

## Faculty of Computer Sciences

**German computer science has its roots at the Universität Karlsruhe. It was here, in 1957, where the first German chair in information processing was established and first held by computer science pioneer Karl Steinbuch.**

**It was also here that Karl Nickel did his basic research on computer application and programming languages during the 1950s and 60s. It was upon Nickel's initiative that an institute for informatics was first founded in 1968, and in 1972, it became today's Faculty of Computer Sciences. Universität Karlsruhe was the first German university to offer a full graduate degree in computer science.**

With computers increasingly moving into all aspects of economic, public, and private life, the career options for computer science graduates are growing larger and becoming both more complex and more demanding. Universität Karlsruhe's Faculty of Computer Sciences is known for its exceptional diversity of both research and teaching, and it places great importance on giving its students a strong theoretical foundation and developing their practical abilities. At the Universität Karlsruhe, computer science is a constructive, systematic science that is closely related to other engineering sciences at the university. The areas on which graduate students may concentrate loosely reflect the faculty's research programs and range from algorithm technology and automatic language translation, embedded systems, communication and ubiquitous systems to robotics and subareas of anthropomatics.



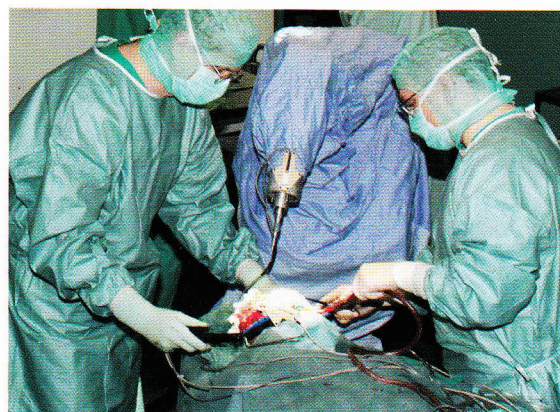
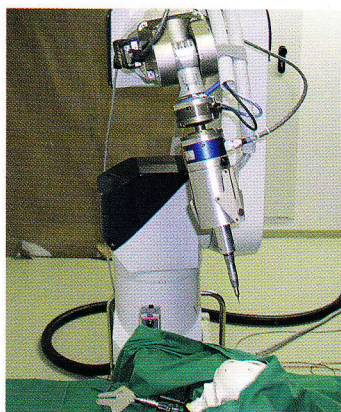
### Top-quality teaching

With around 2 900 students, Universität Karlsruhe's Faculty of Computer Sciences is not only one of the largest academic education institutes for computer science students, but also one of the best among Germany's higher education institutes. The Faculty has occupied top positions in all major nationwide rankings for years, and has consistently ranked best in terms of its reputation, technical equipment, the level of support provided to students, and the amount of third-party funds received.

Another important issue is the interdisciplinarity of research and teaching. In addition to its standard degree program in computer science, the Faculty offers a degree in information management in conjunction with the Faculty of Economics and Business Engineering; this degree program is unique in Germany and covers subjects in computer science, economics and business engineering, and law. By combining competencies from three subject fields, students are taught to recognize, create, and assess information flows and products and then implement them within an organization.

### The applications of computer science: computer-aided surgery

One example of the diverse applications of computer science at the Universität Karlsruhe is research training group 1126: "Intelligent surgery – development of new computer-based methods for the surgical workplace of the future." Since 2005, researchers from both Universität Karlsruhe und Universität Heidelberg as well as the



Computers in surgery: experimental robot use in cranial surgery (left); a sensor-based robot system that aids surgeons during skull operations (right).

German Cancer Research Center in Heidelberg have been working on new developments in perioperative data collection, planning minimally invasive surgical procedures, telemanipulation, and man-machine interfaces. This process involves tools based on artificial intelligence, robotics and sensor data processing as well as three-dimensional geometry models and visualization techniques.

### Humanoid robots

For robot systems to be helpful to humans in everyday life, they must have complex abilities and features, such as human behavior, multi-modality and the ability to cooperate and learn. The Collaborative Research Center "Humanoid Robots – Learning and Cooperating Multi-Modal Robots" aims at developing concepts, methods and concrete mechatronic components for a robot with human behavior.

More than 40 researchers are currently working on this interdisciplinary project. These types of endeavors promote an exchange of ideas within the university and scientific dialog between researchers in and around Karlsruhe.

### Sensor actor networks

The term sensor actor network refers to a group of several miniaturized sensor-actor nodes embedded in a given area and wirelessly linked to each other so they can cooperatively observe and influence a distributed phenomenon. Typical applications include observing large geographic areas, intelligent buildings, microscopic sensors, actors used inside or on the human body, and sensors used to monitor devices and machines. Research Training Group 1194, a joint initiative of the Faculty of Computer Sciences and Faculty of Electrical Engineering and Information Technology, takes an





A robot hand prototype with flexible fluidic actors.

interdisciplinary approach toward examining the basic concepts of self-organizing sensor actor networks, such as their architecture, efficient operation, and the development of systematic procedures and reference models.

#### Computers for everyday use

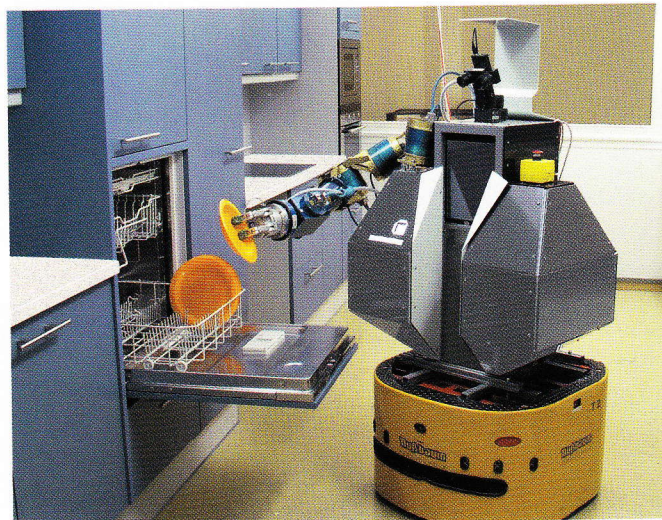
An example of cutting-edge research in the area of telematics at the Universität Karlsruhe is the Faculty's projects in the field of mobile communications. Researchers are working on integrating different networks such as mobile and fixed-line networks, different computer systems and diverse software components so that users can access a number of services efficiently. This involves intelligent personal-assistant functions being performed by several collaborating systems that can be built into everyday items. These systems are networked together, interact with their environment, and are also connected to existing communication networks. Research into this field is being conducted at the Telecollaboration Office (TeCo) in close cooperation with companies in the industry.

#### Visionary energy system

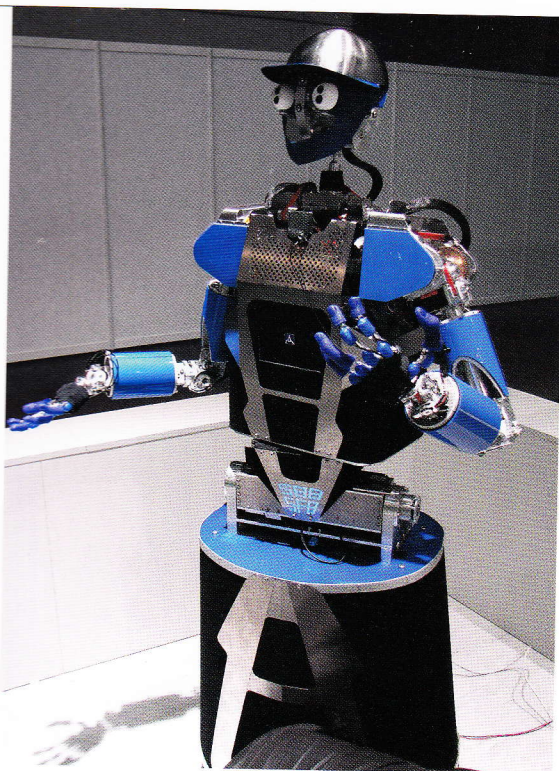
With the earth's resources rapidly dwindling, designing future-oriented energy systems represents a major challenge. There is an interdisciplinary project entitled "Self-Organization and Spontaneity in Liberalized and Harmonized Markets" (SESAM), funded by the German Federal Ministry for

Education and Research as part of research on the Internet economy. This project pursues the vision of creating such an energy system. This involves a number of small, decentralized power plants – small-scale combined heat and power plants, fuel cells, and solar plants – that connect to self-organizing energy markets, creating a virtual power plant to be used in conjunc-

Home helpers: Albert, a humanoid robot, can perform simple household tasks on his own.







Everyday helpers: Humanoid robots – such as this ARMAR system – are capable of learning and can behave similar to humans.

## For additional information

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tion with conventional large-scale power plants. The project is based on the assumption that an Internet-based market uses a liberalized, open-market model; ultimately, this is the best guarantor for resource-efficient energy generation. SESAM's aim is to build an integrated, networked platform with which to simulate and analyze a self-organizing market within the framework of such a visionary energy system.

### Information management and market engineering

Electronic markets have gained considerable significance over the past few years. Unlike physical markets, electronic markets do not develop by themselves; instead, they must be designed, implemented, and set up on the Internet, which requires open and flexible platforms, appropriate standards, and access to information services. Together with the Faculty of Economics and Business Engineering, the Faculty of Computer Sciences is conducting research in the field of "Information Management and Market Engineering" on behalf of the German Research Foundation.

This research project combines research in the fields of economics and business engineering, computer science, and law. Its objective is to develop a systematic theory on market engineering.

### Practical computer science in the TechnologieRegion Karlsruhe

One of the strengths of the Faculty of Computer Sciences is its proximity to the diverse group of information technology-oriented research institutions and IT companies in the Karlsruhe area. Many of these have their roots in the Faculty of Computer Sciences, and today the TechnologieRegion Karlsruhe is exemplary in terms of productive collaboration between university research and business. There is close collaboration between the Helmholtz Association's Karlsruhe Research Center, the Fraunhofer Institute for Information and Data Processing (IITB), the Research Center for Information Technologies (FZI), and SAP. All of these institutions are creating an environment located in Karlsruhe – Germany's Internet capital – that is stimulating and practice-oriented for both research and study.

Simultaneous speech-translation using goggles.

