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Cadastres, Nations and States

The work of land surveyors can be seen in the context of state and nation building

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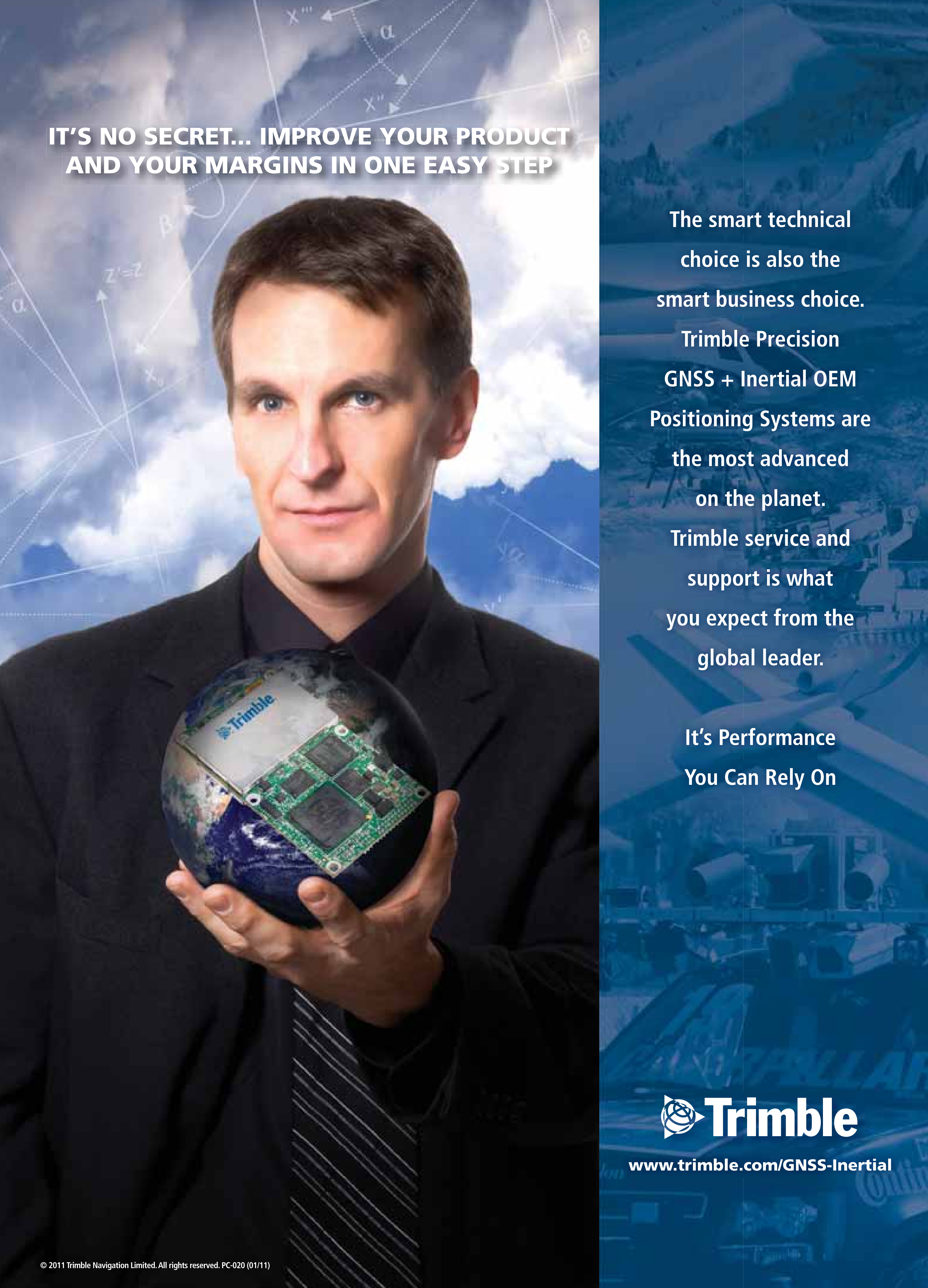
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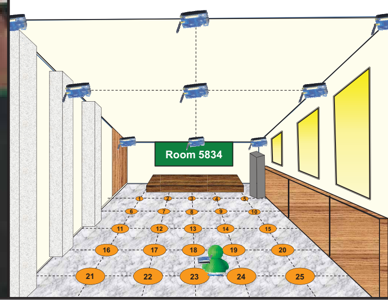

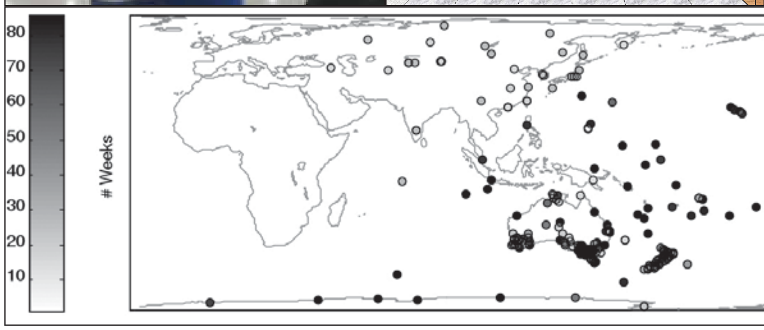

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Fast and steady

The dragon moves.

And moves faster.

Has already sent into the orbit.

The 8th navigational satellite.

A transition appears.

From ‘one of the players’ to ‘the player’.

Will set the tone of the future GNSS,

And redefine the dynamics,

Among various stakeholders in GNSS.

With its own stakes, high.

Bal Krishna, Editor
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Cadastres, Nations and States

The work of land surveyors and land registrars can be seen in a context of state and nation building

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In the book 'Congo' (2010), the author David van Reijbrouck reports about the roundtable conference in Brussels in January 1960. There, the Belgian and Congolese delegation agreed on independence of the Congo already in June of that year. From an institutional side, hardly anything was in place in the -soon 'former'- colony. Executive staff was panicking: 'how to get a popular census in place in six months, a number plate administration, a cadastre…'.

This is a nice illustration that – somehow- cadastres have to do with the building of a nation. As we know that cadastral systems world wide show a great difference (although they also share features), it is worthwhile to have a closer look to the relation between cadastres and nation-building.

'Cadastres', or broader 'a land administration system' is defined by the UN Land Administration Guidelines, 1996/2005 as 'the process of determining, recording and disseminating information about ownership, use and value of land, when implementing land management policies'.

Nation Building

What is Nation building? Here we enter a very sensitive domain. Politicians easily mix up Nation and State; see for example the 'United *Nations*', or '*nationalism*', which are always associated with the 'state' as the main focus of an individual's loyalty…

Its is sensitive, because scholarly publications make clear that ethnic diversity, ethnic consciousness and ethnic loyalty, easily lead to a situation where people tend to be loyal to one's own ethnic group, and not necessarily to a State.

Therefore, the literature makes clear distinction between Nation and State, as follows: a 'Nation is a social group sharing common ideology, institutions, language and homogeneity', while a 'State is a legal concept describing a social group that occupies a certain territory and is organised under common political institutions and an effective government'.

To say it more easily: a Nation is a tight knit group with common culture, and a State is self governing entity

Nation and State

By consequence, the boundaries of Nations do not necessarily coincidence with the boundaries of a State. Statistics show that about 50% of the countries in the world have a situation where States include various Nations or where Nations cover various States. Examples of the latter are the Kurd nation in the Middle East, the Hungarian nation in central Europe, or the Ashanti Kingdom in Africa. Examples of the first are many, actually every country that host various ethnic Nations, such as the Han, Mongols, Uyghur's or Tibetans in China, or closer to home, the Flamands and Walloons in Belgium.

When we speak about Africa, we can find many examples, finding their origin in the Berlin Conference of 1884, where the scramble for Africa was formalised.

'Oneida Nation', tribe of Indians (US)

However, also countries without a colonial history such as Ethiopia or Thailand had to face this situation, with respectively the Eritreans and the Lao people. Today, about 60 conflicts take place between Nations and the State, often based on separist movements however in any case based on ethnic consciousness, such as Sri Lanka (Tamils), India (Punjab, Kashmir), Kirgizstan (Uzbeks), Sudan (Darfur), Kenya (Kikuyu, Lua tribe), Turkey (Kurds), Kosovo (Albanians en Serbs), and who can ever forget the fight between Hutu's and Tutsi's in Rwanda, leading to the genocide of 1994.

Land Administration

The distinction between Nation and State is a very useful distinction also for land administrators, because we know that the common culture of Nations often include a specific understanding of what property rights are. Referring to the definition of a land administration system, especially where it speaks about the determination of land rights, this different understanding of property cannot be without impact on how we think about land registration and cadastre. Actually, I see three different situations exist.

The **first** is the relatively simple case of the Nation-State, where the common culture of a Nation equals loyalty to a State government.

The **second** case is the State that comprises various Nations and which has the challenge to build a State-edifice where an individuals' loyalty to the Nation can exist alongside the loyalty to the State.

The **third** case is the fragile and post-conflict State, where reconciliation should develop between groups that were formerly in conflict with each other.

Nation States

In the first case, the Nation States (which are to a certain extent quite homogeneous), the question is under which kind of State the society should further develop. Here we enter the domain of political economics, namely what is the nature of the intervention of the State in society. This is called 'State building', namely the construction of the foundation of the government edifice, within which governance ought to operate. Without prior construction of this edifice, governance interventions are likely to have only limited effects. It differs whether a society opts for a welfare or neo-liberal approach. In the first case, it is believed that free market forces are in major societal fields unable to deliver socially optimal outcomes. The policy advises of the World Bank and the International Monetary Funds take another stance, namely that it is the free market that will bring progress and prosperity ('*Washington Consensus*'). In the neoliberal State, rules are considered as rigidities which prevent the smooth operation of market forces. Political evaluations have shown that such neo-liberal policy advises often resulted in economic catastrophes, such as in Ghana, Kenya, Zimbabwe, and many countries in Latin America.

Another approach, 'institutional economics', considers the role of the State as an entrepreneur, providing for a vision for society, and creating the institutions required to achieve that vision. Why? Because basically the State is the only 'agent' (as it is called in sociology) which may represent the society as a whole.

The State has to coordinate, which -by the way- brought earlier Karl Marx to the opinion that this State coordination would bring expansion of the State interventions, leading ultimately to central planning under socialism.

'Institutional economics' is the domain of scholars like Douglas North (who got a Nobel price in 1993) and Oliver Williamson (who got it in 2009).

'Real life' parcel numbering in Namibia

Why these remarks about State intervention? Especially in the approach of Douglas North, I see a clear connection with land administration systems. North defines institutions as 'the humanly devised constraints that shape human interactions'. Without these 'rules of the game' (whether the rules are based on the law or on social norms and values) we -as human beings- cannot


Modern urban cadastre Moscow

deal with each other. In his elaboration of what institutions are, North distinguishes three elements, namely market exchange should be complete (which means should include externalities), the transaction costs of market exchange should be a low as possible, and -where there is a risk of market failure- the market should not coordinate but the government, in the form of organisations.

So, a sound definition of property rights and their registration in a land administration system definitely belongs to the necessary institutions to build a State, as is shown in the publications of the chief researcher of the World Bank, dr. Gershon Feder and in the dissertation The Human Right to Property of the late dr. Theo van Banning, the Dutch representative to the FAO in Rome.

Public kiosk urban cadastre Xi'An (China)

State and various Nations

When it comes to the second case, namely those States that comprise a various amount of Nations (ethnic groups), there the situation is more complex, as various property regimes might exist in one and the same country, property regimes that include different rights to land, different ways of transferring such property right, different ways of inheritance, different role of men and women when it comes to holding land rights. The introduction of the Basic Agrarian Law in 1960 in Indonesia provided for inclusion of 'adat' rights, in practice however it seems to be impossible as almost every kampong has it own property arrangement. Papua New Guinea hosts more than 1000 ethnic groups, each of them with own understanding of property rights.

Cadastral Archives in Accra

The main challenge for the States comprising various Nations, is to accept loyalty to Nations alongside loyalty to the State, in stead of imposing central power and policy. This choice is described as either Nation-building, or Nation-destroying. When it comes to property rights, we can read in the book 'The State of Africa' of Martin Meredith (2005), that there are many examples of the latter, imposing land rights regimes, such as Kenya, where -after independence in 1963- the Kenyatta administration adopted the colonial freehold and leasehold as the only permitted form of land tenure, neglecting the variety of tenure forms that were practised by local communities, or the collectivization of community property during the Ujamaa policy of Julius Neyere in Tanzania in the seventies.

Innovative cadastral data aquisition Ethiopia

The land tenure regimes of local tribes are often substantially different from the western notion of private property, in the sense that in large parts of Africa the concept of common property is practised. Tribes, families, villages hold their lands in common, ruled by the chief, family head, or village elderly.

The publication The Tragedy of the Commons, in 1968 in the authoritative journal Science by Garret Hardin, however, suggested that common property regimes might result in over-exploitation of land with negative outcomes for environmental preservation. This view, created the fundament for the first land reform policy paper in 1974 of the World Bank, encouraging abolishment of common property in favour of private property. Until recently, this approach to land tenure, has driven the policy advises of the Bank to developing countries, and by consequence the enforcement of many land titling programmes all over the world.

The discourse between common and private property was subject to political debate in Europe already in 1840, when Pierre Joseph Proudhon published his famous book on 'What is property', leading to the slogan 'property is theft!', or 'property is robbery', later adopted by the young Karl Marx and Friedrich Engels in the first point of the programme of the Communist Manifesto in 1848, namely the 'abolition of private property in land and application of all rents of land to public purposes'.

Project evaluations demonstrate that many titling project brought disaster for local communities, and failed in delivering the benefits assumed to be associated with individual private property rights. This was clearly described by World Bank researchers John Bruce and Sam Migot-Adholla, in their seminal book 'In search for land tenure security in Africa', in 1993, where they provided evidence that common lands were well managed, according to traditional environmental understanding, which had proven to be valid during decennia, and that -at the contrary- private property resulted in over exploitation, because of private owners sub-optimizing their own benefit, despite occurrence of negative externalities. This book effected on the understanding of the value of customary land tenure and land management practices is such a way, that after extensive consultation by the World Bank, a policy research report in 2003 by the Bank, 'Land Policy for Growth and Poverty Reduction' (K. Deininger) embarked on more recognition of customary land tenure arrangements and land management practices, to provide for land tenure security and socially desirable land use. The matter became very serious, when Eddie Mabo, an aboriginal, on 3 June 1992 won a dispute before the Supreme Court of Australia with the state of Queensland, about recognition of his tribe's rights to land which existed before the British vested their own land rights in what they considered as terra nullius. Since then, land rights of indigenous peoples everywhere were recognised, not only the so called 'native titles' in Australia, but for example 'Maori titles' in New Zealand, and 'native titles" for Indians and Inuit in the US en Canada respectively.

In anthropology such situation is indicated as 'legal pluralism', which means that people might have various jurisdictions in their head.

To cope with various land tenure regimes in land administration system design, the pioneering work of Christiaan Lemmen and Peter van Oosterom on the 'Land Administration Domain Model' should be mentioned, because the model they developed aims at accommodating all kinds of land rights in a standardised and therefore manageable way. This is luckily recognised by the big players in the land administration world, because the domain model is currently adopted by UN/Habitat, while World Bank, FAO en the US based MCC are on track in adopting the model. The Model is on its way to become a ISO international standard.

State and Nations in Conflict

When it comes to the third case, the fragile and post conflict States, we still are not sure how to tackle the property rights issue. These –about 40- States cannot yet exercise the core functions of governance, as there are the monopoly of violence, revenue generating, enforcing the rule of law, and the delivery of basic services. They lack weak institutions and a fundamental lack of capacity. In many peace agreements and interim government policy plans however, the establishment of property rights and appropriate registration got priority, such as UNMIK policy plan in Kosovo in 2002, the 1996 Treaty for Peace in Guatemala, the 1991 Peace Treaty in Cambodia, the 2002 National Development Framework of the -then-intern government of Afghanistan, the 1992 peace accord for El Salvador and the Arusha Peace Treaty in Rwanda in 1993.

But how to do? From theory we know that the desirable sequence is first to create constitutive capacity, which can be followed by the development of public administration leading to the rule of law and security. The UN Habitat promotes in the Handbook for Post Conflict Land Administration and Peace Building (2007) that land records as exist prior to a conflict should be protected as much as possible, to have at least some historical material when it would come to rebuilding a cadastre, and not -as happened in Kosovo- where the Serbs took all land registers and cadastral maps from Pristine to Belgrade, where they still are today, leaving a country without an opportunity to reconstruct land rights based on historical evidence. Their plea is that military intervention forces immediately should protect cadastre offices in order to avoid any deletion or theft.

One thing is very clear: when the land registrar writes a name of an owner in the land book, and the land surveyor draws a line on a cadastral map indicating a boundary, and both are not accepted as fair by the population, the country might enter into a second conflict, which for example is said to be a risk for Guatemala.

Epilogue

The paper shows that the work of land surveyors and land registrars can be seen in a context of state and nation building. A cadastre is an institution that contributes to the government edifice, in which governance can take place. Whether this 'governance' can meet the international supported norms of what 'good governance' is, also depends on whether land professionals can associate with wider concepts. When they understand the concepts of State and Nation they can design land administration systems that meet the token of time.

Satellite navigation

Which route should companies take?

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As the consumer satellite navigation industry continues to evolve, it is interesting to look at the various business models of the industry players and how these drive their market positioning. At a basic level, we see two types of business models currently in the industry. On one side, there are the map providers; a mixture of global and regional/local players and on the other, data-driven technology firms such as Google (Google Maps) and Microsoft (Bing Maps). Whilst the former have expertise in map development and navigation, the latter tend to be stronger in content acquisition and management.This is an interesting evolution from an industry make-up standpoint and raises questions around which model is likely to be dominant going forward? Can both co-exist given their respective strengths or are we likely to see major changes in how these companies operate within the satellite navigation space?

How the industry has evolved

Location-related data is increasingly embedded into software and systems that we use and we have seen a significant increase in combining location data with other layers of content to drive additional value-add. For the consumer satellite navigation industry, this means that consumers look for more than maps and directions getting them from A to B. In response to this, the industry has developed content additions such real-time traffic and weather updates. Furthermore, industry players have developed vast databases of places of interest, from hospitals to restaurants and linked phone number information to enable users to find a desired restaurant, call and make a booking and then be guided there through the turn-by-turn navigation that the device provides, whether PND or Smartphone.

Companies involved in this industry need to adapt to these market requirements by developing a core competency in data acquisition and management as this will continue to be increasingly central to the product development. However, this is a balancing act; as companies make decisions about how to allocate resources (labour and capital), there needs to be a clear understanding of what customers value and how the product strategy focuses on the customers' value drivers. This will depend on which customers are being targeted.

Different segments, different uses

The market for satellite navigation can be split into three distinct groups; Personal Navigation Devices (PNDs), Smartphones and in-car systems and each have different requirements, with varying degrees of importance attached to each.

PND and in-car systems are predominantly used as navigation-applications and therefore the ability to input the desired destination and to have the device provide accurate and reliable directions, taking into account traffic and weather conditions is most critical requirement. This has consequences as to how the product is developed because there is a high focus on map accuracy as well as developing the correct traffic attributes to make sure that the directions given are optimal.By contrast, map-based applications on Smartphones tend to be used more from a pedestrian standpoint. As such, whilst the navigation remains important, the breadth and depth of the content layered on top of the map becomes most important for Smartphones. This is because users look to discover and find out about new places of interest near to where they might be at any particular time. Without this rich content on top of the map layer, the user experience is limited.

This highlights how the end-user behaviour dictates requirements and therefore what the various products should deliver. It also suggests an alignment between the industry players and the end-market they serve; with the more traditional map providers (with a legacy focus on map accuracy and navigation) best placed to serve the PND and in-car systems and the data-centric technology companies serving the Smartphone segment.

What this means for industry players

Firstly, it is important to recognise the different market segments and understand how and why satellite navigation products are used because this helps to identify the customers' key purchasing criteria. From this, one can develop a product development strategy which focuses on meeting the needs of the key segments targeted.

Secondly, the challenge for the traditional map providers will be how they compete with likes of Google and Microsoft in the Smartphone segments. This may require a change in how they acquire and manage data, such as using user-generated content which enable a more scalable approach to data collection, or using web-crawling technology to pick up new or update existing content. Developing competencies in data acquisition and collections will also mean strengthening internal capabilities, to reduce the cost of data acquisition and management and making sure the right processes are in place to build and grow the content base in a timely manner to ensure that not only is there content growth but the data is up-to-date and accurate.

Final thoughts

In conclusion, we are likely to see convergence between the various business models employed by the satellite navigation industry players. The main shift is likely to come from the traditional-map players as they will need to adapt to the ever increasing layers of content being delivered to customers. This will mean developing products that are fit-for-purpose across the market segments and developing the capabilities to acquire and manage data on a larger scale than ever before. The winners will adapt quickly to the ever-increasing data-centric market environment.

The APREF Project

The Asia-Pacific Reference Frame (APREF) is an initiative that recognizes the importance of improving the regional geodetic framework in the Asia-Pacific region

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The Asia-Pacific regional geodetic reference frame, presently characterized as a patchwork of national and regional datums, is below the standard that is now available, and expected, in other regions of the world such as Europe (Bruyninx et al, 2001), South America (Luz et al 2002) and North America (Henton et al 2007). In contrast to these other regions, the reference frame of the Asia-Pacific is comparatively sparse, inhomogeneous in accuracy, infrequently realized, often difficult to access, and while there are a number of high-quality Global Navigation Satellite Systems (GNSS) networks the inter-relationships between networks are poorly understood as is their linkage to the global frame, the International Terrestrial Reference Frame (ITRF) (Altamimi, 2007). Commencing in March 2010, as an initiative of the Permanent Committee on GIS Infrastructure for Asia and the Pacific (PCGIAP) and the International Association of Geodesy (IAG), the Asia-Pacific Reference Frame (APREF) is a regional GNSS-coordination effort which aims to address these limitations.

The broad objective of APREF is to create and maintain an accurate and densely realized geodetic framework based on continuous observation and analysis of GNSS data. This regional framework is to provide improved support for positioning applications in hazard assessment, mining, agriculture, construction, emergency, land, utility and asset management by improving access to GNSS data and the International Terrestrial Reference Frame. In this paper, we highlight the progress of the APREF initiative and review the first results.

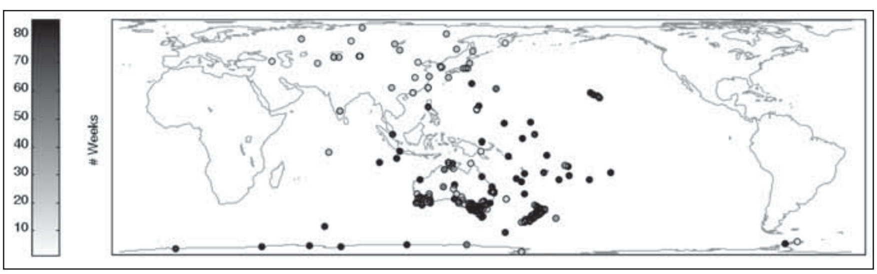

Fig 1: Number of weeks that stations were included in the APREF solution (from GPS Week 1512 until 1597)

The APREF Project

APREF is mandated by Resolution 1 (Regional Geodesy) of the 18th United Nations Regional Cartographic Conference (UNRCC) for Asia and the Pacific, 26 – 29 October 2009, Bangkok, Thailand. Demonstrating a broad community desire to improve the reference frame it is also endorsed by the International Global Navigation Satellite System Service (IGS), the United Nations Office for Outer Space Affairs (UNOOSA) and the Federation of International Surveyors (FIG). APREF is a voluntary, collegial, non-commercial endeavour, and has to date encouraged wide participation from government agencies, research institutes and the private sector. There is no central funding source and each participating organization is contributing their resources. APREF is encouraging the sharing of GNSS data from Continuously Operated Reference Stations (CORS) in the region while also developing an authoritative source of coordinates, and their respective velocities, for geodetic stations in the Asia-Pacific region.

In response to the March 2010 Call for Participation (CfP) a large number of agencies have agreed to participate in APREF, Table 1 summarizes their commitments. APREF products presently consist of a weekly combined regional solution, in SINEX format (Blewitt, 1994), and a cumulative solution which includes velocity estimates. In addition to those stations contributed by participating agencies, the APREF analysis also incorporates data from the International GNSS Tracking Network (Dow et al 2009), including stations in the Russian Federation (16), China (10), India (3), French Polynesia (2), Kazakhstan (1), Thailand (1), South Korea (3), Uzbekistan (1), New Caledonia (1), Marshall Islands (1), Philippines (1), Fiji (1), and Mongolia (1). Figure 1 shows the current distribution and the number of weeks that stations were included in the APREF processing from early 2009 (GPS week 1512) until June 2010 (GPS week 1597). The increase in the number of stations reflects both greater participation in APREF and the inclusion of additional IGS stations in the analysis.

First APREF products

The first APREF products consist of weekly ITRF2005 coordinate solutions for the stations in the APREF tracking network. The procedure that leads to the combined solution is illustrated in figure 2. There are currently two active APREF analysis centres, Geoscience Australia (GA) and the Curtin University of Technology (CUT), and both undertake analysis using the Bernese GPS Software Version 5.0 (Dach et al. 2007). Both analysis centres adopt a conventional approach to regional GNSS solutions where satellite orbits and EOPs were fixed to the IGS final products. Station coordinates were estimated once every 24 hours and the datum was defined using a free-network approach. A Neill mapping function (Niell, 1996) was used and tropospheric delays estimated every hour and horizontal gradients in the N-S and E-W directions were estimated once every 24 hours. The site displacement modelling was consistent with the IERS Conventions 2003 (McCarthy and Petit, 2004) and ocean tidal loading corrections were applied according to the GOT00.2 model, which is an updated version of the GOT99 model (Ray, 1999). Satellite and antenna phase centre corrections were applied from the IGS05 model (Schmid et al, 2007). Carrier phase ambiguities were resolved in a baseline by baseline mode using the Quasi-Ionosphere-Free (QIF) approach (Mervart and Schaer, 1994). The daily solutions were combined into a weekly solution at the normal equation level and subsequently converted into SINEX format.

The GA and CUT solutions were combined using the procedures and algorithms implemented in the Combination and Analysis of Terrestrial Reference Frames (CATREF) software (e.g., Altamimi et al. 2007). Specifically, the alignment of the weekly solutions is undertaken using a Helmert transformation in a minimal constraint approach. Approximately 250 stations are presently included in the analysis. Besides the combined APREF solution the individual contributions of the analysis centres to the combined solution are also available for further analysis.

Figure 3 shows example coordinate time-series for stations Alice Springs (ALIC), in the centre of Australia and Pago Pago (ASPA) American Samoa in the Pacific ocean from the GA APREF analysis. The input data are the GA, daily, operational SINEX products and were combined using the CATREF software. Each daily solution is aligned to the combined solution by application of a seven parameter (Helmert) transformation. Estimated discontinuities are indicated by a vertical red line, which for ASPA station are co-seismic in origin.

Figure 4 shows the raw-velocity field of the horizontal velocities APREF station in South-West Australia based on the combination of the weekly GA and CUT SINEX files with Bernese Software Version 5.0. The stations shown in this plot have been in the network for at least 52 weeks. The velocity field is homogeneous, although there are differences in the relative (compared to mean, Figure 4) velocities of the stations in the region. The relative velocities are at the noise level of the velocity estimation and no conclusion can be given on the relative velocities. Vertical velocities have not been shown here. The estimated vertical velocities of the stations are at the noise level of the vertical velocity estimation. To provide accurate vertical velocities a longer time span of APREF solutions is needed.

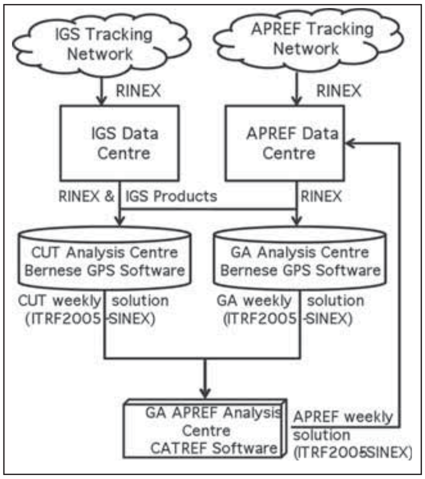

Figure 2: The procedure for generation of the APREF weekly ITRF2005 coordinate solution

Further development of APREF

The major objective for APREF in the short term is to encourage greater participation to support ITRF densification in the region. In particular, new additional analysis centres need to be identified to support the development of a more robust regional solution.

The CUT GNSS Research Centre will continue to act as an analysis centre and plans integration of GLONASS in the daily processing in the near future to improve the APREF solution and to include next generation GNSS/RNSS systems when they become available. New products from the Curtin AC will include site specific troposphere values and regional ionospheric maps. As a user of APREF the group will rely on the data from the APREF network, the combined APREF solutions and the individual analysis centre results for its research on next-generation GNSS, atmosphere and optimal GNSS data processing algorithms.

Conclusions

The APREF initiative recognizes the importance of improving the regional geodetic framework in the Asia-Pacific region. The cumulative combination of the APREF solutions will be contributed to the International Association of Geodesy (IAG) Regional Dense Velocity Field Working Group. The APREF Call for Participation will remain open for all organizations until December 2010.

Currently two analysis centres contribute to the combined APREF solution, more analysis centres will have to be identified to support the development of a more robust regional solution. The combined solution is available for data from January 2009 and in the first 24 months of data processing the number of stations included in the combined solution has been tripled to approximately 300. The combined APREF solution is available from the APREF archives, the first operational archive centre for APREF is run by Geoscience Australia.

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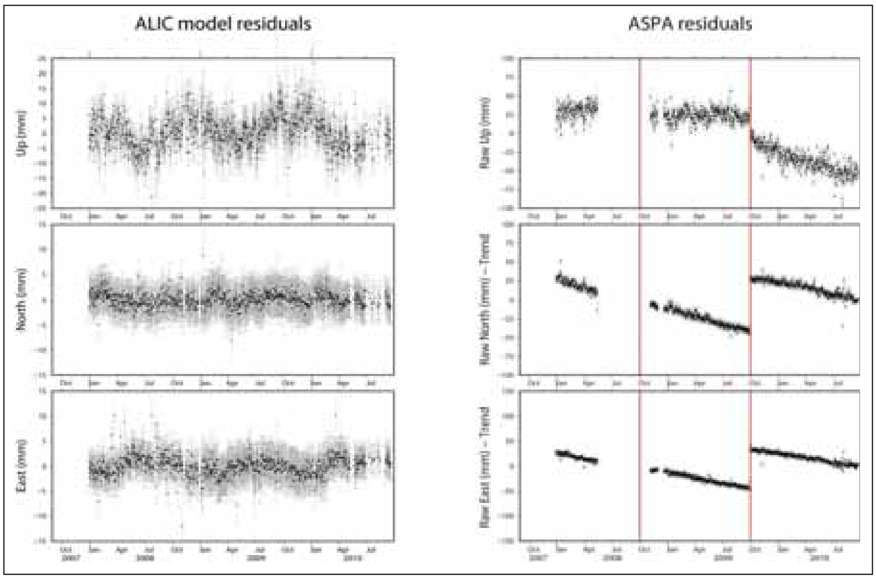

Figure 3: Example time series from the daily GA APREF solution, shown uncertainties are 1 sigma. Left: Computed residuals (mm) after outlier removal, velocity and offset estimation for the ALIC station (Australia). Right: Raw time series (mm), the east and north components are shown after linear trend removal for the ASPA station (Pacific ocean), the vertical red line indicates estimated discontinuities which are co-seismic in origin.

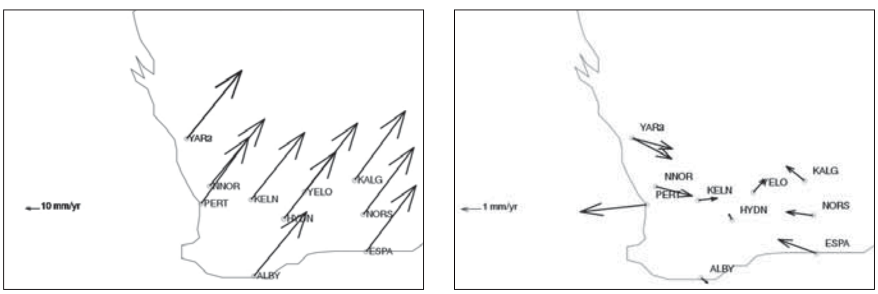

Figure 4: Absolute (left) and relative (compared to mean, right) velocities derived from combination of the individual GA and CUT APREF solutions using Bernese GPS Software version 5.

Country/Locality	Responding Agency	Proposed Contribution		
		Analysis	Archive	Stations
Afghanistan	National Geodetic Survey (USA)			2
Alaska, USA	National Geodetic Survey (USA)			90
American Samoa	National Geodetic Survey (USA)			1
Australia	Geoscience Australia	✓	✓	50
Australia	Curtin University of Technology	✓		1
Australia	University of New South Wales	✓		
Australia	Department of Environment and Resource Management, Queensland			8
Australia	Department of Sustainability and Environment, Victoria	✓		55
Australia	Department of Lands and Planning, Northern Territory			5
Australia	Department of Primary Industries, Parks, Water & Environment, Tasmania			2
Australia	Land and Property Management Authority, New South Wales			52
Cook Islands	Geoscience Australia			1
Cook Islands	Geospatial Information Authority of Japan			1
Federated States of Micronesia	Geoscience Australia			1
Fiji	Geoscience Australia			1
French Polynesia	Geospatial Information Authority of Japan			1
Guam, USA	National Geodetic Survey (USA)			1
Hawaii, USA	National Geodetic Survey			19
Hong Kong, China	Survey and Mapping Office			6
Indonesia	Bakosurtanal			4
Iran	National Cartographic Center, Iran			5
Iraq	National Geodetic Survey (USA)			6
Japan	Geospatial Information Authority of Japan	✓	✓	10
Kazakhstan	Kazakhstan Gharysh Sapary			2
Kiribati	Geoscience Australia			1
Kiribati	Geospatial Information Authority of Japan			2
Macau, China	Macao Cartography and Cadastre Bureau			3
Marshall Islands	Geoscience Australia			1
Micronesia	Geoscience Australia			1
Nauru	Geoscience Australia			1
New Zealand	Land Information New Zealand	✓	✓	38
Northern Mariana Islands	National Geodetic Survey (USA)			1
Papua New Guinea	Geoscience Australia			1
Philippines	Department of Environment and Natural Resources, National Mapping and Resource Information Authority	✓	✓	4
Samoa	Geoscience Australia			1
Solomon Islands	Geoscience Australia			1
Tonga	Geoscience Australia			1
Tuvalu	Geoscience Australia			1
Vanuatu	Geoscience Australia			1

Table 1: Responses to the APREF CfP. Responding agencies have indicated whether they would undertake analysis, provide archive and product distribution or supply data from GNSS stations. Geoscience Australia has agreed to act as the Central Bureau coordinating the overall activities of APREF.

Research Infrastructure Strategy (NCRIS), an Australian Commonwealth Government Programme. The third author is the recipient of an Australian Research Council Federation Fellowship (project number FF0883188): this support is gratefully acknowledged.

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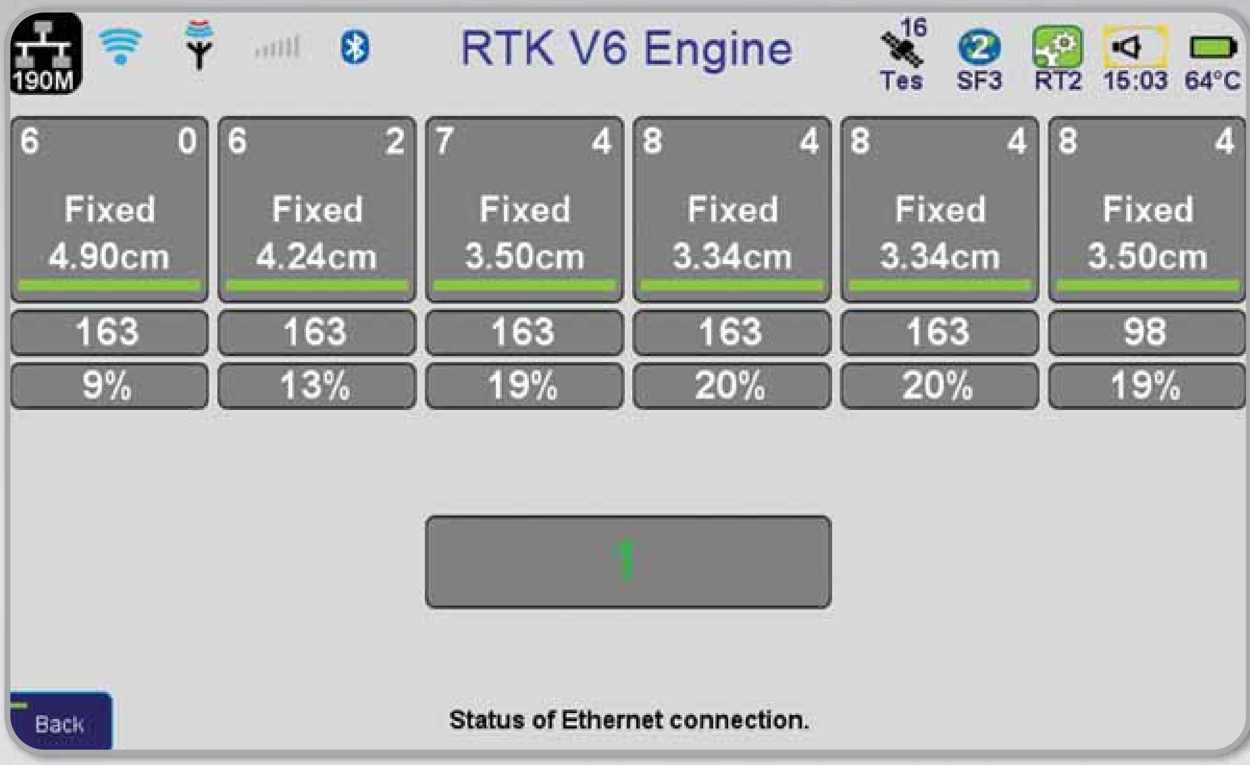


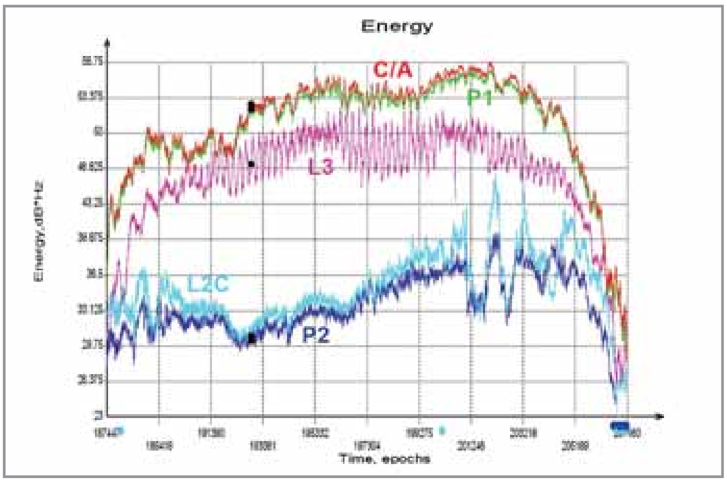
We invented and implemented the six pack RTK V6 engine (patents pending). Six RTK engines work in parallel to produce the best results in all conditions.

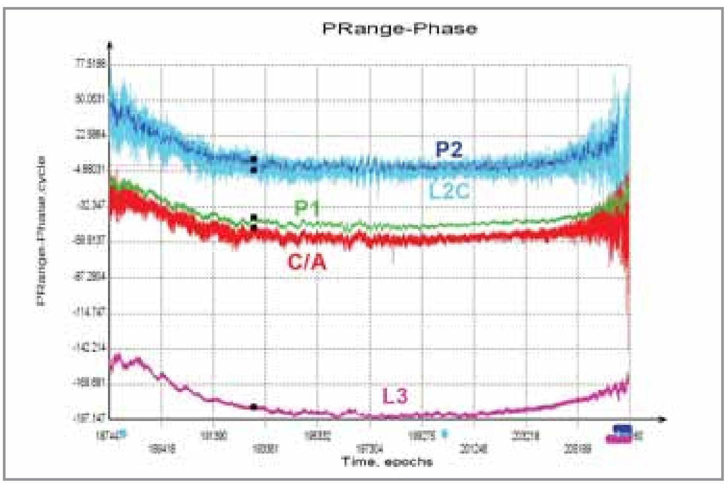
Please see www.JAVAD.com for details.

GLONASS-K L3 CDMA

Starting 02:30 GMT on April 8, 2011 we tracked the first CDMA signals of GLONASS-K satellite on L3 GLONASS band.

Data were logged at our Moscow office on April 11, 2011 from 00.00 till 07.30 Moscow time. Satellite's ground path, code-minus-phase and SNR are shown below. Data quality is quite similar to GPS.



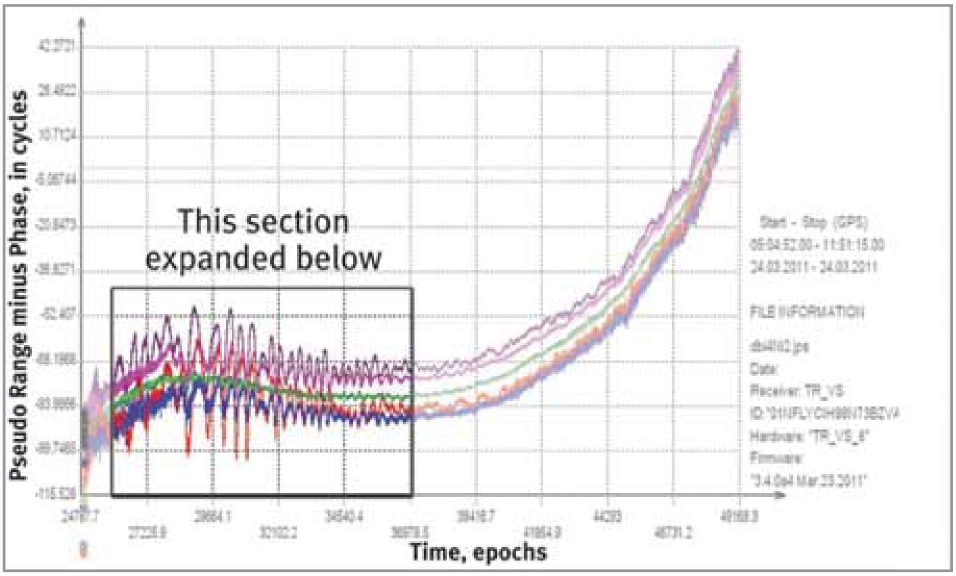


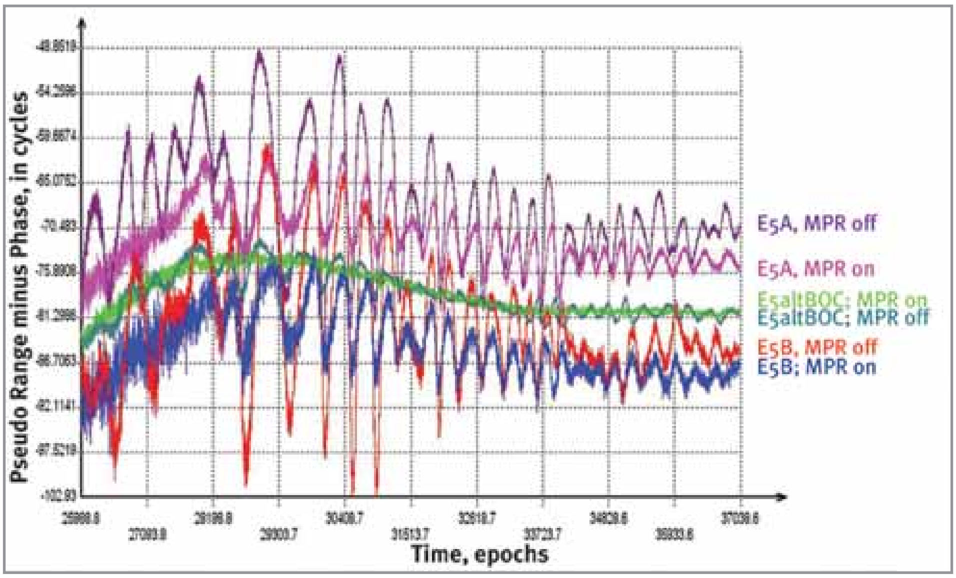
These are not lab tests;

Galileo E5 altBOC

Truimph-VS receiver has the option to track E5A, E5B and E5altBOC signals now. These 3 signals may be tracked independently, but as expected, E5 altBOC combination shows great multipath reduction compared with separate E5A or E5B signals. JAVAD's superior multipath reduction (MPR) technique makes it almost perfect.

Six plots in this graph show three signals, each with and without JAVAD's multipath reduction feature.





all in receivers that we

QZSS Satellite

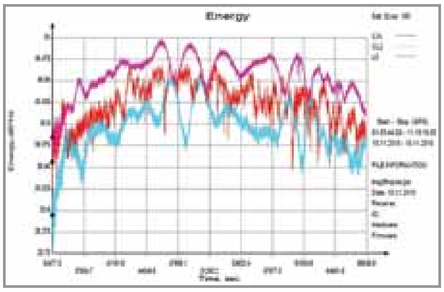
Another first: On the afternoon of Friday October 29, 2010, JAVAD GNSS engineers in Moscow tracked Japan's first QZSS satellite and its new L1C signal, as we reported earlier.

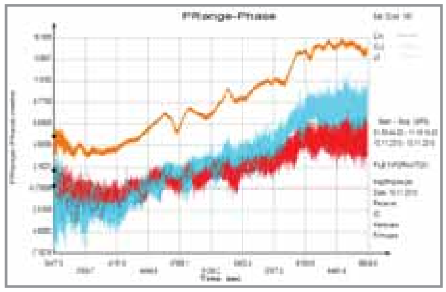
We update our report by presenting C/A, L2C, L5, SAIF and the new L1C signals that were collected on November 10, 2010 from 02.00 till 12.00 UTC, when QZSS-1 satellite was visible in Moscow. QZSS is the first satellite which transmits new L1C signal.

All of the current JAVAD GNSS receivers, including OEM boards, ALPHA, DELTA, SIGMA, TRIUMPH-1 and TRIUMPH-VS can track QZSS signals with a software update. The software upgrade may be released as early as next week.

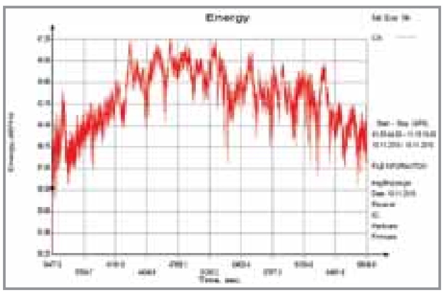
Figures below show "SNR" and "code-minus-phase" plots for all the above signals

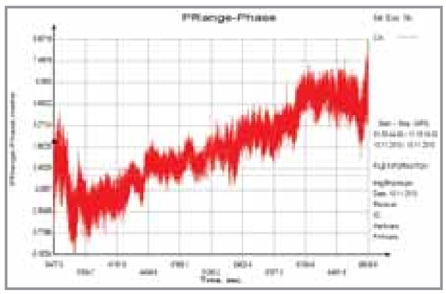
QZSS C/A, L2C, L5 signals:

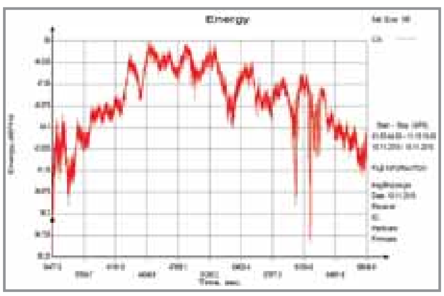


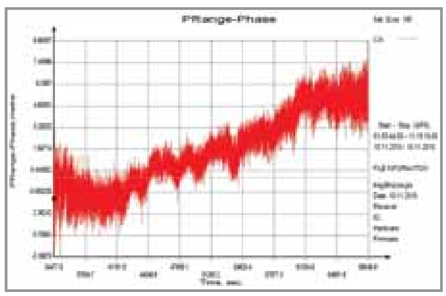


QZSS SAIF signal:







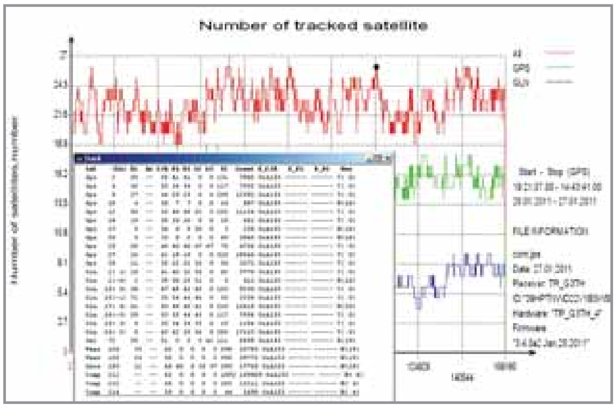


ship in mass production t

Chinese Compass (Beidou-2)

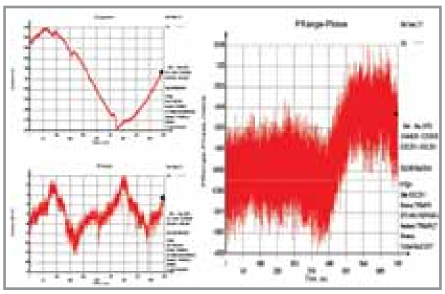
With modified firmware, all JAVAD GNSS receivers can track Chinese COMPASS B1 signal now. This is 6th GNSS system supported by JAVAD GNSS (GPS, Glonass, Galileo (Giove), SBAS, QZSS, COMPASS). Log file, collected on TR_G3TH board in Moscow during weekend, reported up to 26 (!) satellites locked simultaneously see picture below.

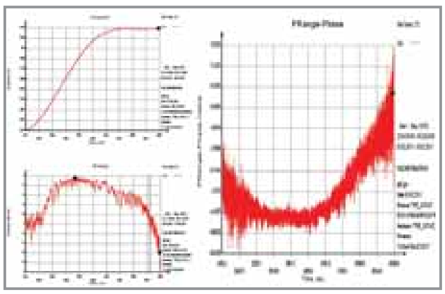
Among them:
11 GPS satellites with C/A, P1, P2, L2C, L5;
8 Glonass satellites with C/A, P1, P2, L2C;
1 Galileo (Giove) satellite with E1, E5A;
2 SBAS (Egnos) satellite with C/A;
1 QZSS satellite with C/A, SAIF, L2C, L5, L1C
3 Compass satellites with B1.

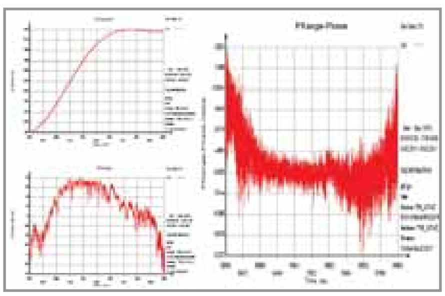


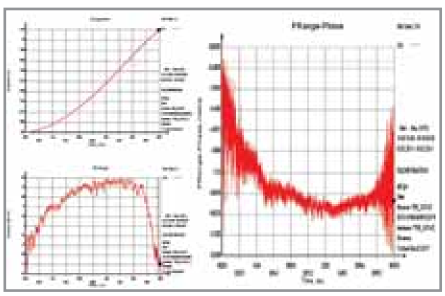
Compass system currently consists of 6 alive satellites, 4 of them are visible in Moscow: COMPASS-G3, COMPASS-IGSO1, COMPASS-IGSO2 and COMPASS-M1. Their day track is shown on next picture.

Below are Doppler, SNR and "code-minus-phase" graphs for all these satellites (G3=211, IGSO1=212, IGSO2=213, M1=214), collected during their pass:









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TRIUMPH-1

TRIUMPH-4X

Alpha

Delta

Sigma

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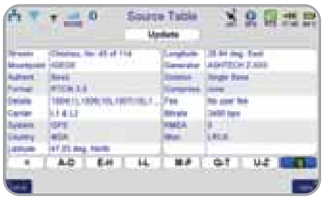
Introduction to Triumph-VS

RTK with base station and UHF

Maps & Points

In the Field With RTK

Draw (Manage Points)

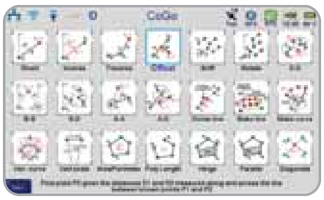


VRS (LAN, Wi-Fi, GPRS, NTRIP)

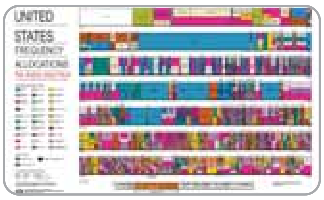
Six Pack RTK V6 Engine

Selecting local coordinate system

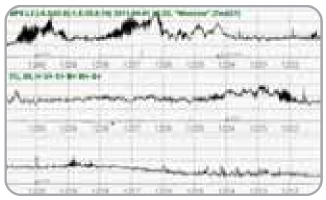
Creating local coordinate system



CoGo



Introduction to GNSS Spectrum



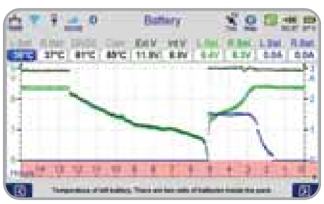
TRIUMPH-VS GNSS Spectrum Analyzer

Stakeout and Stake-Survey

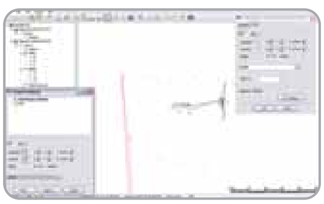
Structure Monitoring

Base station

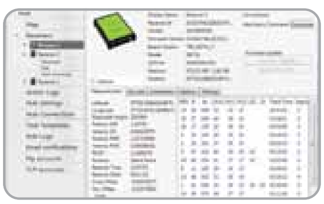
Support, update software, OAF



Inside Batteries



JustinLink



NetHub

NetView

Geodesic based trajectories in navigation

The paper presents the current and uniform approaches to sailing calculations highlighting recent developments. Here we present the first part of the paper. The concluding part would be published in June issue

Adam Weintrit
Gdynia Maritime University, Gdynia, Poland

Piotr Kopacz
Gdynia Maritime University, Gdynia, Poland

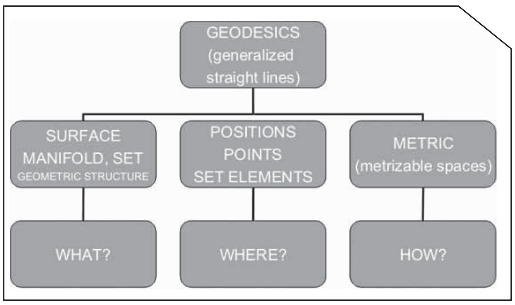


Fig 1. Geometrical basis in geodesic analysis [Kopacz, 2006]

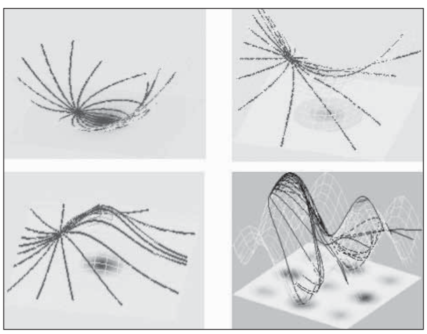


Fig 2. Flows of geodesics (distance functions) on locally modelling surfaces of differing curvatures

The geometry of approximating structures implies the calculus essentially, in particular the mathematical formulae in the algorithms applied in the navigational electronic devices and systems. Thus, we place special emphasis on the geometrical base of the subject. The question we ask affects the range and point in applying the loxodrome (rhumb line) in case the ECDIS equipped with the great circle (great ellipse) approximation algorithms of given accuracy replaces the traditional nautical charts based on Mercator projection. We also cover the subject on approximating models for navigational purposes. Moreover, the navigation based on geodesic lines and connected software of the ship's devices (electronic chart, positioning and steering systems) gives a strong argument to research and use geodesic-based methods for calculations instead of the loxodromic trajectories in general.

A common problem is finding the shortest connection across the Earth surface between two positions. Such trajectory is always a part of a geodesic (great circle, great ellipse) on the modelling globe surface. The geodesic is used by ship navigators attempting to minimize distances and the radio operators with directional antennae used to look for a bearing yielding the strongest signal. The spherical model is often used in cartographic projections creating the frame of the presented chart. The trajectory of the geodesic lines and the loxodrome looks different depending on the method of the projections given by the strict formulae. Thus, many map projections are invaluable in specialized applications. A Mercator projection is not the only one used by navigators, as the loxodrome does not usually coincides with the geodesic. More commonly applied to large-scale maps, the transverse aspect preserves every property of Mercator's projection, but since meridians are not straight lines, it is better suited for topography than navigation. Equatorial, transverse and oblique maps offer the same distortion pattern.

Theoretical base

For curved or more complicated modelling surfaces the metric can be used to compute the distance between two points by integration. The distance generally means the shortest distance between two points. Roughly speaking, the distance between two points is the length of the path connecting them. Most often the research and calculus in navigational literature are considered on the spherical or spheroidal models of Earth because of practical reasons. The flow of geodesics on the ellipsoid of revolution (spheroid) differs from the geodesics on the sphere. There are known different geodesics on the same surface with the same metric considered. However geodesic refers to the metric what is usually not taken into consideration in the navigational lectures. And there are different flows of geodesics on the same surface when different metrics are applied. That means we can obtain geometrically different results in navigational aspect if we change the researched modelling object including its geometrical and physical features [Kopacz, 2006].

Let us focus on two essential notions creating the base for the various fields of the mathematical research: the metric and topology. A metric space is a set with a global distance function (the metric) that, for every two points in, gives the distance between them as a nonnegative real number.

Definition 1. A function $g: X \times X \to [0, \infty)$ is called *a metric* (or distance) in X if

(1) $g(x, y) = 0$ iff $x = y$ (positivity);

(2) $g(x, y) = g(y, x)$ for every $x, y \in X$ (symmetry);

(3) $g(x, y) \leq g(x, z) + g(z, y)$ for every $x, y, z \in X$ (triangle inequality).

Metric as a nonnegative function describes the "distance" between neighbouring points for a given set. When viewed as a tensor, the metric is called a metric tensor. We can define a metric in each non-empty set ($X \neq \emptyset$). Formally the pair (X, g) where g is a metric in a set X is called a *metric space*. Fig. 1 points out the essential role played by the metric in geodesic approach to the subject.

Making one step further we can generalize the metric space to the topological space.

Definition 2. Let $X \neq \emptyset$ be a set and $P(X)$ the power set of X, i.e. $P(X)=\{U : U \subset X\}$ Let $\Omega \subset P(X)$ be a collection of its subsets such that:

(1) $(\forall \iota \in I \quad U_\iota \in \Omega) \Rightarrow \bigcup_{\iota \in I} U_\iota \in \Omega$

(the union of a collection of sets, which are elements of Ω, belongs to Ω);

(2) $U, V \in \Omega \Rightarrow U \cap V \in \Omega$ (the intersection of a finite collection of sets, which are elements of Ω, belongs to Ω);

(3) $\emptyset, X \in \Omega$, (the empty set $\emptyset$ and the whole set X belong to Ω).

Then

- Ω is called a topological structure or just a topology in X;
- the pair (X, Ω) is called a topological space;
- an element of X is called a point of this topological space;
- an element of Ω is called an open set of the topological space (X, Ω).

The conditions in the definition presented above are called the axioms of topological structure. A topology, that is a metric topology, means that one can define a suitable metric that induces it. Additionally we assume here that although the metric exists, it may be unknown. In a metric space (X, g) the family of sets Ω

$$\Omega = \{U \subset X : \forall_{x \in U} \exists_{\varepsilon > 0} B(x, \varepsilon) \subset U\}$$

satisfies the above mentioned axioms of topology. That means (X, g) is a topological space and thus, each metric space is a topological space. There are sufficient criteria on the topology that assure the existence of such a metric even if this is not explicitly given. An example of an existence theorem of this kind is due to Urysohn who proved that a regular T_1-space whose topology has a countable basis is metrizable [Kelley, 1955]. Conversely, a metrizable space is always T_1 and regular but the condition on the basis has to be weakened since in general, it is only true that the topology has a basis which is formed by countably many locally finite families of open sets. Special metrizability criteria are known for Hausdorff spaces (T_2-spaces). A compact Hausdorff space is metrizable if and only if the set of all elements is a zero set [Willard, 1970]. The continuous image of a compact metric space in a Hausdorff space is metrizable. This implies in particular that a distance can be defined on every path in T_2-space.

The mathematical formulae used in approximation of the navigational calculations are being studied and are based on spherical (spheroidal) model. However if we consider different shape of the surface the formulae change considerably. The examples of the flows of geodesics on locally modelling surfaces of differing curvature are presented graphically in Fig. 2.

Let us imagine that the vessels do not sail on spheroidal earth but locally torus - shaped planet. In this case the flow of geodesics (Fig. 3) and mentioned rhumb line or used charts are based on other mathematical expressions due to different geometrical object considered. The torus is topologically more simple than the sphere, yet geometrically it is a very complicated manifold indeed. The round torus metric is most easily constructed via its embedding in a Euclidean space of one higher dimension.

Taking into consideration the main theoretical aspects of the subject above mentioned as well as the practical ones influencing the base and components of the navigational algorithm to be applied we collect all of them together what has been shown in Fig. 4.

The notion of geodesics makes sense not only for surfaces in R^3 but also for abstract surfaces and more generally (Riemannian) manifolds. We also refer to [Funar, Gadgil, 2001] where the notion of a topological geodesic in a *3*-manifold have been introduced. Geodesics in Riemannian manifolds with metrics of negative sectional curvature play an essential role in geometry. It is shown there that, in the case of *3*-dimensional manifolds, many crucial properties of geodesics follow from a purely topological characterization in terms of *knotting* as well as proved basic existence and uniqueness results

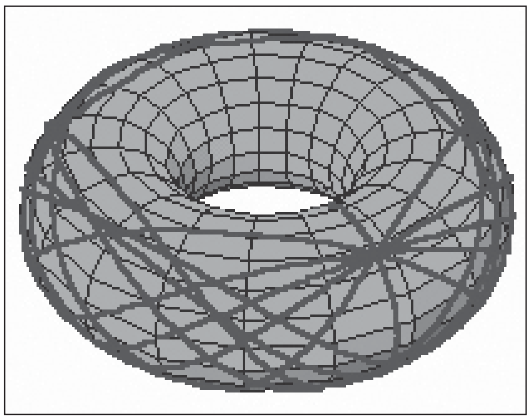


Fig 3. The geodesics on a torus $T^2 = S^1 \times S^1$ coming from an initial position P

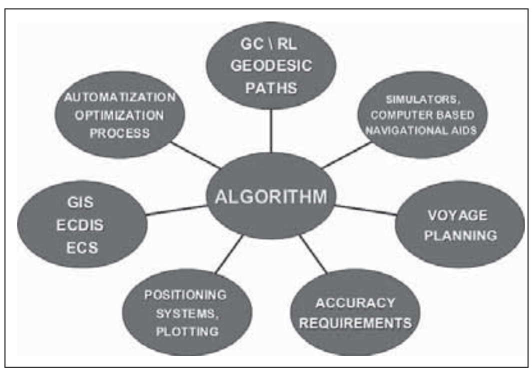


Fig 4. Navigational calculations' algorithm guidelines

for topological geodesics under suitable hypotheses on the fundamental group. For further reading we send the reader to the wide literature on Riemannian and Finsler geometry and topology, in particular the geodesic research.

Plane model

The surface of revolution as the Earth's model - sphere S^2 or the spheroid is locally approximated by the Euclidean plane tangent in a given position. Generally, we approximate locally the curved surface by the Euclidean plane. For some applications such approximation is allowed and sufficient for practical need of research. That is satisfactory if we do not exceed the required accuracy of provided calculations. Hence the boundary conditions of applying the Euclidean plane or spherical geometry ought to be strictly defined. The mathematical components of the plane Euclidean geometry applied in navigational device are widely known and there is a common Euclidean metric used in the calculus as the distance function. We emphasize that the geodesics may look different even on the plane if different metrics are considered. For the practical reasons and the ease of use there is Euclidean plane tangent to the modelled surface used in many applications, for instance in dynamic positioning (DP) software. The plane model enables the satisfactory accuracy in a local approximation. In the local terrain geodesic research the area can be considered flat if it is inside the circle of a radius of ca. 15.5 km. This corresponds to the area of spherical circle which diameter equals ca. 17' of the great circle [Kopacz, 2010]. Practically such an approximation allows the direct geodesic measurements without considering the curvature of the modelled Earth surface and presenting the results on the plane in the appropriate scale. In the global modelling of the Earth's surface (geodesy, cartography, navigation, astronomy) the Euclidean geometry becomes not sufficient for the geometric description and the calculus coming from it. Thus, the limits of application of the approximation methods based on the flat Euclidean geometry must be clearly determined [Kopacz, 2010].

Spherical and spheroidal model

As the Earth's global model an oblate spheroid is used providing the navigational calculations i.e. distances and angles or the sphere for the ease of use. A sphere, spheroid or a torus surface are examples of *2*-dimensional manifolds. Manifolds are important objects in mathematics and physics because they allow more complicated structures to be expressed and understood in terms of the relatively well understood properties of simpler spaces. The study of manifolds combines many important areas of mathematics: it generalizes concepts such as curves and surfaces as well as ideas from linear algebra and topology. To measure distances and angles on manifolds, the manifold must be Riemannian. We recall that a Riemannian manifold is an analytic manifold in which each tangent space is equipped with *an inner product* in a manner which varies smoothly from point to point. This allows one to define various notions such as length, angles, areas (or volumes), curvature, gradients of functions and divergence of vector fields. More general geometric structure a Finsler manifold allows the definition of distance, but not of angle. It is an analytic manifold in which each tangent space is equipped with *a norm*, in a manner which varies smoothly from point to point. This norm can be extended to a metric, defining the length of a curve; but it cannot in general be used to define an inner product. Any Riemannian manifold is a Finsler manifold. Manifold theory has come to focus exclusively on these intrinsic properties (or invariants), while largely ignoring the extrinsic properties of the ambient space.

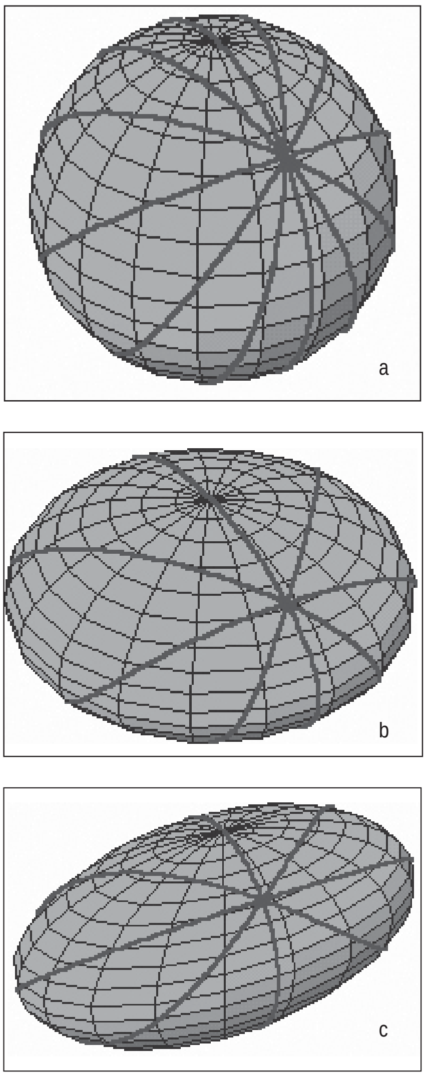


Figure 5. Geodesics coming from an initial position P on 2-dimensional modelling manifolds of positive curvature a)sphere, b) spheroid (ellipsoid of revolution), c) triaxial ellipsoid.

Triaxial ellipsoid as 2-dimensional submanifold M in R^3 is defined by the equation $\Phi = 0$ where

$$\Phi(x,y,z) = \frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} - 1 .$$

Let N be the non-vanishing normal vector field on M. Then

$$N(x,y,z) = 0{,}5\, grad\Phi = \frac{x}{a^2}e_1 + \frac{y}{b^2}e_2 + \frac{z}{c^2}e_3$$

where the $\{e_1, e_2, e_3\}$ is the canonical basis of the vector space R_3. The Gaussian curvature K of the modelling triaxial ellipsoid equals $K = \frac{1}{a^2b^2c^2\|N\|^4}$.

The Gaussian curvature is the determinant of the shape operator. For the sphere

$a=b=c=r$ and then $\|N\| = \frac{1}{r}, K = \frac{1}{r^2}$

where r denotes a radius of the modelling sphere. Thus, we conclude here that the curvature affects the geometry of the locally approximating surfaces essentially and in particular their geodesic trajectories.

2-dimensional sphere S^2 is widely considered to model globally the surface of the Earth. As a calculating tool the spherical trigonometry is used which states the base for the comparison analysis and algorithms implemented in the software of navigational aids e.g. receivers of the positioning systems, ECDIS. The surface of the Earth may be taken mathematically as a sphere instead of ellipsoid for maps at smaller scales. In practice, maps at scale 1:5 000 000 or smaller can use the mathematically simpler sphere without the risk of large distortions. At larger scales, the more complicated mathematics of ellipsoids are needed to prevent these distortions in the map. A sphere can be derived from the certain ellipsoid corresponding either to the semi-major or semi-minor axis, or average of both axes or can have equal volume or equal surface than the ellipsoid [Knippers, 2009].

We recall the great circle is the equivalent of the Euclidean straight line, it has the finite distance and it is closed. The geodesics starting from a given position on three main modelling surfaces (2-dimensional modelling manifolds of positive curvature), i.e. sphere, spheroid and triaxial ellipsoid are presented in Fig. 5. The general question we ask affects the range and point of usage of the rhumb line in case the ECDIS systems equipped with the great circle or great ellipse approximation algorithms of given accuracy replaces the traditional paper charts based on Mercator projection.

Moreover, the navigation based on geodesic lines and connected software of the ship's device (electronic chart, positioning and steering systems) gives a strong argument to use this method for calculations instead of the loxodromic one in general. Although the basic solutions for navigational purposes have already been known and widely used there are still the new approaches and efforts made to the subject. The main efforts affect the optimization and approximation methods which potentially may give the practical benefits for the navigators. As we mentioned above the shortest path between two points on a smooth surface is called a geodesic curve on the surface. Remarkably the path taken by a particle sliding without friction on a surface will always be a geodesic. This is because a defining characteristic of a geodesic is that at each point on its path, the local centre of curvature always lies in the direction of the surface normal, i.e. in the direction of any constrained force required to keep the particle on the surface. There are thus no forces in the local tangent plane of the surface to deflect the particle from its geodesic path. There is a general procedure, using the calculus of variations, to find the equation for geodesics given the metric of the surface [Williams, 1996]. Obviously the Earth is not an exact ellipsoid and deviations from this shape are continually evaluated. The *geoid* is the name given to the shape that the Earth would assume if it were all measured at mean sea level. This is an undulating surface that varies not more than about a hundred meters above or below a well-fitting ellipsoid, a variation far less than the ellipsoid varies from the sphere. The choice of the reference ellipsoid used for various regions of the Earth has been influenced by the local geoid, but large-scale map projections are designed to fit the reference ellipsoid, not the geoid.

To be concluded in June-11 issue.

Real time indoor location based service test bed

The purpose of this paper is to develop low cost and low power consumption Real Time Indoor Positioning System (RTIPS) and then integrate this RTIPS with a self-developed indoor GIS to form a indoor LBS prototype. We have published the first part of the paper in April 11 issue. Here we present the concluding part

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Expriment results

This section conducts the static and dynamic experiments of the indoor positioning algorithms mentioned above, and these results are used to find the best indoor positioning algorithm for the RTIPS. To implement the indoor positioning tests, the classroom 5834 of the DAA building of NCKU is chosen as the experiment place. In this paper, the fingerprinting method based on the RSS is utilized to estimate the user location. Several positioning results are investigated by applying different matching algorithms, including the NN algorithm, the KWNN algorithm, and the probabilistic approach based on the kernel method. In addition, the particle filter is applied to improve the positioning performance, and furthermore the trade-off study between the positioning performance and the computation time are conducted as well.

To implement the indoor positioning system, the first step is to collect and build the positioning database for the positioning system. In this work, we attach 9 IRIS motes developed by Crossbow Inc. on the ceiling of classroom 5834 as the transmitters and divide the floor into 25 grid points. The size of each grid is 137.25 cm by 152.5 cm, and the separation distance between each sensor attached on the ceiling is 274.5 cm. The setup is shown in Figure 3.

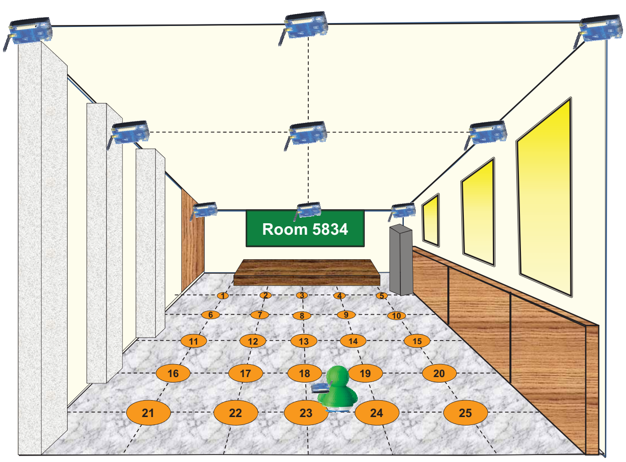
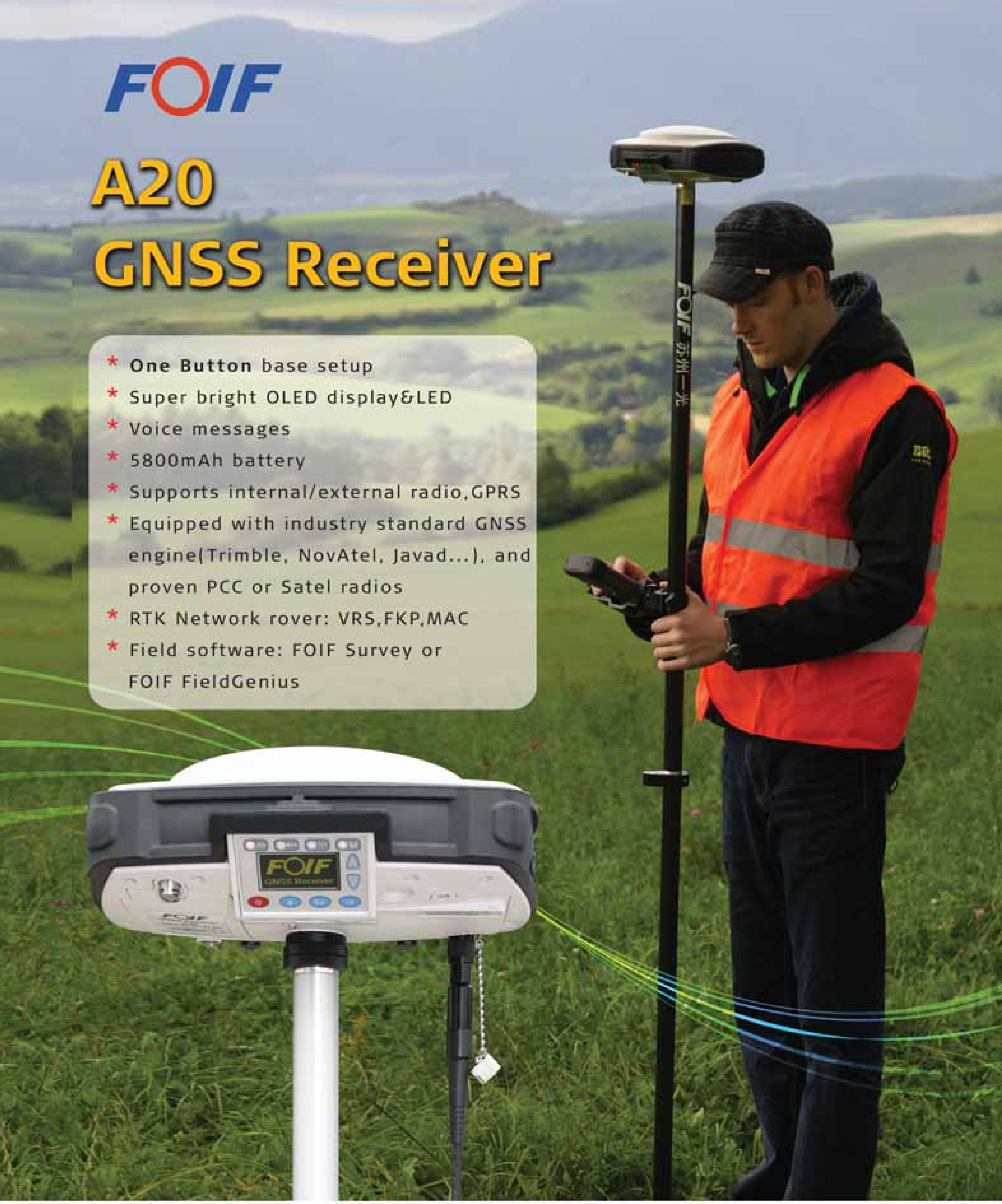


Figure 3: The arrangement of the experimental setup.

In the static experiment, we visit all the grid points sequentially to perform the positioning test, and the number of the test samples is 67500 samples. The Cumulative Distribution Functions (CDFs) of the positioning errors by the NN algorithm and the KWNN algorithm with K =2 to 4 are shown in Figure 4.

In Figure 4, the NN algorithm has a 12% probability to make an exact estimation; however, it also has the worst performance in the maximum error bound. In this case, the maximum error of the NN algorithm is about 8.3 meters. If the indoor positioning system has higher accuracy requirement, then the NN algorithm would not be an appropriate option. In contrast, although the KWNN algorithm cannot make the exact estimation, the maximum error of the KWNN algorithm is less than that of the NN algorithm. For instance, as the value of K is set to 2, the maximum error is about 5.7 meter. As shown in Figure 4, one notes that the maximum error is reduced as the value of K increases, but the improvement diminishes as the value of K increases. Ni [9] and Wang [10] suggested that the K=3 or 4 yielded the best positioning results. Our experiment results are in accordance with the conclusions in [9] and [10]. To investigate the positioning performance improvement gained from the SIR particle filter, we choose K = 4 case to be integrated with the SIR particle filter; the estimations obtained by the KWNN algorithm are used as the input measurements of the SIR particle filter; the number of particles used in this experiment is 1,000. In Figure 4, the maximum positioning error is reduced to 4.3 meters by the use of the SIR particle filter. As a result, the SIR particle filter significantly improves the indoor positioning performance.

This paper also applies the probabilistic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* Voice messages
* 5800mAh battery
* Supports internal/external radio,GPRS
* Equipped with industry standard GNSS engine(Trimble, NovAtel, Javad...), and proven PCC or Satel radios
* RTK Network rover: VRS,FKP,MAC
* Field software: FOIF Survey or FOIF FieldGenius
FOIF
GNSS Receiver

approach based on the kernel method to analyze the CDFs of the indoor positioning errors. The CDFs of the positioning errors with the probabilistic approach based on the kernel method are shown in Figure 5.

As shown in Figure 5, the exact estimations raises to 15% by applying the probabilistic approach based on the kernel method, and the maximum error is about 6.3 meters. According to the experiment results, the probabilistic approach based on the kernel method yields better positioning accuracy than the use of the NN algorithm. In addition, we use the concept similar to the KWNN algorithm to select more candidates and average them according to the probability of each candidate. In Figure 5, there is no notable improvement by selecting more candidates. If we integrate the probabilistic approach with the SIR particle filter, the positioning result is similar to the use of the KWNN algorithm. The velocities and accelerations used in the SIR particle filter for the static tests shown in Figures 4 and 5 are generated by the zero mean normal distribution, $N(0, var)$, where var is the variance. The velocities (v) and the acceleration (a) are determined by Equations (3) and (4), respectively.

$$v \sim N\,(0\ cm/s,\ 250) \qquad (3)$$

$$a \sim N\,(0\ cm/s^2,\ 20) \qquad (4)$$

The values of the standard deviations used in Equations (3) and (4) are determined by the empirical data.

In this paper, a dynamic experiment is also conducted, and we select the trajectory where the user moves from grid point 3 to grid point 23 in a straight line (in Figure 3). The matching algorithms, the KWNN algorithm with K = 1, 2, 3, and 4, and the probabilistic approach based on the kernel method are applied to investigate their dynamic positioning results. Furthermore, to gain possible improvement on positioning performance, the SIR particle filter is also utilized in the dynamic test. The velocities and accelerations used in the SIR particle filter are generated by the normal distribution, $N(\mu, var)$, where μ is the mean and var is the variance. The velocities (v) and the accelerations (a) are determined by Equations (5) and (6), respectively. The mean and the standard deviation used in Equations (5) and (6) are determined by the empirical data, and these velocities and accelerations can be replaced if there are available velocities and accelerations measurements.

$$v \sim N\,(50\ cm/s,\ 250) \qquad (5)$$

$$a \sim N\,(0\ cm/s^2,\ 20) \qquad (6)$$

The positioning error of the dynamic experiment is calculated as depicted in Figure 6.

Table 1 shows the standard deviations of the positioning errors of the dynamic test by the KWNN algorithm and the KWNN algorithm with the SIR particle filter for different values of K. As illustrated in Figure 6, the positioning error is the difference between the positioning result and the true trajectory (i.e., the straight line from grid point 3 to grid point 23). From Table 1, the KWNN algorithm (K = 1) has the largest standard deviation, and one notes that when the value of K is larger than 1 or the SIR particle is used, the positioning results yield smaller standard deviations. In this case, K = 4 has the better positioning result. In addition, the standard deviations of the positioning errors by the SIR particle filter are smaller than that of the KWNN algorithm alone. As a result, the SIR particle filter can enhance the positioning performance as the user is in motion.

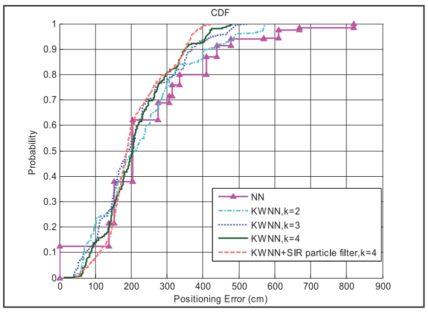

Fig 4: The CDFs of the positioning errors by the NN algorithm and the KWNN algorithms for the static experiment.

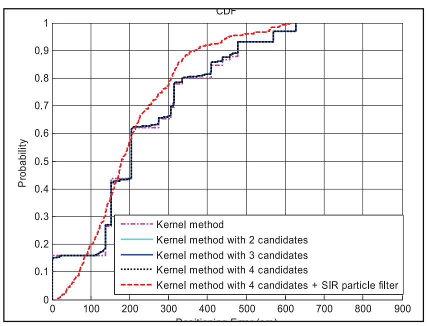

Fig 5: The CDFs of the positioning errors by the kernel method for the static experiment.

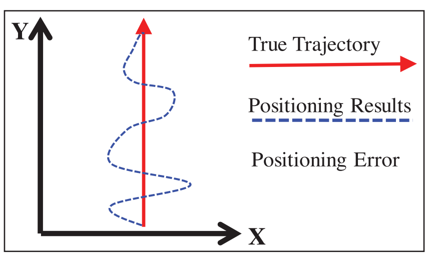

Figure 6: Illustration of the dynamic positioning error calculation.

K / Algorithm	1	2	3	4
KWNN (cm)	99.51	81.51	60.27	58.11
KWNN + SIR particle filter (cm)	40.07	25.54	39.94	26.11

Table 1: The standard deviations of the positioning errors of the dynamic test by the KWNN methods

We also compare the positioning results by the kernel method and the kernel method with the SIR particle filter. Table 2 shows the standard deviations of the indoor positioning errors by the kernel method and the kernel method with the SIR particle filter. From Table 2, there is no significant improvement for the kernel method with more candidates; these positioning results are consistent with the static experiment analysis shown in Figure 7. When the SIR particle filter is applied, the positioning results are smoother than the cases without the SIR particle filter.

Number of candidate / Algorithm	1	2	3	4
Kernel method (cm)	137.25	122.19	121.88	121.89
Kernel method + SIR particle filter (cm)	18.19	12.73	36.81	25.77

Table 2: The standard deviations of the positioning errors by the kernel methods

By the static and dynamic experiment results, it's obvious that the use of the particle filter can improve the indoor positioning results. However, the particle filter is a high computation load algorithm, and it usually requires a large number of particles for its computation to get more accurate results. If a large number of particles is needed, it would be challenging to apply it to a real time application. For an optimal design, the trade-off between the particle number (i.e., the computation load) and the positioning accuracy must be investigated. This paper utilizes the particle number of N = 5, 30, 100, 1000 and 2000 to evaluate their positioning performance. Figure 7 shows the CDFs of the positioning errors of these positioning results.

In Figure 7, there is a limit in positioning performance improvement when increasing the number of particles. When the particle numbers approach to 100, the improvement on the positioning performance becomes lesser. In the other words, there is no significant improvement as the value of N increases from 100 to 2000. The computation load of the particle filter with different particle numbers is also an important issue. Thus, the trade-off study between the positioning error and the computation time for different particle numbers is conducted and the result is shown in Figure 8. As shown in Figure 8, the 95% positioning error bound is reduced from 447.5 to 380.2 cm as the particle number is increased from 5 to 100. However, as we continue to increase the particle number, the positioning results are not significantly improved, and the computation time increases as the particle number increases.

The CPU used in this work is the Intel Pentium 4 3.0 GHz. As indicated in Figure 8, N = 30 to 100 might be the optimal design. When the sizes of the buildings are different, the required optimal particle number for the area of interest has to be considered. Table 3 shows the computation time, the 95% positioning error bounds and the particle densities for different values of N. This paper defines the particle density as the total particle numbers distributed in one square meter. Table 3 shows that the particle densities in the range of 0.9 to 2.99 ($1/m^2$) yield the better indoor positioning results. The evaluation result indicates that the combination of the KWNN algorithm with 4 candidates and the particle filter with 2.99 particle density is the best for the proposed RTIPS.

Particle number (N)	Particle density ($1/m^2$)	Computation time (second)	95% Positioning error bound (cm)
5	0.15	0.032	447.5
30	0.9	0.047	384.5
100	2.99	0.063	380.2
1000	29.86	1.032	393.8
2000	59.72	3.766	403.5

Table 3: The comparison of performance for different particle numbers

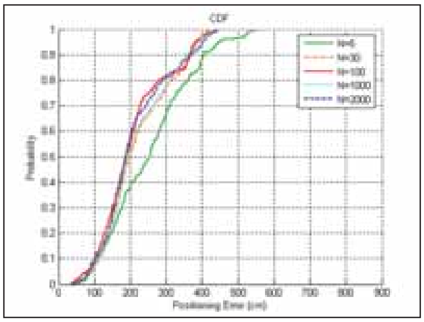

Fig 7: The CDFs of the positioning errors for different particle numbers.

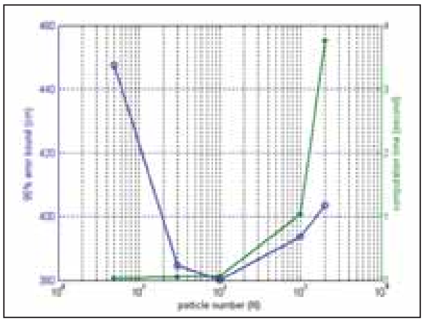

Fig 8: The trade-off study between the positioning error and the computation time for different particle numbers.

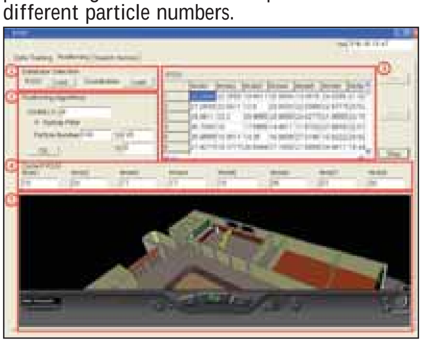

Fig 9: The real time indoor positioning test at the classroom 5834 of the NCKU DAA building.

Fig 10: An example 3D indoor GIS with the integration of the cartography and database techniques.

Real time indoor positioning system

In order to demonstrate the proposed indoor LBS test-bed, the Real Time Indoor Positioning System (RTIPS) of the DAA building at NCKU is developed. The Borland C++ Builder 6.0 is used to build this RTIPS. The main objective of the RTIPS is to provide the real time indoor positioning services on a 3D indoor GIS. In addition, the RTIPS is integrated with the Microsoft SQL Server to provide the classroom search function. This developed RTIPS is composed of the real time positioning and the information search services.

Figure 9 shows an example of the real time indoor positioning test at the classroom 5834 of the DAA building. To implement the indoor positioning system based on the fingerprinting method, the positioning database has to be loaded first. As shown in Figure 9, block 1 provides the positioning database and the associated coordinate system selection. When the positioning database is loaded, the RSS values of the database are shown in block 3. Block 2 is the parameters determination of the positioning algorithm. Users can choose different K values of the KWNN algorithm, and the default value is 4. In addition, the particle filter is utilized to further enhance the positioning performance. The default particle number of the particle filter is 100. The particle number can be changed by users as well, and the velocity V_x and V_y are determined by the empirical data. Block 4 is the display of the current RSS values of the incoming signals of each transmitter, and block 5 is integration of the indoor positioning results and the developed 3D indoor GIS. This RTIPS also provides the search service to complete the indoor LBS. In Figure 10, block 2 is the course table information. When users double click the course table, the course information is shown in the text box of block 1. In block 3, users could click the "Search" button, and the search result will be presented in the 3D indoor GIS. Figure 10 shows an example 3D indoor GIS with the integration of the cartography and database techniques.

Conclusions and future work

This paper utilized a Wireless Sensor Network (WSN) based on the ZigBee radio to implement an indoor positioning system. The positioning algorithm used in this paper is the fingerprinting method. According to the experiment results, the K-Weighted Nearest Neighbors (KWNN) algorithm with K=3 or 4 could obtain the better positioning results. This paper then combined the fingerprinting method with the Sampling Importance Resampling (SIR) particle filter to enhance the positioning performance. However, if the particle filter is applied in the real time application, the trade-off between the particle number and the positioning performance must be considered. According to the analysis result presented in this paper, the particle density in the range of 0.9 to 2.99 (1/m^2) would be a better design.

In addition, this paper successfully demonstrated a rapid and practical procedure to develop the local Geographic Information System (GIS) which applied the Computer-Aided Design (CAD) software and the Virtual Reality Modeling Language (VRML) technique. This paper combined the indoor GIS, the indoor positioning system, and Microsoft SQL Server to complete an indoor Location Based Service (LBS) test bed. Finally, the Real Time Indoor Positioning System (RTIPS) of Department of Aeronautics and Astronautics building at National Cheng Kung University was developed to demonstrate its capabilities. This example RTIPS also provides the course search function, and the search results are presented on the developed 3D indoor GIS.

Because the indoor environment is a complicated system, the uncertainties would have some influence on the positioning accuracy. How to build a more robust indoor positioning system to overcome these uncertainties would be another interesting research topic. Furthermore, the protection level of the indoor positioning system will be investigated in the future to provide users indoor positioning services with safety concerns.

Acknowledgment

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Sweden to join GLONASS

Russian Prime Minister Vladimir Putin invited Sweden to increase its cooperation on GLONASS satellite navigation system, during his visit to the country. Russia will study the Swedish experience in the creation of its SWEPOS satellite navigation system, which uses the GLONASS signal. Both countries agreed to jointly use ground facilities to gather information for operating their own orbital objects and those of third countries. They will also cooperate within a Russian space research project to monitor the Earth's polar regions. It is scheduled to begin in 2015 at an estimated cost of USD 1.23 billion. *RIA Novosti*

Surveyor in India caught taking bribe

The Lokayukta police trapped a surveyor attached to land records assistant director's office in Gokak while "allegedly" accepting a bribe of Rs 12,000. The accused, Rajashekhar Dhawaleshwar, had demanded Rs 15,000 (which was later settled to Rs 12,000) from Vithal Poojari, a resident of Dharmatti village, for conducting a survey of the latter's land. However Poojari, not wanting to pay the bribe, complained against Rajashekhar to Lokayukta police, who caught him red-handed while accepting the bribe. *http://articles.timesofindia.indiatimes.com*

GPS threatened by wireless network

GPS signals across the US are threatened by a new, ultra-fast wireless Internet network that may interfere with everything from consumer navigation devices to police cars to airplanes, reports the Associated Press. A government decision to let the satellite company LightSquared build a nationwide broadband network using airwaves next to those used by GPS has led to the problem of a possible jam in existing navigation systems. By allowing LightSquared to expand its services, the Federal Communications Commission's (FCC) goal is to boost wireless competition and bring cheaper and faster Internet connections to all Americans, even those in remote locations of the country. Although the FCC and LightSquared insist that the new network can co-exist with the GPS systems, manufacturers of GPS

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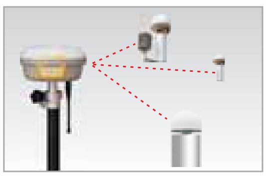

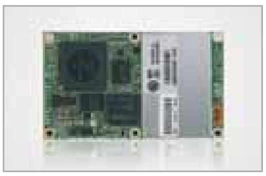

82T

- Advanced BD970 main board, 220 Channels for Multi-Constellation GNSS Support (including GPS and GLONASS), proven Trimble Maxwell 6 technology.
- Dual-Bluetooth technology inside controller, can connect with CORS via cell phone.
- L1/L2/L2C/L5 GPS+GLONASS+Galileo A and B+SBAS support.
- Adopt advanced UHF data link technology, proven low-elevation tracking technology and on-board multipath mitigation. Enhance radio work range more than 10km.
- Rapid and stable network data link via GPRS/CDMA, can work with various CORS system seamlessly.
- Huge data storage-64M, different kinds of data format input and output.
- IP65 dustproof, protected from temporary immersion to depth of 1m(3.28ft), shock and vibration: Designed to survive a 2m (6.6ft) pole drop onto concrete.

86T

- Advanced BD970 main board, 220 Channels for Multi-Constellation GNSS Support (including GPS and GLONASS), proven Trimble Maxwell 6 technology.
- Dual-Bluetooth technology inside controller, can connect with CORS via cell phone.
- L1/L2/L2C/L5 GPS+GLONASS+Galileo A and B+SBAS support.
- Built-in receive/transmit UHF radio(about 3-4km for transmit distance) work mode option and double lithium batteries packages LCD Screen.
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devices believe that their signals will suffer "the way a radio station can get drowned out by a stronger broadcast in a nearby channel." *www.redorbit.com*

Boeing GPS OCS in operational status

Boeing's GPS Operational Control Segment (OCS) gained full operational status with the US Air Force (USAF) 50th Space Wing, Schriever Air Force Base in Colorado. OCS keeps the GPS system operational within specified accuracy to provide secure and precise navigation around the world for military, humanitarian and commercial applications. The Boeing-led team, consisting of Lockheed Martin, Braxton Technologies and a.i. solutions, supported the Air Force in completing a comprehensive series of operational tests and evaluations that began in 2007, when the Air Force transitioned satellite operations from the previous system to OCS. *www.gpsdaily.com*

GPS surveillance for warrantless in US

The US administration urged the Supreme Court to allow the government, without a court warrant, to affix GPS devices on suspects' vehicles to track their moves. The Department of Justice (DOJ) said, "A person has no reasonable expectation of privacy in his movements from one place to another." It demanded to undo a lower court decision that reversed the conviction and life sentence of a cocaine dealer whose vehicle was tracked via GPS for a month without a court warrant. The government told the justices that GPS devices have become a common tool in crime fighting. *www.wired.com*

Criminals to walk to the tune of GPS

In a bid to keep a tab on criminal activities, Haryana State Police in India will tag criminals who go out of jails on parole. The state police have tied up with Sharp Electrotech Inc., Taiwan, for the GPS tagging devices in the form of an anklet or a bracelet. This is for the first time in the country that police is using such device and this scheme will be started from Yamunanagar district of the state. *www.igovernment.in*

Azerbaijan approves time standard

Azerbaijani State Committee on Standardization, Metrology and Patents approved the initial state time and frequency standard. The standard complex includes a synchroniser of GPS-receivers, a time and frequency standard (Fluke910R) and a timer-counter-analyser (Fluke6690) produced in the US. The basic principle of the time and frequency standard is the frequency reception from the satellite through the GPS-antenna, which is regarded as the most accurate. It is formed by cesium decay, is synchronised via the time and frequency standard, and transfers information about the exact time in the country to all telecommunications systems. *www. en.Trend.az*

China's 8th navigation satellite

China recently launched its eighth navigation satellite of the Beidou system. It marks the establishment of a basic system for the navigation and positioning network. A Long March-3A rocket carried the "Beidou," or Compass, navigation satellite. *www.gpsdaily.com*

50th Space Wings accepts ground system upgrades

The 50th Space Wing accepted two GPS ground system upgrades. While the upgrade will likely be transparent to users, it culminates a $1.1B effort to upgrade the original master control station here with a modern distributed architecture, called the Architectural Evolution Plan (AEP) system. AEP, which has been delivered in several installments, provides the capability to fly the first GPS IIF satellite and enabled the new security architecture inherent in modern GPS user equipment. Operational testing of the first GPS IIF satellite and AEP Version 5.5 was conducted in August 2010, and Air Force testers found the system to be "mission capable." Air Force Space Command operationally accepted the AEP Version 5.5 system in January 2011.

Taiwan releases its first aerial photography drone

Taiwan's first indigenous unmanned vehicle for aerial photography- AI Rider is a system based on a six-rotor unmanned aerial vehicle weighing about 1,450 grams. It can carry a payload, such as a video camera, of up to 400 grams, and can climb to an altitude of 550 meters. It has already been used by Taiwan's military and academic institutions for surveillance and geographic surveying. *http://focustaiwan.tw*

India successfully launches RS satellite

Indian Space Research Organisation (ISRO) recently launched the latest remote sensing satellite Resourcesat-2 along with two nano satellites, Youthsat and X-Sat. According to ISRO officials, Resourcesat-2 would help in catering to the national and global data needs to address multiple aspects of resource inventory and monitoring in specific areas of applications including agriculture, water resources, rural development, bio-resources and geological exploration. It weighs 1,206 kg and has space life of five years. It has replaced Resourcesat-1 which was launched in 2003. It will provide data with enhanced multispectral and spatial coverage on natural resources. Youthsat, weighing 92 kg, is a joint Indo-Russian nanosatellite for stellar and atmospheric studies. 106-kg X-Sat is an image applications spacecraft built by Nanyang Technological University, Singapore.

RS technology for Malaysian fisherman

The Sarawak State Government in Malaysia has introduced the Remote Sensing Technology (RST) to the Seine river net fishermen in Sarawak. It aims to turn around low supply of fish in the state. According the officials, RST was an effort between Science, Technology and Innovation Ministry and Ministry of Agriculture and Agro-based Industry to solve the problem of low catches. *www.theborneopost.com*

Iran to build remote sensing satellite with APSCO

Iran has said it will build a new remote sensing satellite in cooperation with the Asia-Pacific Space Cooperation Organisation (APSCO) of which it is an active member. It plans to have a larger share in building the satellite in partnership with APSCO. *www.brahmand.com*

Vietnam to launch first RS satellite in 2014

Vietnam will launch its first remote sensing (RS) satellite in 2014. The satellite, called VNREDSat-1, will be designed and assembled using French technology in 2013, according to Associate Professor Doan Minh Chung, Head of the Space Technology Institute of the Vietnam Academy of Science and Technology. *www. english.VOVNews.vn*

Dr Dadhwal takes over as Director National Remote Sensing Centre

Dr Vinay Kumar Dadhwal, an outstanding scientist has taken over as Director, National Remote Sensing Centre (NRSC), Indian Space Research Organization (ISRO), Hyderabad since May, 2011. His areas of specializations have been Crop modeling, Remote Sensing Applications in Agriculture, Terrestrial Carbon Cycle and Land Cover Land Use Change Modeling, Land Surface Processes. He had held various positions in his long career such as Head, Crop Inventory & Modelling Division,Space Applications Centre (Indian Space Research Organisation, ISRO), Ahmedabad; Dean, Indian Institute of Remote Sensing (IIRS), Dehradun; Director-in-Charge of UN Centre for Space Science and Technology Education in Asia Pacific (CSSTE-AP), Dehradun; Associate Director, NRSC. He has around 140 publications to his credits.

Galileo update

European satnav competition opens for entries

The eighth European Satellite Navigation Competition is now open for innovative ideas in the field of satellite navigation. Deadline for companies, entrepreneurs, research institutes, universities and individuals from all over the world, to submit their ideas is June 30, 2011. One can submit entries online at http://www.galileo-masters.eu. *ESA*

Britain alone in opposing £1.7 billion increase to Galileo system

Britain was a "minority of one" in opposing a £1.7 billion increase for Galileo, the Transport Secretary has admitted. Philip Hammond failed to persuade other European governments to scale back a 30-satellite EU space project which one day aims to rival America's GPS system. "We will continue to object to any increase in the budget," he told The Daily Telegraph. "We will certainly block any further increased spending in the next two years." Earlier this year, the European Commission warned national capitals that a lack of enthusiasm among private investors meant that the cost of Galileo was likely to rise to £4.7 billion. Despite British opposition, a meeting of European transport decided "unequivocally that the programmes should continue to be financed from the EU budget". *http://www.telegraph.co.uk*

Back to search results contract to ensure long life of EGNOS

Acting on behalf of the European Commission (EC), European Space Agency (ESA) signed a framework contract with Thales Alenia Space, an aerospace company, on the evolution of the European Geostationary Navigation Overlay System (EGNOS). As the EGNOS satellite navigation system begins to be used for its primary purpose of guiding European aircraft, this new agreement will ensure the service remains available for a long time to come. The signing came in response to needs expressed by the EC – the formal owner and programme manager of the system – as well as the consortium charged with overseeing EGNOS service provision, the European Satellite Service Provider (ESSP). *ESA*

EU proposes Space Policy 2011

The European (EU) published its proposal pertaining to a new space policy. It is a first step of an integrated Space Policy 2011, to be developed with a new legal basis provided by the Lisbon Treaty. According to the EU's view, priorities for the future EU space policy include:

- Pursue the achievement of Galileo and EGNOS.
- Implement with Member States the European Earth Monitoring Programme (GMES) which is designed for land, ocean, atmosphere, air quality and climate change monitoring, as well as emergency response and security, with the objective to become fully operational from 2014.
- Protect space infrastructures against space debris, solar radiation and asteroids by setting-up a European Space Situation Awareness (SSA) system.
- Identify and support actions at EU level in the field of Space exploration. *europa.eu*

Esri Agreement with NAVTEQ Broadens Access to Map Data

Esri has signed an agreement with NAVTEQ to provide worldwide map data on ArcGIS Online and ArcGIS Data Appliance. This is useful for organizations that depend on up-to-date, high-quality basemap data for routing and other location-finding tasks. It provides a common platform to find, share, and organize geographic content to build GIS applications.

Septentrio AsteRx3 Receiver Tracks First GLONASS CDMA Signal on L3

An AsteRx3 successfully tracked the CDMA L3 signal of the first GLONASS K1 satellite during the weekend of April 10. The AsteRx3 was able to provide a full set of user-level measurements (code, phase, Doppler and C/N0). The GLONASS Information Analytical Center announced on April 7 that the experimental navigation signals of the first GLONASS K1 satellite would be activated. Shortly after this announcement, Dr Tom Willems, a senior GNSS engineer of the signal tracking expert team at Septentrio, succeeded in acquiring the signal with the AsteRx3 receiver. *www.septentrio.com.*

NovAtel and Raven team up

NovAtel Inc., and Raven Industries are new strategic partners that will see NovAtel's industry leading GNSS positioning technology integrated into Raven's comprehensive line of precision agriculture products. The convergence of these two industry innovators is expected to drive new growth opportunities for both companies, and benefit customers by achieving further efficiencies in their agricultural operations.

Trimble's LaserAce™ 1000 rangefinder

Trimble® LaserAce™ 1000 rangefinder is an easy-to-use handheld measurement tool combining a laser distance meter, digital inclinometer, sighting scope and Bluetooth® wireless technology. It seamlessly integrates with its GIS data collection solutions. *www.trimble.com/laserace.*

Trimble to buy Ashtech

Trimble entered into a definitive agreement to acquire privately-held Ashtech S.A.S., headquartered in Carquefou, France, and its affiliates. The acquisition is expected to expand Trimble's Spectra Precision portfolio of survey solutions and allow the company to better address emerging markets worldwide. www.trimble.com

Topcon to track GLONASS K1 satellite signals

Within an hour of the first signal emanating from the new GLONASS K1 satellite on April 7, Topcon Positioning Systems (TPS) engineers were tracking the satellite's L1 and L2 signals.*www.topcon.com*

C-Nav launches new C-NavC2 full constellation GNSS correction services

C-Nav has released a second independent full constellation (GPS + GLONASS) GNSS correction service called C-NavC2 . C-Nav customers now benefit from two independent and orbit correction messages produced by two independent processing hubs as well as two independent satellite networks, Net-1 and Net-2. C-NavC2 features include GLONASS and a GPS (GNSS) clock, as well as orbit correctors (Galileo and COMPASS planned). *www.oilpubs.com*

Leica FPES v10.2

Leica Geosystems v10.2 of Flight Planning & Evaluation Software (FPES) have been enhanced and new productive features have been added to make it the most productive tool for cost-effective flights. It offers the most advanced functionality and highest efficiency in flight planning for all Leica Geosystems airborne sensors to ensure seamless workflow, but also supports other airborne frame, line or on/off sensors.

Magellan introduces a rugged handheld GPS for GIS professionals

Magellan is re-entering the GIS market with the eXplorist Pro 10, a rugged, lightweight and waterproof GPS handheld device specifically designed for GPS/GIS data collection. Featuring a vibrant 3-inch, WQVGA transflective color touchscreen, 533MHz processor and

Ashtech News

Swiss Meteorological Network employs Ashtech® ProMark™ 500

The Swiss Federal Office of Meteorology and Climatology, MeteoSwiss, is employing an Ashtech® ProMark™ 500, smart GNSS receiver, to measure to centimetre-level accuracy the position of each of its more than 1,100 sensors located at 135 stations throughout the country.

HCA recommends Ashtech MobileMapper CX

The Hungarian Chamber of Agriculture (HCA) has recommended farmers to purchase MobileMapper® CX, GPS/GIS receivers to measure and calculate the size of land parcels they farm. The recommendation was made following HCA tests of several competing brands.

Ashtech teams up with GeoSam Oy

Ashtech has teamed up with GeoSam Oy, a newly-formed Finnish distributor of GPS and surveying equipment, to represent Ashtech machine control, GIS, GNSS and GPS products. *www.ashtech.com*

Ashtech ProFlex 500 with NTRIP Caster

Ashtech has released v3.5 firmware for the ProFlex™ 500 GNSS receiver that includes a powerful NTRIP Caster to enable surveyors, municipalities, mining, engineering and agricultural operations to easily implement and control their own very cost-effective and secure corrections network via NTRIP protocol. *www.ashtech.com.*

128MB RAM, the eXplorist Pro 10 packs the power needed to work with maps and large data sets into a compact-handheld form factor. *www.magellangps.com*

Smallest GPS L1/L2 OmniSTAR® receiver by Geneq

Geneq has introduced the smallest GPS L1/L2 OmniSTAR receiver in the world. The SXBlue III-L is designed to use OmniSTAR's HP service to attain decimeter accuracy in all regions of the world including North/South America, Australia, Asia, Africa, Europe, and the Middle East reinforcing Geneq's "Go Real-time, All the Time" strategy. Measuring 14.cm (5.57") x 8.0cm (3.15") x 5.6cm (2.22") and weighing slightly over a pound (1.14lbs, 517g) including battery, the SXBlue III-L GPS is the smallest and lightest GPS L1/L2 OmniSTAR receiver being produced in the world today. *www.sxbluegps.com.*

Bentley Map V8i Is now offered in three editions

Bentley Systems has released Bentley Map V8i (SELECTseries 2), the only desktop GIS software for infrastructure that is intrinsically 3D. Used worldwide by designers, engineers, and geospatial professionals, it serves as a fully featured, universal GIS platform supporting the creation, persistence, maintenance, analysis, and sharing of 2D and 3D geospatial information. *www.bentley.com/500.*

SatLab Geosolutions receives all certification approvals

SatLab Geosolutions AB has received all certification approvals of the iSurvey SL500 geodetic grade GNSS receiver and will now go into volume production. The iSurvey SL500 is a high quality product, incorporating the latest GNSS technology and it is expected to be available in the EMEA market beginning of August 2011. It has been designed to European surveying standards.

Philippines 3-D mapping project

President Benigno Aquino III of Philippines announced that the Government has allocated PHP 1 billion for 3-D mapping of the entire country, which will help minimise the damage during natural disasters. The system had received PHP 154-million grant from the Japanese government through the Japan International Cooperation Agency. *www.newsinfo.inquirer.net*

Geospatial bill hits roadblock

Weeks after the Delhi Assembly cleared the Geospatial Data Infrastructure Bill-2011; work on its implementation has come across a roadblock. The IT department, which has to install 63 IP-based cameras, is yet to find vantage points where they can be installed without being targeted by miscreants. The Delhi government has formed an inter-department committee, along with the Municipal Corporation of Delhi, New Delhi Municipal Council and Delhi Police, for carrying out the work. The Bill envisages the creation of a central GIS office so the system can be shared by 30 departments and local bodies, besides a portal meant for sharing the data. The cameras, an essential part of the plan, are meant to provide real-time data, which can be utilized for any purpose — from managing disasters to checking unauthorized construction activities. *www.indianexpress.com*

Thai NSDI to empower e-governance

The Thai government laid down plans to launch ThaiSDI, country's National Spatial Data Infrastructure (NSDI) website by 2012. National Committee on Geo-Information has appointed Geo-Informatics and Space Technology Development Agency (GISTDA) to host the NSDI portal. GISTDA is currently developing the system by upgrading the existing GISTDA GIS clearinghouse demonstration programme established in 2009. The website will serve as the national gateway for spatial information and pave the way towards "Spatially Enabling" Thailand. *www.futuregov.asia*

Spatial Fusion Enterprise 5.4

CARIS launched Spatial Fusion Enterprise 5.4 with OGC Web Coverage Services for bathymetric data. WCS is an OGC standard for downloading coverages of gridded and point cloud data. This will allow CARIS' marine clients to share their bathymetric data through data downloads in 32-bit GeoTIFF, BAG and XYZ formats. *CARIS*

UltraCamXp in Mongolia

Geosan LLC has contracted with Vexcel Imaging GmbH to purchase an UltraCamXp Wide Angle digital aerial photogrammetric camera system. With this purchase, Geosan becomes the first commercial provider of photogrammetric services in Mongolia to own a digital aerial camera. The mining sector in Mongolia has been a primary driver of economic growth over the past few years, and demand for all kinds of mapping is on the rise. *http://www.microsoft.com/ultracam/en-us/default.aspx*

Indonesia's Geospatial Information Bill

Indonesia's House of Representatives and all factions in the House Commission VII RI accepted Geospatial Information Bill. The draft was prepared in 1990s and now, it reached in final phase. Majority of the House of Representatives expressed their appreciation on the ratification of the bill as this will regulate the availability of geospatial information, not only in the Unitary Republic of Indonesia, but also within its Jurisdiction. *Bakosurtanal*

Indian states sign MOU

Two Indian states, Gujarat and Himachal Pradesh signed MOU to set up Aryabhatta Geo-Informatics and Space Application Centre (AGiSAC) in Himachal Pradesh. AGiSAC will be set up in collaboration with Bhaskaracharya Institute for Space Application and Geo Informatics (BISAG), Gandhinagar. *www. indiaeducationdiary.in*

TomTom apologises

TomTom apologized for supplying driving data collected from customers to police for use in catching speeding motorists. The data has been sold to local and regional governments in the Netherlands to help police set speed traps. As more smartphones offer GPS navigation service, TomTom has been forced to compensate for declining profit by increasing sales in other areas, including the selling of traffic data. *www.theregister.co.uk*

Handhelds for Netherlands Railways

The Handheld Group has been awarded the contract to supply the Netherlands Railways with more than 10,000 rugged Nautiz handhelds, 6,000 of which will be the Nautiz eTicket Pro®, containing an Arcontia RFID module. The NS European tender was the largest tender in the world for rugged PDAs in the public transportation sector during the past 12 months and one of the largest projects in the world for rugged handheld devices for all business verticals. *www.handheldgroup.com*

Indian telecom policy emphasises on LBS

The government is studying the feasibility of giving value added service (VAS) providers access to information related to the location of a cellphone as a part of the National Telecom Policy 2011. "Location-based service (LBS) is going to be part of content enablement under National Telecom Policy. It is important for VAS and everybody knows that VAS is going to be name of the game," according to R Chandrashekhar, secretary, Department of Telecommunications. Once given a go ahead, the service has the potential to locate lost cellphones, tracking people anywhere in the country, by simply feeding the mobile number in a web application even if the handset is not GPS enabled. The government is, however, contemplating how much information related to location of a mobile phone can be given out to public keeping in mind privacy issues and security concerns. *www.economictimes.com*

China tracks govt officials in g-way

The local government of a major Chinese city, Chongqing, is now tracking down the whereabouts of its officials using GPS-enabled phones. Each government official has been provided with a GPS enabled 3G mobile phone to ascertain his location. *The Chongqing Economic Times.*

MARK YOUR CALENDAR

May 2011

FIG Working Week 2011
18-22 May
Marrakech, Morocco
www.fig.net

5th GNSS Vulnerabilities and Solutions Conference
23 - 25 May
Baška, Krk Island, Croatia
http://www.rin.org.uk/

Be Together: The Bentley User Conference
23-26 May
Philadelphia, USA
www.bentley.com/betogether

June 2011

5th International Satellite Navigation Forum
1-2 June
Moscow, Russia
http://eng.glonass-forum.ru

2nd Annual Geospatial Summit
1-3 June
Budapest Hungary
www.flemingeurope.com

Hexagon 2011 International Conference
6 -9 June
Orlando, FL, USA
www.hexagonconference.com

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

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

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

ICL-GNSS 2011
29 - 30 June
Tampere, Finland
www.icl-gnss.org/2011

July 2011

Summer School "Advanced Spatial Data Infrastructures
4 – 8 July (Advanced SDI-Management)
7-15 July (Advanced SDI-Professional)
Leuven, Belgium
www.spatialist.be

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

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

4th International Land Administration Forum
21-22 July
Ulaanbaatar city, Mongolia
www.4th-laforum.gov.mn

August 2011

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

7th International Symposium on Digital Earth
23-25, August
Perth, Australia
www.isde7.net

September 2011

ION GNSS 2011
20-23 September
Portland, USA
www.ion.org

INTERGEO
27 - 29 September
Nuremberg, Germany
www.intergeo.de

October 2011

ACRS 2011
3-7 October
Taipei, Taiwan
www.acrs2011.org.tw

AfricaGIS 2011
10-14 October
Cairo, Egypt
www.eis-africa.org/EIS-Africa

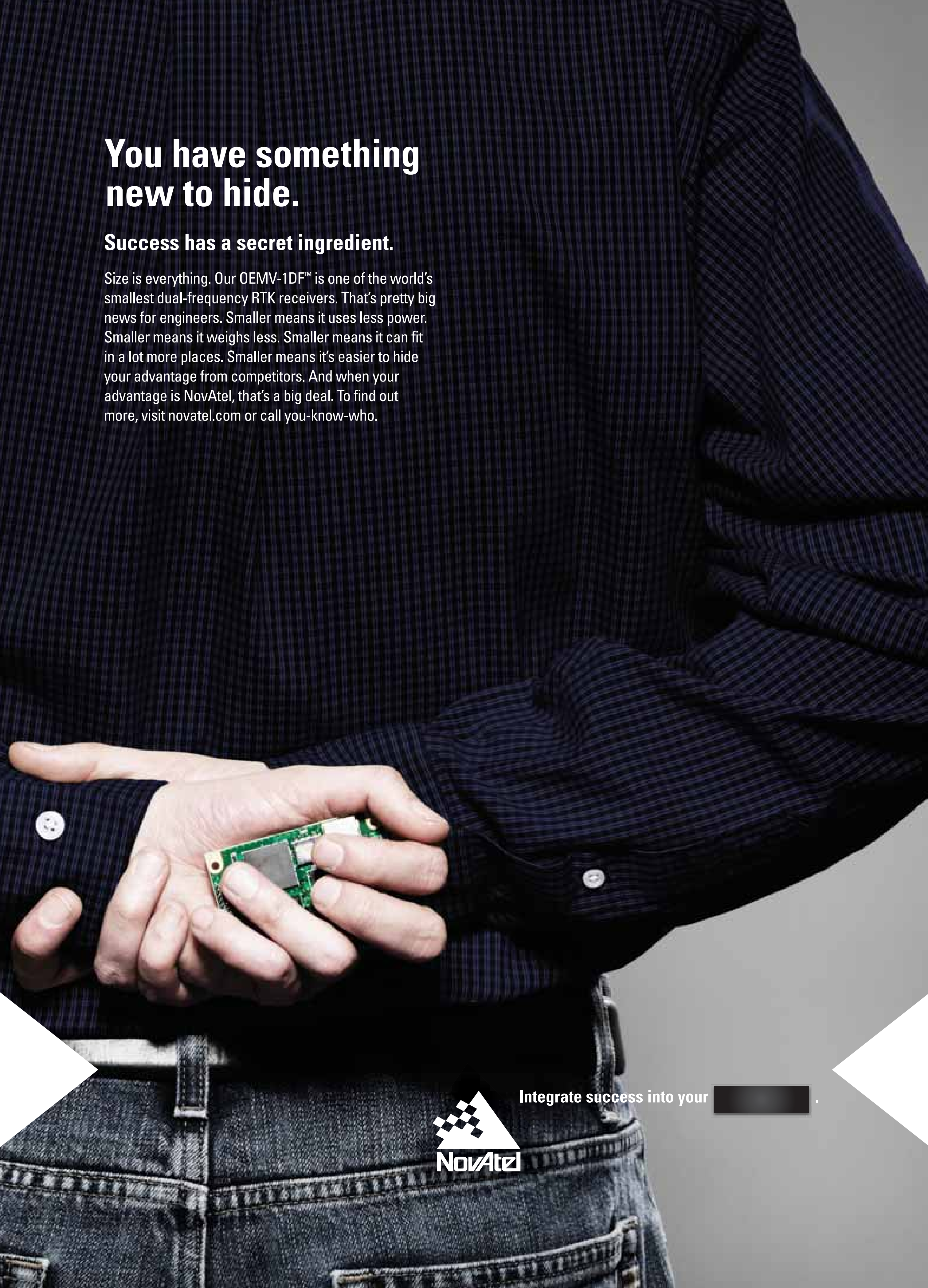
November 2011

IMTA Global Conference & Trade Show
10-11 November 2011
Bangkok, Thailand
www.imtamaps.org

Regional Geographic Conference – UGI 2011
14-18 November
Santiago, Chile
www.ugi2011.cl

International Symposium on GPS & GNSS
15-17 November
Sydney, Australia
www.ignss.org

ENC 2011
29 Nov-1 Dec
London, UK
www.enc2011.org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