RNI: DELENG/2005/15153
Publication: 15th of every month

No: DL(E)-01/5079/08-10
Licensed to post without pre-payment U(E) 28/2008-10
Rs.100

ISSN 0973-2136

www.mycoordinates.org

Coordinates

Volume V, Issue 9, September 2009

THE MONTHLY MAGAZINE ON POSITIONING, NAVIGATION AND BEYOND

Surveying in Identity crisis

High-definition surveying

Interview on *Bhuvan*: Dr V Jayaraman

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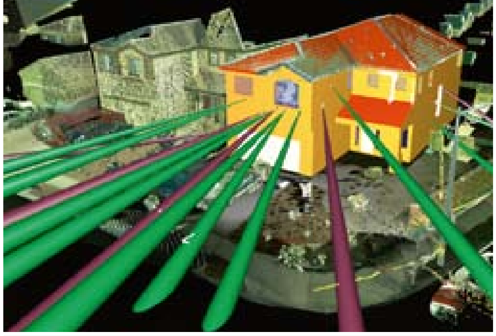


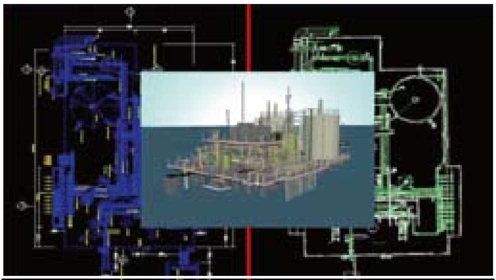
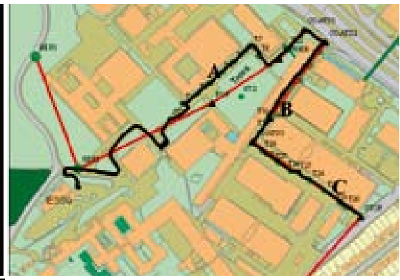

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This issue has been made possible by the support and good wishes of the following individuals and companies Ahmad Taha, Chengke Jiang, Craig Hancock, Erhu Wei, F Khan, Gethin Roberts, John Hannah, Xiaodong Yi, Xiaolin Meng and Datem, Foif, Geneq, Grace, GMV, Hemisphere GPS, Hi-Target, IP Solutions, Javad, Leica, Magellan, Maney Publishing, Navcom, NovAtel, NRSC, Sanding, Septentrio, South; and many others

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Annual subscription (12 issues) [India] Rs.1,200 [Overseas] US$80

Printed and published by Sanjay Malaviya on behalf of Centre for Geoinformation Technologies at A221 Mangal Apartments, Vasundhara Enclave, Delhi 110096, India.

Editor Bal Krishna

Owner Centre for Geoinformation Technologies

Designed at Thomson Press India Ltd.

Printer Thomson Press India Ltd., B 315, Okhla Phase I, New Delhi-110020, India

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We have Bhuvan now!

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Kudos to ISRO.

Bal Krishna, Editor
bal@mycoordinates.org

Surveying: In identity crisis

It is disturbing to know that some members of our profession fail to deliver a truly professional service

John Hannah
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In the rapidly changing economic, technological, political, and social environment that characterises the world as we see it in the 21st Century, every profession faces major challenges, surveying being no exception. While some of these challenges are common across all professions, others are specific to the surveying community. In this discussion I choose to separate the challenges facing the surveying profession into these two categories.

The first challenge common to all professions is one of maintaining currency of knowledge and professional practice in the face of rapid change. It is disturbing to know that some members of our profession fail to deliver a truly professional service because they are no longer capable of using appropriate (often new) technology to solve a problem or because they have failed to adapt to new legislative or environmental requirements. In this context I choose to define one of the important elements of a professional person as being someone who, on the basis of their skills, knowledge and professional advice, is able to add value when solving his/her client's problem.

By contrast, the technician merely undertakes a well defined task, adding little or nothing of additional value. For those of us who have undertaken our initial education and training more than a decade ago, maintaining currency of knowledge is no simple issue. If any ongoing training (and in some cases re-training) is to be successful, it will require time and commitment from both the professional person and his/her employer. This is one of the primary reasons why most professional bodies now have compulsory professional development (CPD) regimes in place for members. This CPD requirement is also one of the reasons why some practitioners refuse to join the relevant professional body. To fail to rise to this challenge on ongoing learning is to risk irrelevance and obsolescence.

The second challenge is to develop the skills necessary to become a facilitator able to build and manage a team of experts. It is now common for the complexity of projects to be such that no one professional group can lay ownership to the project. Increasingly, multi-professional groupings are being created to generate holistic complete life cycles solutions, of which the surveying profession can form an integral component. If the surveying profession does not recognize this trend, and adapt accordingly it runs the risk of becoming marginalised into providing technical services but with little high-end management

oversight. This challenge carries with it the need to be able communicate clearly, to manage effectively, and to avoid becoming so specialised as to be unable to see the larger picture.

The third common challenge is to recognise that the profession works as part of the knowledge society where careers are first made and then established through the provision of value added services. The knowledge society, of which the profession is a major player, requires fundamental, well-trusted and quality controlled data sets upon which to build. It then requires people with the requisite expertise to be able to use and interpret this data so as to achieve a specified end result. Surveyors need to recognize the importance of the shift from data collection to valued-added nterpretation and analysis if they are to be able to adapt and benefit accordingly.

When one looks specifically at the

surveying profession, other challenges become very apparent. Perhaps the first and most importance of these is to arrive at some global agreement as to what core education and training should be expected of a 'surveyor'. For example, the structure of the Royal Institution of Chartered Surveyors (RICS) has a very wide range of specialisms incorporated into a United Kingdom centric model.

Despite the increasingly global membership of the RICS, the idea of an antique valuer or real estate agent being a "surveyor" would be an alien concept and maybe even unethical in other parts of the world. Furthermore, the RICS specialism of "building surveying" is the sole preserve of architects within certain countries of the European Union. By the same measure, the functions undertaken by quantity surveyors (another RICS sub-speciality) are not usually functions of "surveyors" in other EU countries, nor in Australasia.

Indeed, not only are there national variations in skills and expertise, but there are also regional variations. How can the surveying profession undertake any consistent form of promotion at an international level unless it is first able to define succinctly the core skills to be expected of its members? Without a clear, coherent and relevant identity, the profession will continue to have an identity crisis, not only in its own mind, but also in the minds of major international bodies such as the United Nations and the World Bank.

It is very possible that the failure of the profession to deal with the previous problem may be the root cause for the second problem, namely, poor public recognition. This in turn, is a known cause in the inability of most surveying education programs (at least in the Western world) being able to attract a full quota of students.

Overcoming this problem is a challenge the profession must face urgently. Prior to the existing global economic retrenchment, there was a clear shortage of surveyors. Anecdotal evidence suggested, for example, that New Zealand, Australian and Canadian surveying graduates could easily obtain three or more job offers prior to graduation. Their problem was not one of finding a job upon graduation, but rather one of deciding which job to take. There is clear evidence to suggest that the economic costs associated with delayed infrastructural projects due to the lack of skilled personal was very high. With even a moderate resurgence in the global economy, these problems can be expected to return.

To the author's best knowledge the School of Surveying at the University of Otago is the only program in the English speaking world that is heavily oversubscribed with students (150 students competing annually for the 60 places available in each new intake class). This has only come about after many years of a targeted publicity campaign consisting of clear simple messages that have been directed towards high school students and their teachers.

The third specific challenge for the profession is linked to the second, namely, its ability to replenish itself. The age profile of the profession is such that at least in the Western World almost 50% of its practitioners are likely to retire in the next decade. Where will we find the future wave of practitioners? Given the different skill sets currently found between countries, particularly when dealing with local land legislation and ownership issues, immigration is unlikely to be a solution, unless of course appropriate retraining programs are established. Indeed, it is perhaps even arrogant to assume, firstly, that any particular part of the world might remain, or even be considered to be attractive for immigration purposes and, secondly, that there will be a surplus of appropriate surveying graduates in jurisdictions willing and able to participate in such immigration.

There is no doubt that our profession is facing major challenges, but then the same has been true with our forebears. If we rise to these challenges, as they did, then there is a bright future ahead. If we fail to rise to the challenges then there will be multiplied difficulties & disappointments.

INNOVATION – MODERN GEOGRAPHY

Earth's shape and size

Muneendra Kumar
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"I always read that the world, land and water, was spherical... Now I observed so much divergence, that I began to hold different views about the world and I found it was not round.... but pear shaped, round except where it has a nipple, for there it is taller, or as one had a round ball and, on one side, it should be like a woman's breast, and this nipple part is the highest and closest to Heaven...." - *Kenneth C. Davis*

New York Times Best Seller "Don't know much about Geography" Permissions Department, William Morrow and Company, New York, NY, 1992.

Comments

- Thank "Heaven", Prof. Davis did not include any illustration(s).
- It is astonishing that this book got printed and became a best seller.

When the science of Geography would adopt the EXACT shape and size, as determined by the science of Geodesy?

"Bhuvan is a visualisation tool for showcasing India's imaging capabilities and societal applications using remote sensing."

says Dr V Jayaraman, Director, National Remote Sensing Centre, Indian Space Research Organisation, in an exclusive interview with Coordinates magazine on 'Bhuvan'

How do you envisage the role of Bhuvan?

The role is very clear; it is an Indian Earth Observation visualisation portal. Over the past two decades, ISRO has spearheaded myriad unique applications using various spectral, spatial and temporal resolutions offered by the versatile IRS satellites and these have been successfully institutionalized in many important areas of policy making, natural resources management, disaster support, and enhancing the quality of life across all sections of the society. Bhuvan is an initiative to showcase this distinctiveness of Indian imaging capabilities including the thematic information derived from such imagery, which could be of vital importance to common man with a focus on Indian region. Bhuvan, an ambitious project of ISRO is envisaged to take Indian satellite images and thematic information in multiple spatial resolutions to people through a web portal through easy access to information on basic natural resources in the geospatial domain. Bhuvan will portray satellite data as per the Remote Sensing Data Policy and thematic layers that are relevant for societal applications. As a whole, we envisage Bhuvan as a window to ingress into different services ISRO has been providing to the users.

Can everyone use Bhuvan? Are there any terms and conditions or restrictions?

It is open to the public, it is free and anyone can use it. As I said earlier, Bhuvan is only a visualisation gateway; one is not supported to download data from here. For that purpose, they will be led to a website like NRSC Data Centre, Natural Resources Database (NRDB) or NNRMS portal depending on the type of data/information needed wherein their requirements are appropriately addressed. With Bhuvan, we are essentially trying to showcase the Indian imaging capabilities. We have a rich repository of satellite data including very high resolution data better than 1m and on the day Bhuvan was launched and demonstrated at New Delhi, we have shown the full capability with this data. But we have decided not put this high resolution data on the public website due to the sensitivity related issues and in tune with the Remote Sensing Data Policy (RSDP) of our government.

What prompted ISRO to launch Bhuvan now?

This is a thing we have been deliberating for quite some time. We have been selling our data products to different users, in India and abroad. A lot of application projects have also been carried out which are funded by the different user ministries/ departments. But, there was always a feeling that what we are doing is not very well known outside our sphere of activities. Another reason that prompted us was that people would say that they are not able to access our IRS datasets but are able to get data from other sources and portals. Above all these things, the key motivating force was our Chairman ISRO, Shri G. Madhavan Nair. He has always been in the forefront of taking space-based applications to the society such as the Village Resource Centres (VRC), tele-medicine and tele-education initiatives of ISRO. He is primarily behind this initiative of Bhuvan as well. It was due to his constant motivation that when NRSC became a full-fledged unit under ISRO in September 2008, it was decided that there should be 'public good services', delivered on the web in a timely manner, which will provide meaningful services to the community, and also open up opportunities for both private sector and academia to develop innovative challenging programmes that benefit science & society. Thus, Bhuvan initiative assumed much more focused attention and the ball started rolling from November 2008 onwards. Finally, I believe Bhuvan is also the result of many people in the country who are constantly looking for focused inputs from space-based remote sensing data for India's development.

How justified is Bhuvan comparison with Google Earth?

We are unique and we are different, and are not competing with anybody and more so we do not want to be compared with Google Earth or any other image portal. Hats off to Google Earth on one thing – it made remote sensing popular, as nobody has done earlier. But, in Bhuvan as I have been repeatedly emphasising, we are talking about showcasing our own Earth Observation capabilities including the societal applications carried out in India. Whichever way we put, we want to showcase Remote Sensing applications which are important; particularly when we talk in the Indian context and more so of our rural areas. You will see in Bhuvan, IRS data with 5.8 metre resolution with multi-spectral capability provided for whole country including the rural areas, and note that no other portal gives this unique information. We want our data to be used

for many societal applications. For example, with Bhuvan, one will be able to visualise our satellite data over India - it will give a good feel of our natural resources and information on weather conditions. Ultimately, when the administrative layers are overlaid on that, people will really be able to imagine and appreciate. Bhuvan is focused on Indian region at the moment and slowly we'll probably extend to the rest of the world.

Is it possible for other government organisations to join the Bhuvan initiative?

All the ministries that are part of NNRMS become part of Bhuvan, because the applications that we are doing are done jointly with them. ISRO is putting this up by representing the NNRMS interests of the various user departments. So, this is why I'd say Bhuvan is a visualisation tool for showcasing India's societal applications using remote sensing.

What resolution data will be made available on Bhuvan?

As I said earlier, we have put up 5.8 m multi-spectral data across the country. Data of 2.5 m with full stereo imaging capability and data better than 1 m are available with us, but those who want to buy this have to order it from us. Globally there is a mechanism called Global Earth Observation System of Systems (GEOSS) – they are talking about making the 30m data and coarser freely available. If that happens the world over, India may have to take similar steps. For now, Remote Sensing Data Policy is complied in Bhuvan and we will strictly follow the policy as on date. The government of India is revisiting the policy and as and when the policy gets updated we will comply with the same.

Are there any restrictions to use Bhuvan while driving or putting up on a navigation device?

With the current spatial resolution made available on Bhuvan, it may not be feasible for using the data for driving application or can be ported onto a navigational device. As and when the policy permits to stream high resolution data on Bhuvan, at that point of time such navigational application can be explored. For the moment, we are planning to add a navigational option onto Bhuvan with tourist centric approach where in one can navigate on a pre-loaded tourist map and can simultaneous see the corresponding image data.

What would you like to say about the ongoing efforts of NSDI vis-à-vis what Bhuvan has established now?

Every department is supposed to make the data available to the common man for applications. In the overall gamut of NSDI, you can consider ISRO's contribution of Bhuvan as a window to visualise the kind of data that is available with Department of Space. The underlying factor is actionable products and services. This is sort of the triggering point on how products and services can be ultimately used towards food security, infrastructure development, weather, disaster management studies, climate change etc.

When are we going to see the enhanced version of Bhuvan?

It is a continuous effort and we are working towards it. For the next few months we will focus on improving the user experience in accessing and exploring Bhuvan. We are also planning to add a few new features. As and when new development scheme are taken up, for example the Space Based Information Support for Decentralised Planning (SIS-DP) project where larger scale maps will be needed, we have to be prepared to address such requirements. There is also the question of trying to ensure that the data is periodically updated and expand the dimensions horizontally and vertically wherever possible. With the availability of INSAT 3D next year we'll have the possibility of porting temperature and humidity profiling as well. Therefore weather data will be another area where we have to concentrate. We have to do a lot more and we know that expectations are very high.

Could you tell us how a young boy came to coin the name "Bhuvan" for the portal?

The name "Bhuvan" was given by a young scientist who is a part of the Bhuvan team from Dehra Dun and for its aptness, it was unanimously accepted.

Bhuvan
It's different

A review of Bhuvan, the recently launched earth observation portal of the ISRO.

"*We are convinced that if we are to play a meaningful role nationally, and in the community of nations, we must be second to none in the application of advanced technologies to the real problems of man and society*."

A quote by Dr Vikram Sarabhai who is considered the father of Indian Space Programme.This vision of Dr. Sarabhai has been fulfilled by the various initiatives of the Department of Space, Government of India, the latest being Bhuvan, the earth observation portal that was launched by ISRO on the 12th of August – the ninetieth birth anniversary of Dr. Sarabhai.

There are two aspects to Bhuvan, one what Bhuvan is capable of doing and the other what the portal actually offers at present. Making a distinction between the two becomes necessary because what was demonstrated on the launch day – 'full capability' with high resolution data – is not what has been put up on the portal due to security reasons and the restrictions of the Remote Sensing Data Policy of the Government of India.

Basic features of Bhuvan

The Bhuvan portal allows to do the following (as per the site - http://bhuvan.nrsc.gov.in):

- *Visualise multi-resolution, multi-sensor, multi-temporal image data*

Most of the Indian terrain is covered by up to at least 5.8 meters of resolution with the least spatial resolution being 55 meters from AWifs Sensor. The images on Bhuvan are a combination of satellite imagery from the OCM, AWifs, LISS 3, and LISS 4 sensors of IRS, taken over the last three years. The multi- temporal data are from the OCM & AWiFS sensors. The metadata option can be used to determine exactly when a specific area was imaged.

- *Access, explore and visualise 2D and*

3D image data along with rich thematic information on Soil, wasteland, water resources etc.

- *Superpose administrative boundaries of choice on images as required*
- *Visualisation of AWS (Automatic Weather Stations) data/information in a graphic view and use tabular weather data of user choice*
- *Contour map (Displays a colorized terrain map and contour lines)*

The availability of the various thematic and other layers is definitely a value addition on the portal, though the rendering of the layers is little slow. Placeholders marking towns are displayed and a mouse over gives the name of the place along with basic statistics. Drought and flood maps of different years give a taste of the temporal data available.

- *Fly to locations (Flies from the current location directly to the selected location)*
- *Heads-Up Display (HUD) navigation controls (Tilt slider, north indicator, opacity, compass ring, zoom slider)*
- *Navigation using the 3D view Pop-up menu (Fly-in, Fly out, jump in, jump around, view point)*
- *3D Fly through (3D view to fly to locations, objects in the terrain, and navigate freely using the mouse or keyboard)*

The fly through work well. A 'current location' has to be chosen first, and then another location specified to 'fly to'. The 3D navigation menu pops-up using the left click. The city level images are clear and make the best backdrop for the 'fly around'

- *Draw tools (Creates simples markers, free hand lines, urban designs)*
- *Urban Design Tools (to build roads, junctions and traffic lights in an urban setting)*
- *Drawing 2D objects (Text labels, polylines, polygons, rectangles, 2D arrows, circles, ellipse)*
- *Drawing 3D Objects (placing of expressive 3D models, 3D polygons, boxes)*

The various tools listed above do add an edge to the portal, and professionals will definitely want these tools further refined.

Measurement tools (Horizontal distance, aerial distance, vertical distance, measure area) - This is one of the most satisfactory tools on the portal. Marking an area or line and having the measurements for it almost instantaneously will be useful for delineating areas of interest for projects.

Points to ponder

All in all Bhuvan definitely is showcasing the capabilities and services available with ISRO, but…

Much of the hoopla seen after the launch of the portal could have been avoided or directed along more positive lines.

A number of glitches the portal experienced, and that have been sorted out since, were basic and could have been anticipated and worked out before the launch.

This being the beta version of Bhuvan should not be an excuse; the users want and deserve a quality product period. ISRO has definitely won brownie points for breaking through the 'barriers' and showcasing its wide variety of services on the internet, but Bhuvan is still negotiating the path between 'bouquets and brickbats'.

Bhuvan vs Google – the hype

Besides the issues relating to the working of the portal another reason Bhuvan has received flak is because of the constant comparison to Google Earth. The media has definitely played its part in perpetuating the 'vs' hype, but there is no smoke without a fire.

On 4 November 2008, at the inaugural function of the Indian National Cartographic Association (INCA) in Gandhinagar, ISRO Chairman Dr. Madhavan Nair said, "ISRO is planning to launch 'Bhuvan'. It is equivalent to Google Earth, but is going to be much more precise."

Now, it is being said that Bhuvan is 'unique', 'it is different' and it is not competing with anyone. This may be the official stand, but in the public psyche the comparison has taken hold. One cannot deny that Google Earth came earlier and has been around longer. It is now up to ISRO to establish an individual and unique identity for Bhuvan – one that will make it stand apart from other similar portals.

For now, the Bhuvan data does seem to have an edge over the Google Earth data at least in the context of India, and Bhuvan needs to seize this advantage and move ahead.

The road ahead

Having launched Bhuvan, ISRO needs to quickly iron out the glitches in the portal and make it work smoothly. Adding new features could be put on hold till all the features on the current site are working as desired.

The goals of Bhuvan – also need to be more clearly defined. The portal may be open to public, but it must have a purpose of its own. One portal cannot meet the needs of 'all the people, all the time'.

The challenge for Bhuvan in the coming weeks and months will be to maintain a balance between its offerings for the common man and the trained professional. The common person will be looking for easy to comprehend and easy to use functionalities on the portal. While the professional will want more advanced functionalities.

Bhuvan could play an important role in educating the common man about the use of remote sensing technologies, but it cannot afford to oversimplify things. Similarly considering the crucial role Bhuvan can play in expanding the effective use of the remote sensing technologies by the professionals for the betterment of the 'common' man, it should meet the needs the specialists.

There is no doubt that Bhuvan has caught the attention of the public at large, now it needs to keep evolving to retain that attention. It may seem like a tight rope walk, but if anyone can do it, it is team ISRO!

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GPS and INS for centimeter precision during large GPS outages

The aim of this paper is to present the MSIT and to analyze the results of different combinations that are used for GPS and INS integration

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An inertial navigation system (INS) is a self-contained navigation system that primarily measures position, velocity and attitude. The system's inertial frame measures the accelerations and the rotations by using an inertial measurement unit (IMU). The IMU is a group of six inertial sensors which are three linear accelerometers and three gyroscopes (gyros).

The problem with IMUs is that the error from the sensors results in a drift of the position solution over time. To overcome this, other sensors (such as odometer, speedometer, compass or GPS) can be integrated with the INS to provide additional position information. For instance, GPS can be used for real-time calibration of the INS using global latitude and longitudinal coordinates. In addition, GPS and INS are ideal for integration, as their error dynamics are totally different and uncorrelated (Kaplan E. and Hegarty C., 2006). This integration between GPS and INS significantly improves the overall accuracy and reliability compared with the stand alone units (Cramer 1997).

Research into GPS and INS integration is well established. There are two primary integration schemes performed through the process of Kalman filtering: loosely and tightly coupled. In the loosely coupled mode, the GPS receiver and the INS are treated as separate navigation systems. The GPS provides with a position, velocity, and time solution. The INS implements its navigation/attitude algorithms to give a position, velocity, and attitude. An integrated Kalman filter is then applied to combine the GPS and INS solutions. However, in the tightly coupled mode, only a single Kalman filter is applied to process both sets of GPS observables (code and/or phase) and INS measurements (Hide 2003).

In order to achieve high level of accuracy, the Applanix POSRS (a high performance GPS and INS integrated system that uses a NovAtel OEM4 GPS receiver integrated with a high quality navigation grade Honeywell Commercial Inertial Measurement Unit (CIMU)), is employed. Additionally, GPS and INS data were post-processed using different techniques (i.e. smoothed, ZUPT, etc). This research aims to develop a new technique for processing GPS/INS data to meet the requirements of the MTU project. The implementation of this uses a Multiple Steps Integration Technique (MSIT). This

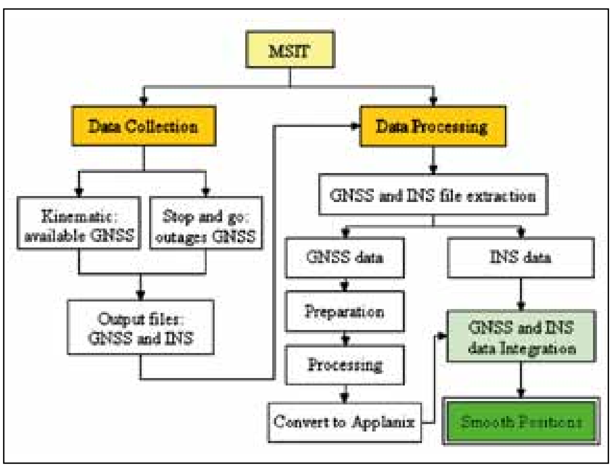


Figure 1 Multiple Steps Integration Technique

Figure 2 Applanix POSRS GPS and INS

MSIT is involved in data collection and data processing. When collecting GPS and INS data, it is necessary to monitor the GPS availability. When GPS positions are available, it is possible to collect kinematic data. However, when working in time periods when no GPS is available, a stop and go technique is initialized using the ZUPT. Additionally, GPS and INS data should be post processed in multiple steps: GPS data preparation, GPS data post processing, converting to Applanix POSPac format and GPS and INS data integration. Using this MSIT, Root Mean Square Error (RMSE) of a few centimeters was verified for the smoothed positions along the testing points as well as in the outages. The results from different tests are analyzed and discusses herein.

Multiple steps integration technique (MSIT)

MSIT (Figure 1) involves both data collection and data processing. When collecting GPS and INS data, it is necessary to monitor the GPS availability. When GPS positions are available,

Quality	Color	Meaning	Accuracy (m)
1 (Q1)	Green	Fixed Integer	0.00 – 0.15
2 (Q2)	Cyan	Converged Float or Noisy Fixed Integer	0.05 – 0.40
3 (Q3)	Blue	Converging Float	0.20 – 1.00

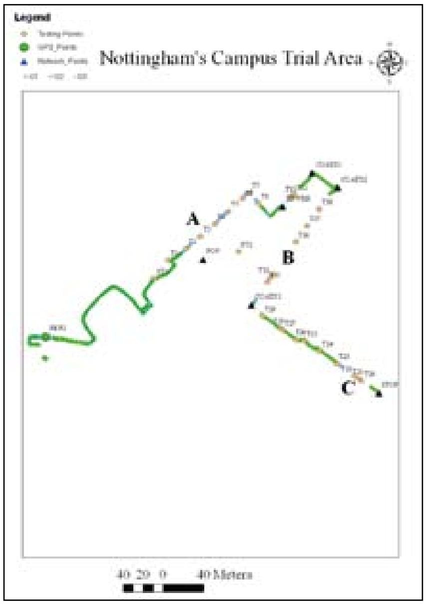
Table 1 PosGPS Quality Number Description

it is possible to collect kinematic positions. However, when working in outages, a stop and go technique to initialize ZUPT must be employed.

GPS/INS data should be post-processed in multiple steps to produce integrated smoothed positions as follows:

- Step 1: GPS and INS data preparation. Using the POSPac software, the GPS/INS file is extracted to produce a GPS observation file and a raw IMU data file. The GPS file is then converted to Rinex format using PosGPS. The RINEX observation file is modified by adding headers in specific location in this file to distinguish between epochs on which the equipment was stopped or moving.
- Step 2: GPS data post processing. A Kalman filter processing for the GPS data can be carried out within PosGPS software (this technique will be called a 'one step technique' or OST). However in MSIT, the modified RINEX file is post processed using the LGO software.
- Step 3: The GPS Phase Solutions are now converted to a Binary Format. The phase and code or the phase solutions from LGO output can be converted to Applanix POSPac binary format using LGO2App software written by the author from either kinematic or stop and go files. However, only the phase solutions are required to be converted to Applanix format for MSIT.
- Step 4: GPS and INS data integration. GPS and INS data can be loosely coupled using Applanix POSPac software (version 4.2) to produce smoothed positions. This integration is mainly dependant on using the GPS positions calculated independently using different software, e.g. LGO. So the GPS KF part in the loose integration will be replaced with an independent GPS position. MSIT is also based on using ZUPT which assists in reducing the INS drift in the GPS outages.

Figure 3 Test1: GPS data processing results (combined solution: Q1, Q2 & Q3)



Using this Multiple Steps Integration Technique (MSIT), a significant improvement has been noticed in the results compared with the conventional loose integration. More details about the results can be found in the following sections.

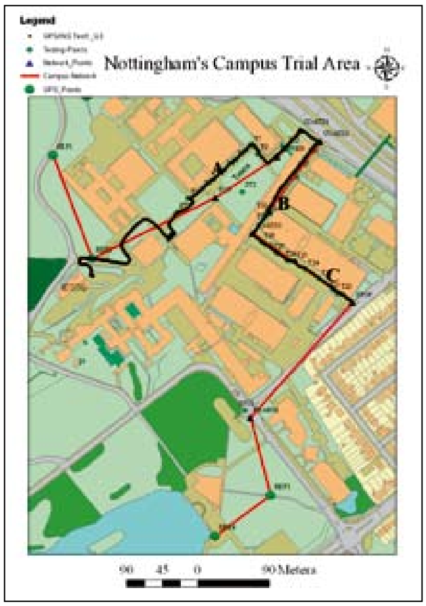
GPS/INS data collection and processing

The GPS/INS data were collected using The University of Nottingham's Applanix POSRS system fixed on a platform (Figure 2). Initially, GPS and INS data were collected along a predefined trial route (Taha 2007).

The Applanix POSRS is a high performance GPS and INS integrated system that uses a Novatel OEM4 GPS receiver integrated with a high quality navigation grade Honeywell CIMU. Such a high specification system can cost the user over £100,000.

Before moving the platform along the trial route and collecting the GPS and IMU data, it is necessary to collect GPS and IMU data, in static mode, for about 20 minutes preferably in an open sky area. This data is required for initialization in order to define the INS alignment (static alignment). GPS/INS data were collected on 7th September 2006 (GPS week of

Figure 4 Test1 GPS and INS smoothed positions



1391), along the trial route, stopping for at least about 60 seconds on each of the known points. The stopping time was noted down during the test and all the data was collected and stored in the POSRS system.

GPS/INS data were post-processed using two different methods: the first processing we call the 'One Step Technique' (OST) and the second one is the MSIT. The only difference between the two techniques is in the post-processing of the GPS data. In the MSIT, the GPS data is post-processed following the strategy described previously in this paper.

For both techniques OST and MSIT, the stored raw GPS and IMU data were extracted using Extract POS Data in Applanix POSPac software. The data extraction allows the detecting of potential data problems, such as gaps in the IMU data. The collected data had one gap In the IMU data of 0.01 second. According to Hide (2008) 'Gaps of 0.005 and 0.01s are pretty negligible since the rotation and acceleration are unlikely to vary much in this time and this is very close to the IMU data rate'.

In the OST, the GPS and INS data were post processed using the Applanix POSPac software (version 4.2). This software uses the loosely coupled GPS and INS algorithms to produce smoothed positions. The loosely coupled system uses the GPS calculated position to aid the INS; therefore RTK GPS positions are first calculated. Within POSPac, this can be performed using the PosGPS software. In general, the default options of the PosGPS processing parameters were used; however, the elevation mask was modified to 10º and the datum to WGS84. Also the option to reject any GPS measurements worse than Quality 3 was implemented. In PosGPS, the quality number can be between 1 and 6 depending on the solution calculated. Table 1 summarizes the quality number description: color, meaning and accuracies of these quality numbers (the accuracies given are only guidelines) (Waypoint-Consulting-Inc. 2004).

Forward and reverse GPS solutions can be combined to produce the final GPS position solution (therefore the described results are achieved using post processing only and cannot be recreated in real-time).

After post-processing the GPS data using PosGPS (as in OST) or using the strategy described in MSIT, both the GPS and IMU data were post-processed using the POSProc part of POSPac.

The automatic Zero-Velocity Update (ZUPT) technique was also used to detect when the IMU is static. ZUPTs are used to mitigate the IMU drift when stationary which results in an improved position solution. The lever arm between reference point and IMU and the reference point and GPS were stored in the Subsystems Setup. Besides, Kalman filter measurement rejections in the Inertial Integrated Navigation (IIN) setup were modified from 50 to 300. This is because the filter was terminated and there were no integrated solution. Other processing parameters are used as in the default values (for detail see (Applanix-Corporation 2005)).

Three tests were carried out on the GPS/INS data set using different processing techniques. The first two tests (Test1 and Test2) are carried out using OST with different GPS data post processed. Test3 uses MSIT to process the data.

GPS/INS results and analysis

The following section discusses and analyses the GPS/INS tests and results. Test1 will be analyzed alone, following that Test2 and Test3 will be analyzed together.

This is to make the comparison between the OST and the MSIT easier. The analysis will include the availability of the GPS solution and the accuracy of the GPS/INS integrated solution. It is worth mentioning that the GPS solution will not be analyzed in terms of accuracy since the GPS antenna was not perpendicular on the testing points and would therefore need to be corrected for tilt before accurate analysis could be made.

Following the processing strategy described previously, the GPS positioning results from the combined solution called 'Test1' are shown in Figure 3.

From Figure 3, the different qualities (+Q1, +Q2 and +Q3) of GPS position solutions were calculated for the positions of the known points. Moreover, there are several areas with GPS outages, highlighted using the letters A, B and C. The length of time without any GPS positions yields a challenge when trying to solve for a position to centimeter level depending only on the IMU data.

The processing results from the GPS and INS combined solution data can be computed as a forward solution or a smoothed (forward and backward) solution. The forward solution can be calculated in real time. The main limitation of this solution is that large gaps where no GPS position are available result in a large drift away from the truth as the position will only be computed from the INS measurements. As mentioned before, the INS errors grow very fast over time, therefore when the data is post-processed using the forward and backward (smoothed) solutions, the INS errors during the GPS gaps are minimized. For this reason, the smoothed solution results will be discussed herein.

Integrated Inertial Navigation coordinates (WGS84 geographic coordinates) obtained from the smoothed solution are converted to National Grid (OSGB36)

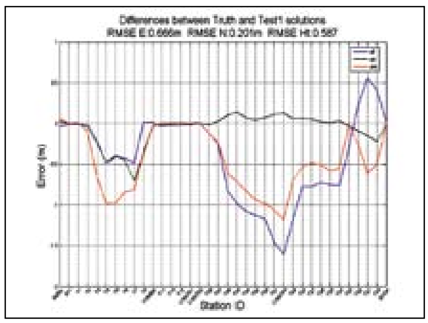


Figure 5 Test1: Differences between the 'truth' and the smoothed integrated coordinates

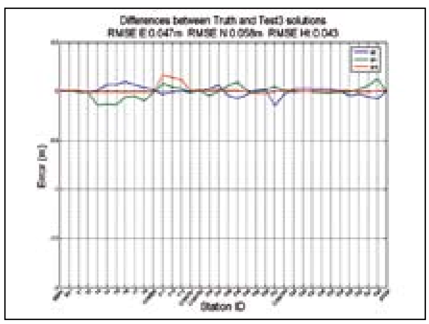


Figure 6 Differences between 'truth' and smoothed integrated coordinates Test3


"Septentrio GPS Technology helps us realize even the most demanding projects."
Erwin De Jonghe, head of Survey Department, Dredging International
CAT
Modern day dredging is a complex business. Ever more challenging projects are started with new technical requirements, extra ecological questions, and a continuous demand for increased productivity, reduced wear and tear and high efficiency.
Accurate positioning is key to the success of every project.
Septentrio's ultra-precise positioning technology makes it happen.
Why?
Because we are reliable experts.
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Versatile OEM Receivers for Demanding Applications
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coordinates using Grid-InQuest version '6.0.8' software and are shown on an Ordnance Survey MasterMap (Figure 4).

From Figure 4 the GPS and INS integration solution fill the gaps in areas A, B, and C. This illustrates the advantages of such integration between the GPS and the INS which ensure high availability, in this case 100% availability, positioning along the trial route. However, the important factor of the position is to be accurate. For this purpose, the resultant grid coordinates were averaged for each of the testing points and compared with the 'truth' coordinates (Figure 5). The points which have a small difference when compared to the 'truth' coordinates in the integrated solution are those which have a Q1 or Q2 GPS position available. However, large differences occurred in the points where there is no GPS available or the GPS position is only Q3.

Test1 has shown that using the OST the maximum drift of the IMU is 1.607m East 0.703m North 1.183m Up when there are no GPS positions for a period of approximately 20 minutes.

From the analysis in Test1, it is clear that the GPS solution using Q1, Q2 and Q3 reduces the position accuracy. For this reason, the same GPS and INS data in Test1 were post-processed twice, once using only Q1 and Q2 GPS positions and another one following the MSIT. The removal of Q3 positions as well as the use of the phase solution of the MSIT increased the GPS outages in Test2 and in Test3.

The testing points from T2 to T8 (in area A in Figure 3) have a Q3 GPS solution, a large GPS outage occurred in this area after the removal of Q3 positions and the use of phase solutions only. These outages could be due to inability of the processor to solve for integer ambiguity in these specific environments.

The resultant coordinates of Test2 were converted to OSGB36 grid coordinates, averaged and compared with the 'truth' coordinates. The maximum position errors of 1.640m and 1.170m in the E and Ht coordinates of COATS3 respectively. This due to the fact that this area was the most difficult area to collect good GPS positions in. Comparing the results of Test1 with the results from Test2 , it is clear that Test2 resulted in the more accurate coordinates. This is due to the removal of the Q3 GPS positions which reduced the accuracy of the integrated positions in Test1. However, the accuracy achieved in Test2 is still not good enough to meet the accuracy requirements for this research. Therefore, another attempt was carried out to post-process the GPS/INS data based on Q1 GPS positions only. This attempt was not successful and the integration fails to calculate any positions. This was one of the reasons for developing the MSIT to overcome such limitations.

Figure 6 shows the results of Test3 compared with the 'truth'. Comparing the results of Test3 with the two previous tests shows a significant improvement in accuracy when using the MSIT. In general, the RMSE of 0.047m, 0.058m and 0.043m with maximum positions error of 0.148m, 0.142m and 0.166m have been achieved in E, N and Ht respectively in Test3.

Conclusion

A Multiple Steps Integration Technique (MSIT) has been developed as a loosely coupled integration of GPS and INS. When collecting GPS and INS data, it is necessary to monitor the GPS availability. When GPS positions are available, it is possible to collect kinematic positions. The GPS/INS data processing is conducted in four steps to produce smooth integrated positions. The key point of the data processing is the use of GPS phase positions calculated independently using different software, e.g. LGO. In addition, MSIT is based on using ZUPT which assists by reducing the INS drift when no GPS positions are available.

Overall, from the discussion and the analysis above, it is clear that high positional accuracy can be achieved in urban environments if GPS positions are available. As well as achieving positions 100% of the time. The integrated positions using OST are highly dependent on the GPS position quality. If, for example, GPS positions with Q1 are available, it is expected that the position solution will achieve a high level of accuracy. However, as the GPS outages increase the integrated position accuracy based on OST will reduce. The use of ZUPT technique has been shown to be and advantage in assisting to reduce the INS drift in the areas without GPS positions and hence increasing the final position accuracy. To overcome the limitation of OST, the MSIT offers higher positional accuracy especially over the very large GPS outage areas (up to 20 minutes in this research).

Acknowledgments

The authors would like to thank the Engineering and Physical Sciences Research Council for sponsoring the Mapping the Underworld project. They would also like to thank Dr Chris Hide for his support and expert advice on INS device and software.

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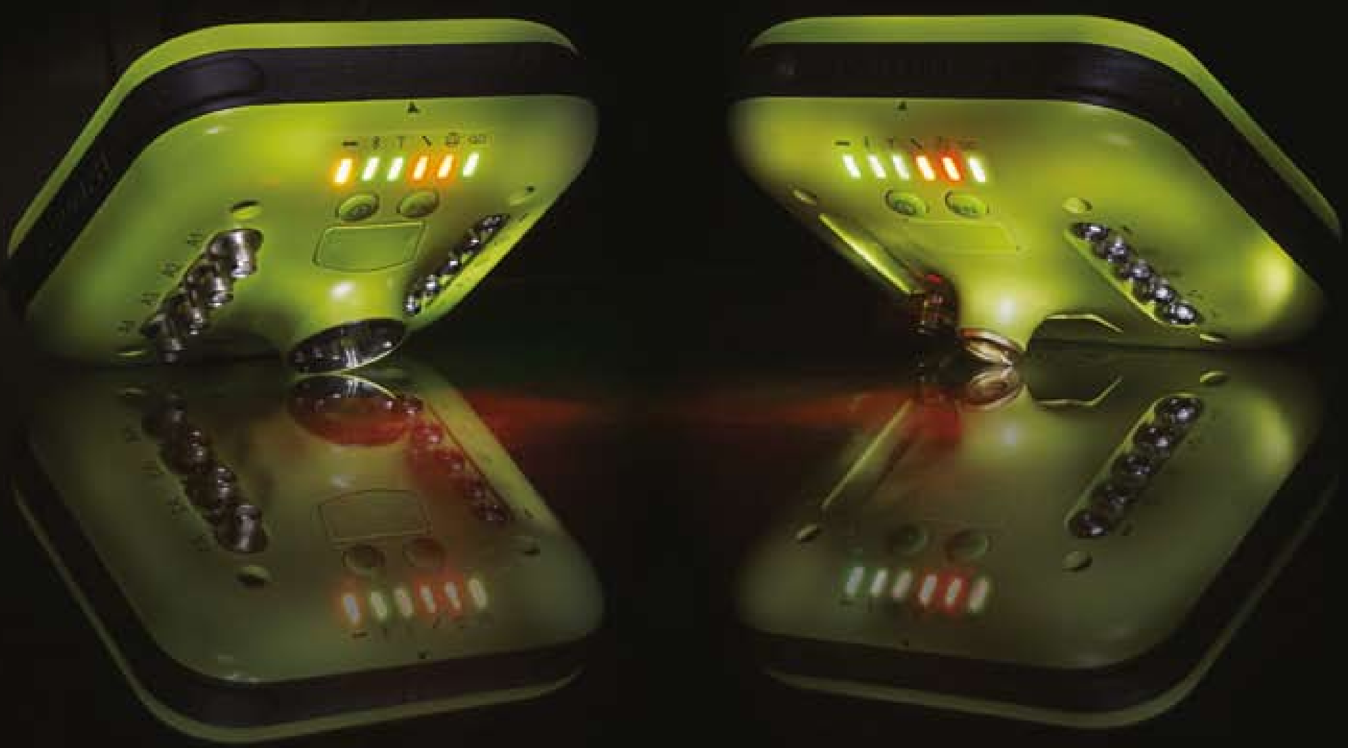
WWW.JAVAD.COM

TRIUMPH 1
TRIUMPH – 4X
216 channels

JAVAD ArcPad Extension
in focus



JAVAD ArcPad Extension

In response to a long-standing request from ESRI, JAVAD GNSS is pleased to announce that, for the first time, ArcPad users can now communicate directly with ArcServer. The need to first process field information through proprietary software has been eliminated, and real-time centimeter-level positioning is now possible!

- 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.
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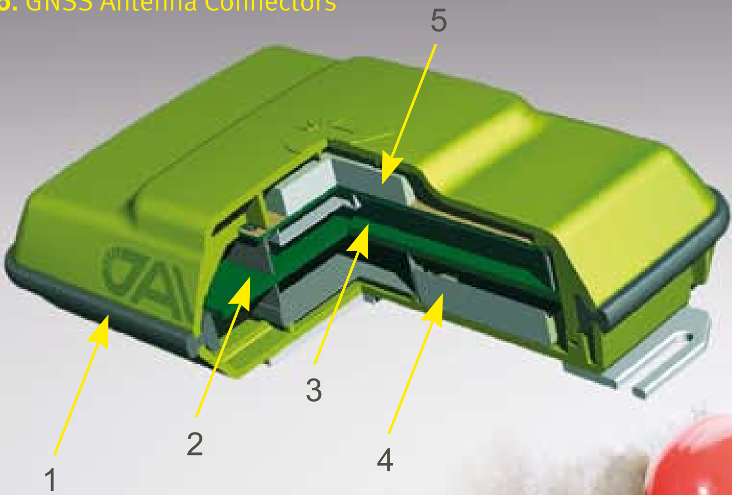
- JAVAD ArcPad Extension is an optimal ESRI-compatible solution for a wide variety of civil engineering or cartography tasks where centimeter level accuracies are required. At the core of this solution lies highly integrated JAVAD GNSS technology optimized for use with ESRI's GIS software.

Please see www.javad.com for details.

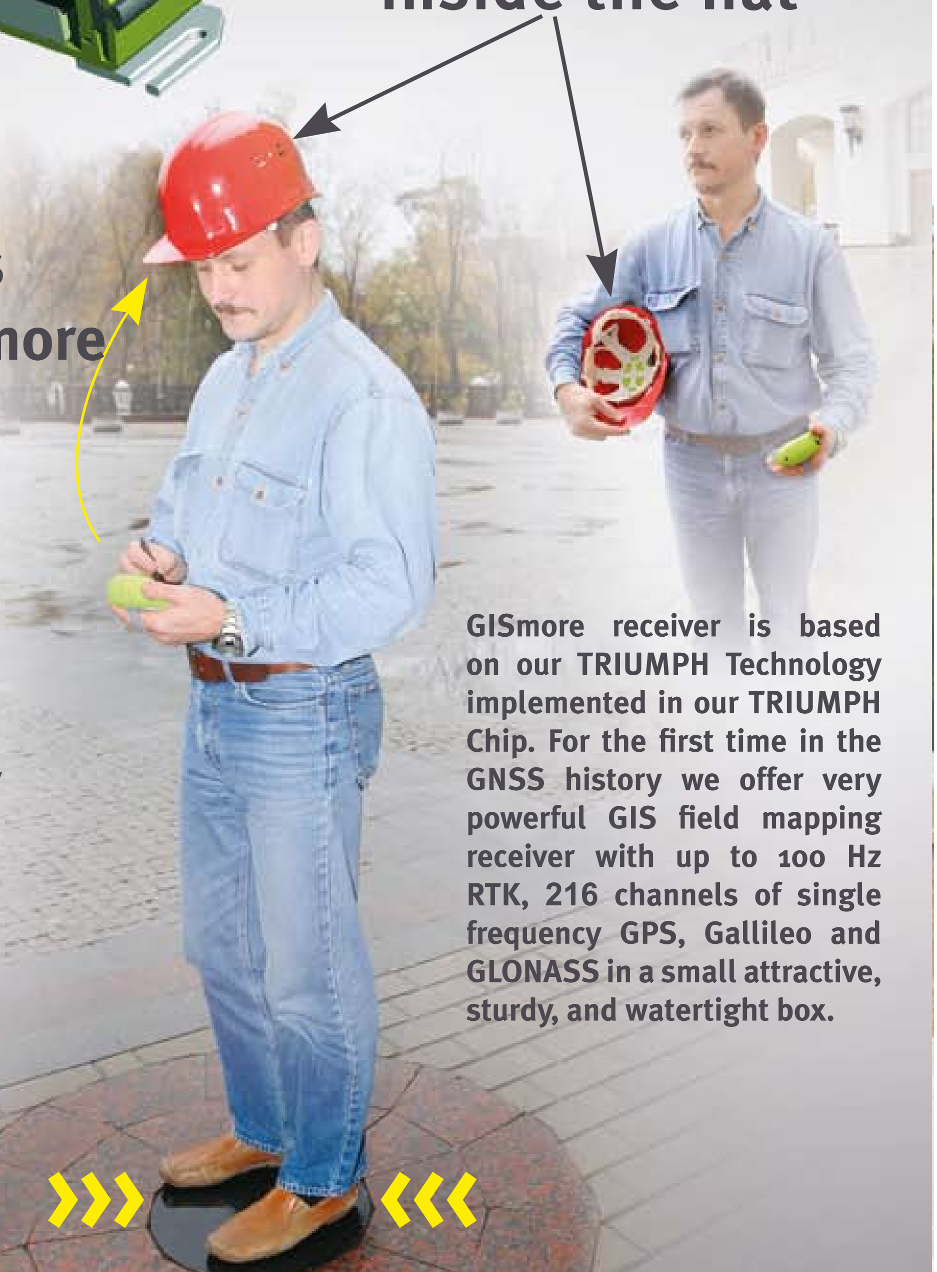
Actual size

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
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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
B
R
One base—one rover, one baseline
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TRIUMPH

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)

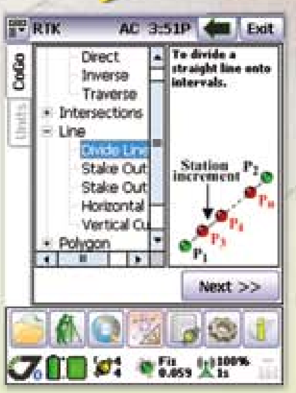
Giodis

Full-featured office post-processing software

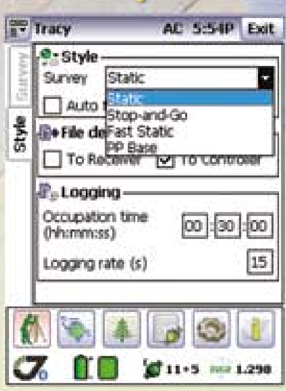
Tracy

A versatile and powerful field software

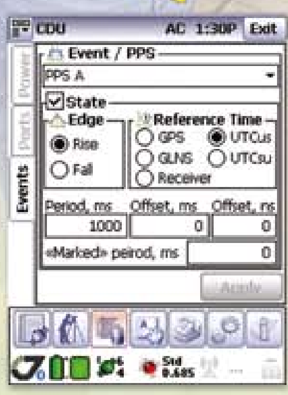
Software for Windows Mobile OS to control receivers, automated GNSS post processing surveying tasks (Static, Fast Static, Stop&Go, Data Acquisition), and to perform RTK survey and stakeout tasks.



Support for survey and stakeout projects



Static, Fast Static and Stop&Go surveying



Configuration of all hardware

GPS SVN 49, Japanese CORS, Galileo

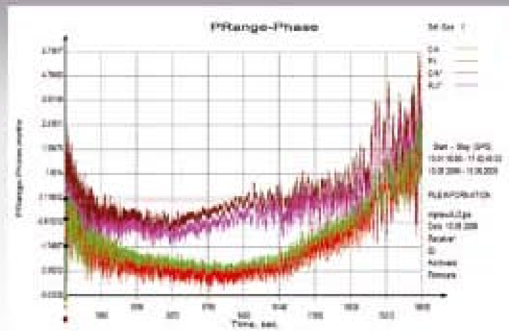
JAVAD GNSS eliminates GPS SVN 49 anomalies

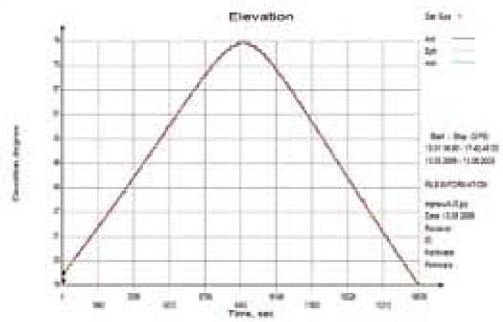
The anomalies in the recently launched SVN49(PRN1) was a chance to demonstrate the advanced multipath reduction capabilities of JAVAD GNSS Triumph technologies.

GPS World magazine, in its August 2009 issue, reported the nature of the anomalies of SVN49, and in a side-article showed how JAVAD GNSS Triumph receivers successfully cope with such anomalies, though the article failed to note that all data was taken from JAVAD GNSS Triumph receivers.

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.

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.





Highest Score in Japanese CORS “GEONET” Selection Process

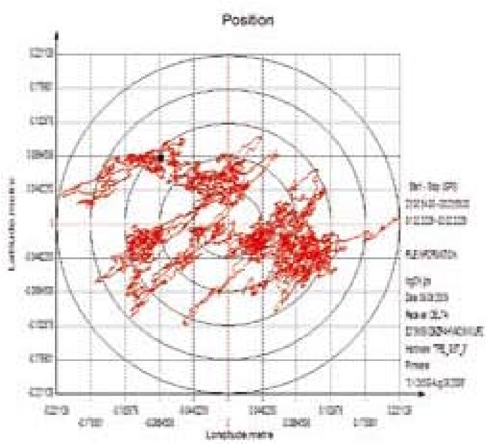
San Jose, California - August 11, 2009 - Javad GNSS (teamed with TOA, Hitachi Industrial Equipment Systems and GNSS Technologies) received the highest technical and system score in the selection process by the Geographical Survey Institute (GSI), an affiliate of the Japanese Ministry of Land, Infrastructure, Transport and Tourism. The tender, however, was awarded to another company due to its substantially lower prices.

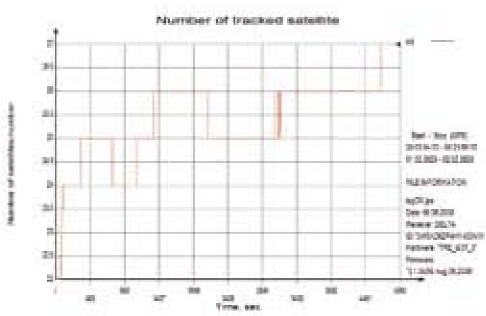
JAVAD GNSS receivers tracked all current and future Galileo satellite signals

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	23	--	46	0	0	63	3818	0xA153	-------	-------	Y(0)
Gps	3	24	--	47	0	0	86	4986	0xA153	-------	-------	Y(0)
Gps	6	27	--	46	0	0	86	4986	0xA153	-------	-------	Y(0)
Gps	11	14	--	44	0	0	77	4422	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	271	0xA153	-------	-------	Y(0)
Gps	22	38	--	47	0	0	86	4986	0xA153	-------	-------	Y(0)
Gps	31	23	--	46	0	0	86	4986	0xA153	-------	-------	Y(0)
Gln	6(-2)	24	--	51	0	0	87	4986	0xA153	-------	-------	Y(0)
Gln	7(-1)	28	--	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	85	4986	0xA153	-------	-------	Y(0)
Gal	78	18	--	50	0	0	81	4893	0xA153	-------	-------	Y(0)
Gal	79	80	--	49	0	0	86	4986	0xA153	-------	-------	Y(0)
Gal	83	23	--	48	0	0	59	3572	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	35	--	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)



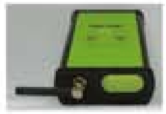


Other Receivers

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:

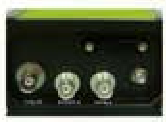
Can have up to 4 connectors of 1-PPS A • 1-PPS B • Event A • Event B • Antenna • CAN • IRIG B

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

High-definition surveying

The technology of HDS, available for a majority of the past 10 years is now increasingly adopted and applied on a multitude of applications in Asia

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The term Terrestrial 3D Laser Scanning scan is commonly referred to the process of collecting large number of data points through high performance hardware devices (3D Laser Scanners) delivering raw data outputs in the form of point clouds or cloud of points (CoP).

The concept of High-Definition surveying, on the other hand, extends the capabilities of 3D Laser Scanners by providing effective field and office workflow solutions in combination with data mining and visualisations (Frei, Kung, Bukowski, 2004) tools that can handle multi-billion data points seamlessly and effectively turn the vast amounts of data points into useful deliverables, including:

- 3D As-Built Models
- 2D Plans/Drawings
- Volumetric Analysis
- Clash Analysis
- Web-based delivered information
- Visualisation products in the form of animations and so on

Two main streams of technologies are offered by manufacturers of 3D Laser Scanners today, namely Time-of-Flight-based (TOF) and Phase-based technologies.

TOF-based systems utilise high-speed timing electronics to measure the time difference of a laser pulse to reach a target and return, effectively giving a range measurement and is done at a rate of typically 50,000 per second. TOF-based systems are suited for longer range (e.g. 700m) applications and also deliver higher accuracies over range than its phase-based counterparts. Phase-based techniques, on the other hand, measure the phase difference and the wavelength of constant waves projected at varying lengths against the reference signal stored in the hardware. This technique generally produces higher data collection rates and higher accuracies at shorter range than its TOF counterpart.

The last aspect of HDS lies in the ability to improve field data collection workflows through the adoption of traditional and robust field collection methods (e.g. resection and traverse workflows) as well as mobile methods including "Stop and Go" scanning as well as Kinematic Scanning through the use of additional hardware equipment and sensors.

Background

Traditional survey instrumentation, such as Total Stations provide surveyors with the ability to capture roughly 400-500 useful points in a day on a project. This is generally due to the fact that a large portion of their time is used in walking the site and the measurement process is manual and relatively slow.

HDS, on the other hand, delivers much higher field efficiencies than conventional methods, at better quality, completeness, safety and accuracy. This has led to a steady increase in the adoption of HDS methods by users from our highly diverse industry across the Asia region.

Applications

Civil and Building Survey

In the areas of Civil and Building Survey, HDS is commonly deployed to create as-built drawings of various types for a variety of structures. In Singapore, we have seen a number of airports laser scanned in the shutdown and low usage period over night, in pitch dark conditions

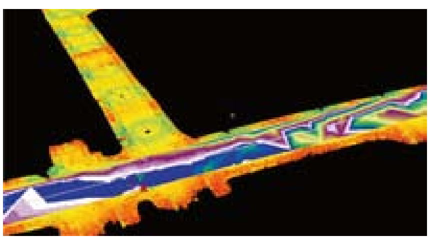


Figure 1 – Singapore Changi Airport scan data with surface model general through CoP

Figure 2 CoP of Victoria Memorial Hall Scan in Singapore

(where laser scanners still perform equally well) for quicker final map outputs with complete information (Figure 1). The completeness of the data eliminates the need for site go-backs which is commonly one of the more expensive costs that one has to manage in a survey operation.

In addition to general topographic mapping of sites, especially for critical, difficult to access, busy or unsafe areas, HDS provides a quick and safe way to capture complex environment as seen in the cases of the survey and mapping of the Victoria Memorial Hall with its intricate architectural details (Figure 2), conventional methods would have taken much longer time and deliver possibly sub-par accuracies due to the higher possibility of human error in the largely manual data collection process.

3D City Modelling

3D City Modelling, for urban planning and redevelopment, homeland security or even mobile and electronic commerce is gaining growing attention from both end users as well as service providers. A recent exciting application in Korea sees the development of 3D City Models for a better on-line immersive experience in the virtual world for gaming as well as other potential applications.

3D City Models are currently commonly developed using Aerial LiDAR technologies but HDS provides an effective way to fuse the “top-down” and “oblique” view of the world for a true 3D experience, both inside and outside, above and below a structure.

Plant Engineering

Plant Engineering remains one of the largest application areas, especially in South East Asia, for the technology. Service providers, who are traditionally not surveying and mapping firms, have readily adopted HDS technology to provide the as-built survey and modelling service for plants of all types (from Oil and Gas to Food Processing) to help in both the design and retrofit process since generally, as-built data of existing facilities is not correct (Figure 3) or in some cases, not even available.

Not only does HDS provide these users with an ability to create final as-built models for design verification or retrofit purpose, HDS also provides designers with an ability to perform virtual fit-up and clash analysis (Figure 4) and reduce the need of rework by bringing the plant to their desktop.

Asset Management

Another growing application of HDS is in the area of Asset Management. Users from a defence establishment in the region have identified the ability of HDS to quickly capture and archive as-build conditions and publish in the form of web portals (Figure 5). This capability allows Asset Managers to access sites located all over the world through a web-based interface from their desktop and perform collaboration, mark-up/tagging, measurement and communication over the environment to better perform the task of asset management.

Forensic and Homeland Security

The objectivity of 3D Laser Scanner lends itself very well towards the applications of Crime Scene Mapping. Numerous Police agencies in the region have adopted the technology for areas such as:

- Crime Scene Investigation
- Pre-Event Security Planning
- Bomb/Arson Investigation
- Risk Management
- Post-Event Forensic Analysis
- Pedestrian/Vehicle Accident
- Crash Investigations
- Vulnerability and Threat Assessment

HDS is commonly used by law enforcement agencies to perform once difficult tasks, such Virtual Bullet Trajectory Analysis (Figure 6) and Crime/Accident Scene Reconstruction.

An animated version of the crime is much better than a picture and even better than words in front of a jury and the visual, accurate, objective and completeness value of HDS makes the technology now a fundamental tool, and heavily used by, for example, the Australian Police agencies in the region.

Model/Technology	Range	Speed
HDS4400 - TOF	700m	4400 pts/sec
ScanStation 2 – TOF	300m	50,000 pts/sec
HDS6100 – Phase-Based	79m	508,000 pts/sec

Table 1. Performance characteristics of TOF- and phase-based 3D Laser Scanners

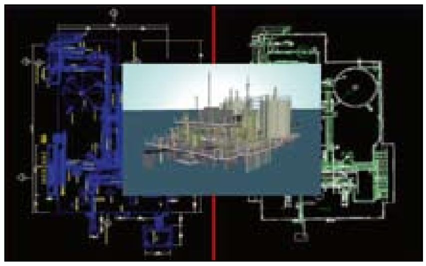


Figure 3 – CoP generated 3D As-Built Model in blue versus contractor supplied as-build drawing

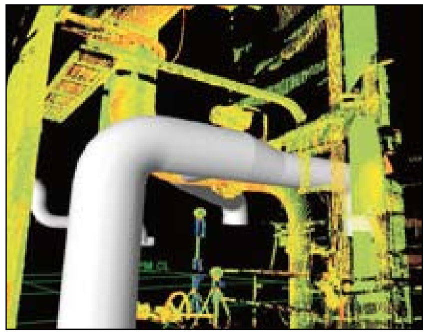


Figure 4 Clash analysis conducted inside CoP

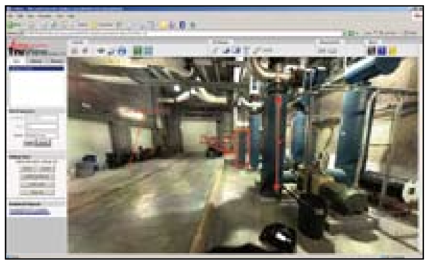


Figure 5 – Asset Management through Leica HDS TruView Portal

Figure 6 – Virtual Bullet Trajectory Analysis

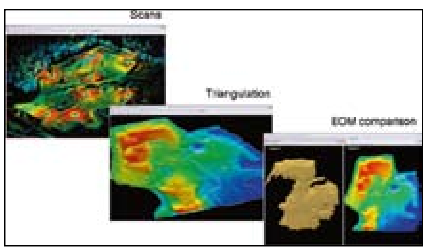
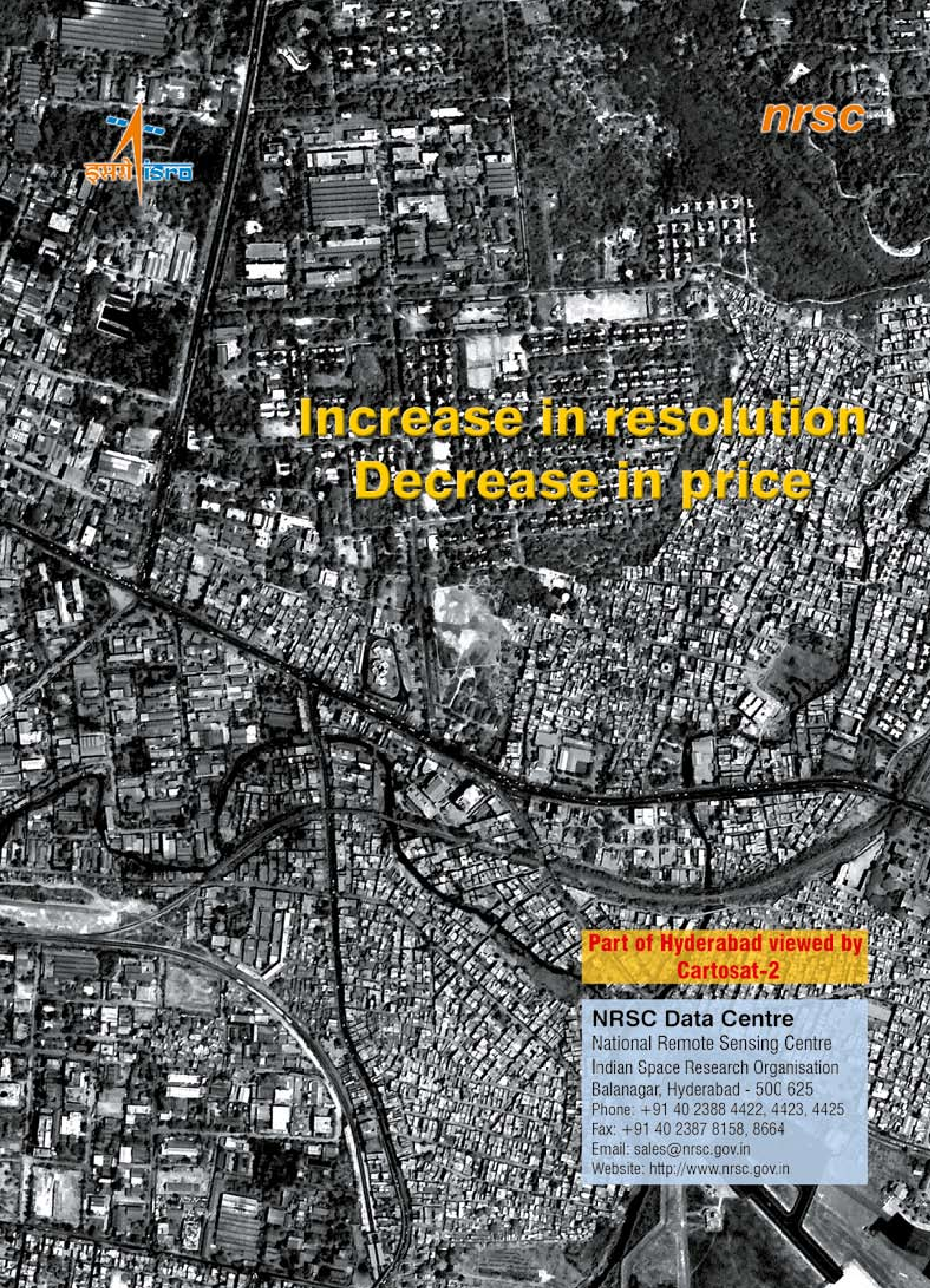


Figure 7 From CoP to End-of-Month (EOM) analysis



Part of Hyderabad viewed by Cartosat-2

As an example closer to home, HDS technology was recently put to use to support post-blast analysis at the Jakarta bomb sites (July 2009) near the JW Marriott hotel.

Volumetric and Mining Survey

The mining industry is under constant pressure to meet production demands and manage operational efficiency and safety standards. Stockpile surveys are frequently required to reconcile quantities, settle contractual obligations and also to manage operations (Figure 7). The generally and relatively less accurate, efficient, safe and complete method of conventional survey is rapidly replaced by 3D Laser Scanning technology for rapid route to deliverables.

In addition to volumetric surveys, scanning technology is used to monitor the stability of various types of man-made and natural structures and sites to maximize the efficiency and safety of mining operations. Image-fused point cloud data is also routinely supplied for geological mapping purpose (Figure 8) to help determine dips/strike angles and also coal seams. The applications of HDS in the mining industry in Indonesia are the most common in the Asia region.

Heritage and Archaeology

The last application segment presented in this paper covers the area of heritage and conservation. The best example to highlight the application of HDS in this area lies at the home of the venue of this Congress and is at the Borobudur World Heritage Site (UNESCO Jakarta Office, 2005).

The Borobudur Heritage Conservation Institute has actively documented the Borobudur temple and site environment and structures and created a highly accurate 3D image and geometrical database of the World Heritage Site for both conservation as well as reconstruction efforts.

HDS provides the ability to scan at 1mm resolution, capturing highly intricate details accurately and without disturbing the site, thus preserving the possibly dilapidated structures for preservation and also reconstruction using the scanned standing structures as models. South Korea stands out in the region in the adoption of this technology where we see both a commercial and government industry strongly supporting the conservation of historical relics and protecting our delicate heritage. It was only recently that the value of such surveys was realised when, due to an unfortunate but deliberate attack, Korea's number one heritage site – the South Gate or "Namdaemun" was destroyed by an arsonist (Figure 9). Fortunately HDS technology was deployed several years ago and a complete 3D model of the structure was available and is now used in the reconstruction efforts.

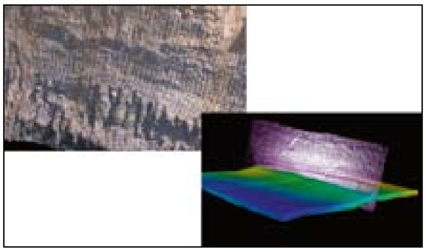


Figure 8 – Image-fused CoP for Geological Mapping

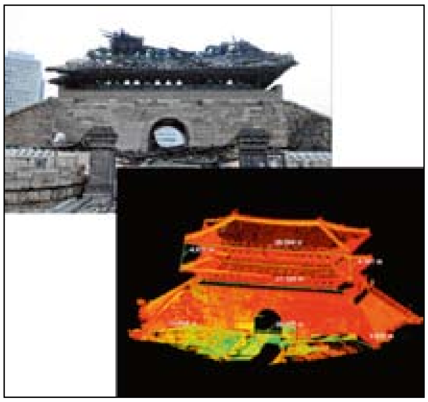


Figure 9 – Namdaemun CoP and aftermath of arson attack

Observation, outlook and conclusion

Observation and Outlook

Although successfully used in many of the projects above, HDS is still a relatively unknown technology in the Asia region. Market education and technology introduction is necessary to not only organisations that will use the equipment but also to those organisations who will benefit from having the value of HDS served to them, an example of which would be the owner/operator of facilities, government bodies, and so on.

HDS is also seen as an expensive technology by both service providers and end-users alike. The performances of older systems were also to the detriment of making the technology a commercially viable solution for every type of organisation. However, recent improvements in technology (e.g. 10-folds speed increase) and significant reduction in system cost now provides organisations the ability to embark into a new era of High-Definition Survey to master the technology and reap the full benefits this technology offers.

Conclusion

The technology of HDS, which combines hardware, software and visualisation technologies, is delivering benefits to a large spectrum of users in a highly diverse industry. The Asia region, in particular has taken encouragingly increasing advantage of the technology, particularly in the Plant Engineering segment. Further education is needed to increase the awareness of the availability and true value of such technologies to owner/operators and "final end users" alike to help reap the full benefit and provide the maximum value of the technology to the society and industry at large.

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High-piled wharf–deformation prediction

On the basis of the Back Propagation neural network and its training method the known data was used in the paper to establish a computation model with Back Propagation neural network to monitor the deformation of the 14th berth of No.2 harbor-pool of Tianjin port

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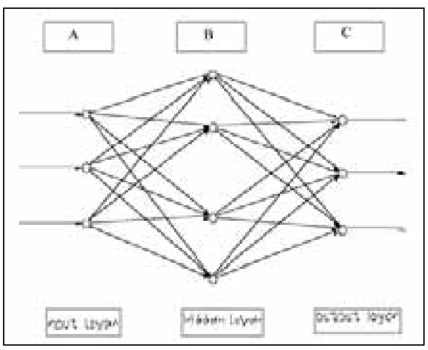

Figure 1. Topology of BP network in 3 layers

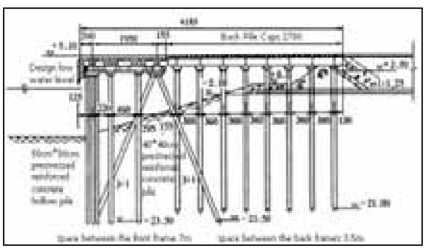

Figure 2. Sectional drawing of bank slope – pile foundation system in 14# berth

The high pile wharf has the advantage of slight wave reflection, steady anchoring condition, little investment and the construction time being short. Therefore it has been widely used in coastal areas where the ground has soft soil. But, on the other hand its penetrant structure raises some problems also for the structure. In order to guarantee the request of ships draft, the front water area of the wharf has to be dug more deep, and the rear area of the wharf needs massive backfill so as to link it with land, which can lead to the balance of soil body being destroyed, and may cause deformation of the bank slope which would influence the stability of the high wharf pile foundation. Thus, if no control measures are carried out (such as deformation monitor forecast), there would be an enormous security hidden danger in the wharf.

Regarding the wharf deformation monitor forecast, the traditional analysis models include the random model, deterministic model and the mix model. But in case of complex influencing factors, it is beyond the ability of the traditional analysis models to describe the non-linear mapping relations between the wharf structure and their deformation, further it affects the data fitting and the precision of deformation forecast.

The artificial neural network model may solve this problem to a great extent with its splendid self-organization, auto-adaptability, fuzzy judgment and inference, and better self-study ability. At present, the BP neural network model has been widely applied in dam examination forecast. This paper establishes an improved BP neural network model used for the deformation observation data analysis with the high pile wharf deformation forecasts system. The BP network is the forward feed network which is composed by a nonlinear transformation unit, and is one kind of teacher's studying algorithm. It revises the connection weight between layers and the threshold value according to the actual output error, making the value of exports and actual value as close as possible, thus enabling the forecast to have good accuracy.

The Principle and algorithm of ANN

BP (Back Propagation) network

The BP neural network usually contains three parts the input layer, the hidden layer and the output layer. The hidden layer may contain one or more layers, and each layer is composed of many neurons. Its network topology is shown in Figure1. Its characteristic is that: the neuron in each layer only connects with the neuron in the neighboring layer; there is no neuron connection within the layer; and there is no non-feedback connection between each neuron layer as well. Firstly, the input signal is transmitted forward to the hidden node, and then with the transition function, the information of hidden node is transmitted to output node where the result should be output after the processing. The transmitting function used in node usually selects the Sigmoid function. As a general rule, the hidden layer uses the S logarithm or the tangent activation function, but output layer selects the linear activation function.

The algorithm of BP neural network study

The BP neural network uses the algorithm of error reverse-transmit study with the technology of gradient searching. It realizes the minimum of mean-square deviation between the actual network output and the expectant output. The procession

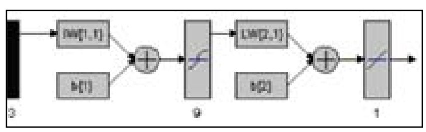

Figure 3. Diagram of BP neural network with 3 layers based on the mode of 3-9-1

of the network study is the one of error transmitting backward on one hand while revising the weight on the other hand.

The study process in the network is composed by forward-transmitting and reverse transmitting. In the forward process, the input signal dealt in each layer begins from the input layer to output layer, and the neuron condition in each layer only influences the next layer. If the expectant output cannot be obtained in output layer, the transmitting changes into reverse which will make the output error return along the original connection circuit. Through revising each neuron layer of the weight, the signal error will become minimized. After obtaining the appropriate network

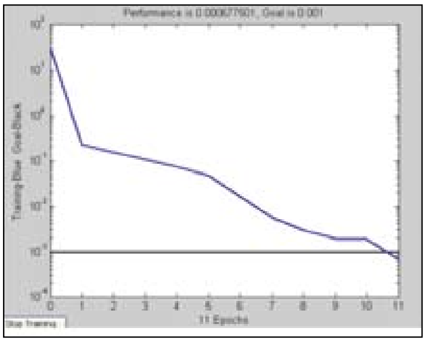

Figure 4. Error testing curve

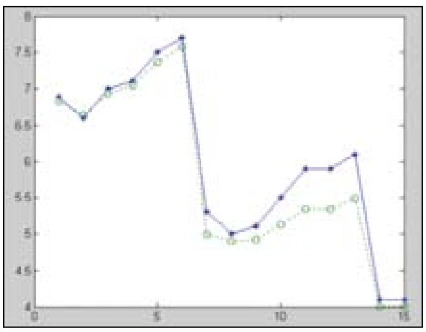

Figure 5. Comparison between surveying and testing Value

of new sample may be carried on.

Information forward transmission

Supposing BP network has L layers, for P the assigned sample and the network expecting output is Td=[Td1,Td2,……,Tdp]

When the Pth sample is inputted, the operating characteristic of jth neuron in l (l=1,2, ...L-1) layer is:

$$net_{jp}^{(l)} = \sum_{i=1}^{n_{l-1}} W_{ji}^{(l)} O_{ip}^{(l-1)} - \theta_j^l \qquad (1)$$

$$O_{jp}^{(l)} = f_l(net_{jp}^{(l)}) \qquad (2)$$

Where W_{ji} is the link weight from neural cell i to j, n_{l-1} is the node number of layer l-1.$O_{jp}^{(l-1)}$ is the present input of cell j; $O_{jp}^{(l)}$ is the output of cell j; f_l is non-linear differentiable non-digression function which usually chooses the S form function as Eq.(3).

$$f_l(x) = \frac{1}{1+e^{-x}} \qquad (3)$$

And for output layer:

$$O_{jp}^{(L)} = f_L(net_{jp}^{(L)}) = \sum_{i=1}^{n_{L-1}} W_{ji}^{(L)} O_{ip}^{(L-1)} - \theta_j^L \qquad (4)$$

The goal of neural network study is to realize for each sample the Ep (see Eq.(5)) being minimized, thus guarantying the total network error E (Eq.(6)) minimizing.

$$E_p = \frac{1}{2}\sum_{j=1}^{m}(T_{jdp} - \hat{T}_{jp})^2 \qquad (5)$$

（p=1,2,…,P, m is the node number）

$$E = \sum_{p=1}^{P} E_p \qquad (6)$$

Where $T_{jdp}, \hat{T}_{jp}$ stand for each output value of expected and actual of jth node in output layer.

2.2.2. Strive for the weight change and the erroneous reverse dissemination using the gradient drop law

When revising the value of network weight and threshold using the gradient drop law, the iteration equation of weight coefficient in lth layer is Eq. (7).

$$W(k+1) = W(k) + \Delta_p W(k+1) \qquad (7)$$
$$W = \{w_{ij}\}$$

Where, k is the iteration number. Let

$$\Delta_p w_{ji} = -\frac{\partial E_p}{\partial w_{ij}^{(l)}}$$

then $-\frac{\partial E_p}{\partial w_{ij}^{(l)}} = -\frac{\partial E_p}{\partial net_{jp}^{(l)}} \frac{\partial net_{jp}^{(l)}}{\partial w_{ij}^{(l)}} = -\frac{\partial E_p}{\partial net_{jp}^{(l)}} O_{ip}^{(l-1)}$

Let $\delta_{pj}^{(l)} = -\frac{\partial E_p}{\partial net_{jp}^{(l)}}$, then

$$\Delta_p w_{ji} = \eta \delta_{pj}^{(l)} O_{ip}^{(l-1)}$$

Where η is the study length.

The procession of network training

(1) Initializing the value of all connecting weight: The initial weight value to the network with group of random numbers is given. Setting the study length being η, the allowance error ε and the network structure (i.e. network layer number L and each node number nl). The initial value should generally be set with small random number so as to guarantee that an unusual saturated case does not exist in the network.

(2) When the appropriate training sample is selected, the sample data are inputted to the network so as to acquire the output value of the network.

(3) After the deviation $\delta_{jp}^{(l)}$ between expected value and output value of sample is computed, each layer weight towards the direction of reducing deviation has been adjusted with the method of gradient drop algorithm from the output layer to the input layer.

If f_l being chosen as the S function, i.e. $f_l(x) = \frac{1}{1+e^{-x}}$

then for output layer :

$$\delta_{jp}^{(l)} = O_{jp}^{(l)}(1 - O_{jp}^{(l)})(y_{jdp} - O_{jp}^{(l)})$$

and for hidden layer:

$$\delta_{jp}^{(l)} = O_{jp}^{(l)}(1 - O_{jp}^{(l)})\sum \delta_{jp}^{(l)} w_{kj}^{(l+1)}$$

(4) Revise linking weight of BP with Eq.(8).

$$W_{ij}(k+1) = W_{ij}(k) + \eta\delta_{jp}^{(l)} O_{ip}^{(l-1)} \qquad (8)$$

Where k is the studying number, η is the studying factor. More the value of η, the fiercer is the weight change, which could lead the studying process to vibrate. Therefore, in order to get the value of studying factor large enough but so as to not lead to vibration, an additional actional value should be added in the weight correlation formula.

(5)Each group data of the training sample should be carried on the training until the entire training deviation meets the accepted degree. The neural network being trained could express accurately the relationship between the input and the output. When the known group is inputted, the output value could be acquired using this neural network.

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BP network applying in deformation forecast of high pile wharf

This paper takes 14# berth bank slope of 2# harbor of the high pile wharf basin in the Tianjin Port as an example to carry on the simulation forecast analysis. The horizontal deformation of the high pile wharf based on the soft soil ground is caused by 1 or 2 main factors and many additional factors[2], the main factors are: the strength of the high pile wharf rear-area carries and the ships lashing rope strength as well as the earth property of pierre-perdue dike. Therefore, we can take the earth elasticity coefficient and the strength of the high pile wharf rear-area carries with the horizontal lashing rope strength of ships as the neural network input parameter; the wharf horizontal deformation as the network output, and establish the neural network model, carries on the deformation forecast for the high pile wharf.

Based on the analysis mentioned above, three layers BP neural network has been established with the input layer being 3 nodes (earth elasticity coefficient, high pile wharf rear-area carries, horizontal lashing rope strength), the output layer being 1 node (horizontal deformation) and the hidden layer nodes have yet to be decided. In many cases, the nodes number in hidden layer could be set according to Eq.(9).

$$n = \sqrt{n_i + n_0} + a \qquad (9)$$

Where n is the node number of hidden layer, n^i is the node number of input layer, n_o is the node number of output layer, is a constant between 1 and 10.

In the paper, the n scope varies from 3 to 12, the neural network procedure has been written using Matlab. The finally training number is 9000 times, the goal error is 0.001, the node number of hidden layer is 9 with which the goal error and the testing time would achieve optimization.

50 sample points have been selected as the training sample of the network study while another 15 sample points picked as the forecast sample for evaluating the network training effect which are shown in Table 1 and Figure 4 and Figure 5.

Seen from Table 1, based on the neural network model, the deviation of horizontal deformation of the high pile wharf in 14# berth between predicted value and actual value is very small, except testing points 11, 12, and 13 (shown in Figure 5). This is caused primarily by the sample quantity not being enough and therefore the network can not study the relationship between every element, like in real life. Although the generalization ability can not be shown well, but the total relative error may be accepted (Figure 4).

Based on the training network, the input value (earth elasticity coefficient, high pile wharf rear-area carries, horizontal lashing rope strength) is given with the weight and the threshold value which have been saved in the network, thus the deformation value of the high pile wharf structural could be output, and the goal of the high pile wharf structural deformation forecast could be realized.

sample book	forecast	surveying	difference
1	6.8326	6.9	0.0674
2	6.6504	6.6	0.0504
3	6.94	7.0	0.06
4	7.0448	7.1	0.0552
5	7.3634	7.5	0.1366
6	7.5905	7.7	0.1095
7	4.9920	5.3	0.308
8	4.8950	5.0	0.105
9	4.9221	5.1	0.1779
10	5.1325	5.5	0.3675
11	5.3353	5.9	0.5647
12	5.3385	5.9	0.5615
13	5.4960	6.1	0.604
14	4.0020	4.1	0.0998
15	4.0033	4.1	0.0967

Table 1. Comparison between forecast and surveying units mm

Conclusion

(1) The synthetic evaluation for water conservancy project structure quality is the multi index, multi-layers hierarchical analysis. Based on the BP neural network method , a new evaluation method used in the high pile wharf quality synthetic evaluation has been put forward, it is a synthetic evaluation model combining with quality and quantity analysis and even more approaches to human thought pattern. Through the study of expert evaluation mode with assigned sample, expert's experience, knowledge, subjective judgment the tendency to the important goal have been acquired. When such object needs a synthetic evaluation, this model could reappear the appraising of expert experience knowledge and the intuition thought. So the combination of qualitative and quantitative analysis should be reached which could guarantee objectivity of the appraisal result of such object.

(2) This paper research is aimed at the high pile wharf structure, regarding other object of water transportation engineering structure (such as dam);. just changing the input parameter (or deformation affect factor), the neural network model for object deformation forecast could be established with the same network structure used above.

(3) It is feasible to use fuzzy artificial neural networks for wharf deformation forecast and the forecast error meets the need of hydraulic engineering while the fuzzy uncertainty between deformation factors have been solved. Nonetheless there are many problems that need to be discussed when the artificial neural network is used for the deformation forecast, such as how to use the sample information fully, how to solve various factors weight evaluation and increase the forecast precision etc. Meanwhile the relevance of each influence factor should be analyzed fully so as to reduce the model input parameter and enhance the output stability.

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Survey of India maps for SatNav

SatNav Technologies and Survey of India (SOI) have signed an agreement that allows SatNav to use SOI maps in its consumer products. It will release SOI-approved digital maps and custom map content for commercial use in personal and mobile navigation and location-based solutions. *www.satguide.in*

Bilora launches photo-geotagger

Bilora recently launched "Bilora photo-geotagger" based on u-blox' "Capture & Process" GPS solution. The photos are matched with fixes and geotagged with latitude/longitude and street address details which can be displayed on a satellite map. *www.bilora.de*

Mobile Mapping System

Gispro have implemented the Land Based Mobile Mapping System (MMS/MLS). The system consists of Riegl laser scanners, digital videoscanners and ground-penetrating radar. Positioning and orientation are established using POS420 and GPS receivers with IMU and DMI, built onto a car. *www.gispro.pl*

Google Maps add layers for mobile phones, adds POI's

Google released an updated version of the S60 version of its Google Maps for Mobile application. It adds a 'Layers' feature which helps organise the information displayed on top of the map including the existing Latitude, Driving Directions and Traffic functionality.

It has also started to add points of interests, featuring tourist attractions, hotels, restaurants, bars and shops. *www.google.com*

New names and numbers for streets of Ajman municipality

The Ajman Municipality in UAE has started a project of renaming and numbering streets, squares and roads in all parts of the emirate replacing the names that are difficult to pronounce with easier ones. The project would also help in the implementation of GIS using GPS and is scheduled to be accomplished in three phases. *www.am.gov.ae*

L2 adds geolocation to Fuse

L2, Inc. revealed the addition of geolocation to their cross media software platform, Fuse. It will help marketers understand where their recipients are clicking from and use that data to initiate two-way conversations. Common uses of the geotagging feature include providing location-based news/information, contact information and directions. *www.l2soft.com*

NAS puts Geographical Intelligence on the Map Visualization

NAS Insights mapping solutions can help determine key locations for print media and radio advertising. Maps can also pinpoint heavily travelled highways and roads to support a billboard campaign, or target highly populated cities to support the use of direct mail. They can even be used to calculate the most favourable local recruiting areas based on miles or drive time. *www.nasrecruitment.com*

Smartphone navigation demand rising in Russia

New analysis from Frost and Sullivan shows that the Russian navigation and telematics market is witnessing a reversal of trends, with GPS-enabled smartphone technology gaining ground over traditional PND. In 2009, the smartphone-based navigation market already exceeded 350,000 units sold in Russia, while the PND market failed to register even half that amount. *www.frost.com*

NAVTEQ reports gender differences in navigation market

NAVTEQ shared a company analysis of research from several proprietary studies which points to key differences between the male versus female audience for navigation. The results offer insights into each group's interest and interaction with navigation across different types of devices. Many women are not taking advantage of advanced features such as POI search and Traffic, and thus, the satisfaction is dramatically lower than men. *www.navteq.com*

INRIX starts real-time traffic flow service in Europe

INRIX is starting a real-time traffic flow for over 50,000 kilometres across 6 European countries: Benelux, France, Germany and the United Kingdom. INRIX traffic services are designed for integration with navigation and traffic services on mobile devices and vehicle-based systems. *www.inrix.com*

GALILEO frequency regulatory support

The European Commission's Directorate-General for Energy and Transport (TREN DG) has launched a call for tenders related to GALILEO frequency regulatory support (GALIFREGS). The aim of this contract is to provide continuous technical support to TREN DG on all the frequency regulatory actions regarding GALILEO, the European global satellite navigation system, and the EGNOS. The contract will cover two main activities:

- preparations for the World Radiocommunication Conference (WRC) and other work developing or modifying international or European radio regulations or recommendations;

- application of radio regulations on behalf of GALILEO and EGNOS.

The contractor will be expected to prepare, attend and represent TREN DG at meetings and report back on the work of individual meetings and any specific action that may be required. *www.ec.europa.eu*

At a Glance

Mergers, Acquisitions and Partnerships

- ►Vodafone and Tele Atlas to offer Location-Based applications.
- ►C1 Group, Australia, Axis Commerce, Malaysia and Leica Geosystems, Hong Kong becomes Blue Marble partners.
- ►NAVTEQ and ESRI Chile agreement.
- ►O2 partners with Telmap
- ►Xora and Gearworks merge for global LBS coverage.
- ►GeoEye Inc. and DLT Solutions Inc partnership
- ►GeoDecisions partnership with Garmin.
- ►INLINE Corporation and Spot Image signs partnership agreement.
- ►Intermap Technologies to supply ESI products and AccuTerra Europe contour data to GIOVE.

Q2 2009 Financial Results

- ►MacDonald, Dettwiler and Associates Ltd. reported net earnings of $25 million compared to $13 million for last year.
- ►Garmin Ltd. total revenue down by 27%.
- ►GeoEye,Inc. 112% increase in revenue.
- ►EADS Astrium increase in revenue of 30%.

Contracts Awarded

- ►RMSI and Al-Arfaj Engineering to develop an Environmental Monitoring Information System for the State of Kuwait.
- ►China Unicom selects GyPSii for social networking service.
- ►MacDonald, Dettwiler and Associates Ltd. to provide RADARSAT-2 satellite imagery to the ESA worth $4.6 million
- ►Infoterra GmbH has won a contract worth 2.2 Million Euro for acquisition and provision of TerraSAR-X radar satellite data.

Miscellaneous

- ►Autodesk 2010 Certification available for Design Professionals.
- ►Microsoft's Vexcel Imaging sold 32 UltraCam Systems in 2009.
- ►GIS security centre by Abu Dhabi Police.
- ►According to Strategy Analytics worldwide GPS smartphone shipments will grow 34% from 57 million units in 2008 to 77 million units in 2009.
- ►GIS/Geospatial industry worldwide growth is forecast to slow to 1%, down from 11% in 2008 and a whopping 17.4% in 2007 according to study by Daratech, Inc.
- ►Gartner Inc. predicts that the number of subscribers using LBS globally will double this year.
- ►Fugro Aerial Mapping A/S to provide Aerial Imagery and LiDAR services in Scandinavia.

Galileo update

Testing Galileo applications for rail transportation

In the future, trains are to be equipped with systems that work with positioning information that is provided by satellite. This will be made possible by "Galileo", which is to be simulated from 2010 onwards at the rolling stock Test and Validation Centre operated by Siemens Mobility in Wegberg-Wildenrath, Germany. A test area for satellite-based navigation for rail systems is already being set up there which will enable tests to be carried out under real conditions before the Galileo system actually goes into operation. By doing so, Siemens is supporting the future-oriented "railGATE" project that is being conducted by RWTH Aachen University and sponsored by the space agency of the German Aerospace Centre (DLR) with funds provided by the Federal Ministry of Economics and Technology (BMWi). With testing slated to begin in 2010, Galileo is due to enter operation in 2013. *www.siemens.com*

China suggests solution to Compass-Galileo problem

China presented one possible solution to the impasse on frequency overlay between that country's Compass system and the European Galileo program. In talks before the International Committee on GNSS (ICG) Working Group A – Compatibility and Interoperability (WG-A) in Vienna, Yuanxi Yang, from the China National Administration of GNSS and Applications (CNAGA) showed plans to move Compass signal modulation to binary offset carrier (BOC), with an altBOC (15, 10) open service (OS) signal in the aeronautical radionavigation band at E5b (cantered at 1191.8 MHz). Yang stated that spectral separation between the respective systems' signals "would be beneficial for all GNSS systems and users," while maintaining that overlapping of authorized service signals and frequencies between all GNSS "is unavoidable." China has not yet published a signal interface control document (ICD) for Compass. *www.unoosa.org*

US report challenges Galileo to fulfil Level-Field commitments

A July 15 report to Congress by the U.S. Trade Representative expresses strong concern regarding the status of U.S. equipment industry access to the European Community's GNSS program. It questions whether the EC will continue to make good on promises of open market access in a timely manner. The report appears to have reinvigorated official dialog on these issues between the United States and the European Commission that had appeared to have lapsed.In response to Congressional direction, the Office of the U.S. Trade Representative (USTR) submitted a report to Congress on U.S. equipment industry access to Galileo markets and Europe's compliance with the trade provisions in the GPS-Galileo Agreement of 2004. The Office of Space Commercialization, which played a key role in negotiating the agreement and serves as the U.S. co-chair of Working Group B on trade-related issues, assisted USTR in preparing the report. Download the report here. In key passages within the report, the USTR cites "three concerns regarding U.S. equipment industry access to the Galileo program and markets: (1) lack of information on how to secure licenses to sell products and/or protect intellectual property rights derived from Galileo Open Service documentation; (2) unequal access to Galileo Open Service signal test equipment; and (3) lack of information regarding the three other Galileo PNT services."

ISRO to develop Indian satellite security cover

ISRO will develop its own version of the US GPS and Russian Glonass system, albeit with a limited, regional capability, with the added advantage of providing the country's defence establishment round-the-clock security cover.

The constellation of seven satellites will keep an eye on a wide swath of territory - 2,000km - in and around the Indian sub-continent. According to ISRO chief, G Madhavan Nair, the Indian Regional Navigational Satellite System (IRNSS) was being developed "considering security related issues". *www.domain-b.com*

Expert moots GPS mantra to tackle Maoist terror

Concerned over the escalating Maoist attacks in the state of Orissa in India, an IT expert has prepared a system to track rebel activities in remote areas, using GPS. Tripathy, who was also member of the team that provided GPS tracking system to Mumbai police, urged the state government to upgrade their system with this foolproof technology. *http://timesofindia.indiatimes.com*

Satellite technology to locate and control weeds

Queensland scientists are using satellite technology to pinpoint the locations of some of the most invasive weeds. Biosecurity Queensland and the Department of Environment and Resource Management (DERM) are working together to map some of the state's worst weeds to further improve control efforts.

The QuickBird satellite image with its high resolution used in the project can detect objects on the ground as small as individual trees. The technology gives accurate coordinates of likely weed infestations which allows the project team to find the weeds using GPS. *http://nqr.farmonline.com.au*

Beijing plans Earth Resource III

According to the State Bureau of Surveying and Mapping in Beijing, China shall launch a satellite carrying the country's first stereo mapping camera. Earth Resource III will be launched in the first half of 2011. *http://en.sbsm.gov.cn*

3D topographic lunar map

China will complete a 3D topographic map of the moon. "Currently, most of the lunar topographic maps were made by data acquired by laser altimeter instruments. With the large amount of highly-detailed images taken by Chang'e-1, the map we are making will be of the highest resolution in the world," Li Chunlai, chief designer of the ground application system with the project said. *http://news.xinhuanet.com*

UK-DMC2 returns first images

Britain's latest imaging satellite UK-DMC2 has returned its first pictures of the US states of Texas and Oklahoma. Their new sensors see double the number of pixels per hectare, giving their pictures a pixel size of 22m. The satellites has a swath of 650km. *www.sstl.co.uk*

First imagery from DubaiSat-1

The UAE's first satellite has transmitted its first series of UAE images from orbit, including a snapshot of the Palm Jebel Ali. The Emirates Institution for Advanced Science & Technology (EIAST) received the images. It could be used for a variety of applications from urban development, scientific research, mapping and GIS etc. *www.zawya.com*

ISRO to launch satellites for US

India will be able to launch smaller satellites for USA into space by indigenously developed rockets at one third of the cost charged by American firms. This is one of the significant features of the space agreement signed with the US during Secretary of State Hillary Clinton's recent visit to Delhi. "Space cooperation with the US has been the agenda of the government. The pact will enable US made satellites or with components of US to be launched from India,"

India approves GSAT-10 Satellite

The Union Cabinet has approved undertaking design and development of GSAT-10 spacecraft. The satellite with 12 high power Ku-band transponders, 12 C-band and 12 Extended C band India coverage transponders and a navigation payload, will replace the ageing INSAT-2E and INSAT-3B satellites, create additional capacity for DTH like applications and provide on-orbit back-up for the GAGAN navigation payload. GSAT-10 spacecraft is planned to be realized within 20 months. *www.isro.org*

Space radar techniques for land mapping

ESA has used radar technology from the agency's Envisat remote-sensing satellite to develop a compact, high-resolution radar that can monitor land and buildings from small aircraft. The radar can monitor structures such as dams, harbours, canals and buildings, leading to maps for urban planning, territory surveillance and cadastral updating. *www.esa.int*

ERDAS releases radar mapping

ERDAS released IMAGINE SAR Interferometry a package of radar workflows featuring advanced radar mapping technologies including new interpolation techniques that increase the quality and fidelity of radar data. *www.erdas.com*

ScanNet for real time monitoring

ScanEx RDC has developed ScanNet technology for real time multi satellite monitoring of objects, processes and phenomena, which can be used for monitoring the state and exploitation of industrial and domestic wastes sites and unauthorised landfills. *www.scanex.ru*

China to regulate its GI industry

Authorities in Guangdong are cracking down on illegal surveying and mapping to better regulate the geographic information industry in the southern province. Foreign organizations, businesses and individuals have been told that they must apply to the central government's surveying and mapping authority for approval to gather geographic information in the southern province. www.chinadaily.com.cn

IN INDIA

Karnataka Disaster Management portal
The Karnataka State Natural Disaster Monitoring Centre in India is building a 'disaster portal' that will provide real-time estimates of drought, rainfall, crop status, earthquake monitors and other parameters. The portal will embed the geodatabase in a map and imaging server software that will allow scientists to model natural hazards and estimate the potential impact. *www.dmc.kar.nic.in*

India's mineral belt to be mapped
The National Mineral Development Corporation (NMDC) has offered to map the mineral reserves of Jharkhand through exploration. "We want to build a solid data base of the mineral reserves which can be used by mining companies", said NMDC CMD. *http://economictimes.indiatimes.com*

3D GIS mapping for Delhi completed
New Delhi Municipal Council (NDMC) has completed GIS mapping of its entire area. The 3D-GIS maps will be used to keep a tab on public utility services as well as improving civic services. NDMC is planning to make the system partly accessible to the public. *www.ndmc.gov.in*

Digital map of Chennai
Survey of India has completed the digitalised mapping of a majority of the Chennai on 1:1000 scale. The digital maps are part of the GIS enabled services to help government departments to formulate schemes and plan infrastructure development. *http://timesofindia.indiatimes.com*

NextMap for Malaysia

Intermap will release 1:50,000 scale data for the whole of Malaysia. The data from X-band radar will be used to generate a DEM, from which the maps will then be created.. *www.intermap.com*

Photo Management Software

Bradshaw Consulting Services has released HyperPic.MOBILE software that simplifies the process of collecting and managing photos for GIS users. It provides a solution for emergency response departments, city utility providers, military groups, etc. to supplement their GIS data. *www.bcs-gis.com*

Version 7.0 of HIPS and SIPS Software

CARIS released its hydrographic processing system, CARIS HIPS and SIPS v.7.0. with new features to assist hydrographic professionals in realizing the full potential of their data. *www.caris.com*

Atlas for the Tibet autonomous region

3.3 million yuan has been invested to compile a colourful "Tibet Autonomous Region Atlas", based on the existing geographic data, combined with the research results in geology, geophysics, geomorphology, climate, hydrology, soil, biology and environmental science and makes use of GIS high-tech mapping techniques. *http://chinatibet.people.com.cn*

TomTom, Toyota win lawsuit over map-viewing systems

TomTom NV, Toyota Motor Corp. and five other companies won patent-infringement lawsuits filed by Encyclopaedia Britannica Inc. over computerised map-viewing systems. Two patents owned by the research publisher were found to be invalid by a federal judge. The patents relate to an interactive mapping system that displays information about sites, a feature it uses in its digital encyclopedias. *http://businessmirror.com.ph*

New Geocentric Datum in Brunei

The Survey Department in Brunei launched its Brunei Darussalam Geocentric Datum (GDBD 2009). Through the project, the department will gain the advantage of mapping GDBD coordinates that are immediately compatible with global coordinates obtained from GPS and with other coordinate systems adopted in many parts of the world. *www.survey.gov.bn*

One-Stop search widget from USGS

The USGS National Geospatial Program has released the Geospatial One-Stop (GOS) Search Widget, a small utility that can be embedded in any Web page. It will enable users to search, identify, view, download and mash-up Web map services currently published in the intergovernmental Geodata.gov geospatial data catalogue. *www.usgs.gov*

GSS6300 from Spirent

Spirent Communications plc. launched GSS6300 Multi-GNSS Signal Generator. It provides GPS, GLONASS, Galileo, and SBAS test solutions from high-end R&D through integration and production applications. *www.spirent.com*

From the desk of JAVAD

JAVAD GNSS receivers track 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.

GPS SVN 49 and JAVAD GNSS Triumph Technologies

JAVAD GNSS Triumph receivers successfully coped with the anomalies in the recently launched SVN49(PRN1) and demonstrated the advanced multipath reduction capabilities. The same multipath reduction capabilities can remove the multipath effects which are a major source of error in precision positioning.

Highest score in Japanese CORS selection process

Javad GNSS (teamed with TOA, Hitachi Industrial Equipment Systems and GNSS Technologies) received the highest technical and system score in the selection process by the Geographical Survey Institute of Japan.

ArcPad Extension for ArcServer

JAVAD ArcPad Extension enhances the spectrum of ArcPads surveying capabilities by adding JAVAD GNSS solutions and provides a full range of functions to control the GNSS receiver and manage the surveying process. The Extension establishes a connection to the receiver via serial, USB, or Bluetooth and is an optimal ESRI-compatible solution where centimetre level accuracies are required. *www.javad.com*

Navcom SF-3050 GNSS receiver

NavCom Technology released SF-3050 multi-frequency GNSS receiver with Sapphire GNSS OEM board, a fully upgradeable GNSS receiver, allowing the receiver to upgrade from single frequency to multi-frequency through software optioning alone. Offering integrated StarFire™/RTK GNSS capabilities, the SF-3050 and Sapphire feature 66-channel tracking, including multi-constellation support for GPS, GLONASS and Galileo. They also provide performance in GNSS receiver sensitivity and signal tracking as well as patented multi-path mitigation, interference rejection and anti-jamming capabilities. *www.NavComTech.com*

Archer Longbow GPS handheld

Juniper Systems and Surveylab have launched the Archer Longbow remote positioning GPS handheld. It combines a computer, GPS receiver, 3D compass, digital camera and a laser rangefinder. The product produces a verifiable, geo-tagged digital image of the target. *www.archerlongbow.com*

GIS-based office and Handheld Asset

Trimble has introduced the Trimble® UtilityCenter® Field Inspector software for handhelds and the Trimble UtilityCenter Maintenance-2 module. In combination with Trimble Mapping and GIS handheld computers with GPS, the software offers electric, gas, water, and wastewater utilities of all sizes a scalable and easy to deploy field solution for improving asset maintenance inspection operations. *www.trimble.com*

Magellan announces advancements in Triton

Magellan announced advancements to its Triton series, including an improved user experience and overall product functionality of all Triton GPS devices and Magellan's VantagePoint desktop software. The new software is available for free download. *www.MagellanGPS.com*

Bentley Substation V8i

Bentley Systems released Substation V8i, the intra-operable software product for intelligent electrical and physical substation design that supports all of the key components and requirements of an electric substation. It also intra-operates with Bentley's portfolio of software offerings, including civil engineering and architectural design. *www.bentley.com*

BAE provides target locators to US Army

BAE Systems will provide US Army soldiers with handheld laser target locators that will enable them to identify target locations while on foot, in daylight, in night and in fog and smoke too. It consists of a direct-view optic system, a night-vision camera, a laser range finder, a digital compass, and a GPS receiver. It has visibility of 4.2 kms away in daylight and 900 meters in total darkness. *www.baesystems.com*

Scanpoint Geomatics IGIS

Scanpoint Geomatics has launched Integrated GIS and Image Processing Software (IGIS), developed in partnership with the ISRO. IGIS combines GPS reception, GIS, image processing and real-time information. It is compatible with OGC and ISO vector and raster data formats and SQL database formats. IGIS has been tested by scientists and experts at more than 12 centres of ISRO for over a year before it was formally released. *www.scanpointgeomatics.com*

Leica CloudWorx for SmartPlant 3D

Leica Geosystems released Leica CloudWorx 1.0 for SmartPlant 3D. It is an addition to the Leica CloudWorx suite of products that enable professionals to use as-built point cloud data directly in their native desktop design and visualisation platform. SmartPlant 3D is Intergraph's next generation plant design platform. *www.leica-geosystems.com*

Topcon for Japanese GEONET

Topcon has been selected by the Geographical Survey Institute of Japan to supply GPS reference stations. It will supply 360 GPS receivers as well as new software and database system for the GPS Earth Observation Network System (GEONET) operated by GSI. *www.topcon.com*

ImStrat and PCI Geomatics team up

ImStrat Corporation and PCI Geomatics have signed a Teaming Agreement, whereby both parties will jointly develop and provide training to their clients around the world. *www.pcigeomatics.com*

DMCii bags contract

DMCii signed a €3.9 million contract from the European Space Agency (ESA) to acquire satellite imagery of sub-Saharan Africa. The data will constitute an essential part of the European funded Global Monitoring for the Environment and Security (GMES) programme and the contract includes changes to the company's systems to interface with the ESA image catalogue. *www.dmcii.com*

MrSID Generation 4 Decode SDK

LizardTech released MrSID Generation 4 Decode SDK complimenting its own LiDAR Compressor. The SDK leverages on the MrSID format that enables users to view and access their LiDAR data much faster than traditional uncompressed formats would have allowed. *www.lizardtech.com*

SOKKIA introduces new products

SOKKIA Singapore has introduced "GYRO STATIONS" GP1X, GP2X, GP3X and GP5X - all incorporating the GP1 manual gyroscope and SET X total stations. It also introduced the "3D STATION" NET05X, a manual-type total station and the "DIGITAL LEVEL" SDL1X designed to achieve 0.2mm accuracy and productivity in levelling and height measurement applications. *www.sokkia.com.sg*

Geospatial Organizations endorse IFTN

Nine other geospatial organizations have joined URISA in supporting a call for a national US digital imagery program, the so-called Imagery for the Nation, a National States Geographic Information Council (NSGIC) initiative to support the development of a sustainable and flexible digital imagery program that meets the needs of local, state, regional, tribal and federal agencies. *www.urisa.org*

ArcLogistics Navigator new release

Designed specifically for fleet and logistics guidance, ArcLogistics Navigator is a fully functional GPS navigation system. *www.esri.com/navigator*

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Bentley Be Connected Online Seminars
September - November
www.bentley.com/BeConnected

October 2009

European Navigation Event 2009
6 October
Houten, The Netherlands
www.navigationevent.com

ILA 2009
Week of October 12
Portland Maine USA
www.loran.org

ACRS 2009
19-23 October
Beijing, China
http://www.aars-acrs.org/acrs

7th FIG Regional Conference
19-22 October
Hanoi Vietnam
www.fig.net/vietnam/

18th UNRCC-AP
26-30 October
Bangkok, Thailand

13th IAIN World Congress
27-30 October
Stockholm, Sweden
www.congrex.com/nnf/iain2009/

November 2009

International Symposium on GPS/GNSS 2009
4-6 November
Jeju, Korea
gnssws@gnss.or.kr
www.gnsskorea2009.org

NAV09
Maritime: 10 Nov, Southampton
Positioning & Location: 12 Nov, Nottingham
Land: 19 Nov, Teddington
Timing: 20 Nov, Teddington
Air: 25 Nov, London
www.rin.org.uk/news-events/events

WALIS International Forum 2009
11-13 November
Perth Convention Exhibition Centre, Australia
www.walis.wa.gov.au

ISPRS (Geospatial Data Cyber Infrastructure)
25-27, November 2009
Hyderabad, India
www.incois.gov.in/isprs

December 2009

IGNSS 2009
1- 3 December
Gold Coast, Queensland, Australia
www.ignss.org

Middle East Spatial Technology Conference & Exhibition
7 - 9 December
Kingdom of Bahrain
rizwan@mohandis.org
www.mest.bh

March 2010

Munich Satellite Navigation Summit
9-11 March
Residenz München", Germany
www.munich-satellite-navigation-summit.org

GEOFORM+'2010
30 March –2 April
Moscow, Russia
www.geoexpo.ru

April 2010

XXIV FIG International Congress 2010
11 - 16 April 2010
Sydney, Australia
www.fig2010.com

June 2010

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

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


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