Fraunhofer

RESEARCH NEWS

09 | 2013 ||

1 Sorting out top-class wines

No vintners want their wine to have a bitter note to it. Now, new sorting equipment with optical recognition can guarantee this is never the case. The machine sorts the harvest into quality grades – sparing winemakers laborious manual work.

2 Asteroid deflection

Potential asteroid impact on Earth can have disastrous consequences. In order to prevent such collisions, earthbound space objects must be deflected. This can be accomplished using a space probe to impact the asteroid.

3 Adding precision to plastics testing

Plastics play an important role in many consumer items. But testing precisely how much load these plastic parts can bear has up to now been a very complicated task. Now, a new instrument achieves simpler and more accurate measurements.

4 Safer shipping with high-tech radar

Traffic volumes are increasing, not only on our roads but also at sea. A new marine radar system with improved antenna technology is set to meet the growing demands of navigation – and protect ships against pirate attacks.

5 Solar energy for sensor nodes

Tiny solar cells applied directly to a silicon chip are a potential way of efficiently and reliably powering wireless sensor networks in the future. Above all, this would simplify large-scale applications, for instance in agriculture.

6 More creativity in post-production

In the throng of the film set, camera operators have to determine the camera angle, the aperture, and depth of field of the camera. In the future, they will be able to change these parameters, even in post-production thanks to a new camera technology.

7 Getting a grip on inventory management using RF

More and more manufacturers are offering their products cooperatively through small retailers, as well as in web shops. Researchers have developed a new RF clip with which products can be labeled. It helps avoid duplicate sales.

8 Newsflash

The Fraunhofer-Gesellschaft is the leading organization for applied research in Europe. Its research activities are conducted by 66 institutes and independent research units at locations throughout Germany. The Fraunhofer-Gesellschaft employs a staff of more than 22,000, who work with an annual research budget totaling 1.9 billion euros. Roughly two thirds of this sum is generated through contract research on behalf of industry and publicly funded research projects. Branches in the USA and Asia serve to promote international cooperation.

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Sorting out top-class wines

The tasters are overjoyed: of over 100 wines that were submitted, this rosé is of exceptional quality. "Fresh, dry, pleasant – a real summer wine," says one; "incredibly well rounded," says another; "delicate," says a third. They also praise its harmony and the balance between sugar and acidity. If a wine is to win jurors over so unanimously, not only must there be no hitches in the processes it goes through at the winery, but all weather-related factors need to stack up, too. For a vintage to be good, the weather has to have encouraged the growth of the grapes at the right time and offered a proper balance of sun and rain over the course of the year. But in Germany, the weather can often quite literally ruin the harvest for winemakers. A novel piece of optical sorting equipment is set to help make the most out of grapes' quality. Researchers from the Fraunhofer Institute for Optronics, System Technologies and Image Exploitation IOSB in Karlsruhe are working to develop the equipment together with Armbruster Kelterei-Technologie GmbH, Ingenieurbüro Waidelich and Geisenheim University in the GrapeSort project, which is funded by Germany's Federal Ministry of Economics and Technology BMWi.

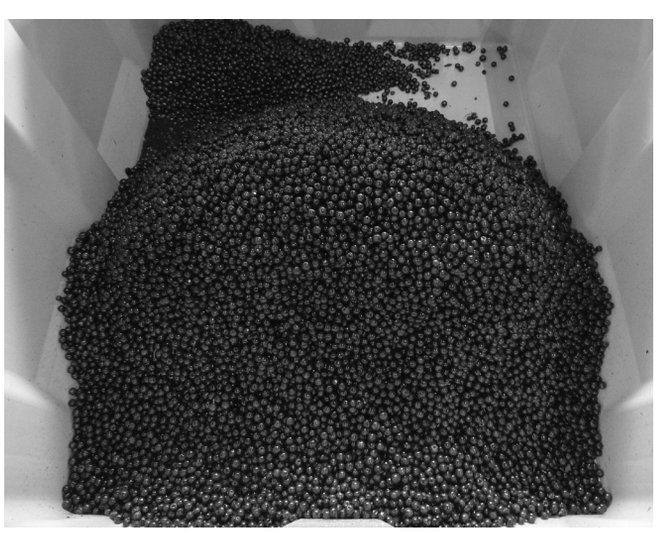
Sorting the good from the bad

Once the vats of grapes have been delivered, their contents pass through a feeding unit into the destemmer provided by Armbruster, which separates the berries from their stems. Next, the grapes are individually placed on a conveyor belt by a newly developed conveying system. "What's important is to get the berries onto the belt without damaging them," says Dr. Kai-Uwe Vieth, a scientist at the IOSB. The grapes are then carried along by the conveyor belt past the IOSB's sorting module at a speed of 3 meters per second. At the heart of the module is a high-speed line scan camera that records the material flow, taking photos of the fruit as it rushes past – 18,000 times a second. IOSB analysis software evaluates each image in milliseconds and controls compressed air jets that blow foreign objects such as insects, vine shoots, stones or twigs out of the material flow. Bad or undesirable berries are also removed by the Waidelich air ejection unit. The "good" berries fall into a container. "Our sorting module is designed to exceed the capabilities of current machines. Not only does it remove foreign objects, it also sorts the berries into various quality grades. That lets you create exactly the wine you want," says Vieth. The camera is trained in advance what to deem "bad". Mold, earwigs, leaves and the wrong degree of ripeness are typical rejection criteria. Sorting is done based on analyses of shape and color.

The researchers are already able to use their equipment to recognize various degrees of berry ripeness based on nuances of color. In future, they also want to be able to tell the ripeness by investigating how much sugar there is in the fruit. "Winemakers measure sugar content using an optical device called a refractometer, which allows them to read out on a scale the degree to which sugar molecules in the must influence the angle of

refraction of incoming light. The higher the sugar content, the more the light is refracted. The line scan camera can also measure reflected light, as it is a light-sensitive line," Vieth explains. This integrated line sensor is sensitive to both visible and invisible light. For the laboratory analyses that run while the measurements are taken, Vieth and his colleagues use imaging sensors for the wavelength range of 240 to 2500 nanometers. The sensors generate spectra for each pixel.

Several tons of grapes pass through the sorting facility every hour. Grapes of the Trollinger, Riesling, Weißburgunder and Lemberger varieties have been successfully sorted in preliminary testing, with project partners unanimously declaring the results of the sorting to be good. An optimized functioning prototype that will serve as a basis for a production-ready facility is set to be tested for the first time in October 2013. All the components undergoing constant development and optimization – the feeding unit, the camera box and the air ejection unit – will be connected up and tested in time for the grape harvest. And the entire project will be put to the sensory test at another premiere in June 2014: the tasting of the resulting wine by the Geisenheim University viticulture experts who are providing their expertise to the project. Vieth and his project partners are convinced that their wines will be a great success: "The sorting system helps to improve quality and separate the harvest into various quality levels. This will allow winemakers to expand their premium output."



The good berries land unharmed in a container. Insects, leaves, unripe grapes and other foreign objects are removed by the optical equipment.
(© Fraunhofer IOSB) | Picture in color and printing quality: www.fraunhofer.de/press

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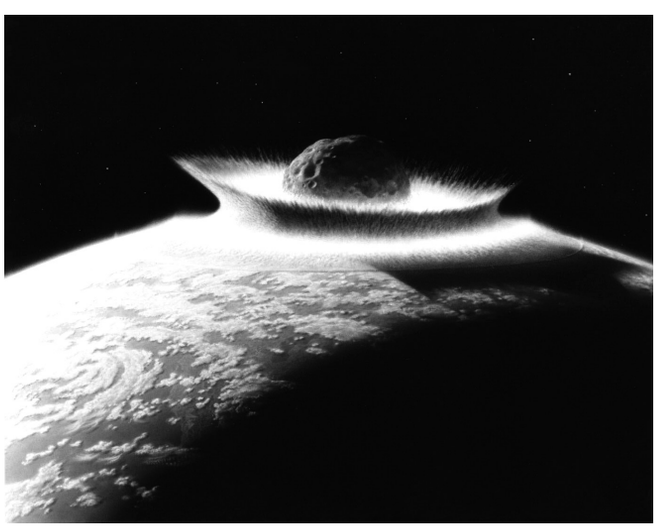
Asteroid deflection

65 million years ago, the Earth was ravaged by tsunamis, a huge dust cloud darkened the skies and acid rain fell on plants and animals. These events marked the latest mass extinction and the creeping end for more than 50 percent of all species on Earth. Not even the dinosaurs would survive this apocalypse. These events were most likely caused by an asteroid approximately 10 kilometers across that impacted the Earth in the area of today's Gulf of Mexico, scarring the planet's surface with a crater over 170 kilometers wide. Is this scenario unthinkable today? To date, astronomers have identified almost 10,000 asteroids with an orbit that approaches or crosses Earths' orbit – and the number is growing. Last February, a meteorite injured almost 1500 people when it exploded over the Russian city of Chelyabinsk, with a population of over a million. At a diameter of some 20 meters, the meteorite had a weight of 10,000 tons.

The objects that Frank Schäfer of the Fraunhofer Institute for High-Speed Dynamics, Ernst-Mach-Institut, EMI in Freiburg deals with are much larger than this. His research is focused on medium-size objects measuring between 100 and 300 meters in length. An asteroid of this size could potentially wipe out entire cities or regions. The scientists have conducted initial laboratory experiments to verify the possibility of deflecting asteroids by impacting them with heavy masses at high speeds – for instance large space probes. The principle behind the impact is similar to a game of billiards: when one ball hits another, the second changes course. "During impact, not only does the probe transfer its own momentum to the asteroid, there is also the recoil of detached material from the crater, which is ejected against the direction of the impact," describes Schäfer with regard to one of the key test findings. "This recoil effect acts like a turbocharger on the deviation of the asteroid." Tests show that, due to this effect, the overall momentum transferred to the asteroid is up to four times greater than that of the probe alone.

To study this more closely, researchers attach various materials with asteroid-like properties – dense quartzite, porous sandstone or airy concrete – to a pendulum and impact them with small aluminum projectiles. What they discovered was that the more porous the asteroid is, the less momentum is transferred. In other words, the projectile approach is particularly effective for denser space objects. The projectiles reach speeds of up to 10 km/s in the laboratory, which means they can attain the impact speeds that researchers are aiming for in future missions. In order to demonstrate the transfer of momentum and the associated efficiency of the impact, the researchers use high-speed cameras and laser interferometers to measure the pendulum's swing."In actual fact, the impact of a space probe would change the speed of the asteroid by just a few centimeters per second. But that's enough to deflect its course to a significant degree over a longer period. So if we want to stop an asteroid on collision course with the Earth from hitting us, we'll need to fire at it many years ahead of time," explains Schäfer.

The pendulum test is part of the NEOShield space project, which is funded by the EU and coordinated by Alan Harris of the German Aerospace Center's (DLR) Institute of Planetary Research. It brings specialists from Germany, France, the United Kingdom, Spain, the United States and Russia together to work on ways to protect our planet from near-Earth objects, which are asteroids whose orbit brings them into our proximity. One of the project's aims is to plan a space mission by mid-2015 to actually deflect an asteroid. There won't be a shortage of objects for the specialists to choose from: according to NASA, there will be over 20 close approaches in September alone. Of these, object "2008 HB38" will come closest to us on the 15th at just under five million kilometers.



An asteroid impacts the Earth. In order to prevent this catastrophe, researchers are looking to fire satellites at these heavenly bodies as they approach.
(© Donald Davis) | Picture in color and printing quality: www.fraunhofer.de/press

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Fraunhofer

Adding precision to plastics testing

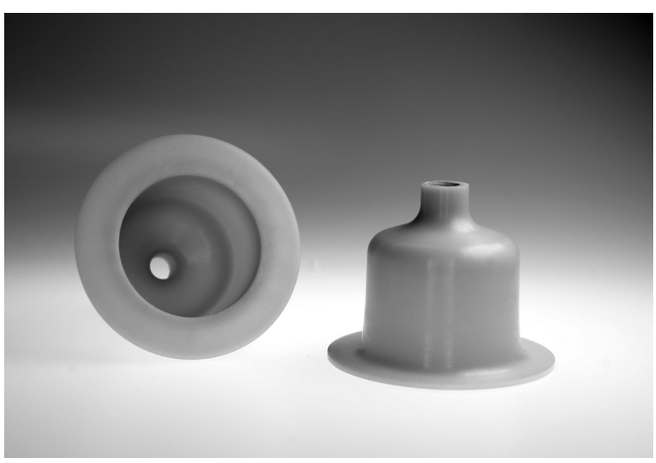
So that relaxed Sunday outing came to nothing. The car broke down after just a few kilometers. Why? Because a tiny crack in the gasoline pump brought the engine to a standstill. An operating life of several thousand hours proved to be too much for the plastic component to take. To keep occurrences of this kind rare, specialists regularly put important plastic components to the test. As a material, plastic's importance goes way beyond cars: it's plastic that keeps our washing machines running, makes sure the coffee that comes out of the machine tastes good, keeps our drainpipes clean, and guarantees that insulating materials don't fail – among many, many other applications. There's just about no end to where plastics are used.

Given that every component reacts completely differently to stresses, it's a tricky business to obtain exact test results. In an effort to keep the workload down to a manageable level, researchers get representative results from a test piece made using the same material, as opposed to testing individual components. Dominik Spancken of the Fraunhofer Institute for Structural Durability and System Reliability LBF in Darmstadt describes the typical approach: "Generally our customer provides us with a certain quantity of plastic granulate, which is the base material for plastic products. We use this granulate to create test pieces and subject these to various loads. Our computers record the values and calculate a lifecycle model for each material." The drawback with this approach is that researchers can only ever study one spatial load at a time, for instance pressure or strain at a single point. But in fact plastic components are mostly subjected to loads along multiple axes – in other words, they are maltreated from all sides. "That's why measurements were often just an approximation," says Spancken of this dilemma.

Water pressure simulates loads

The most realistic way to simulate the loads that plastics are subjected to is with the internal pressure process. This uses a special piece of equipment to press a fluid medium – perhaps water, oil or brine – against the walls of the test piece from within. This simulates an even distribution of pressure. The problem is it wasn't possible to apply this process with the equipment available up to now when the test pieces were solid. So the researchers had to redesign the test piece, the process and the testing equipment. And the result is the MultiTester, a hollow thermoplastic object that looks a little like a bell jar you might put over cheese. Straightforward to produce by injection molding, it can easily be adjusted to a wide range of test scenarios. Wall thickness, environmental influences and load types can for instance all be set to any desired value. What is more, the scientists can determine the degree of influence that reinforcing fibers have. "These special materials can usually cope with double the pressure," describes Spancken.

This new method complements existing test scenarios, which are still used to come up with initial predictions of a given component's load behavior. The MultiTester validates the data collected and defines load limits with even more precision. Anyone wanting to take a closer look at the new test piece should visit the Composites Europe trade fair, which is being held in Stuttgart from September 17 – 19, where the LBF will be presenting this technology to the public for the first time in Hall 6, Booth A02.



The test piece's special shape permits substantially more realistic testing scenarios for plastic components. (© Fraunhofer LBF) | Picture in color and printing quality: www.fraunhofer.de/press

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Safer shipping with high-tech radar

Marine safety has been at risk for many years. One of the biggest risk factors in international shipping is piracy. Pirates attack container ships and tankers, especially off the coasts of Somalia and West Africa. The sorry figures for 2012 show that 174 ships were boarded, 28 hijacked and 28 fired upon last year, with 585 people taken hostage on board around the world. The International Maritime Board (IMB) reports that 26 mariners were taken prisoner in Nigerian waters and six crew members were killed. There are rich pickings for pirates operating in these risky waters: they simply use small, agile speedboats to approach freighters and seize control of them. Traditional marine radar systems with their mechanical rotating antennas cannot reliably detect these small vessels. But a new generation of radar systems with higher resolution is now able to spot the attackers' boats well in advance, and the extra warning time this provides is enough to allow assistance and rescue measures to be taken.

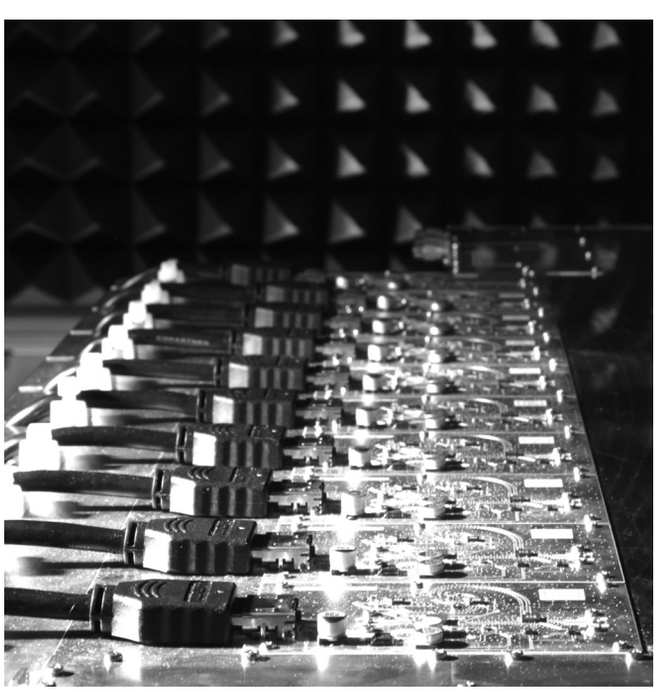
Researchers from the Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR in Wachtberg are aiming to replace conventional marine radar systems – and their rotating antennas and high-power transmit signals – with devices that feature electronically scanned arrays as well as improved generation and processing of signals. "Our radar transmits signals that are reflected by buoys and by the objects being observed. It relies on coherent signal processing, which is to say that the shape and phase of each transmit pulse is essentially identical to the others. There is a certain phase shift between the signal transmitted and the echo received; this makes it possible to measure the elapsed time with great accuracy, which means an object's distance, size, position and speed can all be calculated," explains Dr. Thomas Bertuch, a scientist at the FHR. What is more, this stable phase shift allows a comparison of phases between consecutive pulses, such that interfering echoes produced by wave crests, weather fronts bringing rain or hail can be suppressed more effectively. The FHR researchers' solution operates with low-power transmitting in the frequency range of 2.9 to 3.1 GHz in the S band. In contrast, while conventional radar systems operating on the basis of magnetron tubes offer high transmit power, they are less accurate because the shape and phase of each pulse are random. This is known as incoherent signal processing.

Positioning system can also detect small boats

The FHR's marine radar, with its extremely agile modular phased array and coherent – or pulse-Doppler – signal processing, is able to detect many more and much smaller objects with great accuracy. Unlike systems featuring a rotating antenna, which sweep their environment with circular scans, its beam can be steered very quickly and in any direction. This makes it suited not only to ensuring navigation safety in heavy traffic but also to monitoring ports and sections of coastline. Since the FHR solution is a linear array comprising a large series of antenna elements in a row, it is still able to function

even when a number of elements have failed. Another advantage of phased array radar systems are their low maintenance costs compared to conventional radar systems, in which the magnetron's susceptibility to wear means it must be replaced on an annual basis.

To date, the high manufacturing cost of phased arrays has led to them being used predominantly in military applications. However, new shipping regulations permitting the operation of radar equipment with low transmit power bring inexpensive semiconductor components and technologies into play, which will make phased array systems affordable for use in civilian shipping navigation in future. Each of the FHR array's transmit/receive modules features a silicon-germanium based mixed-signal integrated circuit developed by the Chair of Integrated Analog Circuits (IAS) at RWTH Aachen University according to the FHR's specifications. These chips contain amplifiers, a phase shifter and all digital components needed to control the antenna. The radar also features a patented serial feed network that transfers the signals of individual antenna elements to the receiver. A functioning demonstrator has already been produced. Bertuch and his team are aiming to present their radar system in September 2014 at the biennial SMM maritime trade fair in Hamburg.



The phased array's transmit/receive modules are equipped with silicon-germanium mixed-signal integrated circuits. (© Fraunhofer FHR) | Picture in color and printing quality: www.fraunhofer.de/press

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Solar energy for sensor nodes

Almost wherever you go, the team player is more in demand than the lone wolf – after all, those who pull together get the better results. This isn't just true of people though: sensors, too, are more powerful when part of a team. Sensor networks made up of individual sensor modules that communicate wirelessly with one another have the capacity to measure local parameters over large areas, and then to pass these data on among sensor modules to a central station. This makes sensor networks suitable for a wide range of applications, whether for fire prevention or monitoring large areas of farmland. The issue of how to power the individual sensor modules remains a sticking point in these sorts of applications. Wiring the sensors together is hardly a viable option nowadays due to the cumbersome and costly installation. What's more, many applications require the sensor network to blend unobtrusively into the surroundings and not to have an impact on the aesthetics. An example of this would be the systems used for adjusting window positions as part of smart building management programs. Using batteries to power the sensor network does eliminate the need for inconvenient cables, but the amount of maintenance involved in replacing the batteries regularly as required should not be underestimated, particularly in large networks.

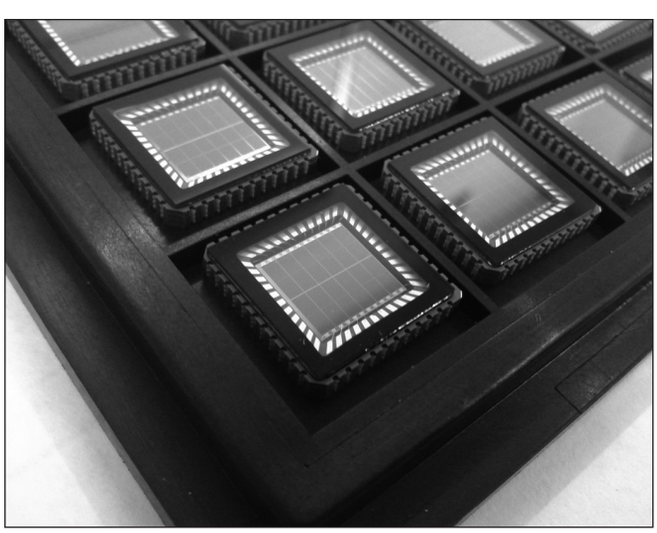
Now, researchers from the Fraunhofer Institute for Microelectronic Circuits and Systems IMS have developed an ingenious alternative based on SOLCHIP Ltd IP. The resource they have harnessed to provide power is one that is freely available in almost any location: sunlight. "We use special process steps to place a mini solar cell straight on sensor modules' silicon chips," explains Dr. Andreas Goehlich, who heads up the project for Fraunhofer IMS. This might sound easy at first, but it actually isn't. For one thing, the Application Specific Integrated Circuits (ASICs) on the silicon chip cannot be disturbed in any way by later steps in the process. ASICs could be termed the brain of the sensor module, facilitating its specific functions. They are manufactured on a piece of silicon in the course of several processing steps, including ion implantation, oxidization or metal deposition. "The structures of ASICs are extremely sensitive, which makes subsequent processing extremely tricky," explains Goehlich. "That's why we use a specially developed 'soft' processing technology that has already proved itself on a variety of different ASICs."

Light as an energy source

In opting for mini solar cells, the researchers from Duisburg are turning to a method that is becoming more and more established in the low-power sector in particular. Energy harvesting, as it is known, is about exploiting resources in the immediate vicinity to generate small amounts of power. This means that the sensor modules are their own mini power stations, independent of external sources of electricity. Potential energy resources include harnessing vibrations or differences in temperature. Goehlich, however, believes that solar cells have a few advantages over these solutions: "Light is

almost always available over long periods of time. What's more, it is not subject to such great fluctuations in supply as other resources." Then there is the advantage that solar energy can be converted into electricity relatively easily.

Development work is currently focusing primarily on agricultural applications. For instance, wireless, energy-autonomous sensor networks known as smart dust could be distributed over large areas of farmland. Goehlich says: "You can picture it as simply scattering the sensor nodes over the field." These miniature smart helpers would then measure details such as the moisture in the soil or the level of sunlight and relay the data to a central interface. The farmer could then use the measurements to regulate the amount of watering or even to predict the expected crop yield. The technology is ready to be implemented and SOLCHIP Ltd. is now taking care of marketing its first product.



The solar cell sits directly on the sensor module's silicon chip.
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More creativity in post-production

And – Action! The set resembles an ant hill. Actors, actresses, extras, cameras – and in between all of this, the director is calling out his instructions. The camera operator has to make sure of the correct settings, pay attention to the flow of the scene, and instruct the camera assistants. Which camera angle should be assigned to which camera? Which part of the image should be sharp, and which should retreat, diffuse and out of focus? Because once the recordings are "in the can", as they say in the movie biz, these parameters can no longer be corrected. At least, not until now. An algorithm combined with a new type of camera array – i.e. an arrangement of several cameras – should enable these changes to be made retroactively in the future – and thereby allow for more creativity in post-production. Filmmakers can then still decide afterwards which area of the scene should be portrayed sharply. Or move around within a scene – virtually – like in the film Matrix. The actor is frozen in the scene, hanging motionless in the air, while the camera moves around, capturing the scene from all sides.

Many perspectives instead of just one

Researchers at the Fraunhofer Institute for Integrated Circuits IIS in Erlangen, Germany, have developed a camera array that makes this feasible and will be exhibiting it at this year's International Broadcasting Convention (IBC) in Amsterdam. "The array consists of 16 cameras in total, arranged in four rows and columns", explains Frederik Zilly, Group Manager at IIS. Instead of having just one single camera as usual, which records the scene from just one position, the 16 cameras collect the light rays at various points in the plane over which the cameras are distributed. The researchers speak of having captured part of the light field from the scene, instead of only one specialized perspective. Although the array consists of 16 cameras, its cross section is only 30 cm by 30 cm (12" x 12"). So it can be conveniently and easily employed on the set and in the studio.

But how does that work, being able to edit the recording so much better retroactively? "The software estimates a depth value for every pixel recorded by the cameras. It therefore determines how far from the camera array the object portrayed is located. Intermediate images can be calculated in post-production from this depth information, so that we have virtual data not from just four columns and four rows of cameras, but from 100 x 100 cameras instead. As the camera operator films the subject, each of the outer cameras is able to look a little bit behind the subject – they have a different angle of view than the cameras located in the middle of the array. After the recording is made, the filmmakers are able to virtually drive around a person or an object, and to change the camera angles and depth of field.

The researchers have already developed the software for processing the recording from the camera array. The graphical user interface is also ready for recording on set. The

researchers are still working on the user interface for the post-editing at present; they should be finished in about six months. The scientists are planning then to produce a stop-motion film that is particularly suited as a test run of the software. "Later, we would like to use it as a demo film," discloses Zilly. "Then we can show interested parties the kind of possibilities and opportunities offered by employing a camera array."

Capturing the light field: The new array from Fraunhofer includes 16 cameras (see it in picture's right above angle). So it is possible to rejust sharpness and camera angle even after the original recordings. (© Fraunhofer IIS) | Picture in color and printing quality: www.fraunhofer.de/press

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Getting a grip on inventory management using RF

From a cocktail dress for the next summer party, to favorite perfumes, or computer accessories. There is almost nothing that you cannot buy on the internet today as well. Many customers value the opportunity of going on a shopping tour from the comfort of their sofa, instead of having to fight their way through the city. Therefore it is not surprising that brand name manufacturers are increasingly offering their goods for sale on the web, not to mention the large online mail-order companies. The companies are increasingly working together with regional specialist retailers. Both sides profit from the cooperation. The manufacturer saves the costs and effort of building up additional logistics infrastructure, since the local retailer delivers the goods that were ordered online or has them available for pick up, and deals with returns of products. The retailer in turn receives access to the online market and can thereby broaden its customer base.

The linkage between retail and online business places high demands on inventory management, however. What is crucial is keeping an overview of how many products of what kind are actually locally available from the web shop. Otherwise, duplicate sales may easily occur – for instance, when a customer in the web shop orders a piece of clothing just as another customer in the store is trying on the same piece and would like to purchase it. To avoid situations like this, the retailer would, however, need to grant the web shop access to its inventory system, which only a very small number are prepared to allow. Above and beyond that, these data are only updated once a day as a rule.

Software takes over synchronizing the data

Researchers of the Fraunhofer Institute for Reliability and Microintegration IZM are working together with logistics provider gaxsys GmbH on a simple and effective alternative. "We furnish the products with an active radio module", explains Stefan Seifert, Developer at Fraunhofer IZM. "This way, you can track how many products are in stock locally and also available any time."

The RF clip consists of a housing with a RF module, a microcontroller, a battery and a miniaturized vibration sensor. This clip is attached directly to the product at the retailer. Only a unique identification number (ID) is stored on the clip. That can be an item number or an arbitrary number, which the software associates with the item data – for instance, model, color and size for a piece of clothing. If the clip is activated at the retailer, the RF module sends its ID at regular intervals to a central receiver in the store. The software compares the inventory and sends the data on to the web shop. This way, the dealer receives a constantly updated overview of the available inventory.The neat thing: as soon as the piece of clothing in the store is moved – for instance, because a customer takes it from a rack to try it on – the miniaturized vibration sensor detects this and sends a corresponding report to the RF receiver. "In this case, the customer in the

store has priority and the product is locked out on the web shop for a period of time," explains Seifert. Duplicate sales are thereby excluded. After the item is sold, the battery in the RF clip is charged and the RF clip can then be assigned and attached to a new item. Thanks to optimized energy management, the RF clip already achieves operating durations of up to nine months at present. This is usually sufficient for the period from receipt of goods to the sale of a product, so recharging is not necessary.

The newly developed RF clip of the researchers in Berlin is expected to be employed by gaxsys Gmbh in the context of a total system design that supports retailers in all relevant steps of process, such as creating, operating and maintaining a web shop, payment processing, documentation, right through to logistics. At the moment the focus of the project partners is the clothing sector. Before long, 20 RF modules will be tested for their operational suitability at a clothing retailer. Seifert sees a lot of potential for using this application with other products in the future, predominantly in the higher-priced market segments. Luxury goods such as expensive watches and jewelry would be possible, for example.

The active RF clip for labeling goods can also be attached to shoes, for example. (© Fraunhofer IZM) | Picture in color and printing quality: www.fraunhofer.de/press

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Relaxing, individualized travel for physically-challenged seniors

The older couple is enthusiastic. "All the cultural activities and the beautiful surroundings!" Despite their advanced age and several age-related restrictions, both of them have signed up again for an individualized trip to Munich. In the morning, a trip to Lake Starnberg, then in the evening to the Bavarian State Opera. The couple can manage this effortlessly – despite mobility and vision impairments. For they put together and booked the trip, hotel, and leisure time activities on an internet platform designed for senior-oriented, individualized travel.

Unfortunately, the scenario described is only a dream of the future. In reality, impaired seniors never sign up for this kind of travel. About 20% of seniors leave their suitcases in the closet – despite longing to travel – mostly for reasons of health, as the Fraunhofer Institute for Industrial Engineering IAO in Stuttgart found out. To change this, the researchers are working on a centralized travel platform for older persons under a project called "Senior Vacation Travel with Individualized Services" (URAiS). There, seniors receive appropriate suggestions for travel that are individually tailored to their needs and they remained in contact with service provider during the trip. An initial pilot version of the URAiS platform will be launched in September, which is also to be offered as an app. Deutsche Bahn (the German national train system) is participating, as is IT service provider Infoman, the Ruppin Seenland Tourist Association, and the Swabian Alps Rehabilitation Clinic.

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Previously, an airplane. Now, a tennis racket.

Aircraft have not been birds of steel for a long while. Instead, they are increasingly built of carbon-fiber-reinforced plastics, because this material is significantly lighter, but has similar strength to metal. The situation for recycling of this material is poor. Recycling the fibers has not been economical so far – no suitable process is available. Of course, the fibers can be separated from the polymer that surrounds them using pyrolysis. In the process, the material is heated in vacuum to 1200 degrees Celsius. The problem: the fibers are crumpled after this procedure and the jumble is difficult to unravel. In addition, they lose tensile strength. The recovered samples lie around 40 to 50 percent. The scientists of the Fraunhofer Institute for Building Physics IBP are therefore developing an advanced process that originally was used in mining – to obtain diamonds from the surrounding rock, for example.

The principle: the researchers "shoot" the carbon-reinforced plastic with lightning. The current flows primarily along the phase boundaries and separates the fibers from the surrounding polymer. If the fibers are bombarded too long, however, they decompose into carbon dust. The researchers have therefore applied water circulation to wash out the fibers which have already been loosened. Their tensile strength is notably better than with pyrolysis. At the moment, the recycled fibers retain 60 percent of their initial tensile strength. The researchers would like to increase this to 80 percent over the long term – enough to fabricate tennis rackets with them, for example. The goal in about two to three years is to recover one ton of carbon reinforced plastic per hour in this way.

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Service robots for seniors

Mr. M no longer sees as well and can only get around with a cane. Nevertheless, moving into a nursing home for the solitary 80-year-old is out of the question. Like Mr. M., most older persons prefer to remain in their own four walls independently as long as possible. In future, semi-autonomous service robots could be supporting seniors in need of assistance to maintain their household and afford them an independent life in familiar surroundings. Researchers at the Fraunhofer Institute for Manufacturing Engineering and Automation IPA have developed the sensor and control functions necessary for such a "shadow robot" as well as the corresponding user and communications interfaces. The researchers have adjusted and tested the implementation on their robotic home assistant Care-O-Bot 3 in conjunction with eleven other partners in the EU-sponsored SRS Project, short for Multi-Role Shadow Robot System for Independent Living.

Normally, the seniors users control the robot themselves. However, an external call center can also intercede and operate it remotely, for instance if the robot cannot solve difficult assignments automatically. The call center can also take over control of the shadow robot in emergencies and use it to establish contact with the senior thus ensuring rapid and appropriate assistance. Using the monitoring functions, concerned family members also have the capability of communicating with their relatives, just as if they were there themselves.

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