Autonomous Robots

"Autonomous Robots"

Algorithms to allow a robot to act autonomously: control architectures, behaviour-based robotics, path planning, robot learning.

- **Professors**:
  - Marc Carreras (marc.carreras@udg.edu)
  - Eduard Vidal – lab & project
  - Lydia E. Kavraki (Rice University) - seminar

- **Duration**: 5 ECTS (European Credit Transfer System)
  5 · 25 = 125 hours (with and without professor)

- **Theory**: - Monday, 12-14h, III-03
  - 12 sessions (2 hours each)
  - Structure: 12:10-13:00 → lecture
    13:00-13:10 → break
    13:10-14:00 → lecture

- **Laboratory:** - Thursday, 12-14h, Robotics Laboratory PII (RL)
  - 10 sessions (2 hours each)

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Timetable

	Monday	Tuesday	Wednesday	Thursday	Friday
08:00 - 09:00					
09:00 - 10:00					
10:00 - 11:00					
11:00 - 12:00					
12:00 - 13:00	AR - T (III-03)			AR - P (RL)	
13:00 - 14:00					
14:00 - 15:00					
15:00 - 16:00					
16:00 - 17:00					
17:00 - 18:00					
18:00 - 19:00					
19:00 - 20:00					

Course Outline:

1. Overview of Control Architectures
2. Behaviour-based architectures
3. Path planning
    - Bug algorithms
    - Configuration space
    - Potential functions
    - Topological maps
    - Graph search
    - Cell Decompositions
    - Sampling-based algorithms

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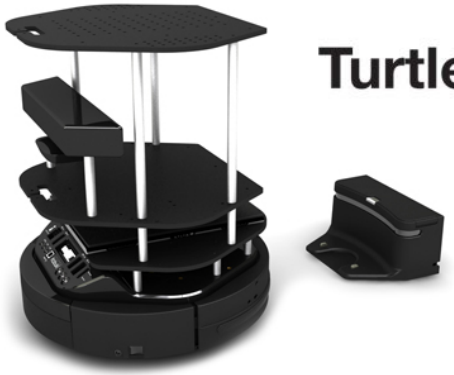
Laboratory:

P1*: Potential Functions – Wavefront planner
P2*: Sampling-based algorithms – RRT
P3^: Mapping and planning with Turtlebot
P4*: Topological maps – Visibility graph
P5*: Graph Search – A* algorithm

*Done individually
^Done in groups

MATLAB®
Product Family



Turtlebot 2

ubuntu

ROS

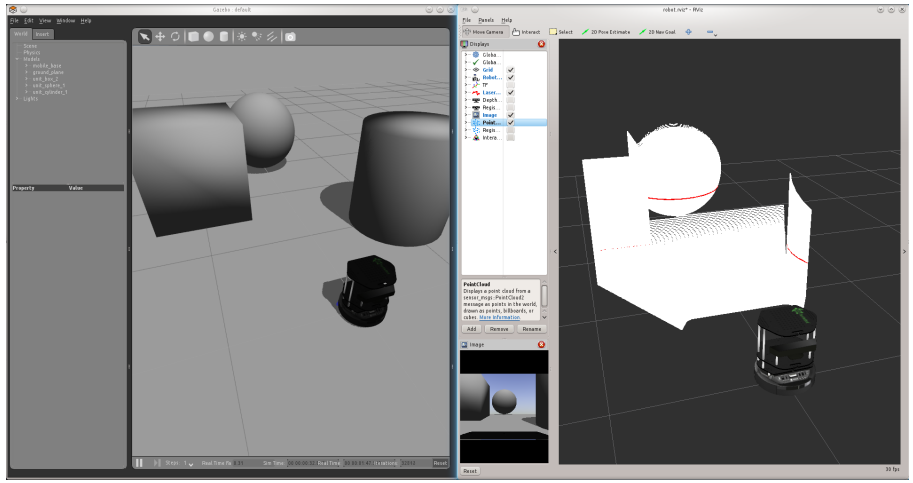
C++

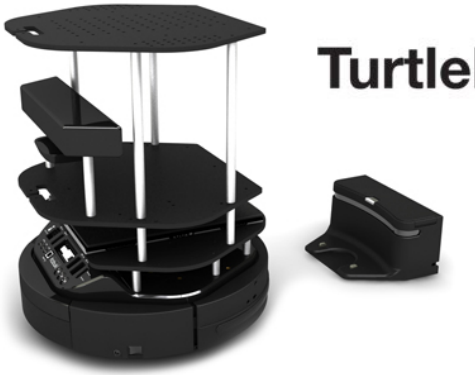
python™

Autonomous Robots

Project:

- Goal: to propose, implement and test a high-level controller for controlling a mobile robot with fixed and moving obstacles.
- Implementation in simulation and then with real robot
- Groups of 2-3 students
- Task: plan trajectories, execute them and avoid unexpected obstacles
- Duration: from March 20th till May 22nd





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Calendar

	THEORY		PRACTICE (LABORATORY)	
Week	**Date**	**Contents**	**Date**	**Contents**
1	06/02/17	Introduction and BBR	09/02/17	
2	13/02/17	Bug algorithms / Q space / Potential functions	16/02/17	P1 - Potential functions
3	20/02/17	Sampling-based algorithms	23/02/17	
4	27/02/17	Sampling with constraints (JDH)	02/03/17	P2 - Sampling-based algorithms
5	06/03/17	Topological maps	09/03/17	P3: Mapping and planning with Turtlebot
6	13/03/17	Graph Search	16/03/17	P3: Mapping and planning with Turtlebot
7	20/03/17	Project proposal	23/03/17	P3: Mapping and planning with Turtlebot
8	27/03/17	Cell decomposition and view planning (EV)	30/03/17	P4 - Topological maps
9	03/04/17	Project revision	06/04/17	
10	10/04/17	EASTER HOLIDAYS	13/04/17	EASTER HOLIDAYS
11	17/04/17	EASTER HOLIDAYS	20/04/17	P5 - Graph search
12	24/04/17	Project revision	27/04/17	
13	01/05/17	HOLIDAY	04/05/17	Project preparation with Turtlebot
14	08/05/17	Project revision	11/05/17	Project preparation with Turtlebot
15	16/05/17		18/05/17	Project preparation with Turtlebot
16	22/05/17	Project presentation	25/05/17	
17	29/05/17	**EXAM Weeks**	01/06/17	**EXAM Weeks**
18	05/06/17		08/06/17	

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- **Evaluation based on**:

  30% laboratory → Each practical exercise will require the programming of some functions that must be submitted through the web page.

  40% project → Original project about autonomous robots.

  30% exam → Theoretical and practical exam.

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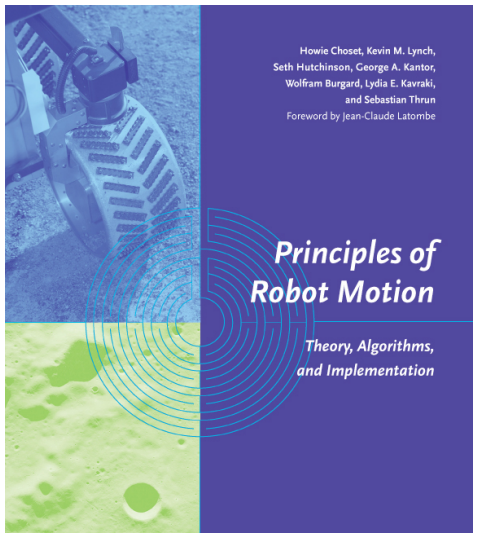
- **Bibliography:**



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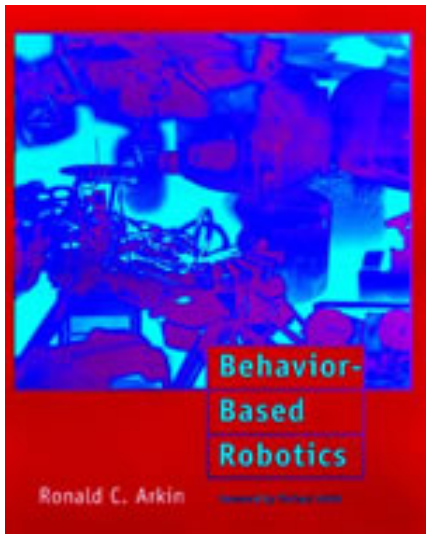
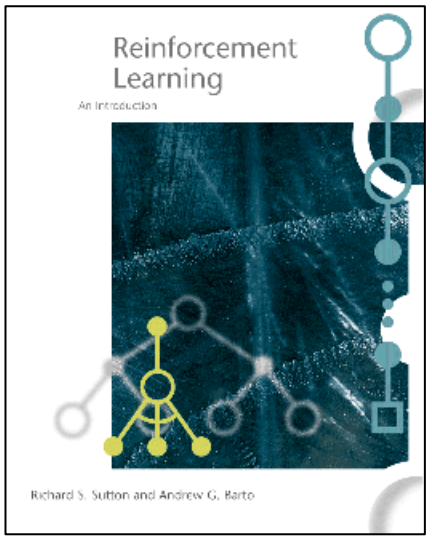
MIT Press, Boston, 2005



Arkin (1998). ***Behavior-based Robotics.*** MIT Press. Sutton, Richard S., Barto, Andrew G. (cop. 1998). *Reinforcement learning : an introduction*. Cambridge, Mass.: MIT Press.



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