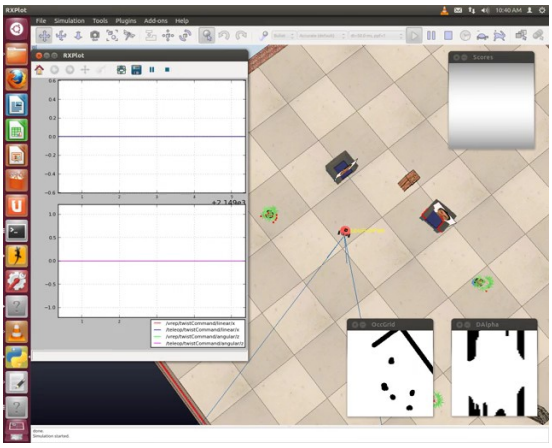
Georgia Tech Lorraine

CS 7630 Autonomous Robotics

Credits	3 Lectures hours 0 Lab hours	Semester Credit Hours:	3
Faculty	Prof. Cédric Pradalier		
Bibliography	Siegwart et al. Thrun, Sebastian, Wolfram Burgard, and Dieter Fox. *Probabilistic robotics*. Vol. 1. Cambridge, MA: MIT press, 2005.		
Assessment	1 mid-term: 15%, 1 projects (5 weeks) : 50%, 9 mini-projects (1 week): 35%		
Course Objectives:	This class will present computational tools useful for the development of robotic applications, covering kinematics, state estimation, planning, control, etc.. The objective is to get a hands-on experience with these tools through some theoretic background and a lot of project work.		
Pre-requisites:	This is a CS class, hence it assumes a familiarity with programming and computers, as well as a reasonable background in maths, in particular linear algebra and geometry. Support will always be available for technical issues. Linear Algebra: being at ease with manipulating matrices. 3D Geometry: change of frame, vectors, velocities... Programming: the projects will require a significant amount of programming in C++ and Python. The students are expected to either know these languages or have the motivation to learn them on the fly. Environment: all the projects will be run under Linux. The students are expected to either know this OS or have the motivation to learn it on the fly.		
Weekly organization:	Outside of the project work, the class will be split in two 90 minute sessions per week. In the first session, theoretical content will be discussed, including lectures, exercises, articles, … The second session will take place in the computer lab to start the weekly project. During the last 5 weeks of the class, the full duration of the class will be dedicated to project work in the computer room with faculty support and interventions on the white board.		



Infrastructure: The (mini-)projects will be conducted in groups of 2 students in a simulation environment installed in GTL's computer room. In addition real robotic platforms (Turtlebots) will be used. The simulation and the robots will use ROS (www.ros.org). The simulation will run on top of V-Rep (www.v-rep.eu).

Description and Class Schedule:

Class Nr	Week	Topic	Homework and Projects
1	2	Introduction	Introduction to the Development Environment
2	3	Perception	Collision avoidance and face detection
3	4	Reactive Systems and Control	Wandering, obstacle avoidance and simple behaviours, pose stabilisation
4	5	Kinematics	Direct and inverse kinematic of a space rover
5	6	Bayesian Localisation: Particle Filter	Particle Filter
6	7	Bayesian Estimation: Kalman Filter	Kalman Filter for Localisation and Mapping
	8	RECESS	
7	9	Path Planning	From Dijkstra to a A* lattice planner
8	10	Obstacle Avoidance	Dynamic window algorithm
9	11	Exploration and Coverage	Exploration
10	12	Mid-Term	Introduction to Final Project
11	13	Visual Servoing	Final Project
12	14	Final Project	
13	15	Final Project	
14	16	Final Project	
15	17	Final Project	
	18	Project Presentations	

Project description: Hunt for Rogue Access Points. The objectives of the final project is to integrate most of the components learnt in the class into a complete application design to search an environment and map the signal strengh of various WIFI access points. Autonomous navigation, localisation, mapping, control, decision and scheduling will all have to be implemented by the students on the Turtlebots.