TECHNISCHE UNIVERSITÄT MÜNCHEN
NEUROWISSENSCHAFTLICHE SYSTEMTHEORIE
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MASTER THESIS

Active dynamic vision based on micro-saccades

Problem description:

This thesis shall explore a new class of active vision algorithms that are based on micro-saccades[2] with a dynamic vision sensor (DVS[1]). The low-latency asynchronous AER output of dynamic vision sensors is an ideal feedback signal to control saccades. Fast saccades, on the other hand, can be used to actively probe the entire visual scene or individual objects therein with a DVS. The output of such a probing, let us call them event maps, can potentially be used as a predictive input for (DVS based) object tracking, depth estimation, noise suppression and image segmentation.
These are the major tasks to follow in this Master thesis:

1. Set up and optimization of the NST robotic head[3] and a suitable software environment
2. Set up and evaluation of fast saccadic movements
3. Evaluation of the corresponding DVS response
4. Implementation of saccadic movements based on direct DVS feedback
5. Assessment of potential vision tasks (see above) that can make use of saccade-triggered event maps
6. Implementation and evaluation of at least two such vision tasks

Bibliography:

[1] Giacomo Indiveri, Rodney Douglas: *Neuromorphic vision sensors*, Science 288 (5469), DOI: 10.1126/science.288.5469.1189, (2000)
[2] Susana Martinez-Conde, Jorge Otero-Millan, Stephen L. Macknik: *The impact of microsaccades on vision: towards a unified theory of saccadic function*, Nature Reviews Neuroscience 14, DOI: 10.1038/nrn3405, (2013)
[3] Marcello Mulas, Manxiu Zhan, Jörg Conradt: *Integration of Biological Neural Models for the Control of Eye Movements in a Robotic Head*, Biomimetic and Biohybrid Systems 9222, DOI: 10.1007/978-3-319-22979-9_24, (2015)

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