

Smart aVLSI Vision Modules for Indoor Flying Robots

Progress report

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Aims of Project

Vision-based navigation (e.g. course stabilization, obstacle avoidance) of indoor flying robots (e.g. blimps, planes) requires real-time image processing capabilities. However, such robots have a dramatically limited available payload (roughly between 10 g for planes and 100 g for blimps). On-board vision modules therefore have tight constraints regarding weight, size and processing speed. Single-chip analog VLSI vision modules with parallel processing can be tailored to meet these requirements for such applications, but the standard packages for VLSI chips, the circuit boards with the biasing and input/output connections, and the optical systems are too bulky and heavy.

This project aims at integrating 1D and 2D aVLSI vision chips (e.g. motion sensors, temporal filters) into small (< 3x3x3 cm) and very lightweight (< 5 g) modules for use on fast, light and small flying robots. Large fields of view (> 100°) are required, e.g., for good lateral optical flow estimation. These are not straightforward to obtain for small chips with lightweight optics. In order to further reduce the weight, COB (Chip On Board) techniques will be used and the numerous required potentiometers (that provide input voltages for on-chip circuits) will be replaced by surface-mount digital-to-analog converters.

The INI will develop, design and test the aVLSI vision chips. The ASL2 will take care of the bonding onto the printed-circuit board (PCB), the system integration, the mechanical parts (optics, lens mount), and the realization of the printed circuit board.

Progress report from ASL2

Lots of email exchanges have been required for setting up the project, defining the details and planning the development of the first module.

André Guignard (member of ASL2, co-designer of the Khepera) has been chosen as the most capable technician for actually building the module and help in the PCB and mechanical design. We have gone through some preliminary tests with a chip from INI in order to determine whether the actual bonding of the chip onto the PCB would be possible in André's workshop.

Progress report from INI

In my part of this project, I have designed a one-dimensional motion sensor for this vision-based navigation project. The sensor will provide both motion signals and the photoreceptor signal for each pixel in the array.

The sensor is out to fab right now and will not be back for about 3 weeks. It will then be mounted on a PCB board. This work will be performed at the Autonomous Systems Lab at EPFL.

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