Universität Bielefeld

Fakultät für Biologie - Neurobiologie
Center of Excellence Cognitive Interaction Technology

CITEC

Student project proposal

"Visual collision avoidance inspired by flying insect neurobiology"

Abstract:

Avoiding collisions is one of the most basic needs for any mobile agent, both biological and technical ones. Flying insects show remarkable ability to fly through cluttered environments, without colliding. Moreover, due to their small size and small number of neurons, their collision avoidance algorithm has to be cheap in terms of computational effort and energy consumption. They are, therefore, a good model to study collision avoidance. The most reliable cue for this task is the distance to objects. Insects can not directly measure the nearness of objects, but estimate the apparent motion of objects (i.e. optic-flow) resulting from self-motion. It has recently been shown that nearnesses can be extracted from the retinal movement pattern, independently of the direction of motion, and that this information can be used to determine collision-free movement direction. However, the detector for retinal movement in the insect brain, the correlation type motion detector (EMD), depends in its response on the scenery, i.e. the pattern contrast and wavelengths. This leads to unreliable nearness estimates. It is therefore difficult to extract all possible collision avoidance directions, i.e. to find every hole.

The thesis project will be to design an algorithm based on nearnesses derived from EMD responses, which can extract several possible collision avoidance directions and reproduce to some extent the avoidance behavior of flies. At least two different approaches can be drawn:

1. Decrease the pattern dependency of the extracted nearnesses map by studying the motion detector response dependencies.
2. Design an algorithm to derive several possible collision avoidance directions from the unreliable nearness map

Applicants are invited to apply by e-mail to olivier.bertrand@uni-bielefeld.de

Skills:

- Programming, preferably knowledge of MATLAB
- A background in physics and (neuro-)biology will be welcome

Laboratory:

The student will work in the Department of Neurobiology of Bielefeld University, and will be supervised by Prof. Dr. Martin Egelhaaf, Dr. Jens-Peter Lindemann, and Olivier Bertrand. For further information: http://web.biologie.uni-bielefeld.de/neurobiology/