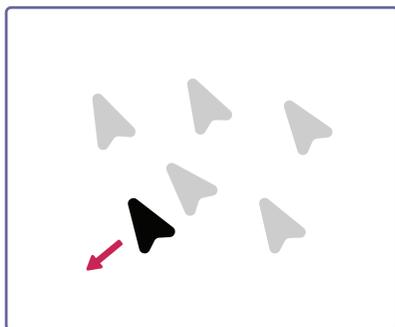
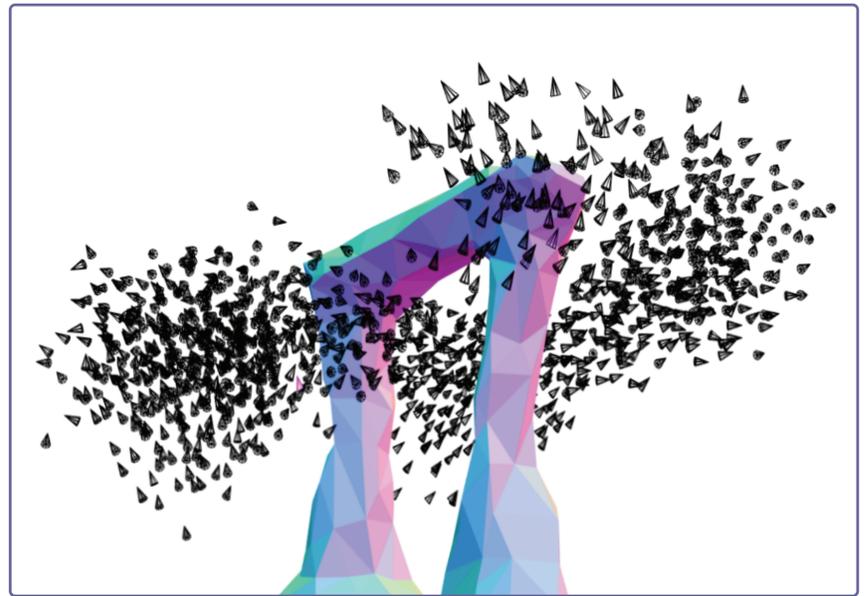


Simulating the Movement of Fish Schools

Project demo page: vetemaa.github.io/fish-simulation

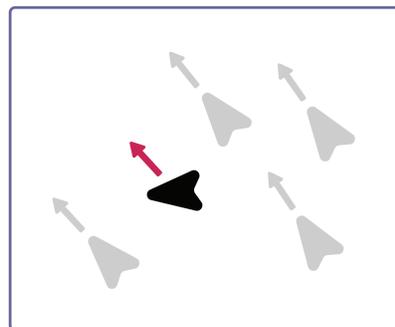
Introduction

Swarm behaviour is widespread in the animal kingdom. It occurs in groups of birds, bees and countless other animals - even humans. The goal of this project was to simulate the swarming behaviour of fish. More specifically, the schooling behaviour of fish, which refers to coordinated swimming. The developed schooling simulation is based on the Boids algorithm that Greg Reynolds published in 1987. The algorithm consists of three rules that each individual of the group will follow. These rules are separation, alignment and cohesion. In this project, these rules were implemented and additional rules for random direction, predator avoidance and obstacle avoidance were developed.



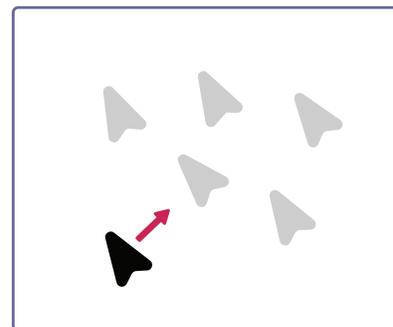
Separation

Separation means that the fish avoids collisions with neighbouring fish. The steering vector for separation is created using vectors from neighbouring fish to the position of the fish.



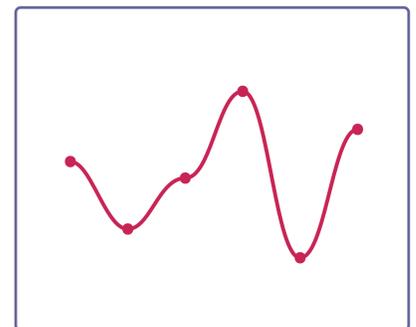
Alignment

Alignment means that the fish matches its direction with its neighbours. The steering vector for alignment is created using the velocity vectors of the neighbouring fish.



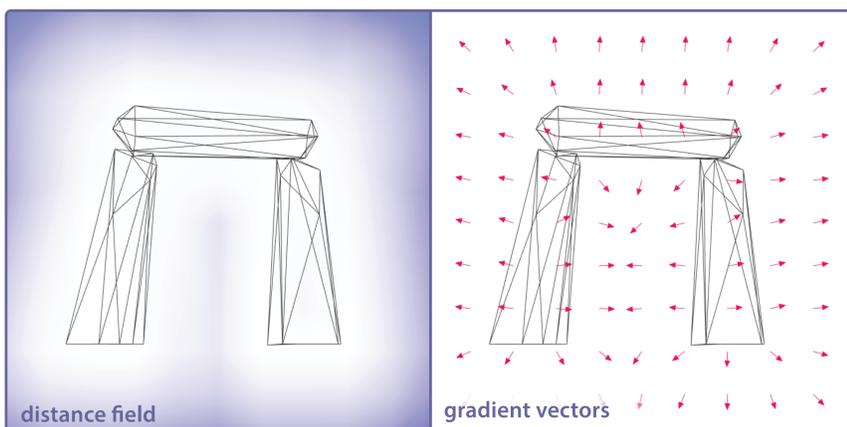
Cohesion

Cohesion means that the fish moves towards other fish. The steering vector for cohesion is created using vectors from the fish to its neighbours.



Random direction

Random direction means that the fish is steered towards a random direction. The steering vector for random direction is created using 1D noise functions as the components of the vector.



Obstacle avoidance

Obstacle avoidance means that the fish steer away from collisions with obstacles. The steering vector for this is created using the distance field of the scene. The distance field is a function that outputs the distance to the closest obstacle for each point in the field. To steer away from obstacles, fish swim in the direction in which values of the distance field increase the fastest. This direction is found using the gradient of the distance field.

Conclusion

The created simulation mimics the real schooling behaviour of fish quite well. The developed algorithm can be used for animating the movement of fish schools which could be useful for films and video games.

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