Starling Flocking Simulation

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1 Introduction

Our aim is to model and simulate this fascinating phenomenon of flocking in starlings. These birds follow certain rules which lead to beautiful patterns in the sky and in this assignment we have displayed their movement and calculated their peak and mean energies. From the perspective of the mathematical modeller, "flocking" is the collective motion of a large number of self-propelled entities and is a collective animal behavior exhibited by many living beings such as birds, fish, bacteria, and insects.[1] It is considered an emergent behavior arising from simple rules that are followed by individuals and does not involve any central coordination.

2 Rules

The following are the main rules-

- **Separation** avoid crowding neighbors (short range repulsion)
- **Alignment** steer towards average heading of neighbors
- **Cohesion** steer towards average position of neighbors (long range attraction)

3 Range

Each boid has direct access to the whole scene's geometric description, but flocking requires that it reacts only to flockmates within a certain small neighborhood around itself. The neighborhood is characterized by a distance (measured from the center of the boid) and an angle, measured from the boid's direction of flight. Flockmates outside this local neighborhood are ignored. The neighborhood could be considered a model of limited perception (as by fish in murky water) but it is probably more correct to think of it as defining the region in which flockmates influence a boids steering.

4 Features

We have added obstacles and predators to our simulation. These can be produced at a point by a right or left click. When a predator comes in the vicinity of a boid then the rule of avoiding a predator gets the highest priority and the boid moves accordingly. The same holds for an obstacle. The obstacles are static and the predator follows a random motion.

5 Implementation

We have used the data,event core and opengl sections of the processing library for java. For each boid we maintain the velocity. The acceleration is calculated from the rules and their weights and consequently I can determine the next state for all boids with a new position and new velocity. For adding more birds efficiently threading can be done smartly. In flocking simulations, there is no central control; each bird behaves autonomously. In other words, each bird has to decide for itself which flocks to consider as its environment. Usually environment is defined as a circle (2D) or sphere (3D) with a certain radius (representing reach).

A basic implementation of a flocking algorithm has complexity big oh of n squared(each bird searches through all other birds to find those which fall into its environment).