

CS250 Final Project Proposal: Boids - A Swarm Intelligence Model

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November 23, 2016

1 The Boids Distributed Behavior Model

1.a Motivation for the model

My final project aims to implement the boids model of swarming, created by Craig Reynolds to generate graphics of a flock of birds for animation in motion pictures. Instead of specifying the path of individual agents, the modeler specifies the behavior of each agent.

1.b The Boids Model

Components in the boids model include

Movement. The mechanism of movement in the boids model is 3D geometric flight. In terms of coordinates, the model contains both global coordinates and local coordinates (perception and action are localized). In terms of actions, the basic operations include roll (rotate around the z-axis, used for banking), pitch (rotate around the x-axis), and yaw (rotate around the y-axis).

Behaviors. The three basic behaviors specified by the boids model are collision avoidance, velocity matching, and flock centering, in order of precedence. Collision avoidance and velocity matching both have an effect of avoiding collision with flocking mates. Flock centering means an agent moves toward the centroid of nearby flockmates. In addition, the acceleration of the flock is the average of agents' acceleration.

Localized Perception. In the boids model, an agent's environmental variables include the position, shape, and velocity (and even intention, see subsection Deliberation, Intentions, and Emotions) of nearby flockmates within the agent's sphere of vision.

Obstacle evasion. A crucial feature of the flock is group collision evasion of environment obstacles. Use steer-to-avoid to localize this behavior.

2 Exploring and Extending the Boids Model

2.a Flying Between Skyscrapers

A basic task for a flock is navigating metropolitan landscapes. Implement the basic model and move the flock along city streets. Assume skyscrapers are infinitely tall.

2.b Deliberation, Intentions, and Emotions

The existing boids model is reactive, using a set of predetermined instructions to plan the next action. Use "emotions" with Markov Chains to implement the Belief-Desire-Intention behavioral model.

References

- [1] Flocks, herds and schools: A distributed behavioral model,
<http://dl.acm.org/citation.cfm?id=37406>