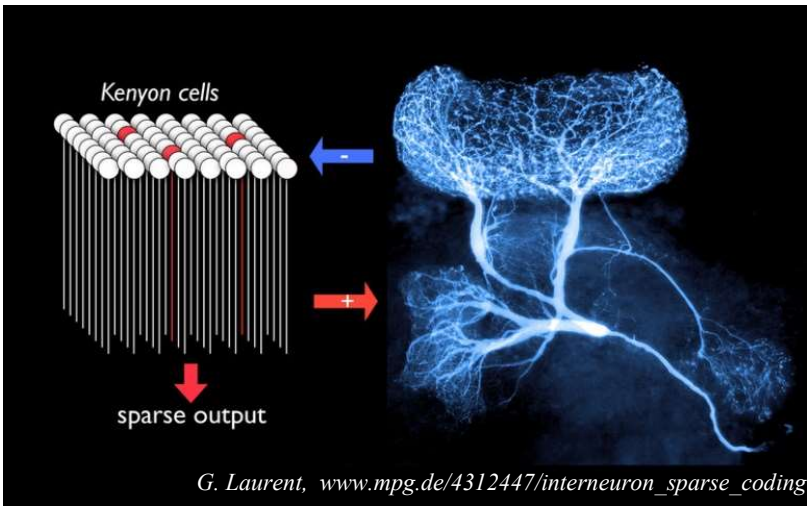
STUDENT PROJECT offered at the Institute for Neurobiology

EBERHARD KARLS UNIVERSITÄT TÜBINGEN

Student project in computational neuroscience

Self-organization of motion-sensitive receptive fields in the zebrafish optokinetic system



Background. Zebrafish larvae show strong optokinetic response to whole-field visual motion stimuli, presumably to compensate for passive drift in flowing water. At the same time, they use their visual system for catching prey and obstacle avoidance. In simple optic flow systems, neurons are thought to exist acting as templates for expected flow patterns. These response specificities are likely optimized for detecting the optic flow patterns in the fish's environment. In this project, we will simulate the zebrafish visual environment and train a sparse coding neural network to develop according templates. These will then be compared to neurophysiological data from the zebrafish.

Project. Virtual reality simulation of the zebrafish visual environment with obstacles, other moving fish, and prey. Generation of realistic motion sequences from real traces of the fish's eye- and body motion. Implementation of the sparse coding network (Olshausen & Field 1969) and modification for motion sequences. Training of the network with motion sequence data. Evaluation of developing receptive fields.

Methods. Virtual reality programming. Self-organization in artificial neural networks, image processing and image statistics, MatLab programing.

Level. The project is currently planned as a MSc-project. Subprojects can be split off as BSc projects. Extension to a PhD-project is possible.

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References

Kubo F, Hablitzel B, Del Maschio M, Driever W, Baier H, Arrenberg AB (2014) Functional architecture of an optic flow-responsive area that drives horizontal eye movements in zebrafish. *Neuron* 81:1344 – 1359

Olshausen BA, Field DJ (1996) Emergence of simple-cell receptive field responses by learning a sparse code for images. *Nature* 381:607 – 609

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