F. Iida (fi224) 01.11.2018

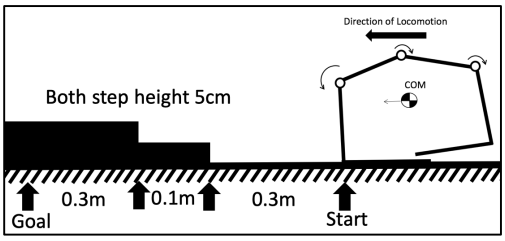
4M20 Robotics (2018) Competition Project and Coursework 2

Instructions

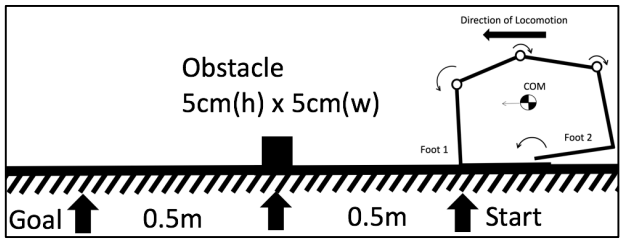
Objective	Experimental investigation of a 3-link robotic kit with position control. Test calculations and algorithms on the real-world platform.
Report	A group presentation and demonstration in the last lecture on 22nd of November 2018. In addition each student should individually submit a written final report of maximum 10 pages A4, minimum font size 11. Undergrad students should use the designated cover sheet with "candidate ID". Postgrad students should indicate name/CRS-ID on cover page.
Presentation	On 22 November 2018, 2pm-4pm. Each team should give a 5-minute brief presentation of the robot design and control strategy, and a 5-minute demonstration and competition of the hardware.
Submission	Individual 10 page report due on 14 December 2018 (4pm) Submission via Moodle: https://www.vle.cam.ac.uk/course/view.php?id=94122

Competition (22 November): By using the provided robot kit, design and build a robot that can solve the two locomotion problems shown below. You are allowed to modify or replace the mechanical parts but allowed to use only up to 3 servomotors provided. Evaluation criteria are: speed of locomotion, reliability, and predictability. You will be asked the expected performance (speed/time and trajectories of your robot) before the demonstrations, and to repeat each locomotion twice. Presentations should include the basic strategies, theories, and tools (that you learnt in the lectures presumably) needed to develop the robot.

Locomotion Problem 1



Locomotion Problem 2



Coursework 2

Q1. (10%) Explain systematically the rationale and strategy of your robot design (both mechanical and control) to achieve the expected performance for the competition. Discuss what methods and tools learnt in the lectures were used in the design of your robot, and what were the limitations of them in practice.

Q2. (30%) Develop a simulator of your robot by using kinematic and/or dynamic modelling methods. Make the simulation that is able to replicate the trajectories of your robot, and/or improve your robot such that the simulation predict better. Compare the trajectories of your robot during the locomotion problems above, analyse the accuracy of your simulator, and identify the causes of inaccuracy.

Q3. (30%) Develop a planning algorithm for your simulated robot in Q2, and demonstrate that your planner can find automatically the joint trajectories to traverse different types of terrain that you define (at least one terrain different from those in the competition). Assume that the terrain is known to the robot, but joint trajectories need to be found autonomously.

Q4. (30%) Develop a Q-learning algorithm that allows the simulated robot above to learn locomotion in simulation on an unknown terrain in a trial-and-error manner. You as a designer provide a terrain in simulation, then let your simulated robot learn how to traverse the terrain. The report should describe the learning algorithm and discuss the number of trials-end-errors needed to learn the task.