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1/2015

HIGH-TECH FOR HIGHER YIELDS

VINEYARDS: AERIAL ANALYSIS
Early Detection of Mildew and the Like

TRACKING DOWN BEET DISEASES
Resistant Species for Fields

UTILIZING MEAT AND BONE MEAL
Recovery of Valuable Phosphates from Ash

Photo: Fraunhofer IFF

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The researchers at the Fraunhofer Institute for Factory Operation and Automation IFF develop applied solutions for smart work systems, resource efficient production and logistics, and convergent supply infrastructures, thus enabling companies to respond to the market quickly and to boost their manufacturing performance and reliability.

www.iff.fraunhofer.de

» Digital solutions are helping farmers use their resources more efficiently to boost their yields and to manage more sustainably. «

Prof. Michael Schenk, Director of the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg.

Editorial

Digitization has made inroads in more than just our daily life. It has established itself as an integral part of every domain of the working world. Even farming is teeming with high-tech.

Digital Farming: Proactive and Precise

Digital solutions are helping farmers use their resources more efficiently to boost their yields and to manage more sustainably. How this is changing agriculture and forestry jobs and operations is a fascinating issue, which we address in this issue.

The researchers at our institute for production engineering, initially specialized in factory planning, have expanded their conception of production over the past years. We also have our eye on the entire production cycle here, from plant research through waste recycling.

Expanding Horizons with Technologies

Farmers used to look to the sky – they could only hope that the weather wouldn't thwart their plans on a given day. Today's farmers look beyond the horizon: Smart assistants such as weather apps let them know what to expect in the coming hours. But this even goes much farther when hyperspectral imaging systems enable a harvester to see through the leaves covering cauliflower to determine which heads are ready to be harvested and which ought to be left alone.

Time consuming or physically strenuous work, on the other hand, is increasingly being reduced or delegated to machinery entirely. For instance, every year there is a shortage of harvest workers when it is time to harvest asparagus. Wherever automated assistants are taking over such work, workers can be put to better use in forests or in farmyards and fields or elsewhere.

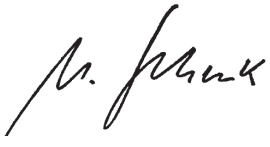
And Humans?

Humans don't need to fear for their jobs. Machines only do what they're programmed to do. Humans have to intervene more often than might be expected, for instance when animals or objects are in a field. And nothing can take the place of a farmer's traditional know-how and instinct, which has often been acquired over generations on a farm. These are people working in and with nature after all.

Teamwork: Technical Assistance Systems for Humans

Just like any advanced, increasingly digitized Industry 4.0 factory, agriculture and forestry also depend on teamwork between humans and machines. We at the Fraunhofer IFF are experts in this. For instance, together with agricultural machinery manufacturers, we are developing valuable assistance systems that enable farmers to detect pest infestation or nutrient deficiency at an early stage and take countermeasures in good time. Rather than having to wield the "chemical club" right away, they can carefully consider their preferred course of action. They can always be looking at the complete picture – and thus protect their crops and even increase yields for precise, resource efficient and thus high-yield agriculture and forestry, which are sustainable.

Your Michael Schenk



Tracking Down Beet Diseases with State-of-the-Art Camera Systems

Whoever wants to maximize yield stability, strives to protect their crops from infections by using pesticides or employing resistant species. Plants that resist such diseases and simultaneously unite other important traits, such as high sugar yield or resistance to mildew, yellowing viruses in their genetic material are in demand.
Researchers from the Fraunhofer IFF are working with the partners Strube Research GmbH and the IPK in Gatersleben on a system that identifies and thus selects resistant plants for cross-breeding.

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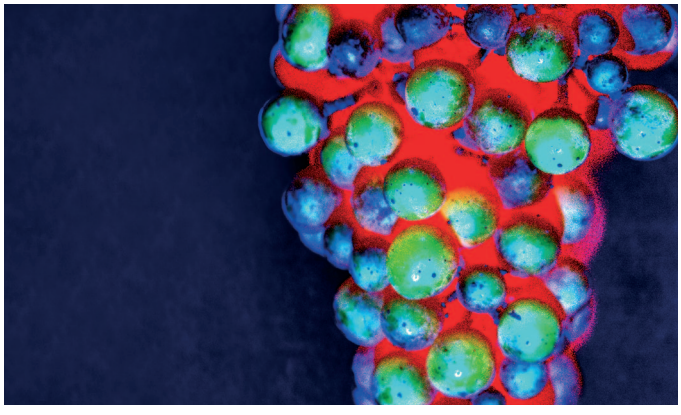

Australian Vineyards: Inspected from Aircraft

If mildew spreads in South Australia's vineyards, farmers often have to treat large areas with chemicals. In the future, they will be able to use hyperspectral imaging to analyze their fields from the air and treat plants before an entire field becomes infected.

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Not Separating the Chaff from the Wheat Right Away

Grain has always been harvested separately from straw, whereas the wrapper leaves of the kernels cannot be used after threshing at all. Enabling farmers to tap chaff's potential energy will have many benefits.

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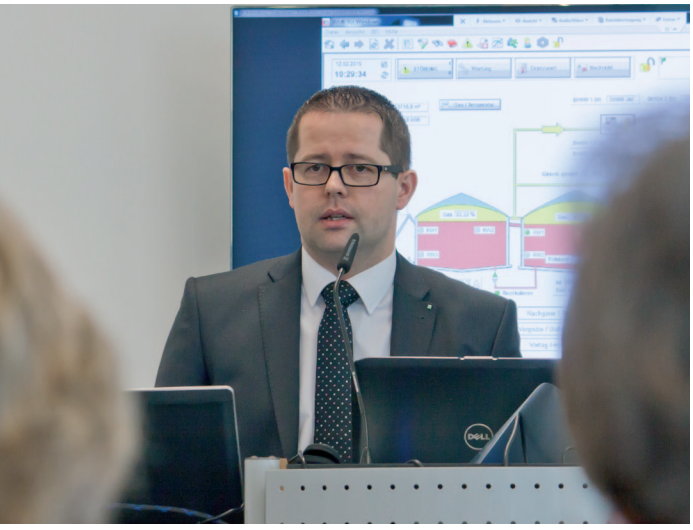
Research and Development: The Basis of Competitiveness

Our interview with Minister Hermann Onko Aeikens covers the significance of agriculture in Saxony-Anhalt and the role of research and innovation for agriculture in the state.

Sharp Minds

Who earned a doctorate? Who is new? Learn more about the people at the Fraunhofer IFF.

Stable Grids Despite the Mix of Energy



"We are looking for possibilities to regulate the voltage d directly with distributed units regionally, thus supporting the grid. In our research, we have determined that distributed units harbor great service potential for regional grids – those are resources that we ought to take greater advantage of in the future," explains project manager Dr. Przemyslaw Komarnicki from the Fraunhofer IFF.

Germany is abandoning nuclear energy and fossil fuels for renewables. In their present form, however, regional electrical grids are not always able to handle a simultaneous supply of energy from different sources. In the research project REStabil, researchers in Magdeburg sought solutions that will enable the electrical grid to handle the energy mix in the future. With success – the researchers have thus gotten a good step closer to being able to implement the energy transition technically.

A town, a business or industrial park could definitely be supplied solely by renewable energies today. Since sun and wind are not easily regulated and geared toward current demand, though, the researchers are relying on distributed units, i.e. photostatic, wind or biogas units, to help regulate voltage in the grid.

Researchers from the Fraunhofer IFF and Otto von Guericke University Magdeburg and their partners ABO-WIND AG, ZERE e.V., Mitnetz Strom and GETEC Heat & Power worked together on this in the research project REStabil. They analyzed how distributed power systems can be used to stabilize the electrical grid and identified the technical changes that this will entail. They additionally researched the requirements this will impose on smart grid management and future control centers.

The research findings from REStabil identify ways to manage renewables to support the grid in order to optimize their interaction.

The researchers presented their findings to the public for the first time at the final REStabil project event on February 12. They regulated the medium voltage distribution grid in Kemberg near Wittenberg in a live trial. They connected a biogas plant to the grid in addition to the wind turbines and photovoltaic power systems and used the plant control system to visualize the changes in the grid parameters in real time.

Saxony-Anhalt Ministry of Agriculture and the Environment supported REStabil with around one million euros from the ERDF. The live trial convinced Minister Dr. Hermann Onko Aeikens of the system approach's great feasibility. "The researchers have demonstrated with these findings that the energy transition is technically feasible. The importance of this can therefore not be overestimated, especially when the impact can be intensified in regional grids in the future," said Aeikens, convinced.

Now, the market merely has to develop new business models for the interaction of suppliers and consumers between system and grid operators so that these solutions can be commercialized. (akw) ■

Magdeburg Business Region Is Using a Virtual Model to Attract Investors

Magdeburg Regional Planning Association presented the virtual model of the Magdeburg business region on January 22. The center of business is looking to attract investors in its industrial and business parks in Magdeburg and environs.

In addition to Thomas Webel, Saxony-Anhalt Minister of Regional Development and Transportation, and Rainer Nitsche, Magdeburg City Commissioner for Business, Tourism and Regional Collaboration, many interested businesspeople, regional planners, and mayors of different municipalities were greeted by CEO Eckhard Gross at the final event at the Fraunhofer IFF Virtual Development and Training Centre.

The starting point for the project Virtual Magdeburg Business Region was the question of how to make an attractive presentation at trade shows and events that would persuade investors of the region's advantages.

Visualization expert Andreas Höpfner presented the planning model's capabilities.

Thomas Webel, Minister of Regional Development and Transportation, next to Prof. Michael Schenk, Director of the Fraunhofer Institute, Manfred Mass, Head of Saxony-Anhalt Investment Bank, and Rainer Nitsche, City of Magdeburg Economic Commissioner (l. to .r.), during the presentation of the virtual model of Magdeburg business region.

In response, visualization expert Andreas Höpfner and colleagues at the Fraunhofer IFF developed a virtual model of the business region.

The project is steadily attracting interest from regional companies not only as a marketing tool but also as an urban and regional planning tool. "The tools from this program enable you to deliver data, for instance on the size or features of a property, to investors promptly and without having to work on it long," explains Hendrik Fries, CEO of Industriepark Mittelelbe, as well as MDR-Fernsehen. You only have to put on 3D goggles to enter the virtual environment, learn about the infrastructure in a specific region, and fill that region with new life to find out, for instance, how a new complex of buildings would fit on the premises. The model includes industry and business parks in Magdeburg, Schönebeck and Burg. The platform is still open to anyone interested. (akw) ■

Skin Scanner Wins Hugo Junkers Innovation Award

Photo: Fraunhofer IFF

A smart medical workplace: Fraunhofer researcher Dr. Christian Teutsch and dermatologist Dr. Daniela Göppner during a test of the dermatological scanner. The prototype is in use at Magdeburg's University Hospital and will assist physicians with skin cancer screenings in the future.

Hartmut Möllring, Saxony-Anhalt Minister of Higher Education, Research and Economic Affairs, verliehen the Hugo Junkers Award for Research and Innovation on December 15, 2014. The dermatological scanner placed third in the category "Most Innovative Basic Research Project".

The dermatological scanner is the outcome of a project of the University Clinic for Dermatology and Venerology in Magdeburg and the Fraunhofer IFF in cooperation with the Magdeburg companies Dornheim Medical Images GmbH and Hasomed GmbH.

The semi-automatic physician assistance system is intended to help detect skin cancer early. Its occurrence has increased at a faster rate than other cancers in the past twenty years. It is also one of the deadliest skin tumors of all.

When the illumination is right the unit's several color cameras scan approximately ninety percent of a person's skin. Two-dimensional image data of the surface of the skin, special detection and recognition software, specific calibration technologies, color comparison models and much more are used to preselect suspicious pigmentation disorders, the development of which can be documented. This makes dermatologists and clinics' work significantly easier and enables them to concentrate on relevant pigmentation disorders.

"Innovative idea and solutions are the foundation of excellent research, successful business and future growth. Whoever wants to keep apace has to have the courage and business sense to break ne ground and recognize future market trends today," explained Minister Möllring at the awards ceremony on December 15.

The award comes with € 90 000 and has been awarded twenty-four times by the Saxony-Anhalt Ministry of Higher Education, Research and Economic Affairs. 122 applicants, including 72 from the university cities of Magdeburg and Halle, entered this year's competition. Decisive evaluation criteria were business strategy, innovativeness, and cost effectiveness and commercial viability. (akw) ■

www.hugo-junkers-preis.de

Experts Want to Use and Protect the Resource Wood

How can forests be used sustainably and protected at the same time? Attendees of the Resource Wood Conference discussed this very animatedly.

Over eighty forest owners, contractors, haulers and processors met at Hundisburg Palace in Saxony-Anhalt on March 24 and 25 to discuss the challenges facing professionals now and in the future. Together with the Fraunhofer IFF and the Northwest German Forest Research Station, the experts examined the ensuing tasks for research and development. Forest protection and timber use were priorities of this year's conference program.

The Resource Wood Conference provides the entire industry a one-of-a-kind national platform to exchange experiences and transfer substantive knowledge. The event is a continuation of the professionals' dialog at the earlier Wood Logistics Conference. (akw) ■

App Provides Information on Forest Fire Danger

When temperatures rise, forest fire danger rises, too. Anybody can use an app to find out about the forest fire danger rating/forest fire threat level in Saxony-Anhalt. The free app "Saxony-Anhalt Forest Fire Danger" was developed by the Fraunhofer Institute for Factory Planning and Automation IFF in Magdeburg in collaboration with the Saxony-Anhalt Regional PEFC (Programme for the Endorsement of Forest Certification) Committee and the State Timber Advisory Board.

The app provides information on the forest fire danger index in effect in Saxony-Anhalt since March of 2014. This nationwide index developed by the Deutscher Wetterdienst (DWD) displays the forest fire danger in five levels. The scale ranges from very low (forest fire danger level 1) to very high (forest fire danger level 5).

The forest fire danger level supersede the forest fire warning levels. Since it responds to wind and precipitation very sensitively, the new system responds to weather activity faster and more directly than the old system. Among other things, it factors in the potential intensity of the fire and the speed of the fire front, litter moisture, dry biomass weight, and the heat of combustion.

Minister of Agriculture and the Environment Dr. Hermann Onko Aeikens said the introduction of the forest fire danger index places us on a par with international standards. Forests often go up in flames because of negligent behavior. "A carelessly discarded cigarette butt or a car's hot catalytic converter can ignite a devastating fire quickly. Forest visitors and owners need to be warned of potential forest fires in time to adjust and behave accordingly."

Agencies registered thirty-two forest fires in an area of seven hectares in Saxony-Anhalt in 2013. The responsible district forest fire supervisor sets and publicizes the forest fire danger levels between March 1 and September 30 on the basis of data from the Deutscher Wetterdienst. (akw) ■

For the latest information on forest fire danger, visit:

www.landeszentrumwald.sachsen-anhalt.de/waldbrandschutz/waldbrandgefahrenstufen

More Transparency in Timber Certification

Since intact forests are valuable CO_2 storage systems, managing them sustainably is all the more important. Certifying that products have been produced safely and sustainably, forest certificates play an important role in environmental protection. More and more forest owners and businesses are losing their bearings in the jungle of certificates, though. Researchers at the Fraunhofer IFF studied and compared forest certification systems for firms throughout the entire timber supply chain for the first time ever.

Many operations have to undergo certification with diverse criteria in order to offer consumers certified products. First, the social and ecological sustainability of the management of a forest by a forestry company and its contractors is assessed. Then, the systems also examines the manufacturers of the (intermediate) products through every stage of processing up through the final product.

Different certification systems with different standards coexist for this process. This is confusing. Forest owners, forestry agencies and businesses do not know which certificate is appropriate for them.

In the deliverable of the project FZ4CoC, researchers from the Fraunhofer IFF compiled recommendations for action for decision makers in order to bring light into the certificate jungle. Among other things, this is intended to eliminate existing hurdles to establishing certification in Saxony-Anhalt.

Funded by the state of Saxony-Anhalt, the project was supported by a number of partners from Saxony-Anhalt, such as the State Forestry Agency, the State Forest Center, the Forest Owners' Association and the Forestry Contractors' Council, the timber industry, and the regional PEFC and FSC committees. (akw) ■

www.iff.fraunhofer.de/fz4coc

Using Plants Efficiently and Sustainably

The German government intends to encourage plant research in Germany.

Supplying a growing population with food, raw material and energy is one of the biggest challenges of the 21st century. Plants are playing a key role here. The German Ministry of Education and Research and the German Ministry of Food and Agriculture intend to step up support of plant research and breeding in Germany and thus consolidate and further German plant researchers' international competitiveness and leadership. The ministries have are making a total of € 64 million available for their funding initiative.

Minister of Food and Agriculture Christian Schmidt is focusing on research in plant breeding and biodiversity protection. The minister stressed the central importance of green, high-quality crop production for German agriculture. "Our organic and conventional farmers are making a valuable contribution to meeting the globally increasing demand for healthy food and feed as well as for renewables as environmental and climatic conditions are changing. To do so, it needs high-yield and stabile plant species that adapt well to different growing and environmental conditions while simultaneously reducing demand for resources."

Minister of Education and Research Johanna Wanka said, "Grain that thrives even during droughts and in poor soil, fruits with particularly high contents of healthy substances, plants that supply valuable raw materials, such examples demonstrate the important contribution plant research can make to meeting challenges such as the globally growing demand for food or climate change. That is why it is so important that plant breeders and agronomists collectively step up their efforts in order to improve the properties of plants and to assure that their cultivation is environmentally compatible and simultaneously delivers good yields."

The ministries will be jointly funding breeding projects that assure that plants are used sustainably, that is, that they are high yielding and conserve natural resources. (akw) ■

Photo: Fraunhofer IFF

15 European Partners Are Building the Robots of the Future

The Fraunhofer IFF in Magdeburg develops technologies for safe human-robot collaboration. Humans and robots will be working right next to each other in manufacturing in the future. The research institute is already developing smart work systems for this today.

Industrial robots not only have to be precise and efficient but also safe. Humans may not be subject to any danger in their shared work area. European robotics experts intend to engineer, build and test pioneering solutions for safe human-robot collaboration in the project FourByThree .

Special hardware and software will modularize robotic solutions in the future, thus making the systems more efficient. The partners include the Fraunhofer IFF, the German Research Center for Artificial Intelligence, Premium Aerotec GmbH and Pilz Industrieelektronik S.L. The robotics experts from the Fraunhofer IFF in Magdeburg are contributing their expertise in safe human-robot collaboration to the FourByThree project. They are lead managing the development and modification of an optical surveillance system that will safeguard work areas shared by humans and robots.

The project with a budget of € 6.9 million, partly funded by the EU's "Horizon 2020" framework program for research and innovation, will run for three years. (akw) ■

Photo: Fraunhofer IFF

Fraunhofer IFF Is One of VW's Nominated Suppliers

Logisticians or assembly technicians wearing the RFID Wristband have both hands free at order picking stations. They immediately see whether they have grabbed the right part.

Logistics firms and manufacturers in the automotive industry gathered at Volkswagen INNOVATIVE LOGISTICS Solution Day 2015 in Wolfsburg on January 28. The ten Nominated Suppliers presented their innovative logistics solutions for Volkswagen Werk- und Konzernlogistik Wolfsburg, which they developed for Innovation Scouting of Volkswagen AG and the Institute for Production Management (IPM).

The Fraunhofer IFF was also invited to join this exclusive circle. The logistics experts presented their RFID Wristband for order picking, which identifies objects clearly, even when they are moving. "Logistic will become increasingly digitized because that makes processes significantly more transparent and controllable. Our RFID Wristband will be part of a smartly designed order picking station. Right now we are working on connecting AR goggles as optical assistance systems to provide the automotive industry future-viable and ergonomic complete solutions," explains Prof. Klaus Richter, Manager of the Material Handling Engineering and Systems Expert Group at the Fraunhofer IFF. Ideally, the Nominated Supplier's innovation will be implemented in the field. (akw) ■

18th IFF Science Days in Magdeburg: How Will We Manufacture in the Future?

Digitization and global networking are not only making inroads in countless people's everyday lives but have also become an integral part of the working world. What does that mean for workplace design and the manufacturing workforce, though? The Fraunhofer IFF invited Germany's experts to discuss this at the 18th IFF Science Days. Over 550 representatives from business and industry, academia and research, and government assembled in Magdeburg on June 24 and 25.

Many businesses are particularly concerned about demographic change and the steadily growing shortage of highly qualified labor. At the same time, digitization and networking in manufacturing are making practicable solutions essential. New technical systems will prove to be instrumental. What technologies will be capable of aiding and assisting humans in their workplaces in the future? What safety standards will ensue? How can efficiency and sustainability be increased in manufacturing? Three different professional conferences on human-robot collaboration, digital engineering, and logistics provided answers to these questions from their specific perspectives and facilitated an exchange of ideas and experiences.

Photo: Fraunhofer IFF

The latest developments and technologies for safe human-robot collaboration and assistive robotics were presented at the IFF Science Days.

Robots as Humans' Assistants

The conference "Assistive Robotics and Human-Robot Collaboration" focused on groundbreaking research and industry projects, primarily in the automotive industry. The issue of safety is always crucial, whether this be for robot-assisted assembly with hybrid division of labor or cognitive and smart robot systems. Only when humans and robots are able to work safely in common areas at the same time will protective barriers disappear from manufacturing, thus paving the way for Industry 4.0.

Using Digital Engineering to Network Manufacturing

The conference "Digital Engineering for the Planning, Testing and Operation of Technical Systems" examined the technical implementation of Industry 4.0 and the role of humans in networked manufacturing: Major companies have clear ideas as far as this goes. Vendors are selling components and tools for networked manufacturing but small and medium-sized enterprises frequently face difficulties recognizing and taking advantage of the potential of Industry 4.0 for themselves. New qualification and training concepts are needed just as much as methods for transferring Industry 4.0 to manufacturing operations.

Hartmut Möllring, Saxony-Anhalt Minister of Higher Education, Research and Economic Affairs, Patron of the Digital Engineering Conference.

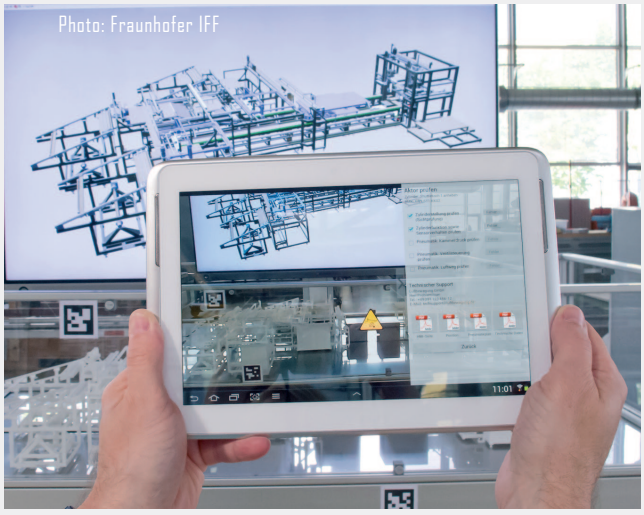
"Especially in the last two years, we have been reading and hearing a lot about Industry 4.0 that networks and digitizes manufacturing, while already the 12th Conference on Digital Engineering for the Planning, Testing and Operation of Technical Systems is being hosted in Magdeburg nun.
Whether businessperson or researcher, you are at the right place here if you want to learn early on about current trends and prospects and are looking for opportunities to integrate them in your world of work."

Secure, Reliable and Sustainable Logistics

The presentations at the "20th Magdeburg Logistics days" dealt with the creation of smart logistics concepts and the implementation of lean material flows in manufacturing. Growing flows of goods, rising demand for transportation, and increasing demand for efficiency and flexibility in internal logistics systems are necessitating new concepts. Smart logistics solutions that facilitate future sustainability are needed. The 20th Magdeburg Logistics days were hosted jointly by Otto von Guericke University and the Fraunhofer IFF. (akw) ■

www.wissenschaftstage.iff.fraunhofer.de

Hannover Messe: TÜV NORD and Fraunhofer IFF Presented Cyber Inspection



Clipboards are obsolete. A mobile assistance system makes inspection of industrial plants easier.

Industry 4.0 is turning manufacturing facilities into complex cyber-physical systems that interconnect mechanical objects with embedded software over the Internet. Digital technologies are also changing traditional testing and certification. At this year's Hannover Messe, TÜV NORD and the Fraunhofer IFF presented an exhibit of a mobile assistance system for the inspection of industrial plants.

Digital technologies such as mobile assistance systems, virtual engineering and augmented reality have many benefits for technical inspection. To this end, TÜV NORD is collaborating with the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg. The research institute is using these technologies to develop systems solutions for smart work systems; TÜV NORD is contributing its expertise in the inspection of complex industrial plants. The strategic objective of their collaboration is to develop innovative technologies for TÜV NORD's service portfolio and to employ them in concrete applications. The partners are presently collaborating in a pilot project. The experts intend to use mobile assistance systems in the future for inspection services during so-called cyber inspection.

Their joint exhibit at Hannover Messe presented a model manufacturing line. Anyone using a tablet and the proper software to view the plant received pertinent information, e.g. checklists, condition data or the last inspection report, superimposed on particular components as augmented reality. "Mobile assistance systems could be used for inspections of different technical facilities in industry as well as for wind turbines or elevators. We are pooling our know-how with the Fraunhofer IFF to test concrete applications," says Dr. Dalibor Jerinic, Innovation Manager at TÜV NORD. (akw) ■

BTU Cottbus-Senftenberg and Fraunhofer IFF Are Collaborating Even Closer

Prof. Jörg Steinbach, President of BTU (left), and Prof. Michael Schenk, Director of the Fraunhofer IFF (right), holding the agreement.

Brandenburg Technical University Cottbus-Senftenberg (BTU) and the Fraunhofer Institute for Factory Planning and Automation IFF in Magdeburg signed a cooperation agreement in January to intensify their collaborative research.

The Technical University and the research institute will enhance the research excellence in joint research and development projects and sustainably support regional networks and clusters of expertise in Brandenburg. The exchange of experience and information between researchers will be expanded. Priority will initially be given to research in Industry 4.0, digital engineering, and energy and resource efficiency in production systems. The researchers additionally intend to collaborate in national and international research projects.

"With the cooperation agreement we are cementing the long-standing excellent relationship between the Fraunhofer IFF and the BTU Cottbus-Senftenberg," explained Prof. Michael Schenk, Director of the Fraunhofer IFF. BTU Cottbus-Senftenberg President Prof. Jörg Steinbach stressed, "We are very pleased about our collaboration with the Fraunhofer IFF. It demonstrates that we are networking outside of academia, too. Factory operation and automation are some of the foundations of our technical university." (akw) ■

Fraunhofer IFF and University Draw Logistics Experts to Magdeburg

Logistics Research from Magdeburg with a Global Impact

Two conferences on logistics research were held during the 18th IFF Science Days in Magdeburg. Both the 20th Magdeburg Logistics Conference and the Global U8 Consortium Conference were hosted. Guests from France, Great Britain, Brazil, Israel and South Korea traveled to the city on the Elbe for it, thus demonstrating the global appeal of Magdeburg's logistics research.

The Fraunhofer Institute for Factory Planning and Automation IFF and Otto von Guericke University Magdeburg hosted this year's Global U8 Consortium Conference from June 22 to 24. The consortium is an international logistics education and research network. University representatives discussed research findings, consulted on their use in the field with international research and industry partners, and discussed the future of logistics in academia.

In addition to the conferences themselves, a workshop on Global Cooperation and Sustainable Development of Renewable Energies was held on the first two days of the conferences. The topics and outcomes were set down in the Magdeburg Resolution and signed by representatives of the member universities. The Fraunhofer IFF is responsible for applied research in the regional economy. The institute used current research in its Human-Robot Collaboration Lab, its Virtual Development and Training Centre VDTC, and the Saxony-Anhalt Galileo Test Bed to show the consortium how its successfully combines academic education is with applied research. (akw) ■

Mehr Informationen unter:

https://gu8.inha.ac.kr

Dr. Günter Heideck and Michael Wenske from Otto von Guericke University Magdeburg.

University President Prof. Jens Strackeljan, Minister Dr. Hermann Onko Aeikens, State Secretary Dr. Tamara Zieschang and Prof. Dr. Gerhard Müller, Deputy Director of the Fraunhofer IFF.

Prof. Dr. Gerhard Müller, Deputy Director of the Fraunhofer IFF and Minister Dr. Hermann Onko Aeikens concur: With these results, the demonstrated how to implement the energy transition technically.

Impressions

Final REStabil Presentation, February 12, 2015

In a live trial, researchers demonstrated how distributed biogas plants can be used to regulate grid voltage.

Erik Kähler, ZERE e.V., and Dr. Christian Röhrig, AVACON.

Jörg Wirtz from ABO Wind AG, one of the REStabil project partners.

University President Jens Strackeljan welcoming the attendees and project partners.

Dr. Przemyslaw Komarnicki, energy expert and REStabil project manager at the Fraunhofer IFF and Dr. Martin Stötzer from the Ministry of Agriculture and the Environment.

University President Strackeljan and Dr. Hartmut Hoppenworth from the Ministry of Agriculture and the Environment.

Marko Mühlstein, Director of the State Energy Agency LENA, chaired the event

Yvonne Jäckle and Beate Weisse from Investitionsbank Sachsen-Anhalt and Rainer Nietsche, Magdeburg City Business Commissioner.

Sebastian Seidel from ICELT GmbH and Michael Selmikat Wernigerode. Municipal Forestry Agency

Roland Henschel from Saxony-Anhalt State Forestry Agency (right) conversing with other guests.

Wolfhard Paul from Saxony-Anhalt State Forestry Agency and his colleague Jörg Peter Kaschner from Ostharz Forestry Agency.

Jenifer de Buhr, German Sawmill and Timber Industry, Diana Forschner, Klausener Holz Sachsen GmbH, and Katrin Büscher, German Sawmill and Timber Industry.

FZ4CoC Closing Event, March 31, 2015

Researchers from the Fraunhofer IFF and their partners presented the guidelines compiled for decision makers, which are intended to bring light into the "jungle" of certificates currently obtainable on the market.

Hubertus Hlawatsch Saxony-Anhalt State Forest Department, Flechtingen Consulting Forestry Department.

Klaus Wiegand from RAL Gütegemeinschaft Wald- und Landschaftspflege e.V., Dr. Peter Fischer from Pro Wald und Landschaft and Tobias Geserick from Waldbau Stackelitz-Harz GmbH.

Wilhelm Uschmann from Saxony-Anhalt State Forestry Agency and Frank Specht from Saxony-Anhalt Ministry of Agriculture and the Environment.

All names from left to right.

Research and Development: The Basis of Competitiveness

Interview with Dr. Hermann Onko Aeikens,
Minister of Agriculture and the Environment Saxony-Anhalt

Agriculture is an important branch of the economy in the German state of Saxony-Anhalt. Farms, the foundation of the successful food and feed industry, have to produce efficiently and sustainably. This interview with Minister Hermann Onko Aeikens covers the significance of agriculture in Saxony-Anhalt and the role of research and innovation.

Anna Mahler

You live in the countryside, in the Magdeburg Börde, which is known for its fertile soil. Magdeburg, on the other hand, is famous for its tradition as a center of machinery manufacturing. To what extent do both sectors stand for modern Saxony-Anhalt?

Aeikens: Historically, the two belong together. Boilers were the foundation for plowing engines and steam tractors. Wherever there is farming, machinery is needed, developed and built. Both sectors were profoundly restructured after Reunification. Effective policies created favorable conditions for both sectors. They are some of the growth sectors in the state. Agriculture and machinery manufacturing will also be priorities of future business development, which the state government intends to support long term

What significance does agriculture have in Saxony-Anhalt?

Aeikens: Agriculture is one of the important sectors in Saxony-Anhalt. It generates significant job potential. Agriculture accounts for over 25,000 jobs here in the state. This is augmented by the workforce in the downstream and upstream industries. Future challenges are many and diverse. Agriculture not only assures the supply of food, supplies sustainable raw materials, and cultivates the land. It also has to do its job while satisfying societal demands for animal protection and environmental conservation.

Sustainable management is particularly important in this sector. What is your assessment of farms' innovativeness?

Aeikens: Agriculture is increasingly winding up in public discourse about food production, environmental conservation and animal protection. Honest dialog between agriculture and consumers is important here. Only this can enable agriculture to continue evolving and assure its competitiveness. Sustainability means harmonizing economic, ecological and social demands, though. This is not always easy and has to be communicated. Our farms are already highly mechanized today. Increasing market orientation and concomitant price fluctuations are necessitating adaptation. Our state's agriculture has demonstrated, however, that it is able to respond to market signals very quickly.

Apart from introducing equipment, what can research and development do for agriculture and forestry?

Aeikens: Research and development are also the underlying basis of agriculture and forestry's future competitiveness. I see a priority in agronomy. For instance, crop plants will have to be made more resistant to water scarcity and pest infestation in order to be able to effectively counteract the impacts of climate change. Research and development in the field of animal breeding can contribute to improving the treatment of livestock. The Fraunhofer IFF is also extremely successful in developing and implementing new technologies, for instance, in the field of biomass logistics.

When when we talk about the production of raw materials by farming and forestry, we are dealing with the bio-

» AGRICULTURE PRIMARILY HAS TO PRODUCE FOOD. BUT WASTE AND RESIDUALS OUGHT TO BE MORE HEAVILY INTEGRATED IN MATERIAL CYCLES IN THE FUTURE. THE POTENTIAL THERE IS SUBSTANTIAL. «

economy. What goals is the state government pursuing in this field?

Aeikens: Agriculture primarily has to produce food. But waste and residuals ought to be more heavily integrated in material cycles in the future. The potential there is substantial. Modern agriculture, a strong chemical industry and a broad research base, especially in agronomy, provide the state optimal conditions for a bioeconomy. Groundbreaking initiatives such as the Leibniz Association's Plant-Based Bioeconomy Science Campus or the Leading Edge BioEconomy Cluster are turning Saxony-Anhalt into a model region in Germany. This was demonstrated by the first International bioeconomy conference in Halle in May of 2015. The state has specified this as one of five priority fields in its Regional Innovation Strategy.

As minister of the environment, questions about renewable energies also fall under your purview. What contribution can agriculture and forestry make to the nuclear power phaseout?

Aeikens: A large portion of the energy supply in Saxony-Anhalt is recovered from biomass. In the past, the legal framework sometimes gave rise to inefficient supply structures that failed to adequately take advantage of existing potential. In the future, attention will have to be focused on boosting efficiency. I see particular opportunities for development in the recovery of biological residuals and waste. The energy transition offers opportunities for our agriculture. Biomass units run by farming companies are a branch of business that makes such companies more stable. I am however opposed to units run by non-farming investors. This makes farmers merely deliverers of substrate. The value added ought to remain in rural areas and in farming.

What options do small and medium-sized enterprises have to collaborate with research organizations?

Aeikens: The collaboration between businesses and research organizations is one of the priorities of the state's innovation policy, which will be backed up with numerous opportunities for funding. The new EU funding period as well as in the new EU HORIZON 2020 Framework Program for Research and Innovation are intended to fund such projects. One example from the domain of agriculture is the new European Innovation Partnership intended to transfer innovations into practice. The state program that supports so-called Operational Groups (OGs) is in preparation and is expected to be launched in the coming year. These will bring fresh wind to agricultural innovation.

What direct collaboration would you like to see?

Aeikens: My ministry actively dialogs with the universities of applied sciences, universities and research organizations in the "Future Agriculture and Forestry Forum". Businesses and research organizations can profit from collaboration considerably. I hope that this will enable us to initiate many regional projects in the coming years.


Photo: Fraunhofer IFF

Australian Vineyards: Inspected from Aircraft

Dr. Janine van Ackeren

If an infectious disease spreads in South Australia's vast vineyards, winegrowers often have to treat large areas with chemicals. In the future, farmers will be able to fly over their fields in a plane and precisely analyze whether and when and even where mildew or other fungal diseases have taken hold and treat their crops appropriately before an entire field has become infected. This technology can inspect the quality of harvested grapes precisely, too.

Amateur gardeners as well as farmers are familiar with this problem: Once a fungus such as mildew has infested a bush, it spreads throughout a garden or an entire field because, once the spores have permeated a plant's epidermis, they travel inside the leaves. The fungus infests them and produces new spores that the wind carries to adjacent plant where the spectacle starts all over again. The more plants are already infected, the faster others become infected, too.

Mildew is a problem in more countries than just Germany – winegrowers in South Australia also combat this fungus. The problem is far more significant there. The state of South Australia is the largest wine producer on the fifth continent. Grapevines cover all of the tracts of land, one field bordering on the next. Until now, farmers have routinely scoured portions of giant fields to check grapevines with their trained eyes for mildew and the like. That is a time-consuming and tedious procedure, though, which farmers are only able to perform intermittently and, thus, only randomly.

Analyzing Plants Precisely from the Air

Winegrowers could dispense with such walk-throughs in the future and fly over their fields periodically in a plane instead. Although individual fungal spores are barely detectable from above even with the best technology, a winegrower will know exactly after a flight whether a plant is suffering from an infectious disease, where the infected vine is located, and what the pathogen is, long before any leaves display typical signs of fungal infestation. Spores that advance to the insides of leaves trigger a defensive response in a plant, much like the human immune system. While a plant does not respond with increased temperature like a person, it produces particular substances depending on the type of fungus. They are supposed to keep invaders from settling in a plant or at least to check their spread and thus limit damage.

Pilots only see a green carpet of plants from the cockpit but a hyperspectral camera delivers far more information than their human eyes. It not only "looks" at the visible light reflected by a field but also the frequencies outside of this range such as infrared and UV radiation. A mathematical algorithm identifies the particular constituents of the leaves from the light spectrum emitted by particular plants. The hypothesis assumes that pilots will see one or more plants suffering from a disease in the green carpet of plants as a spot when they evaluate the images. More than that, pilots will also be able to identify the disease. At least that is the firm conviction of the researchers from the Fraunhofer IFF. It is well known that plants form different substances depending on the disease. The researchers are using their current work to demonstrate that hyperspectral cameras can detect such disparities from the air.

In the future, this technology will be capable of far more than just detecting diseases. The camera not only detects defined substances but also individual vines' entire spectral fingerprints. In short, by using the right mathematical model, the researchers are able to extract any information on plants from this, for instance, whether the grapes have to be irrigated – a major issue in dry, hot Austra-

lia. Chlorophyll and photosynthesis activity drops in plants that lack water. Or is a plant lacking nutrients? The researchers are collaborating with users in order to customize the numerous applications to their needs optimally: What information is important to farmers? What is technically feasible? The key question is how precise and robust is particular information that is obtainable from the air?

Since the project has just started, it is still hard to say what all can be scanned. Experience has shown, though, that a project often grows with the work. Over time, new things are added and expand the capabilities anticipated at first.

This Technology Is Easy on the Environment and Your Wallet

This novel technology harbors a great opportunity for farmers. Until now, they have been not been able to see mildew until it becomes clearly visible, i.e. when the fungus has already spread through a plant. The technology developed enables the researchers to detect diseases already when vines begin their defensive response. This enables farmers to treat affected plants at an early stage and to check infestation quickly. There is another benefit. Being able to fly over large areas in short time, enables winegrowers to dispense with prophylactic pesticides to a large extent. Plants is no longer have to be irrigated as a precaution, either. Irrigating them whenever they really need it suffices. This is beneficial both ecologically and economically. Less fertilizer, pesticide and other chemicals have to be spread on a field – and fewer chemicals on a field is better for the environment. What is more, less fertilizing, irrigating and spraying of plants by a farmer is more cost effective.

Photo: Fraunhofer IFF

Special contractors are already attempting to help farmers with predictions: How probable is the development of infectious diseases in grapes in particular regions in the coming days? Predictions are inherently not always one hundred percent accurate. This new technology could help here, too. If the farmers transmit their imaging data back to the forecasters, they can use this to improve their models and successively optimize their forecasts.

Objective Assessment of Grapes

Rather than processing their grapes themselves, many Australian winegrowers load them after harvesting on trucks and sell them to specific buyers who then make wine out of them. The prices farmers obtain for their grapes depend on their infestation with mildew, among other factors. No system is capable of measuring infestation objectively, though. Instead, sellers and buyers examine the grapes and make a rough visual assessment of infestation. Time and again, this causes disagreements between winegrowers and buyers because farmers usually spot far less mildew than winemakers do.

The hyperspectral camera constitutes an objective imaging system that does this, too. The principle entails dumping the grapes

» This novel technology harbors a great opportunity for farmers. The technology developed enables the researchers to detect diseases already when vines begin their defensive response. This enables farmers to treat affected plants at an early stage and to check infestation quickly. «

Prof. Udo Seiffert, Fraunhofer IFF

Airborne hyperspectral imaging: The right wing of this plane was outfitted with a special camera to takes scans in Adelaide, Australia.

Conceivable in Germany in the Long Term, too, with Drones

Flying is nothing unusual in Australia. German fields are substantially smaller though and hardly any farmers have their own planes in a shed but this technology could be making its way into Germany and making farmers' work easier as soon as hyperspectral cameras have become so small and lightweight that a drone can fly them over fields, too. The miniaturization of the cameras is already underway. The manufacturers are working on this. And the Fraunhofer-Gesellschaft is also endeavoring to miniaturize the cameras in a consortium in which the Fraunhofer IFF is involved as a user.

from a truck down a chute to a conveyor that moves the fruit to the next processing step. A camera mounted above the conveyor uses the filmed spectra to determine the amount of mildew objectively.

Scans were already taken during grape harvesting season in Australia in April of 2015 where experts ascertained the level of infestation. The researchers use this data to generate a corresponding mathematical model with which the camera will ascertain the extent of mildew in the future. The researchers will be testing the software and validating their mathematical models during the next Australian grape harvest.

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High-Yield and Healthy Grain:

Even in Barren Regions

Dr. Janine van Ackeren

New species of wheat, rye, oats and the like are be relied on to maximize yields not only in our temperate climate but also in inhospitable regions. Until now, complex laboratory analyses have been needed to identify optimal candidates. In the future, it will be possible to analyze new breeds within a few seconds.

Golden grain is swaying in the wind, the ears straining toward the sun. As natural as this scenario may seem to be, it is full of technology. The species of grain that thrive in fields in our temperate climate are designed for high performance. They were specially bred to yield a maximum of grain. And the plant experts' work is continuing: They are growing new species all over the world because the ears are supposed to yield many and, above all, nutritious grains even in mountainous, dry or humid regions. Breeders are therefore hybridizing high-yielding grains with wild varieties that grow in such regions. Initially, this produces numerous genotypes that breeders have to analyze for quality parameters since they are only interested in genotypes that unite the strengths of both varieties, that is, the wild variety's robustness with the high-yielding variety's yield. Naturally, some of the genotypes only exhibit their weaknesses.

Classifying different genotypes is a complex, time-consuming and expensive process, however. Lab technicians pulverize grains from different plants, mix the powder obtained with solvents, and analyze its constituents with the appropriate instruments in what is also called the wet method. The primary question is how many constituents relevant to nutrition does a particular grain contain, i.e. how much starch, sugar and protein?

Automated Genotype Analysis

Researchers from the Fraunhofer IFF are now expediting this selection process. Contracted by the nonprofit institute The Plant Accelerator in Adelaide, Australia, they are developing methods that will be used to automate the analysis of such genotypes automatically. The project is being funded by the German Minis-


Photo: Sarah C. – Pixelio.de

try of Education and Research's International Office and the Australian Academy of Science. The Plant Accelerator is ideal for such automation because it provides botanical researchers from all over the world access to phenotyping infrastructure. In other words, staff in an automated greenhouse characterize grains, perennials, grasses and the like on behalf of international plant breeders. Automated systems cultivate, irrigate, and even measure the size of and biomass in plants – conveyor belts transport the plants to the proper stations. "We have been using digital imaging and processing to measure growth in diverse grains under different stress conditions," explains Dr. Bettina Berger, Senior Scientist at The Plant Accelerator.

A "Snapshot" Instead of Complex Laboratory Analyses

The researchers from the Fraunhofer IFF are contributing methods beyond this state-of-the-art. The key feature of the new technology enables researchers to scan a plant along with its grain simply with a hyperspectral camera instead of having to perform complex laboratory analyses for every plant. Ten second later they receive the unit quantities of every interesting constituent. Unlike conventional cameras, a hyperspectral camera not only photographs visible but also infrared and ultraviolet light. The camera thus more or less sees which light the ears of grain reflect in a very wide

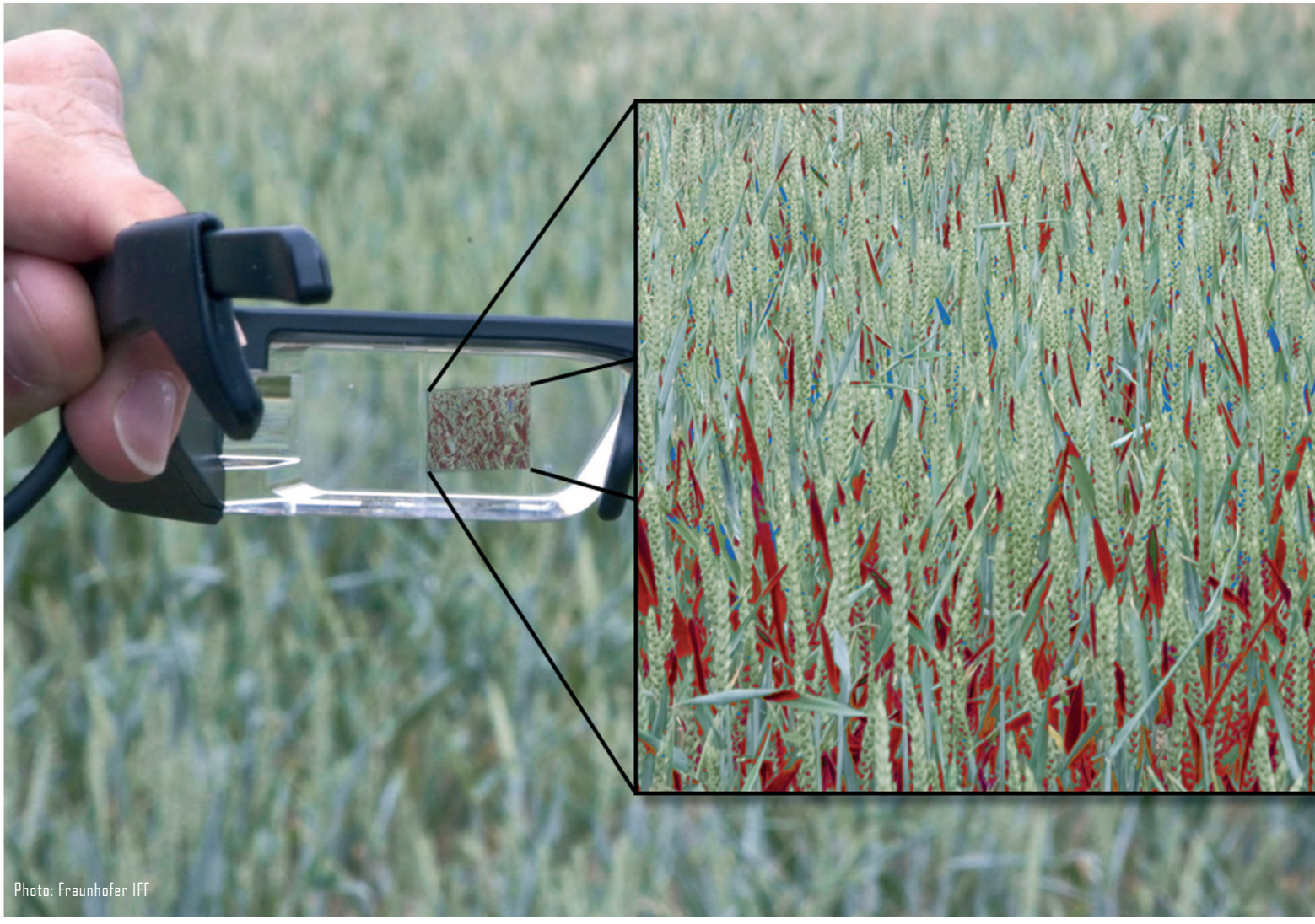
range of wavelengths. In short, it takes the grain's spectral fingerprint. The data it delivered are therefore very complex and extensive. This spectral fingerprint varies marginally depending on the substances contained in the grain. Rather than the camera in and of itself, the heart of this technology is the mathematical model behind it. It extracts the information relevant for the particular task from the mass of data and converts it into quantity units of the pertinent constituents.

The camera can be installed easily as another station on the conveyor belt in the automated process at the Plant Accelerator in Australia. Ears of grain being transported by the conveyor belt to irrigation could also pass the camera and be scanned along the way, thus revealing their constituents within a few seconds. Barcodes stuck to the plant pots make it possible to match, tabulate and save the results.

Customers Save Time and Money – and Launch Their Products on the Market Faster

The Australian partners are thrilled with the technology. "The collaboration with Prof. Seiffert's team provides us the opportunity to test the latest hyperspectral scanners and to profit from Prof. Seiffert's team's unique expertise," says Dr. Berger, pleased. "We are hoping to expand our range of services in the future and also to be able to analyze biochemical constituents and nutrients in plants using the hyperspectral camera."

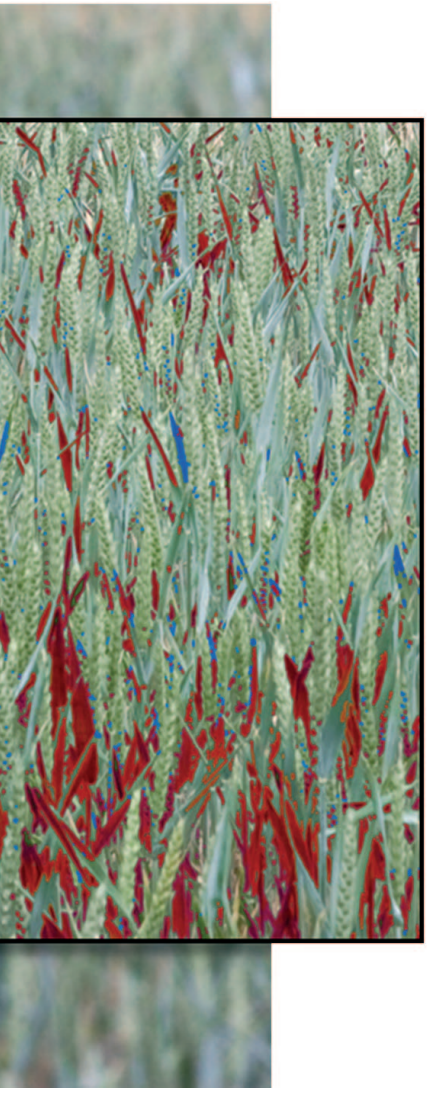
This technology harbors tremendous potential for crop research, both for basic academic researchers and plant breeders, because it provides users several advantages at once. On the one hand, they can cut out expensive laboratory analyses or, at the least, reduce them dramatically. Performing a wet test



Augmented reality (AR) can be used to interactively visualize plant data recorded by a hyperspectral camera. Special glasses insert specific plant data in the viewer's field of vision. Here, proper (blue) and deficient (rot) supply of nutrients is visualized directly in a wheat field.

» The collaboration provides us the opportunity to test the latest hyperspectral scanners and to profit from Prof. Seiffert's team's unique expertise. We are hoping to expand our range of services in the future and also to be able to analyze biochemical constituents and nutrients in plants using the hyperspectral camera. «

Dr. Bettina Berger, Senior Scientist at The Plant Accelerator



from time to time to validate the system is enough. On the other hand, time plays an important role. While manual laboratory tests take a long time, the hyperspectral camera's findings are available in seconds. That is not just a plus per se but additionally makes it possible to scan more plant than before and thus launch new varieties of grain on the market faster. Naturally, this boosts profits, too.

Although the hyperspectral camera is expensive, economic analyses conducted by the researchers from the Fraunhofer IFF together with a German breeder have proven that plant breeders profit from the purchase very quickly since it had paid for itself after just three years. The exact figures depend on the exact plants farmers want to analyze and the number of analyses to be performed every year.

Calibration Provides Objective Results

Apart from speed and cost savings, the camera has another advantage Its cuts the analysis error rate. Plant breeders that rely on this new technology eliminate testing errors by humans who have been analyzing ears of grain. Given human nature, fatigue, hectic or other diversions can cut concentration from time to time. The camera does not have such problems. Day or night, it always delivers objective results, even when in continuous use.

A calibration phase is assuring the necessary objectivity. The staff at the Plant Accelerators in Australia are delivering the results of different wet analyses, i.e. a list of the constituents of the various genotypes, to the researchers at the Fraunhofer IFF. The researchers compare them with the fingerprints delivered by the hyperspectral camera. The mathematical model is thus a kind of black box at first, which the researchers feed with laboratory and spectral data. This progressively teaches the system the correlations between constituents and scanned spectra. In the long term, it will be able to extract the results directly from the camera data and supplant manual laboratory analysis.

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Automatically Harvesting Cauliflower:

At the Optimal Time

Dr. Janine van Ackeren

Machines that harvest vegetables pick everything at once, even unripe heads if the vegetable is cauliflower. That is why human pickers do this job by hand. The machine VitaPanther will make fully automated, selective harvesting possible for the first time ever in the future.

Harvesting cauliflower is a difficult affair because the white heads with their typical buds are hidden beneath numerous leaves. This means that pickers have to pull back the protective leaves head for head to look at the cauliflower and decide whether it is ripe for harvesting. Pickers comb a field approximately four to five times in intervals of two to three days until the very last head of cauliflower has been harvested. This work is strenuous and backbreaking because the pickers are constantly stooping. Another challenge for farmers is their need for numerous pickers at once for a short time when harvest season is pending. Finding enough hands for this hard work is often difficult, though. Harvesters have not been very useful for cauliflower, however, because, unlike humans, such machines harvest an entire field at once. Since cauliflower heads ripen at different speeds, even when located right next to each other, a machine harvests many heads that are still too small or simply unripe. In short, the quality of the vegetable suffers.

Always Available, Fast and Inexpensive

In the future, farmers will no longer need to their rack their brains over where they can find enough pickers because a machine will be harvesting cauliflower just as selectively as human pickers would. Remarkably, it will recognize whether the cauliflower is ripe head by head and only harvest the heads that are ready. This machine is called VitaPanther and is being developed by researchers at the Fraunhofer IFF and their colleagues at ai-solution GmbH together with five other partners, including farmers, machinery manufacturers and research organizations. Funded by the German Ministry of Research and Education, the research project covers

every facet from research to the implementation and exploitation of the findings. VitaPanther will benefit farmers in several ways at once: The machine harvests cauliflower heads significantly faster than human pickers and could additionally work at night, too. This makes harvesting less costly. Another plus is that farmers will be able to do away with troublesome searches for pickers, which is becoming more and more difficult.

Martin Steig, farmer and CEO of Steig GmbH and one of the future potential users of the harvester is convinced it is needed. "Farming is the last profession in which profits can only be made with a large workforce. Automation is essential for us farmers, though, because vegetable harvesting is no longer feasible with the minimum wage. Harvesting is sustained by two components: the availability of a seasonal workforce and the pay. If one of the components changes, as is the case with the minimum wage, the structure is at risk. This makes technology highly necessary and

» This makes technology highly necessary and the cauliflower harvester is thus a very good start. «

Martin Steig, Farmer and CEO of Steig GmbH

the cauliflower harvester is thus a very good start."

The Hyperspectral Camera "Sees" Ripeness

So far, so good; but how can a machine recognize the vegetable's ripeness without seeing its "whiteness", without weighing it, without knowing its size? After all, a machine would most likely have difficulty pulling the leaves back and looking at the cauliflower heads as human pickers do. This problem is what the researchers from the Fraunhofer IFF are working on. They are researching and developing the necessary sensor systems together with the software that analyzes and preprocesses the data obtained so that the machine receives clear information on whether to harvest or wait.

The researchers are taking advantage of an effect they discovered in preliminary tests. The leaves of ripe cauliflower have a different biochemical composition than the leaves that cover unripe heads. The researchers do not have to use shears and test tubes on the heads, though, nor is a laboratory needed for the analysis. They are relying on hyperspectral cameras instead. Cameras mounted on the harvester scan the heads of cauliflower. Whereas a conventional camera only works with visible light and produces a color picture consisting of red, green and blue tones, a hyperspectral camera scans a defined range of wavelengths beyond human vision, generally encompassing infrared and ultraviolet light. Applying a mathematical model, the researchers can determine the biochemical composition of the leaves and thus the ripeness of the cauliflower based on the intensity of the light reflected in the different wavelengths scanned. In other words, the light that ripe leaves reflect into the camera differs negligibly from the light reflected by the leaves of unripe heads.

The researchers are not analyzing the exact biochemical composition of the leaves, however, because the machine is only supposed to receive a yes-no command to harvest. The mathematical model that decodes the camera images into exactly this command is based on algorithms that originated with machine learning. This means that the researchers are using examples to teach it. They "show" the camera different heads of cauliflower, which are simultaneously being inspected by human experts. Following such a teaching phase, the system is able to decide autonomously which cauliflower should be harvested or not, even when the heads of cauliflower are unfamiliar

Objective Examination Instead of Subjective Assessment

The "Spargelpanther", developed in a previous project, will also be harvesting cauliflower and leaf lettuce in the future.

This teaching by an expert gives farmers another advantage. Harvesting becomes less subjective. Pickers have been deciding which cauliflower is ripe and which needs to stay in the field a few days longer. Given human nature, concentration diminishes after a while. An expert tells the system when heads are ripe, thus teaching it and enabling the researchers to create an objective system.

One Harvester, Different Vegetables

While the researchers from the Fraunhofer IFF are attending to the sensor systems and the data analysis, their colleagues from ai-solution GmbH in Wolfsburg are working on the harvester unit itself, i.e. the equipment that will harvest cauliflower heads in the future. Do to so, they are building upon their asparagus harvester "Spargelpanther", which they developed in a prior project. "We now intend to universalize this asparagus harvester in this project so that it can be used for other vegetables, too – for cauliflower and head and leaf lettuce. Then, other harvester modules for other vegetables could be added in the future," reveals Christian Bornstein, CEO of ai-solution GmbH. "Our goal is to build a module that can be adapted to the existing unit, thus making the machine versatile." This means that farmers will only have to purchase one "vegetable harvester" in the future. The proper harvester modules will enable them to harvest cabbage and lettuce as well as asparagus and other varieties of vegetables automatically and always at the optimal time for each.

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Tracking Down
Beet Diseases
with State-of-the-Art Camera Systems

Hyperspectral Imaging Expedites Sugar Beet Growth

Bettina Koch

Rizomania, Cercospora and *Rhizoctonia* like warm and humid climates. Higher average temperatures and more frequent precipitation in the wake of climate change can increase the intensity of infestation among sugar beets significantly. Whoever wants to maximize yield stability, strives to protect their crops from infections by using pesticides or employing resistant species. Plants that resist such diseases and simultaneously unite other important traits, such as high sugar yield, (partial) nematode resistance, and resistance to mildew, yellowing viruses, rust and verticillium, in their genetic material are in demand.

Determining which plants in a line of hybrids are resistant to a particular pathogen is demanding. The leaves of sugar beets are assessed visually, i.e. workers inspect and evaluate leaves singly. The collected data are subjective. A hyperspectral camera system and self-learning software could be used to replace this time-consuming method with a highly efficient one that delivers objective data. Researchers from the Fraunhofer Institute for Factory Operation and Automation IFF are working on this with their partners Strube Research GmbH & Co. KG in Schlanstedt and the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) in Gatersleben in a project funded by the German Ministry of Food and Agriculture and the Fachagentur für nachwachsende Rohstoffe.

Researchers spent one week scanning 1466 sugar beet leaves at Strube Research's greenhouse in Schlanstedt and subsequently flash froze the samples for further testing at IPK. The researchers from the Fraunhofer IFF used a system with two hyperspectral cameras to assess the leaves. While one camera with 160 channels scans the visual range with wavelengths of 400 to 1000 nanometers, a second camera with 256 channels scans the infrared range with wavelengths of 1000 to 2500 nanometers. Illuminated from above, the test subjects are positioned on a translation stage relative to the cameras and scanned line by line. A total of 316 wavelength intensities are scanned. Groups of similar spectra are clustered and the leaves are separated from their background. The system detects successive leaves automatically once they have been computed.

An artificial neural network is supplied with data sets of infested and healthy plants as well as with the researchers' target values. It compares the findings with the specified assumptions, computes the errors and optimiz-

Whoever wants to maximize yield stability, strives to protect their sugar beet populations from infections. Photo: ra3rn – Fotolia.com

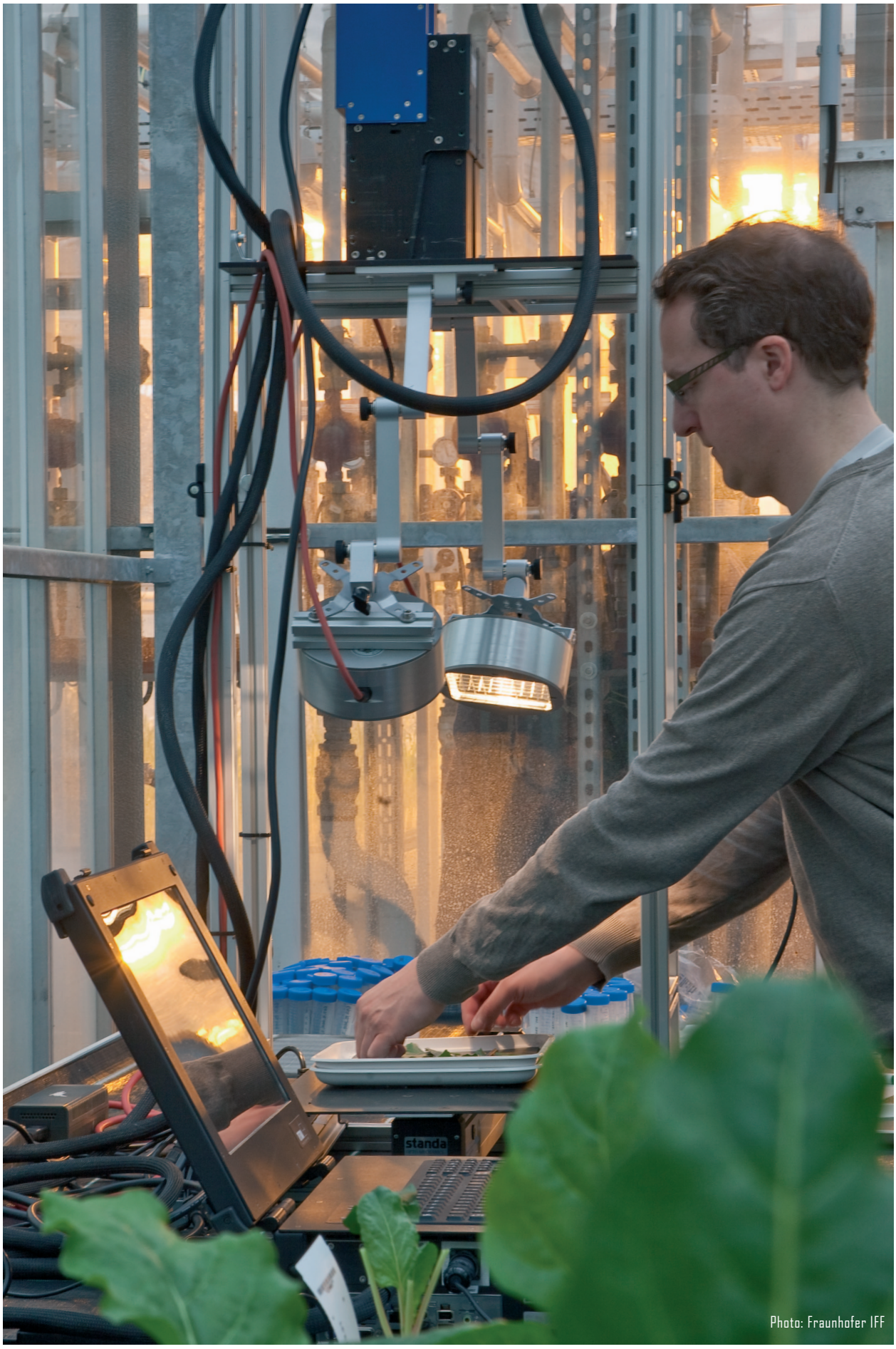
es itself with every mathematical operation. At the end of this learning process, it is able to deliver information on infestation or non-infestation as well as the degree of infestation of analyzed plant parts in real time.

The availability of resistant species is a significant economic factor for farming. Diseased crops can cause substantial losses of yields. Spraying is expensive, time-consuming and also always has an impact on organism that are not the target of control.

Cercospora beticola is a pathogenic fungus that causes gray leaf spot. The spores can survive on remains of plants in the soil. When weather conditions are conducive, the spores germinate and infect leaves through their stomata. The pathogen releases the toxin cercosporin, which is activated by light and produces toxic reactive oxygen species (ROS). Necrosis sets in, destroying the leaf and preventing photosynthesis. The plant's sugar productions is disrupted. Putting its energy into growing new leaves intended to compensate for the loss, it may produce and store less sugar in the beet. Infestation can diminish harvests by up to twenty percent. Phenylpropanoids, substances that can detoxify ROS, are analyzed with metabolite analysis at the Leibniz Institute of Plant Genetics and Crop Plant Research.

Rhizoctonia solani is a soil-borne fungus that causes late beet rot, which damages the beet severely. This leads to poor quality and high and even complete crop losses. *Rhizoctonia* is increasingly a problem in high-yield regions and rotations of corn and sugar beets. "Interestingly, hyperspectral imaging and metabolite profiles of leaves enabled us to distinguished between healthy and infected plants in just a short time following the infection, although the fungus had not infested the leaves directly," stresses Nadja Arens from the Applied Biochemistry group at the IPK. "This is based on a systematic defensive response by the plants."

The disease rhizomania is cause by beet necrotic yellow vein virus (BNYVV) transmitted by the soil fungus *Polymaxa betae*. The pathogens can survive in the soil more than two decades. Symptoms of this most frequently widespread soil pathogen are necrotic yellow vein virus, a strong formation of new lateral roots. The beet shrivels, water absorption is disrupted, and leaf veins yellow. This affects photosynthetic performance adversely. As much as seventy percent of the



Dr. Andreas Backhaus preparing sugar beet leaves for hyperspectral analysis.

Photo: Fraunhofer IFF

> We are hoping that the hyperspectral system will enable us to measure resistance performance significantly before the development of visible symptoms, already during the incubation period. The benefit would not only be higher throughput but also a method of objective measurement.

Dr. Jessica Knüfer, Researcher at Strube Research GmbH

crop can fail as a result. "In our tests, we are able to identify very clear differences between control and infected plants both in the hyperspectral signature and in the metabolite profiles," explains Nadja Arens.

A combination of automated imaging with automated analysis of the collected data would provide a technical system that delivers readings rapidly. This system has another significant edge over the human eye. The cameras start detecting differences between the leaves of healthy and diseased plants as on the third day after test plants have been exposed to the pathogen. The first signs of disease are visible to the eye significantly later. Hyperspectral imaging could expedite breeding of new species resistant to certain pathogens significantly and thus boost yield stability.

"At present, the intensity of infestation is assessed based on the necrosis of leaf or root tissue," explains Dr. Jessica Knüfer, researcher at Strube Research GmbH. "We are hoping that the hyperspectral system will enable us to measure resistance performance significantly before the development of visible symptoms, already during the incubation period. The benefit would not only be higher throughput but also a method of objective measurement that does not depend on people." The new method could save two to three weeks in the case of *Cercospora beticola*, The lead would be several days in the case of *Rhizoctonia solani*. The viral infection rhizomania could be detected faster and analyzed. The time savings sounds slight but every day counts because breeders only have around fourteen weeks from receipt of seeds to selection before Christmas. Any plant not processed by then is unavailable for selection and use in the following year. A faster, more objective procedure could additionally boost the reliability of selection.

The prototype for researching hyperspectral imaging is expensive, however. Providing an affordable and efficient solution for medium-sized breeding companies will necessitate in the next step determining the wavelength ranges of relevant information, the spectra the cameras will actually have to cover, and the camera quality required in order to obtain the desired results. Then, this technology could be used for the most urgent pathogenic systems during selection. This principle could also be applied to other crops such as corn or potatoes. The system would "only" have to learn something more when it has the pertinent data.

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Airborne Screening

Hyperspectral Imaging Will Deliver Data on Forest Condition

Dr. Ina Ehrhardt and Uwe Knauer

Since wood is a valuable resource and an important economic factor, its production, processing and use are part of a variety of value chains. Forestry and timber industries are increasingly employing advanced technologies to manage forests sustainably, economically and ecologically under changing climate and environmental conditions, too. Researchers from the Fraunhofer IFF are providing interesting approaches to organizing raw material production more efficiently and more sustainably.

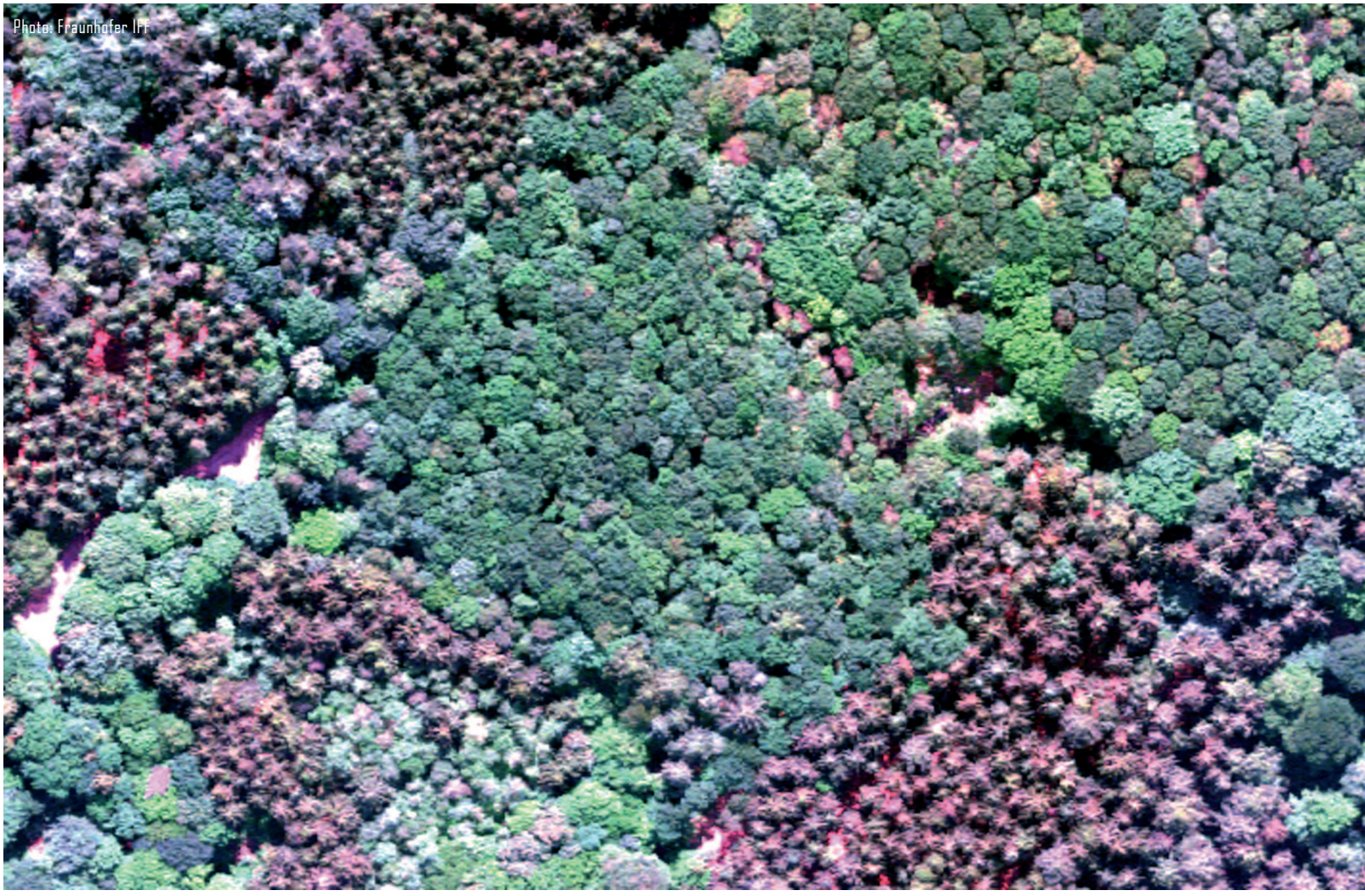

Photo: Fraunhofer IFF

Around 532 000 hectares of Saxony-Anhalt are covered with forest. Oaks account for around 69 000 of those hectares. Forests look like peaceful, green countryside at first glance but are struggling with major challenges. Increasing droughts in the growing season and infestation of secondary shoots with oak powdery mildew combine to cause valuable trees to die slowly. Years of complete defoliation does particularly serious damage. Caterpillars of oak-eating moths multiply cyclically. At its peak, a single female oak processionary moth lays approximately 300 eggs, a female winter moth as many as 400 eggs, before the population collapses again. In phases of mass propagation, affected tree stands are threatened by complete defoliation. This can lead to the loss of valuable forest communities. Mottled umber and winter moths, green oak moths, oak processionary moths and gypsy moths have caused substantial feeding damage in Saxony-Anhalt, especially from 1991 to 1997, 2004 to 2007 and 2010 to 2012. Above all, stand in the northern and northeastern parts of the state were affected.

That is why the forestry and timber industry has a major interest in the assessment of tree condition and early detection of possible pest infestation. Researchers from the Fraunhofer IFF in Magdeburg and their partners from the State Forestry Agency, the State Forest Center and ThüringenForst's forstliches Forschungs- und Kompetenzzentrum (FFK) Gotha are now collaborating in a project being funded by the Saxony-Anhalt Ministry of Agriculture and the Environment. The experts are intent on jointly finding solutions that will increase the forestry and timber industry's profits in the long range and reduce pest damage.

Protecting Tree Stands with State-of-the-Art Technology

In recent years, the Fraunhofer IFF has been developing methods of airborne monitoring of farmland. The hyperspectral cameras and methods of analysis they use are now going to help detect and quantify the vitality of forest trees, their nutritional status and potential pest infestation. The researchers from the Fraunhofer IFF expect to improve early detection significantly and to prevent feeding damage. The hyperspectral imaging system reveals changes in vegetation at an early stage. That also makes it possible to detect new biological threats to a forest in due time and to combat pests more systematically, more ecologically and more greenly.

The forestry operation receives reliable images of the situation in large areas, which can be used to monitor a forest's condition and its development. This will reduce the time needed for this complex job.

Analysis from the Air: How Is the Forest Doing?

Two hyperspectral cameras mounted above a plane's floor hatch very precisely scan the wavelengths of the sunlight in the range of 400 nm to 2500 nm reflected by the forest in the flyover area spatially and spectrally. This very large wavelength range far exceeds the portion of light visible to the human eye (380–780 nm) and its breakdown into many single channels delivers the base of data for the creation of mathematical models that automatically analyze captured image data.

The pilot flies a pattern of parallel lines, an anti-vibration platform partially compensating the plane's movement, in order to scan a plot of forest completely. GPS locations are assigned to every target flown over. Objects' distances and angles to the scanner additionally have to be corrected. Any slightly obscured tracts of land flown over are compared with the terrain model with several

Aerial view of deciduous forest in Saxony-Anhalt. Hyperspectral images allow conclusions about a forest's health. The different hues provide information on tree species and vitality. Feeding damage of oak stands and coniferous forest, for instance, appear reddish pink.

reference points and assembled into a hyperspectral orthoimage. These computations are supposed to be largely automated during the research project.

The researchers intend to test how the two hyperspectral cameras see and scan leafy or thinned crowns on the individual test plots. Several overflights are scheduled, which will be coordinated and carried out by the researchers from the Fraunhofer IFF. Concurrently with the overflights, the researchers from the forstliches Forschungs- und Kompetenzzentrum Gotha will be in action on the selected model plots so that the aerial data can be compared with ground data. They will be assessing specific features of several hundred trees with exactly surveyed locations. They will be assessing the health of these trees based on a multitude of indicators such as foliage, bark condition, and evidence of feeding and compare their observations with findings from previous years as well as with a healthy stand.

Detecting Pest Infestation of Trees: Previously Time-Consuming and Expensive

Detecting pest infestation in forests is very labor and time consuming. A variety of methods are common. Foresters make their feeding assessment of the percentage of leaves eaten from the ground. The webbed nests of oak processionary moths are counted. Glue bands are used to detect winter moth infestation.

The annual nationwide forest condition survey conducted also demand a great deal of time and labor from the staff of forestry operations and agencies. Stands are only surveyed in a very rough scheme, though. This has required four teams to be underway in Saxony-Anhalt for six weeks every summer. They inspect twenty-four permanently marked trees at each of the of 270 condition survey points over a lengthy period every year. They assess the foliage from the ground in order to draw conclusions about the health of individual tree species.

Present forest surveying methods are reaching their limits in this period of climate change, however. Warmth-loving species of pests hitherto unseen in Saxony-Anhalt are spreading as precipitation shifts and temperatures rise. Whether and how trees respond to their encounters with established and new damaging factors and changing climatic influences often cannot be predicted precisely. Such forecasts require long-term observations and analysis of complex correlations. Frequently, these are not evident until damage occurs.

Pest infestation is only controlled whenever complete defoliation threatens and plots larger than one hectare are affected. Control with stomach or contact poison costs around € 150 to € 300 per hectare. In addition to the economic losses incurred by the necessary felling of dead stands, reforestations incurs

Gypsy moth caterpillar.

Individual trees are assessed during the annual forest condition assessment.

» The aerial images make it possible to scan, document and analyze large areas according to specific criteria in short time. «

Prof. Johannes Eichhorn, Head of the Department of Environmental Monitoring at the Northwest German Forest Research Station in Göttingen

costs of around € 20 000 per hectare of forest. "Nature conservation makes the use of chemical agents problematic. They are used with due restraint and only very selectively," stresses Sergej Chmara, Manager of Digital Forest Information Services at Thüringen-Forst's forstliches Forschungs- und Kompetenzzentrum Gotha. Strict regulations such as distances from water bodies, roads or forest-field boundaries have to be complied with.

Hyperspectral Imaging Facilitates Condition Assessment

Prof. Johannes Eichhorn, Head of the Department of Environmental Monitoring at the Northwest German Forest Research Station in Göttingen and in charge of the forest condition assessment in Saxony-Anhalt, sums up the great potential of aerial methods of hyperspectral forecasting: "The aerial images make it possible to scan, document and analyze large areas according to specific criteria in short time." He considers it to be a significant addition to the present procedure and a welcome stage of development but by no means a substitute for sampled data on soil vegetation, fungal infestation of stems, water supply and tree growth.

The Fraunhofer researchers are still working on scheduling the overflights, modifying and programming the analysis software, and refining the hyperspectral camera system. When spring comes to Saxony-Anhalt's forests and leaves begin to appear, they will be ready to take advantage of the brief window of time in which early detection systems can be used effectively. Sylke Mattersberger, Forest Conservation Manager at Saxony-Anhalt State Forest Center, points out, "We only have a few options for the control of oak pest caterpillars, for instance, and only at particular stages of their development. This makes it important to make reliable forecasts early so that we can act efficiently."

Once suitable mathematical models have been created, the aerial hyperspectral images can be used to prepare digital maps of trees' physiological health.

These images could reveal changes long before damage is visible on trees. Supplying this information to users in near real time through forest or geographic information systems, could significantly improve early detection significantly and the effectiveness of pest control.

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Not Separating the Chaf from the Wheat Right Away

Manfred Schulze

The harvester combine painted red, which was harvesting winter wheat on Agrargenossenschaft Bornum's field last summer is only a normal machine at first glance. At second glance, what the specially engineered test harvester looks more like a minor fiasco: The fan suck a a varied mixture of straw, chaff and grain on the attached trailer, the hopper.

This is exactly the intention and part of a major project in which researchers from the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg intend to develop hitherto unutilized biomass together with several partners. Everybody knows that grain has always been harvested separately from straw, whereas chaff, i.e. the wrapper leaves of the kernels, cannot be used threshing at all after. The substantial quantity of ten million tons a year in Germany alone and the correspondingly substantial impact reduced emissions of carbon dioxide responsible for climate change has on the carbon footprint makes chaff anything but a lightweight. "How much of this biomass can actually be retrieved from fields depends of the technically developed recovery systems," explains Dr. Johann Rumpler from the State Institute for Agriculture, Forestry and Horticulture (LLFG Sachsen-Anhalt). Its use necessitates new machinery and technologies, however. The harvested mixture, separated at the silos later, proved to improve the load of the vehicle and trailer advantageously because the total density is significantly higher than that of bales of straw. Hauling grain and straw separately means more work.

While field trials were being conducted under the lead management of the State Institute, a team of four experts from the Fraunhofer IFF was studying the recovery of energy with combustion and gasification. Patric Heidecke, a circular economist, knows the experimental units run by the Fraunhofer IFF in the testing facility at Otto von Guericke University for use in numerous individual projects down to the last detail: Several heat insulated fluidized bed combustors clad with shiny silver film tower four meters high just under the ceiling of the testing facility at Otto von Guericke University where Fraunhofer experts conduct research. With the proper equipment, continuous fluidized bed combustion produce varying power, depending on the size of the combustion chamber. Different actions can be taken in a program, for instance, by changing the fuel supply or the air supply in different zones of the combustion chamber where different probes and nozzles are visible. "In keeping with our progress in a project, we are additionally able to run tests in units of different performance classes, from laboratory scale to almost full sized pilot units. That is a significant advantage," says project manager Torsten Birth.

Inside the combustion chamber of a biomass combustor. The smoke from the fire can be used to produce heat or even to power an ORC module that produces electricity.

At the same time, numerous cables on the vertical experimental units and the blinking diodes in the computers of a small control center constantly collecting and recording countless data on temperature, pressure and the gases produced. "Our project only has good prospects of being transferred to the field on a large scale if we succeed in recovering chaff in such a combustor with an optimal combustion regime," says Patric Heidecke.

Used in power plants for dried pulverized coal for decades, fluidized bed combustion is also considered to be the best technology to recover energy from the relatively light fraction optimally without slag forming or undesired combustion gases or particulates being produced.

"In fluidized bed combustion, we use a mixture of quartz sand and chaff, which air blown into the combustion zone keeps suspended," says researcher Betty Appelt, explaining the processes that occur in the roughly ten centimeter thick pipe of the 15 kW test unit. The bright, uniform flames can be observed through a small sight glass, while the chaff burns. The temperatures in the chamber are distributed more uniformly than in a grate combustor. The absence of temperature peaks and process temperature of approximately 800 degrees Celsius produce fewer nitrogen oxides in the smoke.

Higher process temperatures have to be avoided. Otherwise, the ash particles become relatively soft and could clump. This can be counteracted by the addition of additives such as powdered lime.

The sand with grain sizes from 0.2 to 0.7 millimeters is not only there to fluidize the chaff properly but also as an important retainer of heat and igniter of the reaction. The larger grains also constantly release kinetic energy to smaller grains, thus assuring the best possible utilization of the combustion chamber,

» The substantial quantity of ten million tons a year in Germany alone makes chaff anything but a lightweight. Farmers ought to be exploiting this huge resource. «

Carsten Keichel, Fraunhofer IFF

provided the air is metered properly and blown in at the right places, . "Maintaining the best combustion possible is complicated by the variability of the chaff and the adhesion of soil residue for instance," says Heidecke.

A trial lasts six to seven hour, the individual parameters, such as the air flowing into the intermediate zones, being changed continuously. In addition, the equipment must be started and cooled down, too, each of which takes one and a half to two hours. This does not even include the subsequent cleaning or the analysis of the data.

Fluidized bed combustion is just one, and perhaps even the simpler, part of research on the use of chaff at the Fraunhofer IFF. Whereas it can be gasified, chaff,as well as straw is not suited for the production of methane in the digester tanks of biogas plants. "In the simplest case, by applying heat and removing oxygen, we obtain a biological product gas that can either be used to power gas motors or used as process gas fin the chemical industry. Chaff, which used to be a waste product, is turned into such an energy carrier with high heating values by regulating the air supply so that only a small portion of the chaff burns in the fluidized bed, thus releasing heat for gasification. The remaining biomass outgases and forms hydrogen, methane, carbon monoxide and heavy hydrocarbons, so-called tars, among other things. "These have to be processed, though, which requires very complex refining, especially of the hydrocarbons," reports Torsten Birth. Being a natural material that varies from charge to charge depending on the variety of grain, residual moisture and adhering substances, chaff does not necessarily make the process simpler, especially since the stated goal is to be able to vary the synthesis gas by means of the fluidized bed gasifier's operation. Moreover, some tar-like compounds that only vaporize above 350 degrees threaten to clump when valves and lines form condensate. This must be prevented, of course. Although the petrochemical industry uses tar cracking processes, Carsten Keichel and his colleagues want as local a recovery system as possible. "Having to haul chaff to refineries would worsen the mass balance significantly" he says. The radius of the catchment area should be no more than forty kilometers.

"We are researching both types of recovery simultaneously and currently assume that both are justified depending on where they are used," says Keichel, summarizing the current state of research. He is convinced that the gases obtained can be used wherever cogeneration plants with gas motors are producing heat and power, for instance. In all likelihood, the construction of a boiler to burn chaff in a fluidized bed will be lucrative. "Despite the higher cost of such units, you have to remember that chaff has been nothing but waste, which will therefore cost little apart from the cost of hauling it," says Betty Appelt.

The potential absence of chaff as a component of humus in the soil when it is separated from wheat and utilized hardly needs to be feared, asserts Dr. Johann Rumpler from the State Institute, because substantial quantities of biomass such as roots, stock scrap, and around two thirds of the straw will remain on fields as harvest waste. What is more, chaff ash can also be used as fertilizer rich in minerals. Another significant side effect would arise: Dr. Rumpler expects that the collection of chaff from fields would include seeds of weeds as well, thus reducing the need for herbicides.

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Phosphorous is a scarce raw material all over the world. The mineral is used for fertilizer, for instance. Meat and bone meal contains phosphorus. Recovering it uses this scarce resource significantly more efficiently.

Significantly tighter rules have applied to the handling of waste from the meat processing industry following the outbreak of fatal BSE in Europe two decades ago. Since then, meal made of the bones and unusable parts of animals may no longer be added to animal feed or enter the food chain in any other way. Meat and bone meal, which has a high heating value after drying and simultaneous pressure sterilization, is burned especially in cement kilns and waste incineration plants, thus recovering its energy content. Such disposal is not optimal, though, according Patric Heidecke from the Fraunhofer Institute for Factory Planning and Automation IFF in Magdeburg. "An energy carrier can be burned in many places, of course, but meat and bone meal has very large frac-

Recovering Valuable Phosphates from Ash

Manfred Schulze

tions of phosphorus, an expensive mineral not available worldwide, which we ought to recover from the ash," says the researcher. Meat and bone meal contains three to four percent phosphorus. It primarily comes from bones that store this mineral, which is vital to animals. Concentrations in the ash can even reach fifteen to sixteen percent, as much as in the in the best natural deposits located chiefly in China, Morocco and the USA. In purely mathematical terms, this would cover around five percent of the annual demand for phosphate fertilizer in Germany. We are thus dealing with substantial quantities here.

Establishing material cycles and thus conserving resources is both a simple and a sensible maxim that Patric Heidecke takes up time and again, exotic substances having captured his interest in particular. He has placed numerous jars atop a cabinet at his workplace in the testing facility's control center,. They contain sewage sludge, distillers dried grains and jatropha, for instance, with which he has dealt, and now meat and bone meal, too.

The roughly twenty animal disposal facilities in Germany to which slaughterhouses deliver their waste alone produce over 200 000 tons of meat and bone meal annually. Heidecke opens a large whit plastic bucket and lässt die and lets the granular to powdery substance stream between his hands protected by gloves. "Although the meal is not entirely odorless, the sterilization makes it easy to handle and relatively harmless for our tests," he says. Protective gear and dust masks are worn nevertheless at the test unit in the testing facility at Otto von Guericke University, especially when cleaning equipment parts and pipes. Safe is safe.

Distributed, unblended combustion in special fluidized bed units that deliver heat and power could be the alternative to purely blended thermal recovery. There is another advantage in addition to recovering phosphates. The units could be installed directly wherever meat and bone meal is produce and thus eliminate haulage. At the same time, the heat produced could replace the drying and sterilization presently power by oil and gas. "We are using a wide series of tests to study which parameter have to be met during combustion in order to produce the optimum of energy, on the one hand, and to eliminate the formation of undesirable corrosive gas components such as nitrogen oxides in smoke and combustible residues in the ash," reports Heidecke.

A constant stream or air blown in from below assures that the meat and bone meal mixes ideally with the heated quartz sand, ignites and thus fully incinerates the organic particulates in fluidized bed units. "Meat and bone meal hats a heating value of around eighteen megajoules per kilogram. That is approximately as much as from absolutely dry wood," explains the researcher. Fluidized bed combustion maximizes the recovery of fuel energy and fundamentally minimizes

Photo: Fraunhofer IFF

The test units in the fluidized bed testing facility. The Fraunhofer IFF uses them jointly with Otto von Guericke University Magdeburg for its tests.

corrosive gas concentrations in the smoke, every organic particulate having to be kept in the combustion zone with temperatures of 850 degrees Celsius for at least two seconds. That is probably the biggest challenge because the composition, not even of even meat and bone meal, is never homogeneous. Particulates range in size from a fraction of a millimeter to half a centimeter or even larger. The test series run in smaller experimental units. The first fluidized bed in the testing facility only produced 15 kW, not much more than a large fireplace. The most recently used fluidized bed combustor measures around four meters high and has instruments and probes that are only accessible by grated steps specially built. Its output of 150 kW situates it significantly closer to industrial standards. A cyclone separator, which collects the majority of the lightweight ash particulates before the actual filter unit, is also in operation here. Heidecke is now certain, however, that a unit with 10 megawatts of power could also be built without any difficulty. The filter needed to separate dust and corrosive gas compounds can be made out of standard modules. Numerous parameters such as pressure and temperature in the different zones as well as exhaust components are already measured and automatically recorded in the experimental unit. This makes it possible to adjust combustion optimally and delivers insights into control mechanism parameters.

Only ash remains after animal and bone meal has been burned. Blended with potassium and other nutrients, it can be processed into pellets or granulate and spread on fields as an inexpensive fertilizer substitute.

The quantity of process heat produced in an animal disposal facility would more or less cover all of its needs and additionally suffice to produce power and to supply heat to the neighboring residential development.

As soon as the ongoing relevant economic feasibility studies have been completed, the first commercial unit could already be built at a field partner's facilities at the end of the summer. The quantity of process heat produced in an animal disposal facility would more or less cover all of its needs and additionally suffice to produce power and to supply heat to the neighboring residential development.

Also introducing dehydrated, pre-dried into this combustor could be particularly interesting as well. "The regulations on spreading directly on fields have been tightened again and again in recent years that combustion is virtually essential here, too, and is certainly also economically expedient," reports Patric Heidecke. Disposal by waste incineration plants costs sewage treatment plants as much as € 30 per ton. Hauling is an additional expense. Since sewage sludge is extremely rich in phosphate just like meat and bone meal, blending the two fuels for ash recovery would be advantageous. This would require in-depth analysis of ash composition in terms of the problematic substances contained in sewage sludge, e.g. arsenic or heavy metals. Provided they are solids, they must be separated from the ash in order to optimize downstream phosphorus recovery.

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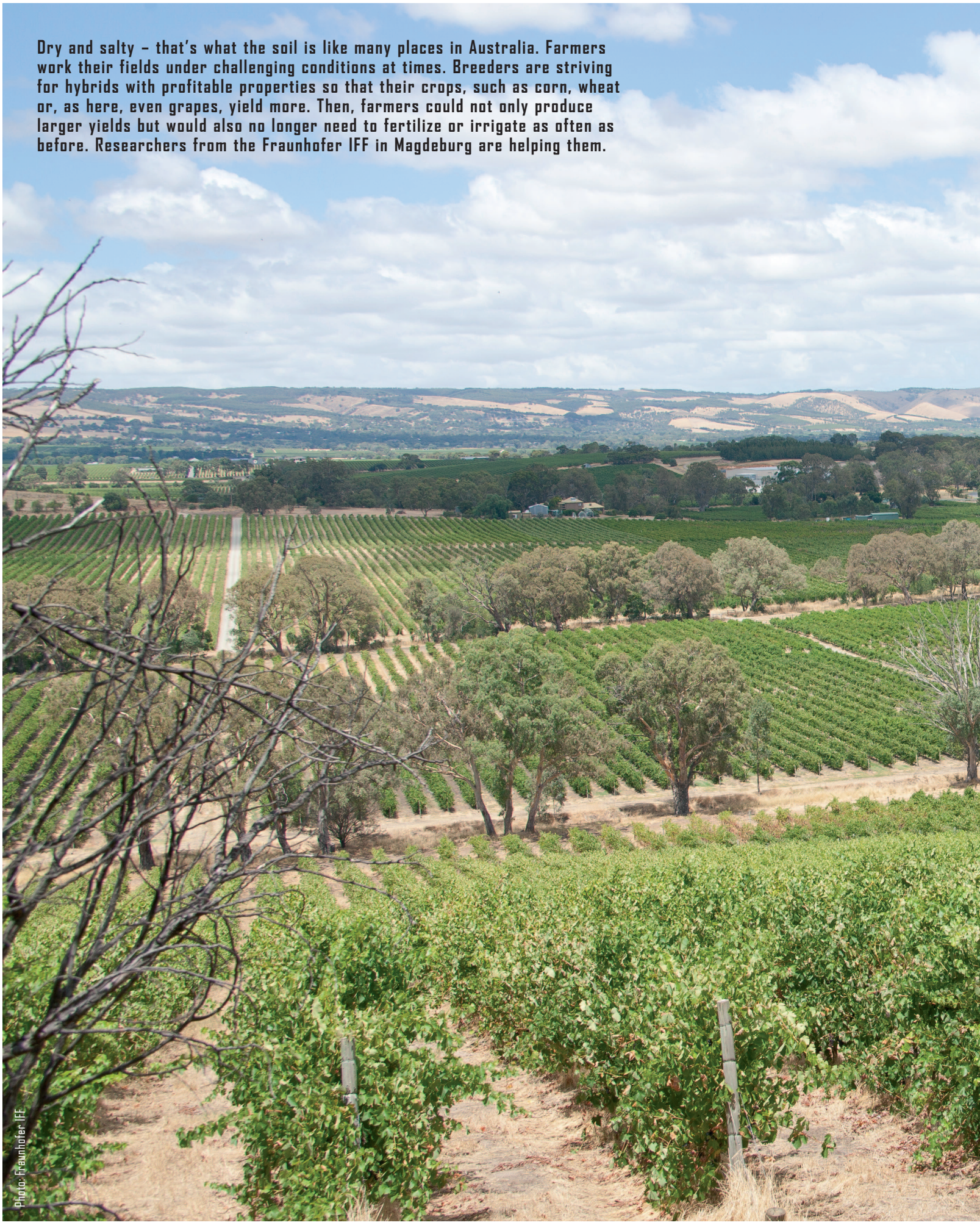
An experimental fluidized bed combustor: The experts at the Fraunhofer IFF develop technologies that recover energy from woodchips, rice husks, meat and bone meal or other, non-biological production waste. The heat produced in the process can cut a company's energy costs significantly.



Dry and salty – that's what the soil is like many places in Australia. Farmers work their fields under challenging conditions at times. Breeders are striving for hybrids with profitable properties so that their crops, such as corn, wheat or, as here, even grapes, yield more. Then, farmers could not only produce larger yields but would also no longer need to fertilize or irrigate as often as before. Researchers from the Fraunhofer IFF in Magdeburg are helping them.

Photo: Fraunhofer IFF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Researchers from Magdeburg even took to the air to analyze the grapevines of the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Adelaide, Australia. They integrated their special hyperspectral camera system in a research aircraft. As Prof. Jörg Hacker from Airborne Research Australia was flying over the vineyards, Dr. Andreas Backhaus was operating the scanners to collect hyperspectral image data.

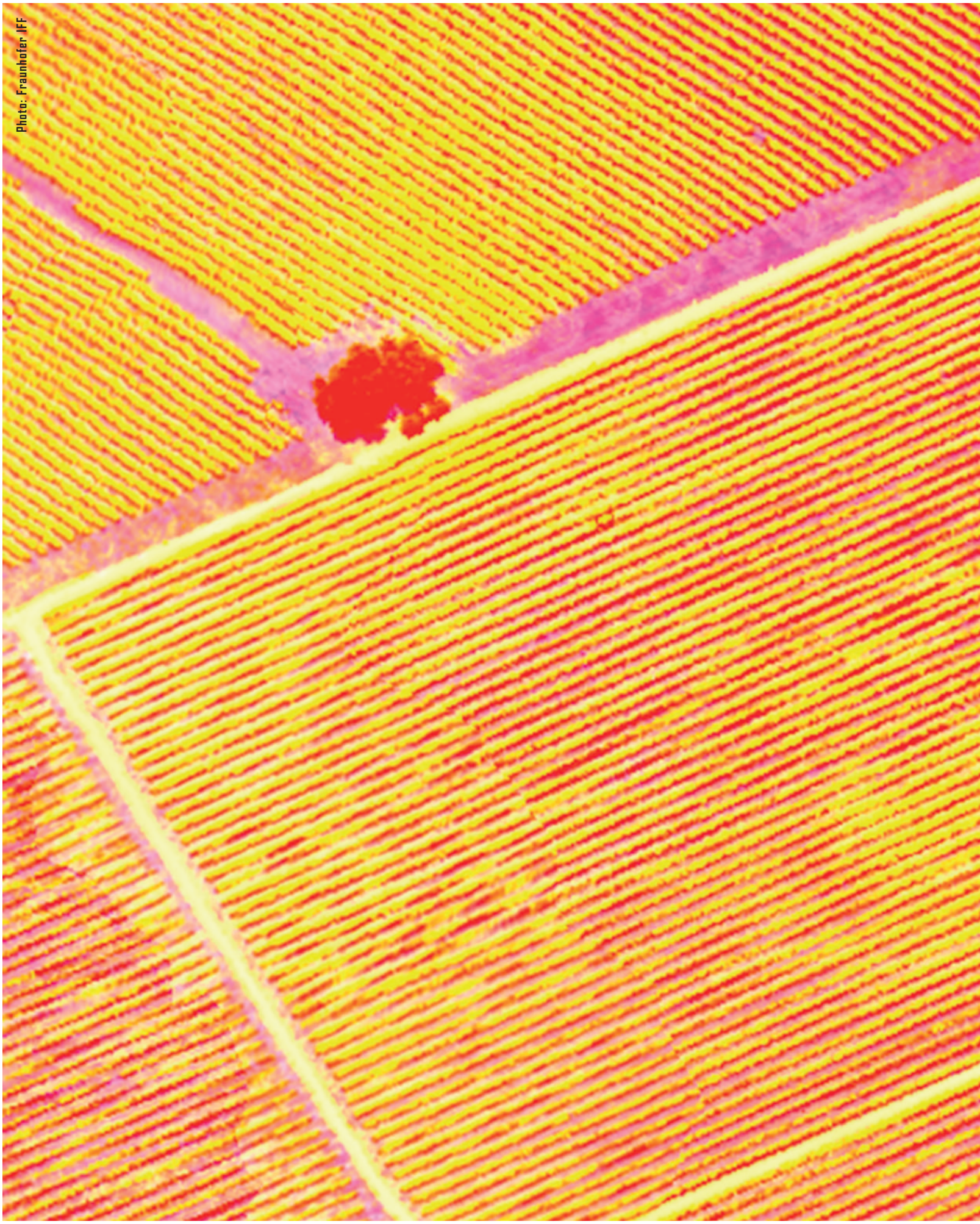

Photo: Fraunhofer IFF

Aerial hyperspectral images of a vineyard: The images deliver far more information than the human eye because the camera "sees" not only the visible light reflected by the vineyard but also the wavelengths outside the spectrum, i.e. infrared and UV rays. A mathematical algorithm uses the spectrum reflected by the particular plants to identify the' specific constituents in their leaves. The hyperspectral images thus enable researchers to draw conclusions about certain constituents and thus vines' water content or health.

Klaus Müller Now Chairman of VDMA East Executive Board

At their last meeting of 2014 on December 5, the members of the VDMA East Executive Board unanimously elected Klaus Müller, CEO of Kranbau Köthen GmbH and member of the Fraunhofer IFF Advisory Board, their new chairman. Müller will now head the board for the next three years.

"During my term of office, I intend to push to respond to our industry's multifaceted challenges together with the business office," said Müller after his election. Profound changes can already be observed in various domains, e.g. increasing internationalization, digital networking, the shift toward user-centric and custom products, the use of new technologies and materials, the energy transition, and expert retention and development.

Klaus Müller, CEO of Kranbau Köthen GmbH (center), was elected chairman of the VDMA East. Here, he is conversing with two other members of the Fraunhofer IFF Advisory Board, Prof. Werner Schreiber (left), manager of Virtual Technology Research at VW, and Bernd Liepert (right) Chief Technology Officer at KUKA.

The issue of experts and future experts is particularly important to Müller. "Companies outside favored metropolitan areas are having increasing difficulty recruiting dedicated, well-qualified and simultaneously affordable employees," says Müller based on his own experience. "That is why we have to make young people in particular aware that even small and medium-sized enterprises can offer interesting fields of work and prospects. On the other hand, many young people know absolutely nothing about the diverse jobs in machinery and plant manufacturing. This is where we have to intensify our efforts. Then, more young people might decide to pursue a technically oriented degree, a dual degree or engineering degree," hopes the new chairman. According to Müller, experts with extensive expertise and willingness to assume responsibility are in demand. (akw) ■

IFF Advisory Board Member Prof. Peer Witten Celebrated His 70th Birthday

Prof. Peer Witten.

Bremen/Hamburg. Otto Group executive board member for over twenty years, president of the BVL executive board for many years, the face of Logistik-Initiative Hamburg: Prof. Peer Witten was instrumental in shaping logistics in Germany for many years. He turned seventy on April 10, 2015.

His professional career is closely tied to the Otto Group in Hamburg. He was hired by the mail order company right after earning his undergraduate degree in business management from the universities in Göttingen and Hamburg as well as his doctorate. Eight years later, at the age of thirty-nine, he was appointed member of the corporate board. He is still a member of the Otto Group advisory board. Peer Witten was an active member of advisory and executive boards far outside Hamburg and chairman of the BVL board from 1999 to 2007. Witten played an influential role in the merger of the formerly rival organizations BVL and DGfL (German Logistics Society). Witten also provided important impetuses to decentralizing and internationalizing the BVL. Continuity and innovation were always his guiding principles as head of the BVL, he says, looking back.
Peer Witten also imagined an academic career when he was a young doctoral candidate. Although that didn't happen, he still feels tied to academia. As a supernumerary professor for International Distribution Logistics at the Institute of Logistics and Material Handling Systems ILM of Otto von Guericke University Magdeburg, he teaches young logisticians. Witten is a member of the Advisory Board of the Fraunhofer Institute for Factory Planning and Automation in Magdeburg and the Fraunhofer Center for Maritime Logistics and Services in Hamburg. (pm) ■

Electrifying Addition to Magdeburg's Network

Bartlomiej Arendarski was the first young researchers to come to the Fraunhofer IFF through the EU's Marie Curie program. He successfully defended his dissertation in June.

Bartek, as his friends and colleagues call him, was born in 1980 in Jędrzejów, Poland. After graduating from school in Miechow, he studied electrical engineering and telecommunications at the Wrocław University of Technology, the second biggest technical university in Poland. He dealt with digital data transmission in smart houses in his Master's thesis.

Arendarski came to the Fraunhofer IFF in Magdeburg in 2006. The aim of the Marie Curie program was to give twelve young researchers from abroad opportunities to collaborate on international research projects for four years, thus acquiring their first practical experience in industry projects. The institute opened its Virtual Development and Training Centre VDTC in November of 2006 at just the right moment for Bartlomiej Arendarski. For Magdeburg offered him the best conditions to launch his research career. Today, he works on electrical grids and electric vehicle networks in the Process and Plant Engineering Business Unit. He earned his doctorate from Otto von Guericke University under Prof. Styczynski in the Department of Electrical Grids and Alternative Electrical Energy Sources. The department and the Fraunhofer IFF have been collaborating actively for years and have produced a number of young doctors at the Fraunhofer IFF. Bartlomiej Arendarski is looking forward to being able to pick up his doctoral diploma soon and officially title himself doctor.

Having earned his doctorate, Arendarski now has more time for fishing and playing soccer again. His wife and he have made their home here in the city on the Elbe and he an imagine his future here, too. You could say he's become part of Magdeburg's network in every respect. (akw) ■

Bartlomeij Arendarski next to his doctoral advisor Prof. Zbigniew Styczynski.

Kathleen Hänsch successfully defended her dissertation and made it through the traditional doctoral initiation.

Rather a Researcher Than a Lawyer

Kathleen Hänsch is happy and satisfied. After all, she is a brand new doctor in the field of process and plant engineering. She recently successfully defended her dissertation entitled "Digital Maintenance History Files for the Support of Process Plant Operation". Full of vigor, she is now focusing on new and fascinating research at the Fraunhofer IFF. She is presently studying the development of information and communications technologies for smart grids and developing components for electrical grids. She is doing this in projects such as eNterop as well as the large energy storage system officially opened recently at the institute, for which she designed software that collects measured data.

"Every project entails a new, intensive challenge and the related collaboration among many different disciplines makes it so interesting all over again every time," says Kathleen Hänsch describing her work with visible enthusiasm. This enthusiasm hasn't always burned in her: "I actually wanted to become a lawyer," reveals the young researcher. She was interested in the profession for a long time. Research can be happy that she followed an entirely different path after all: computer science.

Born in Neu Kaliss and raised in Magdeburg, Kathleen Hänsch attended Otto von Guericke University. She came to the Fraunhofer IFF in 2002 as a student assistant and also wrote her Diplom thesis at the institute. In 2005, she became a research manager in the Process and Plant Engineering Business Unit While she was working on her Diplom thesis, she ran across a call for a doctoral fellowship and applied – with success! She landed one of the six coveted fellowships.

Dr. Kathleen Hänsch now has more time for her personal life again. There's still lots to be done on her newly built house but, most of all, she's looking forward to working in her garden. (mso) ■

Magdeburg Surprised Doctoral Candidate

Dr. Annegret Brandau's colleagues Fabian Behrendt, Dr. Sebastian Trojahn and Dr. Tobias Reggelin (l. to r.) escorted her to the traditional doctoral initiation at the Otto von Guericke monument in downtown Magdeburg.

She earned her undergraduate degree in Konstanz and her doctorate in Magdeburg. Annegret Brandau defended her dissertation in April at the Institute of Logistics and Material Handling Systems ILM of Otto von Guericke University Magdeburg. She was awarded "summa cum laude" for it from her doctoral advisor and ILM chair holder Prof. Michael Schenk and Prof. Béla Illés.

Dr. Annegret Brandau was born in 1982 in Trendelburg near Kassel in Hesse. She moved from the small town to Konstanz in 2008, when the Central Student Placement Office assigned her an undergraduate spot there in biology, a program with limited enrollment. But, after two semesters, Annegret Brandau decided to change majors: Mathematics, with a minor in physics, captured her interest. Mathematics graduates usually enter insurance or banking, but not Annegret Brandau. After graduating, she looked for something with more practical relevance to business, logistics, for instance. She discovered and applied for a job opening in the Department of Logistics Systems of the Institute of Logistics and Material Handling Systems of Otto von Guericke University in Magdeburg. Immediately willing to move to a new city, the young researcher was thrilled to get the job and moved to the capital in 2008. Her research at the ILM also brought her to the Fraunhofer IFF where she collaborated on numerous projects.

"Coming to Magdeburg was worth my while. I've learned a lot here, have been able to collaborate on many industry projects. In my work, I have seen the world: Kazakhstan, Ukraine and other countries. You don't just travel there, otherwise."

Dr. Annegret Brandau's future path, whether research or industry, is still uncertain. She is staying put in Magdeburg for the time being. "When I came here, the slogan was "Magdeburg is surprising". I can attest to that. I didn't expected it to be like this. So many historic places in such a small area. The city has really developed splendidly," says the recent doctor, raving about the quality of her life. Where else can you get affordable place to live with so much nature or even on the river with inner city flair? You only find that here, says Dr. Brandau. (akw) ■

Doctorate without Borders

Melchert during trials on the Agrover in a breeding nursery. The research vehicle records hyperspectral image data.

Earning an international doctorate and pursue research is no problem with the "binational doctoral program". Friedrich Melchert enrolled and earned a dual degree from Otto von Guericke University Magdeburg and the University of Groningen RUG in the Netherlands at the end of his doctoral candidacy.

Melchert always had his sights on his doctorate. He sees it as a fascinating voyage of discovery into the world of machine learning in a biological context. After graduating from high school, the native of Thuringia went to the university in Magdeburg. He completed his Diplom degree in information technology in 2011 and his subsequent Master's degree in mechanical engineering with honors in 2013. His work in the Fraunhofer IFF's Biosystems Engineering Expert Group gave him practical experience analyzing and modeling biological and biomedical applications, especially plant phenotyping. Scientifically researching and creatively discovering this field of work fascinates him to this day and pursued in the topic of his dissertation, too. After researching at the Fraunhofer IFF for one year, he departed for the University of Groningen in 2015 for two years. He will defend his dissertation at his home university.

The program entails many changes for the newlywed. Little time is left for relaxed hours outdoors with his wife and their two dogs. The advantages are obvious, though, and outweigh the sacrifices. "The advantages are more than just becoming proficient in a foreign language. The personal fit and collaboration with industry during this period of research are excellent." (nk) ■

BVL Pin of Recognition Awarded to Holger Seidel

Holger Seidel, Träger of the BVL-Ehrennadel, will maintain close ties to the BVL after his Abschied as Saxony-Anhalt Regional Chapter spokesman

The Bundesvereinigung Logistik presented Holger Seidel, Manager of the Fraunhofer IFF,'s Logistics and Factory Systems Business Unit, with its pin of recognition on November 6, 2014. The association thus recognized the logistics expert's ten year's of voluntary service as spokesman of its Saxony-Anhalt Regional Chapter. Holger Seidel took his leave from active service in the BVL Regional Chapter on this day. His successor is Hans-Jürgen Kaftan, a professor at Anhalt University of Applied Sciences.

Holger Seidel kept the BVL Regional Chapter informed and organized events that were well attended by partners and interested companies. Among other things, he was an excellent networker who brought researchers, businesspeople and practitioners together. As deputy chairman of the Saxony-Anhalt Ministry of Regional Development and Transportation's Logistics Advisory Board, he interfaced with the state government.
The Bundesvereinigung Logistik (BVL) is a nonprofit network that actively promotes efficient collaboration in our globalized economy. Its mission is to raise awareness of the importance of supply chain management and logistics and to advance their use and development. Over 10 000 experts and executives from the industry, retail and service sectors and research and academia are members of the BVL. (akw) ■

The good mood is evident in the team picture. They attacked the opposing goal on the soccer field with as much athleticism as fun.

Out of the Office into Athletic Gear

Our researchers work together well in more than just their laboratories and offices. They make strong teams in their free time, too.

Every year, soccer-loving researchers from the individual institutes compete in the Fraunhofer soccer tournament, most recently on June 27 in Bremen.

Taking second place in the preliminaries qualified the Fraunhofer IFF's soccer players for the finals – unfortunately, not without injuries. The team nevertheless placed an excellent seventh overall.

Altogether twenty-three institute teams were hosted by the previous year's champion Fraunhofer IFAM in Bremen. The Fraunhofer IWM ultimately captured the cup with 2:0 against Institute Centre Schloss Birlinghoven, thus taking the championship cup back with them to Halle and hosting next year's tournament.

A second recurring event in the "athletic calendar" is the Magdeburg corporate relay race. The motto on July 9 will once again be "Running. Motivating. Networking."

Thirty-five staffers and student assistants from the Fraunhofer IFF each ran three kilometers through the Elbauenpark Magdeburg, passed the baton and represented our institute in top form.

The corporate relay race was especially "well run" in its seventh year – 5000 runners from around 500 regional companies competed on 1000 teams. (dm) ■

The corporate relay race is the most athletic meeting in Magdeburg: Researchers from the Fraunhofer IFF, here Sergii Kolomiichuk, were also at the front of the pack..

Upcoming Events

Meet up with researchers from the Fraunhofer Institute for Factory Operation and Automation IFF at these events.

September 23, 2015
11th Laser Scanning and VR Plant Design Industry Working Group, Magdeburg

September 23 – 24,2015
20th Bulk Handling Systems Conference, Magdeburg

September 28 – 29, 2015
RFID tomorrow 2015, Düsseldorf

September 29, 2015
Chamber Dialog "Jobs of the Future: Responding to Demographic Change", Magdeburg

October 5 – 9, 2015
22nd ITS World Congress, Bordeaux

October 10,2015
Visual Intelligence in Smart Logistics and Transportation VILT 2015, Aachen

October 14 – 15, 2015
8th Fraunhofer Vision Alliance Technology Days, Stuttgart

October 16 – 17, 2015
3rd KWF Theme Days, Gross Heins

October 20, 2015,
5th SME Forum "The World of Work of Tomorrow: Technology – Education – Future", Magdeburg

October 21 – November 25, 2015
"Humans and Machines in Interactive Dialog" Guest Lecture Series,Magdeburg

October 22,2015
Automation in Food Production, Vienna

October 27, – 28, 2015
"Robots in the Automotive Industry" Conference, Augsburg

October 28 – 30, 2015
32nd International Supply Chain Conference, Berlin

November 18, 2015
24th Cooperation in Plant Design Industry Working Group, Magdeburg

November 24 – 26, 2015
SPS IPC Drives 2015, Nürnberg

December 9 – 11, 2015
9th International Symposium on Mobile Mapping Technology MMT2015, Sydney

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