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Coordinates

Volume VI, Issue 11, November 2010

THE MONTHLY MAGAZINE ON POSITIONING, NAVIGATION AND BEYOND

"Galileo is the only system which is driven by civil interests"

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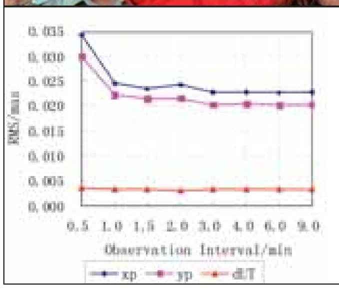

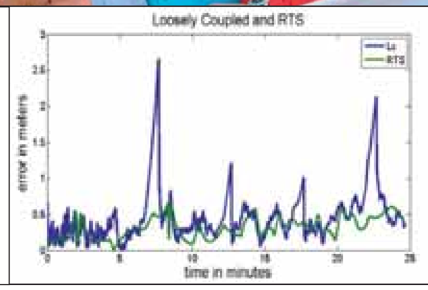

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Mailing Address
11C Pocket A
SFS Mayur Vihar Phase III
Delhi 110 096, India.
Phones +91 11 22632607, 98102 33422, 98107 24567
Fax +91 11 22632607

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

Web www.mycoordinates.org

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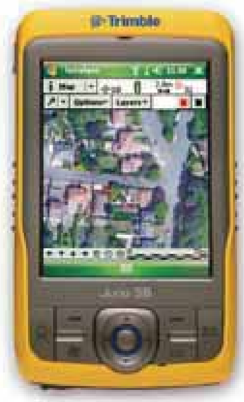

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Living together

Compass and Galileo.

Apparently heading for a ëhead oní,

On frequency and signal issues.

In a world of multi GNSS systems,

With different priorities and agendas,

Such differences are inevitable.

But we do need a compatible and interoperable environment.

At the same time, we do live with conflicts.

Yet coexist.

Donít we?

Bal Krishna, Editor
bal@mycoordinates.org

"Galileo is the only system which is driven by civil interests"

says Paul Verhoef
Programme Manager, EU satellite navigation programme, European Commission, Brussels, Belgium while emphasising on the difference between Galileo and other GNSS systems.

What is the status update on Galileo and in what stages will it become operational?

We are currently defining our initial operational capability (IOC) in detail.

Initially some services will be available which will not be the full services. For example if the availability is 95 percent it will mean that for three weeks in the year one would not be able to receive anything. However, some services can be combined with GPS and as soon as the first satellite is up one will be able to use the ranging capabilities of both the GPS and the Galileo satellites in sight, in particular for the OS (Open Service). There will be ramping up of all the services with time. We will have an initial PRS (Public Regulated Service) available for testing purposes. The SAR (Search and Rescue) Service will be available relatively quickly.

But the Safety-of-Life Service will not be available initially. We may have some elements of it for testing since that service is particularly complicated and we would like to have some test results first. Also, the CS (Commercial Service) will need the entire constellation and therefore will only be tested at IOC stage.

What would be a realistic timeline for the start of initial operations of Galileo?

There can be no illusions. If we look at the GPS and GLONASS history, we see that between the launching of the first satellite and the declaration of full operations there was a period of about eighteen years. We have respect for what the US has achieved with GPS and the experience they have.

I hope we will be able to do it in a much shorter time. If we start launching next year the ramping up should happen in the years 2012-13-14. These systems are very complex and it is not just a matter of sending up the satellites. At the system level the satellites and ground infrastructure together have to deliver a stable service. So a stable IOC will not be achieved before 2014.

What is the significance of the success of EGNOS on the Galileo program?

In systems like this there is always an element of credibility. The political discussions in Europe have proven to be particularly difficult and for a long time there was uncertainty about whether we are going to be able to do this. EGNOS has been important to prove that it is feasible to do GNSS developments in Europe. Now that we have major portions of Galileo under contract, we hope to raise our credibility quickly.

What kind of market do you see for EGNOS in the non-aviation segment?

Today in Europe the biggest market with an enormous growth rate is agriculture. The farmers are keen on precision agriculture as it saves them both time and money. We are working with a number of tractor manufacturers to promote EGNOS and the take off is just phenomenal. Other interests are in the LBS market, the mobile phone market, the road transport market and the maritime market.

Is there going to be any overlap of Galileo and EGNOS?

EGNOS is there for the long-term and will continue to exist after Galileo has become operational. EGNOS could potentially be integrated into Galileo, depending on the final definition of the Galileo Safety-of-Life Service. So it is too early to tell. Also it will take a while to set the full Galileo system up and to ensure that it is technically stable and functioning.

Over the last few years there have been technological developments on Safety-of-Life which we now need to take into account. Earlier we had defined our Safety-of-Life service based on the PPP (Public Private Partnership) approach which we have now changed. We are also talking to the US to jointly provide interoperable Safety-of-Life Services in the future.

What do you think is the scope of co-operation with India on this program?

In principle the cooperation with India should be very broad on all avenues of these systems - applications, standards and frequencies - to make sure that Indian efforts on GAGAN are coordinated properly with us.

In the past when we were considering the PPP mode the question was whether India would participate on the system itself. Since 2007 we have decided the PPP would not work and it would be the Public Sector which would take over the direct responsibility for the system.

Our industry can procure elements of the system, components or sub-systems from outside Europe and there we strictly follow the WTO agreements and our commitment therein. We have joint procurement agreements with countries like US and Canada, though I do not recall whether India is in the Governmental Procurement Agreement (GPA).

Also, over the years it has been realized that this is a critical piece of infrastructure with a number of security measures on it and therefore needs to be properly protected. This has made it difficult for us to cooperate with other countries on the infrastructure element.

However, we are working very constructively and cooperatively with India on frequencies, coordination, signals and are in contact with ISRO on a number of things. We would like to revitalize the relationship with India, only now the focus would be on downstream work like applications and services. We share a good relationship which has evolved taking into account the realities that have happened both here and in India.

> There are no doubts about China's funding abilities and ambitions but technical performance remains a challenge for them

What are the lessons that India can learn from the EGNOS experience?

We have come to realize that an enormous effort is put into such a system. Also, these systems are expensive. I do not know what India has spent on GAGAN, we have spent around 600-700 million euros on EGNOS, so one cannot just have the system sitting there. One has to promote it and engage the various segments on how it is going to be used.

Since it is new technology the uptake is not always obvious. One has to talk to the technology leaders in the market who have the influence to promote the technology. We have a number of teams working with the various segments. For example the use of this technology at the airports - if the procedures are not implemented at the airports, nobody is willing to equip their receivers; but the airports are not willing to put the procedures in place if there are no receivers. One needs to break through this.

Every market has its own dynamics and one needs to understand that. India is a very diverse and large market with a lot of potential and it will require a lot of effort.

Do you think GAGAN is going to be different from EGNOS?

We are all jointly following the same ICAO (International Civil Aviation Organization) standards. There are some challenges though since we have realized that the standards are not always precisely followed. Last year we had an incident with EGNOS where some receivers did not react in accordance with the standards.

If everyone faithfully implements these standards then basically the systems all achieve the same thing though they may achieve it in different ways.

In an ideal world it would mean for example that an aircraft that flies from India via Europe to the US would use GAGAN, EGNOS and WAAS. We all have a joint interest to see that this works, and therefore as these systems go into the rest of the world it becomes critical that everybody follows the standards.

If GAGAN, EGNOS, and WAAS follow uniform standards would interoperability follow automatically?

The uniform standards of ICAO in

theory mean that any equipment which is made for WAAS should be able to work with EGNOS and GAGAN. The reality is that one needs to verify that this is indeed the case and that the implementation of the standards in the systems and equipment is precise.

We have discovered that we have taken a particular interpretation of the standard in the implementation of the system while WAAS has done it differently. Then the question is whether both these interpretations were possible or was the standard badly written. This is an important issue because finally this will be crucial in the functioning of the equipment with the three or four systems which are eventually going to be there.

What are the some of the problems Galileo has faced with respect to the frequencies and signals vis-à-vis other systems?

There have been two issues related to the frequencies and signals with all the systems. One is whether there is interference between the systems and a pure ITU (International Telecommunications Union) frequency interference analysis can determine that. We have not had a problem with that.

The second issue is more complicated and is related to the security requirements which go with the signals. The national security agencies would like to have the means to stop the signals if they are potentially used for terrorist or related activities without causing problems to their own governmental services. In case of the US this would be their military service. We have got a detailed agreement with the US whereby we jointly protect the PRS signals and the encoded military signals on GPS. On this aspect we have a problem with China.

There are certain requirements that need to be fulfilled which China has chosen not to adhere to and this has shown to be a very complex discussion. The situation with China is unfortunate because we have had similar discussions with the US, Russia, India and Japan and have found solutions.

What efforts do you think need to be put in to resolve the frequency issue?

The resolution of frequency matters is an issue that you see with all the satellite and terrestrial systems that use them, also in satellite navigation. All the providers have an interest in providing new frequencies, signals, designs, plans and constellations. Therefore it has to be a continuous discussion between us to make sure that all of this works. We all have a joint interest in facilitating each other and ensuring that each has a robust service.

What we would like to do with China is come to a point where they understand that it is in our joint interest to find a solution to this compatibility issue. And, if possible, move further to a certain level of interoperability because that is what will benefit the users. If there is interoperability between the systems the users can use all the systems and draw the maximum benefit from them.

Towards this we have an agreement with the US in case of our open service with the GPS civil signal - both are now coordinated and made interoperable. As a result in the future there will be single chipsets which will be able to receive both the constellations. The availability of positioning services for the user will increase with more interoperable satellites in sight.

COMPASS started after Galileo but its pace is much faster, what impact does this have on Galileo?

China does seem to have been quicker probably because their system has been developed within their military structure. This is possibly somewhat easier than the political environment we have.

China also seems to have the ambition and the political interest to do it quickly. However if we look at it from the quality perspective there are serious doubts that they are going to have a reliable system with a given number of operational satellites in a reasonable time frame. Quality has been a problem for the industry in China and we have seen that some of their recently launched satellites have had troubles. There are no doubts about China's funding abilities and ambitions but technical performance remains a challenge for them.

This is a small but high profile industry therefore we all have an interest in maintaining good quality of the systems. If one or more systems fail it will bring uncertainty to the entire industry. Therefore we all need to help each other and deliver what we say we can.

Do you think eventually the focus will shift from having more systems and satellites to improving the ones that are already there?

There are a number of elements involved here. In the US, Russia and China these systems are primary driven by military interests. Galileo is the only system which is driven by civil interests. Therefore for most nations some autonomy is for strategic applications and thus the pressure to have independent systems will remain.

If there are five systems and consequently a hundred fifty satellites around the world it might give the illusion that we are over supplied. However for military purposes each nation would use only its own system. For civil use it would be different but the question is how much we can de-correlate civil and military use.

It is still early to say what we can all do together on the civil side. We have made some headway with the US and are trying to see whether we can make our interoperability steps with the others as well. Therefore it is not only a matter of looking at the civil side of things there is a layer of politics involved.


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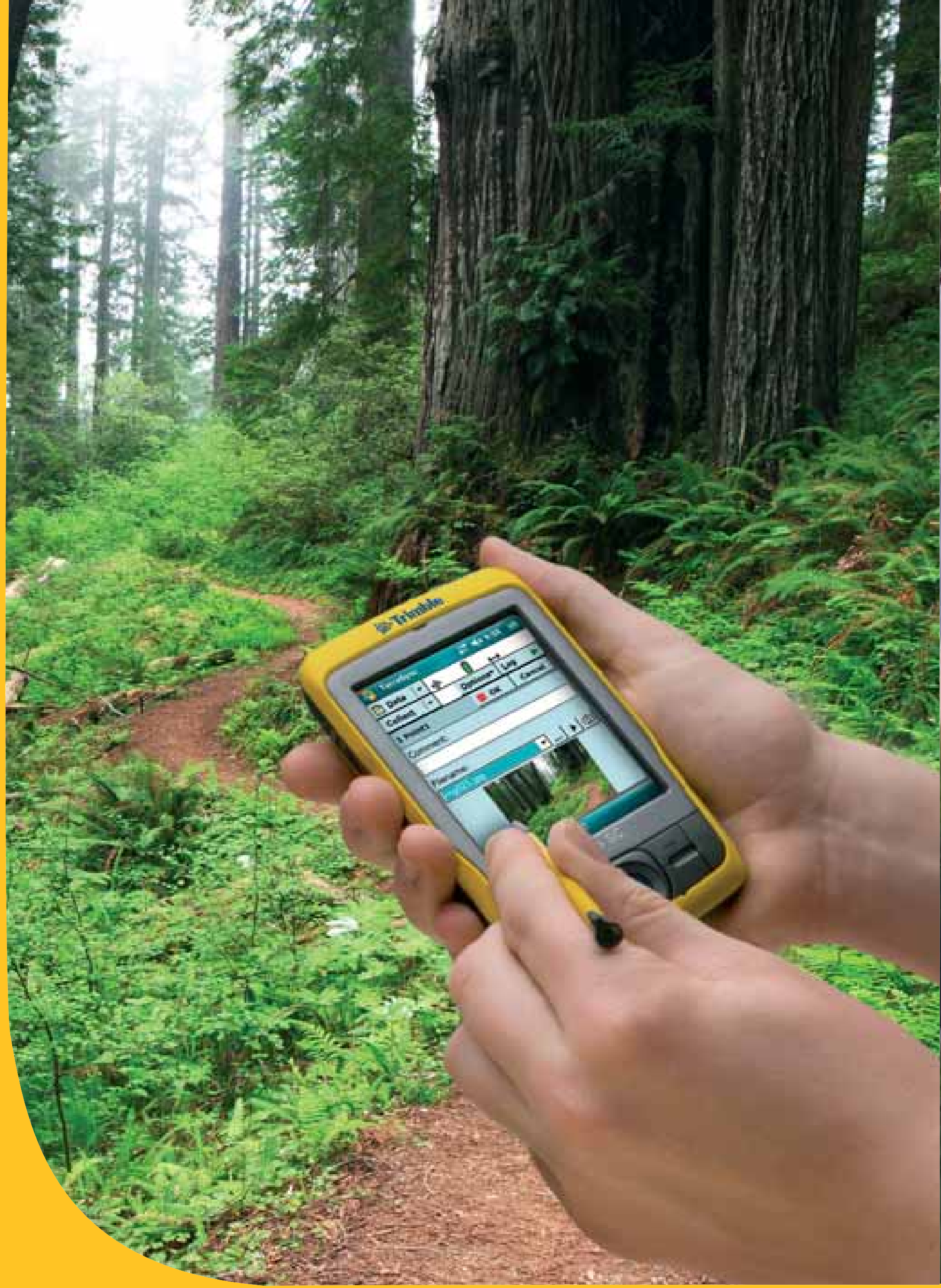
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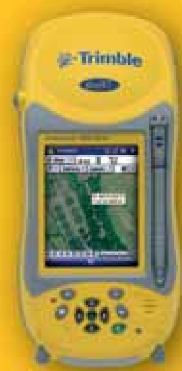

Trimble Solutions at Work

City of Shanghai Digital Greening Project

Over the past several years, the City of Shanghai has been focusing on creating a greener and more sustainable city. To support this effort, the Shanghai Greening and City Appearance Administration has implemented a digital greening project which aims to transform Shanghai through increased planting and better management of trees on public land. Trimble hardware solutions are critical to this project for a variety of data collection, ongoing maintenance, and inspection tasks, including:

- Trimble GeoXT™ handhelds for updating a database of over nine million trees to submeter accuracy as part of city-wide, environmentally conscious initiatives in advance of World Expo 2010
- Trimble Juno SC handhelds for ongoing maintenance and inspection tasks including recording the current health of trees, responding to damaged or diseased trees, and monitoring wildlife in the green areas

"Trying to manage this data with pen and paper was never an option" says "We just wouldn't have had the data fast enough or regularly enough and so it would have been pointless trying to do this without an electronic solution."
Qian Jie, Director of the Shanghai Landscape Administration Information Center

To read the full customer profile along with other examples of Trimble solutions at work, visit www.trimble.com/mgis/customer_stories.

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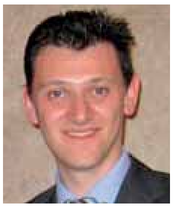
SAT-SURF: An innovative & flexible HW+SW platform to assist research

The integration of navigation and communication functionalities is one of the key elements exploited in new location-based systems and services

Gianluca Falco
PhD program, Electronics and Communication Engineering, Politecnico di Torino, Italy



Fabrizio Dominici
Project manager, ISMB Navigation lab, Istituto Superio Mario Boella, Italy

Gianluca Marucco
Researcher, Istituto Superio Mario Boella (ISMB), Italy

Antonio Defina
Researcher, Istituto Superio Mario Boella (ISMB), Italy

GNSS technologies are progressively becoming one of the key elements in most of innovative wireless applications. Most location-based services and systems are in fact employing standalone GPS, GPS+EGNOS (or WAAS), Assisted-GPS and Differential GPS as core technologies. In order to support the fast diffusion of such technologies, and in order to be ready for the Galileo innovations, companies and academy need to invest at the R&D level as well as to train engineers, technicians and students on these subjects. For this purpose a novel platform has been designed and developed by the Navigation Signal Analysis and Simulation (NavSAS) group (research lab in cooperation with Politecnico di Torino and Istituto Superiore Mario Boella), focused on navigation & localization research topics.

SAT-SURF/ER: A brief description of the system

The new device is composed by SAT-SURF, a hardware box integrating NAV/COM capabilities, and SAT-SURFER, a software suite able to control and communicate with the hardware [1].

A graphical image of the hardware/software device is depicted in Fig.1.

The SAT-SURF hardware includes components of the shelf, i.e. mass

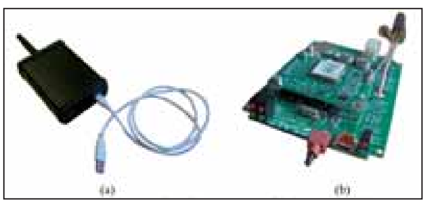


Fig. 1: SAT-SURF : view of the case (a) and of the hardware board (b)

market GPS and GSM/GPRS modules. The innovation of this platform resides in its flexibility, since it has been designed not for a GPS module made by a single manufacturer, but it is has been conceived with a multiple footprint (i.e. pinout of a GPS module) of different GPS receivers. In detail, the current version of SAT-SURF can mount the following five GPS modules:

- uBlox ANTARIS 4 GPS module (DGPS compliant);
- uBlox 5 GPS module (OMA-SUPL Assisted GPS compliant);
- Falcom JP13-LP GPS module based on SiRFstarIII (low power consumption);
- Falcom JP15 GPS module based on SiRFstarIIx (DGPS compliant).
- SkyTraq Venus634LPx-T, a high-performance, low-power, precision timing GPS module.

SAT-SURF also allows to get the data from a remote receiver via TCP/IP connection. In particular SAT-SURF is capable of getting and logging data from all receivers supporting the Septentrio proprietary protocol called Septentrio Binary Format (SBF).

At time of writing, there is no Evaluation Kit (EVK) in the market allowing the same degree of freedom.

SAT-SURFER is the software suite running on standard PC that gets and processes data from SAT-SURF (Fig.2).

SAT-SURFER uses the proprietary protocols (not only NMEA) of GPS modules to get all the available receiver parameters and raw measurements, in addition to conventional positioning information. Such data are displayed in real time on a graphical user interface in order to easily monitor satellites, signals, receiver and user's position. The same data are also logged with the related GPS time stamp and stored in different file formats (ASCII text files, MATLAB®, Microsoft Office Excel®, binary, RINEX 2/3, KML and NMEA) for easy post-processing and analysis purposes.

Such tool provides the possibility to have a common interface towards different GNSS receivers in order to perform measurements and detailed analysis on a common set of data. In particular considering the DGPS technique, it is possible to get the differential corrections as computed by the base receiver through different ways of connection (via COM, GPRS or TCP). Furthermore in case of TCP connection SAT-SURF is able to connect to a Networked Transport of RTCM via Internet Protocol (NTRIP) caster to obtain the required corrections and store all the parameters according to the RTCM standard.

SAT-SURF is equipped with a GSM module in order to provide AGPS functionalities as well. The connection to the Assistance Server can be set via TCP or via GPRS by using the GPRS modem integrated within SAT-SURF. All the communication sessions between the two terminals (Assistance Server of the Base Station and SAT-SURF) are based on OMA-SUPL protocol.

Recently SAT-SURFER allows the user to collect data from three different external Inertial Measurement Units (Microstrain 3DM-GX2, Microstrain 3DM-GX3, and Crossbow IMU.). An Inertial Unit is able to measure accelerations and angular rates of the system that is monitoring.

The supported IMUs implement three axes accelerometers, three axes gyroscopes and, only on the Microstrain models three axes magnetometers. Collected data are tagged using the IMU internal clock, synchronized with GPS (when it is required) and stored in MS Excel, Matlab or text files.

The core of the SAT-SURFER is realized in managed C++ based on .NET 2.0 and is able to control all the other software modules, including the data logging functionalities and several drivers for each GPS receiver, for the GSM modem and for other advanced functionalities (e.g. AGPS, NTRIP DGPS, SISNeT, etc.). Each driver is written in native C++ (unmanaged) allowing to a low level control of the connected hardware modules.

An example of different SAT-SURFER configurations and settings is reported in Fig.3.

SAT-SURF for research and educational purposes

The SAT-SURF and SAT-SURFER features discussed in previous Section offer a wide range of potential type of analysis and applications both for education and research purposes.

On an educational point of view some possible uses can be the following ones:

- practical training in the field of GNSS and communication technologies: in fact SAT-SURF and SAT-SURFER can be used in order to complement the necessary theoretical knowledge giving to the students a practical experience with real receivers;
- analysis of the evolution of different signal and receiver parameters and observables (including number of satellite in view and used for the PVT computation, C/N0, Doppler frequency shift, carrier phase, GDOP, ephemeris parameters, ionospheric parameters, satellite positions) versus GPS time and

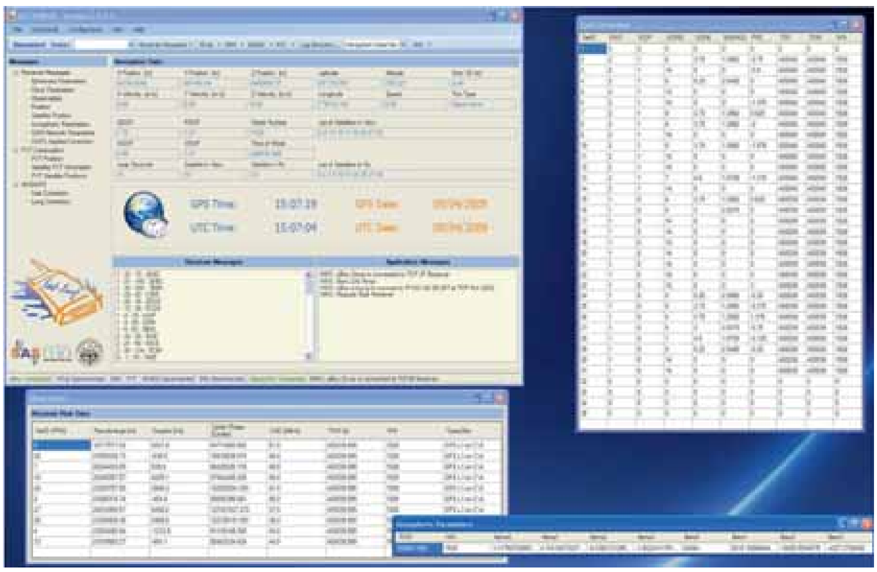


Fig. 2: Screenshot of SAT-SURFER Graphical Unit Interface

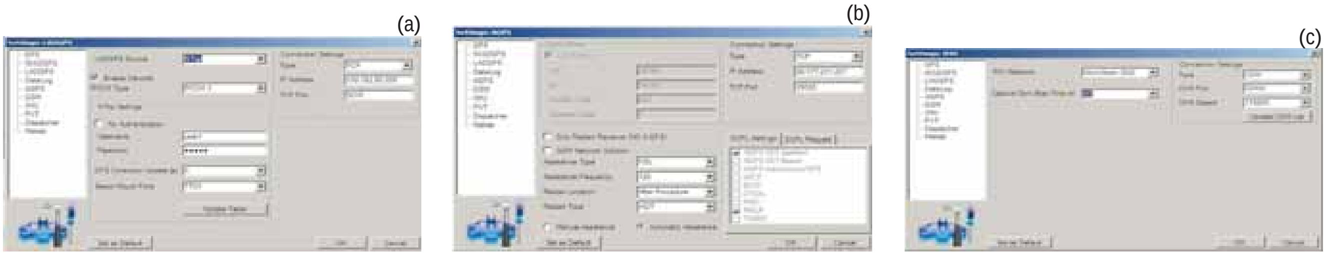


Fig.3: An overview of different settings and configurations of SAT-SURFER: Local Area Differential GPS (a), Assisted-GPS (b), Integration with external sensors: IMU (c).

in different environmental conditions (e.g. outdoor vs light-indoor);

- implementation and performance validation of PVT computation strategies using raw pseudorange measurements and reliable comparison of positioning performances.

At the same time, SAT-SURF represents a valid and effective instrument to be used by researchers which can give the possibility to store a huge amount of raw data and satellite parameters as well as to simplify the analysis in post-processing. At the time of writing SAT-SURF has been successfully exploited in several research experiments. The most remarkable ones are cited in the following part of the section:

- Since there is not a clear-cut answer on the corrections update rate effect, the aforementioned device has been used to investigate how the time interval between a correction set and the following affects the positioning. Several tests both in static and dynamic mode have been run 2-4 hours long in different times of the day order to have exhaustive results [3]. For each of these trials four SAT-SURFs running in parallel were used and set to receive DGPS corrections with rates of 1, 15, 30 and 59 seconds. Results are plotted in Fig.5.

- One parameter that characterizes the performance of a GPS receiver is represented by the Acquisition Sensitivity that corresponds to the minimum power level a receiver is able to correctly identify a satellite signal [4]. By the combined use of SAT-SURF and a signal generator we have tested two mass-market GPS receivers and a professional one [5]. The final acquisition sensitivity values are then compared with respect to the parameters reported on their data sheets (Fig.6)

- The benefits of a GPS/INS integration are that the INS estimates be corrected by the GPS estimates and that the INS can provide position and angle updates at a quicker rate than GPS. For high dynamic vehicles such as missiles and aircraft, INS estimates can interpolate between GPS estimates. The two systems are complementary and are often employed together. Numerous

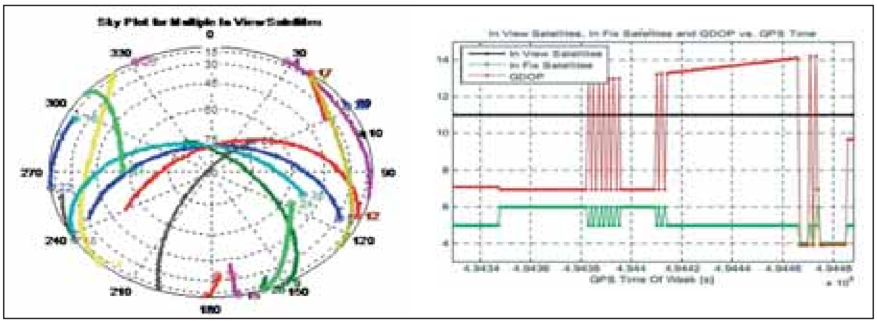


Fig.4:SAT_SURF as a tool aimed at GNSS education: sky plot of satellite in visibility (a), number of satellite in fix and in view respectively with the related value of GDOP (b)

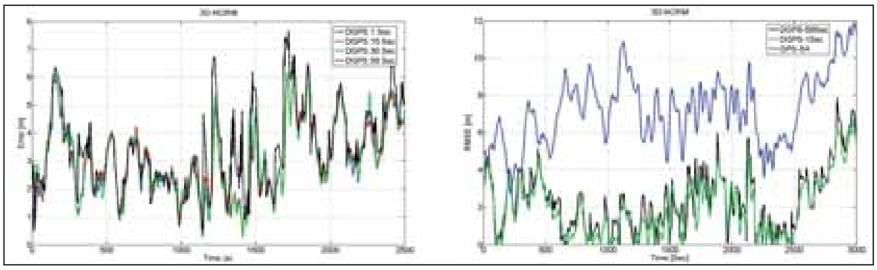


Fig.5: 3D-Error evaluation for different DGPS correction rate in Stationary Condition (a) and in a dynamic Open Sky scenario (b).

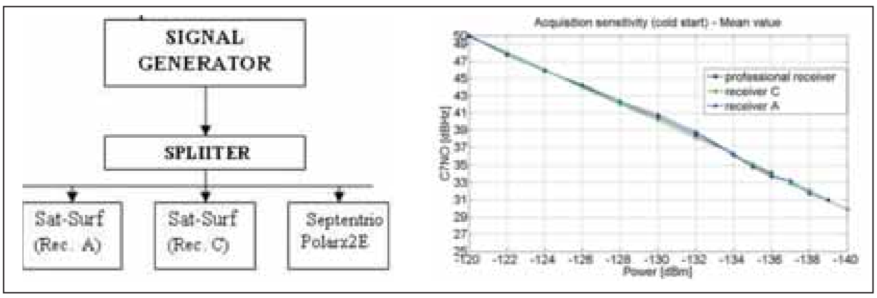


Fig.6: Acquisition sensitivity (b) evaluated in cold start condition for different GPS modules (a).

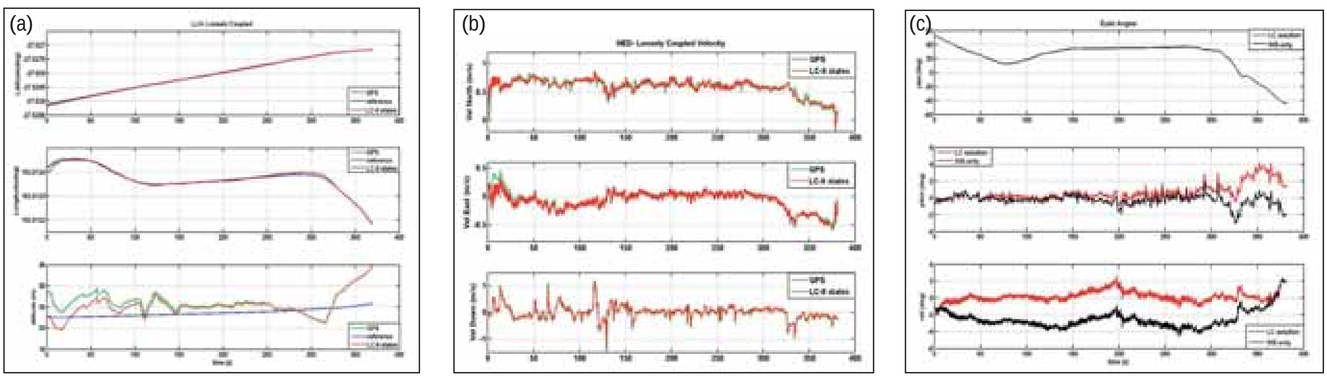


Fig.7: Loosely Coupled performance: position (a), velocity(b) and Euler Angles (c).

approaches are possible for the integration of GPS and INS estimates to provide a combined navigation solution. Differences between the various approaches are based on the type of information that is shared between the individual systems. There are two main categories of integration approaches: loosely coupled (LC) and tightly coupled (TC). The first method uses GPS position and velocity measurements in a Kalman filter that models INS error dynamics. The second (?) approach uses GPS estimates of Pseudoranges and Doppler (determined by using satellite ephemeris data) and inertial estimates within a Kalman filter. By the use of SAT-SURF that collects raw IMU data synchronized with the GPS a loosely and tightly performance has been investigated. In Fig.7 an example of loosely coupled GPS/INS integration is shown [6].

- The integration of navigation and communication functionalities is one of the key elements exploited in new location-based systems and services. The Assisted-GNSS is a strategy based on such integration delivering through the COM channel assistance parameters[7]. The most recent architecture for the interchange of GPS assistance data is the so called OMA-SUPL [8] (Open Mobile Alliance – Secure User Plane Location). Specific tests in the field of Assisted-GPS proved the capabilities and flexibility of the tool highlighting interesting features in the use of aiding over embedded systems. For example we have run trials based on the architecture as depicted in Fig.8a where the SET is an embedded system (SAT-SURF) controlled by a SW tool (SAT-SURFER) that acts as SUPL agent and data logger[9]. The experiments have shown the benefits of the assistance in terms of TTFF (Time to First Fix) as well as of accuracy and sensitivity for an indoor scenario (Fig.8b)

Conclusions

In this paper a novel NAV/COM platform for research and educational purposes has been introduced, presenting in detail the hardware (SAT-SURF) and the software (SAT-SURFER) feature and also showing some examples of applications. The examples described in the paper have stressed once again how the new device offers a high range of flexibility and how it can be a strong support for different research topics.

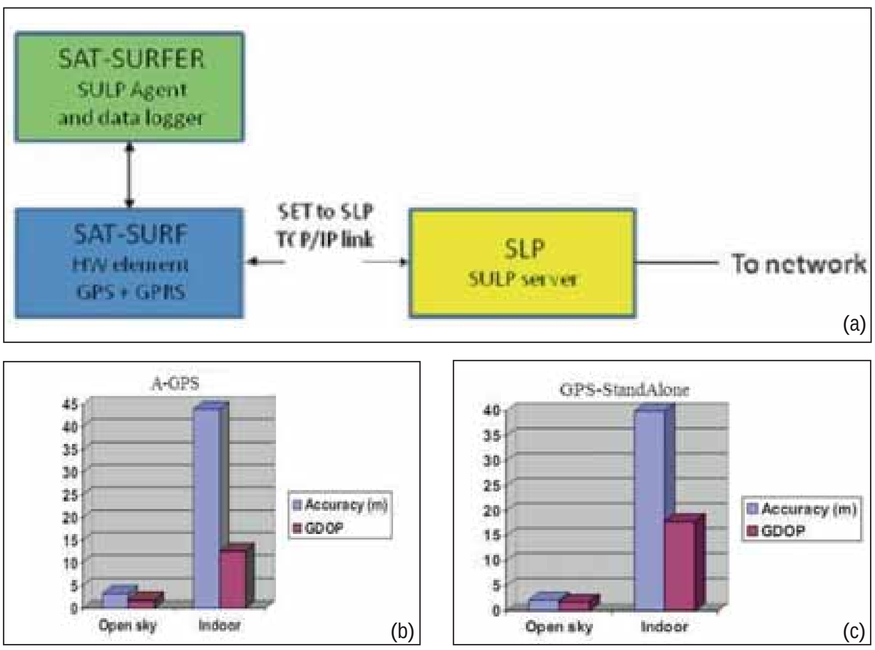


Fig.8: AGPS setup (a), Accuracy performance in case of an Open Sky and Indoor Scenario with and without Assistance (b), (c).

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The implementation of a simulation platform for INS/GNSS integrated systems

Readers may recall that in last issue we published the components of INS/GNSS simulation platform and principle of the simulator. Here we present the results and discussion

Chih-Yu Hu
Department of Geomatics, National Cheng Kung University, Taiwan

Meng-Lung Tsai
Department of Geomatics, National Cheng Kung University, Taiwan

Kai-Wei Chiang
Department of Geomatics, National Cheng Kung University, Taiwan

Results and discussions

Some numerical examples are given in this section to illustrate the applicability and capability of proposed simulation platform. All the simulation scenarios are conducted with the specification of a tactical grade IMU with 0.0001g accelerometer bias and 0.75 deg/hr gyro drift.

Assume that DGPS measurements is undertaking so that the standard deviation of position solutions from GNSS are considered 0.5m. Besides, 4 periods of GNSS outage (no visible satellite) which last 60 seconds are designed to verify the performance of the optimal estimation engine. The RTS smoother is implemented in both Loosely-Coupled and Tightly-coupled architectures, respectively. The trajectory is generated by the trajectory generator. The maximum speed in straight line is about 60 km/hr. Simulation time last 24.7 minutes. All the navigation solutions are compared to "true" data to verify the performance of the estimation algorithms

Filter tuning

Some initial knowledge are required to start a Kalman filter, such as state transition matrix ($F_{k,k-1}$), design matrix (H_k), noise coefficient matrix (G_{k-1}), system noise covariance matrix (Q) and measurement noise covariance matrix (R). Among them, the Q and R matrices are the most important factors for the quality of the Kalman filter estimation for an INS/GPS integrated system.

Theoretically, the optimal Q and R matrices can guarantee the optimal estimation; however, it is not easy to obtain such information. In fact, tuning optimal Q and R matrices can be time consuming and it requires strong experience and background in both systems. Consequently, the requirement of human interference for Q/R tuning is very high. In other words, the tuning process can be regarded as a special form of learning process as it is usually done by experienced people and it needs a period

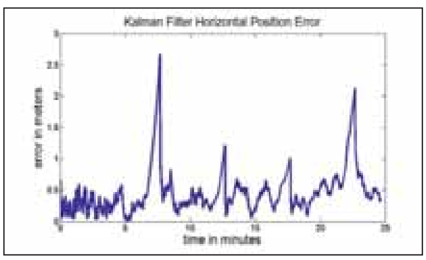

Fig 15: Well-tuning KF

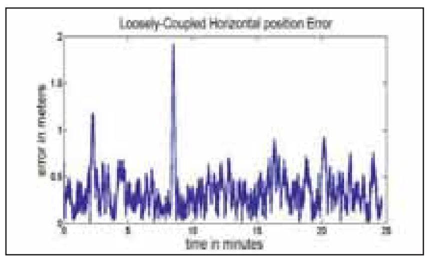

Fig 17: Result of Loosely-coupled with good GNSS

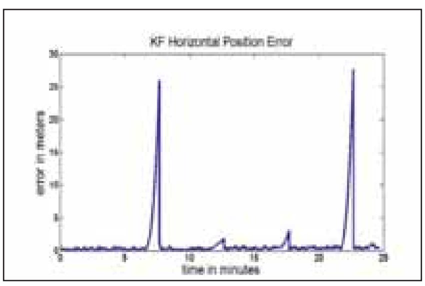

Fig 16: Improper Q matrix

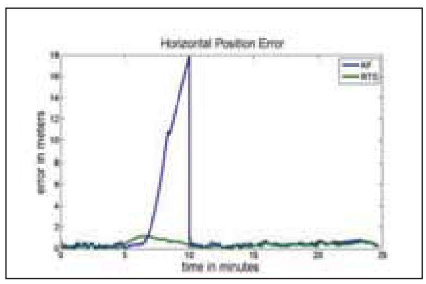

Fig 18: 300s GNSS outage

of time to obtain the optimal solution that might not even exist. The requirement of prior knowledge is not a burden; however, how to obtain correct and useful knowledge is, for example, tuning optimal Q and R matrices for Kalman filter processing is time consuming and frustrating unless it is done by experts.

This simulator provides an easy way to understanding the behavior while tuning the matrix. Figures 15 and 16 illustrate the results with well-tuned and improper Q matrices, respectively.

It clearly sees that when GNSS outage occurs the INS performance with impropriety Q will cause position error growing faster than a fitter one. There are four GNSS outage assign to the simulation. Each of them lasts 60 seconds. The maximum position error in GNSS outage can reach about 26m and its RMS is 11.4987m as shown in Figure 16. Comparing to well-tuning Q, the maximum of position error is only about 2.6m and its RMS is 1.508m.

The need to re-design algorithms based on the Kalman filter (i.e., states) to operate adequately and efficiently on every new platform (application) or different systems (i.e., switch from navigation grade IMU to tactical grade IMUs) can be very costly. In addition, the Q and R matrices tuning is heavily system dependent. For example, it is impossible to use the sets of parameters that are designated for navigation grade IMU for the estimation utilizing tactical grade IMUs. By using the proposed simulation platform, user can appreciate the filter tuning process using various "pseudo" IMUs with different accuracies. In this case, it can be used as a tool to train people how to tune the Q matrix theoretically according to the grade of IMU selected without actually getting a pricy IMU and conducting time consuming filed tests.

The comparison between loosely coupled EKF and RTS

Figure 17 illustrates the results of the commonest INS/GNSS integrated architecture. The RMS of positional errors is 0.4013m. No GNSS outage is simulated in this case.

Figure 18 compares the results of EKF and RTS smoother with a segment of simulated GNSS outage with 5 minutes in length. .The RMS of positional error arises to 8.78m. On the contrary, The RTS smoother did a great job compensating the state vector during GNSS outage. Therefore, the position RMS after using RTS smoother can be reduced to 0.83m. The improvement in term of positional error after applying RTS smoother reaches 90%.

Figure 19 illustrates the performance of EKF and RTS smoother during frequent GNSS outages. Table 2 illustrates the RMS values of positional errors during simulated GNSS outages for EKF and RTS smoother, respectively.

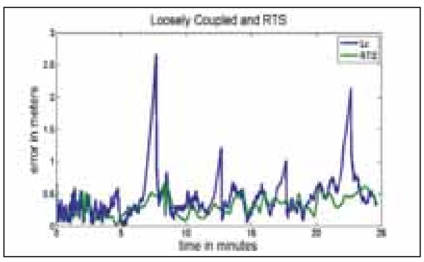

Fig 19: Four 60s GNSS outage

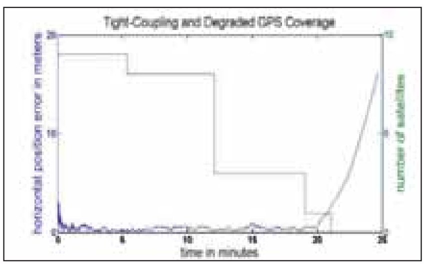

Fig 21: Tightly-Coupled with GNSS Degradation

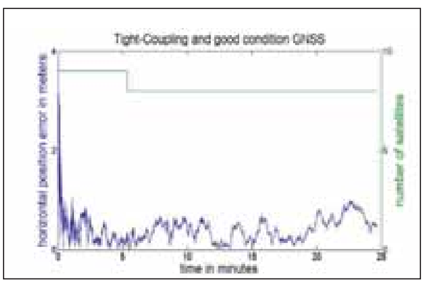

Fig 20: Tightly-Coupled with well-condition GNSS

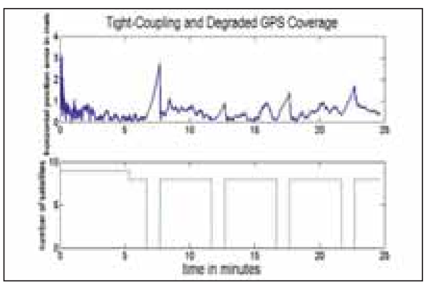

Fig 22: Tightly-Coupled in GNSS outage

Table 2 RMS in GNSS outage (Loosely-Coupled only)

Outage	1	2	3	4
EKF-RMS	1.51m	0.66m	0.67m	1.37m
RTS_RMS	0.28m	0.13m	0.08m	0.15m

The comparison between tightly coupled EKF and RTS

The number of satellite in view is an interesting problem when the tightly coupled integration architecture is implemented. Figure 20 illustrates the performance of the tightly coupled architecture when no GNSS outages occur. The RMS of positional error is 0.4754m, which is similar to the result of the loosely couple architecture, as shown in Figure 17.

When degraded GNSS coverage occurs, the advantage of tightly-coupled appears. Figure 21 illustrates the situation of degrading GNSS coverage. When the number of satellites becomes less than 4, the tightly coupled architecture can still provide reasonable position solution. Figure 22 illustrates the performance of tightly coupled architecture during frequent GNSS outages. The above figure indicates the performance when there is no GNSS signal available and lower one illustrates the variation of the satellite in view. Table 3 illustrates the RMS values of the positional error during each GNSS outage. With no satellite in view during those GNSS outages, the performances of loosely coupled and tightly coupled architectures are quite the similar, see Tables 2 and 3 for comparison.

Table 3 RMS in GNSS outage (Tightly-Coupled only)

Outage	1	2	3	4
RMS-EKF	1.42m	0.42m	0.81m	0.99m
RMS-RTS	0.18m	0.08m	0.09m	0.10m

Figure 23 compares the performance using EKF and RTS smoother, respectively. The RMS values of positional error after applying RTS smoother is given in Table 3.

The comparison between loosely coupled and tightly coupled EKF

After discussing the performance of loosely coupled/tightly coupled EKF and RTS smoothers, Figure 24 illustrates the performance between the loosely coupled and tightly coupled EKF when degraded GNSS coverage occurs. While received GNSS signal become less than 4 satellites, the loosely coupled EKF can't provide integrated navigation solution but the tightly coupled EKF still work properly till there is no satellite available.

Figure 25 illustrates a conceptual plot concerning the impact of the RTS smoother on the positioning error in case of a GPS outage. As illustrated in Figure 25, the use of RTS smoother is able to remove the residual errors of KF significantly; however, some residual errors still remain. It can be seen that the proposed INS/GNSS simulation platform can not only emulate measurements for advanced algorithms research but provide optimal estimation engine for investigating some practical issues concerning the development of INS/GNSS integration algorithm. Therefore, it is a cost effective tool not only for research but for education as well. It becomes easier in studying INS/GNSS integration algorithm and Kalman Filter arguments tuning through the simulator. Without experience hardware, it totally composes of software thus the system becomes more fixable.

Conculsions

This study exploits a complete INS/GNSS simulation platform. Its architecture includes trajectory generator which can generate all kind of trajectory by user defined. Measurement generator created IMU and GNSS measurements according to the user designed path data and senor error model. Estimator has two different data process strategy, feedforward which suit for high grade IMU and feedback for tactical grade or MEMS IMU. Besides, The EKF and RTS smoother are implemented by loosely coupled and tightly coupled integration architecture.

It will become easier in studying INS/GNSS integration algorithm and Kalman Filter arguments tuning through the simulator. Without expensive hardware, it totally composes of software thus the system becomes more fixable. Not only in study but also the result of simulation also can be the principle of IMU purchase. User can easy create a varied environment where desired IMU is expected to work. Then through simulation, the adaptive IMU can be selected. In the future, not only in the high demand of accuracy in mapping or low-cost navigation for personal use, this simulator can provide precise simulation as possible. To reach all kind of demands, the estimation process engine is implemented to process real measurement as well.

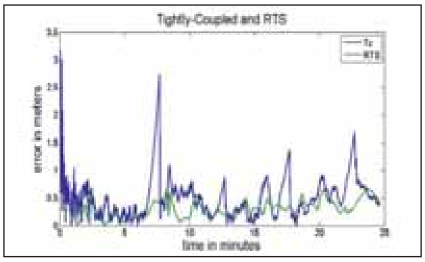

Fig 23: Tightly-Coupled and RTS

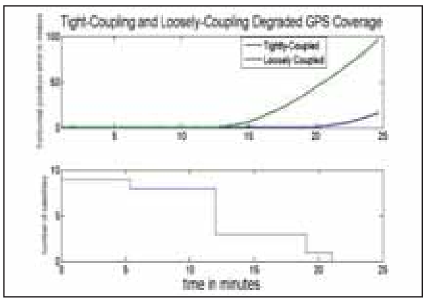

Fig 24: Loosely-Coupled and Tightly-Coupled in GNSS degradation

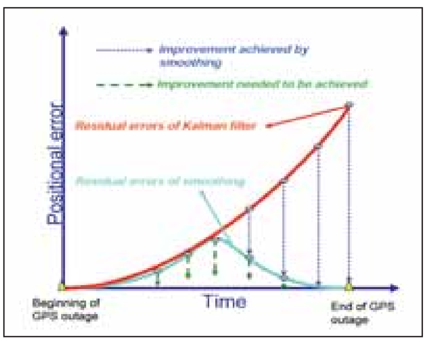

Fig 25: The impact of RTS smoother on positional error during outage

Acknowledgements

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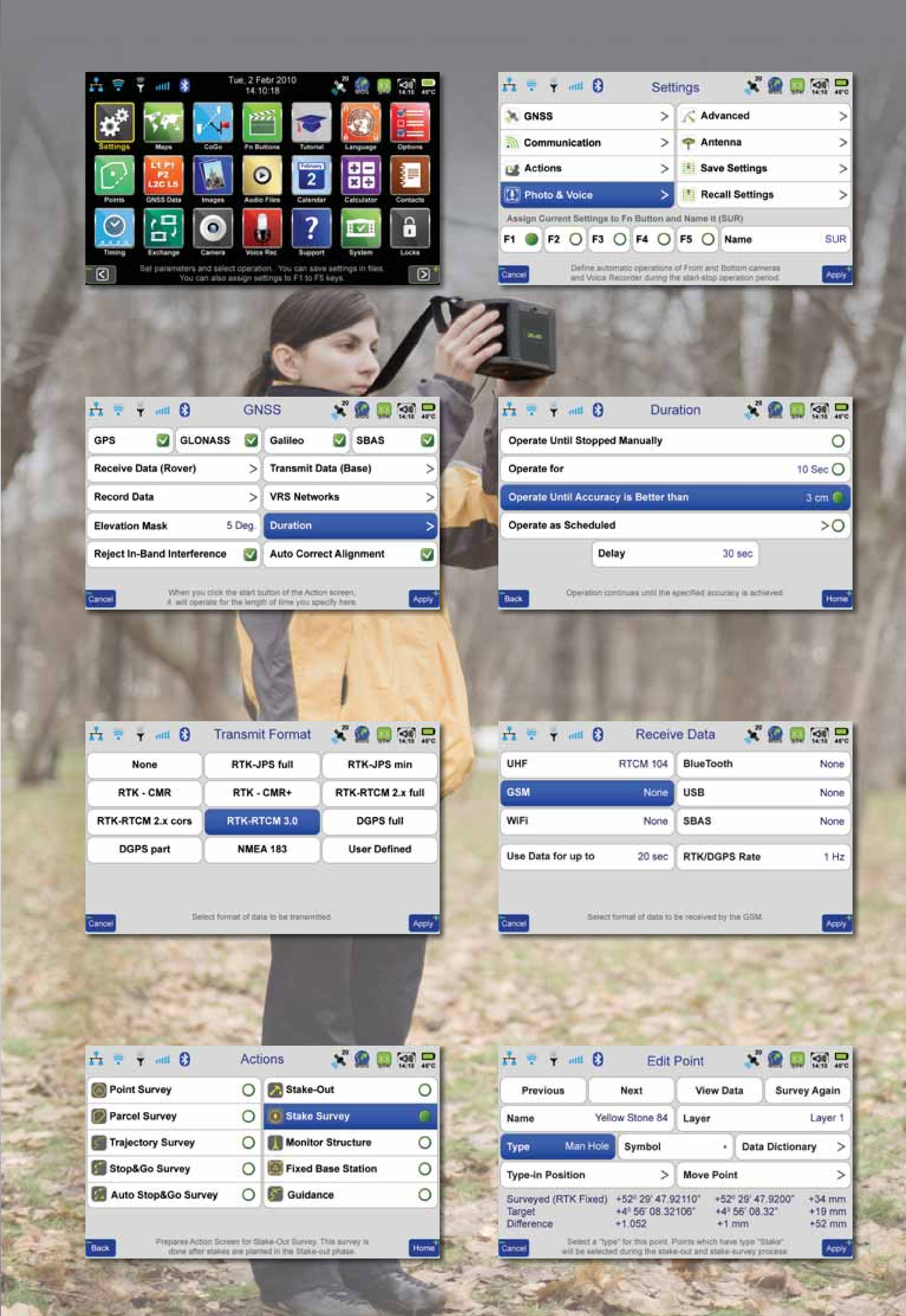

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Set parameters and select operation. You can save settings in files.
You can also assign settings to F1 to F5 keys.
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Communication
Antenna
Actions
Save Settings
Photo & Voice
Recall Settings
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and Voice Recorder during the start-stop operation period.
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SBAS
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it will operate for the length of time you specify here.
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3 cm
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30 sec
Back
Operation continues until the specified accuracy is achieved
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Parcel Survey
Stake Survey
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Stop&Go Survey
Fixed Base Station
Auto Stop&Go Survey
Guidance
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Prepares Action Screen for Stake-Out Survey. This survey is
done after stakes are planted in the Stake-out phase.
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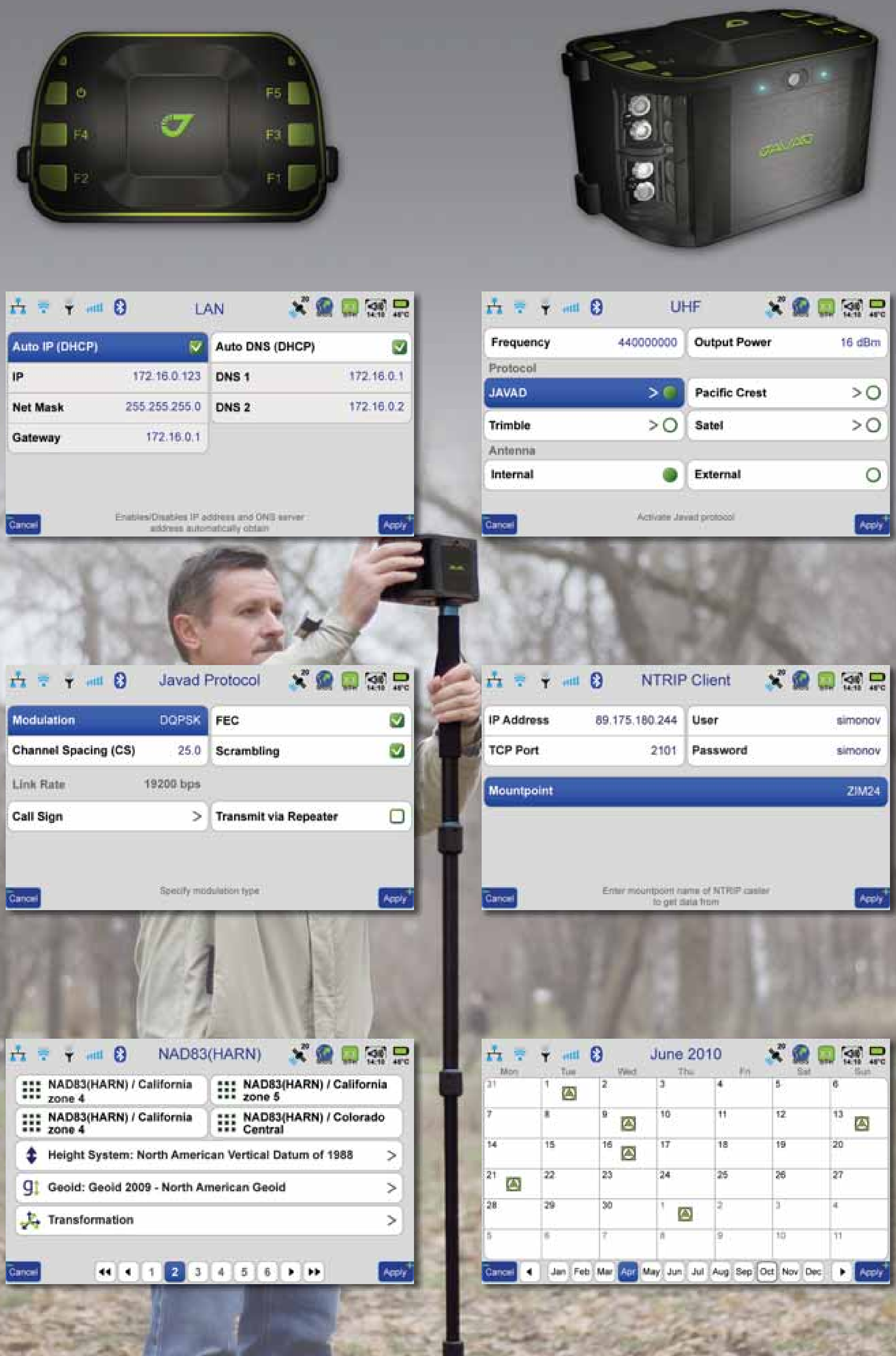

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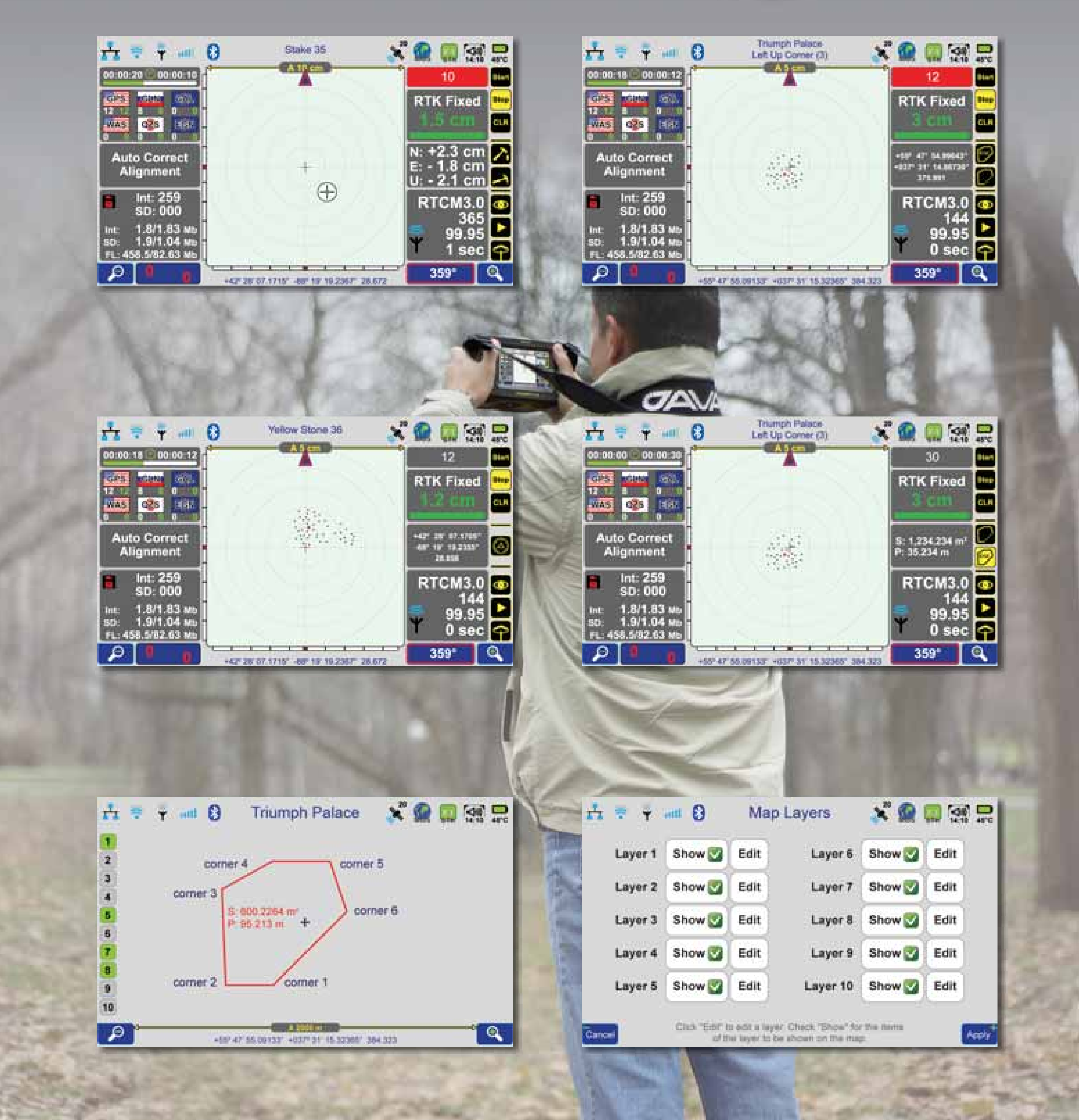

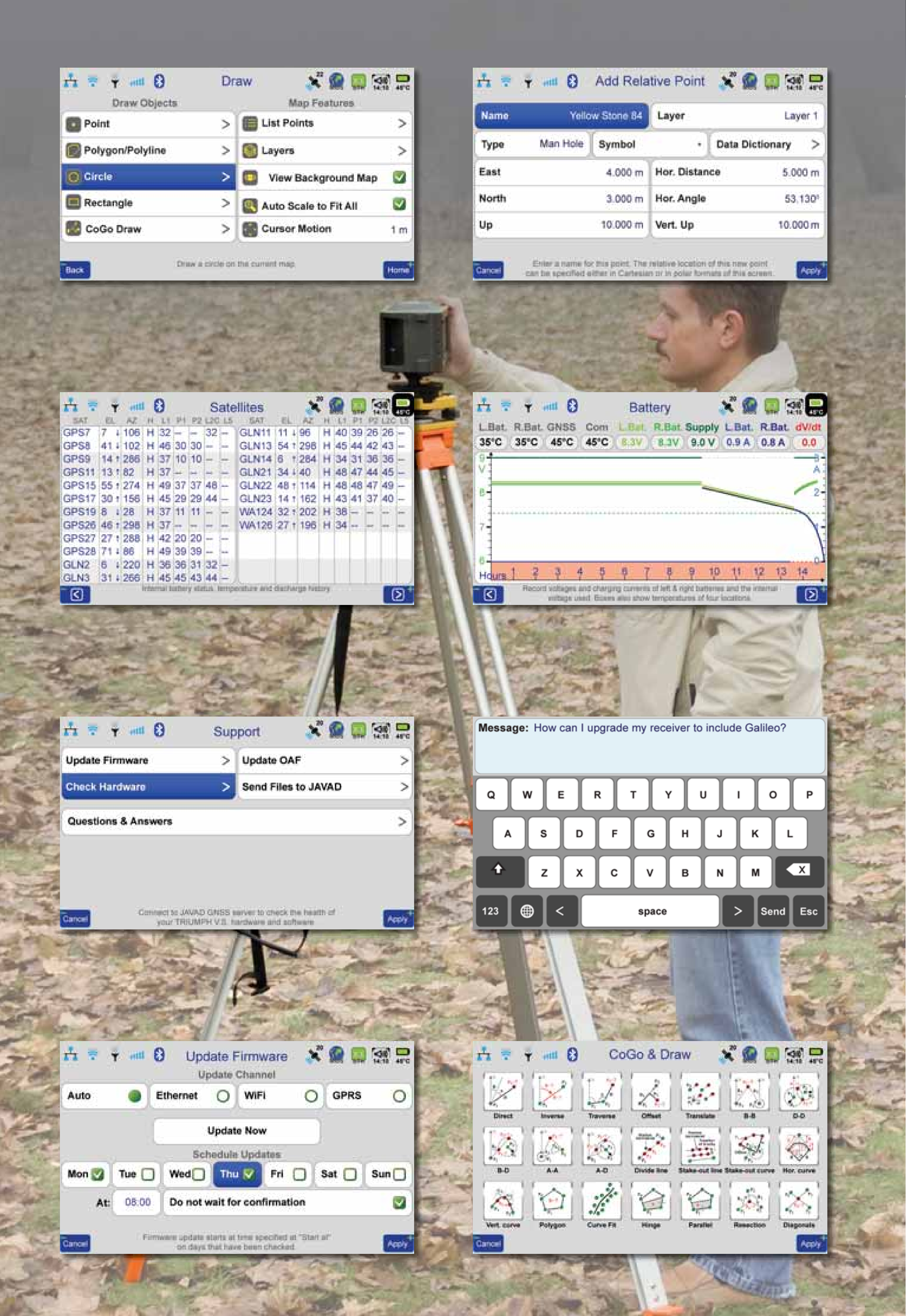

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Internal battery status, temperature and discharge history
Battery
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Record voltages and charging currents of left & right batteries and the internal voltage used. Boxes also show temperatures of four locations.
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Update OAF
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Questions & Answers
Cancel
Connect to JAVAD GNSS server to check the health of your TRIUMPH V.S. hardware and software
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Message: How can I upgrade my receiver to include Galileo?
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Firmware update starts at time specified at "Start at" on days that have been checked.
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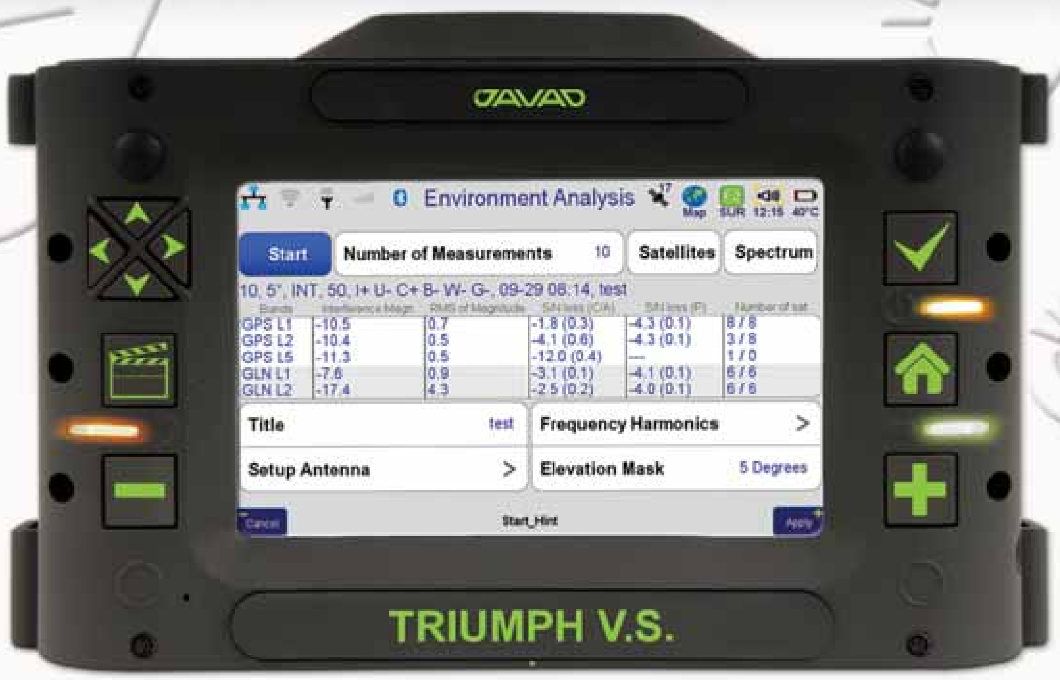
216 Channels GPS + GLONASS + Galileo Geodetic Receiver

Patent Pending



TRIUMPH-VS not only scans the GNSS bands and shows the shape and frequencies of the interferences, but it also quantifies the magnitude of the interferences in two distinct and complementary ways: a) by analyzing the analog signal and determining the “Interference Magnitude”, and b) by analyzing the S/N (Signal-to-Noise ratio) of all satellites’ signals after they are digitized and processed (after code and carrier correlations) and determining the “Satellites S/N loss” due to interferences.

“Interference Magnitude” is determined by analyzing the amount of gain that we can apply to the GNSS signal before digitizing it. The more interference there is, the less we can amplify the signal to avoid saturation. We can determine the “Interference Magnitude” by comparing the actual amplification magnitude with our nominal amplification magnitude (when no interference exists).

“Satellites S/N loss” is determined by comparing the actual measured S/N of each satellite (for each of its signals) with its nominal S/N at that elevation angle and then averaging all such deviations for all satellite signals.

TRIUMPH-VS not only analyzes and shows interferences, it also has In-Band Interference Rejection option that removes in-band interferences.

Numerical simulations of the optimal geodetic conditions with radioastron

The feasibility for the estimation of EOPs has been investigated, then appropriate number of stations and epochs for the estimation of parameters have been analyzed

Erhu WEI
PhD, Professor, School of Geodesy and Geomatics, the Key Laboratory of Geospace Environment and Geodesy, Ministry of Education, Wuhan University, China

Sándor FREY
astronomer
PhD Institute of Geodesy, Cartography and Remote Sensing (FOMI), Satellite Geodetic Observatory Budapest, Hungary

Peilai ZHOU
engineer, Xiuzhou District Branch, The Bureau of Land and Resources Jiaxing, Jiaxing, Zhejiang, China

Jingnan LIU
professor, Academician of CAE (P.R. China), GNSS Center,Wuhan University, China

Space Very Long Baseline Interferometry (SVLBI) is the unique space technology that can directly interconnect the three reference systems, which include the Conventional Inertial System (CIS) fixed in space and defined by radio sources, the Conventional Terrestrial System (CTS) fixed to the Earth and defined by a series of observing stations on the ground, and the dynamic reference system defined by the movement of a satellite. In this paper, the Space VLBI mathematical model with notation parameters, and its feasibility for estimation of EOPs are discussed. Simulations have been done for the SVLBI observations and related parameters for RADIOASTRON. With the results of the simulation, the feasibility for the estimation of EOPs has been investigated, then appropriate number of stations and epochs for the estimation of parameters have been analyzed.

Introduction

For all the three pillars of space geodesy (the geometry of the Earth surface and its displacements, the orientation of the Earth axis and its rotation speed, and the Earth's gravity field and its time variations), well-defined, highly accurate and stable global Earth-fixed and celestial reference frames are of primary importance. Over the last decade considerable changes took place in space geodesy: the accuracy of the space geodetic techniques has improved dramatically up to 10^{-9} for geometric geodesy, Earth rotation and gravity field measurement. Many new missions are being prepared, planned, or on-going. All these developments pose new and demanding challenges concerning the consistency and accuracy of the three pillars and thus better-defined, more accurate and stable global Earth-fixed and celestial reference frames are crucial to meet these challenges. As a new and rapidly developing technique, SVLBI has tremendous potentials in geodetic research. SVLBI can not only directly interconnect the above two reference frames by determining the 5 Earth orientation parameters (EOPs) which include 3 Earth rotation parameters ($xp, yp, \theta k$) and 2 nutation parameters ($\Delta\Psi$, $\Delta\varepsilon$), but also it can be used to avoid or examine the systematic errors made by the other co-located multi-techniques.

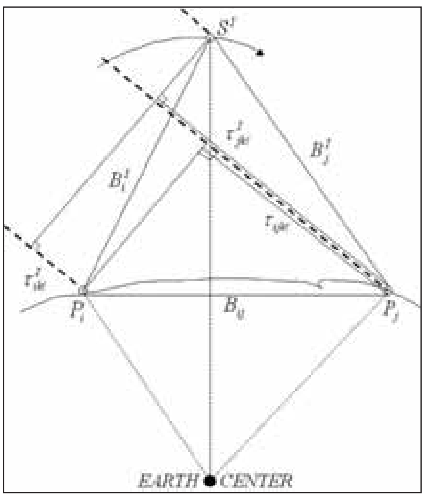


Fig 1 Geometric Figure of Ground-Space Baseline

Following the VLBI Space Observatory Programme (VSOP) of Japan, another Space VLBI mission, called RADIOASTRON, is being planned by Russia with international collaboration for a launch as early as 2010. The two VLBI observatories in Urumqi and Shanghai of China may participate in the observations.

However the present and foreseeable practical realizations of SVLBI are driven by astrophysical goals. Also, with VSOP observations, the geodetic test result by Frey et al. (2002) showed that it was difficult for VSOP to improve the precision of the determination of EOPs with the astrophysical observation conditions. So, it is necessary to determine the optimal observing conditions,so that RADIOASTRON can be used to improve the precision of the determination of EOPs.

In this paper, the modified SVLBI mathematical model with the EOPs is introduced. The possibility of the model for estimating EOPs has been theoretically studied by Erhu Wei (2008a), and the estimable parameter sequence has been extracted too. Based on these results, the SVLBI observations and the values of related parameters for RADIOASTRON are simulated in this paper. According to the simulated parameters, a matrix A of observation equation will be designed to discuss the validity of the modified model for estimating different EOPs. Finally, the effect of the number of stations, the number of observation epochs and the observation interval on the precision of the EOPs is studied, and the conclusions are presented.

Mathematical Model

Geometric Model

In the network of SVLBI, $B_j^l(t_k)$ is the baseline between the space-based radio telescope S^l and ground-based radio telescope P_j at the time t_k, τ_{jkl}^l and $\dot{\tau}_{jkl}^l$ are respectively the delay and delay rate observations of the radio signal between S^l and P_j (Figure 1). So, the ground-space baseline observation with clock parameters can be expressed by Eq.(1) and Eq.(2).

$$d_{jkl}^l = c\tau_{jkl}^l = -B_j^l(t_k)\cdot e_l + c[\Delta C_{0rj}^l + \Delta C_{1rj}^l(t_k - t_0)] \quad (1)$$

$$\dot{d}_{jkl}^l = c\dot{\tau}_{jkl}^l = -\frac{dB_j^l(t_k)}{dt} + c\Delta C_{1rj}^l \quad (2)$$

Where e_l is the unit vector of the orientation of the radio source l, ΔC_{0rj}^l and ΔC_{1rj}^l are clock parameters, c is the speed of light, t_0 is the beginning observing moment.

Adam (1990) has derived the mathematical model of ground-space VLBI time delay observation, in which there are no nutation parameters that are used to connect the terrestrial coordinate system and the celestial coordinate system. In order to improve this model, Erhu Wei et al. (2008a) has derived a new SVLBI observation model, which contained the nutation parameters and can be expressed as Eq. (3).

$$d_{jkl}^l = -\left\{ \begin{bmatrix} X_j \\ Y_j \\ Z_j \end{bmatrix}^T R_y(-x_P)R_x(-y_P)R_z(\theta_k) - \begin{bmatrix} X_K^l \\ Y_K^l \\ Z_K^l \end{bmatrix}^T \right\} \times \left\{ N \begin{bmatrix} \cos\delta_l\cos\alpha_l \\ \cos\delta_l\sin\alpha_l \\ \sin\delta_l \end{bmatrix} \right\} + c[\Delta C_{0rj}^l - \Delta C_{1rj}^l(t_k - t_0)] \quad (3)$$

Where

X_j, Y_j and Z_j are the CTS coordinates of the observing station, X^l_K, Y^l_K and Z^l_K are the true-of-date celestial coordinates of satellite S^l at moment t_K, α_l and δ_l are the mean right ascension and mean declination of radio source l at the moment t_K with precession corrections;

x_p, y_p and θ_k are Earth rotation parameters;

$R_i(\phi)$is the rotation matrix around axis i (Φ is the rotation angle);

c is the speed of light;

t_0 is the beginning observing moment;

ΔC^l_{0rj} and ΔC^l_{1rj} are the clock error and clock drift between the reference clock at the monitor station and clock P_j at the observing station.

N is the nutation matrix , which can be expressed as Eq.(4) and Eq.(5)

$$N = R_x(-\varepsilon - \Delta\varepsilon)\cdot R_z(-\Delta\psi)\cdot R_x(\varepsilon) \quad (4)$$

$$N = \begin{bmatrix} 1 & -\Delta\psi\cos\varepsilon & -\Delta\psi\sin\varepsilon \\ \Delta\psi\cos\varepsilon & 1 & -\Delta\varepsilon \\ \Delta\psi\sin\varepsilon & \Delta\varepsilon & 1 \end{bmatrix} \quad (5)$$

Where ε is the mean obliquity of the ecliptic, Δψ and Δε are respectively the nutation in longitude and the nutation in obliquity. In Eq.(3), the systematic effect of clock is naturalized in the geometric time delay observation by modeling with 1st-order polynomial.

On the other hand, the coordinates of the ground station, satellite and radio source are transformed to the real celestial coordinate system at the moment tk by Eq.(3), which solves the transformation between the conventional celestial system and the real celestial coordinate system in the observation. So, all coordinates in the model are united in the same reference frame for the next derivation.

Estimable parameters

In the mathematical model, there are three coordinates of a station on the ground, three coordinates of the satellite, two coordinates of a radio source, three parameters of the Earth rotation, two nutation parameters, and the clock parameters. So the estimated parameters in the model can be listed in Eq.(6)

$$\{X_j, Y_j, Z_j, X_K^l, Y_K^l, Z_K^l, \Delta\psi, \Delta\varepsilon, x_P, y_P, \theta_k, \alpha_l, \delta_l, \Delta C_{0rj}, \Delta C_{1rj}\} \quad (6)$$

In order to investigate the estimability of the parameters above, Erhu Wei et al. (2008b) has derived the analytic expression of Eq.(3), and its differential equation Eq.(7),

$$d(d_{jkl}^l) = \sum_x C_x dx \quad (7)$$

Where C_x is the partial derivative with respect to the parameter. In this paper, the coefficient matrix A is formed according to Eq.(3) and Eq.(7) and the simulation

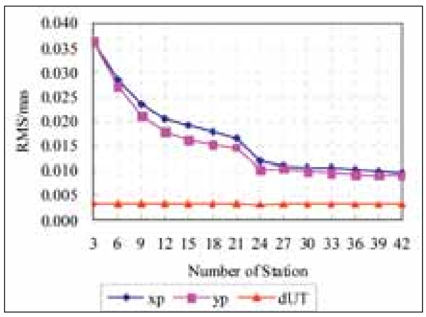


Fig. 2 Effect of Number of Stations on x_p,y_p and dUT

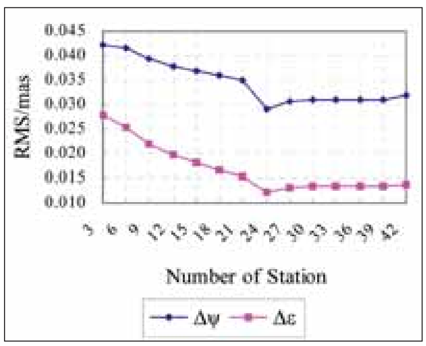
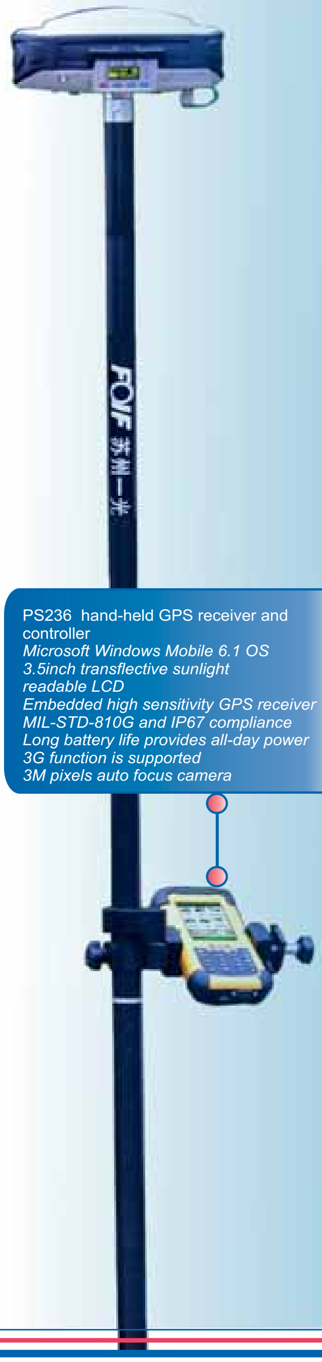


Fig. 3 Effect of Number of Stations on Nutation Parameters

FOIF GNSS Receiver A20

More flexible system with following features:

- Fully rugged design with simple "One Button" base setup
- Equipped with industry standard GNSS engine(Trimble, NovAtel, Javad...), and proven PCC or Satel radios
- Compatible with existing popular brand GNSS systems
- It is available for wireless data link by FOIFNet transceiver
- GPRS data link reconnecting automatically as base station
- Switch from internal radio to GPRS, or both can work together
- RTK Network rover:VRS, FKP, MAC
- Modular design - simple to extend or replace the Bluetooth, radio or GPRS and SD/SIM card module
- Field software: FOIF Survey_GPS or FOIF FieldGenius



PS236 hand-held GPS receiver and controller
Microsoft Windows Mobile 6.1 OS
3.5inch transflective sunlight readable LCD
Embedded high sensitivity GPS receiver
MIL-STD-810G and IP67 compliance
Long battery life provides all-day power
3G function is supported
3M pixels auto focus camera

GNSS antenna

Voice messages

Super bright OLED display & LED

Li-ion battery, 8hrs continuous working time(RTK)

Multi interface: RS232X2, Bluetooth PPS, Ext Event USB&Ethernet supported

Supports internal /external radio, GPRS

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of the conditions of RADIOASTRON observations. Then, the effect of each parameter in Eq.(3) is analyzed by designing different matrix A.

Model for Sensitivity Analysis

The adjustment is necessary for the time delay observation because the number of the SVLBI observations is very large. The least squares adjustment is adopted here, and the observation equation is derived from Eq.(3) and Eq.(7), which can be expressed as Eq.(8).

$$y = Ax - v \qquad (8)$$

Where A is the coefficient matrix formed by partial derivation C_x, v is the error vector, x is the vector of unknown parameters. According to the variance-covariance propagation law, the variance-covariance matrix can be written as Eq.(9).

$$D(\hat{x}) = \sigma_0^2 (A^T P A)^- \qquad (9)$$

So, it is possible to estimate variance D by designing different matrix A and assigning a priori weight matrix P to the observation or a priori value to the variance of unit weight σ_0. In this paper, P is the unit matrix, and the value of σ_0 is obtained from the precision of time delay observation, which is assumed to be 1 ns.

In the paper, the estimates of variance of EOPs are considered. So A is divided into two parts as Eq.(10).

$$A = [A_1 \quad A_2] \qquad (10)$$

In Eq.(10), the matrix A_1 contains the partial derivative of EOPs, while A_2 contains the partial derivative of other parameters, and the prior weight matrix P_2 is assigned according to the precision of these parameters, such as station coordinates, radio source coordinates and so on. So the normal equation matrix is expressed as Eq.(11).

$$N = \begin{bmatrix} A_1^T A_1 & A_1^T A_2 \\ A_2^T A_1 & A_2^T A_2 \end{bmatrix} = \begin{bmatrix} N_{11} & N_{12} \\ N_{21} & N_{22} + P_2 \end{bmatrix} \qquad (11)$$

According to the inverse of matrix N and variance- covariance propagation law, the variance matrix of EOPs is derived as Eq.(12)

$$D(x) = \sigma_0^2 [N_{11}^{-1} + N_{11}^{-1} N_{12} \tilde{N}_{22}^{-1} N_{21} N_{11}^{-1}] \qquad (12)$$

Where, $\tilde{N}_{22} = N_{22} + P_2 - N_{21} N_{11}^{-1} N_{12}$, $\sigma_0^2 = 1$.

In this paper, only the sensitivity of EOPs will be investigated, and all the other parameters are assumed known or fixed. The precision of EOPs is studied by designing different matrix A.

Numerical Tests

Data for the Numerical Tests

From the analysis above, only the value of matrix A needs to be calculated. So only the approximation of the parameters mentioned in Eq.(12) needs to be simulated. The coordinates of radio source, approximation of EOPs were found from the IERS Website in Oct.2008. And the Orbit parameters for RADIOASTRON were found from Website RADIASTRON in Oct.2008. With the prior value of these parameters, the partial derivative coefficient can be calculated and matrix A can be formed. In the simulation, some necessary parameters are listed in Table 1 and Table 2.

During the simulation, the number of radio sources is not changed. Each observation epoch contains only one radio source. In the experiment, 9 radio sources are used in order to improve the space distribution of the observation and enhance the visibility of the ground stations and the satellite antenna to the same radio source at the same epoch. The configuration range of other parameters is shown in Table 3.

Satellite	orbital elements
initial epoch (MJD)	54748.0
a (km)	189000.0
Eccentricity	0.8
T (d)	9.50
i (º)	51.6

Table 1 Orbit parameters for RADIOASTRON

RADIO SOURCE	Right ascension (h m s)	Declination (°)
1753+183	17 55 59.717551	18 20 21.77756
0212+735	2 17 30.813363	73 49 32.62176
2007+777	20 05 30.998519	77 52 43.24761
1807+698	18 06 50.680650	69 49 28.10852
0003+380	0 05 57.175409	38 20 15.14857
0923+392	9 27 03.013916	39 02 20.85195
1404+286	14 07 0.394410	28 27 14.68998
0552+398	5 55 30.805608	39 48 49.16500
1641+399	16 42 58.809951	39 48 36.99395

Table 2 Coordinates of radio sources

Parameter	value
Number of observation epochs	300-9000
Sampling interval (min)	0.5-9
Number of stations	3-42

Table 3 Parameter configuration

Effect of the Number of Stations

In order to analyze the effect of the increase of observing ground stations on the estimated EOPs, the number of observation epochs will be fixed as 10000, the observation interval will be fixed as 1 min and the number of stations will be increased from 3 to 42 by the step of 3. The results are shown in Fig. 2 and Fig. 3. It can be seen that the precision of each parameter is improved.

The RMS of x_p decreases from 0.0363 mas to 0.0098 mas, the RMS of y_p decreases from 0.0365 mas to 0.0092 mas, and for nutation parameters, the RMS of $\Delta\psi$ decreases from 0.0423 mas to 0.0317 mas, the RMS of $\Delta\varepsilon$ decreases from 0.0277 mas

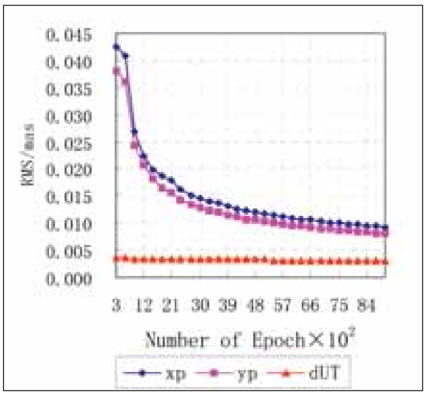

Fig 4. Effect of Observation Epochs on x_p, y_p and dUT

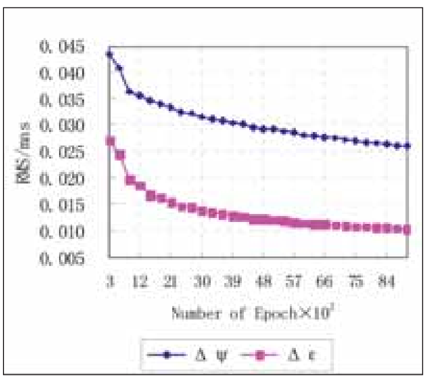

Fig 5. Effect of Observation Epochs on Nutation Parameters

to 0.0138 mas. On the other hand, the RMS of dUT doesn't change quickly. It is about 0.033 ms. According to the figure, it can be seen that the change of the estimated parameters' precision is sharp in the beginning, but then tends to ease with the increase of the number of stations. Hence it can be concluded that the optimum number of observing ground stations is about 27.

Effect of Observation Epochs

The results of the effect of the number of observation epochs on the estimated parameters are shown in Fig. 4 and Fig. 5. During the experiment, the number of stations is fixed as 24, the observation interval is fixed as 1 min, the number of radio sources is 9 and the observation epochs are increased from 300 to 9000. It is clear from the figure that the precision of the estimated parameters is improved with the increase of observation epochs. The RMS of xp decreases from 0.0424 mas to 0.093 mas, the RMS of yp decreases from 0.0379 mas to 0.081 mas, the RMS of Δψ decreases from 0.0434 mas to 0.0259 mas and the RMS of Δεdecreases from

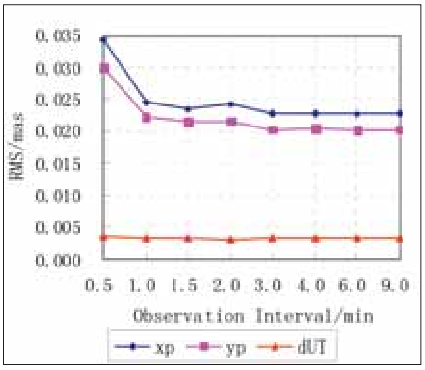

Fig 6. Effect of Observation Interval on x_p, y_p and dUT

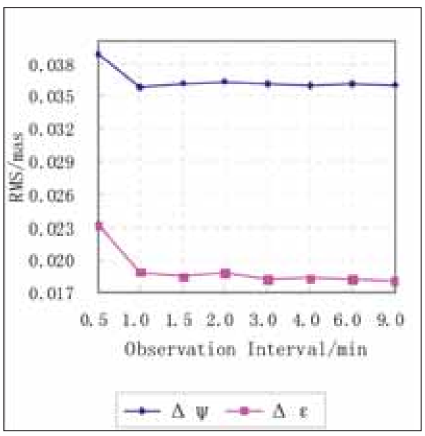

Fig 7. Effect of Observation Interval on Nutation Parameters

0.027 1mas to 0.0103 mas. On the other hand, the RMS of dUT doesn't change quickly. It is about 0.11 ms. As shown in the figure, there is no substantial gain in the precision of estimated parameters after about 3000 observation epochs.

Effect of Observation Interval

In this experiment, the number of stations is 24, the number of radio sources is 9 and the number of observation epochs is 1000. The observation interval is changed from 0.5 min to 9 min. The results are shown in Fig. 6 and Fig. 7. According to the figure, the effect of observation interval is similar to the effect of the number of stations and the number of observation epochs. The RMS of x_p falls from 0.0343 mas to 0.0277 mas, the RMS of y_p falls from 0.0299 mas to 0.0202 mas; for nutation parameters, the RMS of Δψ falls from 0.0388 mas to 0.0360 mas, the RMS of Δε falls from 0.0232 mas to 0.0181 mas, and the precision of dUT doesn't have an obvious change. The effect of observation interval on the precision of estimated parameters is not obvious until observation intervals are greater than 1 min.

Disscussions

According to the results above, it can be concluded that the optimum number of system parameters could be 27 observing stations, 3000 observation epochs and 1 min observation interval, which are propitious to improve the precision of EOPs estimated with the SVLBI observation from RADIOASTRON.

We must stress, however, that these are simulated results. In fact the present and foreseeable practical realizations of SVLBI are driven by astrophysical goals. The realistic observing setups for RADIOASTRON will be far from making possible to reach the optimum parameters as determined above. For example, the satellite will most likely observe together with a small network of ground radio telescopes (3-5 stations). Due to technical limitations, the pointing of the space-based radio antenna (i.e. the attitude of the massive satellite) cannot be changed quickly enough and over a large angle in the sky. However, the above simulation results will have great reference to the use of RADIOASTRON satellite for geodetic research.

Acknowledgements

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Until next time...

After the euphoria over the successful Chile mine rescue it is time to analyse the incident and ponder on the lessons learned

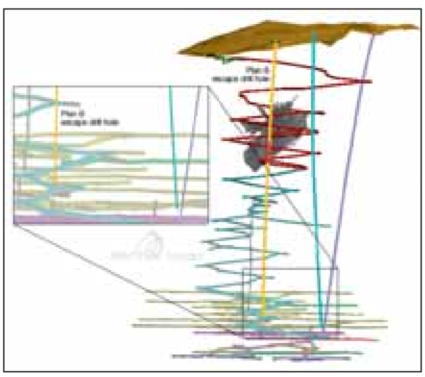
Mines and accidents have been intertwined since time immemorial. But the Chile mining accident has become a watershed. Not because of the accident itself - this was no different from the many that have taken place across the world over the years. It is a pivotal point for the response it invoked and for focussing the attention of the world on issues related to mining safety.

The miners are safe now and the Chilean President Sebastián Piñera said they were rescued with "unity, faith and hope". Another important ingredient of the whole rescue drama was technology - without which all other factors would have been helpless.

Modelling the labyrinth

Every obstacle, every challenge in the 69 day ordeal was overcome with the help of technology. Equipment, expertise and experts from around the world worked together round the clock on the rescue mission.

When the main shaft of the Copiapó mine in San José collapsed on the 5th of August 2010 it was uncertain how many men were trapped inside the mine. Next day the count of missing men was pegged at 33, though their fate was unknown.



A Vulcan 3D model was the basis for accurately targeting the location of the miners trapped underground. (courtesy - *www.maptek.com*)

It was only with the help of a 3D representation of the labyrinth of underground shafts, generated by a team from Maptek, that possible 'refuge' locations of the missing miners were zeroed on. The Maptek team also helped to design the direction and orientation of the exploratory boreholes that were drilled to try and locate the miners.

On the 22nd of August 2010 the drill bit of the eighth borehole came back up with a message from below - "We're alright in the shelter, the 33 of us". After an agonising 17 days it was finally confirmed that all the 33 mines were alive.

Fast forward scenario

In the future technology using advanced sensors and beacons could help pinpoint the location of trapped miners almost immediately after an accident. Sensors could also help the drills to navigate directly to the refuge locations and would not have to depend on outdated maps. Robots and escape vehicles fitted with sensors would be able to negotiate through smoke and gas to reach survivors.

The hard reality

In the present it took weeks to drill an escape tunnel. Three teams worked with different drilling equipment on three plans - A, B and C. It was the Schramm T130XD used by the Plan B team that first reached the trapped miners with its widened shaft on the 9th of October 2010. It took another two days to put in place the winch and pulley system that would operate the rescue pod Fénix 2. The NASA engineers and Chilean Navy had custom built three pods for the rescue, eventually only one was used.

In the weeks that the rescue operation took shape the trapped miners were put on a strict regime to keep them fit physically and mentally. Three grapefruit sized boreholes became their points of contact with the outside world and their means of survival. All material was exchanged with them through a borehole in five foot long capsules nicknamed 'palomas' meaning doves. Here again technology enabled the rescuers to design in miniature form or redesign everything that was needed by the men trapped below.

The euphoria

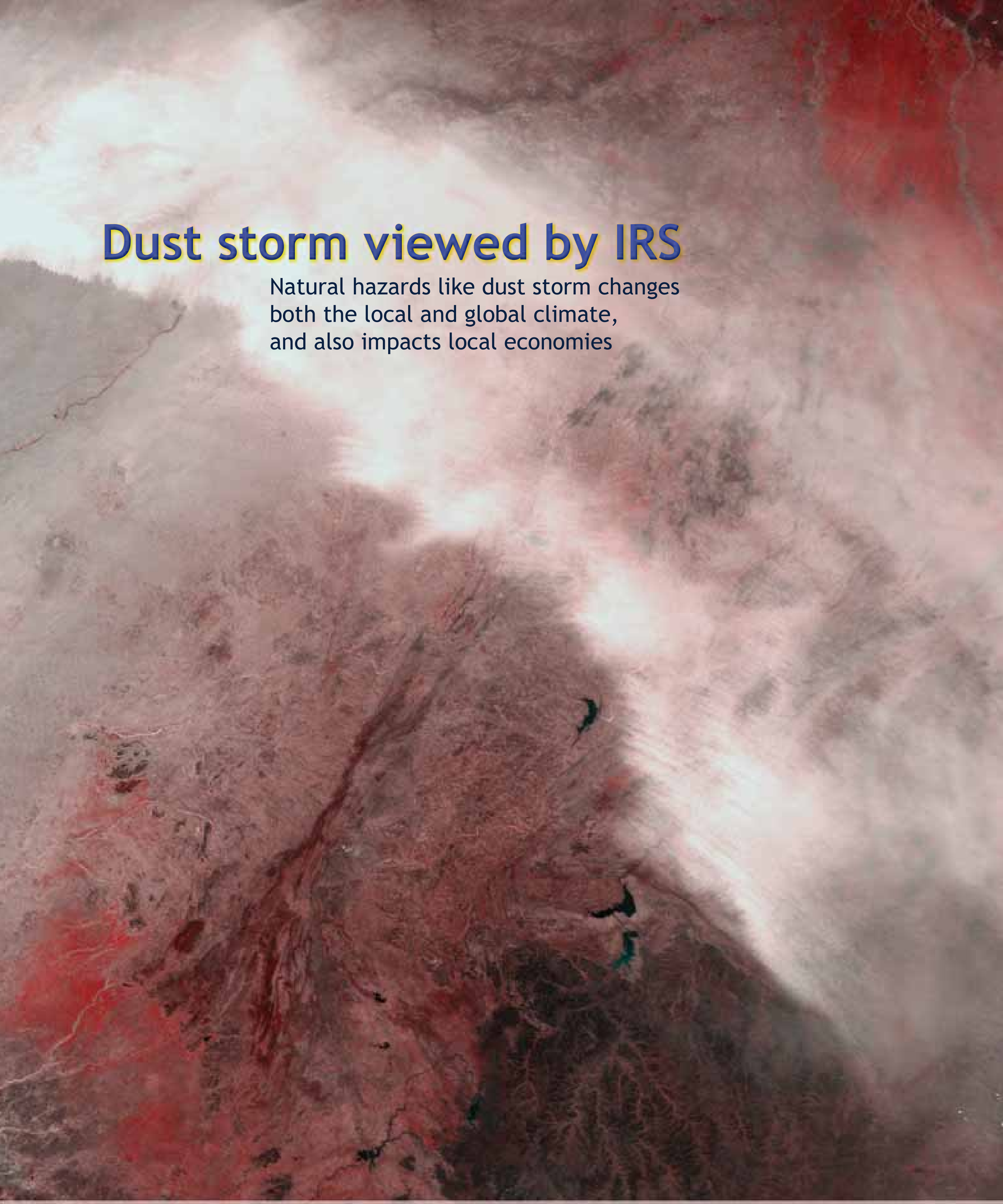
Operación San Lorenzo or Operation St. Lawrence (named after the patron saint of miners) to retrieve the miners began on the 12th of October 2010. The mine's shift supervisor at the time of the accident, Luis Urzúa was the last of the 33 miners to come out. President Piñera personally covered the rescue shaft to signal the close of the operation.

Until next time

Kelvin Brown from Perth based Reflex Instruments who was part of the rescue team has been quoted saying - "Only a matter of time before another mine disaster". It is not just our mines, all around us there are disasters 'waiting' to happen. It is our preparedness and response to each disaster that will determine the final outcome - happy or fatal. The keyword therefore seems to be 'preparedness' - plan for the worst and hope for the best.

This article has been written with the help of information available on the internet. The author would especially like to acknowledge - Wikipedia, TechNewsDaily, Maptek and WA News.

– *Shubhra Kingdang*



Dust storm viewed by IRS

Natural hazards like dust storm changes
both the local and global climate,
and also impacts local economies

AWiFS Sensor

Resolution: 56 m
Swath: 740 km
Revisit: 5 days

NRSC Data Centre

National Remote Sensing Centre
Phone: +91(40)2388 4422, 4423, 4425
Fax: +91(40)2387 8158, 8664
Email: sales@nrsc.gov.in
Website: http://www.nrsc.gov.in

Air Force rebuts auditor's GPS concerns

A report from the Government Accountability Office, the investigative arm of Congress, said the latest GPS satellite was launched almost 3½ years behind schedule, and further delays could leave the system with fewer than the 24 orbiting satellites it needs as older models wear out and stop working. Col. David Buckman of the Air Force Space Command at Peterson Air Force Base said the report's facts were correct, but "we think it draws overly pessimistic conclusions based on those facts." Buckman said satellites currently in the design or construction phase are on schedule, and the Air Force has 31 healthy, operational satellites in orbit. *http://durangoherald.com*

CellGuide introduces HiMap

CellGuide HiMap technology for precision urban positioning now commercially available for CellGuide's ACLYS chip, ACLYS IP Core, and GPSense engine. It is also available for licensing as an add-on to GNSS receiver manufacturers. HiMap improves GNSS navigation performance in urban canyons. *www.cell-guide.com*

GPS chips in rhino horns

South African rangers plan to implant GPS devices in the horns of rhinos in a new effort to combat rampant poaching. The GPS chips link up to a computer monitoring station where park rangers track the rhinos. An alarm signal activates if the rhino lies inert for longer than is deemed normal, or becomes unusually active. *news.yahoo.com*

MICHIBIKI transmits L1-SAIF signal

JAXA has been conducting the initial functional verification of "MICHIBIKI," including its attitude control and communications systems, and satellite bus. The functions of the attitude control and communications systems have been confirmed. Transmission of one of the positioning signals, namely the L1-SAIF signal (*1) from the L1-SAIF antenna (*2) of the MICHIBIKI started after turning on the onboard positioning mission devices. During the verification Non Standard Code (NSC) is being used. *www.jaxa.jp*

Broadcom supports QZSS

Broadcom's single-chip GPS solution for mobile devices supports the new Quasi-Zenith Satellite System by Japan. The BCM4751 solution has built-in support for QZSS and also supports additional satellite constellations including the SBAS making as many as nine additional satellites available for use in navigation. *www.broadcom.com*

Rockwell Collins completes Formal Qualification Testing

Rockwell Collins has completed two milestones in the Modernized User Equipment (MUE) receiver development program. It completed Ground-Based GPS Receiver Application Module-Military-code (GB-GRAM-M) receiver formal qualification testing and delivered receiver cards to support Air Force GPS Wing developmental testing. It has also acquired and maintained track of the M-code signal being broadcast from the first GPS Block IIF series satellite in orbit using the GB-GRAM-M receiver. *www.rockwellcollins.com*

N Korea jamming GPS signals: S Korea

North Korea's ability to jam GPS signals presents a new threat, one that Seoul is working to deal with, according to Kim Tae-young, Defense Minister, South Korea. "We have an intelligence report that says North Korea can jam GPS signals within 50- 100kilometer radius," the minister said. *http://english.yonhapnews.co.kr*

Sokkia releases the new data collectors

Sokkia has added two new models - the SHC25 and SHC25A - to its data collector lineup. Each model integrates the 20-channel L1 GPS receiver that provides point positioning accuracy of 5 meters and DGPS accuracy of 1 to 3 meters using SBAS signals.*www.sokkia.com*

Compass/Beidou-2 Signal products

OlinkStar Co. Ltd. has moved into the marketplace with a line of GNSS products that can use signals currently being transmitted by some of the five Beidou-2 satellites already on orbit. *www.olinkstar.com*

51% control of GLONASS by Sistema

Sistema plans to acquire 51% of Navigation Information Systems, operator of Glonass, for as much as $16 million from its units OAO Sitronics and OAO Concern RTI Systems by the end of the year, the company said. "The development of the Glonass project and the commercialization of its services are among the top state priorities," the company said. *www.bloomberg.com*

Raytheon completes GPS OCX Integrated Baseline Review

Raytheon team, developing the next-generation GPS Advanced Control Segment (OCX) successfully completed on schedule an integrated baseline review with the U.S. Air Force. The contract represents the first two development blocks of the advanced control segment, which will have a significant impact on GPS capabilities. The OCX system will include anti-jam capabilities and improved security, accuracy and reliability and will be based on a modern service-oriented architecture to integrate government and industry open-system standards. *www.raytheon.com*

SPACEBEL will help Europe navigate

Spacebel has been selected by OHB-System AG in Germany, the prime contractor for the first 14 satellites of the Galileo constellation, to develop the on board standard services that support the ground operations. *www.spacebel.be*

A Breakthrough in Handheld Accuracy

Features

- Handheld sub-meter, decimeter or centimeter accuracy modes
- Very lightweight and compact
- Extended built-in communications
- Flexible Windows Mobile® 6.5 platform
- Ruggedized for professional use

MobileMapper™ 100

Powerful GPS+GLONASS handheld for high-precision mobile mapping

Whether or not you're a coffee fan, you will enjoy starting your day working with the MobileMapper 100. MobileMapper 100 is the ultimate GNSS handheld designed for high-precision GIS data collection and mapping. Combined with MobileMapper Field software or third-party application, the MobileMapper 100 quickly maps and positions assets in real-time with sub-meter down to centimeter level accuracy. Powered by the Ashtech's BLADE technology, the receiver also maintains high accuracy in urban canyons and under dense canopies.

MobileMapper 100 is a rugged, compact handheld with built-in GSM/GPRS and Bluetooth communications. Compatible with RTK networks it's the perfect answer for demanding mobile GIS jobs. Very lightweight for maximum comfort, the MobileMapper 100 is a true handheld solution for the field workforce. It provides maximum flexibility and GNSS reliability for optimal data collection, virtually anytime and everywhere.

MobileMapper 100 will develop your taste for precision GIS. Discover it's full features, performance and specs at www.ashtech.com.

For more information:

France (HQ) +33 2 28 09 38 00
China +86 10 5802 5174
APAC +65 983 842 29

professionalsales@ashtech.com

BLADE™ TECHNOLOGY INSIDE

ashtech™

All-in-one Vehicle Telematics System

Masternaut has launched a new type of vehicle tracking system based around a single intelligent mobile communication unit. It comprises a Mobile Communication Centre combining vehicle tracking, GPS satellite navigation, hands-free mobile communications and real-time job scheduling and messaging in a single unit. The all-in-one unit eliminates the need for separate Sat-Nav, mobile phones and hands-free equipment. *www.masternaut.co.uk*

Navmii introduces free iPhone Nav App

Navmii introduced NavFree, an onboard, turn-by-turn GPS navigation solution for iPhone & iPad as a free download from iTune. The UK is a test market before an international roll out. *www.navmii.com*

NAVTEQ expands coverage in LatAm

NAVTEQ has expanded its coverage in Latin America and Caribbean Islands. The company has unveiled its navigable map of Colombia as well as "Intermediate Map sets" for Costa Rica, Dominican Republic, El Salvador, Jamaica, and Panama. *www.navteq.com*

Dubai gets real-time traffic on Mio Devices

The Roads and Transport Authority in Dubai introduced the Dalili Navigation System, a Mio-made PND that is first to offer real-time traffic information in the Emirate. *www.mio.com*

GeoSpatial Experts releases GPS-Photo Link 5.0

GeoSpatial Experts has introduced GPS-Photo Link 5.0 bundled with the latest GPS-enabled cameras from Sony, Ricoh, and Nikon. The software is offered in two editions. GPS-Photo Link Express, for avid photographers and business users and GIS Pro for geospatial professionals. *www.geospatialexperts.com*

Galileo update

Norway signs Galileo agreement with Commission

Norway and the European Commission have signed a cooperation agreement on satellite navigation. Norway is an important participant in the Galileo programme: Norwegian industry is involved since the beginning of the programme, two important ground stations are hosted in Norwegian territory: one on the island of Svalbard and one in Antarctica. A third is planned for on the Jan Mayen island. *www.esa.int*

Galileo ground station takes shape in Pacific

The latest addition to the worldwide network of stations serving the Galileo satellite navigation system has been inaugurated in New Caledonia. This French-administered group of islands is in the southwest Pacific. The new ground station is located near the capital Nouméa on New Caledonia's main island of Grand Terre. *www.esa.int*

Emergency EU Galileo sat-nav service plans develop

Secure satellite navigation for emergency and security services moved closer to reality under proposals published by the European Commission.

The proposals cover access rules for the Public Regulated Service (PRS), which will be set up on the back of Galileo satellite system and will use highly encrypted signals to protect against threats to infrastructure in the case of disasters or terrorist threats. PRS will only be accessible to authorised governmental bodies and, according to the Commission, „third [party] countries and international organisations who conclude the appropriate agreements with the European Union".

„The safety and security of each and every European citizen lies at the heart of this proposal," industry and entrepreneurship commissioner Antonio Tajani said in a statement. „Given our increasing reliance on satellite navigation infrastructures, there is an urgent need to ensure that key services, such as our police forces and rescue and emergency services, continue to function in moments of crisis, terrorist threat or disaster.

„Furthermore, the market for PRS applications offers an important opportunity for Europe's entrepreneurs," he added.

According to the Commission, PRS will be resistant to so-called spoofing, where satellite signals are distorted or jammed. „PRS could be used in crisis situations where it is important that emergency and security services continue to function even when other services have been cut as part of security measures," the Commission said.

The proposals are intended to control who accesses PRS, the production of service's receivers and the potential export of the service's receivers. Member states who wish to use the system will gave to set up a PRS authority to manage and control end-users and the production of PRS receivers. The European Parliament and Council will have to approve the new rules if they are to come into force.

PRS is one of five services that will be offered over the Galileo satellite constellation. The other services are an open service for public sat-nav, a search-and-rescue service, a ‚safety-of-life' service and a commercial service. *www.zdnet.co.uk*

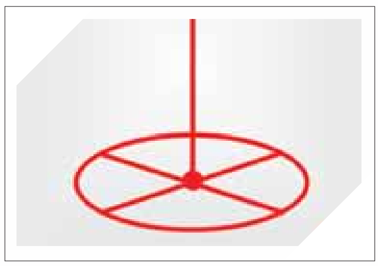
Always keep moving forward, upgrading version STS-750R series will come soon!

STS-750RC series

- SD card date storage(maximum 2G)
- Mini USB port for communication
- Built-in laser plummet (optional)
- Dual axis compensation
- Onboard programs upgraded
- 300m reflectorless

USB cable transfer

SD card Function and USB interface



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Phone: 0120 2425491 Mob: 9810788846, 9810703308 Email: supertechsns@rediffmail.com

New Survey Aircraft

RIEGL Laser Measurement Systems and Diamond Aircraft Industries introduced their next generation survey aircraft. RIEGL airborne laser scanner LMS-Q680i fully integrated into the "Universal Nose" of the Diamond DA42 Multi Purpose Platform, an efficient overall system for surveying missions is available now. *www.riegl.com*

DigitalGlobe and TERI University initiative

DigitalGlobe announced a joint research initiative with India's TERI University. The company will contribute ideas, expertise and high-resolution 8-Band multi-spectral satellite imagery from its WorldView-2 satellite to TERI University's current research projects. *www.digitalglobe.com*

Optech and DiMAC next-gen camera controller

Optech announced a tighter technical integration with the DiMAC ULTRALiGHT+ product line. New packaging, specifically conceived for lidar mapping solutions, takes advantage of recent technology advances for a more robust and flexible design. *www.optech.ca*

Japan develops unmanned aircraft

Researchers from the University of Tokyo and Mitsubishi Electric Corp. have developed an unmanned aircraft to provide detailed aerial images of wetlands, mountains and other natural areas that are difficult for humans to reach. The camera onboard can take up to 400 color images during a single flight, capturing objects on the ground as small as 2 square centimeters in size. *http://mdn.mainichi.jp*

Indonesia to launch two satellites in 2011

Indonesian Institute of Aviation and Space Agency (LAPAN) will launch two satellites in the second quarter of 2011 - Lapan – A2 and Lapan - Orari. Lapan-A2 will be used for data collection of weather, ships navigation, transportation, education, healthcare and defense. Lapan - Orari will support the Indonesian Amateur Radio Organization and in disaster mitigation efforts for Earth observation by remote sensing, land use, natural resources and environmental monitoring. *www.jakartaupdates.com*

Euromap and ESA Commence Interface to GMES

Euromap GmbH and the European Space Agency (ESA) have commenced operations with the interfaces between Euromap and ESA's Coordinated Data Access System infrastructure.

Euromap has now become the first GMES Contributing Mission Entity of an optical mission to operationally provide data and services through the version 1 interfaces developed as part of the GMES Space Component Data Access project. *www.euromap.de*

Earth science data for Africa

A partnership between NASA and agencies in Africa and Europe has sent more than 30 terabytes of free Earth science satellite data to South African researchers to support sustainable development and environmental applications in Africa. The data from one of the instruments on NASA's Terra satellite provide observations of Africa's surface and atmosphere, including vegetation structure, airborne pollution particles, cloud heights and winds. *www.nasa.gov*

Taiwan, Nicaragua satellite imaging pact

Taiwan and Nicaragua have signed a satellite information cooperative agreement under which Taiwan will provide aerial view photographs to Nicaragua to help with disaster prevention and land utilization efforts there. *www.taiwantoday.tw*

Global Earthquake Model

Global Earthquake Model Foundation (GEM) has selected OpenGeo to support its development of open source earthquake modeling tools. OpenGeo will be developing enhancements for GeoServer and GeoTools to expand the capabilities for collaboration on hazard, risk and socio-economic impact models within the global earthquake risk assessment community. *http://opengeo.org*

National Geographic Atlas

National Geographic has recently completed the Ninth Edition of the Atlas of the World. It adds new maps of conflict areas such as Afghanistan, Pakistan, and Iraq. There are also spreads dealing with trends such as water scarcity, global warming and energy resources. GIS was first used for the seventh edition in 1999. *www.nationalgeographic.com*

China to draw "risk map"

Chinese authorities are drawing up a national natural disaster "risk map" in a bid to improve planning of urban construction projects in western China to avoid potential catastrophes. China's vast western regions have experienced three major natural disasters in recent three years. *http://news.xinhuanet.com*

Malaysia launches E-Cadastre project

The newly launched Malaysian E-Cadastre Project is integrated with various systems such as eTanah, eLJT, JUPEM Geoportal and MaCGDI, which allow sharing of facilities and information for the benefit of Land and Mine Office, Land Office, Land Surveyors Board and Land and Mine Office director-general. The main objective of the project is to expedite the preparation of title plans and issuance of final title plans from two years to less than two months. The web-enabled programme would allow faster and more accurate work process with less human intervention.*www.mmail.com.my*

Privacy code for online mapping

The government of Germany has called on Google Inc. and other providers of online navigation services to create a set of voluntary data protection guidelines for services such as Google's "Street View" by the end of the year. Failure to do so would result in the imposition of new market regulations to protect consumers. *www.redorbit.com*

Kenyan slum dwellers mapped

Residents of one of Africa's biggest slums designed a digital map of Kibera. Kibera, on the outskirts of the Kenyan capital, Nairobi, is home to thousands of people but still appears as a forest on government maps. Thirty of its inhabitants used the GPS technology to establish the location of such landmarks as roads and health clinics and uploaded the resulting map onto the Open Street Map website which anyone can update with new data. *www.alertnet.org*

Geotagged Photos of Gulf oil spill

Thousands of GPS-stamped photos showing the locations of sensitive habitats and wildlife impacted by the oil spill in the Gulf have helped decision makers determine where to deploy clean-up crews. These 'geotagged' photos are served out via the web to multiple Emergency Operations Centers (EOC) using photo-mapping software from GeoSpatial Experts LLC, as well as GIS technology. *www.geospatialexperts.com*

Open roads for London Olympics

The National Street Gazetteer (NSG) is being used as part of the planning for the Olympic Route Network (ORN) and Paralympic Route Network (PRN) in order to minimize any disruption to the network in the lead up to, during and after the London 2012 Olympic and Paralympic Games in London. The ORN/PRN is the definitive list of designated transport routes essential to the smooth running of the games. *www.intelligent-addressing.co.uk*

Bangladesh digital maps by 2016

According to Survey of Bangladesh (SOB), Bangladesh is going to set up six permanent GPS stations in six districts next year. All maps in the country would be converted into a digital format with creation of a geo-database by 2016 under a project in collaboration with Japan International Cooperation Agency (JICA). JICA have initiated a project titled Bangladesh Digital Mapping Assistance Project (BDMAP). *www.thedailystar.net*

SERVIR program

NASA and the USAID to launch a web-based environmental management system for the Himalayan region called SERVIR-Himalaya, at the International Centre for Integrated Mountain Development (ICIMOD) in Kathmandu, Nepal. *www.nasa.gov*

Winners of 2010 Be Inspired Awards

Bentley Systems announced the winners of the 2010 Be Inspired Awards and Be Inspired Special Recognition Awards. The awards honor the extraordinary work of Bentley users improving and sustaining the world's infrastructure. A total of 24 award winners, representing project work in 16 different countries, were recognized. *www.bentley.com.*

Wipro, Leica Geosystems bag Coal India deal

Wipro and Leica Geosystems have bagged a Rs 120-crore project that involves setting up operator-independent truck dispatch systems (OITDS) at Coal India's (CIL) 11 large mines. The project will save idle time for both trucks and equipment operating in these mines leading to savings. Trucks will be installed with a mobile data transmitter (MDT) which will send crucial data and the co-ordinates to four satellites hovering over the mine at that time. Shovels and other excavation equipment will also be installed with these transmitters. These satellites will, in turn, beam the data on a real-time basis to a control room near each mine. In the first phase, 11 mines under various CIL subsidiaries will be included in the project. While Wipro will be responsible for installing the system at four mines under SECL and ECL, Leica will install the system at seven mines. *http://economictimes.indiatimes.com*

u-blox launches LISA

u-blox announced LISA, a new family of small, ultra-fast wireless modems. LISA enables a wide range of high-bandwidth applications such as mobile computing, car infotainment, telematics systems and hand-held terminals where wireless high-speed Internet connection is essential. *www.u-blox.com*

CHC GNSS board passes evaluation and qualification

CHC Navigation announced the successful completion of the evaluation and qualification of its patented GNSS board by the China Instrument and Control Society encompassing fourteen different Chinese authorities and independent experts in the field GNSS technology. *www.chcnav.com*

Contour hands-free GPS video camera

Contour has selected u-blox' GPS technology for its ContourGPS video camera. It integrates u-blox 6 GPS module and AssistNow Offline accelerated GPS technology to achieve the fast fixs. It works with Contour's Storyteller software. *www.contour.com*

Leica News

Leica XPro V5.0 DSM extraction module provides advanced ground processing from data download to image generation. Users can now generate stereo-viewable frame images from line sensor data acquired with the Leica ADS Airborne Digital Sensor.

Leica Geosystems new robotic Imaging Total Station, Viva TS15 has an advanced imaging functionality combined with dynamic tracking capabilities for one-person surveying.

Leica Viva NetRover uses the Viva GS08 GNSS receiver and has been designed to create an ideal RTK network rover.

New Leica Zeno 10 3.5G and Zeno 15 3.5G has new dual-constellation, network-enabled handheld GNSS receivers and the newest Zeno Field v1.2 software.

Leica Geosystems announced the latest version 3.00 of the Leica SmartWorx Viva onboard software.

New Leica Cyclone v7.1 speeds these key office steps: (1) accurately registering multiple scans together and (2) navigating to and clearly visualizing specific areas of interest.

Leica Geosystems announced the successful flight testing of its new Point Density Multiplier technology for airborne LIDAR. It allows the use of a single laser and scanning mechanism to provide over double the data collection productivity of previous systems. *www.leica-geosystems.com*

Topcon HiPer II

Topcon Europe Positioning B.V. introduced the HiPer II an integrated RTK and static receiver that receives GPS and GLONASS signals. The 72-channel receiver will also pick up all available signals from additional satellite constellations that come on line in the future. *www.topcon.eu*

New Nikon-Trimble TS

Nikon-Trimble introduced the Nikon® Nivo™ 1.C one - second angle accuracy, reflectorless mechanical total station and the Nikon DTM-322 prism-based 3" dual-faced total station. *www.nikonpositioning.com*

Carlson Software new GNSS receivers

Carlson Software has released a new line of GNSS receivers. It has chosen Ashtech GNSS Technology as the engine to power the new receivers. These receivers will address various applications: Carlson MC Pro 500, MC Pro Lite, MC Pro Lite Duo, and MC Pro GS. *www.carlsonsw.com*

Ashtech News

Ashtech® has selected the NavX®-NCS Professional, a multi-constellation and multifrequency GNSS RF navigation constellation simulator from IFEN GmbH, as the new GPS, Galileo and GLONASS reference simulator for its professional receiver development and testing.

Ashtech® announced the availability of Web Mission Planning, a self-contained, completely automatic web-accessible GNSS survey planning tool.

The Ashtech ProFlex 500 receiver has been selected to provide GNSS position data to the recently introduced FieldSens underwater utility mapping system from Optimal Ranging Inc. *www.ashtech.com*

NovAtel News

NovAtel announced that the recent 1.011 Firmware release for its OEMStar L1 GNSS receiver has significantly reduced the card's power consumption. It now consumes only 450mW for GPS+GLONASS operation and 360mW for GPS-only operation.

NovAtel OEM6 GNSS receiver offers support for all current and upcoming GNSS constellations and satellite signals including GPS, GLONASS, Galileo and Compass. The OEM628™ board expands positioning capabilities with the inclusion of such features as RAIM (Receiver Autonomous Integrity Monitoring) for safety critical applications, integrated LAN Ethernet port with NTRIP Client and Server capabilities for seamless integration into reference network applications, and 100 Hertz measurements for high dynamic positioning. *www.novatel.com*

Hemisphere GPS News

Hemisphere GPS announced the release of miniEclipse – a compact dual frequency GPS OEM board that incorporates the same digital and analog ASIC design as the recently released EclipseTM II OEM board.

R320 is the first GNSS receiver built on Hemisphere GPS' new Eclipse II OEM board. It offers extremely quick startup and reacquisition times, tracks GPS L1/L2, GLONASS L1/L2, SBAS augmentation signals, and OmniSTAR HP/XP/VBS. *www.hemispheregps.com*

Spectra Precision introduces additions

Spectra Precision introduced FOCUS® 30 line of optical survey solutions and new features for the Spectra Precision Survey Pro™ field software. *www.spectraprecision.com*

Septentrio PolaRxS

Septentrio PolaRxS is an ultra low noise multi-frequency multi-constellation receiver dedicated to ionosphere monitoring and space weather applications. It offers 136 channels capable of tracking simultaneously GPS, GLONASS, Galileo and SBAS signals in L1, L2, L5 and E5ab/AltBOC bands. *www.septentrio.com*

MapQuest opens in India

Mapquest has opened a new site focused on maps in India. It provides mapping of streets in India, based on the OpenStreetMap project. It is in English and allows users to edit any of the data on the map. *www.techrockies.com*

Google ordered to brand Street View cars in Italy

In Italy, Google has been asked to clearly mark its "Street View" cars, publicly state the specific routes its cars would take and publish publicly information in local newspapers and on radio in each individual district where its cars would operate. *http://thenextweb.com*

China claims Arunachal as its part

China's recently launched mapping service Map World shows Arunachal Pradesh as part of China. Beijing claims this part as 'Southern Tibet', however though the map makes no specific mention of southern Tibet its borders cover up to Arunachal Pradesh. Also the Aksai Chin, which India asserts as part of Ladakh in Jammu and Kashmir, has been included in the map as part of the Chinese Xinjiang province. The map is being used in I-phone and by other mobile users. *www.indianexpress.com*

Episode 1 of "The Geospatial Revolution Project" is now online

Episode 1 of the Penn State Public Broadcasting's (PSPB) four-part online video series, "The Geospatial Revolution Project," is now available in its entirety or in shorter chapters at Penn State Public Broadcasting's website, *http://geospatialrevolution.psu.edu.*

India may launch lightweight US satellites

Lockheed Martin's India Chief Executive Roger Rose suggested that one area of cooperation that could be explored between India and US is using Indian capabilities in low-cost launch. This would of course be subject to an overall policy and agreement framework acceptable to both the Indian and United States governments and compatible with U.S. export control regulations. *www.indiastrategic.in*

Norway and Japan Space agreement

Norway and Japan will increase cooperation in space. The Norwegian Space Centre (NSC) and the Japanese Aerospace Exploration Agency (JAXA) have now signed a new and broader agreement. *www.norwaypost.no*

Trimble News

Trimble introduced two new features for its Trimble® 4D Control™ software solution for monitoring systems. The new features include support for geotechnical sensors and a Web Module.

Trimble introduced additions to its portfolio of Connected Site™ survey solutions for the field and office. It allows surveyors to collect, share and deliver data faster to improve accuracy, efficiency and productivity.

Trimble GPS Pathfinder® ProXRT receiver is a decimeter receiver combining dual-frequency GPS with Trimble H-Star™ technology, along with optional OmniSTAR and GLONASS support. It is also capable of tracking Galileo test satellites for signal evaluation and test purposes.

Trimble® DSS WideAngle is the latest option for its medium-format, directly georeferenced aerial imaging system. Its WideAngle option is designed as a high-productivity, mapping-grade solution for color-orthophoto and vertical mapping applications. *www.trimble.com*

MARK YOUR CALENDAR

November 2010

European Lidar Mapping Forum
30 November – 1 December
The Hague, Netherlands
www.lidarmap.org/ELMF/

February 2011

ILMF 2011
7 - 9 February
New Orleans LO, USA
www.lidarmap.org/ILMF.aspx

16 International Geodatic Week
13 - 19 February 2011
Obergurgl, Austria
http://geodaesie.uibk.ac.at/obergurgl.html

March 2011

The Munich Satellite Navigation Summit 2011
1-3 March
Munich, Germany
www.munich-satellite-navigation-summit.org

GEOFORM+2011
15-18 March
Moscow, EcoCenter Sokolniki
www.geoexpo.ru/defaulteng.stm

April 2011

Geo-Siberia 2011
27-29 April
Novosibirsk, Russia
www.geosiberia.sibfair.ru/eng/

May 2011

ASPRS 2011
1-5 May
Milwaukee, Wisconsin, USA
www.asprs.org/milwaukee2011/

Gi4DM 2011
3-8 May
Istanbul, Turkey
www.gi4dm.org

June 2011

Trans Nav 2011
15-17 June
Gydnia, Poland
www.transnav.am.gdynia.pl

South East Asian Survey Congress
22 - 24 June 2011
Kuala Lumpur, Malaysia
www.seasc2011.org

2011 Cambridge Conference
26 June - 1 July
Winchester, England UK
www.cambridgeconference.com

July 2011

Survey Summit
7 - 11 July 2011
San Diego, California
www.thesurveysummit.com/

ESRI International User Conference
11 - 15 July 2011
San Diego, USA
www.esri.com

August 2011

XXV Brazilian Cartographic Congress
21-24 August 2011
Curitiba - State of Paraná, Brazilia
sbc.tatiana@gmail.com

XXII ISPRS Congress
25 August - 1 September 2011
Melbourne, Australia
http://www.isprs2012.org