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A MONTHLY MAGAZINE ON POSITIONING, NAVIGATION AND BEYOND

The 3rd dimension

India heads for a regional navigation satellite system

Determination of lag-time in kinematic GPS recording

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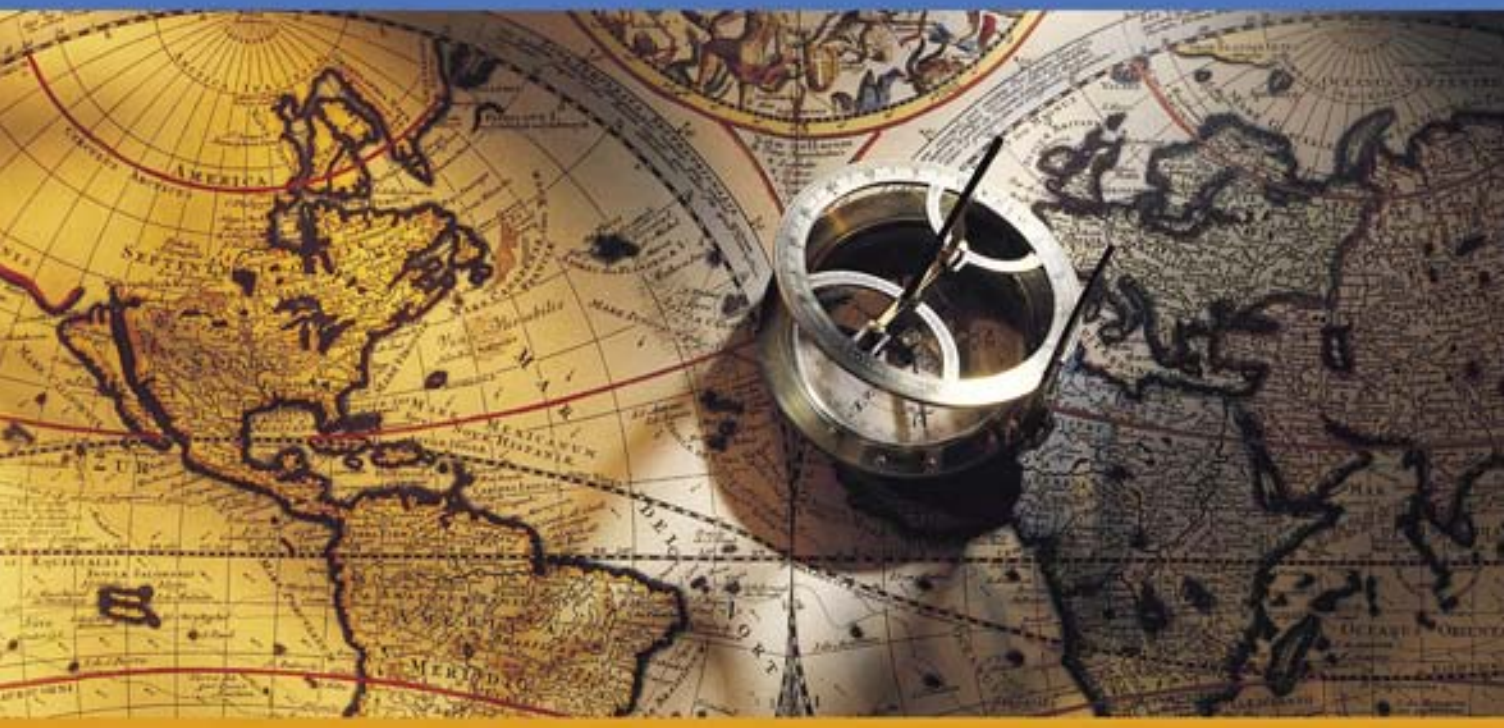

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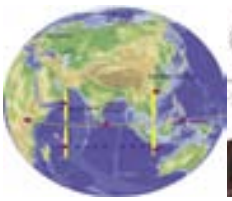


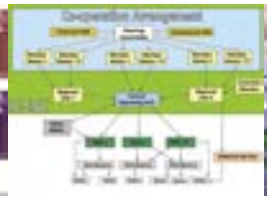
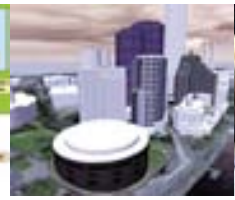


Columns

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

A lunar ambition

According to the reports published recently, ISRO plans to put an Indian in space by 2014 and another on the moon by 2020.

Ambitious.

The manned mission into space is likely to cost around Rs 10,000 crore.

This may trigger a debate.

A debate on 'costs' and national 'priorities'.

However, for a country like India, it is a must to own the technology.

Not only owning the technology but also creating a space in space technology.

And there is a cost attached to that.

Most of the time, a prohibitive cost.

But if investments are not made now, there are possibilities that 'this research domain' may go out of the domain of many countries.

Some may argue that the 'elitism associated with' are the 'privileges of a few' only.

Hence, let us touch the moon.

Before it goes out of reach.

Bal Krishna, Editor
bal@mycoordinates.org

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India heads for a regional navigation satellite system

Indian Space Research Organisation has taken up a project called Indian Regional Navigation Satellite System for the establishment of an independent regional navigational infrastructure

Dr Arjun Singh and Dr S K Saraswati

Indian Space Research Organisation (ISRO) has taken up a project called Indian Regional Navigation Satellite System (IRNSS) for the establishment of an independent regional navigational infrastructure. The system main objective is to provide high positional accuracy (comparable to the existing constellations) real time position, velocity and time for various users in the region. IRNSS services will be available on a 24x7x365 basis irrespective of the availability of other constellations over Indian airspace. The system leverages the technological competence of ISRO in satellite, ground and other critical technologies

Proposed IRNSS Architecture

The proposed architecture of the INRSS consists of space segment, ground segment and user segment. The space segment consists of three GEOs located at 34° E, 83° E and 132° E and four GSOs. The 4 N-GSOS will be placed in the orbit at an inclination angle of 29° with longitude crossing at 55° and 111° East. The ground segment consists of INRSS ranging and integrity monitoring which will be located at 20 places and most of them will be located in the airports along with GAGAN ground elements. IRNSS will have the two Master Control Stations (MCS), which may be co-located with GAGAN INMCC. The proposed INRSS architecture is shown in Fig. 1. The intended coverage area for IRNSS has been proposed to be over the Indian subcontinent and service area will be primarily on the Indian land mass and adjoining areas. The service area for IRNSS is specified as between longitude 40oE to 140o E and between latitude ± 40o. More specifically the coverage should include the Indian subcontinent plus about 1500 Km beyond the Indian geographical area. IRNSS system provides dual frequency (S & L5 band) usage with a targeted position accuracy of less than 10 meters within India. At present one down link in S-band and three down links in L5 band are planned. The system can be augmented with local area augmentation for higher accuracy.

Table-1

System Errors	INRSS (1 σ)	GPS (1 σ)
Ephemeris	5.0	1.4
Clock	2.2	1.8
Ionosphere	2.0	0.5
Troposphere	0.2	0.2
Receiver noise	0.6	0.6
Multipath	1.5	1.5
UDRE (m)	6.1	2.84
HDOP	3.0	1.5
VDOP	3.0	2.3
Position Accuracy –H (m)	~18.3	4.3
Position Accuracy –V (m)	~18.3	6.5

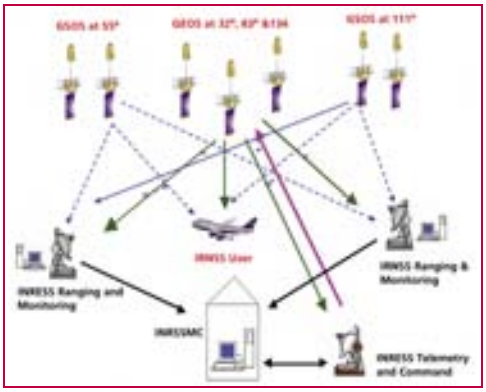

Fig.1 IRNSS architecture

The error budget of the proposed IRNSS is given below in Table 1.

The proposed IRNSS will be designed indigenously and launched from Indian soil through Polar Satellite Launch Vehicle (PSLV). The proposed satellite specifications are given below.

- Dry mass of the satellite ~ 600 kgs
- Power generation 1400 watts
- Fuel loading capacity ~ 785 kgs
- Accommodates navigation payload of weight 102 kgs and 375 watts of power

The snap shot of IRNSS GEOS & GSOS satellite locations are shown in Fig. 2.

IRNSS payload

It will provide signal generation on board and there will be two downlinks providing dual frequency operation with EIRP of 31.5 dBW at EOC. INRSS payload will have 3 Rubidium clocks and Navigation data up link will be through telemetry command link.

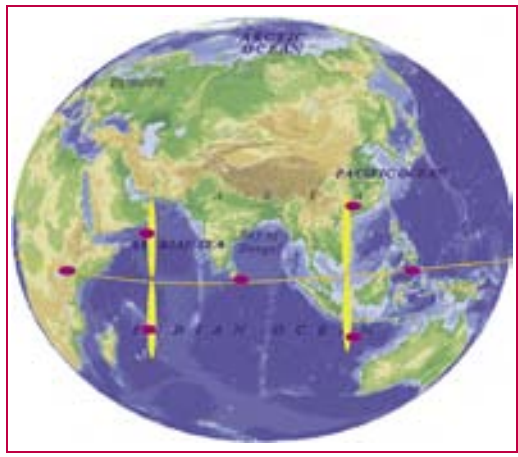

Fig. 2 Locations of snap shot of IRNSS GEOS & GSOS

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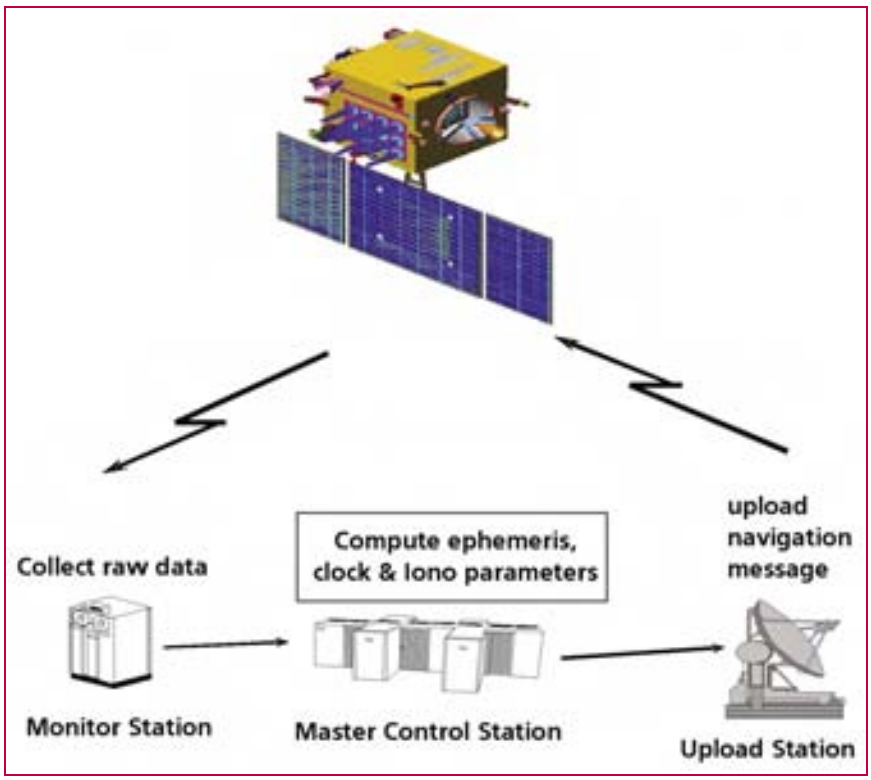

Fig 3 Basic Building Blocks of IRNSS

The payload beam of GSOS will be steered to take care of the inclination

IRNSS Ground Segment Functionality

The ground segment consists of MCC, INRSS Ranging and Integrity Monitoring (IRIM) Stations and IRNSS telemetry and command stations. The function of MCC is to estimate and predicts the ephemeris; calculate corrections for SV clock & maintain IRNSS time, Ionospheric corrections and Integrity. The function of IRNSS IRIM stations will be receiving the data from the GEOs and GSOs, transmit the data to MCC and one way ranging of the GEOs & GSOs in S band. The function of IRNSS telemetry and command stations will be to receive telemetry from the IRNSS constellation, Telecomm and the IRNSS constellation and navigation updates

USER Segment

The user segment will consist of a specially designed inter operable dual frequency receiver, which may receive the data from other constellation of navigation satellite. User segment receiver may be called as multi constellation receiver. The user receiver to get the required position accuracy will continuously track all the seven satellites of INRSS. The user receiver will have minimum G/T of -25 dB/K similar to GPS.

Conclusion

The INRSS is under planning stage and ISRO is the main agency to design and implement the entire infrastructure required for operation of the system. It has also to do certification and validation of the signal will be before declaring operational for the users.

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India may quit Galileo

India's participation in the Galileo project, a satellite navigation system being developed by EU and European Space Agency, expected to rival the United States' GPS , has run into the hard ground realities of security concerns. India fears that sharing of sensitive data may not be adequately firewalled from individuals and other nations participating in the enterprise.

India had signed up to the 30-satellite landmark space navigation project in September last year. The details of the Indian participation were to be completed during the just-concluded summit meeting of Prime Minister Manmohan Singh with EU leaders in Helsinki.

But the expected progress could not be made in Helsinki, sources said, adding that the Indian concerns related to the access that the satellite system will have to all manner of geographical and tactical locations in the country. Further, there were questions over how widely would the very precise data the system would provide of facilities, and even individual phone and vehicle users, be accessed. These issues, said sources, had not been resolved at Helsinki and despite the official statement before the PM's visit, that details of Indian participation in the Galileo project were close to completion, there was a lack of progress when Indian and EU officials discussed the issues in Finland.

Recently, the European Commission suggested, in a policy shift that sets it on a collision course with UK and the US, that Galileo might be opened up for military use.

While Indian military and civilian facilities are open to satellite surveillance from US and other military-use satellites, the problem with Galileo project is uncertainty over users of the data.
The Times of India, October 16, 2006-11-12

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The 3rd dimension

Finding suitable height data for 3D GIS

David Jonas and Nils Mathews

Spatial data is the fuel for 3D Applications, but all too often the fuel supplied is inappropriate. The software applied and expertise required when modelling a flood event or predicting a cityscape's lineof-site is exactly the same using highly precise data as it is for generalised data. The difference is in how well that analysis relates to the real world … i.e. whether the analysis is correct or not. Conversely, supplying highly accurate or dense data to a generalised analysis can cost both time and money which is not reflected in the final product. Hence the word of this paper is: appropriate. Apply the most appropriate data to your application. There is nothing wrong with "approximate" or "inexpensive" 3D data, as long as it is appropriate for the level of analysis being performed.

After reviewing four major components of a dataset's composition, a number of recent case studies are offered.

Finding Appropriate Data

The authors contend that there are four characteristics of a dataset which define its suitability for a 3D application, viz. resolution, accuracy, currency and format. Each is discussed briefly in turn.

Resolution

Resolution refers to the density of information available. In 'the old days", it was best summed up as the "scale" of the material under consideration. Everyone accepted that you could not do detailed design from a 1:20,000 mapsheet, or hope to see manhole covers on 1:80,000 photography. These concepts still apply to the Digital era, even though the concept of scale has been reduced to the field one enters in the PRINT window. This concept is best illustrated on two visualisations recently completed to support the Penang Outer Ring Road project. The first example is a regional dataset using Landsat imagery and SRTM surface heights (Fig 1 left). Resolution of Landsat is 30m and SRTM 90m spacing ... both quite coarse but sufficient for regional analysis and often available from existing archives.

The higher resolution version (Fig 1 right) involves Digital Globe imagery (at 0.6m resolution) and LiDAR surface heights (at 1m resolution). This higher resolution allows visualisation and analysis at the building-by-building level.

In these cases, the resolution of the two datasets was paired well. Draping a high resolution image over low resolution surface model would have resulted in an incorrect heighting of the pixels; draping a low resolution image over a high resolution surface model would have meant the longer processing times and LiDAR capture costs were not fully returned to the project.

Resolution in the context of a built environment was well described and quantified by Kolbe and Bacharach (2006), shown in Fig 2. The five "Levels of Detail (LoD)" show how the resolution (or definition) in a building can vary from a generalized outline, to intricate components.

Accuracy

Errors in spatial data are to be understood and enjoyed. Here is a news flash to many readers: every spatial dataset has errors. A detailed engineering survey will have errors at the millimetre level; a spatial dataset over the country will have errors at the metre level. The science of surveying is to understand the project's "error budget" and arrive at a dataset with accuracy appropriate for its intended use. (The corollary to this is to insist that every dataset you receive comes with a metadata statement recording the accuracy and other characteristics of the dataset. A regional dataset accurate to a few metres is fine for conceptual planning, but you don't want this data ending up in the hands of the engineers who set about detailed design work).

Another news flash to readers might be that it is impossible to say how accurate every point or pixel is in your dataset. In statistical terms, data measuring is subject to random errors. Therefore it is impossible to say that "every point is accurate to 0.2m". Because measuring and surveying are subject to the laws of statistics, surveyors rely on statistical measures to describe how accurate the dataset is. The common term to

Fig. 1

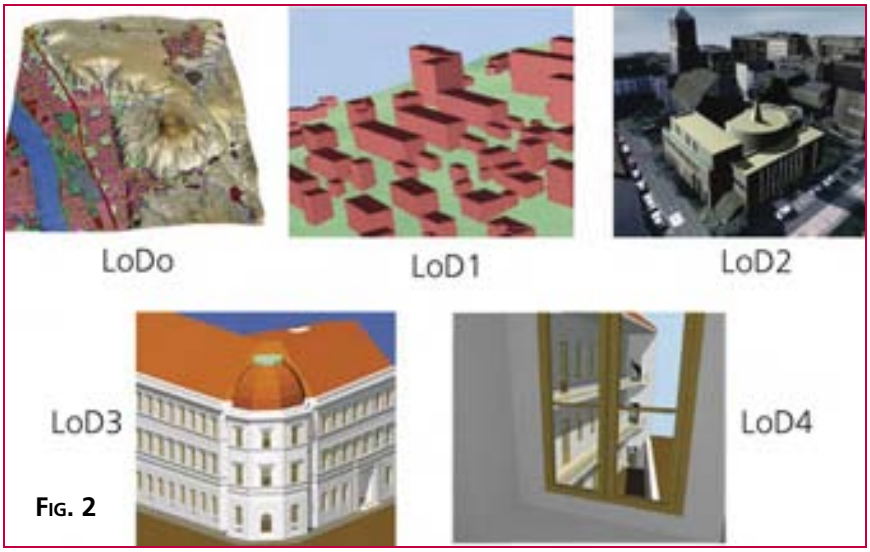

Fig. 2

describe a dataset is "root mean square" error or "rms". Other terminology for the same measure is "rmse", "one-sigma", "1σ" or "standard error".

What this concept means is that if you see a statement saying that "The vertical accuracy of this dataset is 0.2m rms", it means that if you compared every point or pixel in the dataset with the truth (if somehow that were possible), then 68% of points would be within ±0.2m of the truth. Statistical theory leads on to show that 95% of points will be within ±0.4m (twice the rms), 99.7% will be within ±0.6m (three times) etc etc etc.

The reason to use appropriately accurate data is clear to all. What is not so clear is that the work of the engineer or the effort of the visualisation specialist is generally the same regardless of the level of accuracy of the data. It is only when the flood study or the line-of-sight calculation is put back into the field and compared with reality is the quality of the underlying spatial data truly revealed.

In projects involving 3D visualisation, especially in built environments, the issue of accuracy often extends to whether the buildings are defined in the application by measurement or estimation. Estimation techniques include positioning the buildings from tourist maps, estimating from imagery, or simply from memory. Building heights can be estimated by memory, reference to known heights or by counting floors. All of these estimation techniques are valid, as long as the resulting accuracy level is commensurate with the project aims. In many cases, it separates whether the project is one of "actual" or "schematics".

Currency

Currency refers simply to the date at which the information was captured. Decisions relating to currency typically involve assessing the relevance of off-the-shelf data, compared with the costs involved in acquiring current data specifically for your project. Acquiring current data also brings the advantage of setting resolution, accuracy and format for your project, instead of inheriting them from data acquired for other purposes. Currency can also be complicated when datasets are compiled from multiple-epochs. This typically occurs with archive imagery, where no one epoch has cloud free coverage, so a mosaic is compiled from different epochs to minimise cloud cover. Once again, this is a valid technique to employ, but highlights the importance of supplying detailed metadata with the dataset.

Format

Format refers to the characteristics of the dataset (eg. grid, point or vector) and is often linked to the means of data capture and/or the extent of the dataset. The differences between formats are best illustrated in a built environment.

The most cost-effective means of defining a cityscape is by employing the mass-points measuring technique of LiDAR (or Airborne Laser Scanning). This technique measures a dense array of accurate 3D spot elevations across the cityscape. Typical point spacing is sub-metre, with some cityscape projects in Europe now employing point spacings of a few decimetres. A LiDAR point measurement of a city defines the building height and position accurately, but the level of detail (or cartographic appeal) is relatively low. The image shown in Fig 3 is of a recent LiDAR survey of Kuala Lumpur; it illustrates the high

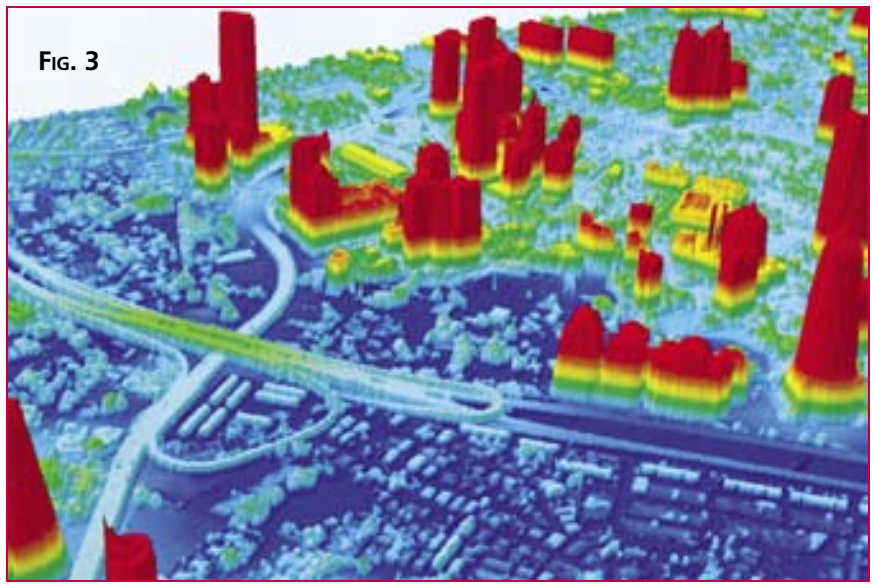

Fig. 3

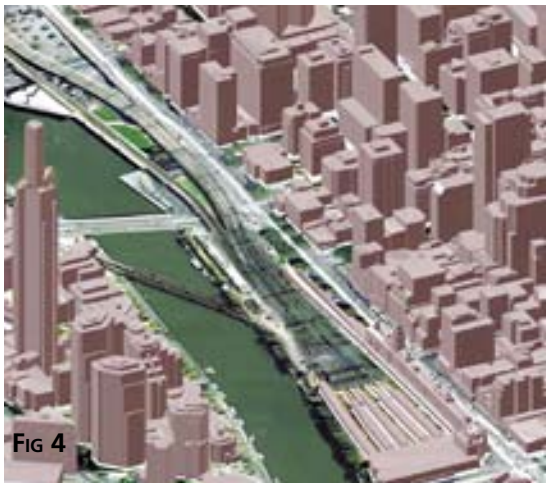

Fig 4

spatial integrity but low cartographic appeal of the mass-point format.

3D-Vectors provide the most rigorous means of defining a cityscape. Typically they are obtained by stereo-digitising building outlines from overlapping aerial photography. As it is a manual task, the stereooperator can pick and choose which polygons or building features needed to adequately define the building shape and appearance. The benefit of Vectors is that they provide a crisp definition of the building. Software can then extrude the 3D vectors down to the ground level to give the appearance of more lifelike structures (shown in Fig 4, from Melbourne, Australia).

Because it is a manual process, costs are directly proportional to the number of buildings, and number or elements within each building, are required.

Summarising

When deciding whether a dataset is appropriate, one needs to consider its resolution, accuracy, currency and format. Assessing the data requirements for each project will raise a series of choices.

For example, a vector definition of a cityscape will look more lifelike, but it may be far less accurate than a points definition. If you have to make a choice, would you want the buildings to be lifelike or in their correct position ? You can have both, but at a significantly higher cost. Does your project warrant that investment ?

On another project, you might be presented with low resolution current imagery, or high resolution archive imagery. You will have to decide whether the recent changes to the project site will detract from the information extracted from the dataset.

Whatever the decision on how you assess these variables and specify your dataset, it is vital to document these characteristics so future users know the true attributes of the dataset.

Applying Appropriate Data

The following section provides a few recent case studies with which the authors have been involved when asked to provide suitable height data to a 3D GIS.

Case Study 1 – 3D Visualisation of Elevated Roadway

This project involved the visualisation of a proposed elevated roadway in Karachi. The roadway is to be built along an existing corridor between multi-story buildings. The task was to illustrate the visual impact of the roadway on the cityscape. As the task was primarily one of information and promotion, the client was keen to maximise the reality of the visualisation. It needed to be interactive and lifelike, to stir enthusiasm amongst the decision makers for the project. Field crews took digital photographs of the major buildings so as to provide the necessary building texture and appearance to the visualisation (Fig 5). The road design was incorporated into the visualisation dataset.

The client was also keen on maximising the accuracy of the visualisation, but the local aviation and government infrastructure was not able to support a LiDAR survey of the route. Instead, building locations and heights were approximated with basic field survey techniques. The result was a high resolution (LoD 2), low accuracy visualisation, employed in an application which gave interactive flythrough capabilities to the client. In this case, the level of accuracy did not detract significantly from the project outcomes.

Case Study 2 – Supplying the 3rd Dimension in a Marine Cadastre

As urban development around coastal waterways increases, the need for legal clarity on who is responsible for which areas is becoming more important. Most jurisdictions have legislation which refers to tidal boundaries. Terms such as “low water mark”, “Highest Astronomical Tide”, “tidal influence” etc abound in legislation, but cannot be easily marked out on the ground. Problems arise when these boundaries have to be delineated accurately on the ground as their extent depends upon tidal variations, and upon coastal terrain models. Recent examples involved a cadastral boundary extending down to “the high water mark”, the local Ports

Fig 5

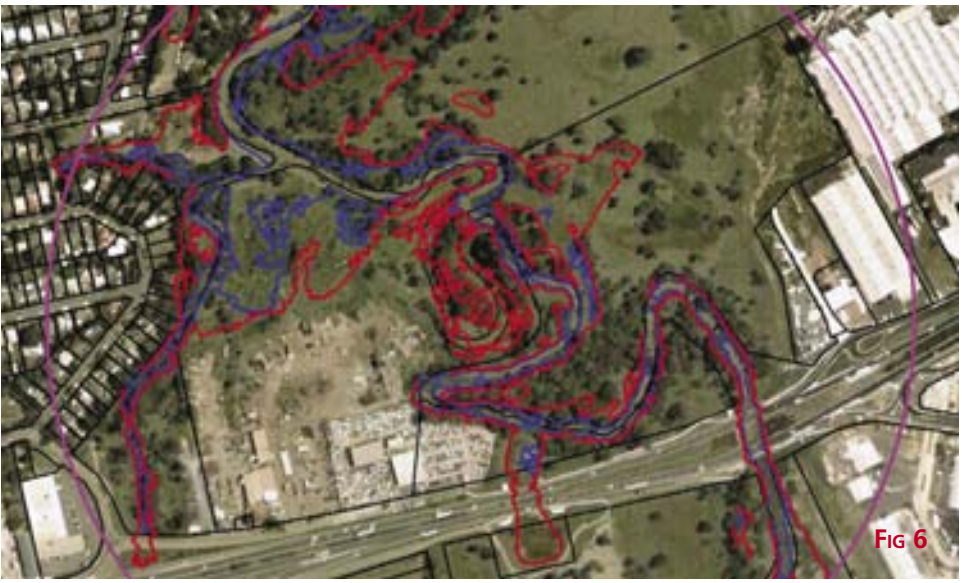

Fig 6

Authority responsible for areas "to the High Spring Tide" mark, but the Environment Department interested in "5m above the high water mark" for the monitoring of acid-sulphate soils. The issue is further complicated as coastal terrain models are frequently changing by erosion and accretion.

In Australia, the Queensland Department of Natural Resources and Mines is undertaking a pilot programme which seeks to clarify the processes and derive the tools to resolve these boundary conflicts (Todd (2005)). The programme uses a LiDAR definition of the coastal zone (flown at low tide) to define the current terrain shape, plus a series of tide gauges to establish the local tide model. Specialised software was written to find the intersection between the two 3D surfaces: terrain shape and tide model. From these lines of intersections, the horizontal extent of the legal boundaries can be found.

In the example shown in Fig 6, the landowner thinks he owns the property defined by the black lines (the "cadastral boundaries"). However State Legislation limits his ownership to "Mean High Water Spring Tide", show in blue. Clearly there are large areas of land where he thinks he owns but does not. Finally, the red line denotes "Highest Astronomical Tide" defining the extent where the landowner has limited control as separate legislation has conferred rights and obligations to the local Ports Authority.

Only by applying the 3rd dimension to this application has the true legal boundaries been established. The consequences of these queries are often minor, but can become considerable when applied to prime riverside properties, or in areas under consideration for development. This research is also being used to create storm-surge models in coastal areas.

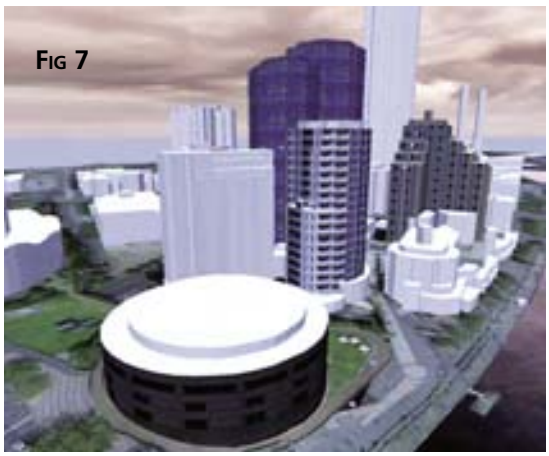

Fig 7

Case Study 3 – Constructing 3D City Models

Recently, AAMHatch created a 3D model of the City of Melbourne. The model was created using specialised photogrammetric techniques, which involve the measurement of the building's 3D shape from high-resolution aerial photography. These 3D city models have an inherently high degree of accuracy so they can be confidently used in analysis and measurement, such as when determining height restrictions.

The 3D model is a "living model", which will be regularly updated from new aerial photography. The savings in development proposal review, consultation and dispute resolution are potentially significant, and now form the major business justifications for 3D visualisation in city management. Large savings annually in legal and submission costs have been demonstrated.

In practice, the 3D model is used as the reference for appraising proposed developments interactively, by inserting the proposal in the model to determine the shadows and reflections it casts, which views it obscures and what it will look like from any viewpoint.

Advances in 3D computer software and performance have meant that more realism can be employed in the 3D model by using digital photos of the actual building facades, as well as trees and other objects such as street furniture, as textures for the 3D model.

Fig 8

Fig 9

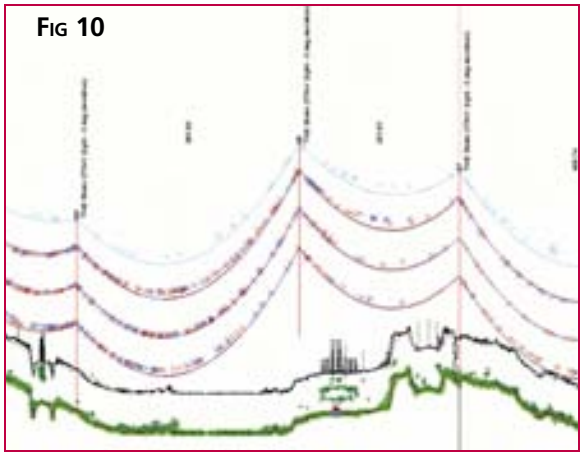

Fig 10

Samples of Melbourne CBD streetscape modelling are shown in Fig 8 and 9.

Case Study 4 – 3D Utility Mapping in Electricity Industry

Another interesting application where the 3rd dimension is now available to GIS is in the Electricity Industry. Utility GIS systems have evolved in line with advances in software and survey techniques. First generation GIS systems were largely schematic, where network and assets were largely recorded by connectivity diagrams. Next came the AM/FM applications where their geographic location could be entered with full asset and connectivity details. Spatial queries such as "identify five year old insulators within 10km of the substation" were now possible. The emergence of LiDAR as a viable survey technique has provided the Electricity Industry with the third dimension on their transmission networks. Spatial queries such as "Identify those spans along this route where the conductors are closer than 5m to the underlying vegetation" (see Fig 10). These queries can be extended to: "If I were to pump 5% more electricity down this line, the temperature of the conductors will rise by 4°, and will sag 0.5m lower. Show me the spans where this 0.5m sag will cause clearance concerns". In these days of increasing energy demand and high cost of building new transmission lines, these queries can be very powerful.

A project recently completed for Tenaga Nasional Berhad (TNB) supplied the third dimension to the major north-south transmission lines running between Kuala Lumpur and Penang. The LiDAR project provided the 3D survey data, software and training for TNB to perform these line-optimisation queries, to allow TNB to achieve the maximum line loading in a safe and well managed process (Fig 11).

Case Study 5 – 3D Topology in an Industrial Site

The final case study presented here involves a 3D survey in an industrial site. The project involved a major expansion to a minerals processing plant. The design engineers needed an accurate plan of the current structure, so they could design, construct and fit the extension structures with minimal downtime on the operating plant. The third dimension in this case was supplied by Terrestrial Laser Scanning (TLS). This survey technique employs a similar technology to the LiDAR system, except that the laser sensor is mounted on a tripod and the measuring laser measures the structure to millimetre precision and millimetre point spacing. The benefit of the TLS is that it is able to supply an accurate 3-dminesional definition of complex structures as diverse as piping, building facades, structures under load or rock faces. The data is acquired without contact, allowing definition of unstable landforms, hot engineering surfaces, vibrating elements or inaccessible structures.

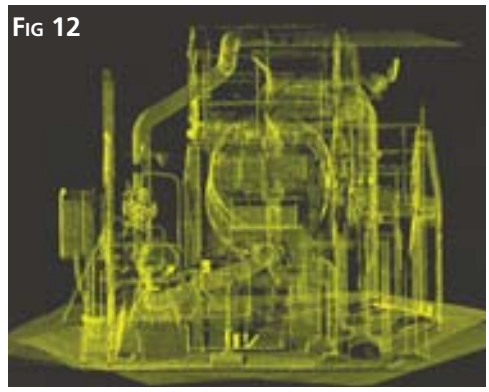

Fig 12

Fig 13

The project involved over 120 TLS setups and literally a billion data points collected. From this wealth of accurate 3D data (Fig 12), the relevant pipes and structures were identified by the engineering team. Those features relevant to the expansion plans were converted to CAD elements (Fig 13). The ability to define the CAD elements in their true position, orientation and condition allowed the engineers to design their expansion elements knowing that they were fitting to "actual" elements and not just "as built" plans. Of the 503 connection points in the expansion, all bar 3 fitted without need for rework. Those three problematic joints were traced to changes in design, not errors in the 3D GIS.

Fig 11

In Closing

The paper has presented the philosophy that there is no such thing as "bad" spatial data, only "inappropriate" data. Estimating building heights may be suitable for a visualisation, but would be of limited use to the telco engineers. Investing heavily in a vector-based photogrammetric cityscape will need subsequent users to utilise both the accuracy and appearance of the buildings to have that significant investment returned. Project managers need to consider the implications of their decisions specifying resolution, accuracy, currency and format.

The exciting part is that survey techniques and application development is now allowing users to dictate the characteristics that their dataset requires to meet their project needs. It is critical to document and retain these characteristics with the dataset to ensure that all subsequent uses of the data are appropriate to their respective needs.

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Galileo update

Galileo – the European Programme for Global Navigation Services for civil purposes is an initiative led by European Union. We provide regular updates to our readers on the Galileo programme.

EU's transport chief eyes military use for satellite system

The European Union should consider employing its Galileo satellite navigation program for military uses in addition to the civilian purposes for which it was designed, the EU's transport chief said. "Galileo was supposed to be a civilian system only but I wonder whether we shouldn't question that," Transport Commissioner Jacques Barrot told a conference in Luxembourg. "Using it for military purposes, for defence purposes ... would be very interesting in terms of paying for the infrastructure and the investment," he said of the multi-billion-euro project. *www.defensenews.com*

Management of the European Satellite radio-navigation programme

European Parliament adopted a non-binding report by the Chairman of the Industry, Research and Energy Committee - Giles CHICHESTER (EPP-ED, UK) on the management of the European Satellite radio-navigation programme. The report was adopted with 555 votes in favour, 27 against and 27 abstentions. The purpose of the proposal is to amend Council Regulation 1321/2004/EC to enable the European GNSS Supervisory Authority (responsible for the European Satellite Navigation programmes - Galileo and EGNOS) to complete the development phase of the Galileo programme after the Galileo Joint Undertaking is wound up. The Galileo Joint Undertaking should be wound up on 31 December 2006 and its activities transferred to the Supervisory Authority. *www.noticias.info*

Tracking station key for EU satellites

A Southland-based tracking station may become a key player in Europe's plans to build a global navigation satellite system, Galileo. The European Space Agency (ESA) plan to have the station operational next year, in time for the much-anticipated launch of the Jules Verne – Europe's first automated supply vehicle. Based on an Awarua farm site, between Invercargill and Bluff, the station will record a segment of the rocket's movements as it carries supplies to the international space station, up to 11 times over eight years. The tracking station will record the movements of the supply vessel during the critical period when a second series of rockets propel it into orbit following its launch from French Guiana, in South America. *www.stuff.co.nz*

GIOVE-A laser ranging campaign successful

Fourteen laser ranging stations participated in a campaign to track ESA's GIOVE-A satellite during the spring and summer of 2006, providing invaluable data for the characterisation of the satellite's on-board clock. The campaign was coordinated by the International Laser Ranging Service (ILRS) and the GIOVE Processing Centre at ESA-ESTEC.

GIOVE-A, developed by Surrey Satellite Technology Ltd (UK), was launched from Baikonur Cosmodrome on 28 December 2005 and placed into a medium Earth orbit with an altitude of 23 260 km. Carrying a payload consisting of rubidium clocks, signal generation units and a phase array of individual L-band antenna elements, GIOVE-A started broadcasting Galileo signals on 12 January, securing the frequencies allocated by the International Telecommunications Union for the Galileo system. *http://www.esa.int*

Determination of lag-time in kinematic GPS recording

An attempt to compute the Lag-time in Air Borne Kinematic GPS (ABKGPS) recording with the help of exposure station coordinates derived by conventional aerial triangulation method

Sreenivasa Rao K and Jayalakshmi I

Since the staring of GPS, many researchers have investigated its application in aerial photogrammetry. Today, with the full constellation of 24 GPS satellites operational, enabling excellent satellite geometry any time of the day, the need to apply the full potential of GPS for real time aircraft navigation and photogrammetric mapping can be realized. The use of GPS to determine relative positional data for ground control points in a photogrammetric block adjustment is widely accepted and practiced. The camera exposure station coordinates derived by Airborne Kinematic GPS drastically reduces, the number of horizontal and vertical control points needed in aerial triangulation.

In large-scale mapping, the accuracy level of control data required is very high. The lag in time between the camera exposure and the GPS epoch recording in the GPS receiver is critical in deriving accurate coordinates for the exposure station (principal point) coordinates. Due to delay in the electronic transfer of data from camera clicking to GPS receiver in recording the event makes the Lag in time to occur. To meet the high accuracy requirements for the large-scale photography and mapping projects the lag in GPS recording time should be derived and applied. In this study, an attempt is made to compute the Lag-time in airborne kinematic GPS derived exposure stations from aerial triangulation.

Aerial triangulation is carried in Digital Photogrammetry work station with conventional method of using ground control points, and the exposure station coordinates are derived. Lag-time is computed by finding difference in coordinates of exposure stations derived from conventional aerial triangulation and from airborne kinematic GPS. The results of this project will help to improve the locational accuracy of GPS derived exposure stations in aerial triangulation.

Methodology

Aerial photography is carried out in the study area on 1:6000 scale with forward overlap at 60% and lateral overlap at 20% using RMK TOP30/23 camera. During aerial photography the airborne GPS is operated to record the exposure coordinates.

The computer controlled navigation system (CCNS) is loaded with flight planning data from World Wide Mission Planning (WWMP). During aerial photography CCNS takes coordinates of aircraft position from navigation system and navigate pilot for alignment as per flight plan. Based on navigation coordinates, CCNS sends signals to camera for exposure. The camera exposure system is connected to Trimble 4000 SSI dual frequency GPS system on board, which records GPS data continuously at 1.0sec sampling rate. During the camera exposure, camera system sends signal to the onboard GPS system, which record each exposure as an event marker in the GPS data. The GPS data is processed along with ground reference GPS data in differential and the camera exposure station (Principal point) coordinates are derived.

The exposed film is processed using Versamat processor. The total number of photographs accepted for stereo coverage of entire area is 323 in eleven runs/strips. Each photograph is uniquely numbered with project number, run number and photo number. Photo index is prepared with relative location of different runs and photographs for easy handling.

Ground control survey is conducted such that with out exposure coordinates the aerotriangulation could be carried out with required accuracy as per the preplanning. The data collected and processed in lab using the Leica Geo office software and computed the co-ordinates for 51 GCPs in WGS 84 system.

The aerial negative film is scanned in high precision photogrammetric scanner at 16-micron resolution. Each photograph is stored in separate file of size 230 MB in TIFF format.

Photogrammetry project is created in digital photogrammetry system with software SOCETSET. The scanned images are imported in to the project with support files and pyramid layers are generated. These pyramid layers are useful for quick display of images during the various processes. The flying direction for each run is incorporated as per the flying report given by the aircrew.

Interior orientation is done by AIO –automatic interior orientation for 280 frames and 53 frames are oriented manually. The rate of AIO success depends more on the image quality like contrast and sharpness at the edge of frames where the fiducial marks are registered. The

maximum residual accepted in Interior orientation is 0.5 pixels.

The aerotriangulation and block adjustment is carried out with ORIMA – the orientation management software. The Ground control point coordinates are also imported. The APM – automatic tie point measurement is executed. Total 4800 tie points are collected through this program. The connection between the projection centers and tie points are graphically checked. It is observed that the connections between consecutive photographs are sufficiently generated whereas between runs it is not so. This is because of failure of image correlation technique in relief displaced thick vegetation areas like forest. For increasing the stability of block in bundle block adjustment, one hundred tie points are manually measured. Then Common Adjustment Program in Aerotriangulation (CAP-A) is executed for bundle block adjustment. The adjusted coordinates for tie points and projection centers are recorded in separate files.

The RMS changes at ground control points are 10 cm in X, 8 cm in Y and 8 cm in Z directions. Figure 2 shows the flow chart of the work.

The projection center coordinates derived by aerotriangulation with only ground control points and the exposure coordinates derived from Air borne kinematic GPS are compared and the differences along three directions are computed. The summary of results are tabulated in Table 1 and graphically represented in Figure 1.

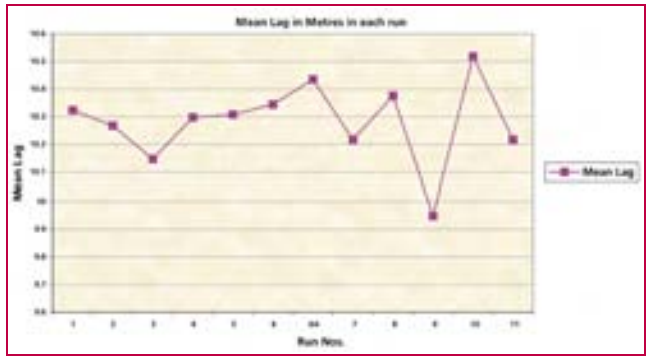

Figure 1 Mean lag

Results

One set of camera exposure coordinates are derived by post-processing Airborne GPS data. This data is with lag in the time of GPS recording.

The difference in coordinates of exposure stations derived from photogrammetric method compared with ABGPS derived exposure coordinates for the determination of Lag-time. Run wise mean difference in coordinates of all runs is shown in figure 1.

Delta X represents the difference in X coordinates in metres.

Delta Y represents the difference in Y coordinates in metres.

Delta Z represents the difference in Z coordinates in metres.

It is observed that the lag in time is more in X direction i.e., in the direction of flying compared to Y direction and very less lag is observed in the elevation.

The mean lag observed is 10.28333 metres. The aircraft's speed during operational flying is 180 knots as per the flying report given by aircrew.

i.e., 180 x 1.852 = 333.36 km per hour.
∴ the lag-time = [(10.28333 / 1000) ÷ 333.36] 60 x 60
= 0.11105 seconds
= 111.05 milliseconds

This lag-time correction can be applied during the processing of ABKGPS data, which improves the locational accuracy of the exposure station coordinates.

Conclusions

Flying has been carried in East – West direction. The average lag observed in X direction i.e., in the direction of flying is 10.2616 metres, in Y direction it is 0.4071 metres and in Z direction it is 0.1645 metres. This is because, the kinematic ABGPS acquired data at one sec sampling rate and the instant of exposure time is recorded back to GPS system. The coordinates for that instant of exposure time are interpolated by GPS system. The time difference in recording by the GPS system is one of the factor causing lag in time of recording GPS epoch.

Table 1 Run-wise Mean of differences in coordinates and standard deviation

Run No	Mean difference of coordinates						
	Difference in X	Std. Dev.	Difference in Y	Std. Dev	Difference in Z	Std. Dev	Combined difference
1	10.2301	0.1843	1.3713	0.148	0.0852	0.0409	10.3231
2	10.2508	0.2627	0.2502	0.4084	0.3411	0.1399	10.2686
3	10.1347	0.1807	0.1035	0.196	0.3971	0.2177	10.1471
4	10.2421	0.1717	0.9104	0.4157	0.3647	0.1165	10.2978
5	10.2944	0.2226	0.202	0.4827	0.0989	0.0762	10.3079
6	10.3404	0.1891	0.1007	0.2511	0.0557	0.0543	10.3441
6A	10.4313	0.0461	0.285	0.0315	0.0789	0.0122	10.4355
7	10.2119	0.1875	0.089	0.2694	0.1858	0.0483	10.2175
8	10.3601	0.2263	0.3843	0.3847	0.1449	0.0417	10.3752
9	9.9218	0.2638	0.6687	0.2221	0.1138	0.1026	9.9479
10	10.5102	0.1588	0.2974	0.2896	0.0211	0.0683	10.5184
11	10.2112	0.219	0.2223	0.2358	0.0864	0.0853	10.2169
Mean	10.2616		0.4071		0.1645		10.2833

This is in the order of milliseconds.

It is also observed that the lag is not a constant amount all through out the flying. This is because of the change in the flying speed, wind direction and wind speed. This clearly indicates that a mechanism to continuously record the aircraft speed, wind speed and direction is required.

The lag in lateral direction i.e., delta Y is changing abruptly at some instances of exposures. This phenomenon is observed in Run No.1; the lag is consistent, where as in Run No.2 fluctuations are more. It is noticed in Run No.2 the difference in Y is maximum. This is caused drift and it can be concluded that the cause is more lateral winds during flying.

Similar fluctuations are noticed in other runs also. Wherever drift occurred the difference in Y is more fluctuating. The difference in Z, which is along vertical axis, is very less compared to difference in X and difference Y. But in some instances the difference in the vertical direction also noticeable. This is because of fluctuation in flying height of aircraft.

It is advisable to record the speed of the aircraft continuously throughout the mission along with the wind out side the aircraft along with the direction. The lag in the GPS recording should be applied prior to the GPS post processing of the Air borne kinematic GPS for deriving photo exposure coordinates.

In aerial triangulation, the number of ground control points can be reduced drastically, by using these accurate exposure station coordinates.

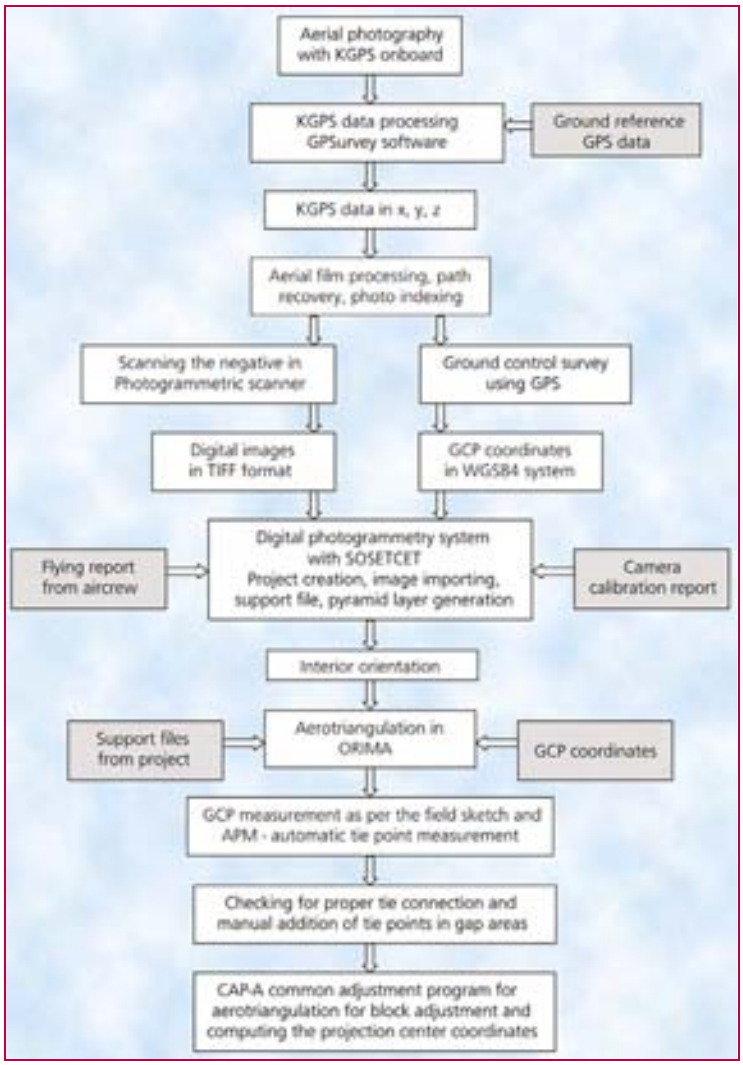

Figure 2 Work flow of aerotriangulation

With the great strides being made in technology, the combination of airborne GPS with other technology such as video-grammetry, digital cameras, CCD, Inertial Navigation and LIDAR is bound to find very useful applications in measurement science. If these technologies become less expensive and more accurate then perhaps high accuracy mapping can even be performed without analytical aerotriangulation.

Acknowledgement

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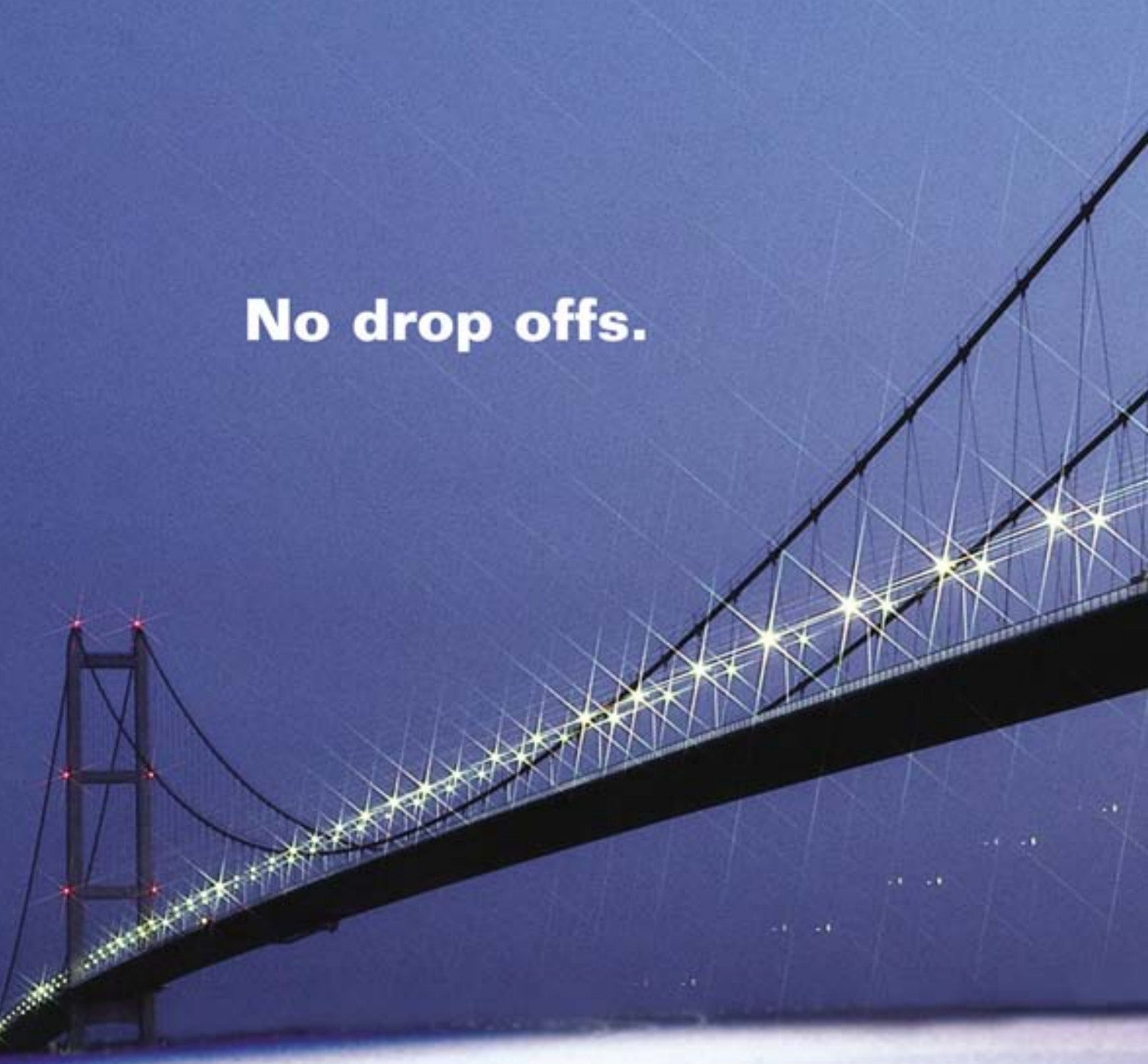

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"India is a very important and promising market"

Stig Pedersen, Director of Marketing Strategy Survey/GIS, Magellan Professional on key products, focus and trends

Tell us about the transition from Thales to Magellan?

At the end of August, private equity firm Shah Capital Partners (SCP) completed the acquisition of Thales Navigation and the company was renamed Magellan. This is a great milestone for the company and puts us in a position to compete more effectively as an independent GPS/GIS company with a focused shareholder who brings great operational expertise to the mix. The entire company – consumer and professional businesses - is part of the acquisition so we will continue to serve the survey, GIS, OEM and consumer markets we serve today.

We plan to expand our business and build on our unique ability to leverage the high-volume consumer manufacturing and ease-of-use expertise to bring cost-effective and user-friendly solutions to the professional markets. We see significant interest in the Survey/ GIS markets in particular, for more accessible solutions and we will also tap businesses that have not been able yet to take advantage of GPS.

Your key products?

Our survey and GIS products are now marketed under the Magellan Professional brand - a brand that illustrates both the heritage and pioneering force of our company, but also conveys that this product line is designed for professionals. The flagship products in this line include the ProMark3, Z-Max. Net and the MobileMapper CE. All of these solutions are flexible products that allow customers to get the GPS functionality and performance they need at a cost that their business can afford.

- ProMark3 is a centimeter accurate GPS survey solution that also allows surveyors to offer GIS services without further investment in equipment. ProMark3 continues the leadership of the ProMark2, the best-selling single-frequency GPS survey receiver on the market.
- The Z-Max.Net GNSS surveying system is one of the .Net generation of Magellan solutions that offer VRS, FKP, NTRIP and GPRS, RTCM V3.0 network communication. It's also the most flexible survey GPS available, offering simplicity of operation and the strongest RTK in the business.
- MobileMapper CE is also part of the .Net generation, offering the same communication flexibility for mobile mapping professionals. By teaming with a variety of software business partners such as ESRI, Geosurf, Geospatial Experts and others, the MobileMapper CE is the perfect handheld GPS data collector for applications like asset management, utilities, forestry, agriculture and many more.

How are your offerings different from the others?

In addition to being more flexible than offerings from competitors, Magellan Professional solutions offer leading technology advantages but with a lower investment both in terms of learning curve and expense. ProMark3, for example, is half the cost of the nearest competitor and allows surveyors to perform centimeter accurate surveys with only three-screen operation in the field. ProMark3 guarantees easier operation, faster survey and reliable data. Magellan Prism™ technology reduces survey data collection time significantly over competitors for a marked increase in productivity. Our products are all about giving an advantage in productivity to customers and we can only do that if we provide features that enable rapid surveying and data collection like fast signal acquisition, multiple communication options, and ease of use.

How do you differentiate your consumer and professional products?

The customers are very different so naturally the solutions are also very different. Our consumer products focus on navigation and are based on 3-meter accuracy, which is plenty accurate enough for consumer usage scenarios. They incorporate features like multimedia and points of interest, waypoint tracking, and other applications that are useful to drivers and outdoor enthusiasts. Magellan Professional products can benefit from some of these "consumer" features and from underlying technologies, such as

We view Indian users as being very technically savvy in the purchase and use of GNSS receivers. We see an above average adoption of GNSS technology

Bluetooth connectivity, color touch-screen and turn-by-turn route guidance. However the professional products require much higher accuracies for the collection of positioning data, enhanced ruggedness, strong performance and reliability of surveys. Both product lines benefit from increasingly more portable form factors, power consumption advances, simpler user interfaces and cost-reduction, but a higher level of performance and accuracy will continue to be key in the professional line.

How do you educate your potential customers?

Introducing the Magellan Professional brand is one of the important first steps in this education. We don't want our professional customers to mistake the Magellan brand for a consumer brand, so we have dedicated a professional brand to this business. We plan to remind customers and prospects frequently in the next few months through advertising and other communication campaigns that highlight the "Professional" in Magellan Professional. And when you are talking about the integration of GLONASS, Instant RTK technology, and centimeter-accurate surveying, it's unlikely that our professional customers will be confused about the level of performance Magellan Professional solutions provide compared to Magellan consumer products.

How do you see the advent of GNSS systems like Galileo?

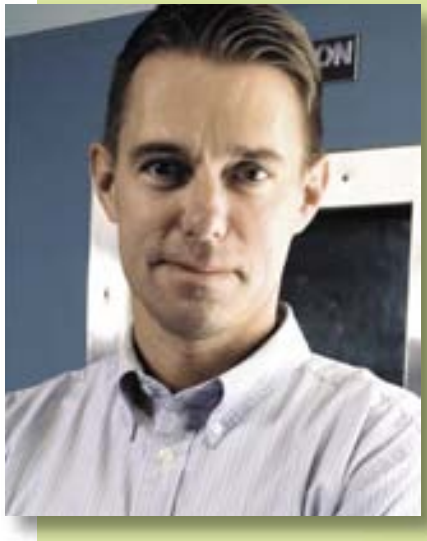
Magellan is a huge proponent of Galileo and has been intimately involved in the development of the first Galileo receivers. The introduction of this system underscores the coming expansion of this market. Galileo will increase signal availability when it's fully deployed, but it will be years still before it is, so for now, we are adamant about not passing on the cost of incorporating a technology that can offer no benefit to our customers. When Galileo is ready for deployment, we'll be among the first to provide compatibility and dual functionality in products where the benefit will truly be felt by the customer.

How prepared are you to offer products and services compatible to the range of existing and proposed GNSS systems?

Magellan - then Ashtech - created the very first GLONASS receivers and, as I mentioned, we have been at the forefront of Galileo receiver development, so we probably have a technology advantage over competitors in this area. We have chipsets today that are Galileo-ready. The implementation of technology compatible with these systems is not an obstacle for Magellan. However, we are committed to providing these technologies when they can benefit the customer. Otherwise, we're just playing a marketing game and selling technologies to customers that they can't possibly use today.

What are your strategies to deal with the market like India which is too price sensitive?

Markets like India are actually the strongest opportunities for our growth because Magellan has a cost structure and product options that can meet the stringest price demands of these regions. No competitor will be able to offer the low-cost solutions that Magellan can because of it's high-volume consumer manufacturing. We see India as a very important and promising market both with Survey and GIS and view Indian users as being very technically savvy in the purchase and use of GNSS receivers. In the region we see an above average adoption of our GNSS technology in India versus other countries in the region.



With a talent for reading the market and developing products to meet market needs, Stig Pedersen is responsible for developing all of Magellan's survey and GIS products for a variety of customers, including federal agencies, local law enforcement agencies, forestry departments, agricultural organizations, city governments, and more.

Pedersen spent eight years at Leica Geosystems, where he held a number of senior positions in both product management and business leadership. During this period of rapid growth within Leica's GPS business, Pedersen oversaw all aspects of the GIS business from product development to sales.

Earlier in his career Pedersen was a key contributor to the Magellan consumer line of GPS products now created and marketed by Magellan Professional. He was employed by Magellan Systems until 1995 in program and product management positions, as well as vital research roles. Magellan Systems acquired Ashtech in 1997 and became Magellan Corporation, which was then acquired by the Thales Group in 2001, and renamed Thales Navigation. Recently acquired by private equity firm SCP, the company is now Magellan and maintains its survey and GIS business under the Magellan Professional brand.

Pedersen holds a B.S. and an M.S. in Business Administration from the Aarhus School of Business in Denmark. He is working as Director, Marketing Strategy, Magellan Professional.

Illness and politics

An acrimonious period

For extended periods throughout his long stay in India Everest was plagued with illness. Not only did this result in the two periods of sick leave – S Africa in 1820 and England 1825 to 1830, but also shorter periods of severe incapacity when he did not leave India for better climates.

In 1837 Everest corresponded with his masters at the East India Company regarding the latest of his attacks of illness and the Directors were sufficiently worried by what he said to appoint a successor-designate as Surveyor General. A move about which Everest knew nothing until some months later. The person in question was Thomas Jervis, who, as far as Everest was concerned, was one of the persons least able to succeed him. On the strength of his appointment Jervis went to England and made the acquaintance of many influential persons which led to his being asked to address the British Association in 1838. It was when a copy of the Jervis's paper was sent to Everest that he became furious and this resulted in an exchange of letters between him and the President of the Royal Society which amounted to some 150 pages. Unfortunately there appear to be no copies of any of the responses to Everest from the Royal Society.

The spark that ignited the fury was that the tone of Jervis's paper was written as if he were already Surveyor General. However this was further fuelled by a document supporting that paper and signed by 38 eminent scientists, most of whom were Fellows of the Royal Society. This document contained a series of recommendations on how survey in India could be improved, and concluded by suggesting that Major Jervis should avail himself of advice from various persons including Sir John Herschel, Mr Baily and Mr Airy. Everest's responses direct to the Duke of Sussex, as President of the Royal Society, were acid in the extreme. He considered the various suggestions to be quite impractical in terms the staff and resources available. How could a group of such eminent gentlemen talk in such terms about a situation of which they had no first hand knowledge? In his letters Everest detailed at some length his work on the Arc, described all the hardships faced and the fact that there was "….not a single person [in India] who had the slightest experience of Geodetical operations, except three of my sub-assistants, who are not scientific men.". He raised issues as to why the Royal Society had suddenly become interested in Arc measurement when it had not been interested when he commented on the problems with the Cape Arc of LaCaille?

In one letter he took Sir John Herschel to task for implying that there were several aspects of the Arc survey that Everest had not done with regard to standards of measure and the use of thermometers yet Everest was able to refer him to his Report of 1830 wherein all those points had been detailed. By 1839 the letters had been widely circulated and it appeared that certain of the signatories involved were coming to feel that the circumstances surrounding the appointment of Jervis and everything connected with that were becoming an embarrassment. So much so that George Airy, the Astronomer Royal, considered that he may well have been under a misapprehension over the whole affair and this resulted in the East India Company indicating that the appointment of Jervis was dependent upon the death or resignation of Lieut Col. Everest.

Everest had in effect won the battle but at the expense of considerable time, effort and strong words. He was even more determined to see the Great Arc to its conclusion come what may and that Jervis would have no part in that. The letters between Everest and the Duke of Sussex together, with various of the supporting documents, were published by Everest in 1839 as "A Series of letters addressed to His Highness the Duke of Sussex as President of the Royal Society, remonstrating against the conduct of that learned body." Not only do they detail the arguments but hidden away in some of the letters are snippets of personal information regarding George Everest that have not been found elsewhere.

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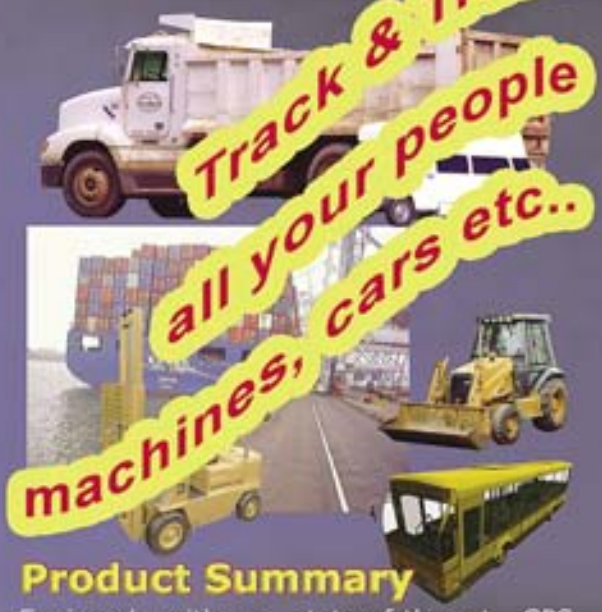
KCS TraceME

GPS/GPRS/SMS Module



Distributors welcome!

The KCS TraceME/TrackME GPRS/GPS Module enables you to remotely track & trace a variety of objects, e.g. cars, trucks, containers or ships. Its small, lightweight aluminum design makes it easy to install and together with the extended position logging, it's ideal for use in fleet management, anti-theft and M2M applications.
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Consumer-grade GPS for efficient GIS and mapping applications

A methodology for extending the geospatial data collection functionality of the consumer-grade GPS for circumstances that previously required very expensive equipment, software and training

R M Mikol

The GPS is a ubiquitous tool on the planet today. Its ability to pinpoint a person's position on the globe, and store information about that location has been one of the most significant contributions to society in the latter Twentieth Century. Currently, the systematic collection of geospatial attribute data is limited to very expensive GPS receivers and specially trained personnel. The general procedure for collecting geospatial attributes with the consumer-grade GPS has required the use of "add-ons", such as hand-held computers, laptops and palm pilots. These add-ons are frequently outside of the financial and technical reach of many communities, organizations and under funded agencies. The protocols and procedures presented here are designed to modify and merge existing methods and technologies to overcome these financial and technical barriers.

Methodology

The GPS provides four major data collection functions: (1) precise location (waypoints); (2) precise time (a date/time stamp at waypoint collection); (3) a name for that location; and (4) tracks (routinely collected by the GPS, which in turn can display an area surveyed).

While items: One (1), Two (2) and Four (4) are self descriptive: item number Three (3) is the data collection engine for this naming convention protocol. It is in the waypoint name that the user is able to record specific data attributes about that location. For example, currently and commonly the waypoint name provides a location attribute such as "HOME," for a persons' domicile or an abbreviation like "ST_J_LK," for a place like St. John's Lake. In the GPS receiver's small database, the waypoint name is also the primary key field, in which no two names can be alike. A common number of character spaces provided on today's GPS' are ten and the number of available alphanumeric characters are 36 (10 numerals and 26 letters).

By using a data dictionary and a set of data structures for the waypoint name, even casual GPS users can provide organizations with high quality, accurate and sophisticated geospatial data. This data, created with the waypoint name, is both a unique descriptor for that location and the primary key value for the relational database. Also, once the waypoint name is parsed, a set of data fields are created with very specific attribute information about the location surveyed. At a minimum, the waypoint name and subsequent parsed fields should describe: the GPS (including the operator); data id and something about that location. In the event of an oil spill, additional data might include information on: shoreline type; presence of oil; vegetation; birds; animals; mammals and fish. An entire list of possible items need not be included in the lists to describe the shoreline, vegetation, etc. just those most common to the area. All of the fields created in and parsed out from the naming convention will be sorted out in the RDBMS.

Prior to any field use, a data dictionary should be established. The nature of the survey will determine the format and content of the naming protocol and structure. For example a set of protocols for mapping out a trail system might only have five data entries in the name: GPS ID, Trail ID, Data ID, and Trail Attribute ID. The number of character spaces allotted for each data ID will depend on the number of items involved in the survey. If you do not expect to ever have more than 36 GPS receivers in your database, then one character space will be enough. The same is true for the number of trails to be surveyed. On the other hand, if the number of GPS units (or trails) can be expected to exceed the amount of 36 over the life of the project, then two character spaces should be allocated. Two character spaces will provide 1296 alphanumeric ID combinations. So, a small trail mapping project might only have one character space allocated for the GPS ID, one space allocated for the Trail ID, two spaces assigned to the Data ID and one space allocated to the Trail Attribute ID. The waypoint name might look like this: "270C4". This waypoint name, parsed out in the database provides the following information: GPS #2 (owner, make and model); Trail #7 (St. John's Lake Trail, 23.8 km, moderate difficulty, average round trip speed 6 ~ 8 hours); Data ID #0C (the 12th data entry for that trail); Trail Attribute ID #4 (a bridge). Connect this data into a GIS and you have a trail made from tracks whose symbology indicates moderate difficulty and a waypoint on that trail that indicates a bridge. This same set of protocols and database design can now be modified for Search and Rescue (SAR): Trail ID becomes Sector ID; and the Trail Attribute ID becomes Hazard/Item of Interest Attribute ID. Everything else stays the same.

Now imagine, 15 SAR personnel going out looking for a lost hiker. Each has their GPS receiver turned on, recording their tracks. Each member of the team also has a waypoint naming convention key that explains how to enter the waypoint name. As each person returns to base, the data in the GPS is downloaded directly into a database and immediately displayed in the GIS for review and analysis. At the end of the day a map document is produced of their efforts, with minimal effort and within a few minutes.

Coastal Oil Spill Model

Often when an environmental disaster strikes, the nearest local community is the first to know and the first to respond. Federal and state government resources, along with private contractors, though experts in their field, often take days to fully mobilize. During that time, precious information is lost through the absence of data. This is an opportunity where members of the community, with local knowledge of plants, wildlife, and terrain, can be mobilized to collect high quality, precision data with simple, consumer-grade GPS receivers.

If a community is fortunate: then they have a flexible response plan in place and have had an opportunity practice that plan. The elements of a response plan are likely to look like the following outline:

- Purchase GPS units (or find out who has them)
- Develop a data dictionary
- Develop a database (more precisely known as a Relational Database Management System or RDBMS)
- Figure 1, GPS waypoint naming convention for the oil spill model
- Store the Data Dictionary in the RDBMS (this can then be printed and distributed on a moments notice)
- Simulate emergency situations and train with the GPS receivers and GIS resources

In Figure 1, it is important to note that several of the fields only allow for the specific choice of 33 values, where three input values are reserve characters for Not Present (0), Not Known (1) and Other (Z). This is particularly useful when a single character space is being used to identify an attribute. In many cases, 33 variables will be enough to identify the presence of a common feature of concern

Data Collection

Once and emergency has been identified it will be important to contact community members with knowledge of all aspects of the local geography, including the weather, vegetation and wildlife. Next, pass out GPS receivers, the naming convention keys and a map, along with a track line or area to cover.

In the field, the waypoint data is collected according to established protocols. This means that each waypoint is given a name, and each character in the waypoint name corresponds to a specific attribute value in the data dictionary and that attribute value is specific to the location in the waypoint name. A written record is made of the data point and this includes:

- Time of data entry
- Waypoint name
- Attributes identified

Additionally, tracks from the GPS are collected according to protocol. Most likely this will simply involve setting the "polling" rate or the position data collection rate at a specific interval. This may be a standardized rate of 10, 20, 30 or 60 seconds, or it may vary with each GPS in order to distinguish one GPS unit from another.

Data Integration

Upon returning from the field, each member of the data collection team needs to download the data from their GPS and load it into the relation database management system. This may be a direct download to the database, or it may involve more steps. For the purpose of this protocol set, we will use more steps to ensure data quality.

This is more likely to be necessary if you are using members of a community who have not had much training in emergency procedures or GPS units.

To begin with, download the raw waypoint and track data from GPS to a text file. Next, label this file with the date of data collection (in reverse format), the letter "r" (indicating raw data), underscore, and first waypoint name (i.e. "060416r_ 0101011). By including the first waypoint in the file name you will be identifying the GPS (possibly the user) and the area surveyed.

Next, import the file into a spreadsheet. This will allow for easy and efficient data checking and editing if necessary, essential for quality control. Each user should be responsible for checking their own data for accuracy. If necessary, this should be done with a member of the GIS team.

Next, import the "clean" data (waypoints and tracks) into the database. All of the waypoints can go into a single table. The waypoint naming convention ensures that each

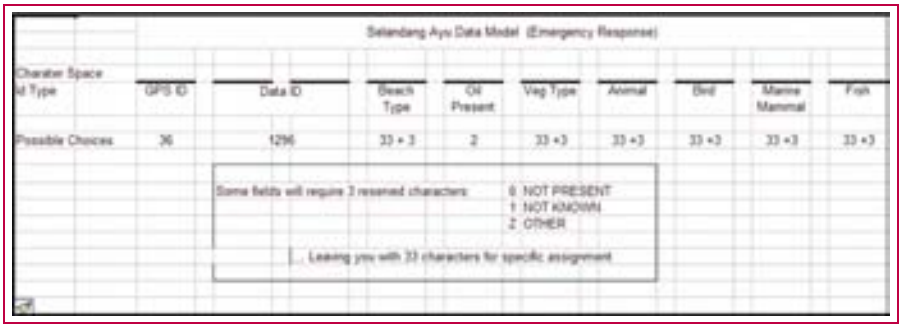

Figure 1. GPS waypoint naming convention for the oil spill model

waypoint can effectively be used as a primary key value. Additionally, the naming convention allows for extracting information related to a single GPS or survey area. The database administrator (DBA) may want to import track data into tables designed for each GPS. This would be the easiest and most effective way to distinguish one set of GPS tracks from another.

Data Management

The RDBMS will need to have a set of reference tables and transaction tables. The example set listed below uses the Unalaska Trail Mapping Project (UTraMP) model. The UTraMP model is particularly useful in that it is the easiest to understand and modify for single attribute acquisition, like stream surveys or search and rescue operations.

UTraMP Reference Tables:

GPS reference table (tbl_GPSId)
- cGPS_ID (GPS receiver Id number in the database)
- cGPS_Make (Manufacturer)
- cGPS_Model (Model of GPS)
- cGPS_SN (Serial number)
- cGPS_Owner (Owner or operator)
- cGPS_Name (Written on the case of the GPS, i.e. "CRC-1," in this case it meant the first GPS unit for that organization. Others were labeled CRC-2, CRC-3, etc.)

Trails reference table (tbl_TrailInfo)
- cTrail_ID (Trail ID number in the database)
- cTrail_Name (Name)
- nTrail_Length (the trail length in linear distance)
- nTrail_Time (the amount of time it takes to go out and come back)
- cTrail_Difficulty (on a scale of 1 ~ 3)

Trail Attribute table (tbl_WayPtsId)
- cTrail_AttributeID (This was the primary key value for the table and the waypoint key value for the naming protocol)
- cTrail_AtributeDescription (This was the description of the ID value, i.e.: 1 = Start of trail; C = Cabin. Note that the Attribute ID was a mnemonic to the description.

UTraMP Transaction Tables:

GPS Waypoints table (tbl_WyPts)
- cType (this field is information generated by the GPS unit to indicate whether the data is a waypoint or track point)
- cWypt_Name (a user defined field, in this case, this is where the attribute information for the specific location is stored)
- Figure 2, Data flow from the GPS unit to the RDBMS
- nLat (Latitude, generated by the GPS receiver)
- nLon (Longitude, generated by the GPS receiver)
- dtTime (Time and date, generated by the GPS receiver)

GPS Tracks table (tbl_Trax)
- cType (this field is information generated by the GPS unit to indicate whether the data is a waypoint or track point)
- nLat (Latitude, generated by the GPS receiver)
- nLon (Longitude, generated by the GPS receiver)
- nAlt (Based on the GPS datum, generated by the GPS receiver)

Data Manipulation

Data manipulation is done through the use of queries: either by combining tables or queries of related data and/or running calculations on them. In this database, the common data manipulation is parsing the Waypoint Name field (cWyPt_Id) and "joining" or linking the newly created parsed fields with the primary key fields of the associated attribute table.

Figure 3, is an illustration of the data flow for the Selandang Ayu Data Model for oil spills. The illustration is simplified from the actual RDBMS.

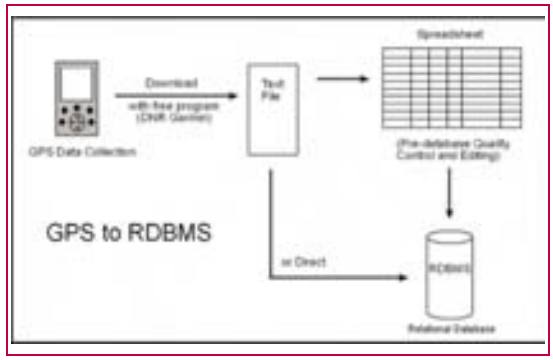

Figure 2. Data flow from the GPS unit to the RDBMS

In the actual RDBMS all data tables become queries before any relation is applied. This is done as a precaution to protect the integrity of the original data.

Data Analysis

At this point, the geospatial data is ready for visualization in a GIS. Now the management team can see what areas have been surveyed, who surveyed them and what was found. Most likely, you will have had to acquire or create our own base maps. You will have had to ensure that all of the maps and data are in the same projection with the same datum and you will have had to create symbology for the different attributes of your data.

At this point, you are also ready to perform advanced analysis on your data. From here you can buffer points and lines; and use other tools that will allow you to clip, merge and intersect your GPS data with other map features. Also, if this were a disaster, you could use advanced statistical calculations on the collected data in order to evaluate the nature and spread of a given contaminate. If this were a SAR operation, a view shed analysis could be performed from the elevation of the hiker and a maximum area of observation could be obtained.

A coastal resource assessment protocol has been investigated using this protocol. As of this time it is still in development. It was originally a modified version of the Oil Spill model, but going through a list of items and plugging them into a GPS was overly tedious and time consuming. Possibly, a better

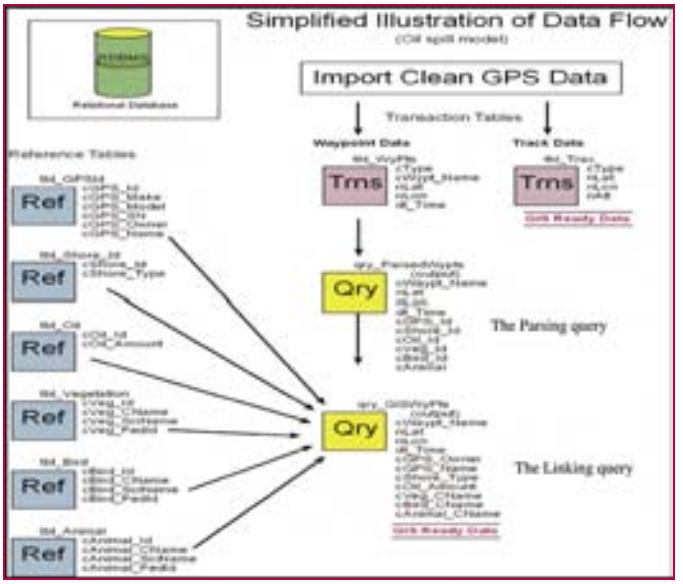

Figure 3. Minimum database structures for the Oil Spill data collection model

model, soon to be tested, involves limiting the number of items of concern to subsistence species or indicator species or both. In this case the data field would identify either a Boolean value of either presence or no presence, or presence and quantity.

Summary

The elimination of Selective Availability and the incorporation of WAAS and DGPS have greatly increased the accuracy and precision of the consumer-grade GPS. This new, high precision tool has the potential to greater expand the resources of communities to respond to challenging situations that require immediate geospatial information. Additionally, having this information and the knowledge that comes with it, as an emergency unfolds, can empower a community to make better decisions with the hope of a better outcome.

Acknowledgements

The author would like to thank Wendy Svarny-Hawthorne and the shareholders of the Ounalashka Corporation for their support in the UTraMP project, without them this protocol concept and method could not have been so rigorously field tested. Further thanks go out to University of Alaska Fairbanks professors, Anupma Prakash and Michael Sfraga, both of whom gave their time and support to write up this project. Anupma was kind enough to read and comment on several drafts. Finally, Tom Heinrich from the Geographic Information Network of Alaska encouraged this project and helped clean up several working drafts of this document. His kindness and talents are greatly appreciated.

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Indian electronic navigational charts : A digital journey

The Indian Hydrographic Office has converted all its Indian waters charts into digital environment

Rajesh Kumar

The Basic role of a Hydrographic Office's (HO) is to provide essential hydrographic Services to support safe and efficient navigation and promote national maritime development for the nation. In recent years HOs all over the world are playing leading role in development of Electronic Navigational Charts for marine community so that vessels can navigate safely on their voyage across oceans.

Navigation of ships in and out of the nation's coastal waters and channels could be made safer by improving the Navigational systems by adopting new navigation technologies. In recent years, -publicized shipping disasters have called into question the safety of life at sea both to the mariners and ocean environment, the effectiveness of navigation technology thus is facing challenges and looking into future for a technology that the Navigation system uses. Presently although Navigational systems for the most part are safe, but could be made more safer with improvements in onboard navigational systems performance by better use of new technologies including improved coordination of vessel traffic and using digital/electronic navigational charts for improved safety.

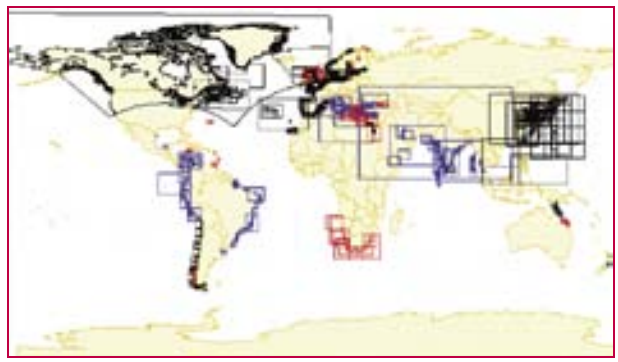
Innovations in navigation technology hold significant potential for reducing operational risk and improving safety performance, and their introduction should be expedited. Use of Electronic Chart Display and Information Systems (ECDIS) to replace paper charts holds particular promise. When combined with data from Global Positioning System, satellites, electronic charting systems can provide accurate real-time positions, as well as steering guidance, automatic hazard warnings, and a permanent navigation record. However, the full benefits of this and other new technologies are not likely to be gained in the near term unless deliberate measures are taken to promote their introduction. A comprehensive & specific familiarization for use of the ECDIS should be made before implementing this new navigation technology. Such measures must include establishment of technical and operating standards and improvement in charting of water depths and other hydrographic data. Professional training in the use of these new technologies is essential. The international nature of the shipping and maritime industry is well known,therefore in order to improve standards and to recognized the actions required to improve safety in maritime operations would require more efforts at an international level rather than by individual countries acting unilaterally and without co-ordination with others. With this aim it was decided that Electronic Navigational Charting is such a source that would increase safety of navigation and facilitate everyday mariner's work. First electronic charts and related systems had appeared on the market in early 80s. These charts were merely scanned and digitized paper chart reproductions-so called raster electronic charts.

The quality and contents of nautical charts is the cornerstone of safety at sea, and is strictly controlled by international agreements. Thus the industrial development of technically elegant solutions is not enough, the products must meet a well-defined standard for international approval of IMO/ IHO. As a result an international S-57 standard has been established.

Worldwide ENC coverage

The lack of comprehensive ENC coverage along major shipping routes has been significant and also there was confusion about policies regulating the use of ENC and paper chart, furthermore, uncertainty was also about using SENC in ECDIS when the original ENC produced by a national HO are available to the user. This ambiguity was resolved in July 2002, when the revised version of SOLAS chapter V came into force, and the status of ECDIS and ENCs has been clarified, and as a result HOs, if they wish, can support delivery of their ENC data in SENC formats.

With this in mind, the IHO recently conducted a survey to determine from its member States how many ENCs have already been produced. The findings of this survey are quite revealing, and full details can be found

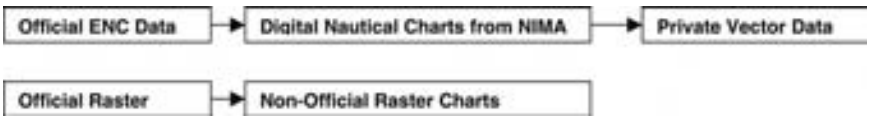


Source: IHO Website
Fig1 World ENC Coverage

on the IHO website (http://iho.shom.fr/). One of the main conclusions from the survey was the large number of ENCs that are already available, along with a significant amount of ENC data that are either in production or which have been produced but which are not currently available to the mariner (shown in red and blue respectively in the Fig 1).

Availability of ENCs

Presently the hydrographic community is under a transition phase form old paper chart days to more sophisticated digital chart days ahead The lack of official S-57 data has created lacuna in the navigation market and this lead to the development of non-official data form private data producers (Fig 2). Today both official and non-official data exists in the international marine community and the mariner is thus bent to take derived products from private vendors although the risk is high. The priority available for using data as envisaged by mariner today is:



Initial accomplishments in Indian ENC programme

The Electronic Navigational Charting programme of India started with a vision to gain a greater appreciation and understanding of the use of electronic charts when operating in its waters. Beside this the purpose was to develop an information system and demonstrate world that India is capable of producing full coverage of its National Chart series digitally and as per the specifications laid down by IHO/IMO. With a solid core of experienced cartographers and Hydrographer, equipments and the nations most extensive holding of bathymetric and hydrographic data, a quest for development of Electronic navigational Charts started in 1997. For Indian hydrographic Office creating Electronic NavigationalCharts for its waters was a very prestigious project. Initial hurdles include source for generating ENCs and populating it with data. The obvious choice for source for its creation was initially paper chart, although limitations of a paper chart is that if it is used for creation of ENC to enrich it, all the limitations corresponding to the scale would be transferred to ENC, but due to financial and other constraints it was decided to digitized the paper chart information for the purpose of creating ENCs rather than going for original source material. Then came the problem of finance and after careful review the task was contracted to an Indian firm who then utilized CARISTM Suite of Software for implementing S-57 standards of IHO/IMO for obtaining full coverage as per national chart series of India. Stringent QA/QC checks were employed to follow that resultant product i.e. ENCs are fully compliant as per IHO Product specifications and as a result India attained full ENC coverage of its Indian waters in 2002. (Fig 3)

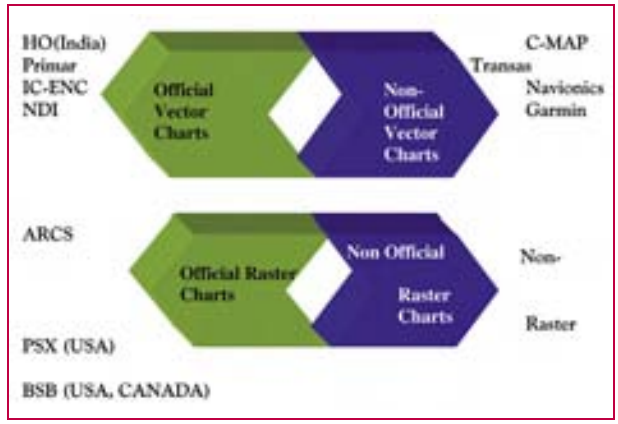


Fig-2 Various form of Electronic Charts

The scale of a ENC is determined by the type of navigation for which it is intended, the nature of the area to be covered and the quantity of information to be shown. Various scale terms are used in the S-57 IHO Product Specifications Appendix B, such as Overview, General, Coastal, Approach, Harbour and Berthing which belongs to Chart series of medium-scale, large-scale, and coastal series.

The IHO product specifications for ENCs although mentions navigational purpose of ENCs, but it did not specify the scale range that should be applied to eachENC. The reason behind it is that different HOs have their own scale ranges to meet the navigational purpose. The Indian Hydrographic Office followed INT M4 chart specifications for the simple reason that each ENC cell is roughly equivalent to limits as per paper chart.

As per IHO S-57 Product Specifications Appendix B India produced as of 31st March 2006 215 ENC cell with usage band/scale range as given in the Table 1

Future Plans

At present India is distributing its ENCs worldwide through its appointed ENC distribution agent M/s C-Map, in an secure and encrypted format CM93/3 which is compatible to most ECDIS systems in the world. However Indian HO is also looking towards other sources of distribution so as to keep in pace with international

Fig 3. ENC Coverage of Indian Water

Table 1

Code	Scale Range	Navigational Purpose	No of Charts in Usage band
1	1:3.5- smaller	Overview	5
2	1:500,000-1:1.5M	General	6
3	1:150,000-1:300,000	Coastal	50
4	1:37,500-1:100,000	Approach	40
5	1:25,000-1:35,000	Harbour	101
6	1:6000-1:20,000	Berthing	13
			TOTAL 215

organization involved in similar activities and it is for this reason that our future focus would be to develop a regional distribution centre of IC-ENC (International center of ENC) for marketing and distribution of its product to end-users.

IC-ENC is an association of national hydrographic organizations which are working together to harmonize the production & distribution of high quality official Electronic Charts.

IC-ENC does the following basic functions such as:

a) Collation of ENCs from member
b) Validation of ENCs & updates
c) Database Management
d) Exchange set creation

IC-ENC functions are based on the following structure

IC-ENC operating unit (OU) in Taunton IC-ENC appoints Value Added Resellers to be specialist distributors who develop their own services based around ENCs, typically including additional complementary electronic products, and provide these tailored services through their own distribution networks.

Conclusion

The Indian Hydrographic Office (INHO) has come a long way and has converted all its Indian waters charts into digital environment. It wants to promote its products and services in international market and also take advantage of adding its data to international distributors in order to maximize return of its investments. It will also help Indian HO play a leading role in the development and operation of Regional ENC (RENC) co-ordination center in asian subcontinent.

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rk_khatri03@yahoo.ca

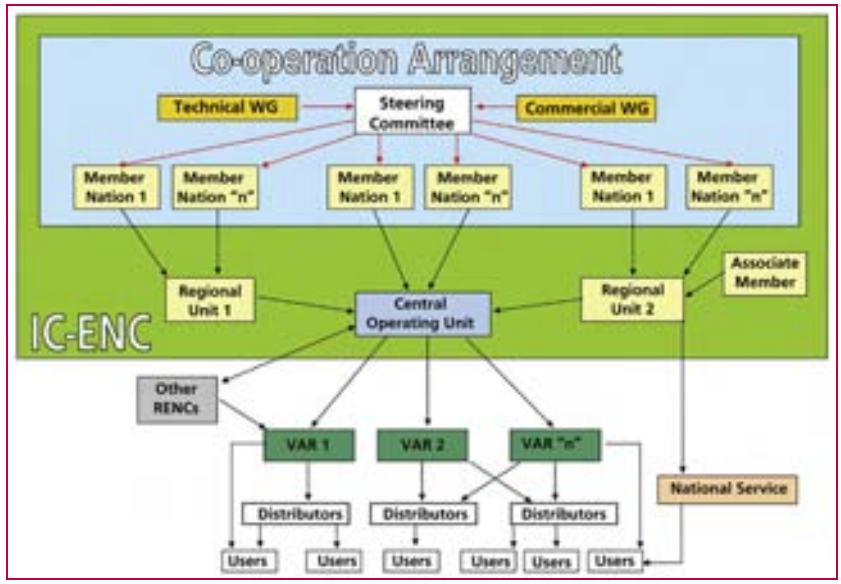


Fig 4 Functions that are provided by the central

US agency says China used laser to jam US satellite

China has beamed a ground-based laser at US spy satellites over its territory, a US agency says. The action exposed the potential vulnerability of space systems that provide crucial data to American troops and consumers around the world. The Defence Department remains tight-lipped about details, including which satellite was involved or when it occurred. The Pentagon's National Reconnaissance Office Director Donald Kerr has acknowledged the incident, first reported by Defence News, but said it did not materially damage the US satellite's ability to collect information. "Space is a much bigger part of our military posture than it used to be, so any effort by the Chinese or anybody else to jam our satellites is potentially a big deal," said Loren Thompson, Defence Analyst with the Virginia-based Lexington Institute. Clearly, the incident sparked fresh concerns among US officials about the US ability to determine if satellite problems are caused by malfunctions, weather anomalies like solar flares, or targeted attacks. *www.theage.com.au*

Russia clears space pact with India

Clearing the way for joint space exploration and transfer of space technology to New Delhi, the Indo-Russian space cooperation agreement has been signed into a federal law by Russian President Vladimir Putin. Putin signed the pact into a federal law after both houses of Russian parliament unanimously approved the pact last month. By being signed into law, Indo-Russian space cooperation will acquire strategic character and would speed up joint collaboration in completing and operationalising the GLONASS. Under the GLONASS agreement, Indian Space Research Organisation will launch Russian navigational satellites Glonass-M with the help of Indian space launch vehicles and jointly develop with Russia a new generation navigational satellite Glonass-K. *www.dnaindia.com*

South Korea to introduce new geodetic system

The South Korean Government has designated Ullung Island as the starting point of a new geodetic system prior to changing to the World Geodetic System (WGS-84). To date the Tokyo Datum has been used for measuring distances after Japan occupied the peninsula in 1910. The geodetic system is a means of measuring the distance and location of objects on land by using a specific starting point. The starting point of the previous system was Tokyo. Under the new geodetic system, the coordinates of the Ullung Island starting point will be changed from 37 degrees 28 minutes 47.2005 seconds latitude north and 130 degrees 54 minutes 1.1705 seconds longitude east to 37 degrees 28 minutes 57.4331 seconds latitude north and 130 degrees 54 minutes 2.7496 seconds longitude east. The difference in measurements from the Tokyo Datum and those from the WGS-84 is 365 meters southwestward. *http://times.hankooki.com*

China starts to build own satellite navigation system

China announced to build a satellite navigation system that will include up to 35 satellites and be working in the Asian region by 2008, state press said. The system, called "Beidou", will include five geostationary earth orbit satellites and 30 medium earth orbit satellites. Navigation services open to commercial customers will provide users with positioning accuracy within 10 meters (33 feet), velocity accuracy within 0.2 meters per second and timing accuracy within 50 nanoseconds, the report said.

Indian school installs GPS in its buses

The Cathedral and John Connan High School in Mumbai has installed GPS units in each of its 52 buses, making it a first for city schools. This satellite-based tracking system, installed in August, will be fully functional in a month's time and enable both school authorities and school bus operators to track the buses. *http://timesofindia.indiatimes.com*

US adopts new space policy

The US has adopted a tough new policy aimed at protecting its interests in space and denying "adversaries" access there for hostile purposes. The document - signed by President Bush - also says "freedom of action in space is as important to the United States as air power and sea power". The document rejects any proposals to ban space weapons. But the White House has said the policy does not call for the development or deployment of weapons in space. The 10-page strategic document states that the US national security "is critically dependent upon space capabilities, and this dependence will grow". "The United States will preserve its rights, capabilities, and freedom of action in space... and deny, if necessary, adversaries the use of space capabilities hostile to US national interests," it says. The document also sets out US commercial ambitions, saying it is committed to encouraging and facilitating a growing entrepreneurial space sector. The new elements of the policy include using space support for homeland security, emphasizing and strengthening interagency partnerships, and renewing the emphasis on the value of mission success in the U.S. government's space acquisition programs. It is the first revision in US space policy for 10 years. It addresses concerns voiced in a 2001 Pentagon report that said technological advances would enable potential enemies to disrupt orbiting US satellites. Unclassified details of the policy (http://www.ostp.gov/html/US%20National%20Space%20Policy.pdf) published on the Internet say space capabilities, including spy and other communication satellites, are essential for national security. *http://usinfo.state.gov*

Leica GPro version 3.2 launched

With the new version 3.2 for its Leica GPro download and ground processing software, Leica Geosystems is now offering improvements and new capabilities to its Airborne Sensor customers, such as increased speed and simplified handling. In this new version 3.2, Leica GPro offers a new project information file structure, which enhances usability and productivity. Increased speed for pixel-wise orthorectification is provided. Plus, Leica GPro now supports the newly launched ADS40 2nd Generation sensor heads SH51 and SH52. *www.leica-geosystems.com*

Trimble AgGPS Implement Steering system

Trimble, USA introduced its AgGPS Implement Steering system for keeping implements pulled by tractors using the Trimble RTK Autopilot automated steering systems on the same repeatable path, even on extremely sloped fields. The system includes its own implement-mounted GPS receiver and T3 roll-compensated control system. A single display in the tractor communicates desired path information to the implement, instantly adjusting the steerable coulters. This information instructs the implement to directly follow in the path of the tractor. *www.trimble.com*

Trimble VRS Now to be launched in Germany

Trimble will launch its Trimble VRS Now service for Germany in December. The commercial subscription service will provide surveyors, civil engineers and geospatial professionals with instant access to real-time kinematic (RTK) GNSS corrections without the need for a base station. Using GNSS reference station data from SAPOS, the SAtellite POSitioning Service of the German State Survey, the Trimble service will deliver centimetre-level RTK positioning customized for each GNSS receivers exact location anywhere in the network. The Trimble VRS Now service will supply fast, easy to use and accurate GNSS positioning for a variety of applications.

Magellan Professional brand of survey and GIS solutions

Magellan (formerly Thales Navigation) has launched Magellan Professional, the new brand under which it will market its survey and GIS business. The company has also launched its Magellan Professional website today which can be easily accessed from *www.pro.magellanGPS.com.*

Leica HDS6000 scanner

Leica Geosystems has announced the launch of Leica HDS6000, its next generation, ultra-high speed laser scanner. Also announced was Leica Cyclone SCAN v5.6, companion laptop software for controlling the new scanner. The Leica HDS6000 features several major "next generation" advances that increase the versatility, portability, and productivity of ultra high-speed, phase-based laser scanning for many as-built survey applications. *www.leica-geosystems.com*

GPS-PND shipment volume falls 44.8% in Taiwan

There were 37,000 GPS portable navigation devices (PNDs) shipped to the Taiwan market during the second quarter of 2006, dropping by 44.8% from the 67,000 units delivered in the preceding quarter, according to IDC (International Data Corporation) statistics cited by local industry sources. The large quarter-on-quarter decrease was mainly the result of retail networks launching intense sales promotions in a peak period prior to the 2006 Chinese New Year, on January 29, as well as Garmin and local brands, including Mio, Asustek and PaPaNav, launching new GPS PND models late in the second quarter, the sources pointed out. *www.digitimes.com*

Nordnav launches GPS receiver

Nordnav has announced the launch of a new ultra-sensitive indoor GPS Reference tracking 10 times weaker signals than any other commercially available GPS receiver. The reference receiver allows the user to measure the exact signal lavels on every satellite, compare the fading between the indoor and outdoor signals, characterize the multipath effects on every satellite signal. *www.nordnav.com*

BlueMarble's GeoObjects promotion

Blue Marble Geographics announces the GeoObjects® Royalty Free Promotion, available for a limited time. GeoObjects, Blue Marble's map display and data translation developer toolkit, is the display library behind much of their software. Blue Marble, known for their coordinate conversion technology, is also the creator of industry leading map display, image reprojection, referencing, gps tracking, and Internet mapping technology. *www.bluemarb legeo.com*

Autodesk launches Civil 3D Community Site

Autodesk recently announced its Civil3D Community Site. The new site helps engineers and surveyors stay informed on the latest Civil 3D-related developments, interesting projects and other activities. Users can share templates, participate in discussion groups, access extensive training materials and receive invitations to participate in webcasts to learn more about the latest Civil 3D features. *http://civilcommunity.autodesk.com.*

INPHO launches OrthoVista 4.2

OrthoVista is the premier software for fully automated color balancing and mosaicking of geo-referenced image blocks. The new OrthoVista

4.2 provides a number of new features for optimizing quality, speed and productivity. It has significant processing speed and 33% faster than the previous version on average. The new OrthoVista 4.2 and INPHO 5.0 can be downloaded from INPHO's *website www.inpho.de.*

Neural Robotics' Autonomous Mini-Helicopter

NovAtel Inc. announced that its GPS engine is onboard Neural Robotics Inc.'s (NRI) AutoCopter(TM) Express Unmanned Aerial Vehicle (UAV) - a fully autonomous and electric-powered mini-helicopter that can be used for applications including aerial photography, surveillance, pipeline and utility line inspection, convoy escort, and mine detection. Further, Johannes Kepler, Vice President and CTO, Novatel Inc. has received the Johannes Kepler Award from the Institute of Navigation (ION). It was presented by Dr. Elizabeth Cannon, Chair of the ION Satellite Division and Dean of Engineering at the University of Calgary, at a ceremony held in Fort Worth, Texas. for sustained and significant contributions to the development of satellite navigation.

Topcon opens new Brisbane technology center

Topcon Positioning Systems (TPS) recently opened a new Topcon Technology Center (TTC) in Brisbane, Australia. The center produces key software systems for the company's machine control and land surveying products used around the world.

OmniSTAR 8200HP: the new HP+ capable receiver

This easy-to-operate 10 Hz receiver with an LCD display is very suitable for a wide range of applications, from agriculture to surveying, from construction to aviation. Combined with the dedicated Z+ antenna and an OmniSTAR HP+ subscription it delivers worldwide decimetre real-time accuracy.

GPS coming to GSM handsets

After years of anticipation, GPS technology should finally arrive in a significant number of GSM mobile handsets in 2007, according to a new study by market research analyst ABI Research, USA. The report also says that 25 percent of WCDMA handsets will incorporate GPS by the end of 2008. The factors like government regulations covering location technology for emergency services such as E911 as well as a recognized demand for LBS will be responsible for the expected rise of GPS in GSM and WCDMA handsets, according to Alan Varghese, ABI principal analyst. *www.eetimes.com*

Navigate India with MapmyIndia.com

MapmyIndia.com, the 2 year old online maps portal for India, unveiled v-2007, its easier to use, futuristic version. MapmyIndiav-2007 allows users to drag the maps (at all zoom levels) to explore adjoining areas not currently on the screen. According to Mr Rakesh Verma, Managing Director, CE Info Systems Pvt Ltd, "The new version brings online mapping closer to the consumer expectations. It is a manifesation of our efforts to make MapmyIndia an accessible, usable and valuable proposition for users."

BSNL comes up with LBS in Patna

The BSNL, India has launched location-based cell broadcast services through which vital information and message can be given to all CellOne (post-paid mobile phone) subscribers in a particular or entire service area. Cell broadcast services can be utilised to provide vital information to CellOne users about any disaster, disaster management measures or any other important information. The location-based services include fleet management to enable subscribers to know the whereabouts of their vehicles, friends and information relating to whereabouts of users, traffic alert service, city sightseeing, emergency service, public safety, navigation, information regarding weather etc. *http://timesofindia.indiatimes.com*

deCarta partners with GlobeXplorer

Headquartered in San Jose, California deCarta, the supplier of software platforms and services for the LBS industry and GlobeXplorer, California, USA, provider of the world's largest commercial library of aerial photos, satellite imagery and geographic maps, announced a strategic partnership enabling deCarta customers to leverage sophisticated high-resolution aerial and satellite imagery in their LBS applications.

The partnership between the two companies addresses the next-generation of LBS application feature enrichment for a wide range of markets including real estate, travel, Internet, government and business intelligence. *http://biz.yahoo.com*

TomTom enabled Nokia E61

TomTom, USA has teamed up with mobile operator 3, UK to offer the exclusive launch of its satellite navigation system on Nokia's E61 smartphone. The Nokia E61 handset, which features a large screen for easy viewing of maps and directions, will come with TomTom Navigator 6. The software will allow users to see maps of UK and Europe for both driving and pedestrian routes. *www.esato.com*

Cingular, HP release GPS iPAQ

Cingular, USA released a new HP iPAQ hw6920/6925 with Wi-Fi and GPS navigation. The GPS enabled hw6920 will arrive with Cingular's LBS application. Called TeleNav GPS Navigator, the software provides turn-by-turn directions, access to points-of-interest information, and search tools via voice and onscreen to customers when driving or walking. *http://abcnews.go.com*

China's GI industry to exceed $10 billion by 2010

The geographic information industry is a burgeoning and fast-growing industry. Statistics from overseas authoritative institutions show that since 2000, the annual growth rate of the geographic information industry has exceeded 25 percent. More and more large international enterprises, such as Microsoft and Google.com, have begun to enter into this field. According to a recent report published in the China Economic Net website China has proposed in the Outline of the 11th Five-Year Plan for National Economy and Social Development "to intensify the construction of infrastructures and facilities for surveying and mapping, enrich, develop and utilize the fundamental geographic information resources, and develop the geographic information industry". The report further says that the total output value (based on incomplete statistics) of China's geographic information industry reached RMB 26 billion Yuan (more than 3 billion USD) in 2005 and the industry is becoming a rapidly rising burgeoning industry among modern service industries and a new growth point for the economy. The annual total production value of China's geographic information industry is expected to exceed RMB 80 billion Yuan (more than 10 billion USD) by 2010. *http://en.ce.cn*

GIS technology assists rural road connectivity in India

Many poorly-connected rural communities exist within India, and a massive rural roads program was established in 2000 to provide all-weather access to these unconnected terrains. Called GeoApproach (Geomatics-based Application for Planning Rural Road Connectivity to Habitations), this project designed and developed at National Informatics Centre (NIC), Bhopal, is using GIS to enable a faster response to the changing ground realities of development planning. Through the program, habitations with a population of over 1000 will be connected with an all-weather road by 2009. *www.pcigeomatics.com*

Natural disaster info on mobiles in India

A natural disaster information dissemination system to alert people within seconds on mobile phones, claimed to be the first in the world, is in place in India."India is the first country in the world which has introduced an easy-to-use, bilingual disaster warning dissemination system. Through this alert system the common man would come to know about natural disaster in 30 seconds," the Union Science and Technology Minister Mr. Kapil Sibal told reporters in New Delhi. *www.hindustantimes.com*

South Korea to construct national digital map database

Recently, the Korean administration began overhauling its national mapping system. Its largest scale open source mapping system GIS project will use digital street maps and addresses meet international standards. The Korean address system uses land based numbering system. In other words, it combines a land lot number with an address. The past and inferior, outdated system, created traffic congestions and added extra expenses. This situation led Korean government to focus on upgrading its national map and address system to new one that can meet the current global trend. *www.zdnet.co.kr/etc/eyeon/*

Indian government sanctions major project under NUIS

The Union Ministry for Urban Development, Government of India, has sanctioned a major project under the National Urban Information System (NUIS) for eight cities in the State of Gujarat. The cities to be covered under the project are Ahmedabad, Surat, Rajkot, Vadodara, Jamnagar, Bhavnagar, Junagadh and Nadiad. The Chief Town Planner of the State office has been appointed as the nodal agency for the project. Under the project, aerial photography and GIS would be used to gather special information to prepare urban development plans for these cities. Basic information like population, employment, economic development, and infrastructure development would be gathered and used to prepare maps for the cities. According to the officials of the urban development department, the total cost of the project is around Rs. 8 crore of which 75 per cent funds would come from the Central Government while remaining 25 per cent would be contributed by the State Government. *http://cities.expressindia.com*

Dr B.K Gairola new Director General of NIC

With Dr N.Vijayaditya superannuating on October 31st' 06 after an illustrious tenure as Director General, National Informatics Centre (NIC), Dr.B.K Gairola took over the reins of NIC as its new Director General on November 1st'06. Dr B.K Gairola, the new Director General has had a long stint till now as the Deputy Director General, in charge of many key areas and projects being implemented by NIC. He has always been regarded as a dynamic visionary known for his penchant for emphasizing the adoption of ICT at the very ground level itself. *http://home.nic.in*

New SDI project in Riyadh, Saudi Arabia

The envisioned urban SDI within the city of Riyadh should allow public and private agencies to share mapping data and to distribute data changes and updates in near real-time. The objective of this project is to enable users of the system to significantly reduce data redundancy cost and increase productivity through access to timely data. Agencies such as Saudi Post, Riyadh Water & Sewage, Arriyadh Development Authority, Riyadh City Hall and Saudi Telecom will share in real time the data that is of interest to specific participants to enhance their decision-making processes. *www.galdosinc.com/archives/267*

India's space agency moots manned mission to space

A "registration of intent" to send an Indian astronaut into space on a home-made space capsule using an Indian launch vehicle from Sriharikota in Andhra Pradesh was made before Indian Prime Minister Manmohan Singh in New Delhi. Indian Space Research Organisation (ISRO) Chairman G. Madhavan Nair made a brief slide presentation on the possibility of sending an Indian astronaut into space. A press release from the Prime Minister's Office on October 18 said: "The Prime Minister reviewed India's space and atomic energy programmes on October 17. Detailed presentations were made by the Chairman of the Space Commission and the Atomic Energy Commission... The possibility of the Department [of Space] developing a manned space programme was also discussed."

A small step towards sending an Indian astronaut into space on an indigenous space capsule will be taken in December 2006/January 2007 when a Polar Satellite Launch Vehicle from Sriharikota puts in orbit a recoverable satellite weighing around 550 kg. ISRO has named it Space Capsule Recovery Experiment. After the SRE stays in orbit for some days, ISRO scientists will bring it back in a planned manner so that it enters the atmosphere without burning up and touches down in the sea with parachutes and flotation systems. In orbit, the SRE will perform experiments in micro-gravity. The SRE will be an important step towards ISRO mastering the complex re-entry technology. *www.hindu.com*

Beijing to use three satellites for monitoring land use

Beijing will use three satellites to monitor land use as part of a crackdown on illegal real estate development activities, a local land official has said. Starting November, Beijing will investigate and prosecute major cases of illegal use of land, especially those that violate government plans or national industrial policies and those that infringe on farmers' legitimate rights, Beijing News reported Saturday, quoting An Jiasheng, Director of the Beijing Municipal Bureau of Land and Resources. Authorities can now avail themselves of satellite remote sensing technologies to discover and prevent the illegal use of land. *www.chinadaily.com.cn*

ISRO postpones Cartosat-2 launch to January

The Indian Space Research Organisation (ISRO) has postponed the launch of Cartosat-2, the advanced remote sensing satellite, to January due to problems faced during the testing phase. "There has been a delay in testing," an ISRO official said in Bangalore. "We have solved most of the problem". *www.hindustantimes.com*

Antrix Corp takes up direct overseas marketing of IRS data

Antrix Corporation, ISRO's commercial entity, has quietly taken up direct overseas marketing of Indian remote-sensing (IRS) data. Antrix's Executive Director K.R. Sridhara Murthi confirmed that his company now deals with its overseas markets for IRS imageries directly. The exclusive arrangement with Space Imaging (SI), its marketing ally since 1994, ceased automatically when Orbimage acquired the US-based SI earlier this year, Mr Murthi said. In January 2004, Antrix and SI extended a contract to market downlinks and imageries from ISRO's Resourcesat. Now, Antrix has worked out an understanding with GeoEye - the post-merger entity of SI and Orbimage-to service part of that older deal, according to Mr Murthi. *ww.thehindubusinessline.com*

UNEP unveils unique website

If a picture is worth a thousand words, digital satellite imagery could inspire tomes' worth of new environmental policies. At least that's the hope of the designers behind the 'Atlas of Our Changing Environment' (http://na.unep.net/digital_atlas2/google.php), a unique new Web site that uses a digital map framework to catalog damage inflicted on the Earth over the last few decades. "It is as simple as seeing is believing," said Patrick Joseph, an environmental journalist who writes a blog for the nonprofit Sierra Club. "You can read a million times over that the Amazon is being deforested, but satellite imagery really helps give you an idea of the scale on which it is happening." *http://news.nationalgeographic.com*

Kerala uses satellites for locating cannabis plantations

The Forest Department of the State of Kerala will soon use satellite imagery to pinpoint ganja (cannabis) plantations inside deep forests in the State. The department has sought the help of the Indian Remote Sensing Agency for this purpose, according to Chief Conservator of Forests (Vigilance) R.R. Shukla. Using remote sensing technology, satellites could pick up the distinct radiation emitted by ganja plantations to identify their exact location. Forest enforcers would use GPS to reach the identified areas, he said. *www.thehindu.com*

Better evaluation of crop output by using of remote sensing

Launched by the Ministry of Agriculture, FASAL is a program for Forecasting Agriculture output using Space, Agro-Meteorology and Land-based observations for better accuracy in crop production. Initially the program will cover two commodities — wheat and rice. Later it will be extended to all major crops. Crop output forecasts will be made one month before harvest, taking into account drought, floods, frost and such weather situations. "Recognizing the need for authentic and scientific forecast of crop production estimates, including cash crops, we have launched this scheme. It will be a scientific basis for crop estimates which are so far dependent on the four decade-old traditional crop cutting exercise by State governments at the block level." said Agriculture Secretary Radha Singh. *www.hindu.com*

ION GNSS 2006

26-29 September 2006, Texas, USA – A report

With activities in the GPS, GLONASS, and Galileo programs in full swing (although not always swinging in a forward direction), the ION Satellite Division's GNSS 2006 conference rolled into Texas for the first time in its nearly 20-year history. The world's oldest and largest GNSS conference, the 2006 event featured a Texas-sized line-up of nearly 290 paper presentations in 36 technical sessions — all synchronized to a fare-thee-well by ION's (in)famous and rigidly enforced traffic-lighting system for speakers. According to Todd Walter, the 2006 program chair, more than 570 abstracts were received and evaluated for this year's meeting.

Patrick Fenton, chief technology officer for NovAtel, Inc., received the Institute's coveted Johannes Kepler Award for "sustained and significant contributions to the development of satellite navigation." The Bradford W. Parkinson Award for the outstanding graduate student in the field of Global Navigation Satellite Systems (GNSS) went to Dr Julien Olivier.

ION is riding the wave of a growing familiarity with GPS as a household term and a burgeoning market for GNSS products. GNSS users number in the hundreds of millions already, and market studies predict annuals sales of more than 300 million receivers within five years. And the GNSS community is doing more than just talking about multiple satellite-based systems for positioning, navigation, and time. Even though the European GNSS system has only a single experimental spacecraft in orbit and is years away from completion, this year's conference included reports on development of Galileo receivers and the demonstration of several (albeit using signal simulators) in the exhibition. GLONASS technology also is appearing in a growing number of GNSS user equipment displayed at the conference.

"Interesting Times"

The Tuesday evening plenary session, moderated by Dr Per Enge of Stanford University, got the conference going with a high-level panel speaking under the theme, "We Live in Interesting Times."

Lt. Gen. Michael Hamel, commander of the Space and Missile Systems Center at Los Angeles Air Force Base, addressed the audience in the afterglow of a successful launch the day before of the second modernized Block IIR satellite. Hamel assured his audience that the GPS vision was been well taken care of by a program that is delivering performance better than specified in a "model of government/industry/military institutional cooperation." Rainer Grohe, executive director of the Galileo Joint Undertaking (GJU), provided an update on the current status and prospects for conclusion of negotiations for a 20-year concession contract with a consortium that will finishing building and operate the Galileo system. Sizing, managing, and allocating the financial risks — particularly of liability exposure for Galileo operations — remains a sticking point in the talks.

Carlene Stephens, curator of exhibitions about time at the Smithsonian Institution, described plans for a new exhibition, "Finding Time and Place: From Chronometers to GPS," that will open in 2010. The Smithsonian is partnering with the U.S. Naval Observatory, which provides the time standard for GPS and the Department of Defense in general. ION has provided seed money for the exhibition and is continuing to support its formative efforts. Kanwar Chadha, cofounder of SiRF Technology, continued his role of itinerant GNSS visionary by predicting that "geosearches" would become as common an activity as Google searches or Yahoo searches on the Internet. Development of new multifunctional platforms incorporating GNSS and other technologies will continue vigorously, according to Chadha.

Professor David Last, with an even-handed skewering of GNSS program foibles of every stripe, undoubtedly got off the best line of the evening in characterizing the interwoven GNSS "signals wrapped intimately around each other, yet never touching. It's safe sex in the frequency domain."

Brad Parkinson, ION's long-time Satellite Division chair and author of the quotation sent into space on Block IIR-M(2), closed out the evening's discussion with a call for a renewed investment in the GPS program and the expansion of the satellite constellation to 30 or more spacecraft. Constellation sustainment is the leading issue facing GPS, Parkinson said, and reprogramming of funds from GPS as a result of the better-than-expected performance of the satellites has made GPS supporters "victims of our own success."

On the exhibition floor

Nearly 90 exhibitors occupied more than 90 booth spaces and an additional 16 exhibit "islands." Fully operational Galileo receivers were demonstrated by a few companies, including NordNav, NovAtel, and Septentrio, and several — among them u-blox, Nemerix, others announced Galileo-capable equipment. Topcon announced survey equipment that the company says has tracked GPS, GLONASS, and the Galileo experimental signal on the GIOVE-A satellite launched last December.

Reflecting the general trend toward smaller form factors (plus anticipated market growth in portable devices incorporating GNSS, particularly mobile phones), many companies announced new GPS chips or chipsets.

CGSIC warms up the crowd

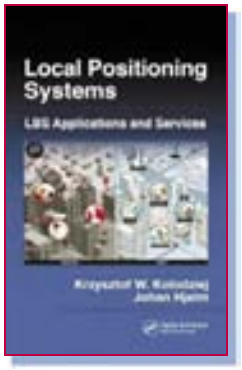
The Civil GPS Service Interface Committee (CGSIC), held on the two days before GNSS 2006, serves as a sort of warm-up act for ION's show. Some of the issues that inform and energize the ION conference often get their first hearing in CGSIC sessions.

A September 25 panel chaired by US GPS Industry Council executive director Mike Swiek and comprising representatives of three prominent GNSS vendors expressed their frustration and anxiety about the Galileo program's handling of commercial issues: Javad Ashjaee, CEO of Javad Navigation Systems; Tony Murfin, vice-president for business development at NovAtel, Inc.; Greg Turetzky, SiRF Technology's marketing director for new product technology and IP; Milton Vaughan, with Agrium Crop Production Services.

Their critique reiterated several key points: the specifications of the evolving Galileo signal and system design should be open and freely available for commercial development – preferably unlicensed and without charge or with only a nominal fee, including royalties on receiver chipsets. Further, that the political considerations of the Galileo public-private partnership or PPP should not force an unworkable business model on the system's development.
By Glen Gibbons. Reprinted with permission from The Institute of Navigation Fall 2006 Newsletter, Vol. 16, Number 3.

BOOK REVIEW

The new book, Local Positioning Systems, explores the different types of indoor, urban, and seamless indoor–outdoor location-aware applications, their requirements in terms of the infrastructure needed to support them, and the current limitations. The book gives detailed coverage on the most promising technologies, which are WLAN fingerprinting, RFID positioning, and indoor positioning with non-radiolocation positioning with infrared and ultrasound. The book also addresses the problems created by the lack of a common, integrated approach to universal positioning technologies, a lack which drives the current demand for stand-alone, vertically-integrated (hardware/software) solutions. The TV-GPS positioning technology that is featured in the book has the promise for enabling seamless indoor–outdoor positioning. LBS has been trying to become the "killer app" but privacy, indoor coverage, and market awareness are still pending issues. This book addresses all of these issues.



The chapters of the book describe the design and implementation of several positioning systems and real-world applications and show how these tools are being used to solve problems that can be related to the reader's own applications. This book is a result of 4 years of research that began at MIT. *visit the book's website at http://indoorLBS.com*

MARK YOUR CALENDAR

November 2006

Southeast Asian Geography Association Conference (NIE-SEAGA) 2006
28-30 November, Singapore
www.hsse.nie.edu.sg/staff/changch/seaga/seaga2006.htm

December 2006

The 6th International Workshop on Web and Wireless Geographical Information Systems
4-5 December, Hong Kong, China
chlorisyip@cuhk.edu.hk
www.dl.kuis.kyoto-u.ac.jp/w2gis06

Navigation USA 2006
5 - 6 December, San Jose, CA, USA
Ven@telematicsupdate.com
www.telematicsupdate.com/navigationUSA2006

Conference on Business
6-8 December, Trivandrum, India
bgisindia.info@gisesociety.org
www.gisesociety.org/bgisindia/

Laser Scanning and Digital Aerial Photography. Today and Tomorrow
6-8 December, Moscow, Russia
www.rsprs.ru/english.html

The GISnet 2
14-18 December, Vietnam

January 2007

Second Asia Pacific Conference for ESRI Users
18-19 January 2007
The Taj Palace Hotel
New Delhi
www.esriindia.com/apuc2007

National Technical Meeting "GNSS Benefiting Mankind"
January 22-24, 2007, San Diego, CA
www.ion.org

February 2007

Integrated Water Resource Management- (IWRM-2007)
5-7 February, Banglore, India
www.angelfire.com/planet/kerf/

Geomatica 2007: Geomatics for Development
12-16 February Havana, Cuba
www.informaticahabana.com/

Conference on 'Current Trends in Remote Sensing and GIS Applications'
15-17 February 2007, West Bengal, India
iitkgpconf2007@yahoo.com
amkb@gg.iitkgp.ernet.in

Current Trends in Remote Sensing and GIS Applications
15-17 February, West Bengal, India
iitkgpconf2007@yahoo.com

3rd Annual GIS Conference and Exhibition
19-21 February, Kuwait
www.gulfgis.com

March 2007

Munich Satellite Navigation Summit 2007
6 - 8 March 2007, Munich, Germany
info@munich-satellite-navigation-summit.org

April 2007

63rd Annual Meeting, Featuring New Bio Navigation Workshops
April 23-25, 2007, Cambridge, MA
www.ion.org

May 2007

Spatial Sciences Institute Biennial International Conference
14-18 May, Hobart, Tasmania, Australia
www.ssc2007.com

Intergraph 2007
21-24 May, Nashville, Tennessee, USA
http://www.intergraph2007.com

International Conference on Integrated Navigation System
28-30 May, Saint Petersburg, Russia
elprib-onti@telros.net

Geoinformation for Disaster Management (Gi4DM2007)
23-25 May, Toronto, Canada
junli@ryerson.ca

5th International Symposium on Mobile Mapping Technology
28-31 May, Padova, Italy
naser@geomatics.ucalgary.ca

June 2007

27th ESRI International User Conference
18-22 June San Diego, California USA
www.esri.com

Geoinformation Forum Japan
20-22 June, Pacifico Yokohama, Japan
geoforum@jsurvey.jp

July 2007

Cambridge Conference 2007
15-20 July Cambridge, UK
www.ordnancesurvey.co.uk/

September 25-28, 2007

ION GNSS 2007
September 25-28, 2007, Ft. Worth, TX
www.ion.org

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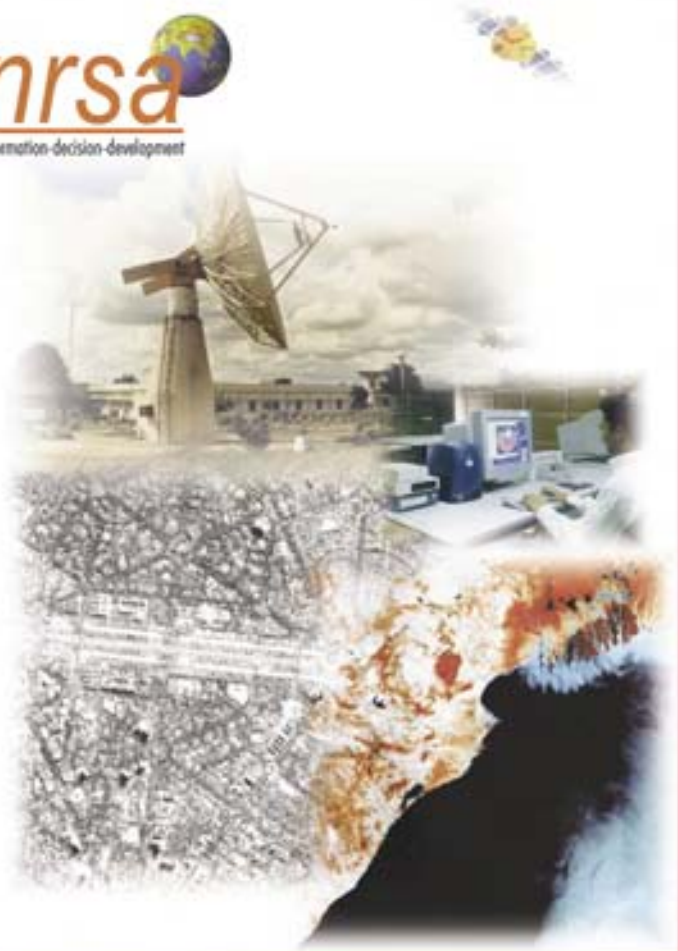
information-decision-development



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  - Forestry and ecology
  - Land use
  - Oceanography
  - Infrastructure planning
  - Urban Resource Information System
- **Disaster support and environment**
  - Support towards disaster mitigation
  - Environment impact assessment
- **Technology**
  - Deployment of satellite/ground based systems for data reception and processing from Indian satellites anywhere on globe
  - Satellite and aerial data services
- **Capacity building**
  - Training and education

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Department of Space

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