# iqr Tutorial 06-Robot-Braitenberg vehicles

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

- Build models of neural systems that produce complex behaviors when they are used to control a mobile robot.

## Building the System

This tutorial is based on models developed in the classic book *Vehicles* (Braitenberg, 1986).

The tutorial is divided into three parts. In these parts, you will develop and study:

- a reactive control structure which allows the robot to explore its environment and avoid obstacles in its path;
- a robot which will approach or avoid light sources, behaviors which represent loosely fear and aggression;
- a light-feeding robot, which approaches light only when it is hungry.

You will need an e-puck/Khepera robot and a flashlight or lamp for this tutorial. Do not use a cigarette lighter, as you will damage the expensive robots. It may also be useful to prepare a small "arena" with walls for your robot to explore in.

**Reactive control structure:** First build the reactive control structure as described in "Tutorial 5: Interfacing to an e-puck/Khepera mobile robot". A reactive control structure enables a behaving system to respond to stimuli in a stereotyped way using prewired connections between sensors and effectors. This case, it allows the robot to explore its environment and avoid obstacles in its path.

**Fear and aggression:** First read about Braitenberg's vehicle 2. Find out which of the e-puck/Khepera's sensors respond to your flashlight and make the robot fear light sources (the robot detects light and moves away from it) or move aggressively towards light sources (the robot moves towards light). The reactive control structure has the basis for these models. Light-sensitive cells should be connected to specific reflexes in the Reflex group. Note that the fearful robot uses different reflexes than the aggressive robot. If a collision occurs, the priority is to avoid the obstacle. Use an inhibition from the Collision cells onto the Explore and Light cells to establish the priorities.

**Feeding on the light:** Using the aggressive robot, make the robot approach light for a period of time, after which it wanders away. This behavior will resemble feeding, with the robot wandering away when its appetite is satisfied. do this, add a Satisfied cell group which uses low input gain, high membrane persistence and high threshold. When this cell is not active, the robot should approach the light and the Satisfied cell membrane potential should increase. When the Satisfied cell becomes active, the robot is full and should wander away from the light (inhibit the light seeking behavior).

## Exercise

As you complete each step, test it thoroughly under different combinations of conditions. In particular, you should make sure that the behavioral priorities are correct, e.g. obstacle avoidance is more important than feeding.

- What parameter(s) in your model balance its tendencies to avoid obstacles and follow light sources?
- What parameter(s) in your model control how long it will follow a light source until it is satisfied?
- When you are satisfied that everything is working, document your design in such a way that someone could reproduce the robot behaviors you were able to achieve.