

TOMORROW TODAY

Developing the technologies, methods and tools of tomorrow



Peter Palensky, Principal
Scientist at the AIT Austrian
Institute of Technology

→ HEALTH & ENVIRONMENT

TESTING FOOD USING MOLECULES

6

Bacterial infections caused by contaminated food continue to be a serious problem even in the Western world. Novel detection methods, based on DNA or protein analysis, are providing a fast and reliable way of identifying bacterial contamination in food and beverages.

THE QUEST FOR THE BEST GENES

10

The AIT Gene Resource Center offers both the expertise as well as the genetic material required to make trees, plants and breeding animals more resistant and perform better, by using the "best" genetic material.

→ SAFETY & SECURITY

PROTECTING CRITICAL INFRASTRUCTURES

14

Transportation hubs and other vital infrastructures attract pickpockets and even terrorists. Many facilities, including power stations, government ministries and banks need special protection – in particular by means of innovative video surveillance systems.

→ ENERGY

SMART GRIDS GO LIVE

18

It is a well-known fact that renewable sources of energy have to be integrated more strongly in the energy infrastructure. This can be done with the help of smart grids. In the Austrian provinces of Vorarlberg and Salzburg they have become reality.

→ MOBILITY

THE RIGHT DRIVE FOR E-MOBILITY

22

The cornerstone of sustainable e-mobility are economical yet powerful electric drive concepts. With virtual design technology from the AIT Mobility lab the necessary components and systems can be rapidly and efficiently produced.

→ FORESIGHT & POLICY DEVELOPMENT

KNOWLEDGE MAPS

26

A wealth of valuable information lies dormant among the data continually being heaped up in the digital era. Aided by highly advanced techniques and tools, experts at the AIT Foresight & Policy Development Department are mining such hidden knowledge treasures for AIT's clients.



The cover page of the Tomorrow Today December issue features AIT Principal Scientist Peter Palensky

03 INTRODUCTION

06 HEALTH & ENVIRONMENT TESTING FOOD USING MOLECULES

Bacterial infections caused by contaminated food continue to be a serious problem even in the Western world. Novel detection methods, based on DNA or protein analysis, are providing a fast and reliable way of identifying bacterial contamination in food and beverages.

10 THE QUEST FOR THE BEST GENES

The AIT Gene Resource Center offers both the expertise as well as the genetic material required to make trees, plants and breeding animals more resistant and perform better, by using the "best" genetic material.

SAFETY & SECURITY

14 PROTECTING CRITICAL INFRASTRUCTURES

Transportation hubs and other vital infrastructures attract pickpockets and even terrorists. Many facilities, including power stations, government ministries and banks need special protection – in particular by means of innovative video surveillance systems.

ENERGY

18 SMART GRIDS GO LIVE

It is a well-known fact that renewable sources of energy have to be integrated more strongly in the energy infrastructure. This can be done with the help of smart grids. In the Austrian provinces of Vorarlberg and Salzburg they have become reality.

MOBILITY

22 THE RIGHT DRIVE FOR E-MOBILITY

The cornerstone of sustainable e-mobility are economical yet powerful electric drive concepts. With virtual design technology from the AIT Mobility lab the necessary components and systems can be rapidly and efficiently produced.

FORESIGHT & POLICY DEVELOPMENT

26 KNOWLEDGE MAPS

A wealth of valuable information lies dormant among the data continually being heaped up in the digital era. Aided by highly advanced techniques and tools, experts at the AIT Foresight & Policy Development Department are mining such hidden knowledge treasures for AIT's clients.

CAREER MODELS

30 CAREER PATHS AT AIT

31 SERVICE

IMPRINT. Media owner and publisher: Bohmann Druck und Verlag GesmbH & Co. KG., 1110 Vienna, Leberstraße 122, phone: +43 1 740 95-0. **DVR:** 0408689. **Management:** Gabriele Ambros, Gerhard Milleit. **Publisher:** AIT Austrian Institute of Technology, Tech Gate Vienna, Donau-City-Straße 1, 1220 Vienna, phone: +43 (0) 50550-0. **Editors-in-chief:** Michael Hlava, e-mail: michael.hlava@ait.ac.at, Christian Klobucsar, e-mail: klobucsar.zv@bohmann.at. **Editors:** Margit Noll, Daniel Pepl, Victoria Reinicke. **Authors of this edition:** Alfred Bankhamer, Raimund Lang, Angelika Prohammer, Doris Griesser. **Project management:** Daniel Pepl. **Graphic design:** Anita Frühwirth/EFFUNDWE. **Layout:** Markus Frühwirth. **Print:** Leykam Druck GmbH. & Co KG. **Cover shot:** Krischanz & Zeiller. **Publication:** 6 times a year. Section 44 paras. 1 and 2 of the Austrian Copyright Act. ISSN 1994-5159 (print), ISSN 1994-5167 (online). **Free subscription via e-mail:** cmc@ait.ac.at.

member of 
corporate
communication
cluster
vienna

TAKING STOCK

/// Dismissed as a hopeless basket case just three years ago, AIT is established as Austria's top research institute on an international scale today, engaged in technology developments to meet the "grand challenges" of the future with the emphasis on infrastructure issues. ///

A CORPORATE TURNAROUND is regarded as the ultimate achievement in the scale of ambitious management goals. Both AIT's owners, the Ministry for Transport, Innovation and Technology (BMVIT) and the Federation of Austrian Industries (IV) were correspondingly skeptical when the new AIT management presented to them the necessary strategic plans three years ago. However, the systematic new positioning and structural reform produced the hoped-for result: today the turnaround is well and truly under way; AIT, with its new governance program, is widely seen as a model of best practice, and it can point to a very satisfactory order book.

AMBITIOUS TARGETS

At the AIT owners' press conference on November 23, 2011 at Vienna TechGate, the owner representatives Doris Bures, Austrian Infrastructure Minister, and Veit Sorger, President of the Federation of Austrian Industries, along with Hannes Androsch, AIT President of the Supervisory Board, took stock. In the early days of AIT many members of staff saw this strategy and the new governance structure as a major opportunity; for AIT's owner representatives, however, it was more like a last chance. So in 2008 it was agreed between the two shareholders, BMVIT and the Federation of Austrian Industries, to evaluate AIT's position after three years.

In the course of this evaluation, over the last few months its economic performance has been reviewed, implementation of the 23 recommenda-



Happy about AIT's successful evaluation: Hannes Androsch, President of the the Supervisory Board, Doris Bures, Infrastructure Minister, and Veit Sorger, President of the Federation of Austrian Industries

tions originally stipulated by the Austrian Court of Auditors was looked into and the strategy of the company again thoroughly investigated by the internationally renowned Strategic Research Advisory Board (SRAB). The result was extremely

HANNES ANDROSCH ///
President of the AIT
Supervisory Board

"AIT has been gathering pace and has generated profits for the fourth year in a row. Given this stable background, its staff can show fully-fledged performance." "



positive. AIT's Strategic Research Advisory Board, which advises the company's Supervisory Board, issued a favorable testimonial for AIT's 2020 positioning strategy.

FIT FOR THE FUTURE

The Federation of Austrian Industries will consequently strengthen its commitment to AIT, increase the number of members in the VFFI (Verein zur Förderung von Forschung und Innovation - Association for the Promotion of Research and Innovation), and it has already renewed its shareholder agreement. Says Veit Sorger, President of the Federation of Austrian Industries: "Industry stands firmly behind AIT as the undisputed Austrian research institution. With its focus on technology developments to meet the grand challenges and its emphasis on the infrastructure issues of the future, AIT represents an important partner for Austria's industry."

The BMVIT, together with the IV and Supervisory Board President Hannes Androsch, have succeeded in putting AIT on track to be a national research organization of international stature.

Federal Minister Doris Bures: "The new positioning of AIT has been a resounding success; it has developed into an economically sound company." If it now systematically pursues this path, AIT and its technological achievements will continue in future to be an important player in securing Austria's reputation as a place to do business.

AIT IS ECONOMICALLY SOUND

With profits on ordinary activities of over EUR 3.5 million in 2010, the company has produced a stable and satisfactory operating result. Although some EUR 1.5 million will be reinvested in strategic research projects in the current year 2011, AIT still expects to achieve profits on ordinary activities of

EUR 2 million. Since 2007 central administrative costs have been reduced by 16% or EUR 1.8 million. Research contracts in 2010, worth EUR 121.8 million, were well up on the 2009 figure of EUR 107.2 million, and at EUR 60.5 million new contracts were also about 10% up year-on-year (2009: EUR 54.6 million).

MINOR STRATEGY ADJUSTMENTS

Fine adjustments are still being made to the strategy in the Health & Environment Department with the main emphasis on reinforcing its market and customer orientation.

At marketing subsidiary Seibersdorf Labor GmbH business activities in the field of toxicology will be discontinued as of the end of this year. Toxicology, one of our six Business Units, operates in a very tough international market with strong competition, small profit margins and under heavy cost pressures. This measure will affect 26 employees who will not only be catered for by a comprehensive social plan but can also expect maximum support on the part of AIT in easing their transition to new employment relationships. The other Business Units at Seibersdorf Labor GmbH are operating successfully on the market.

THE GRAND INFRASTRUCTURE CHALLENGES

With its focus on eleven research topics in five Departments AIT achieves the critical mass necessary to produce excellent results. Whether we are talking about intelligent energy for smart cities, smart models for ground-breaking logistics and multi-modal mobility solutions, sensors and procedures for the medical care of the future or ICT

DORIS BURES ///
Infrastructure Minister

"As we can clearly see from AIT's success story, R&D is the appropriate response to the crisis. Premier performers like AIT pave the way for Austria as the leader in innovation."



security for critical infrastructures, such as the control centers of energy providers and transport operators, AIT researchers can call on the know-how and systems expertise needed to achieve innovative solutions for their customers.

“AIT 2020” STRATEGIC PLAN

To prepare the company for the challenges of the years to come, the owners have set it a number of key objectives. As the leading national research partner of Austria’s industry, infrastructure operators and public sector institutions, AIT is to aim for even greater visibility on the international scene as it addresses the key issues.

Each of AIT’s five Departments is to establish its international reputation with at least one flagship area. The focus will remain on the infrastructure issues of the future (energy, mobility, safety & security, etc.). The Departments will aim to go on growing and successfully develop a critical mass with up to 250 staff in each Department.

INTERNATIONALLY RECOGNIZED SCIENTIFIC EXPERTISE

One key objective is to capitalize on having a number of managers of international stature at AIT. This will include appointing one or two Principal Scientists in each Department who will epitomize the excellence of the research activity beyond the national borders (editor’s comment: see also our interview with Principal Scientist Peter Palensky on page 30). AIT will aim in the next few years to become one of Europe’s leading career hotbeds for high potentials and top international researchers within their fields of interest.

Thanks to its firm foothold in European institutions, AIT will reinforce its position as the essential national hub for industry and as research partners for public sector institutions, making it a pillar of the national innovation system. With its international activities AIT will in this way open doors for Austria’s business community, securing it lasting access to human resources. AIT will thus make a significant contribution to securing and developing Austria as a center of industry and research.

Hannes Androsch, President of the Supervisory

VEIT SORGER /// President of the Federation of Austrian Industries

“Given AIT’s turnaround, we have here a research organization that stands out in international comparison. The Federation of Austrian Industries will continue to play a central role.”



Board: “AIT has done excellent work in its early phase and the strategy is beginning to bite. The company has made profits for the fourth time in succession and looks set to achieve positive earnings in 2011 as well. Nevertheless, it is important always to go on tweaking the strategic direction and making adjustments. Our aim must be to be in the vanguard in all our key research activities!”

NEXT EVALUATION IN 2017

Yet the positive trend of the last few years must not be an excuse for resting on our laurels. So another evaluation will take place in 2017 to check the strategy is the right one and that the numerous tasks that AIT will face up to 2020 really will be delivered on. ///

AIT’S 2020 STRATEGIC PLAN

- AIT is the major Austrian research institute engaged in technology development to meet the grand challenges of the future with the main focus on infrastructure issues.
- Core business: research and technology development
- Close links with industry, business, infrastructure operators and public sector clients.
- The company aims in its various Business Units to:
 - develop lasting technology and systems expertise
 - exercise its function as a national and international network hub, and
 - provide a central research infrastructure
- AITs ambition: to be a leading research institution at a global level
- The company will concentrate on key activities in which it will develop long-term solutions expertise and maintain a rigorous connection between its technological and substantive core competence and industrial demand on the one hand, and national and societal requirements and support on the other.
- Within the framework of the overall AIT strategy, each Department will aim to establish a leading international position in selected fields of technology and to develop general systems competence with high potential for integration into clients’ systems. ///

TESTING FOOD USING MOLECULES

/// New detection methods based on DNA or protein analysis provide a fast and reliable way of identifying bacterial contamination in food and beverages. Experts at AIT are devising a variety of molecular tests to be used in detecting pathogens and determining how they spread, or to analyze the effects of food additives. ///

● IN A NUTSHELL

Bacterial infections caused by contaminated food continue to be a serious problem even in the Western world. Pathogens in particular, representing the most common cause of infections, pose a dangerous threat to human health. Such organisms therefore need to be identified quickly and precisely when suspected as a cause. At AIT, molecular techniques that are both very fast and highly precise are being developed for the purpose of detecting salmonella, EHEC and similar pathogens, covering a broad spectrum of applications. The research program at the Health & Environment Department also focuses on innovative techniques for identifying food additives and their effects on the human body as well as on protein-based quality control methods, used for example for analyzing milk.

IN 2009, i.e. prior to the E. coli crisis, the European Food Safety Authority recorded 5,550 instances of food-borne disease outbreaks within the EU, affecting 49,000 individuals and causing 46 mortalities. Obviously, such diseases do not only affect developing nations. In the Western world the problem is exacerbated by aging societies as the elderly have increased sensitivity to pathogens and allergens in food and drink. Consequently, top priority needs to be given to reliable food testing and the development of appropriate techniques. As a research institution

focused on practical applications, the AIT Health & Environment Department has for years been working intensively on food safety issues.

SOPHISTICATED DIAGNOSTIC TOOLS

"We are working on two highly complementary diagnostic tools for identifying bacterial pathogens such as salmonella or E. coli," molecular biologist Tanja Kostic reports. "These include protein-based methods as well as techniques at the DNA level." The two novel approaches are extremely fast compared with conventional techniques. In a one-on-one comparison, the protein-based methods usually rate better, at least in terms of speed and quantifying capacity. "Yet they provide less detailed results, making them very well-suited for certain types of investigations but inappropriate for others," Kostic observes. If, for example, researchers wish to assess how a pathogen will spread and the danger that it will pose, it will not do to merely identify its biological genus. Such cases require more detailed typing. In response to this need, for example, experts at AIT have worked in cooperation with research groups in Canada and the UK to develop a DNA-based microarray for detecting the most common salmonella serotypes in Europe and North America.

RESEARCH TARGETS ORGANIC VEGETABLES

Even before the E. coli outbreak, the EU PathOrganic project had been initiated with the aim of gathering new knowledge about the occurrence of pathogens in organic farming as well as ways of avoiding their occurrence. As the Austrian partner in the project, AIT is providing substantial contributions. "Animal feces are frequently used as a natural fertilizer in organic farming," Tanja Kostic explains. "This kind of manure is often contaminated with strains of enterobacteria such as E. coli or salmonella that live in the animal's intestine without harming it." Such bacteria can then pass from the manure to the vegetables and in this way be ingested by humans. The analyses carried out by AIT experts using the DNA-based PCR (polymerase chain reaction) technique produced alarming results, Kostic notes, "We were very surprised at the number of pathogens, for the most part salmonella and E. coli germs, which we were able to detect both in manure and later on in vegetables. For that reason the E. coli outbreak in the summer was anything but a surprise."

TANJA KOSTIC /// Scientist at the AIT Health & Environment Department

"We are working on two highly complementary diagnostic tools for detecting bacterial pathogens: protein-based methods and techniques at the DNA level."



RISK POSED BY POOR (KITCHEN) HYGIENE

What implications do these research findings have for practical life? "Guidelines for minimizing risks were prepared and distributed to farmers," Kostic relates. The main focus was on the proper treatment, storage and selection of organic fertilizers. Once pathogens reach vegetables, there is no alternative to consistent hygiene practices in the kitchen: thoroughly washing both fresh food as well as one's hands continues to be the best method of fighting food-borne infections. "Most cases of disease in this area are to be attributed, in Europe as well as anywhere else, to poor kitchen hygiene," Tanja Kostic points out. "Actually, what we really could do with are information campaigns about how to wash your hands properly to raise people's awareness of the problem."

Pathogens, the most common cause of infections, must be identified quickly and accurately to enable timely counteraction. In response to this need, AIT is developing molecular techniques for detecting salmonella, E. coli and similar strains, both very quickly and with high precision.

ALPINE LIVESTOCK DISTRIBUTES PATHOGENS

One of the research topics in this field that has been largely neglected to date involves the spread to ground and surface water of pathogens originating from wild animals or alpine livestock. Within the framework of a cooperative project funded by the Vienna Waterworks, scientists from AIT and from the Research Institute of Wildlife Ecology (FIWI) at the University of Veterinary Medicine analyzed the droppings of wild and domestic animals living on Schneeberg, a mountain near Vienna. The object was

to identify four frequently occurring pathogens. Among the bacteria detected were salmonella, *Campylobacter* spp. and pathogenic *E. coli* strains, which could seep with rain into groundwater or springs. How might this be prevented? "That would be difficult with groundwater, but spring source areas could be closed off," Kostic says. "Still, in Austria there is hardly any risk of drinking water becoming contaminated because here, unlike many other areas of the world, the water is purified and disinfected," the researcher notes, allaying any fears.

WHAT ARE NANO-PARTICLES DOING IN THE SLIM SHAKE?

In addition to DNA-based diagnostic techniques, AIT is developing protein-based methods for the fast detection of pathogens in food. So far primarily used in medical diagnostics, it is envisaged that in future such methods will also find increasing use in food analysis. The rapid test involves coating microarrays or microtiter plates with antibodies that bind the targeted pathogens. The pathogens can then be detected using a specialized optical system. "We are currently particularly interested in a technique for identifying food additives," Claudia Preininger, scientist at the Health & Environment Department, reports. "The added particles, such as silver, iron or silicates, can trigger intolerance responses in some people, and we therefore wish to develop methods for detecting the effects of such substances."

The group of food additives has for some time also included nano-particles, used for example as anticaking agents in soup powders or as a vitamin

CLAUDIA PREININGER /// Senior Scientist at the AIT Health & Environment Department

"Nano-particles are increasingly used in food additives. That is why we want to develop specialized detection systems."



carrier matrix in slim shake products. "Yet we still don't know what the effects of such particles are," the researcher says. "That is why we want to develop specialized detection systems." It is, in fact, mainly because of the increasing use of nano-particles in food that a number of governments in Europe are planning to issue directives specifying more stringent monitoring of food additives.

COST-EFFECTIVE QUALITY CHECKS FOR MILK

Quality control in beverage production is yet another area in which AIT researchers are planning to use protein-based rapid testing. Specifically, work is currently underway on a system for detecting antibiotics and coliform bacteria in milk. The new system is slated to be available for use within two years. In contrast to previous measurement techniques, the system will be capable of detecting multiple and highly diverse analytes, with the potential of greatly enhancing the efficiency of dairy industry production. ///

Further details: Health & Environment
Department, Susanne Kiefer;
Phone: +43 505 50 -4406;
e-mail: susanne.kiefer@ait.ac.at;
Web: www.ait.ac.at/departments/health_environment/





ANDREW SOLDAN,
VLA SCIENTIFIC, ANIMAL
HEALTH AND VETERINARY
LABORATORIES AGENCY,
ABOUT THE CHALLENGES
TO FOOD SAFETY ...

*Mr. Soldan, what challenges
do you anticipate for food safety
inspection in the coming years?*

General issues such as microbial

evolution, antimicrobial resistance, new production/preparation methods, identification of source and tracing foodstuffs will continue to be important. Risk based approaches are increasingly being adopted for food safety inspections in response to the need for ever greater efficiency in terms of effectiveness, inspectors time and industry compliance. In the UK Olympic preparedness in relation to food safety is a key issue for 2012, not just London as there are a wide range of venues.

*AIT is developing molecular biological methods for fast and accurate
pathogen detection. What relevance do these technologies have in food
safety applications?*

The speed of molecular tests can be advantageous in the rapidly moving food supply chain. Having the result today rather than having to wait for culture results can mean the detection of contamination before it enters the consumer part of the food chain and help to improve efficiency in distribution systems. The ability to detect dead organisms with molecular tests means that root cause analysis of earlier contamination will be easier. The speed, sensitivity and, in some cases, reduced cost of molecular tests improves on existing methodologies. However some developments will not simply be improvements on older technologies but step changes in the detection ability. Multiplex tests able to detect multiple pathogens or genes of interest (e.g. virulence genes or antimicrobial resistance genes) will lead to better surveillance systems - many of which will be able to be automated within processing plants. Sequencing techniques are dramatically improving the ability to trace back to the source of contamination. In the near future hand held molecular detection systems will be used at the point of decision and routine submission to a sophisticated laboratory will not be necessary except for further analysis.

*In your view, when will these new methods become firmly established on
the market?*

Standard real time PCR tests are already well established and run routinely in many laboratories. Currently there is very significant investment being put into in-clinic molecular detection systems for human medicine. These small desk top machines require little user knowledge to generate accurate results within 30 to 60 minutes. This investment will lead to several competing systems on the market that will then be looking for other avenues to generate revenue. The food safety sector will be high on the list of potential markets and companies will be looking for tests that are suitable for running on their machines. Within 5 years I believe that there will be very significant developments in this market and food safety laboratories, often located very close to the point of sampling, will be running these tests routinely. Routine salmonella serotyping is likely also to move to molecular methods within the next five years. ///



RESEARCH SERVICES

At AIT, DNA-based diagnostic tools are being developed that surpass by far the limitations inherent in conventional techniques for pathogen detection and immunological typing. The Department can draw on a platform for DNA-based serotyping of salmonella, and offers a molecular microarray-based method for parallel detection of a range of bacterial food and water pathogens.

Another focus is on the development of customized DNA-based detection methods (including qPCR analysis) and protein-based rapid tests. AIT experts provide expertise and implementation services for every step in the development process - ranging from probe and assay design and immobilization on membranes, slides and microtiter plates through to optical detection (using fluorescence or absorption) and data analysis.

- Molecular biological technologies (PCR, microarrays) for the detection and quantification of micro-organisms
- Development of immunological tests for bacteria, food additives and chemical residues
- Development of customized DNA and protein-based detection techniques for various applications ///

THE QUEST FOR THE BEST GENES

/// The AIT Gene Resource Center offers both the expertise as well as the genetic material required to increase resistance and improve productivity in trees, plants and breeding animals by using the “best” genetic material. ///



● IN A NUTSHELL

More than half a million DNA samples originating from plants and animals are stored under high-tech conditions at AIT's Gene Resource Center. The repository affords scientists access to decoded genetic material from all over Europe along with the corresponding scientific documentation and makes it available for scientists' individual use. Forestry also makes use of this unique system of resources in joint research with AIT experts, for instance to identify particularly resistant genotypes of various tree species. Together with partner organizations, AIT has also begun performing estimates of genomic breeding values (GBV) for young bulls, a procedure enabling predictions to be made about a calf's future performance.

THE INTERNATIONAL YEAR OF FORESTS, WHICH JUST CAME TO A CLOSE, , has once again heightened people's awareness of the vital role played by forests as a natural resource in Austria. We benefit in many ways from our forests. In terms of the multiple uses of forests, Austria is in fact regarded as a model for other countries. Commercial use of our forests renders substantial profits and wood prices are high while ecological conditions remain satisfactory. A prerequisite for continually redefining and

maintaining such a balance among the interests of the various forest users is an ongoing dialog among stakeholders, specifically from the lumber and tourist industries and from environmental initiatives. Yet, such a dialog, if it is to produce useful results, presupposes an understanding of the entire forest ecosystem. As a key supplier and exchange point for such complex knowledge, the AIT Gene Resource Center relocated in the past year from Seibersdorf to Tulln, where the facility has become part of Lower Austria's new Technopol Tulln biotechnology cluster.

GLOBALLY UNIQUE GENETIC DATABASE

This gene repository for green biotechnology, up to now the only one of its kind worldwide, currently houses 645,000 genes and complete genomes of tree, plant and animal species. Sorting, storing and retrieving the valuable DNA samples is a highly demanding task, taken care of here with the aid of a fully automated robot system with parallel refrigeration systems maintaining a constant temperature of -20 C. "Two basic kinds of genetic material are stored at our facility," explains Silvia Fluch, molecular biologist and Head of the Gene Resource Center. "We have genetic material that has already been characterized, such as genes, and we also store genomes that have not yet been completely 'decoded' and that can be used as for further studies." All sample data is documented in a centralized database and can be accessed via the PICME web portal (www.picme.at).

SHORTCUT TO DISPERSED MOLECULAR BIOLOGY KNOWLEDGE

Of course, many research teams who have material stored at the center in accordance with strict quality control standards also have their own databases. Anyone interested in accessing this more detailed information is directed to the specific location via the AIT server (www.evoltree.eu). "We are an information hub featuring a strong bioinformatics component," Fluch notes. "A number of servers are continually available in order to be able to respond to even highly specialized queries." For example, a user looking for a previously characterized poplar gene that reacts to dry stress will be automatically referred to the appropriate sub-databases. "By linking information in this way, users are able to access a wide variety of databases without having to

**SILVIA FLUCH ///
Senior Scientist at the
AIT Health & Environment
Department**

"We have genetic material that has already been characterized, but we also store genomes that have not yet been completely 'decoded'."



know where the required information is stored," the molecular biologist explains. To keep the origin of data transparent, and to create an atmosphere of trust for sample owners, owners are required to consent to the sharing of their material and of the related documentation.

BENEFITS FOR FORESTRY

Besides basic researchers and ecosystem scientists, the forestry industry is one of the main partners and clients of the AIT Gene Resource Center. This sector is currently most interested in the spruce tree, which accounts for more than 50% of all forested areas in Austria and consequently represents a vital factor in the economy as well as playing a prominent role in research. One aim is to

Researchers are searching for particularly resistant spruce genotypes in order to find out how climate change is affecting Austria's most common tree species.



find out how climate is affecting this tree species and how to better prepare it for adverse conditions such as frequent and extended dry periods. To this end, a research cooperation has been formed with the Austrian Federal Forest Office (BfW) and industrial partners under the auspices of the Forest-Wood-Paper Cooperation Platform (FHP). The researchers involved have embarked on a quest to identify particularly resistant spruce genotypes.

RESISTANT SPRUCE

Due to the transfer of seed from the crown lands of the Habsburg Monarchy, today's Austrian spruce is a genetically diverse mixture, which raises the question as to possible implications for the resistance of this tree variety. Are the "unadulterated" local genotypes, which occur more frequently in western Austria, more resistant? Or, rather, the more genetically mixed spruce forests in the east of the country? "Spruce varieties from certain regions have already been identified as being highly resistant to drought stress," Silvia Fluch reports. It would be advisable to establish new seed plantations in such areas. "We have collected and partially analyzed DNA samples from more than 3,000 spruce trees from all over Austria. On completion of the project, our industry partners will directly apply the findings."

GENOMIC ESTIMATION OF BREEDING VALUE

The center at Tulln not only stores genes and genomes of tree and plant varieties but also includes genetic data on breeding bulls.

obtained is the basis for deciding on the animal's further use. If the genes predict offspring with poor performance, the bull will end up in the slaughterhouse – instead of as a high-earning sperm donor. Silvia Fluch explains, "Previously, breeders were able to predict the future performance of young bulls only on the basis of physical appearance and pedigree; this often resulted in inaccurate assessments, wasting both time and money."

PREDICTING THE PERFORMANCE OF YOUNG BULLS

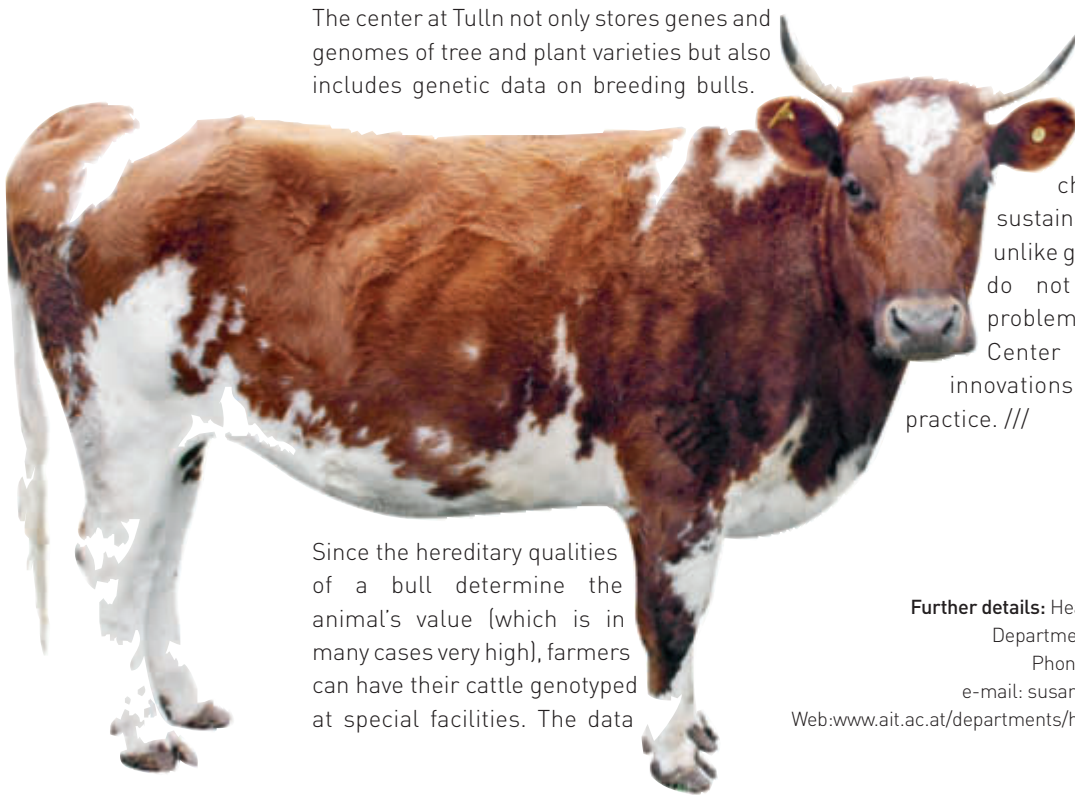
Estimates of genomic breeding value, in contrast, offer a very high level of certainty. The technique specifically entails correlating genetic analyses with the animals' pedigree data in order to identify the breeding bulls with the best potential just a few weeks after birth.

The technique can draw on superior quality data: cattle pedigrees are based on well-kept records, and about 30 parameters, including meat or milk yield, are collected for all offspring of any fertilization. Combining this data with genetic information enables highly reliable performance predictions. This type of breeding value estimate is currently carried out for about 10% of all male calves. That is a considerable number, and the service is attracting great interest among breeding associations and cattle farmers.

The need for expertise in the area of genetic breeding in order to obtain resistant and productive trees, plants and animals will continue to grow in future. Climate change, dwindling resources and a growing world population are challenges urgently requiring sustainable solutions of the kind which, unlike genetic engineering for example, do not entail general acceptance problems. The AIT Gene Resource Center is developing the necessary innovations and establishing their use in practice. ///

Since the hereditary qualities of a bull determine the animal's value (which is in many cases very high), farmers can have their cattle genotyped at special facilities. The data

Further details: Health & Environment
Department, Susanne Kiefer;
Phone: +43 505 50 -4406;
e-mail: susanne.kiefer@ait.ac.at,
Web: www.ait.ac.at/departments/health_environment



RESEARCH SERVICES

Collection, storage and supply of genetic material

The Gene Resource Center collects, stores and manages genes as well as complete genomes of those tree, plant and animal species that play a particularly important economic role in agriculture and forestry.

- Extraction of genomic DNA from various kinds of tissue (plant: fresh/dry leaf, root, bark; animal: blood, sperm, tissue)
- Fully automated storage of custom samples (BACs, gDNA, tissue) in accordance with strict quality control standards (ISO 9001:2008)
- Access to sample data via the www.picme.at web portal
- Supply of DNA microarrays for a large number of plant and tree species
- Online service for BLAST searches in the EST (Expressed Sequence Tags) sequence database, to identify genes of interest and select them for downstream applications (custom microarray spotting, clone ordering)
- Database interlinking and bioinformatics analysis

EVOLTREE EU network of excellence

Scientists from across Europe have established this research network as a basis for studying the impact of climate change on forest ecosystems. The Gene Resource Center is a key partner in the effort, providing comprehensive database expertise as well as genetic reference material.

- Supply of reference material for controlled crosses of poplar, pine and oak for ecological research
- Supply of genomic DNA of entire forest populations
- Database node: interactive search service for distributed data via the eLab web portal

Forest genetics and forest plant selection

- Scientific support in identifying spruce genotypes with high stress resistance to frequent and extended dry periods
- Identification of oak genes responsible for drought tolerance

Estimation of genomic breeding value

In order to avoid costly waiting periods, the Gene Resource Center performs genetic typing of young bulls.

- DNA extraction for high-throughput genotyping, for the purpose of identifying breeding animals with the highest performance potential as early as several weeks after birth, by correlating the results of genetic analysis with pedigree data
- Management of reference samples for later detailed studies and verification of new markers ///



KURT RAMSKOGLER,
MANAGING DIRECTOR OF
LIECO GMBH & CO KG, ON
THE BENEFITS THE GENE
RESOURCE CENTER HAS
TO OFFER FOR PLANT
RESEARCH

*The United Nations declared 2011
the International Year of Forests.
How important is the sustainable*

management of this resource for Austria's forestry industry?

For generations, the Austrian forestry industry has been working in line with the principles of sustainability, and we supply a highly competitive lumber industry as well as a growing biomass energy sector. Currently, there are 1.1 billion cubic meters of trees growing in Austria, with forests accounting for 47.2%. Forests are a source of income for those who manage them commercially and create added value in rural areas. It is now necessary to secure the supply of this renewable resource in order to meet growing demand as well as to fulfill society's expectations of forests and secure the income of those managing them in the long term. In doing so, it will be increasingly necessary to analyze the genetics of forest tree species while bearing in mind current and future requirements.

Spruce trees, which make up more than 50% of all trees in Austria, represent a key economic factor. LIECO is Austria's leading producer of containerized seedlings. How significant is research for you?

Through research and development, we at LIECO, a company belonging to the Prince of Liechtenstein Foundation, have succeeded in developing a unique containerized seedling system for forestry and have become the no. 1 supplier in the market. Corresponding market demand only exists for a successful afforestation system with a provenance guarantee that delivers optimum customer benefit. Through continued work focused on the further development of both the product and the relevant production conditions (i.e. provenance, genetics, technology etc.), we are able to continuously optimize our specialized expertise. This makes LIECO a strong partner in a number of related research projects including, for example, the spruce genetics project being carried out in cooperation with AIT and BfW.

What in your opinion are the most important benefits offered by the AIT Gene Resource Center?

The AIT Gene Resource Center and the cooperation with the Austrian Federal Forest Research Center are enormously important for the forestry industry in Austria and across Europe. At international level, it has become increasingly important to improve our knowledge and the availability of knowledge concerning the genetics of the major species used in industrial forestry and of the gene resources available for use in practical forestry. Building on this knowledge, we can develop improved seed and plant material to serve as the basis for the higher yields required in the future and for stable and healthy forests, as is already being implemented in a number of countries. From our perspective as the leader in the field of successful afforestation, the results of research carried out by AIT and BfW will also be of long-term significance for ensuring the competitiveness of the Austrian forestry and lumber sector, in other words the entire value chain, and of rural areas. ///

PROTECTING CRITICAL INFRASTRUCTURES

/// Airports and subway stations are studded with numerous cameras in order to provide enhanced security for passengers in crowded locations.

Unfortunately, transportation hubs and other vital infrastructures attract pickpockets and even terrorists. This means many facilities such as power stations, oilfields, government ministries, banks and companies need special protection. ///



TO INCREASE SECURITY at airports, subway stations and other infrastructures, AIT is developing intelligent camera systems, which, thanks to real-time image analysis, can alert security personnel rapidly when suspicious incidents occur. Special algorithms and software combined with computing power integrated in the cameras enable objects and persons to be detected and marked during recording. For security personnel this digital processing of numerous video streams in real time is a great help in rapidly identifying suspicious persons or other critical incidents.

Video surveillance is an important factor in security concepts for critical infrastructures. At the same time - at airports for example - passengers' personal privacy must come into the equation. "In projects like this, social and data protection aspects are extremely important for public acceptance," emphasizes Bernhard Strobl, video and security technology expert at the AIT Safety & Security Department. Surveys of users of public transportation systems suggest that the overwhelming majority of them are in favor of technical aids like video surveillance for enhanced security. What is important is that the public has clear information on how the video surveillance is being used.

When video surveillance is done with today's high-resolution HD cameras, huge quantities of unstructured data are produced. With the latest generations of high-speed processors, improved compression processes and intelligent image analysis algorithms allowing significant image elements to be

● IN A NUTSHELL

Video surveillance systems provide greater security for the public in crowded places like airports and subway stations. Protection against criminals or terrorists is an important issue today, which must be balanced with the need for personal privacy. To enable critical situations to be identified more quickly, AIT is developing intelligent camera systems which can actually alert security personnel while recording using real-time image analysis. Special algorithms allow objects and persons to be instantly identified in the data flow - and in video archives. AIT's experts are already now working on video systems with the next-but-one generation of processors and on intelligent camera networks and future standards for the transmission of video data.

BERNHARD STROBL ///
Thematic Coordinator at the
Safety & Security Department

"Video surveillance is an important factor in security concepts for critical infrastructures. At the same time passengers' personal privacy must be taken care of."



highlighted, the whole process is greatly speeded up and data volumes to be transmitted are reduced at the same time. AIT has been able to develop extensive know-how in these areas over years of research and development.

The software solutions it has developed allow significant object content to be extracted and persons and events to be detected. And all this in real time. But care must always be taken that surveillance systems are absolutely fail-safe.

NEXT-GENERATION VIDEO SURVEILLANCE

For future video surveillance systems AIT is developing intelligent cameras and encoding systems, new algorithms with real-time capacity for searching objects and persons, and algorithms for automatic configuration and calibration of multi-camera systems. It works closely in this research with infrastructure operators, administrative authorities such as the Austrian Ministry of the Interior and security companies.

When AIT's activities in the field of video technology started, it was concerned with an issue that is still important: data compression. Back in 2003 a group of researchers was working on how to pack the MPEG-4 Codec for video compression into an embedded system, in other words directly into the video encoder/decoder electronics. In 2004 a new industry partner was found in Funkwerk plettac electronic GmbH. When Funkwerk plettac came across AIT's new video en-decoder at a trade fair, the German security specialist found it the ideal addition to its video surveillance solutions. AIT specialists are now working on a multi-core processor system that has the advantage of being able to implement more complex algorithms on this system.

STRONG DEVELOPMENT PARTNERS ON BOARD

An important collaboration partner for AIT's experts in the field of video and security technology on the

hardware side is Texas Instruments (TI). AIT's cooperation with this processor manufacturer developed so satisfactorily over the past eight years that at the end of 2010 TI nominated it an "early adopter". "That means we get information on advances in the development of new processor generations at a very early stage", explains Michael Cyniburk, video and security technology expert at the AIT Safety & Security Department. "Given this advance intelligence, we can adapt our architectures and platforms to the new hardware options more quickly." This is utilized, for instance, to manufacture very early prototypes for product development and so obtain a clear development advantage.

The current development work on a new video surveillance system is using the latest TI multi-core processors, which provide the basis for analyzing the video data stream in the camera itself. This means, for example, that even as the shot is taken moving objects can be captured with higher resolution, comparisons can be made with existing data sets or unusual incidents can be marked. This then helps in any subsequent detailed analysis or to raise the alarm in real time.

DETECTION RATE INCREASED

"New functions such as selective image information compression allowing us, for example, to compress faces less severely and show them in extra high resolution greatly enhance the detection rate and help handle the data explosion (driven by the megapixel trend and the number of cameras)," says Bernhard Strobl emphatically.

To find and track specific persons, say, in huge crowds of people at an airport you can calculate trajectories for moving objects.

MICHAEL CYNIBURK ///
Senior Engineer at the AIT
Safety & Security Department

"Thanks to our early-adopter status at TI we get information on advances in the development of new processor generations at a very early stage, which gives us a temporal advantage."



JOHANNES KNORR ///
Engineer at the AIT Safety &
Security Department

"Cameras are increasingly developing into fully-fledged PCs. This is based on a Q7 standard board. The whole electronic system is contained in only 7x7 centimeters."



Given that there are often thousands of cameras operating at airports, the co-ordination between all the components in camera networks is an important factor. Several camera perspectives taken together give, of course, a more exact picture of a person. To get the best focus needs a "proficient cutter" in the background. Intelligent camera networks can fulfill these functions, greatly improve video surveillance and thus relieve the load posed on security personnel. Other important questions are maintenance and the exact position of cameras, because that is where construction works, for example, can cause camera failure or displacement. All this has to be taken into consideration when setting up a well-functioning video surveillance system.

THE ULTIMATE IN SYSTEM SKILLS

AIT has clocked up years of experience with the hardware components of camera systems and in particular their firmware. "One of our special strengths is that we also know the firmware of the cameras in every detail," says Strobl. For instance, AIT developed a video transmission solution via satellite for a project in Russia. For this particular application it had to adapt a network protocol, which demonstrates AIT's flexibility in developing solutions to meet clients' wishes. This specialist knowledge is complemented by the expertise of AIT's image processing experts. Meantime, thanks to its broad cross-disciplinary structure, it can cover the entire field from image capture and system networking through to evaluation using analysis software in the surveillance centers. "But we are also working on the new standards for the transmission of video and metadata like ONVIF and PSIA," says Strobl.

INTELLIGENT CAMERA NETWORKS

The main headline project for the AIT team is the development of intelligent camera networks where it

is already working on the next-but-one hardware generation and future protocols and standards. In order to get most of the analytical work done automatically in the camera itself, the cameras are increasingly developing into fully-fledged PCs, which can also store large quantities of video material on their storage cards.

This is based on a Q7 standard board. "So everything associated with the multi-core processor fits into seven by seven centimeters," explains AIT hardware specialist Johannes Knorr. More recently AIT has been increasingly using open source software for the development of systems and applications - albeit under certain restrictions, always bearing in mind the special requirements of security applications.

MORE EFFICIENT SEARCHING OF ARCHIVES

Under the aegis of the Austrian research development program KIRAS - an initiative of the Federal Ministry for Transport, Innovation and Technology (BMVIT) - AIT experts are working on a number of projects including SECRET (Search for Critical Events in Video Archives) and its successor project SECRET-interactive on special new high-speed methods for searching video archives. This is done by converting search criteria into a mathematical description of the optical properties of an event. With an avatar-like description language and sample images the archive images can then be analyzed. This means the security staff is provided with specific suggestions much more quickly than with conventional forensic methods.

In the context of today's fast-moving globally networked world the experts of AIT's Safety & Security Department are making a significant contribution to the hardware and software architectures of camera networks in the critical infrastructures of tomorrow - and thus the future security of our society. ///

Further details: Safety & Security
 Department, Michael Mürling,
 Phone: +43 505 50-4126,
 e-mail: michael.muerling@ait.ac.at,
 Web: www.ait.ac.at/safety_security



RESEARCH SERVICES

All4surveillance

This area of research focuses on the processing of visual information for enhanced security in order to assist the main infrastructure operators and their industrial partners with methods, tools and systems. Visual data is automatically prepared from video streams, for example, in such a way that relevant features of objects can be extracted and persons and incidents can be identified. The research activities are pursued in close collaboration with major Austrian infrastructure operators, public sector administrative authorities and companies operating in the video surveillance industry. Research contracts and innovations are offered in the following fields of expertise:

- Object search for image and video archives
- Detection and tracking of persons in single and multi-camera systems
- Embedded systems for image processing and video encoding

Object search for image and video archives

Searching of image and video archives for relevant information can be enormously simplified with new and innovative systems. A remarkably wide variety of search tasks can conveniently be handled in hundredfold real time. The latest findings from scientific research are applied directly to ready-for-use technologies.

Personendetektion

To allow stable detection and tracking in realistic video surveillance applications, information on the camera geometry and details of the scene are combined with the visual features of a person and processed in novel ways. AIT's methods greatly simplify the often laborious configuration of image processing systems, providing detection and tracking of persons in larger groups and over larger surveillance areas.

Embedded systems for image processing and video encoding

AIT has outstanding know-how developed over years in the field of video encoding and decoding (MPEG 4 and H.264). The hardware is developed from scratch and can extend to prototyping and production. In addition, its expertise in the development of image processing algorithms and their implementation as firmware for processors makes the Safety & Security Department a solid partner for customers seeking optimum solutions to their specific problems. For example, embedded algorithms have been analyzed and implemented for the detection of static or moving objects. ///



UDO KÜRZDÖRFER,
HEAD OF PRODUCT
MANAGEMENT FOR
FUNKWERK PLETTAC
ELECTRONIC GMBH
(GERMANY), ON THE
LATEST DEVELOPMENTS
IN VIDEO SURVEILLANCE.

*Mr. Kürzdörfer, your employer
Funkwerk plettac specializes in*

*industry and system solutions for video security and collaborates with
AIT's Video and Security Technology Business Unit in the development
of video surveillance systems. How did Funkwerk plettac find out about
AIT?*

The contact came about through the head of our camera and codec development department Manfred Richter. Mr. Richter was looking at the time for a DSP technology platform (editor's note: digital signal processor). But he had to find a partner to operate the DSPs that could support us in developing the firmware. It was when we asked the chip manufacturer about possible partners that we made contact with AIT.

*In which areas does the development know-how of AIT's experts bring
the greatest benefits for your company?*

The main benefits for us are in the hardware and firmware development for DSP modules for processing video and audio streams in real time, and network streaming and display on PC-based systems. In addition, we value enormously its expertise in video analysis and we are working jointly with AIT on a product which is already performing signals analysis in the DSP.

*What trends in video surveillance technology do you foresee in the next
few years?*

The main trends we foresee in the field of video analysis are: designing interfaces to meet the requirements of specific standards, intelligence at the edge, metadata generation to enhance performance in the downstream evaluation of video signals and the increasing use of high resolution HD cameras including for outdoor applications. All these issues are addressed with the products we develop jointly with AIT.

*What is your opinion of AIT's innovative achievements as an
organization for applied research?*

We value AIT very highly as a partner in all areas having a bearing on the technologies of tomorrow. It is especially important for us that its know-how is based not just on theoretical basic research but that AIT can give us specific support with the practical implementation, in other words in developing finished products that are ready to go into production. ///

LIVE PREMIERE FOR SMART GRIDS

/// AIT has many years of expertise in the development of intelligent control strategies for smart grids. At the end of 2011, the first of the next generation control systems took over voltage management in two network sections in Vorarlberg and Salzburg. ///

WITH A SIGNIFICANT INCREASE IN the amount of electricity generated from renewable energy sources, the EU aims to attain a massive reduction in CO₂ emissions while at the same time strongly reducing Europe's dependency on imported energy. The increased use of energy from the sun, wind and biomass, however, also leads to a growing decentralization of electricity generation and poses new challenges for grid operators. Experts at the AIT Energy Department working on the "DG DemoNet" project have therefore developed control strategies for tailored voltage management in order to ensure power quality even with a high share of fluctuating distributed power generation.

FROM ONE-WAY SYSTEM TO ACTIVE DISTRIBUTION NETWORK

Currently, electric energy is generated in central large power plants and delivered on a "one-way street" to the customer. In future, more and more

WOLFGANG HRIBERNIK ///
Head of Business Unit
„Electric Energy Systems“

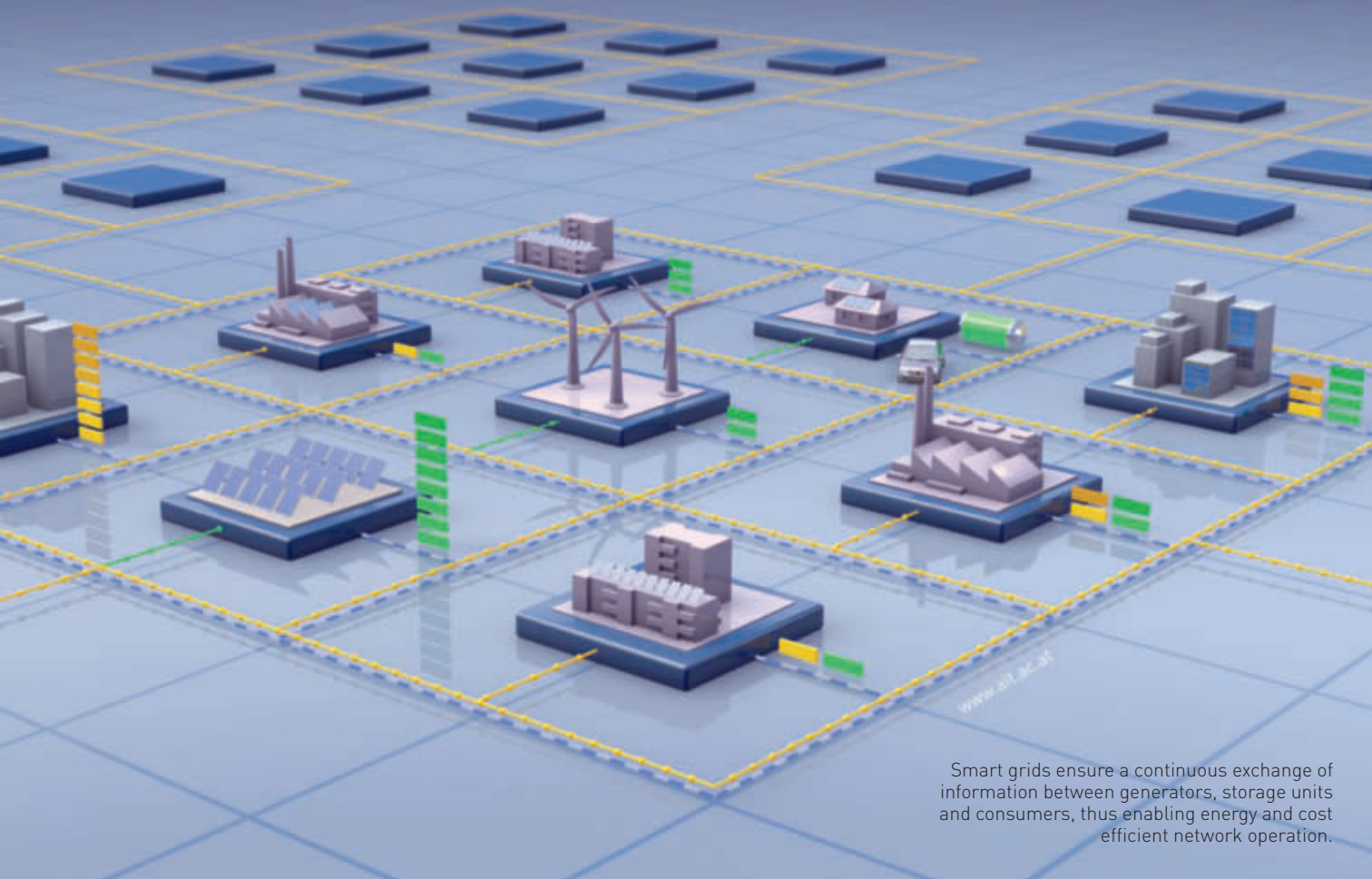
"Over the past few years, researchers at the AIT Energy Department have earned an international reputation in the field of smart grids".



● IN A NUTSHELL

In view of climate change and increasing scarcity of fossil fuels, much greater use needs to be made of renewable energy sources in the future. "Smart grids" have a key role to play in providing a solution to the challenges facing the energy infrastructure. Through the continual exchange of information between generators, storage facilities and consumers, these intelligent electricity networks enable energy efficient and cost efficient network operation. In the "DG DemoNet" project the Energy Department has developed control strategies, which enable intelligent voltage management in medium voltage networks and considerably increase their capacity to integrate distributed power sources. The innovative control concepts are being field tested for the first time in the Lungau region in Salzburg and Grosses Walsertal in Vorarlberg.

solar, wind and biomass power will be fed into the distribution networks and can lead to undesirable voltage fluctuations. Many network operators therefore find themselves facing the challenge that without expensive line reinforcement they will no longer be able to integrate any further decentralized power plants into their networks in the foreseeable future. "Due to the international dimension of power supply this problem can only be solved on a cross-border basis", explains Wolfgang Hribernik, Head of Business Unit "Electric Energy Systems" at AIT. Over the past few years, numerous international and European initiatives have been launched to make energy systems fit for the future. "Smart grids play a key role here – these are electricity distribution



Smart grids ensure a continuous exchange of information between generators, storage units and consumers, thus enabling energy and cost efficient network operation.

networks, which facilitate intelligent energy management through bidirectional communication between power generators, consumers and storage facilities,” says Hribernik.

INTERNATIONALLY ACCLAIMED EXPERTISE

Over the past few years, AIT has gained international expertise and reputation in the field of smart grids, which it contributes to the International Smart Grid Action Network (ISGAN) and the European Energy Research Alliance (EERA). On behalf of the Federal Ministry for Transport, Innovation and Technology, AIT is also responsible for coordination of the “Member States Initiative” of the European Electricity Grid Initiative (EEGI). This initiative is aimed at assessing the Smart Grid activities in the individual Member States in order to explore future action and funding requirements at national and European level and to provide the basis for joint pilot projects. The “DG DemoNet” project is a highly promising candidate in this context: in cooperation with the network operators Vorarlberger Kraftwerke Netz AG, Salzburg Netz GmbH, Energie AG Oberösterreich Netz GmbH and in collaboration with Vienna University of Technology, experts from the AIT Energy Department have developed innovative

control concepts for distribution networks in order to facilitate the integration of distributed power generation using intelligent voltage management – two of these concepts are about to be implemented in Austria.

CONTROL SYSTEMS WITH EYES AND BRAIN

“The limited possibilities for measurement and control have forced grid operators to ‘oversize’ their medium-voltage networks so they are equipped to cope with all possible operating conditions”, reveals Helfried Brunner, Deputy Head of Business Unit “Electric Energy Systems” at AIT. “Intelligent voltage management needs ‘eyes’ in the network as well as direct access to both the transformer in the substation and the power plant.” Therefore in recent

HELFRIED BRUNNER /// Deputy Head of Business Unit „Electric Energy Systems“

“Intelligent voltage management needs ‘eyes’ in the network as well as direct access to the transformer in the substation and the power plant.”



BENOÎT BLETTERIE ///
Senior Engineer, AIT
Energy Department

"Using the algorithms developed by AIT, the 'Central Voltage Control Unit' is able to control the voltage level and range, i.e. the spreading of the maximum and minimum voltage, independently of each other."



months the necessary measurement devices and control systems have been installed in two network sections in the Lungau region of Salzburg and in Grosses Walsertal in Vorarlberg. The CVCU (Central Voltage Control Unit) acts as the central "brain" in the substation, which processes the values measured at critical points and manages the controllers in the power plants." Using the algorithms developed by AIT, the CVCU is able to control the voltage level and range, i.e. the spreading of the maximum and minimum voltage, independently of each other", explains AIT Senior Engineer Benoît Bletterie. "Specific control of the transformer enables voltage levels in the grid to be increased or decreased as required. If the spreading between the maximum and minimum voltage is too large, the controller must also manage the reactive power of the generators". This means considerably better use of reserves and ensures that the voltage remains within the defined limits at all times.

SIMULATED REALITY

The measurement devices, generator controllers and CVCU constantly exchange data in order to be able to react in real time to the dynamic processes in the grid. As the control concept should not be limited to a specific technology, the validation project is set to explore a range of different communication options. Data are exchanged either directly via the power line (PLC, Power Line Carrier) or via specially installed radio links and the mobile phone network, depending on local conditions. These communication paths as well as the specially developed algorithms were tested in real time simulations carried out in the laboratory. This involves the control system being connected up and operated in a simulation environment where it is confronted with various grid conditions. "In this controller-in-the-loop simulation we can test signal delays in the communication system as well as the way the controller behaves in the case of maintenance or emergency shutdowns due to short circuits", explains AIT Scientist Matthias Stifter.

GOING LIVE

The all important step from laboratory simulation to real network operation has been taken by the end of 2011. After test runs, the control system has gone live on the grid and fully assumed all management tasks. In the subsequent one year test phase it will have to deal with all kinds of operating conditions and seasonal fluctuations. Brunner explains: "It will of course be interesting around Christmas – a time when power generation is low while demand is very high, or when the snow melts and the hydropower plants are running at full capacity while at the same time shifting of sectioning points has to be made due to maintenance work." From the experience gained in the initial test runs, Brunner and his team are confident that the intelligent control strategy will stand the test of going live and will make an important contribution to increasing the share of distributed generation in power networks. "In the simulation trials, our concept was able to handle a

MATTHIAS STIFTER ///
Scientist, AIT Energy
Department

"In the controller-in-the-loop simulation we can test signal delays in the communication system as well as the way the controller behaves in the case of emergency shutdowns due to short circuits."



50 per cent increase in biomass, hydroelectric and wind power in Vorarlberg as well as in Salzburg", says Brunner proudly. Two hydropower plants in Vorarlberg have been approved for connection to the grid only on the condition that they are equipped with an interface to the new AIT control system. With the existing operating approaches, grid connection of the two power stations would only have been possible with the help of expensive line reinforcement. In view of the considerable national and international interest in this European pioneering project, smart control is expected to play a key role in the energy system of the future. ///

Further details: : Energy Department,
 Julia Jene, Phone: +43 505 50-6688,
 e-mail: julia.jene@ait.ac.at,
 Web: www.ait.ac.at/energy



RESEARCH SERVICES

Grid system studies

With the help of numerical grid simulations the Energy Department is studying how new players in the grid, i.e. renewable energy sources, electric vehicles or smart buildings, will impact on the entire system. This way, grid operators obtain important information for planning and operating their infrastructure and can ensure the quality of the voltage even if there is a high proportion of decentralized energy production.

- Integration of decentralized energy production and storage
- Power-quality analyses
- Voltage control concepts

Connecting inverters to the grid

Grid-coupled photovoltaic systems feed electricity directly into the supply grid and for this reason must play their part in safeguarding the quality of the voltage. In this process, the inverter plays a key role as the interface between the photovoltaic system and the electricity grid. The Department's inverter laboratory is equipped with the most modern grid and photovoltaic simulators and allows realistic studies of different operating conditions. The performance, the grid characteristics and the safety functions of these core components for smart grids can be assessed independently and on a scientifically sound basis in accredited test, measurements and analyses.

- Performance of inverters and MPP trackers
- Power quality & grid interaction
- Grid monitoring and safety equipment

Development support of grid components

The rising cost pressure and the dynamic control concepts of the future electricity grids place high demands on the reliability and safety of the energy infrastructure, primarily switchgear, fuses, transformers and isolation systems. The Department has established itself as a central development partner for power suppliers and industrial enterprises in the study and optimization of these key components. Simulation tools and the most state-of-the-art equipped high-current and high-voltage laboratory are used to support the manufacturers of technical components used in the energy field throughout the entire development process.

- Switching devices
- Isolation systems / high voltage
- Coupled numerical simulation of switchgear

Research infrastructure – SimTech

A large laboratory for simulation technology is currently being set up at the Energy Department. The heart of this SimTech laboratory is the "Power Hardware in the Loop" simulations where grid components are integrated into a simulated grid as hardware. The link between the virtual and the real world allows for the development of innovative control concepts and also for the optimization of prototypes.

- Grid simulations, e.g. power flow studies, dynamic grid analyses
- Component tests, e.g. accredited tests of components, durability tests, checking of the grid interface
- System analyses e.g. interplay between grid structures and decentralized generation plants. ///



WERNER FRIESENECKER,
HEAD OF DISTRIBUTION
NETWORKS AT VKW NETZ
AG ON INNOVATIVE
VOLTAGE CONTROL
CONCEPTS FOR MEDIUM
VOLTAGE DISTRIBUTION
NETWORKS.

Mr. Friesenecker, the increasing decentralization in electricity

generation places entirely new demands on the distribution networks.

What do you regard as being the main challenges in future in the design of smarter infrastructure?

It will be vital not to overload the networks with all manner of industrially available technology but to ascertain the right solution on a case by case basis for a "locally effective standard". The current network components such as power lines and transformers last 40 years or longer and are extremely robust. We need to be aware that we are now adding a range of components with a much shorter lifecycle such as computers, programs and operating systems and incorporating them in our reliable distribution networks – and these new communication tools will need replacing every ten years or so. We'll also inevitably have to deal with additional potential sources of error.

94 per cent of communities in Vorarlberg report above average supply reliability from VKW Netz AG. How do you guarantee smooth operation of the network?

The consistently low incidence of non-availability amounting to less than ten minutes per year also represents a top performance in Europe and is primarily down to 30 years of consistently replacing breakdown-prone medium voltage overhead lines with cabling. Other important factors contributing to the high level of reliability include condition-based maintenance, the efficient organisation of both the decentralized and the central fault clearance services, the timely replacement of old and breakdown-prone equipment as prescribed by our asset management, accurate power line maps for civil engineering companies as well as the use of mobile emergency power generators.

What criteria have been critical in the cooperation with the experts at AIT? What role do you see AIT playing as a non-university research institute in the integration of renewable energy sources in medium voltage distribution networks?

As Austria's largest non-university research institute with a wealth of relevant experience in distribution grid technology, AIT was a natural choice for such a joint undertaking. For some years now, the close cooperation between grid operators and innovative engineers from a research institute with close links to Austrian universities of technology has proved highly beneficial. Concrete real-life solutions based on actual grid and load data are developed to the construction stage, such as currently in the case of intelligent voltage control for the "DG-Demo- Net" medium voltage network being installed in the Biosphere Reserve in the region Grosses Walsertal. ///

THE RIGHT DRIVE FOR E-MOBILITY

/// The key to sustainable electromobility lies in economical yet powerful electric drive concepts. With virtual design technology the necessary components and systems can be rapidly and efficiently produced. ///

THERE WILL BE MORE AND MORE electric and hybrid vehicles on our roads in the future. The cornerstone of these new generations of vehicle is the electric powertrain. "To achieve the optimum design of this complex system of battery, electric motor and power electronics, we have to get away from today's concepts," says Senior Engineer Claus-Jürgen Fenz. "The development of electric drives requires a systemic approach and completely new methods and tools."

While other development providers tend to specialize in a certain part of the system, the AIT Mobility Department models the entire powertrain on the computer. "The great advantage here is that by altering the parameters we can produce a wide range of virtual variants quickly and efficiently and so filter out the best solution, which is then developed into a prototype," explains Fenz.

This virtual design results in a definite reduction in time to market and reduces the costs and the risk

CLAUS-JÜRGEN FENZ ///
Senior Engineer,
Mobility Department

"To achieve the optimum design of this complex system of battery, electric motor and power electronics, we have to get away from today's concepts."



of developing new drive concepts. With many years of expertise in electric drive technologies, AIT is now a sought-after partner for the leading European automotive manufacturers and suppliers.

CONTROL CENTER IN THE POWERTRAIN

AIT's experts have particular experience in the field of power electronics, a key component of modern vehicles and growing in importance. In conventional vehicles they control various auxiliary systems.

In e-vehicles, however, the relevance of the power electronics is several times greater, because they also control the interaction of all the electronic components and are therefore vital to the efficiency of the whole system. "Power electronics are vital to the electric powertrain," says Fenz. "Their job is to convert the DC battery voltage into AC voltage for the motor and apart from the engine control it has a monitoring and diagnostic function."

COMPLEX INTERACTION

In developing power electronics components the first step is to determine the minimum requirements for the drive and then determine the

● IN A NUTSHELL

The electric powertrain is the cornerstone of the new generation of hybrid and electric vehicles. To achieve optimum alignment of the individual components with each other, experts in the AIT Mobility Department rely on virtual design. The motor, battery and power electronics, and indeed the entire vehicle, are simulated on the computer in order to develop new drive concepts with high energy efficiency.

In close association with several Austrian small and medium-sized enterprises AIT has developed an entirely new electric vehicle from scratch using complex modelling and simulation tools - the first solar-powered public bus made in Austria has been trialling in the village of Perchtoldsdorf on the outskirts of Vienna since last fall.



specifications based on them. With the aid of simulations the researchers then plan the most suitable switching topology and investigate the interaction of motor and battery in defined drive cycles on the computer.

The process has to consider both thermal and electrical aspects and include different timeframes, as Fenz explains: "The thermal behavior of the power electronics varies in a matter of seconds, but the control electronics operate about a thousand times more quickly, with the transient switching behavior of the semi-conductors even taking place in the nanosecond range." The multiphysical simulations give a highly precise picture of the electrical and thermal condition of individual components throughout the drive cycle and thus allow better utilization of reserves. This means you can produce very compact yet powerful drives.

VEHICLE IN BITS AND BYTES

Besides simulating individual components AIT also casts the entire vehicle in bits and bytes. "Whole-vehicle simulations are an indispensable part of the development process," explains Senior Scientist Dragan Simic. "They are used to determine the minimum standards for the individual components in advance and to optimize thereafter the co-ordination in the system as a whole."

In the overall vehicle model the wheels, brakes, axles, gears, motor, power electronics and battery are all simulated as virtual components. Then comes the bodywork so as to include drive resistance factors as well as various other auxiliary systems.

The model produced is driven by a virtual driver over a predetermined route with defined speed and elevation profiles so as to analyze the operational characteristics in use. In the prototype stage real components can also be linked to the virtual environment using hardware-in-the-loop simulations.

SOLAR BUS MADE IN AUSTRIA

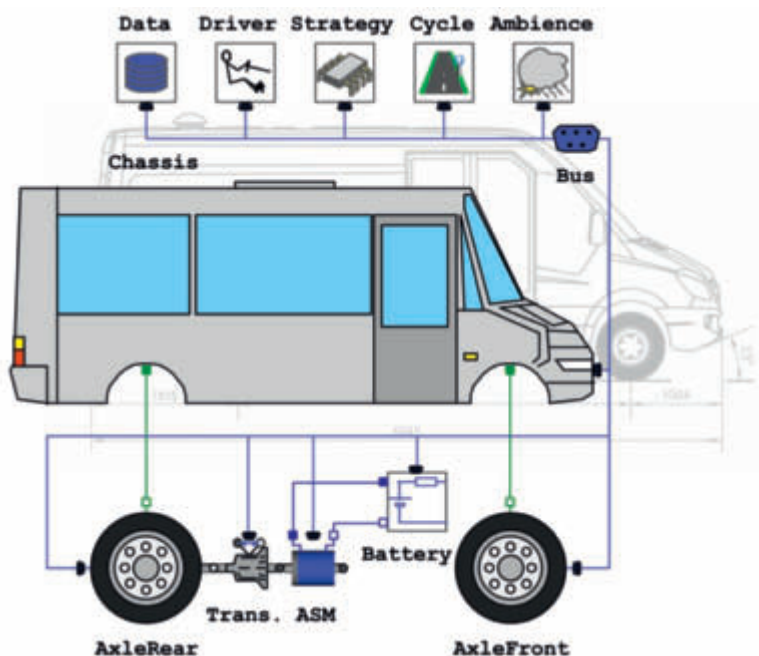
This extensive know-how has been utilized in various projects including the FFG (Austrian Research Promotion Agency) solar bus project. A purely Austrian consortium of research institutes

Outstanding development: as a partner contributing to the solar bus project, the AIT Mobility Department has been awarded the Mobility State Award by the Federal Ministry for Transport, Innovation and Technology in the category "Innovativ E.mobil".

DRAGAN SIMIC /// Senior Scientist, Mobility Department

"Whole-vehicle simulations are an indispensable part of the development process. They are used to determine the minimum standards for the individual components in advance."





Whole-vehicle
simulation:
solar bus

and SMEs set themselves the task of developing a solar-powered bus from scratch for use in local public transportation.

AIT was responsible for the design and development of the whole powertrain. Based on the dimensions and specifications of the bus manufacturer, the AIT experts started to design a rough vehicle model. Using a GPS a route profile was recorded which the bus had to cover in regular service in the model village of Perchtoldsdorf. "On the basis of this information we were able to specify the requirements for the electric motor, the battery and the power electronics and estimate the weight of the individual components," says Fenz.

The powertrain and operating strategy were developed in extensive simulations and refined in several optimization cycles until the drive delivered the maximum performance with the minimum weight and energy consumption. The solarbus, manufactured on the basis of the simulation findings solely in Austria, was presented to the public in June and has been in trial operation in Perchtoldsdorf since the fall. One major asset of the innovative bus made in Austria: with its highly efficient drive and consistent light-weight design, its energy consumption is well below that of any comparable vehicle on the market.

MISSION: MAXIMUM ENERGY EFFICIENCY

Improvements in energy efficiency will continue to play a key role in electromobility in future, as lots of

other components apart from the motor in electric vehicles draw their power from the battery and therefore restrict the range.

"One major energy consumer, for example, is the air conditioning system," explains Simic. "So in future we shall have the passenger area play a greater role in the whole-vehicle simulation. This means we can optimize the operating strategy so that high passenger comfort is guaranteed with the minimum possible energy use."

OPPORTUNITIES FOR INDUSTRY

Another trend is in the direction of customized vehicles for specific applications. This diversification offers a major opportunity for smaller manufacturers to carve a niche for themselves in the promising future market for electromobility.

AIT therefore offers development assistance for small and medium-sized enterprises which do not have the necessary know-how and infrastructure for the demanding design work involved. "The solar bus project has already demonstrated the huge innovative power of Austrian SMEs," Fenz emphasizes. "And it has shown that by using virtual design it is possible to develop a highly efficient vehicle from scratch - faster and more satisfactorily than by the conventional methods." ///

Further details: Mobility Department,
Claudia Hable, Phone: +43 505 50-6322,
e-mail: claudia.hable@ait.ac.at,
Web: www.ait.ac.at/mobility



RESEARCH SERVICES

Modelling, simulation and library development

Power electronics

In electric and hybrid vehicles it is the electronic components that are chiefly responsible for engine control as well as monitoring and diagnosis of the whole powertrain. The Mobility Department performs extensive multiphysical simulations to achieve the optimum alignment of the power electronics with the other vehicle components, so ensuring maximum drive efficiency.

- Thermal and electrical models of power electronics components for harmonisation with battery and motor and integration into the overall vehicle concept
- Simulation of different topologies for optimum efficiency
- Modelling of switching characteristics

Vehicle

In the whole-vehicle simulation models of individual vehicle components are linked and aligned with each other and with the engine control and operating strategy in defined drive cycles.

- Simulation of existing vehicle concepts as a benchmark
- Model-based development and optimization of alternative concepts
- Comparison of different concepts including potential savings
- Variation calculus with different components as a basis for specifications
- Provision of data for the design and prototyping of powertrain components

Testing and validation of electrical components

Power electronics

High-precision measurement of mechanical, electrical and thermal variables of the motor and power electronics is of crucial importance in the development of new drive concepts. The research infrastructure in the Mobility Department allows precise testing - from small drives for auxiliary equipment to entire powertrains for electric and hybrid vehicles.

- Testing of power electronics in combination with the motor for optimum adjustment of switching characteristics and engine control
- Error analysis of power electronics components

Vehicle

AIT has years of experience and boasts a high-quality laboratory infrastructure enabling it to measure precisely the power requirement of vehicles in defined drive cycles. Ultra-precise data are used to define the specifications for individual components and form the basis for the development and validation of realistic simulation models.

- Characterization of vehicles in relation to power requirement under different driving conditions
- Electrical, mechanical and thermal measurements on the road (real life cycle tests) and on the roller test bench
- Benchmarking and comparison of different vehicle concepts ///



ERNST KIENINGER,
SOLARMOBIL AUSTRIA,
ON THE POTENTIAL USE
AND EFFICIENCY OF
SOLAR VEHICLES IN THE
URBAN ENVIRONMENT

Mr. Kieninger, where do you see the potential and possibilities for e-mobility in general and for local public transportation in particular?

The solar bus project is the first local public transportation system in Europe operated solely by electric batteries and solar power. This makes the Austrian solarbus, which combines a wide range of engineering innovations, a prime example of Austrian e-mobility expertise in a highly promising market. For public transportation purposes there is enormous potential for cutting CO₂ emissions, especially when looking at the diesel-operated buses currently in use. The advantages of electromobility are exceptionally striking for inner-city transportation and in agglomerations. And the positive image effect is also exciting; the solar bus is currently trialling in regular service at Perchtoldsdorf, and has already become a symbol for sustainable mobility. We must build on that.

What role did the AIT Mobility Department play in the development of the solar bus?

There were no appropriate lightweight electric buses for use in local public transportation, so in this research project a completely new electric bus concept was developed. We found the ideal partner in AIT for the manufacture of a prototype, which could be tailored rigorously for maximum energy efficiency. AIT has developed the entire electrical drive, the battery design with exchangeable packs and the power electronics. And the first trials have confirmed that we really have succeeded in putting a highly efficient vehicle on the road. With a carrying capacity of 35 passengers, the solar bus uses a mere 65 kWh/100 km in urban transport, that's the equivalent of less than seven liters of diesel. A comparable conventional diesel bus hardly moves at less than 35 liters/100 kilometers.

What was your greatest joint challenge in this research partnership with AIT?

The partnership with the AIT Mobility Department is not just professional but we share the same passionate determination to come up with the best technical solution each time. The real challenge was to stick firmly to our goal of producing the maximum efficiency on a very tight budget. So for example, to enhance the drive efficiency even further a special two-stage gear was designed, and the development of the battery exchange station was another feature that came about through the work of the ambitious AIT project team on this research project under the leadership of Hannes Lacher. ///

KNOWLEDGE MAPS

/// A wealth of valuable information lies dormant among the data continually being heaped up in the digital era. Aided by highly advanced techniques and tools, experts at the AIT Foresight & Policy Development Department are mining such hidden knowledge treasures for AIT's clients. ///



● IN A NUTSHELL

As global data volumes continue to grow, it becomes increasingly important to glean specific information from this mass of data. With longstanding experience in data mining, AIT offers its clients comprehensive data analyses. The analyses reveal concealed relationships and generate new knowledge, providing public and private sector organizations with a basis for making well-informed decisions affecting the future and for optimizing strategies to guide further development.

IN OUR KNOWLEDGE SOCIETY, INFORMATION IS THE CURRENCY.

Always knowing a little more than others can secure a decisive competitive edge. But it also gives companies and organizations the option of defining their strategies and policies based on a solid knowledge foundation. There is no dearth of raw material for producing knowledge. A study compiled by market researcher IDC suggests that the global data volume doubles every two years.

Yet, quantity alone is not decisive but the ability to extract from the huge mass of data the specific information required in the individual case. AIT has concentrated the expertise gained in this increasingly significant field by establishing a separate Monitoring & Data Mining Research Area. On behalf of policymakers, private companies and public institutions, the AIT scientists analyze large amounts of data in order to derive answers to specific questions raised by their clients. The findings are additionally visualized in the form of graphic maps, rendering them intuitively intelligible.

THE IMPLICIT BECOMES EXPLICIT

Most of the data that is distributed worldwide throughout numberless servers is not structured. Yet, even when data is available in structured form, such as in databases, lists or tables, much of the information remains concealed – “between the lines”. The endeavor in data mining is to render such implicit information explicit. This specifically involves searching for patterns within existing data structures, using mathematical and statistical methods.

The methods to be applied in the particular case depend on the type of data material and the specific question to be answered. The patterns identified in this way can, subsequently, be interpreted as answers to a variety of questions. The procedure

results in a new kind of knowledge, one that is first recognized in the process of analysis. Consequently, both in terms of the goal pursued and the procedure for realizing it, data mining clearly differs from the classic search engines familiar to web users.

One of the many data mining applications offered by AIT is the analysis of research activities. An example is a study, carried out on behalf of a multinational technology corporation, to reveal the worldwide pattern of scientific involvement with motors and generators. "In a conventional study, you would do a keyword search of a research database and get a list of thousands of journal articles," Edgar Schiebel, Head of the Technology Management Business Unit, explains. The researcher would then need to examine the articles individually to determine their relevance. "But that takes a very long time, and there are only limited options for analyzing the content." With the BibTechMon software, developed by Schiebel, AIT offers a powerful tool that takes care of the job largely without human intervention. As the basis for analysis, the program uses bibliometric information stored in scientific publication databases such as Scopus and Web of Science. A number of analysis functions can then be applied to the databases and the results visualized graphically.

THREE-DIMENSIONAL COORDINATE SYSTEM

If, for instance, the program is fed with the bibliometric data for all articles entered with "motors" and "generators" as keywords, the system can further differentiate according to specific topics. Each individual scientific publication is then plotted as a point within a three-dimensional coordinate system. The specific position of a point is determined by the relative mutual proximity of two articles, with the number of sources commonly used by the two articles serving as the measure of similarity. The more common sources two articles cite, the closer they are together in the visualization.

With a sufficiently great number of articles, this technique results in structures similar to mountain chains. In the specific case, each mountain would represent a research area within the general subjects of "motors" and "generators", examples being "synchronous machine", "permanent magnet" or "regulation". A list of all the articles making up the mountain can be viewed with a mouse click. BibTechMon offers more, including an automated text analysis function. It shows the terms that occur more frequently in the articles of a specific mountain

**EDGAR SCHIEBEL ///
Head of Technology
Management Business Unit**

"Using conventional search routines, thousands of individual hits had to be viewed in a cumbersome process up to now. The BibTechMon software takes care of the job largely without human intervention."



than in all other mountains. In this way the user is able to identify at a glance the research topic which the mountain represents.

INTELLIGENT CONCLUSIONS

Such a view gives rise to a number of insights. One of them is the relevance of a topic in scientific research. A large number of publications in a research area implies that the topic is important. Based on such information, businesses can decide the topics to which they wish to devote more attention in future and align their investment strategies accordingly.

Institutions awarding research grants, on the other hand, are provided with a basis for deciding how to define future programs. Research institutions or universities wishing to enter a new area of research often look for partners with experience. In such cases a query can be performed to identify the organizations or individuals that have issued a particularly large amount of publications on the subject. Maps revealing researchers who often publish articles jointly are also highly informative. "It is especially interesting to look at the geographic distribution of these network relationships,"

In a way similar to the tag clouds widely used on the web, BibTechMon visualizes results in the form of individual mountains. Within this "topography of knowledge", the higher peaks represent more common terms.

Schiebel notes, adding: "Relationships between researchers in Asia and Europe are often seen to exist for the most part indirectly, by way of American scientists." Knowing these interrelationships helps make much more effective inquiries about possible cooperation.

MEANINGFUL VISUALIZATION

Performing such an analysis in regular intervals using the same parameters allows even very subtle changes in research activity to be clearly recognized over time. Such changes are seen in the maps generated by the analysis, for instance in the growth of individual mountains, or in shrinking – when that particular research topic becomes less relevant within the scientific community. In this way it is possible to recognize promising fields of research, referred to sometimes as “emerging fields”, at an early stage.

AIT performed such a study on behalf of the Lower Austrian office of the Federation of Austrian Industries, specifically analyzing research activities in the area of joining technology and lightweight construction. It was revealed that friction stir welding, a relatively unknown technique up to now, is becoming increasingly prominent, and the players who have already gathered expertise with this technology were identified. That is key information for companies active in the sector.

Analyzing cell phone data enables the study of the movement patterns of a large number of individuals. From the shape of the curves, it can, for instance, also be recognized how many people go shopping right after work, near their jobs, and how many shop near home.

The information can be used as a basis for well-grounded decisions as to whether or to what extent to become involved in this area. Despite the intensive use of formal methods of analysis, data mining is not a fully automated task. “You always need to develop an understanding of the topic you are currently working on and acquire background knowledge,” Schiebel notes. “Because that influences your choice of research data and of methods to use, and later on the interpretation of results.”

ANALYZING PERSONAL MOBILITY PATTERNS USING ANONYMIZED CELL PHONE DATA

Wolfgang Loibl, regional scientist and Senior Scientist in the Regional & Infrastructure Policy Research Area at AIT, is another researcher who sifts through large amounts of data to obtain information that cannot to be identified under superficial examination. Among the issues he investigates at AIT is urban development and mobility, analyzing in this context cell phone data to

WOLFGANG LOIBL ///
Senior Scientist at the AIT
Foresight & Policy
Development Department

“We visualize the recorded positions of cell phone users in individual grid cells and can, for instance, identify collective patterns of movement in Vienna on a daily basis.”



glean insights into the mobility patterns of large groups of people.

The data originates with A1, a cell phone service provider that sells this information as a commercial product. All data records are, of course, anonymized, i.e. every user is represented by a random number that is modified on a daily basis. Included in the data records are the time and place of every “event” triggered through the use of a mobile end device. An event can be one of many things, from switching the phone on and off and making a call to changing radio cells, which occurs when the user changes locations. There are about twelve million subscriptions for cell phone services in Austria.

The number of cell phone users assigned to one radio cell can be used to visualize on a virtual city map the number of individuals at a particular location at any one time. Whether or not those people are currently making a call is not relevant, they only need to have their phones switched on.

COLLECTIVE MOVEMENT PATTERNS PROVIDE VALUABLE INFORMATION

“We are interested only in the movement patterns of groups within the population, and specifically in the ongoing change in population distribution within a space,” Wolfgang Loibl notes. In order to visualize changes in the distribution of Vienna’s population during the course of a day, the recorded positions of cell phone users were aggregated in 500 by 500 m grid cells. A 3D map was then used to display fluctuations in the number of individuals within each quarter of Vienna as the day progressed, with a bar for each grid cell changing in height in response to movements.

Viewing the patterns in short intervals results in a “short film” depicting collective patterns of movement throughout Vienna on a daily basis. It comes as no surprise that the tallest bars are found in the inner city districts during the day. The peaks dwindle towards the evening, as the bars within heavily populated suburban districts and areas outside the city limits increase in size. The visualization enables observation of the impact of

commuter movements during morning and evening rush hours, for example.

A further application is to extract the points of departure and destination of traffic links, information which can then be used indirectly to derive traffic flows. This can be done not only for morning hours, for instance to analyze commuter movements, but for any other period during the day as well.

In addition to spatial analysis, time-related evaluations can also be performed. Specific information that can be derived from the data includes time of travel, distance, duration of stay at the destination and speed of travel. Obtaining this information involves analyzing individual movements, independent of space, using distance-time diagrams. If the position information for the cell phone users is sufficiently accurate, data such as the distance travelled, travel times and the time spent at the particular destination can be identified. "In the ideal case, the speed of travel can be interpreted from the slope of the curve sections, and to a certain extent the means of transport chosen for the trip as well," Loibl explains. "Previously, information about travel times, distances, travelling speed and duration of stay at intermediate destinations during daily travel could only be obtained by surveying small samples of the population."

Analyzing cell phone data allows the study of the movement patterns of a large number of individuals. Even concealed details of behavior, otherwise hardly identifiable, can be visualized. From the shape of the curves, it can, for instance, also be recognized how many people go shopping right after work, near their jobs, and how many shop near home.

MAIN BENEFICIARY: COMMUNITY INFRASTRUCTURE

The detailed knowledge about people's travel patterns provide urban planners or organizations responsible for operating public infrastructures with valuable information for designing facilities – what the best locations are and when best to offer opening hours, for instance. Based on this knowledge, public transportation can be optimally planned.

Specifically, the operating hours and frequency of means of public transport can be adapted to better meet actual needs, or additional incentives created to increase utilization of public transportation, e.g. by relocating stations or making new stops.

Subsidized by funding from the EU's Seventh Framework Programme, AIT is collaborating with eight partners, including the cities of Vienna, Sofia,

Bologna and Vitoria-Gasteiz, on the urbanAPI project (Interactive Analysis, Simulation and Visualisation Tools for Urban Agile Policy Implementation). In this context, the use of cell phone data is one of three applications being developed with the aim of supporting urban planning and public participation. "In some cities, cell phone data is being used to identify the places where a particularly large number of people pass, or to find out where and when there are a lot of people in some pedestrian zones and less in others. Using our analyses as a basis and by drawing on other spatial data, we can provide explanations for these conditions," Loibl explains. ///

Further details: Foresight & Policy Development Department,
Beatrice Rath, Phone: +43 505 50-4508,
e-mail: beatrice.rath@ait.ac.at,
Web: www.ait.ac.at/f_pd



RESEARCH SERVICES

Society and Technology

While technology is a product of social shaping, technical artifacts also have a sustained, far-reaching impact on society and on individuals. The portfolio of the Society and Technology research service includes a variety of project types which aim to explore on behalf of clients the trajectories along which modern technologies develop under societal influence, and at the same time to provide these clients with options for shaping and assessing these technologies.

Climate protection and climate change impact

Strategies and measures are needed for dealing with the impacts of climate change on the environment and society in the future. The Department is involved in the recording and the assessment of pollutant emissions in order to develop appropriate recommendations for measures to reduce these emissions. This implies both technical measures for climate protection and the development of ideas for the design of a regional, national and international technology policy. Regional climate simulations provide a data basis for developing coping strategies, aimed at enabling adjustment to emerging environmental change in a way that is both economically feasible and socially acceptable.

Emerging technologies

AIT customers are introduced in a comprehensive, systematic way to new areas of technology and research and receive information about activities and current developments within the scientific community as well as information about networks and potential partners. For businesses, but for public organizations as well, independent analyses represent a very useful resource in decision-making and orientation. ///

CAREER PATHS AT AIT

/// Tomorrow Today spoke with Peter Palensky, recently appointed Principal Scientist of the AIT Energy Department, about his new responsibilities. Peter Palensky is the first employee to be appointed to such a position as part of the AIT career model program. ///



Peter Palensky
Principal Scientist
at the AIT Austrian
Institute of
Technology

Mr. Palensky, you have been working at AIT since 2009, doing research into energysystems for the buildings and cities of tomorrow. How would you describe your new responsibilities?

Peter Palensky: As a Principal Scientist you are appointed for a five-year term and can concentrate exclusively on pioneering research efforts during this period of time. You can look far into the future and give thought to the trends and topics that will dominate a certain area of research in the long term as well as to possible interrelationships that might arise with current focuses of research. In my research field, for example, which is centered on the topic of complex energy systems, models and simulations play a major role. We run through scenarios with an eye to identifying any irregularities, so as to ultimately be able to draw conclusions about the mechanisms at work in the overall system. In contrast to evolutionary research, where you usually know fairly precisely what to look for, we often do not know in advance what we will discover. But this

approach supports us in better understanding complex energy systems and identifying novel options for the future.

Before your appointment as Principal Scientist, you were heading the Sustainable Building Technologies Business Unit at AIT. How does this experience now help you?

Palensky: As Head of the Business Unit, I had management responsibilities and my research work was more or less on hold while holding that position. Yet for me as a scientist, the position provided an opportunity to gather important experience in areas such as managing internal business processes and client relationships or in human resources management and developing social skills. That experience will certainly benefit me in my further career.

You can already look back on a university career lasting several years, some of it in South Africa. What do you see as the differences between university research and AIT?

Palensky: University research is much more highly specialized in individual fields. Each institute has its own specialization. That allows you to delve into issues deeply and do basic research. Interdisciplinary cooperation is much more difficult at universities, however. Here at AIT you find an "orchestra" of scientists performing together. There are mathematicians, physicists, mechanical engineers, architects and many other kinds of researchers who may work jointly on an issue depending on the task at hand. That is a tremendous advantage for my research activities. That, together with AIT's selection of research topics and strategic alignment, results in an ideal working environment that includes contacts and a reputation at the international level. Those considerations also played a key role in my career decision. That doesn't apply just to the research opportunities as such but also to the people contributing to the environment. In addition, Vienna is a city offering a superior quality of life. That made my decision even easier. ///

AIT CAREER MODEL PRINCIPAL SCIENTIST

The Principal Scientist is the highest level within the AIT career model program. The main responsibilities include developing novel research areas or investigating in greater depth and expanding knowledge of existing research focus areas. In this way the Principal Scientist supports the development and implementation of the Business Unit's or Department's research strategy. Principal Scientists are the contact person for professors and heads of research units, and maintain close contacts with strategic customers. Responsibilities additionally include assisting colleagues, and particularly Senior Scientists. For realizing the role, AIT envisions a variety of models, all of which include, as a central concern, developing a network of research contacts with universities or non-university research institutions.

Requirements

- PhD, post-doctoral teaching qualification or equivalent scientific qualification and several years experience as head of specialized research teams
- Influential referenced and peer-reviewed publications in journals and books and from relevant conferences
- Internationally recognized expert having a reputation extending beyond the immediate speciality field
- Proven ability to define and implement strategic research lines
- Leadership skills and experience with assembling research groups

AIT-SERVICE

Dates

JANUARY 1-12, 2012: SMART CITY LINZ ACTION PLAN 2050 STAKEHOLDER FORUM

At the Smart City Linz stakeholder forum, an action plan is to be prepared for 2050.

Information: <http://smartcities.at>

JANUARY 16, 2012: AQUAMICRO PROJECT WORKSHOP

The findings of the AquaMicro research project will be presented at the workshop. An overview will be provided on the current state of developments as well as an outlook on future progress and improvements in methodology. Afterwards a discussion will be held with the participants that will focus on the project findings and the future prospects for the newly developed methods of analysis. The AquaMicro project is co-funded by the European Regional Development Fund (ERDF) of the European Union and the Technopol program of the Lower Austrian Department of Business, Tourism and Technology (WST3).

Venue: UFT Tulln, Konrad-Lorenz-Strasse 24, 3430 Tulln an der Donau, Austria

Information: www.ait.ac.at/news-events/events

JANUARY 26-28, 2012: EUROPEAN SEMINAR – GEOGRAPHY OF INNOVATION

The aim of the European Seminar is to bring together scientists, data specialists and public stakeholders in the area of innovation to discuss topics related to innovation and policy as well as specific indicators.

Venue: St-Etienne, France

Information: <http://uk.eurolio.eu>

FEBRUARY 29 - MARCH 2, 2012: 27TH PHOTOVOLTAIC SOLAR ENERGY SYMPOSIUM

The Photovoltaic Solar Energy Symposium has for many years been one of the main events in the annual calendar of photovoltaic events. Representatives from industry, research and government have an opportunity at the event to obtain information about current developments in the photovoltaic sector. The three-day program includes presentations (during general and parallel sessions), a poster exhibit, specialized exhibitions and guided tours. Representatives of the AIT Energy Department will attend to give presentations.

Venue: Kloster Banz, Bad Staffelstein, Germany

Information: www.ait.ac.at/news-events/events

MARCH 11-15, 2012: TMS 2012: LINKING SCIENCE AND TECHNOLOGY FOR GLOBAL SOLUTIONS; ANNUAL MEETING & EXHIBITION

At the TMS 2012 in March, science and engineering professionals hailing from more than 68 countries will gather in Orlando, Florida to present and discuss innovations in the materials sector. Christian Chimani, Light Metals Technologies Ranshofen, will hold a presentation on the topic of "Studies on Flow Characteristics at High-Pressure Die-Casting".

Venue: Swan and Dolphin Resort, Orlando, Florida, USA

Information: www.tms.org/meetings/annual-12/AM12home.aspx

Recent scientific publications

W. Winiwarter, Z. Klimont:

THE ROLE OF N-GASES (N₂O, NO_x, NH₃) IN COST-EFFECTIVE STRATEGIES TO REDUCE GREENHOUSE GAS EMISSIONS AND AIR POLLUTION IN EUROPE

Current Opinion in Environmental Sustainability, Vol. 3 (2011), 5; 438 - 445

T. Weber, S. Wassertheurer, M. Rammer, E. Maurer, B. Hametner, C. Mayer, J. Kropf, B. Eber:

VALIDATION OF A BRACHIAL CUFF-BASED METHOD FOR ESTIMATING CENTRAL SYSTOLIC BLOOD PRESSURE

The Journal of Hypertension; 58 (2011), 825 - 832

R. Benosman, S. Ieng, P. Rogister, C. Posch:

ASYNCHRONOUS EVENT-BASED HEBBIAN EPIPOLAR GEOMETRY

IEEE Transactions on Neural Networks, 22 (2011), 11; 1723 - 1734

D. Bauer, M. Ray, S. Seer:

SIMPLE SENSORS USED FOR MEASURING SERVICE TIMES AND COUNTING PEDESTRIANS: STRENGTHS AND WEAKNESSES

Transportation Research Record: Journal of the Transportation Research Board; 2214 (2011); 978-0-309-16728-4; 77 - 84

R. Schütz, D. Potts, L. Zdravkovic:

ADVANCED CONSTITUTIVE MODELLING OF SHOTCRETE: MODEL FORMULATION AND CALIBRATION

Computers and Geotechnics, 38 (2011), 834 - 845

Additional publications may be viewed from the AIT Publication Database at <http://pubdb.ait.ac.at>.

The database contains articles published in journals, books and book articles, articles published in conference transcript as well as presentations and poster presentations. A full text search function is provided for searching the database for any keyword.

Work @ AIT

The AIT Austrian Institute of Technology provides its staff of highly qualified employees with an ideal environment for research that meets the highest standards of excellence. Projects geared toward the needs of the future are initiated, advanced and completed within the framework of a global network including universities, research institutions and leading corporations in industry and technology. If you are interested in pursuing a career at AIT we look forward to receiving your application to: jobline@ait.ac.at.



As a pioneer within the Austrian scientific community, AIT is presenting Webcast, a novel communication tool. Select Webcast at www.ait.ac.at

AIT presentations and seminars can be viewed in full length with the complete information content, accompanied by the lecturer's Powerpoint slide presentation.

THE BEST WAY TO PREDICT THE FUTURE IS TO SHAPE IT.



If your company is looking for cutting edge innovations, then AIT Austrian Institute of Technology is your partner of choice. Because in our institute the most acute minds in Europe are working today on tomorrow's tools and technologies, laying the ground for the solutions the future demands.

Learn more about the future by visiting www.ait.ac.at

AIT
AUSTRIAN INSTITUTE
OF TECHNOLOGY
TOMORROW TODAY