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New GNSS will cause a synergetic effect and not chaos

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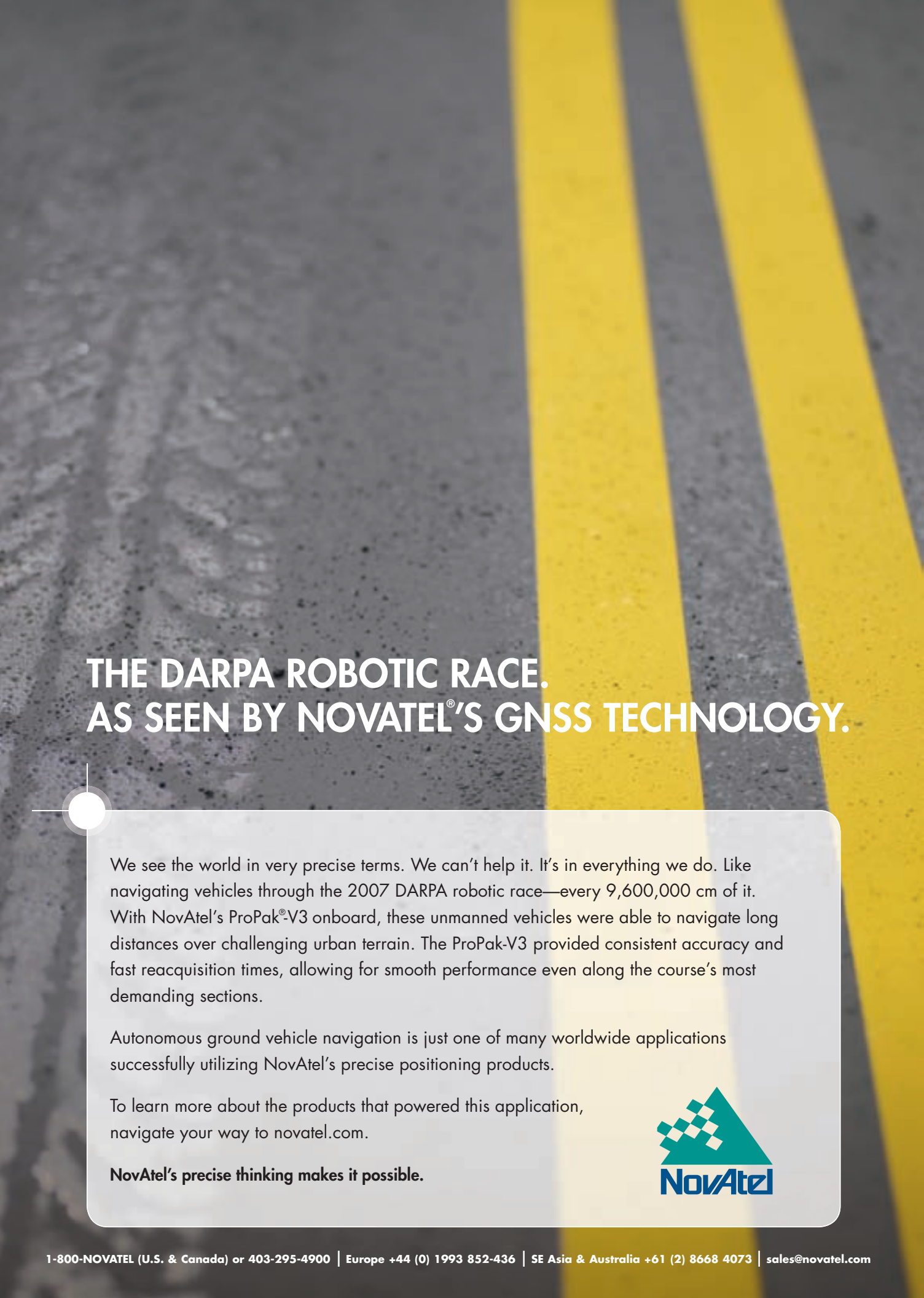

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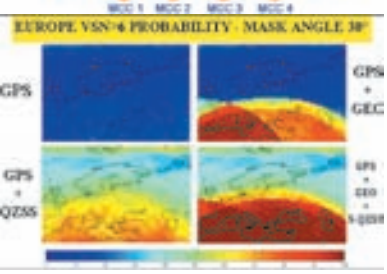

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This issue of Coordinates is of 40 pages, including cover.

The food crisis

The soaring food price in recent months has been unprecedented.

Increased food prices could lead to increased poverty and unrest.

Even, UN call for urgent measures.

But, why this sudden spur.

Some may attribute to oil price rise, some may say due to preference to bio fuel on crop production.

Probably, the issue is more basic.

It may be a consequence of changing priorities.

Perhaps, the market driven 'needs' have overtaken the fundamental needs.

Despite all the 'development and growth' the basic issue remains.

The availability and access to food.

To most of us.

Bal Krishna, Editor
bal@mycoordinates.org

New GNSS will cause a synergetic effect and not chaos

Sergey Revnivykh, Deputy Director General, Head of PNT Information Analysis Center of the Central Research Institute of Machine Building (TsNIImash), Federal Space Agency on GLONASS status and modernization plans

Sergey Revnivykh, Deputy Director General, Head of PNT Information Analysis Center of the Central Research Institute of Machine Building (TsNIImash), Federal Space Agency.

Sergey Revnivykh graduated from the Moscow Aviation Institute in 1978 majoring in flight dynamics and aircraft control. Since then he has started working for TsNIImash, which is the head enterprise of the Federal Space Agency. He received his degree in 2006. Since 2001 he was actively involved in the GLONASS Federal Programme development. Dr. Sergey Revnivykh is a recognized specialist in the field of experimental ballistics and modern technologies of satellite navigation.

GLONASS system is an element of the critical state infrastructure. Please elaborate this statement?

GLONASS is a dual-use system, which is applied to meet the needs of national security, as well as of the economic growth in various branches of Russian economy, including transportation, communication, energy, and mining, i.e. in those areas, which constitute the background for the economic strength of Russia.

What stage is GLONASS now?

At present we are working on the modernization of the GLONASS system using Glonass-M space vehicles. It is expected that the full orbital constellation will be deployed in 2010 and the system performance characteristics will be improved. This will lay the foundation for the large-scale implementation of GLONASS both in Russia and abroad.

Use of GLONASS is the binding in Russia for the governmental users and critical applications. Pl. comment?

In 2005 The Government of Russia adopted the Resolution № 365, enacting the obligatory use of GLONASS across Russia. This mainly concerns the governmental users and the users from the key strategic branches of the Russian economy. This requirement has been anchored by the Presidential Decree of May 18, 2007. At present we are completing the legal base formation to implement the taken decisions. At the same time, there are no restrictions imposed on the use of other systems, provided that the user equipment is sure to use the GLONASS signals along with the signals of other systems.

What about GLONASS availability to users in entire globe?

At the moment we have the routine replacement of the old Glonass space vehicles by the new Glonass-M. By the end of 2008 the GLONASS orbital constellation is expected to comprise 18 operational satellites, and the continuous navigation across Russia will be provided. As for now, the combined use of GLONASS and GPS provides the reliable and continuous navigation even in the city jungles.

What are your modernization plans?

We are planning to enhance the level of performance characteristics, to develop the GNSS augmentations, electronic maps of the required scale and coverage, competitive user equipment and the essential preconditions for its mass production, and to implement the pilot projects of the GLONASS use in various areas. The GLONASS modernization plan suggests the introduction of new navigation signals for the civil users, including those with the code division.

How do you see GLONASS vis-à-vis US GPS and Europe's Galileo?

The GLONASS modernization plan implies the activities to achieve compatibility and interoperability of signals, geodetic frames and time systems of all existing and perspective GNSS. They all will operate together, but each will remain under national control.

How much conflict or compatibility you see among these GNSS?

We do not see any conflict among GLONASS, GPS and Galileo, COMPASS. All compatibility issues shall be resolved within ITU coordination procedure.

On the contrary, as I have already emphasized, we see that in future these GNSS will complement each other for the benefit of users throughout the world.

What about international cooperation of GLONASS with country like India?

We have a really close cooperation with India in the field of satellite navigation. There is an intergovernmental agreement on cooperation in this sphere, covering the joint efforts in the GLONASS development, as well as in the augmentations and user equipment issues. Our common task is to make this agreement work.

Countries like India, China, Japan aspire to have their own GNSS. Are we heading for a GNSS chaos?

We are convinced that the emergence of the new GNSS will cause the synergetic effect, rather than chaos, for they will operate together and complement each other in a mutually beneficial way. In this respect, much is expected of the International Committee on GNSS, established following the United Nations General Assembly resolution. It seems to me, that the main task of this Committee in terms of the GNSS providers would be the development of the common "GNSS gaming rules". Thus the consumers worldwide will gain substantial advantage from the combined use of all systems, primarily through the enhanced reliability of navigation.

Do you think of a scenario when there in one Global Satellite Navigation System for all?

We are progressing toward combined united GNSS where each system will operate independently under national control. Thus, I believe we will succeed to provide compatibility and interoperability of all systems to benefit all users over the world and all applications.

Solving the GPS gap

Coverage analysis of a super-constellation made up of GPS+EGNOS+S-QZSS

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THE current GPS civil service provides suitable performance only in situations of good electromagnetic visibility; the positioning becomes difficult in severely signal degraded environments, e.g. mountainous or urban areas, where a lot of GPS signals are blocked by buildings or natural obstacles. The GPS gaps can be partially solved employing space-based augmentations systems; in this paper we consider geostationary and geosynchronous constellations. A simulation software has been developed in MATLAB® environment in order to study the integration of existent and feasible constellations.

Detailed coverage analysis of a super-constellation made up of GPS+EGNOS+S-QZSS is presented, based on existent GPS-EGNOS satellites and hypothetical Shifted-QZSS constellation over Europe.

Both systems, in different way, could improve the main parameters that quantify the performance of a navigation satellite system, i.e. availability, accuracy, continuity and integrity, but their own constellations have different features and different potential uses. The used indicators, to compare the various satellites configurations, are the VSN (Visible Satellites Number) and GDOP (Geometric Dilution Of Precision), which represent the quality of positioning; such parameters are computed for a single observer and global observers grid, particularly in Europe. A statistical analysis is also introduced in order to obtain meaningful results. Moreover we will define a Service Area.

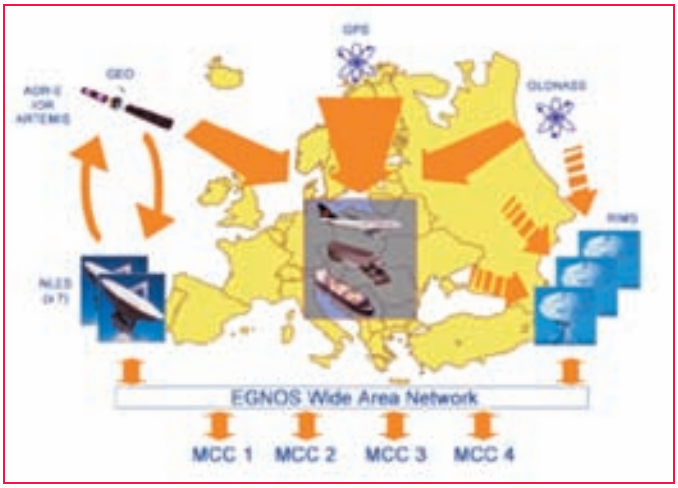

Fig.1: EGNOS Architecture

Background

EGNOS is the European SBAS (Satellite Based Augmentation systems), it has been developed by the ESA in co-operation with the European Commission and Eurocontrol. The system is made up of 3 segments (Fig.1): Space segment, Ground segment, User segment. In this paper we are focused on space segment, which is composed by already existing GPS constellation and 3 geostationary satellites broadcasting WAD (Wide Area Differential) corrections and integrity informations. Geostationary satellites also broadcast GPS-like signal that should improve the satellites geometry. EGNOS already works, but is under final phase of testing and will be declare operative (as system) during 2008.

QZSS (Quasi Zenith Satellite System) is a joint program of the JAXA and a consortium of Japanese industries; QZSS is a space-based positioning system, designed to be a GPS augmentation on urban and mountainous areas of Japan. The first QZSS satellite will be launched in 2009.

QZSS is composed by a Space Segment, a Ground Segment and a user segment. The Space Segment consists of three geosynchronous satellites that move on three identical Higly-inclined Elliptical Orbits (HEO) with coincident 8-shaped ground tracks centred on 135°E meridian.

QZSS constellation is planned to have always at least one satellite near zenith over Japan, so that users can receive signals without obstructions in "urban

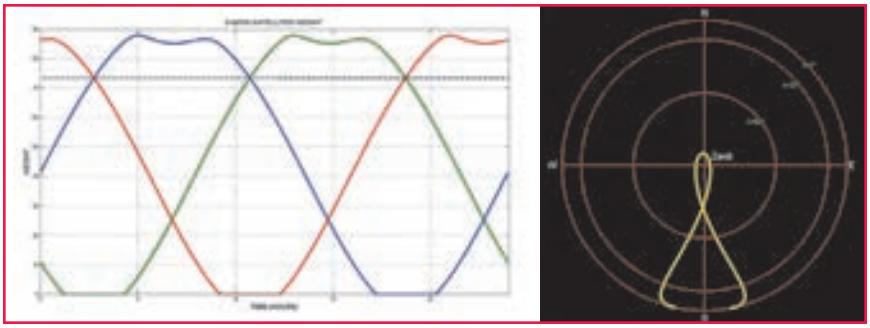

Fig.2: S-QZSS satellites heights and sky-plot (observer at Naples)

canyons" and mountainous areas.

In order to do such simulation we use a constellation obtained by ideally shifting the QZSS constellation on Europe, changing only central longitude of ground trace (15°E). We call the simulated constellation "Shifted-QZSS" or S-QZSS to distinguish it from the original one. The main features that resumes the S-QZSS constellation are shown in figures 2-3-4.

The constellation is conceived to have at least one S-QZSS satellite always visible at elevation angle more than 75° from service area; SV at elevation angles of 70°-80° is usually visible for observers placed in urban canyons.

Number of Satellites	3
Number of Orbits	3
Inclination	43°
Eccentricity	0.075
Major Semiaxis	42164 Km
Orbital Period	1 Sideral Day
Perigee Distance	39002 Km
Apogee Distance	45326 Km
Raan	To be Defined
Argument of Perigee	270°
Central Long. Ground Trace	15°

Fig.3: Shifted-QZSS orbital parameters

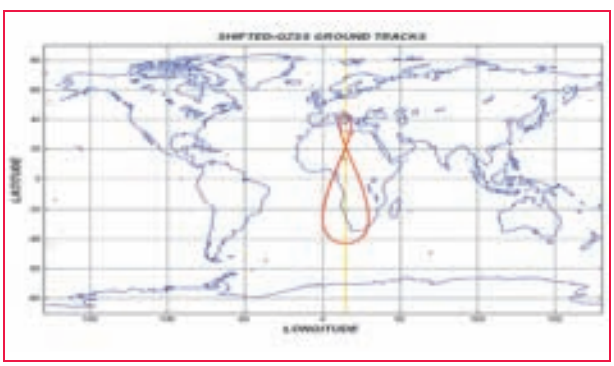

Fig.4: S-QZSS ground tracks

Coverage analysis

We want to examine the worldwide and European coverage, provided by GPS and EGNOS and S-QZSS augmentation. For this purpose we have developed a simulation software in MATLAB® environment, resumed in the block diagram in Fig.5.

Inputs are GPS and EGNOS Rinex navigation files, which contain the daily broadcast ephemerides. Rinex data, related to 02/16/2008, were stored by a Septentrio PolaRx2 receiver placed near Naples.

The algorithm first block deals with the extraction and selection of GPS/EGNOS satellites ephemerides from Rinex files.

The selected ephemerides and the theoretic S-QZSS orbital parameters are the inputs of an orbit propagator, which updates the ephemerides at observation epoch. The satellites ECEF coordinates, outputs of orbital propagator, are transformed in the local ENU coordinates and then in elevation and azimuth relative to the observer. In the last block of the software, VSN and GDOP are computed for a given mask angle.

The software can work in two ways:

- Considering a single observer for a lot of epochs with a constant mask angle, or a masking changing versus azimuth in order to simulate a real environment.
- Considering a grid of observers evenly distributed on Earth or on a part of it for a fixed epoch with an average mask angle.

In the first mode VSN and GDOP evolutions versus time are plotted; in the second one VSN and GDOP maps are obtained for a certain area at a fixed epoch. In order to obtain more significant plots, global and regional grids of GDOP and VSN values are generated every 15 min for 24h, producing a 3D matrix of data (Fig.6).

Regional results

To analyse the global coverage of GPS and its space-based augmentations, we consider a grid of observers placed evenly on Earth surface, with a step of 5° in latitude and longitude; VSN and GDOP are computed w.r.t. every observer at observation epoch. Mask angle values of 15°, 30° or 40° are adopted to represent different visibility conditions. To obtain a complete scenario for a fixed mask angle, probability of VSN>6 and GDOP<4.5 are estimated using a time step of 15 min for 24 hours.

Thresholds VSN>6 and GDOP<4.5 are adopted as conservative conditions.

With a mask angle 15° the GPS stand-alone provides a probability to have a VSN>6 of about 100% at polar zones and 80-90 elsewhere and provides a GDOP<4.5 probability near to 90% worldwide. Geostationary and geosynchronous augmentations in this case improve the visibility and GDOP in

Fig.5: Software block diagram

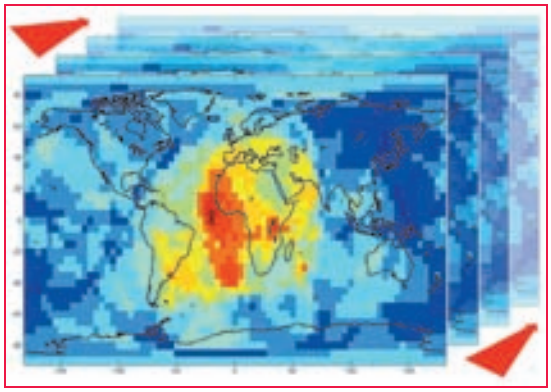

Fig.6: Plot of 3D-grid

similar ways and the super-constellation enhances further the situation.

The simultaneous use of EGNOS and S-QZSS satellites with GPS constellation provides of course the best results: VSN>6 probability is 100% and GDOP<4.5 probabilities almost 100% over Europe. At low mask angle (~15°) the stand-alone GPS is sufficient to guarantee good coverage performances w.r.t. availability and continuity; in this scenario, which certainly doesn't represents the worst case, EGNOS and S-QZSS could be useful for upgrade accuracy and integrity.

A mask angle 30° is a good approximation of a quite adverse but not prohibitive environment for signal propagation and PVT solution. In these conditions the VSN of GPS constellation is rather poor, the probability to have a VSN greater than 6 is about 10-20% almost everywhere, while over polar zones is 35-40% (Fig.7). The GPS coverage situation is quite critical, in fact the GDOP<4.5 probability is about 20-30% almost everywhere and near to 0% at high latitudes where it's impossible a precise positioning (Fig.8). The GPS+EGNOS constellation provides a considerable visibility improvement above all on the area defined by footprints intersection of 3 EGNOS SV; this area includes Southern Europe and has a VSN>6 probability about 85-95%. In this area GDOP<4.5 probability is about 50-70%. Also by the sides of this area we note a VSN between 40% and 70%, and a GDOP between 25% and 45%.

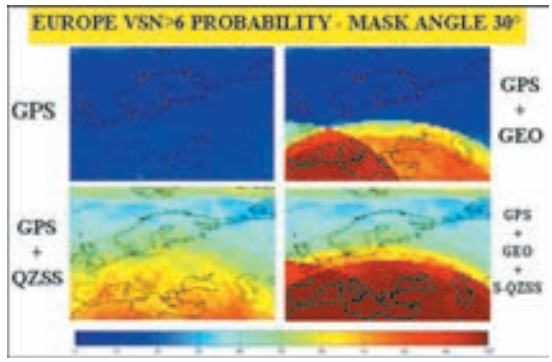

Fig.9: VSN>6 Probability (mask angle 30°)

Comparing with previous case the GPS+S-QZSS constellation improves the visibility in different way; a wider area takes advantages, but with worse performances. VSN>6 probability is 70-80% in Africa, 60-70% in Europe and the benefits of S-QZSS augmentation are clear at higher latitudes too. A similar improvement is obtained for GDOP; GDOP<4.5 probability is 50-70% in Africa and 50-55% in Europe. The super-constellation improves the visibility in both ways: a wide area is well covered with good performances. In this case the VSN>6 probability is 100% in Africa and Southern Europe. Good GDOP coverage is also obtained; GDOP<4.5 probability is between 65% and 90% in Africa and between 60% and 70% over Europe.

By the examination of Figures 9-10, which represent coverage performances over Europe with a constant mask angle 30°, we can see that in this condition GPS constellation is insufficient to provide precise positioning. The integration of GEO SVs produces a coverage improvement only over Southern Europe; on the rest of the Europe the coverage remains insufficient, owing to geostationary satellites problems to cover high latitudes. S-QZSS integration produces a good improvement in visibility and GDOP (55-70% and 40-50% respectively), but we can see some continuity issue. The GPS+EGNOS+S-QZSS super-constellation provides a full coverage on Middle and Southern Europe with a VSN>6 probability near to 100% and a GDOP<4.5 probability about 65-80%. Northern Europe is served by at least 6 SVs 60-70% of time, with a good observation geometry about 50% of time; the aforesaid coverage shortage could be overcome, handling geosynchronous orbital parameters.

A common urban environment can be simply represented considering an average mask angle 30°; in this condition the super-constellation is suitable to offer good performances with reference to availability

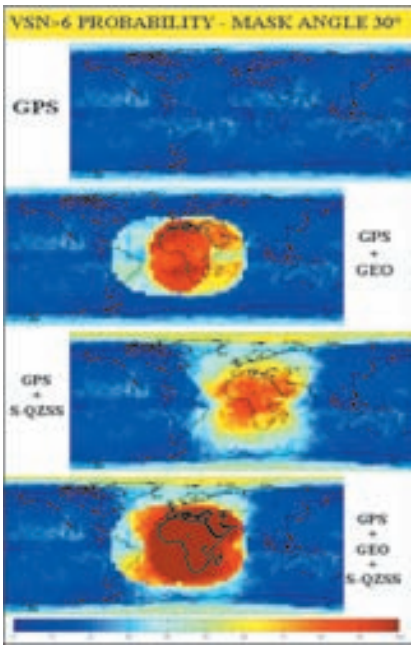

Fig.7: VSN>6 Probability (mask angle 30°)

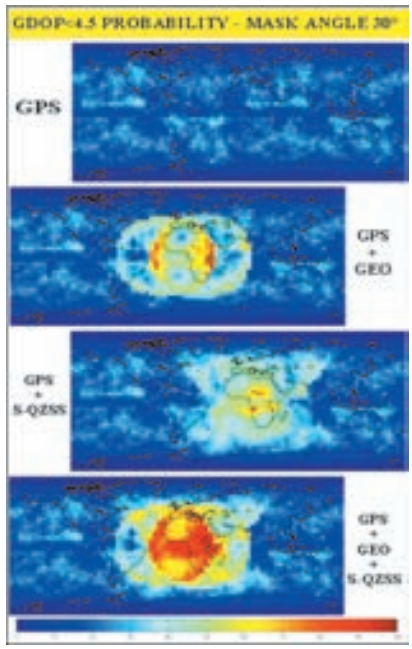

Fig.8: GDOP<4.5 Probability (mask angle 30°)

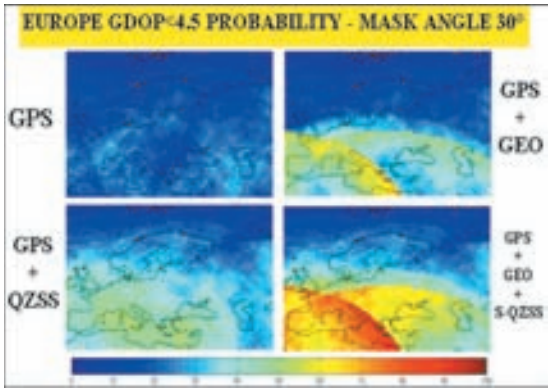

Fig.10: GDOP<4.5 Probability (mask angle 30°)

and continuity thanks to the visibility improvements. The coverage quality is enhanced thanks to GDOP improvement, which causes a more accurate positioning. If S-QZSS is able to broadcast EGNOS-like signals, accuracy will be further enhanced; it should give more probability to receive SBAS correction and integrity message also in urban environment.

GPS constellation with a mask angle 40°, is inadequate to provide a continuous and precise positioning; both VSN>6 and GDOP<4.5 probabilities are near to 0%. The super-constellation allows a good visibility enhancement on Africa, but with a GDOP very poor. On Europe such a masking makes impossible a continuous and accurate positioning service; the super-constellation provides a coverage

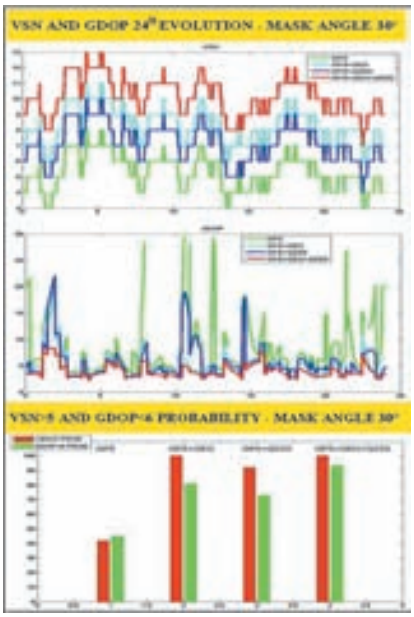

Fig.11: Naples coverage evolution (mask angle 30°)

improvement only at low latitudes.

Local results

The developed software is able to analyse the coverage evolution for a certain period, considering a single observer; this application is useful to study in detail the behaviour of a navigation constellation over a not wide zone. Now we want to examine deeply the behaviour of GPS constellation and its augmentations over Europe; for this purpose we have selected Naples centre area to test the coverage evolutions of the considered constellations.

A first analysis is made considering mask angles 15°, 30°, 40° which represent masking conditions of growing difficulty; for a fixed observer VSN and GDOP were computed every 60 seconds in a whole day and a statistical analysis with VSN>5 and GDOP<6 probability is carry out. The observer is placed at Naples at coordinates (φ: 40°50' N; λ: 14°15' E).

With a mask angle 15° GPS stand-alone constellation provides good performances: VSN>5 and GDOP<6 probabilities are 100%. For the super-constellation GPS+EGNOS+S-QZSS, VSN is between 11 and 16 and the GDOP value is ever below 3.7.

With a mask angle 30° (Fig.11) sometimes the only GPS has a VSN<4, so it's impossible the determination of 3D fix; VSN>5 probability is about 40% and GDOP<6 probability is about 45%. Instead w.r.t. super-constellation, VSN is between 7 and 13, and GDOP between 2.5 and 8; GDOP<6 probability is about 95% and so a continuous good geometry is guaranteed.

With a mask angle 40° GPS is inadequate to provide a continuous 3D positioning service, because very frequently there is a poor constellation coverage (VSN<4). VSN of super-constellation are between 5 and 11, so a continuous positioning service is guaranteed; the accuracy is not too good, because GDOP<6 probability is near to 40%.

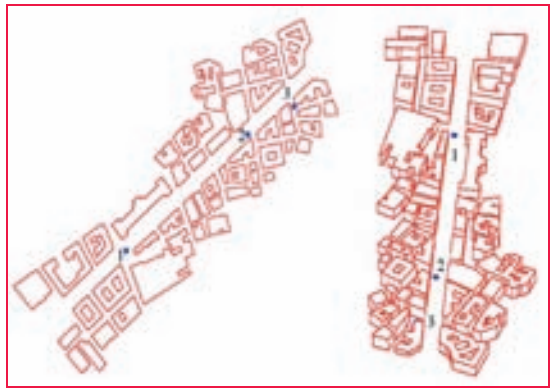

Fig.12: 3D model of a Naples street

A further analysis is made considering a real environment rather than constant mask angle, building a 3D model of an urban area in AutoCAD (Fig.12); a map of historic centre of Naples is considered and the third dimension was obtained extruding the buildings contours with rough height values. In the 3D model three different observers are considered and for each of these VSN and GDOP are computed every 60 seconds for 24 hours. The observers (marked by blue spots on Fig.12) have different types of blocking situation; the first observer has a low masking angle (comparable to the blocking configuration with constant mask angle 15°), the second with a high masking and the third one with a very high masking angle. With a weak urban masking (observer 1 Fig.12) the GPS coverage is suitable to provide a good positioning service, the VSN is at least 5 and the GDOP value rarely exceeds 10.

The augmentation constellations improve further the performances. The super-constellation works very well, the VSN is between 9 and 17 and the maximum GDOP value is about 5.

With an high urban masking (obs.2 Fig.12 and results showed in Fig.13) the stand-alone GPS is not sufficient to provide good coverage performances; VSN>5 probability is near to 30% and positioning service is often cut off.

In these masking conditions and with an observer at middle latitude, S-QZSS and EGNOS augmentations work differently;

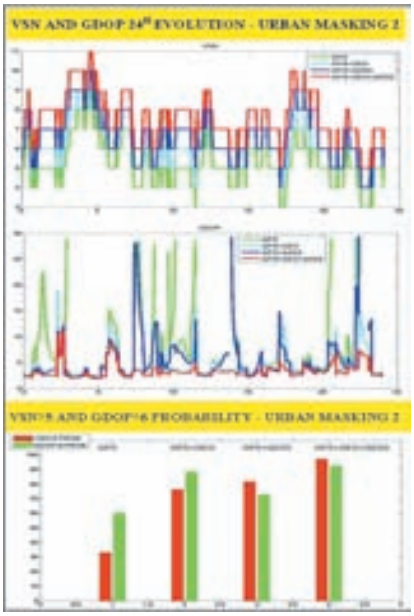

Fig.13: Naples coverage evolution (strong masking)

S-QZSS provides a better visibility, while GEO constellation supplies a better GDOP. The super-constellation combines and exalts the qualities of EGNOS and S-QZSS constellations, VSN>5 and GDOP<6 probability approach to 100% in these adverse conditions too.

With a very high urban masking (obs.3 Fig.12) the coverage performances of GPS are very poor, so the 3D position solution is often impossible or uncertain. GPS+EGNOS+S-QZSS constellation provide a continuous service but it couldn't be guaranteed high accuracy: VSN>5 probability is near to 100% but GDOP<6 probability is about 55%.

Service Area Definition

The obtained results encourage defining a "service area" (highlighted by ellipses in Fig.14) where both considered parameters (VSN and GDOP) reach appropriate values to guarantee availability and continuity of good satellite geometry. The following parameters have been chosen to define the service area:

- Simulation interval: 24 h
- Time step: 15 min
- Observers grid step: 1deg x 1deg
- Mask angle: 30deg
- GDOP< 6: Probability > 70%
- VSN ≥ 5: Probability ≈ 100%

Conclusions

In this paper the coverage performances of four constellations are analysed: GPS, GPS+EGNOS, GPS+S-QZSS, GPS+EGNOS+S-QZSS. Coverage is globally examined; over european region, different masking angle conditions are considered. With a not severe environment, GPS constellation provides good coverage performances. In moderately adverse environment (masking up to 35°), EGNOS and S-QZSS constellations are useful augmentations. A wide service area, including Southern Europe and Africa can be defined, where the super-constellation GPS+EGNOS+S-QZSS guarantees good performances in terms of visibility and GDOP. In the near future we wish to simulate a theoretic constellation with orbital parameters suited to improve coverage performances at high latitude. The obtained results encourage the implementation of a European program dealing with launching of some geosynchronous satellites in order to improve navigation satellite coverage over Europe. Waiting Galileo system deployment, such constellations could be used as gap-filler, or in future as backup system or as Galileo ERIS (External Region Integrity Systems) support.

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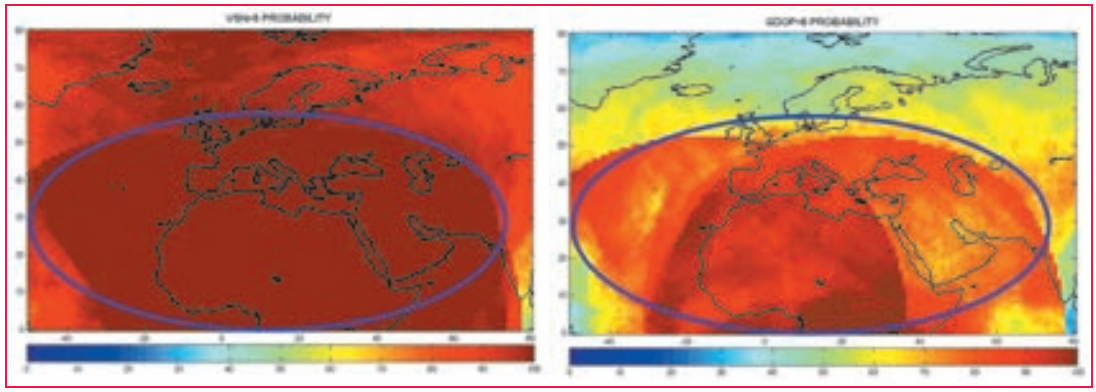

Fig.14: Service Area

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Comparative analysis of Thailand's successful national program in remote sensing

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SATELLITE remote sensing has been used to varying degrees around the world for over three decades. Over that time the degree to which the technology has been applied has varied greatly from country to country – from being broadly embraced to being used hardly at all. Simply stated, where remotely sensed data and related geospatial data are used in a limited fashion the full economic and social value of the data for resource evaluation, sustainable resource management, and environmental protection is not realized. This paper examines the key factors that appear to be associated with varying use of the data and consequent derivation of benefits.

At one time it was thought that this use was related to the economic situation within a country or the quality of training and education. While these factors are of course important, this work isolates other factors as being equally if not more important. These factors include data policy, approaches to commercialization, the level of applied research and links to "real" users. This paper explores the importance of these other factors with special reference to data policy in Thailand and Canada.

Background

In the examination of why some remote sensing programs in less developed countries were more successful than others Ryerson and Quiroga (2000) suggested that a number of factors come into play. In a review of over 200 projects around the world it was found that successful projects seem to share the operational characteristics outlined in Table 1.

Experience has also shown that if tangible results are expected it is critical to involve the potential community of end users through self-sustaining institutions very early in the design stage.

While this work seemed to explain the level of success at the project level, and while it helped explain some of the level of success at the national level, there were situations at the national level that did not appear to be explainable solely on the basis of these factors. The remainder of this paper addresses these factors.

The importance of data policy

We have been involved in detailed studies of geospatial and remote sensing data policy in general and specifically in the USA, Europe, Australia, Canada and Thailand. In a land mark comparative

study of data policy in Canada, the USA, and Australia, our team found (Sears 2001) that cost recovery policies adversely affected the level of use of geospatial data. Furthermore, we found an inverse relationship between the levels of cost recovery fees charged and the growth of the geospatial industry. While this study has resulted in a reduction in cost recovery for base-layers of geospatial map information in Canada (and in Australia), it has had limited or no impact on the high cost of remote sensing data in Canada where the study was done. Canada seems to have adopted a low-volume high-cost model for remote sensing data and by so doing has had an impact on several areas, including data use, development of value-added industry, and the derivation of benefits from widespread data use. With our findings a data policy framework was developed (Ryerson 2005). The essential elements of that policy believed to be relevant to data use are summarized in the early paper by Ryerson, and are available from the author.

The framework was subsequently applied and modified somewhat for Thailand in a September 2006 Workshop held in Bangkok hosted by the GeoInformatics and Space Technology Development Agency (Public Organization) (GISTDA) of Thailand and Kim Geomatics Corporation of Canada.

What is especially interesting in the Thai case is that Thailand has long had a low-cost/high volume remote sensing data policy as was recommended for geospatial data in Canada. Furthermore it has not had to significantly modify its policies either for international data or for THEOS data to conform to best practices related to increasing use or to international agreements developed under the auspices of the United Nations.

The Government of Thailand made the decision to subsidize the acquisition of remotely sensed data to ensure that the country could derive the full downstream public-good benefits that are associated with the data's use. Thailand, through GISTDA, has thus developed a special relationship with many data suppliers so that GISTDA could provide data on a COFUR - Cost of Furnishing a User Request - basis. Part of the work leading up to the workshop was an analysis of the use of remotely sensed data in Thailand that has resulted from this policy.

Low cost leads to high use and high benefits

Interviews were conducted with officials involved in the management and use of remote sensing data in a number of government agencies responsible for forestry, parks, land use, agricultural economics, fisheries, hydro-electric power generation and distribution, narcotics control, hydrology, defense, mineral resources, and municipal government.

Satellite data are currently being used for all of these applications on an operational and on-going basis. Many applications can be directly linked to important government policies in Thailand and elsewhere – including the Millennium Goals. Equally important, if the agencies involved had to pay the so-called "commercial rate" for data, our interviews determined that few if any of these public good applications would be carried out and the country would thus have poorer information for resource

Table 1: Operational Characteristics of Successful Remote Sensing Projects

• There was some previous experience with satellite or other remote sensing imagery;	• There were close ties to real users with the interest, dedication, and ability to sustain the work;
• There was a clear focus;	• There were close personal ties to scientists in the developed-country sponsor;
• There was a combination of experienced researchers and bright innovative younger scientists involved in the project;	• Training, personal ties, and the experience noted above resulted in the development of confidence and a lack of fear of failure on the part of the in-country project leaders; and
• There was great attention to detail – technical and financial;	• There was an entrepreneurial "can-do" spirit.
• There was a basic understanding, either explicit or implicit, of the economics of the use of remote sensing for the specific application;	

Table 2: Operational Satellite Remote Sensing Applications in Thailand

• Forest inventory	• Land use at various scales
• Forest change detection	• Crop type mapping (12 major crops)
• Forest fire	• Crop area & crop statistics
• Human impacts	• Statistical sampling frame development
• Mapping and monitoring fishing activities (freshwater, coastal, marine)	• Land cover
• Aquaculture monitoring	• Flood zone mapping
• Coastal shrimp	• Landslide mapping
• Vessel detection and monitoring	• Disaster and risk management and reduction
• Environmental feasibility studies	• Soil mapping
• Security	• Route selection and corridor planning and terrain suitability studies
• Municipal/local area tax mapping	• Base mapping (topographic)
• Mineral resource mapping	• Water management
• Field work planning	

management planning. While beyond the scope of our study, we believe it accurate to say that a few million dollars invested in the data has led to many millions of dollars in terms of improved information and better decision-making for the sustainable management of Thailand's natural and environmental resources.

To put the data use within Thailand into a more international context, consider that over 4000 images are provided annually by GISTDA. Given the size of Thailand and the size of Canada, this rate of use would be the same as Canada's governments (federal and provincial) using 77,600 images. Even counting the use of Radarsat imagery for ice monitoring, our information is that Canada comes nowhere near this level of data use. While the use of alternate sources of data collection (such as statistical surveys) plays a role in this disparity, we believe that one reason is data policy – or put more bluntly: high remote sensing data costs.

Of those interviewed in the key Thai user agencies all had an on-going need for the information obtainable from satellite data. Most had some level of in-house research or applications development capacity – often tied to university researchers, and in a few cases (such as fisheries) with international development assistance. Technology transfer from these applications development efforts was also an on-going activity. In some agencies as many as 70-100 people were users of the data, while in others it was fewer than twenty. In virtually all of the agencies interviewed the operational requirements to achieve success noted above were met.

In some cases such as forestry, the monitoring has been on-going for as long as thirty years. In others data use on an on-going and operational basis was a new activity that came as a direct result of the lowering of data costs. As one senior Thai resource management official said "the lower price motivates the government user where cost - and not profit - is the controlling factor." This sort of comment was repeated again and again. Low data cost was cited as a primary reason to use the data to the extent that they now do for each and every agency.

The approval of THEOS by the Government of Thailand is a strong endorsement and statement on the value of remote sensing data to the country.

General application of the price model

While this finding is especially important in less developed countries, it is also important and can be transferred for application to developed countries.

The United States has examined several models for data delivery – and seems to have settled on a combination of commercial for high resolution data and COFUR for satellite data for the derivation of public good information. Europe seems to have opted for a similar blend, although the emphasis within the European Space Agency as well as within some national space agencies seemed to be geared more towards the widespread distribution of lower cost data to ensure that the public good benefits are derived. India has also worked hard to get data into users' hands to derive these same benefits. (Radhakrishnan, 1999.) It is worth noting that a number of authors have stated that one of those benefits is the creation of a robust industry to interpret the large volumes of data that are consumed under the low-price/high-volume model.

France and Canada seem to be among the few advocating the commercial sale of data at commercial rates by commercial entities from what began as (and in some cases still are) nationally subsidized systems. It is worth noting that at a meeting on Radarsat-2 Canadian Space Agency staff suggested that the follow-on radar constellation will not be distributed commercially, but rather will be provided by government – which we assume means at a lower price. With each shift in data policy and/or level of competition one can observe a shift in the development of industry, as well as in the application of the data as several previous studies cited in the references below have shown.

Conclusion

Data cost has been a limiting factor in achieving the full benefits of remote sensing in both developed and developing countries. The approach developed by Thailand to data cost and other elements of data policy, research, and the emphasis on technology transfer have together resulted in a vibrant user community in government using far more data for far more applications on a comparative basis than many other countries in the world – including so-called developed countries.

Thailand's extensive use and derivation of benefits of remote sensing across government provides a clear demonstration of both the impact and importance of both an informed data policy and the use of "home grown" applied research.

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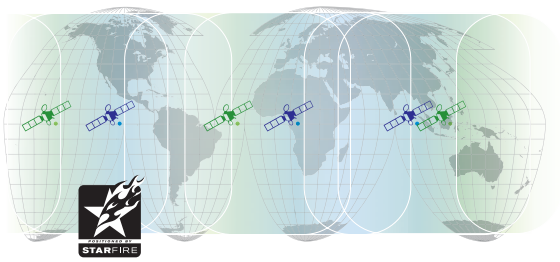

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VLBI geodetic precision with different models

This article introduces several common ocean tide models and nutation models, and computes the global VLBI data during 2001-2007 using the OCCAM 5.0 software platform

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VERY Long Baseline Interferometry (VLBI) is the unique space geodetic technique which can provide the Celestial Reference Frame (CRF), the Terrestrial Reference Frame (TRF) and the relationship between the two frames --- Earth Orientation Parameters (EOP) at the same time. VLBI has a widely usage in space geodetic, ground geodetic, geophysical fields and so on. Presently, it can determine the position of the radio source outside the galaxy with 1mas precision, and determine several kilometers length of baseline on the earth's surface with 1cm precision. Due to its high stability and high precision character, the Celestial Reference Frame outside the galaxy based on VLBI has been the best realization of the quasi-inertial reference frame since 1980s. VLBI stations are the most important benchmarks in the International Terrestrial Reference Frame (ITRF), and VLBI is one main supporting technique which determines EOP. Till now, space and ground VLBI have accumulated more than 20 years' data. They provide continuous and long-term data guarantee for space geodetic, ground geodetic and geographical research.

Though there are several kinds of common ocean tide and nutation models, there have no article giving us the best model combination through special comparison and analysis. This paper firstly introduces several common ocean tide models and nutation models, and then computes the global VLBI data during 2001-2007 using the OCCAM 5.0 software platform. It compares and analyzes the precision of geodetic parameter's result using these models, and gives us the best ocean tide and nutation model combination.

Model introduction

OCCAM is a common software in processing space VLBI and ground VLBI data. It is used in describing the physical model of time delay and time delay rate, computing and adjusting all parameters' partial derivative. Generally speaking, there are three physical models in this software[1]:

1) Computing model and setting up Standard Data File (SDF) model: the preparation of the data (DTAU0), precession and nutation and (PN), the correction of station's displacement and partial derivative (STATION), geometry model (GEOMET), all five parts.
2) Adjusting scheme model: Kalman filter method, Least square method and least square collocate method, all three parts.
3) Application program model: obtaining information from the standard data files (SDF) in OCCAM, obtaining information from Obs-Calc files, all two parts.

OCCAM 5.0 software is made up of several executing programs. Only operating in definite sequence, we can get the accurate VLBI computing results. In this paper, we will compute with multi-baseline Kalman filter method, the detailed processing please refers to [2].

EANES model (CSR4.0 ocean loading model)

The EANES model[3] used in this paper is the CSR 4.0 ocean tide model, which is computed on the basis of the Orthotide model of Eanes et al., Center of Space Research, University of Austin, Texas, kindly made available to the world in

April 1999. It is a further development of CSR 3.0 and contains 239 circles (about 6.4 years) of TOPEX/POSEIDON altimetry. Like the CSR3.0 ocean tide model, CSR4.0's grid resolution is 0.5°×0.5°. It has the same orthotide frequency model; and it comprises the diurnal and semidiurnal bands.

For the computation of the loading effects, a land-ocean mask was constructed from ETOPO5. The same mask was used in CSR3.0. The reason for this is that many coastal model nodes of CSR3.0 inundate ETOPO5 land. Since the altimetry solution does not impose local water mass continuity conditions, the masking does not degrade global mass conservation (which is a more important error source in loading effects than in the tide elevation itself), but improves the realism of the load distribution. This model still uses concentrated load circling method and computes the close load through gradual reduction discrete points in the integral.

RAY model (GOT99.2b ocean loading model)

RAY Ocean tide model[4] is a long wavelength adjustment of FES94.1 using TOPEX/POSEIDON data and is given on a 0.5 by 0.5 degree grid. FES94.1 Ocean tide model is a pure hydrodynamic tide model tuned to fit tide gauges globally. It has been calculated on a finite element grid with very fine resolution near the coast but the version used here is given on a 0.5 by 0.5 degree grid. GOT99.2b also becomes equal to FES94.1 outside the 66 degree latitudes.

IAU 1980 nutation model

In 1979, J.Wahr and H.Kinoshita introduced re-comprehensive calculation for a practical nutation of the earth, they considered the force generated from earth's solid tide to earth itself --- deformation, nutation and rotation rate changes, and at the same time, they thought about the natural effect and ellipse sphere delaminating effect in the matter of three main layers of the earth. They drew a conclusion in 1980, we call it "IAU 1980 nutation theory"[5].

There are 106 items in ecliptic nutation $\Delta\psi$ and obliquity nutation $\Delta\psi$ evolving formula. From 1984, the computation of nutation all adopts this nutation theory. Practicality, we split ecliptic nutation $\Delta\psi$ and obliquity nutation $\Delta\psi$ formula into secular terms and short terms. All cycles that are shorter than 35 days are short terms. The formula of $\Delta\psi$ and $\Delta\varepsilon$ are:

$$\Delta\psi = \sum_{i=1}^{106}(a_i + b_i T)\sin(m_{1_i} l + m_{2_i} l' + m_{3_i} F + m_{4_i} D + m_{5_i}\Omega) \quad (1)$$

$$\Delta\varepsilon = \sum_{i=1}^{106}(a_i' + b_i' T)\cos(m_{1_i} l + m_{2_i} l' + m_{3_i} F + m_{4_i} D + m_{5_i}\Omega) \quad (2)$$

In these formula, a_i and a_i' are the coefficients of longitude nutation and obliquity nutation; b_i and b_i' are time changing velocity of a_i and a_i' separately; $m_{j_i}\,(j = 1,2,3,4,5)$ are the fundamental arguments of l、l'、F、D、Ω, which denote respectively: Mean anomaly of the Moon; Mean anomaly of the Sun; F = L – Ω, with L mean longitude of the Moon; Mean elongation of the Moon from the Sun; Mean longitude of the ascending node of the Moon. The formula correspondingly is:

$$l = 485866.733'' + (1325^r + 715922.633'')T + 31.310''T^2 + 0.064''T^3 \quad (3)$$

$$l' = 1287099.804'' + (99^r + 1292581.244'')T - 0.577''T^2 - 0.012''T^3 \quad (4)$$

$$F = 335778.877'' + (1342^r + 195263.137'')T - 13.257''T^2 + 0.011''T^3 \quad (5)$$

$$D = 1072261.307'' + (1236^r + 1105601.328'')T - 6.891''T^2 + 0.019''T^3 \quad (6)$$

$$\Omega = 450160.280'' - (5^r + 482890.539'')T + 7.455''T^2 + 0.008''T^3 \quad (7)$$

In the formula, $1^r = 360^\circ = 1296000''$. T is the number of the Julian century calculated from $J_{2000.0}$ (TD=2451545.0), that is to say if TDBJ.D. represents the Julian Day at one instant (TOB), then the corresponding Julian century number can be expressed as:

$$T = \frac{TDBJ.D. - 2451545.0}{36525} \quad (8)$$

HERRING nutation model

The HERRING nutation model[1] in this software will compute the complete KSV_1996_3 nutation series with the associated corrections for planetary nutation, the freely excited Free-Core-Nutation (FCN), the precession constant change and a rate of change of obliquity. This model is designed from several aspects as following:

1) The Souchay and Kinoshita Rigid Earth KSRE95 nutation series;
2) Factors of the Retrograde Free Core Nutation (RFCN) resonance factors from the nutation formula the Mathews et al.
3) The effects of annual modulation of geodetic precession;
4) A prograde annual nutation has been estimated along with the resonance coefficients;
5) The free RFCN mode was estimated once every two years for the data after 1984;
6) The new Simons et al., fundamental arguments are used in this version.

MHB_2000 nutation model

VLBI and LLR observations[6] showed that there are obvious defect existing in the IAU 1976 precession model and IAU 1980 nutation theory which have been the criterion for a long time. For example, these theoretical model doesn't include the changing rate of obliquity in nutation that can't be observed; the precession rate exists the difference about -3.0mas/yr between observation value and adoption value (the adoption value is too high); for nutation, the difference between observation model and adoption model exists about 20mas between each top. In short, the difference between the observations and models used in the past has exceeded the achieved observation precision far more. We need to get the nutation theory with including ocean tide's and atmosphere's non-rigid body and all in the order of magnitude of 0.1mas level known effect, and get the nutation series reaching the level of 5mas new rigid body earth. Based on many years of research, IAU 2000 convention[7] decided that the newly IAU 2000A precession-nutation model, that is MHB_2000 model (up to the level of the accuracy of 0.2mas) and IAU 2000B precession-nutation model (up to the level of the accuracy of 1mas) will replace the IAU 1976 precession model and IAU 1980 nutation theory. Improved precession rate, obliquity nutation changing rate, as well as the Celestial pole offsets consistent with newly precession-nutation model on J2000.0 epoch will be given in IERS 2003 convention.

MHB_2000 model[8] was proposed by Mathews, and it was developed

on the basis of setting the problem of linear dynamic equation for wobbly nutation. It uses the estimated value of 7 parameters in the theory, obtains one newly precession-nutation VLBI data sequence in the theory of least squares. This nutation sequence depends on rigid earth nutation sequence found by Souchay (1999). It explains the change of geodynamical ellipticity implied by the observing correction of equator lunar-solar precession by the multiplier of 1.000012249. The new model contains the deviation between reference frames, geodetic precession and geodetic nutation. The Free Core Nutation (FCN) can't be strictly forecast, so this model doesn't include it. New precession-nutation model avoids the artificial separation in precession and nutation, but the precession model and nutation model is used separately in the system based on the spring equinox.

Tidal fluctuations in water height and currents will induce retrograde diurnal variation of equatorial oceanic angular momentum (OAM), hence small perturbation on nutation at the level of 1mas and most important contributions come from water height variations[9]. Considering the influence of anelasticity covering effect, the ocean tidal effect, electromagnetism coupling effect, which produced from the liquid outer core and solid core and the nonlinearity item. The MHB_2000 nutation model improves the accuracy of IAU 1980 nutation theory.

The method of experiment

The data resource

In this experiment, we use the software of OCCAM 5.0 and the data in 2001-2007[10] computing the corresponding geodetic parameters. Based on the needs of the software, we choose the data of moderate memory (about 1M) to facilitate rapid comparative analysis.

The method of model combination

In order to compare the use of different software models in the results between the levels of accuracy, we classify these models into 6 items:

I In the calculation of the daily and sub-daily change of Earth Orientation Parameters (EOP) from ocean tide term, we choose EANES model; in the calculation of the precession and nutation, we choose IAU1980 nutation model;

II In the calculation of the daily and sub-daily change of Earth Orientation Parameters (EOP) from ocean tide term, we choose EANES model; in the calculation of the precession and nutation, we choose HERRING nutation model;

III In the calculation of the daily and sub-daily change of Earth Orientation Parameters (EOP) from ocean tide term, we choose EANES model; in the calculation of the precession and nutation, we choose MHB_2000 nutation model;

IV In the calculation of the daily and sub-daily change of Earth Orientation Parameters (EOP) from ocean tide term, we choose RAY model; in the calculation of the precession and nutation, we choose IAU1980 nutation model;

V In the calculation of the daily and sub-daily change of Earth Orientation Parameters (EOP) from ocean tide term, we choose RAY model; in the calculation of the precession and nutation, we choose HERRING nutation model;

VI In the calculation of the daily and sub-daily change of Earth Orientation Parameters (EOP) from ocean tide term, we choose RAY model; in the calculation of the precession and nutation, we choose MHB_2000 nutation model;

The criteria of precision compare

In the work of surveying, the power of the observation is the relative numerical indicator which denotes its precision. It is used in weighing various observation of different precision for handling these observations. For one group of observation, if its sigma is smaller, then its power is larger; or if its sigma is larger, its power is smaller. In this paper, the constant "FACTOR" means the value of the limitation for editing the data, the OCCAM software then sets this "FACTOR" value in the control files "KVLBI.OPT" and "KVLBI_IE.OPT", it can compute the limitation of the observation delay value subtract the computation delay value. If the difference between observation delay value and computation delay value is bigger than the "FACTOR" multiplies the expectation of the sigma, that is to say the precision obtained from this observation is not good, in this case, we will reduce the power of this observation (explained with * in this paper). If the number of the observations being reduced is too much, then the usability of this observation is small. The data of CHI-SQ is one indicator of reflecting the precision with kalman filter method, if its value is close to 1, then the precision of this result is good.

The analyze of the experiment result

Based on the combination of the above models, we compute the data following the chronological order:

The compare result by adopting the data of 2001

In calculating the data of the year 2001, after the relevant solution, we choose the better data 010424XE.NGS on April 24 to explain the result. The specific calculating result please refer to table1 (I- VI represent various combination of different models, the figures shown in this table represent the value of CHI-SQ):

Table 1 the processing result of 010424XE.NGS

In the data processing on April 24 2001, we can see that if we choose ALGOPARK and FORTLEZA as the reference station for adjustment, in addition to the fourth group, the effects of the others are not ideal. After removing the results of these two stations, we average the other four stations, and then we get the first group of average.

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- GNSS Policy & Plans
- Novel Applications
- GNSS Ground-Based Augmentation Systems
- Galileo & GPS/Galileo Reference & User Receivers
- Galileo Signal Structure, GPS/Galileo Interoperability
- Galileo System Design & Services
- GNSS Space-Based Augmentation Systems
- Timing & Scientific Applications
- Integrity, Multi-constellation RAIM
- GPS & GLONASS Modernization, QZSS, & Other GNSS

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The 21st International Technical Meeting of the Satellite Division of The Institute of Navigation

Table 1 the processing result of 010424XE.NGS

2001.04.24	I	II	III	IV	V	VI
GILCREEK	1.1584	1.1573	1.1582	1.1610	1.1594	1.1600
KOKEE	1.1439	1.1439	1.1444	1.1462	1.1457	1.1461
NYALES20	1.1361	1.1354	1.1363	1.1396	1.1380	1.1393
WETTZELL	1.1184	1.1180	1.1189	1.1217	1.1209	1.1210
ALGOPARK*	1.3759*	1.1590*	1.3752*	1.0488	1.2424*	1.1740*
FORTLEZA*	1.3890*	1.1806*	1.3975*	1.0569	1.2451*	1.1950*
AVEGE [1]	1.1392	1.1387	1.1395	1.1421	1.1410	1.1416

Table 2 the processing result of 020711XE.NGS

2002.07.11	I	II	III	IV	V	VI
MATERA*	1.4597*	2.1871*	1.8396*	1.6353*	1.3078*	1.5727*
NYALES20	0.9726	0.9711	0.9712	0.9601	0.9581	0.9582
WETTZELL	0.9261	0.9245	0.9246	0.9272	0.9250	0.9251
KOKEE	0.9591	0.9569	0.9570	0.9392	0.9366	0.9367
FORTLEZA*	0.9394	1.2611*	1.4481*	1.3055*	1.3930*	1.6432*
ALGOPARK*	0.9746	1.2956*	1.4876*	1.3590*	1.4293*	1.7177*
AVEGE [2]	0.9526	0.9508	0.9509	0.9422	0.9399	0.9400

Table 3 the processing result of 031021XE.NGS

2003.10.21	I	II	III	IV	V	VI
GILCREEK	1.6649*	1.6653*	1.6653*	1.6595*	1.6602*	1.6602*
SESHAN25	1.7437*	1.7443*	1.7441*	1.7396*	1.7404*	1.7402*
TSUKUB32	1.6919*	1.6916*	1.6915*	1.6413*	1.6413*	1.6412*
URUMQI	1.3806*	1.3805	1.3804*	1.3757*	1.3759*	1.3758*
HOBART26	10.9243*	2.9124*	2.9170*	6.6041*	11.8069*	8.1903*
AVEGE [3]	1.6203	1.6204	1.6203	1.6040	1.6045	1.6044

Table 4 the processing result of 040601XA.NGS

2004.06.01	I	II	III	IV	V	VI
NYALES20	0.8571	0.8231	0.7543	0.8215	0.784	0.8108
TSUKUB32	0.7385	0.8979	0.7696	1.7865*	0.995	0.9811
WETTZELL	1.0085	1.3346*	1.1048	0.7167	0.8387	0.8898
TIGOCONC*	1.9740*	0.7697	1.1898*	5.1021*	2.5111*	0.7726
WESTFORD*	2.0230*	0.9132	1.3620*	5.1753*	2.5282*	0.9174
AVEGE [4]	0.8680	1.0185	0.8762	1.1082	0.8726	0.8939

Table 5 the processing result of 2005.08.25, 2006.09.21 and 2007.10.21

DATE	I	II	III	IV	V	VI
2005.08.25	0.9026	0.8928	0.9025	0.9068	0.8943	0.8954
2006.09.21	0.8900	0.8980	0.8927	0.9227	0.9332	0.8894
2007.10.21	0.8130	0.8113	0.8114	0.8145	0.8125	0.8126

Table 6 the general result of all kinds of combination

DATE	I	II	III	IV	V	VI
2001.04.24	1.1392	1.1387	1.1395	1.1421	1.141	1.1416
2002.07.11	0.9526	0.9508	0.9509	0.9422	0.9399	0.94
2004.06.01	0.868	1.0185	0.8762	1.1082	0.8726	0.8939
2005.08.25	0.9026	0.8928	0.9025	0.9068	0.8943	0.8954
2006.09.21	0.89	0.898	0.8927	0.9227	0.9332	0.8894
2007.10.21	0.813	0.8113	0.8114	0.8145	0.8125	0.8126
AVEGE	0.9276	0.9517	0.9289	0.9728	0.9323	0.9288

The compare result by adopting the data of 2002

In calculating the data of the year 2002, after the relevant solution, we choose the better data 020711XE.NGS on July 11 to explain the result, the specific calculating result please refer to table2 (I - VI represent various combination of different models, the figures shown in this table represent the value of CHI-SQ):

In the data processing on July 11 2002, we can see that if we choose FORTLEZA and ALGOPARK as the reference station for adjustment, in addition to the first group, the effects of the others are not ideal. When choosing MATERA as the reference station to calculate, all six groups' precision are not ideal. After removing the results of these three stations, we average the other three stations, and then we get the second group of average.

The compare result by adopting the data of 2003

When we processed the data on October 21 2003, we found that there were a considerable number of observations were reduced their power, and their availability and the results is not very good to deal with. In the final model comparison, we choose not to consider this data. The specific calculating result please refer to table3 (I - VI represent various combination of different models, the figures shown in this table represent the value of CHI-SQ):

The compare result by adopting the data of 2004

In calculating the data of 2004, after the relevant solution, we choose the better data 040601XA.NGS on June 1 to explain the result, the specific calculating result please refer to table4 (I - VI represent various combination of different models, the figures shown in this table represent the value of CHI-SQ):

In the data processing on June 1 2004, we can see that if we choose TIGOCONC and WESTFORD as the reference station for adjustment, in addition to the

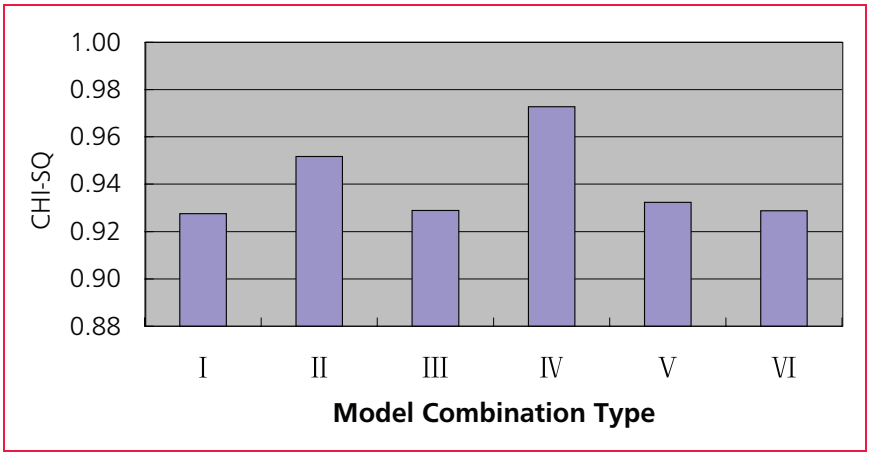

Figure 1 the general result of all kinds of combination

second and sixth group, the effects of the others are not ideal. After removing the results of these two stations, we average the other three stations, and then we get the third group of average.

The result by adopting the data of 2005-2007

Adopting this method, we get the results on August 25 2005, September 21 2006, October 21 2007, the final processing result please refer to table 5 (I - VI represent various combination of different models, the figures shown in this table represent the value of CHI-SQ):

Compared results

After doing these works, we compute the precision of various model combinations, and list the result with table 6: (I - VI represent various combination of different models, the figures in this table represent the value of CHI-SQ):

Then we represent the result correspondingly create the figure 1:

From figure 1 and table 6, we can see that in these six kinds of categories, the fourth model of the results of the final classification sought by the CHI-SQ value is 0.9728, the closest to 1.00. Though the precision of the other combinations is near 1.00 too, their gap is very small. We believe that in the same circumstance, choosing the combination of RAY ocean tide model and IAU_1980 nutation model is the best choice.

Conclusion

On the basis of briefly introducing several common ocean tide models and nutation models, this paper uses the OCCAM 5.0 software platform and the global VLBI data during 2001-2007, compares and analyzes the precision of the geodetic parameter result getting from these models. The final results show that: using RAY ocean tide model and IAU_1980 nutation model, we can obtain the best precision result in this kind of model combination. This paper has done basic work for future data processing and analyzing.

Acknowledgement

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"Design is critical for infrastructure management"

Says, Lisa Campbell, Vice President, Geospatial Solutions, Autodesk Inc.

Tell us about Autodesk's geospatial solutions

Autodesk provide solutions to design, operate and manage infrastructure. Our geospatial solutions are meant for the entire lifecycle of infrastructure design to management, be it water or electricity network or utility infrastructure. We offer solutions with geospatial perspective. Our technology helps in mapping, civil engineering and design data.

What solution you offer as an integration of CAD & GIS?

Our customers demand integration. By providing CAD and GIS functionality in a single offering, we deliver a great deal of functionality to our customers. Our solutions are transforming the civil engineering in design development and documentation process. The solutions are of immense use for government and utility organizations. We make our products as easy to use as possible, so that its adoption is easy and fast streamlining complex processes and simplify the sharing of data.

How important is precision in Autodesk's geospatial solutions?

It is hard to have geospatial solution unless we have a good design story. In case of utility and water infrastructure management, design is critical and so is precision. That ultimately leads to you to the accurate answers to the questions like where is my asset and in what condition it is in.

Do you have any customized solutions for India?

India is changing very fast especially if you look at the pace of urbanization. The government and utility organisations are under stress in extending the proper services to urban population. Autodesk solutions have a major role to play. We have understanding of local needs and do customize our products to suit their needs. To help us in this, we have talent and knowledge base here. India is a country which continues to attract our attention.

Any comparison between India and China?

In fact both countries are focusing on infrastructure development. If Beijing is getting ready for Olympics then Delhi prepares itself for Commom Wealth. In both case there is huge opportunity for managing infrastructure like airports, hotels, buildings, etc. We have perfect offerings not only to manage them but also for future analysis and simulations.

What about the acceptability of these solutions?

We ensure that our customers are successful in adoption of the technology. Our solutions are easy to learn and adopt. We have large trained engineers and customer base. We provide training to our customers. We are also training students in Universities as well.

How closely do you work with Universities in India?

Autodesk is working very closely with some of the leading institutes of India. We are working on development of laboratories on "Innovative Design and Research" with Indian Institute of Technology, Kanpur and Chennai. We are also working with National Institute of Design to promote design education in India. We are not simply providing the software but also involving research associates in live projects for prototyping and simulations. By interacting with these institutes, we are able to create a talent pool and also bring academia and industry closer to each other.

Has Autodesk growth in India spilled over to the SAARC region also?

There is tremendous interest in these countries. We have customers in Sri Lanka, Bangladesh, Nepal and Bhutan. However, the initiatives are isolated and need to be taken to the next stage. The advantage is that they can learn from our mistakes. Our interaction continues with senior level officials there. Although slow, still there is a growth, a definite growth.

Going deeper underground

The 'National Underground Assets Group (NUAG) Approach' forms the basis of a national high-level framework in UK to deliver a set of minimum performance standards

Marc Hobell
Member of the ICE/ICES Geospatial Board, AGI Utilities SIG and NUAG

Jim Stancliffe
Inspector with HSE's Gas and Pipeline Unit
Inspector, Health and Safety Executive (HSE)

BENEATH our feet in the UK lies a vast labyrinth of millions of kilometres of buried pipes and cables, delivering key products and services essential to our social and economic well-being. These networks of buried assets need repair and maintenance, and the growing demands of the UK economy mean that in years to come the networks will continue to grow significantly, as will the amount of traffic on the streets under which many of these assets lie.

There are now more companies involved in digging holes across the UK than ever before. Latest estimates put this figure at around 4 million holes dug by utility companies annually, and this excludes any excavations made as part of construction projects and works away from the street. Every time a hole is dug it impacts on traffic and the local environment. Often, holes turn out to be 'dry' – inaccurate information means that assets thought to be there cannot be found.

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In addition, with every hole or trench dug or excavation carried out there is a risk of hitting and damaging buried equipment. The estimated cost of third-party damage to utility companies alone is approximately £150 million a year. This figure is dwarfed by the annual £5.5 billion cost to society through delays to road users, disruption to business, environmental damage and safety costs.

Of all the types of underground assets in the UK some buried pipelines are more hazardous than others, due to the contents they carry or the pressure under which those contents are transported. In the UK such pipelines are classified by the Pipelines Safety Regulations as Major Accident Hazard Pipelines (MAHPs). There are nearly 22 000 km of MAHPs in the UK with 20 000 km transporting gas above 7 bar, 1 000 km transporting ethylene and the remainder transporting spiked crude oil and other hydrocarbons.

Whilst these extensive networks are an efficient and low-risk means to transport large quantities of liquids and gases around the country, there is considerable potential for third-party damage to occur if excavation works adjacent to pipelines are not adequately controlled. In particular, where the pipelines enter urban areas or are sited near to communication routes this potential rises sharply. The consequences of damaging an MAHP can be devastating for people and the environment.

In the UK we have thankfully not witnessed the kind of catastrophe that can result from damage to an MAHP. However, on 30 July 2004 just such an incident occurred in Ghislenghien, Belgium. A high-pressure gas pipeline, operated at a pressure of 70 bar, ruptured following recent third-party damage. Twenty-five people died as a result and 150 were hospitalised, mostly with severe burns. It is thought that damage to the pipeline occurred during the final stages of a car park construction project as a mechanical soil stabiliser was driven over it. Two weeks after the completion of the car park the gas pressure was increased in the pipeline, which then ruptured with disastrous results.

Regular maintenance and upgrading of the UK's MAHPs has revealed instances where damage has occurred to pipelines but has not been reported to the operator. The UK Onshore Pipeline Association believes it is essential for all cases of damage to be reported to the operator immediately. This applies even in cases where only the pipeline


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coating or surface appears to be scratched, as this can lead to corrosion and a weakening of pipeline integrity.

Things can only get better

Currently, there is no national approach to the way information on the nature and location of underground infrastructure is captured, recorded and shared. Records are not always complete. There are varying degrees of accuracy and referencing approaches. The time it takes to capture, store, retrieve and share data, how it is stored and policies and procedures followed also differ. Even scales of drawings, level of detail and symbols used are not standard across organisations. All of these factors combine to reduce efficiency and effectiveness, and increase health and safety risks. But all this is on the change. Following the work of the ICE/ICES Geospatial Engineering Board, the National Underground Assets Group (NUAG) was established in 2005 to deliver a new way of looking at the issues. In July 2007 it published the 'NUAG Approach' for capturing, recording and sharing underground asset information.

The 'NUAG Approach' forms the basis of a national high-level framework to deliver a set of minimum performance standards. It envisages a structured transition towards more comprehensive data capture using GPS-enabled methods, more consistent data being held in GIS as well as web-based enquiry and information sharing. It also seeks to improve the quality and consistency of legacy asset data through an opportunistic approach, with no requirement to convert all legacy data from a stated date; rather, the aim is for an improvement over time. Implementation of the 'NUAG Approach' will inevitably take time. The performance standards proposed are deliberately challenging in response to identified stakeholder requirements and can only be achieved as organisations change their processes and the market responds with more affordable and useable technologies.

Stakeholders have identified the lack of a statutory common approach as a major underlying cause of the problems, and are supportive of the NUAG recommendations and standards. Using the 'NUAG Approach' as the basis for wider engagement with appropriate government departments, NUAG is making positive progress on key issues of ownership, legislation and resources. In agreement with the Department for Transport (DfT), and the Highway Authorities and Utilities Committee (HAUC(UK)), the July 2007 NUAG report will form the basis of the forthcoming review of their Code of Practice for Recording of Underground Apparatus in Streets.

As the next part of its overall plan, NUAG is currently embarking on a project to build on its work to date with wider support from the Health & Safety Executive, Regulators and wider government stakeholders such as DEFRA and the Scottish Executive. The 'NUAG Approach' sets out standards to ensure data on underground assets is more accurate, consistent and complete, and made available more quickly. It also sets out a high-level process for sharing and displaying asset information in response to enquiries. This new project aims to define and describe in much greater detail the necessary underlying processes, protocols and technological capability, and how they might be implemented, based on an understanding of user requirements and available technologies.

This will be the next step in moving towards achieving the NUAG vision: All information on underground assets, and appropriate associated above-ground assets, will be shared between stakeholders in a consistent way, on demand.

The costs and risks associated with the lack of a common approach are high, and will continue to grow unless action is taken to resolve the problem. NUAG's extensive stakeholder engagement over the last two years confirms widespread and strong support for action to improve the situation. NUAG is trying to piece together a road map to enable everyone involved with buried assets to develop their organisations so that all reach a common point at an agreed date. Successful deployment of the 'NUAG Approach' is fundamental to this aim and to the delivery of significant associated benefits to utility companies, highways organisations, and society in general.

More information about NUAG, and downloadable copies of NUAG reports, can be found at *www.nuag.co.uk*.


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BEst practices for sustaining infrastructure

BE conference, May 28-30, 2008 Baltimore, USA

BE conference focused on BEst Practices for Sustaining Infrastructure was held May 28-30, 2008 at the Baltimore Convention Center in Baltimore. At this two-and-half-day event, decision makers and senior practitioners from infrastructure organizations around the globe, including owner-operators and AEC firms shared innovative best practices using Bentley solutions. The highly focused agenda of BE Conference 2008 enabled attendees to explore innovative ways to increase productivity, improve project quality, and reduce the costs and risks associated with sustaining infrastructure.

In the context of Bentley's new theme, "Sustaining Infrastructure," CEO Greg Bentley reviewed key business developments at Bentley and in the world of infrastructure, as well as new Bentley solutions, products, and acquisitions in 2007. He focused on Bridge Information Modeling (BrIM) as an example of the way Bentley is making its solutions portfolio more comprehensive while advancing interoperability over the asset lifecycle.

The guest keynote was addressed byAndrew Winston, coauthor of the bestseller Green to Gold, which highlights what works – and what doesn't – when companies go "green." Winston is a globally recognized expert on green business, and his work has appeared in The Wall Street Journal, Time, Newsweek, BusinessWeek, Forbes, The New York Times, ABC News, and CNBC.

There were many announcements made during the conference including the release of its Annual report. The report, which was distributed to more than 2,000 attendees, reviews Bentley's business priorities and highlights milestones for the past year, including:

- 2007 revenues reached $450 million, reflecting 16 percent growth over 2006,
- Bentley colleagues around the world now exceed 2,800,
- Bentley users work in 169 countries,
- Almost 80 percent of the ENR Top 50 rely on ProjectWise collaboration services,
- Bentley was named the world's No. 2 provider of geospatial software solutions in a just-completed Daratech research study.

Bentley has been named the world's No. 2 provider of geospatial software in a second consecutive Daratech research study. Styli Camateros, Bentley vice president, Civil and Geospatial Products said, "The entire geospatial team is proud that Bentley has been named the No. 2 geospatial software vendor in the world in a second consecutive Daratech study. We've listened closely to our users in developing our technologies, and the new capabilities in our growing range of advanced geospatial products are all based on that invaluable input.

During the conference Bentley announced Bentley OpenPlant PDx Manager, a new software tool built on ISO 15926 that makes existing plant design system data, such as PDS data, open and interoperable with other applications. With Bentley OpenPlant PDx Manager, engineering/procurement/construction firms, owner-operators, and suppliers can connect to a live PDS project and open up the entire PDS project database without affecting the underlying PDS model or data.

It was also announced that Bentley has acquired the global business of Common Point, Incorporated. ConstructSim has become widely established in plant projects, has been successfully deployed on building projects, and, along with OpSim, can also be applied in civil infrastructure projects. The integration of Common Point's technology with Bentley's ProjectWise Navigator platform and comprehensive portfolio of applications and collaboration servers will enable Bentley to accelerate integrated project delivery for infrastructure projects by closing gaps between design, construction, and operations.

Bentley Systems, Incorporated announced the winners of the 2008 BE Awards of Excellence, which honor the extraordinary work of Bentley users improving and sustaining the world's infrastructure. Seventeen projects in the professional portion of the program received BE Awards during the BE Conference in Baltimore. These projects set benchmarks and showcase the imagination and technical mastery of the organizations that created them. In addition, for only the second time, a BE Award was presented for Lifetime Achievement. In the academic portion of the program, BE Awards went to the Educator of the Year and the top four student designs. *www.bentley.com/BEconference.*

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RMSI ranked the 'Best Workplace' across all industries in India

RMSI has been ranked first in the Top 25 Great Places to Work in India by a study conducted by the Great Place to Work® Institute, US, along with The Economic Times, a financial daily in India. RMSI provides geospatial services, consulting to application development to spatial analysis and modeling to remote sensing and data conversion. *www.rmsi.com*

28th Annual ESRI International User Conference explores Geography in Action

This summer, more than 14,000 professionals from more than 120 countries will experience the paramount event of the year for the ESRI software user community, the ESRI International User Conference to be held August 4–8, 2008, at the San Diego Convention Center in California. Regardless of their industry or level of experience with GIS technology, all ESRI GIS users are encouraged to attend this enlightening and inspiring forum designed around the theme GIS: Geography in Action. *www.esri.com*

Trimble news

Trimble has introduced a software package to continuously monitor and control DGPS broadcast sites for marine navigation – Trimble® Coastal Center™. It provide network operators the ability to monitor and control multiple DGPS beacon stations from one central location, saving time by automating functions and tasks remotely.

Trimble has also introduced the Trimble® NetR3™ GNSS reference sensor. It seamlessly integrate into any Trimble Virtual Reference Station network or other infrastructure application, for tracking and streaming data.

Trimble has also been chosen by Croatian Ministry of Finance to supply 31 Trimble® NetR5™ Reference Stations, 31 Trimble Zephyr Geodetic™ antennas and Trimble VRS™ (Virtual Reference Station) technology to establish a nationwide GNSS infrastructure network. *www.trimble.com.*

Leica IPAS20 and MobileMatriX v3.0

The new Leica IPAS20 system delivers direct georeferencing for a wide range of airborne sensors such as imaging, LIDAR, SAR, thermal and multispectral systems. It is equipped with GPS/GLONASS technology and a plug and play IMU interface.

Leica Geosystems has also released Leica MobileMatriX v3.0. It offers the ability to synchronize survey data with an enterprise geodatabase, transfer digital images taken from a mobile phone via Bluetooth and link it with a feature. *www.leica-geosystems.com*

Blue Marble gets Company of the Year award

Blue Marble Geographics were honored with the Governor's Award for Technology Company of the Year at the TechMaine Technology Awards Showcase on May 20, 2008. It is for success in creating a financially stable, cutting edge business that supports the people of Maine by providing skilled technology jobs. *www.bluemarblegeo.com*

CalAmp implements u-blox 5 across MRM products

CalAmp Corp. unveiled a series of mobile resource management products built around u-blox's GPS platform. The u-blox 5 contains a 50-channel GPS receiver and features more than 1 million correlators and separate acquisition and tracking engines, capable of massively parallel searches. It can achieve -160 dBm acquisition and tracking sensitivity. *www.u-blox.com*

Pendulum rolls out GPS/ GLONASS frequency standard

Sweden's Pendulum Instruments has released GPS and GLONASS controlled frequency standard dubbed GPS-12RG. The reference and calibration instrument is based on this standard, which contains a high-stability rubidium atomic clock; its internal oscillator gives excellent stability of a few parts in 10-12, even in hold-over operation when satellite contact is lost. *www.pendulum-instruments.com*

Spirent improves high dynamics of GSS8000

Spirent Communications has unveiled improvements of Spirent GSS8000 GNSS simulation system supporting up to 20,000 g signal dynamics, up to 120,000 m/s velocity, and 50 Hz processing rates. Motion data can be generated using its on-board vehicle models or using real-time, high-rate host vehicle trajectory data over a remote interface; it supports full 6 degrees-of-freedom trajectory data. *www.spirentcom.com*

Spirent supports all 3GPP AGPS testing, provide A-GPS testing for China

Spirent UMTS Location Test System now supports full certification testing of the 3G Partnership Project's, Assisted GPS, RF Minimum Performance test cases for both W-CDMA and GSM devices. Those AGPS testing standards include RF performance, signaling conformance and Secure User Plane Application Enabler. Spirent has signed with China Telecommunications Technology Labs for assisted-GPS testing in China. CTTL will use the Spirent ULTS Location Test System as its standard platform for various testing. *www.spirent.com*

Fast, affordable scanning solution by Contex

Contex, and VIDAR, a Contex Group company, have launched the SD Series user-friendly scanners with all-new enhanced CIS technology. It is ideal for customers who primarily scan technical documents and maps. The SD Series' ability to separate fine lines and details in technical documents delivers the sharpness that customers in architecture, AEC, GIS, and copy and reprographics shops require.

GPS Industries signs master supply agreement with GPSi Asia

GPSi Asia and GPS Industries has signed a Master Supply Agreement for

A new receiver with exceptional navigation capabilities

NovAtel Inc. has recently launched SPAN-CPT™, a powerful GPS/INS receiver. It has fiber optic gyro and MEMS accelerometer inertial components from KVH Industries in one compact unit. Comprised entirely of commercial components, it has no special export restrictions, minimizing the operational complexities for customers whose products cross international boundaries. **Mr. Jason Hamilton**, product manager for SPAN group talks more about the receiver

What is so unique about SPAN-CPT receivers

SPAN-CPT brings together NovAtel's high-accuracy, dual frequency GPS technology with high-performance Fiber Optic Gyro IMU to create a combined GPS/INS product. Unlike some products that have the GPS and INS as separate hardware components, SPAN-CPT has the GPS and IMU combined into a single, compact enclosure. The product will have the tightly-coupled GPS/INS integration already familiar to users of our SPAN technology which gives customers an optimal combination of GPS and IMU data. SPAN allows for faster satellite reacquisition during difficult GPS tracking scenarios and excellent absolute solution accuracy in challenging conditions. Solution data will be available at up to 100Hz.

What kind of applications these receivers will be best used for?

The product will be usable for applications that require robust positioning in environments that are traditionally difficult for GPS, like urban or forested locations; applications that require a full attitude output (roll, pitch, heading) and high output data rates. Applications for the product include manned or unmanned navigation, antenna pointing, mapping, aerial or ground survey and machine control. For applications where a local base station is not feasible, L-Band corrections using the Omnistar correction service is available.

What is your collaboration with KVH Industries in developing these receivers?

NovAtel is providing the GPS side the product in the form of our OEMV receiver. KVH is providing the IMU for the system using their patented FOG IMU technology. The software in the system will leverage NovAtel's tightly coupled SPAN GPS/INS integration.

The companies are both OEM-focused and have a strong track record in providing robust, high-quality products to their customer bases. Both parties are excited about the opportunities this new product provides for our customers.

sales in China. It will purchase 15 or more systems or up to 1,750 Inforemer HD Mobile Display Units.As per the agreement, it has advanced an initial deposit to GPSI to initiate production of the first 5 systems and to obtain preferred pricing. *www.gpsindustries.com*

New Asia-Pacific office for Rolta

The Indian geospatial company Rolta has opened an office in Sydney to be the headquarters of its Asia Pacific operations. The company track record spans 25 years and has market capitalisation of over a billion dollars and now operates on six continents.

NAVTEQ signs new deal with MapQuest

NAVTEQ has agreed with MapQuest, to have access to all 73 countries in the NAVTEQ map database, as well as future country releases. MapQuest will utilize NAVTEQ data in both its Internet and mobile applications.

TomTom wins EU approval for Tele Atlas acquisition

TomTom and Tele Atlas have received unconditional clearance from the European Commission for the proposed acquisition by TomTom of Tele Atlas. This merger "would not significantly impede effective competition" stated EU Competition Commissioner Neelie Kroes.

Optech lidar technology delivers weather reports from mars

The Phoenix Mars lander made a dramatic landing on the Red Planet on Sunday, May 25th after a journey of 10 months and hundreds of millions of miles through deep space. The first lidar results from Mars arrived late in the evening of May 28th, amid cheers and applause from NASA officials .The Phoenix lidar was designed and built by Optech in partnership with MDA Space Missions, with funding from the Canadian Space Agency. The analytical lidar, which probes the atmosphere above the lander, is the first of its kind to be sent to another world.

China to investigate Google for illegal maps

China has launched an investigation into online mapping services by Google and Sohu in an effort to protect state secrets and territorial integrity. According to vice head, State Bureau of Surveying and Mapping, authorities hope to get rid of online maps that wrongly depict China's borders or that reveal military secrets. The government began the investigation into the problematic maps in April and will continue it until the end of the year. Min cited five areas of concern - Taiwan, the Spratlys and Paracels island chains in the South China Sea and the Diaoyu Islands in the East China Sea. *http://afp.google.com/*

Water lines to be digitally mapped in Kolkata, India

The civic authorities of Kolkatta have decided to prepare digital map of the underground water pipes that were laid more than 70 years ago. The Calcutta Municipal Corporation will approach the National Urban Renewal Mission for funds — Rs 1,000 crore — for the mapping as well as installation of flow and pressure monitors at strategic points in the network that supplies water to over 2.8 lakh households. *www.telegraphindia.com*

GIS in Vietnam – Improving resettled lives

The multibillion-dollar, government-financed hydropower project will help Vietnam meet its increasing demand for energy once the project is completed in 2015, but it will displace more than 20,000 families—mainly ethnic minority people from Son La, Dien Bien, and Lai Chau provinces. While the Government has approved 687 million USD for a resettlement plan, its planning and implementation suffers from many problems.

A due diligence report conducted by the Asian Development Bank on the project's resettlement revealed a need for capacity building support in planning and implementing of such a large and complex resettlement plan, particularly in the area of livelihood restoration. In November 2005, ADB approved a 1 million USD technical assistance project, financed by the Poverty Reduction Cooperation Fund, to increase the capacity of both resettlement authorities and grassroots stakeholders to develop appropriate livelihood programs for the resettled people. In 2 years, the TA trained government staff on how to select appropriate relocation sites using GIS, how to assess soil types and availability of natural resources, and how to plan and implement suitable and sustainable livelihood activities. *http://english.vietnamnet.vn*

ERDAS announces update for ArcGIS® desktop products

ERDAS announced the release of ArcGIS® 8.x and 9.x ECW JPEG 2000 Plug-in 4.1. It provides seamless interoperability with ArcGIS desktop products and the ECWP high-performance streaming imagery protocol. The ECWP protocol allows users to access massive amounts of image data easily over the internet or intranet.

Intergraph® GeoMedia® to support Microsoft SQL Server 2008

The Intergraph® GeoMedia® will support Microsoft's SQL Server 2008 spatial enhancements to provide Intergraph customers with an improved capacity for interoperability and information sharing.

The Intergraph® Foundation will provide a $25,000 donation and match additional employee contributions to the American Red Cross China Earthquake Relief Fund to aid survivors and relief efforts of the devastating May 12 earthquake.

ESSP SAS formed

ESSP SAS has been recently formed in Rome with objective to become the certified service provider for EGNOS. The Headquarters will be in Toulouse having two units: the Service Provision unit in Madrid and Operations in Toulouse. The negotiations between the European Commission and the EOIG experts have reached a conclusion on the EGNOS Agreement and foresee to initial the Agreement in the coming weeks. michel. *calvet@aviation-civile.gouv.fr*

ION announces annual award winners

The Institute of Navigation presented its Annual Awards during the IEEE/ION PLANS 2008 Conference. Dr. Maarten Uijt de Haag, for contributions to LADAR based navigation, aircraft precision approach and integrity for synthetic vision systems. Dr. Yoaz Bar-Sever for contributions to the art of GPS satellite orbits and signal modeling for high-accuracy space-borne navigation and science application. Mr. Patrick Reddan for contributions to development of navigation systems, technical leadership of the WAAS, and oversight over implementation of its geostationary satellites. Dr. Peter Maybeck for lifelong accomplishments in navigation, education and research at the Air Force Institute of Technology. Captain Jens Lyndrup for his superior leadership and significant contributions to the effective combat employment of the United States and Iraq Air Force C-130s as an instructor navigator. *www.ion.org*

Ahmedabad municipality to add 200 more buses

The Ahmedabad Municipal Transport Service, India will add 200 CNG buses to its fleet fitted with GPS. The buses would be taken on contract and for the first time penalty clause for various offences ranging for not maintaining time schedule to dirty buses have been introduced. *www.gujaratglobal.com*

US Postal Service Selects GPS Fleet Solutions

GPS Fleet Solutions agreed with the US Postal Service to begin a GPS

vehicle tracking project. According to VP of Sales, 500 unit pilot is to be installed in greater Chicagoland. Key expectations from this project include improved route efficiency, driver safety, customer service, and reduced vehicle costs. *www.gpsfleetsolutions.com*

Lockheed wins GPS satellite contract

The Air Force awarded Lockheed Martin a $1.5 billion contract to build the military's next generation of navigation satellites. It beat out rival Boeing for a contract to develop and build two satellites, with an option for 10 more, the first batch of a constellation called the GPS III. The Pentagon would probably order 20 satellites on top of that. *www.washingtonpost.com*

ABI: GPS handset market poised for huge expansion

The market for GPS-enabled handsets is set to boom over the next four years, with more than 550 million units shipping in 2012, market research firm ABI Research said. Cellular service providers have begun offering both on-board and off-board navigation, following in the wake of PND market success over the course of the last several years. Carriers have also begun offering other location-based services, such as local search and friend-finding apps on GPS-enabled mobile phones. Furthermore, community and social-networking-related functionality, such as the sharing of points of interest and geo-tagged pictures, is also becoming popular and will boost GPS-enabled handset adoption even more, ABI suggested. *www.abiresearch.com*

Japan asks for limits on cell phone use by kids

The Japanese government is urging parents to limit the use of cell phones by children. The government has adopted recommendations by a government panel requesting manufacturers to enhance Internet filtering and include GPS technology in phones that could keep track of kids. 1/3rd of sixth graders and around 60 % of high schoolers own cell phones in Japan, costing $30 per month. *www.allheadlinenews.com*

Galileo update

Galileo and GPS systems to work together

The UK government has published the agreement between it and fellow European governments, and the USA, over the promotion, provision and use of the Galileo and GPS systems.

After many years of wrangling, the Galileo project was finally given the go-ahead by the European Union back in December 2007. Galileo is intended to be an independent alternative to America's GPS. As recently as the year 2000, the US only provided limited access to GPS to the general public.

Both the United States and the EU signed an agreement way back in June 2004 that GPS and Galileo signals would be interoperable, but it has taken several years for the agreement to be approved by member states. *www.techworld.com*

Galileo satellite sends first signals to Earth

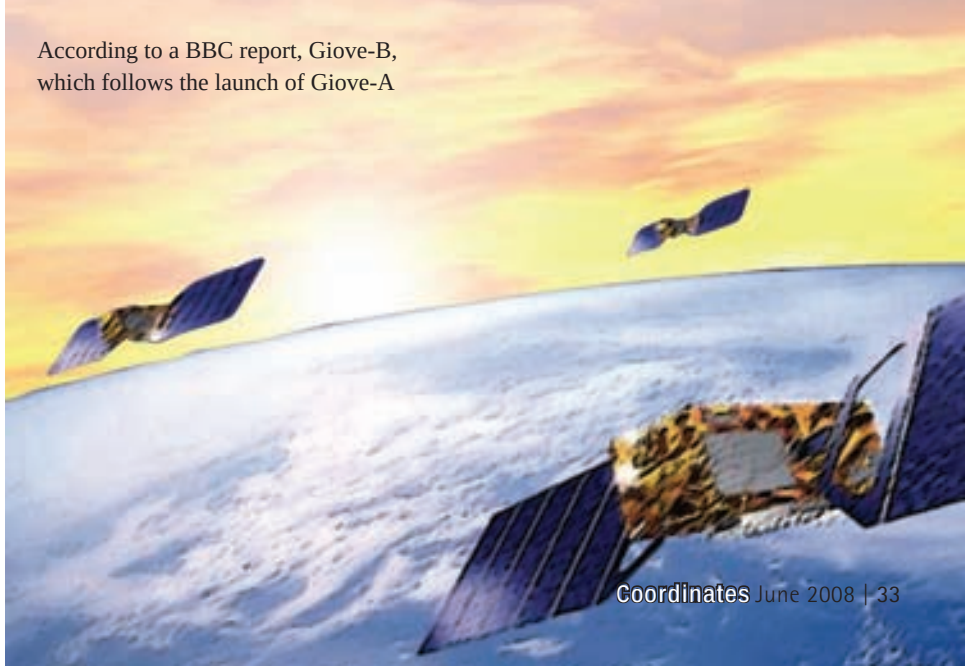
Giove-B, the test satellite for Europe's Galileo system, has sent its first navigation signals back to Earth, marking what the European Space Agency (ESA) called "a historic step," showing that Galileo can work alongside the GPS system of the United States.

According to a BBC report, Giove-B, which follows the launch of Giove-A in 2005, carries the most accurate clock ever sent into orbit, key to its intended capacity of providing location information that's accurate to a meter. The Galileo fleet will be fully operational by 2013. More sophisticated than its predecessor, the half-tonne, 2.4x1x1m box will test further the key Galileo technologies such as the atomic clocks that provide the precise timing underpinning all sat-nav applications. *www.eetasia.com*

SSC supports the GIOVE B mission

Swedish Space Corporation (SSC) is for the moment supporting the GIOVE B mission during the Launch and Early Orbit Phase (LEOP), via four ground stations included in PrioraNet*, the largest satellite ground station network in the world.

As soon as the LEOP is over, SSC will deliver routine Telemetry, Tracking and Command (TT&C) for GIOVE B during its operational lifetime. GIOVE-B will extend the first Galileo demonstration. In addition to the LEOP and TT&C support for GIOVE B, SSC is also establishing the head TT&C ground station for the future Galileo satellites here at Esrange Space Center. We are planning to be a part of the Galileo mission for a very long time, says Mr. Johan Sjöström, project manager at Esrange Satellite Station, SSC. *www.ssc.se*



GeoEye scheduled to launch next-generation earth imaging satellite

GeoEye has announced August 22, 2008 as launch date for GeoEye-1. It remains at the Gilbert, Ariz. facility of General Dynamics Advanced Information Systems, GeoEye's prime contractor and integrator for the satellite bus and telescope. *www.geoeye.com*

ISRO to set up Indian Space Science Data Centre, signs with NASA

Indian Space Research Organization is setting up the Indian Space Science Data Centre, to process, archive and disseminate data from Scientific Satellite missions. The centre will be used by scientists for investigations. Set up near Bangalore, it will be operational by end of 2008. A study has been initiated for preparing a feasibility report by the faculty of IIT in consultation with ISRO scientists for developing a small satellite (less than 100 kg weight). A Framework Agreement was also signed on Feb 1, 2008 between the ISRO and NASA for co-operation in the exploration and use of outer space for peaceful purposes with an initial validity of ten years. The areas for co-operation include earth science, observation and monitoring; space science; exploration systems; space operations; and other relevant areas of mutual interest. *pib.nic.in*

Microsoft satellite map project sued over name

Microsoft's TerraServer-USA satellite imagery project has been slapped with a trademark lawsuit from a small North Carolina company with a similar name. The 10 year-old Microsoft research project makes satellite images and maps from the U.S. Geological Survey freely available over the Internet. In 2005 the project was rolled into Microsoft's Virtual Earth product, but Microsoft continues to maintain the *TerraServer-USA.com website. www.pcworld.com*

China seeks U.S. satellite data on quake

China has asked the US for satellite images of quake-stricken Sichuan province to help locate victims and identify seriously damaged roads and infrastructure. The request, hand-delivered to the State Department by a Chinese embassy official seeks high-resolution imagery of the region. The National Geospatial-Intelligence Agency has already begun analyzing imagery of the earthquake's aftermath taken from U.S. spy satellites. The Bush administration has offered spy satellite images and analysis to foreign governments coping with natural disaster in recent years to help organize rescue and recovery operations. *www.reuters.com*

In recent Earthquake in Sichuan, China, 700 people could be saved in Cao Ping after their message "SOS700" had been discovered in imagery collected with a Leica ADS40 airborne digital sensor.

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Canalys surveys Taiwanese and Indian consumers about navigation and LBS

Market research firm Canalys highlighted a recent consumer survey in Taiwan for GPS navigation and LBS on mobile phones and PNDs. The survey found more than 80% of Taiwanese being familiar with what satellite navigation could do. With 60%, the idea of searching for directions on the web and printing them out was either the first or second most common method used to plan a route when travelling to a new place for the first time. *http://gpsbusinessnews.com*

Highlights of Indian consumers survey about navigation and LBS

Canalys also surveyed around 1,200 Indian consumers which indicated that there is significant potential for certain navigation and LBS, particularly among younger, tech-savvy, middle class consumers. While India is still in its very early stages as a market for PNDs, and GPS is not yet widely understood as a technology, it is already a significant market for smart phones, with over 3.5 million shipping there over the past year.

Indian consumers willing to share their location 87% of those surveyed said they would be comfortable to let someone see their location if their phone were to broadcast it continuously. 45% said they would want this restricted to people they chose specifically, one-third would be happy to let their spouse or partner see this information. These comfort levels were higher than those shown by consumers in several Western European countries surveyed by Canalys last year.

GPS navigation solutions, whether on a phone or on a dedicated device, also have great potential to make life easier for drivers in India. Of the frequent road users surveyed, 38% said they get stuck in traffic jams at least once a day, a further 27% said they encountered congestion every time they travelled and another 22% at least once a week. Two-thirds of those that get stuck in jams said the average delay was 10 to 30 minutes, with 11% finding it was usually even longer. 58% of those that got stuck in traffic regularly said they would be willing to pay for a solution that re-routed them around the jams, while only 5% said they did not need such a system. *http://bangalore.canalysnavigationforum.com*

Garmin, TomTom and Magellan dominate latest ratings

Garmin, TomTom and Magellan are still making the best GPS. The three brands accounted for 16 of the top 20 rated models in the latest tests in Consumer Reports June issue. Rounding out the top five scoring units were the Garmin Nuvi 760, 660; TomTom Go 920T, Garmin Nuvi 350 and Magellan Maestro 4250. *www.ConsumerReports.org.*

Geotagging hits mobile phones

Sony Ericsson will introduce geotagging with its C702 mobile phone out this year helping users to tag multimedia on their phones using standard GPS information. It will enable them to arrange their photos and videos not only be date or time but also by location. *http://mybroadband.co.za*

Asus P230 GPS PDA handset

Asus P320 comes with GPS, camera, PDA functionalities as well as a phone in one device. It works on Mobile 6.1 Professional operating system for easy access to documents for presentation. *www.techgadgets.in*

Yulop kicks off location-based search

Yulop, a Bangalore, India-based location-based startup is launching its location-based search service using triangulation technologies and offers consumers listings of find businesses (shops, restaurants etc.) based on geo-tagged data from its database. It plans to offer service in six more cities. *http://gigaom.com*

MapmyIndia launches 'iNav' navigation services

'MapmyIndia has launched 'iNav,' - GPS navigation solutions for mobile phones. According to company Director Rohan Verma "our vision is to make maps and navigation as an integral part of the country's basic infrastructure. After making maps freely available on the internet via MapmyIndia. com and launching of MapmyIndia Navigator for in-car navigation, we hope that GPS navigation can benefit all mobile phone users across the country." *www.mapmyindia.com*

ASUS-Lamborghini launch the ZX1 PDA phone in India

ASUS and Lamborghini, together, launched the ASUS-Lamborghini ZX1 PDA phone that runs on Windows Mobile. Along with other feature it is also equipped with wireless 802.11b+g, Bluetooth v2.0+EDR, USB2.0, 3.5G and even GPS. *www.tech2.com*

SatNav launches SatGuideTM on laptops and desktops

SatNav Technologies has launched SatGuide turn-by-turn navigation and planning solution for laptops and desktops for the retail market. SatGuide's laptop and desktop version can help improve his efficiency by at least 15% during a trip by an individual outside his/her office or to another city. *www.satnavtechnologies.com*

Dialog and IWS GIS launch Sri Lanka's first Mobile SatNav

Dialog Telekom PLC in partnership with IWS Geographical Information Systems has launched first Mobile Navigation System in the country. It is a fully featured GPS based mobile navigation system incorporates a digital street directory of Colombo which includes Class A, B, C and D roads in the Colombo Municipal Council area and suburbs. *www.dailymirror.lk*

StarHub launches Singapore's LBS mobile advertising

StarHub has launched Singapore's first nation-wide LBS for mobile advertising. For advertisers, send marketing messages to subscribers when they are

in contextually relevant location. For customers, they get appropriate messages to what they are doing, both on a where and when basis. *www.intomobile.com*

Tata Indicom announces plans to deploy first A-GPS LBS in India

Tata Teleservices will commercially deploy a new LBS that is the first to use Qualcomm's Assisted GPS (A-GPS) technology in the Indian market. Based on Qualcomm's QPoint(TM) solution and gpsOne(R) chipset technology, with hosting services from TeleCommunication Systems, the service is expected to be available on multiple handsets from Tata's catalog and deployment is expected in late 2008. *http://money.cnn.com*

Cutting-edge technology to track Indian fishermen on the high seas

The State Fisheries department and the Gujarat Maritime Board will jointly implement the Rs 153-crore vessel tracking and warning system, coupled with the biometric identification of fishermen. The system will work on a combination of GPS and GIS creating a geo-fence – a kind of virtual fencing along the IBL between India and Pakistan. A data centre on the shore will monitor and control the vessels using a two-way secured, non-hackable radio communication. Each boat will have an embedded digital contraption that will get activated and alarm the fishermen the moment it crosses the border. *www.expressindia.com*

Wayfinder updates navigator

Sweden's Wayfinder Systems has released a new version of its Navigator mobile software with integrated search and social networking capabilities. It renders results from numerous selected local services including new Yellow and White Pages content and points of interest databases. It will also enable set and share locations among Facebook users; other Wayfinder users can share their location with others via Google Earth. *www.wayfinder.com*

Infoterra introduces Rapid Surveyor

Infoterra Ltd has recently launched Rapid Surveyor, a new mobile laser mapping system. It has been specifically designed for mobile use, to as to enable the capture of precise information of the built as well as natural environment at supreme resolution and coverage. The Rapid Surveyor is useful for utility companies, local and central government, as well as planning and infrastructure management.

DigitalGlobe expands imagery solutions for oil and gas industry

DigitalGlobe has released ImageConnect: Oil and Gas, an online imagery service for oil and gas professionals around the world, with on-demand access via GIS and WMS services to areas of global oil and gas exploration.

It provides high-precision, accurate imagery of geographic areas important to upstream oil and gas exploration.

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www.munich-satellite-navigation-summerschool.org

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www.esri.com

Geo-Information Technology Exhibition
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santi@ptmediatama.com
www.geospatial-exh.com

GITA 2008
25-27 August Sydney, Australia
http://gita.org.au/08sydney.php

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Symposium on High Mountain Remote Sensing Cartography
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www.geometre-strasbourg2008.eu/?lang=en

CARIS 2008
September 22 - 26, Bath, United Kingdom
www.caris.com/caris2008

Asia GIS conference 2008
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suh@pknu.ac.kr
http://www.asiagis2008.com

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www.intergeo.de

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October 21-23, 2008
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The European Navigation event,
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The Netherlands
e.wendrich@jakajima.eu
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gnss@gnss2008.jp
http;//www.gnss2008.jp

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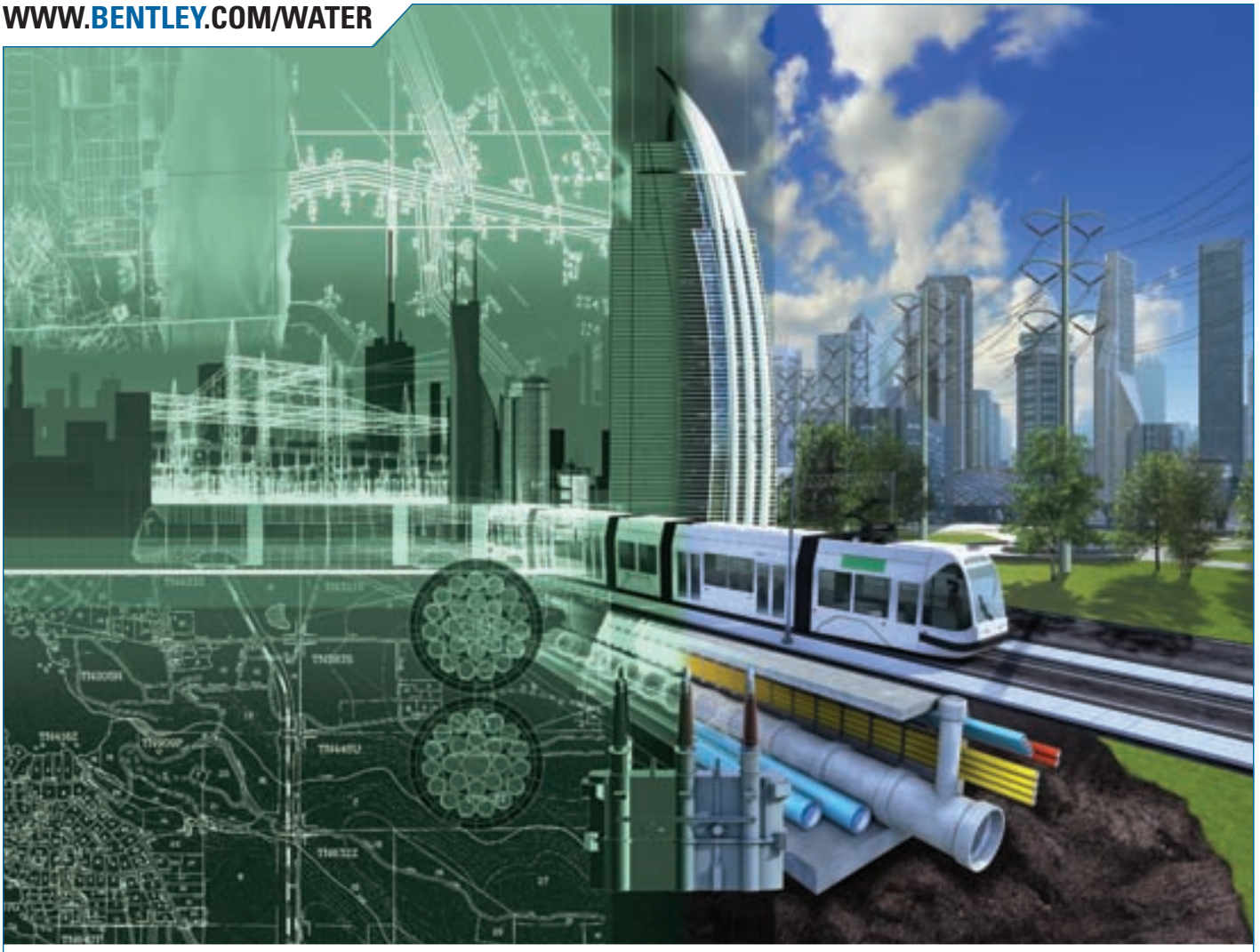

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1998 Spirent introduce first commercial GLONASS simulator

2004 Spirent introduce first modernized GPS L2C, L5, AES M-code systems

2005 Spirent introduce first NATO STANAG 4572 GPS/Inertial test system

2005 Spirent introduce first 7-element CRPA test system with GPS + coherent interference

2006 Spirent introduce first commercial Galileo/GNSS constellation simulator

2007 Spirent introduce first SDS M-code test system

2007 Spirent introduce first single chassis GPS/Galileo constellation simulator

2008 Spirent introduce first single chassis GPS/GLONASS/Galileo constellation simulator

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