Series 02 – Ground Sensor, Wall following & PID

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Handout on March 7th 2019 Due on March 17th 2019

Reading
Study the lecture notes and source code available on Moodle.

Sections to be completed in the template report

— *Section 2.2 Sensors → Infra-red ground sensor*
— *Section 3.2 Behaviours → Line-following*
— *Section 3.3 Behaviours → Wall-following*

Ground sensor response

On a *real* robot, record the ground sensor response when the robot crosses a thick black line

a) perpendicularly,
b) diagonally (the robot trajectory making an approximate angle of 45° with the line).

Use the provided controller `S02_Ground_Measurement` and python script `plot_ground.py`. Present the graphs and discuss the results (mention the robot number) in Section *2.2 Sensors → Infra-red ground sensor* of the report template.

Line following

For one e-puck, design, implement, test and comment a behaviour that follows a thick black line on the arena.

Follow these steps :

a) Use the same basis as the Braitenberg behaviours (LOVER/EXPLORER).
b) An example world with two lines (octagonal and rectangular) is available on Moodle, as well as two lines in the robotics lab. Implement a line-following behaviour working for the octagonal one.
c) Test this behaviour on the rectangular line. **Discuss** possible differences and implications for your implementation.
d) Record a video.
e) *Bonus :* Implement a line-following behaviour working for the rectangular line.

Include your presentation and discussion in Section *3.2 Behaviours → Line-following* of the report template.

Wall following

On a single real e-puck, implement a PID controller that follows a wall along when it detects one. On his right side when it detects it on its right , and the other way round. Implement a behaviour that

a) detects on which side it encouters a wall

b) follows a straight wall on the side it detects it

c) turns when reaching arena corners

Bonus : implement a solution to make the e-puck turn around a rectangular block.

Hint : check on which side is the obstacle and apply a different IR sensor mapping depending on this information. Use LEDs to display which robot side is following.

You are provided with a basic semi-complete implementation [1]. At the beginning of the controller you will notice the definition of 'General parameters' and 'PID parameters'. The former define the weights of the different sensors, the desired setpoint, etc. You can improve those values, but if they are changed, explain it in your report. The 'PID parameters' are the values you have to tune to implement the wall following behaviour.

Using the plotting script provided, follow the procedure proposed in the lecture notes. Tune in this order (not all of them are relevant for the problem) :

a) K

b) T_d

c) T_i

Once you have a satisfying controller, record a short video, using the LEDs to indicate which robot side is being followed (Rule : right led on when following right, idem for left).

Using the final controller, make an analysis of the influence of each parameter on the value of the speed differential `ds`. Vary each parameter **once** to show an interesting difference, plot the values and discuss the difference in Section *3.3 Behaviours* → *Wall-following* of the report template.

Important : The lab will not be accessible on Monday March 18 between 10h30 and 16h30. Since you are supposed to hand out the series the day before, it should not have any influence on your work. Make sure however that the lab is clean when you leave it given that it will be used by others.

1. If you prefer implementing your own solution from scratch, feel free to do so and skip this template, or use some of its code excerpts as spare parts.