Multi-robot navigation in cluttered and dynamic environments

Distributed intelligent system 2019

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Introduction

- Flocking in nature
- Methods for mobile robots
- Goals of the project
Obstacle avoidance

Braitenberg Algorithm

- Smooth avoidance
- Very robust
- Require a fine tuning of the weights to work well
Flocking behavior

Reynold’s rules

- Cohesion
- Dispersion
- Consistency

Flexible behavior
Particle swarm optimisation

Has to optimise the metrics given for the project

- Velocity
- Cohesion
- Orientation

Our implementation didn’t give proper results.
Obstacle simulation

Parameters:

Aggregation: 0.20, weight: 1.6/10
Dispersion: 0.12, weight: 0.01/10
Consistency weight: 3.2/10
Migration weight: 0.02/10

Braitenberg:
{12,23,27,8,6,−30,−44,−60,−57,−46,−28,6,8,28,22,14}
Demonstration:

- Obstacle

https://youtu.be/X3QDcK9PBY0
Crossing simulation

Parameters:

Aggregation: 0.15, weight: 0.9/10
Dispersion: 0.08, weight: 0.01/10
Consistency weight: 3.0/10
Migration weight: 0.01/10

Braitenberg:
\{15,29,34,10,8,-38,-56,-76,-72,-58,-36,8,10,36,28,18\}
Demonstration: Crossing

https://youtu.be/A-4UQpd5TSw
- From Webots to the real epucks.

- Real world very different from the simulation

Challenges:

- Limited Communication
- Receiver only / Emitter only problem
- Lots of calibration is needed for good performance
Demonstration:

- Obstacle avoidance

- Very good performance with 2 epucks
Demonstration:

- Obstacle Avoidance

(3 epucks: Communication problems. One epuck receives fewer messages)
Conclusion

Braitenberg easy to implement
Reynolds very fine to tune
PSO didn’t give good results
Simulations results are acceptable, but not optimal
Use a Finite State Machine for Reynolds + Braitenberg
Real world implementation has to be done once the simulations give proper results
Thank you for your attention!

Questions?