MICROROBOTICS AND PACKAGING

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Research in Microrobotics at CSEM is based on three Technology Platforms (see Figure 1):

- Robotic Assembly of Microsystems
- Life Sciences Robotics
- 3D Microsystems Packaging

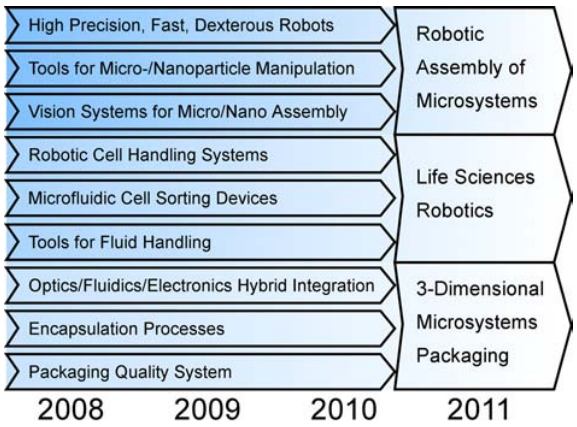

Figure 1: Roadmap Microrobotics

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

In 2006 CSEM developed 2 new types of parallel Delta robots (Pocket Delta and Desktop Delta) with integrated controllers. Cabling and space requirements were reduced dramatically. In 2007 these robots will be in service in industry. For efficient integration of vision systems CSEM uses commercial and proprietary vision hardware in connection with CSEM proprietary algorithms. Workspace surveillance was demonstrated successfully using CSEM 3D camera.

CSEM actively pursues the path towards nanorobotics and hybrid assembly of micro- and nanosystems. This is accomplished within the framework of two European projects, “NanoHand” and “Hydromel”. These programs run from 2006 until 2011.

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

Within the life-science robotics platform CSEM has developed a high precision robot for automated cell handling. Automated pick and place of 6 μm beads can be demonstrated. Applications will be in cell biology, for example microinjection of compounds into cells.

Proper sealing of sensors is still a big challenge in microfluidics. Among the highlights in 2006 was the successful bonding of a glass-based surface plasmon resonance (SPR) sensor into low-cost thermoplastic microfluidic scaffolds.

Packaging and interconnect technologies

In 2006 CSEM set up a packaging cleanroom at its premises in Alpnach (CSEM Central Switzerland Center). The cleanroom is class 10’000, with a flip-chip bonding workspace of class 100. The cleanroom is equipped with machinery for bonding and sealing (Flip-Chip, die and wire bonding) and with extensive test equipment (mechanical, optical, SEM, and environmental testing). Packaging highlights in 2006 were the development of a 90° releasable fiber optic connector (CTI project with Huber & Suhner) and the set-up of flip-chip bonding on polymer (“soft”) substrates.

Integration of disciplines and industrial relevance

The strength of CSEM Microrobotics research program is the integration of various disciplines, like robotics, embedded systems, SW engineering, microfluidics, optics, and material science. The integration of disciplines is fully in line with the mission of CSEM. The successful collaboration between robot system engineering and process development is of prime importance in Microrobotics.

CSEM Microrobotic technology platforms are relevant for industry. The reason is that many steps related to the assembly of precision components (micro-drives, watches, medical systems) are today still done by hand. Therefore automatic assembly is extremely important, especially for a country like Switzerland with high salaries. In addition laboratory automation and diagnostics represent a fast growing market. As for packaging and interconnect technology it is known that packaging costs can amount to 80% of the total production cost.

Research partners

The research partners of CSEM in the field of Microrobotics are ETHZ (Eidgenössische Technische Hochschule Zurich), EPFL (Ecole Polytechnique Fédérale de Lausanne), IMT (Institut de Microtechnique, Université de Neuchâtel), and HTA Luzern (Hochschule für Technik und Architektur).

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