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Coordinates

Volume XI, Issue 07, July 2015

THE MONTHLY MAGAZINE ON POSITIONING, NAVIGATION AND BEYOND

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Complete constellation of 7 satellites of IRNSS will be deployed by 2016

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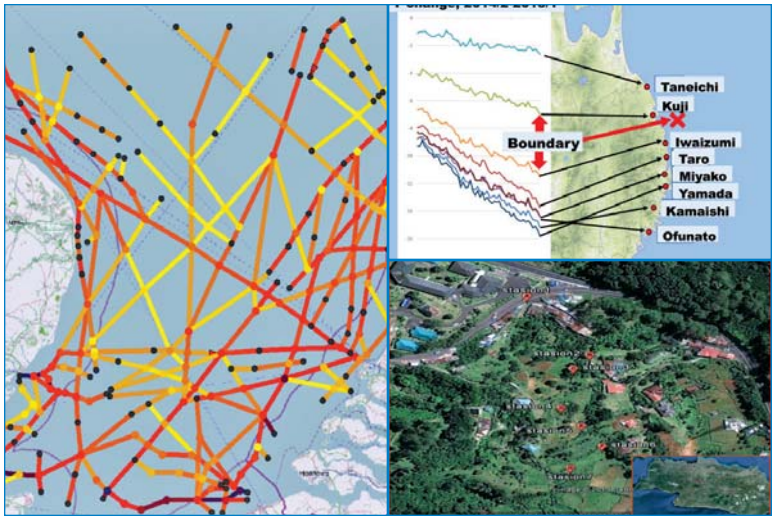

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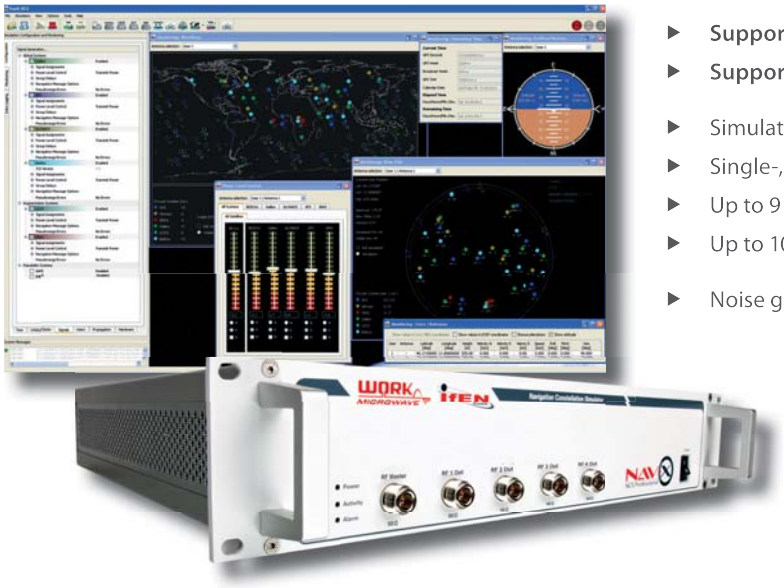
IRNSS-1 | GPS | GLONASS | Galileo | BeiDou | QZSS | SBAS

Simulate the IRNSS-1 constellation using the **NavX®-NCS Professional** GNSS RF signal generator



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Power to Empower

The Digital India programme is

A flagship programme of the Government of India

With a vision to transform India,

Into a digitally empowered society and knowledge economy.

Equally important will be

To build requisite infrastructure and develop policy framework

With an appropriate and much needed emphasis on spatial component,

The initiatives like the National GIS

Not only needs revival

But its possible integration with 'Digital India programme'

Can also be explored

Bal Krishna, Editor
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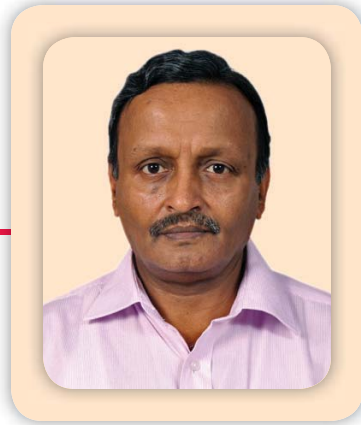
"The complete constellation of 7 satellites of IRNSS will be deployed by 2016"



Says A S Ganeshan, Program Director, Satellite Navigation Program, ISRO Satellite Center, India

Congratulations for successful launch of 4th IRNSS satellite. What is timeline for the complete installation?

The successful launch of 4th IRNSS satellite is a proud moment for all of us. With IRNSS-1D on orbit, we have 4 operational IRNSS satellites meeting the minimum satellite requirement and Independent position solution using an Indian satellite-based navigation system is now a reality. The complete constellation of 7 satellites will be deployed by 2016.

What are ground stations preparations for the utilisation of IRNSS signals?

Ground Segment is responsible for the maintenance and operation of the IRNSS constellation. The IRNSS ground segment comprises spacecraft control facility, navigation centre, network timing centre, reference stations, two-way ranging stations, laser ranging stations and data communication network. Most of the ground stations are operational to support the satellites operations and navigation parameter generation required by the user for position estimation. The complete ground systems including the redundant systems will be functional by 2016.

Is it possible to achieve the positioning relying only on IRNSS signals?

Definitely Yes. With the 4th satellite broadcasting navigation signals, independent position determination with IRNSS is now possible. The receivers at ISRO and various academic institutes (like IIST, IIT Kanpur, IIT Gandhinagar, Jain University Bengaluru etc) are already receiving the signals and providing position solutions.

The analysis of results has shown accuracy better than 15 metres for 20 hrs in a day over India. It is to be noted that the position fix for duration of 20 hours in a day is possible because of uniqueness of the constellation design with the satellites located in the Geostationary Earth Orbit (GEO) and Geo Synchronous Orbit (GSO). This duration will improve as more satellites fill up the constellation.

Will using IRNSS signals have an edge vis-a-vis other contemporary systems especially over Indian subcontinent region?

For users in the Indian sub-continent IRNSS services shall be competitive with the performance of civilian services provided by other contemporary systems. The major advantage being the constellation designed for a regional system ensures 24 x 7 visibilities of all the spacecrafts over Indian sub-continent. The IRNSS signal and data structure has been uniquely designed to provide optimal performance to its users. IRNSS transmits unique Grid-based ionospheric parameters as part of its navigation message. The parameters provide a single frequency (L5) user with position accuracies comparable to that of a dual frequency user. The IRNSS signals are also transmitted in S-band which experience minimal ionospheric errors. IRNSS is designed to be interoperable with other GNSS services and thereby providing the users with improved accuracy for multi-GNSS receivers.

Are the existing receivers able to receive the IRNSS signals properly or will they need any technological modification?

Conventional GNSS receivers operate in L1, L2 and L5 bands. The IRNSS signals for civilian users are available in

Most of the ground stations are operational to support the satellites operations and navigation parameter generation required by the user for position estimation.

The analysis of results has shown accuracy better than 15 metres for 20 hrs in a day over India

L5 and S bands. For a single frequency user in L5, a firmware update may be required to the existing GNSS receivers to receive IRNSS signals. For a dual frequency or an S-band receiver RF front-end of the receiver needs to be suitably modified along with the firmware to utilize the IRNSS services in S-band.

What are your parameters to measure the success of IRNSS?

From the technological perspective, the independent positioning using IRNSS, after the launch of 4th satellite, demonstrated the proof of concept. This can be seen as a first step of success towards realizing an independent satellite-based navigation system in India. The next step is to achieve the primary objective of IRNSS, i.e providing an all-time, all-weather service to users over the primary service area (covering the Indian landmass and 1500km beyond its geo-political boundary), with a position accuracy better than 20m.

Also, various agencies within India (like National Atmospheric Research Laboratory (NARL) Gadanki, Trimble at Chennai etc) and outside the country (like Finnish Geodetic Institute at Finland, Javad at Moscow etc) have reported successful reception of IRNSS signals and have validated its performance.

At ISRO we consider IRNSS a success when the benefits of its positioning, navigation and timing services reach the common man of this country.

How are the industry and academia involved to assess the performance of IRNSS and encourage its uses?

The industry and academia have gone hand-in-hand with ISRO in most of its projects and IRNSS is no different. Few industries have partnered with ISRO for the production of the initial set of IRNSS receivers. The receivers have been distributed among various ISRO centres and academic institutes to assess the initial performance of IRNSS. Also, ISRO is in touch with various receiver manufacturers to promote bulk production, miniaturization of IRNSS receivers, and development of various application softwares. The major challenge is the development and bulk production of ASIC based receivers by the time IRNSS becomes fully operational. Also, integrating IRNSS into today's highly popular smartphone platform shall encourage maximum utilization of its services.

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Is there any plan to engage the neighbouring countries to share the benefits of IRNSS?

The IRNSS civilian services are available free-to-air in the primary and secondary service areas which cover our neighbouring countries. Satellite Navigation has been one of the areas identified for mutual cooperation with some of our neighbouring countries, including all the SAARC nations. Bilateral discussions with various countries were held this year and areas of cooperation in satellite-based navigation have been identified.

What are the plans to encourage the uses of IRNSS and GAGAN?

ISRO has conducted a GNSS User Meet in 2013 and a conference on Space Based Navigation in 2014 at ISAC, to spread the awareness about IRNSS & GAGAN among the user community. A second GNSS User Meet with the theme "Towards self reliance in Satellite Navigation" is planned this year with expected participation from the GNSS community within and outside India. The meet shall mainly focus on applications using IRNSS and GAGAN.

Are users in India ready for IRNSS?

ISRO has released the 'IRNSS Signal-in-Space interface control document for Standard Positioning Service ver 1.0', the document that comprehensively provides all the information required by a user to utilize service of IRNSS. The document is available at http://irnss.isro.gov.in. The ICD has been downloaded by leading GNSS receiver and chipset manufacturers, service providers and academia. Quite a few industries have expressed keen interest in developing IRNSS receivers and IRNSS-based applications. We are confident that once the IRNSS constellation is fully deployed the Indian user community will be ready for receiving IRNSS.

IRNSS transmits unique Grid-based ionospheric parameters as part of its navigation message. The parameters provide a single frequency (L5) user with position accuracies comparable to that of a dual frequency user

What are the plans to widen the usage of ISRO's satellite navigation services on a bigger scale?

The utilization of Indian satellite navigation services can be maximized over the Indian region by integrating the mapping services of Bhuvan, and navigation services of IRNSS & GAGAN to provide location based services to users in the Indian sub-continent. BIG (**B**huvan-**I**RNSS-**G**AGAN) is definitely good for various other applications too. It is essential to mandate usage of GAGAN and IRNSS for all applications including the emergency services by the Government and this certainly widen the usage of ISRO's satellite based navigation services over India.

What is the current status of GAGAN?

Subsequent to the certification of GAGAN system by DGCA for Safety of Life APV1.0 level of service on 21st April 2015, the GAGAN system was commissioned for APV1.0 Precision Approach services over Indian landmass on 19th May 2015. GSAT-8 and GSAT-10 broadcast GAGAN signal with PRN 127 and 128 respectively for use by aviation and non-aviation users in Indian region.

How GAGAN is being used in India?

GAGAN being a high integrity system is primarily meant for Safety of Life (SoL) services in Civil Aviation Applications for En-route and Precision Approach operations. Airports Authority of India is in the process of developing GAGAN approach procedures and conducting flight test at various airports to use GAGAN signal within Indian airspace. Apart from Civil Aviation, GAGAN is being is used in surveying, road transportation, Railways, Urban development, forestry, timing applications etc.

Is there any effort to popularize GAGAN among GNSS users in India?

GAGAN is free to air service and most of the existing SBAS receivers available in the market are capable of receiving GAGAN signals. Efforts are underway to create awareness among the GPS user community about the benefits of GAGAN and its usage across India. ISRO and AAI conducted several user meets to highlight benefits of GAGAN and the Ministry of Civil Aviation had formed an Inter Ministerial Group(IMG) to explore the potential usage of GAGAN across various ministries and mandating them to use GAGAN services wherever possible. Also, the upcoming second User-meet will give yet another opportunity to familiarise the benefits of GAGAN for position and timing applications.

How future development/ expansion of GAGAN is envisaged?

In the near future, another GEO Satellite, GSAT-15 with PRN139 will be added to existing space segment. Addition of more ground elements such as data communication network, up-link station, reference station etc., are planned to enhance/expand GAGAN services in the neighbouring regions. Expansions of GAGAN to the neighbouring countries have been taken up by AAI.

ACCSEAS: The Innovative North Sea e-navigation Demonstration

The project shows that there is much more work to be done, but the principle and the advantages of using e-Navigation is made clear, and that Europe is leading the way for harmonised information and navigation systems onboard vessels

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The ACCessibility for Shipping, Efficiency Advantages and Sustainability (ACCSEAS) project aims to identify issues which obstruct maritime access to the North Sea Region (NSR), identify potential solutions, prototype and demonstrate these successful solutions using the International Maritime Organisation's (IMO) e-Navigation concept in a test-bed. The project developed 'proof-of-concept' tests which led to a proposed sustainability plan for future e-Navigation provision in the NSR and will look to inform the e-Navigation initiative globally. The entire process of the implementation of prototype solutions in the e-Navigation test-bed was supported by training and simulation, so that the test-bed had aspects of both real-world and simulated implementation. The project was part funded by the European Regional Development Fund through the INTERREG IVB programme.

The ACCSEAS Project ran from April 2012 to February 2015, with budget of over €5M. The partnership consisted of: General Lighthouse Authorities, United Kingdom; Chalmers University of Technology, Sweden; Danish Maritime Authority, Denmark; Federal Waterways & Shipping Administration, Germany; Rijkwaterstaat, Ministery for Infrastructuur and the Environment, Netherlands; Swedish Maritime Administration, Sweden; Norwegian Coastal Administration, Norway; SSPA Sweden AB, Sweden; Flensburg University of Applied Science, Germany; Maritiem Instituut Willem Barentsz, Netherlands; World Maritime University, Sweden.

This paper will provide an overview of the project's achievements, starting with the detail of the requirements gathered, through the logic used to identify potential e-Navigation services that can be considered for demonstration, to the implementation and demonstration of the solutions. The potential solutions will consider the many different services that can be provided by the many different providers as part of their e-Navigation Maritime Service Portfolios (MSPs), which will include a review of services offered today as well as potential services that can be introduced. These new services include the potential for route guidance information, improved information exchange as well as enhanced position, navigation and timing information from multiple sources.

Analysis of the region

The NSR faces a number of problems in the near future, with increased density of shipping, reduced sea space and manoeuvrability as a result of the growth in offshore installations. This could lead to traffic pinch-points at approaches to ports and potentially increased risks of collision and grounding.

There are many sources of data that provide a picture of competing demands on sea space in the region in the 2020+ timeframe. A view such as the planned wind farms of the UK, Denmark and Germany overlaid on the vessel traffic density shown in Fig. 1 provides a simple introduction to the nature of growth in offshore renewable energy installations.

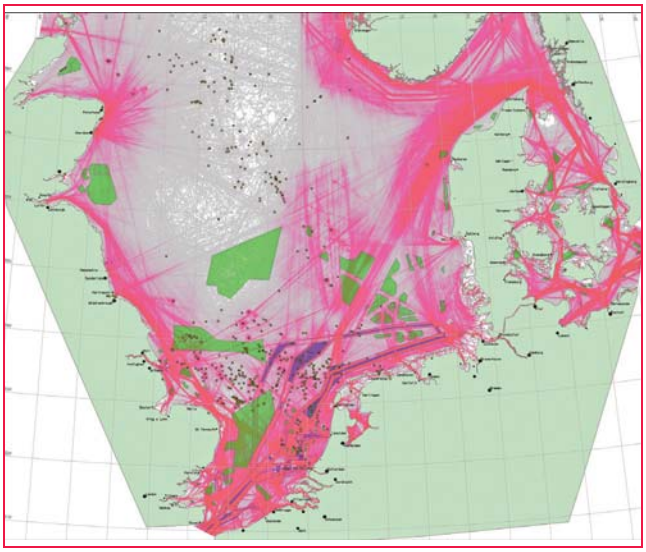

Figure 1: Traffic density of traffic during 2012. Green areas shows proposed windfarm areas; purple highlights the traffic separation schemes; yellow dots represent oil/gas platforms. Note that the grey area in the northern North Sea represents limited traffic data, and does not necessarily represent a lower density of traffic in that area

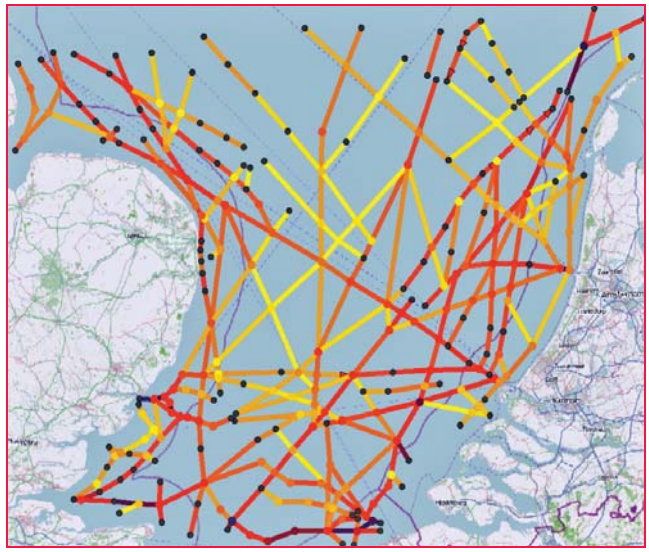

Figure 2: Risk analysis results of the routes identified in the southern North Sea. Darker the colour, the higher the risk of collision and/or grounding

It is immediately apparent that large areas of the North Sea could be dedicated to the use of renewable energy, thereby reducing the sea space for ships to navigate and manoeuvre. When taken together with the trend in the growth in shipping – both in numbers and size of vessels – it is clear that higher density of ships may be forced to navigate in more restricted sea areas. A typical container ship size enables it to transport around 4,000 to 10.000 TEU (Twenty Foot Equivalent unit based on a single 20ft container). The Marco Polo vessel started operation in November 2012 with a capacity of 16,020 TEU; it is 396 m long, 54 m wide, with a draft of 16 m. Even larger vessels up to 20,000 TEU or more are currently being considered [1]. Higher density of shipping and larger vessels in the increasingly confined sea space of the North Sea could correlate with greater risk of grounding and collision, hence impacting the safety and efficiency of access to the region's ports. The e-Navigation services being prototyped in ACCSEAS are, among other instruments, intended to mitigate this increase in risk.

Based on expectations about the impact of areas of open sea being allocated for energy extraction (such as wind farms), ACCSEAS' research suggests that the North Sea Region's navigable space will be reduced [2]. The research indicates that navigable space allocated to wind farms could increase by up to 5240% within just a few years, from the current c.440km² up to c.23,500km². This would constitute c.5.5% of all navigable space in the region, with a further 860km² taken up by exclusion zones around oil and gas platforms. Crucially, the precise location of many planned and proposed wind farm sites means that they could have a significant impact on manoeuvrability within key shipping lanes in the North Sea Region. The size and location of such sites, coupled with projected increases in shipping traffic and vessel size, may pose serious safety and efficiency concerns.

The project's Geographic Information System (GIS) enables officially recognised transnational data to be collected to determine a picture of the region as it may appear in the timescales of 2020+. Based on this data, the project can assess maritime traffic trends and the issues that obstruct available safe access. It is important that the picture of the 'North Sea Region tomorrow' generated by ACCSEAS is based on officially recognised sources of data. So great care has been taken to seek out these sources and maintain their traceability within the ACCSEAS GIS to the original data.

The combination of these data sources overlaid on each other produces the very complicated picture of the North Sea Region in 2020+ that is shown in Figure 2.

Using the latest AIS data, ACCSEAS has been able to apply the IALA Waterways Risk Assessment Program (IWRAP) to the identified routes to determine the risk of collision and grounding in the region. The results, in Fig. 2, show that there are certain areas that are of higher risk than others, in particular in the southern North Sea where it is predicted that there will be 4.2 accidents per year in the region shown, 25% of which are in the darker area at the southern-most point of the figure.

Not all the designated areas under consideration for offshore renewable energy installations will necessarily be developed in the 2020+ timescale. It is also unlikely that in practice wind turbines will be built within Traffic Separation Schemes, but the picture demonstrates the need for the NSR maritime community to be adequately represented in future transnational marine spatial planning.

It is clear that the 2020+ picture is particularly congested with conflicting and competing uses for sea space, especially in the southern part of the North Sea. The need for transnational coordination of sea space management and marine

spatial planning is evident. It is reassuring to know that the European Union has recognised the importance of this, and that one of the North Sea Commission's objectives is maritime spatial planning [3].

e-navigation services

The services that could be included in the MSPs are a major outcome of the ACCSEAS project. In this paper, we shall focus on a selection of those services, and how they could improve the efficiency and accessibility of shipping in spite of the challenges raised above.

No-go Area

The "No-go" area service is a means for the mariner to determine, in a simplified way, the areas that they should avoid due to insufficient clearance under the keel of their vessel. The service takes into account detailed bathymetry data, and using the current tidal conditions together with the vessel's dynamics, it is able to determine, on the fly, the location the vessel should avoid. The project demonstrated the service in the Humber Estuary where shifting sands pose a constant grounding risk to vessels approaching the ports along the estuary, and in simulator to capture the user experience for training purposes. Whilst there are technological challenges to overcome, a key element to the success of the service will be the portrayal of the information. A polygon is created on the screen to tell the mariner that this is an area that has a high grounding risk if the vessel was to enter that area. With this information, the spatial awareness of the mariner is increased considerably, particularly in tighter channels, and this was reflected in the user feedback from the participants of the trial and demonstrations

Maritime Safety Information/ Notices to Mariners (Temporary and Permanent) Service

The most important information to vessels is that related to safety, including Maritime Safety Information (MSI), Notices to Mariners (NM) and chart corrections. These three information types, together with nautical charts and position updates form the basis for safe navigation of ships.

Chart corrections, and the way they are promulgated, have evolved tremendously over the past 10 years. Chart corrections are geo-referenced and displayable by nature. MSI and NM, on the other hand, are often geo-referenced but not necessarily displayable with internationally standardised text and symbols.

The main differences between MSI and NM today are the method of promulgation and the speed of handling and thereby quality assurance. The contents of the two message types are, however, very similar. MSI is today promulgated in text or voice via SafetyNET, NAVTEX, coast radio stations and is in some countries accessible on the Internet. NM's are promulgated on paper weekly, fortnightly or monthly and are often accessible on the internet in PDF format. The handling of data and information provided through the above methods are time consuming for the mariner, increases their workload, and there is a risk of human error causing important information to be lost or misinterpreted.

Maritime Information messages, MSI and NM, may in the future be broadcast or transmitted via any available communication method, e.g. satellite, GSM (mobile), VHF-data, AIS, etc. in addition to traditional systems such as NAVTEX and radio broadcasts. Maritime Information Messages should be received and displayed on navigation displays automatically for correct and immediate assessment by the navigator.

It is important that ALL vessels still receive ALL Maritime Information messages. To avoid the often discussed overload of information, it should be possible for the Mariner to filter the Maritime Information messages so only messages relevant to the specific vessel's navigation is displayed, e.g. by distance from own vessel and route. Important information should be shown on a navigation display without further action by the navigator, for example, as shown in Figure 3.

Vessel Operations Co-ordination Tool

The Vessel Operations Co-ordination Tool (VOCT) builds on promising results from tests conducted during a previous EU project, EfficienSea. It was recognised that communication, timely and correct, between parties during a Search and Rescue (SAR) operation is of utmost importance. Today information is primarily exchanged via different ways of voice communication which is both time consuming and contains a risk of misunderstandings. The VOCT is a service to optimise communication and improve situation awareness during SAR, counter pollution and similar operations. Search areas, search patterns, datum, drift calculations, areas searched and other important information is exchanged electronically between parties and is presented graphically on vessels' and coordinators' displays. Inclusion of a calculation module for search areas and patterns into the Ship e-Navigation Prototype Display (EPD) and Shore-EPD was investigated, and good response has been received by users in trials carried out in ACCSEAS.

Other Services

The ACCSEAS project has investigated other services, such as augmented reality, Inter-VTS Exchange Format, Route Topology Model, dynamic ship movement prediction, route exchange/ suggestion and automated FAL reporting. More details of these services can be found in [2] or on the ACCSEAS project website (www.accseas.eu).

Resilient positioning, navigation and timing

High precision positioning in the maritime domain is now the norm since the introduction of Global Navigation Satellite Systems (GNSS). Unfortunately, it is well known that as low power, satellite-based systems, GNSS are vulnerable to interference (both naturally occurring and manmade); hence, the development of an alternative backup system is recommended. A variety of

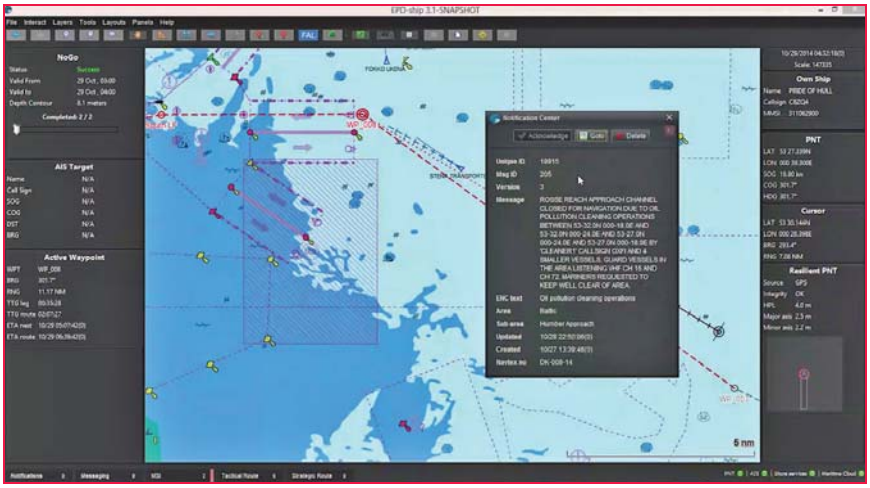

Figure 3: e-Navigation Prototype Display with MSI/NM Service being used to notify the mariner of an oil spill at the entrance to Humber Port. Screenshot captured during ACCSEAS demonstration on the P&O ferry, Pride of Hull

technological solutions to this backup requirement are possible; in the radio frequency (RF) domain we have the so-called "Signals of OPportunity" (SoOP) approach. This report considers several SoOP solutions to provide a Ranging Mode (R Mode) Position Navigation and Timing (PNT) alternative to GNSS.

Absolute Radar Positioning

ACCSEAS investigated the use of absolute Radar positioning using modified radar and Racon equipment. A trial carried out off the East Coast of the UK demonstrated the feasibility of such a system as an alternative non-GNSS means for determining the ship's position [4].

The trials took place over four days, which were used for 'static' and 'dynamic' tests. In the static tests, the vessel held station at a number of points, at different distances from the Racon locations, and the dynamic tests involved sailing parallel with the coast through the trials area. The data processing associated with the radar used both range and bearing from the racons, to calculate position, combined with the latitude and longitude encoded using FSK modulation on the dash of the Morse character of the Racons. The appearance of the Racon paints on the experimental radar was similar to that on the vessel's conventional radar. The first dash of the Racon response showed striations from the modulation, but was clearly distinguishable.

The maximum ranges at which the Racons could be seen was about 20 M, however, responses at these ranges were sporadic and inconsistent. The maximum ranges at which consistent responses were received varied between 8 and 12 M depending on location and time. Therefore, a usable range of 10 M is probably to be expected. The accuracies also varied considerably, depending on the number of Racons being received, their geometry relative to the vessel and the consistency of response. During static tests 'ideal' locations were found at which both Racons were almost continuously available, with ranges of less than 10 M and the geometry was good – the two Lines of Position (LOP) crossing at right angles. Combined position accuracies at these points were 5-10 m. When geometry was poor or only one Racon could be received, accuracy was in the region of 50-100 m. The plots shown in Figure 7 indicate typical performance, with single Racon accuracy of 40 m within 5 M, 100 m at 12 M, but with two Racons accuracy of 2 m was achieved. Whilst the availability of the single Racon fix at under 5 M was 98%, the availability of the two-Racon fix was dictated by that of the more distant Racon at 87%. The results of the trial were encouraging, although more work is needed to fully understand the capabilities of the system.

R-Mode Radiobeacon Differential GNSS

Following a comprehensive study of R-Mode options for maritime navigation [5], the ACCSEAS project embarked on the world's first R-Mode test bed using MF DGNSS transmissions. The trial was carried out in early 2015, which limited the scope of the tests in the concluding ACCSEAS project. However, even a limited test can serve as a proof-of-concept and provide a basis for further work.

The installation of the system components enables the following tests:

- usability of standard MF transmitter and antenna setup for R-Mode operation
- proof of R-Mode concept using MF transmissions from IALA radio beacons
- co-existence of R-Mode signals and DGPS-transmission within one channel
- achievable accuracy figures (range and timing) in the test area
- mutual influence of R-Mode and DGNSS signal

Test Bed in Ijmuiden

An R-Mode transmitter was installed at the location of Ijmuiden, Netherlands

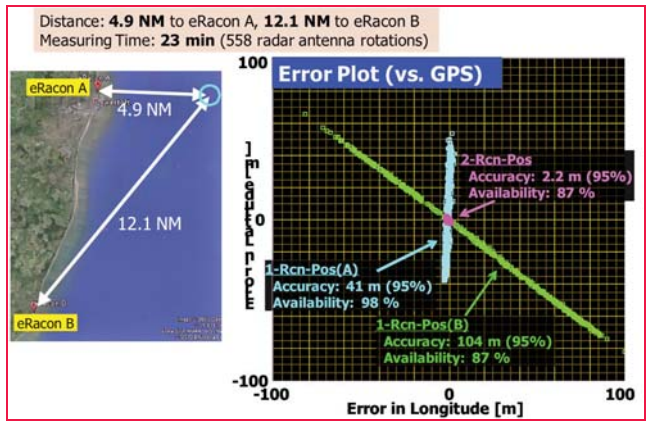

Figure 4: Absolute Radar Positioning results from trials carried out in the ACCSEAS project

which provides a usable range for R-Mode tests of about 100 km. For the transmission of the R-Mode signals, a typical MF transmitter and antenna was used. Based on the 3 different solutions evaluated in the feasibility study, the R-Mode transmitter provides 3 signals:

- One standard MSK signal for the normal data channel
- Two CW signals for navigation purposes

An R-Mode modulator was developed which enable the transmission of standard RTCM messages used for the DGNSS service and two independent CW signals with adjustable frequency and output level. Furthermore, the transmission of the ranging signals used a reference timing from a rubidium clock.

The R-Mode receiver needs to have the capability of measuring the pseudorange from the R-Mode transmitter, as well as being able to demodulate the MSK signal and decode the RTCM messages. This data on pseudoranges were logged along with position and time for later analysis. For the R-Mode test bed, a prototype R-Mode receiver was developed consisting of an H-field antenna, a band filter with attenuator and a PC with ADC board and a MATLAB software. The receiver together with a rubidium clock was installed on a lighthouse tower in Noordwijk. The distance to Ijmuiden is about 25 km.

After the setup of the R-Mode equipment in Ijmuiden and Noordwijk, a measurement campaign was performed over two days. The recorded data was analysed with respect to signal to noise ratio and the accuracy of the range accuracy phase measured from the phase determination of the two CW signals and the beat frequency of both signals to solve the ambiguity. Fig. 5 shows the measured range errors in metres for CW1 and CW2 over the time, and they are typically better than 10m, which is a great result.

The effects of the own skywave at night are clear to see, with the error fluctuating more than during the day. Nevertheless, the early results from this trial shows that, in principle, the modified DGNSS transmissions can be used to provide a source of resilience to maritime PNT. However, much more work and research is needed before a viable system is deemed possible. The current trial includes only one station, and therefore, a position fix is not yet possible. However, now that the principle is at least tested, the next phase will look into bringing more stations into the trial and produce the world's first DNGSS-based positioning system.

Conclusions

The ACCSEAS project started by looking at the challenges to maritime accessibility in the North Sea Region. In particular, the impact of increasing traffic density and larger ships in reduced sea-space was considered and explored. As a result of this work, the solutions detailed earlier in this report were proposed in the ACCSEAS Baseline and Priorities Report, first published end of 2013. Now in its third edition, it covers the IMO's work on the Sustainable Maritime Transport System and the Strategic Implementation Plan (SIP) for the e-Navigation concept that underpins all the solutions in ACCSEAS [2].

Improved Spatial Awareness

Improving the spatial awareness of the mariner and shore-based authorities will allow those users to get a better understanding of what's happening around them. The Baseline and Priorities Report highlighted the potential issue of increased traffic in tighter shipping lanes created by windfarms, particularly in the southern North Sea. There will be an increased reliance on ship systems to navigate through these areas to ensure that the risk of collision and grounding remain low.

Through demonstrating e-Navigation services such as the Tactical Route Exchange, No-go Areas and the Augmented Reality Head-up Display, ACCSEAS has shown that solutions can be developed that will allow users either to receive information they cannot yet get or is more difficult to obtain. This information will enable the mariner, and shore-based authorities, to understand their immediate and near future environment in a more clear and intuitive way. The demonstrations have shown that users are enthusiastic about the improved view of the environment that the ACCSEAS solutions provide.

By improving the spatial awareness, the users of the Region will gain a better understanding of how to traverse the Region with more confidence, efficiency and safety. This can only serve to gradually increase accessibility in the North Sea Region.

Improved Information Integrity

Information integrity is crucial in informing all uses of the situation in the maritime space. It underpins the acceptance and ultimate success of e-Navigation as an emerging driver for improved safety and efficiency. It is therefore unsurprising that a number of the solutions demonstrated in ACCSEAS have the aim of ensuring that the information presented to both the mariner and shore-based authorities is accurate and delivered in a timely manner.

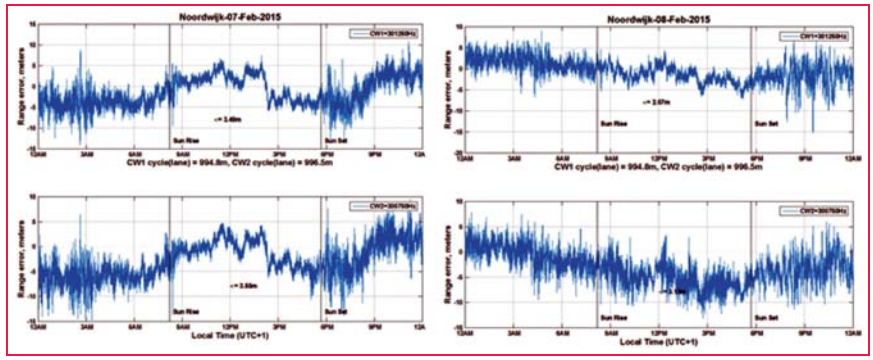

Figure 5: Ranging error of CW1 and CW2 over time from the trial R-Mode DGNSS transmissions

Good examples of such services are Resilient PNT (improved integrity of positioning and navigation information), MSI/NM (improved and more reliable maritime safety information delivery), Vessel Operations Co-ordination Tool (faster and more reliable delivery of search and rescue information) and Inter-VTS Exchange Format (improved shore-based visualisation of the sea-space).

The impact that improved information integrity has on accessibility is very clear. By ensuring that the mariner and shore-based authorities get reliable information, the decision making can be more certain and less likely to cause collision and grounding. Reliance on unreliable information, whether deliberate or not, can only cause an increase in the risk to the vessels and the environment. The solutions, demonstrated in ACCSEAS to real users of the North Sea Region, has the real potential to minimise the informational errors and increase confidence, safety and efficiency in the North Sea Region.

Impact on Training

The ACCSEAS project has demonstrated solutions that will have an impact on accessibility to the North Sea Region and its ports. The solutions would be of limited value if the users were not suitably trained on the using the services to maximum benefit. The Training Needs Analysis and the Use of Simulators in e-Navigation Training and Demonstrations Reports [6] highlight the need for robust training of users in the new technology and its application in navigating the seas. It is here that the training and research institutes play a critical role in covering the human factor of e-Navigation services and solutions.

Without this, the solutions developed in the ACCSEAS project will not achieve the intended outcome of improving accessibility in the North Sea Region, and even has the possibility of causing collisions or grounding due to misunderstanding or too little training on the systems. As e-Navigation solutions develop, including the ones demonstrated in ACCSEAS, it is imperative that training and the human factor is a key aspect at all stages of implementation to ensure that maximum benefit, including improved maritime accessibility, is realised.

ACCSEAS has gone a long way to investigate the human factor of e-Navigation technology, and has proposed further work to ensure that as the concept evolves, the training evolves alongside it. This will give e-Navigation the best opportunity to provide the maritime users of the North Sea Region, and beyond, much needed tools to tackle the challenges of the future.

Further information

ACCSEAS has a wealth of information about the services and solutions it has developed on its website, www.accseas.eu. All the reports and videos of the demonstrations are available, as are the conference reports and presentations. Readers are encouraged to look at these resources for more details on the project and its achievements.

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SNIPPETS

At a Glance

- Caliper Offers Updated Germany Data for Maptitude
- Global Mapper and GM LiDAR SDKs v16.2 Released
- SimActive Provides Integrated LiDAR and Photo Solution to Altoa
- Indonesia Regional Planning and Development Sector Powers Up Mobile Mapping by SuperPad
- Esri's Randy Frantz Named Internet of Things Colead by TM Forum
- NavtechGPS to Distribute Forsberg
- StarLink GNSS Product Line in U.S. and Canada
- GIS Cloud comes to Australia and New Zealand
- Tasmania deploys drones in $15 million dam project
- Hexagon Geospatial partners with BlackSky Global
- Dutch Kadaster switches to PostgreSQL
- HYSight Technologies awarded FAA exemption that expands, expedites UAV sales
- Wolseley introduces vehicle tracking system for smart driving
- Intermap Technologies unveils NEXTMap World 10
- Proteus enters into partnership with GeoSlam
- Topcon acquires agricultural technology company NORAC
- Autodesk solutions get Topcon 3D scanning integration

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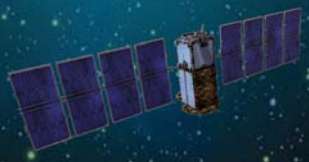

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Overview for the prediction of larger earthquakes in Japan

The prediction method is based on the authors' experience of 13 years as well as three indicators which are computed from daily Global Navigation Satellite System (GNSS) data from about 1,300 Continuously Observing Reference Stations (CORS) established all over Japan by Geo-spatial Information Authority (GSI)

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The prediction results for seven larger earthquakes that occurred in Japan in 2015 are validated against published mail magazine data that were disseminated to the customers in advance to the earthquakes. The largest earthquake was M8.1 with the epicenter near the Ogasawara Islands in the South Pacific Ocean, about 1000 km from Tokyo. The prediction method is based on the authors' experience of 13 years as well as three indicators which are computed from daily Global Navigation Satellite System (GNSS) data from about 1,300 Continuously Observing Reference Stations (CORS) established all over Japan by Geo-spatial Information Authority (GSI).

Although the predictions do not show 100% success, the readers should understand the scientific background to why and how the predictions of these earthquakes were carried out by looking at the graphs and figures shown in this article. All seven earthquakes introduced hereinafter are completely different in strength, epicenter depth, appearance of pre-signals, quake characteristics and so on; therefore it is not easy to predict earthquakes in advance using a single indicator or automatic decision making.

Introduction

Since the earthquake prediction private company, namely Japan Earthquake Science Exploration Agency (JESEA), commenced operations in January 2013, the authors, as the company's advisors have been responsible for the "Weekly MEGA Earthquake Prediction" which is disseminated to about 50,000 individual customers, mainly through a mail magazine. For the seven earthquakes larger than Japan Meteorological Agency (JMA) Seismic Intensity 5- (called SI hereinafter) that have already occurred in 2015, the authors have summarized how JESEA has provided the prediction information to the customers in the mail magazine.

Although the prediction method using GNSS data has been published several times in "COORDINATES" in the past, it has been improved over the last two years as experience has been accumulated, as well as data analysis and visualization techniques have been improved.

While the authors are not in a position to say that the predictions published in the mail magazine are correct or not, we show how the prediction or pre-signals have been determined. This may be useful for the readers to judge the correctness of the predictions. All this information is based on scientific background represented in graphs or figures to protect ourselves from legal claims.

Because the journalists of magazines and TV are also our customers and they recognized the correctness of the prediction, JESEA's success in earthquake prediction has been included in about ten magazines and on Fuji TV five times in the last two years.

Remarks: The Richter Scale or so called Magnitude (M) indicates the energy of an earthquake at the epicenter while Seismic Intensity (SI) means the quake intensity which is directly related to the damage caused by the quake. JMA SI is classified into 1, 2, 3, 4, 5-, 5+, 6-, 6+ and a maximum 7. An intensity larger than 5- will be classified as a large earthquake with some sort of damage in Japan. Earthquake damage and SI are not always the largest near the epicenter particularly in the case of a deep earthquake, say deeper than 50 km. For developing preparedness against earthquake damage SI would be more important than Magnitude. Therefore JESEA targets SI rather than M in the prediction.

The prediction method

JESEA so far adopts the following three indicators in its earthquake prediction method.

1) Weekly height change: short term height changes in 7 days. The larger the SI, the greater the number of stations and the wider the area that shows abnormal height changes above 4 cm, which is considered from our experience as the threshold. The indicator is useful to detect sudden changes, which occur in the case of an earthquake with a shallow epicenter or volcanic activity.
2) Increase or decrease in X, Y, Z geo-centric coordinates or H (ellipsoidal height) compared with corresponding values two years earlier, or a long term tendency of abnormal increases or decreases in over two years. The maximum increase or decrease in geo-centric coordinates or H in a certain area compared with neighboring areas is a critical value and should be useful for predicting quake areas.
3) Six monthly accumulated daily deformations in geo-centric coordinates or H compared with two years earlier are useful indicators of slow changes, which appears in the case of quakes with deep epicenters.

The prediction is undertaken in the two steps. The first step involves computing the above indicators and visualizing them graphically and as figures for comparison with the knowledge based thresholds. The second step involves reviewing the abnormal phenomena considering also the local/regional geographic and geological characteristics, past history of earthquake occurrences, temporal changes or trends over five years, climate and tidal changes and so on.

Of importance are the zones with abnormal phenomena (called pre-signal by the authors) indicating the possibility of earthquakes larger than 5- SI rather than predicting "where" and "when" they may occur.

Since daily GNSS data from about 1,300 stations in Japan are available every week on Monday on the Internet from GSI free of charge, the authors work hard on the prediction from the afternoon of Monday to the morning of Wednesday each week. In the afternoon of Wednesday JESEA disseminates "weekly MEGA earthquake prediction" to the customers on the Internet. One of the weak points of the prediction method is the lack of accuracy of "when" the actual earthquake will occur, since the time ranges from a few weeks to several months. This is a function of the different types and characteristics of earthquakes. For example an earthquake with a shallow epicenter normally occurs very soon after the occurrence of pre-signals, say a few weeks after the first pre-signals have been detected, while a very large earthquake with a deep epicenter can occur slowly, say more than six months after several repeated pre-signals.

Validation of the seven earthquakes for 2015

Table 1 shows the seven large earthquakes that have occurred in Japan in 2015 by the beginning of June 2015 and Figure 1 shows their locations. The validation using the published mail magazine information are described in the following which will enable the readers to judge the correctness or the scientific value of the predictions.

Table 1: List of larger earthquakes in Japan in 2015

No	Date	Name	Location	M	SI	Depth of Epi-center	Damage
1	15/2/6	South Tokushima	N33.7, E134.4	5.0	5+	10km	Little
2	15/2/17	Iwate Offshore	N40.1, E142.1	5.7	5+	50km	Little
3	15/5/13	Miyagi Offsore	N38.9, E142.2	6.8	5+	50km	Little
4	15/5/22	Amami Oshima Offshore	N28.6, E129.6	5.1	5-	20km	Little
5	15/5/25	North Saitama	N36.1, E139.6	5.5	5-	60km	Little
6	15/5/30	West Ogasawara Islands Offshore	N27.9, E140.8	8.1	5+	682km	Rail ways stopped
7	15/6/4	Middle South Kushiro	N43.5, E144.1	5.0	5-	<10km	Little

South Tokushima Earthquake (M5.0, SI 5+) 2015/2/6; with a depth of 10 km

Tokushima Prefecture is located in the south east of Shikoku Island where a huge earthquake occurred with resulting very large Tsunami in the past. People living in the region are seriously afraid of earthquakes but fortunately the damage from this earthquake was minor. The SI value is large compared with M as the epicenter was very shallow. In the mail magazine published on the 17th December 2014, about two months in advance to the occurrence of Tokushima Earthquake, the authors warned that the southern two capes of Shikoku Island showed completely different movement in X axis (East/West direction) compared with

Figure 1: Locations of larger earthquakes in Japan in 2015

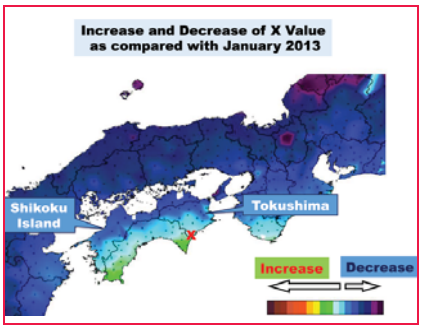

Figure 2: Validation for South Tokushima Earthquake

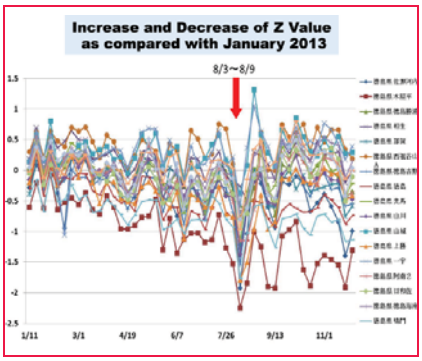

Figure 3: Pre-signals at Tokushima GNSS stations

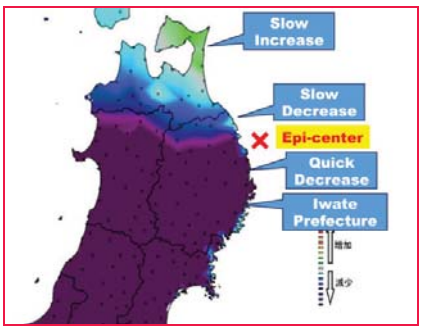

Figure 4: Boundary of rapid and slow decrease of Y values in Iwate Offshore

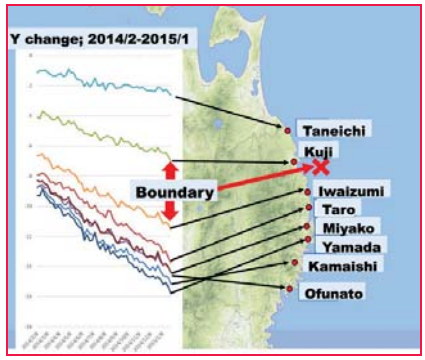

Figure 5: Boundary of rapid and slow speed of Y values in Iwate Offshore

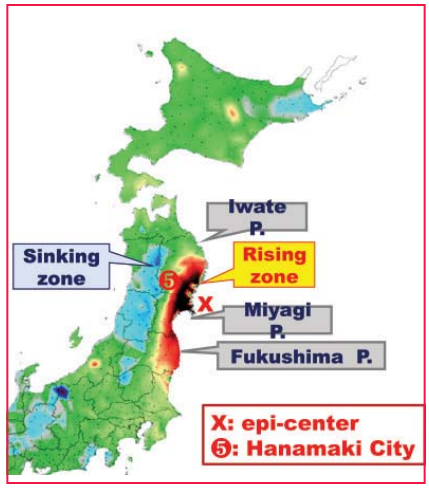

Figure 6: The most SI area and the epicentre of Miyagi Offshore Earthquake

other Shikoku areas. The two capes revealed an increase or positive movement, shown in green color in Figure 2, while the other areas revealed a decrease or negative movements displayed in blue color. The epicenter of the earthquake, indicated by X in the figure was located exactly on the boundary between positive and negative movements. In addition we predicted that Tokushima Prefecture would be critical as Tokushima simultaneously showed abnormal pre-signals in Z values in the beginning of August 2013 as shown in Figure 3 which was also disseminated to the customers.

Iwate Offshore Earthquake (M5.7, SI 5+) 2015/2/17; with a depth of 50 km

Iwate Prefecture is located in the north east of Tohoku Area which was seriously damaged by the Great East Japan Earthquake and Tsunami of 2011/3/11 with many victims. After the Great Earthquake, Iwate area has been rising drastically although the area subsided several ten of centimeters during the quake. This rise in the area after the Great Earthquake caused an accumulation of new energy for new earthquakes, which have occurred mainly in the three prefectures; Iwate, Miyagi and Fukushima. In the mail magazine published on 10th December 2014 the authors showed how the speed of change in the Y coordinate values (North/South direction) compared with values in January 2013 in the Iwate Offshore was different as shown in Figure 4. In the mail magazine published on the 18th February 2015 after the earthquake, we explained that the speed of Y value changes displayed large differences between the two northern and six southern stations as shown in Figure 5. Very fortunately the damage from the earthquake was minor.

Miyagi Offshore Earthquake (M6.8, SI 5+) 2015/5/13; with a depth of 50 km

Since the epicenter of the Great Earthquake which occurred on 2011/3/11 was 130 km east offshore of Miyagi Prefecture, the Pacific coast of Miyagi Prefecture revealed the largest rise after the earthquake, while the inner-land of Tohoku showed the largest sinking. These after-changes have generated large earthquakes over the past four years. Therefore in the mail magazines, the authorities in the Pacific Coast of Tohoku as well as the inner land were warned that this is a critical zone indicating future earthquakes. Though the epicenter of the Miyagi Offshore earthquake was located as shown in Figure 6, the largest SI was located at Hanamaki City in the inner land area, which is at the boundary between rising and sinking zones. The boundary between such opposite movements is recognized from experience as a critical zone. In spite of the rather large magnitude quake, the damage was minimal.

Amami Oshima Offshore Earthquake (M5.1, SI5-) 2015/5/22: with a depth of 20 km

Amami Oshima Island is located about 380 km south west of Kyushu Island and about

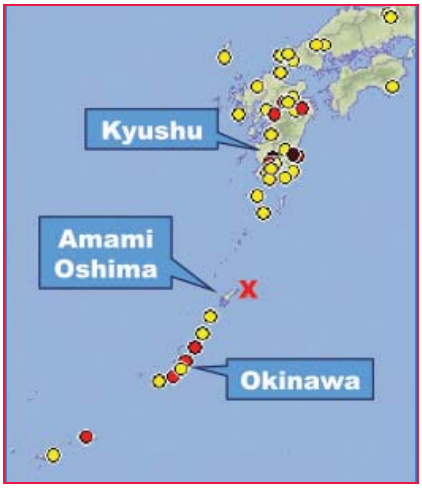

Figure 7: Pre-signals appeared 10 months before

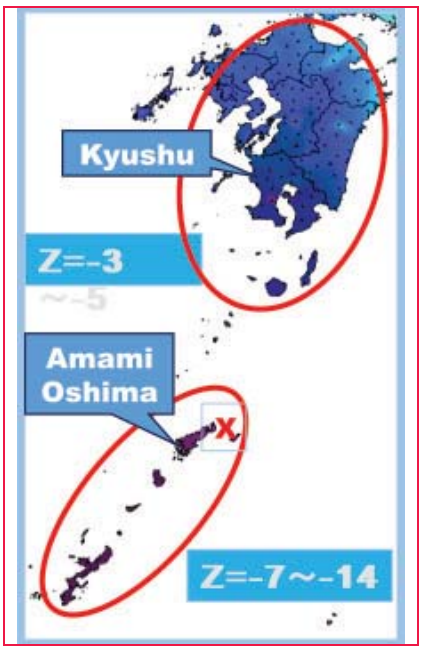

Figure 8: Large differences of Z value between the two areas

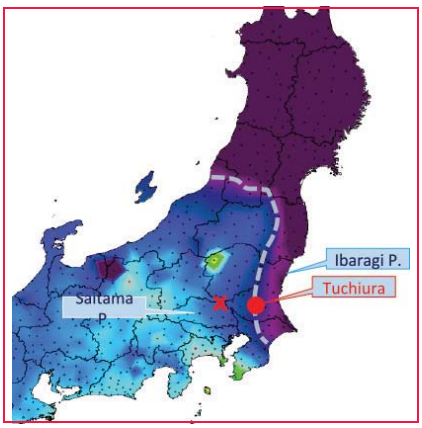

Figure 9: Boundary of rapidly occurring north-south deformations

200 km north east of Okinawa. There were pre-signals in July 2014, about 10 months before (Figure 7), as well as nine months before the quake. Since then JESEA continued warning that this area should " extremely careful". But as the Amami Oshima area had been subsequently calm without any abnormal phenomenon for more than six months JESEA reduced the advisory to "careful" level. However we recognized big differences between the Kyushu Zone and Amami Oshima and Okinawa Zones in Z (height) values as shown in Figure 8. The former zone showed Z value changes in the range of -2 to -5 cm while the latter zone revealed changes of -7 to -14 cm. This differences could trigger an earthquake. The exact time between the appearance of pre-signals and the actual earthquake is very difficult to predict. However it was not surprising that an earthquake occurred following the appearance of these pre-signals. Fortunately the damage was little in this case

North Saitama Earthquake (M5.5, SI5-) 2015/5/25: with a depth 60 km

As the depth of the epicenter is relatively deep, the largest SI or the most quaked area was about 50 km east of the epicenter namely in Tuchiura City, Ibaragi Prefecture. In the mail magazine, we pointed out that the boundary between rapidly occurring deformations as shown

Figure 10: The epicentre and the seriously quaked areas

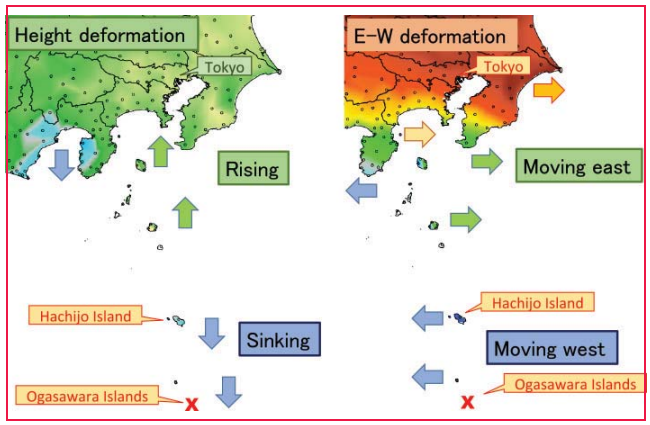

Figure 11: The epicentre and the seriously quaked areas

in purple color in Figure 9 and the slowly occurring deformations in blue color in the coordinates in the north/south direction (Y coordinates) may be critical in generating energy for an earthquake. In the figure the boundary between the zones with different deformation characteristics is shown by dotted lines. The most quaked area was Tuchiura City which is located on this boundary. As Tokyo Metropolitan Area was also quaked with SI 4, many railways including subways stopped for a short time to confirm safety.

West Ogasawara Islands Offshore Earthquake (M8.1, SI5+) 2015/5/30: with a depth of 682 km

Though Ogasawara Islands are located about 1,000km south of Tokyo, Tokyo Metropolitan Area was seriously quaked with SI 5+ as well almost all of Japan as shown in Figure 10. This is because the epicenter was very deep at 682

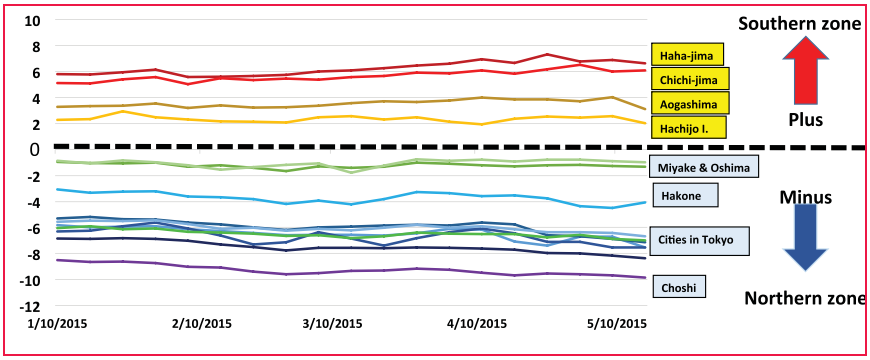

Figure 12: Difference in X value between the southern and the northern stations

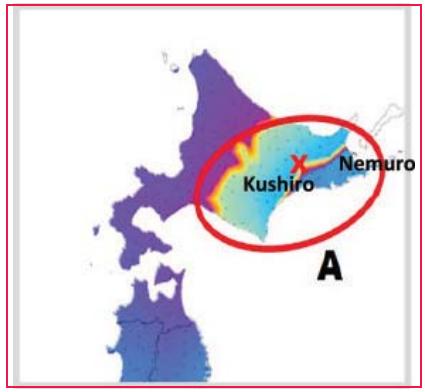

Figure 13: Enhanced image of horizontal changes in Kushiro Area

km. It was the deepest epicenter ever recorded in the history of earthquakes in Japan. About 20,000 elevators of tall buildings stopped and almost all railways including "Shinkansen" or bullet train automatically stopped for several hours. Very luckily no one was killed. The quake was rather long with a low frequency.

In the mail magazine, we pointed out that the direction of height (Z coordinate) and east-west (X coordinate) deformations for the inland area and south areas were opposite to those for the Hachijo Island to Ogasawara Islands, as shown in Figure 11. These opposing deformations would be a precursor of an earthquake. In addition, about a month before the earthquake there was a pre-signal of height deformation at one of Ogasawara Islands. We also noted the drastic differences in North/South (Y) values between the southern zone, comprising Ogasawara Islands (mainly composed of Chichi-jima and Haha-jima; meaning father and mother island) and Hachijo Island, and the northern zone, comprising Miyake Island, Izu Oshima Island, and the inland area such as Tokyo Metropolitan Area as shown in Figure 12. The former zone shows high changes in Y values (positive) while the latter zone shows small changes in Y values (negative) which would generate large energy to trigger the large earthquake.

Middle South Kushiro Earthquake (M5.0, SI5-) 2015/5/30: with a depth of 10 km

Kushiro is located in the east of Hokkaido Island where horizontal deformations (X and Y directions) were concentrated and also mixed as shown in Figure 13 which has been enhanced to show the horizontal deformations. In the mail magazine published on the 3rd June 2105 we announced an advisory that Kushiro and Nemuro areas shown by the symbol A and the circle in the figure must be 'careful'. Just one day after dissemination of the mail magazine to the customers, surprisingly the earthquake occurred because its depth was very shallow. Fortunately little damage occurred in a limited and narrow area.

Conclusion

The seven large earthquakes that have occurred in Japan so far in 2015 have been introduced as well as the methods used for their prediction by the authors based on scientific analysis of GNSS position and elevation data as well as past experience. The critical zones are the boundaries between rapid deformations in GNSS data, which are revealed by changes in the signs of numerical values of coordinates of GNSS data in neighboring zones. Since the type and depth of earthquakes are so different, the occurrence patterns are different which makes it difficult to predict the exact time of an earthquake. However "where" and "how large" can be roughly predicted while "when" ranges from a few weeks to several months depending the earthquake type which as yet is unknown in advance.

Ackonowledges

The authors would like to express their appreciation to Mr. KITTA Toshihiro, the president of JESEA and Mr. TANIKAWA Toshihiro, Executive of JESEA for their kind support of research. The authors also thank GSI for providing weekly GNSS data of 1,300 stations free of charge. The authors would like to appreciate Prof. John Trinder for editing and correcting English.

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Role of surveyors in urban regeneration projects in Turkey

In this paper, the role and effectiveness of surveying and geomatics engineers in urban regeneration projects in Turkey are analyzed

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Unhealthy living spaces emerge due to many reasons such as poverty, migration, rapid urban growth, physical deterioration of built environment and development of illegal settlements. In developed countries like the UK or the USA, unhealthy living spaces occur mainly because of regional economic changes such as closing down large factories or docks that lead to the physical and social deterioration of those areas. In developing countries on the other hand, unhealthy living spaces occur not only from physical deterioration of formal neighborhoods but also from rural-to-urban migrations and lack of affordable housing supply that leads to the squatter settlements. Either way, these places become favorable for low-income people because of the low rents and prices offered here.

'Building-based renewal' in problematic areas might sound a reasonable method at first glance; however there are problems with that approach. For instance, building-based renewal cannot provide sustainable results in terms of social, economic and environmental aspects, because the whole focus is put on physical improvements in these projects by disregarding the long term social, economic and environmental needs. 'Urban regeneration' on the other hand, targets the 'regeneration of areas' which can enable people to address various problems simultaneously and help different groups to work together and think comprehensively on one goal, without considering their professional backgrounds. This way, the synergistic works can provide enhanced results, especially in social and economic terms. For instance, social problems can be addressed by designing projects that stimulate job generating initiatives and encourage educational activities (Zheng, Shen, & Wang, 2014).

Various professionals are required in regeneration projects in order to address their respective fields; and surveyors (surveying engineers and technicians, geodesy and photogrammetry engineers, geomatics engineers) are one of those professionals. Surveyors are highly educated in terms of spatial data management and planning, which is one of the core components of regeneration projects. In this paper, the role of surveyors in regeneration projects in Turkey are analyzed; their skills gaps are explored in the light of interviews with the experts in public authorities. Interestingly, there is little information about the role of surveyors in urban regeneration in the literature in Turkey and worldwide. It is thought that the conclusions of this paper can suggest educational institutions review their surveying/ geomatics programs with respect to urban regeneration. It can also help raise awareness of urban regeneration among surveyors, and help them develop new set of skills which essentially benefit them to address complicated urban problems and offer a variety of services, and ultimately, contribute to a healthy urban environment for all.

Methodology

In 2006, a research was carried out by Adams, Turok, and Wilson (2006) to explore the role and effectiveness of

surveyors in regeneration for Scottish Centre for Regeneration, Communities Scotland and the RICS Scotland by means of face-to-face interviews, telephone interviews, focus groups and online questionnaires; and a report was made with conclusions. That research is in harmony with the purpose of this paper; however the extent and methodologies of the two studies differ. In this paper, literature review and telephone interviews were made with a number of surveyors (disregarding statistical concerns) who work in regeneration projects in municipalities in Izmir, Konya, Ankara and Istanbul, and in Housing Development Administration in Ankara. They were asked four basic questions to examine what type of works they carry out, what challenges they are faced with and if they have recommendations about filling the skills gaps of surveyors in regeneration field.

Urban regeneration in Turkey

History

The needs for urban regeneration in Turkey emerged because of both deteriorating building stock and illegal settlement problems at the same time. In order to understand the status of illegal settlements in Turkey, it can be a good idea to look back at its history. Technological development and mechanization in the agricultural sector, starting from the 1950s, caused a large rural-to-urban migration in Turkey. Peasants left their villages to find new livelihoods in the metropolitan cities. The growing demand for affordable housing in cities and lack of it eventually led the newcomers to build their own homes over lands that they did not own (preferably state lands). Due to economic difficulties, the State could not provide social houses; neither the private sector was strong enough to supply the demand. Authorities chose to ignore this illegal housing movement and a type of *de facto* home possession found its place because another alternative could not be found at the time (Baharoglu & Leitmann, 1998; Erman, 2001).

In 1984, the Act No. 2981 was enacted (known as the Development Amnesty Act) in order to enable squatters to upgrade their homes physically and legally. In this way, their *de facto* home possession would be legalized and it would provide them tenure security. The owners could then invest in their homes to make them better physically and local taxes could be collected by the authorities efficiently. Many squatters applied to the authorities to legalize their homes according to the Act. However, many of them have not finalized their legalization procedures and they have kept using their homes peacefully without any interventions from authorities until today (Uzun, Çete, & Palancıoğlu, 2010). Building unlawful homes (construction without a permit) still continue very slowly and quietly in squatter neighborhoods by adding extra stories to the houses without permission, because it is difficult for authorities to detect them in those areas. However, such unlawful developments cannot take place in formal neighborhoods because they can be detected and demolished very quickly. The distinction between the past and present is that the driving force for unlawful development today is not a basic housing need anymore, rather an economic benefit for the doers with the expectation of further 'amnesties' that may arrive in the future, or having more homes ready when their neighborhoods are announced as regeneration areas and expecting that it may help them claim more apartment units from the new projects.

Legislations and Organizations

Urban regeneration projects are massive development projects. Therefore, legal framework and law enforcement are required. In Turkey, there are three different Acts describing urban regeneration activities in certain conditions.

The Municipality Act 2005 No.5393, Clause 73, is the Act that frames how urban regeneration of an area can be realized by the hands of local authorities (municipalities and provincial administrations). It describes that municipalities are authorized to carry out urban regeneration projects for the purposes of developing residential, industrial, commercial and recreational areas; rebuilding and renovating decay areas; protecting historical and cultural urban texture and taking measures against earthquake risk.

Renewal of the Areas under Disaster Risk Act 2012 No.6306 outlines the renewal principles for the areas and buildings under disaster risk; such as risk of collapse, ground-sliding or earthquakes. This Act contains more obligatory clauses than others and it allows building-based renewal which is not possible with the *Municipality Act.* It authorizes the Ministry of Environment and Urbanization as the responsible party.

Renovation, Conservation and Use of Dilapidated Historical and Cultural Immovable Assets Act 2005 No.5366 was enacted to authorize municipalities and provincial administrations to carry out regeneration projects, in order to renew and protect historical and cultural assets and provide residential, commercial, cultural, touristic and social areas within protected zones.

According to the laws; municipalities, provincial administrations, the Housing Development Administration and the Ministry of Environment and Urbanization are allowed to carry out urban regeneration projects.

Role of surveyors in urban regeneration projects

Interdisciplinary Nature of Urban Regeneration

Interventions to decay areas require extensive planning and consideration. The changes in those areas do not affect only buildings, but also peoples' lives and environment. There are many different aspects intertwined with each other in these projects. Therefore various professions are required to get involved in regeneration projects to address the relevant problems. Because of the reasons

explained above, urban regeneration is naturally an interdisciplinary method which includes engineering, sociology, finance, economy, architecture, planning, environment and many other aspects. Urban regeneration departments in public authorities in Turkey employ people mainly from these professions: civil engineers and technicians, architects, city planners, sociologists and surveyors. However, people from other professions can get involved too.

A discussion in the UK was raised by the Urban Task Force 1999 Report which argued that there were 'skills gaps' in the regeneration field. According to it, strict educational preferences and accreditation systems of different professions create barriers. Instead, more general courses should be given in order to address unique problems and enable interdisciplinary working among different professions (Adams et al., 2006). In Turkey, the skills gaps in regeneration are filled by individual initiatives of professionals when a gap is experienced in a situation, rather than being prepared for it earlier. The gaps are being found step by step. Area-based regeneration is a respectively new subject in Turkish urbanization agenda, and there are lots of things to learn and experience in it.

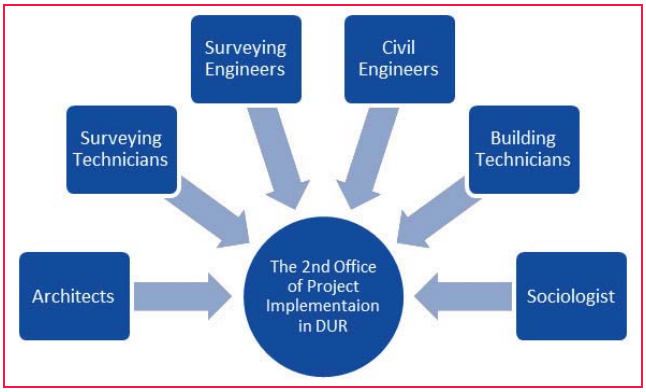

Figure 1. Personnel of the 2nd Office of Project Implementation at Department of Urban Regeneration in Izmir Metropolitan Municipality.

Regeneration professionals get involved in many different types of services in the projects, however, the core duties of some of the professionals can be repeated shortly. Civil engineers/technicians and architects generally take care of the building structure and design issues. Land-use planning of the regeneration areas are handled by city planners such as deciding where the roads, parks, residential and commercial areas will be. It is becoming more and more acknowledged that social and socio-economic issues in regeneration projects should be handled by sociologists. Therefore, many municipalities today employ sociologists in their regeneration departments. Finally surveyors, who are the main subject in this paper, perform mainly land management related services. However, all of these professionals go beyond their professional boundaries and help each other in many areas. In the following sections, the role of surveyors is deeply analyzed.

Role of Surveyors in UR Projects

The core of surveying discipline can be defined as collecting, managing and analyzing spatially referenced data. From the fact that regeneration projects target the redevelopment of neighborhoods which contain large spatial data, surveyors are highly required in regeneration teams of relevant authorities in order to handle those data. However, just like any other professionals, surveyors need to go beyond their professional boundaries and take part in other fields as well.

In order to learn how many surveyors are involved in regeneration services in Turkey, one needs to visit the Chamber of Survey and Cadastre Engineers (CSCE), which is the professional board of surveying engineers in Turkey. CSCE has many responsibilities such as promoting and representing the profession and inspecting its members' services. Recently, the CSCE showed increasing interest on the regeneration issue. It organizes conferences about urban regeneration in order to raise awareness among surveyors. However the CSCE cannot provide information about the number of its members that are in regeneration business. There are two reasons for this. Firstly, the registration to the CSCE is compulsory if a surveyor wants to open a surveying engineering office or company; however, many surveyors who work as an employee do not feel the need to register, unless they do not sign legal surveying documents. Therefore, many surveyors in Turkey are not registered in the CSCE even though they perform surveying services. This causes a lack of information. The second and most important lack of information occurs due to the fact that the CSCE registration does not require information from its members about which branch of surveying that the member is specialized on or willing to perform at. Even though there is a possibility that the members can log in to the CSCE website and update their current work status, very few people update them. Therefore, there is no data about the number of surveyors who are occupied in regeneration services in Turkey at the moment.

Urban regeneration works are generally carried out at 'urbanization' and 'development' departments in municipalities. In those municipalities, urban regeneration works are divided between relevant departments and the personnel of those departments carry out only the parts of the job that their departments are responsible for. However, some municipalities prefer to establish 'urban regeneration' departments for only regeneration issues, in order to institutionalize and manage regeneration works in a respectively elastic and independent way. This also seems to enable them to manage the process more easily. In order to exemplify an organizational structure of a municipality, Izmir Metropolitan Municipality (IMM) can be analyzed. The Department of Urban Regeneration (DUR) in the IMM was established in 2010 in order to handle regeneration works completely. DUR has three subdivisions and those are 1st, 2nd and 3rd Office of Project Implementation. Regeneration areas are assigned to one of these offices and every office has its own director and technical personnel to design and implement regeneration projects in their own responsibility area. For instance, the 3rd Office of Project Implementation employs 10 personnel and 2 of them are surveyors (20%); the 2nd Office employs 15 personnel and 5 of them are surveyors (33%). The other employees in the 2nd Office are architects, civil engineers and building technicians (Figure 1). A sociologist is also employed in the DUR to help all three offices.

The telephone interviews were carried out with a number of surveyors from municipalities in Izmir, Konya, Ankara and Istanbul, and from Housing Development Administration in Ankara. They were asked four questions. The aim of the questions was to understand what type of activities are performed by surveyors in regeneration projects; in which field the surveyors feel insufficient and require more education, and lastly, to ask their suggestions concerning the improvement of the skills of surveyors and surveying education at universities. All of the answers collected from the interviewees were put together without any consideration of statistical concerns. Because the interviewees are experts who are directly involved in regeneration and one may have different experiences and responsibilities than the other, all the answers were valuable.

The answers of all the interviewees for the first question were:

Question 1) Which activities do the surveyors carry out in UR projects?

- Determination of regeneration area
- Mapping
- Construction surveying
- Property ownership determination and analysis
- Title deed transfers
- Real estate appraisal
- Geographic Information Systems (GIS) management
- Allocation of building areas
- Expropriation
- Project feasibility calculations
- Cost analysis
- Implementation of guidelines
- Setting standards about procedures
- Attending negotiation commissions
- Project presentation

Although the interviewees used different terminologies for their services, the answers could be categorized in the above list. The interviewees generally gave very similar answers which specially concentrated on the surveying-related services. However, non-surveying-related services were also given, such as negotiations with stakeholders and cost analysis.

Skills Gaps of Surveyors in UR Projects

According to the answers of the expert interviewees, surveyors in regeneration seem to be highly mobile and they deal with different types of issues by partnering with their non-surveyor co-workers. The strength of surveyors are naturally concentrated on land management fields such as defining regeneration area, mapping of real estate, determination of real estate ownership, expropriations and land readjustment.

The skills gaps of surveyors on the other hand were scrutinized by asking about the fields that they felt insufficient at, in terms of knowledge or experience. According to the answers, the skills gaps of surveyors are concentrated in the following fields:

Question 2) In which fields of urban regeneration do you (or your surveyor co-workers) feel insufficient?

- Knowledge of laws and regulations
- GIS-based computer software
- Knowledge of development plans (zoning) and architectural plans and their vocabulary
- Public relation
- Finance

Even though courses about real estate law are given at surveying/geomatics engineering programs in Turkey, the interviewees stressed that they and their surveyor co-workers observed lack of knowledge in this field. Legal issues that occur in the projects require deep knowledge of laws and regulations and also surveyors need to update their knowledge continuously.

GIS courses are also very essential in surveying/geomatics programs in Turkey. However, lack of GIS-based computer software knowledge and experience were also complained about.

Architectural plans are not taught in surveying/geomatics programs in Turkey. Therefore, the interviewees complained about the lack of knowledge about reading basic architectural plans and understanding their vocabulary. Some degree of development plans (zoning) are taught in universities, however lack of knowledge about reading these plans were also mentioned.

Public Relation is another field in which surveyors are having difficulties. Since surveying/geomatics is a solid engineering field, having any initial education about social subjects is not something expected. It is the same for finance.

The third question was to understand their ideas and recommendations on how future surveyors could be more effective in urban regeneration projects.

> There is an indicator that more GIS software courses should be given in surveying/ geomatics programs

Question 3) What do you recommend surveyors do to become more effective in UR projects?

Surveyors who want to be in UR projects were recommended to develop themselves primarily in these fields:

- Real estate law
- General laws and regulations
- Real estate appraisal
- GIS software
- Basic development and architectural planning and vocabulary
- Public relations
- Finance

Urban regeneration is a new field in the Turkish urbanization agenda; therefore the courses that are taught in universities may not reflect the novel problems of regeneration projects of today. In order to have feedback from the interviewees, their views were asked about the education of surveying/geomatics engineering in universities and if UR related courses should be given as well.

Question 4) Should urban regeneration related courses be given in surveying/geomatics engineering programs?

All participants agreed on this. Everyone recommended provision of courses on subjects surveyors in regeneration felt insufficient when they graduated from surveying/geomatics engineering programs. The importance of practical courses was powerfully stressed by the participants. Internships and practical courses were suggested to be carried out in urban regeneration projects.

Results

According to the answers, surveyors' core responsibilities are land management and related services such as GIS management, mapping and title transfers. However, they take part in financial issues as well, such as project feasibility calculations, cost analysis and mostly real estate appraisal. One another important contribution of surveyors is in the social field. They join negotiations and give presentations to stakeholders in regeneration projects. All the interviewees agreed that they need more social skills. Unsurprisingly, social courses do not exist in surveying engineering education in Turkey. These 'softer skills' (Adams et al., 2006) can be acquired through experience in the field or through personal development. The interviewees stressed that, for regeneration work, surveyors should continuously develop themselves in a range of skills to address complex problems that occur in the projects.

The interviewees also said that more practical courses should be given in university education; and internships could be done in regeneration projects. Practical education could enhance the students' awareness in complex regeneration problems and could lead them to develop themselves individually in the fields that they will not receive any help in universities.

Some of the interviewees expressed that the CSCE should take more responsibility in regeneration subject such as organizing educational programs and seminars. Some interviewees also said that educational programs or seminars for additional qualifications outside university can be helpful. This can be done by municipalities or the CSCE.

Conclusions

First of all, it was an interesting finding that the answers of the interviewees were very similar to the findings of the report of Surveyors in Regeneration in Scotland (Adams et al., 2006). Even though it is thought that almost every jurisdiction

in the world has novel problems and unique regeneration approaches, the findings of this paper in Turkey and the report of Surveyors in Regeneration in Scotland actually show that the differences are not significant at all. Therefore, it can be said that the documentation of experiences of urban regeneration projects in a country can be of great help for another country. Scientific papers are good apparatus for this purpose.

The interviews were carried out with the surveyors who work in urban regeneration projects in public authorities. It should be admitted that there are advantages and some disadvantages with this approach. One advantage is that the answers of the participants are 'inside information'. They are performing activities in regeneration projects every day and are faced with challenges. They know where they are good at and where they are not. However, these are all personal views. The answers about their effectiveness and skills gaps can be compared with the views of non-surveyor co-workers or project managers in regeneration projects too as Adams et al. (2006) did in their research. These outsiders (outside surveying profession) can provide valuable information about the role of surveyors as well.

As the CSCE is the professional network of surveyors in Turkey, it could be a good idea for it to start recording their members' occupation and expertise. Members can log in to their website with their username and password and update their profiles. This can help the CSCE know the number of surveyors in a certain expertise, notify its members about job opportunities, and also help establish professional branches within the members and get feedback from those specific expertise groups for the betterment of the overall surveying profession. Such feedback can be discussed in meetings and help universities adapt new courses for the challenges that the members face every day, that are not mentioned in university classrooms.

According to the answers of the interviewees, surveyors in regeneration do not have problems about surveying related subjects in general. However, there are some areas that are taught in surveying/geomatics programs and that surveyors still feel insufficient at. It is normal if senior surveyors have problems with GIS management and software because they may have not received any GIS education in the past. Therefore, they need to develop themselves privately. However, the younger interviewees also complained about insufficiency at GIS software. This is an indicator that more GIS software courses should be given in surveying/geomatics programs.

Another surveying related complaint came from the real estate law. Many programs offer courses of real estate law. However, their extent or significance is in question. The interviewees all agreed on that they felt a lack of understanding in this field.

There are some gray areas where surveyors are not directly involved but related. Zoning is one of them. Surveyors are having problems about reading and analyzing these plans. Courses about how to read these plans and how to analyze land-use policies can be given at surveying/geomatics departments.

There are some areas that surveyors are not directly involved in, but need a certain level of knowledge. Construction and architectural plans are the fields that surveyors come across when they are employed in construction surveying. This skill is also required in regeneration projects. The interviewees especially complained about not understanding architectural vocabulary. Courses about basic architectural plans can be adapted in the programs. This skill directly affects their performance in real estate appraisal field as well. Real estate appraisal was another field that all the interviewees acknowledged the importance for surveying discipline.

Financial and social courses are not taught in surveying/geomatics programs in Turkey. The interviewees did not suggest giving these courses in the programs; however students can be encouraged to take selective courses about these issues if they are interested in urban regeneration.

It was acknowledged by all the interviewees that the surveying/geomatics departments in Turkey need to review their curriculums from the perspective of urban regeneration. Also, more research is required in this field.

Finally, urban regeneration is not a subject that only one type of profession can claim. Therefore, other disciplines that are involved in regeneration services should also review their position in order to improve their skills for the ultimate success of realizing beautiful, healthy and prosperous living environment.

Acknowledgement

The author wishes to thank the interviewees. This research is based upon their precious contributions.

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A User Report

JAVAD TRIUMPH-LS – Accidental Extreme Multipath/Interference Test

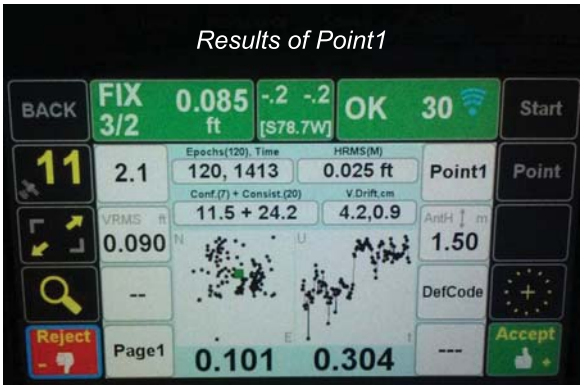
The following is an example of how well the JAVAD TRIUMPH-LS deals with multipath and interference. The test was not conducted with any sort of scientific procedure or confirmation of results from an independent source. It was purely accidental as to how the test was even conducted but none the less the results amazed me and I wanted to share with others.

So the story goes: I was sitting at my kitchen counter playing around with DPOS on the LS and my 5 year old daughter was watching with some interest so I figured it was a good time to see if my daughter could figure out how to navigate the map screen. I went into the "collect" module and just went to next so it was in the "collect" action screen and allowed my daughter to start playing with the map. I just happened to have a job setup with corrections being received from the VRS/RTN network over my home WiFi connection and told my daughter to let me know if the solution type box turns green(Fixed solution). I was talking to my wife when I heard "Daddy its green" and looked at the screen and low and behold 4 out 6 engines were fixed! Without really thinking I had my daughter start observing the position(hit start button) and before I knew it the LS was collecting data in my house!! The RTK verification was "with reset" and I had it set to 120 epochs with 2 engines set for verify. Amazingly enough the LS finished the collection process (definitely took a little bit) and had results! I figured OK big fluke no way that just happened so I had my daughter start another observation expecting it to possibly get a result but I did not think it would be even close to the first point. Well it turns out that the results of the 2 points were impressive so I went ahead and had another observation taken. I repeated the observations 1 week later and about 7 hours earlier and the results were again impressive for the situation.

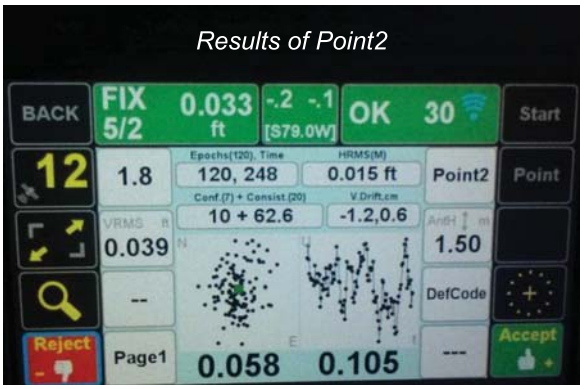
The following are pictures of the point observations, COGO inverses, and average results.

Day 1 Observation Results:

Results of Point1



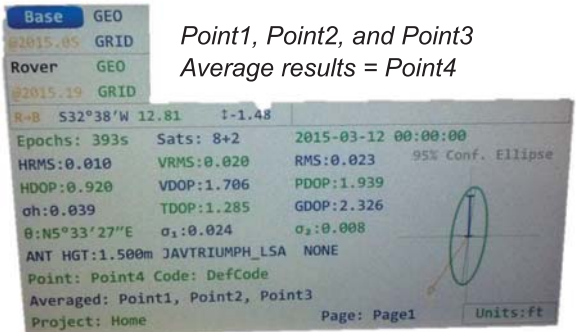
Results of Point2



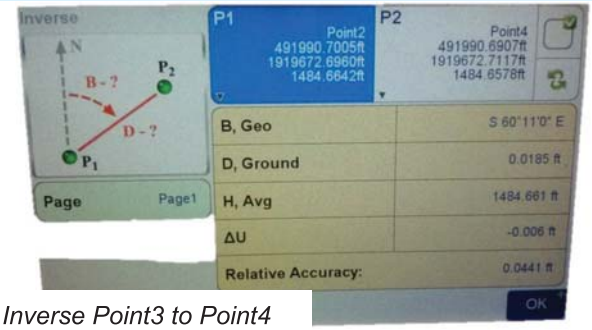
Results of Point3

Continue reading next page

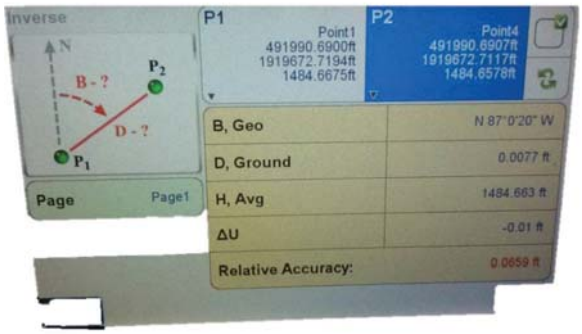
Day 1 Average Results and inverses:



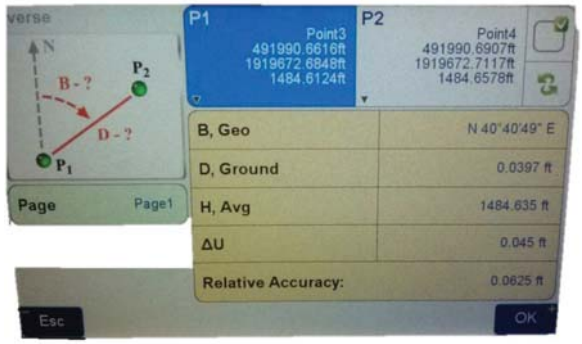
Point1, Point2, and Point3
Average results = Point4



Inverse Point3 to Point4

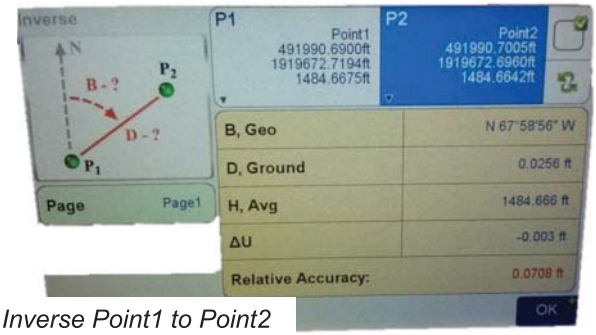


Inverse Point1 to Point4

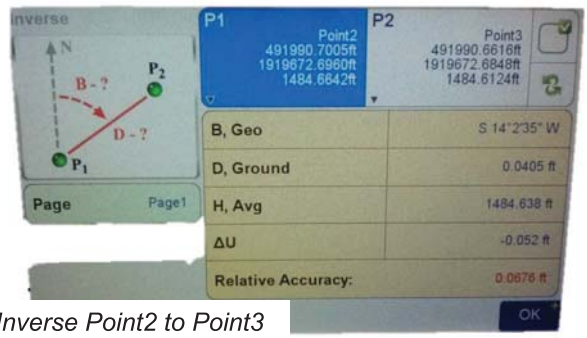


Inverse Point3 to Point4

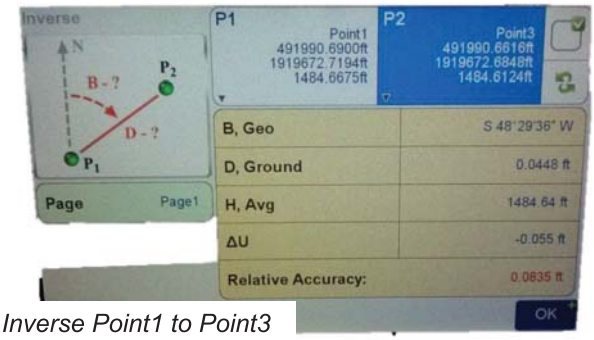
Day 1 Point observation inverses:



Inverse Point1 to Point2



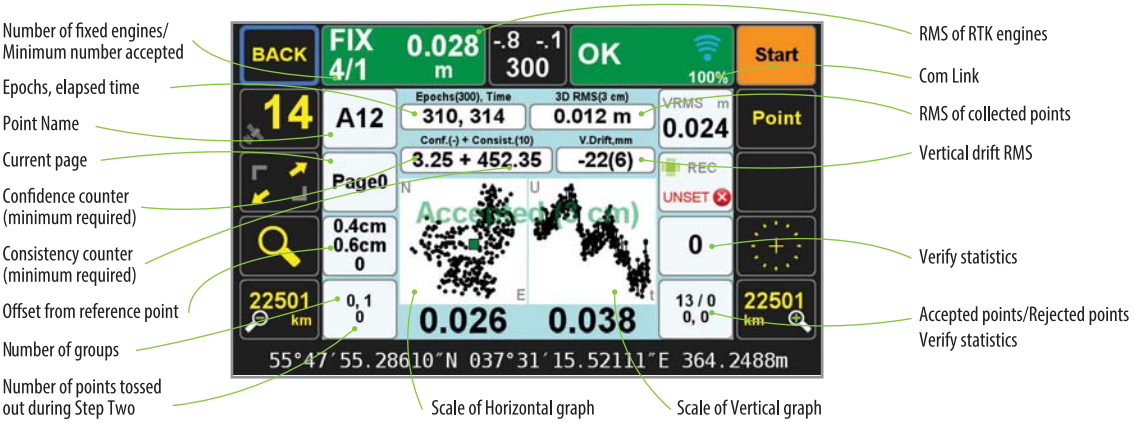
Inverse Point2 to Point3



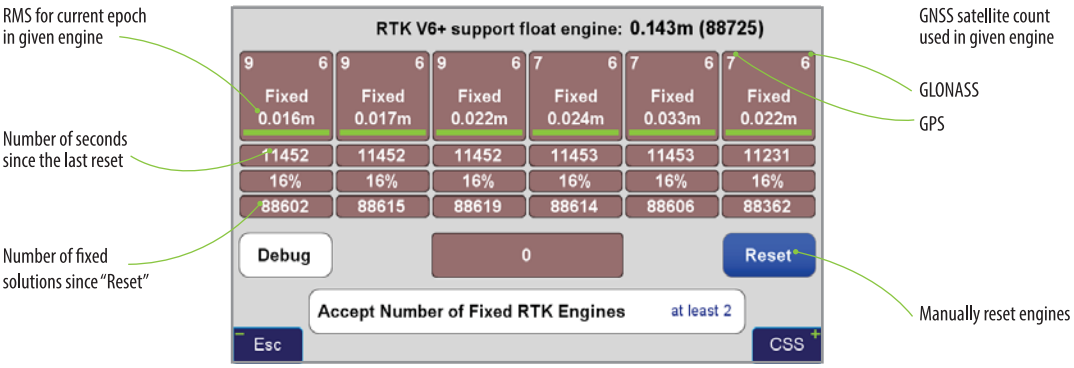
Inverse Point1 to Point3

I personally was impressed with the results considering the observations were in a house. I don't even know where to begin with the multipath issues with GNSS in a building. The location the LS observed these points was on a counter top about 12 ft. from south wall with a door window and a large picture window. The east wall has no windows(interior wall) so no satellite signals from that direction, the west wall was about 10ft. away with 2 windows (one 2½x5 ft. and one 2x2 ft.), and the north wall was about 12 ft. away with a small door window. I would provide pictures but my wife was not too keen on that idea! Anyway the room has no skylights and 8 ft. ceilings so as you can guess they was not much for clear signals and the LS warning light was on the entire time indicating severe interference in the GNSS signals. In my opinion this is an excellent example of the LS's ability to isolate interference and eliminate it from an observation. If it can produce repeatable results in a house then with proper RTK field procedures I can definitely feel confident in my results on projects particularly in the areas that have satellite signal interference from sources other than multipath. Another little detail is the fact that my corrections were from a VRS system that is provided by my Minnesota DOT and as many already know there is a big difference between a base on site and RTN/ VRS as far as speed and quality of fixed solutions. I won't get into details but suffice it to say that a base on

RTK V6+
six engines plus one support



Auto Verify... Auto Validate...



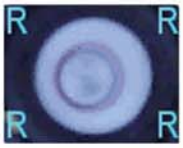
This vigorous, automated approach to verifying the fixed ambiguities determined by TRIUMPH-LS gives the user confidence in his results and saves considerable time compared to the methods required to obtain minimal confidence in the fixed ambiguity solutions of other RTK rovers and data collectors on the market today. The methods required by other systems are not nearly so automated, often requiring the user to manually reset the single engine of his rover, storing another point representing the original point and then manually comparing the two by inverse, all to achieve a single check on the accuracy of the fixed ambiguities. Acquiring more confidence requires manually storing and manually evaluating more points. Conversely, J-Field automatically performs this test, resetting the multiple engines, multiple times (as defined by the user), provides an instant graphic display of the test results, and produces one single point upon completion.

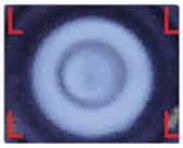
Read details inside and compare with other receivers that require Multiple Point survey, Manual Evaluation, Single Engine, and Single Ambiguity Check per Point.

With TRIUMPH-LS you need Single Point survey, Automated Evaluation, Multiple Engines, and Multiple Ambiguity Checks per Point.

Double Bubble

A 40 min vial for fast set up. Next to it is an 8 min vial for precision set up. All in a small package.





The vials can be viewed on the TRIUMPH-LS screen via the bottom camera.

Survey results can be documented with the on-screen image of the vial.

The internal electronic levels can be calibrated with the mounted vials.

Introducing

RAMS

Remote Assistance & Monitoring Services

JAVAD has gone and done it again! The brilliant minds at JAVAD GNSS have created yet another incredible first in surveying history: Remote Assistance & Monitoring Services (RAMS).

The RAMS Viewer is an elegant web interface. Using your own web browser, RAMS Viewer allows you to connect to your Triumph-LS from anywhere in the world when both your computer and Triumph-LS have access to the Internet.

RAMS is much more than just a remote data manager. Every function of J-Field that is available to the operator of the Triumph-LS that's in the field, is available to the remote viewer!

This incredible tool has many uses including facilitating live support by the PLS Support Team directly to Javad customers in the field, structural monitoring, training and other educational opportunities presented to large audiences in real time.

Using the Files tab, upload files to the Triumph-LS remotely from the office to the field... or right there on your desk in the office. Likewise you can download files wirelessly to the cloud or your own PC using RAMS Viewer.

Using the Status tab, quickly collect 18 screen shots in close succession showing your receiver's vital statics and bringing it all together at that very moment.

RAMS Server, the program running on the hosting computer, is at the heart of it all. This means you can set up RAMS Server locally on your own PC and keep it all in-house, or leverage the Internet using Javad's hosting server.

www.javad.com

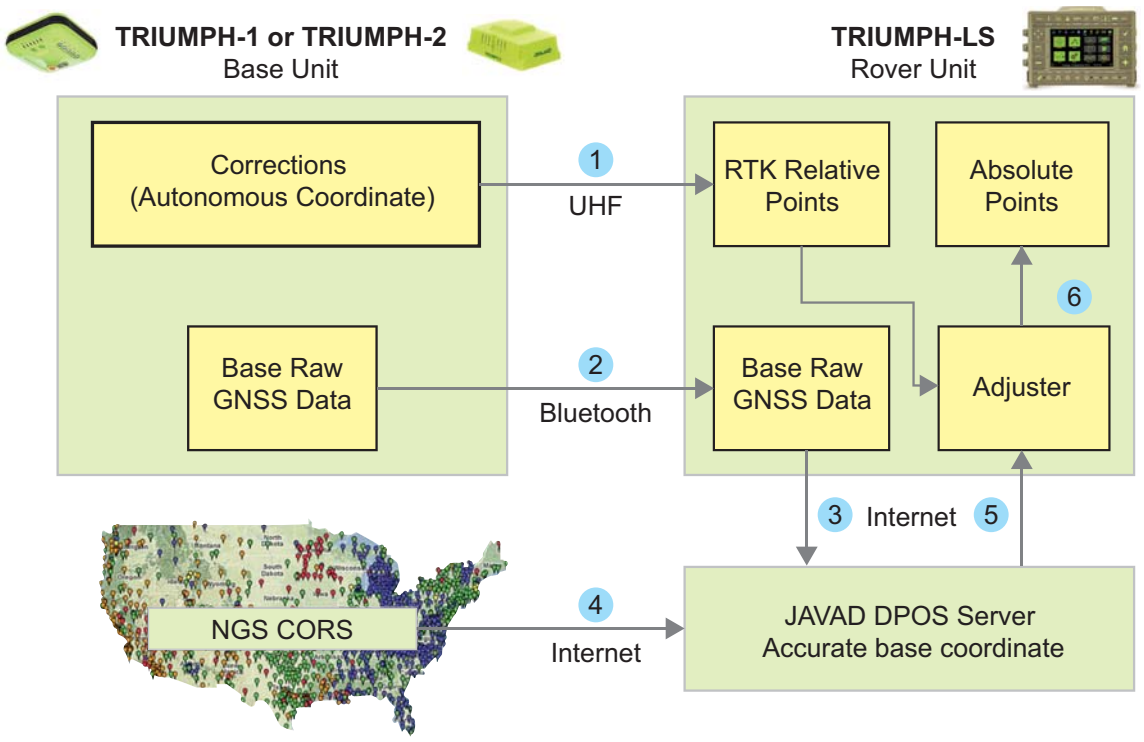
VB-RTK

Reliable, Fast, Accurate, Less Cost

Get on the Grid with VB-RTK. For over a decade American surveyors have been using the National Geodetic Survey's Online Positioning User Service. Surveyors employing RTK have been a significant share of the user segment of OPUS.

A significant share of OPUS users are surveyors using RTK. Often a surveyor will set up his base on a new, unknown position and allow an autonomous (or standalone) position to be used for the base coordinates. While he is performing his RTK work with fixed vectors between his base and rover, he stores data at the base to be submitted at a later time to OPUS. Once he is finished with his work, he downloads this file to his computer, converts the file if necessary, and submits it to OPUS. He then receives an email response back with a precisely determined coordinate for his base station. He then must take this coordinate, relate the coordinate to his project coordinate system, and then translate the work from the autonomous (or standalone) position he used in the field to this new coordinate. This procedure can produce excellent results and anchors the survey to the NSRS. The down side to this is that there are several steps that must be carefully observed and each of these error prone steps costs time.

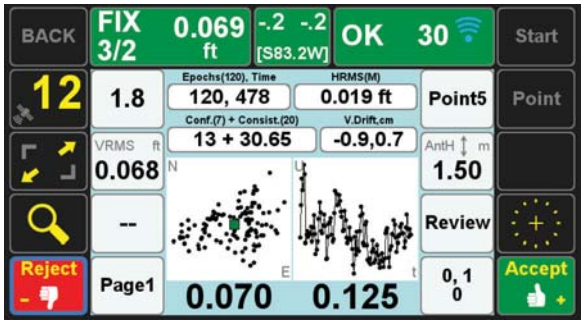
With J-Field data collection software, JAVAD has been automating many tasks that surveyors have been doing for years, making the tasks more efficient and reducing sources of potential error. One example, "**Verify RTK with V6 Resets**", is being recognized by surveyors across the country as the most accurate and efficient way to confidently determine RTK positions. Rather than taking a shot, manually resetting (or dumping) the receiver and taking a second shot for comparison, Verify RTK does this automatically with a user defined number of reset iterations.



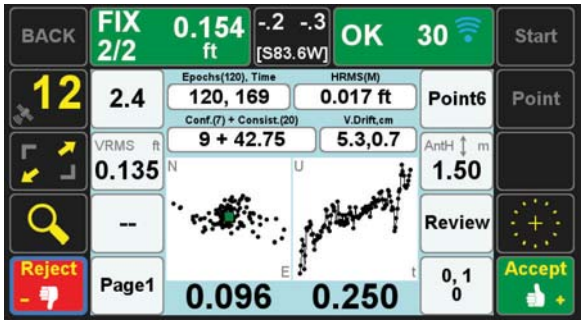
You do 1, the rest is automatic

Read more at **www.javad.com**

Day 2 Observation Results:

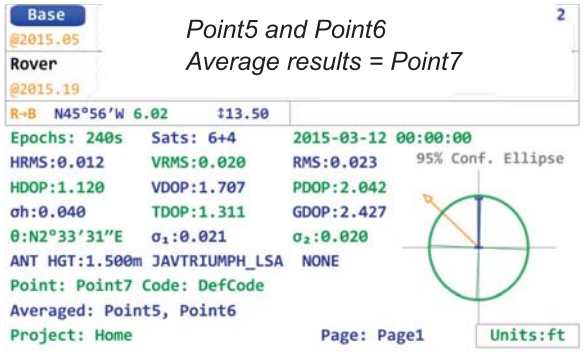


Results of Point5

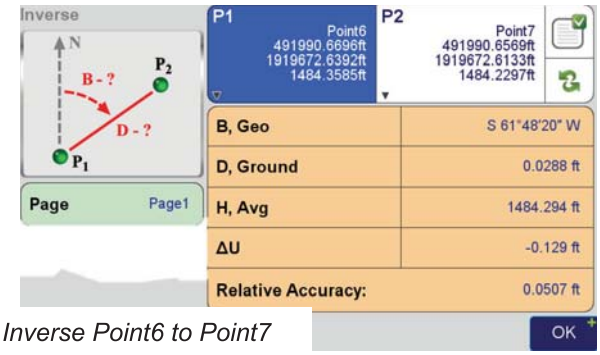


Results of Point6

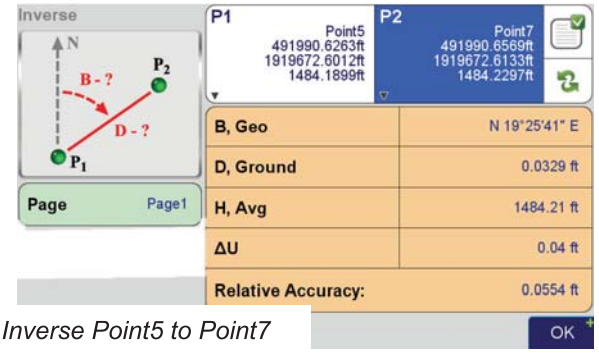
Day 2 Average Results and inverses:



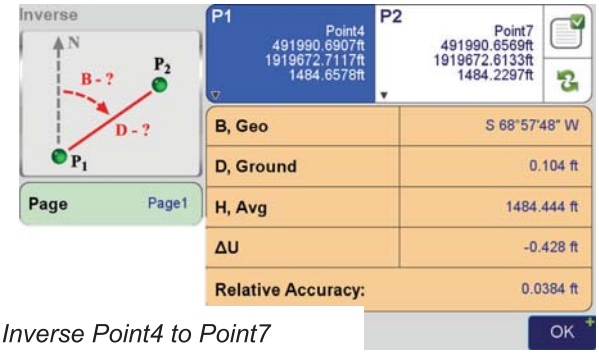
Point5 and Point6
Average results = Point7



Inverse Point6 to Point7

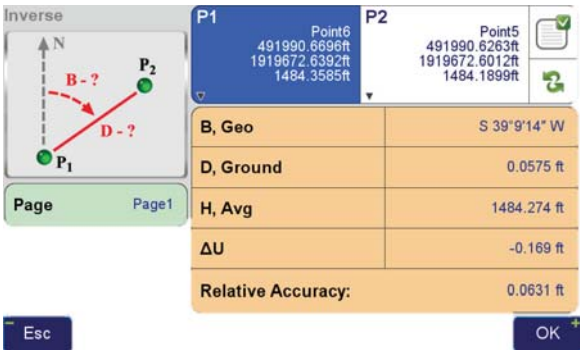


Inverse Point5 to Point7



Inverse Point4 to Point7
Day1 average to Day2 average

Day 2 Point observation inverse:



site would have been less surprising to me as far as fixed solutions with severe multipath and interference.

I would like to thank Minnesota DOT for providing such a robust VRS system for FREE!!! If your state provides a RTN/VRS system like Minnesota then make sure and thank your provider as you have it better than many states!!!

Well there you have an example of what JAVAD TRIUMPH-LS can do, but PLEASE DO NOT use this test as a reason to start pushing your RTK into buildings or ridiculously bad locations for GNSS, after all it is just another tool not the great black box that can measure anything in any environment-use your professional judgement!

BTW: All coordinates and projection info were eliminated from pictures to protect the innocent and remain anonymous!!

The one and the only Digital Radio Transceiver in the world!

Unique adaptive digital signal processing, which has benefits: the full UHF frequency range and all channel bandwidths worldwide • the best sensitivity, dynamic range, and the highest radio link data throughput • embedded interference scanner and analyzer • compatibility with another protocols

Cable free Bluetooth connectivity with GNSS receivers and Internet RTN/VRS access via embedded LAN, Wi-Fi, and 3.5G

And all this with competitive prices!

HPT435BT/HPT135BT/HPT225BT*

$2,710

35 W UHF/VHF Transceiver

HPT404BT/HPT104BT/HPT204BT*

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4 W UHF/VHF Transceiver

HPT401BT/HPT101BT/HPT201BT*

$2,040

1 W UHF/VHF with internal battery

L-Band/Beacon

$1,550

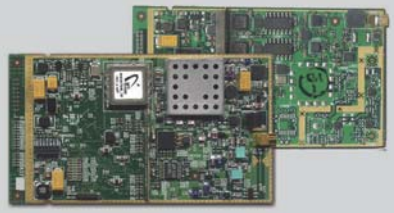
Receivers for multiple applications

ISM Radio

$840

CEPT 868-870 MHz, FHSS 902-928 MHz

OEM Solutions



$840

902-928, 360-470, 225-255, 138-174 MHz

JLink 3G*

$2,375

Web-interface Wi-Fi, Ethernet, 3.5 G, UHF/VHF/FH915

JLink 3G BAT*

$2,735

Web-interface Wi-Fi, Ethernet, 3.5 G, UHF/VHF/FH915, internal battery

*Power, data cables and antenna are included.

The GPS data campaign for the slip surface estimation

Ciloto Landslide Zone Case Study, West Java, Indonesia

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Geodetic Department, Technical Faculty, Winaya Mukti University, Bandung, Indonesia

Landslide is one of the mass movements at a slope that people known very well. According to Cruden and Varnes' definition (1992), landslide is a mass movement of soil down the slope toward slip surface or relative to intensive shear strain (Abramson et.al, 1996). Generally, landslide is a local failure which is caused by heavy losses in the economy, and even threatens human security. Thus, mitigation efforts should be made to minimize the risk of landslides. In order to minimize the probability of landslides hazard, it is very important to monitor a material stability of the slope. A common monitoring method done by physical method which it calculates the slope stability value or safety factor? The computation uses physical parameters such as slope geometry, resistance of the forming slope material, hydrogeology, soil-rock layers, weather, and geological structure. Physical parameters can give a realistic output to describe the landslide phenomenon, but it is also related with different kinds of materials and field morphology. Sophisticated and expensive tools are required.

Another alternative to monitor a slope material stability is carried out by a geometric method. It is simpler than the physical method. Early indication of landslide is the formation of cracks on the original ground surface that will become a main scarp of landslide zone. The shape of landslide zone scarp will give a clue about the shape of slip surface, eg., circular or planar. The kinds of landslides may be rotational, translational and compound.

In a landslide zone, the slip surface is a plane that divides a stable and unstable material in the slope. If we can estimate the slip surface location, we can determine the depth and border of the slip surface. This information leads to landslide mitigation. The purpose of this research is to estimate the slip surface location by GPS (Global Positioning Satellite) measurement campaign. The phenomenon of landslide can be identified by the displacement from the monitoring point. This method will be implemented in the landslide case where the soil movement has a slow velocity. The characteristic of landslides is defined by the displacement vector which is derived from the monitoring point in a landslide zone. The type of landslide will be defined by the kind of material forming the slope and soil movement mechanism. The slip surface denotes a border between unstable or moving soil and stable soil, as sliding plane. Location, shape and size of slip surface will be estimated using geometric

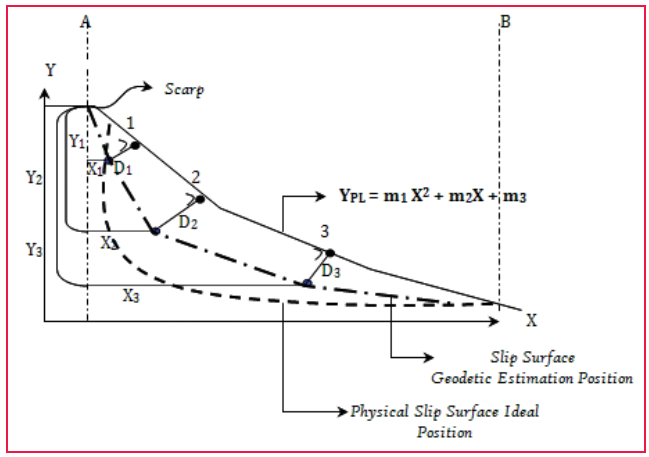

Figure 1: Idea of Estimation of Slip Surface Position (Sadarviana, 2006)

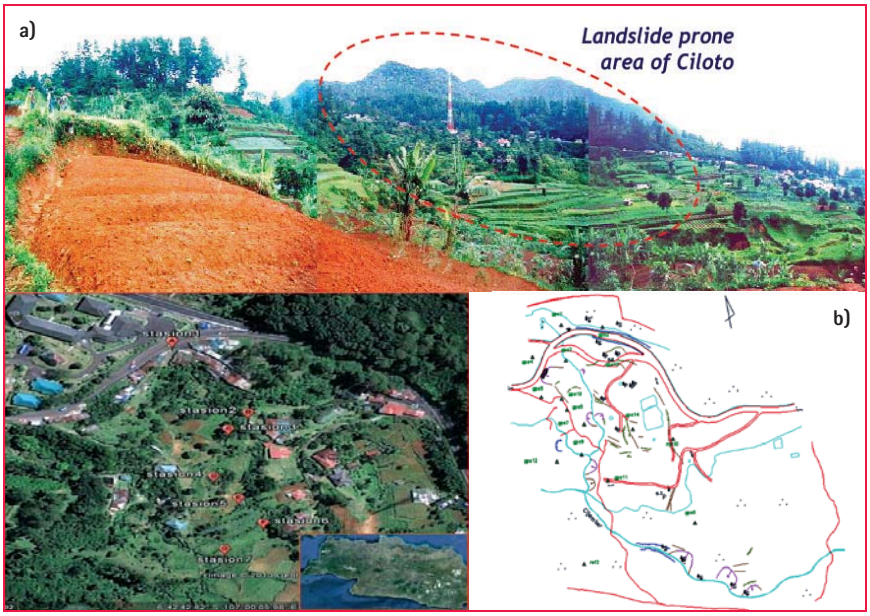

Figure 2: a) and b) Ciloto Landslide Zone (Nugraha, 2013), b) Monitoring points Distribution (Sadarviana, 2006)

method, as illustrated in figure 1.

The advantage of the information is to determine the procedure of technical engineering for mitigation that is very useful for an early warning system and evacuation of housing areas.

Characteristics of Ciloto landslide zone

The geographic position of the research location is 107˚00˙00˝-107˚00˙20˝E and 06˚42˙40˝- 06˚43˙00˝S at kilometer 88.1 Cianjur-Puncak, Kampung Baru Puncak, Desa Ciloto, Kecamatan Pacet, Kabupaten Cianjur West Java, see figure 2. Ciloto landslide zone is across approximately 40 hectares. The base rock of this area is a quarter of a material that has undergone weathering, which is volcanic tuff breccia's 3-7 meters depth. The physical property of the soil is loose and the roots are soft, unable to hold the soil together. However, weathering soil resistance to steep slopes when the conditions are dry is not an issue, but when in the presence of saturated water then the material easily collapses. A Geology research unearthed that the Ciloto landslide zone has a soil material category of debris type. Ciloto Peak Region has 5 landscapes units, namely:

1. Unit I that includes Gunung Lemo;
2. Unit II that includes Pondok Cikoneng, Gunung Mas, Gunung Gedogan, and Gunung Jongklok;
3. Unit III that includes Puncak, Jember and the surrounding areas;
4. Unit IV that includes Sindanglaya areas; and
5. Unit V is the slope of Cempaka hillsides, Tugu and its surrounding areas.

Rain water that is trapped in the region of Unit I will accumulate on the Cijember River, which then becomes ground water. Cijember local groundwater will flow through the narrow water bearing layers that causes increased pressure on local ground water (Purnomo, 1993).

The Ciloto area has a population density of ± 626 man/km^2 (based on population census in 2007). The primary jobs of people lie in the agricultural sector, accounting for 62.99% of the population. The Ciloto landslide zone includes a vegetation plantation and fish pond.

Table 1: Measurement Strategy

Measurement Method	Differential Static
Equipment Type	Dual frequency geodetic type
Data Type	P and C/A code, Carrier L1 and L2
Duration	4 - 6 hour
Campaign Interval	30"
Elevation Mask	15 ^{0}

Table 2: Equipment Type

Receiver	unit
Ashtech Z-XII3	3
Trimble 4000SSi	7
Leica SR9500	2
Leica SR520	2

Table 3: GPS Data Availability

Point Name	Campaign 1	Campaign 2	Campaign 3	Campaign 4	Campaign 5
POS G	✓	✓	✓	✓	✓
REF 2	✓	✓	✓	✓	✓
GPS 1	✓	✓	✓	✓	✓
GPS 2	✓	✓	✓	✓	✓
GPS 3	✓	✓	✓	✓	✓
GPS 4	✓	✓	✓	✓	✓
GPS 5	✓	✓	✓	✓	✓
GPS 6	✓	✓	✓	✓	✓
GPS 7	✓	✓	✓	✓	✓
GPS 8	✓	✓	✓	✓	✓
GPS 9	✓	✓	✓	✓	✓
GPS 10	✓	✓	✓	✓	✓
GPS 11	✓	✓	✓	✓	✓
GPS 12	✓	✓	-	-	-
GPS 13	✓	✓	-	-	-
GPS 14	✓	✓	-	-	-
M010	✓	✓	✓	✓	✓

Table 4: Model Mathematic of Geometric Method for Displacement

Model	Input	Output
Static	Coordinates of the monitoring points $(E, N, h)_{i-1}$ and $(E, N, h)_i$, i=1,2,3,4,5 (i: survey period)	Vector of displacement the monitoring points (scalar and direction)
Kinematic	Coordinates of the monitoring points $(E, N, h)_{i-1}$ and $(E, N, h)_i$, i=1,2,3,4,5 (i: survey period)	Prediction result: displacement position, velocity and acceleration to time

Such kinds of land use make the water pressure in the soil higher than usual.

Acquisition data

The data obtained from five campaigns by GPS measurement from 2002-2005 includes 15 monitoring points and 2 reference points. In table 1 we see the measurement strategy and data availability.

Mathematical model

This research has a GPS processing in scheme like in figure 3 and slip surface estimation scheme in figure 4. We can see the distribution of the monitoring points in Figure 2. By processing GPS data, we obtained the position of monitoring points at each campaign in UTM coordinates (E, N, h). Statuses of the displacement of a monitoring point are obtained by the geometric method which is divided in two kinds of mathematical model, namely static and kinematic model.

Equation of static model:

$$d_j = x_j^{(i)} - x_j^{(i-1)} \quad (1)$$

Equation of kinematic model:

$$X_j^{(i)} = X_j^{(i-1)} + (t_i - t_{i-1})V_{Xj} + \frac{1}{2}(t_i - t_{i-1})^2 a_{Xj} \quad (2)$$

Notation: d_j is displacement of the monitoring point, $X_{j(i)}$ is coordinates of the prediction of monitoring point j at campaign i, $X_{j(i-1)}$ is observation coordinates of the monitoring point j at campaign (i-1), V_{xj} is displacement velocity of monitoring point j, a_{xj} is displacement acceleration of monitoring point, t_i,t_{i-1} is measurement campaign at i and (i-1). Further, the next computation step can be seen below.

$$\overline{Y}_{i,1} = T_{i,(i-1)}\hat{Y}_{(i-1),1} \quad (3)$$

$$Q_{Yi,Yi} = T_{i,(i-1)}Q_{Y(i-1),Y(i-1)}T_{i,(i-1)}^T \quad (4)$$

$$\hat{L}_{i,1} = L_{i,1} + v_{Li,1} = A_{i,i}\hat{Y}_{i,1}$$
$$v_{Li,1} = A_{i,i}\hat{Y}_{i,1} - L_{i,1} \quad (5)$$

Notation: $\hat{Y}_{(i-1),1}$ is vector status matrix (position, velocity and acceleration) in campaign or epoch (i-1), $T_{i,(i-1)}$ is prediction matrix, $\overline{Y}_{i,1}$ is vector status prediction matrix in campaign i, $Q_{Y(i-1),Y(i-1)}$ is prediction vector status cofactor matrix in campaign (i-1), $Q_{Yi,Yi}$ is prediction vector status cofactor matrix in campaign i, $\hat{L}_{i,1}$ is GPS true (corrected) data matrix, which is the function of prediction vector status in campaign i as parameter.

Prediction vector status matrix in campaign i is by the Kalman Filtering Method. The step is illustrated below (Cross, 1983) :

- Value estimation $\hat{Y}_{i,1}$:
  $\hat{Y}_{i,1} = (A_{i,i}^T P_{i,i} A_{i,i})^{-1} A_{i,i}^T P_{i,i} L_{i,1}$ (6)
  $P_{i,i}$: weight matrix
- Cofactor matrix $\hat{Y}_{i,1}$:
  $Q_{\hat{Y}i,\hat{Y}i} = (A_{i,i}^T P_{i,i} A_{i,i})^{-1}$ (7)
- First vector status matrix:
  $\overline{Y}_{i,1} = T_{i,(i-1)}\hat{Y}_{(i-1),1}$ is equation number (3)
- Kalman gain matrix $K_{i,i}$
  $K_{i,i} = Q_{\hat{Y}i\hat{Y}i}A_{i,i}^T(P_{i,i}^{-1} + A_{i,i}Q_{\hat{Y}i\hat{Y}i}A_{i,i}^T)^{-1}$ (8)
- Prediction vector status $\overline{Y}'_{i,1}$
  estimation value $\hat{Y}_{i,1}$:
  $\overline{Y}'_{i,1} = \hat{Y}_{i,1} + K_{i,i}(L_{i,1} - A_{i,i}\hat{Y}_{i,1})$ (9)
  Cofactor matrix $\overline{Y}'_{i,1}$ is:
  $Q_{\overline{Y}'_i,\overline{Y}'_i} = (I_{i,i} - K_{i,i}A_{i,i})Q_{\hat{Y}i\hat{Y}i}$
- For iteration, assuming that (i=i+1) dan $\hat{Y}_{i,1} = \overline{Y}'_{i,1}$, so prediction vector status $\overline{Y}_{i,1}$:
  $\overline{Y}_{i,1} = T_{i,(i-1)}\hat{Y}_{(i-1),1} + N_{i,1}$ (10)
  $N_{i,1}$: *noise*
- Cofactor Matrix $\overline{Y}_{i,1}$:
  $Q_{\overline{Y}i,\overline{Y}i} = T_{i,(i-1)}Q_{Y(i-1),Y(i-1)}T_{(i-1),i}^T + Q_{NNi,i}$ (11)

For the smoothing, we used:

$$\overline{Y}_{(i-1),1} = \hat{Y}_{(i-1),1} - (A_{(i-1),(i-1)}^T P_{(i-1),(i-1)} A_{(i-1),(i-1)})^{-1} T_{i-1,i}^T A_{i,i}^T G_{i,1}$$
$$G_{i,1} = -(P_{i,i}^{-1} + A_{i,i}(A_{i,i}^T P_{i,i} A_{i,i})^{-1})(L_{i,1} - A_{i,i}\hat{Y}_{i,1}) \quad (12)$$

Slip surface estimation

The landslide zone has three characteristics of movement or displacement mechanism, namely the top, middle and toe of the landslide zone. The top of the landslide zone has indicates that the material displacement has a tendency to subsidence

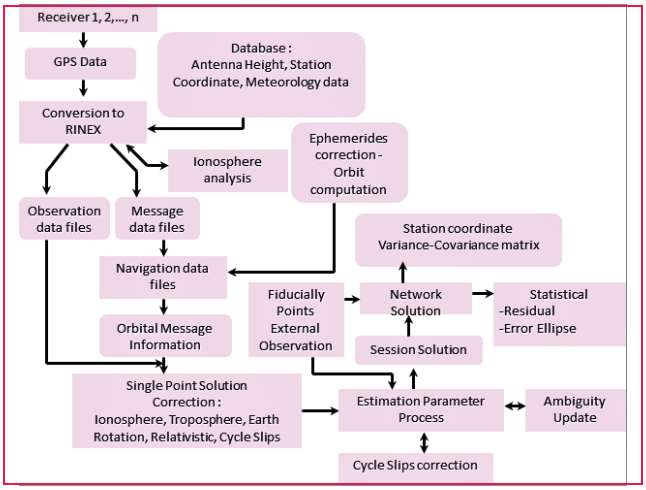

Figure 3: GPS Processing Scheme

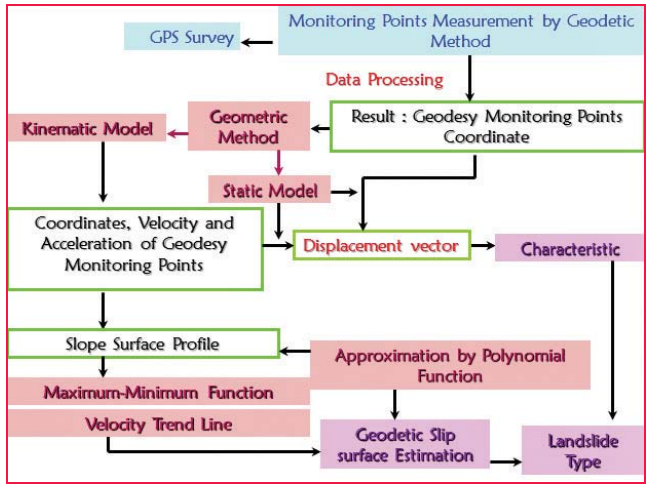

Figure 4: Idea Scheme of Slip Surface Estimation (Sadarviana, 2006)

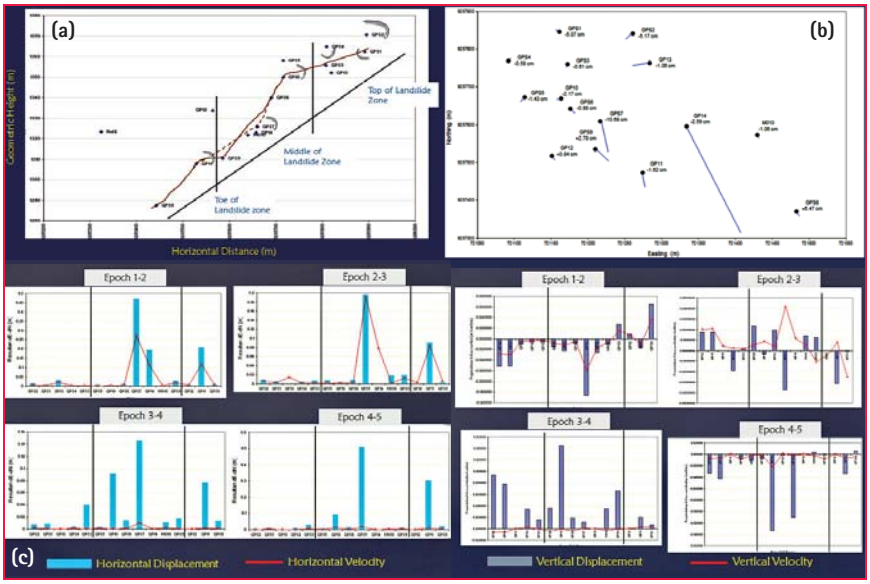

Figure 5: (a) Landslide Zone Dividing (b) Horizontal Displacement Vector (c) Vector Status of The Kinematic Model (Sadarviana, 2006)

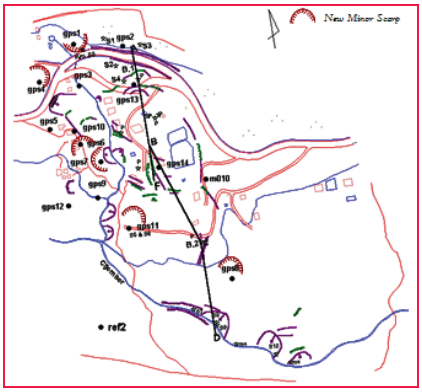

Figure 6: Interpretation of Minor Scarp Location (Sadarviana, 2006)

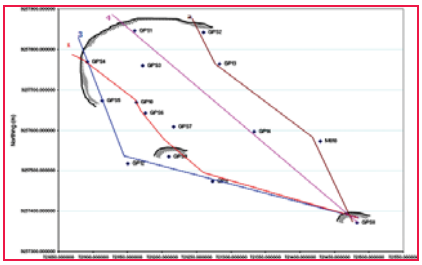

Figure 7: Cross Section Line Based on the Same Direction of Horizontal Displacement (Sadarviana, 2006)

(negative vertical displacement higher than horizontal displacement) or sinking or a crack. In the middle of the landslide zone, the material has a tendency to slide with the horizontal displacement being higher than the negative vertical displacement. The toe of landslide zone, i.e., the soil in the lowest of the slope (toe) has a tendency to accumulate and become a bulge due to positive vertical displacement which is higher than horizontal displacement.

The Ciloto landslide zone is a major landslide hazard zone. There are several minor-zones in a major-zone. Each zone has the same indication of characteristics. A crack usually indicates the top of the landslide zone defined as minor scarp, whether a major or minor zone. If we interpret the vertical displacement of each monitoring point, we will find several minor scarp locations - this can be seen in Figure 6. The field check is needed to get the truth of that interpretation. The facts give a clue that the number of a scarp is the same as the number of slip surfaces. The conclusion supports another assumption that one slip surface effect to similar direction of the monitoring point displacement. As the Ciloto landslide zone has several displacement directions, hence this zone has more than one slip surface.

In figure 7, the cross section line is made by the similarity direction identification of horizontal displacement. We have four cross section lines.

By the result of a kinematic model, we can make a displacement Velocity Trend Line (VTL) for each monitoring point of a cross section line. We assume that all material has the same velocity on the same plane of slip surface. So we need an intersection of VTL. The illustration of a slip surface formation can be seen in the figure 8.

As can be seen in the graphic, the depth of slip surface is around 5 metres until 60 metres. If we integrated the slip surface estimation from 4 cross section lines, we will get the geodetic estimation of a slip surface. For the validation, the geodetic method to geometric estimation of slip

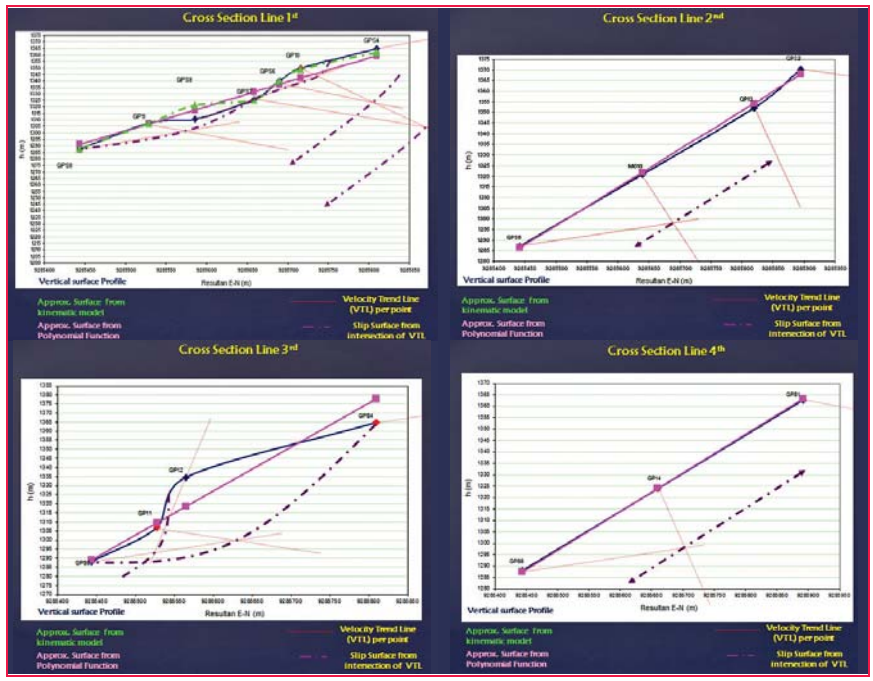

Figure 8: The illustration of Slip Surface Formation by VTL Intersection

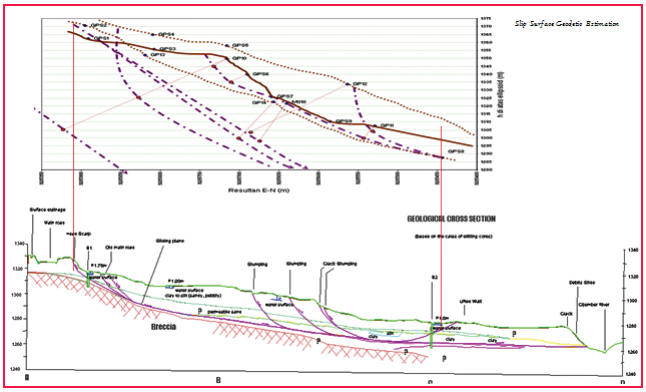

Figure 9: Comparison of Slip Surface from Geology and Geodetic Method (Sadarviana, 2006 and Sugalang, 1989)

surface will be compared to the slip surface from geology method to physical approach in Ciloto landslide zone. The illustration can be seen in figure 9.

Discussion

The mechanism of Ciloto soil movement is rotational and translation or compound type because the landslide zone has two kinds of slip surface, namely circular and planar. Each of the monitoring points could have a different direction of displacement in every campaign. It means that one monitoring point can be on more than one slip surface. In the left side of the zone, there is a scarp that is curved and its topography profile is hilly. It is the indication of a rotational slip surface. In the right side of the zone, we did not find a scarp and topography profile that was smooth, i.e., indication of translational slip surface.

From the perspective of a geology investigation, we know that the material of slope was of debris type. Accordingly, the Ciloto landslide zone map and minor scarp location in Sugalang's research report in 1989 plotted minor scarp interpretation on the same map. The all scarp plotting almost had the same location and there were new scarp developing (retrogressive landslide). See illustration in Figure 6. Soil movement velocity is 5 x 10-5 to 5 x 10-7 mm/second (very slow). Validation is done by comparison of the geodetic slip surface (result of geodetic method estimation) and slip surface used in geology research done by Sugalang (1989) in the same location.

Conclusion

By geodetic data, soil movement can be quantified and identified as new phenomenon in landslide zones like new scarps or cracks and known displacement vector and velocity of soil.

Characteristics of Ciloto landslide zone are included in a very slow category of 5 x 10^{-5} – 5 x 10^{-7} mm/second and various directions of movement.

The geometric method can be used to a location and shape of slip surface estimation by intersection of Velocity Trend Line (VTL) of each monitoring point. Slip surface by geodetic and physical method gives a good conformity. The type of landslide zone is multiple compound (rotational and translational) debris slides.

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Defining National GIS Standards

National Institute of Advanced Studies (NIAS), Bangalore has undertaken a sponsored techno-consulting project for Department of Science and Technology (DST) to define National GIS Standards, an authoritative National Spatial Framework and critical GI technologies that will be useful and relevant, in the long run, for National GIS. We reproduce the summary of the report

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Standards are fundamental requirement for any GIS to enable technologies – imaging, GIS, GPS and applications – thematic mapping, services and outputs etc to work together. Standards are important not only to facilitate data sharing and increase interoperability but also to bring a systematization and "automation" into the total process of mapping and GIS.

From a national perspective, National GIS must bring vast benefits to governance and also to the stakeholders (ministries/policy-makers/decision-makers/citizens) by bringing about the geographical depiction of the aspirations and needs of the people, analytics of the state of national resources and economy, disparity (gaps/needs) in current state of development and bring forth decision-options that can be the basis of a "inclusive and scientific governance" – a unique Decision Support System (DSS) powered by upto-date image and map information with geo-tagged tables and developmental data.

National GIS implementation will fundamentally require:

- National GIS Standards – a suite of technical standards and protocols for National GIS that will allow easy GIS Asset organisation/maintenance, GIS services of Data and Applications on a standards-based GIS Portal
- An authoritative National Spatial Framework (NSF) as a nation-wide, uniform GIS template.
- Capability in important GI technologies that the nation would have to develop/acquire, in the long run, for National GIS.

Indian standards definition efforts have centered more around data generation (images/maps etc) and less on data services and applications

Globally, GI has emerged as a key determinant in shaping contemporary societies and supremacy of nations and has emerged as vital differentiators for DSS in diverse spheres such as governance, business endeavors and citizen centric activities. There is hardly any nation in the world that does not rely on GI for its planning, development and defence/security needs.

In today's transforming world, nations that possess an advanced and progressive system of GIS would lead and chart ways in their own national and in the international arena far ahead of those that would use more traditional forms of information management. GIS technology is gaining critical importance in the international and multilateral frameworks – like, addressing cross-cutting issues of environment, rivers/drainage systems, borders, climate change and even in homeland security cooperation and in defence (particularly as defence equipment and systems are based on geospatial technology usage).

International scenario

A detailed view of GIS standardisation environment in the world has been studied. GIS Standardisation started in late 1980s when the earliest concept of a Spatial Data Infrastructure (SDI) was proposed in USA.

US has undertaken tremendous leading work on GIS standardisation and we feel that US looks at standardisation

from a stand-point of a nation that already had well-organized, multi-source digital map data, images and geo-tagged data available. Federal Geographic Data Committee (FGDC) is the key US interagency committee that promotes the coordinated development, use, sharing, and dissemination of geospatial data. The recent focus of FGDC has been on standardisation related to GIS applications and services - both, data and applications services and exchange of GIS data across "systems". The USGS National Map is a national service from USGS that fully adopts and conforms to FGDC standards and is a visible example of use of GIS Standards.

- Europe-INSPIRE has excellent standards that define Metadata, Data Specifications, Network services, Data and Service sharing and Coordination and measures for monitoring & reporting. INSPIRE has focus is on Content Standardisation in a considerable way. Thus, INSPIRE defines what content should be included and what schema details are essential for each data element – these are well defined in INSPIRE.
- OGC standards are immensely popular and adopted by government and industry and bring about a high-level of focus on inter-operability and open-ness – though open standards are a different regime from OGC standards. OGC standards have been defined to systematize metadata, map services and web-services and host of applications services. Driven by the advanced GI eco-system in US and the intensive involvement of private sector, OGC standards are de-facto services and applications standardisation across government and industry and has brought the focus of inter-operability across GIS environment. OGC standards have been adopted by many nations and commercial data providers as part of their Spatial Data Infrastructures, and offer an effective mechanism for sharing geospatial information
- ISO/TC 211 is a standard technical committee formed within ISO, tasked with covering the areas of digital geographic information (such as used by geographic information systems) and geomatics. The work within ISO/TC211 is done in working groups, each with a specific focus. ISO standards are more driven by government agencies and are an effort to bring about a slow-process of standards definition for imagery, geo-spatial services, quality and information management.
- China claims that they have made efforts in GIS standardisation but we have not been able to access, in spite of repeated contacts with SBSM and NASG and other agencies, the "standards documents" to be able to make a judgment on these. However, it appears from initial web-analysis of China-NASG, that they are progressing on a definitive path towards a nation-wide GIS and map data availability and services.

> Content is what "makes or breaks" a GIS Portal and thus the GIS Portal must have high-quality, verified and scrutinized and upto-date GIS Content

GIS Standardisation is viewed differently in different nations. This difference is emanating because the development of maturity of a GIS in nation is different. US has a long heritage of digital map data available from 1970s (Digital USGS maps and TIGER data and Street-Address data) and thus they have evolved much earlier on nation-wide content and updation. Thus, US focus is on data exchange/access and services. Europe has varying levels of maturity on Europe-wide GI content – and thus they also address GI content definition along-with access/exchange, services.

The following key parameters are identified for standards development:

- Content Standards – standards that define GIS content.
- Metadata Standards – that define the details of Metadata – data about GIS content.
- Schema/Data Dictionary/Data Models – defining the data dictionary and schema for each of the Content in the GIS.
- Spatial Framework – defining the geographical-envelope of the national frame based on precise boundaries and also including the internal spatial relationships of reference points that "pin" the data to precise locations on Earth in relative to the spatial frame of the boundary.
- Quality – defining quality parameters and value-limits for GIS content.
- Image – defining what images (and their parameters) form a part of the National GIS.
- GIS Services – defining standards for GIS data and application services on web platform.
- Mobile GIS Services - defining standards for GIS data and application services on mobile platform.
- Portal Standards – defining the standards for Portals and their Security
- Interoperability – defining the standards for inter-operability related to data and services.

Indian perspective

In India, GIS Standardisation efforts have been on-going from 1990s and these include:

- NNRMS, an inter-agency programme of the Department of Space (DOS), has published NNRMS Standards in 2005. NNRMS standards are quite comprehensive and cover the gamut of basic GIS elements - Image Standards, Thematic Mapping Standards, GIS Database Standards, Output Standards, Thematic Accuracy Standards. NNRMS Standards also has proposed a spatial framework.
- India's National Spatial Data Infrastructure (NSDI) was defined in 2001 and the first major effort was made in defining common conventions and standards. NSDI Standards are limited to Metadata definition and SOI data exchange. Similarly, the NSDI Exchange

Standards – which were extremely narrow-spectrum applicability for SOI DVD data have out-lived their relevance in present time-frame and we do not see any practical cases of NSDI Exchange Standard being practically applied anymore.

- Ministry of Urban Development (MUD) initiated the National Urban Information Systems programme in 2004 and in 2006 adapted, from NNRMS Standards, a set of customized NUIS Standards pertain to urban development – urban planning. The NUIS Standards have been applied for NUIS project 153 town and have some validity and robustness.
- NIC has also built upon the initial standard used for 2004 National GIS Pilot which was based on NNRMS Standard. NIC seems to have made their own variations and defined and adopted their own internal standards for their GIS Portal quite successfully. This shows that users do have customizing capabilities when they use commercial COTS GIS engines and can undertake a level of standards activity based on what the software provides.
- Karnataka state defined its Karnataka-GIS (K-GIS) vision in 2013. To demonstrate the K-GIS seamless and applications concept, Karnataka defined its own proto-type K-GIS standard as a logical extension to its own RS and GIS activity bust basing much of its definitions based on NNRMS Standards – thus its learnings also will be important when National GSI Standards is defined.

Indian standards definition efforts have centered more around data generation (images/maps etc) and less on data services and applications. This, is because in Indian image and GIS data availability and accessibility has major gaps and not easily available for users – thus efforts are being repeated for organizing GIS data.

There is no standard spatial framework on which maps/GIS is generated – data foundations are not uniform and in-compatible bringing data mis-match prominently.

> Unless care is taken to define quality standards, measure quality of data and ingest only data of highest quality, National GIS will fail in its objective to be that one-source authoritative data

Good definitions/description are lacking in India but they are a must for GIS Standards – as it brings extremely good and uniform understanding of the standards (we have seen that in Indian standards even a common feature "Landuse" is defined differently in different GIS and thus bring different understanding).

Analysis of GIS portals

National GIS Portal is envisaged as a national gateway for accessing all GIS services – GIS data, GIS applications and GIS Metadata. It is through the National GIS Portal that users will make smarter governance decisions, develop relationships and increase citizen engagement. As a part of looking at National GIS Service Standards, various GIS portals of the world were evaluated and assessed – to determine a "bar" that needs to be set for functionality, excellence and quality for National GIS Portal. Below is a summary of the evaluations:

- The NATIONAL MAP 2.0 Portal of United States Geological Survey (USGS) provides a "window" to US spatial data along with satellite images and has robust capabilities of GIS services – viewing and querying. USGS National Map doesn't really offer specific GIS applications – especially as it is mainly a map viewer. The most important aspect of the USGS Portal is the rich data content for the whole of US. The Portal facilitates building queries among spatial data as well as attributes data.
- Google Earth is the most widely used image and map Portal to view earth's surface and other planet's data. Google offers 1m images all over India and even 0.30m images in certain areas. Apart from images, GoogleEarth offers basic layers of road, railines and large volume of POI data. Ease of use is the strongest point of GoogleEarth as even common citizen and government agencies depend upon Google Earth. Design is very robust and the Portal is high-performing.
- Bhuvan is a "portal" of National Remote Sensing Centre (NRSC) for displaying IRS images and thematic maps – providing a "window" into the spatial data holdings of NRSC and NNRMS projects. Bhuvan has "lots of data" – mainly coming from NNRMS project outputs from 2002 onwards – this makes it more a "GIS data-bank" or a digital map REPOSITORY of NNRMS projects. Bhuvan services are just visualization tools and Bhuvan does not have integrative/applications and decision-support capability – even basic GIS querying capability is lacking. Design of Bhuvan and its user-interface needs considerable improvements – as it is too "complex" and not uniform functionally – thus making it very difficult for users to understand and use the Portal for regular decisions. Reliability of the content and displays has major gaps – performance is quite slow and also non-uniform across modules.
- India-NSDI Portal is supposed to facilitate search on India's map/image metadata holdings – one of the earliest portals aiming to provide spatial information metadata services. A basic India administrative hierarchy is encapsulated in the Portal – but there is hardly any Metadata populated – though the schema and structure of NSDI Metadata Standards has been encapsulated. NSDI portal does not have any GIS applications and integrative capabilities. Performance is very slow and reliability of data is a major gap.

- MapmyIndia Portal is first private map Portal in India - through which it provides "visual window" of nation-wide basic map data holdings and large amount of POI data that are constantly updated. Location-based address geo-coding has been successfully provided in many cities in the Portal. The Portal offers specialised location/navigation services and also commercial services. MapmyIndia has good basic GIS data that is well-updated BUT does not offer any GIS applications/integrative capabilities.
- G2G GIS Portal has been developed by Karnataka State Remote Sensing Application Centre (KSRSAC) through which it provides access to its large state-wide image/map data access with tools for "displays and basic queries". The Portal has 51+ 1:50k content AND alls of these are seamless to the state of Karnataka – BUT are of different time-lines (coming from different RS and GIS projects of KSRSAC). G2G Portal does not have applications/integrative decision-support capabilities.
- Surveykshan is a Geoportal of, Survey of India which is responsible for all geodetic, geophysical and topographical surveys and maps within India. Surveykshan displays Survey of India's Digital OSM maps in WMS format, which is at present available for 22 states of India. The Portal is quite poor in performance and reliability and continuity of data – which are not GIS_Ready. GIS Applications for decision-support is not available.
- NICMAPS is a "portal" of National Information Centre (NIC) through which it provides "visual display" of GIS data from NIC and map data from Survey of India (SOI) and other agencies alongwith non-spatial data holding of NIC. NICMAPS provides a "window" to full-coverage Indian spatial data along with satellite images. NICMAPS does not support any application on the portal but has advance services like Locators, Swipe & Spotlight, Elevation profile and so on. The portal is quite stable and data available on it is quite robust.

Perspectives for national GIS portal

some of the observations from analysis of the GIS Portals, in the context of National GIS, include:

- **Content** is what "makes or breaks" a GIS Portal and thus the GIS Portal must have high-quality, verified and scrutinized and upto-date GIS Content – and the mantra needs to be "keep Content that is GIS-ready, uniform, good quality, current, seamless and standardized". In the Indian context, we observe that none of the GIS Portals have content that conforms to what should be in National GIS. In our analysis, National GIS cannot be a "collection of whatever map/ image data is available" – a systematic GIS Asset needs to be designed with layer/image definitions, feature definitions, schema definitions – which are seamless across the nation uniformly, standardized as per a National GIS Standard and constantly updated as per an update cycle.
- **Metadata** is an important element of any Portal – that helps understand the data about the data. In our analysis, Metadata is poor across all GIS Portals that we have studied and analysed except the USGS National Map Portal that contains Layer Metadata as per FGDC Standards. In our assessment, National GIS must organise Metadata systematically – in fact, it can be the easiest to organise and systematically populate at the first step – thereby allowing users to immediately know what data is available in National GIS and allow for efficient search.
- **Data Dictionary**: A data dictionary is a collection of descriptions of the GIS feature objects or items in a GIS data model for the benefit of users, application developers and others who need to refer to them – basically, identifying each GIS feature and its relationship to other objects. Efforts at making a good data dictionary is yet to be put and visible in the Indian Portals. National GIS needs a well-designed Data Dictionary that will be the foundation of all data development, exchange and integrated analysis.
- **Quality of GIS content** is extremely important for a GIS Portal to be authoritative and useful for applications. There are typically three types of consistency that is important for GIS portals - point in time consistency, ensuring that all GIS content and its data model are uniform at a specific point in time; transaction consistency, consistency of a piece of GIS content across a GIS Portal operation and application consistency, transaction consistency between various GIS Applications and processes across the Portals. The importance of ensuring data consistency is to maintain the integrity of the GIS content available on the Portal. This is lacking in most Indian GIS Portals. Unless care is taken to define quality standards, measure quality of data and ingest only data of highest quality, National GIS will fail in its objective to be that one-source authoritative data.
- **Image inclusion** is important for GIS portals – not just satellite images, aerial images or UAS images BUT any image that can be geo-tagged has to be an important element of the National GIS content. From a satellite image perspective, GoogleEarth is best as it provides highest resolution image across the country; Bhuvan has reliable IRS image inclusion BUT they are mostly of resolutions around 2.5m and coarser. In both these portals, latest images are not available and mostly ~5+ years old images are seen. Fusion of images over maps is critical and important – only google Earth allows

National GIS services – both, GIS Data Services that allow access and download of GIS-Ready data and GIS Application services for different users

The National Spatial Framework (NSF) is a critical and essential element to develop an authoritative and reliable National GIS Asset. Without a NSF, in-consistency in GIS data will be very high

for this in a limited content. Bhuvan does not have this fusion capability that is extremely important for decision-making. Images – be they from satellites/air-platforms/ground, are the fundamentals of National GIS Portal. Robust image management techniques and fusion techniques are important. Worldover satellite images are reaching sub-metre levels operationally and with global coverage – why is it that Indian IRS systems, even today, are still "struggling" at metre-level resolutions for operational availability? In late 1990s, India was the world's leading country with highest resolution civilian satellite of 5.8m PAN – but in 2015, India seems to have trailed behind in the world as far as state-of-art in high-resolution image operational availability is concerned. Should governance or Decision Support in India suffer because of the non-availability of high-quality/ resolution satellite images – which, today is anyway available all over the world from non-Indian commercial satellites? In fact, National GIS must demand for high quality and high-resolution images and drive ISRO to plan and provide best quality/resolution satellite images in an operational manner – comparable, if not superior, to what is available in the world?

- **GIS Services** is the heart of any GIS portal. The more services that are offered the better characterized is the GIS portal. GIS services should include GIS Data Services (that is 2-way on-line GIS data service - access to actual GIS-Ready data and ability to upload GIS-ready data to Portal) and GIS Applications Services (that is providing variety of GIS applications and modelling capability of display, query, integrative modelling, geo-correlation analysis, geo-analytics, routing applications, predictive applications, simulative applications etc; allowing variety of GIS Apps to be publishable). Just data visualization and display cannot make a good GIS Portal. In our assessment, we hardly see Decision Support capabilities of any of these Indian GIS portals. National GIS must have well-designed and robust National GIS services – both, GIS Data Services that allow access and download of GIS-Ready data and GIS Application services for different users (agriculture/urban/rural/governance/ citizens……) which needs to be a set of decision-tools packaged into a GIS Application Decision Support module.
- **Mobile GIS Services** are basically the availability of mobile apps for GIS Portals by way of which GIS data and Apps can be easily accessed on mobile and hand-held devices. GoogleEarth, MapmyIndia have excellent mobile services capability – these are quite robust and widely used. Other Indian Portals "claim" mobile-services but there are basically low-performing data visualization**.**
- **Interoperability** is related to producing GIS portal results in standard compatible web browsers, GIS engines, operating systems and devices and are based on the latest web standards. In the GIS domain, OGC has defined a set of inter-operability GIS Apps standards that must forma base for all Portal interoperability. Most of the Indian Portals are poor in inter-operability and need robust standards adoption**.**

National GIS standards

National GIS will require a quantum jump from the existing philosophies, approaches and design, content and technologies, development and operations that have been adopted in India – leading ahead quickly into an operational GIS Decision Support capability in next 2-3 years BUT also excelling the national capability in GIS activities for next 10-15 years, at the least. In our view, fresh and new efforts to organize National GIS Asset/Application Services/Portal will be is best step forward.

NIAS has identified the following categories of Standards for National GIS:

- National GIS Content Standard – which basically includes what content needs to be included in National GIS.
- National GIS Database Standard (including Quality) – which defines the details of GIS database related standards for the National GIS and includes data quality parameters
- National GIS Services Standard – basically outlining Data, Applications and Portal services.

The National GIS Content Standards needs to include ~84 features, including 43 essential and 41 additional content for National-GIS – grouped into 17 categories. It would be important to have a National GIS Content Thesaurus – that defines the class-categories and enables a common understanding and also links the categories to the purpose and use of the classification system. Naming Convention for National GIS content so that the name is easily understandable typology. Coding schemes for National GIS content must follow the source coding schemes.

28 parameters of a National GIS Database Standard and their values have been identified for a systematic GIS database to be organised to power National GIS.

As part of the National GIS Services Standard, details of National GIS Metadata Standards, National GIS Portal standards, National GIS catalog standard, National GIS map services standard, National GIS map tiling services standard, National GIS feature services standard, National GIS portal encoding standard, National GIS exchange standard, National GIS web coverage services standard, Georss simple standard, National GIS sms ingest standard and National GIS Applications standard have been provided.

National Spatial Framework

The National Spatial Framework (NSF) is a critical and essential element to develop an authoritative and reliable National GIS Asset. Without a NSF, in-consistency in GIS data will be very high. In our study of GIS data of different Indian Portals (as well as foreign) we have seen the in-consistency in data in large measures - for example, Bhuvan administrative boundaries do not match with Surveykshan administrative boundaries; Bhuvan's 1:50k wasteland do not match with 1:10k landuse; NICGIS has its own roads that do not match with Bhuvan roads; MapmyIndia points-of-interest data do not match with Bhuvan points; …..and so on are many examples.

In National GIS, content will come from any of these 4 basic sources – each having its own referencing systems:

- satellite image – the satellite image is on a "pixel-frame" with a Earth-reference coordinate system super-imposed.
- Topographic frame – defined by geographic frame of SOI OSM maps – thus derivative maps using the OSM frame carry-forward the geographic referencing.
- Administrative frame - villages/taluk/district/state/nation on which all administrative data and governance are associated. This does not have an inherent geographic referencing.
- Ground surveys (using instrument like GPS/TS and Smartphones etc) – by which lat-long coordinates of the instrument positioning devices (commonly using positioning satellites – GPS, Glonass or in future IRNSS) providing geo-referencing.

The 84 features of National GIS Content that have been identified are based on one of the above four basic frames – thus they carry the characteristic of the basic frame in the GIS. The issue is to cross-correlate and geo-reference these 4 basic frames – so that across the 84 features a common geo-referencing is achieved – allowing easy super-position/overlay and integrated analysis. This will, more importantly, also ensure ground-match of features – so that location, distances, area etc are well maintained.

The key is to develop a NSF where a "one-time effort" is made to standardize the reference of satellite-image based coordinates; SOI OSM based coordinates and GPS/TS based coordinates. For this one time exercise, it would be essential to use a SOI topographic map's geographic frame for precise national boundary (this is presently available on 1:50k); the best-accurate Indian administrative boundary frame (state/district/taluk boundaries – this is available in 1:50k SOI OSM maps); the best-resolution satellite-image for India (which is corrected using GCPs – would be good to use ~1m images as they are available) and "fuse-integrate" these 3 together to create the basic foundation frame – so that this foundation can easily assimilate the features coming out from satellite images or features of SOI OSMs and the administrative frame. It would be essential to use a set of Ground Control Points (precision measured coordinates in this frame) that can be super-imposed on the precision Indian boundary layer and create cross-referencing to satellite images and for local referencing – thus also ensuring in the GIS that a "tight pinning-down" of the frame to Indian land-mass. Integrating village boundaries will be easy into the taluk boundaries (of the administrative boundary frame) and thus creating a seamless village layer for the country. When any local survey is done, the GCP frame will provide a cross-referencing to the survey points to the NSF – thus the data will "sit properly".

NSF must become the basic geo-referencing frame for any GIS data ingest into National GIS BUT more importantly ensure that all GIS data are co-registered. NSF must be a basic freely-available product form national GIS.

NSF can also be the foundation of a very quickly organised National Spatial Foundation Dataset (NSFD) – a minimalistic template product from national GIS.

The National GIS Standards needs to be compliant with international ISO TC211 processes – especially as India is already committed to ISO standardisation efforts through the Bureau of Indian Standards

Way-forward for National GIS

The National GIS Standards needs to be compliant with international ISO TC211 processes – especially as India is already committed to ISO standardisation efforts through the Bureau of Indian Standards (ISO is a multi-lateral body for standardisation and India is represented by BIS). A Expert Standing Committee can be tasked to help National-GIS to review, update the National GIS Standards from time-to-time.

A concerted effort needs to be taken to make aware, promote, encourage and generate/organise these GIS Standards, NSF and GIS Process documents and also encourage for using these to be able to integrate into the common platform of the National GIS. All government/enterprise and other private agencies would comply with these standards and NSF so that practices within their own processes will be able to contribute to and benefit from National GIS.

National GIS implementation will require India to acquire technological capability in key areas of geo-spatial technology –a suite of technologies have been identified for India. National GIS must also assess futuristic applications that would be "demanded" from the nation and also develop the broader GI eco-system in India in next 10-15 years.

The full report, is available on http://nias.res.in/docs/R30-2015.pdf

"An available National GIS could have easily been the corner-stone for Digital India"

says Mukund Kadursrinivas Rao, Adjunct Faculty, National Institute of Advanced Studies (NIAS), India

Initiative on National GIS now has been a lost opportunity. Comment.

Good and sincere efforts (that too by so many professional experts) in the interest of the country can never be "lost". Even now, as I gather, there are sincere and committed efforts that are being made for a nation-wide GIS. Actually, in my view, demand for a good, reliable and high-quality nation-wide GIS has never been more at any time than it is today. I am aware that departments are being motivated and persuaded to shed their "silo-turf" out-look and look broader at the interest of the nation; they are being persuaded to work in an aligned manner – I think at the top-level there is conviction that India cannot do without high-quality images and map services for its governance, growth and development. Bear in mind, GIS brings in an all-together new-type of integrated work-practice hitherto less practiced in India – integration not just of maps, data and images or hardware and software but foremost, multiple "silo" role-based agencies/departments have to change their work-practice and "align and integrate their tasks" and commit to work-together – that is extremely important and critical for getting a nation-wide GIS going and operational for perpetuity. For years now, departments and ministries have only worked in their own "silos" and have hardly realised that today's governance and development need is to over-arch and integrate tasks and products with what other departments and users – cross-cutting impacts are so many. For example, rural development decisions must take into consideration land ownership, urban infrastructure needs, demographics, weather etc; urban development cannot ignore needs of rural areas, movement of goods, amenities/facilities and so on. Thus, inter-dependency and alignment across departments is utmost essential today – one technology department cannot be all and end all for GIS in governance. I feel that this needs to be "inculcated" and in my view, this government is thinking on those lines and the process seems to have started – it is taking time – almost looks "lost opportunity" but, being an optimist, I believe that underneath the perception of what appears, a new-structure is emerging as a new foundation for integrated governance and use of GIS. I am confident because that is the only way-forward for the country – images and maps are becoming fundamental way-down tools in the hierarchy of the nation's governance and meeting aspirations of citizens. In fact, anybody (or any department) who "resists" or "blocks" this "juggernaut" will be doing so at their own existential peril. I am sure that the key 4 or 5 important government departments for a nation-wide GIS are all thinking on same lines and are wise and pragmatic – they all want their individual department to "shine" but their aspirations can best be realised when they align to "national goals" and learn to work all together and not by pulling in different directions.

Had National GIS been place in now, it could have acted as a backbone to many of the recent government initiatives regarding e-governance, smart cities, Digital India, etc.

Yes, no doubt about it. Just imagine, the vision and programmatic details were all ready by end 2011 and today by 2015 the whole system would have been ready and fully operational – note this would have been the only such world system even in 2015. Had a nation-wide GIS been operational and available, then not just these initiatives that you mention but a whole host of governance could have started to get streamlined – based on ready-to-use GIS. Take, for example the 2013 Uttarakhand disaster or 2014 and 2015 J&K flood disaster and others – the real-time management of these disasters could have been easily supported by accessing a real-time, uptodate, scientific map and image database of realities of the ground-level.

Another major aspect where National GIS would have helped is mapping of public-funds utilisation on every "inch" of land – this is something we are trying out. If we can look at every village/ward of land in India and see what is the public fund expended over past 1-, 3-, 5- and 10-years and compare that with what is the aspiration/need/expectation of that village/ward, we will see a disparate dynamics of development mapped out. And add population density to that, add water availability (or school education or health) - we would have got a very different perspective of our country in map form at village-ward level – this could have been major input to Smart City programme or

We've been precise for over 80 years.

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Exactly.




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A highly sophisticated system with auto focus function

rural development initiatives. An available National GIS could have easily been the corner-stone for Digital India (even now I think one element of Digital India frame can be a nation-wide GIS; it is so easy to make that element operational in a few months). Similarly, Smart-city selections and planning could have been lot easier – with scientific ward-wise data and landuse maps and city growth maps available from National GIS. Land Acquisition could have been supported by nation-wide GIS maps in a transparent manner. Changing crop production and assessment, mapping of crop-migration from normal agriculture crops to horticulture or floriculture that is happening in the country could be easily mapped and analysed – even impact of these changes on economic scenario at local-level and what is its long-term impact to economy could have been mapped out. Another major benefit could have been to launch farmer-advisories as a service – so that each farmer could have obtained real-time advisory for his farm/ cadastre – it would have helped farmers so much (and also provided major analytics for farmer suicides by doing a psycho-metric analysis of farmer's land and economic scenario over time). We still do not know with precision whether our country is still having 140mha under agriculture – or has it shrunk or expanded – I feel these could have been real-time annually provided. Even for Jan Dhan Yojana, one could have got maps of all bank accounts linked to Aadhar and mapped out bank-transaction patterns or pension-claim patterns. All schools and colleges, hospitals and health centres, bridges, roads, banks, seed centres, agriculture yards, fertiliser centres, government offices, Post Offices etc could have all been mapped and visualised in map form for whole country. Such a detailed GIS System of System could have easily brought out the gaps and challenges of development in the country and a different perspective of poverty (nay, development) could have emerged for policy-makers. Just imagine, if all of these GIS analytics were available to Hon'ble PM and decision-makers – what a difference it would have made for them to make their policies and decisions - citizens would have benefited in a much more effective and meaningful manner.

Do you see any future for National GIS in current scenario?

Yes, I am very hopeful that the present government will take pragmatic steps. In fact, our Prime Minister is so tech-savvy and he is fully aware of the power of GIS and maps – I personally know the drive he gave to Gujarat to organise a state-wide GIS and also ensured that it is best utilised. Gujarat has done it so well, so has Karnataka and few other states – there are also islands of GISs in few cities, panchayats - that is the way to go for the whole country. Actually, I am also seeing that states are getting much more active for State GISs and many of the states have taken leadership steps to provide a state-wide GIS for their own governance. Maybe in 2015, that is the model to work upon – motivate, support and enable State GISs and then a "smartly aggregated sum of these state GIS could automatically become a nation-wide GIS". In fact, such a path may be easier because the pulls and tugs of the departments that is seen at centre has less impact at state level – so states can easily organise and own and use their GISs. At same time, there is another model that can happen – route of Indian private-sector organising and owning a nation-wide GIS and allowing users to pay-per-use model. We are seeing signs of that as some companies have already organised nation-wide GIS layers and provide LBS and other navigation services. And of course, there is this massive international effort of Google Maps and others – they are slowing getting the "teeth" of a GIS character and are most widely and easily used across our billions. So, to me, these are options – though, I personally would like an indigenous effort of National GIS fructifies because that will spur lots of jobs, "promotions" to many existing government scientists/ people and more importantly will strongly build a national capability in imaging, GIS and Information Systems – which is very weak in India, presently.

But whatever the model, we must make a serious and committed effort – not a frivolous "I too can" or "I already have it" approach. I say this based on what we are hearing about some interesting "claims" in some corners - that in 80/120 crores National GIS can be achieved (or augmented to what "we have") – good, I say, that is "peanut amount". The nation should just go ahead and get National GIS established from the claimant but, yes, do make them fully accountable and responsible if it is not delivered. Some claims are there that "take my images, take their maps, top it with all other data-you-have" and, bingo, that is National GIS – maybe few 100s crores. Good, I say, ask the claimants to get going but make them accountable and responsible for non-delivery. To me, claims are for insurance companies - there is only one way according to me – please implement the well-thought out and largely-inclusive National GIS Vision of 2011 – it can only and only help and benefit the country. Will it be done – a 3000 crore question, I hear!!

Do you think that National GIS initiative should be realigned along with Digital India programme?

You know I have been hearing this for sometime. When arms of the government still squabble in silos (and mark turfs) and think so parochially, what option does the government of the day have than to re-position or re-christen or re-align and still achieve the goals of nation-wide GIS under a different nomenclature. But, as they say, a "good wine" is always a "good wine" and will remain that way. But now, with the Hon'ble PM bringing fresh breath and vigour to "national good" and wanting to "Make in India", hopefully the re-structuring could happen and could lead to good success for National GIS to become a driving force across the country and certainly across governance. I am hopeful and optimistic – the only thing I would say is do not reduce and marginalise the scope that has been defined in the National GIS vision. In whatever nomenclature, I am sure GIS will be a primary element of the nation's good and if that means through Digital India (or any other nomenclature), so be it (but I would not like it to be a "East India Co" model of yore – that will not be good for the nation!!).

Coordinates

10 years before

mycoordinates.org/vol-1-issue-2-july-05/

10 years – a long period! Really?

Was early warning of Sumatra earthquake possible?

The authors have discovered serious signals within ten days before the earthquake with respect to the daily change ratio of triangle areas near the origin of earthquake

SHUNJI MURAI, HARUMI ARAKI

Conclusions

- It was easy to have detected Sumatra Offshore Earthquake itself from GPS daily data.
- The evidence of early warning was found in the daily change ratio of the triangle area of ntus-lhas-kunm (Singapore-Lhasa-Kunming) in YZ plane on the 18th December 2004, 8 days before the earthquake, and bako-ntus-lhas (Indonesia-Singapore-Lhasa) in XZ plane on the 21st to 23rd December 2004, 3 to 5 days before the earthquake.
- On the day of the earthquake, the three triangles of ntus-lhas-kunm, bako-ntus-lhas and bako-ntus-kunm showed very drastic change. The two triangles of bako-ntus-lhas and bako-ntus-kunm showed the reverse movements along the boundary of the Indian and Eurasian Plate.

License required to operate GPS in India

"We are committed to meet genuine requirements of the GPS users" says P K Garg, Wireless Adviser to Government of India, Wireless Planning and Coordination (WPC) Wing, Ministry of Communications and IT, Government of India. Mr Garg expresses his frank opinions on issues ranging from role and mandate of WPC to rationale of licensing and its implementation issues

Is it true that one needs a license from WPC before using a GPS?

Yes, it is true. If we go strictly by rule that exists on paper, making a GPS operational without a license from WPC is not allowed. However, the government is always alive to the practical situations and requirements. For example, the cordless phones were exempted from licensing requirements with specified frequencies and RF power.

HOPE vs HYPE

India's National Map Policy

The unveiling of the National Map Policy by Ministry of Science and Technology, Government of India in May this year is a historic decision, a major step forward. However, the policy raises both expectations and questions. Many of them will hope fully be addressed by the guidelines that are expected to follow. Meanwhile, Coordinates initiates a discussion on National Map Policy. From now onwards, we will publish opinions of a cross section of the geomatics community in every issue

The applications of Global Navigation Satellite Systems

United Nations / Russian Federation Workshop, 18-22 May 2015, Krasnoyarsk, Russia - A report

United Nations/ Russian Federation Workshop on the Applications of Global Navigation Satellite Systems (GNSS) was held at Siberia Expocentre, Krasnoyarsk, Russian Federation during 18-22 May, 2015. The event was jointly organized by United Nations Office of the Outer Space Affairs (UNOOSA) and Russian Federal Space Agency (ROSCOSMOS), co-organized and co-sponsored by ICG and was hosted by JSC Academician M F Reshetnev Information and Satellite System (JSC ISS Reshetnev).

The Welcome and Keynote presentation session of the workshop on 18 May, 2015 brought together more than 100 delegates representing 21 countries from Asia, Africa, Europe, North and Latin America. Chaired by Nikolay Testoyedov, ISS-Reshetnev Company's General Director, the opening session included welcome speeches presented by Sharafat Gadimova, Program officer at the International Committee on GNSS at the UNOOSA, Victor Meshkov, Head of department in the Ministry of Foreign Affairs of the Russian Federation, Mikhail Khailov, Deputy head of Roscosmos and Victor Tolokonskiy, Governor of the Krasnoyarsk region.

The workshop program was included nine presentation sessions those covered issues dealing with the formation and development of GNSS and Satellite based augmentation systems (SBAS) in operation and development, their infrastructures, technology developments, training and capacity building efforts and application case studies through examples of projects implemented by various countries.

The event was aimed to discuss the opportunities of utilizing GNSS for countries' social and economic development. Workshop participants have discussed and delivered presentations on how these systems can complement each other to ensure the most effective use of the systems and shared their expertise of implementing GNSS services on current and prospect benefits.

In three discussion sessions participants discussed on possible networking for joint efforts, on the issues of risk mitigation and protection of GNSS signals from interferences, and on increased use of GNSS for disaster monitoring and support. The workshop participants also put increased focus on the education, training and capacity building issues in the field of the application of satellite navigation systems and services.

The five-day workshop resulted in framing of a set of recommendations based on the discussions those would be communicated to national and international bodies through UNOOSA. It also resulted in developing a proposal to set up an international education and training centre under the ISS Reshetnev Company that will cooperate with UNOOSA as well as regional centres located in Morocco, Nigeria, India, Brazil and China.

As part of the workshop, all the delegates had the unique opportunity to visit ISS-Reshetnev Company's facilities. Being a prime contractor responsible for the space segment of the GLONASS system, the company demonstrated the advanced Glonass-M and Glonass-K classes of navigation satellites, communications satellites as well as its latest developments in the field of satellite construction technologies.

The magazine "Coordinates" was the media partner for this workshop. Detailed program, abstracts and copies of presentations can be found at UNOOSA website http://www.unoosa.org/oosa/en/ourwork/psa/gnss/workshops.html.

- Dr Anindya Bose, Burdwan University, India

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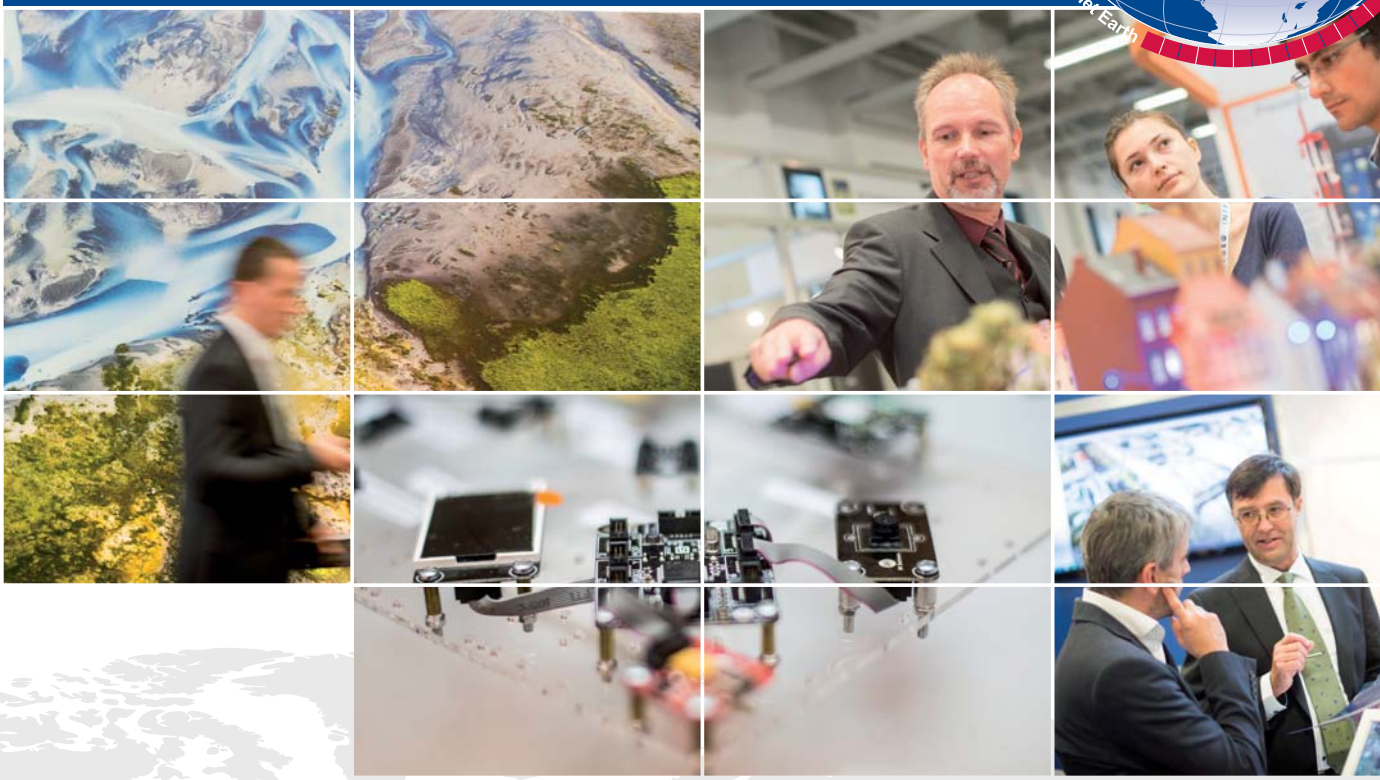

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Galileo update

European GNSS R&D

A free app for both iOS and Android features the results of European GNSS Agency (GSA) supported research and development initiatives. The new EGNSS Research and Development (R&D) application highlights the tangible results coming out of the 7th Framework Programme (FP7) and is designed to serve as inspiration for those participating in the Horizon 2020 (H2020) period.

The FP7 and H2020 programs, supported by the GSA, aim to support the development of EGNSS applications in key market segments. Both are geared towards accelerating the development of a European market for satellite navigation applications and creating new opportunities for European industry.

In addition to the search function, des Dorides notes that the demographics included with each project can help users identify opportunities for partnerships across segments and regions, and create virtual R&D networks.

The FP7 programmes had a considerably positive impact on the GNSS market. Within the frame of the projects, 45 products were developed, and 80 prototypes were tested and validated during the 115 demonstrations that took place. Horizon 2020 is bringing new opportunities for GNSS applications development. Information on the 25 projects granted in the first H2020 Galileo call is already included in the application, and early next year it will be updated to include the 2nd call portfolio of projects.

Four Galileo Satellites Now at ESTEC

Europe's latest Galileo was unboxed at ESA's technical centre in the Netherlands in May, bringing the total number of satellites at the site to four.

ESTEC in Noordwijk is the largest satellite test facility in Europe, with all the equipment needed to simulate every aspect of the launch and space environment under a single roof. It is an essential stop on the way to space for Europe's Galileo satellites, built by OHB in Bremen, Germany, with navigation payloads from Surrey Satellite Technology Ltd. in Guildford, UK.

The satellite will begin with a thermal vacuum test in a 4.5-meter-diameter stainless steel chamber, subjected to about five weeks of hard vacuum and the temperature extremes of space.

Galileo-11 recently completed the same trial before moving on to final system testing, including a compatibility run with the ground network.

Meanwhile, the ninth and tenth satellites are in storage at ESTEC, having passed their own checks. They will be flown to Europe's Spaceport in French Guiana in late July for launch by Soyuz in September, which will bring the total in orbit into double figures.

eLoran Signal tests start

Congressman Frank LoBiondo, R-N.J., flipped a switch at a decommissioned Loran-C station in Wildwood, New Jersey, to begin transmission of an enhanced Loran or eLoran signal. The signal, which is part of a yearlong test, will be receivable up to a 1,000 miles away and will help establish whether the old facilities can become the foundation for a reliable eLoran network to provide positioning, navigation, and, perhaps most importantly, timing (PNT) information in the United States.

Recently, Department of Homeland Security (DHS) and the U.S. Coast Guard (USCG) signed a cooperative research and development agreement (CRADA) with Harris Corporation and UrsaNav to evaluate and demonstrate such a network. The Wildwood signal is part of that effort. The powerful signals from an eLoran ground-based radio navigation system are widely seen as a cost effective backup for GPS and have been endorsed by leading PNT experts including the National Space-Based PNT Advisory Board. ELoran signals would be very difficult to jam and are able to reach underground, underwater, through buildings and into other obscured areas where the GPS cannot penetrate. GPS and eLoran operate on different frequencies and share no common failure points.

Kalashnikov rifle with internet, GPS, GLONASS

The legendary Russian Kalashnikov rifles can now be now equipped with a special module to monitor the status and movement of military personnel or receive useful information during training and transmit the encrypted data via internet. This device is the first of its kind for the rifle according its developer Red Heat, and StarNet Alliance, a company which specializes in the Internet of Things. According to StarNet Alliance, Kalashnikov rifle has received "new functionality due to integration of special sensors working via Internet of Things technology in the handguard of the weapons." The sensor "is powered by a common battery, and transmits all the necessary information" to the networks, which are maintained both in Russia and abroad, the company

says, adding that the online module can also be maintained by GPS and GLONASS systems. http://rt.com/

Russia Begins Mass Production of Glonass-K1 Navigation Satellites

According to Roscosmos, the mass production of Glonass-K1, the third generation of GLONASS navigation satellites, has begun. This is aimed at ensuring the further development and expansion of the Glonass satellite network through 2017-2019. Glonass-K1 satellites have an increased lifetime of 10 to 12 years, a reduced weight of only 935 kilograms and offer an additional L-Band navigational signal. *http://sputniknews.com*

Demo of M-Code GPS receiver

GPS Source and Rockwell Collins have successfully demonstrated the ability of the Military-Code Ground-Based GPS Receiver Application Module (GB-GRAM-M) receiver card to fit within the Defense Advanced GPS Receiver (DAGR) Distributed Device (D3). GPS Source and Rockwell Collins are the first to provide this capability for the M-code signal, which is one of the key elements in the modernization of military GPS capabilities. *www.rockwellcollins.com*

Raytheon Demonstrates Advanced GPS OCX Capabilities

Raytheon has demonstrated the advanced capabilities of the GPS's next generation Operational Control System (GPS OCX) to key Defense Department and other stakeholders through a series of realistic operational demonstrations. These demonstrations, which incorporated software that will be delivered with the Launch and Checkout System, validated how automation will improve system efficiency and effectiveness. GPS OCX is the ground-based command and control system that will manage GPS satellites with significantly improved accuracy and precision, while providing unprecedented levels of cyber protection. The demonstration provided DoD and other stakeholders with a compelling look at how OCX will automate many tasks currently performed manually, resulting in reduced opportunities for error and increased operational tempo for delivering military and other applications. *www.raytheon.com*

Damage to Russia's property registry agency linked to GLONASS exceeds $2.5m

The Prosecutor General's Office has revealed over 130 million rubles ($2.5 million) worth of acquisition violations at the Federal Service for State Registration, Cadaster and Cartography (Rosreestr), including some that are part of the federal targeted program for maintaining, developing and using the Glonass system in 2012-2020.In 2014 Rosreestr transferred about 200 million rubles ($3.8 million) in payments under three contracts with JSC Roscartography carried out as part of the Glonass program. Under the contracts, Roscartography was to compile digital city plans and to review digital navigation and topographic maps. *http://www.rapsinews.com/*

Russia, China to install GLONASS/Beidou on trucks

Russia and China will start equipping trucks transporting goods across the Sino-Russian border with the GLONASS/Beidou navigation systems, GLONASS's Director of International Non-Commercial Partnership Projects Alexander Bondarenko said. According to Bondarenko, transportation companies will be offered a series of services, primarily in the fields of security, navigation and information. He added that truck drivers would not have different devices, and instead would be using the same apparatus. *http://rbth.com/*

Multi-GNSS Module by OriginGPS

OriginGPS has launched the Multi Micro Hornet, a tiny fully integrated multiple constellation antenna module. The innovative architecture packs functionality and high-quality components in a small space to improve wearables' fashion and function. The Multi Micro Hornet is designed for devices that require a small form factor, low power consumption, and high sensitivity.

China sends up remote sensing satellite

China has launched a high-resolution optical Earth observation satellite recently. The Gaofen 8 satellite lifted off from the Taiyuan space center in northern China's Shanxi province. Chinese officials said the Gaofen 8 satellite is part of a civilian program, joining the Gaofen 1 and Gaofen 2 Earth observation satellites launched from the Taiyuan space center in 2013 and 2014. Imagery from Gaofen 8 will aid in general land surveys, land ownership evaluations, urban planning, road network planning, crop yield measurements, and responding to natural disasters. *http://spaceflightnow.com*

New Belarusian-Russian remote sensing satellite within 2-3 years

A new Belarusian-Russian satellite for the remote sensing of the Earth will be created within 2-3 years. The statement was made by Chairman of the Presidium of the National Academy of Sciences of Belarus (NASB) Vladimir Gusakov. He said that the satellite will be created through joint efforts of the two countries. *http://www.atom.belta.by*

New RS Facility launched in Bengaluru, India

Karnataka Chief Minister recently inaugurated the new Karnataka State Remote Sensing Applications Centre (KSRSAC) facility at Doddabettahalli. He also launched the GIS portal K - GIS which will provide data and map services to various departments of Karnataka governments. The database has 54 GIS layers. *www.newindianexpress.com*

Bluesky signs aerial mapping contract with Ordnance Survey Ireland

Aerial mapping company Bluesky has signed up Ireland's National Mapping Agency as an exclusive reseller for the public sector market. The agreement between Bluesky and Ordnance Survey (OS) Ireland covers the provision of the highest resolution, most up to date aerial photography for the Republic of

Ireland, together with associated 3D height products. Under the terms of the agreement OS Ireland, with support from Bluesky, will exclusively licence Bluesky's Ireland products to public sector organisations such as local councils, central government departments and executive agencies. *www.bluesky-world.com*

Belarus, India to develop joint RS program

Belarus and India intend to develop a joint program in the field of remote sensing of the Earth. "The National Academy of Sciences of Belarus is actively developing cooperation with partners from the Republic of India. Negotiations are underway with the Ministry of Science and Technology of India on the mechanism of initiating joint programs in the field of remote sensing of the Earth," the NASB explained. *http://eng.belta.by*

Sentinel-2A to provide colour vision of Earth

Sentinel-2A is the first optical Earth observation satellite in the European Copernicus programme. On 23 June at 03.51:58 am CEST, a Vega launcher took off from the spaceport in Kourou, French Guiana, carrying the satellite developed and built under the industrial leadership of Airbus Defence and Space for the European Space Agency (ESA). The 1.1 tonne satellite has been designed to operate for at least 7 years and 3 months in a polar orbit around 780 kilometres above the Earth.

The Sentinel 2 mission will contribute to the management of food security by providing information for the agricultural sector. It will also enable the condition of and changes in land surfaces to be mapped and forests worldwide to be monitored. Also the mission will provide information about the pollution of lakes and coastal waters. Images of floods, volcanic eruptions and landslides will aid the production of disaster maps and facilitate humanitarian aid activities.

Drones for aerial photography open market, tests law in Taiwan

The Environmental Protection Bureau of Taichung in central Taiwan has decided to deploy cameras attached to drones in its efforts to catch those damaging air quality and jeopardizing road traffic safety by burning dry straw on open ground. It will be the first time the city has used this form of technology to catch polluters after patrol vehicles on the ground often fail to accomplish the task, bureau officials said. *www.wantchinatimes.com*

AUVSI lauds two new UAS legislation

The Protecting Firefighters and Promoting Innovation Act, introduced by Rep. Kyrsten Sinema (D-AZ), and the Future Transportation Research and Innovation for Prosperity (TRIP) Act, introduced by Rep. Daniel Lipinski (D-IL) are good things according to Brian Wynne, president and CEO of the Association for Unmanned Vehicle Systems International (AUVSI).

Wynne says the two pieces of legislation underscore the many societal benefits of robotic technologies, from helping fight wildfires to improving transportation systems. He also commends the act introduced by Lipinski, saying it establishes a foundation for the widespread use of connected, intelligent vehicle technologies. "A new generation of intelligent machines, including automated vehicles, will improve the safety of our transportation system, provide mobility to the elderly and disabled, and reduce cost and waste."

Rustom-1 drone to monitor maritime boundary with Lanka

The international maritime boundary line (IMLB) between India and Sri Lanka, frequently violated by fisherfolk and smugglers from both sides, could soon be kept under surveillance by the Rustom-1 unmanned aerial vehicle (UAV) - a drone developed by the Defence Research & Development Organisation (DRDO).lok

The DRDO is working with the navy to fit the Rustom-1 with an Automatic Identification System (AIS) that will identify Indian fishing vessels along the maritime boundary. The AIS on the Rustom-1 will transmit an "interrogator" signal that reflects back from a transponder that will be fitted on every Indian fishing boat. If an Indian vessel strays into Sri Lankan waters, or an unidentified boat enters Indian waters, a digital data link between the UAV and a ground control station (GCS) on the Indian coast will alert the navy and coast guard in real time. *www.business-standard.com*

Anti-UAV system to be developed

A consortium of British and French companies has signed an agreement to develop a counter-unmanned air vehicle system. The UAV Watch and Catch System (UWAS) radar-based system will be developed by JCPX Development, DSNA Services, Aveillant, Skysoft and ENAC, and will detect and track UAVs that weigh less than 25kg (55lb).

The system will be offered in both mobile and fixed configurations, while the consortium claims that the technology that will be incorporated is already compliant and certificated by civil aviation authorities, and will be a turnkey system based on Aveillant's H24 radar system. *www.flightglobal.com*

FAA Grants Section 333 Exemption to Property Drone Consortium

The Property Drone Consortium (PDC), announced the grant of a Section 333 exemption and a Certificate of Waiver or Authorization (COA) from the Federal Aviation Administration (FAA) to the PDC. Working in conjunction with EagleView Technologies, the exemption authorizes the PDC to legally fly and conduct restricted research and development on the use of UAS for aerial data collection, in the U.S. National Airspace System. *www.eagleview.com*

OGC® adopts WPS 2.0 standard interface

The Open Geospatial Consortium (OGC) membership has approved the OGC Web Processing Service (WPS) Version 2 Interface Standard.

It provides rules for standardizing how inputs and outputs (requests and responses) for geospatial processing services, such as polygon overlay, can be structured in a standard way. WPS also defines how a client can request the execution of a process, and how the output from the process is handled. By implementing this standard, any geospatial processing service, regardless of the source, can be "wrapped" with a standard interface and integrated into existing workflows. WPS supports both immediate processing for computational tasks that take little time and asynchronous processing for more complex and time consuming tasks. *www.opengeospatial.org/.*

Louisiana DOTD selects Intergraph

Louisiana Department of Transportation and Development (DOTD) in the US has selected an integrated, automated permitting and routing solution from Intergraph and Cambridge Systematics, which will improve customer service and traveler safety on Louisiana's roads. Louisiana DOTD will replace a legacy, in-house developed oversize/overweight (OS/OW) vehicle permitting system with Intergraph's OS/OW permitting and routing solution. *www.intergraph.com*

New GIS Roadmap delivered for Environment Agency – Abu Dhabi

In support of the Abu Dhabi 2030 Environmental Vision, Environment Agency - Abu Dhabi (EAD) has come closer to establishing itself as a leader within the global environmental community through the development of a partnership with Ordnance Survey International and the creation of a new GIS Roadmap.

EAD is committed to significantly improving the environmental sustainability of the Emirate and becoming a global advocate for environmental protection and sustainable living. *http://os.uk/eadgisroadmap*

Global market for smart cities technology to triple by 2019

Global urbanisation is swelling cities around the world, with more than 70 percent of the world's population already living in urban areas. BCC Research reveals in its new report that information and communication technologies (ICT) will play a vital role in how cities become smarter in sustaining quality of life without upsetting the ecological balance.

The global market for smart city technologies will grow from $212.3 billion in 2013 to $668.5 billion in 2019, reflecting a five-year compound annual growth rate (CAGR) of 17.9 percent. North America, the largest market, is anticipated to reach $218.3 billion in 2019, with a 16.1 percent CAGR. Europe, the region with the highest projected growth rate at 23.1 percent CAGR, will reach $197.7 billion by 2019. *http://bwsmartcities.com*

City of Groningen and Huawei signs agreement

The City of Groningen in the Netherlands signs an agreement with Huawei, the leading global ICT solutions provider, to explore implementing the company's Smart City concepts. A three party MoU was signed between Huawei, Groningen City Government and the University Medical Center Groningen (one of the largest medical groups in Europe). In the Netherlands, Groningen is the fourth city, after Amsterdam, The Hague and Tilburg to sign a Smart City MoU with Huawei. *http://enterprise.huawei.com/*

Dutch Ministry and Kadaster for world wide registration of land

The Dutch Ministry of Foreign Affairs and Kadaster join forces to advocate the world wide registration of land use and property rights in the short term. This cooperation has been officially announced as the Partnership Land Administration for National Development (LAND) in The Hague, on 11th June 2015.

Appropriate land registration is a condition for economic development. In 70% of the world, however, land rights have not (yet) been formally registered. The Partnership LAND's purpose is to support start ups for fast, cheap and reliable land registration in countries that have a need for this. Basic principle is the use of a new approach which focuses first on the demand for the registration of land and in a later phase on further development and refining. *www.kadaster.nl/*

South Australia Spatial Data Map Now Available

The South Australian government has released a new web map that shows all of the state's spatial data in one place. It includes rest stops for long drives, walking trails, the location of every boat ramp in the state, mineral license applications and current leases, school zones, air quality, public transport options, school zones, healthcare facilities and more.

A vast array of open data is available to overlay on the map, with more than 160 sets already and more planned. Each dataset is searchable and the maps can be shared under a Creative Commons licensing agreement.

Mobile application for reporting disaster events

ICIMOD and Kathmandu University, Nepal, launched 'Disaster Reporting', an android application that enables users to report disaster events along with essential information, such as impact and immediate relief requirements. The application allows the user to select the type of disaster event (e.g., building damage, fire, landslide or public utility damage) and provides an option to include information on the extent of damage, number of people injured, people who perished and were displaced, along with current need in the field. Details of any incidents reported can be visualized on an interactive web map at the address: http://118.91.160.230/nepeq/. The application also offers the option to customize the features according to the need of the user organizations. *www.icimod.org*

Baidu makes investment worth $11.5 million in free mass transit Wi-Fi service

Chinese search engine titan Baidu and two private equity firms have invested $11.5 million in a public transport advertising network and free Wi-Fi service on buses and metro systems across China.

The funds will go toward an affiliate of VisionChina Media, a company that provides mass transit wireless Internet access and mobile Internet value-added services in China. The deal covers around 35,000 buses in major cities across the country, including Shanghai, Shenzhen and Guangzhou.

Baidu and VisionChina's affiliate, Qianhai Mobile, will jointly develop and monetize mobile app distribution and other mobile passenger services powered by Baidu Map. *http://en.yibada.com*

Ruckus unveils new location-based services solution

Ruckus Wireless, Inc. has unveiled a major expansion of SPoT LBS. The expanded Ruckus LBS solution lets service providers and enterprises improve the ROI and monetization of their wireless infrastructure. Organizations can now actively engage with customers through value-added business services tailored for the user online experience. Fundamental enhancements to the Ruckus LBS solution uniquely combine, for the first time, virtualized SPoT LBS software, calibration-free deployment, user presence and integrated support for Bluetooth Low Energy (BLE) beaconing to streamline the installation and delivery of location-based wireless services. *http://vsr.edgl.com*

Facebook Inc. could use LBS to turn messenger into a real business

Facebook built that feature into its most recent update of Facebook Messenger. With two clicks, users can send their location, or they can agree on a meeting place with just an extra swipe.What's more important is that the new location feature lays a foundation upon which Facebook can build. Getting users to share locations as part of making plans opens the door for Facebook or third parties to build LBS on top of Messenger. *www.fool.com*

Uber acquires part of Bing's mapping assets

Uber is absorbing data-collection engineers from Microsoft to bolster its own mapping work. Microsoft handing Uber part of its operating expenses is minor, given the financial scale of the firms. *http://techcrunch.com*

HERE expands into 50 countries

HERE, a Nokia company is expanding its real-time traffic service to 50 countries, from the current 44. Next month, HERE will add Bahrain, Kuwait, Oman and Qatar to a growing footprint of live traffic data in the Middle East, giving it the most comprehensive traffic coverage in the Gulf region today. In addition, HERE just expanded its European coverage by adding Bulgaria and Romania. *www.here.com*

Warrington's bid for £40 million of Highways Prudential Borrowing

Yotta's Horizons visualised asset management platform has played a key part in Warrington Borough Council's successful bid for £40 million of prudential borrowing. The funding will be used to maintain Warrington's most valuable asset – a network of some 1,137 km of roads.

By investing in preventative maintenance and reducing spend on reactive works such as pothole repairs, Warrington aims to cut the cost to the local economy of road traffic collisions, and therefore show significant savings. Yotta was commissioned to work with Warrington to produce an initial appraisal of the Future Highway Funding Strategies report. The report, created using Horizons software with support from Yotta's consultants, provided crucial evidence to support the funding bid. It included impact analysis for different investment strategies and the identification of optimum planned maintenance budgets to prevent further deterioration of the network. *www.yotta.co.uk*

FICCI-PwC report suggests deployment of LBS for smart cities

The proposed National Land Use Policy which seeks to regulate land use efficiently would help in augmenting the use of waste and non-cultivable land and integrating them with LBS would make it easier to update and maintain digitized land records.

This was stated by Ms Vandana Kumari Jena, Secretary, Department of Land Resources, Ministry of Rural Development, at a conference on 'Location Based Services 2015: Transforming Coordinates to Business' organized by FICCI in partnership with the Ministry of Earth Sciences, Government of India.

Speaking about how LBS could transform India's landscape, Ms. Jena said that the government has been trying to digitize land records of the country and so far 23 states have digitized its records and 24 states have a computerized registration for land. She added that only 10 states have integrated the two systems. Hence, to leverage the true potential of LBS, it was necessary that all states of India have real-time information on land records.

The report recommends that in order to mitigate challenges and ensure effective implementation of LBS along with smart city components across cities, there is a need to use LBS during assessment of city master planning; create a single agency for generating, collecting and utilising location and geospatial data of a city and frame a policy for data security and privacy.

S N Murty, Associate Director and Smart Cities Leader, PwC, said LBS would add a different dimension to the way people work, will become core to providing mass customized products & services, transform the way government provides services to citizens and leverage the mobile penetration and couple that with urban development. *www.business-standard.com*

CLOUDEO – The going live challenge

The tremendous amounts of data produced by the European Earth observation programme Copernicus and its Sentinel satellites hugely benefit science and public authorities and open the door to countless products and applications in a wide array of business sectors.

The annual Earth Monitoring competition Copernicus Masters was initiated to aid visionary entrepreneurs in bringing their innovations to market.

Its CloudEO Going Live Challenge is now calling for proposals for EO-related products and services that are ready to be tested and implemented. Areas of special interest include ice detection, agriculture & forestry, oil, gas & mining, maritime, and radar applications. Entrants are invited to submit a concrete plan for using CloudEO's ecosystem to transform partially or fully developed applications based on Earth observation data into operational commercial services. After an initial evaluation by an expert panel, the top three contestants will be rewarded with the opportunity to conduct a reality check trial at the CloudEO Living Lab along with relevant user communities and potential future customers. *www.cloudeo-ag.com*

Spectra Precision aids Kenya Land Survey efforts

The Kenya Department of Surveys has acquired eight Focus 30 total stations and an additional eight Epoch 50 GNSS receivers as part of an ongoing major effort to adjudicate land and prepare deeds.

According to the Lands Cabinet Ministry, until recently 67 percent of the country had yet to be adjudicated even as the work was supposed to be completed within 20 years after it was commissioned in 1957 by the British colonial government.

Leica ScanStation P30 & P40

The ScanStation P40 offers highest versatility including long range capabilities. Delivering outstanding range, speed and data quality whenever and wherever needed it is the perfect solution for any tasks in 3D laser scanning. The ScanStation P30 is a high versatility scanner suitable for a wide range of typical scanning solutions. With its optimal mix of speed, range and accuracy paired with unmatched robustness it is the all-in-one solution for the most comprehensive variety of applications.

Hemisphere GNSS Debuts Atlas

Hemisphere GNSS has announced the release of Atlas, its all new entrant into the GNSS global correction services market, offering the most innovative correction service option available in the industry, providing performance that meets or exceeds that delivered by other industry leaders, at market-leading prices. It is the most flexible service on the market, delivered via L-Band or the Internet at accuracy levels ranging from meter level to sub-decimeter level. Atlas support is being introduced across a wide range of hardware, including Hemisphere's new AtlasLink™ smart antenna, also launched. *www.HGNSS.com*

Spectra Precision introduces SP60 GNSS receiver

Spectra Precision has launched a new GNSS receiver, the SP60. Designed to meet the evolving needs of surveyors, the SP60 is a versatile solution combining next generation Spectra Precision GNSS technology, a high level of configuration flexibility and an innovative design. It is a part of Spectra Precision's latest portfolio of GNSS receivers specifically designed for the mainstream survey and construction applications such as cadastral, topographic, control, stakeout and network RTK.

Fugro positioning for DeepOcean Group vessels body

DeepOcean Group, the Norwegian subsea organisation recently awarded a five-year contract by BG Group for ROV-based inspection, maintenance and repair work covering UK and Norwegian assets in the North Sea, has in turn appointed Fugro for provision of precise satellite positioning for its entire worldwide fleet of 18 vessels.

NovAtel News

SPAN GNSS/INS now available on NovAtel's SAASM Receivers

NovAtel's SPAN GNSS/INS technology is now available on the company's OEM625S dual-frequency SAASM GPS plus civil RTK receiver. The addition of SPAN offers system developers with SAASM requirements the benefit of continuously available 3D positioning, velocity and attitude (roll, pitch, yaw) for their U.S. Department of Defense (DOD) applications.

Authorized defense customers need access to the Precise Positioning Service (PPS) for DOD applications. When keyed, the existing OEM625S board level receiver provides an RTK PPS solution by taking the raw measurements from an L-3 XFACTOR SAASM and applying them to NovAtel's industry leading RTK algorithm. SPAN technology couples NovAtel's precision GNSS receivers with robust IMUs to provide a more reliable, stable solution, even during short periods of time when satellite signals are blocked or unavailable.

NovAtel Picked to Supply QZSS Reference Receivers

NovAtel has announced an agreement with NEC Corporation to supply reference receiver products for use in Japan's Quazi-Zenith Satellite System (QZSS). The QZSS equipment will be based on NovAtel's third-generation (G-III) family of reference receivers. Designed for integrity monitoring and reference measurement applications, the receivers track signals independently to provide precise code and carrier phase reference measurements as well as signal-quality measurements and other integrity monitoring metrics.

Under the three-year agreement, Fugro will provide three completely independent decimetre GNSS while also supplying its latest Starfix G2+ service which is capable of producing a 3D accuracy approaching that of GNSS RTK (real-time kinematic) systems; also available will be the company's Starfix G4 correction service.

CHC Introduces UAV Ground-Control Specific GNSS System

CHC Navigation has launched a new UAV Ground Control (UAV GC) and post-processing kit for high-precision UAV systems. This kit is designed to provide an easy-to-operate complete system, and be cost-effective for producing centimeter-level control for UAV projects.

The standard kit includes five GNSS receivers with expansion of additional receivers in pairs. The core of the system is the X900+OPUS, a dual-frequency triple-constellation receiver capable of cm positioning of the project at 200 km in absolute geodetic space. The secondary X20+ receivers serve as ground-control points for orthorectification, project verification, and other high-accuracy positional tasks.

Tiny CAM-M8 module from u-blox

More online services than ever are based on location awareness being integrated into M2M systems and other IoT devices. The tiny CAM-M8 module from u-blox offers a quick and easy way to add reliable global positioning in these applications. It offers the option of concurrent operation with any two of the three main satellite-positioning systems currently in operation – GPS, GLONASS and BeiDou – to provide accurate positioning data anywhere in the world.

Septentrio launches OEM Receiver targeting UAS

Septentrio has launched its AsteRx-m UAS, an OEM GNSS receiver specially designed for the unmanned aerial systems market. The AsteRx-m UAS provides real-time kinematic–level positioning accuracy with low power consumption, less than 600 milliwatts with GPS alone and less than 700 milliwatts with GLONASS. The launch of the AsteRx-m UAS board is complemented by the release of GeoTagZ software suite, which works together with UAS-borne camera and image processing to provide centimeter-accurate position tagging of images without the need for a real-time data link.

FOIF GNSS Receivers Aid with Australian Pipeline Survey

Three years ago, engineering survey company G & C Sadlier Design was engaged to perform a route selection and centerline pegging survey for gas pipeline duplication between Somerton in Victoria and Young in New South Wales, Australia. To accomplish the work, G & C Sadlier Design turned to FOIF GNSS receivers. So far, about 225 kilometers have been surveyed and constructed, with 306 kilometers still to be surveyed, designed and built, according to surveyor Greg Sadlier. The current focus is a 100-kilometer section in Victoria and a 70-kilometer section in New South Wales. Recently completed are two linear static control surveys over 80 kilometers in Northern Victoria and 70 kilometers at the end of the project near Young in New South Wales.

JAVAD GNSS remote assistance and monitoring services

Together with free live technical support provided by practicing professional land surveyors via phone, email, message board and text messaging, JAVAD GNSS has announced the release of another innovative product, RAMS - Remote Assistance and Monitoring Services for J-Field software. J-Field is the field controller software developed for the TRIUMPH-LS GNSS receiver and the VICTOR-LS field controller. RAMS is currently available to all users of J-Field, JAVAD's powerhouse software for survey data collection, stakeout, and computations.

With the J-Field enabled receiver/controller connected to the Internet (via internal GSM SIM card, Wi-Fi hotspot or Ethernet), users can make their receiver/controller accessible to JAVAD's customer support team from anywhere in the world with three button presses. *www.javad.com*

Averna's RP-6100 Series

The Averna RP-6100 Series is a self-contained, record-and-playback solution for RF application validation. It can capture all GNSS bands, as well as HD Radio, WiFi, LTE, radar, and cognitive radio – plus impairments – to significantly advance RF projects and harden product designs. It features up to 4 channels, 160 MHz of recording bandwidth, tight channel synchronization, an extended frequency range of 10 MHz to 6 GHz, and 14-bit resolution.

Satelline TR4 from Satel sets a new milestone!

The new Satelline TR4 from the Finnish manufacturer of radio data transmission systems Satel sets a new milestone. The compact UHF transceiver with transmitting power of 1,000 mW is compatible with the protocols of Pacific Crest, Trimble and Satel. The type certifications in all important regions of the world make the TR4 ideal for integration in end devices that are intended for international use. With a weight of only 18 g, transmitting power of 1,000 mW and an "over the air" data transmission rate of 38,400 bps it fulfils all present-day standards. The smallest UHF transceiver in its class, with dimensions of 56 mm x 36 mm x 6 mm, is designed for easy integration. *www.satel.com*

SatGen Version 3 now includes BeiDou signals

SatGen V3 is a powerful and intuitive software package that gives the ability to create scenarios for replay through any LabSat simulator – and now it includes BeiDou! The software creates either user generated or imported trajectory files for use with a LabSat. The addition of the BeiDou B1 signals means that you can now test your device's effectiveness as if it were being used within the operating area of the Chinese constellation – which at present only provides full coverage in Asia.

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www.esnc.eu, www.copernicus-masters.com

August 2015

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3-7 August
United Nations Headquarters, New York, USA
http://ggim.un.org

CPGPS MIPAN'2015
26 and 28, August
Xuzhou, Jiangsu, China
www.cpgps.org/new_site/news2015.php

UAV-g 2015
30 August - 2 September
Toronto, Canada
www.uav-g-2015.ca

ESA/JRC International Summer School on GNSS 2015
31 August - 10 September
Barcelona, Spain
http://congrexprojects.com/2015-events/15m21/registration

September 2015

GIS Forum MENA
6 – 9 September
Abu Dhabhi, UAE
http://gisforummena.com

InterDrone
9-11 September 2015
Las Vegas, USA
http://www.interdrone.com/

ION GNSS+
14-18 September
Tampa, Florida, USA
www.ion.org

INTERGEO 2015
15 – 17 September
Stuttgart, Germany
www.intergeo.de/intergeo-en/

ISPRS GEOSPATIAL WEEK 2015
28 September - 2 October
La Grande Motte, France
www.isprs-geospatialweek2015.org/

EGNOS workshop
29 - 30 September
Copenhagen, Denmark
www.essp-sas.eu/news

October 2015

Surveying & development regional conference
03-06 October
Sharm El-Sheikh, Egypt
www.sd2015-eg.org/

Commercial UAV Expo
5 - 7 October
Las Vegas, Nevada, USA
www.expouav.com

DIGITAL EARTH 2015
October 5-9
Halifax, Canada
www.digitalearth2015.ca

20th UN Regional Cartographic Conference for Asia and the Pacific
5-9 October
Jeju Island, Republic of Korea
http://unstats.un.org/unsd/geoinfo/RCC/

Intelligent Transportation Systems: 22nd ITS World Congress
5 - 9 October
Bordeaux, France
http://itsworldcongress.com

Geo Empower Africa Summit
6 - 7 October
Johannesburg, South Africa
http://itc.flemminggulf.com/geo-empower-africa-summit

36th Asian Conference on Remote Sensing
19 - 23 October
Manila, Philippines
www.acrs2015.org

2015 IAIN World Congress
20 – 23 October
Prague, Czech Republic
www.iain2015.org

Joint International Geoinformation Conference
28 - 30 October
Kuala Lumpur, Malaysia
www.geoinfo.utm.my/jointgeoinfo2015/index.html

November 2015

ISGNSS 2015
16 - 19 November
Kyoto, Japan
http://www.isgnss2015.org/

Drone World Expo/MAPPS Conference
17 - 18 November
San Jose, CA United States
www.droneworldexpo.com

GEOTECH RWANDA
18 - 20 November
Kigali - Rwanda
www.geotechrwanda2015.com/

December 2015

The Geoinformation Technologies for Natural Hazards Management (7th GiT4NDM)
8 - 10 December
UAE University
http://conferences.uaeu.ac.ae/eogc-git4ndm/en/index.shtml

9th International Symposium on Mobile Mapping Technology (MMT 2015)
9 - 11 December
UNSW, Sydney, Australia
www.mmt2015.org

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