Please fill out all requested data and send back the form to emaro-adm@ircyn.ec-nantes.fr before 9th May.

<table>
<thead>
<tr>
<th>Subject:</th>
<th>Event-based bio-inspired motion in depth for collision avoidance on the iCub</th>
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<tbody>
<tr>
<td>Supervisor(s):</td>
<td>Fabio Solari, Manuela Chessa, Chiara Bartolozzi</td>
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<tr>
<td>Laboratory:</td>
<td>Slipguru (DIBRIS - UniGE), iCub Facility (IIT)</td>
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<tr>
<td>Field of research:</td>
<td>Bio-inspired vision for humanoid robotics</td>
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Motivations and general objectives:
The goal of this thesis is the implementation of collision avoidance for the iCub robot, using event-driven (ED) vision sensors and bio-inspired models for perception of motion in depth and 3D vision. Event-driven sensors provide a novel encoding of the visual signal, whereby the traditional frames (or static snapshots of the scene) are replaced by a continuous stream of asynchronous digital pulses with micro-second precision, that correspond to fixed changes of illumination at pixel level. This encoding is extremely efficient as it removes redundancy at the sensor level and is relevant for the design of novel strategies for high-speed, robust artificial vision. This is especially suited for the robotics application domain, where real-time performance and robustness are crucial. Collision avoidance requires the timely estimation of motion of objects approaching the robot, that is usually derived from the 2D optical flow. Biological models of perception of motion in depth are based on V1-inspired binocular receptive fields suitable to the use with event-driven sensors.

This thesis will focus on
- adaptation and optimisation of the model for motion in depth for the use with event-driven vision sensors
- the implementation of the resulting system on the iCub platform equipped with dynamic vision sensors and the SpiNNaker parallel processing board
- the validation and demonstration of the system with
collision avoidance movements of the robot

The student will demonstrate the following system capabilities:

- localization of a moving object and its velocity towards the robot
- avoidance or block of colliding objects

The thesis work will require both the integration of existing SW components and the development of new ones.

Proposed work plan

The student is expected to carry out the following tasks:

1. Analysis of state of the art approaches to motion in depth in bio-inspired, traditional, and event-driven vision.
2. Modification of the algorithm for motion in depth for event-driven input.
3. Integration of the devised algorithm on the iCub.
4. Validation and demonstration of the system on the iCub robot by comparison with ground truth and, if possible, with the robot performance in object avoidance or block

According to the specific results of the thesis, the student will be involved in the preparation of related scientific publications.

List of bibliographic references


Short description of the hosting laboratory

The thesis will be carried out as a cooperation between the Slipguru (focus: development of the biologically inspired algorithms) and the iCub Facility (focus: development of the iCub humanoid platform). Specifically, within the iCub Facility, the work will be tutored by the Neuromorphic Systems and Interfaces group, that has the main goal of porting and exploiting the emergent neuromorphic technology on the iCub platform.

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Signature of the local coordinator

Date