KIT Presents Innovations at the 2014 Hanover Fair

Machine Components of Variable Eigenfrequencies – Intelligent Storage System for Solar Electricity – Energy Supply via Glass Fibers – Topography and Wafer Mapping – X-ray Computer Tomography and 3D Printing

KIT's lightweight slide enhances quality in production (Photo: KIT, wbk).

Monika Landgraf
Chief Press Officer

Kaiserstraße 12
76131 Karlsruhe, Germany
Phone: +49 721 608-47414
Fax: +49 721 608-43658
E-mail: presse@kit.edu

At the Hanover Fair from April 7 to 11, 2014, Karlsruhe Institute of Technology (KIT) will present innovations for the sectors of mechanical engineering, energy, and materials testing. At its central booth, KIT will exhibit a lightweight slide for mechanical engineering, a system for the interim storage of electricity from renewable sources, a solution for energy supply of sensors via glass fibers, and technologies for the quality control of wafers and the X-ray examination of materials. In addition, KIT will be represented at other booths. The electronic press kit can be found at:

http://www.pkm.kit.edu/hannovermesse2014.php

KIT central booth, hall 2, C16
Leading trade fair "Research & Technology"

Lightweight Slide Enhances Quality in Production. Automatic production systems consist of several individual machines that cooperate in a synchronized manner. The feed rate and spindle speed of a single machine are given precisely. From the dynamic point of view, however, the machine may not be designed for these requirements. Resonance vibrations occur, which are associated with quality losses, such as chatter marks. An innovative solution is to design

the movable machine parts as lightweight components. For this purpose, carbon fiber-reinforced plastics (CFRP) are used. Their weight is far below that of conventional steel and cast materials, while stiffness is high. At KIT, researchers have developed an innovative lightweight slide of chamber design, whose eigenfrequency can be adjusted flexibly by the variable filling of the chambers with a fluid. In this way, quality and productivity of production can be increased considerably.

Storage System with Intelligent Energy Management. A major objective of the transformation of the energy system is the increased use of renewable energy sources. But how can electricity from fluctuating sources, such as the sun and the wind, be made available in the amounts needed? Scientists of KIT and Siemens have developed a stationary system for the storage of excessive solar power that can then be used to compensate fluctuations. The system is especially profitable if used for the electricity generation instead of Diesel generators. By licensees of the KIT, this system is commercialized worldwide. Its performance and storage capacity can be scaled up to the megawatt and megawatthour range. The PowerKIT Control© software developed by KIT represents the automation level and controls energy flow taking into account generation and consumption prognosis data calculated by the software itself. The software controls the system autonomously and can meet a large range of user requirements, from base-load supply to scheduled energy supply to peak load capping to the supply of control energy. In addition, the control unit protects the battery to maximize the service life of the storage system. At the booth, real-time data from the pilot system built at KIT will be presented.

Energy Supply via Glass Fibers. KIT researchers have developed an optical solution for the energy supply of electrically operated sensor networks. First, the technology is envisaged to be used for the fail-safe remote monitoring of rotor blades of wind turbines. However, it is also suited for a broad spectrum of other applications. For energy supply and data transmission, glass fibers are used. Compared to the copper lines used so far, glass fibers are characterized by high transmission capacities, a low susceptibility to failure, and high protection against strokes of lightning. At a base station, laser light is coupled into a glass fiber. Thus, the light can be transported over several kilometers to the sensors. The sensor units accommodate a photovoltaic converter that converts the incoming light energy into electric energy. Consequently, sufficient energy is available not only for the senor proper, but also for the data acquisition and processing electronics. An energy-efficient fiber-optical transmitter

transmits the sensor measurement data back to the base station via the same or a second glass fiber.

Topography and Wafer Mapping. X-ray topography is indispensable in the production and processing of wafers, i.e. thin disks of semiconductor material, which are used as a basis of integrated circuits. By means of this imaging method, defects in the crystal structure and damages can be detected and analyzed. ANKA, the synchrotron radiation source of KIT, possesses a worldwide unique beamline for white-light topography. The services offered by ANKA extend from the generation of detailed images to general overviews of complete wafers. All conventional materials up to 450 mm in diameter can be imaged at a very high resolution (up to 2.5 µm/pixel). After stitching many individual images, small defects on large areas can be localized and characterized and large defect structures can be analyzed in detail.

X-ray Computer Tomography and 3D Printing. X-ray computer tomography has long been established in medicine and industry. In combination with a synchrotron as a radiation source, several advantages result when examining materials: Increased photon flux, shorter exposure times, phase contrast. The experts of the ANKA synchrotron radiation source at KIT can also analyze difficult samples. The data obtained can be transferred directly to models using ANKA's new 3D printer. At a resolution of up to 750 x 750 x 1600 dpi and a layer thickness of just 16 µm, plastic models are printed by multi-jet modeling.

KIT Technology Market. RESEARCH TO BUSINESS, the technology market of KIT, will present more than 100 technology offers. The innovations of KIT are suited for transfer to marketable products and processes.

Other KIT Topics at the 2014 Hannover Messe

TU9 (hall 2, booth D36). The association of the nine leading technical universities in Germany (TU9) is represented at the booth of the VDI. KIT, a member of TU9, presents itself by a film.

Fatigue-resistant Components Modeled on Nature (hall 2, booth A01). In the course of time, cyclic loading of components may cause incipient cracks that grow with increasing load cycles and finally end up in a fracture. This failure due to material fatigue mostly starts at notches, whose shape determines the lifetime of the component. With the growth of a tree being used as a model, the method of ten-

sion triangles is used to design notch shapes for long-lived components having a high loadability.

Gripper for Carbon Fiber Composites (hall 6, booth D44). On the "lightweight construction" platform, KIT presents a gripper for semi-finished products made of carbon fiber composites. Thanks to the high process safety, flexibility, and energy efficiency, the gripper is particularly suited for use in automatic process chains for the production of endless fiber-reinforced plastics. The gripper meets high gripping requirements and allows for novel production technologies.

KA-RaceIng – The Formula Student Team of KIT (hall 6, booth D44). About 60 students of various disciplines, i.e. electrical engineering, informatics, business engineering, economics, and physics, make up the team of Ka-RaceIng. Every year, the students develop, construct, produce, and test two racing cars, one with a combustion engine and one with an electric drive. With these cars, they take part in the Formula Student construction competition and compete against more than 500 teams of international universities. At the Hannover Messe, KA-RaceIng presents a racing car and specially developed lightweight components.

Superconductivity in Energy Technology (hall 13, booth C50). At the joint booth "SuperConductingCity", KIT presents innovative developments and applications of high-temperature superconductivity. It allows for the transmission of energy with hardly any losses, increases energy efficiency, helps to simplify grid structures, and facilitates safe integration of decentralized and regenerative energy sources into the grid. The joint booth will focus on the longest superconducting energy cable in the world (length 1 km) installed in the inner city of Essen and developed jointly by RWE, NEXANS SC, and KIT under the AmpaCity project funded by the Federal Ministry of Economics.

Karlsruhe Institute of Technology (KIT) is a public corporation according to the legislation of the state of Baden-Württemberg. It fulfills the mission of a university and the mission of a national research center of the Helmholtz Association. Research activities focus on energy, the natural and built environment as well as on society and technology and cover the whole range extending from fundamental aspects to application. With about 9000 employees, including nearly 6000 staff members in the science and education sector, and 24000 students, KIT is one of the biggest research and education institutions in Europe. Work of KIT is based on the knowledge triangle of research, teaching, and innovation.

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