

MICROBOTICS

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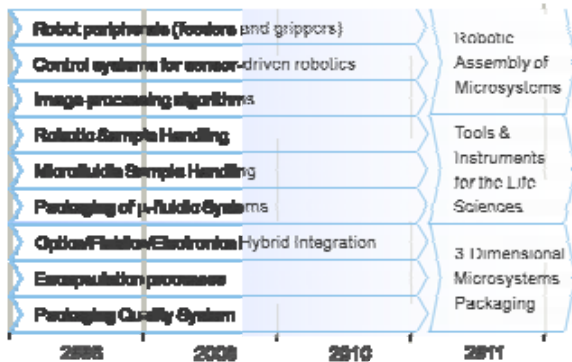


Figure 1: Roadmap Microrobotics

The research in Microrobotics at CSEM is based on three Technology Platforms (see Figure 1). A new platform on sensor integration will be started in 2008.

Development of fast and precise desk-top industrial robots for microcomponent assembly

In March 2007 the CSEM Robotics team won the first prize of the Swiss Technology Award with the concept of the Micro Factory for assembly processes. Based on the PocketDelta the concept was shown as a live demonstration at the Hannover Fair 2007 where it was nominated for the Top Five of the prestigious Hermes Award for excellent technical innovations.

In order to extend the technology platform for the MicroFactory to a wider scope of Assembly, the research activities are focused on the three topics (i) modular software tools of object oriented robotics (ii) generic image processing for automation, and (iii) process-driven robotics control. In 2007, the existing platforms were supplemented and the software framework and the control electronics were adapted to current industrial needs.

A large part of the research activities were carried out within two EU projects. In the project Hydromel a process for the automatic recognition of the position and orientation of unordered parts has been developed. In the project Nanohand algorithms have been developed for the control of a camera-guided mini robot to handle carbon nanotubes.

Handling of fluids and of cells in fluids by combining microfluidics & robotics

The Microfluidics & Microhandling team has developed novel methods for the handling of samples and reagents in life sciences. This is achieved through a combination of microfluidics and robotics that allows the sorting and concentration of small particles (cells, functionalized microbeads). A further topic is the fabrication of completely packaged microfluidic systems.

Within these activities the integration of sensors and actuators in microfluidic systems played an increasingly important role throughout last year. The infrastructure for the fabrication of

prototypes was extended through a micromilling machine, a thermal bonding machine and a lamination apparatus. In addition, the combination of precision robotics and microfluidics has led to the development of a system that allows the automatic selection, immobilization and collection of cells for microinjection.

Packaging and interconnect technologies

The Optics & Packaging team has developed customer-specific integration solutions from the design phase to the assembly for products in the field of optoelectronics, sensing, MEMS systems and microelectronics. A special focus was put on the development of bonding processes (adhesive fixing, soldering).

The packaging activities at CSEM were further extended and Alpnach could establish itself as the center for this domain within CSEM. In terms of technology the existing flip-chip bonding processes were extended. This now allows the simultaneous application of electrical contacts to smart Silicon sensors and leak-tight sealing with respect to liquid and gases. Typical applications are in the area of biodiagnostics with liquids and the hermetic sealing of MEMS devices.

Integration of disciplines and industrial relevance

The strength of CSEM Microrobotics research program continues to be the integration of the various disciplines including robotics, embedded systems, SW engineering, microfluidics, optics, sensing as well as microsystems integration and packaging.

A representative example is the development of a highly compact laser scanner for dermatologic applications carried out for the industrial client Pantec Biosolutions AG which also led to the nomination of the Medtech Award 2007. The successful implementation required the following competences: actuator driver engineering (robotics), digital signal processing and algorithms, mechanics with micrometer precision, optics, sensing, electronics.

Research partners

CSEM research partners in the field of Microrobotics are ETHZ (Eidgenössische Technische Hochschule Zürich), EPFL (Ecole Polytechnique Fédérale de Lausanne), IMT (Institut de Microtechnique, Université de Neuchâtel), HSLU (Hochschule Luzern), and BFH-TI (Berne Fachhochschule Technik und Informatik, Biel)

Research at CSEM Microrobotics Division in Alpnach is supported by the Cantons of Central Switzerland through the Micro Center Central Switzerland (MCCS).