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Coordinates

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A MONTHLY MAGAZINE ON POSITIONING, NAVIGATION AND BEYOND

"

It is a time to talk about Asian satellite navigation system
– Gyu-In Jee

GNSS technology has evolved as a necessary utility – Michael Lindsay

Compared with Europe and USA, we still see a pioneering spirit in Asia – Flemming Lindholm

"

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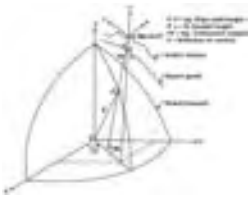
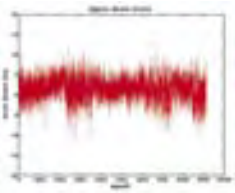
Articles





Columns

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Setting standards

Dr Manmohan Singh, Prime Minister of India has recently expressed concern over the 'decline in standards of research in universities including the IITs'.

He observed that China and South Korea have leapfrogged ahead of India in their mastery over science and technology. (Hindustan Times, October 7, 2006)

Interestingly, the Prime Minister chose to give the examples of China and South Korea to make his points. No harm, if that motivates.

However, what does harm, is the lack of standards, at least in the centres of educational and technological excellence, to measure their success.

In a similar context, it would be interesting to understand the research trends in geomatics in the country.

So should we only aim to keep pace with other countries?

Why not aspire for Nobel prizes? Why not for inventions?

And if that happens, the nation might like to embrace the academic arrogance with a sense of arrogance.

Bal Krishna, Editor
bal@mycoordinates.org

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The 'Namuru' Open GNSS Research Receiver: An update

The receiver was introduced in the Coordinates January 2006 edition and in this article we first provide a brief recap and then look at the latest developments and results from testing

Peter Mumford, Kevin Parkinson and Andrew Dempster

Development of a Field Programmable Gate Array (FPGA) based GNSS receiver platform has been underway at the University of New South Wales (UNSW) 'SNAP' lab since 2004. The receiver now has a name; 'Namuru' that means 'to see the way' in the language of the Eora people who inhabited an area around Sydney, including the UNSW campus, before the arrival of the British. The receiver was introduced in the Coordinates January 2006 edition and in this article we first provide a brief recap and then look at the latest developments and results from testing. But before launching into this, the question of why such a research and development platform is desirable must be answered.

GNSS research development platforms

Development platforms (or kits) come in two main flavors; 1) Application Specific Integrated Circuit (ASIC) based GNSS receivers with application firmware that can be modified to some extent and 2) Software based receivers that run on a PC, often with external Radio Frequency (RF) front end hardware. Type 1 kits include Mitel's GPS Architect, the Signav MG5021 and the uBlox Antaris SCKit. These kits include application firmware that can be modified, and target hardware based on ASIC chips that are typically small, low power, inexpensive OEM boards. Note that the GPS Architect is no longer supported or available but is important as it has become some sort of standard reference design. Type 2 kits include offerings from NordNav and Accord that provide USB RF front-end hardware and software receivers that run in real-time on a PC, and Data Fusion Corporation that offers a Matlab solution that does not run in real-time. These can provide great flexibility in receiver design, but do not map very well to current portable devices due to high processing demands. This is due to the fact that while an ASIC GNSS baseband processor provides parallel signal processing, a general purpose processor such as an Intel Pentium 4 must do this work in series. Of course, as processing capacity increases and power consumption decreases this becomes less of an issue and eventually the flexibility of the software approach will be available on portable devices. The Namuru receiver falls between these two types (I'll call it type 3) and therefore can fill a gap, providing more design flexibility then type 1 platforms, but not requiring the high power processor of type 2 platforms. Designs realized on type 3 platforms potentially have a better defined migration path from development to commercial product than developments on type 2 platforms.

In addition, the Namuru platform is an open source project, where all aspects of the design are freely available.

Research potentials for Namuru

Many possibilities have been identified for the Namuru platform, and the list can extend as far as your imagination permits. Broad areas of activity include:

- developing GNSS IP for integration with other functions in an FPGA-based device
- rapid-prototyping new ideas in GNSS receiver design
- GNSS teaching

Receiver design research streams include:

- Weak signal and multi-path mitigation techniques
- Investigating new signals (Galileo, Modernized GPS…)
- Interference
- INS/GNSS integration
- Bi-Static radar

Fig. 1, Namuru prototype circuit board

Namuru Overview

The platform has three components; circuit board, baseband processor design and application firmware. The prototype circuit board has been built and verified, and a new board is currently being designed. The prototype board includes:

- L1 RF front end based around the Zarlink GP2015 chip
- Altera, 'Cyclone' 2C35 FPGA chip (35000 LE's)
- SRAM, serial flash and non-volatile memory
- JTAG interface, two serial ports, one Ethernet port, general purpose I/O
- 3 axis accelerometer

The new board (Namuru V2) will be a short production run and will include:

- Two front ends – 2 x L1 or L1 + L2
- Altera 'Cyclone' 2C50 FPGA chip (50000 LE's)
- Large DRAM, serial flash and non-volatile memory
- USB 2, two serial ports, JTAG interface and general purpose I/O
- 3 axis accelerometer, 3 axis gyro

The baseband processor is realized on the FPGA chip and is written in Verilog and VHDL. It nominally has 12 channels, and is traditional in design. It attaches to an Altera NiosII soft-core processor (also on the FPGA chip) as a memory-mapped peripheral. More details on the design can be found in the Jan 06 Coordinates article and on the Namuru website. The application firmware controls the baseband processor, collecting measurements, forming pseudoranges, calculating the position/velocity/time (PVT) solution and communicating with the user. The firmware runs on a NiosII processor and is developed using Altera's NiosII integrated development environment. Currently the application firmware is a port of the Mitel GPS Architect. The GPS Architect was available for some time as a development kit, but is no longer supported or available. Original GPS Architect license holders can distribute binaries without royalties, but the source code is restricted. Open source solutions are being investigated, and one obvious option is to port the firmware developed under the Open Source GNSS GPL-GPS project to the Namuru receiver.

Testing

For testing purposes, the Namuru and a reference receiver where connected to the same RF source via a splitter and data was collected and analyzed under static and dynamic scenarios. The reference receiver was a Signav MG5001 running the GPS Architect firmware, providing a very similar platform for confirming the correct operation and performance of the Namuru receiver. For static testing, the RF source was real GPS signals from an antenna mounted on the roof of the Electrical Engineering Building at UNSW. For dynamic testing, the signal source was a Spirent GSS6560 Multi-Channel GPS simulator, running a number of scenarios, including simulating an airplane flying round in circles at a fixed height and speed. Results from one static test and the airplane scenario are presented here.

Fig. 3, Dynamic test setup.

	Mean error (m)			Standard deviation error			Max error (m)		
	North	East	Down	North	East	Down	North	East	Down
Signav	-0.22	-0.27	3.88	3.77	5.77	10.44	22.10	27.75	77.60
Namuru	-0.42	-0.35	4.46	3.46	5.14	9.72	16.00	25.66	78.85

Table 1. Static test statistics, 2.3 hours duration.

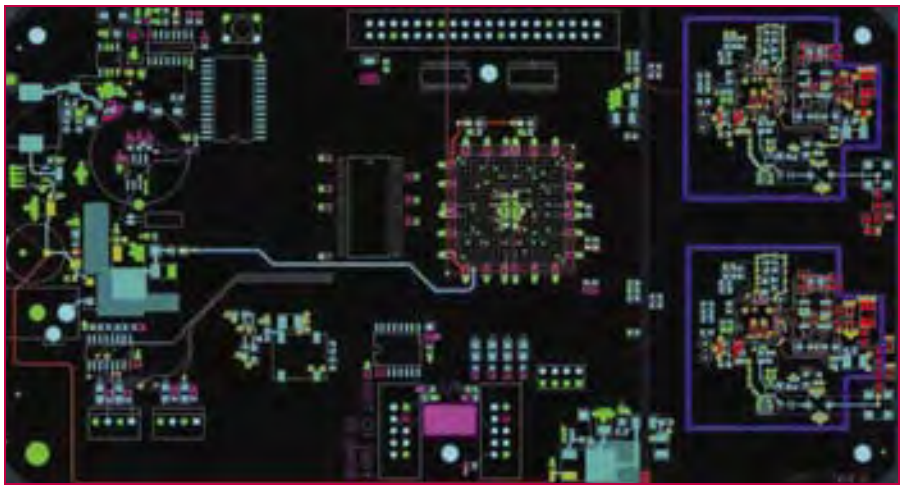

Fig. 2, Namuru V2 circuit board layout

Static test

The static test provides a basic feel for the overall performance of the receiver once it has acquired satellite signals and providing a PVT solution. The statistics of the error from the ground truth provide an indication of the position performance of a receiver. Scatter and height time-series plots, along with a table of statistics are provided for both the Namuru (in blue) and Signav MG5001 (in red) receivers for a static test of around 2 hours duration.

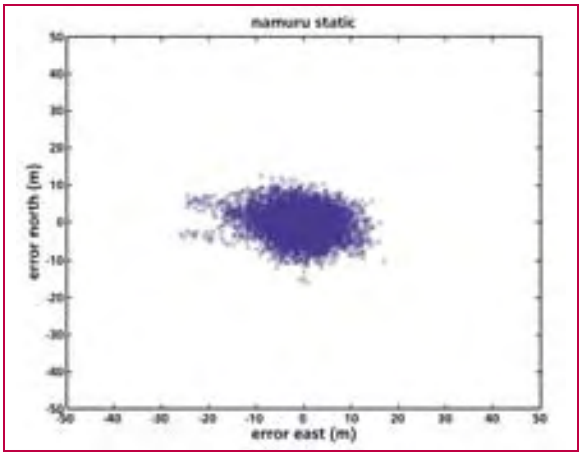

Fig. 4, Namuru static test scatter plot.

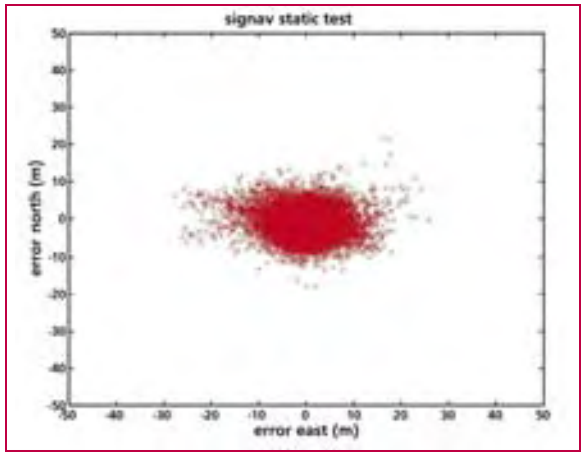

Fig. 5, MG5001 static test scatter plot.

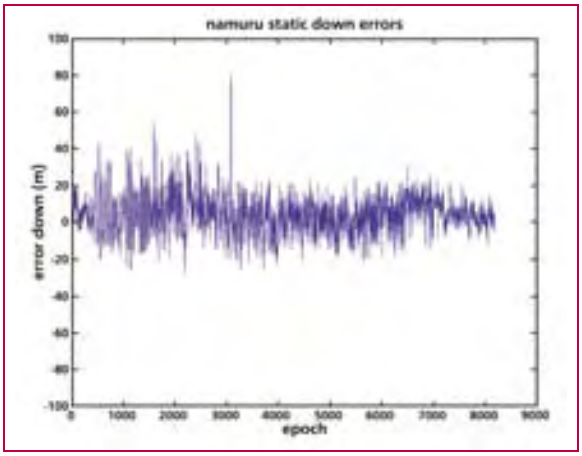

Fig. 6, Namuru static test down error time series.

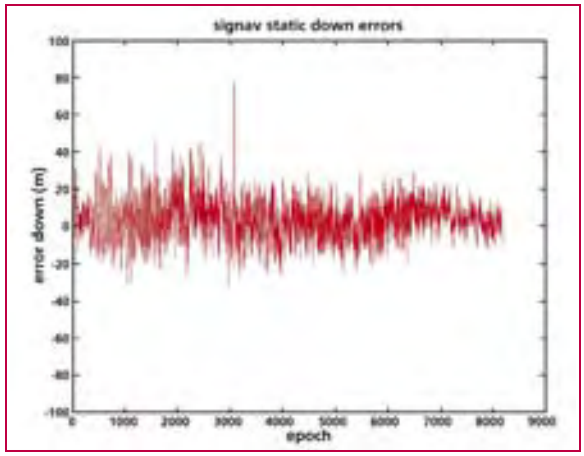

Fig. 7, MG5001 static test down error time series.

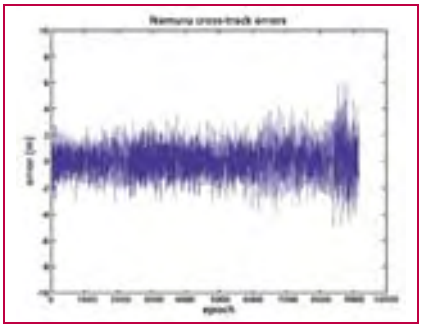

Fig. 8 Namuru cross-track errors, dynamic test.

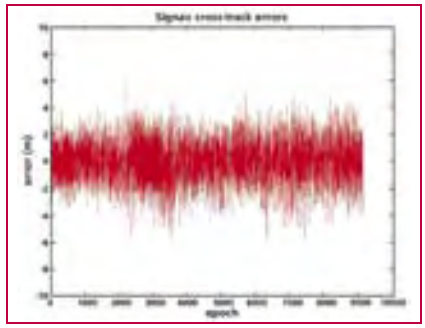

Fig. 9 MG5001 cross-track errors, dynamic test.

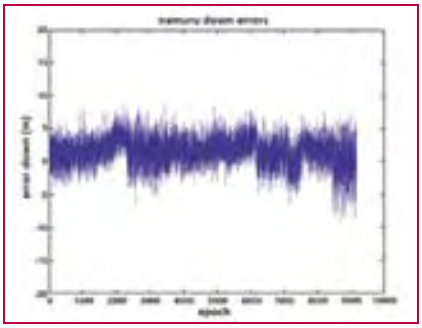

Fig. 10, Namuru down errors, dynamic test

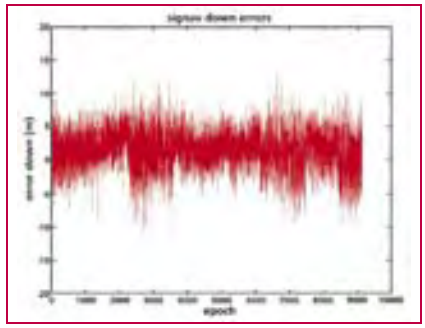

Fig.11 MG5001 down errors, dynamic test

The message hevre is that there is no significant difference between the two receivers performance for this test.

Dynamic test

The dynamic test is designed to exercise the receiver tracking loops. The airplane scenario is convenient as it is easy to calculate cross-track and height errors, and provides a constant acceleration of around 1.6G. Time series plots for cross-track and height errors are shown, as well as a table of statistics.

Conclusion

The Namuru project has reached a significant milestone – we have a proven circuit board, reference baseband design and application software. The performance of the receiver during static and dynamic tests has been shown to be comparable

	Down errors (m)			Cross-track errors (m)		
	mean	std	max	mean	std	max
Signav	1.57	2.86	13.12	-0.007	1.47	6.07
Namuru	1.49	2.07	8.59	0.085	1.07	6.02

Table 2. Dynamic test statistics, 2.5 hours duration.

to a well established receiver. A new circuit board is on the way, offering dual front ends, USB 2, a bigger FPGA part and more memory. The main hitch is the application software, and plans are underway to tackle this issue.

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Everest returns to India (1830 to 1839)

After his extended sick leave Everest reached India again in October 1830, taking with him various items of equipment that represented the state of the art at that time. In particular was the set of compensating bars and he made the first use of these on the Calcutta baseline in 1831-2. Why Calcutta when that was a very long way from the meridian arc?

During his absence on leave Joseph Olliver had observed a longitudinal series from near Sironj on the Great Arc to within about 100 miles of Calcutta. With his headquarters in Calcutta and the added incentive to try out the new baseline equipment, Everest decided to use his new equipment and to close out this longitudinal arc at the same time and immediately sought out a likely site.

As soon as the catch-up administrative work that had amassed in his absence was on the way to being cleared he set out to plan this new baseline. It took 45 days and nearly 100 personnel to complete the nearly 34 000 feet. The value calculated through the 671 miles from Sironj agreed with the measured value to 7 ft 11 inches. The base itself was considered to be good to little more than 1 inch.

In late 1832 Everest moved his headquarters from Calcutta to Dehra Dun where it remains to this day. As will be seen later, however, he also established a personal estate in the hills above Mussoorie. By then he was thinking of a control baseline on the meridian arc and seeking a suitable site near Dehra Dun. However before being able to do that it was necessary to triangulate across the flat Doab region from Agra northwards to Delhi and then on towards Dehra Dun. It was so flat that in one stretch of 160 miles there was only a rise of some 268 feet. It was 1835 when it became possible to measure the Dehra base and complete the meridian chain from Sironj. Measured twice, this base was nearly 39 200 feet long and the repeated measure agreed to 2.4 inches with the first. Thus with the Calcutta and Dehra baselines proved the worth of the compensating bars.

During extended periods Everest was again laid low with illness but struggled onwards both on the Arc and with minor series. He had new instrumentation in the form of two astronomical circles, but these caused some problems. He had a workshop at his Estate in the hills and there spent much time supervising changes to these instruments until he was happy with their operation.

In 1837 he was back on the meridian arc – no doubt his first love and one he intended to see through to completion come what may. The various other series underway at that time were essential to the overall picture very much took a back seat.

Towards the end of 1838, after over 30 years in India – albeit interrupted for sick leaves- Everest felt that he was entitled to some suitable recognition for all the effort he had put into the Survey of India. He had noticed how many military personnel had achieved honours and felt that his achieved outweighed many of them and so he submitted a memorandum in effect asking for the award of a decoration – a CB (Companion of the Order of the Bath) was what he had in mind. At that time he was to be unlucky as in a later similar request.

During all this period there were intermittent bouts of fever and other ailments but he pulled through all of them. At one period he was so ill that he was bled to fainting by the use of 1000 leeches and the application of 30 or more cupping glasses. Both were means of extracting "bad" blood and were, at the time, though to be an appropriate treatment. A cupping glass was a heated vessel that was applied to the skin as an alternative to leeches to draw out blood. Both sound quite barbaric.

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"GNSS technology has evolved as a necessary utility"

Says Michael Lindsay, Chief Operating Officer, NavCom Technology while sharing his observations on NavCom' vision, expertise and trends in technological innovations

What is so unique about NAVCOM? Tell us about NavCom.

NavCom is the only company in the high precision GNSS products business that owns the core intellectual property behind both GNSS receivers and a Global Satellite Based Augmentation Service (GSBAS). NavCom's ability to tightly couple the design of its GNSS receivers and its StarFire™ GSBAS service allows us to provide innovative solutions to the marketplace that enhance the quality and competitiveness of our customers' solutions. One example of this is our RTK Extend™ feature that is unique in the market. By alleviating the constraints of local radio propagation concerns, RTK Extend allows Surveyors, for example, to complete their missions without interruption despite potentially inconsistent radio coverage, thus increasing productivity in the field.

Tell us about the vision and expertise of NavCom

NavCom provides an extensive range of GNSS receivers as well as our StarFire GSBAS service to the high precision positioning and navigation markets. Our close relationship with our parent company, John Deere, has translated into substantial growth and innovation within the Precision Agricultural marketplace by providing a number of advanced products and services that have revolutionized farming practices and substantially enhanced farm productivity. Our vision is to replicate this successful formula in other market sectors such as Construction, Land Survey, Offshore Exploration and others by partnering with John Deere and other companies that have the same goals and aspirations as ourselves in delivering customer solutions which provide a sustainable competitive advantage.

What key products and services do you offer?

NavCom offers an extensive range of high precision GNSS receivers as well as the StarFire™ Network, the world's first SBAS providing base station-free decimeter accuracy across the globe. Along with being a highly cost-effective solution, the system enables a broad range of user benefits and flexibility options from one centimeter to decimeter real-time positioning up to millimeter positioning with post processing. In addition, NavCom provides consulting services in the fields of precise positioning, wireless communication and robotics.

What market trends do you see in the field of precision GPS and wireless communication?

GNSS technology has evolved as a necessary utility in today's world as a result of the fundamental productivity improvements that it enables, therefore, its adoption is accelerating dramatically. Although this is most evident in the lower precision market segments such as car navigation and outdoor recreational activities, the adoption rate in high precision applications is also accelerating. GPS is routinely used in land, sea and aerial survey applications, and it is also very common to see it used in GIS/mapping applications as municipalities are committed to building ever more accurate geo-spatial databases of their assets. Finally in the area of machine control, whether fully autonomous or guidance assisted, GPS is making dramatic changes to the way that routine work is performed.

The field of wireless communications is undergoing equally dramatic changes with the advent of many new and feature rich services that are enabling advanced connectivity and communication on an unprecedented scale. In fact by deploying wireless technologies, countries such as India are bypassing many earlier generations of communications technology and rapidly deploying a more updated communications infrastructure, resulting in significant quality of life changes for their populations with a corresponding beneficial effect on their economies.

Which direction is the technology heading in terms of innovations and applications?

It is probably not too trite to say…smaller, cheaper, faster and more features. With all electronics technologies there is an endless challenge to do more with less, and GNSS is no exception. So I see continued technical innovation aimed at improving the performance of GNSS in signal acquisition, signal tracking, multi-path mitigation and interference rejection while at the same time reducing size, power consumption and cost and adding support for more GNSS constellations (Galileo, Glonass, IRNSS etc.)

In the applications space, the fairly recent adoption of GNSS technology

Michael Lindsay is the Chief Operating Officer of NavCom Technology, Inc., a John Deere Company, where he has responsibility for developing NavCom's precise positioning and navigation business worldwide. Prior to joining NavCom, he worked in the terrestrial and satellite based telecommunications industry for a number of companies including STM Wireless, Dowty Communications and Case Communications. Born and educated in the United Kingdom, Michael holds a BA (Hons.) degree in Economics and Financial Control from the University of Lancaster in the United Kingdom and is an Associate member of the Institute of Chartered Accountants in England and Wales. Michael has worked as a senior executive in a number of roles for public, private and venture backed start up companies in both the UK and USA and he has extensive experience in building, developing and marketing businesses both domestically and internationally.

in Agriculture has proved a major factor in enhancing farm economic performance. I see this continuing to grow rapidly, and as the productivity benefits are widely publicized, the adoption of this technology in other market segments will also accelerate. In the USA we are already seeing extensive and rapid deployment of GNSS technology in the Construction industry with systems that provide automation of earth moving equipment. Although most of today's uses of GNSS technology for robotic applications are within the military sector, we see significant opportunity for such technologies in commercial non-military environments whereby GNSS receivers will be a large part of the localization and navigation solution for non-military robotic vehicles.

How do you see the market in the developing world in general or in India in particular?

As I noted earlier, the market for high precision GNSS technology is growing rapidly and we expect that to continue for a while. On a global basis, we are still at the early part of the adoption curve for this technology and there are many exciting applications that remain unexplored. As the performance of GNSS receivers increases, as we add more GNSS constellations and as the cost of GNSS receivers comes down, I expect the high precision market to grow dramatically. In India, while the use of GNSS technology is still at an early stage, the implementation of the GAGAN-TDS augmentation system and success of its preliminary tests confirm the commitment and acceptance of the technology and point to much more growth to come and many applications to explore. We are excited by the prospects for the Indian market and glad to be able to participate through both collaborative and newly defined opportunities.

Is there any basic difference in approach and response in between the developing world and the developed world?

It is really a question of application maturity. In the developed world, there is more infrastructure in place and as a result, the usefulness of GNSS technology is amplified by the more immediate effect it has on multiple areas of life. In the developing world, GNSS technology is primarily used to build infrastructure that is needed and as such the amplification factors will come at a later stage. However, as with wireless communications, the developing economies have the opportunity to bypass some of the interim systems and technologies already adopted and later discarded by the developed world. By doing this, the developing world will leap straight to state-of-the-art systems.

Many feel that India is a price sensitive market and that at times it is difficult to make inroads in such a market. Any comments?

All markets are price sensitive markets. We live in a global economy and all products and services whether technology based or otherwise, have to prove their worth to the consumer. For us, it is a simple equation. We must demonstrate to our customers that their investment in our products and services will be paid back at a high rate of return. If we do this, we will succeed in the market. If not, we will fail. This same basic rule applies to all the markets we play in. The only differences come in the nuances added by local conditions. Thus in India, for instance, where labor costs are lower than in say the USA, it may take a little longer for labor-intensive applications to adopt GNSS technologies if the only perceived benefit these technologies provide are lower labor costs. However, where the deployment of GNSS is a core enabler of applications that would otherwise be very difficult or impossible without GNSS, then the adoption rate in India is likely to be similar to the rest of the world.

How do you see the emergence of alternative space based positioning systems like Galileo?

Galileo, IRNSS and other similar systems are welcome additions to the GNSS sector. By adding robustness and density of coverage to the constellations available for use in positioning and navigation, these added systems make all of our lives better and provide stronger assurances that the tools we have grown to rely on as part of everyday life, will be there when we need them.

'Work together for managing disasters'

"No one can hold back the power of nature. But globally we have developed the science and technology to understand these phenomena to effectively plan and mitigate. And I am convinced that only by working together can we face natural disasters effectively and minimize the losses," exhorted Irwin Itzkovitch, Assistant Deputy Minister, Earth Sciences Sector, Natural Resources Canada.

Presenting the keynote address after inaugurating the Second International Symposium on Geospatial Information for Disaster Management (Gi4DM) held in Goa, India during 25-26 September, Itzkovitch detailed the technological expertise Canada possesses in effectively tackling the disasters – be it prevention of floods, seismic monitoring, tsunami monitoring and warning systems or storm surges management – and said that Canada is ready to share its expertise with the world. There is a big difference between the developed and developing world when it comes to the effects of natural disasters. While there is an enormous loss of property with little loss to life in the developed world, in developing countries there is a tremendous loss to life, Itzkovitch said.

Earlier, Dr Shailesh Nayak, in his opening remarks, said India is witnessing strange phenomena like floods in totally unexpected places like Rajasthan and cyclones on the Arabian coast. It is necessary to understand this changing weather pattern. Satellites, both weather and remote sensing, have sophisticated equipment to monitor disasters and develop predictive models for managing disasters.

Briefing about the activities of ISPRS TC-4, Working Group 8, Sisi Zlatanova, Chair, WG IV/8 said her group is working with various international organizations like FIG, OGC, ICA, ICT for Environment and AGILE of Europe and added that it is essential to have 100% cooperation and integration of different technologies during emergencies.

AS Rajawat, organizing secretary, Gi4DM proposed the vote of thanks.

Dr Shailesh Nayak, Director, Indian National Centre for Ocean Information Services (INCOIS), made a presentation on the Early Warning System for Tsunami and Storm Surge of India, which is being set up at INCOIS, Hyderabad. He said the system includes an exhaustive network of tidal stations, bottom pressure recorders, broadband sensors across the country and is coupled with a strong communication network. Once this is operational, the system would be able to give out a tsunami alert within half-an-hour of the occurrence of earthquake in the region. The system is expected to get operational by September, 2007, he said.

Geospatial Databases for Sustainable Development

"Create synergy between the science and application of geospatial databases," exhorted PS Goel, Secretary, Ministry of Earth Sciences. Delivering the keynote address after inaugurating the four-day International Symposium on Geospatial Databases for Sustainable Development held in Goa during September 27-30, Dr Goel, who has done commendable work as a space scientist until recently, said that his first observation after coming from space to earth is that when people talk about sustainable development, it is imperative they talk about issues relating to earth. India is looking for a database for development. But the issue is not just about the creation of databases but to make them available to the right person at the right time. Goel said it is equally important to develop common standards to make different systems interoperable to facilitate the exchange of data and to have some agency that can take the responsibility of maintaining the databases, like the NSDI. Apart from these ingredients, Goel said space is the basic enabler of spatial data, in which India has made significant capacity.

Earlier, R Navalgund, Director, Space Applications Centre, Ahmedabad, welcomed the guests and the delegates and made his opening remarks. Briefing on the activities of SAC, Navalgund said SAC is a place where a host of space scientists, physicists, geologists, anthropologists, biologists and even social scientists work hand-in-hand for the benefit of society vis-à-vis space. The organization is helping in capacity building, which is a vital requirement in a developing country like India, he added.

Detailing the activities of ISPRS TC-IV, Dr Shailesh Nayak, its president, said that data is being generated manifold, but the issue of concern is updating the same. Briefing the delegates over the activities of ISRS, Dr Radhakrishnan, Director, NRSA said the members are doing extremely good work in promoting remote sensing among the student and scientific community of their respective regions. Industry too is working for the broader application of remote sensing beyond the government arena.

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National Forest Cover Assessment

Forest Survey of India has completed nine biennial assessments, the latest being the State of Forest Report, 2003

Alok Saxena

Space borne Remote Sensing technology has proved to be an important tool in rapid assessment and mapping of natural resources over a large area with reasonable accuracy. Application of satellite data in assessment of forest cover in India was first demonstrated by the National Remote Sensing Agency (NRSA), Department of Space, Hyderabad in 1985 when it came out with first ever estimate of country's forest cover based on interpretation of Landsat (an American Satellite) data. Almost simultaneously, Forest Survey of India (FSI), Ministry of Environment & Forests started interpretation of satellite data for assessment of forest cover of the country and published country's forest cover in 1987 using Landsat (MSS) data, the most reliable data at the time.

Thereafter, FSI was mandated to assess and map the forest cover of the country on a two-year cycle and monitor the changes in forest cover during the intervening period. Since then FSI is assessing and mapping forest cover of the country using satellite data on a two-year cycle. Results of these assessments are published in the form of a biennial report- State of Forest Report (SFR). So far FSI has completed nine biennial assessments, the latest being the State of Forest Report, 2003. During this period, there had been a rapid development in satellite-based technology and also in related high-end hardware and software for digital image processing of satellite data. FSI kept pace with these developments by continuously updating its methodology to suit the new developments. Each assessment had improvement over the previous one and some unique features. Following is a brief account of special features of each assessment made by FSI since 1987 is given below:

SFR 1987

The first satellite data based assessment of forest cover made by FSI was published as the State of Forest Report 1987. It was based on the visual interpretation of Landsat Multi Spectral Sensor (MSS) satellite data with spatial resolution of 80m x 80m pertaining to the period 1981-83. The scale of interpretation was 1:1 million and cartographic limit of mapping was 400 ha.

Thus patches of forest cover more than 400 ha only could be delineated. Interpretation was followed by extensive ground truthing. The forests were classified into dense forest (crown cover of more than 40%) and open forests (crown cover between 10-40%). Mangroves were delineated as a separate class. Degraded forests having crown cover of less than 10% were classified as scrub (a non-forest category). The forest cover of the country was estimated to be 640,819 km^2 which was 19.52% of the country's geographic area.

SFR 1989

The second assessment was based on the satellite data of Thematic Mapper (TM) of Landsat that had a resolution of 30m x 30m. The data period was 1985-87. Technique of interpretation remained visual but the scale of interpretation improved to 1:250, 000. As a result cartographic limitation improved to 25 ha and forest cover could be estimated with better accuracy. As per SFR 1989, forest cover of the country was 640,134 km^2 (19.47% of country's geographic area).

SFR 1991

The third assessment was based on satellite data pertaining to the period 1987-89. The sensor of the satellite, its resolution, method of interpretation and cartographic scale were the same as

used in the 1989 assessment. However, there were some improvements in this assessment over the previous ones. Geographic area figures of the country, states and districts were revised based on figures received from the Survey of India and accordingly area under forest cover was computed. Another important feature of this assessment was that for the first time FSI provided District-wise forest cover of the country. The forest cover was estimated to be 639,182 km^2 (19.44% of the geographic area). During this period, an important development, at FSI was the procurement of the then state of art computer (VAX-11/780) in 1989 which made the beginning

25 and counting

Forest Survey of India which was created in June 1981 as a successor to Pre Investment Survey of Forest Resources (PISFR) is celebrating its Silver Jubilee in 2006. As par of the Silver Jubilee celebrations of FSI, a number of activities were planed like publication of Souvenir and other reports, production of a short film, honoring former senior officers of PIS and FSI and staff of FSI etc. The Silver Jubilee celebrations culminated on September 28 & 29, 2006 by organizing a two-day workshop on 'Review of Geomatics in Forest Resource Assessment to mark the occasion.

The workshop was inaugurated by Shri C L Bhatia, former Inspector General of Forests, & former chief Coordinator PIS. Shri C L Bhatia highlighted FSI's illustrious history and praised the efforts made by FSI in the field of forest resource assessment of the country. Shri J C Kala, Director General of Forests & Special Secretary, Government of India, speaking at the inaugural ceremony, said that FSI is the premier institution today in the field of forest resource assessment and can be compared with the best in the world.Dr. Devendra Pandey, Director General, FSI while welcoming the delegates outlined FSI's future plans and highlighted its achievements. He emphasized the importance of mapping and measuring forests

for their management. The Vote of Thanks was delivered by Shri. Saibal Dasgupta, Joint Director, FSI.

A short film made by FSI titled 'Activities of Forest Survey of India' was released as part of the celebration. The 20-minute film showcased FSI's record and profile. A visually appealing slideshow showcasing FSI activities & profile was also displayed. A number of publications including Silver Jubilee 'Souvenir, 'Forest Atlas',' Van Darpan' and 'FSI Project Overview' were released ceremonially at the function. In the afternoon session, the senior forest officers, who have had association with FSI, regaled the audience with their experiences. In the technical sessions, representatives of FSI, Space Application Centre, Ahmedabad, National Remote Sensing Agency, Hyderabad and State Forest Departments of Andhra Pradesh, Tamil Nadu, Karnataka, Orissa, Chhattisgarh, Gujarat, Punjab etc. presented their respective work in the field of use of Geomatics in forestry. The two day workshop culminated on the 29th of September, 06 after the session on panel discussion and recommendations.

of digital interpretation of satellite data. Digital interpretation has the advantage of overcoming subjectivity prevalent in visual interpretation. In order to develop the technique of digital interpretation of satellite data, a full-fledged separate unit called National forest Management Centre (NFDMC) within FSI, Dehradun was created in 1989.

SFR 1993

The fourth assessment marked a modest beginning in the field of digital interpretation when forest cover of some parts of Bihar, Himachal Pradesh, Madhya Pradesh and Uttar Pradesh was assessed digitally. In this assessment, satellite data of Landsat-TM for the period 1989-91 was used and scale of mapping was 1:250,000scale. As per this assessment, forest cover of the country was 640,107 km^2 (19.47% of its geographic area).

SFR 1995

Though the method of interpretation and scale of mapping remained same in this cycle, but the most significant feature of this assessment was the use of Indian Remote Sensing Satellite (IRS-1B) data for the period 1991-93. While data pertaining to most of the States was interpreted visually, data of Madhya Pradesh, Maharashtra (Part) and Orissa (Part) was processed digitally. This report showed forest cover of the country as 639,600 km^2 (19.45% of the geographic area). This report also contained information on growing stock (above ground wood volume) of country's forests and its annual increment. Country's total wood volume was estimated to be 4741 million m^3 and volume per ha was estimated as 74.42 m^3. The annual increment of India's forests was estimated at 87.62 million m^3.

SFR 1997

It was based on IRS-1B (LISS-II) data pertaining to the period 1993-95. Satellite data of Madhya Pradesh and Maharashtra was interpreted digitally while for other States visual interpretation was done. The scale of mapping remained 1:250,000 scale. As per this report, forest cover of the country was 633,397 km^2 (19.27% of the geographic area). Salient feature of this report was that for the first time FSI provided forest cover information on Hill districts and Tribal districts. This report also provided revised estimates of forest cover of previous assessments after adjusting corrections due to interpretational errors or due to other reasons. Another very significant field-inventory based finding of this report was that in Haryana State, wood volume of areas outside forest was about seven times higher than that inside forest areas.

SFR 1999

There was a significant improvement in the infrastructure in NFDMC due to procurement of high-end workstations and state of art software for digital image processing. Due to this, satellite data of fourteen States/ Union Territories (UTs) could be interpreted digitally. The data for the remaining States/UTs was interpreted visually on 1:250,000 scale. Though digital interpretation was done on

Satellite Data for Forest Cover Assessments from 1987 to 2001

Assessment and Year	Data Period	Sensor	Data Form	Spatial Resolution	Scale of Interpretation	Forest Cover* in km²
I 1987	1981-83	Landsat - MSS	Hard Copy FCC	80 m	1:1 million	640,819 (19.49%)**
II 1989	1985-87	Landsat - TM	Hard Copy FCC	30 m	1:250,000	638,804 (19.43%)
III 1991	1987-89	Landsat - TM	Hard Copy FCC	30 m	1:250,000	639,364 (19.45%)
IV 1993	1989-91	Landsat - TM	Hard Copy FCC	30 m	1:250,000	639,386 (19.45%)
V 1995	1991-93	IRS-1B LISS II	Hard Copy FCC	36.25 m	1:250,000	638,879 (19.43%)
VI 1997	1993-95	IRS-1B LISS II	Hard Copy FCC	36.25 m	1:250,000	633,397 (19.27%)
VII 1999	1996-98	IRS-1C/1D LISS III	Hard Copy FCC	23.5 m	1:250,000	637,293 (19.39%)
VIII 2001	2000	IRS-1C/1D LISS III	Digital	23.5 m	1:50,000	675,538 (20.55%)
VIII 2003	2002	IRS-1D LISS III	Digital	23.5 m	1:50,000	678,333 (20.64%)

** Revised figures of forest cover from 1989 to 1995 are given after incorporation of interpretational corrections.*
***Figures in parenthesis are percent of geographic area.*

1:50,000 scale, the interpretation was transformed to 1:250,000 scale to make the data comparable with the previous assessment for detecting real changes. Satellite data of LISS-II of IRS-1B and LISS-III of IRS-1C & 1D for the period 1996-98 was used in this assessment. Forest cover of the country was assessed to be 637,293 km² (19.39% of the geographic area). The report provided not only forest cover in Hill and Tribal districts but also valuable information on forest plantations raised since 1951 to 1999, land use in the country, forests in villages, area under Joint Forest Management (JFM) and Protected Areas, mining in forest areas and shifting cultivation in North-East region. During this period, three large States namely Bihar, Madhya Pradesh and Uttar Pradesh were bifurcated to constitute three new States namely Jharkhand, Chhattisgarh and Uttaranchal. FSI issued a supplementary to SFR, 1999 providing information on these six newly carved States.

SFR 2001

With the availability of efficient digital image processing software and powerful workstations, and capacity building of technical manpower of FSI, it became possible for FSI to completely switch over to digital interpretation of satellite data. Consequently, FSI interpreted the satellite data of the entire country (LISS-III of IRS-1C & 1D of the year 2000) through digital image processing at 1:50,000 scale during this cycle. The improvement in the methodology led to generation of a new baseline data on forest cover as for the first time FSI could map forested areas down to 1 ha while in the previous assessments this limit was 25 ha. As per SFR 2001, the forest cover of the country has been assessed to be 675,538 km² (20.55% of the geographic area). In addition, FSI also estimated tree cover which were less than 1 ha in extent or which could not be captured in the satellite data. The area under tree cover was estimated to be 81,472 km² (2.48% of geographic area). Forest and tree cover of the country thus was estimated to be 757,010 km² (23.03% of the geographic area). Mangrove cover though assessed separately, were merged with the corresponding density classes of the forest cover.

SFR 2003

This has been the latest series, where satellite data of LISS III of IRS-1D for the period 2002 was interpreted digitally. The significant features of this report were (i) introduction of an additional density class by bifurcating dense forest (with more than 40% canopy density) into Moderately Dense Forest (canopy density between 40% and 70%) and Very Dense Forest (canopy density of more than 70%), (ii) use of high resolution data in tree cover estimation and (iii) estimation of growing stock of the country's forests. The forest cover of the country was assessed to be 678,333 km² (20.64% of geographic area), tree cover was estimated as 99,896 km² (3.04% of geographic area) and total forest and tree cover was thus estimated to be 778,299 km² (23.57% of geographic area). The total growing stock of the wood in the country was estimated to be 6,414 million m³ that includes 4,782 m³ inside forest area and 1,632 m³ of TOF (Trees outside Forests). The average growing stock per ha of recorded forest area worked out to be 61.72 m³. A summary of the forest cover assessments made by the FSI since 1987 is given in the following table, which provides the synoptic view of the technological and methodological changes.

FSI is currently working on the tenth cycle of forest cover assessment which will be published as SFR 2005. For this assessment, FSI is using LISS-III data of IRS- P6. In addition, FSI is also procuring high resolution data of LISS-IV (resolution of 5.8m x 5.8m) for remote areas where accessibility is a problem and also for areas vulnerable to shifting cultivation, encroachments, mining etc., FSI is also carrying out a number of remote sensing and GIS based national level projects taking the advantage of advancements in remote sensing technology.

Dr Alok Saxena
Conservator of Forests in Andaman & Nicobar Islands, Former Joint Director, Forest Survey of India, Dehradun

"It is a time to talk about Asian satellite navigation system"

Prof Gyu-In Jee, Chairman of Korea GNSS Technology Council on GNSS Programme, technological and application trends in South Korea

What are the programmes of Korea in the field of GNSS?

National GNSS plan has been established on Dec. 13, 2005. One of the key plans is that Korea will participate in Galileo project. On Sep. 9, 2006, Korea and the EU have signed a cooperation accord on Galileo project. The sectors for cooperation include radio-spectrum, scientific research and training, industrial cooperation, trade and market development, standards, certification and regulatory measures, ground augmentation systems, security, liability and cost recovery. To date cooperation accords have been signed with China and Israel. Korea is now a new partner to the Galileo project.

According to the national GNSS plan, a national GNSS research center was established in KARI (Korea Aero Space Research Institute) this year. This institute will lead and coordinate national GNSS R&D plan. Currently, two R&D projects are planed: The first one is Development of GNSS Test and Evaluation Facility and the second one is Development of GNSS based Transportation Infra Technologies. The first project will develop S/W platform for performance evaluation of air navigation system using GPS/ Galileo augmentation, PTF S/W platform for navigation satellite time synchronization, simulation tool for maritime GNSS augmentation system, GNSS signal generation simulation tool and receiver S/W platform, virtual GNSS reference station, and crustal movement modeling for GNSS ground system. The second project will develop GNSS ground system, GNSS based inter-modal auto navigation technologies, and integration/test/validation of GNSS based inter-modal ground system.

What are the applications focuses in South Korea?

Many Korean companies are interested in GNSS receiver and its IT related applications, like LBS and telematics. Korea's participation in Galileo will activate GNSS receiver development especially for mobile device in Korea. A government supported GPS/Galileo dual mode chipset development project is planned to launch this year.

Any specific constraint you would like to mention?

There are two issues here. The first one is definitely accuracy. Many cellular users complain about poor accuracy and the non-availability of current GPS-based location system. For example, young people, they are interested in knowing their friend's location whenever they want and wherever their friends are. They want to be able to pinpoint locations, even indoors. The second one is protection of personal location information. Too much regulation on the use of location information may restrict LBS market growth.

Please tell about the technological trends?

Besides Korea cash investment in Galileo, Korea government will invest in Galileo related R&D projects. As mentioned in above, several research institutes plan to develop Korea GNSS infra including GNSS ground system and GNSS test and evaluation facility.

Your perception about the initiatives like Galileo?

I don't exactly understand your question. I think it is time to start to talk about Asian satellite navigation system. It could be another global or regional satellite navigation system. China has Beidou, Japan has QZSS, India has GAGAN, and Korea will develop GNSS infra. Could it be possible to integrate all of them to make an Asian satellite navigation system? Let's think about it.

Gyu-In Jee, PhD is currently working as Professor in Department of Electronic Engineering, Konkuk University, Seoul, Korea. He did his PhD from Case Western Reserve University, Cleveland, OH in Control and Systems Engineering. His research interests are GNSS Software receiver, Positioning Technology for LBS and Ubiquitous System, wireless Location System, Anti-Jamming and Interference Mitigation, Kalman Filtering and Estimation/detection and Digital Control System. He is a Member of IEEE, ION, The Institute of Control, Automation and Systems Engineers, Korea. He is Chair of Korea GNSS Technology Association, Korea; Wireless Location Working Group in Korea LBS Standardisation Forum; and Navigation Guidance, and Control Working Group in the Institute of Control, Automation and System Engineers, Korea.

A much needed initiative

NEGeo 2006: A report

NEGeo 2006 has happened. It was historic, encouraging and incredible. Historic as never before has a conference of this scale, importance and success taken place in the region. Encouraging, as stakeholders from all states were present and participated actively. Incredible because of the enthusiasm and spirit of participation that was displayed by the attendees.

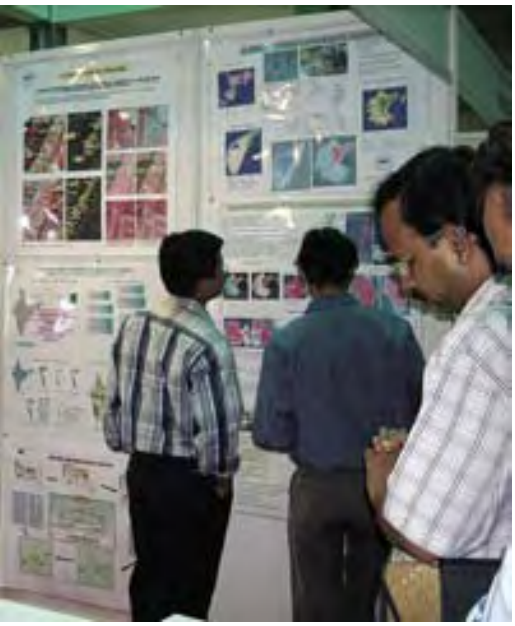
The success of conferences cannot be judged only by the number of participants but also by the technical inputs that arise during relevant debates. The objective of NEGeo 2006 was to understand and identify the developmental issues and needs of the North East region and explore the role of geo-information technologies. It envisaged to increase awareness levels and act as a platform to assimilate various initiatives being taken by different states. In this conext, NEGeo is a significant step. It has a triggered a process and that's where the success of NEGeo lies.In his keynote address, Brig CS Bewli, Deputy Surveyor General, Survey of India highlighted the challenges related to mapping and surveying in North East Region. While addressing the gathering of over 200 participants, he emphasized that although the region is economically underdeveloped, it is rich in natural resources and as such, Geo-Informatic technology should be used for planning and developmental purposes in the NE region. The inaugural session was addressed by Prof Gautam Barua, Director, IIT Guwahati; Brig RC Padhi; Military Survey, Indian Army, Dr KC Bhattacharya, Director, NESAC; Dr Vandana Sharma, Senior Technical Director, NIC; and Prof SC Patra, Director, NERIWALM. The NEGeo 2006 conference held at Assam Administrative Staff College, Guwahati from Sept 21-22 was organized by Centre for Geo-Information Technologies (cGIT), publisher of *Coordinates* magazine. The conference was co-organised by IIT Guwahati, National Informatics Centre, NERIWALM, Department of Science & Technology, Survey of India, NESAC, Guwahati University, NEHU, Planning Commission, ISRO etc.

During NEGeo 2006, Department of Science and Technology orgainzed a session on NE SDI and NERWALM organized a session on Land and Water Resource Management. Some of the key speakers were Brig B Nagarajan, Survey of India; Dr G Chennaiah, Director SRSAC, Arunachal Pradesh; Prof Dulal Goswami, Guwahati University; Dr RP Singh, Census of India; Prof BS Mipun, NEHU; Dr Zavei Hiess, Director; Nagaland Science and Technology Council; and Dr TG Antony Balan, Chairman Brahmaputra Board etc. More than 25 presentations were made

during the conference. A three-day residential training program was also organised on 18-20 Sep at IIT Guwahati. The programme was attended by around 30 participants.

Exhibition

Additionally, an exhibition was also organized during the conference which was participated by the Survey of India, NERIWALM, NE Space Application Centre, National Informatics Centre, Forest Survey of India, Census of India, Canon, Lepton Software, Aerial Services, AMIL Ltd, CADD Centre, Elcome Technologies, PCI Software, IDS, ERDAS India and many more players from the industry.



NEGeo 2006 communique

NEGeo 2006 was organised by Coordinates and co-organised by IIT Guwahati, NE-SAC, NERIWALM, DST, NIC, Survey of India, Planning Commission, ISRO, Geography department, Gauhati University, Manipur University, Mizoram University, Forest Survey of India, Assam Administrative Staff College, NEHU, Meghalaya S&T Council, Brahmaputra Board etc.

In a two-day conference attended by more than two hundred delegates, academia, industry, and various government departments deliberated on several key issues pertaining to the growth of geomatics in the NE region.

NEGeo 2006 understands the need of spatial data in the region for developmental purposes. Although some data is available pertaining to NE region with national agencies and a few organizations in the region, it is not in standardized format, thus restricting utility value for the lowest level of governance like village councils, village development boards, gram panchayats, municipalities and traditional and tribal institutions. There is no system for data acquisition, updation or dissemination. These issues are discussed in the first of its kind conference NEGeo 2206.

The release of National Map Policy last year in May and the adoption of NSDI resolution this year in June by the Government of India is a very positive step in creating the spatial data infrastructure to be used by one and all in case planning and development. Specific policy framework/guidelines under the overall national policy relevant to North East region is the need of the hour.

The presentations by the Survey of India and NIC indicated that they are coming forward with much more openness to share and provide data e.g. digital toposheets at Rs 5,500 (1:50,000 scale) and NIC through their network freely. Updating maps of 1:10,000 scale and the rationalization of the projection system are welcome steps. We will welcome a time frame for the NE region for such updated maps.

The initiative taken by the DST on NESDI was appreciated in a session devoted to NESDI and the vision was endorsed by the delegates. The DST, being a forward looking organisation, should take the lead and establish the NESDI under NEC which is an apt body under the Government of India, with mandate for planning and development. The methodology and the results of work conducted in different states of NER has formed a base to prepare the strategy for NESDI and standardize the formats and procedures.There is a need for institutional mechanism for NESDI and resolution other related issues. The approval of Secretary, NEC to establish NESDI is welcome. A core group may be formed to continuously work and provide the necessary inputs for establishing and functioning of NESDI.

The creation of a digital data base involves technology inputs. Sophisticated instruments and software are essential and expensive requirements; many who are interested in getting involved in digital data creation, often cannot afford to. Hassle free functioning and maintenance and other technical support is an added

bottleneck. The non-availability of high-resolution satellite data from NRSA to academic institutions hinders research activities in this region. The NEGeo recommends resolving such issues on priority.

NEGeo 2006 emphasised the need of trained technical man power for efficient implementation of geo-information technologies in the region. A well thought-out capacity building programme with networking of resource institutions may be planned.

Enhancing the training facilities in the region to quickly meet emerging requirements is also recommended.

There is a need for more collaboration among the various government and non-government organisations working the field of geo-information technologies in NE region. NEC may act as a nodal agency for this.

The presentations made at NEGeo 2006 have led to the conclusion that digital data will have to be created for all kinds of digital data projects. This should be encouraged by the funding agencies, implementation agencies, state governments and district administration, which can be implemented in a phased manner.

Ministry of Science and Technology should enhance funding for digital data creation and technology development, on one hand and other ministries such as Ministry of IT, DONER, Ministry of Water Resources, Ministry of Agriculture, Ministry of Rural Development, Ministry of Environment and Forests, Ministry of Urban affairs, Ministry of Surface Transport etc should earmark funds for such activities in NER in their programmes. Planning Commission may also formulate special programmes for NER to create digital data base.

It was also recommended that NEGeo should be held annually .

The recommendations are discussed at NEGeo 2006 and endorsed by the gathering.

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GPS based control points for mapping

The objective of this paper is to discuss a simple method for finding out grid coordinates as well as elevation of control points in a topocentric coordinate system using GPS data. A case study implementing the method for finding out the position of control points has been discussed

Jayanta Kumar Ghosh, Ojaswa Sarma and Amit Goyal

To carry out the infrastructural development in any area, topographical maps (accurate, reliable and updated) of that area are of vital important. Topographic maps are also important aids for administrative and strategic planning, disaster mitigation, socio-economic development and other related activities. In order to prepare topographic map, it is prerequisite to have grid coordinates as well as elevations of control points.

GPS has already been used as an important tool for establishment of control points accurately, quickly and economically in a versatile way. Though it provides precise planimetric position of a station but it provides gross imprecision in height (Ghosh and Rao, 2001). Moreover, the coordinates of the points are obtained in the WGS 84 reference system, a global coordinate system. But, for preparation of topographic maps, cartographers are in need of grid coordinates in local (topocentric) coordinate system. To find the local coordinates from global coordinates, transformation parameters between the local and the global system are required which requires at least known three common stations. But, due to security reason, often the precise local geodetic coordinates of control points are not made available to civil users. The problem of non-availability of local geodetic coordinates can be circumvent by adopting an appropriate method.

The objective of this paper is to discuss a simple method for finding out the grid coordinates as well as elevation of control points in a topocentric coordinate system using GPS data followed by a case study implementing the method.

Methodology

To prepare a topographic map, it is a usually convenient to have grid coordinates in a topocentric coordinate system having geographic North, East and Vertical up directions as the three reference axes. In this section, a methodology has been discussed for positioning of control points in a topocentric coordinate system with geographic North, East and Vertical up directions as the three reference axes from GPS observation (in WGS 84 – a global geocentric coordinate system). With reference to figure 1, let us consider a global geocentric coordinate system representing WGS 84 system be defined by three mutually perpendicular axes X,Y and Z. Let a topocentric coordinate system be defined by n, e and u at station P. The n axis points towards geographic North; the e axis toward East, and the u axis in vertical up direction. The axis u is along the plumb line at P and thus axes n and e are in a horizontal plane tangential to earth's surface at P.

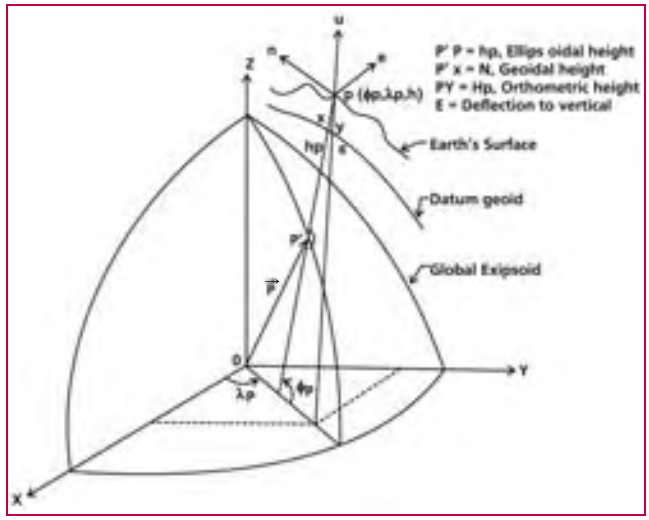


Figure 1. Global Ellipsoid system and local topo-centric system

Let the spatial orientation of the local coordinate system with origin at P is specified by the global geodetic coordinates (ϕ_p, λ_p, h_p) i.e., global ellipsoid latitude of station P be ϕ_p, global ellipsoid longitude of station P be λ_p and global ellipsoid height of station P be h_p. The corresponding global cartesian coordinates of the station P be (X_p,Y_p, Z_p). Let the topo-centric coordinates of any terrestrial point Q (X_q, Y_q, Z_q) having origin at P be (n_p, e_p, u_p). The relationship between the local topocentric coordinate system and the global Cartesian system can thus be given by

$$\begin{bmatrix} n_p \\ e_p \\ u_p \end{bmatrix} = P_2 R_2(\phi_p - 90^\circ) R_3(\lambda_p - 180^\circ) \begin{bmatrix} \Delta X \\ \Delta Y \\ \Delta Z \end{bmatrix} \quad (1)$$

Where P_2 is a reflection matrix, R_2 and R_3 denote the usual rotation matrices (Vanicek and Krakiwsky, 1986) and

$$\begin{bmatrix} \Delta X \\ \Delta Y \\ \Delta Z \end{bmatrix} = \begin{bmatrix} X_q - Xp \\ Y_q - Yp \\ Z_q - Zp \end{bmatrix} \quad (2)$$

Thus,

$$P_2 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad (3)$$

$$R_2(\phi_p - 90^\circ) = \begin{bmatrix} \sin\phi_p & 0 & \cos\phi_p \\ 0 & 1 & 0 \\ -\cos\phi_p & 0 & \sin\phi_p \end{bmatrix} \quad (4)$$

$$R_3(\lambda_p - 180^\circ) = \begin{bmatrix} \cos\lambda_p & -\sin\lambda_p & 0 \\ \sin\lambda_p & -\cos\lambda_p & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad (5)$$

$$\begin{bmatrix} n_p \\ e_p \\ u_p \end{bmatrix} = \begin{bmatrix} \sin\phi_p\cos\lambda_p & \sin\phi_p\sin\lambda_p & \cos\phi_p \\ -\sin\lambda_p & \cos\lambda_p & 0 \\ \cos\phi_p\cos\lambda_p & \cos\phi_p\sin\lambda_p & \sin\phi_p \end{bmatrix} \begin{bmatrix} \Delta x \\ \Delta y \\ \Delta z \end{bmatrix} \quad (6)$$

$$= \begin{bmatrix} n_p^T \\ e_p^T \\ u_p^T \end{bmatrix} \begin{bmatrix} \Delta X \\ \Delta Y \\ \Delta Z \end{bmatrix} \quad (7)$$

Thus, the axes n, e and u of the local (tangent plane) coordinate system at P corresponds to the North, East and up directions, are thus represented in the global system by

$$\vec{n}_p = \begin{bmatrix} \sin\phi_p\cos\lambda_p \\ \sin\phi_p\sin\lambda_p \\ \cos\phi_p \end{bmatrix} \quad \vec{e}_p = \begin{bmatrix} -\sin\lambda_p \\ \cos\lambda_p \\ 0 \end{bmatrix} \quad \vec{u}_p = \begin{bmatrix} \cos\phi_p\cos\lambda_p \\ \cos\phi_p\sin\lambda_p \\ \sin\phi_p \end{bmatrix} \quad (8)$$

Let us consider, another terrestrial point Q such that the line joining P and Q is a straight line (the distance between the terrestrial points are limited to that extent that the plumb lines through P and Q are parallel to each other) (Figure 2). Let the vector between these two points be defined as $\overrightarrow{PQ} = \vec{Q} - \vec{P}$ in the global coordinate system and as $\overrightarrow{pq}$ in the topo-centric system with origin at P.

Let $\vec{n}_{pq}$, $\vec{e}_{pq}$ and $\vec{h}_{pq}$ are the components of the vector $\overrightarrow{pq}$ in the local coordinate system. These components can be obtained by projection of the vector $\overrightarrow{PQ}$ onto the axes n,e and u. Analytically, this is achieved by the inner products as shown by Equation (9)

$$\overrightarrow{pq} = \begin{bmatrix} \vec{n}_p \cdot \overrightarrow{PQ} \\ \vec{e}_p \cdot \overrightarrow{PQ} \\ \vec{u}_p \cdot \overrightarrow{PQ} \end{bmatrix} = \begin{bmatrix} \vec{n}_{pq} \\ \vec{e}_{pq} \\ \vec{u}_{pq} \end{bmatrix} \overrightarrow{PQ} \quad (9)$$

Thus, from equation (6),

$$\overrightarrow{pq} = D_p^T \overrightarrow{PQ} \quad (10)$$

the vectors $\vec{n}_p$, $\vec{e}_p$, $\vec{u}_p$ of the local level system as the columns in a matrix D.

where

$$D_p = \begin{bmatrix} -\sin\phi_p\cos\lambda_p & -\sin\lambda_p & \cos\phi_p\cos\lambda_p \\ -\sin\phi_p\sin\lambda_p & \cos\lambda_p & \cos\phi_p\sin\lambda_p \\ \cos\phi_p & 0 & \sin\phi_p \end{bmatrix} \quad (11)$$

Case Study

A dam is proposed is to be constructed on a river named Gola, situated in the Lower Shivalik Ranges of Himalayas in the district of Nainital of Uttaranchal State of India. The purpose of the dam is to fulfill the drinking requirements of the people of a nearby town Haldwani and the adjoining villages. During winter the discharge of Gola river reduces significantly and it is very difficult to meet the water demands hence it is proposed to construct a storage dam there. So, a Roller Compacted Concrete Dam of around 150 m in height was planned to be constructed. The dam was proposed several years earlier and its axis was defined. However, a major slip (Figure 3) occurred in the downstream side of the proposed axis and hence required revaluation of the site and to propose a new axis for a dam to be constructed.

Figure 3. Proposed dam site with a slip

Study Area

As a prime requisite of the project work, a survey campaign was organized at the proposed dam site on River Gola. It was proposed to carry out a topographic surveying and mapping of an area of about 800 meter long and 300 to 400 meter wide in the bed of Gola river. Since the duration of surveying work was limited, it was planned that area to be surveyed is divided into parcel of land across the river having over lapping in each side. It was decided that each area would be provided with control points. To obtain accurate, quickly as well as easily, control points were planned to be established through GPS. Thus, coordinates of the terrestrial points are thus obtained are in a global system. But to prepare of topographic maps, topocentric coordinates of the control points are required. The requirement was met by transformation of global coordinates into topocentric local coordinates as discussed in previous section.

Observation and Result

The observation was taken on December 29, 2002 starting from 09hr 31min 55sec to 16hr 46min 55sec i.e., a duration of 7 hr 15 min starting from morning to evening. On next day i.e, on December 30, 2002 the observation session started at morning (08 hr 31 min 30 sec) and continued till evening (14 hr 32min 25 sec) for a duration of 6 hr 12 min 55 sec. The observed data was processed in SKI 2.3 in relative positioning mode. Dual frequency data were used in processing. Broadcast ephemerides were used to compute the

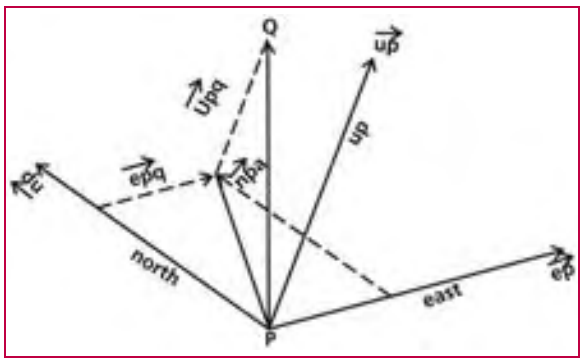
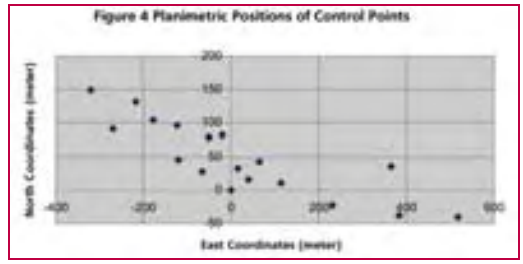


Figure 2. Measurement vectors between two terrestrial



position of satellite. Hopfield model was used to take into consideration the delay caused by troposphere but no model was used for ionospheric interference. After processing the data, positions of the B.M. and other control points have been found in WGS 84 coordinate system.

The global coordinates thus found are then converted to local Cartesian Coordinates (Topocentric System) with origin at B.M. using the Equation (10). The local Cartesian Coordinates of the control points are obtained considering B.M. as origin. A plot of the planimetric position of the control points is as shown in Figure 4.

To find the vertical position of the control points two types of heights i.e., orthometric height and reduced level have been found. The concept of datum transformation (Hofmann-Wellenhoff, 2001) has been used to find orthometric height. In this, first the amount of geodetic undulation at the B.M. is calculated from geodetic height (606.794 meter, found from GPS obsevation) and the orthometric height (637.5000 meter) as established field data. This has been found to be 30.706 meter (637.500- 606.794). The reduced level (R.L.) of the control points are calculated using the R.L. of the B.M (637.5000 meter) and the difference in vertical elevation (z) between the B.M. and that of considered control point [as found by the transformation equation (10) given in Table 1, the z component]. The orthometric height and the R.L. of all the control points thus obtained are as shown in Table 1.

Table 1 Orthometric height, Reduced Level of control points

	Orthometric height, H (m)	Reduced Level (m)	Difference between H & RL (m)
B.M.	637.500	637.500	0.000
CP1	631.157	631.147	0.010
CP2	629.279	629.273	0.006
CP3	631.818	631.814	0.004
CP4	631.666	631.662	0.004
CP5	632.253	632.251	0.002
CP6	632.442	632.440	0.002
CP7	632.836	632.835	0.001
CP8	633.341	633.341	0.000
CP9	633.748	633.747	0.001
CP10	636.755	636.755	0.000
CP11	638.369	638.369	0.000
CP12	636.421	636.421	0.000
CP13	653.639	653.637	0.002
CP14	644.374	644.370	0.004
CP15	642.266	642.256	0.010
CP16	643.066	643.055	0.011
CP17	644.782	644.762	0.020

Discussion

To minimize the inherent errors associated with in GPS observations (Leick, 1995) due precausion had been taken all throughout the campaign. Moreover, observations were taken in relative positioning mode and the area surveyed is small thus it has been assumed that the residual error, if any, is the same for all points.

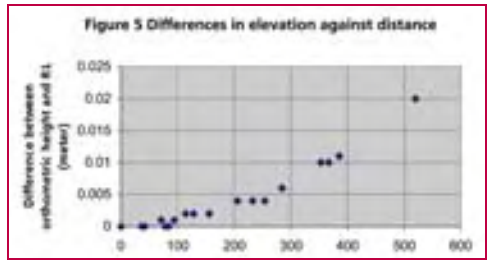
The topo-centric local grid coordinates of control points are calculated from GPS observation. A transformation matrix based on geodetic coordinates of the origin (based on GPS observation in the global geodetic system) has been used and no other data is required for finding out the planimetric positions. The vertical height of points are also found from the same GPS observation. Thus, all the three components of the position of any control point are based on same set of GPS observation. This helps in minimizing the field work drastically over the traditional methods.

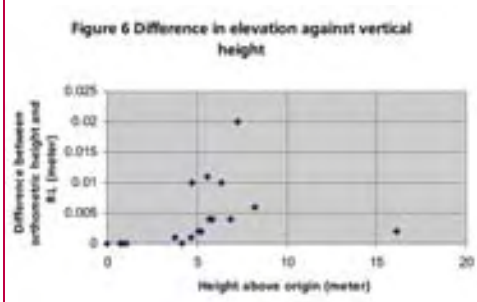
The elevation of points has been found by adopting two independent methods using the same set of GPS observation. First one is the method of datum transformation. In this method, the orthometric heights of points have been found. Since, the distance between origin and other points are small with respect to geodetic consideration, it has been assumed that the difference in the angle of deflection to vertical (ε) between the origin and other points is negligibly small. Next, the reduced level (vertical elevation) of control points are calculated using the vertical height (found by transformation matrix) and R.L. of B.M. These heights are found to be mostly equal to that of orthometric heights. The deviations of R.L. from orthometric heights within the study area noted to be increasing with the distance from origin (Figure 5) but do not depend on the height of points above origin (figure 6). Thus, the variation in heights may be attributed to the variation in geodetic undulation with distance, as expected since the terrain is hilly.

Further, the grid coordinates thus calculated can easily be related to other local or global network as the considered directions (north, East and vertical) of axes are universal and origin (B.M.) is well established.

Conclusion

Transformation of GPS observation will help cartographers by providing a topo-centric coordinate system with B.M. as origin. This method results in very accurate positioning of control points for a small area. This method is quite simple and easier than conventional transformation methods. Moreover, this will lead to overcome the problem of non-availability of precise geodetic coordinates of control points. Determination of vertical height of points is quite simple. However, to restrict the amount of accuracy within desired limit, the variation of geodetic undulation at the site is to found before further surveying operation. The areal extent to which the undulation deviates from that of the origin within the permissible limit (depending on the desire accuracy of the campaign) first better be determined. Thus, if area to





be surveyed is large and the desired accuracy is high, a number of bench marks are required to be available in the site or to be established first and subsequently, the command area for mapping using GPS observation around the bench marks are to be found.

Acknowledgement

Students of B.Tech (2002-2003) Final year (Civil) of IIT Roorkee for collecting the data. Authors also acknowledge the help rendered by Prof A.K.Mathur and Dr. M.Singh in organizing the survey campaign successfully.

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"We continuously invest in latest technology"

Says Flemming Lindholm, Regional Sales Manager-Europe, Asia and Africa Contex A/S while sharing his perception and approach for Asian market

Would you like to explain "When Imaging Matters"?

Well, this is a slogan Contex started to use last year after the acquisition of the 3D printing company Z-Corp in Boston, USA. The Contex Group controls companies within scanning as large document scanning, medical X-Ray film scanning, DNA scanning and now we are in 3D printing. We approach customers with high demands for quality scanning and printing and this is why imaging matters.

Tell us about Contex?

Contex Scanning Technology is the leading manufacturer of wide-format color and monochrome scanners from 25 to 54 inches, and this year introduced the COPYmate 18 flat bed scanner and the DESIGNmate 3D printer. Contex is also the developer of advanced scan and copy software for these products. Contex delivers solutions for a diverse customer base, including CAD, GIS, Photography labs, Reprographics, Graphic Arts, document archival, copy shops, POP/ exhibit providers, pre-press, and sign and billboard production, as well as architecture and engineering professionals around the globe.

Contex, founded in 1923, was for many years involved in the design and manufacture of inventive and "time-saving" machines—printing machines, mechanical and electronic calculators, and electrostatic copiers. These machines were distributed and sold worldwide under the Rex-Rotary and Gestetner brand names. The foundation was laid for the establishment of Contex Scanning Technology in early 1980.

In 1986, development of modular scanning technology began, and, in 1988, Contex introduced its first black-and-white (monochrome) large-format scanner and presented a complete line of black-and-white scanners in 1990. The first wide-format color scanners were introduced in 1996.

Anything specific for GIS segment?

Contex digital solutions provide a seamless path to capture technical documents, drawings and other input in order to view, edit, archive, convert files or print the output data for various applications and jobs. Contex scanners also make the perfect wide-format digital copiers by linking a Contex scanner to a large-format printer. Contex solutions are for companies requiring in-house copying; scan to file of large GIS documents, posters and drawings. In August 2005 we acquired Z-Corp. in Boston and two 3D color printers being offered through a select group of distributors, with expansion plans not only in the GIS segment, but in many other areas as well to provide users with the magic like benefits of 3D printing. These new products will start a whole new era in printing techniques.

In addition, Contex Large Format Scanners and scanning solutions are designed for versatility so that they can be used with almost any business working with large documents - including those who need high quality Map Scanners. Most GIS and mapping companies work with ARCH and ANSI standard sizes and will find the Contex 42" and 36" large format scanners perfect Map scanners for digitizing their maps. However, many original maps will exceed these sizes making the 54" scanner a "can't lose" alternative. But size and scan width is not the only parameter to consider when investigating the market for Map Scanners. They also need high accuracy, colour precision, ability to extract special GIS features, etc.

Would you like to share with us the "Research and Development" at Contex?

Contex has modern manufacturing facilities in Svendborg and Denmark. Contex produces most of its mechanical components using state-of-the-art numerical and computer-controlled machinery and a highly skilled workforce. With self-sufficiency and huge production flexibility, Contex is able to maintain extremely competitive short lead times in its order-driven production capabilities.

Ongoing product development has resulted in a number of patents, providing Contex with a lasting technological platform. A strong emphasis on continued research and

development ensures Contex clients of state of-the-art capabilities. Our areas of expertise include digital scanning and imaging software and expansion into other technologies which include 3D printing and medical scanning.

How do you see the market in Asia as different vis-à-vis other parts of the world?

Asia is a very important area for Contex. In many regions in Asia there is a fast growing economy, which will lead to a higher demand for our scanners. Compared with other parts of the world we see countries in Asia, who are very focused on building up infrastructure.

This is a very important segment for Contex. Some of the smaller customers such as copy shops have increased their interest for scanning technology and many smaller engineering companies are now investing in wide format scanners. Compared with Europe and USA we still see a pioneering spirit in Asia. Many local governments are taking serious actions in developing there region. Contex wants to be part of this development. We know that digitizing of large format documents is a part of this process.

How are you different from other players in this segment?

Well, first of all, we are the market leaders in technology and the largest wide format scanner manufacturer in the world. Through a very strong distribution network, we control approximately 80% of the world market of wide format colour scanners. Second, we have a strong development team where 25% of our employees are dedicated to ????. We work together with some strong partners in the scanning business. We are able to reach even the most remote areas of the world and still being able to support our customers in any technical matter.

We continuously invest in the newest technology and our customers can always be assured that they are investing in the latest technology.

Our goal is to continue surfing on the technology wave and always make sure that we are ahead of any competitor. This is how we build our company starting from a small company in Denmark to a multinational company with branches in USA, UK, China and Japan.

Any specific issue you would like to share when you operate in India or similar countries in the region?

The secret behind our success was first to develop an understanding the Indian market and thereafter finding a strong Indian partner.

Foreign companies joining forces with Indian partners are really able to create some tremendous opportunities for both parties.

The Government of India have over the past few years been able to increase the economical activity within the country and at the same time opened up for foreign investors. This has given India a high increase of economical growth, which will continue for years ahead of us. Combined with political stability India will without no doubt soon become the land of opportunity.

Flemming Lindholm is the Sales Managerof Contex for Europe, Asia and Africa region. He was Born in Nigeria 1957 and graduated from the Danish Business School 1982.He worked as international marketing and research consultant, mainly active in Scandinavia and the Northern part of Western Europe

Ordnance Survey vision helps shape a VISTA for underground assets

VISTA (Visualising integrated information on buried assets to reduce street works) is a collaboration of 21 organisations developing an integrated infrastructure to enable data sharing for all buried assets across Great Britain. Ordnance Survey's intelligent large-scale data OS MasterMap Topography Layer is the reference base underpinning preliminary trials by researchers at Leeds and Nottingham Universities to integrate disparate records of buried pipes, cables, ducts and wires. VISTA will combine this information with in-situ survey observations using real-time centimetre-level services provided by OS Net, Ordnance Survey's GPS correction network, and by Leica Geosystems' SmartNet, which is enabled by OS Net. OS Net is a network of more than 90 GPS base stations that improves the standard accuracy of raw GPS readings to augment any application that requires GPS positioning. *www.ordnancesurvey.co.uk*

IGN accused of France knowledge economy

The Institut Géographique National (IGN), the French national mapping agency, is being accused of hindering France's knowledge economy by the high prices it charges for digital data and the obscure way it calculates them. Government auditors also accuse the institute of conflicts of interest in setting national policy for a sector in which it is the dominant player. These criticisms have cross-channel resonance. Although the directly subsidised IGN is run on a different model to its British equivalent, Ordnance Survey, its problems spring from the conflict that arises when a public agency tries to market data commercially. Now an official inquiry in France has suggested a possible solution along the lines of that proposed by Guardian Technology's Free Our Data campaign. This is to make taxpayer-funded data sets freely available to all comers on the web. *http://technology.guardian.co.uk*

Malaysian Deputy Prime Minister praises MACRES

Remote sensing technology will be extended nationwide in Malaysia to curb illegal logging and control forest fires. Deputy Prime Minister Datuk Seri Najib Razak said the satellite-based data gathering and monitoring system would also provide authorities with up-to-date information on the inventories of forests in the country. "The technology will enable the gathering of data on species of flora and fauna as well as the volume of trees in our forests," he said. Praising the technology developed by the Malaysian Centre for Remote Sensing, he said after the technology was successfully tried out in the Gunung Stong State Park in Kelantan, the Government was expanding its usage. *www.nst.com.my*

Major India-German science and technology initiative launched

India and Germany have launched a new initiative in collaborative Science &Technology (S&T) programme that will strengthen as well as expand their S&T cooperation. Following the sixth meeting of the Indo-German Committee on S&T, officials of the German Federal Ministry of Education and Research and the Indian Department of Science and Technology identified focal areas for cooperation including nanotechnology, biotechnology, disaster management, production technology, space technology of RS applications, climate change, clean and efficient energy research as well as medical research on cancer and infectious diseases and brain studies. *www.thehindu.com*

China's first public database of water pollution

A Beijing-based environmental organization began operating China's first public database of water pollution. The China Water Pollution Map (www.ipe.org.cn/water), provides information on water quality and the sources of water pollution discharge in 300 Chinese cities. It lists more than 2,500 enterprises accused of causing water pollution. *www.chinadaily.com.cn*

India to achieve 33 percent forest cover by 2012

The Union Minister for Environment & Forest, Government of India, Thiru. A Raja said that Central Government is committed to the cause of achieving 33% forest and tree cover by 2012 while inaugurating a two-day conference of Principal Chief Conservator of Forests & Chief Wildlife Wardens from all over the country in New Delhi. The 12th Finance Commission has allocated Rs.1,000 crore for the conservation and protection of forests. *http://pib.nic.in*

Dr R Siva Kumar elected to OGC Board of Directors

Dr. R. Siva Kumar and Ben Eazzetta have been elected to the Open Geospatial Consortium, Inc. Board of Directors. Dr. Siva Kumar heads the Natural Resources Data Management Systems and the National Spatial Data Infrastructure Division of the Department of Science and Technology, Government of India. Mr. Ben Eazzetta is President of the Security, Government & Infrastructure Division of the Intergraph Corporation. *www.opengeospatial.org*

India develops more accurate crop production forecasting system

Amidst controversy over whether the country has landed into a wheat crisis this year because of lower production or low inventory, the Centre has decided to make its estimates for evaluating crop output more scientific using remote sensing, agro meteorology, GIS and land observations. Launched by the Ministry of Agriculture, FASAL is a programme for Forecasting Agriculture output using Space, Agro-Meteorology and Land-based observations for better accuracy in crop production. Initially the programme will cover two commodities – wheat and rice. Later it will be extended to all major crops. *www.hindu.com*

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LBS subscribers will total 315 million in five years

In 2011, the total population of GPS-enabled LBS subscribers will reach 315 million, up from 12 million in 2006, according to a new study from ABI Research, USA. This represents a rise from less than 0.5% of total wireless subscribers today to more than 9% worldwide at the end of the study's 5-year forecast period. The LBS market took off first in South Korea and Japan, driven by personal navigation and some family- and people-finder services. In the United States, Nextel and Sprint initially drove LBS adoption with a focus on fleet applications. *www.abiresearch.com*

BSNL to provide LBS to mobile customers

The Bharat Sanchar Nigam Limited (BSNL) is all set to bring to India the country's first LBS for mobile phone users. Telenity - a provider of converged services platforms and applications for communications networks - provided this service to BSNL, has already done a soft launch in India and the services are being used by the staff of BSNL for the past couple of months. With Telenity's Canvas LES, BSNL subscribers can easily find, locate or monitor phones and other assets based on their geographic position, points of interest and securely fine-tune their privacy profile on the fly when they want it. *www.asianage.com*

Nokia introduces N95 multimedia computer

Nokia's first HSDPA (3.5G) device Nokia N95 is an all-in-one multimedia computer with integrated GPS functionality and support for high-speed mobile networks. The 2-way slide concept with multimedia controls and a keypad on opposite end of the phones makes it easy to switch between different modes. 3D graphics provides an intuitive user interface. A GPS is integrated into the device with anticipated accuracy of around 10m (satellite signal permitting). *www.nokia.com*

World's first Galileo-ready receiver IC

SiGe Semiconductor Inc., announced Galileo-ready SE4120 receiver for mass market consumer electronics, which will enable the integration of high-accuracy navigation services into portable devices including laptop computers, PDAs, media players, cell phones, and cameras. The combination of GPS and Galileo will improve user experience of LBS by enabling products to determine position data much more consistently, quickly, and accurately. *www.sige.com*

GPS navigation through bluetooth enabled devices

Garmin International Inc., a unit of Garmin Ltd., USA announced Garmin Mobile 10, a unique product that turns Bluetooth enabled devices such as laptops, smartphones, Pocket PCs, and PDAs into GPS navigators. *www.garmin.com*

HP introduces mobile messenger series in India

HP India has reportedly launched the iPAQ hw6900 Mobile Messenger series in India. The series includes a 3-inch transflective TFT display, and sports an integrated GPS, which is a fully-functional satellite navigation system allowing users to track their exact location on a global map. *www.techtree.com*

Mobile phone vehicle tracking

DCT Australia has developed net based software which allows customers to satellite track live their vehicle anytime, viewing clear virtual images of their vehicle location including street name, date and time on the mobile phone. DCT's engineers have combined GSM with Satellite GPS technology to combat vehicle theft or assist in fleet tracking services. *www.ferret.com.au*

Japan launches Solar-B

The Japan Aerospace Exploration Agency (JAXA) launched the 22nd Scientific Satellite (SOLAR-B) aboard the M-V Launch Vehicle No. 7 (M-V-7) at 6:36 a.m. on September 23, 2006 (Japan Standard Time, JST) from the Uchinoura Space Center (USC), Kagoshima prefecture. The 900-kg satellite – incorporating a set of optical, extreme ultraviolet and X-ray instruments designed to investigate the sun's magnetic field - was headed for a north-south orbit around the Earth pointing continuously at the sun. Scientists said the satellite would help them understand the origin and consequences of active phenomena that take place in the sun's corona by surveying the visible surface of the sun. *www.jaxa.jp*

Nigeria to launch second Earth observation satellite

Nigeria has started work on the design and construction of its second Earth observation satellite billed for launch in 2008. Director General of the National Space Research and Development Agency Robert Boroffice has said that the satellite known as NigeriaSat-2 would be an improvement on NigeriaSat-1, which is a medium resolution Earth observation satellite. He said his agency was considering suitable payloads for the NigeriaSat-2 spacecraft, adding that a 2.5m panchromatic camera, 5m multispectral camera in five bands and a 32m multispectral camera in three channels would be used to ensure high resolution. *http://english.people.com.cn*

Indonesian satellite planned for October launch

Lapan (Lembaga Penerbangan dan Antariksa Nasional), Indonesia's national space agency, is expected to launch the first indigenous satellite in late October, a milestone that will put the country on the world map of space technology. Agency Chairman Adi Sadewo Salatun said the micro-satellite Lapan-Tubsat

would take pictures of regions affected by the disasters that have plagued the country recently, including volcanoes, earthquakes, forest fires and tsunamis. *www.thejakartapost.com*

Japan to ease spy-satellite law

Japan will reportedly consider legislation that will allow for the eventual deployment of more advanced military spy satellites. A bill drafted by the Liberal Democratic Party would allow Japan to use space for "defense purposes," which in this day and age would include monitoring the nuclear program of nearby North Korea with better imaging technology. *www.upi.com/SecurityTerrorism*

Indian army to utilize Cartosat-I for surveillance

The Indian Army is all set to implement its first ever space based force multiplier -- the Satellite Based Surveillance and Reconnaissance (SBS) system. The project is expected to be completed by January end 2007 although the original deadline was early 2006. Sources in the Armed Forces say the SBS project, once fully-operational, will allow them to keep closer tabs on troop movements, missile silos, military installations and airbases of neighbouring countries, as well as augment surveillance over Indian airspace. *www.india-defence.com*

KOMPSAT-2 satellite sends first images

Korea's KOMPSAT-2 Earth observation satellite, launched 28 July, has returned its first images from orbit 685 kilometres above the planet. In-orbit commissioning and operational qualification are proceeding according to plan, paving the way for commercial sales of very-high-resolution (VHR) imagery in a few months' time. Spot Image is the exclusive distributor of KOMPSAT-2 data for the Korean Aerospace Research Institute (KARI) outside Korea, the United States and the Middle East. *www.spotimage.fr*

Innovative battlefield learning experience for soldiers

The Singapore Armed Forces (SAF) has introduced an innovative training and learning system for its soldiers called Battlefield Instrumentation (BFI). Utilising modern laser and information-communication technologies, BFI System brings together soldiers, weapon systems and fighting platforms. It uses the GPS, computer simulation and data communication to record details of battlefield engagements between opposing forces. *www.channelnewsasia.com*

GPS satellite system for Chiang Mai police

Thailand's northern region police chief launched a new satellite tracking system for police cars to help them pursue criminals. The Global Positioning Satellite's electronic control room is based at the police regional command centre. GPS receivers and wireless cameras have been installed in police cars and motorcycles. *http://etna.mcot.net*

Modernized GPS satellite launched successfully

A modernized Global Positioning System Block IIR (GPS IIR-M) satellite - designated GPS IIR-15(M) - built by Lockheed Martin was launched successfully from Cape Canaveral Air Force Station, Florida. *http://biz.yahoo.com*

Taiwan GPS PND makers face falling gross margins

The gross margins of Original Equipment Manufacturers of GPS Portable Navigation Devices have dropped 5-10percent from last year due to increased competition from manufacturers in China and South Korea. In order to minimize GPS navigation software costs to maintain its gross margin, Mitac International, has changed software partners many times in the past three years. *www.digitimes.com*

In India

- The National Centre of Experimental Mineralogy and Petrology (NCEMP), Allahabad University, will install a high precision GPS at Ghoorpur near Allahabad to record the movement of Indian lithosphere. The Department of Science and Technology (DST) has sanctioned Rs. 22 lakh (USD 47,491) for the five-year project undertaken by NCEMP. *www.hindustantimes.com*
- Haryana Roadways Transport Corp (HRTC) buses would soon be equipped with GPS technology. A state transport spokesman said the GPS technology would help in detecting the location of the state's buses. Haryana Roadways has nearly 4,000 buses that transport 1.1 million passengers daily. *www.dailyindia.com*
- The Mumbai police are upgrading their camera surveillance vehicles with GPS and Outdoor Broadcasting (OB) facility to maintain law and order. The city unit is already in possession of four such vehicles with cameras that allow for live and still photography. *www.dnaindia.com*
- The Thiruvananthapuram city police have installed a GPS to track patrol vehicles with the help of satellites. Fifteen `Flying Squad' vehicles and the police ambulance have been equipped with the tracking system. The Police Control Room uses electronic tracking devices to monitor the movement of police vehicles real time on a digital map. *www.hindu.com*
- By March 2007, all chair cars in trains of the South Central Railway (SCR), India will have GPS display boards giving out the data about the location of the train and the time it will take to reach destination. The data would be constantly displayed and updated. Some trials on the Secunderabad-Kazipet route were carried out recently by SCR officials. *http://timesofindia.indiatimes.com*
- India is shrinking by 2 cm every year. A new analysis of satellite-based data has given precisely the rate at which the country is shedding size as it pushes northward against the Himalayas. "India's size is decreasing by 2 cm every year," says geophysicist Paramesh Banerjee of the Dehradun-based Wadia Institute of Himalayan Geology. *www.hindustantimes.com*

Leica AT504 Geodetic Choke Ring Antenna now supports GNSS

With the introduction of the Leica AT504 GG, Leica Geosystems is announcing a brand new version of its successful AT504 choke ring antenna for permanent reference stations and networks. This new antenna tracks GNSS observations, supplying high quality GPS and GLONASS data when used in conjunction with Leica GPS1200 GNSS receivers. The design of the AT504GG choke ring antenna effectively suppresses multipath effects and has a very stable phase center making it ideally suited for geodetic applications using GNSS observations.

Leica Geosystems also introduces the new V2.2.0 for Leica GPS Spider software for GPS reference stations and networks. With this new update of GPS Spider, Leica Geosystems continues its policy of continued product development and improvement of its GPS Reference Station solutions. *www.leica-geosystems.com*

Sony debuts PSP GPS at TGS 2006

For the first time ever, the PSP's new GPS receiver was out in the public at the Sony booth at Tokyo Game Show. The receiver is extremely compact at less than two square inches (45mm x 41mm x 17mm). It supposedly only weighs 16 grams, which is about half an ounce (0.56oz). *http://crunchgear.com*

Septentrio announces dual frequency OEM receiver platform

Septentrio has announced AsteRx2TM, a compact high-end dual-frequency GNSS receiver for demanding industrial and professional applications. AsteRx2TM is the second product in the new AsteRxTM family of GNSS receiver boards from Septentrio. AsteRx2TM is a compact OEM board with low power consumption, featuring high-quality all-in-view dual-frequency GPS tracking and offering excellent measurement quality for high-precision positioning even in challenging environments. Moreover, AsteRx2 TM features optional GLONASS functionality. *www.septentrio.com*

BMW adds real time traffic information

BMW announced the availability of Real Time Traffic Information (RTTI) for major metropolitan areas across the U.S. The service will offer timely traffic information and dynamic rerouting on navigation systems in select 2007 BMW models. *http://biz.yahoo.com*

NovAtel launches SMART-V1 and FlexPak V Series

NovAtel, Canada has launched its next-generation SMART-V1 and FlexPak V Series products and Waypoint Products Group's Inertial Explorer software version 7.61 at this year's Institute of Navigation (ION) Global Navigation Satellite Systems conference in Fort Worth, Texas. Powered by the OEMV-1 single-frequency GPS+L-band engine, the SMART-V1 is a GPS receiver combined with an antenna. The product is available with support for CAN Bus or USB communication and features 14 channels for L1 code and phase tracking. *www.geospatial-online.com*

Spirent to provide GPS/Galileo test equipment for ANASTASIA

Spirent Communications, UK, a provider of satellite navigation test equipment, has been selected by DLR (German Aerospace Centre) for delivery of advanced GPS / Galileo test systems. DLR will be using Spirent solutions in the context of the EU & FP6 funded project "Airborne New and Advanced Satellite Techniques and Technologies in a System Integrated Approach" (ANASTASIA). *www.spirentcom.com*

Atmel and Magellan introduce new GPS chipset generation

Atmel Corporation and Magellan announced the availability of a new GPS chipset that integrates the world's latest GPS correlation technology with an ARM926EJ-S™-based microprocessor. This new device includes an extended instruction set with DSP extensions and a rich set of peripherals, designed to simplify the design, and drive down system costs, for the rapidly expanding market for Personal Navigation Devices (PNDs), car navigation, and recreational applications. *www.atmel.com*

u-blox announces dual GPS and GALILEO chip

u-blox AG, Switzerland announced the u-blox 5 family of GPS and Galileo-ready single chips and chipsets featuring an acquisition performance of under one second. The new chips also feature SuperSense -160 dBm acquisition and tracking sensitivity, power needs of less than 50 mW and a footprint smaller than 100 mm2, making u-blox 5 receivers ideal for PDAs, personal navigation devices, cameras, cell phones, media

Mehra Eyetech to distribute Topcon GPS and survey products

Topcon South Asia expands its network in India and signed up with Mehra Eyetech for distribution of its GPS and Surveying products for the western states of Maharashtra, Goa and Gujarat from Sep 2006. The company has been selling and distributing Topcon Optical and Medical Products from over a decade and half in India. Presently the company shall sell and service through its branch office in Mumbai and Pune and shall soon have branches in Ahmedabad and Goa.

players and other battery-operated portable devices. *www.u-blox.com*

Topcon robotic surveyor assistant

Topcon, USA, a developer and manufacturer of positioning equipment launches GPT-9000A total station series includes a field controller and tracking system designed to work as a complete robotic system. GTS-900A and GPT-9000A series include Topcon's FC-200 field controller and RC-3 tracking system. In addition, a new updated software release for TopNET CORS and TopNET RTK networking software has been announced by Topcon Positioning Systems. *www.topconpositioning.com*

MAPublisher 7.1 for Adobe Illustrator

Avenza Systems Inc., producers of MAPublisher cartographic software for Adobe Illustrator and Geographic Imager spatial tools for Adobe Photoshop announces the release of MAPublisher 7.1 for Adobe Illustrator CS and CS2. MAPublisher 7.1 is the latest version of this powerful mapmaking software used to produce high quality maps from GIS data. *www.avenza.com*

Location Intelligence to improve business processes

According to a survey conducted by MapInfo Corporation and BusinessWeek Research Services, 64 percent of business executives believe that location intelligence can improve business processes, and 21 percent are planning to investigate it in the next year. 1,700 business executives participated in this international study to gauge the role that technology can play in delivering powerful, business-relevant location intelligence to leading organizations. Location intelligence is a combination of software, data, services and expertise that enable an organization to detect patterns, risk and opportunities that CRM, ERP and BI overlook. *www.mapinfo.com*

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 and the Republic of Korea seal their agreement

During the EU/South Korea summit held in Helsinki, the two parties formally signed an agreement on co-operation on the European satellite radio navigation programme GALILEO. The agreement provides for numerous areas of co-operation, including cooperative activities in the areas of scientific research and training, industrial cooperation, trade and market development, standards, certification and regulatory measures. *http://europa.eu.int*

SSC gets GALILEO RF license

The Swedish Space Corporation (SSC), a developer of satellites, subsystems and experiments for sounding rockets as well as airborne systems for maritime surveillance is the first space company in the world to receive a long-term Radio Frequency S-band license for GALILEO. The license was applied on behalf of ESA and granted by the Swedish National Post and Telecom Agency and will last until 2037. *www.ssc.se*

New Czech government interested in Galileo navigation system

The new Czech government will seek the location of the headquarters of the European Satellite Navigation System Galileo in the Czech Republic, Prime Minister Mirek Topolanek told journalists after a cabinet meeting. "It is necessary to send our offer to the European Commission," Topolanek said, adding that the new government would continue the efforts of the previous cabinet aimed at Czech participation in the European project. *www.ceskenoviny.cz*

Software simulates EU satellite system

Siemens researchers have developed simulation software that can test the precision of Galileo. Developed at Siemens' Roke Manor research centre in southern England, the software is based on the signals to be transmitted by Galileo and includes GPS. This makes it possible to calculate whether a receiver can also detect navigation signals under unfavourable conditions. By analysing blueprint plans and ground plans of buildings as well as satellite and aerial photographs of cities, the software accurately forecasts signal strength and expected measurement errors. *www.miningweekly.co.za*

GALILEO test satellite delayed

GALILEO is experiencing delays, with the launch of the second test satellite, GIOVE-B, set back several months. "The launch is now planned for spring 2007," the spokesman for Galileo Industries was quoted by the Financial Times Deutschland. Initially planned for spring of 2006, the launch of the GIOVE-B test satellite had already been postponed until this autumn. *http://technology.inq7.net*

MEPs call for creative solutions

In adopting a joint resolution on the Galileo programme, Member of European Parliament (MEPs) call on the Commission to assess what modifications in legal and procedural regulations could be made in order to ensure the continuous progress of the project. The House points out that this does not imply reducing the competences and responsibilities of institutions, but may mean the application of solutions that are more creative and more appropriate to the objectives of the programme. MEPs acknowledge the new updated timetable and calls on the Commission to comply with it and to enforce compliance; together with the approval of the concession contract, asks to be informed about the additional costs resulting from the delay. *www.europarl.europa.eu*

Global Positioning Systems versus Local Positioning Systems

Indoor location-aware applications require micro-detailed geo-referencing to satisfy users' growing needs.

KRZYSZTOF KOLODZIEJ

In the last several years we have seen an explosion of consumer GPS products. Telematics systems, LBS applications on cell phones, GPS-enabled PDAs, and more novel GPS products such as pet finders have flooded the marketplace, with new products and applications announced almost daily. Likewise, public awareness of the potential utility of GPS has increased. Microsoft's and Google's entrance into the GPS and mapping market have helped accelerate consumer understanding and adoption of location technology. This is also causing a major demand among users of LBS technology to "show what is around me." In a word, GPS is a general term in the marketplace to which consumers are accustomed in how they understand and explain all location-enabled products and applications.

What's interesting is that GPS is not even the positioning-enabling (or location-enabling) technology inside many of these new location-aware applications that are getting a lot of traction these days. Moreover, Google and the other online mapping consumer websites are a disruptive technology for GPS because they don't require the use of GPS – users can either self provision by entering a street intersection or applications like Google Local and Microsoft Local Live use WiFi for location sensing to the nearest access point.

Today, there is a vast array of location technologies that are involved in the calculation of a user's or object's position in a space or grid, based on some mathematical model. Positioning here means allowing a mobile device to be aware of its location with different degrees of precision and accuracy. The technology required for provision of automated location information to mobile devices has been in continual development for several decades. While the majority has its roots in the military (e.g., GPS), modern consumer technology is also rising to meet the challenges, specifically in metropolitan areas. Telecommunications initiatives, like the U.S. FCC's E911 and Europe's E112, have generated a lot of interest in the potential for "Location Based Services" (LBS)--application and services that are a function of a person's or object's location.

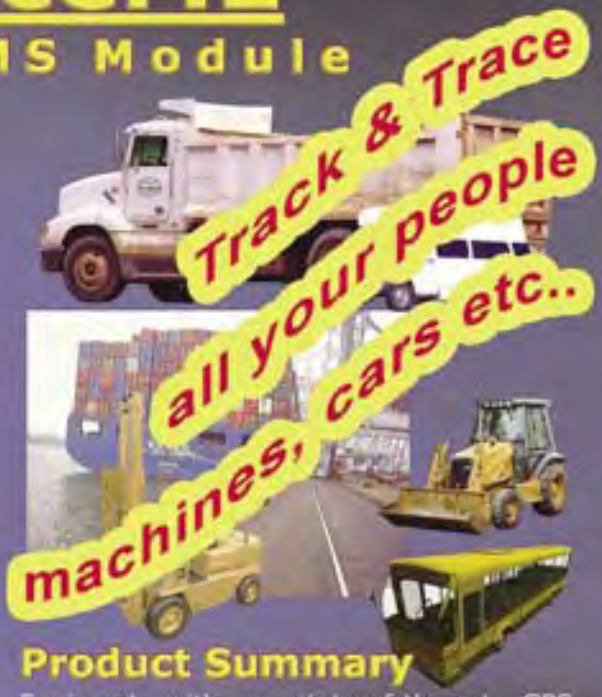
Unfortunately, LBS fails because it does not work where people are: indoors and in cities. GPS is great, but not for many of the end-user (consumer-facing) and 'local' applications that will prove to be the backbone of the LBS market. That is, millions of square meters of indoor space and urban areas are out of reach of GPS systems. Conventional GPS receivers do not work inside buildings due to the absence of line of sight to satellites, while cellular positioning methods generally fail to provide a satisfactory degree of accuracy, resulting in a greater part of the world's commerce and social interaction that is being conducted indoors not being able to take advantage of outdoor positioning systems like GPS. The delivered position fixes cannot even be used for determining whether a target person stays inside or outside a certain building, not to mention that it is by no means possible to locate it with the granularity of rooms or floors.

A multitude of applications and services can benefit from indoor (in building) positioning and navigation such as logistics, routing, sales, asset tracking, personal safety, and emergency response (e.g., Department of Homeland Security's advanced 3D locator system), as well as consumer handset LBS applications. With the last, location-based advertising is a good example, where vendors care about building a closer relationship to the potential consumer. Google, with billions of dollars in annual revenue generated through targeted ads associated with online searches, might be able to improve the economics of such plans via location-based advertising.

Fortunately, over the past decade, advances in location positioning technology have made it possible to locate users and objects indoors (locally; i.e., in urban centers and inside buildings). These alternative technologies are now being introduced

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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Product Summary

Equipped with a state-of-the-art GPS receiver, the KCS TraceME/TrackME Module provides reliable and accurate navigational data. All communication is handled rapidly and effectively by a GPRS/GSM modem (dual/tri-band version available) through a GPRS network or, if not available, by means of a GSM network. In areas with no GPRS/GSM coverage, position-data and events are stored in memory. As soon as communication is restored, all information is transmitted.
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to the market, enabling many kinds of indoor location-aware applications. Different technologies will demand different capabilities from devices, while they bring various constraints. Outside the remit of 2G, 2.5G, 3G, and 4G cellular networks exist other families of positioning technologies that are often referred to as "local positioning", which make use of short-range networks such as 802.11, Bluetooth, RFID, ultrasound, UWB, IrDA, or TV radio signals.

Indoor positioning and tracking applications are not just a vision or found only in the lab. The potentials of location-aware indoor applications were realized in the early 1990s. They were explored in conjunction with research on ubiquitous/sentient computing. Indoor environments present opportunities for a rich set of location-aware applications such as navigation tools for humans and robots, interactive virtual games, resource discovery, asset tracking, location-aware sensor networking, and others. Further, typical indoor applications require different types of location information such as physical space, position, and orientation.

Indoor location-aware applications require micro-detailed geo-referencing to satisfy users' growing needs. It is not enough to geo-reference a building if the position of users and other objects inside the building are also relevant. Objects are used as landmarks, and relationships among the objects are crucial for symbolic representation of the whole system.

Krzysztof Kolodziej
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kkolodziej@indoorLBS.com

MARK YOUR CALENDAR

October 2006

The 12th IAIN World Congress 2006
18-20 October, Jeju, Korea
http:// 203.230.240.83/

Geoinformatics 2006
28-29 October, Wuhan, China
lilyshi@lmars.whu.edu.cn

9th Middle East and Africa Conference for ESRI Users 2006
31 October- 2 November, Amman, Jordan
meauc2006@infograph.co.jo

November 2006

Space Technology and Geo-Informatics 2006 Theme: Space Technology and its Applications in Global Society
2-5 November, Pattaya, Thailand
info@gistda.or.th.
www.gistda.or.th

GSDI-9 - Geospatial Information: tool for reducing poverty
03-11 November, Santiago de Chile, Chile
gsdi9@igm.cl
http://www.igm.cl/gsdi9

Trimble Dimensions
05 - 08 November, Las Vegas NV
http://www.trimble.com

AFITA-2006
9-11 November, 2006
The Indian Institute of Science, Bangalore
http://www.afita2006.org

GIS-IDEAS 2006
9-11, November
Ho Chi Minh City (HCMC), Vietnam
http://wgrass.media.osa-ka-cu.ac.jp/gisideas06/

2006 International Map Trade Association (IMTA) Global Conference and Trade Show
14-17 November, Singapore
imta@maptrade.org

The 12th IAIN World Congress 2006
18-20 November, Korea
jkinpr@mail.hhu.ac.kr

13th Australasian Remote Sensing and Photogrammetry Conference
20-24 November, Canberra, Australia
arspc@icms.com.au

China Geotech 2006
21-23 November, Shanghai, China
info@together-expo.com
www.together-expo.com

XXVI INCA International Congress
New Delhi
November 23-25, 2006
siva_k@nic.in, colbhat@yahoo.com

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

GEO-INFORMATICS
8-9, December
V.P.M's Polytechnic,Thane(Maharashtra)
geo_vpm@rediffmail.com

The GISnet 2 Conference and Exhibition on GIScience, RS, GPS, Space Science and Technology Applications
14-18 Dece mber, Vietnam

January 2007

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

February 2007

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

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

June 2007

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

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www.ordnancesurvey.co.uk/

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