iqr Tutorial 06-Robot-Line follower

iqr tutorials will provide you with a practical introduction to using the neural simulation software and give you an insight into the principles of connectionist modeling. They are intended to be complementary to the detailed operation manual.
The home page of iqr is at iqr.sourceforge.net. Up to date information, documentation and tips and tricks ca be found in the iqr wiki (sourceforge.net/p/iqr/wiki/Home/).
The repository of iqr packages is here: sourceforge.net/projects/iqr/files/. iqr is open source software. You can browser the entire source code of iqr here: http://sourceforge.net/p/iqr/code/HEAD/tree/. Please contribute to iqr by reporting bug (sourceforge.net/p/iqr/bugs/) and requesting features (sourceforge.net/p/iqr/feature-requests/).

Aims

- Develop a simple system that allows the e-puck robot to successfully follow a predefined path by using its camera input.

Building the System

The e-puck robot is equipped with a low resolution color camera (40 x 40 pixels). The onboard camera enables us to create neural simulations to perform an almost unlimited number of tasks with the e-puck. In this case, we will use the camera to detect a path indicated by a thick line (use for instance colored tape) and generate the appropriate motor commands for the robot to stay always centered on it.

First connect the e-puck using the e-puck module and make sure you enable the video input in its properties. Be aware that the e-puck uses the same transmission system (serial port over bluetooth) to read both the sensor readings and the camera video output. Thus, by activating the latter you will compromise considerably its update rate, being it reduced to a few cycles per second. Thus, the robot will have to move at a relatively slow speed. Check the space plots of the R, G, and B iqr groups containing the RGB color layers of the input image and make sure you can get a clean video signal.

One way of building a system to follow the line is to:

- Create an image processing that is able to segment the line from the background.
- Split the visual field into separate areas for left/center/right.
- If a line appears in the left side, move to the right, and vice versa for the right side.

You will need to use the notion of competition to determine which direction to move. The simplest way to do this is to use cells with large receptive fields on the left or right side of the image. The robot should then move in the opposite direction of the highest overall activity. Try to make your system follow the line as fast as possible.

Exercise

- How did you segment the line from the background?
- Explain the motor control system that you built

Does the robot display an unstable behavior (oscillatory)? Tune the turning speed of the motor control such that the steps are large when the line is in the periphery of the image while they are small when it is close to the center. In this case, you may want to define extra receptive fields to find out this information. Save your system when you are finished.

Augment now your system with collision avoidance using the infrared sensors. Does your test circuit include a number of crossings? If not, please use one containing some and make sure your robot does not enter a circular behavior. How can you do it? Try creating a crossing detection mechanism that chooses randomly either left or right, and describe it in detail.

- Document your working system so that someone else could reproduce its functionality.