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# RESEARCH NEWS

08 | 2014 ||

## 1 Charging electric cars efficiently inductive

We already charge our toothbrushes and cellphones using contactless technology. Researchers have developed a particularly efficient and cost-effective method that means electric cars could soon follow suit.

## 2 Comfortable climate indoors with porous glass

Proper humidity and temperature play a key role in indoor climate. In the future, establishing a comfortable indoor environment may rely on porous glass incorporated into plaster, as this regulates moisture particularly well and keeps mold at bay.

## 3 Simulation models optimize water power

The Columbia River basin in the Pacific Northwest offers great potential for water power; hydroelectric power stations there generate over 20 000 megawatts already. Now a simulation model will help optimize the operation of the extensive dam system.

## 4 Sensors that improve rail transport safety

A new kind of human-machine communication is to make it possible to detect damage to rail vehicles before it's too late and service trains only when they need it – all thanks to a cloud-supported, wireless network of sensors.

## 5 Presentations collectively prepared

Today, every speaker compiles his or her own presentations to accompany their lectures. With a new Internet platform that uses Wikipedia as its model, slide show presentations can now be drafted, distributed, and translated together with others.

## 6 Crash-testing rivets

Rivets have to reliably hold the chassis of an automobile together – even if there is a crash. Previously, it was difficult to predict with great precision how much load they could tolerate. A more advanced model now delivers realistic projections.

## 7 Customized surface inspection

The quality control of component surfaces is a complex undertaking. Researchers have engineered a high-precision modular inspection system that can be adapted on a customer-specific basis and integrated into the production process.

## 8 Newsflash

The Fraunhofer-Gesellschaft is the leading organization for applied research in Europe. Its research activities are conducted by 67 Fraunhofer Institutes and research units at over 40 different locations throughout Germany. The Fraunhofer-Gesellschaft employs a staff of around 23,000, who work with an annual research budget totaling 2 billion euros. About 70 percent of this sum is generated through contract research on behalf of industry and publicly funded research projects. Branches in the Americas and Asia serve to promote international cooperation.

**Editorial Notes:**

RESEARCH NEWS l Frequency: monthly l ISSN 09 48 - 83 83 | Published by Fraunhofer-Gesellschaft l Corporate Communications l Hansastraße 27 l 80686 München l Phone +49 89 1205-1333 l presse@zv.fraunhofer.de | Editorial Staff: Beate Koch, Britta Widmann, Tina Möbius, Tim Schröder, Tobias Steinhäußer l Reprints free of charge. We encourage you to favor the online version and newsletter via www.fraunhofer.de/fhg/EN/press This bulletin is also available in German as FORSCHUNG KOMPAKT.

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## Charging electric cars efficiently inductive



Cables are fast disappearing from our daily lives. The computer mouse has already lost its tail, our telephones and headphones have become wireless – even electric toothbrushes and cellphones don't need cables anymore. Information is transmitted wirelessly, and power needs can be met via an electromagnetic induction supply system. Researchers are in the process of developing wireless charging technology for electric vehicles, too. "Cables are annoying, especially in winter or when it's raining. Whatever gets on the cable – snow, sludge, water – also gets on your hands," says Dr. Bernd Eckardt, head of the Vehicle Power Electronics department at the Fraunhofer Institute for Integrated Systems and Device Technology IISB in Erlangen, Germany. Dr. Eckardt knows what he's talking about, because he drives an electric car himself. It would be much more convenient to charge these plug-in vehicles remotely with contactless technology. And it's possible. The way to do it is using electromagnetic induction, whereby electrical energy is transferred over the air between two objects via an electromagnetic field. Dr. Eckardt explains the physics behind it as follows: "Any wire that carries a current generates a magnetic field. As the English physicist Michael Faraday demonstrated in the 19th century, this magnetic field generates voltage or electromotive force as well. By correctly positioning two wires in relation to one another inside a magnetic field, it is possible to transmit energy over the air. In principle this works just like a transected transformer." Familiar examples of products that use this kind of energy transfer include charging stations for electric toothbrushes and smartphones, and induction hobs.

Researchers from the scientific and industrial communities have been working for several years to find ways to use induction to charge electric vehicles. The current approach involves mounting induction coils on the underside of the vehicle and installing charging stations in the ground. But this brings with it a number of significant challenges. The coils need to be very powerful for the method to work because of the significant gap of up to 15 cm between car and ground. Powerful coils are large in size – and large coils are expensive, which pushes up costs. There is also the problem of objects or animals impeding the charging process by blocking the transmission of power. Cats, for example, are attracted by the gentle warmth emitted from the charging station in the ground, and so see this as a comfortable resting place. Another particularly problematic issue is that metallic paper such as chewing-gum wrappers or cigarette packaging can blow under the car and into the induction zone, where it can get so hot that it bursts into flame.

Researchers at the IISB began pursuing an alternative approach in a bid to resolve these problems. Working as part of the Energie Campus Nürnberg research platform it took them less than a year to develop a system for charging electric vehicles from the front end (http://www.encn.de). Since this allows the car to be driven much closer to the induction source – essentially touching it – the coils themselves are much smaller in

diameter than in the floor-based version, coming in at 10 instead of 80 cm across. The system is more efficient, more cost-effective and makes it less probable that obstacles will disrupt the flow of energy. The charging column is approximately waist-high and made of plastic. It bends backwards if pushed by the vehicle, and is even designed to flip down and out the way if the pressure applied is too strong. "The car could drive over it if necessary. Touching the charging station causes no damage to the car body," says Eckardt. The coils are arranged in such a way that charging can take place even if the driver has not positioned the vehicle exactly in front of and centrally to the column. Clusters of coils that overlap vertically in the column and horizontally behind the license plate allow the current to flow irrespective of the vehicle's size or height.

Scientists at the IISB have been working on power electronics for electric vehicles for some twelve years now, and have been researching inductive charging for the last two. During this time they have accrued extensive expertise in the fields of power electronics, field simulation and current distribution within electromagnetic induction systems. In order to keep exchange resistance to a minimum, for instance, they designed coils that themselves consist of several thin coils each insulated one from the other. The design of the wire coils is important because it is the coils that determine the direction and strength of the magnetic field. "We've been consistently upping the system's performance over the past year, and are now in possession of a prototype that is able to transmit three kilowatts (kW) at an overall efficiency of 95 percent. Today's electric car models can be recharged overnight," says Eckardt. The researchers are now looking to further increase the power of the coil, primarily to keep up with developing battery technology, and to cut the cost of the charge spot even further. "Nowadays, charge spots are offered as part of the sales package when customers buy an electric vehicle. This technology will only become a mass product if the price is right," Eckardt explains.


**Charging electric cars by induction is still a distant vision. By installing the charging system at the front of the vehicle, scientists have found a new efficient and cost-effective approach. (© Fraunhofer IISB) | Picture in color and printing quality: www.fraunhofer.de/press**

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# Comfortable climate indoors with porous glass



Almost nothing worries tenants and homeowners more than mildewed or moldy walls. The black spots are not just ugly; they also pose a danger to people's health. More than anything else, stringent insulation standards governing living spaces can lead to more moisture, which is the main cause of mildew or mold. In 2002, the German federal government brought in energy saving regulations stating that the external components of new and renovated buildings must be made air-tight to ensure that as little heat as possible escapes. The flip side is that excess moisture becomes trapped inside. "That's why humidity-regulating materials are becoming increasingly important," says Ferdinand Somorowksy, researcher at the Fraunhofer Institute for Silicate Research ISC in Würzburg.

**Particularly fast water absorption**

In collaboration with Bayreuth University and the company Keimfarben GmbH, the researcher and his team are developing supplements for paint and plaster that have a compensating effect on indoor climate and humidity in particular. The project partners have selected artificially manufactured porous glass for the additive because the inorganic material's pore size, volume and particle form can be selectively controlled – an advantage the naturally occurring alternatives don't offer. Particular attention was paid to glass particles in their flake form, since they have the ability to very quickly absorb, store, and then slowly release moisture. "As invisible vapor, there is always water in the air. A pleasant indoor climate only remains pleasant when excess moisture released into the room's air by showering, cooking and sweating can also dissipate again somehow. Walls and ceilings offer large surfaces that could be used for moisture management – and by adding glass particles to plaster, stucco and paint, we can even out daily and seasonal humidity differences. The result is a simply more comfortable living space. Up to now, between 95 and 98 percent of all plasters available have been without additives," explains Somorowsky.

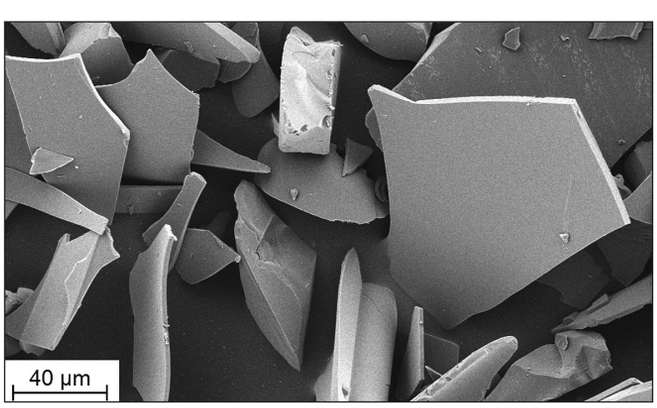
The glass particles are based on Vycor® glass. With this glass type, pores form when manufactured in a certain way; adjusting the process parameters allows for selective modification of the pores. In addition to round shapes, these glass particles can be manufactured in fiber or flake form, while other materials with absorption properties, such as zeolite or ceramic, can't be. Filler material can be produced with a pore size ranging from between just a few nanometers to several micrometers. "Since porosity and pore size can be exactly specified, we can also regulate humidity effectively. A minimal change in pore size adapts the material for different temperatures and various applications, such as living areas, rooms with consistently higher humidity or basement rooms," says the researcher.

Porous glass is inexpensive, non-toxic and non-combustible; for the preliminary tests, it was successfully manufactured in large quantities of several hundred kilograms.

In practical testing, researchers demonstrated that, in comparison to other materials used for regulating humidity, such as zeolite or fiberboard, the glass flake and plaster mixture can absorb considerably more moisture and then release it all again. Tests were conducted at a constant temperature and humidity based on a typical indoor climate. In follow-up tests using benchmark plasters, the inorganic material proved itself superior. As humidity increased, the mass of the glass-flake infused plaster increased more and consequently absorbed more water compared to the reference materials. "In a room with a volume of 30 cubic meters, the walls and ceiling offer approximately 4o square meters of surface area that could be used for a moisture regulating plaster. In order to reduce the humidity from 72 % to 47%, some 180 ml of water needs to be absorbed. And our glass flake plaster can actually adsorb more than a half liter of water," says Somorowsky. Mold spore inhibitive substances can be added to the plaster as well.

Another positive effect of the porous glass flakes is their influence on the building's energy balance. In cases of high humidity, water is adsorbed on the glass surface. The energy released makes the room drier and warmer. The opposite occurs with low humidity, when desorption cools and humidifies the room. These processes take place in both winter and summer, which saves primary energy for heating or cooling. The evenly dispersed glass flakes in the plaster layer particularly benefit the indoor environment during heating.

Currently, the project partners are examining how the glass-based material functions under additional paint layers and wallpaper. They estimate that it will take another two years before the environmentally friendly, moisture regulating plaster reaches the market.




**Scanning electron microscope (SEM) image of glass flakes. (© Fraunhofer ISC) | Picture in color and printing quality: www.fraunhofer.de/press**

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# Simulation models optimize water power



Researchers at the Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB in Ilmenau are developing information technology to make water power generation systems more efficient. The Advanced System Technology (AST) department is creating simulation and optimization models that consolidate external factors such as weather data, water levels and market prices with system infrastructure and generate optimized plans for operational facilities, such as the opening and closing of sluice gates, reservoir water level regulation and hydro turbine operation. This information helps the operator to fine-tune each hydroelectric power station's generating power to meet current energy economics and to sell the generated power for the highest possible return.

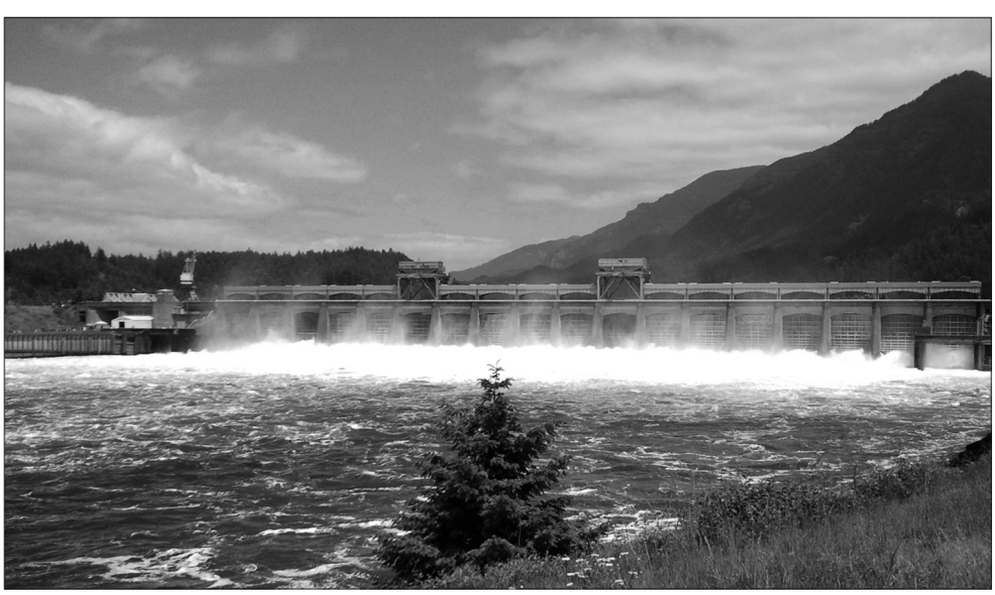
**22,000 MW in the Columbia River basin**

Following projects in Germany and China, and in cooperation with the Dutch-American company Deltares, IOSB researchers are now applying their expertise to one of the world's largest hydropower operators. The Bonneville Power Administration (BPA) in the northwest of the United States runs a complex and extensive dam system in the Columbia River basin that collectively generates around 22,000 megawatts (MW). This is more than five times the output in Germany, which operates some 7500 hydroelectric plants on rivers and lakes and generates 4300 MW. More than 12 million people live in the BPA's catchment area, which covers parts of the U.S. states Oregon, Washington, Montana, California, Nevada, Utah and Wyoming. Together with Deltares, researchers on the HyPROM project have developed a functioning simulation and optimization model that ensures the best possible operation of the BPA dam system based on predefined parameters.

"Very different parameters come into play when it comes to generating hydroelectric power – rainfall levels, volume and speed of the water, not to mention general climate factors. At the same time, regulations regarding the protection of fish, flood control or environmental guidelines have to be accommodated," says Dr. Divas Karimanzira from the IOSB project team. "Hydroelectric plants can be operated optimally only when you take all the variables into account. As an additional challenge, HyPROM takes on the complexity of the extensively networked Columbia River basin dam system – it covers two different rivers with an average water flow of 7,500 cubic meters per second, ten hydro plants, ten reservoirs and an altitude difference of 350 meters."

Currently, researchers are working on expanding the simulation and optimization model to better encompass energy-economic aspects, bearing in mind the fluctuating availability of wind and solar energy as well as randomly changing market prices. "Then we can incorporate even more information in our calculations. This creates a scenario that comes much closer to reality," explains Karimanzira.

The project partners plan to integrate the newly developed technology into a system that will help employees to make the right decisions in running the facility. The aim for the future is to enable BPA to adjust its entire control and management system in under an hour to react to changing circumstances. That way, BPA could choose to sell hydroelectric power only when the price is right. At other times, it could replenish its reservoirs to empty them later, when it makes economic sense or is technically necessary. "For operators who sell not only hydroelectric energy but also other energy sources with a fluctuating supply, such as wind and solar energy, the price is an especially important factor," says Karimanzira.



**The hydroelectric plants in the Columbia River basin in the Pacific Northwest generate 22,000 MW in output. In the photo: a dam wall in the many-branched dam system. (© Fraunhofer IOSB) | Picture in color and printing quality: www.fraunhofer.de/press**

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# Sensors that improve rail transport safety



A train running on damaged wheels could easily be heading for serious trouble. This is why German national rail corporation Deutsche Bahn continuously monitors the wheelsets of its intercity express trains – a process that costs a considerable amount of time and money. Researchers at the Berlin-based Fraunhofer Institute for Reliability and Microintegration IZM are collaborating with industry partners to develop a solution that ensures a great safety while reducing effort and cost. "We want to root out any damage early on and move away from maintenance at set intervals in favor of condition-based maintenance," explains Dr. Michael Niedermayer, microsystems engineer and head of the IZM's Technology-Oriented Design Methods working group. He is also project coordinator for "Mobile Sensor Systems for Condition-Based Maintenance," or MoSe for short.

**Seamless monitoring**

It's all based on a cloud-supported, wireless network of sensors. Every axle and undercarriage on a train is fitted with small radio sensors, which collect data on the condition of wearing parts. These data are then transferred to the online maintenance cloud, where the measurement and analysis data are encrypted and stored ready for use. The sensors can detect even the tiniest scratch on a ball bearing. As Niedermayer says, "Here we have sensor nodes that can capture even the slightest variations in vibration. We call this in-depth diagnosis." As a result, repairs can be made before anything works its way loose and causes damage.

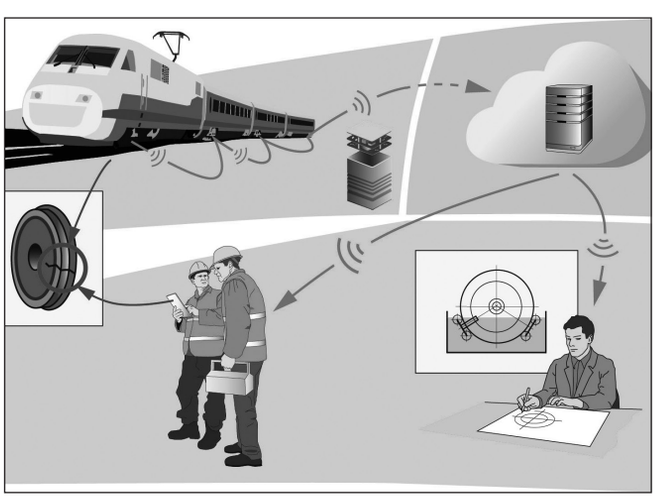
"What's remarkable about this approach is that it allows everything to be monitored with the train in service, rather than having to inspect it at the rail yard. And in any case, visual checks are not 100 percent reliable," says Manfred Deutzer from project partner Deutzer Technische Kohle GmbH. Although there are wired sensors out there that can be used to examine rail vehicle chassis for wear and tear, these fail to match the high diagnostic quality standards the MoSe developers are striving for.

Using the new method, it is possible to get precise data on, say, whether an axle bearing will have to be replaced three months down the line, which avoids the need to replace it prematurely just in case. The latter is just as uneconomical as the custom of overhauling wheels at preset intervals with a view to resolving any wheel flats that could damage rails. "Wheels can tolerate such repairs no more than three times before they have to be scrapped," Deutzer reports. "It would make more sense and cost less to grind only those wheels we know actually turn poorly. The problem is that there has never been a suitable way of checking for wheel flats." MoSe is to change all that and much more besides.

"Not only do we intend to improve diagnostics, a top priority is also to process the data collected in as detailed and tailored a manner as possible," says Niedermayer. The idea is to provide train drivers with all relevant data (for instance about critical wheel damage), diagnostic technicians with detailed measurement data so they can assess how fast gear damage is progressing, and designers with measurement statistics covering wear to all parts, enabling them to improve the technical design of the next product generation. Making sure everyone involved receives the data they need in a form they can work with right away involves developing some clever diagnostic algorithms. "Yet another advantage is that wireless sensors can be easily retrofitted," adds Niedermayer.

What's also new is that the system can adapt to the different rotational speeds of the parts being examined – such as the wheels on a train – and in doing so, deliver incredibly precise data at whatever speed the train happens to be traveling. It used to be that sensors were designed to work at constant rotational speeds. Although this setup may be easier to manage, it means that the diagnostic quality suffers. Thanks to analysis algorithms, this is set to change. But developing these algorithms is a balancing act: "Since the system is intended to work without batteries, the algorithms mustn't drain unnecessary energy by using up excessive computing power," explains Niedermayer. As MoSe uses energy harvesting, it can tap energy from the vibrations and heat generated as the parts rotate.

Over the next couple of years a prototype will be developed that will be tested in a tram run by the German city of Brandenburg an der Havel. The system could then be used for monitoring purposes in suburban or long-distance trains.



**Cloud-supported sensor network for the condition-based maintenance of rail vehicles. (© Fraunhofer IZM) | Picture in color and printing quality: www.fraunhofer.de/press**

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# Presentations collectively prepared

Presentations are ubiquitous. If you want to pass on your knowledge or expertise nowadays, you throw it on the wall via beamer. At the office, employees use presentations to share the latest business figures with their coworkers; at universities, professors structure their presentations with them. Anyone who has attempted to compile a presentation knows how much time it will cost. Typically days pass before thoughts have been wheedled down to a handful of words, with the relevant graphics worked in. The problem: Every speaker creates a personalized version - even though good slide shows may already exist on many myriad topics. That is an immense waste of time.

**Sharing the work: SlideWiki**

In order to save precious time, researchers from the Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS in Sankt Augustin, in collaboration with the Universities of Bonn and Leipzig, have developed an open-source Internet Platform where interesting presentations can be prepared and translated collectively. "The challenge was to write a software which enables all authors to work on the slides simultaneously. Slides are more complex than plain text. They include texts and pictures and can change their order," says Project Manager Prof. Dr. Sören Auer from the Department of Organized Knowledge at IAIS. In the style of Wikipedia, the online encyclopedia, the developers have named their platform "SlideWiki," because the operating principle is quite similar. With Wikipedia, hundreds of people work as a collective force to put together the entries in this virtual reference resource. Thus, after some time, a vast treasure trove of knowledge has come into being. The same thing is taking place with SlideWiki. Each registered user can upload his or her presentations onto the platform, or change or amend those of other members."This saves lecturers from having to constantly reinvent the wheel," says Auer.

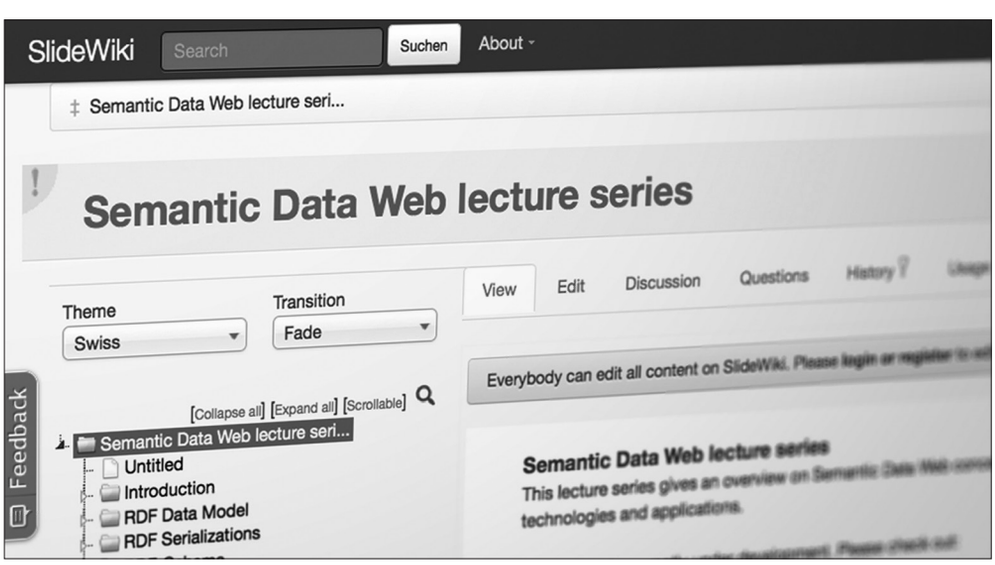
Auer is also a professor at the University of Bonn and works there, among other things, on the topic of "open education," i.e., the development of educational platforms on the Internet that are accessible to every human being with Internet access. Unlike in German or English, he explained, in some languages there is so far hardly any publicly accessible information on too many subjects. In the future, SlideWiki could help with this by allowing the experts to make their presentations accessible to other people in various languages. What's more: in many regions today, only a marginal number of people attend schools or universities. But with SlideWiki, soon anybody with an Internet connection can acquire this knowledge.

Of course, there are already websites on the Internet from which users can download presentations on a variety of topics. However, the presentations are frequently out-of-date and cannot just be simply updated. Moreover, they typically originate just from a single author. By contrast, in SlideWiki, a whole slew of experts are constantly contrib-

uting and revising the presentations so that they are kept up-to-date. In addition, no copyrights are violated with SlideWiki. Since the content on this open platform is openly available, users can utilize them without hesitation. On SlideWiki, users can additionally compile new presentations at their discretion, embellish them with their own slides, and upload them again. One unique feature is the "question function," which lecturers can attach questions to their own slides. This way it is possible for students to test their knowledge on their own.

A translation function is linked to SlideWiki that transfers the presentations into another language at the push of a button. Of course, post-editing work is necessary, because the program is incapable of conveying the terms or concepts with any precision, Auer adds. Nonetheless this clearly saves more time than having to manually translate slide after slide.

There are currently more than 3,000 presentations on SlideWiki, and with each new user, more are added on. Auer and his team have already earned recognition for their innovative approach to making knowledge publicly accessible – and editable – in presentation format. In April of this year, they received the Creative Innovation Award of the Open Education Consortium, a global association that advocates the free and open access to knowledge and expertise.




**On the Internet platform "SlideWiki," users can prepare, optimize and translate presentations collectively, just like Wikipedia, the platform on which it is modeled. Currently presentations from the field of information technology predominate. However, the portal is open to users from all scientific disciplines, along with industry as well. | Picture in color and printing quality: www.fraunhofer.de/press**

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# Crash-testing rivets

Steel, aluminum, magnesium, fiber-reinforced plastics: cars are built from a wide array of materials today. These have to be connected with each other reliably. To wit: even if the joints become loose in a crash, passengers must face no greater risk of injury than before. Manufacturers use their welding equipment for cars made entirely of steel. However, if you want to combine steel together with aluminum, for example, or steel with plastic materials, then conventional welding techniques are entirely unsuited, plain and simple. Automakers therefore resort to mechanical connections instead, such as rivets.

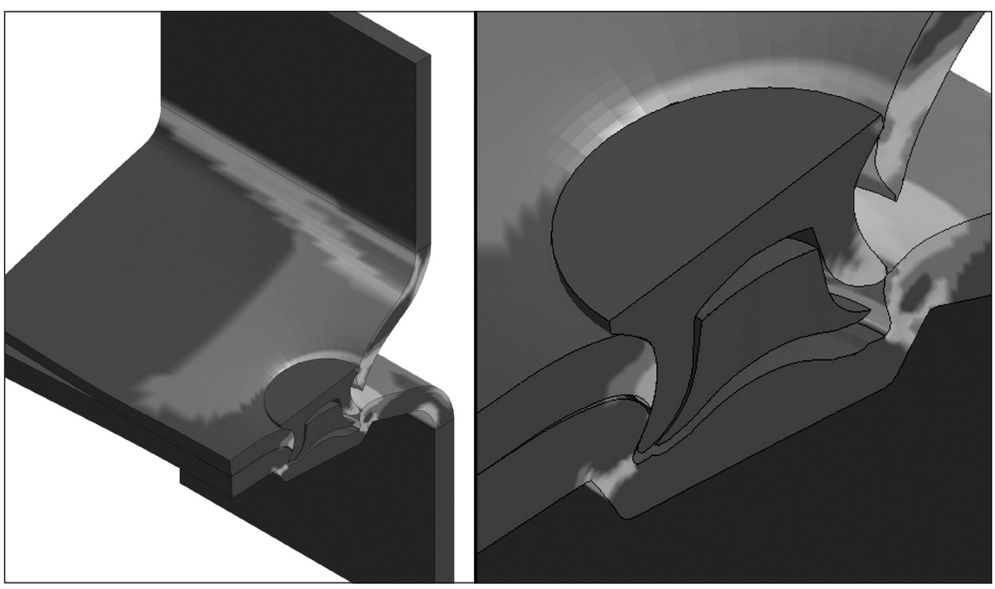
Very often, connections are the weak points: in a crash, they are typically the first thing to fail. And since a car has about 3,000 to 5,000 joints, manufacturers strive to minimize this risk. This is why automakers use simulations to verify if the various connection points sustain these stresses in an accident. Yet how stable are they in the first place? In many cases, the calculations can clearly predict how the individual joining points will perform, but not for every type of strain, though. If the joined components become bent (experts refer to this as a "flexural load" or "bending load"), then the simulations are quite often off the mark. For example, such computations could ascribe a greater load capacity than the rivets can actually bear under real emergency conditions. This uncertainy is something automakers greatly wish to eliminate.

## Realistic projections through a new model

Researchers at the Fraunhofer Institute for Mechanics of Materials IWM in Freiburg – working together with their colleagues from the Laboratory for Material and Joining Technology LWF in Paderborn, and the Association for the Advancement of Applied Computer Science GFaI in Berlin – have essentially eliminated this drawback now, at least in the simulations. "We have further engineered a model that allows us to forecast rivet performance more reliably – both with slow and fast bending loads, as well as with pull and shear forces that emerge when the joined components become shifted, relative to each other," explains Dr. Silke Sommer, Group Manager at IWM. For this purpose, researchers produced individual "sample components" from a variety of materials, connected them with rivets, and then applied stress. They bent them in a variety of directions, and pulled them and pushed them at varying speeds. They then integrated the performance of the rivet points into the mathematical equations. "These equations contain various parameters – to account for the different materials and their densities, for instance," Sommer says. The researchers at IWM and LWF studied about 15 different combinations of materials. Based on these data, their colleagues at GFaI prepared projections for other similar material and density combinations.

If car manufacturers now want to calculate how the rivets perform in the event of an accident, then as a rule, they simulate the crash first. What forces appear at which

points on the car? If these data are known, then the engineers can determine – for each rivet – whether it could withstand the strains at precisely this point or in that position. The model is finished and automakers can already use it, and therefore make their cars even safer than before.



**A punch-riveted joint fails under bending load: the brighter areas were particularly seriously deformed. (© Fraunhofer IWM) | Picture in color and printing quality: www.fraunhofer.de/press**

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# Customized surface inspection



Before a workpiece leaves the production plant, it is subjected to rigorous inspection: because even the most infinitesimal fracture or impact point could diminish the reliability or durability of a component. And when it comes to safety-critical applications – such as in the automotive or aerospace industries – manufacturers can only use the most impeccable parts. But esthetic aspects also count - for example, with ceiling panels or components for the cabin of the automobile.

In order to check a component, manufacturers apply image processing methods. Multiple cameras take pictures of component surfaces from various angles, which are analyzed by a software program. "Every material substance has its own unique surface structure. In order to evaluate its quality, the testing procedure has to be gauged precisely to these specific properties," explains Markus Rauhut of the Fraunhofer Institute for Industrial Mathematics ITWM. Even the size and shape of a component play a role – as well as the desired resolution of the images. Even though there is an array of surface inspection systems on the market already, these are only configured for specific materials and dimensions. Standard solutions cannot cover the entire spectrum of possible testing objectives. The researchers at ITWM have closed this gap: The scientists from Kaiserslautern engineered a modular inspection system they have dubbed "MASC: Modular Algorithms for Surface InspeCtion," which can be modified to customer-defined specifications. "Our system is suited for the most diverse materials – like metals, leather, textiles or paper – and covers a size range from tiny components for medical technology through to entire sheets of rawhide or ceiling panels," Rauhut adds. MASC-STeX for the inspection of cover plates and MASC-Dehnzelle for the inspection of expansion cells are already in practical use in the industry.

**Basic version with over 300 algorithms**

First, the surface of the workpiece is illuminated and scanned using multiple cameras set at a wide range of angles. "This is important, so that you can also pick up impact points or fractures that are only visible from one side," explains Rauhut. With free-formed surfaces, regions are also recorded in this manner that are covered by curvatures or corners. The more complex the geometry, the more cameras are needed, as a rule. "To keep the costs within limits, we are concentrating on areas in a practical setting in which a defect would actually have negative implications," the researcher said. For the analysis of the images, the scientists have developed mathematical evaluation algorithms and from this, built up a comprehensive software library. "For instance, one algorithm is programmed to find edges or certain color points in the image," explains Kai Taeubner of ITWM. The basic version of the software alone comprises more than 300 algorithms that could also be combined, depending on the testing task.

One particular challenge includes those inspection procedures that require very high resolution. No surface is quite homogenous; indeed, they feature small scratches or fluctuations in brightness. For projects where resolution reaches the microscopic level, it becomes increasingly difficult to differentiate between anomalies in the surface texture and actual defects. The consequence: components that are actually free of defects get sorted out as defective. "That is another advantage of our procedure: With the aid of our algorithms, we can refine the analysis to such a degree that incorrectly identified flaws become virtually eliminated," Taeubner indicates.

Once all testing parameters are set, the procedure is integrated into the production process with the customer. The cameras are either installed directly on the assembly line for this purpose, or applied using robots. When a defect is found, the production process automatically stops; at the same time, the machine operator is notified. The detected defects are classified and the test object is divided into quality classes.

**Prototypical inspection of the surface of a BLISK (Bladed Integrated Disk) with two cameras and a light source. (© Fraunhofer ITWM) | Picture in color and printing quality: www.fraunhofer.de/press**

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## Treating rare tumors effectively

In Germany, approximately 100,000 people each year develop tumors in the gastrointestinal tract. Only two percent of these patients are diagnosed with GIST (Gastrointestinal Stromal Tumors). Unfortunately, this highly uncommon form of cancer often remains undetected in the early stages as the connective tissue tumors develop gradually. By the time the disease is eventually diagnosed, the cancer will have already metastasized in one out of every two patients. The average patient life expectancy is typically less than 3 years. GIST is currently treated with Tyrosine Kinase inhibitors (TKI), which causes specific proteins involved in cell proliferation, resident on the cells surface, to be blocked. However, GIST frequently develops TKI resistance.

In the EU project "MITIGATE," ten partners from research and industry are devoting themselves to the creation and validation of a closed loop process, so that patients with GIST and metastatic GIST can be treated effectively. This personalized treatment concept encompasses innovative strategies for biopsy extraction and cell analysis. Furthermore, imaging processes and corresponding concepts for minimally invasive treatments will be optimized and adapted for this purpose.Researchers in the Project Group for Automation in Medicine and Biotechnology PAMB of the Fraunhofer Institute for Production Technology and Automation IPA are developing a flexible biopsy needle for extracting tissue samples. The endoscopic instrument features an interface with a module for breaking down the tissue. The GIST cells are then specifically isolated by immune-magnetic labelling. Researchers at the University of Mannheim will then characterize specific molecular markers present in individual patient's GIST cells through mass spectrometry. The "spectral fingerprint" that results from this data will be compared against an information database of GIST cell subtype classification s, known patient treatment and outcome.  In this manner, ineffective therapies can be excluded before the treatment process begins.

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## Effective identity management in the cloud

Too many cooks spoil the broth? In production, that hasn't been true for a long time now. Usually a whole series of partner companies and suppliers are involved in the development of a product. To ensure the various actors can work together effectively without losing time, you need a common platform - cloud based infrastructures unlock highly promising options here. Mind you, certain measures do have to be taken to ensure that only authorized individuals have access to the data. For this purpose,

companies use various authentication procedures – based on chip cards, for example, or password generators. The research staff at the Fraunhofer Institute for Industrial Engineering IAO, together with multiple collaborative partners under the auspices of the „SkIDentity“ project sponsored by the Federal Ministry for Economics Affairs and Energy BMWi, is working on integrating the already existing authentication process in cloud computing infrastructures and, in this manner, markedly simplifying identity management. The Stuttgart-based scientists will be exhibiting how this might look in a business setting using a technology presentation for the automotive industry. Engineers at the fictitious automotive corporations and suppliers can identify themselves and log in there, using various chip cards, such as company IDs or the new German personal identity card, in order to work with various authorities within the cloud workspace. Thanks to this management tool, companies would no longer issue their own cards or password generators to partners or suppliers – and thus would save on administrative outlay and expenses.

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## Monitoring road bridges

Many bridges in Germany are in a poor state. Scientists at the Fraunhofer Institute for Structural Durability and System Reliability LBF and the Technical University of Darmstadt have now developed a system for analyzing the structure of bridges. They measure the vibrations that bridges are subjected to, establish their vibrational attributes, and observe them over an extended period of time. For this purpose, they developed a network of highly sensitive acceleration sensors – which are linked to each other wirelessly – into a model bridge. A model train emits the vibrations when crossing over. The sensors are based on MEMS Chips (MicroElectroMechanical Systems), which were equipped with specially adapted housings at LBF's facilities. Based on the collected data, and compared with previously defined reference structures, the experts identify defects before the consequences can potentially become dangerous to automotive traffic or rail passengers. »In the coming years we expect to see the sensors to be gradually integrated in real bridges and that we could review the bridges online. Corresponding European activities are currently on the way«, says project manager Andreas Friedmann from LBF.

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