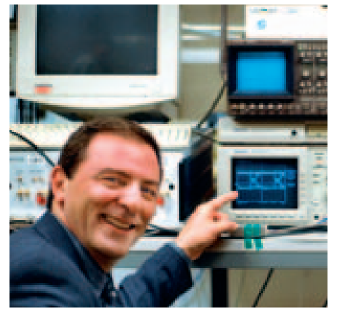
Undergraduate education



The department offers about 100 different courses in four main areas: Control Systems, Electronics, Image processing, and Telecommunications. Courses are mainly given to students in the masters programs of: Applied Physics and Electrical Engineering (Y), Computer Science and Engineering (D), and Information Technology (IT). Nevertheless a large number of students in other programs, such as the Master of Science in Engineering, the Bachelor of Science in Engineering and other Master's Programs, are taking our courses as well.

Our courses typically cover theory but they also put strong emphasis on engineering skills like problem solving, experimental laboratory work, and sometimes complete projects including construction.

Research and postgraduate education

The department has research in four main areas: Control Systems, Electronics, Image processing, and Telecommunications. All research is characterized by active participation in the scientific forefront both in Sweden and internationally. Strategic collaborations are manifested by several excellence centers within the department. As a result the postgraduate education successfully combines relevance and quality.

Research and postgraduate education is pursued in the divisions: Automatic Control, Communication Systems, Computer Engineering, Computer Vision, Electronic Devices, Electronics Systems, Information Coding, and Vehicular Systems.

FOR MORE INFORMATION:
www.isy.liu.se

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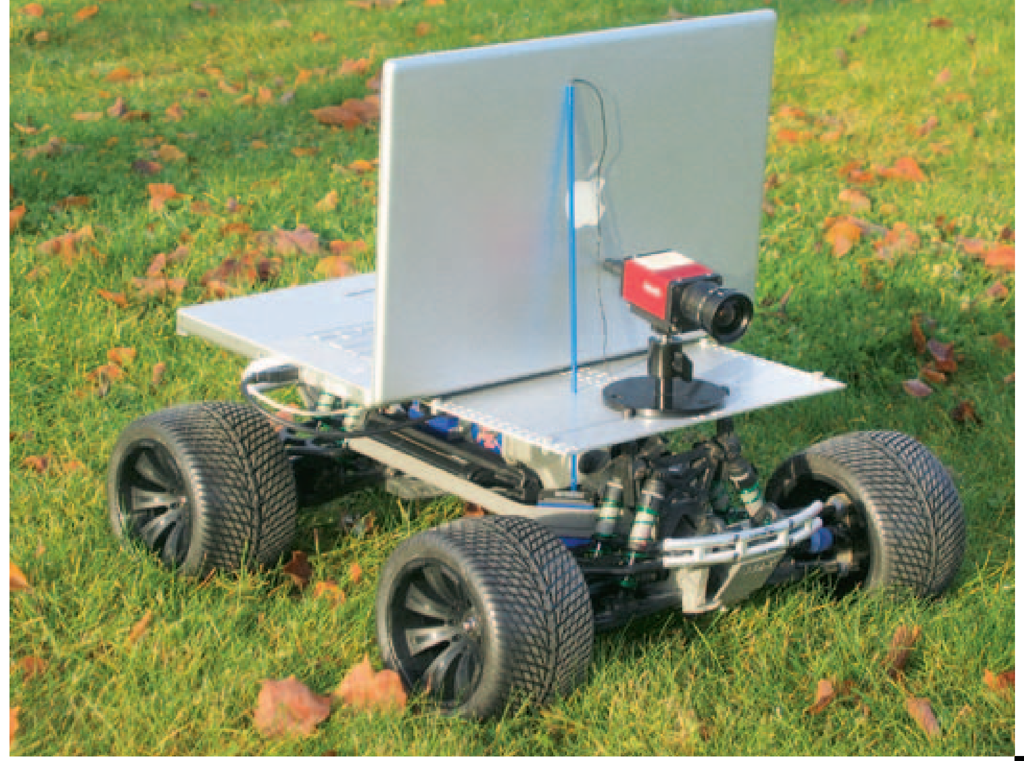

Linköping University
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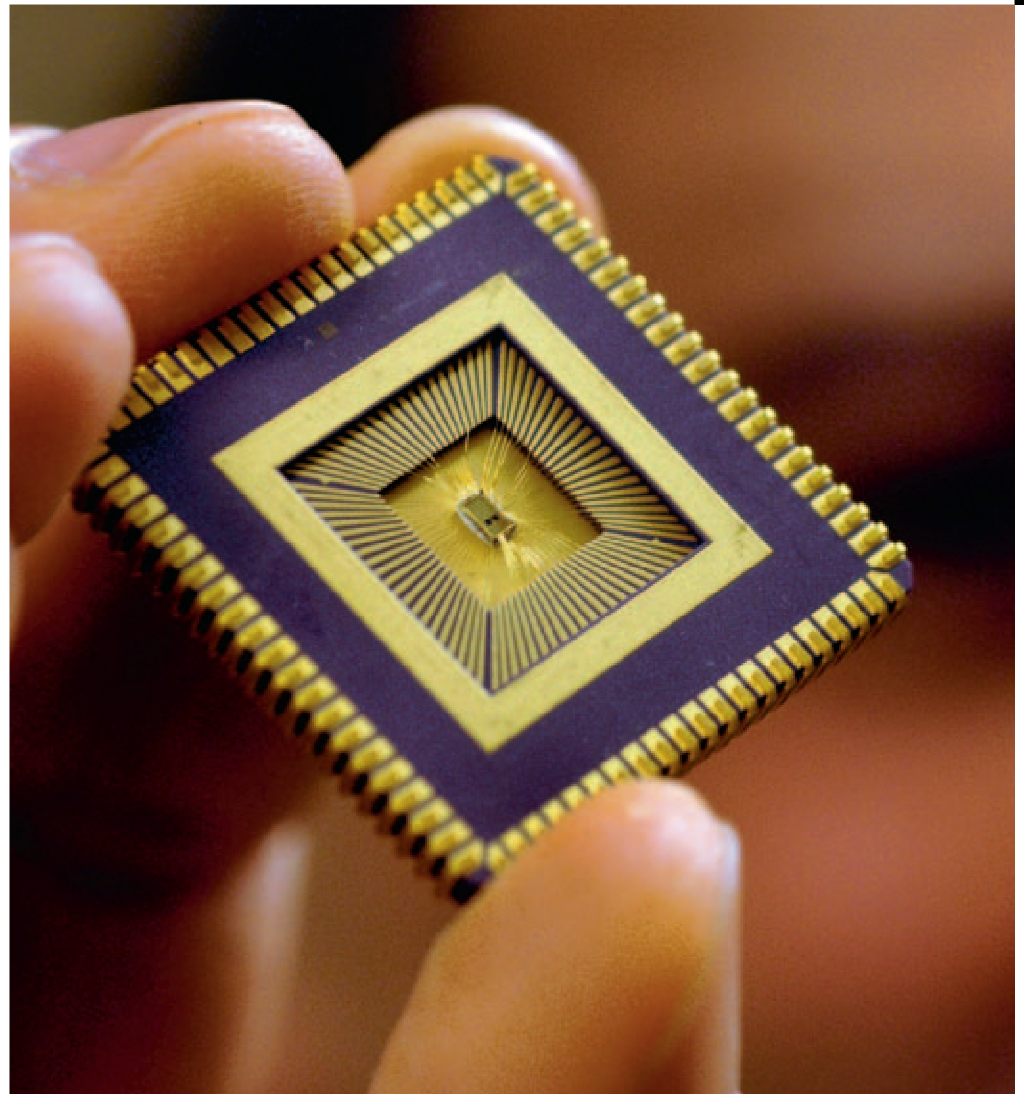
THE DEPARTMENT OF
Electrical Engineering
LINKÖPING UNIVERSITY



THE DEPARTMENT OF Electrical Engineering

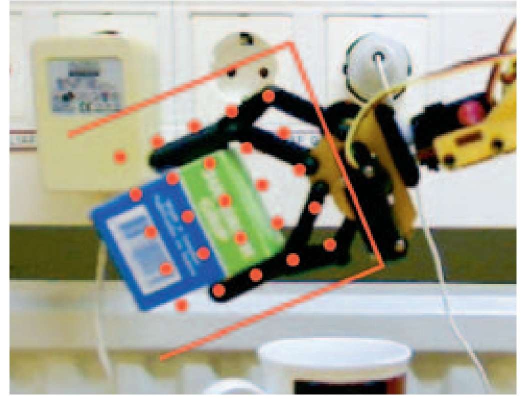
(ISY) is central to the engineering education at the Institute of Technology, one of four faculties at Linköping University, and this regards both basic and applied knowledge. The research is based on industrial needs, and ranges from basic research to direct application in collaboration projects.

The department of Electrical Engineering was formed in 1972 and has since then been active in the technical development in Sweden. Several new companies have evolved from research at the department, but the research has also been instrumental in the established industry through all former graduated students and engineers now employed. The basis for all this has been the strong connection and good interplay between education, research, and the world outside the university.

Welcome to the department of Electrical Engineering.

Research in **Computer Vision**

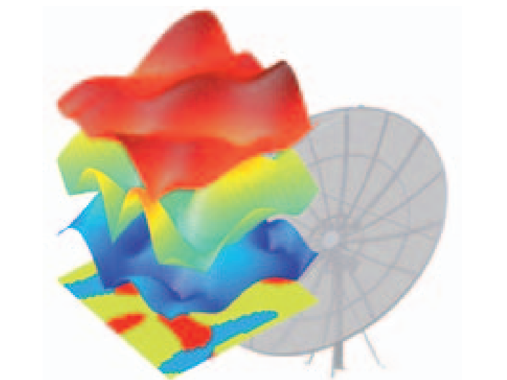
The research at the Computer Vision Laboratory (CVL) covers a wide range of methods within three-dimensional computer vision, cognitive vision systems, object recognition, image analysis, and medical imaging. These methods have their application in vision-based reconstruction of three-dimensional scenes (3D maps), learning robots and intelligent systems that interact with humans (e.g. driver assistance systems), content-based image retrieval (image search), image enhancement and automated analysis (e.g. tracking vehicles), and image reconstruction in computer tomography and magnetic resonance. The research focuses on the development of novel approaches to the representation and extraction of visual information, machine learning for information processing and vision based control, and the efficient and accurate processing of huge amounts of image data.



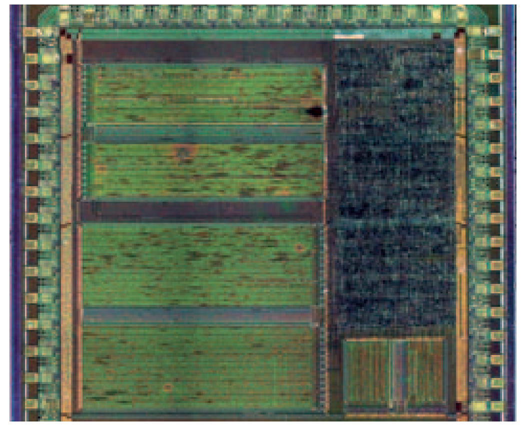
Visually controlled low-cost robot, holding an object that has been automatically detected and analyzed.

Research in **Communication Systems**

The division of Communication Systems conducts research on communications engineering, and wireless communications in particular. A basic problem in wireless communications is that the part of the electromagnetic spectrum that is suitable for radio communication is rather small. This part of the spectrum is therefore a limited resource. Another problem is the limited power consumption that mobile electronics can afford. The primary limiting factor is the limited capacity of batteries. Typically, much power is spent on signal processing, for example, extraction of digital information from analog waveforms. New applications will require even more advanced signal processing than today's systems. At the same time, end users will require more mobility and longer battery time. This generates a need for efficient signal processing algorithms which can optimally exploit modern hardware. The research in the division addresses these fundamental problems.



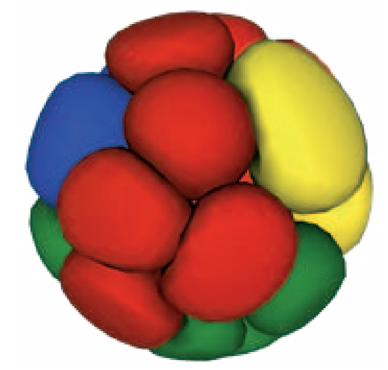
Visualization of fading channels for different users in a multiuser wireless communication system.



Example of a multimedia DSP.

Research in **Computer Engineering**

The research includes embedded system design, on chip parallel computing system for data intensive applications, design of Application Specific Instruction set Processors (ASIP), and hardware acceleration for computing extensive and special algorithms. Since 2008, the division has been working with Ericsson for low power, low silicon cost, and low latency conflict free parallel memory subsystems for parallel and data intensive computing. The subsystem includes the system architecture, the parallel programming methodology, and programming tools. The research in the division covers also SW-HW co-design and ASIC-FPGA co-design. Applications behind the research are computing platform for media communications, and other embedded electronics.



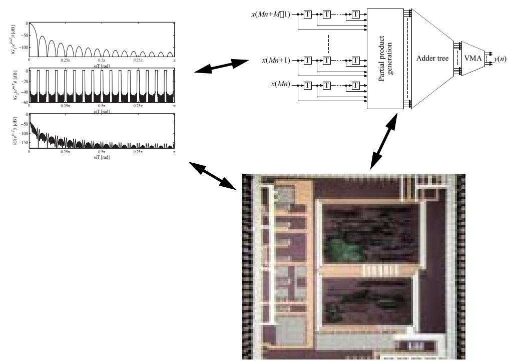
Communication within and between cells. The figure shows a snapshot from a three-dimensional simulation of cell division of the early embryonic phase of the C. elegans nematode.

Research in **Information Coding**

The research spans topics within image coding, communication networks, cryptography, and systems biology. The common denominator is the efficient and robust representation of information. Past achievements include one of the first proposals for video coding, later developed into the H.26x and MPEG standards. The group has also done early work on model-based coding of face images. Current activities include extended 3D modeling and analysis of images and techniques for robust video distribution over packet-based networks. Within the field of communication security, the research is focused on analysis of protocols for quantum cryptography. Also in this field the division has been active in international standardization committees. Information representation of the biological cell is studied, with the goal to develop mathematical models that describe the interrelation between the genetic code and the development of organisms.

Research in **Electronics Systems**

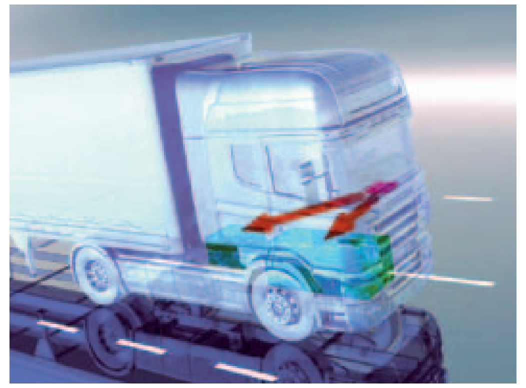
The research within the Electronics Systems division is directed towards design and implementation for analog and digital signal processing and telecommunication systems. This includes all design levels starting from specification, system architecture, algorithms, mapping to hardware structures, arithmetic, logic circuits all the way down to integrated circuit design. The focus is on algorithms and hardware architectures for application specific and algorithm-specific digital signal processing and communication subsystems with low energy consumption and stringent requirements on the computational capacity. Examples include digital filters, filter banks, transforms, and error-correcting decoders. The research also encompass techniques for digital enhancement and automated design of analog and mixed signal circuits.



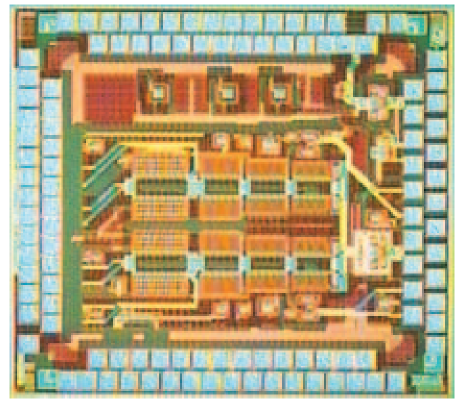
Algorithm-hardware co-design leading to an efficient decimation filter chip with an input sample rate of 16 GSa/s for a superconducting AD-converter.

Research in **Vehicular Systems**

The division of Vehicular Systems conducts research in control, diagnosis, and supervision of functions in vehicles. The overall aim is to develop control systems to obtain performance, safety, energy utilization, and environmental stability. Our strategy is to focus on system science aspects, and to collaborate with others when it comes to mechanical construction or industrial evaluation. The functions under consideration include advanced engine control, control coordination of vehicle and power train systems, and autonomous functions in intelligent vehicles and intelligent roadways. Important methodological research is performed in applied optimal control and in general research on model-based fault diagnosis, where we have a general interest in many kinds of applications, e.g. aircrafts, gas turbines, automotive engines, and hybrid vehicles.



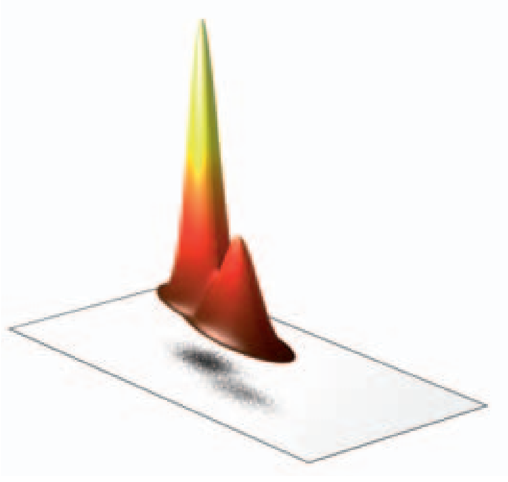
Control algorithms automatically plan fuel-optimal uphill and downhill driving.



A chip fabricated in 130nm CMOS technology; a flexible radio sampling-receiver for WLAN, including one of the first reported inductor-less (smallest) wide-band low-noise amplifiers.

Research in **Electronic Devices**

Research in the division of Electronic Devices is focused on future analog/digital/radio-frequency integrated circuits and chip design challenges in advanced semiconductor technologies. The division develops efficient circuit techniques for a wide range of applications which require cutting-edge high-speed and low-power operation. Examples of current research projects are: Flexible multi-band, multi-standard radio transceivers for future software-defined radio and radars, high-speed analog-to-digital converters for Gigabit Ethernet, ultra-low-power radio and data converters for medical implant devices such as pacemakers, un-cooled low-cost infrared network camera for continuous surveillance of critical infrastructures, high data rate on-chip and off-chip communication links. Historically, the division is recognized as one of the forerunners in design of high-speed and low-power CMOS circuits. The group has contributed with a number of solutions and techniques utilized in advanced commercial products such as microprocessors, internet routers, cameras, data converters, etc.



The picture illustrates uncertainty in a position estimate, which is a central issue in target tracking, localization and navigation.

Research in **Automatic Control**

The division works with a broad spectrum of problems in control, modeling and signal processing and aims at a good and productive balance between theoretical developments and industrial applications. System identification, which is the area of building mathematical models from observed input and output signals, is a prime target for analysis and development of methods and algorithms. Other areas of theoretical studies are nonlinear dynamical systems, sensor informatics (how to best process information from different sensors), and optimization in control applications (in particular modeling of predictive control). Modeling and control of industrial robots, sensor fusion, and decision support for automotive and aeronautical vehicles are important application areas of industrial relevance.