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Coordinates

Volume VI, Issue 4, April 2010

THE MONTHLY MAGAZINE ON POSITIONING, NAVIGATION AND BEYOND

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also:

Maps: Changing approach

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Mailing Address
11C Pocket A
SFS Mayur Vihar Phase III
Delhi 110 096, India.
Phones +91 11 22632607, 98102 33422, 98107 24567
Fax +91 11 22632607

Email
[information]talktous@mycoordinates.org
[editorial]bal@mycoordinates.org
[advertising]sam@mycoordinates.org
[subscriptions]iwant@mycoordinates.org

Web www.mycoordinates.org

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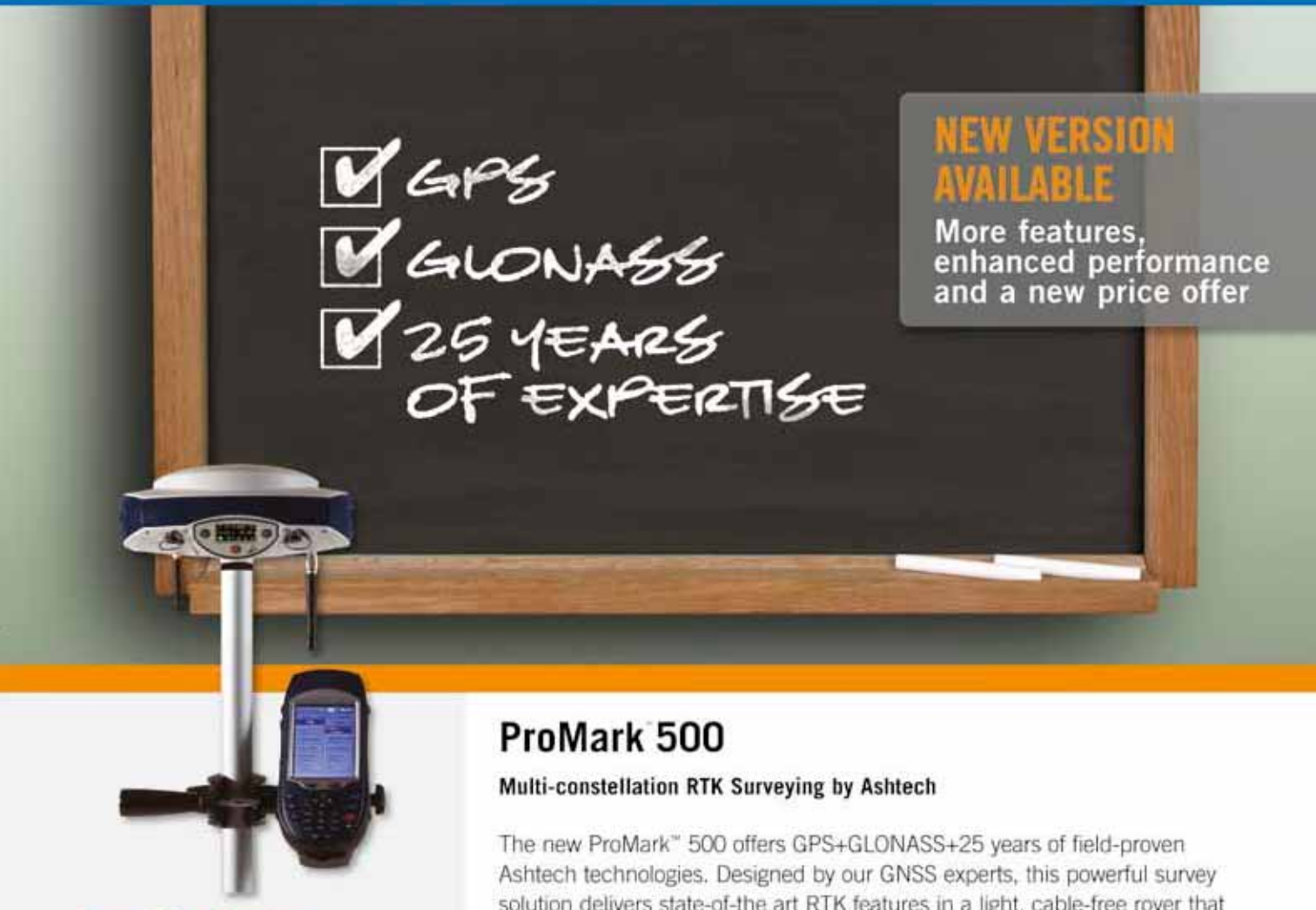

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My identity

Do you know...

That I know...

The process.

To determine positions.

Accurate positions.

Of 'what' and 'where'.

On and around this Earth.

I prepare the foundation.

The basics of 'knowledge'.

On which much can be built.

I play a role.

A very important role.

Who am I?

I know that you know.

Still, I reiterate.

That I am a surveyor.

Bal Krishna, Editor
bal@mycoordinates.org

ADVISORS Naser El-Sheimy PEng, CRC Professor, Department of Geomatics Engineering, The University of Calgary Canada, George Cho Professor in GIS and the Law, University of Canberra, Australia, Associate Professor Abbas Rajabifard Director, Centre for SDI and Land Administration, University of Melbourne, Australia, Luiz Paulo Souto Fortes PhD Associate Director of Geosciences, Brazilian Institute of Geography and Statistics -IBGE, Brazil, John Hannah Professor, School of Surveying, University of Otago, New Zealand

Maps: Changing approach

Web 2.0 allows small amateur mapmaker to produce maps that can almost immediately be published to promote and support their cause

William Cartwright
President
International
Cartographic Association
Professor, School of
Mathematical and
Geospatial Sciences,
RMIT University, Australia
william.cartwright@rmit.edu.au

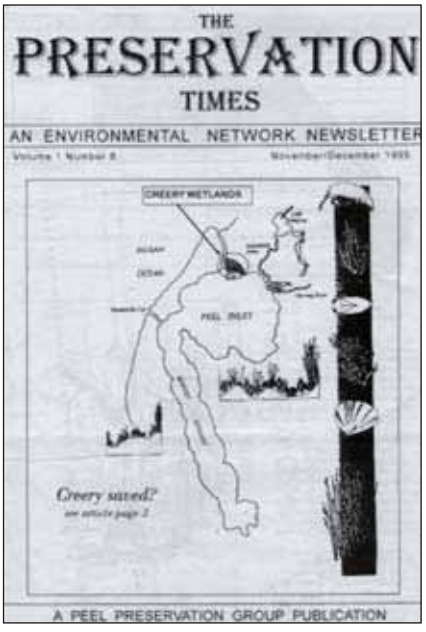

Fig 1. Source: http://www.green.net.au/ppg/creerywetlands.html

With the wide access to relatively inexpensive or freeware computer software for map production and using the Internet and the World Wide Web (Web) for dissemination this process has been automated somewhat, enabling the production of products and (Web) publishing to be fairly straight-forward. Using the Web as a publishing medium has allowed these relatively small voices to disseminate their viewpoint, which might otherwise be impossible if only conventional media could be utilised. Most recently using social media and Web-map Application Programmatic Interfaces (APIs), under the 'umbrella' of what has come to be called Web 2.0 (O'Reilly, 2005), provides a conduit whereby information and maps can readily be produced and made available, globally.

This paper looks at how movements for environmental protection now use Web-maps and other geospatial artefacts to disseminate their message. In the past various graphics and maps were developed, mainly in-house by amateur cartographers, to represent the information pertinent to environmental issues. Due to the very nature of the organisations, which, in many cases are staffed by volunteers, the maps produced have been produced by non-experts and generally printed on paper for subsequent distribution – until relatively recently. Now, with access to a wide range of geospatial products published via Web 2.0 software these organisations can be better informed.

Fig 2. United Nations Environment Programme (UNEP) Atlas of Our Changing Environment
Source: http://na.unep.net/digital_atlas2/google.php

Web 2.0

Web 2.0 was described as:

"… the transformation of the original Web of static documents into a collection of pages that still look like documents but are interfaces to full-fledged computing platforms. These Web-based services are proliferating so fast because they can be built using shared, standardized programming tools and languages developed, for the most part, by open-source software community" *(Roush, 2005, p. 49)*.

It has been made possible by three broad technology trends:

- Inexpensive Internet access;
- Inexpensive wireless computing devices; and
- The Web as a platform for personal publishing and social software (Roush, 2005).

About Web 2.0, O'Reilly (2004) coined a term «architecture of participation» to describe the nature of systems that are designed to encourage user contribution. Therefore, with Web 2.0 users make their own contributions, they share documents and they are attuned and skilled at composing their own compilations of rich media to facilitate 'self-help' information provision. Web 2.0 is basically about the use of Social software for 'personal publishing' via Blogs (personal electronic 'journals' built on-line using sites like Blogger, LiveJournal, Movable Type and WordPress (Roush, 2005)), retrieve collaboratively assembled information resources (including geospatial resources) using Wikis (Web sites that allow the free posting of un-moderated

content that is continually reviewed and modified by contributors – eg. Wikipedia (http://www.wikipedia.org), and, for mapping, publish maps via mash-ups.

Web 2.0 and cartography

Web 2.0 presents a new view on what can be done when provisioning users with cartographic materials. It is a different way of delivering cartographic media which, in many cases is basically non-cartographic, but delivers information that needs to be spatially defined and controlled if us-able geographical information is to be assembled. Maps are being enhanced by the use of social software to make them more affective, so as to personalise them and to thus impart more usable and pertinent information. This will rely on 'pulling' resources from the Web and also having Web resources 'pushed' to users via software like RSS (Really Simple Syndication) readers.

Perhaps the main issue for cartography is the fact that now the amateur map publisher is now a map provider as well as traditional publishers. Collaboration via Web 2.0 allows users to produce maps as mash-ups, which combine already available maps and satellite imagery (for example from Google Maps© or Google Earth©) and overlay their own data. Base maps or satellite imagery is 'mashed' together with pre-existing geospatial artefacts. Mash-ups allow maps to be produced by mixing services delivered through a third party using a publicly-accessible and usable interface or an API, Perhaps the most widely-used mapping application is that provided by Google Maps©. It provides base maps of almost anywhere that can be used as an 'underlay' for individual annotation with default symbols or specially-created symbology. Map views are available as topographic or street maps (perhaps the most widely used maps are street maps), imagery (satellite or aerial), hybrid (maps plus imagery) and street (360 degree views of some locations). They allow user-producers to generate information overlays and map annotations that could be described as 'geo-notes'.

Case Study – Environmental movements in Australia

In Australia many Environmental protection movements depend on volunteer-produced publications, with included maps to accompanying articles. They were produced 'in-house' and had a 'homespun' look, even in the mid-1990s. An example is shown below - the Preservation Times - an "Environmental Network Newsletter". An example of a map from this publication is provided in Figure 1. Historically, these maps were prepared by hand-drawn techniques and replicated by printing. Later, publications, were probably produced using DeskTop Publishing (DTP) tools and multiple copies made using relatively inexpensive processes like photocopying. The production of the maps was hampered by the availability of graphics production tools or software. This could result in products that, when evaluating the 'look' of maps compared to their commercially-generated counterparts, appeared to be inferior. New and available tools were needed for map production and publication. Web 2.0 provides a method for collaborative publishing using Social Software that enables amateur cartographers to produce professional products. This method for map publishing is covered next.

Fig 3. Redfern/Waterloo Tour Of Beauty. Source: http://www.squatspace.com/blog/.

Social media and map publishing

Perhaps the best products of this genre are Google Maps© and GoogleEarth©. Both products enable maps and 3-dimensional drawings to be produced on-line. Both Google products have generated an enormous interest in Web-delivered geographical information. Google Maps© grew by 51.57% in 2007 and the site received almost 90,000,000 unique visitors in 2007, up from around 60,000,000 in 2006 (Techcrunch, 2007).

Web 2.0 and maps to support movements

International and national organisations have embraced Web 2.0 for map publishing. It has enabled them to produce high-quality graphics to promote their particular cause. One international example is the United Nations Environment Programme (UNEP) Atlas of Our Changing Environment (Figure 2). This atlas uses Google Earth© as an underlay for depicting environmental changes. Users can view global information and make international comparisons. As well, individual country and regional information can be viewed by zooming into a particular area of interest. Hot spots then allow interrogation of specific information elements and to open additional pages. The product is a Web-delivered atlas, with base imagery and maps coming from the Google Earth© application. Organisations like UNEP can become almost instant atlas publishers, without the need to build their Web atlas application from scratch. Now looking at Web 2.0 and two Australian movements – Squat Space, a local organization in the Redfern/Waterloo suburb of Sydney and the environmental movement. These two case studies have been chosen for inclusion in the paper, as they illustrate the diverse nature of how Web-map APIs have been used to support the dissemenation of spatially-defined information. Squat Space is a small organization that endeavours to improve the living conditions of this deprived inner city area. At the other extreme is the environmental movement: nationally organized, enthusiastically supported and championing causes that stand against actions that might degrade the quality of Australia's environment.

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Squat Space organised the Redfern/Waterloo 'Tour Of Beauty', an event that invites residents to explore their suburb, so as to better understand the elements that constitute where they live and also to provide an opportunity for residents to get to know each other. Advertising for the event began with the distribution of a paper map, and accompanying literature asked residents interested in participating in the Tour of Beauty to return the map, with their location of domicile marked. Once this information was returned and collated the Tour was planned and advertised. This was done using Google Maps© (Figure 3). This example shows how local resident action movements can better promote and organise their activities using Web 2.0. The maps produced as part of the Tour of Beauty supported information communication in a manner that was more effective than conventional 'print and post' methods. Wider scale applications of map publishing with Web 2.0 is described in the following sections.

The Anti-logging movement in Australia involves many active organizations.One major concern in Australia is inappropriate logging of prime forests, with little influence from the general public about what happens. Because timber harvesting occurs in remote areas the problem, for many, was that the actual logging activities were "out of sight out of mind". Massive tracts of forest were being removed, causing untold devastation to the environment. For example, each year in the Australian State of Tasmania, approximately 15,000 hectares of native forest are destroyed. (The Wilderness Society, 2006).

Information about what would happen is hard to get for an interested citizen. Areas designated for felling need to be identified on 'formal' governmental publications like appendices to Acts (maps) or to make educated speculations, supported by official forest reserve maps. But, for information seekers who might be inexpert at map resource research they will remain uninformed or ill informed without the means to track-down pertinent information. How can they discover "what's happening"?

Small organizations rely on making information available by taking governmental maps, scanning and cropping the information needed about a particular logging area and then making this information available through their Web site. Typical of these small organisations is the Dingo Creek anti-rainforest logging organisation (http://www.geco.org.au/2005/dingock05.htm). It works to halt logging in the East Gippsland (in the State of Victoria) rainforest by protesting at the forest coup and also undertaking legal proceedings. The organization publishes maps of the coups under threat of logging, or already being logged. The maps are annotated government publications and contain no additional information from the organisation itself. More impact is had from the publication of paper maps (produced with DTP tools) by Australia-wide organizations. They can collect information and then publish their information as maps.

The map shown in Figure 4 is such a map – produced jointly by the Wilderness Society, The Australian Conservation Foundation and Greenpeace. Now the Wilderness Society uses Google Earth© to show the impact of forest clearing. Its Web site provides immediate information about Australia-wide environmental issues. The screen grab shown in Figure 5 illustrates the Society's pages focusing on logging for woodchip production in Tasmania.The Tasmanian arm of The Wilderness Society and the Victorian Rainforest Network (VRN) produced maps (Figure 5) pinpointing where trees were being harvested, providing clear evidence of the impact of timber harvesting in this State. Google Earth© imagery was also used to highlight the sheer size of woodchipping in the State by including an image of the Gunns› woodchip mill at Bell Bay, Tasmania (Figure 6). It was included in the Wilderness Society Web page that highlighted the impact of clearfell timber harvesting and the eventual use of this natural resource: to produce woodchips for export. Looking further north, in the State of Victoria, clearfell logging was permitted in the Otways until 2008, when all remaining sawlog licences expire. Google Earth© images were generated to illustrate where logging would occur up until this time. The overlays were developed by the Otway Ranges Environmental Group (The Wilderness Society, 2006).

Another organization that monitors environmental matters is Bad Developer. Through its Web site and by utilising Google Maps© and Google Earth© it highlights inappropriate development.Looking at one example of maps published using Google Earth© is in the State of Victoria, where a water supply company, Southern Rural Water, was found to be using Acrolein. Bad Developers exposed the results of this practice. On the mashup shown in Figure 7 the orange shows location of channels sprayed with Acrolein in January and November 2005.

This section has provided some examples of how Google Earth© and Google Maps© have been used to publish maps by an inner city urban movement and environmental organizations for highliting inappropriate development or activities in environmentally sensitive areas. These organizations have found that publishing in this manner is a most effective conduit for their information transmission. They have said: "Google Earth allowed the group to more effectively convey the impact of logging, which had been difficult to do previously as many Tasmanian forest areas were closed off to the public". «For those people who don›t go out to the forest a lot, it basically unlocks the gates,» … (Moses, 2006).

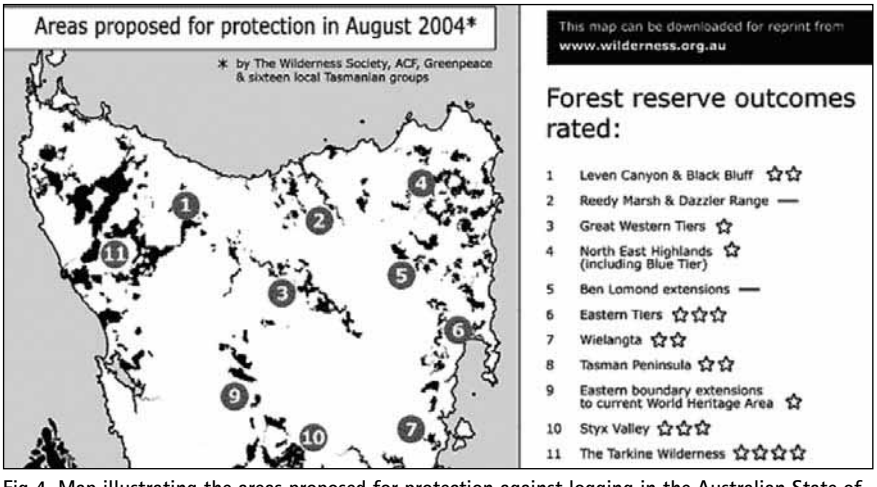

Fig 4. Map illustrating the areas proposed for protection against logging in the Australian State of Tasmania (August 2004). Source: http://www.news-tasmania.com/forestry-outcome.gif

Changes

Crawford (2006) wrote that computers are being used differently with Web 2.0. This illustrates a shift from the conventional publishing model. She writes: "But what has changed over the past 15 years is that they (the users) no longer represent the only way to produce and distribute creative work. As computing power has become more affordable and software has become more powerful, the creative potential of what can be done at home – and at relatively low cost – has soared. And there has been an explosion of creative production as a response. It has been described as "mass amateurisation": the masses now have greater access to the means of cultural production. We are witnessing a crucial shift as the gap narrows between what can be done at home and what is professionally produced; amateur productions take on professional approaches and professional productions make use of the amateur aesthetic." (Crawford, 2006, p. 23). She goes on to say: Everyone is making something, collaborating on something or distributing something. It doesn't matter if it's a zine, a new media installation, a piece of software, an album, a short film or a photo blog" (Crawford, 2006, p. 23).

Conclusion

With access to sophisticated computer hardware and software, linked by communications devices that are now readily available, the map-maker's palette is now richly and extensively provisioned with the means for depicting and delivering renderings of geographical information in a more timely, resourceful and exciting manner. The use of Social Software and Web 2.0 typifies this. Web 2.0 allows small amateur mapmaker to produce maps that can almost immediately be published to promote and support their cause. The use of such technologies and their ability to communicate globally is clear. How best to include emotion in these sandardised look and feel products needs to be addressed if powerful messages are to be delivered.

Fig 5. Woodchip production in Tasmania. Source: http://www.wilderness.org.au/campaigns/forests/tasmania/tas-forests-google/

Fig 6. Gunns› woodchip mill at Bell Bay, Tasmania Source: http://www.wilderness.org.au/campaigns/forests/tasmania/tas-forests-google/

Fig 7. Source: Bad Developers http://www.baddevelopers.green.net.au/Docs/gmw.htm

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Presented at UNRCC, Bangkok October 2009

Being under watch

All cars in the Netherlands will be equipped with an OBU logging all movements. At the end of the month the registered keeper of the car will be invoiced for the usage of the infrastructure. That's the plan of the government and the implementation beginning in 2012 should be finalized in 2017. Does this open the door for a continuous monitoring of citizens?

Martin Grzebellus
Managing Director
NavCert GmbH
Martin.Grzebellus@tuev-sued.de

The Netherlands are a small country in the North West part of Europe with a high density of population. The area of only 41.000 km² is used by 16 Mio. Inhabitants, resulting into 400 inhabitants per km². There is an excellent infrastructure with 2.300 km of motorways and 137.000 km of roads in total complemented by a network of railways and bicycle tracks. The roads are used by 8 Mio. cars and 140.000 heavy goods vehicles. Although the motorways offer up to 6 lanes per direction, during peak time the roads are completely congested. The congested area is not only close to the main metropolitan areas of Amsterdam or Rotterdam like Paris in France or London in the UK but covers nearly the complete country; thus a distance of 100 km only on motorways typically requires 3 hours for driving with an average speed of 33k/h.

Already in 2004 a Mobility Memorandum was agreed as the congestion ranked high on the political agenda and in addition also the climate changes and CO_2 emission played an important role. The Netherlands Minister of Transport, Mrs. Karla Peijs installed a platform "alternative payment for mobility" with the involvement of directors of social organizations and representatives from the private sector. One year later the platform recommended in the Memorandum Road Pricing the main components for construction, utilization and pricing. In 2006 a joint fact finding with social organizations and government agencies was initiated and complemented by a market survey on system costs. Again one year later under the government of Mr. Balkenede, the government opted for the introduction of road pricing which led in 2008 to the start of the certification and tendering process. In the same year, the legislative proposal was accepted by the council of states. In the last year 2009, the Road Pricing Proposal was presented to the Lower House of Parliament. At the same time the market consultation began and a number of mobility projects were issued in parallel.

The kilometer pricing was based on the principles presented below. All fixed vehicle taxes both for the purchase and the use of the cars should be eliminated, instead a variable fee depending on the kilometers driven should be introduced in which the charge depends on the car used. In order to allow a control and management of the traffic, the fee should be dependent on time of day and type of route driven. Thus opposed to a tax on gasoline driving on high frequently used roads would be more expensive than on a standard road and even more expensive during peak time. The fee should be applied on all roads in the Netherlands and be applicable to all vehicles. To reflect the environmental requirements, the cars should be classified largely according to their CO_2 emission. As there is no chance to install toll portals on all roads for all segments, the only feasible technology for this project is to use GPS as the dominating meter to calculate the trip distance. In order to allow a high privacy, a smart OBU would be required which can calculate the fees per trip and will only transmit aggregated fees but no individual trip data nor the actual position and heading of the car in real time. One important factor was that there would be not be any tendering process to select one service provider collecting all fees but that this should be achieved in a fair open competitive market. Thus in principle every company would be allowed to operate as a service provider. However to ensure that the fees will be collected and transferred with high reliability and quality, a certification of the service provider and appointment by the ministry would be key to become a service provider.

The next step is now to implement the legislation during the run of 2010. In this year all (parallel) mobility projects should become operational. The set up for the certification should be defined and the tendering contracts issued. Most important the definitive go / no-go decision has to be taken and based on this the further structuring of the organization and the systems could be initiated. Unfortunately in February this year the government resigned for other reasons and the project will be on hold till the election of the next government in May 2010. In case of a positive decision a large scale operational test will start in 2011 with 60.000 cars as a preparation for the introduction of road pricing for heavy goods vehicles in 2012. At the same time the introduction of road pricing for passenger cars will start and finally in 2018 the fixed car taxes should have been completely phased out and the road pricing should be fully set up and implemented.

Looking to the expected positive results to the environment, society and the Individual however the new government will have difficult times not to proceed with the project. The Table 1 shows the overall expected positive effects although the overall number of cars will have been increased by 2 to 3% by that time:

In order to convince the voter that

Expected effects in 2020	
Number of kilometers driven	-10% to -15%
Travel time	-40 to 60%
CO_2	-10%
Particulate matter	-10%
NOx	-19%
Kilometers on public transport	+6%
Traffic safety	+7%

Table 1

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the project will not lead into any disadvantages, the ministry and the minister have given three guarantees in the beginning of the project:

In average nobody will pay more

The fees for the usage of roads will not be charged in addition or be higher than as of today but just be in total a replacement of the existing fixed taxes on purchase and use of cars. On an individual base however, somebody who uses his car only occasionally should have much less costs with the new system than with the existing taxes and somebody who drives regularly high frequently roads during peak hours will have more costs than as of today.

Ceiling for operation costs

All service providers offering to collect the traffic fees have to accept that they will get at most 5% of the collected taxes as handling fee. The administration costs in other countries are ways above and typically in the range of 10

to 15%. However service providers today do not serve such a huge market and everybody is looking to scaling effects to offer a profitable service.

Privacy will be respected

Every service provider has to offer a smart OBU in which all the individual calculation of the trips will be accomplished. Only aggregated fees will be transmitted to the service provider preventing the usage of real time position data.

In the following only the privacy aspects will be further analyzed.

As every service provider will have to offer to its clients a smart OBU, there is no necessity to transfer trip data outside of the OBU. Only aggregated data will be transmitted to and processed by the service provider. However in case of dispute the registered keeper of the car will have access to check his individual trip data. So there will be a method to retrieve the trip data out of the OBU and quite some efforts have to be implemented to prevent misuse. However as it is today not clear which information will be shown on the invoice and how detailed aggregated still might be, it is too early to confirm that the privacy will be assured in any case. In addition the judiciary will also have the right to access the data without the support by the registered car keeper. In Germany with a similar system in place

NXP and IBM announce results of landmark Road Pricing Trial

Netherlands trial demonstrates how advanced road pricing technology can incentivize drivers to change their behavior and reduce traffic congestion
NXP Semiconductors and IBM announced the final results of a landmark road pricing trial conducted in the Netherlands, which demonstrated that with the help of technology, drivers can be motivated to change their driving behavior, reducing traffic congestion and contributing to a greener environment. The six-month road pricing trial, conducted in the city of Eindhoven, was designed to provide the Dutch government with insights to address the challenge of traffic congestion in the Netherlands. The test was overwhelmingly successful, with 70 percent of drivers changing their behavior to avoid rush-hour travel when presented with the right incentives, demonstrating that road pricing systems can have a positive effect on driving habits and help alleviate traffic.

Key findings of the trial included:
70 percent of drivers improved their driving behavior by avoiding rush-hour traffic and using highways instead of local roads.

On average, these drivers in the trial saw an improvement of more than 16 percent in average cost per kilometer.

A clear system of incentives is critical to changing driving behavior.

Instant feedback provided via an On-Board Unit display on the price of the road chosen and total charges for the trip is essential to maximizing the change in behavior.

The Netherlands Road Pricing Trial in Context
The Netherlands will be introducing a new road-use charge starting in 2012 for trucks and lorries, and 2013 for passenger cars. The new road pricing system – Paying differently for mobility (Anders Betalen voor Mobiliteit) – is expected to be up and running nationwide by 2016.

Many EU countries are now in the process of exploring road pricing programs as one of the measures to reduce congestion and CO2 emissions. In the Netherlands, once fully implemented, the Price per Kilometer (De kilometerprijs) system is expected to achieve the following benefits. (1)

A 58 percent reduction in delays caused by traffic jams;
A 15 percent reduction in the total number of kilometers driven annually;
A 10 percent reduction in CO2 emissions;
A 6 percent increase in total passenger kilometers via public transportation;

More than 50 percent of Dutch households will pay less than they do currently for the motor vehicle tax and vehicle purchase tax. *www.ibm.com www.nxp.com*

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only for heavy good vehicles, a special law was issued to prevent the usage of the individual trip data for any other reason outside of road charging. In the past year there was a serial murderer active on highways and the police could trace down the number of suspects to truck drivers. They were quite sure to identify the murderer by analyzing the data collected for road charging and still available about the exact movements of trucks. However due to the legal framework, the (mis-) use of this data was rejected by court even in case it would help to prevent further murders. But this level of privacy will not be replicated in the Netherlands and the balance between trust and control will be more on the control side. In addition the service provider will be able to offer value added services, which typically require knowledge on location and heading in real time. Thus it is planned that the service provider also might make use of thin OBUs which transfer all position data and information about driven distance in real time. In this case, the registered car keeper has explicitly give his prior written approval for the processing of individual trip data, however it is still open how this might be communicated to the driver of the car. Lease companies might consider this as a excellent idea to collect further fees by charging fees per kilometer for which the speed of the car was higher than the legal maximum speed for this leg of the road. The service provider is legally bound in the usage and processing of the data by the Personal Data Protection Act effective since 01-09-2001. During the certification process the proper implementation and correct usage might be checked and validated.

Looking to the initial discussion on big brother one can conclude that in principle the guarantee of the minister on privacy can be achieved as

- Only aggregated data is transferred
- Access to trip data in OBU only by registered car keeper
- Privacy law in place.

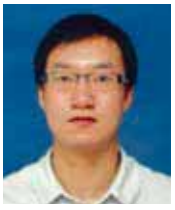
However as of today the processes and procedures are not know about potential threats like

- Details of aggregated invoice might provide too much information
- Access to trip data available in which cases of criminal activities under which conditions
- Requirements and control for processing of location and trip in real time
- Communication to driver of the car about monitoring his individual trips and not only to the registered keeper of the car

The privacy will be assured on three complementary levels. On the first level, the privacy is secured with technical measures; e. g. the OBU will protect the individual trip data against unauthorized access like a safe. On the second level the regulation will provide additional confidence requiring obeying the law on Personal Data Protection Act like a guard in the entrance to the safe. The last level relies on check and validation by independent highly trustworthy entities, accredited and appointed by the ministry, like the TÜV organization to certify conformance with all requirements for the products with the initial type approval and within the service providers based on periodic certifications. Then big brother will not be watching you.

On the estimable parameters for selenodesy with space VLBI

In this paper, based on the SVLBI observations, the basic observation mathematical model for geodesy and selenodesy is introduced



Wei YAN
Ph.D candidate, School of Geodesy and Geomatics, Wuhan University, China
2201feihong@163.com

Erhu WEI
PhD, Professor, School of Geodesy and Geomatics, the Key Laboratory of Geospace Environment and Geodesy, Wuhan University, China
ehwei @sgg.whu.edu.cn

Jingnan LIU
Professor , Academician of CAE (P.R. China) , GNSS Center, Wuhan University, China
jnliu@whu.edu.cn

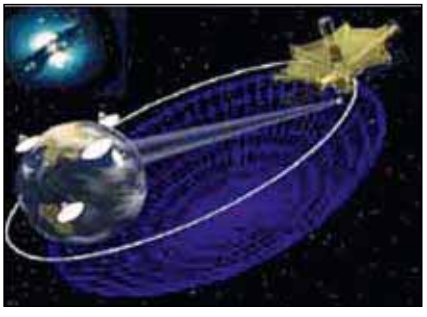


Fig. 1 Space VLBI

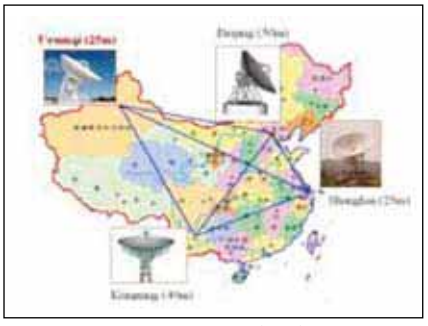


Fig. 2 Chinese VLBI Network (CVN)

Space Very Long Baseline Interferometry (SVLBI) is an extension of the ground-based VLBI technology to space, which involves a simultaneous observation of the same radio source by two stations; one on the ground, the other being space-based. It could not only overcome the baseline length limitation problem specific to ground-based VLBI technology, with a great improvement on the observation resolution, but could also directly interconnect the important three reference systems (that is Terrestrial Reference System, Celestial Reference System, and the Dynamic Reference System). These advantages imply tremendous potential for SVLBI in space geodetic applications. The successful launch of Chang'e-I lunar probe makes it possible to place a VLBI antenna on the lunar probe some day to form ground-space VLBI observations. As an important component of the Chinese VLBI Network (CVN), Urumqi astronomical observatory will play an essential role. Based on all these factors, it is necessary for us to investigate the mathematical model with SVLBI observations in selenodesy studies.

Basic mathematical model

We suppose the propagation of the signal observed by Space VLBI from extra-galactic compact radio source to nearby earth (including the surface of the earth and the deep space probe) as being parallel. The range difference L between two antennas toward some certain radio source can be described as: $L=c\tau_g$ (1.1)

Where c denotes the vacuum light speed, τg denotes the time delay. Assume that $\vec{B}_i^I$ represents the baseline vector between ground-based VLBI station and the deep space probe, $\vec{K}$ represents the direction of the observation source, then we could get:

$$\tau_g = -\frac{1}{c}(\vec{B}_i^I \cdot \vec{K}) \quad (1.2)$$

Motions of both the earth and the probe result in the constant change of the baseline vector, thus τ_g is a function of time. Its derivative with respect to time could be described as the delay rate $\dot{\tau}_g$, which is

$$\dot{\tau}_g = -\frac{1}{c}\frac{\partial}{\partial t}(\vec{B}_i^I \cdot \vec{K}) \quad (1.3)$$

The main observations of Space VLBI in the deep space geodesy are time delay and its rate. In real circumstance, we could not obtain τ_g directly, for various kinds of errors are unavoidable in the actual observations, such as clock error, equipment time delay, propagation medium latency, etc. Suppose that τ denotes the actual latency observation, then we have: $\tau=\tau_g+\tau_c+\tau_i+\tau_p+.....$ (1.4)

Where τ_c denotes the clock synchronization error between stations, τ_i denotes the equipment time delay between stations, and τ_p denotes the propagation medium latency. Therefore, the range difference yield by real VLBI observation can be described as:

$$L=-(\vec{B}_i^I \cdot \vec{K})+c(\tau_c+\tau_i+\tau_p+.....) \quad (1.5)$$

Where $\vec{B}_i^I, \vec{K}$ are often defined in different coordinate systems. In order to hold the equation, we should transform all different terms into a unified coordinate system. In the following section, we will discuss the different coordinate systems involved in the launching process of the lunar probe, their transformation as well as the mathematical model for Space VLBI in selenodesy.

Coordinate system

The orbit of lunar probe can be divided into phasing orbit, cislunar transfer orbit and circum-lunar orbit. According to

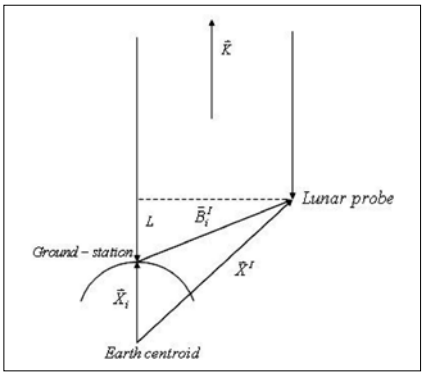


Fig. 3 The theory of SVLBI

the coordinate systems corresponding to different orbits, here we demonstrate the phasing orbit and cislunar transfer orbit as cislunar period, with earth satellites as its probe; and illustrate the lunar orbit as the circum-lunar period, with lunar satellites as its probe.

Coordinate systems corresponding to different periods

Cislunar period

Real space VLBI observation should be done under the Newton inertial coordinate system. Because of its independence from the self-rotation of the earth, the coordinate of every point on the earth under the inertial system varies with the earth's rotation. In order to conveniently describe the position of ground stations, an earth-fixed coordinate system should be established depending on the technologies of GPS, etc, which could be named as Conventional Terrestrial System (CTS). In cislunar period, position of the ground VLBI station should be described under this system. Also, the lunar probe in the cislunar period serves as an earth satellite, therefore we could define both its dynamic equation and coordinates under the *J2000.0* geocentric inertial coordinate system. Radio source direction vector is established based on *FK5* star table under the *J2000.0* heliocentric inertial coordinate system.

Circum-lunar period

In this period, ground VLBI station and radio source direction vector still refer to the earth-centered earth-fixed coordinate system and the *J2000.0* heliocentric inertial coordinate system respectively. Coordinate of the lunar probe in this period has a close relation with the barycenter of the moon (that is lunar ephemeris), while planetary ephemeris of the solar system is given in the heliocentric ecliptic coordinate system, thus motion status of the interstellar probe away from earth should be discussed in this kind of system too. At present, the applied heliocentric ecliptic coordinate system refers to the *J2000.0* heliocentric ecliptic coordinate system, with its basic plane and principle direction indicating the *J2000.0* mean elliptic and mean equator respectively. Position of the lunar probe in the circum-lunar period could be demonstrated in this system. On the other hand, for convenience, chang'e-1 lunar orbiter still gives the coordinate of the lunar probe under the *J2000.0* geocentric inertial coordinate system, which only has a translation amount with the selenocentric inertial coordinate system. Therefore, coordinate of the lunar probe could be also given in the selenocentric inertial coordinate system, whose definition is similar to the *J2000.0* geocentric inertial coordinate system, and could be named as *J2000.0* selenocentric inertial coordinate system.

Transformation between coordinate systems

Coordinate system transformation involves coordinate translation and rotation, among which the coordinate rotation is often realized by basic rotation matrixes as:

$$R_X(\theta)=\begin{bmatrix}1 & 0 & 0\\ 0 & \cos\theta & \sin\theta\\ 0 & -\sin\theta & \cos\theta\end{bmatrix},\quad R_Y(\theta)=\begin{bmatrix}\cos\theta & 0 & -\sin\theta\\ 0 & 1 & 0\\ \sin\theta & 0 & \cos\theta\end{bmatrix},\quad R_Z(\theta)=\begin{bmatrix}\cos\theta & \sin\theta & 0\\ -\sin\theta & \cos\theta & 0\\ 0 & 0 & 1\end{bmatrix}$$

Where subscript $i(i = X,Y,Z)$ denotes rotation with respect to i-axis, θ denotes rotation angle, $R_i(\theta)$ refers to orthogonal matrix with following property: $R^{-1}(\theta) = R^T(\theta) = R(-\theta)$, among which R^{-1} and R^T indicate inversion and transposition of matrix R respectively.

(1)Transformation between the CTS and the *J2000.0* geocentric inertial coordinate system can be described as:

$$R=(EP)(ER)(NR)(PR)r \qquad (2.1)$$

Where r represents the position vector under the *J2000.0* geocentric inertial coordinate system, R represents the position vector under the CTS, (EP), (ER), (NR), (PR) denotes the polar motion matrix, diurnal rotation matrix (Greenwich hour angle), nutation matrix, and the precession matrix respectively. Specifically, we have:

$$(PR) = R_Z(-z_A)R_y\theta_A R_Z(-\zeta_A)$$

$$(NR) = R_x(-(\bar{\varepsilon}+\Delta\varepsilon))R_y(-\Delta\psi)R_z(\bar{\varepsilon}) = R_x(-\Delta\varepsilon)R_y(\Delta\theta)R_z(-\Delta\mu)$$

$$(ER) = R_z(S_G)$$

$$(EP) = R_Y(-x_p)R_x(-y_p)$$

Where ζ_A, Z_A, θ_A indicate the equatorial precession parameter; $\Delta\mu = \Delta\psi\cos\varepsilon, \Delta\theta = \Delta\psi\sin\varepsilon$ represent the right ascension and declination nutation respectively, $\bar{\varepsilon} = \varepsilon - \Delta\varepsilon$ denotes the mean obliquity, $\Delta\varepsilon$ and $\Delta\psi$ denote the nutation in obliquity and longitude respectively; S_G indicates the earth rotation angle, i.e. Greenwich sidereal time; and x_p, y_p denote the polar motion components. Therefore transformation between the *J2000.0* geocentric inertial coordinate system and the CTS can be demonstrated as:

$$r = (PR)^{-1}(NR)^{-1}(ER)^{-1}(EP)^{-1}R \qquad (2.2)$$

(2) Transformation between the heliocentric coordinate system and the geocentric coordinate system

Suppose the coordinate of some certain occurrence under *J2000.0* heliocentric inertial coordinate system and the *J2000.0* geocentric inertial coordinate system as $\vec{X}$ and $\vec{x}$ respectively.

Then according to the time and space theory of Newton classical mechanics, relationship between two coordinate systems satisfies Gallilean transformation shown as follows:

$$\vec{X} = \vec{x} - \vec{X}_E(t) \qquad (2.3)$$

Where $\vec{X}_E(t)$ denotes the geo-center position vector under the heliocentric inertial coordinate system at time t. This transformation completely neglects the influence of Lorentz contraction and gravitational contraction, together with relativity geodetic precession and the temporal bent effect. With improvement of the VLBI technology, time delay observation precision obtained by VLBI at present is superior to $5\times10^{-11}s$, while influence of relativistic effects on time

TRIUMPH 1
TRIUMPH – 4X
216 channels

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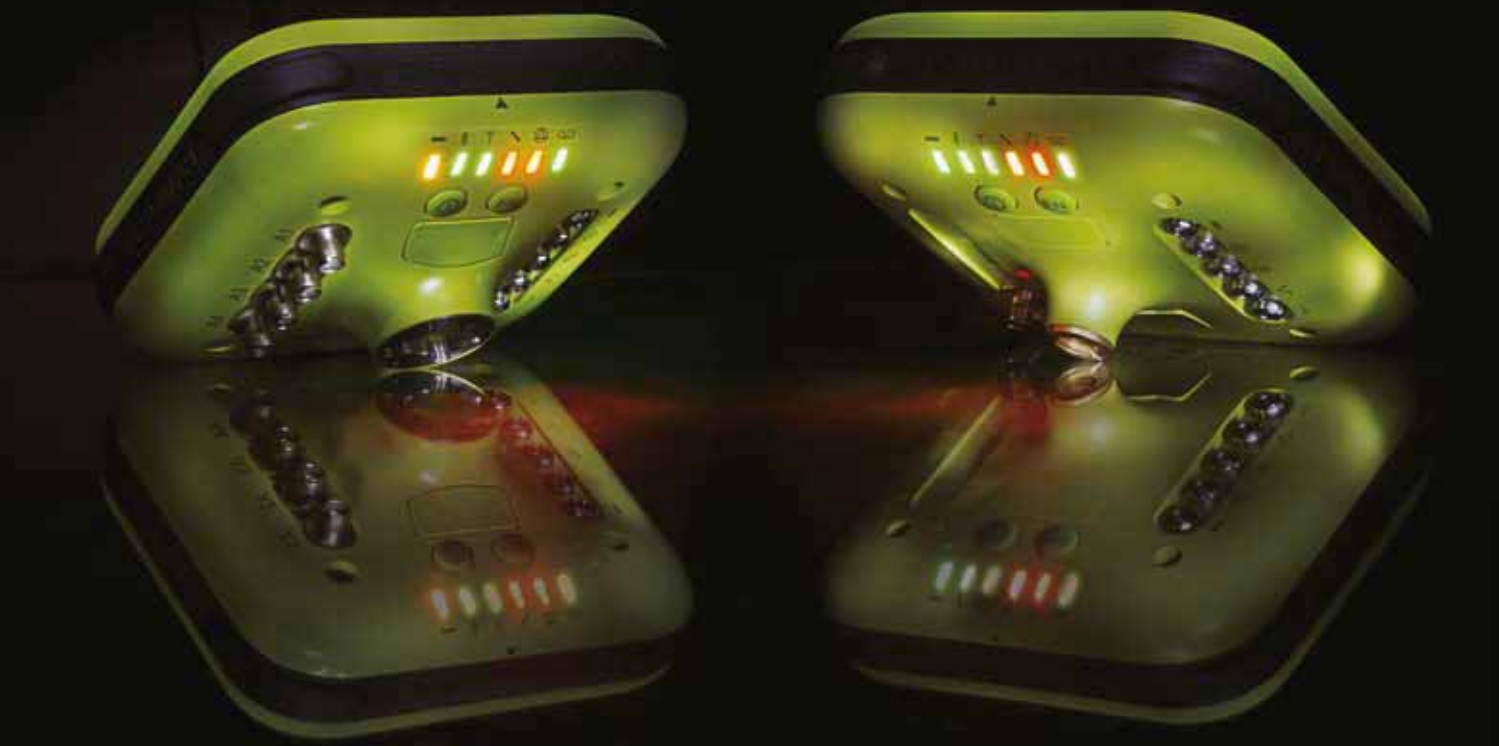
JAVAD ArcPad Extension
in focus



JAVAD ArcPad Extension

In response to a long-standing request from ESRI, JAVAD GNSS is pleased to announce that ArcPad users can now communicate directly with ESRI ArcGIS Server via our Triumph receiver so no additional devices (external radio) or settings are required. Real-time centimeter-level positioning is now possible in the field for ArcPad users.

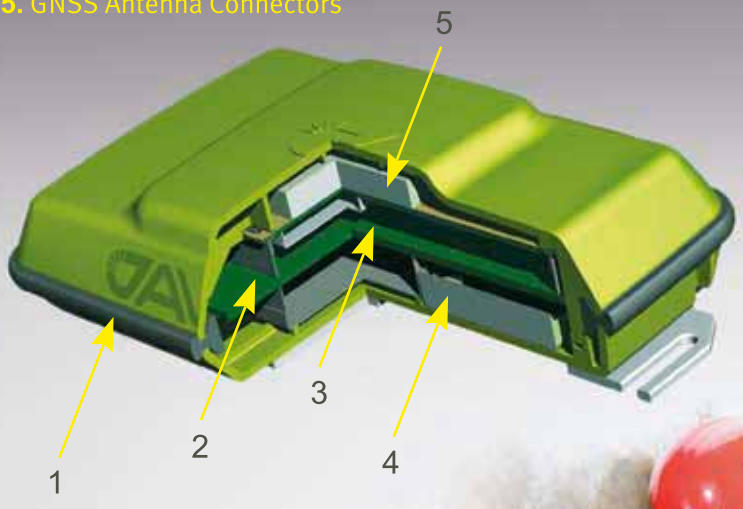
- JAVAD ArcPad Extension enhances the spectrum of ArcPad's surveying capabilities by adding state of the art JAVAD GNSS solutions. JAVAD ArcPad Extension provides a full range of functions to control the GNSS receiver and manage the surveying process.
- JAVAD ArcPad Extension establishes a connection to the receiver via serial, USB, or Bluetooth and configures the base station parameters that govern the RTK and UHF radio setups, and GSM modem settings.

- Quality control of real-time positioning results are assured in the field. The JAVAD GNSS Victor PDA displays the status/process progress continuously via the Bluetooth connection to the receiver.
- Advanced RTK accuracy and ArcPad vector/raster map visualization capabilities deliver reliable object positioning and a new level of job control in the field.
- JAVAD ArcPad Extension is an optimal ESRI-compatible solution for a wide variety of civil engineering or cartography tasks where centimeter level accuracies are required. At the core of this solution lies highly integrated JAVAD GNSS technology optimized for use with ESRI's GIS software.

Please see www.javad.com for details.

Actual size

1. Guard Bumper
2. Bluetooth/GSM Antenna
3. GNSS Receiver, Power Board, GSM/Bluetooth and Memory
4. Rechargeable li-Ion Battery
5. GNSS Antenna Connectors



GISmore

stand-alone or inside the hat

Bluetooth wireless connection to GISmore

- GPS L1
- Galileo E1
- GLONASS L1
- 100 Hz update rate
- 100 Hz update rate
- RAIM
- WAAS/EGNOS
- Rechargeable Li-Ion Battery
- GNSS Antenna
- GSM Module
- Bluetooth® Interface
- Bluetooth/GSM Antenna

GISmore receiver is based on our TRIUMPH Technology implemented in our TRIUMPH Chip. For the first time in the GNSS history we offer very powerful GIS field mapping receiver with up to 100 Hz RTK, 216 channels of single frequency GPS, Gallileo and GLONASS in a small attractive, sturdy, and watertight box.

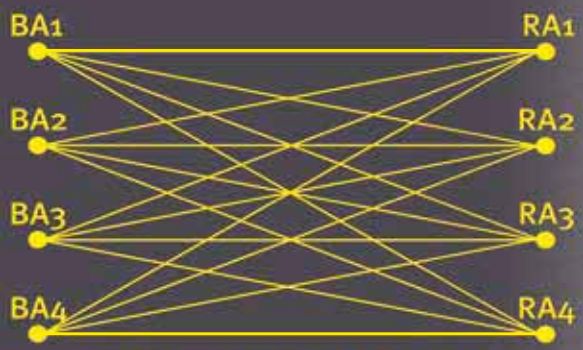
Many ways to use

GPS + GLONASS + Galileo

TRIUMPH 1

4x4... ALL WILL DRIVE... RTK!

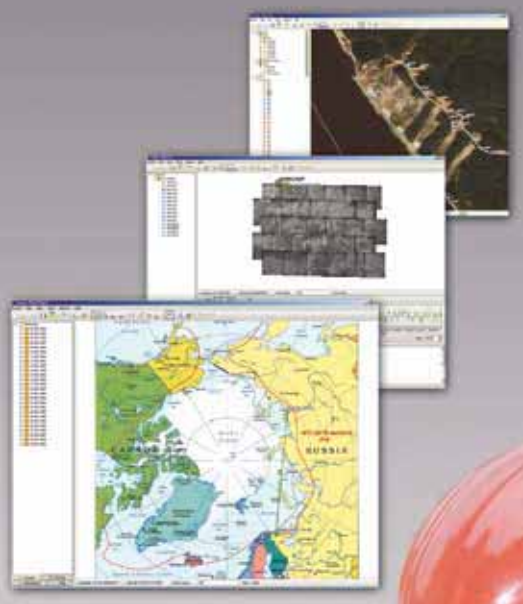
TRIUMPH-4x



4 base — 4 rover, 16 baselines

Please see www.javad.com for details

Software solutions for all tasks



Justin

A comprehensive Survey and GIS software

Justin has integrated native tools to use ESRI or MapInfo cartography windows.

It can import data files as well as whole folders. Justin employs special technique to process high rover data rates (up to 100 Hz) using low base data rates. Other features include single epoch static solution, manual postprocessing with time line chart, using vertical profile to filter out suspected data and scientific data analysis and viewer.

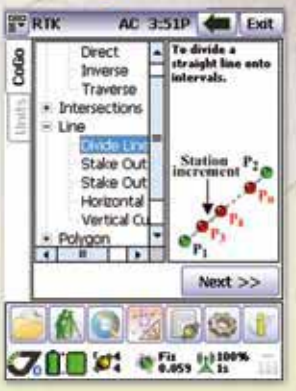
Victor

Victor is pre-loaded with our Tracy field software. When turned on, Victor automatically connects to TRIUMPH-1, TRIUMPH–4X or GISmore via its internal Bluetooth and guides you through field operations. It manages the GNSS receiver and modem operations automatically.

- **Lightweight (17 ounces; 482 grams) magnesium case with easy-to-grip over-molding**
- **Operating temperature -22°F to 122°F (-30°C to 50°C)**
- **Connectivity via built in Bluetooth, USB Host and Client, plus 9-pin RS-232 and optional WiFi and Modems**
- **Rechargeable, field replaceable, Li-Ion battery**
  It operates for more than 20 hours on one charge (3 to 5 hours of charging time)

Giodis

Full-featured office post-processing software



Support for survey and stakeout projects

Static, Fast Static and Stop&Go surveying

Configuration of all hardware

Tracy

A versatile and powerful field software

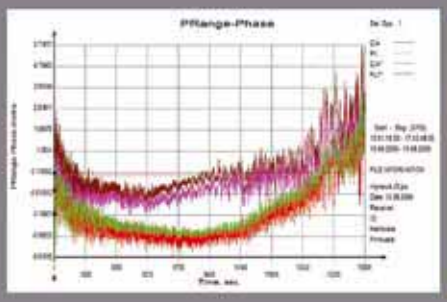
Software for Windows Mobile OS to control receivers, automated GNSS post processing surveying tasks (Static, Fast Static, Stop&Go, Data Acquisition), and to perform RTK survey and stakeout tasks.

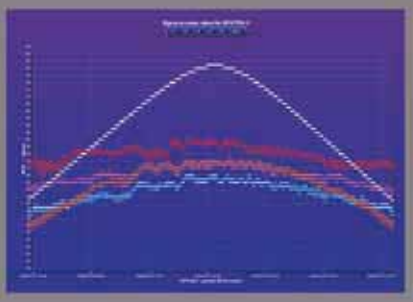
Javad eliminates GPS SVN 49 anomalies

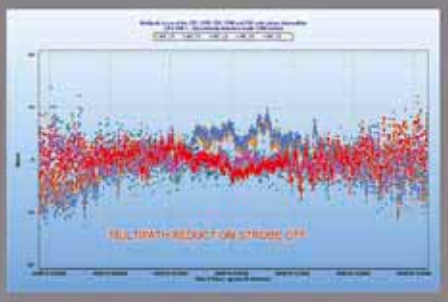
The anomalies in the recently launched SVN49(PRN1) was a chance to demonstrate the advanced multipath reduction capabilities of JAVAD GNSS Triumph technologies.

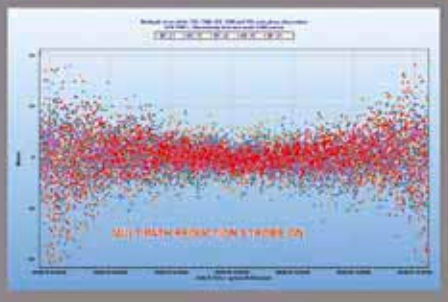
Figure below shows SNV49 (PRN1) code-minus-phase plot for usual correlator (magenta - C/A code, brown - P/L1 code) and for “mpnew” (red - C/A code, green - P/L1 code), which shows almost all anomalies and satellite multipath are removed.

Figures below also describe the multipath performance of a pair of Triumph-1 receivers we ran in a zero baseline test. The left figure depicts the code multipath errors of the GPS PRN1 pseudoranges measured by the receiver with the ‘normal’ strobe enabled. The right figure shows the code multipath as estimated for the second receiver, where the optimized multipath reduction strobe was enabled. The center screenshot displays the signal-to-noise ratios and elevation angles of GPS SVN49 over the time interval analyzed.

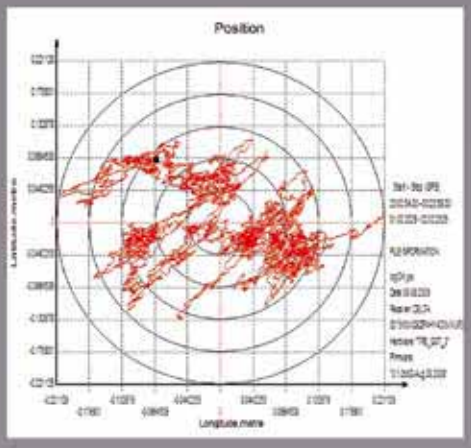








The optimized multipath mitigation technique implemented in our Triumph technology allows nearly complete compensation for the satellite-induced multipath anomalies that would otherwise badly affect GPS SVN49 measurements. The same multipath reduction capabilities which removed the SVN49 multipath anomalies can remove the multipath effects which are a major source of error in precision positioning.



JAVAD GNSS receivers tracked all current and future Galileo satellite signals

JAVAD GNSS receivers successfully tracked all Galileo satellites from Spirent simulator and produced Galileo-only and triple satellite (Gps+Glonass+Galileo) positions. Up to 27 satellites were tracked simultaneously.

The experiments were performed jointly by Spirent and JAVAD GNSS.

Sat	(Fn)	El	Az	C/A	P1	P2	TC	Count	F_C/A	F_P1	F_P2	Use
Gps	1	29	--	46	0	0	68	3818	0xA153	------	------	Y(0)
Gps	3	24	--	47	0	0	86	4986	0xA153	------	------	Y(0)
Gps	6	37	--	44	0	0	86	4986	0xA153	------	------	Y(0)
Gps	11	14	--	46	0	0	77	4622	0xA153	------	------	Y(0)
Gps	14	20	--	45	0	0	86	4986	0xA153	------	------	Y(0)
Gps	16	78	--	49	0	0	86	4986	0xA153	------	------	Y(0)
Gps	18	7	--	47	0	0	86	4986	0xA153	------	------	Y(0)
Gps	19	10	--	48	0	0	86	4986	0xA153	------	------	Y(0)
Gps	20	7	--	47	0	0	4	272	0xA153	------	------	Y(0)
Gps	22	38	--	47	0	0	86	4986	0xA153	------	------	Y(0)
Gps	31	23	--	45	0	0	86	4986	0xA153	------	------	Y(0)
Gln	6(-2)	24	--	51	0	0	87	4986	0xA153	------	------	Y(0)
Gln	7(-1)	26	--	51	0	0	87	4986	0xA153	------	------	Y(0)
Gln	9(1)	21	--	50	0	0	87	4986	0xA153	------	------	Y(0)
Gln	10(2)	76	--	52	0	0	87	4986	0xA153	------	------	Y(0)
Gln	11(3)	44	--	50	0	0	81	4911	0xA153	------	------	Y(0)
Gal	71	18	--	50	0	0	86	4986	0xA153	------	------	Y(0)
Gal	78	18	--	50	0	0	81	4892	0xA153	------	------	Y(0)
Gal	79	30	--	49	0	0	86	4986	0xA153	------	------	Y(0)
Gal	83	23	--	48	0	0	59	3672	0xA153	------	------	Y(0)
Gal	84	70	--	49	0	0	86	4986	0xA153	------	------	Y(0)
Gal	85	58	--	50	0	0	84	4986	0xA153	------	------	Y(0)
Gal	86	13	--	49	0	0	86	4986	0xA153	------	------	Y(0)
Gal	89	33	--	50	0	0	85	4986	0xA153	------	------	Y(0)
Gal	90	36	--	51	0	0	86	4986	0xA153	------	------	Y(0)
Gal	91	11	--	51	0	0	86	4986	0xA153	------	------	Y(0)
Gal	97	8	--	50	0	0	29	1742	0xA153	------	------	Y(0)

Other Receivers

ALPHA

- Internal battery
- Charger
- GSM
- Bluetooth

for: TR-G3, TR-G2T, TR-G3T

Front panel connectors:

Power Input + serial port A + USB + Antenna

Back panel connectors:

Can have up to 3 connectors of 1-PPS • Event Marker • IRIG • GSM Antenna (without Bluetooth antenna).

When Bluetooth antenna is installed only one extra connector can be installed.

Example 1: BT Antenna + GSM Antenna
Example 2: 1-PPS output + Event Marker + GSM Antenna

DELTA

for: TRE-G2T, TRE-G3T, Duo-G2, Duo-G2D, Quattro-G3D

Front panel connectors:

Option 1: Power Input + Serial A + Serial B + Serial C + Antenna

Option 2: Power Input + USB + Serial A + Serial C + Antenna

Options 3: Power Input + USB + Serial A + Serial C + Ethernet

Back panel connectors:

Can have up to 4 connectors of 1-PPS A • 1-PPS B • Event A • Event B • Antenna • CAN • IRIG B

Example: 1-PPS A + 1-PPS B + Event A + Event B

SIGMA

- Internal battery
- Charger
- Modem
- GSM
- Bluetooth

for: TRE-G2T, TRE-G3T, Duo-G2, Duo-G2D, Quattro-G3D

Front panel connectors:

Can have Power Input • Second Power Input • USB • Serial A • Serial B or C • Ethernet

and up to 4 connectors of 1-PPS A • 1-PPS B • Event A • Event B • Antenna • CAN • IRIG • RS422

Back panel connectors:

Can have SIM door and GSM Antenna connector and up to 4 connectors of 1-PPS A • 1-PPS B • Event A • Event B • Antenna • IRIG • Modem Antenna • Bluetooth Antenna

Example: GSM Antenna + SIM door + 1-PPS A + 1-PPS B + Event A + Modem Antenna

delay is higher than magnitude of 10^{-8} s. As a result, the above transformation is not suitable for establishment of high-precision VLBI data processing model. In real circumstance, computational model for time delay and its rate should be set up by relativistic temporal theory. By using relativistic temporal theory, the coordinate transformation between solar barycentric coordinate system and geocentric coordinate system can be described as:

$$\vec{X} = \vec{X}_E(t) + \vec{x} - \vec{V}_E(\vec{V}_E \cdot \vec{x})/2c^2 - (\psi/c^2)\vec{x} \quad (2.4)$$

Where c denotes the light speed, $\vec{V}_E$ is the speed of geo-centre under the heliocentric inertial coordinate system, ψ represents the planet gravitational potential (including sun and moon, apart from the earth). Its first-order term can be expressed as:

$$\psi = \sum_{A \neq M} GM_A / r_A \quad (2.5)$$

Where G is the gravitational constant, M_A denotes the mass of gravitational body A, r_A *and* represents the distance between gravitational body A and the geo-center.

(3) Transformation between heliocentric ecliptic coordinate system and the heliocentric equatorial (inertial) coordinate system

Transformation between heliocentric ecliptic coordinate system and the heliocentric equatorial coordinate system involves only rotation illustrated as:

$r = Rx(-\bar{\varepsilon})_E$ (2.6)

Where r, r_E denote the position vector under the *J2000.0* heliocentric equatorial coordinate system and the heliocentric ecliptic coordinate system respectively, $\bar{\varepsilon}$ and is the mean obliquity.

Mathematical model establishment

Mathematical model during the cislunar period

According to equation (1.5) and the coordinate system transformation above, we could establish a mathematical model under the instantaneous geocentric celestial coordinate system as follows:

$$L = -\left\{ \begin{bmatrix} X_i \\ Y_i \\ Z_i \end{bmatrix}^T R_1 - \begin{bmatrix} X^I \\ Y^I \\ Z^I \end{bmatrix}^T R_2 \right\} \cdot R_3 \left(\begin{bmatrix} \cos\delta\cos\alpha \\ \cos\delta\sin\alpha \\ \sin\delta \end{bmatrix} - \vec{A} \right) + c(\tau_c + \tau_i + \tau_p + ...) \quad (3.1)$$

Where X_i, Y_i, Z_i represent the coordinate of ground VLBI station under the CTS, X^I, Y^I, Z^I represent the coordinate of lunar probe under the *J2000.0* geocentric inertial coordinate system, α, δ denote the right ascension and declination under the *J2000.0* heliocentric inertial coordinate system respectively, R_1, R_2, R_3 indicate the rotation matrix, $\vec{A}$ indicates the translation amount. Other symbols represent the same meanings as in equation (1.5). Then question comes down to the determination of R_1, R_2, R_3 and $\vec{A}$. R_1 denotes the transposed rotation matrix from CTS to instantaneous geocentric celestial coordinate system, which could be illustrated as:

$$R_1 = ((ER)^{-1}(EP)^{-1})^T = R_Y(-x_p)R_X(-y_p)R_Z(S_G) \quad (3.2)$$

R_2 denotes the transposed rotation matrix from *J2000.0* geocentric inertial coordinate system to instantaneous geocentric celestial coordinate system. Due to the long period of precession, i.e. 26000 years, lunar probe could not detect this process by current technology, so here we neglect the precession matrix. Therefore, expression of R_2 could be shown as:

$$R_2 = ((NR)(PR))^T = (NR)^T = R_X(-\bar{\varepsilon})R_Z(\Delta\psi)R_X(\bar{\varepsilon} + \Delta\varepsilon) \quad (3.3)$$

Coordinate transformation of the radio source from *J2000.0* heliocentric inertial coordinate system to the instantaneous geocentric coordinate system should obey the following steps: Firstly, apply translation transformation $\vec{A}$ yielding to coordinate under *J2000.0* geocentric inertial coordinate system; then apply rotation matrix R_3 yielding to coordinate under instantaneous geocentric coordinate system. From equation (2.3), we could have: $\vec{A} = \vec{X}_E(t)$ (3.4)

R_3 denotes the rotation matrix from *J2000.0* geocentric inertial coordinate system to the instantaneous geocentric celestial coordinate system, which could be demonstrated as:

$$R_3 = (NR) = R_X(-(\bar{\varepsilon} + \Delta\varepsilon))R_Z(-\Delta\psi)R_X(\bar{\varepsilon}) \quad (3.5)$$

Taking account of the relativity effects, then from equation (2.4), we could have:

$$\left. \begin{aligned} \vec{A} &= \vec{X}_E(t) - \vec{V}_E(\vec{V}_E \cdot \vec{x})/2c^2 \\ R_3 &= (NR)/(1-\psi/c^2) = R_X(-(\bar{\varepsilon} + \Delta\varepsilon))R_Z(-\Delta\psi)R_X(\bar{\varepsilon})/(1-\psi/c^2) \end{aligned} \right\} \quad (3.6)$$

Mathematical model during the circum-lunar period

Here we also give the mathematical model expressed by instantaneous geocentric celestial coordinate. First of all, circumstance of lunar probe in the heliocentric ecliptic coordinate system should be considered as follows:

$$L = -\left\{ \begin{bmatrix} X_i \\ Y_i \\ Z_i \end{bmatrix}^T R_1 - \left(\begin{bmatrix} X'^I \\ Y'^I \\ Z'^I \end{bmatrix}^T R_4 - \vec{A}^T \right) R_2 \right\} \cdot R_3 \left(\begin{bmatrix} \cos\delta\cos\alpha \\ \cos\delta\sin\alpha \\ \sin\delta \end{bmatrix} - \vec{A} \right) + c(\tau_c + \tau_i + \tau_p + ...) \quad (3.7)$$

Where X'^I, Y'^I, Z'^I denote coordinate of the lunar probe under the *J2000.0* heliocentric ecliptic coordinate system, R_4 is the rotation matrix. Other symbols represent the same meanings as in equation (3.1)

Coordinate transformation of the lunar probe from J2000.0 heliocentric ecliptic coordinate system to the instantaneous geocentric celestial coordinate system should obey the following steps: (1) Apply rotation matrix R_4, transforming J2000.0 heliocentric ecliptic

coordinate system to J2000.0 heliocentric equatorial coordinate system; (2) Apply translation transformation $\vec{A}$ yielding to coordinate under J2000.0 geocentric equatorial (inertial) coordinate system; (3) Apply rotation matrix R_2 yielding to coordinate under instantaneous geocentric celestial coordinate system. R_4 could be illustrated as (transposed): $R_4 = (R_X(-\bar{\varepsilon}))^T = R_X(\bar{\varepsilon})$ (3.8)

If we obtain coordinate of the lunar probe under the selenocentric celestial coordinate system, then equation (3.7) should be modified as:

$$L = -\left\{ \begin{bmatrix} X_i \\ Y_i \\ Z_i \end{bmatrix}^T R_1 - \left(\begin{bmatrix} X''^I \\ Y''^I \\ Z''^I \end{bmatrix}^T - \vec{B}^T \right) R_2 \right\} \cdot R_3 \left(\begin{bmatrix} \cos\delta\cos\alpha \\ \cos\delta\sin\alpha \\ \sin\delta \end{bmatrix} - \vec{A} \right) + c(\tau_c + \tau_i + \tau_p + ...) \quad (3.9)$$

Where X''^I, Y''^I, Z''^I denote coordinate of the lunar probe under the J2000.0 selenocentric inertial coordinate system, $\vec{B}$ is the translation amount. Other symbols represent the same meanings as in equation (3.1).Simplified coordinate transformation of the lunar probe from J2000.0 selenocentric inertial coordinate system to instantaneous geocentric celestial coordinate system can be demonstrated in the following step: Firstly apply translation transformation $\vec{B}$ yielding to coordinate under J2000.0 geocentric inertial coordinate system; then apply rotation matrix R_2. Expression of $\vec{B}$ is obtained by $\vec{B} = r_{EM}$ (3.10)

Where r_{EM} denotes the position vector of geo-center under the lunar inertial coordinate system. and r_{EM} from equation (3.8) and (3.10) are both important parameters in determination of the lunar ephemeris, thus introducing these parameters in Space VLBI would make new contributions in its improvement and optimization.

After all these discussion, we could make a summary about the selenodesy parameters in various mathematical models. According to equation (3.1), mathematical model parameters involved in the trans-lunar period include: three coordinate parameters for ground station, three coordinate parameters for satellite, two position parameters for radio source, three earth rotation parameters, two nutation parameters, heliocentric vector parameter, clock error parameter, as well as other error parameters, which can be illustrated as:

$$(X_i, Y_i, Z_i, X^I, Y^I, Z^I, \alpha, \delta, x_p, y_p, S_G, \Delta\varepsilon, \Delta\psi, \vec{X}_E(t), \tau') \quad (3.11)$$

Also, according to equation (3.7), mathematical model parameters involved in the circum-lunar period are:

$$(X_i, Y_i, Z_i, X'^I, Y'^I, Z'^I, \alpha, \delta, x, y, S_G, \Delta\varepsilon, \Delta\psi, \bar{\varepsilon}, X_E(t), \tau') \quad (3.12)$$

From equation (3.9), we could describe the parameters under the selenocentric inertial system as:

$$(X_i, Y_i, Z_i, X''^I, Y''^I, Z''^I, \alpha, \delta, x, y, S_G, \Delta\varepsilon, \Delta\psi, \bar{\varepsilon}, X_{EM}(t), \tau') \quad (3.13)$$

The estimability of geodetic parameters

Equation (3.1) can be rewritten as follows by expanding the rotation matrixes:

$$L = -(a_1 X^I + a_2 Y^I + a_3 Z^I + a_4 X^I + a_5 Y^I + a_6 Z^I) + c(\tau_c + \tau_i + \tau_p + ...) \quad (4.1)$$

Where $a_i (i=1,...,6)$ are the coefficients of ground station and lunar probe coordinates. The following approach is applied during the expansion:

Where navigation meets the world

The Munich Satellite Navigation Summit 2010 was held from March 9 – 11 in the famous Residenz Munich, traditionally organized by the Institute of Geodesy and Navigation of the University FAF Munich. Prof. Bernd Eissfeller, Director of the hosting Institute, was delighted to welcome 450 attendees from about 25 nations.

GNSS – quo vadis?

This year´s motto "GNSS – quo vadis?" dealt of course with the growing global interest in GNSS as much as the rush in developing Satellite Navigation Systems all over the world. But where is GNSS going – what decisions should be made to improve technical, political, financial and even global social matters? The guests of the Opening Panel in the beautiful Court Church of All Saints addressed these issues with their interesting views.

Galileo must become a success

Prof. Klaus Dieter Scheurle, Permanent State Secretary of the German federal Ministry of Transport pointed out that it is a non-negotiable German position that Galileo as first EU project of such a large dimension must become a success. But Scheurle drew also attention on the fact that international cooperation is the only way that can guide satellite navigation to success.

Prof. Johann-Dietrich Woerner from the German Aerospace Center (DLR) started by asking whether Galileo is a never-ending story. Then he mentioned the outstanding importance of Galileo in the field of air traffic control and logistical innovations, in particular with respect to electrical mobility, because mobile energy storages may in future substiute the current way of energy provision. Paul Verhoef, Programme Manager of EU Satellite Navigation programs at European Commission made clear:

"I hope for my part that [Galileo] is a never-ending story. If it is an ending story, I think we've had a problem on the way." Verhoef stressed the fact that users had to be won and this being the real challenge for the project.

The program went on with topics like GNSS Program Updates, Safety of Life: Realizing the Vision?, Knowledge and Technology Transfer

in GNSS?, Big Brother is watching you! - Privacy Issues contra Satellite Navigation?, Bridging the Gap - A Journalistic View on Progress and Problems of GNSS, etc.

What is GNSS?

The closing session of the Munich Summit titeling Bridging the Gap - A Journalistic View on Progress and Problems of GNSS was an absolute journalistic session which dealt with the question if GNSS already arrived in public. Bal Krishna, editor of Coordinates from India pointed out that the problems in India as a developing country are very different from the problems of developed countries. Missing maps are making positioning nearly useless and new technology is viewed more as a bad ghost than as an improvement. Glen Gobbons, editor and publisher of Inside GNSS was convinced that the name GPS will continue representing satellite navigation in the mind of the end users for a long time.

Christina Teuthorn, political editor of the BR, a very famous German radio station, agreed with Gibbons. She found out that the word GNSS does not appear in the archives of her company. Contrariwise there are many search results for GPS. Alan Cameron, editor in chief of the GPS world hold the view that the world as a whole is not ready for new GNSS applications. It is ready for the old ones.

Exhibition & Future Prospects

As in the last year the traditional Summit exhibition was fully booked. The attending companies used the opportunity to present their innovative products and activities in the charming atmosphere of the Residenz Munich. The Bavarian State reception as well as the Summit Space Night afforded the opportunity of making top-quality networking.

The next Munich Satellite Navigation Summit will be held from March 1-3, 2011. Register in time & get more information on www.munich-satellite-navigation-summit.org
- Heike Haas, *heike.haas@unibw.de*

$$\cos(\bar{\varepsilon}+\Delta\varepsilon) \cong \cos\bar{\varepsilon}\cos\Delta\varepsilon - \sin\Delta\varepsilon\sin\bar{\varepsilon}\cos(\Delta\psi) \cong 1 \quad \cos(\Delta\varepsilon)\cong 1$$
$$\sin(\bar{\varepsilon}+\Delta\varepsilon) \cong \sin\bar{\varepsilon}\cos\Delta\varepsilon + \sin\Delta\varepsilon\cos\bar{\varepsilon}\sin(\Delta\psi) \cong \Delta\psi \quad \sin(\Delta\varepsilon)\cong\Delta\varepsilon$$

$$\begin{array}{ll} \sin x_p \cong x_p,\ \sin y_p \cong y_p & \Delta\psi\Delta\psi \cong 0 \quad x_p y_p \cong 0 \\ \cos x_p \cong x_p,\ \cos y_p \cong 1 & \Delta\psi\Delta\varepsilon \cong 0\ ;\ x_p x_p \cong 0 \\ & \Delta\varepsilon\Delta\varepsilon \cong 0 \quad y_p y_p \cong 0 \end{array}$$

Therefore, the specific forms of coefficients are as follows:

$$\begin{aligned} a_1 &= \Delta\psi\cos\bar{\varepsilon}\cos\delta\sin(S_G-\alpha) + \cos\delta\cos(S_G-\alpha) - \Delta\psi\sin\delta\sin\bar{\varepsilon}\cos S_G \\ &\quad - \Delta\varepsilon\sin\delta\sin S_G + x_p\sin\delta \\ &\quad - \bar{A}_X(\cos S_G + \Delta\psi\cos\bar{\varepsilon}\sin S_G) - \bar{A}_Y(\sin S_G - \Delta\psi\cos\bar{\varepsilon}\cos S_G) \\ &\quad + \bar{A}_Z(\Delta\varepsilon\sin S_G + \Delta\psi\cos S_G\sin\bar{\varepsilon} - x_p) \end{aligned}$$

$$\begin{aligned} a_2 &= \Delta\psi\cos\bar{\varepsilon}\cos\delta\cos(S_G-\alpha) - \cos\delta\sin(S_G-\alpha) + \Delta\psi\sin\delta\sin\bar{\varepsilon}\sin S_G \\ &\quad - \Delta\varepsilon\sin\delta\cos S_G - y_p\sin\delta \\ &\quad + \bar{A}_X(\sin S_G - \Delta\psi\cos\bar{\varepsilon}\cos S_G) - \bar{A}_Y(\cos S_G + \Delta\psi\cos\bar{\varepsilon}\sin S_G) \\ &\quad + \bar{A}_Z(\Delta\varepsilon\cos S_G - \Delta\psi\sin S_G\sin\bar{\varepsilon} + y_p) \end{aligned}$$

$$\begin{aligned} a_3 &= -\cos\delta(\cos(S_G-\alpha)x_p + \sin(S_G-\alpha)y_p) + \Delta\varepsilon\cos\delta\sin\alpha + \Delta\psi\cos\delta\cos\alpha\sin\bar{\varepsilon} + \sin\delta \\ &\quad + \bar{A}_X(x_p\cos S_G + \sin S_G y_p - \Delta\psi\sin\bar{\varepsilon}) + \bar{A}_Y(x_p\sin S_G + \cos S_G y_p - \Delta\varepsilon) - \bar{A}_Z \end{aligned}$$

$$a_4 = \cos\alpha\cos\delta - \bar{A}_X$$

$$a_5 = \sin\alpha\cos\delta - \bar{A}_Y$$

$$a_6 = \sin\delta - \bar{A}_Z \qquad (4.2)$$

Differentiation of Equation (3.1) yield the usual form of the adjustment model (error equations),

$$d(L) = \sum_1 C_I\, dI$$

where C_i is the partial derivative of each parameter in the expression. The specific forms are:

$$C_{X_i} = a_1 : C_{Y_i} = a_2 : C_{Z_i} = a_3 : C_{X_i} = a_4 : C_{Y_i} = a_5 : C_{Y_i} = a_6 :$$

$$\begin{aligned} C_\alpha &= X_i(\cos\delta\sin(S_G-\alpha) - \Delta\psi\cos\delta\cos\bar{\varepsilon}\cos(S_G-\alpha)) \\ &\quad + Y_i(\cos\delta\cos(S_G-\alpha) + \Delta\psi\cos\delta\cos\bar{\varepsilon}\sin(S_G-\alpha)) \\ &\quad + Z_i(\Delta\varepsilon\cos\alpha\cos\delta - \Delta\psi\cos\delta\sin\alpha\sin\bar{\varepsilon} + \cos\delta(\sin(S_G-\alpha)x_p - \cos(S_G-\alpha)y_p)) \\ &\quad - X^I\sin\alpha\cos\delta + Y^I\cos\alpha\cos\delta \end{aligned}$$

$$\begin{aligned} C_\delta &= X_i(-\sin\delta\cos(S_G-\alpha) - \Delta\psi\sin\delta\cos\bar{\varepsilon}\cos(S_G-\alpha) - \Delta\psi\cos\delta\cos S_G\sin\bar{\varepsilon} - \Delta\varepsilon\cos\delta\sin S_G + \cos\delta x_p) \\ &\quad + Y_i(\sin\delta\sin(S_G-\alpha) - \Delta\psi\sin\delta\cos\bar{\varepsilon}\sin(S_G-\alpha) + \Delta\psi\cos\delta\cos S_G\sin\bar{\varepsilon} - \Delta\varepsilon\cos\delta\sin S_G - \cos\delta y_p) \\ &\quad + Z_i(\cos\delta - \Delta\varepsilon\sin\alpha\sin\delta - \Delta\psi\sin\delta\cos\alpha\sin\bar{\varepsilon} - \sin\delta(\cos(S_G-\alpha)x_p + \sin(S_G-\alpha)y_p)) \\ &\quad - X^I\cos\alpha\sin\delta - Y^I\sin\alpha\sin\delta + Z^I\cos\delta \end{aligned}$$

$$\begin{aligned} C_{S_G} &= X_i(\Delta\psi\cos\bar{\varepsilon}\cos\delta\cos(S_G-\alpha) - \cos\delta\sin(S_G-\alpha) + \Delta\psi\sin\delta\sin\bar{\varepsilon}\sin S_G \\ &\quad - \Delta\varepsilon\sin\delta\cos S_G - \bar{A}_X(\Delta\psi\cos\bar{\varepsilon}\cos S_G - \sin S_G) - \bar{A}_Y(\cos S_G + \Delta\psi\cos\bar{\varepsilon}\sin S_G) + \bar{A}_Z(\Delta\varepsilon\cos S_G - \Delta\psi\sin S_G\sin\bar{\varepsilon})) \\ &\quad + Y_i(-\Delta\psi\cos\bar{\varepsilon}\cos\delta\sin(S_G-\alpha) - \cos\delta\cos(S_G-\alpha) + \Delta\psi\sin\delta\sin\bar{\varepsilon}\cos S_G \\ &\quad + \Delta\varepsilon\sin\delta\sin S_G + \bar{A}_X(\cos S_G + \Delta\psi\cos\bar{\varepsilon}\sin S_G) - \bar{A}_Y(-\sin S_G + \Delta\psi\cos\bar{\varepsilon}\cos S_G) - \bar{A}_Z(\Delta\varepsilon\sin S_G + \Delta\psi\cos S_G\sin\bar{\varepsilon})) \\ &\quad + Z_i(\cos\delta(\cos(S_G-\alpha)y_p - \sin(S_G-\alpha)x_p) + \bar{A}_X(\cos S_G y_p - \sin S_G x_p) + \bar{A}_Y(\cos S_G x_p - \sin S_G y_p)) \end{aligned}$$

$$C_{x_p} = X_i(\sin\delta - \bar{A}_Z) - Z_i(\cos\delta\cos(S_G-\alpha) - \bar{A}_X\cos S_G - \bar{A}_Y\sin S_G)$$

$$C_{y_p} = -Y_i(\sin\delta - \bar{A}_Z) + Z_i(\cos\delta\sin(S_G-\alpha) + \bar{A}_X\sin S_G + \bar{A}_Y\cos S_G)$$

$$C_{\Delta\psi} = X_i(\cos\bar{\varepsilon}\cos\delta\sin(S_G-\alpha)-\sin\delta\sin\bar{\varepsilon}\cos S_G-\bar{A}_X\cos\bar{\varepsilon}\sin S_G+\bar{A}_Y\cos\bar{\varepsilon}\cos S_G+\bar{A}_Z\cos S_G\sin\bar{\varepsilon})$$
$$+Y_i(\cos\bar{\varepsilon}\cos\delta\cos(S_G-\alpha)+\sin\delta\sin\bar{\varepsilon}\sin S_G-\bar{A}_X\cos\bar{\varepsilon}\cos S_G-\bar{A}_Y\cos\bar{\varepsilon}\sin S_G-\bar{A}_Z\sin S_G\sin\bar{\varepsilon})$$
$$+Z_i(\cos\delta\cos\alpha\sin\bar{\varepsilon}-\bar{A}_X\sin\bar{\varepsilon})$$

$$C_{\Delta\varepsilon} = X_i(-\sin\delta\sin S_G+\bar{A}_Z\sin S_G)+Y_i(-\sin\delta\cos S_G+\bar{A}_Z\cos S_G)+Z_i(\sin\alpha\cos\delta-\bar{A}_Y)$$

$$C_{\bar{A}_X} = -X_i(\cos S_G+\Delta\psi\cos\bar{\varepsilon}\sin S_G)+Y_i(\sin S_G-\Delta\psi\cos\bar{\varepsilon}\cos S_G)$$
$$+Z_i(x_p\cos S_G+\sin S_G y_p-\Delta\psi\sin\bar{\varepsilon})-X^I$$

$$C_{\bar{A}_Y} = X_i(\sin S_G-\Delta\psi\cos\bar{\varepsilon}\cos S_G)-Y_i(\cos S_G+\Delta\psi\cos\bar{\varepsilon}\sin S_G)$$
$$+Z_i(x_p\sin S_G+\cos S_G y_p-\Delta\varepsilon)-Y^I$$

$$C_{\bar{A}_Z} = -X_i(\Delta\varepsilon\sin S_G+\Delta\psi\cos S_G\sin\bar{\varepsilon}-x_p)-Y_i(\Delta\varepsilon\cos S_G-\Delta\psi\sin S_G\sin\bar{\varepsilon}+y_p)-Z_i-Z^I$$

$$C_{\tau.} = c \qquad (4.3)$$

Parameter I in Equation (3.1) can usually be determined in a standard least squares adjustment from the information present in the observables. The detection of which parameter is estimable and which is not is through the design matrix C formed by the partial C_I derivativesabove. If there exist linear relationships between the columns of design matrix C, its column rank will be deficient (will not be full) and the normal matrix C^TPC (P is the weight matrix of the observables) will consequently be singular implying that not all of the parameters are estimable.

The following linear relationships can be detected among the partial derivatives in Equation (4.3):

$$C_{x_p} = X_i C_{Z_i} - Z_i C_{X_i}$$
$$C_{y_p} = Z_i C_{Y_i} - Y_i C_{Z_i}$$
$$C_{S_G} = X_i C_{Y_i} - Y_i C_{X_i}$$
$$C_\alpha = -C_{S_G}/W_d + \bar{A} C_{\bar{A}}$$

Since there exist linear relationships among the partial derivatives, it is not possible to estimate all of the parameters from space VLBI time delay observations. Only 11 parameters of the initial 15 ones in Equation (3.11) can be estimated simultaneously. The estimable parameter sequence is listed as follows:

$$(X_i, Y_i, Z_i, X^I, Y^I, Z^I, \delta, \Delta\varepsilon, \Delta\psi, \bar{X}_E(t), \tau') \qquad (4.4)$$

In the same way, the estimable parameter sequence of circumlunar mathematical model is respectively listed as follows:

$$(X_i, Y_i, Z_i, X^I, Y^I, Z^I, \alpha, \delta, \Delta\psi, \bar{\varepsilon}, \bar{X}_E(t), \tau') \qquad (4.5)$$

$$(X_i, Y_i, Z_i, X^I, Y^I, Z^I, \delta, \Delta\varepsilon, \Delta\psi, r_{EM}, \bar{X}_E(t), \tau') \qquad (4.6)$$

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NRSC User Interaction Workshop 2010

The NRSC User Interaction Workshop 2010 organised by the National remote Sensing Centre (NRSC), Department of Space, India was an opportunity to inform the Geo spatial user community regarding the various developments that have happened in terms of Products and services available to them and also for the user community to share their experiences.

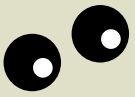
G. Balachandran, Additional Secretary, Department of Space, spoke about the achievements in remote sensing by India, in his inaugural address. Oceansat products and a document on Water Resource Assessment by NRSC were released and the exhibition on Space Applications for Planet Earth, Man and Moon was also inaugurated.

Five technical sessions and by the industry were held. The session on Oceansat Sensors dealt with the technical specifications, data acquisition methodologies and the features of the sensors. The session on future Earth Observation Missions and Applications gave an overview of Resourcesat-2, microwave sensors in India and the future Cartosat missions. Discussions were also held on Climate Change and the SARAL mission. The session on High Resolution Data Utilisation focussed on the applications using such data and the growing need for high resolution data. ISRO's geoportal - Bhuvan - was also showcased.

Dr. R Nagaraja of NRSC Data Centre gave an update on the data products and services. He also talked about the customer feedback received and the action being taken on it. He highlighted the efforts being taken by NRSC to promote the data and the status of data acquisition. Other discussions included those on capacity building by Indian Institute of Remote Sensing and concerns of the user community regarding the process of data access.

In the Industry session, the presentations by Digital Globe, GeoEye and Scanpoint Gomatics Limited highlighted their offerings.
www.nrsc.gov.in

At a Glance



- GeoEye, 2009 fourth quarter revenues were $73.2m, 80.0% increase in corresponding period of 2008.
- Infoterra SGSA has acquired 100% of Enifosa's shares.
- Orbital Sciences acquires General Dynamics' satellite manufacturing business.
- ESRI Australia to acquire MapData Sciences
- DigitalGlobe 2009 fourth quarter revenues was $72.9m, 1.0% increase compared to the same period last year.
- AAMHatch changes name to AAM.
- Terrasolid to sell Bentley MicroStation bundled with its product suite.
- Topcon Positioning Systems signs a data license agreement with Autodesk.
- REKOD and ScanEx to expand cooperation in Russia.
- Waze partners with Location World.
- Trimble has acquired LET Systems, Ireland.
- NAVGEOCOM is the new ERDAS distributor in Russia.
- TerraServer signs reseller agreement with Aerials Express.
- GNX Technologies will represent SuperGeo in Singapore.
- Luminous ETS appointed reseller of SuperGIS series software in India (except Karnataka).
- Globalstar to deliver 15,000 SPOT satellite communicators from DeLorme.
- Jürgen Dold becomes new President and CEO of Leica Geosystems AG from 1 April 2010.

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Google exists or exits

A household name with its ever pervading presence on the internet, Google has revolutionised our lives. Their ever increasing bouquet of offerings and services has had an impact on net users across the world. Google follows its own core principles and has been able to play a pivotal role in information access across many parts of the world.

The sixth of Google's ten principles - 'you can make money without doing evil', has been brought into sharp focus by the consequences of a hacking incident that happened in December 2009. Google alleged that China was behind the attack. Although no one supports hacking, in the aftermath of the incident the 'role of Google in China' came under the arc lights, and a new perspective seems to emerge.

The degrees of evil

See no evil, hear no evil and speak no evil - a Gandhian principle many of us may think we follow. And it could well be true since our perceptions of 'evil' differ. It is therefore difficult to arrive at a universal definition of evil. There has to be a context to the situation.

It is for this reason that Google's stance that it wants to pull out of China because it is no more willing to go along with what is sees as the 'evil' ways of the Chinese authorities is a little difficult to digest. From the gigabytes of information available on the issue one thing is clear, what Google considers 'evil', China does not. So the question is who is going to decide? Public view is divided.

The other degrees...

Today, information is not only a powerful tool it is a mutli-billion dollar business in which many want a stake. But information is not dealt with in the same way by all, some countries exercise more control and others less. The controls exist - it is only a question of degree. It is our perceptions which make us brand some countries more open and liberal and others as authoritarian vis-à-vis information access and dissemination.

Every country also has a legal framework which is binding on its citizens and residents. Here again some countries are considered to have 'liberal' laws and others are considered 'rigid'. But again, the laws exist everywhere.

'When in Rome do as the Romans'

The ideal place to do business would therefore be a country where the controls are less and the laws are liberal. Unfortunately this combination is not available everywhere and therefore like everyone else the businesses also have to make the best of an available situation.

Here comes the question of how much businesses are really willing to adapt to local conditions. The universal truth is that businesses need to make a profit, but the hard truth is that those who can carry the locals along have more staying power. And for this, mere lip service is not enough, one has to be more attuned to the 'peculiarities and sensibilities' of the locals. It is more about being 'acceptable' than anything else.

Doing business therefore is not a 'black and white' issue, there are always shades of grey, as the business 'adapts' to various situations, to well - stay in business. Google seemed to move into this 'grey' area when they decided to 'compromise' on their principles and enter China in 2006. They did make an attempt to adapt to the local situation, but the compromise does not seem to have worked very well.

The 'panacea' syndrome

Google might see themselves as the champions for the 'information freedom'. There is no denying that they have been pioneers in information services propagation. But ultimately they are only a service provider mandated to do business in China. Stepping beyond this mandate seems to be a 'step out of line'. The 'prescriptive' mindset where we believe that 'our' way is not just the 'best' way, but also should be the 'only' way leaves little room for dialogue or manoeuvrability. The current impasse has highlighted the issues of information flow in

China, but then these are issues that the Chinese people need to address with their Government. What role Google thinks it can play here, is not clear.

The ambiguity cloak

With their ever expanding services, Google has earned tremendous accolades, but they have also received their fair share of brickbats. They have faced criticism from various parts of the world for issues ranging from security to privacy concerns. They have responded to these concerns, in weeks months or years depending on how much pressure was put on them and by whom. Google still does not have a universal policy for addressing these concerns, they 'respond' as and when the issues are raised or brought to their notice.

> The 'prescriptive' mindset where we believe that 'our' way is not just the 'best' way, but also should be the 'only' way leaves little room for dialogue or manoeuvrability.

The 'get away with it if you can' attitude does not bode well for any business. It is here that the boundaries between legal-illegal are easier to define, but those between right-wrong and ethical-unethical get blurred. Littering in Singapore is a legal offence; you litter you pay a fine, case closed. Is littering right? Would you litter just because no one is keeping tabs on you? That is where ones own 'morals' come into play.

Drawing the line

In the present situation China's stand is clear - follow the law of the land and you are welcome to do business in the country. But then, this is also the stand of every 'liberated' country on the planet!

In a similar disagreement with another country where dependence on a service like Google is high, the story would probably have panned out quite differently. China simply does not seem to care!

– Shubhra Kingdang and Bal Krishna

ARE YOU HEADING IN THE RIGHT DIRECTION?

The Trimble BD982 GNSS system is a compact dual-antenna receiver designed to deliver centimeter accurate positions and precise heading to challenging guidance and control applications. The receiver supports a wide range of satellite signals, including GPS L1/L2/L5, GLONASS L1/L2, OmniSTAR as well as Galileo GIOVE-A and GIOVE-B test satellites for signal evaluation and test purposes.

For more info, go to www.trimble.com/GNSS-Inertial

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RapidEye has China covered

RapidEye have successfully completed a contract to image 7.8 Million km² of the country of China ahead of schedule. The contract is with the Ministry of Land and Resources of China. "What the Ministry wanted was 80% of China, almost 8 Million square kilometers, with less than 10% cloud cover in a six month time window," remarked Head of RapidEye's Operations Department. Most areas of the country were imaged five, and in some cases six times in order to fulfill the contractual requirements. *www.rapideye.de*

Netherlands @ 10cm available

Aerodata International Surveys has successfully completed the NL2009 10cm project covering the entire territory of the Netherlands (over 40.000 sq km). During 2009 nearly 100.000 images were acquired and processed to a seamless orthophoto mosaic of 10cm. *www.aerodata-surveys.com*

Bangladesh seeks help in setting up RS satellites

Prime Minister Sheikh Hasina has sought Chinese support and cooperation in satellite launching and setting up remote sensing satellite and providing scholarship facilities to the foreign service officials. *www.thedailystar.net*

PCI Geomatics signs contract with BSEI

PCI Geomatics has signed a million dollar contract with Beijing Space Eye Innovation Technology Co. Ltd. to supply an automated image processing system to the China Centre for Resources Satellite Data and Application. *www.pcigeomatics.com*

Nano satellite Jugnu ready

At IIT-Kanpur a team of students, working under Dr NS Vyas and other faculty members of the institute, have successfully made the India's first nano-satellite. Weighing less than three kg and with most functionalities of a normal satellite on a small platform, the payload of the satellite will include an indigenously designed camera for near remote sensing and a GPS receiver. 'Jugnu' will transmit blinking signal at all times, all over the Earth. *http://timesofindia.indiatimes.com*

Indian land scam investigation

Karnataka, India: A central government appointed probe panel has found "sufficient evidence" of land grabbing against the controversial Karnataka High Court Chief Justice, PD Dinakaran.. The survey team has taken the help of National Remote Sensing Centre for satellite images and used the GPS and other instruments to verify the facts. *www.hindustantimes.com*

Shoreline Mapping Solution

Applanix LANDMark™ Marine mobile mapping solution enables the creation of seamless models of near shore environments by providing a highly accurate geo-referenced point cloud which integrates with equivalent multibeam sonar data. *www.applanix.com*

Optech CMS V400

Optech's CMS V400 is a scanning solution for dangerous and inaccessible cavities, offering improved safety in standard mining operations. The system is easy to transport and set up, and is fully programmable, allowing the user to define scan parameters such as elevation step, azimuth step and scan limits. *www.optech.ca*

China launches surveillance satellite

China has launched Yaogan IX, remote-sensing satellite. The purpose and performance are similar to the US white cloud system. This would be used to conduct scientific experiments, carry out surveys on land resources, forecast grain output and help with natural disaster-reduction and prevention endeavour. *www.china-defense-mashup.com*

MAPPS seeks legislation in US Congress

A bill to authorize the program known within the geospatial community as "Imagery for the Nation" is being presented for introduction in Congress, MAPPS announced. "'Map it once, use it many times' is not only a mantra in the geospatial community, but it is technologically feasible through the use of satellite and aerial imagery and GIS. MAPPS is urging Congress in the US to authorize and fund a program of geospatial image maps through a bill known as the Making America Prosperous Act, or MAP Act," said Jeff Lovin, MAPPS President. Dozens of Federal agencies, virtually every state, and hundreds of regional, local and tribal units of government acquire imagery each year. "Today, these agencies each acquire their own imagery. These ad hoc programs result in costly duplication. A consolidated program provides an economical approach to inter-governmental use of ortho imagery and help provide data for hundreds of applications in the U.S. economy," Lovin said. *www.MAPPS.org*

CARIS launches Spatial Fusion Enterprise 5.2

CARIS released Spatial Fusion Enterprise (SFE) 5.2 as part of its Ping-to-Chart™ product suite. SFE is web-enabling technology for geospatial information that aims at leveraging the investment of collecting and maintaining data by making it more visible and accessible to stakeholders. www.caris.com

Intergraph® introduces enhanced Map Publishing Solution

Intergraph® has introduced a newly enhanced geospatial solution to enable the efficient production of high-quality map products by U.S. state departments of transportation, military and national mapping agencies around the world. GeoMedia® Map Publisher is used for enhanced cartographic capabilities and high levels of map production automation to produce series and ad-hoc hard copy maps. *www.intergraph.com*

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ISRO budget 2010

In the recent Budget, presented by the Indian Finance Minister, the allocation for the Indian Regional Navigational Satellite System (IRNSS) was pegged at Rs 262.10 crore against the revised estimates of Rs 220 crore last year. *www.business-standard.com*

India, Russia to produce GPS receivers

India and Russia are planning for a joint venture to produce dual band GPS / GLONASS receivers for civilian and military use. "We are actively working on a project to establish a joint venture on Indian territory to produce various navigation equipment" said CEO of Navigation and Information Systems (NIS) Alexander Gurko said. *www.india-server.com*

Boost for Indian maritime safety

VXL Technologies Distress Alert Transmitter (DAT) is a GPS based search and rescue beacon, which promises to strengthen India's maritime safety and security system. In case of distress at sea, DAT fitted on-board the vessel sends out a continuous stream of signals to the INSAT 3A satellite of ISRO, which then beams the signals down to the Chennai-based Maritime Rescue Coordination Centre (MRCC) of the Indian Coast Guard. With an accuracy of less than 5 metres it allows the Coast Guard to locate the craft in distress, even on the high seas and in adverse weather conditions. *www.indiaprwire.com*

Sat-nav under threat from 'jammers'

Technology that depends on satellite-navigation signals is increasingly threatened by attack from widely available equipment, experts say. While "jamming" sat-nav equipment with noise signals is on the rise, more sophisticated methods allow hackers even to program what receivers display. A UK meeting outlining the risks was held at the National Physical Laboratory in Teddington. It was organised by the government-funded Digital Systems Knowledge Transfer Network. What brought this group of policy-makers, academics and industry figures together, is that the signals can be easily swamped by equipment back on Earth. The immediate solution to the problem is not clear. *http://news.bbc.co.uk*

Map of Chilean Earthquake

The Central and Southern Andes GPS Project (CAP) team led by Mike Bevis at Ohio State University have computed the coseismic displacement field associated with the recent earthquake in south-central Chile. Peak measured displacement is 3.04 meters near the city of Concepcion, Chile. Precise point positioning was used to determine the position of the GPS station near Concepcion every 30 seconds during the hour of the earthquake. Results show that most of the approximately 3-meter displacement occurred within about 60 seconds of the onset of the earthquake. A precise trajectory of the station during the earthquake will be determined once the high-rate (1 Hz) data currently stored at the station is made available. *https://listserv.unb.ca*

Raytheon to enhance Air Traffic Management Systems in India

Raytheon has been awarded a contract by the Airports Authority of India to automate air traffic control services at the Chennai International airport. Raytheon will install AutoTrac III to help reduce delays in aircraft arrival and departure. It will also have real-time meteorological information to assist air traffic controllers in adjusting to changing weather conditions. Raytheon is also upgrading air traffic management systems at the International Airports of Mumbai and New Delhi. AutoTrac III features a new generation of flight and surveillance data processing systems to ensure air traffic safety. *www.raytheon.com*

Delayed GLONASS Satellites launched

Roscosmos has confirmed a successful launch of the GLONASS-M satellites. In the first communication session with the satellites, telemetry data was obtained that confirmed that the state of all systems of the spacecraft is normal and corresponds to the flight program. The satellites launched were numbers 31, 32, and 35. *www.roscosmos.ru*

GPS tariff hike to be decided year end

Proposed increases for import duties on navigators supporting only the GPS system are expected to be agreed on by the end of this year, said Alexander Gurko, head of the NIS, GLONASS. *www.just-auto.com*

ESA receiver brings satnav indoors

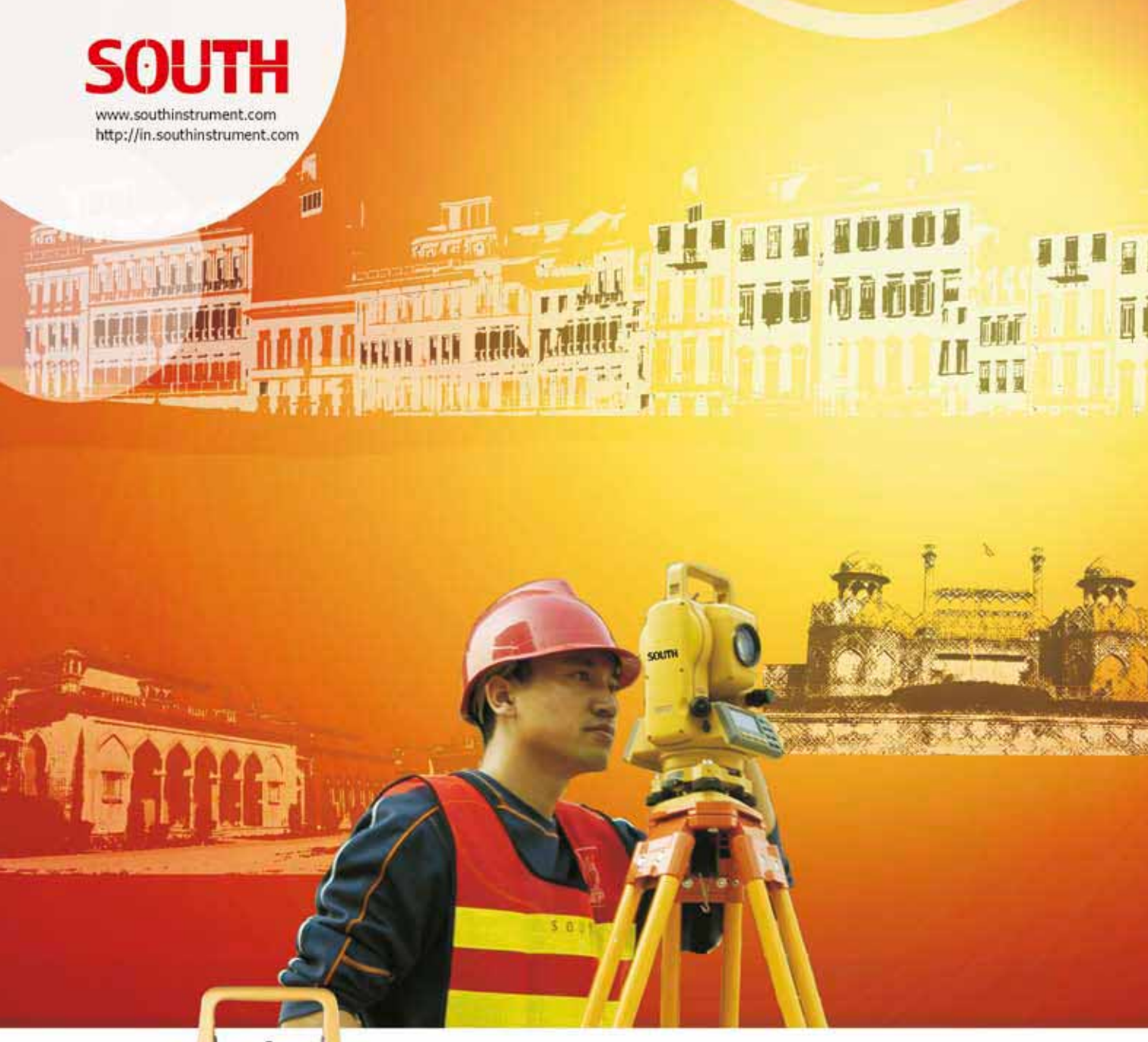
The ESA's DINGPOS (Demonstrator for Indoor GNSS Positioning) project combines a highly-sensitive receiver capable of picking up GPS and Galileo signals indoors with additional positioning methods. These include accelerometer and gyroscope sensors, local WiFi-based positioning and 'map-matching' – associating available location data of its user in terms of a computer model of the building concerned, like a character moving through a video game. A pair of consortia – one led by IFEN in Germany in partnership with UFAF, AUDENS and Telespazio and the other led by GMV in Spain and Portugal in partnership with TAS-F, UAB, ADI and Saphirion – are developing and testing separate platforms in parallel. *www.esa.int*

Sunderbans will drown in 60 years

The World Wildlife Fund has warned that in 60 years vast tracts of the rare mangrove forests of Sunderban will be inundated by the rising sea. Unlike previous efforts in a study, focussed on Sunderbans in Bangladesh, WWF's deputy director of conservation science Colby Loucks and his colleagues used a high-resolution digital elevation model with eight estimates of sea level rise to predict the impact on tiger habitat and population size. The team was able to come up with the most accurate predictions till date by importing over 80,000 GPS elevation points. *http://timesofindia.com*

SOUTH

www.southinstrument.com
http://in.southinstrument.com



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Email: india@southsurvey.com

Statement from CTIA – Protecting privacy

CTIA-The Wireless Association® Senior Vice President and General Counsel Michael Altschul issued the following statement after he testified on location-based services before the U.S. House Energy and Commerce Subcommittee on Communications, Technology, and the Internet and Subcommittee on Commerce, Trade, and Consumer Protection: "For more than 15 years, CTIA has been at the forefront of efforts to ensure location privacy while balancing the legitimate needs by law enforcement and in cases of emergency. Along with our members and other interested parties, we voluntarily developed the industry's 'Best Practices and Guidelines' in 2008 that would promote and protect the privacy of wireless customers' location information." "When the Wireless Communications and Public Safety Enhancement Act of 1999 was passed, there was a widely held assumption that LBS would involve a wireless carrier having access to a user's location information and then using or sharing that information to provide a location-based service.

Due to the rapid evolution toward open platforms, the tremendous consumer adoption of smart phones, and the increased prevalence of GPS-enabled LBS applications that can be downloaded and enabled without any involvement or knowledge by a wireless carrier, CTIA is in the midst of updating the guidelines. While the new guidelines have yet to be finalized, rest assured they will balance public safety's needs with consumers' privacy. "As technology continues to evolve, we would encourage Congress to clarify the terms under which location information may be released to law enforcement. When dealing with these issues, we also urge Congress to recognize the interstate nature of location-based services and the mobility of wireless users so they take a national approach so customers' privacy are maintained while fostering innovation, investment, and the introduction of new location based services by wireless carriers, device manufacturers, operating systems developers, and pplications creators." *www.ctia.org*

Vodafone closes down Wayfinder

Vodafone has announced the proposed closure of its Wayfinder Systems AB subsidiary. The competitive environment for turn-by-turn navigation has changed significantly in the last six months as competitors have chosen to make this service free to customers. *www.vodafone.com*

ATX proposes new approach

ATX Group unveiled a proposal to help accelerate deployment of the European Commission's initiative to enable vehicles to automatically notify local emergency responders in the event of a crash and pinpoint the location of the emergency from anywhere within the continent. ATX proposes using one approach, which relies upon a telematics or Third-Party Service Provider (TPSP) to move the voice call from the car to the TPSP via SMS technology and in-vehicle satellite positioning technology. The focus of the Commission's second approach entails directing the call into local 1-1-2 response centres. Based on the scope of the eCall data received, the automated messages could also convey additional crash severity information as well as the access code to a Web portal with the associated data. The self-dispatch approach offers a significant advantage to vehicle manufacturers because it provides a thin client approach. *www.atxg.com*

Taking GPS indoors using TV signals

Rosum Corporation announced the launch of ALLOY™, a location and synchronization solution for indoor and urban environments. It was developed in partnership with Siano utilizes broadcast TV signals to provide precise frequency, timing and location information. *www.rosum.com*

Tracking devices by Locate Mobiles

Locate Mobiles launched 3 new personal mobile GPS location tracing products, a watch, a PC pen, and the rechargeable GPS matchbox. To check the watch's location, a user calls the sim card placed in the GPS watch from a mobile phone. The GPS chip determines its precise location and then sends a text message back to the phone with a map link. The product uses Google Maps, which is free. The GPS Pen is a plug-and-play movement recorder. Like an aircraft black box recorder it stores all its movements on an internal memory chip and has a built in LCD screen. A less expensive option for vehicle tracking. *www.mobilelocators.com*

Road Pilot includes 30,000 Indian tourist locations

MapmyIndia has launched Road Pilot, a GPS navigator pre-loaded with maps of 620 Indian cities, 576,000 towns and villages, 30,000 tourist locations and 2 million unique destinations. It provides information about hotels, tourist locations, ATMs, petrol pumps and eating joints. Neither SIM card nor GPRS connection is required for this GPS navigator. It offers an 'always on' GPS navigation experience, even in places where mobile phone GPS navigation would have failed. *http://navigator.mapmyindia.com*

"SatGuide" mascot

SatNav Technologies launched "SatGuide". The idea was to create an image for the company and its many GPS based products and services to rally around and establish a very strong connect with its target audiences. "We believe that the "SatGuide" mascot is an initiative that will provide a greater connect with our consumers with better awareness about GPS technology and its applications," said Amit Prasad, Founder and CEO, SatNav Technologies. *www.satnavtech.com*

Mio's PND based on u-blox GPS

Mio has selected u-blox' AMY-5M GPS module to power the Moov V780, a high-end PND and multimedia player. It combines personal navigation with multimedia features including web browsing, high-definition TV, photo/ music management, etc. *www.u-blox.com*

Galileo update

Astrium awarded €1 million study

Astrium GmbH Services has won a €1 million contract with the European GNSS Supervisory Authority to undertake a key study, which will define the measures needed to defend Europe's satellite navigation systems and services against radio interference. PROTECTOR is a European Commission FP-7 programme. The PRS and Operational Tool to Evaluate and Counteract Threats Originating from Radio-sources (PROTECTOR) study will be undertaken by a consortium led by Astrium GmbH Services. The study will focus on how best to defend Europe's Galileo and EGNOS satellite navigation systems and their related services against interference from radio sources in L-band, S-band, Ku-band and C-band. The study will therefore map out the technical and economic parameters to developing an effective system to defend Europe's satellite navigation systems. *www.astrium.eads.net*

Application Village brings Galileo closer to the public

The Galileo Application Village was a success with the public during Galileo Application Days (GAD) that took place in Brussels. Camped out around the public esplanade beside the Commission's Berlaymont building were some 32 cutting-edge location-based applications funded through various European Commission, European Space Agency, and national and regional initiatives. In welcoming delegates to the main conference, Pedro Pedreira, Executive Director of the European GNSS Supervisory Authority (GSA), described the Application Village as allowing the event to "break through the walls of the conference room to show the citizens, the taxpayers, what benefits GNSS satellite applications can bring." *www.gsa.europa.eu*

The European Satellite Navigation Competition

On 1st May 2010, the idea database for application innovations in satellite navigation will be opened for the seventh time. Participation in the European Satellite Navigation Competition is a chance to play a part in shaping the dynamic, growing market for navigation applications and to win prizes worth EUR 500,000. 20 partner regions across the globe foster the realisation of your business idea.

European authorities urged to boost GNSS Research

Key European Industry and University representatives rallied in Brussels to stress their deep concerns with regard to the future of GNSS Research in Europe and to celebrate the launch of a Manifesto for "a More Committed Europe towards the Development of GNSS Applications". Funding originally allocated within the EU Seventh Framework Programme (FP7) to support GNSS applications development has been removed in 2007 to fill in a gap in the Galileo infrastructure development finances. Today, there is no more budget beyond the up-coming third call, to foster GNSS R&D within FP7. Such a situation is very critical as it may prevent many European Universities, Research organisations and industries, and in particular smaller companies to pursue their research and development activities towards EGNOS and Galileo applications. *www.galileo-services.org*

V100 GPS Compass revolutionize Parking Enforcement

The traditional solution to parking regulation was for enforcement officers to manually mark vehicle tires with a line of chalk and later handwrite a ticket to unmoved vehicles in violation of parking regulations.By partnering Hemisphere GPS' V100 GPS Compass with Tannery Creek Systems Inc's patented autoChalk™ software, parking enforcement can now

ticket offenders in real-time as they drive past in their patrol car. The backbone of autoChalk™software is Hemisphere GPS' V100 GPS Compass which provides heading and positioning data to determine the exact time, location and parking enforcement area of an offending vehicle. Digital cameras mounted on the side of the patrol vehicle automatically take a before and after picture of the vehicle to be analyzed for infractions. All of this is done while patrolling at 40 km/h and scanning at a rate of two vehicles per second, from up to eight feet away. The V100 GPS compass' two multipath-resistant antennas ensure that the signal is not misinterpreted when false signals are being deflected off downtown skyscrapers. However, if terrain causes a loss of signal, data from the vehicle's transmission is paired with input from the integrated gyro and tilt sensor of the compass to keep carrying a position for up to 10 minutes. *www.hemispheregps.com*

Pacific Crest's new UHF Receiver

Pacific Crest new ADL RXO is the latest addition to its Advanced Data Link (ADL) product family of high-speed wireless data links. It is a receive-only UHF radio and is available in two 40 MHz frequency bands (390-430 and 430-470 MHz) to cover the entire commercial UHF band without sacrificing radio performance. Its next generation RF design offers higher bit rates to easily handle RTK corrections for

the current and expanding GNSS satellite constellations. *www.PacificCrest.com*

New GPS receiver from Magellan

Magellan Navigation new receiver, ProFlex 500 is now available in single or dual-frequency versions. Each ensures RTK performance with a precision ranging from sub-metre to centimetre level. Embedded communication features include integrated GSM, UHF and Bluetooth for wireless options as well as Ethernet and USB connections. It is capable of rapid initialisation and transmitting both GPS and GLONASS data. *www.magellangps.com*

GeoEye selects Lockheed Martin

GeoEye has selected Lockheed Martin to build GeoEye-2, the company's next-generation, high-resolution Earth-imaging satellite system. Bill Schuster, GeoEye's COO, said, "GeoEye-2 will be the same class of satellite as GeoEye-1 but will benefit from significant improvements in capabilities to better serve our customers' demands for increased quantities of imagery at higher resolution. Some of these improvements include enhanced tasking capabilities and the ability to collect more imagery at a faster rate." *www.geoeye.com*

Leica News

The Leica IPAS Freebird is designed to improve flight economy and simplify GNSS-IMU processing. It no longer requires a continuous lock of satellites and frees up mission planning by allowing much tighter turns between flight lines. The results are up to 25% improvement in flight economy for sensor missions and time saving of several minutes per turn.

The Leica AR10 wideband GNSS antenna with integrated radome and large ground plane uses an all new antenna technology to provide signal tracking, phase centre accuracy and multipath suppression. It is ideal for reference station, monitoring and campaign applications. It provides exceptional low noise for superior measurement quality.

The Leica Zeno GIS offers a multi-functional and easy GNSS/GIS solution. It provides a one-click automated workflow between the field and office. It provides a colour graphic display in portrait format and a numeric keypad. Alternatively users have the choice to purchase the larger Leica Zeno 15 with a full QWERTY keyboard and a display in landscape format. *www.leica-geosystems.com*

u-blox launches photo geotagging

u-blox unveiled a complete hardware and software solution enabling a low-power photo geotagging system for digital cameras. When embedded in a camera, the chip takes a snapshot of all necessary GPS satellite data in a fraction of a second. When photos are uploaded to a PC or Mac, the data is quickly resolved to latitude/longitude or street address by u blox' YUMA software. *www.u-blox.com*

MobileMapper® Software

MobileMapper Field and MobileMapper Office is a new GIS and mapping software suite from Ashtech. The suite provides a new graphical interface, common to Field and Office, and it includes all the features and options previously available in Mobile Mapping and MobileMapper 6 Office software. Also MobileMapper Field enables collection of multiple features at the same time, the ability to label collected features, configuration of antenna height, and support of the DXF, MIF or CSV formats. *www.ashtech.com*

Zachry standardizes on ConstructSim

Bentley Systems announced that Zachry Holdings has standardized on Bentley's ConstructSim. It produces a construction information model that links data from design deliverables, schematics, project management tools, materials, and resource management systems in a virtual and visual environment. It enables owner-operators and construction managers to avoid costly mistakes and change orders by creating and tracking work packages that closely match the actual construction workflow. *www.bentley.com*

Carlson SurvCE 2.5 released

The new Carlson SurvCE 2.5 has been released. It is a free upgrade for Carlson customers already using SurvCE 2.0 and newer and works with numerous brands of Total Stations and GPS receivers. *www.carlsonsw.com*

Trimble News

Trimble BD982 is an RTK GNSS receiver for guidance and control applications. It is designed to allow OEMs and system integrators to add centimeter-level positioning and heading to specialized or custom hardware solutions. The receiver is based on a pair of Trimble's advanced 220 channel Maxwell 6 chips, which allow dual antenna inputs and the calculation of multiple GNSS RTK baselines. This eliminates the traditional GNSS problem of determining vehicle heading in static or low-dynamic environments. It supports GPS L1/L2/L5 and GLONASS L1/L2 signals.

Trimble has also formed a new industry solutions group within its Mapping & GIS Division - Market Solutions Team. It will work with key industries to develop advanced data use solutions for field workers involved in the collection, management and utilization of geospatial information. *www.trimble.com*

Raytheon awarded Next-Generation Control Segment Contract (OCX)

The U.S. Air Force has selected Raytheon Company for an initial contract of $886 million to develop a new element of the GPS to improve the accuracy of information from GPS satellites. The contract represents the first two development blocks of the OCX, which will have a significant impact on GPS capabilities. The OCX system will include anti-jam capabilities and improved security, accuracy and reliability and will be based on a modern service-oriented architecture to integrate government and industry open-system standards. The OCX will dramatically affect GPS command, control and mission capabilities and make

it easier for the operations team to run the current GPS block II and all future GPS satellites. *www.raytheon.com*

Honeywell's Handheld for Helicopters

Honeywell Bendix/King by Honeywell AV8OR handheld GPS is now available for helicopter operators. It is a portable touch-screen GPS for use in the car or in the air, with real-time weather capability, moving-map navigation and video-in capability. The moving map display incorporates helicopter symbology, low altitude helicopter routes, helipads and controlled airspace. *www.honeywell.com*

OmniSTAR Glonass improves convergence by 30%

There was a test done with two OmniSTAR 9200G2 running parallel for 2 days, restarting every hour. One receiver was used with Glonass and GPS. The other receiver did only have GPS corrections. The Glonass enabled receiver converged on average within 10 minutes, while it took the receiver with only GPS 13 minutes to converge to 30 cm. The Glonass receiver showed a 30% faster convergence. An important improvement with the use of Glonass was also increased availability in difficult circumstances.

Vexcel Imaging partners with PCI

Vexcel Imaging GmbH, announced its partnership with PCI Geomatics, an industry leader in geo-imaging products and solutions. The partnership is designed to leverage the strengths of the two organizations to produce an end-to-end image processing system developed specifically for customers of Vexcel Imaging's UltraCam series of high-resolution digital aerial cameras and UltraMap photogrammetric software.

GMV Technology for Malaysia

GMV was selected by Putrajaya Corporation to supply a GPS based fleet control system for the city of Putrajaya, Malaysia. In a consortium with Raisevest Sdn Bhd, GMV's fleet management experience for urban passenger transportation will make Putrajaya the first city in Malaysia to operate one of today's most advanced urban-transportation systems for giving real-time passenger information.

IFEN's GNSS Constellation Simulator awarded certificate

IFEN GmbH GNSS RF navigation constellation simulator NavX®-NCS has been awarded the official certificate of the TÜV SÜD stating the conformance concerning high precision signal generation and Galileo OS SIS ICD conformance of signal characteristics and signal quality. *www.ifen.com*

Topcon 'MS' measuring stations

Topcon Europe released MS05A and MS1A automatic total stations in the European Market. The MS05A features 0.5" angle accuracy. The sub-millimeter EDM measures up to 3,500m range with a single standard prism with 0.8mm + 1ppm precision and the typical measurement speed is 2.4 seconds. *www.topcon-positioning.eu*

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Geo-Siberia 2010
27-29 April
Novosibirsk, Russia
www.geosiberia.sibfair.ru

ASPRS 2010
26-30 April
San Diego, CA, USA
www.asprs.org/SanDiego2010

May 2010

INTERGEO East
19 - 21 May 2010
Istanbul, Turkey
www.intergeo-east.com

TIDES 2010
20-21 May
Taipei, Taiwan, R.O.C.
derc@mail.pccu.edu.tw

International Conference on Integrated Navigation Systems
31 May - 02 June 2010
Saint Petersburg, Russia
http://www.elektropribor.spb.ru

June 2010

Toulouse Space Show 2010
8 - 11 June
Toulouse, France
contact@toulousespaceshow.eu
www.toulousespaceshow.eu

IMTA Asia Pacific Conf. & Trade Show
18 - 19 June
Melbourne, Australia
www.maptrade.org/events

GEA'2010
22 -24th June
Cracow, Poland
jacek@gea.com.pl
http://gea.com.pl/targieng.php

July 2010

ISPRS Centenary celebrations
4 July
Vienna, Austria
www.isprs100vienna.org

ESRI International User Conference
12–16 July
San Diego, USA
www.esri.com

September 2010

IPIN 2010
September 15-17, 2010
ETH Zurich, Campus Science City
(Hoenggerberg), Switzerland
www.geometh.ethz.ch/ipin/

ION GNSS 2010
21-24 September
Portland, Oregon, USA
www.ion.org

G-Spatial Expo
19 - 21 September
Yokohama, Japan
g-expo@jsurvey.jp
www.g-expo.jp/en/

International Astronautical Congress 2010
27 Sep - 01 Oct
Prague Czech Republic
iac2010@guarant.cz
www.iac2010.cz/en

October 2010

INTERGEO
5 - 7 October
Cologne, Germany
www.intergeo.de

GSDI-12 World Conference
19-22 October
Singapore
www.gsdi.org

GEOINT 2010
25-28 Oct
Nashville, Tennessee, USA
http://geoint2010.com

November 2010

Trimble Dimensions 2010
8 - 10 November
Las Vegas, USA
www.trimble-events.com

FORM IV

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I, Sanjay Malaviya, hereby declare that the particulars given above are true to the best of my knowledge and belief.

March 1, 2010 Signature of publisher

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