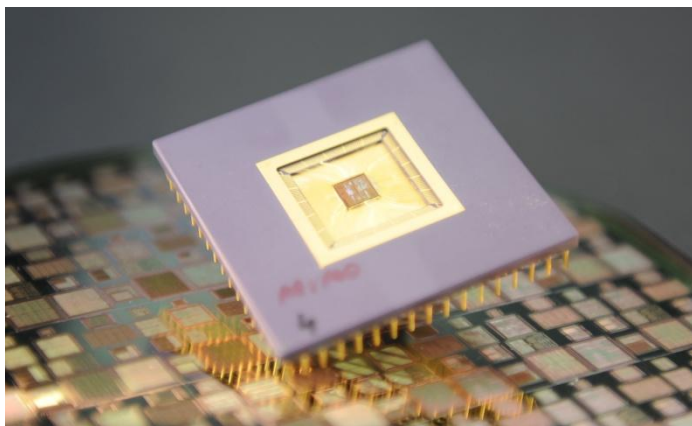




# Microelectronic Circuit Design

## Focus

While the various labs in the department are concerned with applying scientific and electrical engineering methods to a multitude of fields, the Microelectronics Design Center concentrates on how to design and build actual circuits and systems.



VLSI chip for MIMO wireless communication designed and tested by students as part of a term project.

## Services

We currently support the design of integrated circuits (VLSI chips and ASICs, digital, analog, and mixed-signal), the application of field-programmable logic components (primarily FPGAs), and the design of printed circuit boards. To that end, the Design Center is operating a vast array of commercial EDA software packages. Building workable design flows for numerous target processes and multiple manufacturers is another important service to students and researchers at D-ITET and ETH Zurich. We further provide tool trainings, design reviews, and assistance with chip finishing, tape-out, component selection, board mounting, circuit testing, and more.

## Imparting Practical Engineering Know How

All our teaching is about hands-on experience with real-world technologies and industrial tools. Microchips designed by students typically get fabricated and tested, thereby closing the feedback loop. In addition to the VLSI courses taught by Prof. Kaeslin and Dr. N. Felber, our staff teaches PCB design along the same line twice a year and participates in other courses oriented towards practical circuit design.



Digital thermometer board designed by students on the basis of a commercial microcontroller during the course "Applied Electrical Circuit and PCB Design".

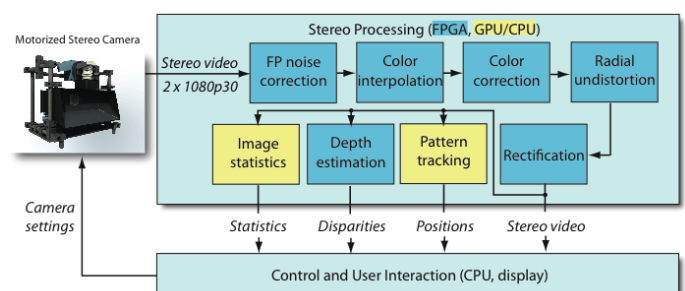
## Research Highlights

H. Kaeslin has always been actively involved in research projects related to microelectronic circuit design at D-ITET. Following his promotion to Professor in 2010, he has assumed a more direct role in supervising Ph.D. students in digital information processing applications from video and audio processing, telecommunication, IT security, and the like. The common theme is that the capability of devising dedicated hardware architectures and circuits with specific features can lead to systems that substantially outperform software-only solutions in terms of throughput, energy-efficiency, and/or security in certain applications.

### Real-time stereoscopic 3D processing for cinematographic applications

The recent revival of stereoscopic 3D (S3D) video has been partly enabled by the advances in digital video processing and distribution. However, producing and displaying visually appealing S3D content is still a non-trivial process, requiring computationally intensive pre- and post-processing steps. Obviously, the data bandwidth is at least doubled. Another challenge comes from how to optimally set stereo camera parameters during acquisition and how to match the resulting two video streams to obtain a pleasing 3D experience. In this project we investigate and implement the crucial steps of a real-time stereo video processing pipeline. Target application is a stereoscopic acquisition system, able to process and react to incoming high-definition video streams on the fly.

The video processing tasks are partitioned on a high-performance computing system featuring an FPGA and a GPU. The FPGA efficiently handles stream processing tasks such as noise removal, geometric correction and basic depth estimation while the GPU is engaged with high-level, memory intensive processing tasks. The obtained scene meta-information is used for automatically setting camera parameters such as focus or the distance between the two cameras in real time.



Real-time 3D stereoscopic processing system (source: S. Heinzle, et al. "Computational Stereo Camera System with Programmable Control Loop", ACM Transactions on Graphics, 30(4) 2011).

### Compressed Sensing for Wireless Systems

Compressed sensing is a new paradigm in signal processing that allows to reduce the number of measurements below the Nyquist frequency if a signal is sparse, such that it can be represented by a small number of components in any given basis. While reducing the complexity of analog frontends, the digital post-processing becomes much more challenging. The goal of our research is to demonstrate the feasibility and efficiency of compressed sensing in systems for wireless communication and localization. To this end, we select promising applications, build demonstrators, and design digital reconstruction chips.

For more information visit [www.dz.ee.ethz.ch](http://www.dz.ee.ethz.ch)