

"Useful" Robot Collaboration from Local Rules

Raúl Sosa San Frutos
Irene Cortés Lafuente
Adrián Hernández Gimeno

February 15, 2017

CONTENTS

- 1 INTRODUCTION
- 2 SWARMING
- 3 IMPLEMENTATION
 - Overview
 - From Local Rules to Collective Behavior
- 4 DEMONSTRATION
- 5 FUTURE WORK
- 6 QUESTIONS

Introduction

Objectives

- Model a swarm of robots in an large virtual environment
- Implement collective behavior rules
 - Cohesion
 - Separation
 - Alignment
- Include reaction triggering events
 - Predator attack
 - Response to food

Swarming

Swarm intelligence (SI)

Sometimes used as a synonym of collective intelligence is the collective behavior of decentralized, self-organized systems, natural or artificial.

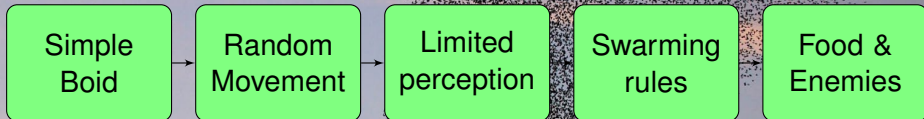
Gerardo Beni and Jing Wang in 1989, in the context of cellular robotic systems.

Inspiration

Swarming, Flock of birds, Fish schools, Colony of Ants ...

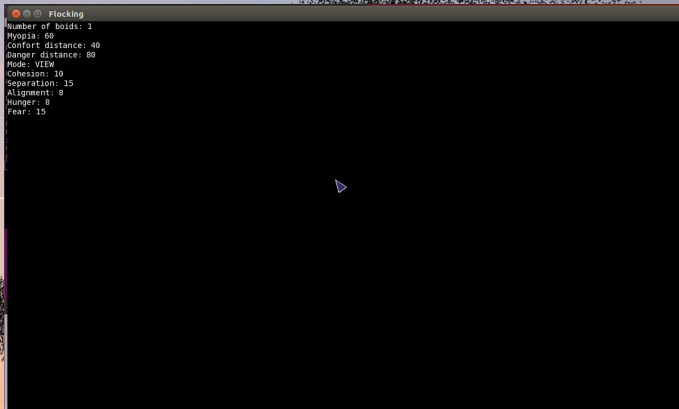
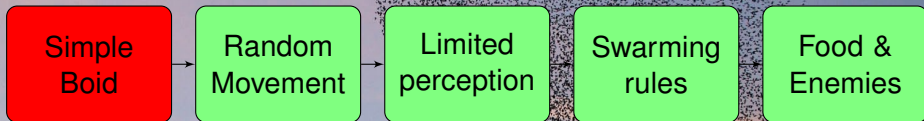


Implementation - Overview

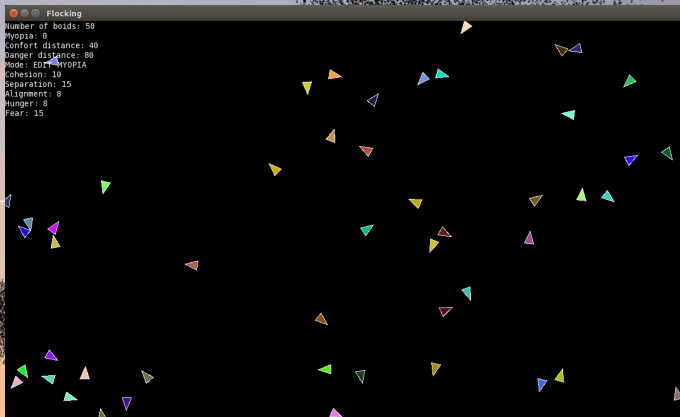
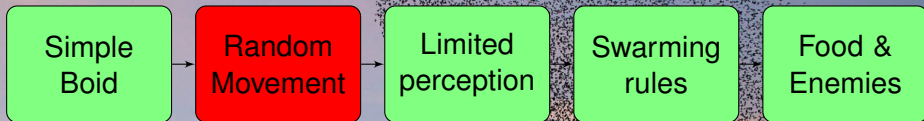


Coded in C++ using OpenCV libs & SFML libs
If you want to see more of this, check out Github repository
<https://github.com/sirselki/Boids>

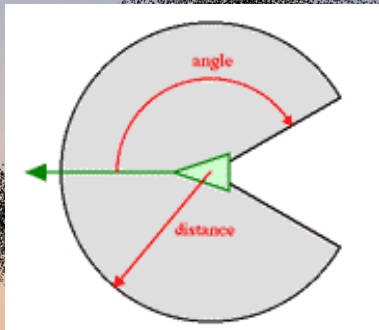
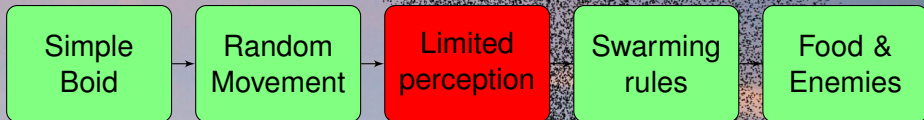
Implementation - Overview



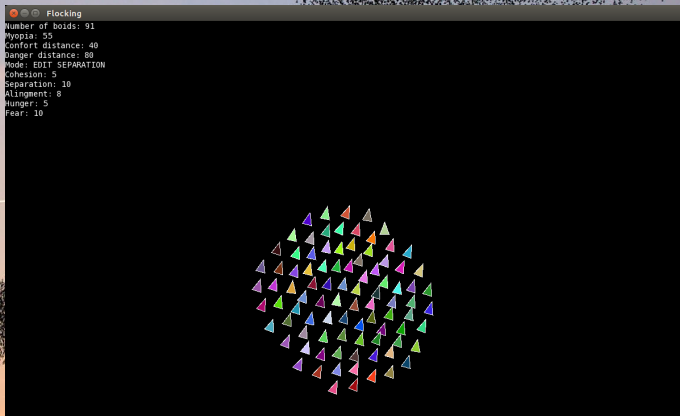
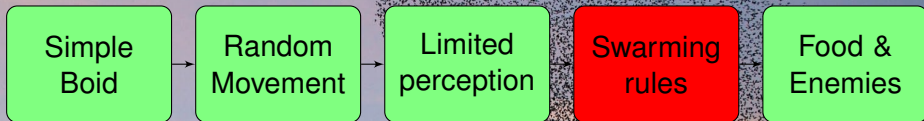
Implementation - Overview



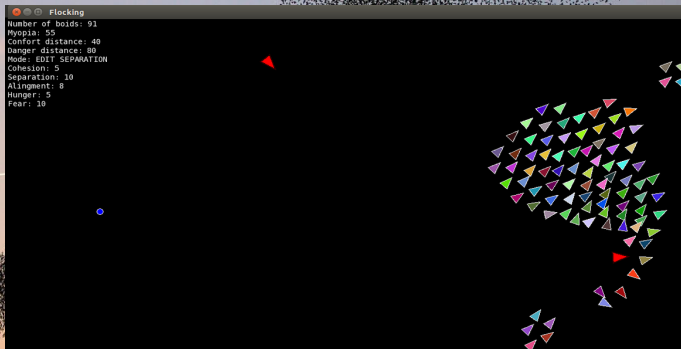
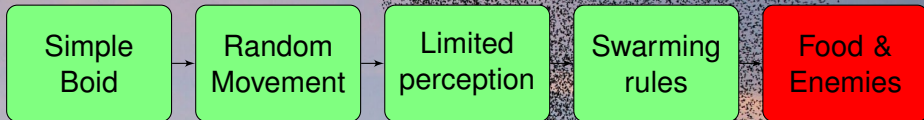
Implementation - Overview



Implementation - Overview



Implementation - Overview



From Local Rules to Collective Behavior

Rule 1: Cohesion

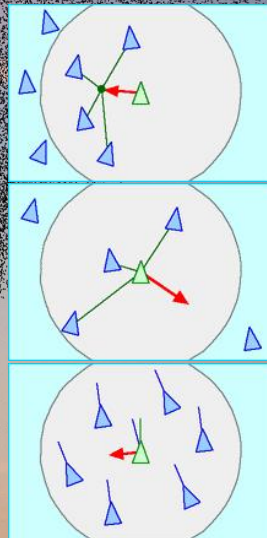
Steer towards the average position of local flockmates

Rule 2: Separation

Steer to avoid crowding local flockmates

Rule 3: Alignment

Steer towards the average heading of local flockmates

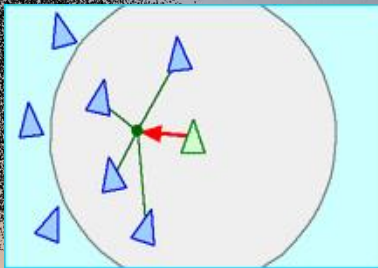


From Local Rules to Collective Behavior

Rule 1: Cohesion

Steer towards the average position of local flockmates

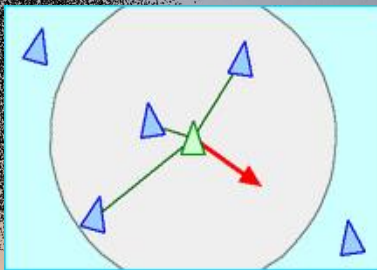
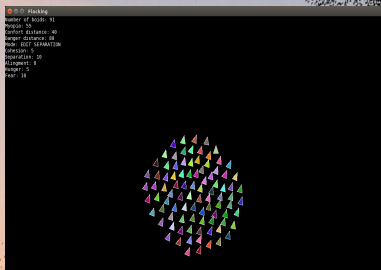
```
Flackin  
number of birds: 51  
position: 50  
cohesion distance: 40  
cohesion strength: 0.8  
cohesion: 5  
separation: 20  
alignment: 1  
separation: 5  
separation: 10
```



From Local Rules to Collective Behavior

Rule 2: Separation

Steer to avoid crowding local flockmates



From Local Rules to Collective Behavior

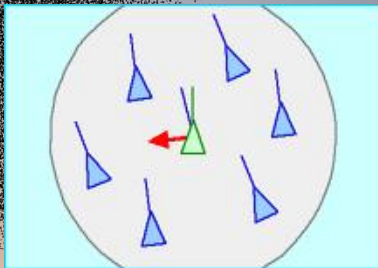
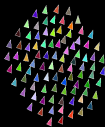
Rule 3: Alignment

Steer towards the average heading of local flockmates

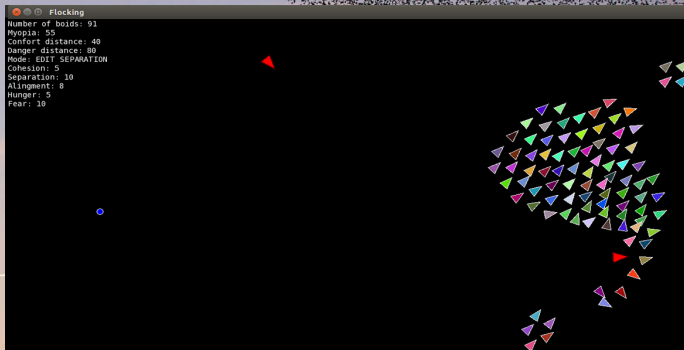
```

@(#) flocking
number of birds: 51
velocity: 50
current distance: 40
wigner distance: 10
max. dist. to flock: 100
cohesion: 5
separation: 10
alignment: 5
wigner: 5
step: 10

```



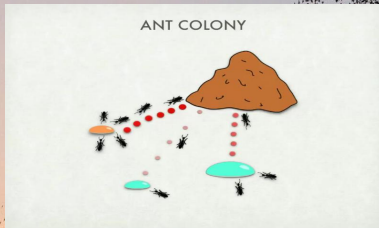
DEMO



Future Work

Possible future improvements and advances

- Make the simulation 3-dimensional
- Modify the purpose of the swarm
 - Food gathering (Ant Colony)
 - Group building (termites)



A large flock of birds, possibly starlings, is captured in flight against a soft, hazy sunset sky. The birds are concentrated in a large, dense V-shape that points towards the bottom left of the frame. The sky transitions from a pale blue at the top to a warm orange and yellow near the horizon. The overall mood is serene and natural.

ANY QUESTIONS ?

Thanks for watching, and thanks for the opportunity of engaging with this international project and the ShanghAI lectures.