

Scientific Computing - Assignment 1

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Introduction

As our first assignment in the Scientific Computing course, we were given an assignment, where we should create a Processing program, which displays the motion of several objects, by using vectors for forces, acceleration, velocity, and position.

I chose to simulate some fish, who randomly swims around in the sea. These fish have a colour, a position and a velocity.

There will also spawn sharks at random position. These shark enters the water and swims through the fishes. The fishes should react and swim away from the shark.

Solution

Since I needed fishes and sharks, I made a class for each. These are stored in arraylists. There is a small explanation for each of the classes below.

Fish

The fish is defined by a randomly generated colour and a mass. The mass affects the maximum speed, in which the fish can move, the size, and the how well it's affected by the forces.

Since the fish was supposed to move around randomly, I generated waypoints for them. These waypoints are randomly generated, within a radius of the fish's current location. The waypoint attracts the fish, by drawing a vector between them. The vector's magnitude, which represents the force, is calculated with the following equation: $F = strength / (distance * distance)$.

The equation is based on the repeller class, from the "*particle_system_with_repellers*" program, provided during the course.

According to Newton's second law, $F = m * a$, the force applied is equal to the mass multiplied by the acceleration. The movement of the fish, is applied by adding an acceleration vector to the velocity vector. The acceleration vector is calculated, by dividing the mass with the applied force vector. This way, the fish will get smooth movement, based on nearby forces.

Shark

The shark functions as a repeller. It works the same way, as the waypoints attraction, except that it repels the fish, by adding a negative force. This is done, by multiplying the force with -1 . This pushes the fish away from the shark.

The sharks spawn randomly on one of the edges. This is done with a switch. Based on the side the shark spawns on, it gets an angle, in which it moves along in a straight line. The angle is randomly generated within 90° , and another 45° , relative to the spawn side, is added. For instance a shark

spawning on the eastern side, would have an equation like this: $135 + \text{random}(90)$, meaning it moves towards the west.