



13 | July | 2010

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## **DLR: Security-critical applications based on GNSS: New technologies, new tasks**

Increasing complexity is a characteristic of our modern society. As the vulnerability of infrastructures, systems and processes increases, the demand for security is growing at least at the same rate. DLR has understood the extraordinary importance of this field and implemented security as its fifth line of research. Working in an interdisciplinary approach, the programme is to encompass security-related aspects of DLR's four major research areas aviation, space, energy and transportation.

Advanced GNSS-based applications can provide an almost unlimited range of services and integrated solutions through the whole security chain. DLR Technology Marketing together with the German Space Agency offer a Special Topic Prize "Next Generation Navigation" to reward the brightest ideas for SECURITY-CRITICAL APPLICATIONS.

Hence, DLR is seeking technical and application-oriented solutions of an outstanding, innovative character, focusing especially on the following aspects:

1. Enhancement of ACCURACY and AVAILABILITY through methods such as multi-frequency usage, local augmentations, hybrid sensors, and redundant systems,

2. Recognition and suppression of INTERFERENCING SIGNALS within the GNSS receiver, as well as through the signal processing chain,

3. Use of GNSS applications and integrated solutions for SECURITY-RELATED TASKS like rescue and police operations, crisis management, and disaster relief,

4. Robust navigation for TRAFFIC and TRANSPORT with maximum security and reliability in real time.

To learn more about the DLR's special topic prize and to submit an idea please go to: [http://galileo-masters.eu/index.php?anzeige=special\\_prizes\\_dlr.html](http://galileo-masters.eu/index.php?anzeige=special_prizes_dlr.html)



## **Forum SatNav MIT BW: Call for Safety & Security in the logistics and transport sectors**

The Forum for Applied Satellite Navigation and Mobile IT Baden-Württemberg e. V. (Forum SatNav MIT BW) believes in the enormous economic potential satellite navigation presents, especially for Baden-Württemberg. The forum focuses on the development of applications and services based on navigation, information and communication technologies. In particular, it seeks to support small and medium-sized companies in launching innovative products and services as well as in the creation of strategic alliances, cooperations and partnerships. By sponsoring a special topic prize for security-relevant solutions in the transport and logistics sector, Forum SatNav MIT BW seeks market-ready submissions from companies, universities, and research institutes that create value in logistics by means of applications in satellite navigation and mobile IT. Doing so requires both innovations and improvements to existing solutions.

Submissions to be shortlisted should:

- involve an innovative solution, application, and/or process from the areas of satellite navigation and mobile IT
- be market-ready and oriented along the value chain

- feature either an enhancement of an existing solution or a radical innovation

The winner of the call for safety and security in the logistics and transport sectors will be awarded more than just one prize:

The first prize will be the chance to present his/her idea at the fifth National Galileo User Conference staged by the Federal Ministry of Transport, Building and Urban Development in Stuttgart on 3rd of November 2010. The winner will also get a free two years membership in the Forum for Applied Satellite Navigation and Mobile IT as well as a business coaching, in which the Forum will establish the contact to a venture capitalist for the winner. Last but not least the winner will get a small prize pool full of software licenses of software developed by members of the forum (for example a developer license of the software sphinx open by integrierte informationssysteme GmbH ([www.in-gmbh.de](http://www.in-gmbh.de)) with a value of 5800 € or a license of the software TourExplorer and MagicMaps2Go by MagicMaps GmbH ([www.magicmaps.de](http://www.magicmaps.de)) with a value of 200 €).

[http://galileo-masters.eu/index.php?anzeige=special\\_prizes\\_satnav-bawu.html](http://galileo-masters.eu/index.php?anzeige=special_prizes_satnav-bawu.html)



## Baden-Württemberg: Focusing on Safety and Security



Located in southwest Germany and home to nearly 11 million people, the state of Baden-Württemberg is one of the most university-rich and research-intensive regions in Europe. Local companies demonstrate an impressive level of innovation; in satellite navigation applications, the region's many

security-related solutions stand out in particular. This is why Baden-Württemberg is sponsoring a special topic prize in the field of security in the European Satellite Navigation Competition (ESNC) and establishing a corresponding study group at the state level. The ESNC Safety & Security Newsletter provides a glimpse of the current projects and products of members of this new study group – as well as other Baden-Württemberg companies – by presenting 12 articles in the following areas:

- Monitoring systems for buildings, vehicle drivers, landing systems and forest workers sound an alarm in dangerous situations. Combining different methods of analysis in a central control system reduces the complexity of monitoring such incidents.
- New opportunities in access control fulfil legal requirements in sensitive production processes and provide documentation functions that ensure legal security.
- More accurate elevation measurement and the analysis of signal integrity serve as the necessary technical basis for new security-related applications.
- Assistance systems for trucks, fire brigades, and minesweepers are some further examples of Baden-Württemberg innovations presented in this newsletter.

[www.galileo-bw.de](http://www.galileo-bw.de)

[www.galileo-masters-bw.de](http://www.galileo-masters-bw.de)

### | SUCCESS STORIES

## Protecting valuable lives

Participating in competitions helps companies and those seeking to start them to gain a foothold in dynamically growing markets. Take Erich Franke of AFUSOFT GmbH, for instance, whose idea for securing freight came in first in the Baden-Württemberg (Germany) region in the 2008 European Satellite Navigation Competition. However, Franke has since found a different area of application for his invention. Instead of valuable goods, his monitoring system now watches over forest workers – independently of mobile networks – and quickly organises help in dangerous situations.

Franke explains his patented approach based on the following scenario: "A shepherd watches over his flock by regularly counting his sheep. Whenever a sheep is missing, he immediately sends the sheepdog to find it." When safeguarding valuable goods, a batch-scan process handles the counting of the individual freight items, which are outfitted with tiny radio transmitters. These are similar in function to RFID, but do not require a scanning station.

In calling for aid, the system foregoes GSM services in favour of geostationary satellites through which its signal – accompanied by positioning data – reaches a central

control location and notifies rescue personnel. The advantages? Area-specific breakdowns in the GSM network are no longer a problem, and the system also works in remote locations not covered by mobile networks.

As mentioned, a new area of application was identified for this patented system during its realisation. Instead of goods, it now monitors forest workers, whose dangerous working environment is typically far removed from the nearest mobile transmission towers.

If one of the system's standard detectors determines that a forest worker is in danger, it notifies the base station in the worker's vehicle by radio. This station then informs both the worker's nearby colleagues and the control centre by satellite, thus arranging for rapid assistance.

[www.AFUSOFT.de](http://www.AFUSOFT.de)



## Using mobile GNSS with M<sup>3</sup>

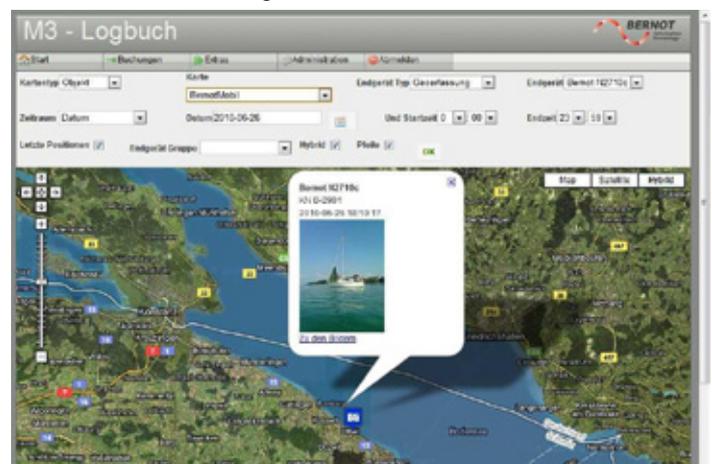
M<sup>3</sup> facilitates counterfeit-proof, georeferenced, multimedia real-time monitoring and documentation of construction sites and other work locations, mobile security personnel, plant security, BOS, places of residence and other buildings, and various types of vehicles (cars, motorcycles, transport trucks).

M<sup>3</sup> was presented outside of Germany for the first time at the Eurisy conference, which took place on 25 June 2010 with the theme of "Fostering the Competitiveness of European SMEs Through the Use of Satellite Services". This conference aimed to consolidate the political support for and recognition of the potential of satellite services to enhance the competitiveness of SMEs that have no relation to the space industry or the provision of satellite services, as well as of the necessity of measures and actions to facilitate SME access to these innovative tools.

Bernot IT developed M<sup>3</sup> (German: Mobile Mitarbeiter / Maschinen Management, or mobile employee / machine management) with the mechanical engineering firm BES GmbH as part of a ZIM project supported by the German Federal Ministry of Economics and Technology (BMWi). Designed to enable counterfeit-proof collection of image, position, time, and other types of data, the M<sup>3</sup> system has already received several accolades: the regional prize of Baden-Württemberg (Germany) in the 2007 European Satellite Navigation Competition, runner-up for the ESA special topic prize for a more advanced version of M<sup>3</sup> in the 2009 ESNC, and third place in the category "Innovations for Mobile Business Applications" at the KIS Mobile Conventi-

on in Stuttgart, Germany, on 18 May 2010.

M<sup>3</sup> is based on more than 20 years of experience in security-critical distributed systems in connection with the adaptability of SMEs in using cost-effective mobile devices (smartphones, etc.). With M<sup>3</sup>, users can monitor machines, construction sites, places of residence, and more with georeferencing based on images, audio, video, and data transfer. The information transmitted can be accessed in near-real-time through a secure Internet connection.



M<sup>3</sup> is highly scalable, can be used anywhere in the world, and supports numerous interfaces for importing and exporting data. It also offers the ability to monitor distributed and mobile objects, as well as significant cost reductions in mobile engagements. [www.bernot.net](http://www.bernot.net)

## | MARKET

## Security Study Group at Forum for Applied Satellite Navigation and Mobile IT BW

The European satellite navigation system Galileo will be responsible for providing multiple services and signals in the field of security (PRS: public-related service, SOL: safety-of-life, SAR: search and rescue). The Forum for Applied Satellite Navigation and Mobile IT Baden-Württemberg (Forum SatNav MIT BW e.V.) has recognised the fundamental need to accommodate the growing demand for security-related competencies, having established a study group on the subject.

The members of the Security Study Group hail from companies, universities, and research institutes in various regions of the southwest German state of Baden-Württemberg. The body considers itself a panel of experts that can be contacted for advice on any issues concerning security

in Galileo-related settings. Its goal is to promote networking among users and providers, as a close proximity to real-world users of security-related applications that leverage satellite navigation is of particular importance. To achieve this, the group plans to use information events, conference exhibitions, meetings of experts on specific topics, and other measures. The potential areas of application are many, including support for emergency services in planning and utilising the shortest possible routes to the places they are needed. Satellite-aided information can be transmitted more precisely from a central control station for use by workers on-location.

The Security Study Group welcomes enquiries through the office of Forum SatNav MIT BW at [info@galileo-bw.de](mailto:info@galileo-bw.de).

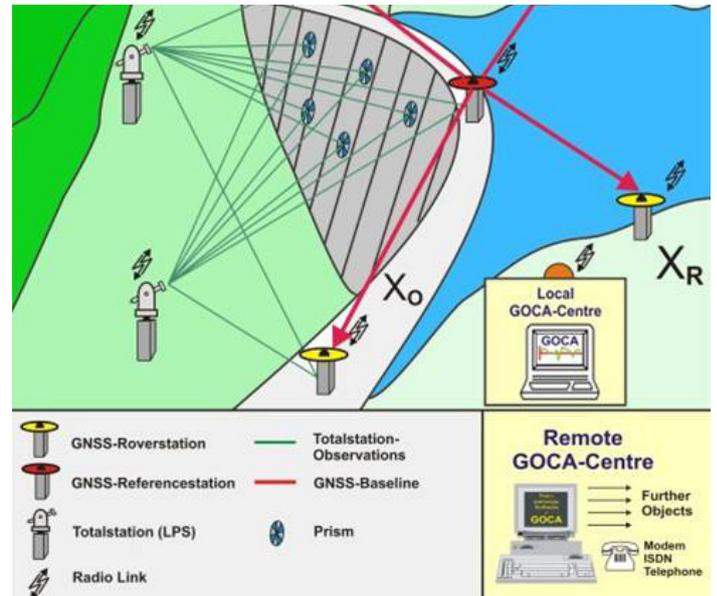


## GNSS secures dams and cities located above tunnels

Real-time monitoring of the earth's surface and security-critical structures aids the early detection and/or prevention of catastrophes. In the corresponding market, applications based on global navigation satellite systems (GNSS) are gaining importance. The GNSS/LPS/LS-based Online Control and Alarm System (GOCA) – owned by Hochschule Karlsruhe, a university in Germany – stands out thanks to its high-precision real-time kinematics. In June 2010, GOCA was used to perform geo-monitoring on a densely populated building complex in Bruck an der Leitha, Austria, where road construction activities had endangered the buildings' structural integrity.

The GOCA monitoring system utilises GNSS, terrestrial local positioning systems (LPS), and local sensors (LS), such as inclinometers. In natural disaster prevention, GOCA sees particular use in monitoring landslides, volcanoes, underground and surface mining, and tunnel construction, as well as security-critical buildings, dams, and other geo-technical facilities. Developed under the direction of Dr. Reiner Jäger of Hochschule Karlsruhe's Institute for Applied Research, relies on real-time monitoring capable of sub-millimetre precision to detect shifts in all three spatial directions at high frequencies.

Plans are currently being made to use the geodetic GOCA system to monitor the geologically unstable Kremlin in Moscow, Russia. During the now complete project in Austria, a GOCA alarm management system had to be integrated, as Bruck's former barracks and current residential



complex would have to have been evacuated immediately in case of an incident.

For such alarms to function, both appraisal of the current situation and precisely defined trend estimates are key. This makes it possible to predict critical situations requiring building evacuation. Thankfully, no alarms were triggered in the course of the Austrian construction project.

[www.goca.info](http://www.goca.info)  
[www.monika.ag](http://www.monika.ag)

## Independent GBAS monitoring system for air-traffic control

[continuation on page 06 ...](#)

The instrument landing systems (ILS) pilots rely on emit guide beams to ensure a safe landing, even under adverse weather conditions. However, ILS has reached the limits of its capacity.

These systems are now to be supplemented successively and eventually replaced by satellite navigation solutions. These GNSS-based systems require a ground-based augmentation system, which needs to be tested so that aircraft can land with satellite support. Commissioned by Deutsche Flugsicherung GmbH, Salem, Germany's NavPos Systems GmbH developed a monitoring system that is now in use at the airports in Frankfurt (Main) and Bremen, Germany.

UGM, NavPos Systems' independent GBAS monitor, oversees the performance of GBAS systems, recording all outgoing transmissions and simulating a stationary or mobile user. UGM is modular in its configuration,



The independent GBAS monitoring system UGM consists of three components: a server unit (below), a GNSS unit (middle), and an MMR unit (above).



... continuation from page 05

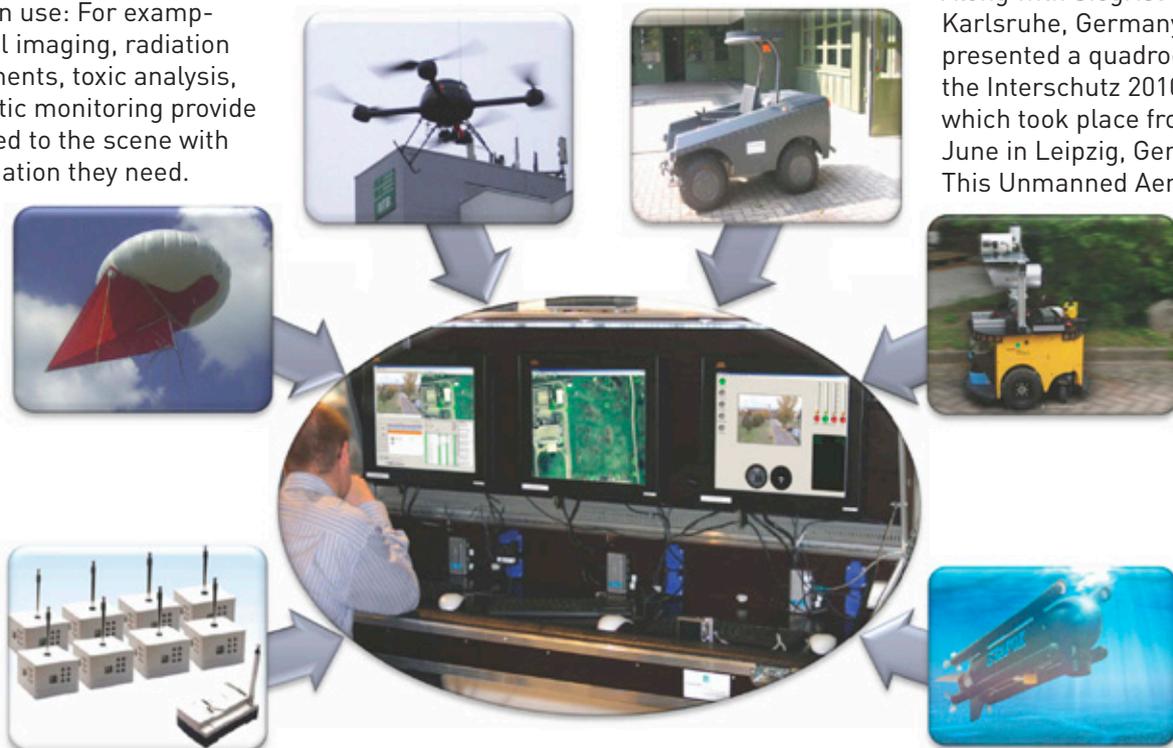
with a basis system consisting of a server unit and a GNSS unit. Comprising two GNSS receivers and a GBAS receiver, the mobile GNSS component sees use in both planes and ground vehicles. UGM can also be operated with an integrated multimode receiver (MMR) used in air traffic. In addition, the system's modular character both continuous

operations – including data recording in compliance with air traffic guidelines – and use in stationary and mobile tests. During such tests, the server unit can be replaced with a laptop.

[www.navpos.de](http://www.navpos.de)

## Centralised monitoring

Whether in dealing with company facilities, traffic hubs, major events, or areas affected by catastrophe, rapid oversight increases security in virtually any situation. When incidents occur, various methods of observation are often in use: For example, thermal imaging, radiation measurements, toxic analysis, and acoustic monitoring provide those called to the scene with the information they need.



toring Through Miniature Aircraft) controls various sensor devices and sensor network hubs combined to survey and monitor situations on land, at sea, and in the air.

Along with Siegrist GmbH of Karlsruhe, Germany, IOSB presented a quadcopter at the Interschutz 2010 event, which took place from 8-13 June in Leipzig, Germany. This Unmanned Aerial Vehicle

The AMFIS system developed by Germany's Fraunhofer Institute of Optronics, System Technologies, and Image Exploitation (IOSB) provides comprehensive overviews of even the most complex environments.

Different incidents require fast action specific to the situation at hand. When multiple mobile sensor systems are needed, individual applications quickly reach their limits. Personnel with the corresponding training have to be available to control each separate system. AMFIS (German: Aufklärung und Überwachung mit Miniaturfluggeräten im Sensorverbund, or Joint-Sensory Survey and Moni-

(UAV) serves as one of the AMFIS system's sensor carriers. Meanwhile, the system's modular structure and open interfaces enable it to adapt to the requirements of specific situations. Police officers, private security personnel, and other users can employ AMFIS to quickly obtain an overview of the circumstances at hand without having to manually operate individual sensor devices.

[www.iosb.fraunhofer.de/servlet/is/18599/](http://www.iosb.fraunhofer.de/servlet/is/18599/)  
[www.siegrist.de](http://www.siegrist.de)



## Safeguarding production processes

In delicate manufacturing processes, such as those involved in medicinal or food products, access control and monitoring systems are legally required. Rather than just restrict the physical presence of people in certain areas, these systems also have to keep an eye on server systems and comply with audit trail requirements. SysDesign GmbH of Baden-Württemberg, Germany, developed its KeyPilot solution to provide corresponding support.

KeyPilot is an electronic key switch suitable for industrial use. Thanks to globally unique identification numbers, it can assign keys to individuals while maintaining the highest possible level of security against manipulation. All ac-

cess attempts and user actions are automatically recorded in an electronic logbook. Unlike conventional key switches and password protection solutions, KeyPilot thus supports straightforward individual authorisations and the demands of the audit trail.

With KeyPilot's flexible administration software, users can manage access and usage authorisations for an entire facility from a single central server.

The solution's small reader unit consists of sophisticated analytical electronics and connects to control systems through a PROFIBUS, RS232, or USB interface. For simpler systems or those only needing an add-on solution, KeyPilot also comes in versions with relay output or three digital outputs.

In addition, KeyPilot can enhance TrackLock systems with person-based access control for use in the satellite-aided tracking and safekeeping of valuable and/or hazardous shipments.

At CeBIT 2010 in Hanover, Germany, SysDesign GmbH presented the TrackLock system as part of the SatNav Forum, a cooperation involving the German Aerospace Center and the German Federal Ministry of Transport, Building, and Urban Development. [www.keypilot.de](http://www.keypilot.de)



## Wesel fire brigade now putting out fires faster

When there's a fire, every second counts. The fire brigade of Wesel, Germany, now uses satellite technology to locate the nearest hydrants when on calls. Its firefighters rely on the navigation software RC-Win from Krämer Automotive Software GmbH of Reutlingen, Germany, which has been tailored to lead them to the water they need every time.

RC-Win's ability to import Point-Of-Interest (POI) data in a wide variety of formats is one of its most important features. For example, Wesel's fire brigade imports the GPS locations of hydrants in .klm (Keyhole Markup Language) format and displays them as specified POI icons on a map. The corresponding hardware includes a touchscreen Asus EeePC T91MT and a Navilock NL-302 GPS mouse.

When on a call, the lead firefighter uses the navigation computer to obtain directions and information on nearby sources of water. The map's zoom function makes it easy to determine the actual distance between hydrants, the fire, and the firefighters' current position. The Wesel fire brigade's 70 full-time members and some 250 volunteers have quickly become familiar with the new tool. "Wesel's firefighters are a great example of how modern commu-



nications technology can be used to increase efficiency," says Hans-Peter Schmidt, CEO of Krämer Automotive Software. Having started in early 2010, this ongoing reference project is now being expanded to other fire brigades.

[www.kraemerautomotive.com](http://www.kraemerautomotive.com)



## PTV Truck Navigation: Safety comes first

Trucks that drive on unsuitable roads can cause damage and endanger others. This is why truck drivers are warned time and again not to use navigation systems designed specifically for passenger cars: The guidance such devices provide often cannot meet the requirements they face. In truck driving, every centimeter counts, particularly in turning and performing other maneuvers. Plus, finding out too late that a bridge is too narrow or a tunnel's clearance height is too low can be expensive for transport companies.

PTV's truck navigator offers navigation optimised for trucks, saving time and money by giving priority to proper roads and avoiding secondary roads and residential areas. As a key safety feature, the software also factors truck-specific data into its map material. This includes limitations concerning weight, clearance heights, and routes where trucks are prohibited, as well as warnings about sharp curves, up- and downhill grades, and much more. The amount of truck data has been increased significantly in the latest version of truck navigator's maps, now covering around 80% of Germany's highways and 100% of those



in Switzerland, Austria, Great Britain, and the Benelux countries. Truck data is also available for other European countries.

The current version of truck navigator now also displays realistic road signs and intersection perspectives.

[www.mapandguide.com/products/mobile-navigation/truck-navigator/functions/](http://www.mapandguide.com/products/mobile-navigation/truck-navigator/functions/)

## A car that cares

Increasing car safety and enabling wellness applications in an automotive environment will help to reduce accidents. A joint European activity has created an open automotive infrastructure for network sensors and external communications in vehicles. As a result, enhanced integration of wireless communication and position location strengthened citizens' need for safety, health and wellness coupled to mobility.

After years of research and testing, a prototype car has been designed that supports citizens' needs in mobility and safety in the future. According to the market research company Strategy Analytics, the volume of electronics

installed in cars has grown from 2% to more than 20% of the production cost in the last 20 years.

Therefore, the focus of the investigation was not to build completely new systems but to deploy the electronics already available and establish an innovative sensor network. The resulting platform can then be used to run applications that will monitor a driver's vital signs and respond accordingly. In this way, the in-car environment can be adapted to the driver, resulting in a reduction of the accident potential and a corresponding decrease in the overall costs of transport. Additionally, the system can be used to monitor the state of health of passengers and alert healthcare services accordingly. An advanced emergency call combining positioning and multimedia services allows the establishment of a videocall between passenger and Public Safety Answering Point.

The open-source system has been implemented on a middleware platform applying OSGi technology for fast and easy gateway deployment. The car gateway is built over several layers integrating external communication (UMTS, WiFi etc.) and standard device protocols like UPnP.

For further information please contact Prof. Dr. Ralf Seepold, Chair for Ubiquitous Computing at HTWG Konstanz (Germany), E-Mail: [ralf.seepold@htwg-konstanz.de](mailto:ralf.seepold@htwg-konstanz.de)





## Quickly recover detected bombs and mines

Vallon GmbH of Germany is one of the technical leaders in the field of land mine and UXO detection worldwide. It offers complete detection systems, including data loggers and evaluation software. The detectors have outputs and inputs for computer evaluation and DGPS navigation for examining large areas on land and water.

The export functions of the software Vallon EVA 2000® 2.x also enable vectorial geo-referencing exporting of the colour map to a GIS, such as Google Earth™ or AutoCAD®.



Brand new: The software has been upgraded in order to allow rapid reacquisition of evaluated objects of interest after data evaluation. The corresponding object list with GPS coordinates is transferred to the Vallon Field Computer VFC2 (PDA). A GPS system is connected to the VFC2 (PDA) on-site. After selecting the desired object from the list, the operator is directed to the object by means of an arrow or a target symbol.

This makes clearance work very fast and efficient, better protecting the civil population against the dangers of the explosive remnants of war or other dangerous goods stored in metal containers.

[www.vallon.de](http://www.vallon.de)



## | MARKET - TECHNOLOGIES FOR APPLICATIONS

## Guarding GPS receivers against interference

Satellite positioning is an indispensable component of many of today's civil applications. Unlike in military uses, however, awareness of the GPS signal's susceptibility to interference is still low. Research performed by the electrotechnology department of HTWG Konstanz, a university of applied sciences in Germany, has demonstrated how vulnerable standard commercial GPS receivers are to disruptive signals.

In these experiments, GNSS signals were bombarded with narrow- and broadband interference, with a particular focus on disruptive signals that are similar to GNSS. While observing tracking loss and the associated lock-out, the

scientists involved also analysed measurement accuracy in follow-up operations. The study was led by Professor Wolfgang Skupin, a founding member of the security study group of the SatNav MIT Baden-Württemberg forum. Meanwhile, the study is now being supplemented with simulation experiments that replicate receiver behaviour under disrupted reception conditions. The goal of all this research is to analyse and improve signal integrity, as reliable positioning data is of great importance – particularly in security-related applications.

[www.htwg-konstanz.de\Fakultaet\\_EI.html](http://www.htwg-konstanz.de\Fakultaet_EI.html)



## Online geodata transformation enables high-accuracy elevation measurements

The importance of accuracy in measuring elevation is increasing in many fields. For example, while data from geographic information systems (GIS) is typically still limited to lowland areas, GIS applications that include elevation measurements are seeing more and more use. In order to derive common reference elevations (NN, NHN) from GNSS data (ellipsoidal elevations), a complex conversion programme is required. With its 3DIM line of products, the Seiler engineering company of Bühlertal, Germany, has come up with a suitable solution. The elevation measurements it produces are accurate down to the centimetre and are being utilised in surveying, construction, and increasingly in security-related areas.

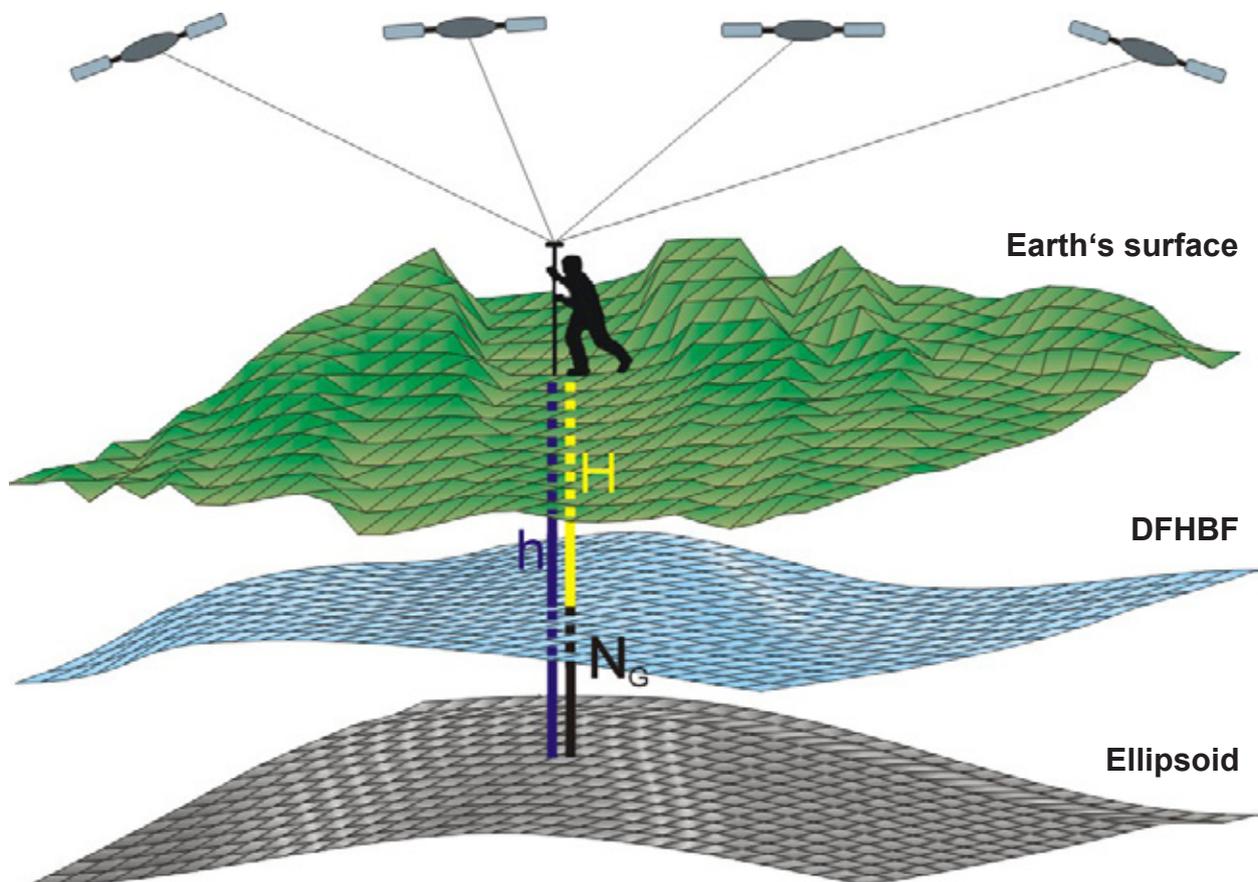
The worldwide RTCM standard serves as the foundation for the high-accuracy positioning of many GNSS corrective data providers. The GNSS data used in numerous applications is originally referenced based on the GRS80 ellipsoid or ETRS89. Conversion to local reference elevations is ne-

cessary. Seiler's 3DIM products handle this transformation online for high-accuracy fields in all three dimensions. Use of 3DIM is currently limited to Germany; Trimble GmbH is just one of the companies taking advantage of these products so far, having done so for six months.

According to Stephan Seiler, founding member of the security study group of Forum SatNav MIT Baden-Württemberg, "The trend we're observing in using elevation information more often in applications will make reliable and accurate three-dimensional geo-referencing indispensable." In addition to the increased prevalence of high-precision applications in surveying and construction, Seiler expects demand to grow in security-critical fields. "The technical requirements for safety and security applications have now been met," he says.

[www.ib-seiler.de](http://www.ib-seiler.de)

[www.dfhbf.de](http://www.dfhbf.de)





## 25 - 27 August: 1st Living Lab Summer School in Paris / France

## 22 September: Growing Galileo in Brussels / Belgium

Learn about the third call for proposals for GNSS research under the EU's 7th Framework Programme (FP7) at the Growing Galileo Information Day on 22 September in Brussels. Growing GALILEO 2010 will help interested researchers and companies hone their applications for satellite navigation projects under FP7. A total of €38 million is available through the third call, which will be published at the end of July 2010.

<http://www.gsa.europa.eu/go/news/growing-galileo-focuses-on-fp7-third-call>



## GNSS Seminars of Carl-Cranz-Gesellschaft

The Carl-Cranz-Gesellschaft has been imparting practical and relevant knowledge to specialists and executives working in the fields of engineering sciences within its seminars at university level for more than four decades. This autumn 3 seminars, taking place in Oberpfaffenhofen will be dedicated to GNSS. The scientific coordination of the seminars will be undertaken by Dr. J. Furthner, from the German Aerospace Center (DLR), Prof. Dr.-Ing. B. Eissfeller of the University of the Federal Armed Forces Munich, and Dr.-Ing. G. Heinrichs of IfEN GmbH.

### 12 -15 October:

Basic principles of satellite navigation and GPS modernization

### 8 - 12 November:

GPS/INS-Integration and Multisensor-Navigation

### 30 November - 2 December:

Indoor Navigation

## 5 October: ESA Investment Forum in Milan / Italy

## 6/7 October: Space Economy in the Multipolar World, SEMW-2010 Vilnius, Lithuania

## 18 October: ESNC Awards Ceremony in Munich / Germany

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