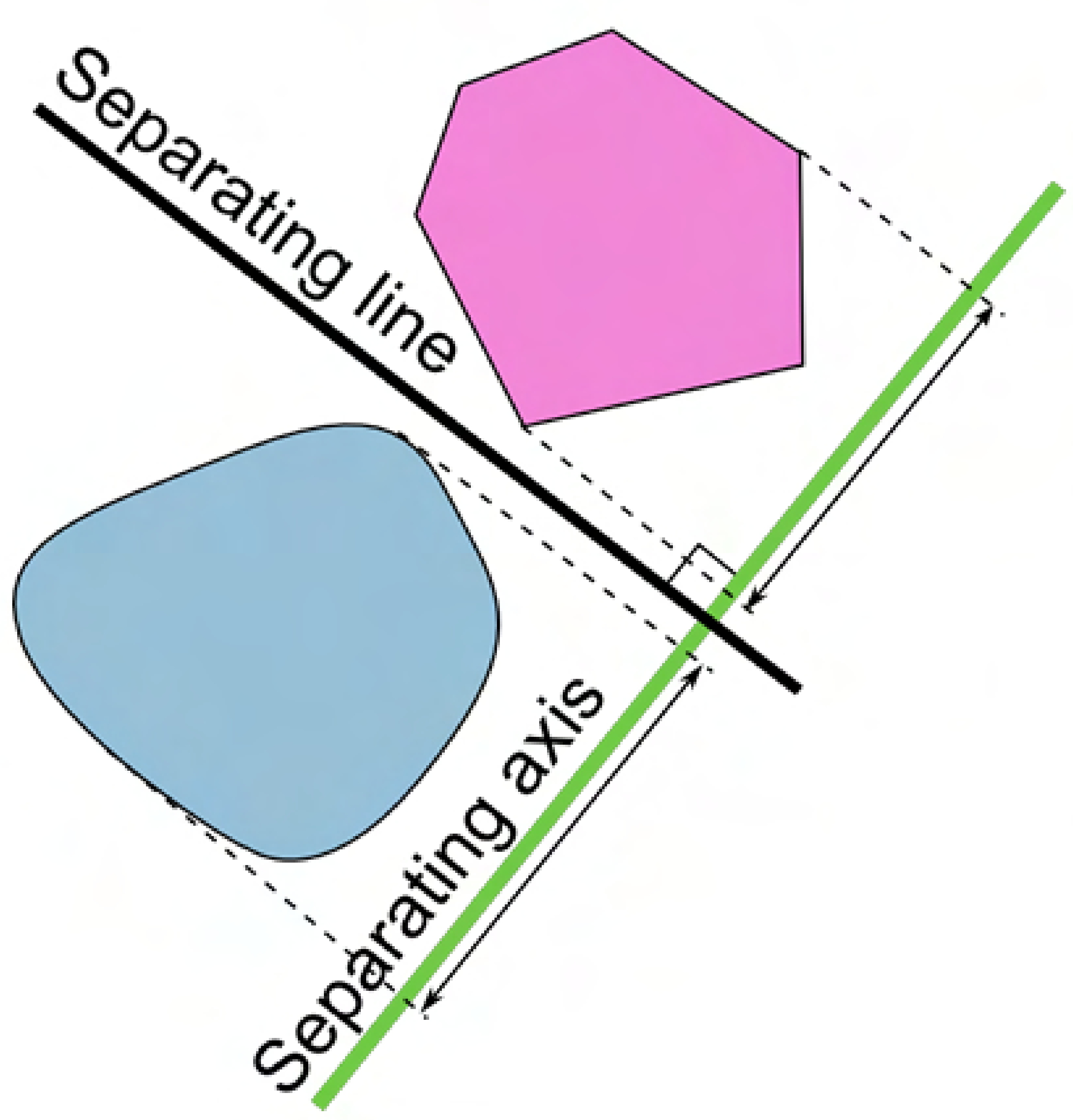
Abstract

This project will attempt to create an accurate physics simulation engine that can be used by physics students to visualize and solve physics textbook problems. The project can be broken down into two parts: the physics engine, and the simulation interface, both of which will be written in Java. The interface will allow the user to draw various physical objects, such as masses and springs, and then run the simulation to see how they interact over a time interval. The engine will utilize modern mathematical techniques, such as Runge-Kutta integration, to properly simulate physical simulations. Following the engineís completion, a variety of physics problems will be simulated, and the accuracy of the engine will be assessed.





Definition and Purpose

The proper visualization of physical situations can be a difficult process for physics students, especially beginners. It is not always possible to simulate situations using actual physical components in the classroom, and comput- ers can therefore be a very valuable tool towards helping students visualize physics problems. Furthermore, when physics problems can be visualized using a computer, specific interactions can be studied over and over again at varying speeds and perspectives, something that cannot be easily done in a classroom. The goal of this project is to develop such an accurate physics problem simulation engine, so that physical setups can be visualized on a computer, and the complex interactions between various objects can be vi- sualized.

Scope of Research and Expected Results

The physical situations simulated in this project will most likely remain in the 2D world, as moving into 3D would result in a complex simulation not well suited for the classroom environment. Initially, the projectís scope will be limited to kinematics and collision detection, but it will ultimately expand to include angular momentum and other physical phenomena. Furthermore, the interface will initially be limited to simple graphic representations of the simulation (primarily for testing purposes), but it will ultimately expand into a full-fledged drawing environment that will allow users to draw and simulate physical components. The project is expected to yield accurate visualizations of the physical situations being modeled, in addition to providing accurate data as to the state of the physical set up after a given time period.