Make a statement as to the meaning or interpretation of something, giving sufficient detail as to allow it to be distinguished from similar things.

**<Anything between pointed brackets> or states to [Delete this] around a subject and this text box must be addressed and the original template content deleted, also remember to remove the draft watermark before submitting.**

Custom Physics Documentation

nEtix library

Justin Green

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# 1.0 - Custom Physics Simulation Class Diagram

Graphical user interface

Description automatically generated with medium confidence

# 2.0 - Custom Physics Simulation Interactions

[Delete This] ***Define*** in your own words what your Custom Physics Simulation is demonstrating and ***outline*** how the physical bodies can interact together as dynamic and static objects. [/Delete This]

My custom physics simulation demonstrates most aspects of real-world physics that can be applied to a 2d environment. What this means is that real world interaction of physics bodies can be simulated together within a real-time application and interact both as dynamic and static objects.

The Netix library uses no third party physics library and allows for simulations of static and dynamic rigid bodies, applied forces to dynamic rigid bodies and the expected interaction of static and dynamic rigid bodies.

This library implements rigid bodies to simulate common objects. These objects have basic attributes such as position, mass and velocity to more advance attributes like orientation, moment, and drag both linear and angular. Static objects can also be simulated as kinematic bodies and are treated with infinite mass.

There are only 3 primitive types within this library, dynamic circles, dynamic boxes and static planes each with their own collision detection. All objects detect collision with planes by using velocities and the plane’s normal. Sphere collisions use simple radius and distance detection. The boxes are oriented bounding boxes which use extents and contact points to detect collision.

Netix uses the concepts of Newton’s three laws of motion to provide a realistic model of physics implementation. These laws are applied by treating rigid bodies as a single point mass and finding the acceleration of the point for given forces by dividing the force by the mass which provides acceleration that can be used to calculate the objects movement.

Newton’s laws are also applied to the collision resolution between two physics bodies. When it comes to collision resolution the conservation of momentum is used as a core concept and a key indicator for the accuracy of applied impulsive forces and the collision normal for objects. This ensures expected interaction between both rigid and static bodies.

The Netix library demonstrates a physics simulation for a 2d environment through the implementation of dynamic and static rigid bodies, accurate application of force and by displaying the expected interaction of two physics objects.

# 3.0 - Custom Physics Simulation Potential Improvements

[Delete This] The objective of this simulation is to demonstrate static and dynamic objects interaction in 2D space. ***Examine*** what improvements you could make to your simulation; this could be to:

* Support further features.
* provide a more accuracy.
* Make it more precise.
* Improve the quality.

(This refers to custom physics simulation library you are creating, not directly the game you have created. These are not always mutually exclusive however.) [/Delete This]

Although the Netix library can provide for accurate enough physics simulations, there are a couple of improvements that can be made to improve accuracy and efficiency of the simulations being made, such as the implementation or toque and quadtrees.

## 3.1 - Improvement #1: Torque

In Netix there are many rotational equivalents to translational physics equations, this can also occur in force. Force alters translational motion of objects, there is a rotational counterpart to this called torque which alters the rotational motion of an object around an axis.

Implementing force means the implementation of three main concepts; the further force is applied from an objects axis of rotation the more angular acceleration there is, effectiveness of force depends on the angle of which the force is applied and force magnitude must be involve. Another thing to note is that torque is either clockwise or counterclockwise relative of the object’s pivot point. Torque can be calculated by multiplying applied force by the perpendicular distance from the rotational axis to the line of action of the force.

## 3.2 - Improvement #2: Quadtrees

Performing collision checks against every object in a scene every frame can get quite costly, this is where quadtrees can become useful. Quadtrees are partition based data structures (sometimes referred to as bounding volume hierarchies), which recursively subdivide equal amounts of space into smaller sections using trees, nodes and leaves.

Quadtrees specifically are subdivided into four smaller squares at each recursive step and can be implemented as a collision detection by storing objects within leaves of the quadtree. These objects are inserted into these leaves by checking if the object intersects with a node, then recurses until leaf level is reached, and are then added to the collection. Collision detection occurs when exacting the steps to insertion however the object is tested for collision against all objects the collection

# 4.0 - Visualised Game Using Your Custom Physics Simulation

[Delete This] ***Define*** what your visualisation (chosen game) is and then ***explain*** how you created it and how it works. (Include Image/s). [/Delete This]

Make a statement as to the meaning or interpretation of something, giving sufficient detail as to allow it to be distinguished from similar things.

The visualised physics simulated game I created using my custom physics library was Eight Ball pool, as this game is an ideal framework that showcases basic laws of physics while also providing an enjoyable experience.

# 5.0 - Third Party Libraries

[Delete This] ***Identify*** and ***explain*** third-party non-physics libraries used, if any. Otherwise ***identify*** why none where used [/Delete This]

1. AIE bootstrapper

# 6.0 - References

[Delete This] List of references and research material used to influence the creation of your custom physics simulation and where you researched to improve the quality of the system.

Use the Harvard Citation Method to cite books and websites used. Here is a link to a good citing website if you are unsure how to do so <https://www.citethisforme.com/citation-generator/harvard> [/Delete This]

Moebs, W., Sanny, J. and Ling, S.J. (2016) 10.6 torque - university physics volume 1, OpenStax. OpenStax. Available at: https://openstax.org/books/university-physics-volume-1/pages/10-6-torque (Accessed: February 21, 2023).

Ericson, C. (no date) Real-time collision detection. Amsterdam: Elsevier.