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
6. Conclusion

1. Introduction

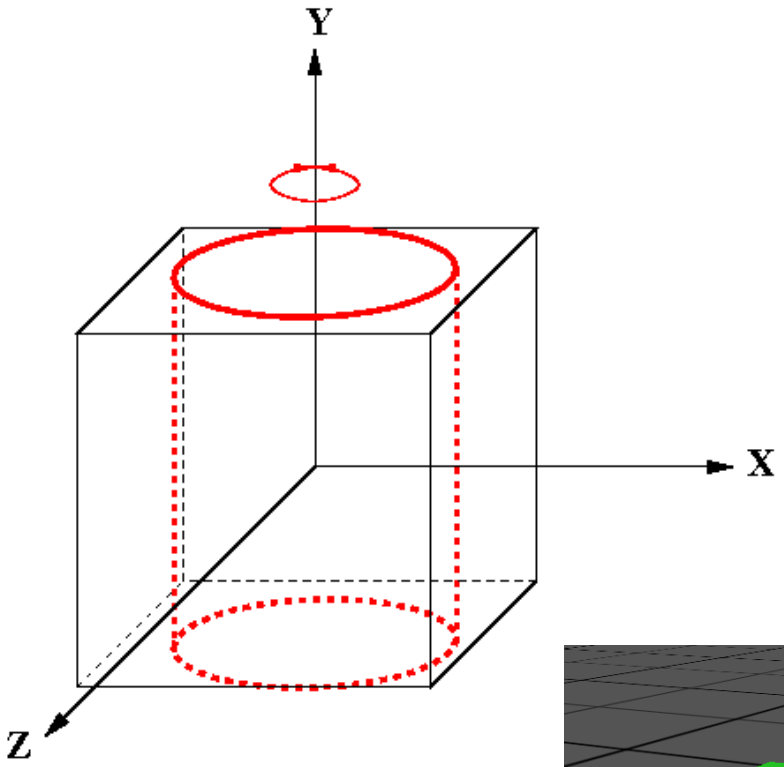
- Part of the *Roombots* project
  - Searching for a suitable basic module
  - Analyzing the movements of the best module
- Starting from scratch

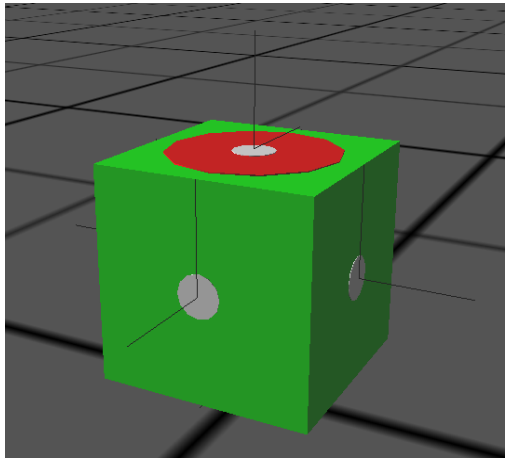
2. The Modules

- Five different modules
  - Four proposed by Dr. Asadpour
- Have cubic shape
  - Dense and compact structure
  - Moving eased

2.1 *Cube1*

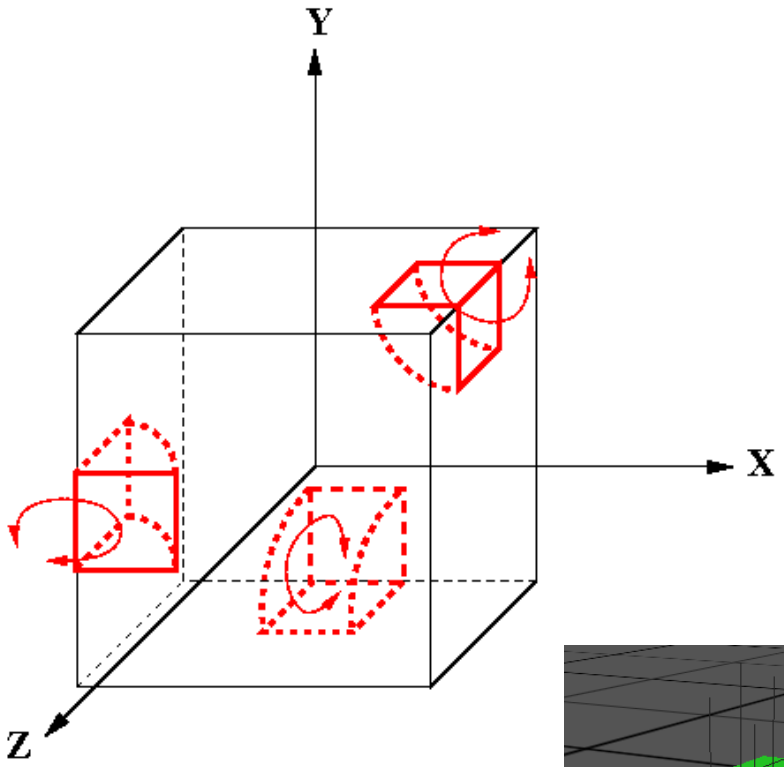
- 1 DoF
- 2 rotating faces
- No angular limitations
- 1 Connector per face

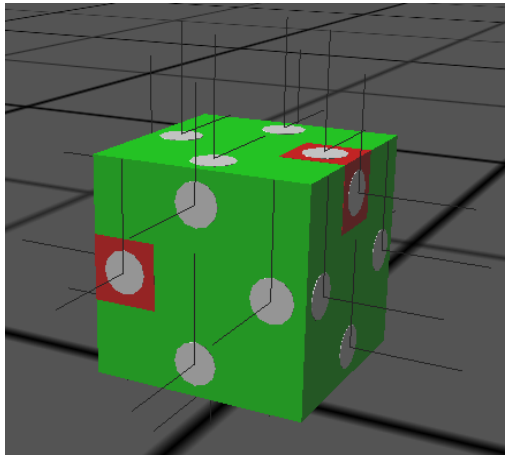




2.2 *Cube2*

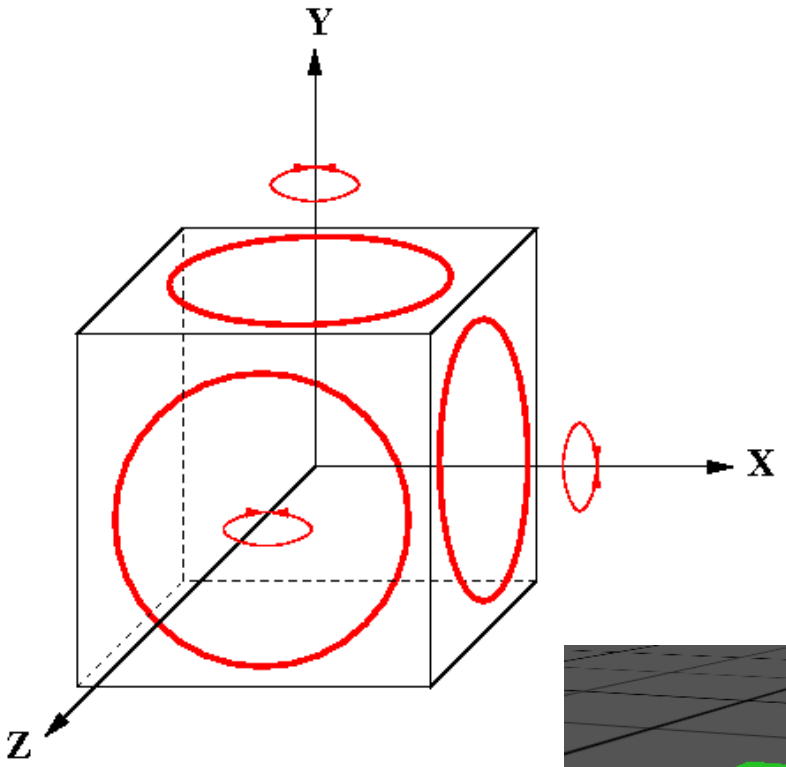
- 3 DoF
- 6 rotating faces
- Angles in [-180, 180]
- 4 Connectors per face

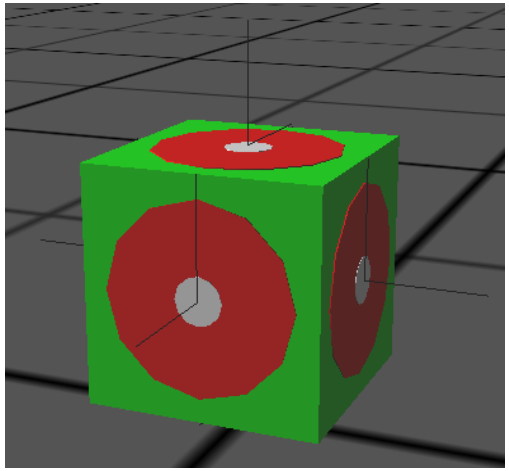




2.3 *Cube3*

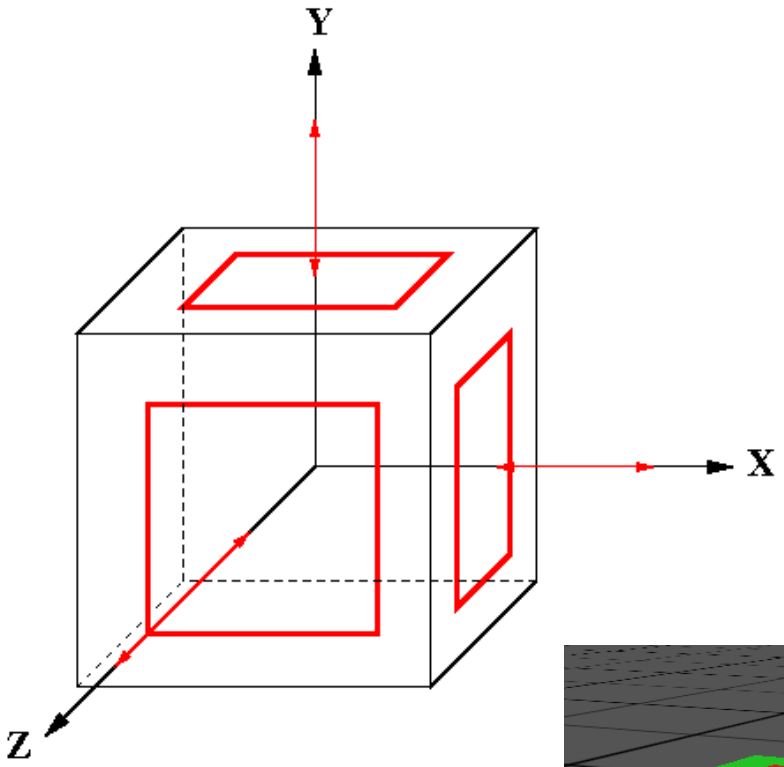
- 3 DoF
- 3 rotating faces
- No angular limitations
- 1 Connector per face

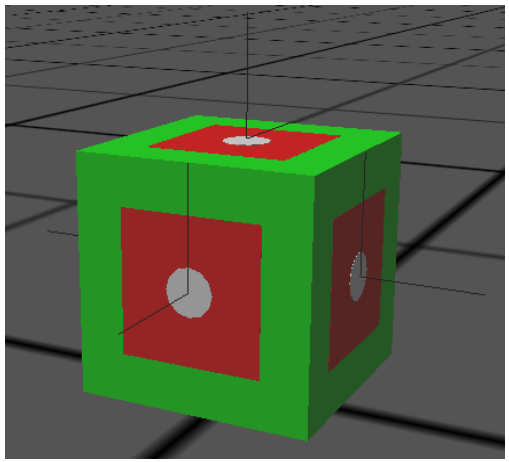




2.4 *Cube4*

- 3 DoF
- 3 moving faces
- Distance in [0, 1]
- 1 Connector per face



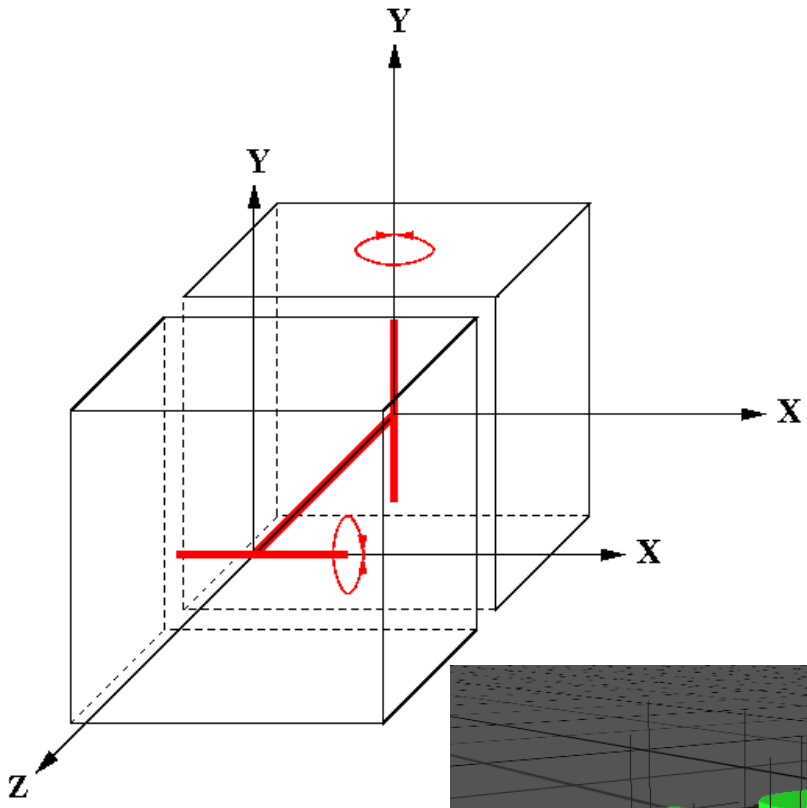


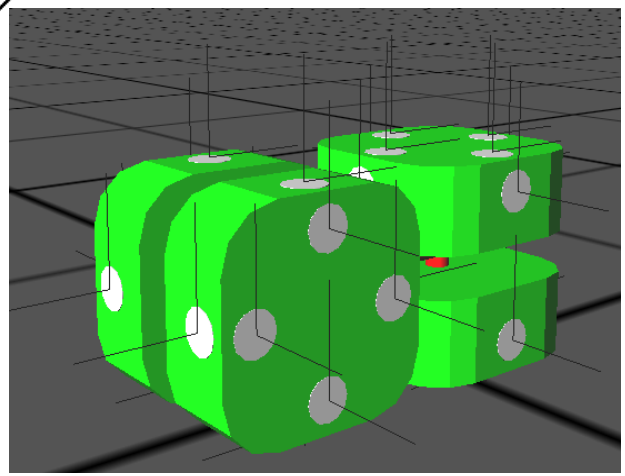
- Did not pass the tests

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

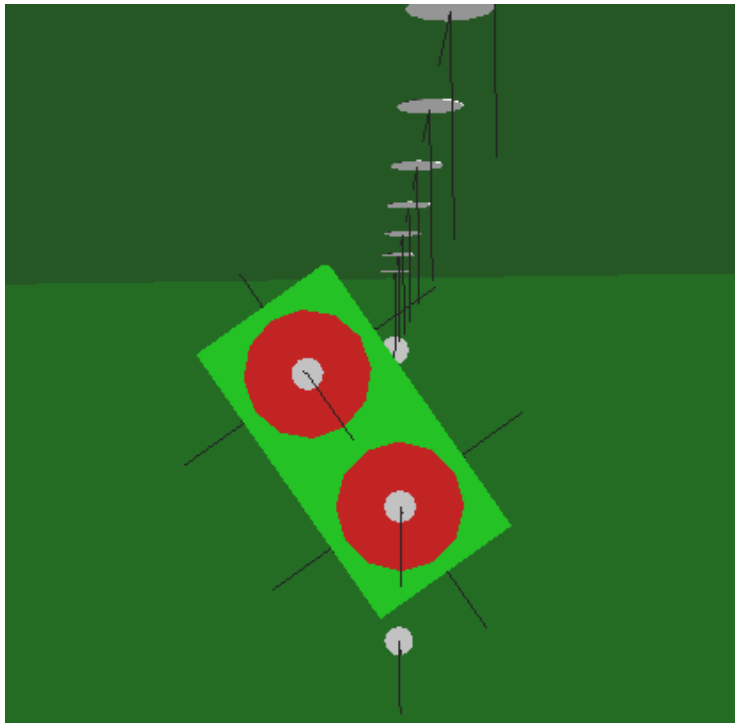
- Five movements
  - T1: Straight forward
  - T2: Turn 90° left
  - T3: Turn 90° right
  - T4: Turn 90° up
  - T5: Turn 90° down

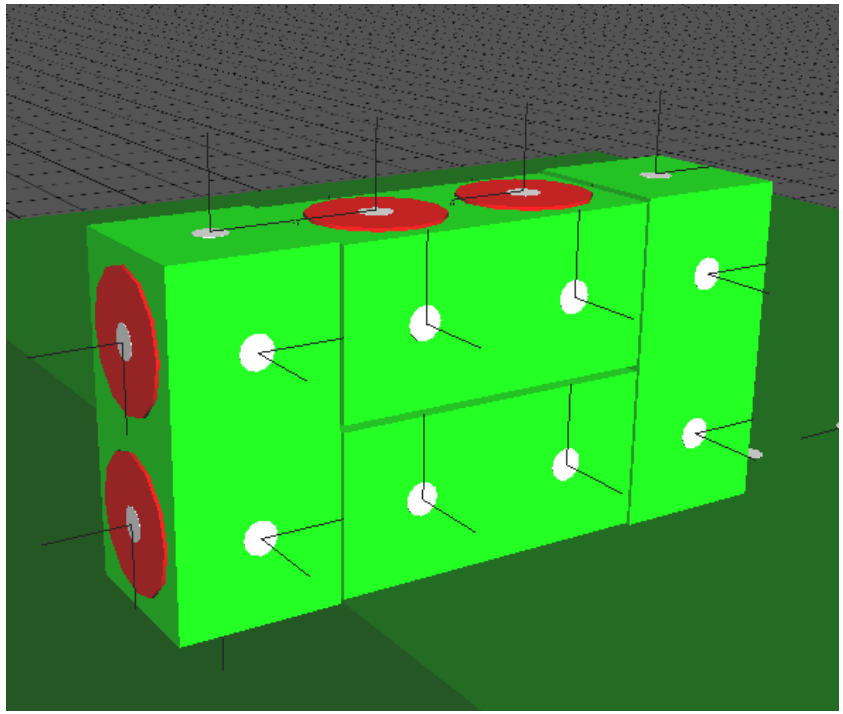
$$cost = servos * actions$$

- Two environments
  - Passive structure
  - Active structure

4.1 Fitness Results

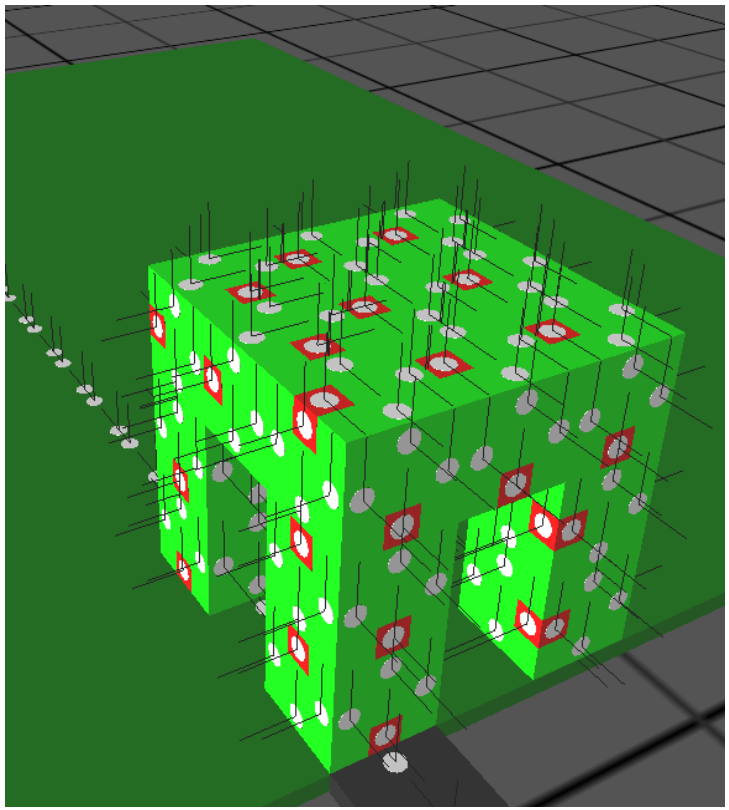
Module	Passive Structure						Active Structure					
	T1	T2	T3	T4	T5	Total cost	T1	T2	T3	T4	T5	Total cost
Cube1	2	1	1	X	X	4	10	1	1	16	12	40
Cube2	4	80	80	0	2	166	20	2	2	0	15.5	39.5
Cube3	2	1	1	X	44	48	10	1	1	16	12	40





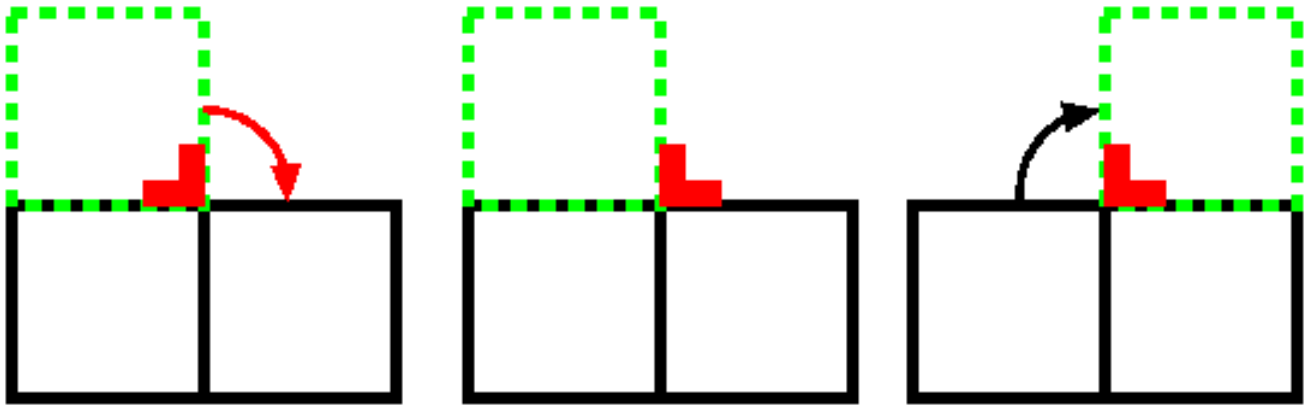
5. Macro-movements

- Cube2 selected
  - Self-reconfiguration ⟺ Active structure
- Deduced from a piece of furniture
  - Sequence file
- Five movements found

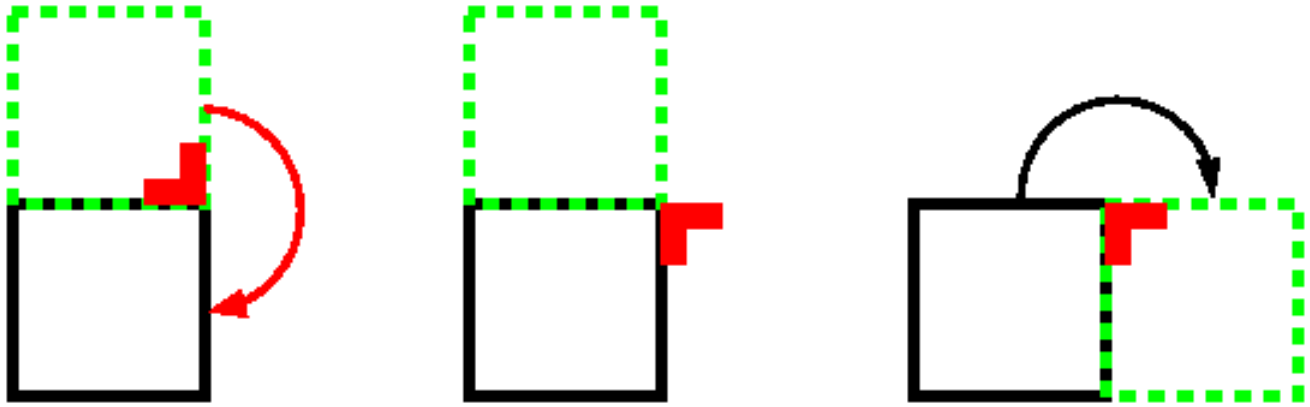


5.1 Macro-movements Results

- M1

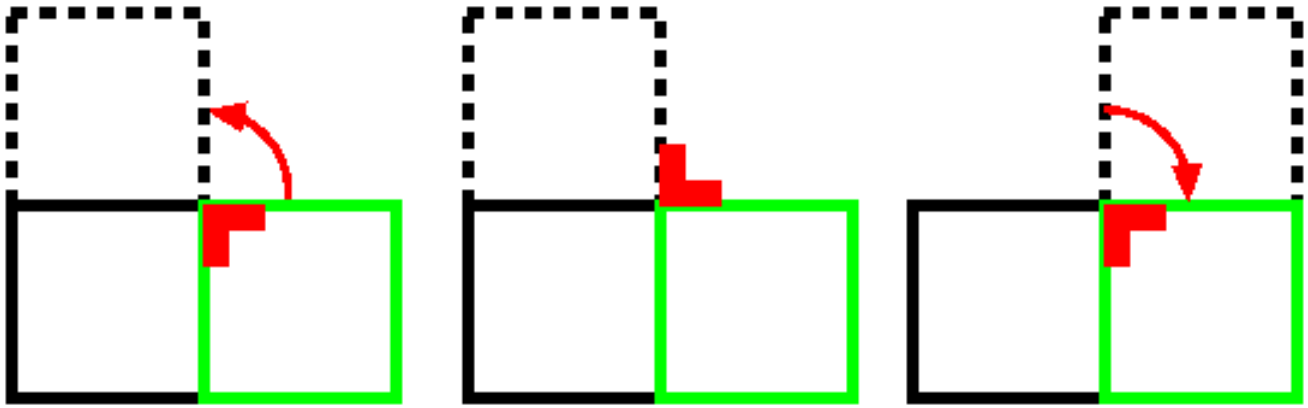


- M2

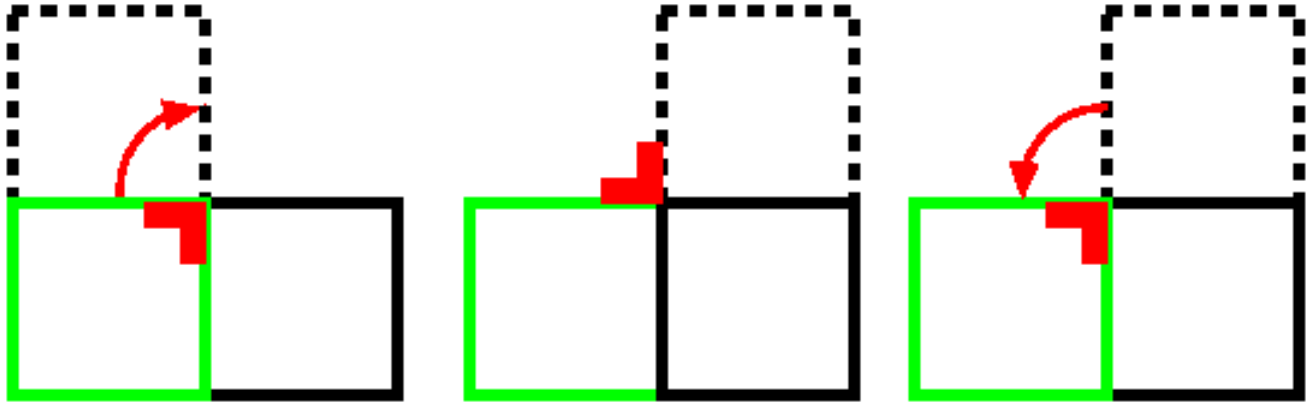


5.1 Macro-movements Results

- M3

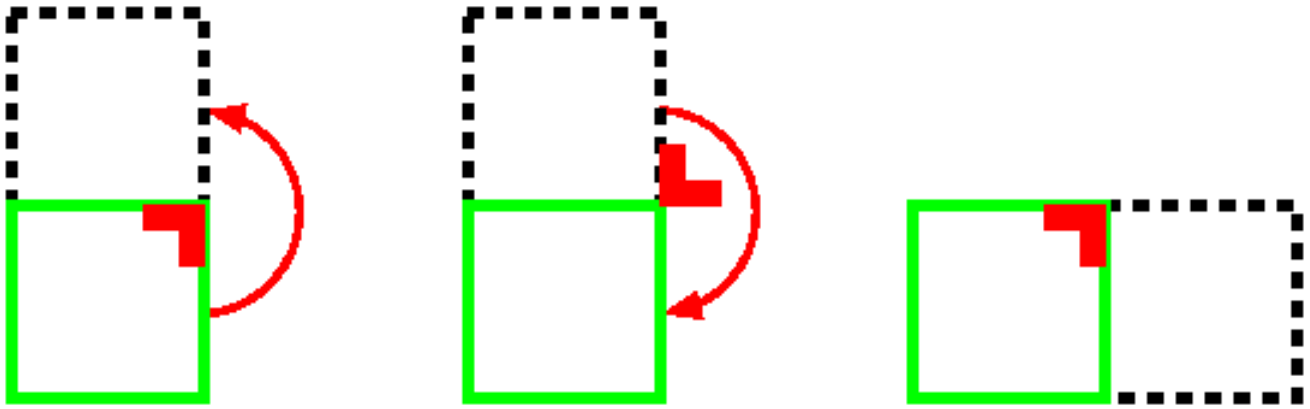


- M4



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 $\Longleftrightarrow$ self-reconfiguration

Thank you !