Research Training Group "Self-organizing Sensor-actuator Networks"

The Graduates

Young Scientists Conduct Fundamental Research into Intelligent Nodes in Wireless Environments

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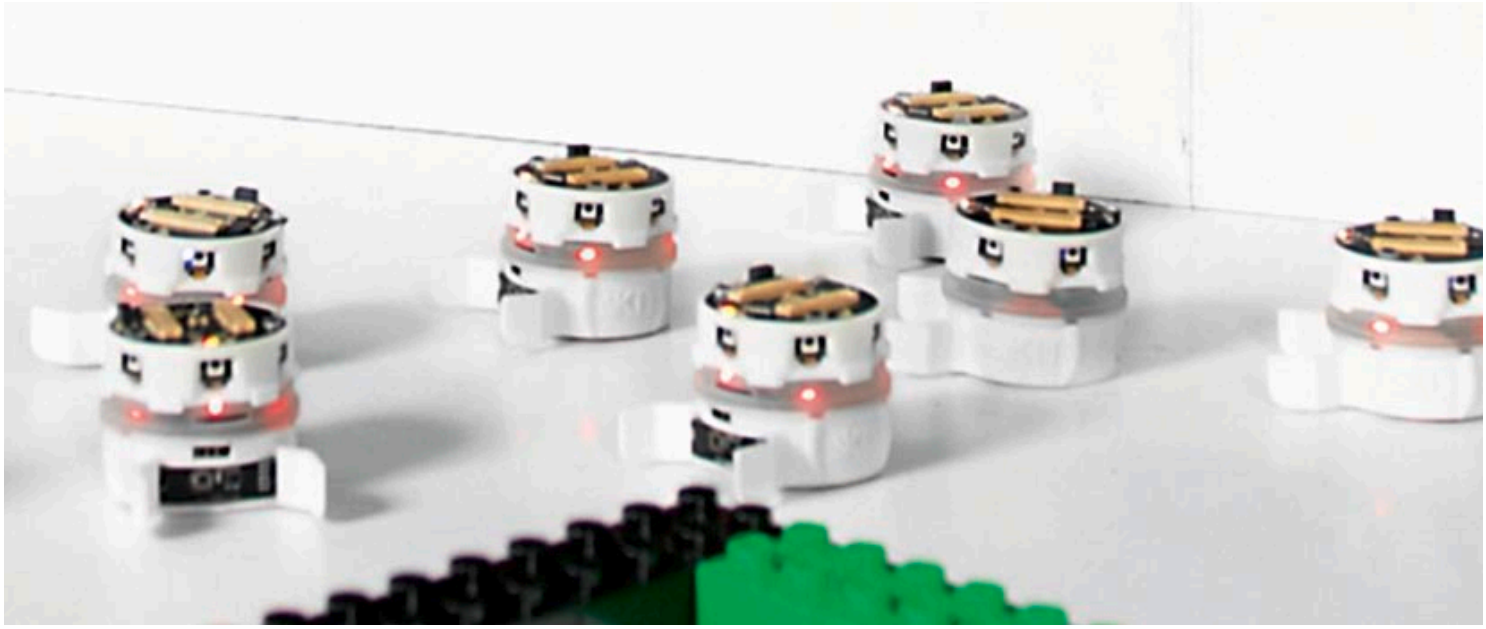
Knoten um Knoten: Im Graduiertenkolleg entwickeln die jungen Wissenschaftler die Technologie weiter.

Node by node: In the research training group, the young scientists develop the technology further.



The object that Johannes Schmid puts down in front of him looks like an electronic computer component at first glance: A minute processor, a chip, and a number of small braze points. But that is not correct: This is a sensor-actuator node that is lying on the table. The young researcher wants to embed it in a wireless network to locate people: "During catastrophes in particular, it can facilitate the logistic coordination of missions, if the locations of the task forces and victims are known," says Schmid. Further development of this technology for important practical applications is the objective of this scientist from the Institute for Information Processing Technologies (ITIV) and the other PhD students in the research training group, "Self-organizing Sensor-actuator Networks." Over nine years, 30 young scientists overall will do fundamental research in this group.

In autumn 2005, the research training group was launched with total funding of about EUR 8 million by the German Research Foundation (DFG). Its duration is nine years with an evaluation after the first half, which the group passed successfully in 2009. The first generation of graduates completed their PhDs in the beginning of 2009, the same time that a second generation started. In spring 2012, a third group of diploma or master students will start. The research training group "gives PhD students the opportunity to conduct interdisciplinary research," explains Professor Uwe D. Hanebeck, spokesman of the group and head of the Intelligent Sensor-actuator Systems Division (ISAS). Experts from the Departments of Informatics and Electrical Engineering and Information Technology cooperate closely. The advantage: Problems of sensor-actuator networks, such as reliability, energy efficiency, or self-organization, which have been studied separately so far, are now examined in an integrated manner by the research training group. Communication, information processing, and hardware or software integration are multidisciplinary issues. The young scientists concentrate on the performance and service lives of the nodes, and they test solar cells.

Hanebeck is highly satisfied with the research training group so far. More than 100 publications have been issued. Ten professors are involved in the group, with two of them supervising each PhD student. The young scientists meet regularly to exchange experience and know-how. They acquire additional skills in lectures, seminars, and practical trainings. In addition, they attend workshops, summer schools, or work abroad. "This is a valuable experience for the graduates," emphasizes Dr. Frederik Beutler from ISAS, the coordinator of the research training group.

The graduates focus on research associated with these easy-to-install, stable nodes. Such nodes can determine their position themselves via a global positioning system, if deployed during a forest fire, for instance. They communicate in a wireless manner, gathering information e.g. on smoke development or temperature, and then transmitting the data. The PhD students pursue a variety of projects. To describe only some of them: Tessa Tielert from the Institute of Telematics concentrates on evaluating the efficiency of wireless communication among vehicles. Alexander Kettler from the Institute of Process Control Technology, Automation, and Robotics works on new tools and methods to more reliably determine the location and state of a swarm of many autonomous mobile robots. Christoph Roth from ITIV focuses on simulation models that may be used to monitor work processes in the agricultural sector, for instance. And Markus Völker from the Institute of Theoretical Informatics develops robust and efficient algorithms for energy-efficient transmission of news in wireless networks. The PhD students focus on ground research bearing in mind possible applications of wireless sensor-actuator networks – the control of cold chains or the prognosis of avalanches, the control of vibrations of a bridge or the detection of leaks in the sewage system. ■

Graduiertenkolleg
Sensor-Aktor-Netzwerke

Die Reifeprüfung

Die Technologie von Sensor-Aktor-Knoten und drahtlosen Netzwerken so weiterzuentwickeln, dass sie wichtigen praktischen Anwendungen gewachsen ist – das ist ein Ziel der mehr als 30 Doktoranden im Graduiertenkolleg „Selbstorganisierende Sensor-Aktor-Netzwerke". Im Herbst 2005 fiel der Startschuss für das Kolleg, das die Deutsche Forschungsgemeinschaft (DFG) mit insgesamt rund acht Millionen Euro fördert. Laufzeit: neun Jahre. Das Kolleg „gibt den Doktoranden die Möglichkeit, interdisziplinär zu forschen", erklärt Professor Uwe D. Hanebeck, Sprecher des Kollegs und Leiter des Bereichs Intelligente Sensor-Aktor-Systeme (ISAS). Experten der Fakultäten für Informatik, Elektrotechnik und Informationstechnik arbeiten eng zusammen.

Vielfältig sind die Forschungsvorhaben der Doktoranden rund um die einfach zu installierenden, stabilen Knoten, die über ein Navigationssatellitensystem (GPS) ihre Position selbst bestimmen, wenn sie etwa bei einem Waldbrand ausgebracht werden, und drahtlos kommunizieren. So befasst sich Tessa Tielert vom Institut für Telematik mit der Leistungsbewertung der drahtlosen Kommunikation zwischen Fahrzeugen. Und Markus Völker vom Institut für Theoretische Informatik entwickelt robuste und effiziente Algorithmen, um unter anderem das energieeffiziente Übertragen von Nachrichten in drahtlosen Netzen zu ermöglichen. Die Doktoranden betreiben Grundlagenforschung und bedenken dabei mögliche Anwendungen der drahtlosen Sensor-Aktor-Netzwerke – etwa bei der Überwachung von Kühlketten oder der Vorhersage von Lawinenabgängen, bei der Kontrolle der Vibrationen einer Brücke oder bei der Lokalisierung von Lecken in der Kanalisation.

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