Semester Project
Study of new Roombots modules

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0. Overview

1. Introduction
2. The Modules
3. The Controllers
4. Modules' Fitness
5. Macro-Movements
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1. Introduction

- Part of the *Roombots* project
  - Searching for a suitable basic module
  - Analyzing the movements of the best module
- Starting from scratch
2. The Modules

- Five different modules
  - Four proposed by Dr. Asadpour

- Have cubic shape
  - Dense and compact structure
  - Moving eased
2.1 Cube1

- 1 DoF
- 2 rotating faces
- No angular limitations
- 1 Connector per face
2.2 Cube2

- 3 DoF
- 6 rotating faces
- Angles in [-180, 180]
- 4 Connectors per face
2.3 Cube3

- 3 DoF
- 3 rotating faces
- No angular limitations
- 1 Connector per face
2.4 Cube4

- 3 DoF
- 3 moving faces
- Distance in [0, 1]
- 1 Connector per face
- Did not pass the tests
2.5 Cube5

- 2 DoF
- 2 rotating cubes
- No angular limitations
- 4 Connectors per face
- Not used in tests
3. The Controllers

- Decentralized controller
  - Closer to ideal solution
  - Finite state machine

- Centralized controller
  - Easier to use
  - Supervisor with file parser

- ODE plugin
4. Modules' Fitness

- Five movements
  - T1: Straight forward
  - T2: Turn 90° left
  - T3: Turn 90° right
  - T4: Turn 90° up
  - T5: Turn 90° down

- Two environments
  - Passive structure
  - Active structure

\[ \text{cost} = \text{servos} \times \text{actions} \]
## 4.1 Fitness Results

<table>
<thead>
<tr>
<th>Module</th>
<th>Passive Structure</th>
<th>Active Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T1</td>
<td>T2</td>
</tr>
<tr>
<td>Cube1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Cube2</td>
<td>4</td>
<td>80</td>
</tr>
<tr>
<td>Cube3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
5. Macro-movements

- Cube2 selected
  - Self-reconfiguration ↔ Active structure

- Deduced from a piece of furniture
  - Sequence file

- Five movements found
5.1 Macro-movements Results

- M1
- M2
5.1 Macro-movements Results

- **M3**

- **M4**
5.1 Macro-movements Results

M5
6. Conclusion

- Cube2 is promising
  - Difficult to construct?
- Cube3 is not more powerful than Cube1!
- Developed useful tools
  - Ease the work with *Roombots* modules
- Macro-movements ↔ self-reconfiguration
Thank you!