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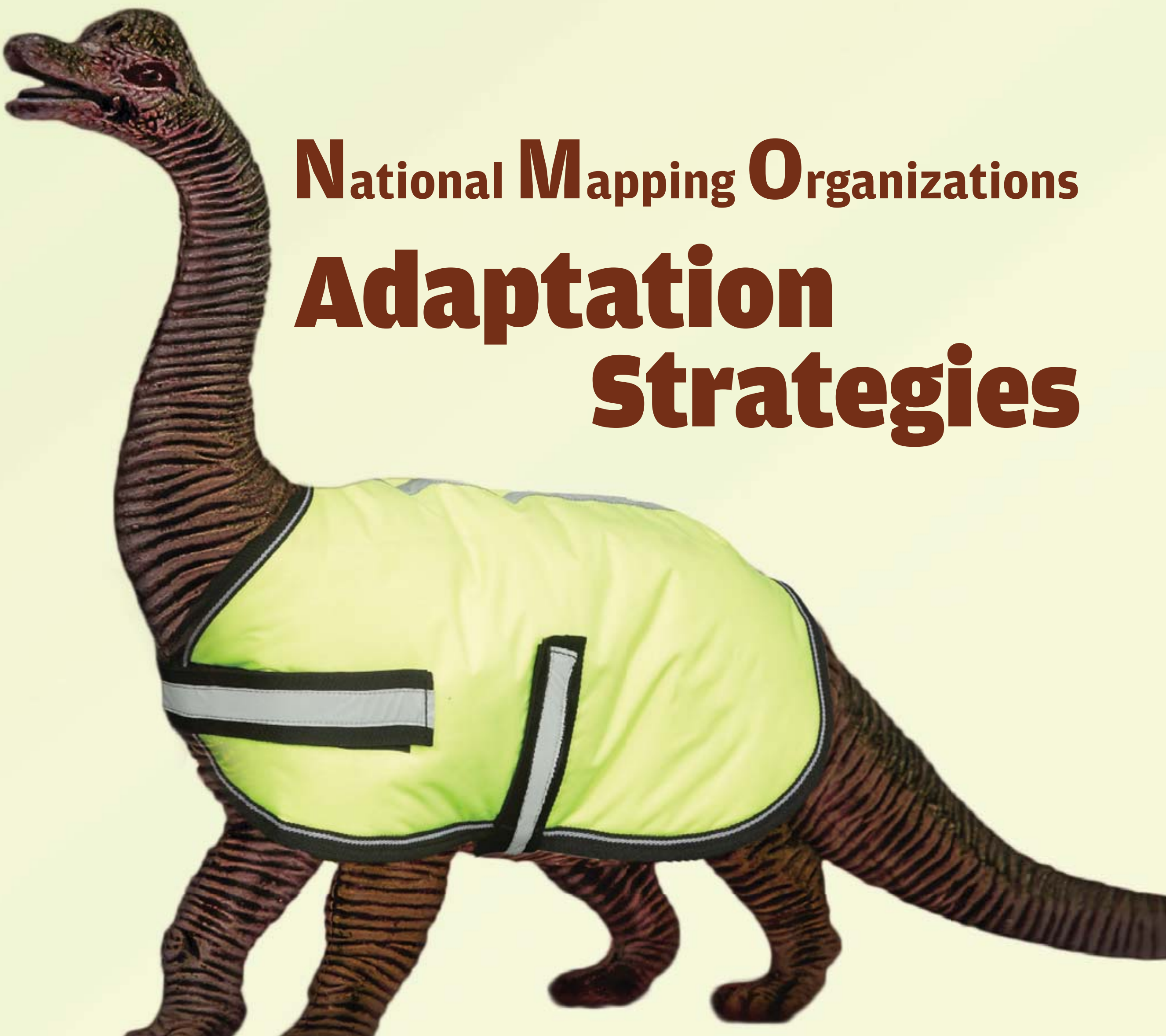
THE MONTHLY MAGAZINE ON POSITIONING, NAVIGATION AND BEYOND

National Mapping Organizations

Adaptation Strategies



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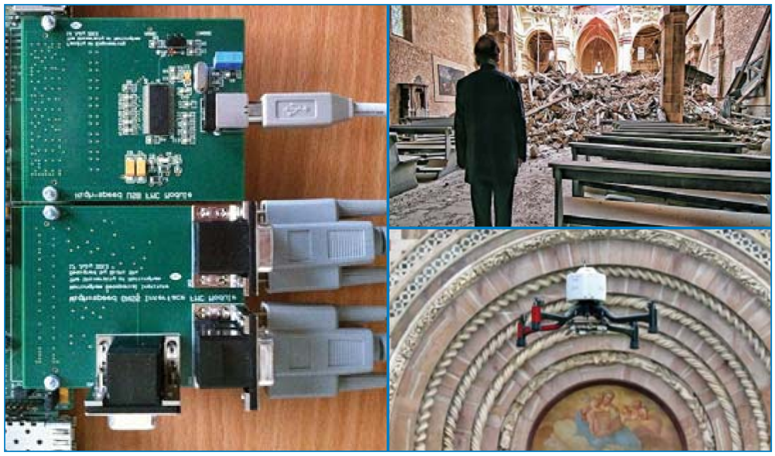

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Coordinates Volume 9, Issue 10, October 2013

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Columns

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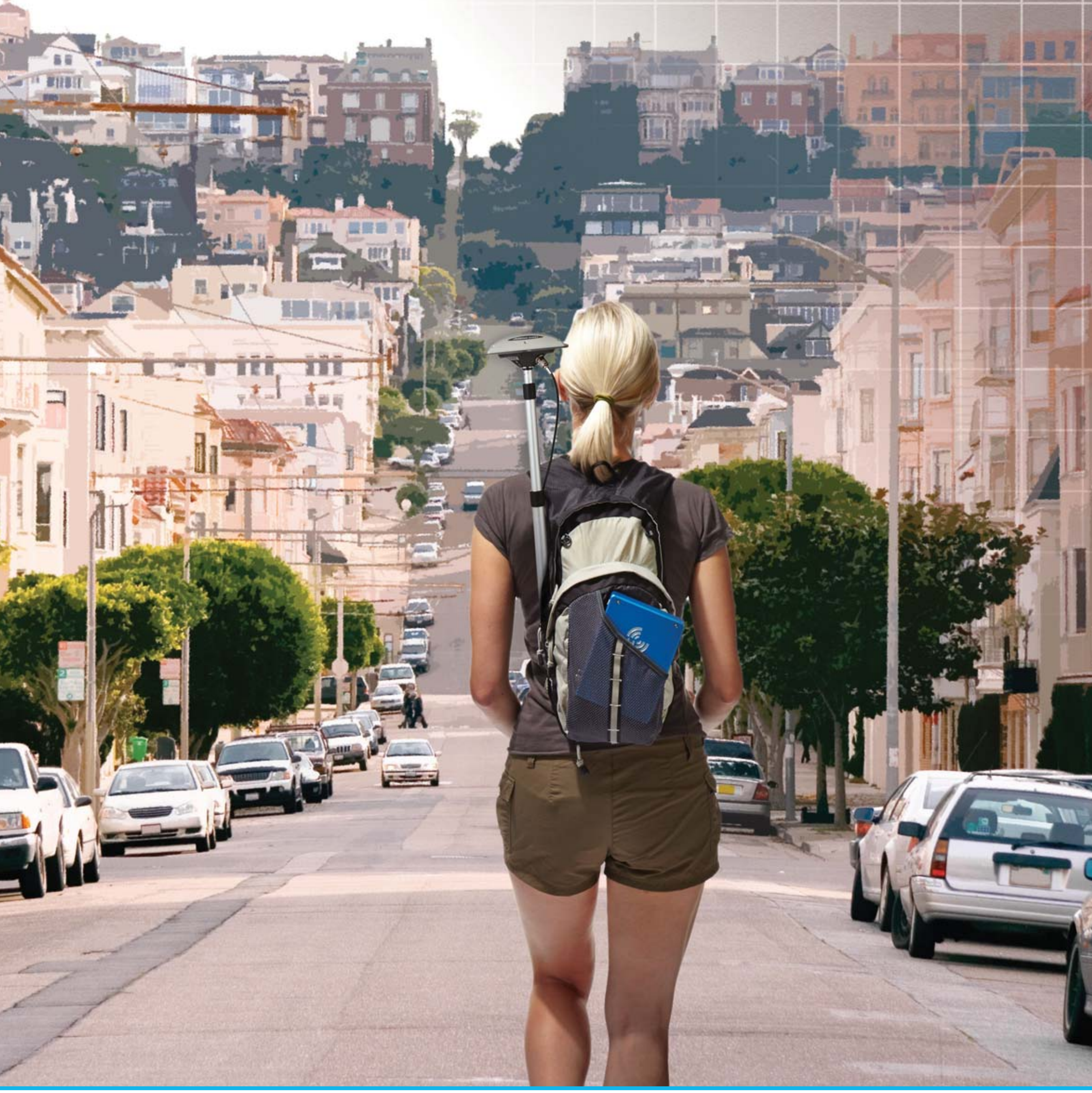

Orienting NMOs towards citizens' needs

Many National Mapping Organizations (NMOs) gear up

To embrace the challenges

Of meeting the needs of their citizens

Who are increasingly getting more aware and demanding

In the backdrop of conducive and facilitative technological ambience.

They are also evolving their roles further

From conventional map makers to active service providers

Serving needs of the society at large.

NMOs are aware and conscious of the changing scenario

And willing to adapt and reorient

Not only to remain in the mainstream and relevant

But also to lead the transformation.

Bal Krishna, Editor
bal@mycoordinates.org

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"We are successful because our customers are successful with our products"

Says **Mr. Alexander Wiechert**, Business Director, Microsoft Vexcel Imaging GmbH - a Microsoft Company in an interview with Coordinates

Please describe how the photogrammetry business is in an ever-growing stage?

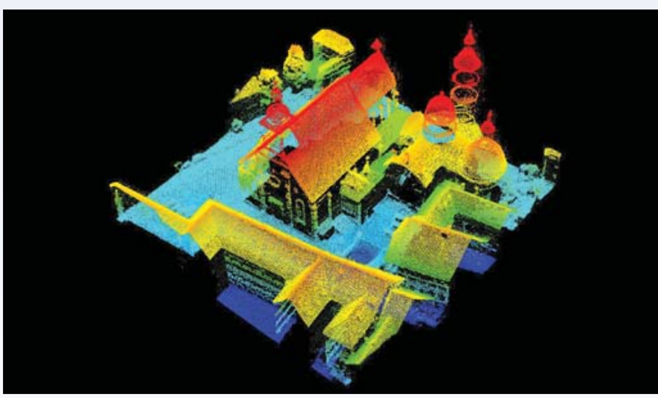
Traditionally, photogrammetry required significant manual effort, which limited its utilization. Since digital photogrammetry was introduced, there has been a constant improvement of the camera systems and the processing workflow. More data can now be collected and processed. The software has much richer feature sets and more meta-data are generated with a higher degree of automatization. The IT industry helped a lot, storage became cheaper and processing power increased. All this supported the growth of photogrammetry which is on-going.

Tell us more about the new UltraCam Osprey oblique digital aerial sensor system.

The UltraCam Osprey is a new oblique camera with a unique design. Competing oblique camera systems consist of just a set of standard tiled camera heads. This design probably does not deliver the best possible quality and efficiency. The UltraCam Osprey integrates a photogrammetric nadir camera with additional oblique images. It builds on the 3rd generation UltraCam architecture also used for the UltraCam Eagle and UltraCam Falcon. It features the same third-generation UltraCam camera electronics, storage system, housing concept, and has UltraNav as an option. The specifications of the UltraCam Osprey are quite impressive - the photogrammetric nadir part of the camera features an almost 12,000 PAN pixels across the flight strip , a RGB color cone and a NIR cone (pan-sharpen ratio 1:2). This makes the nadir subsystem a high-performing photogrammetric camera that delivers sub-pixel accuracy. Additionally, the UltraCam Osprey hosts RGB Bayer pattern cones that collect forward/backward and left/right oblique images. The centerline of the wing images are tilted by 45 degrees. The footprints have been designed in a way that the full PAN footprint of almost 12,000 pixels can be used for the mission planning and such that the wing images overlap sufficiently between the flight strips. Additionally, the left and right wing images overlap with the nadir image. This allows a significant improvement of the orientation of the wing images by a tie-point collection between the wing images and the nadir image. So the Osprey user benefits from the experience and rich feature set of the UltraMap software and can add the Osprey to an existing sensor fleet with minimal to zero ramp-up effort.

What significance does the launch of UltraCam Osprey and its benefits hold for the industry?

The UltraCam Osprey's unique design makes 3D city mapping more efficient and helps build better models with a higher degree of automatization. The Osprey is also used for the current 3D mapping projects of Microsoft/BING maps, and we are building up a larger ecosystem of Osprey flyers around



the globe that we can subcontract for our flying. Through these programs, the industry benefits from the business we are feeding back.

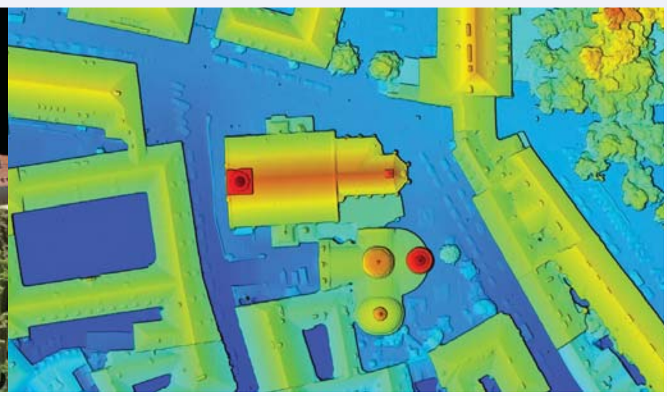
'The UltraCam Osprey is the ideal sensor system for projects such as urban mapping and 3D city modeling'. Please explain.

With respect to these projects, the current camera market splits into two. We have a) photogrammetric cameras for nadir mapping and generation of accurate 3D geometry, and b) Bayer pattern based oblique cameras for texturing images. Both deliver good quality in their domain of use and are less suitable outside it. Certainly one can use the output of wide-angle photogrammetric cameras to texture not only the ground but also facades, but the result would be sub-optimal thanks to lower image resolution on facades. Also, it is of course possible to use Bayer pattern based RGB cameras to derive geometry from it, but that would also produce lower quality results due to the missing high-resolution PAN channel. Especially if production of the 3D models shall be as automated as possible, it is necessary to collect high quality data in both domains (nadir and oblique). This led to a typical scenario that two flights have been required, one flight with the photogrammetric camera to get the geometry in upmost quality and a second flight with the oblique system for façade textures of the best possible quality. This is mere waste of resources. UltraCam Osprey combines a photogrammetric camera (PAN, RGB, NIR) with additional Bayer pattern RGB wing images, and thus addresses both domains in one camera. One camera, one flight and a versatile dataset with upmost quality in both domains.

Having been 10 years in the market, how has the UltraCam continued to remain ahead of its competitors? Do you still maintain the lead in the frame-based cameras sold worldwide?

We are, in fact, celebrating 10 years of UltraCam this year. The UltraCamD was first announced in 2003 at ASPRS in Anchorage. A lot has happened since then and the UltraCam series has been established as the leading photogrammetric digital aerial camera system. The competition stopped disclosing sales figures already years ago, but from our market intelligence, we believe that we have an over-all market share of around 50% and growing to around 60% of all new cameras sold per year are UltraCams. This success is based on a set of winning factors, such as the unique, underlying UltraCam design with multiple smaller CCDs, all nadir oriented, and synpotic exposure triggering. The result of this concept is a camera system with well-balanced, best-in-class specifications. Key is the

parallax-free large or even ultra-large PAN image with sub-pixel accuracy and stunning radiometric dynamic you get due to the patented UltraCam design. Competing camera designs fail in at least one of that criteria. The next winning fact is our strong innovation path, combined with the upgrade program. We consistently increased the image footprint size much more quickly than the competition as well as the frame rate so that UltraCam users could fly more efficiently than others. Pixel collection rate of UltraCam along track and across track is unmatched—a significant benefit for the UltraCam users. With the UltraCam Eagle we introduced a camera system that has three different focal lengths



implemented in an exchangeable lens system. Another strength is the UltraCam camera family. We now have a broad offering which allows the user to pick the camera system that fits best to its project landscape and budget. The upgrade program ensures that with changing demand, one can grow the camera system within the camera family. The processing software UltraMap is also a key factor. We implemented a rich set of outstanding features such as automated and distributed processing, monolithic stitching, project-based color balancing, automated haze removal, sun angle corrections, etc. With UltraMap 3.0, we introduced a dense matcher module for automated point cloud, DSM and DTM generation, and extended the workflow through an OrthoPipeline module for automated DTMortho and DSMortho processing. Project turn-around time becomes a winning factor for our customers and we are addressing this by focusing on an intuitive and integrated processing workflow, automated processing and a rich feature set. Thanks to development efforts that are done in alignment an in cooperation with the Microsoft BING maps project, we have a big push here with investments that feed back into the commercial UltraCam product line. And, lastly, besides all hardware specs and software features, our support is also a key winning fact. If things go wrong, we have calibration labs in the three major time zones, and the customer has access to our photogrammetric experts.

With your key customer, AEROmetrex collecting the 1,000,000th frames of UltraCam aerial imagery, what makes UltraCam digital systems so popular?

We are certainly proud to have customers like AEROmetrex and others who extensively used the UltraCam. The UltraCam is popular because it is a high-performing and unique camera system. The image quality is stunning with respect to geometry and radiometry. We believe that our innovation is unmatched. UltraMap is such an impressive workflow system for image processing with a rich and innovative feature set and breathtaking software technology such as Dragonfly. We are successful because our customers are successful with our products.

Is it possible for old customers to upgrade their existing UltraCam with the latest one?

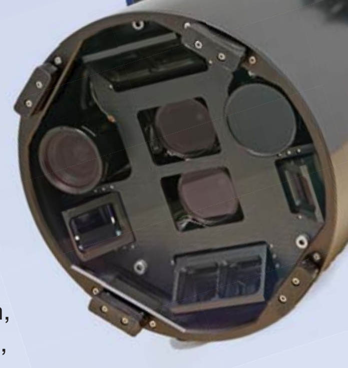
We always offered and will continue to offer a competitive upgrade path. Depending on the UltraCam model you are moving up from, upgrade is possible either through refurbishment or through trade-in. This ensures that customers always stay at the forefront of technology for the benefit of their business and to retain the value of their investment. This fall, we released the UltraCam Hawk, a system that replaces the UltraCamLp, that features similar specifications as the UltraCamLp as far as image footprint and lens focal length but that takes advantage of the third generation UltraCam architecture of the Falcon and Eagle. This brings significant improvement to the entry level UltraCam, including the ability to be upgraded to either a Falcon or Eagle, and allows customers to select a system that meets their present business needs, budgets and upgradability through refurbishment as those needs and budgets evolve.

With technical advancements on the rise, do you think it invades the privacy of the public? Are there any legal conditions laid down to the civic use of your products?

Privacy is an important topic. Cameras can now collect really impressive resolutions from the air. Privacy requirements vary from region to region and we have everything from total restriction to complete freedom around the globe. Thus, it is upon the camera operator to address these local requirements.

How does Vexcel Imaging aid in the development of Microsoft's Bing Maps?

With substantial know-how of the UltraCam team in Graz, we play an essential role in the development of BING maps. Naming just a few, we developed the UltraCamG exclusively



for the Bing Maps GlobalOrtho project which enabled Microsoft to map and publish online the entire USA and Europe at 30cm resolution in just two years. Additionally, we are responsible for a lot of software research and development for BING maps.

How do these two businesses (Bing Maps and UltraCam) support each other?

This is indeed a great combination that benefits both Microsoft and the UltraCam business as well as the community. We are a R&D center for BING maps and are helping Microsoft develop BING maps by developing specific camera systems and specific software for 3D modeling. We are also responsible for key research for 3D modeling algorithms which will help Microsoft generate the 3D models for the BING platform. Over time, the innovations we bring to Microsoft spin off into the commercial product line and the customers benefit. A current prominent example is the Dense Matcher technology that we developed for Microsoft which was released in January 2013 as a module in the commercial UltraMap software system. That makes this incredible feature now available to all UltraCam customers. Also, Microsoft acts as a customer to the community, contracting a lot of flying project work to the UltraCam customer base to acquire data for BING maps.

Which markets are you looking at expanding with UltraCam's products & services?

We are already globally present, either directly or through our network of partners. Since 2003, we have manufactured and shipped almost 300 cameras world-wide. This is an industry record and consequently there are UltraCam systems flying all over the world. Having said this, the markets are in different stages. Whilst Europe is somewhat saturated and more in an 'update' instead of an 'expanding' mode, other markets such as Asia, China or India and Africa are in a fast-growing mode or still in an infant stage.

How is Vexcel Imaging's experience helping in running projects such as the Global Ortho Project? Could you tell us more about this project?

This project was performed by Microsoft to collect a consistent dataset of Western Europe and USA at 30cm resolution for the BING maps platform. We developed a very specific camera system, the UltraCamG, for this project.
High-altitude ortho mapping has very specific challenges due to the huge amount of atmosphere between the camera system and the ground, such as color shifts. As the UltraCam collects images in RAW format, we have all the potential to correct for that during post processing. These algorithms have also been implemented into UltraMap and now support the high-altitude mapping of the Eagle f210.

With the opening of the UltraCam Calibration and Service Center in Singapore last year, which countries does it cater to?

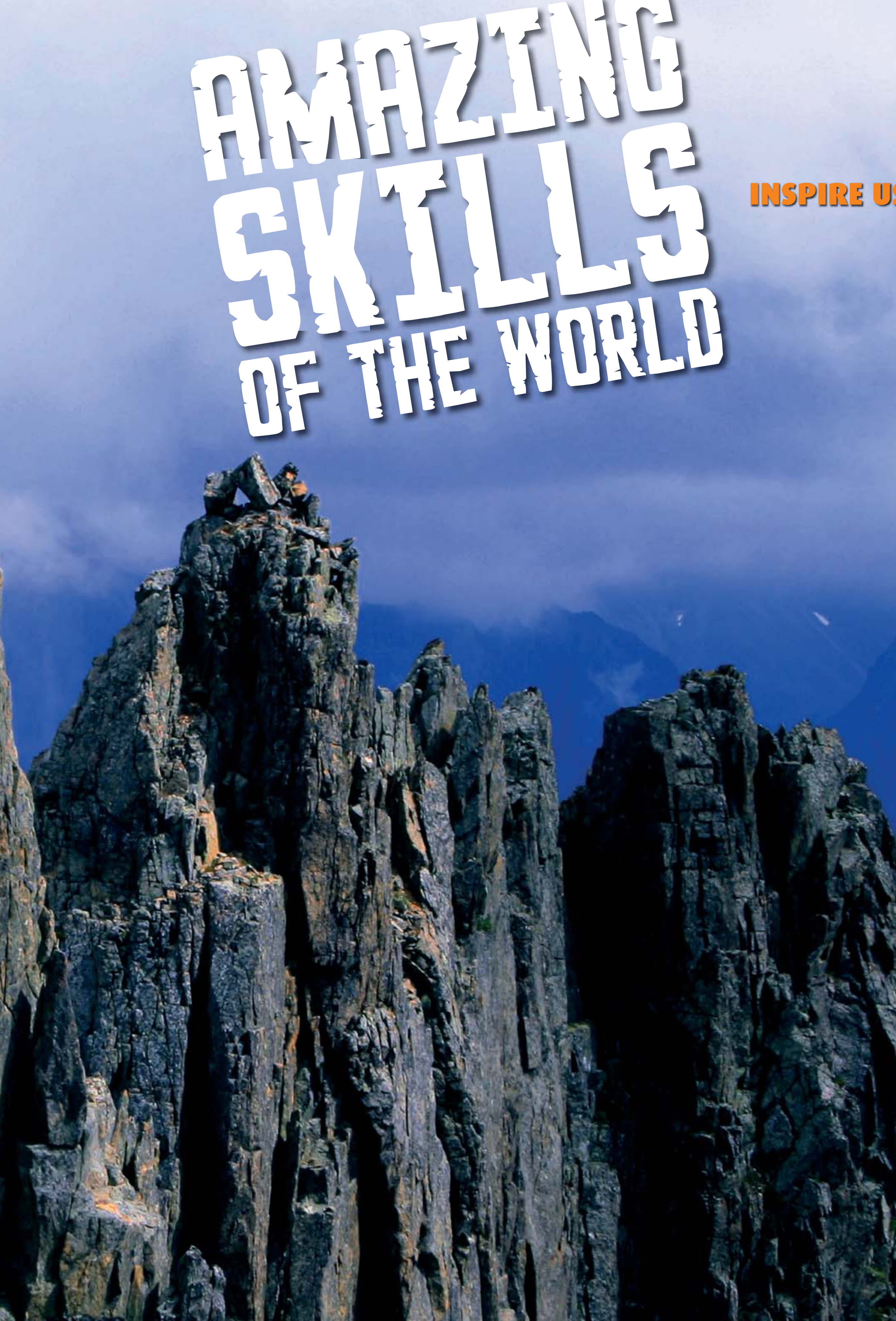
The lab in Singapore serves the broader Asian Pacific region. However, thanks to our setup with three calibration labs world-wide, we can nicely balance workload. If required, depending on the workload of the individual labs, we can direct cameras to labs with a currently lower workload to optimize on utilization to ensure quickest turn-around for the customer.

Photo: Hermod Halse

NORWEGIAN EXTREME ARTIST, ESKIL RONNINGSBAKKEN, DURING A ONE-HANDED HANDSTAND AT THE DISTINCTIVE NEEDLE PEAK, BLADET, NORWAY, 2010.

AMAZING SKILLS OF THE WORLD

INSPIRE US ...



NMOs: Adaptation strategies

National Mapping Organizations (NMOs) are positioning themselves vis-à-vis the aspirations of the citizens of their nations. Why and how? Heads of NMOs explain

There will always be a requirement for authoritative data

Dr Vanessa Lawrence CB
Ordnance Survey
Director General and
Chief Executive, UK

Over the last decade we have witnessed a number of significant developments which have affected and changed the global geospatial industry. The two biggest drivers to this change have been advances in technologies and the global recognition of the power of mapping information. Today, thanks to advances in technology, geospatial data is being used extensively across the globe by businesses, governments, developers and individuals to drive efficiencies, underpin decision making, support growth and to help tackle global issues, including sustainability and resource management. The expansion of the Internet and advances in mobile technology has opened up digital mapping to the masses. The growth of consumer familiarity, coupled with the recognition from businesses and governments, has been overwhelming and has resulted in increased demand for even more products, services and applications underpinned by geospatial information.

Today there are thousands of businesses, organisations and individuals operating in the geospatial information industry, helping to attract new 'non-traditional' customers through a range of innovative products, services and applications. We work in a thriving industry, which has resulted in an explosion of data from a range of sources including, national mapping authorities, international companies, SMEs and open source enthusiast, all providing the customer with unprecedented levels of choice.

At Ordnance Survey, we design all our products and services around the customer; they are at the centre of everything we do. Our challenge has been to make sure that Ordnance Survey's products and services meet the needs of all our current and future users. Ordnance Survey is renowned for our data capture and maintenance operations, and we continue to invest in this area, both in technology and people, to ensure that our products and services are underpinned by accurate and trusted data. We have also structured the organisations to ensure that we can meet, and exceed, the expectations and needs of our many diverse customers.

> The expansion of the Internet and advances in mobile technology has opened up digital mapping to the masses

We therefore operate across the consumer, business, government and developer sectors, which all have their own demands and specific requirements. Our focus is to listen to these groups and gain insight to help drive our future product developments and identify new markets that could benefit from geospatial information; we also encourage them to be involved in our development phases and to give us regular feedback.

Examples of Ordnance Survey meeting our changing customer demands include the release of a range of digital mapping services for the leisure industry, including an online portal for the outdoors and two new mobile applications, which complement our traditional paper maps that are still sold to over two million people per year. Within the business and government sectors we have continued to enhance our flagship product, OS MasterMap, with the release of new intelligent layers including functional sites and river networks. We have recently worked with an individual customer to develop bespoke rail networks to support their operations. Within the developer community we focus on releasing data and tools to support new users looking to innovate with geospatial information. For example, we have recently released a new 3D Terrain model, a range of vector datasets, a software development toolkit to help developers use Ordnance Survey data within their apps and further enhanced our popular API known as OS OpenSpace.

We also understand that we cannot meet all the customer demands alone and therefore work with over 300 partners who add value to our data and who produce many products and services to a diverse range of market segments and households. In addition, we have created an innovation network, GeoVation, which supports new geography based ventures to develop ideas.

This is an exciting time for the geospatial industry, which is providing customers with a huge amount of choice. I strongly feel that there will always be a requirement for authoritative data, even though ever increasingly it will be exposed to the customer in many different ways, and believe that national mapping authorities can work alongside private organisation and open source providers to meet the changing needs of the customer.

Vital role in providing accurate data

Datuk Prof Sr Dr Abdul Kadir Bin Taib
Director General of Survey and Mapping Malaysia

The requirements and expectations of citizens are rapidly changing with time and becoming more complex due to improved educational levels and various information avenues available to them. As a result, they are more knowledgeable and discerning in their choice of services. The NMOs in Malaysia namely; Department of Survey and Mapping Malaysia (JUPEM), will continue to play its vital role in providing the most accurate and reliable geospatial information for the citizens through Geoportal and Malaysia Geospatial Data Infrastructure (MyGDI). JUPEM is the main provider of geospatial information for other agencies and geospatial users in this country. Most government agencies are able to obtain the departmental data at no cost. We also intend to increase the awareness and trust among geospatial data providers to share their accurate and updated information easily and freely among government agencies. As for other than government agencies, all departmental data are made available to the public via the Geoportal / MyGDI for only at a nominal charge. Such charges are required to prevent misuse of the data provided. We believe that abuse of the system and data will occur once we allow unlimited access and usage, which will inevitably, slows down the system. Departmental records indicate that the geospatial information is mostly used for development projects and as such its cost is only fractional compared to the project cost.

JUPEM is therefore supporting the growth of the geospatial industry. Within the next five years we anticipate that the sharing of data will become more open and applications developed to support seamless integration between the various land related agencies to provide users with the utmost geospatial information. More geospatial experts will be needed to support this industry both in the government and the private sector. In future, we will see the geospatial industry moving into a ubiquitous environment where geospatial information is blended into every industry. In the next 10 years:

i) Widespread use of geospatial data in almost all government and private sector especially towards Malaysia becoming a developed country in the year 2020;
ii) Web map will be used in daily moving and traveling for the citizens;
iii) Geospatial subject will be taught at the primary classes in schools;
iv) There will be a complete database that includes cadastral data, mapping data, utility data and marine data;
v) Geospatial industry will be powered by the private sector including in the area of GIS, GPS, utility mapping and marine mapping; and
vi) New geospatial products will be available due to the fast development and integration of technologies.

In conclusion, our aim is to connect the geospatial community with the non-geospatial community in order to be Spatially Enabled Government and Society in the year 2020.

It is important to keep our maps updated

Hiroshi Murakami
Director General, Planning Department, Geospatial Information Authority, Japan

I value the activities of citizens on geospatial information as they have been expanding the envelope of geospatial applications in the country. Although our roles are different, I consider those people as co-workers, complementing each other in disseminating geospatial applications/services to the society. At the same time, they are also customers of our products and services and it is important for us to capture their voices. In this connection, our organization is actively involved in listening to their voices through emails as well as interviewing/sending questionnaires to them in order to better serve our customers. When we find it necessary, some of our employees set up a customer-satisfaction research team in an ad hoc basis, to do research on user needs of our products and services. The results are analyzed and fed back to the operational offices for future improvements. By continuing these efforts, I believe people will appreciate our products and services while enjoying different types of geospatial contents developed and provided by citizens.

We allow users to get direct access to our web map data for their applications, free of charge

One of the user needs we have found important is to keep our maps updated, particularly for man-made features including roads. Most cars in the country are equipped with a sophisticated car navigation system, and people now frequently look up maps on their mobile devices, which makes people increasingly intolerant on outdated maps. To meet such a need, our organization has been incorporating CAD data that was prepared for road construction planning by the road management authority, so that the newly built primary roads will show up on our web map on the very day they are made open for the public use.

Another need is to integrate our web map data into their applications. In order to meet the need, we now allow them to get direct access to our web map data for their applications, free of charge. This provision has led many venders to develop new applications that employ our web map data on the web, PCs, tablets and smart phones, and has enhanced the user accessibility to our data. A new award for those applications that use our data has also been set up to encourage the venders to develop useful applications. The information on the awarded applications is posted on our website to recognize the achievements. We have also been improving the user interface of our web map service by allowing the users to draw additional features on the map and export them for data sharing.

Also, we have been making efforts to meet a need from experts. As for surveying, the real-time information from our 1,240 GNSS receiving stations has greatly enhanced the efficiency of geodetic surveys and machine control for construction. We now allow surveyors, based on their request, to employ GNSS on the establishment of benchmarks in remote areas where accurate level survey will be costly and take much time.

By responding to these needs of individuals including experts, I am confident that our organization will be able to continually provide stable and trustworthy services that have been and will be appreciated by many individuals and organizations including those citizens with latest technologies and equipment.

**The views expressed here are personal opinion of Dr Murakami.*

Surveyor should deliver geospatial products at a faster rate

Prof Peter Chigozie Nwilo
The Surveyor General of the Federation, Nigeria

Effective Physical Planning, Urban and Regional Development projects would be impossible to implement without current and accurate maps in the right quantity, quality and format. This is because all the sectors and sub-sectors are map dependent, without which the objectives would not be realized.

Essentially, the primary assignments of the Office of The Surveyor General of the Federation **(**OSGOF) are:

- Provision of requisite geo-information in right quantity, quality and format in almost real time for National development and other stakeholders.
- Delineation, Demarcation and maintenance of interstate and international boundaries.
- Co-ordination and harmonization of all Surveying and Mapping activities in the country.

In order to meet up with the aspirations and demands of the citizenry especially in this era of fast technological advances, the Office has put the following into action:

- Proper documentation of all available information in OSGOF.
- Acquisition of current, high-resolution imagery covering the country for mapping.
- Articulation/formulation of a Mapping policy for the country

The technology is not going to lower the entry level of practitioners in the surveying profession

- Timely delineation, demarcation, maintenance of International and Interstate boundaries
- Production of National master plan and geo-data set for all sectors of the economy
- Production of updated, adequate maps that that can respond adequately to disaster, environmental challenges and developments.
- A workforce that is up-to-date in Surveying and Mapping technique in line with the world best practices.
- Acquisitions of state-of –the-art Surveying and Mapping equipment, and
- Undertaking all vital national Surveying and Mapping activities
- Providing the Government and the public with geo-information and definitive geo-spatial data of Nigeria; through User requirement Analysis;
- Capacity building to establish best practices in geospatial data management;
- Creation and maintenance of a National Repository of Meta data for all trigonometrical, Cadastral, Topographical, Hydrographical and Geodetic data in the Federation;
- Creation and maintenance of Survey Units in relevant Federal Ministries, Departments and Agencies (MDAs)
- Collaboration with Government Agencies.
- Advocacy in the need for geospatial information on all aspects of government economic and social service deliveries.

I do not think the technology is going to lower the entry level of practitioners in the Surveying profession. It will rather strengthen it. It will also increase the rate at which products are delivered to clients.

The focus for today's surveyor should be able to deliver geospatial products at a much faster rate. Traditionally, emphasis was on production of maps, cadastral plans and establishment of controls at all levels. Today, the interest goes beyond this. It covers application of geospatial information methods in virtually every sphere of life at a much faster rate. The advantage of the Surveyor is that he is well trained in several branches of Surveying including geodesy, hydrography, photogrammetry and remote sensing, GIS and cartography.

More emphasis on providing service, than that of mapmaking

Brigadier General Md Wahidul Islam Talukder
NDC, AFWC, PSC Surveyor General of Bangladesh

Survey of Bangladesh (SOB) is the National Mapping Organization (NMO) of Bangladesh. As the NMO, it carries out Geodetic Control survey activities as well as establishment of Control points throughout the country. SOB conducts topographical survey and produces various types of maps, Geospatial data including geo-database for nation building projects. Digital maps are produced for various purposes along with GIS data base. Survey of Bangladesh also controls all Aerial Photographs and the lone custodian of these. Besides, demarcation of International Boundary of Hilly districts is another important function of SOB which is carried out jointly with bordering countries.

Modern mapping was a challenge for Bangladesh until last decade. As technology is evolving fast to facilitate the map makers to mitigate the demands of the aspiring large number of people, we need to endeavor a little more to keep their hopes alive. By introducing sophisticated hardware and software, SOB has enhanced its capabilities and efficiencies in many folds. As national geospatial topographical data repository, it is now heading for fully digital system in order to help all the government, non-government and private agencies in achieving the national aspiration. Survey of Bangladesh envisages taking its product to the door-steps of common people. It also strives for improving surveying and mapping activities through close cooperation and coordination with the global communities.

'Geospatial Data' is very much required by the planners and partners of Development Projects, who all need updated data and topographic maps and the demands are in increase in Bangladesh. Survey of Bangladesh takes the challenge of providing accurate and precision data at right time and at right place. Our Government also facilitates the dissemination of information to the user level at the earliest.

As a head of the National Mapping Organization, I always ponder a lot to satisfy the growing needs and aspirations of our citizens. I emphasized more on providing service, than that of mapmaking. Digital environment gives the extra boost in respect of time and volume of works which could not be easily done by analogue methods. Few efforts like 'Installation of Permanent Global Navigation Satellite System' (GNSS CORS), preparation of Digital Topographic Maps and Datasets, making of digital large scale Topographical maps of urban areas and creation of Digital Elevation Model (DEM), are worth mentioning.

SOB has designed and continuously updating its website to provide most frequently asked data and information through the web portal. However, acquiring of geospatial data and processing those are still a mammoth task. Being the NMO of developing country, Survey of Bangladesh put its efforts in satisfying the urgent needs of users. Our objective is to acquire, update, organize and disseminate spatial data as per the aspirations of citizens. SOB assures and maintains accuracy and quality of all products for better results. Our trained and skilled manpower will endeavor to fulfill the requirements of users of maps and geospatial data.

Digital environment gives the extra boost in respect of time and volume of works which could not be easily done by analogue methods

We must have high professionalism

Brigadier General Dr Eng Awni Khasawneh
Director General of Royal Jordanian Geographic Centre
Director General of Regional Center for Space Science and Technology

Royal Jordanian Geographic Centre (RJGC) was established in 1975 as a national, scientific and specialized institution on both national and regional level in the field of surveying works, producing maps in various scales to meet the needs of Jordan and other countries in the region.

We introduce ourselves as a unique geographic centre in the Middle East and South Africa, especially in the following fields:

- Producing topographic, operational & Thematic maps.
- Building & maintaining the national Geodetic Network.
- Orthophoto, Digital Maps, cartography, aerial photography, Remote Sensing, GIS.
- Delimitation & Demarcation of international boundaries of Jordan.
- Helping in preparing detailed cadastral charts of properties and real states.
- Land cover of Jordan at different scales.
- Building digital geographic data base.
- Hosting the Regional center for Space Sciences and Education for Western Asia affiliated to the United Nations.
- Offering required consultancy, advice and guidance for government institutions and ministries as well as the private sector.
- Obtaining advanced equipment and special software for the works of survey and maps.
- Providing high quality training in those fields for participants from inside and outside Jordan.
- Signing several agreements and MOU with many authorities and ministries to get benefit of our technical and training capabilities.

Also RJGC is a member in many international leagues such as: ADEGN, UNGEGN, ISPRS, IAG, ISNET, COPUOS, IAG, ICA, IUGG, AARS.

We put a strategic plan (2013-2016) to meet the updated developments, facilitate the procedures, providing alternatives and concentrate on the quality of the product offered to various institutions and individuals.

In the last three years, we concentrated our efforts on holding scientific days, lectures and workshops to activate the role of RJGC locally and internationally and participate in making field applied studies by using Remote Sensing techniques and Geographic Information Systems (GIS) specially those related with natural resources such as ground water gatherings.

In light of the challenges of the modern era represented in rapid changing, intense competition and the enormous development in information and communication technology, which made the RJGC keep pace with those developments closely, particularly regarding modern software and digital survey, including aerial photography, production of maps and determining the coordinates accurately.

Modern technology allows the producers of maps to provide users with data quickly, accurately and in digital form services upon request, which was not available before as the production of the map before was taking long time and stages which allowed others to present different interpretations to the enthusiasts who are not concerned with map industry

And as we face a strong competition in the market today and the emergence of new applications and rapid changes, we find that we must have high professionalism and good specifications to ensure the quality and durability of our products

It is necessary to use all scientific and technical developments for the benefit of our citizens and to find optimal solutions for their problems and daily suffering so that those plans and strategies are reflected positively on their living standard and daily life.

Achievements

- Hosting the Regional Centre for Space Sciences and Education for Western Asia affiliated to the United Nations which aims to develop the skills and knowledge of university educators, scientists and universities working in the field of environmental research, remote sensing and related sciences, assist educators to develop environmental and atmospheric sciences, develop the skills in the field of satellite communications, including those associated with rural development, disaster mitigation, business networking between professionals and scientists, government institutions in order to facilitate the exchange of new ideas, data and experiences, enhance regional and international cooperation in the field of space science and technology and application programs and assist in disseminating and explain the importance of space science and technology to the public and its value in improving their everyday quality of life.
- Hosting the Arab Division of Experts on Geographical Names.

Ambitions and vision

- Hosting the National Geographic Information System (NGIS) in coordination with the concerned authorities.
- Establishing the King Abdullah II City for Space Sciences & Astronomy which will include a planetarium, an optical telescope observatory for astronomical researches and crescent observation, radio telescope, Satellite receiving station.
- Converting satellite dish (32m) diameter located in Amman to a radio Telescope to connect it to the (EVLBI) network.

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Quality standards have to be strictly observed

Dr Peter N Tiangco
The National Mapping and Resource Information Authority (NAMRIA) Administrator, Philippines

As a national mapping organization (NMO), we recognize how technologies constantly revolutionize and shape our surveying, mapping and geospatial information management industry. The combined advantages of GPS, GIS, ICT and Internet, for example, are overwhelming that they have empowered the mapmakers and providers both on the institutional and individual levels breaking the barriers between professional practitioners and map enthusiasts. Needless to say, technologies will certainly evolve and continue to impact the industry players and market dynamics.

Are NMOs still relevant? Yes. For a country like the Philippines, at least the regulatory dimension of mapmaking is still of utmost importance to us and quality standards have to be strictly imposed and observed even if mapmaking is outsourced. In fact, a national administrative order was issued in this regard to coordinate the acquisition of geospatial data to address inefficiencies in the use of our government resources.

Volunteered geographic information, participatory GIS and crowd sourcing have become another interesting dimension of mapmaking. Generally, we cannot restrain anyone from being an instant service provider, industry player or stakeholder, but ideally, everyone has to come around the standards table in the spirit of producing authoritative maps. In the long run, we can make strategic partners, not competitors, out of these actors, to carry out common national development agenda. These actors can also provide valuable inputs into our agency's quality management system for the continual improvement of our geospatial products and services.

The National Mapping and Resource Information Authority or NAMRIA is the central mapping agency of the Philippine government. It is mandated to produce topographic maps, nautical charts and other geospatial products and to make such products as accurate, timely, available and accessible as possible across all government levels and the citizenry. Amidst the fast and incessant technological shifts, it is also incumbent upon the agency to address some social needs, i.e., bringing our maps closer to people, by utilizing technical advances. Along this line, NAMRIA is currently undertaking two initiatives namely, the Philippine Geoportal: One Nation One Map Project (PGP) and the Unified Mapping Project (UMP). The PGP aims at establishing a web portal that provides a system for sharing of and access to geospatial information using one common multiscale basemaps. The system will provide a mechanism for a clearinghouse, data management and exchange standards and protocols, and institutional interface that will facilitate the flow of information across the network, with safeguards to protect misuse and potential risks to individuals, community and country. The PGP also intends to provide a platform for multiagency collaboration and business partnerships.

The UMP involves the updating of large-scale topographic maps for the whole country that will eventually be served on the geoportal. While we recognize the importance of large-scale maps to various applications, the project aims at providing new high resolution base information for emerging applications such as disaster risk reduction and management and climate change adaptation.

By making great strides toward being a citizen-centric organization, the agency envisions a geospatially empowered Philippines by 2020, a vision wherein the government capitalizes on geospatial information for effective governance and a citizenry that benefits from the use of such information.

NMOs are under immense pressure to deliver services

Dr Swarna Subba Rao
Surveyor General of India

With the penetration of GIS technology into all important aspects of Governance, social and public related activities especially with the activities on Web like Google Maps etc. today, the usage of Maps and Geo Spatial Data has increased manifolds and subsequently the demand has also gone up several folds. This has put National mapping organizations under immense pressure to deliver services whose nature is changing very fast as consequent of developments in other sectors like Web technology. This is driving the map makers change their mandate to meet the above described demands from all societies of the country.

The technology has developed substantially in the past few decades bringing in many user friendly equipment and methods in survey, map making and data collection. For example, till 1980s to provide one ground control point, by using triangulation methods it used to take two to three weeks for the survey teams. Today, the GPS technologies made it possible in a matter of hours. The same analogy is applicable in map making and data collection as well.

This shift in the technological arena has facilitated many of enthusiastic map makers to produce reasonably good products in a very short time. These products are capable of meeting majority of social needs and to some extent the needs of planning and governance exercises as well. This is compelling the NMOs to accommodate these very new demands into their work. The advances in the mobile technology and it's integration with GPS and other technologies are opening up many new arenas of effective usage of geospatial data. The change in thinking of governments and their increased demands for purpose specific geospatial data is another reason to celebrate as well feel concerned for the NMOs.

Presently, in India the major initiatives like NGIS, mapping the country on 1:10k mapping in a GSI compatible format in a very short duration is an indicator of the growing importance of geospatial data and it's producers. National GIS is acting as a driver for various activities within the Government of India agencies that are now expected to integrate their data with geospatial data and add the geospatial component into their planning and analysis. Though this is a welcome development that leads to a comprehensive and better planning and governance in a sustainable way and gives way to geospatial g-governance culture, initially the NMO has to deliver several innovative and complex services to achive this goal. They have to adopt and practice new technologies and strategies.

NMOs has some unavoidable and leadership role to play at the national scene. NMOs are responsible for providing direction to the mapping community of the country. They are shouldered with the responsibility of ensuring a balance between enthusiastic mapping and data collection and protecting the national interests specially with respect to national security within and from outside. NMO are also mandated to provide necessary infrastructure to ensure all the mapping activities are properly supported with facilities and technology. SoI proposes to fulfill this requirement by way of extending it's consultancy and advisory services and establishing Continuously Operated Reference System for providing GPS signals across the country.

In a way one can surmise that NMOs across the world are facing challenges due to penetration of GIS technology and advancements in mobile and GPS technologies. SoI in India is gearing itself up and preparing to face these challenges with its programmes.

The requirement for authoritative data is crucial

Luiz Paulo Souto Fortes, PhD
Brazilian Institute of Geography and Statistics (IBGE), University of the State of Rio de Janeiro (UERJ), Currently at the Department of Geomatics Engineering, University of Calgary

GNSS technologies have impacted many activities in all countries of the planet, and the same is especially valid for the land administration sector. In Brazil, a law was published in 2001 making mandatory the link of the perimeter of all ~five million rural properties in the country to the Brazilian Geodetic Frame. GNSS has been playing a fundamental role in supporting the corresponding surveys, carried out by professional surveyors certified by the Land Reform Institute (INCRA, from Portuguese) for this task. In order to improve the reference framework to support these surveys, INCRA and IBGE established a cooperation which has allowed the densification and modernization of the Brazilian Network for Continuous Monitoring of GNSS (RBMC), the national CORS network, up to more than 90 GNSS stations working continuously. In addition to it, under cooperation with Natural Resources Canada (NRCan), IBGE has released a Precise Point Positioning (PPP) service in the country and surrounding areas, benefitting many positioning applications since the survey results are also referred to SIRGAS2000, the official geodetic reference system adopted in Brazil (and compatible with many other systems in the continent). Since 2010 professional surveyors are officially allowed to use this PPP service for processing of rural properties' surveys. Figures 1 and 2 show information related to the use of this service (in terms of spatial distribution and number of monthly submissions, respectively) since its release in 2009 - which is impressive. Recent advances also include the broadcast of International GNSS Service (IGS) real time satellite ephemeris and clock corrections through the Internet, supporting PPP real time positioning applications. All these GNSS-based resources have decisively been facilitating the accomplishment of the challenging task of improving the land administration structure in Brazil. This is a good example on how GNSS technology may positively support an application with strong social impact in the country. Looking to the future, with the availability of more GNSS signals from space, it is expected that a required positioning accuracy will be achieved faster than before. But even with the ongoing technology evolution, the requirement for authoritative data is crucial, which reinforces the role to be played by national government institutions in providing the proper geospatial framework, besides producing and/or certifying the associated information. This is especially the case in land administration applications.

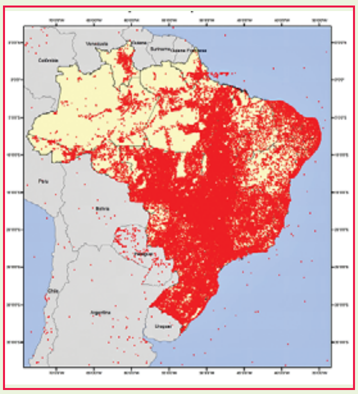


Figure 1: Spatial distribution of GNSS stations processed by IBGE PPP service (source: IBGE Coordination of Geodesy)

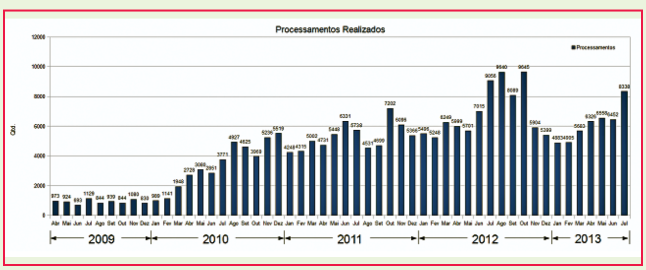


Figure 2: Number of monthly processing jobs carried by IBGE PPP service since its release, in Apr 2009 (source: IBGE Coordination of Geodes

Bringing Geographic Authority to Information

Cambridge Conference and Third Session of the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM3), July 22 – 26, 2013, Cambridge – A report

The 22nd July 2013 saw the start of the first combined meeting of the Cambridge Conference and UN-GGIM. Both these conferences bring together geospatial leaders from around the world to discuss the pressing matters that are most prominent in this ever changing industry. This year's conference also offered the opportunity for students from both The University of Sheffield and The University of Cambridge in assisting the United Kingdom's Ordnance Survey team in the smooth running of the event. Such an opportunity has giving us, as students, a unique perspective in the running of international events and has allowed us to meet industry experts in the geospatial field.

Held approximately every four years, the Cambridge Conference is an international congregation of senior representatives and leaders from mapping organisations from around the world. Dating back to the 1920s the Cambridge Conference was originally a small gathering of 45 delegates then known as the Empire Conference of Survey Officers. Over the years the conference has dramatically changed in response to ever changing technologies and the increasingly globalised world. The second half of the week was dedicated to third session of the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM). Putting the UN-GGIM meeting back to back with the well-established Cambridge Conference enabled the event to bring together many experts from all areas of the geospatial field.

The Cambridge Conference was based at Churchill College, one of the newer Cambridge colleges, which was founded in honour of Sir Winston Churchill in 1960. The college is normally home to around 500 students, mainly of the scientific disciplines. Appropriately enough the motto of the college is *'Forward'*, taken from one of Churchill's most famous speech *'Come, then, let us go forward together'*.

The members of the student team came from a variety of academic backgrounds, not limited to geography, and range from first year undergraduate students to recent graduates. The University of Cambridge is ranked as one of the world's leading universities, whilst The University of Sheffield has strong links to the conference through notable alumni. These include Dr Vanessa Lawrence CB, the Director General of Ordnance Survey and Co-Chair of the UN-GGIM and Air Chief Marshal Sir Stuart Peach KCB CBE the Vice Chief of the Defence Staff in the United Kingdom.

Throughout the week we were tasked with many diverse roles ranging from welcoming delegates to rapporteuring at the conference proceedings. It wasn't all work however, with social events happening most days including a traditional English garden party complete with croquet, as well as a BBQ in the beautiful setting of the Clare College grounds which introduced many delegates to the traditional Cambridge pastime of punting.

Throughout the week many guest speakers attended the Cambridge Conference. On the first night of the conference, we were delighted to welcome guest speaker Nick Crane, a geographical writer and broadcaster whose publications include a travel book, *Clear Waters Rising*, as well as over 70 films for the BBC. Nick's speech was in honour of the famous cartographer and mathematician Brigadier Martin Hotine CMG CBE and focused on his manifold contribution to the world of mapping. Such achievements include the retriangulation of Great Britain from 1934-1939 which has underpinned Ordnance Survey's reputation for high technical standards and innovation. Other guest speakers included Sir Stuart Peach who focused on the challenges of military cartography in Afghanistan, as well as Paul Davies, the Chief Meteorologist of the United Kingdom Met Office, who highlighted the role of geospatial data in the area of climate change and disaster mitigation. These speeches proved interesting for us, as students, as the material discussed echoed the topics learnt at university.

The remaining sessions saw contributions from experts in the field such as Stefan Schweinfest, the Acting Director of the

UN Statistics Division and Professor Paul Cheung, the Senior Advisor to the UN-GGIM. There were also discussions open to the floor with many nations engaging with the topics and sharing their unique perspective with the global audience. A common theme within the conference was a need for increasing collaboration and a need for international standards to improve the efficiency and effectiveness of geospatial operations.

The second half of the week was based in the more central surrounding of the Cambridge Corn Exchange, which normally serves as a concert venue but was transformed into a world class technological hub for international delegates at the UN-GGIM. The session was led by Dr Vanessa Lawrence and Stefan Schweinfest. This event gave a few of the students the opportunity to play an integral part in the proceedings as rapporteurs which proved to be a challenging but thoroughly enjoyable task. Some of the issues discussed included the future development of linking geospatial information to statistics as well as the integration of land and marine geospatial information.

Thursday evening witnessed one of the highlights of the week, the Gala Dinner. This was a gathering of our delegates at Girton College, one of the first female colleges in the University. Delegates were encouraged to come dressed in their national costume which some delegates embraced enthusiastically, our favourite being the delegate from Georgia. After a wonderful meal many nations contributed to the entertainment by presenting national songs. Highlights included powerful and uplifting vocals from the Chinese delegation, a traditional Australian performance of “Tie Me Kangaroo down Sport” and the Ordnance Survey “choir” singing the classic Proclaimers song “500 miles”. To finish the night off all delegates were invited to join in with the UN-GGIM “anthem”, an adaptation of “My Bonnie Lies over the Ocean”!

As this week draws to a close, although many of us are tired, we are sure that most would agree that the conference has been a great success. It has been an enjoyable and unique experience to be part of this truly international occasion which has allowed us to mix with world leaders in the geospatial field. We would definitely recommend students to take part in any similar opportunities that may come their way as the insight gained may prove invaluable towards future career aspirations. Even for students who do not specialise in this field, the conference has proved useful through acquisition of more general skills and an awareness of a world of which they previously had no understanding.

In short, the conference has highlighted the vital importance of cooperation between countries, organisation and people and we hope Ordnance Survey offer this opportunity to students at the next Cambridge Conference in a few years’ time!

By Amelia Bell-Bentley, Anna Gusev, Jocelyn Moore, Stephen Penson.

Simplicity and ease of use is the key to the success of our drones!

Says Andrea Hildebrand, Co-founder, senseFly, Switzerland while explaining the key features of senseFly drones and new software release – eMotion 2

What are the key features of senseFly drones?

Both the eBee and swinglet CAM have been designed with ease of use for the end user in mind. Our drones are hand launched then fly & land fully autonomously. Safety is high on our list of priorities at senseFly, which is why our systems were developed with a foam airframe and rear-mounted propeller to ensure the safety of both the drone and the people on the ground. We are constantly looking at ways to improve our systems and recently added 3D flight planning to our software, which has further increased the safety of operating when mapping over uneven terrain. Being lightweight and compact the systems are easily transported between projects.

Compared to other commercially available UAV drones in the market, how does senseFly has an edge over others?

Simplicity and ease of use is the key to the success of our drones! Our team has spent a lot of time creating and developing powerful autonomous 2D and 3D mapping tools that not only deliver quality images, but which can be operated by anyone with very little training required. Our systems come complete with full mission planning & control software eMotion 2 and image processing software Postflight Terra thus providing a complete solution.

Our drones are among the lightest on the market with the eBee weighing in at less than 0.7kg and the swinglet CAM weighing in at 0.5kg. Being lightweight not only allows for ease of transportation but also makes the systems safer should a collision occur.

How price competitive are your drones?

We feel that our pricing is very reasonable and highly competitive and our systems generally pay for themselves in a very short timeframe.

What are the optimum weather conditions for both eBee and swinglet CAM drones?

As with all aerial photogrammetry good weather conditions are always the best way to produce optimal

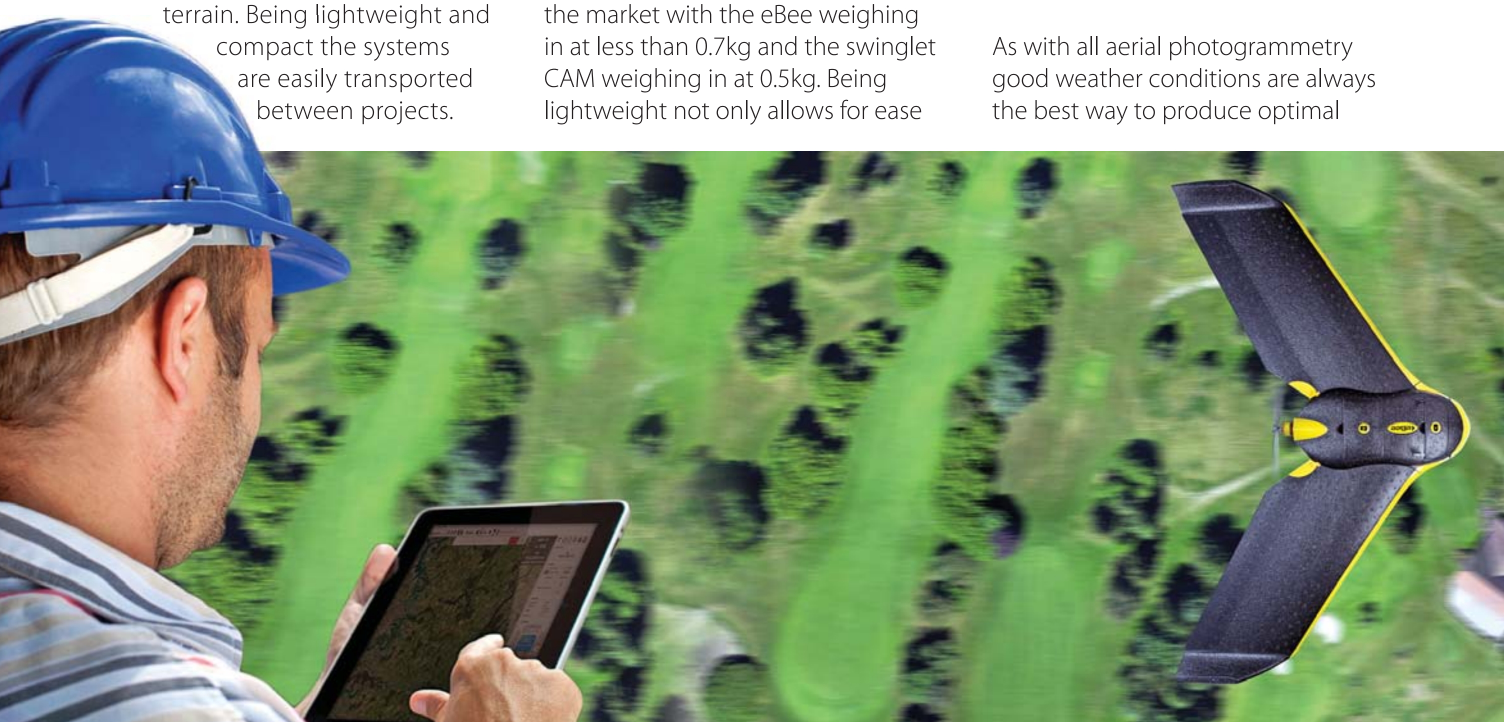
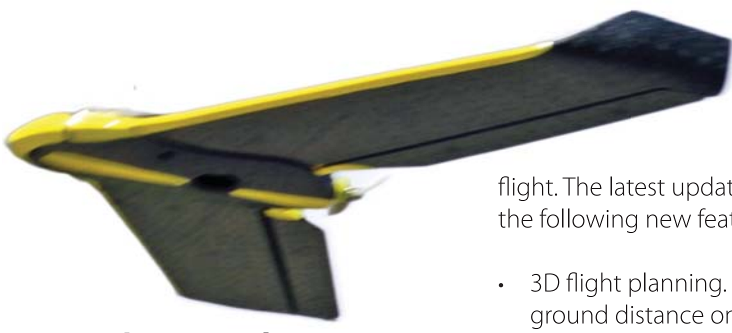


image results. Although even on cloudy days where traditional methods would be hindered, the drones produce quality imagery due to their ability to fly beneath the cloud cover.

With the world marching towards greener technology, how are both the swinglet CAM and the eBee environmental friendly?

Both the eBee and Swinglet CAM have green credentials as they are carbon neutral, due to their electric brushless motors with rechargeable Lipo batteries. They are also extremely quiet thus do not contribute to noise pollution.



Can the senseFly drones be used in city area?

Technically speaking the senseFly systems are more than capable of working in city areas due to the ability to launch and land in small confined areas. However in certain countries regulations will dictate whether the user is permitted or not to operate in these areas.

What are your expansion plans in terms of increasing your market share in UAV market worldwide?

At senseFly we are continually expanding and developing our dealer network, establishing relationships with respected companies within the surveying and agricultural communities throughout the globe which share our enthusiasm and vision for UAV applications. We have dealers based throughout Europe, Australia, South America, Canada and have recently branched into Asia, Africa & the United States. We anticipate further growth within the US market following the new FAA regulations that are expected to come into effect during 2015.

What are the key features of your new software release – eMotion 2?

eMotion 2 is our intuitive ground station software. It allows you to plan, simulate, monitor and control the trajectory of the drone, before and during flight. The latest update includes the following new features:

- 3D flight planning. Constant over ground distance on steep terrains allows minimizing the image pixel resolution variation, thus providing better image quality & results.
- Google Earth visualization. The ability to check a flight plan within a 3D environment increases the safety of the operation.

- Multiple drones operation. Using a single interface to control multiple drones allows greater areas to be covered in less time. They share start and landing waypoints, are coordinated for take-off and landing, and have automated in-flight collision avoidance.
- Integrated data management. Have a look at your former flights, find flight logs and corresponding images, simply create geotags and upload your project to Postflight Terra for image reconstruction.

Documenting monuments

State of the art geomatic techniques for an accurate and complete documentation of the built heritage

Donatella Dominici
Professor of Cartography and Geomatics – Chief Scientist of Geomatica_LAB, Department of Civil, Environmental Engineering and Architecture, University of L'Aquila, Italy

Elisa Rosciano
Environmental Engineer and PhD Student, Department of Civil, Environmental Engineering and Architecture, University of L'Aquila, Italy

Vincenzo Massimi
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Michail Elaiopoulos
Civil Engineer, Geomatica_LAB collaborator, Department of Civil, Environmental Engineering and Architecture, University of L'Aquila, Italy

Each community has the duty to conserve, identify and properly manage its own heritage that, unfortunately, is often susceptible to transformations due to time, anthropogenic factors or damages caused by natural phenomena. Innovative geomatic techniques, when correctly integrated among them, can provide a valid solution for an accurate, fast, safe and especially rich documentation of the build heritage. In this way, 3D geometric models of complicated monuments can be created and enriched with a wide range of information. Such models can reach an extremely high degree of completeness the existed building is surveyed in all its details, both internally and externally, even by air using proximity surveying. This integration permits reaching high quality as a result of the combination between the visual potential of the images with the high accuracy of the geometric surveying. This paper though, illustrates how the traditional surveying has been combined with GNSS, laser scanning and photogrammetry in order to experiment the accurate documentation of two monumental buildings located in L'Aquila, central Italy.

Site's description

The first building of this experiment is the old monastery of "San Basilio" firstly built in 496 A.C. [1]. According to historical notes, the building has been founded by the monks of S. Equitius as a monastery dedicated to the Benedictine nuns of the cloister. In 1703, following a violent earthquake, the monastery's facade has been seriously damaged and rebuilt, additional modifications to its original plans have been made too. During the 17th century, a severe restoration with many complex architectural changes has been made during which the building has assumed the character that still distinguishes it. Then, in 1993, the University of L'Aquila has entered into an agreement with the Municipality for the use of the building for institutional purposes. The building was finally completed in 2008, just a year before the tremendous earthquake that considerably damaged it in 2009 (Figure 1).

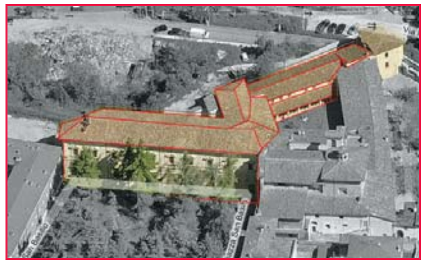

Figure 1: The complex of "San Basilio Monastery" in L'Aquila

The second one is a medieval Unesco protected site always located in L'Aquila, the St Mary of Collemaggio ("Basilica di Collemaggio"). The building presents a long and important history as has been headquarter of Pope Celestine V, who also rests in the church. Constructed between 1280 and 1289 by the Celestine Order, Basilica features an elegant Romanesque facade with a central door and two smaller flanking doors on each side. Internally, the church follows the standard plan of a nave and two side aisles each one divided from it by a row of columns. A row of arches support a tall wooden ceiling that covers a beautiful floor made in the same red and white stone as the facade. Great part of the monument was also seriously damaged in the 2009 earthquake. While the church's front is intact, its cupola,

Figure 2: Basilica of St. Mary of Collemaggio the day after the quake

transept vaults and the triumphal arches have completely collapsed (Figure 2).

The ground control network

Laser scanning and photogrammetry certainly provides powerful, rich and detailed data. However, in order to achieve a notable metric accuracy of the final model, a network of ground control points is needed. This network consists of numerous targets with known coordinates referred to a local reference system. The whole quality of final model then depends on the precision and accuracy of the so-called ground control network. To establish it, a gridding networks is initially set up by using GNSS surveying in static mode. Starting from the vertexes of the gridding network, a 3d geodetic survey is made to calculate the coordinates of all GCPs. These coordinates are finally used to georeference any data like point clouds or photogrammetric sets. In order to achieve results of high quality an adequate planning of the network is needed both to evaluate its functionality, redundancy and to estimate the a priori values of the standard deviation. With these values, a statistical adjustment of all measurements can be made correcting the data, detecting eventual errors and assigning the standard deviations at all points. Finally the whole network undergoes statistical tests that prove its accuracy (chi square

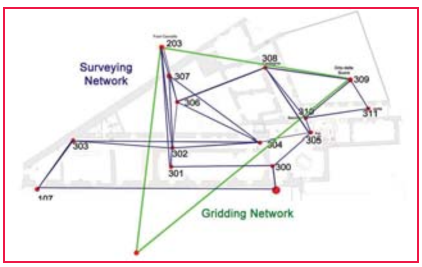

Figure 3: Ground floor of the San Basilio's Monastery: the gridding network in green and the surveying network in blue

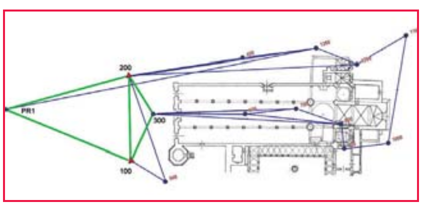

Figure 4: Ground floor of the "Basilica" the gridding network is visible in green and the surveying network in blue

and data snooping). Figure 3 presents the gridding and surveying networks of the San Basilio Monastery while figure 4 presents the gridding and surveying network of "Basilica di Collemaggio".

In addition, the final surveying networks of both cases are presented in figure 5. Totally, 112 control points have been calculated for the first case (San Basilio) while around 60 control points have been used for the "Basilica Of Collemaggio". The precision after the statistical adjustment has been found for both geodetic networks around to four tenths of a millimeter (0.4mm).

Point cloud acquisition and elaboration

During the last decade both the terms "surveying" and "representation" are accompanied by the adjective "digital" that has revolutionized the documentation of the cultural heritage. Laser scanners represent an excellent surveying instrument that has been proven to be versatile and able to offer effective three-dimensional representations of the

Figure 5: Ground floor of the "Basilica" the gridding network is visible in green and the surveying network in blue

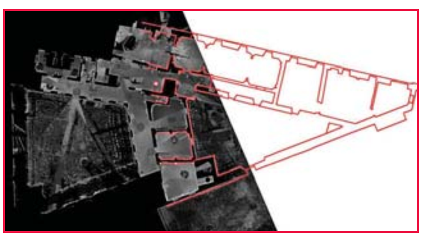

Figure 6: Creating the ground floor's map

Figure 7: The San Basilio Monastery's front prospect

elements present in its field of action. The advantage of using a device such as the laser scanner is that not only the coordinates but also information connected to their radiometric characteristics can be determined and archived. Even though laser scanning is an apparently simple type of survey, numerous issues need to be considered in order to achieve data of significant quality. Firstly, the complexity of the old monumental structure raises the need for a satisfactory projection of the whole survey in order to adequately cover the structure. The network of the ground control points also has to be adequately projected in order to permit sufficient constraints among the various clouds for their registration and following georeferencing. Thus, in the case of "San Basilio, the exteriors were detected using 10 point clouds and 10 paper targets using a high resolution scanning (grid of 7mm) while for the interior around 105 point clouds and 60 targets with a grid density of 15mm. Figure 5 illustrates the global point cloud of the building (San Basilio) while in figure 6 the first map of the building's ground floor is presented.

Interrogating the final model, maps for all floors as well as prospects and sections have been created too, figure 7 illustrates the main facade's prospect.

Regarding the St Mary of Collemaggio, using the same approach, the exterior has been detected with 40 targets and 16 point clouds creating a grid density of 8mm. At the same way the interior has been covered with 22 point clouds achieving a grid density of 15mm.

Having a 16 and a 14 meter tall facades respectively, a study of their verticality was also possible and interesting. Thus, using the rich information included in the already registered and georeferenced global model, the coordinates of all points belonging in both facades have been extracted in a simple txt file. After roto-traslating the origin of the reference system in order to orientate one of its axis parallel to each facade, the obtained modified coordinates have been introduced in a commercial surface plotting software. This elaboration consisted in interpolating all points to create a triangulation, noise reduction, surface mesh and finally the splines that led to the final dimensioned drawing. Figure 8 presents the contour map of the created drawing.

UAV and photogrammetry of proximity

Even though the obtained results offered a satisfying documentation with an interesting accuracy of the metric layer, there are still some parts of the building that remained hidden. Areas of bad visual such as wall portions at the taller parts of the building, as well as the roofs, still contain valuable structural information needed in order to achieve a complete documentation. To encounter these difficulties, unmanned aerial vehicles equipped with both optical and IR sensors can be employed. The new-born so called photogrammetry of Proximity is then operated using the traditional surveying principles. A set of images are being captured from pre-designed positions, so guaranteeing optimal overlapping and distances both from the ground and from the object. Using dedicated software, the digital camera is being calibrated and both the internal and the external orientation parameters are obtained. After mosaicating the photograms obtained from at least two positions, a stereoscopic pair can be created and used to obtain a Digital Surface Model (DSM). Figure 9 illustrates the ANTEOS MINI UAV during an acquisition at the facade of "Basilica". In addition, figure 10 shows the results of the first experiments using an on board IR sensor.

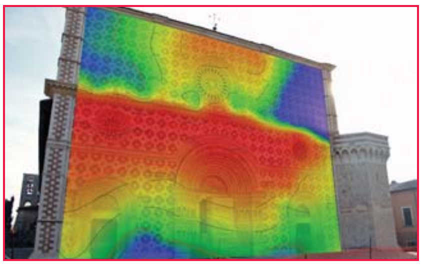

Figure 8: Interpolation of the facade's points for the study of its verticality

Figure 9: Surveying with the Anteos Mini UAV – St Mary of Collemaggio

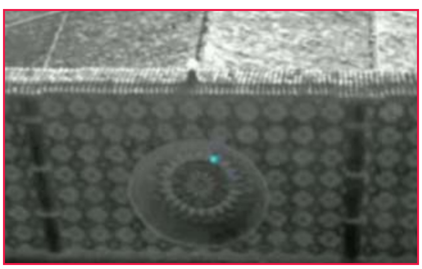

Figure 10: IR thermal data captured from an UAV at the height of 25m

First conclusions and discussion

The developments achieved in the field of geomatics during the last decade are definitely significant. Powerful sensors like laser scanners and compact light cameras, integrated with remotely commanded aerial vehicles, extend the limits of surveying opening new horizons for the documentation of the built heritage. Surveying becomes always faster, more accurate and safe even in extreme situations like the post hazard emergencies.

In this paper, the laser scanning technique correctly integrated to precise geodetic networks has been tested in two monumental buildings. Both the obtained 3D models featured global metric precision up to 5mm. Even if numerous hypothesis connected to the various elaboration routines have been made, the overall results appear to be rather convincing. Thus, the presented methodology can be considered ideal for the architectonical and structural documentation of such buildings both for the satisfactory quality of the final data and for its versatility. On the other hand, the experience of the Photogrammetry of Proximity using UAV, even if presented extremely encouraging also showed the need to improve some aspects, both technical and scientific, as the DSM extraction, the flight's stability and the payload. Thus, the future developments will aim to define the photogrammetric data elaboration, evaluate and exploit the use of the IR data and overally improve this surveying technique. With reference to the Laser Scanning, another aspect that also has to be defined regards the ability to recognize exactly the same point, permitting in this way also its use in monitoring applications.

During the next months all experiments will continue focusing on a better elaboration and integration of the proximal data deriving from the UAV to the global model. All experiments will continue aiming to achieve a complete precise and fast and safe way to document the build heritage.

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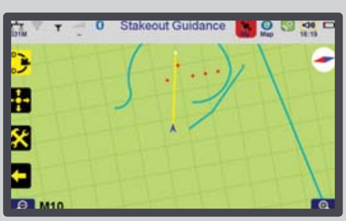

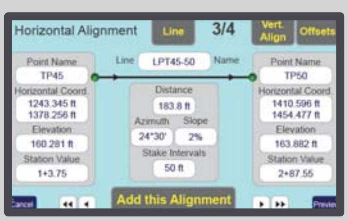

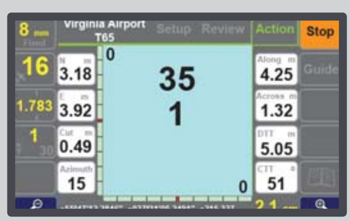

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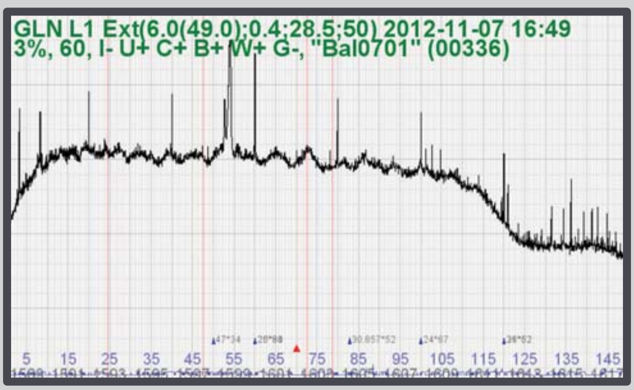
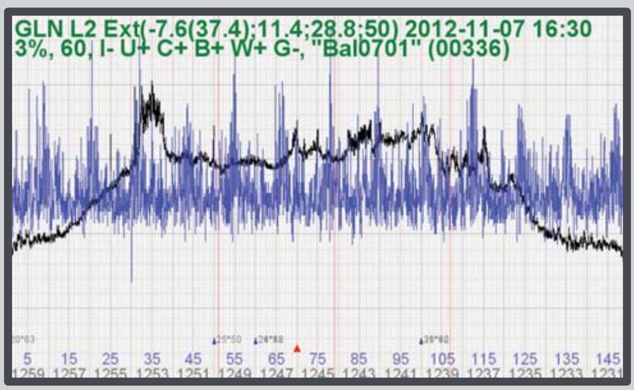


Some interference



Big interference

Productivity & Performance

864 Channels, All Satellite signals, 6-parallel RTK engines, Visual Stake out, innovative simple and accurate field line work.

channels

864

~~440~~

~~220~~

~~216~~

~~76~~

~~12~~

~~4~~

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Battery Life: 25 Hours; System Weight: 2.5 Kg (5.5 lb)

hours

25

~~10~~

~~8~~

~~6~~

~~4~~

~~2~~

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Two hours of charge = Two days of surveying

The internal batteries are field serviceable and can be easily replaced by the user when needed.

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~~50 (110)~~

~~30 (66)~~

~~20 (44)~~

~~10 (22)~~

~~5 (11)~~

2.5 (5.5)

Kg (lb)

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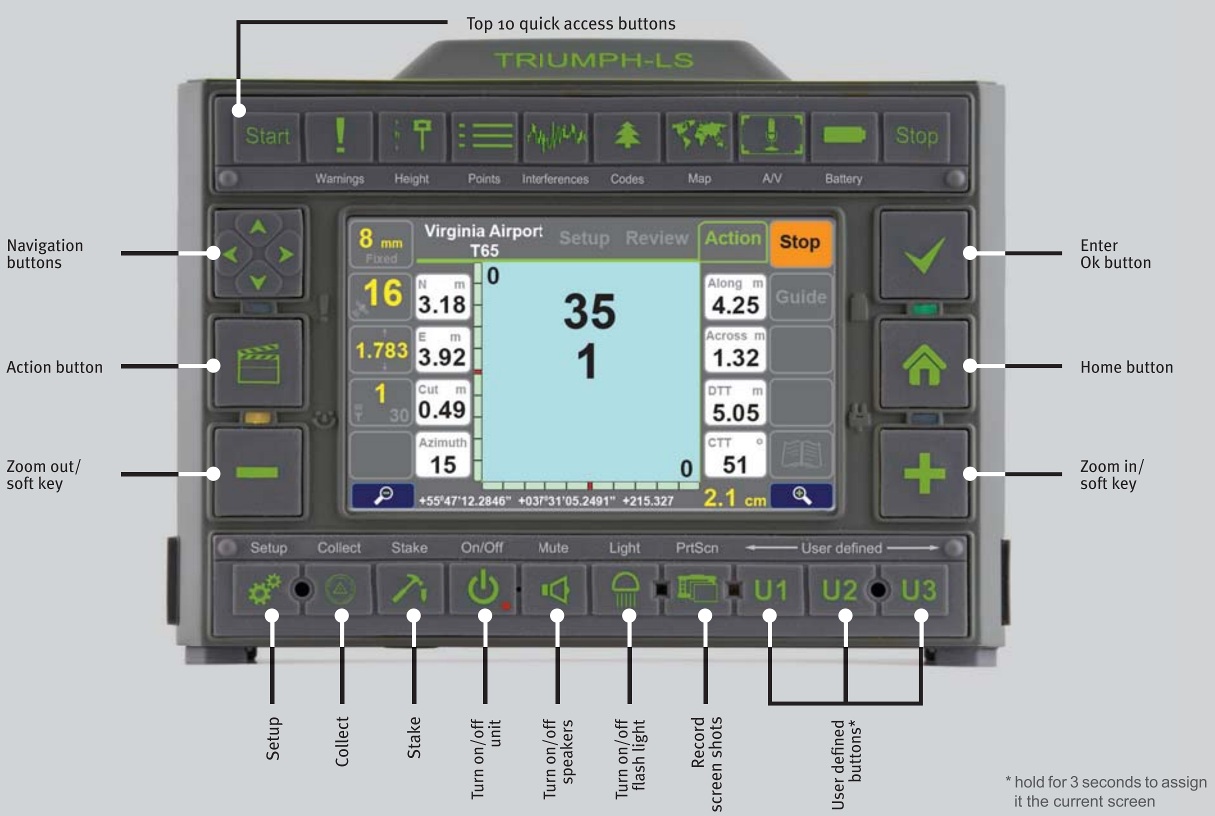
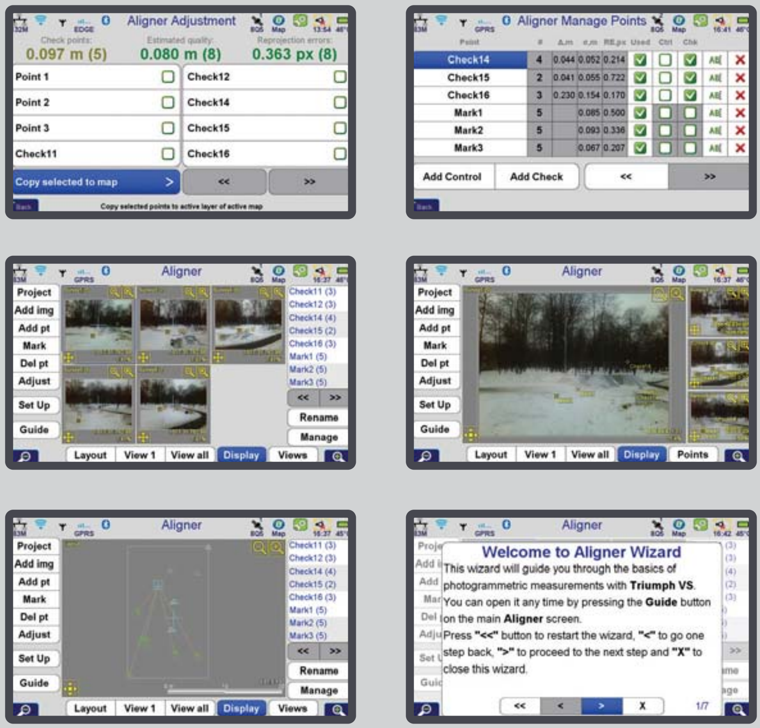
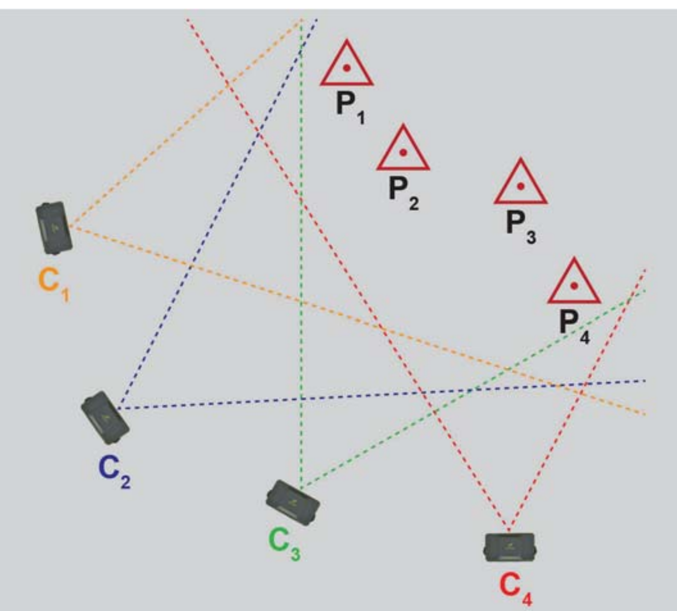


* hold for 3 seconds to assign it the current screen

Offset Survey with Photogrammetry

Offsets can be calculated using the internal camera of the TRIUMPH-LS or with an external camera!





Reconfigurable positioning platform for machine control applications

This platform consists of multiple reconfigurable hardware IP cores to make the platform truly reconfigurable, in terms of hardware architecture

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The Global Navigation Satellite Systems (GNSS) are playing an increasing role in positioning, navigation and autonomous machine control applications. Recently, the Global Positioning System (GPS) has been integrated into the design of bulldozers, motorgraders, drills, excavators, pavers and agricultural equipment produced by the major manufactures for mining, construction, agricultural and environmental applications [1].

The GNSS RTK positioning approach is usually adopted for machine control applications to meet the requirement of high positioning accuracy. From the viewpoint of a rover, a conventional GNSS RTK positioning system consists of the following four modules: 1. A RF front-end module, which is used to receive the GNSS radio frequency signals and then convert them into base-band signals. 2. Base-band processing module, which is used to acquire/track GNSS signals and then output raw measurements. 3. A wireless communication module, which is used to receive network RTK corrections (RTCM messages) from a base station. 4. Navigation solution module, which is responsible for decoding both the raw message and RTCM messages received from the wireless communication module, and then processing the navigation solutions using a Kalman filter with integer ambiguity resolution, such as LAMBDA.

Conventionally, the first three modules are implemented in hardware while the navigation solution module is developed using C language and run in an embedded processor, such as ARM processor, TI DSP processor and etc. The advantage of the software approach for the navigation solution module is that the navigation processing algorithms can be easily updated. When it comes to machine control applications, the processing speed is one of the most demanding factors because high-speed real-time navigation processing means the machines, such as construction machines, can be driven faster to improve the working efficiency [2]. At the moment, the GNSS RTK navigation processing is normally run on an ASIC device, which is a custom design chip for GNSS RTK navigation processing.

Such an ASIC approach offers a great deal of flexibility, which allows the navigation processing algorithms to be updated in a form of firmware [3]. However, one of the key disadvantages is that no hardware architecture can be altered in such an ASIC approach. More specifically, the level of parallel processing is fixed for an ASIC chip, which limits the further improvement of the processing speed for any advanced computationally demanding navigation processing algorithms. Furthermore, another downside of the ASIC approach is that designing and fabricating an ASIC chip is not only costly, but also requires longer time from development to commercial market.

On the other hand, FPGA (Field Programmable Gate Array) devices are reconfigurable hardware and have been developed significantly during the past decade [4]. FPGA devices were only used for GNSS base-band processing to speed up GNSS signal acquisition/tracking using

FPGA parallel processing capability, but it was not quite possible to be used for navigation processing due to the limited logic gates and on-chip memory. However, modern FPGA devices have a massive number of logic gates/DSPS blocks/on-chip memory and have been successfully used for computationally intensive applications, such as real-time HD video processing. Therefore, it is timely to re-consider using FPGA technology for GNSS navigation processing.

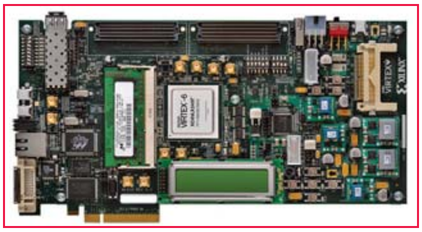

Figure 1: Xilinx Virtex-6 FPGA ML605 board

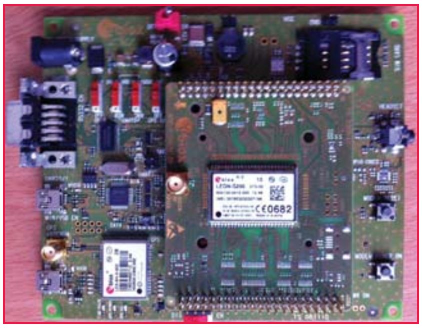

Figure 2: u-blox GSM/GPRS module

Figure 3: NovAtel OEM628 receiver module

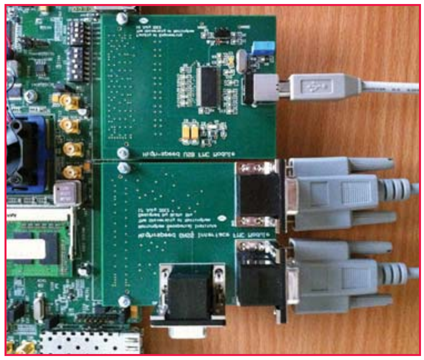

Figure 4: High-speed GNSS interface module and high-speed USB module connected to the Xilinx Virtex-6 FPGA ML605 board

This paper presents the development of a reconfigurable positioning platform for demanding machine control applications. This platform consists of multiple reconfigurable hardware IP cores to make the platform truly reconfigurable, in terms of hardware architecture. Once the platform is implemented it will be tested through use of a GNSS simulator-Spirent GSS 8000[5] at the Nottingham Geospatial Institute (NGI) in the University of Nottingham and its performance will be fully assessed against reliability, continuity, accuracy and integrity parameters, before a series of in-situ tests.

The reconfigurable positioning platform

The reconfigurable positioning platform we are developing physically consists of a Xilinx Virtex-6 FPGA ML605 board (Figure 1), a u-blox GSM/GPRS module (Figure 2), a NovAtel OEM628 receiver module (Figure 3), a custom high-speed GNSS interface board (Figure 4) and a custom high-speed USB board (Figure 4). The multi-constellation and multi-frequency NovAtel OEM628 GNSS receiver module can track the GNSS signals from GPS, GLONASS and Galileo for L1/L2/L5/E1/E5a/E5b [6] and can output the raw measurements at up to 100Hz, which are the key reasons why it has been chosen for the platform, because the raw data needs to be fed into the platform at a high rate to test the novel high-speed hardware architecture of the GNSS signal processing algorithm.

In the reconfigurable positioning platform, the Virtex-6 FPGA device is not only used to implement reconfigurable navigation processing cores, but also implement relevant control interface cores for all other modules. The corresponding block diagram of the reconfigurable positioning platform is also given in Figure 5.

Firstly, a data acquisition control core is developed to acquire/decode raw data messages from both the NovAtel OEM628 receiver module and the u-blox GSM/GPRS module.

Secondly, under the control of a DMA (Direct Memory Access) core, the decoded raw data (raw measurements and RTCM corrections) are written into DDR3 memory directly in real time.

Thirdly, again, under the control of the other DMA core, the reconfigurable navigation processing cores can read out the decoded raw data from the DDR memory directly for relevant navigation processing and then write the results back to the DDR memory in real time. Finally, a MicroBlaze processor can read out the results from the DDR memory and sends them to a PC for display through either

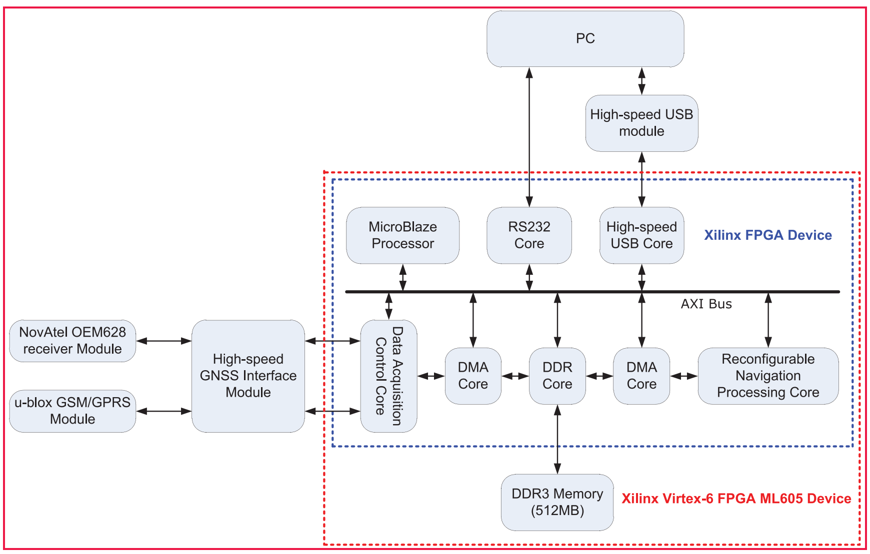

Figure 5: The FPGA based reconfigurable positioning platform

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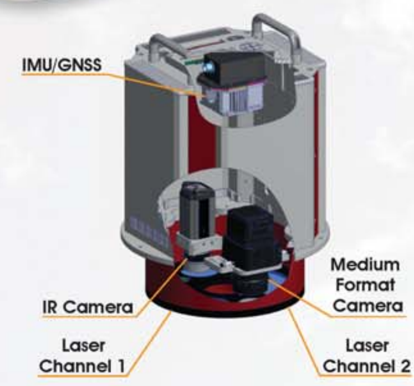

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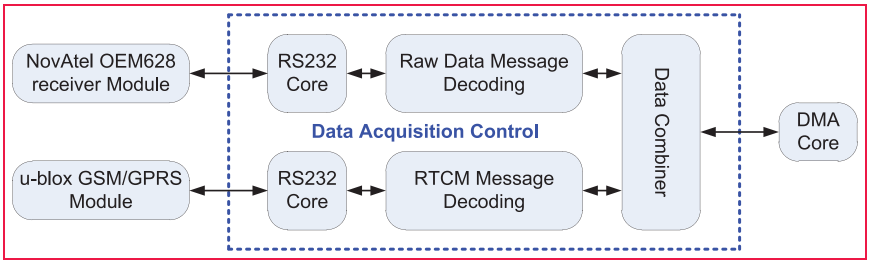

Figure 6: Data acquisition control core

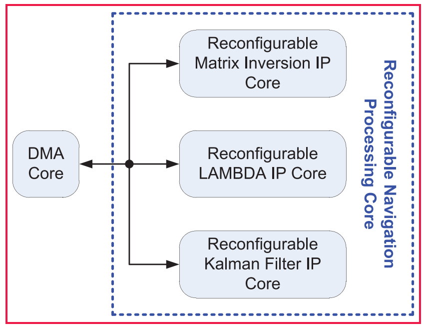

Figure 7: Reconfigurable navigation processing core

the RS232 core (HyperTerminal) or High-speed USB core (USB 2.0 link). In this way, both the MicroBlaze processor and the AXI bus have not been involved in any data flows above except sending the final results from the DDR memory to a PC, this not only reduces the AXI bus traffic, but also allows the MicroBlaze processor to use most time to run non time-critical data processing in the navigation algorithm. In the following, more details will be provided for both the Data Acquisition Control module and the Reconfigurable Navigation Processing Core.

Data acquisition control core

As shown in Figure 6, the data acquisition control core consists of two RS232 cores, a raw data message decoding unit and an RTCM message decoding unit and a data combiner. Basically, each of the two RS232 cores will receive the relevant raw data message from NovAtel OEM628 receiver module and the RTCM message from a base station via the u-blox GSM/GPRS module, respectively. Then, both the received messages will be decoded in individual decoding units in parallel. Finally, the decoded data will be combined together in a certain format and then sent to the DDR memory under the control of the DMA core.

Reconfigurable navigation processing core

The reconfigurable navigation processing core shown in Figure 7 has three hardware IP cores, which are reconfigurable matrix inversion IP core, reconfigurable LAMBDA IP core and reconfigurable Kalman filter IP core, because they have been identified as the most time-consuming modules and need to be implemented in hardware for the purpose of high-speed processing. However, to further speed up the navigation processing, more hardware IP cores can be included in the reconfigurable navigation processing core. Before going further to describe the individual hardware IP cores in the reconfigurable navigation processing core, we need to clarify what 'reconfigurable' means here because, in the context of FPGA technology, reconfigurable usually means that the same FPGA can be reconfigured with a different design without changing the FPGA device itself. For example, an FPGA based electronic system can be easily updated with a new FPGA design without changing any hardware by re-programming the FPGA device. However, this is not what we refer reconfigurable to as in our context. For our reconfigurable navigation processing core, reconfigurable means some parameters of an FPGA design can be changed in real time without re-programming the FPGA device. For example, the size of matrix can be changed in real-time for our reconfigurable matrix inversion IP core.

Reconfigurable matrix inversion IP core

The reconfigurable matrix inversion IP core is based on the GAUSS-JORDAN elimination algorithm [7], in which the matrix size can be reconfigured from 4 to 32. The FPGA architecture of the reconfigurable matrix inversion IP core consists of four modules: 1. A matrix memory buffer of 64 x 2048 bits with dual port access; 2. Forward reduce module; 3. Backward reduce module; 4. Normalization. The matrix memory buffer is used to store both input matrix and the corresponding identity matrix for GAUSS-JORDAN elimination and hence 64 x 128 floating numbers with custom precision. With such a matrix buffer, the other three processing modules can read out/write in an entire column data (up to 2048 bits) in a single clock cycle and hence it significantly improves the I/O access, which is the speed bottleneck of the hardware-based matrix inversion [8][9][10]. However, the previous generation FPGA was not able to create an on-chip memory buffer with a data bus of up to 2048 bits [11].

The key novelties of the platform are that 1. Real-time reconfigurability, in terms of matrix size, which is required by the navigation processing algorithms, so it has to be reconfigurable in real time; 2. FPGA-based floating point processing with custom precision. It is the first FPGA architecture of matrix inversion with the capability of custom precision floating processing, which minimises the usage of FPGA hardware resource with no loss of required precision.

Reconfigurable Kalman filter IP core

Kalman filters are widely used for GNSS navigation solutions [12]. However, we do not believe it has previously been implemented on an FPGA though general Kalman filter pipeline designs have been developed for many years [11][13][14]. The size of the memory on an FPGA is the main issue for FPGA implementation of Kalman filters, because a large memory size has to be used for the required floating point number calculations.

One method is to store data into a DDR memory and then send it to an FPGA for further processing, which obviously will slow down the hardware implementation speed [14]. The reconfigurable Kalman filter IP core is built up from the reconfigurable matrix inversion IP core. More specifically, the reconfigurable

Kalman filter IP core consists of one reconfigurable matrix inversion core and a number of reconfigurable matrix multiplication/addition IP cores.

Therefore, in the reconfigurable Kalman filter IP core, the key tasks are that a high-speed and efficient FPGA architecture for the reconfigurable multiplication/ addition IP core needs to be identified and then integrated with the reconfigurable matrix inversion IP core. As with the reconfigurable matrix inversion IP core, the matrix size is the only parameter that needs to be reconfigured in real time.

Reconfigurable LAMBDA IP core

LAMBDA is used for the integer ambiguity resolution which was first proposed by Teunissen in 1990 and it is believed to be the most reliable algorithm to achieve the fixed solution rapidly [15][16][17]. A reconfigurable LAMBDA IP core is under development based on this algorithm, which mainly consists of an LD factorization unit, an LAMBDA reduction unit and an LAMBDA search unit.

Current status of the platform

Although the platform is still under development and not fully operational yet, the following development work has been completed.

Embedded C model of GPS L1/ L2 RTK navigation processing

An embedded C model of GPS L1/L2 RTK navigation processing has been developed and run on the MicroBlaze processor in the Xilinx Virtex-6 FPGA device successfully. The C model has been tested in a roof based laboratory of the Nottingham Geospatial Building, which is shown in Figure 8. A static test was set on a known point (NGB1) whereas the kinematic test was carried out on a locomotive on the roof track.

Static test

The test was set on a known point (NGB1) on the roof of NGI with an open sky for half an hour. The position was displayed on a laptop and logged into a data file in NMEA format in real time. The positions are retrieved from the NMEA data file, converted to the local coordinate with a coordinate conversion tool, Grid InQuest, and then compared with known NGB1 position in local coordinates. The two dimensional offset results and three dimensional results are shown in Figure 9 and Figure 10, respectively.

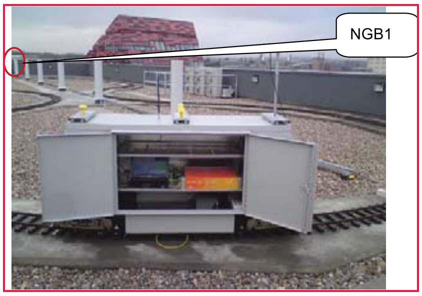

Figure 8: The roof lab electric locomotive and known point NGB1 at the Nottingham Geospatial Institute

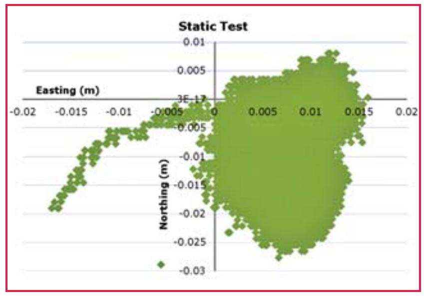

Figure 9 The two dimensional spread of observations for the half an hour static test at NGB1

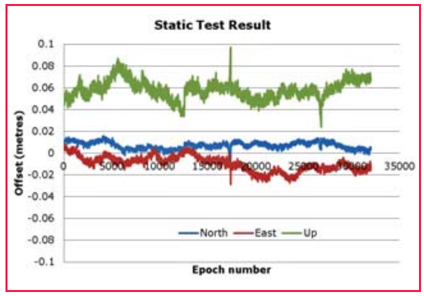

Figure 10 NRTK variation of three dimensions for the half an hour static test at NGB1

It can be seen from Figure 9 that there is an abnormal offset of an out stretch "arm". Having examined the positioning data, we found that the results drifted out from the cluster for 27 seconds in the middle of the test, and then moved back to the cluster due to a satellite signal loss, which caused the drifting.

Figure 10 shows that the big offset happens around the 17500th epoch, which is consistent with the out stretch arm. The average offsets for both easting and northing are less than 2 centimetres. It also shows that the average offset in height is around 6 centimetres.

Kinematic test

An electrically powered locomotive was used for the kinematic test. The locomotive was run on a 120 metres long rail track in a maximum speed of 7.2 km per hour for three loops of the circuit. The test results are shown in Figure 11.

It can be seen from Figure 11 that a significant offset has appeared on the right of the plot. Having looked into the test results further, we found that this big offset lasts for 30 seconds, which coincides with loss of the fixed integer ambiguity. However, the centimetre accuracy positioning is regained after 30 seconds. The reason for losing fixed integer ambiguity may be caused by obstruction from nearby objects. From the position of the offset, it can be seen that this error is just located beside the air circulation system on the roof, which is large with a reflective metal surface. The average offset and standard deviation for position outputs are shown in Table 1.

The test results show that the C model is able to achieve 2 cm horizontal position accuracy with the fix solution.

High-speed GNSS interface module

A high-speed GNSS interface module as shown in Figure 4 has been developed and is fully functional. It has six high-speed serial ports (RS-232, 3MBPS). Although

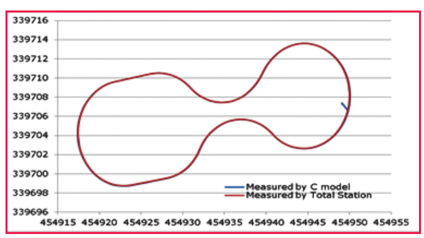

Figure 11 The comparison between the positioning outputs from the C model and a robotic total station for the kinematic test on the rail track

Table 1 The standard deviation of horizontal position for the kinematic test

	Results with 30 seconds fix ambiguity lost	Results without fix ambiguity lost
Average (cm)	12.042	1.987
Standard Deviation (cm)	27.148	1.087

only two ports are used currently, one of which is connected to the NovAtel OEM628 GNSS receiver and the other is used for the u-blox GSM/GPRS module, the remaining four high-speed serial ports can be used for other sensors in future, which allows the platform to cover even more applications.

High-speed USB module

A high-speed USB FMC module as shown in Figure 4 provides a high-speed USB link (USB 2.0, 480MBPS) between the platform and a PC. Firstly, at the early stage of the research, for the purpose of verification of high-speed hardware GNSS signal processing, the high-speed USB link can be used to download the pre-recorded GNSS raw data from a PC to the platform for high-speed hardware GNSS signal processing and then upload the results back to the PC. Secondly, working with the high-speed GNSS interface module, the high-speed USB module can be used to acquire GNSS raw data or the data from other sensors to the PC. Finally, it can be used to display the results on the PC in real time at a later stage of the research.

Discussion

From the viewpoint of system design, the reconfigurable positioning platform under development can accommodate two main phases in the development of real time high-speed navigation solution processing for machine control applications:

Algorithm development

In this phase, the platform can act as a high-speed data acquisition system to receive raw measurements from the NovAtel OEM628 GNSS receiver and RTCM message from an RTK base station, such as SmartNet. The received data can be sent to a PC in real time via the high-speed USB board. Therefore, with the raw data received, the algorithm development can take place in the PC. Of course, more sensors can be accommodated as there are still four serial ports available.

FPGA prototyping

In the FPGA prototyping phase, the RTK navigation processing algorithms (in the form of C or Matlab code) developed in the algorithm development phase are converted into embedded C codes to run on the MicroBlaze processor. Furthermore, those most time-consuming parts of the embedded C codes will be replaced with reconfigurable matrix inversion/Kalman Filter/LAMBDA IP cores to meet the requirement of high-speed processing.

Of course, in the case of a final commercial system based on the FPGA device, the output of the FPGA prototyping phase will be a ready-to-use system prototype, whereby all modules will be integrated into a single PCB board, which not only has the required interface for machine control applications, such as CAN bus interfaces, but also has an FPGA device with the right capacity to provide a compact, comparatively low-cost positioning system.

Conclusions

In this paper, a reconfigurable positioning platform for demanding machine control applications has been proposed and is under development. In such a platform, the most time-consuming parts have been identified in the C model of the RTK navigation processing for machine control applications. These parts are being developed as reconfigurable hardware IP cores in an FPGA by making full use of FPGA parallel processing capability whereas the other parts will be running in the on-chip MicroBlaze soft processor as embedded C codes. In the proposed reconfigurable positioning platform, matrix inversion, Kalman filter and LAMBDA are being developed as a form of reconfigurable IP core. However, if further improvement is required, in terms of processing speed, the other modules can also be developed as hardware IP cores without re-designing any hardware. Therefore, compared with current commercial ASIC based GNSS RTK navigation processing system, the proposed reconfigurable positioning platform can add another dimension of flexibility, which allows completely reconfigurable hardware architecture to meet the requirements from demanding real-time machine control applications, in terms of parallel processing.

Acknowledgments

The authors would like to acknowledge the financial support provided by the UK's Engineering and Physical Sciences Research Council (EPSRC) and Leica Geosystems.

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Galileo update

Europe's Galileo Navigation Satellites unlikely to reach orbit this year

The first four full-operational-capability Galileo positioning, navigation and timing satellites are unlikely to be launched this year because of delays in their preparation, European government and industry officials said.

Jean-Yves Le Gall, president of the French space agency, CNES, and until recently chief executive of Europe's Arianespace launch consortium, said Aug. 28 that only two more launches of the Europeanized Russian Soyuz rocket are planned this year. The Galileo satellites launch on Soyuz rockets two at a time.

The next Europeanized Soyuz will carry four O3b Networks Ka-band broadband communications satellites, to be launched in late September from Europe's Guiana Space Center spaceport on the northeast coast of South America.

The second and final Soyuz launch from the European site will be the late-November liftoff of the European Space Agency's Gaia star-mapping satellite, Le Gall said. Le Gall made his statement at the Moscow air show and a CNES official confirmed it. *www.spacenews.com*

Member States begin testing Galileo's Secure Service

EU Member States have begun their independent testing of the most accurate and secure signal broadcast by the four Galileo navigation satellites in orbit. Transmitted on two frequency bands with enhanced protection, the Public Regulated Service (PRS) offers a highly accurate positioning and timing service, with access strictly restricted to authorized users.

PRS access was initially considered for Galileo's Full Operational Capability phase, but it has been enabled in 2013 in response to the strong interest of Member States in this service. To allow early access to PRS during the current phase, the European Commission and ESA began the joint project 'PRS Participants To IOV' (PPTI) in July 2012. *www.redorbit.com*

Harmful Algal Bloom Forecast Wins Copernicus Masters Best Service Challenge

The online audience of the Copernicus Masters website has voted HAB Forecast - Harmful Algal Bloom Forecast this year's most beneficial Earth-monitoring service for European citizens. The service provides a weekly alert primarily dedicated to fish farmers and regulators via web bulletin at www.asimuth.eu. It is the first forecast system of this kind and designed to combine all available information from Earth (in-situ monitoring stations), space (satellite data) and in-silico (biological and physical oceanic models) sources. The service, which is part of the FP7 project ASIMUTH, was submitted by Julie Maguire for the Irish Daithi O'Murchu Marine Research Station. ASIMUTH is using products from the pre-operational marine service of Copernicus that is currently provided through the EU-funded project MyOcean2. The Best Service Challenge is one of nine categories in the European Earth monitoring competition Copernicus Masters. *www.copernicus-masters.com*

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Conventional and 'Satlevel' collocation model for production of contour map

A case study of Yanbu industrial city

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A contour map is made up of contour lines and depicts the shape of any portion of the earth surface. A contour line is an imaginary line drawn on the map to connect points with the same elevation or height, above or below the earth surface to form a continuous line shown in brown colour on the map. Historically, different types of maps were produced for the Kingdom by the foreign agencies, educational institutions and governments. These maps include but are not limited to the following:

Historical city maps of Mecca, Al-Madinah and Riyadh from Western Arabia and the Red Sea were produced by the Naval Intelligence Division of the Great Britain in 1946; while those of Dharan, Jeddah and Riyadh were produced by the United States of America (U.S) Department of State 1983 and 1986. Furthermore, the shaded relief map of Saudi Arabia was produced in 1974, reviewed in 1991 and 2003 by the Central Intelligence Agency (CIA) of United States. Thematic map from CIA Atlas of the Middle East was produced in 1993. Topographical maps which include contour were produced as part of Operation Navigational chart series by U.S. Defence Mapping Agency Aerospace Centre. Recently, the US National Imagery and Mapping Agency produced the topographical maps of Saudi Arabia in a scale of 1:250,000 [PCL, 2012].

Presently, the Ministry of Municipal and Rural Affairs (MOMRA) is currently handling mapping and mapping related activities in the Kingdom. [Baris, 2012] Apart from production of maps in different scales, different maps are produced depending on the need and purposes by other agencies such as the General Commission for Survey (GCS). King Abdulaziz City for Science and Technology (KACST), Royal Commission for Jubail and Yanbu, Saudi Geological Survey, companies like the Saudi Aramco, Schlumpberger Consulting Engineers Inc., educational institutions such as King Saud University, King Abdulaziz University, Yanbu Industrial Colleges and others with Geomatics and GIS related disciplines.

In Yanbu Industrial City, the Urban Planning Department of the Royal Commission for Jubail and Yanbu, Royal Commission at Yanbu is currently handling all issues of Survey and Mapping under the Survey section that comprises CAD and GIS sections. The Department produces different types of maps, which include topographical map that contained the contours either as a direct labour or contract to reputable mapping companies.

The contour maps, like most complex ones, are designed using index contours. Contour lines are shown in brown colour with the value of height written on it. The height is typically measured with reference to a known Datum. The datum usually adopted is the geoid [Aleem, 2011 and Williams, 2012].

The geoid is the surface which coincides with that surface to which the oceans would conform over the entire earth, if free to adjust to the combined effect of the earth's mass attraction (gravitation) and the centrifugal force of the Earth's rotation. Specifically, it is an equipotential surface, meaning that it is a surface on which the gravitational potential energy has the same value everywhere with respect to gravity. The geoid surface is irregular, but considerably smoother than the earth's physical surface. The sea level, if undisturbed by tides, currents and weather, would assume a surface equal to the geoid when the observation is carried out for a numbers of years, usually 18.61years. [Aleem, 1996, Olaleye et al 2010; Olaleye et al 2011 Aleem, 2013]

Determination of the geoid has been one of major challenges for geodesists. Gravity data have been used in the past with stokes integration and other approaches. These methods are time consuming, expensive and laborious. GNSS provide WGS84 ellipsoidal heights and when compared with orthometric height from geodetic levelling, allows for the computation of the geoid, or the geoid-ellipsoid separation in the region of the survey [5, 6, 7 & 8]. These height differences were used to derive the geoidal models called 'Satlevel' Collocation model [Aleem,2013].

The geoid model will give geoidal undulation at every point of observation. This can be substituted with the ellipsoidal height from GNSS observation to get the orthometric height has given in Equation 1.1[Aleem, 1996, Olaleye et al 2010; Olaleye et al 2011 Aleem, 2013]:

$$H = h - N \tag{1}$$

Where:

H = Orthometric height
h = Ellipsoidal height
N = The Geoid-Ellipsoid separation Geoidal undulation

From the above Equation 1, orthometric height can be computed, which can be plotted on the map as spot heights. The spot heights can be interpolated to produce the contours.

Interpolation of contour

Traditionally, interpolations of contours are often done by rough estimate. The procedure is to first plot all the available spot heights on the map and estimate the point for the contour. However, a more accurate but time consuming method that used to be adopted is the following formula [3]:

$$PC = \frac{D}{Z} i \tag{2}$$

Where:

PC is distance to the point of contour
D is the distance between two spot heights
Z is the difference between the two spot heights
i is the difference between the contour and one of the spot heights.

Distance PC will then be scaled and marked on the map, which will later be connected to form the contour. The use of information technology in surveying and geoinformatics has made the use of software a part of geomatics. Contour maps are nowadays prepared easily with these software.

Contour map software

There are different types of software in the market for production of contour, digital terrain and three dimensional surface model of any part of the world. This study used AutoCAD Civil 3D software.

AutoCAD Civil 3D

A surface in Civil 3D is built on the basis of mathematical principles of planar geometry. Each face of a surface is based on three points within a circum-circle (a circle that passes through each of the vertices of a polygon) forming a triangle and defining a plane. Each of these triangular planes shares an edge with another, and a continuous surface is made. This methodology is typically referred to as a triangulated irregular network (TIN). On the basis of Delaunay triangulation, this means that for any given (x,y) point, there can be only one unique z value within the surface [Golden Software, 2012].

3DField

3DField is a contouring surface plotting and 3D data program that runs under Microsoft Windows NT/XP/Vista/7. 3DField converts the data into contour maps and surface plots. It creates a 3D map or a contour chart from the scattered points, numerical arrays or other data set. All aspects of 2D or 3D maps can be customized to produce the exact presentation desired [Galouchko, 2012].

Other contour map software

Other Contour Map Software includes: Garmin Basemap, mapviewer, Contour storyteller, Function Grapher, Auto plotter, Visual data, Filter test, AutoDEM Li Contour and several other software are available for production of contour map. Any of these software can also be used for the production of Contour map of the study area.

Scope and limitations of the study

The research covers the data acquisition, processing and presentation and comparison of the final product. All these were carried out in Yanbu Industrial City while the following are the limitations of this research**:**

1. The work is only carried out in Yanbu Industrial City.
2. Automatic level was used to obtain orthometric height as against the use of digital or geodetic level.

The study area

The study was carried out in Yanbu Industrial City (popularly known as 'Yanbu Al-Sina'iya' in Arabic which literarily means Industrial Yanbu) in Madina Province of Saudi Arabia. The city was established around 1975, located on the Coast of Red Sea about 350 km North of Jeddah. With latitude $23^{0}59'57.840''$N (23.9994) and longitude $38^{0}13'39.000''$E (38.2275)

Figure 1: Location of Yanbu Industrial city

Yanbu Industrial City has a section called the Royal Commission (RC). Its residents are mostly expatriates mostly from Europe, America and other western countries. RC Yanbu Existing Area is about 185 km² and the expansion area is about 420 km². The industrial developed land is estimated to be 3,240 Hectares [10]. The presence of industries such as the oil refineries, plastics facility and several other petrochemical plants in the existing and expansion of Yanbu Industrial City will require detailed map and updating of the existing map of which contours have a prominent role to play. Contour maps will also enhance monitoring of the existing structures. Therefore, a quick and fast method such the use of 'Satlevel' collocation model will minimise the rigour of data collection of the existing method.

Aims and objectives

The aim of this work is to produce contour map of the study area from data generated using conventional levelling and 'Satlevel' Collocation Model. The objectives are:

1. To acquire data for ellipsoidal and orthometric heights of the study area.
2. To compute geoidal coefficients of the 'Satlevel' Collocation Model in the study area using least squares adjustment.
3. To generate data for production of contour map.
4. To plot the contour map of the study area using AutoCAD Civil 3D software.

Methodology

Materials and data

The equipment needed for the exercise are:

- GNSS receiver and its accessories to acquire data for ellipsoidal height;
- Digital Level and its accessories to acquire data for orthometric height;
- Computer and its accessories for computation and analysis;
- AutoCAD Civil 3D software for plotting the contour; and
- Any software or program that can implement least square adjustment.

In this exercise Microsoft Office Excel was used for all computations. 'Orthometric Height on Fly' [7] was used to validate the results.

'Satlevel' collocation model

Detailed explanation of the derivation and assumption of 'Satlevel' Collocation model can be seen in [Olaleye et al, 2011]. The model is of the form:

$$\begin{aligned} N_i = N_L + {} & A_1\left(\cos^3\phi_i\cos\lambda_i + \sin^2\phi_i\cos\phi_i\cos\lambda_i + \cos^3\lambda_i\cos\phi_i + \sin^2\lambda_i\cos\phi_i\cos\lambda\right) + \\ & A_2\left(\cos^3\phi_i\sin\lambda_i + \sin^2\phi_i\cos\phi_i\sin\lambda_i + \cos^2\lambda_i\cos\phi_i\sin\lambda_i + \sin^3\lambda_i\cos\phi_i\right) + \\ & A_3\left(\cos^2\phi_i\sin\phi_i + \sin^3\phi_i + \cos^2\lambda_i\sin\phi_i + \sin^2\lambda_i\sin\phi_i\right) + r_i \end{aligned}$$

(Aleem, 2013)

Where:

N_L is the long wavelength part of the geoid undulation in the area.

A_1, A_2 and A_3 are the geoidal coefficients which are unknown coefficients to be determined.

ϕ and λ are the WGS 84 geodetic coordinates (latitudes and longitudes)

r_i is residue at an observation point.

The 'Satlevel' Collocation model geoidal coefficients of the area were computed using least squares adjustment observation equation method.

Data acquisition

Levelling operation was carried out to obtain data for orthometric height.

GNSS observation was carried out to acquire data for geodetic coordinates which includes the geodetic latitude, geodetic longitude and ellipsoidal height. Other relevant data such as constant for the referenced ellipsoid were collected from various literature and INTERNET websites for data analysis and processing.

Data processing

Levelling reduction was done; the reduced levels were the orthometric height of each of the points. GNSS observation was processed to get the three dimensional coordinates. These are the geodetic latitude (ϕ), geodetic longitude (λ) and ellipsoidal height (h), which were used in 'Satevel' Collocation model.

The 'Satlevel' Collocation model geoidal coefficients were computed and used to obtain the geoidal undulation of each point in the area, which were connected to get the geoidal surface.

The geoidal undulations and ellipsoidal heights obtained from the result of GPS observations were used in Equation 1 to get the orthometric height of each of the points in the study area.

The orthometric heights generated from 'Satlevel' Collocation and the geodetic coordinates of the area were plotted into contour map using AutoCAD Civil 3D software (Figure 5).

The orthometric heights acquired using geodetic levelling method and the geodetic coordinates of the area were also plotted onto the contour map using AutoCAD Civil 3D software (Figure 6).

The following procedure was used in producing contour maps in Auto CAD Civil 3D 2013:

- The data was imported as text file as CSV (Comma delimited) to create the points of the surface.
- The surface was created by a Triangulated Irregular Network (TIN) method with 1m interval.
- The major contours lines were labelled.

Results and discussions

Results

Some of the data used for this research acquired in Yanbu Industrial City were randomly selected and used to plot chart (Figure 2):

The values of the geoidal coefficients computed using least square adjustment observation equation as:

N_L=7.85995128; A_1=0.36447485; A_2=-0.5309024; A_3=0.15167311

The results of the 'Satlevel' Collocation geoidal

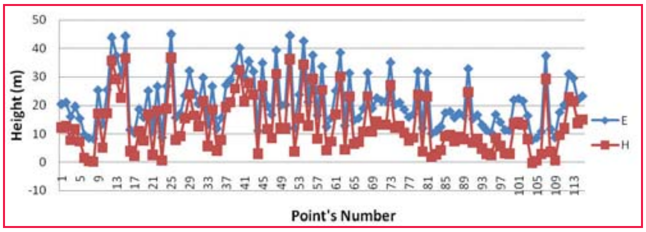

Figure 2: Orthometric and Ellipsoidal Heights of part of Yanbu Industrial City

undulations were plotted into chart (Figure 3):

The result of the "satlevel" collocation orthometric height were plotted into chart (Figure 5):

The results of the "satlevel" collocation Orthometric were plotted into chart (Figure 5)

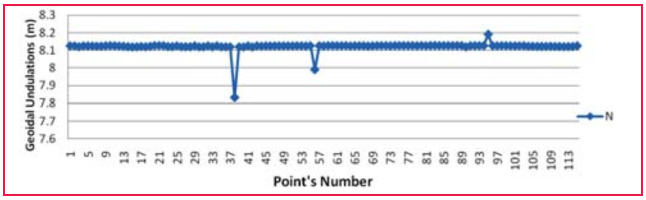

Figure 3: Geoidal Surface of parts of Yanbu Industrial City

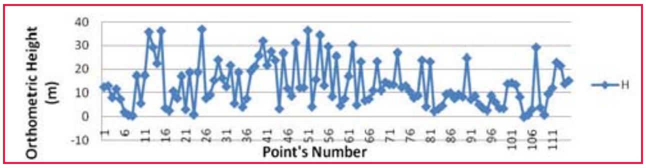

Figure 4: Orthometric Heights of parts of Yanbu Industrial City

The "Satlevel" collocation contour map (Figure 6):

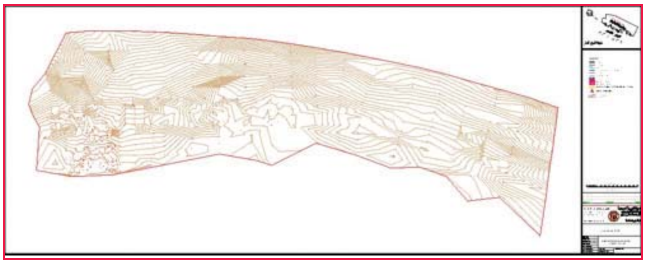

Figure 5: 'Satlevel' Collocation Contour Map of parts of Yanbu Industrial City

Figure 6: Contour Map from Levelling of parts of Yanbu Industrial City

Discussion

In the chart shown in Figure 2, ellipsoidal and orthometric height that follows the same pattern is an indication that the two are true representation of the same terrain.

Figure 4 shows the geoidal surface of Yanbu Industrial City. In this chart, the geoidal undulations of 3 of the points were outrageous, which is an indication that there was presence of outliers in the observations. These observations should have been removed because they are more than 3 standard deviations [Heliani et al, 2004]. This might have created an impact on the map shown in Figure 6. When the outliers were removed, the chart produced a continuous and smooth surface. This is an indication that 'Satlevel' Collocation like any other analyses required removal of outliers from the observation.

Conclusion and recommendation

Conclusion

In this study, levelled heights were established along with GPS observation in some parts of Yanbu Industrial city to model the geoid in the study area. We have coordinated some of the points collocated with both GNSS and levelling in the area. 'Satlevel' Collocation Model was used to get the geoidal coefficients, which were used to get the geoidal undulation for each of the points. Ellipsoidal heights from GNSS observation were used to get the orthometric heights, and used to plot the contour with AutoCAD Civil 3D software. Orthometric height information was also used to plot another map using the same AutoCAD Civil 3D software. The map was compared with the acquired data.

Recommendations

The area of coverage needs to be extended and more data should be acquired to improve the results**.**

Contracts for the production of maps should be awarded to the Institutions of Higher learning in the Kingdom. This will enable the participating staff to acquire more experience, so as to improve the qualities of graduates for future challenges. A local geoid model for Saudi Arabia is hereby recommended to commence.

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Raytheon UK receives first order for its latest GPS Anti-Jam prototype

Raytheon UK has taken its first order for a pre-production MiniGAS, the latest in GPS Anti-Jam technology. This contract, awarded by an undisclosed customer, requires Raytheon UK to produce demonstrator units for customer evaluation. MiniGAS aims to be the lightest and smallest GPS Anti-Jamming system produced by Raytheon UK. It will have flexible form factors, suited to land, unmanned aerial vehicles and missile platforms. *www.raytheon.com*

Jammer car disrupt signals in entire region

A single well-placed GPS jammer or spoofer could disrupt signals in an entire region of the United States, according to an official from the Homeland Security Department. At the same time, the U.S. still "lacks the capability to rapidly detect and geo-locate jamming or spoofing of GPS services," DHS program manager John Merrill told the annual meeting of the Civil Global Positioning System Service Interface Committee, a global forum that fosters interaction between the U.S. and worldwide GPS users. Merrill did not define the size of a region a GPS jammer could knock out. *www.nextgov.com*

China's geomatics industry output estimated at 42 bn USD

The annual total output value of China's geomatics industry is estimated to reach 260 billion yuan (42 billion U.S. dollars) by the end of 2013, up 30 percent from last year, a government statement said.

The geomatics industry has expanded rapidly in the past several years in China, marked by great technological advances and service expansion, according to the Ministry of Land and Resources. Citing officials with the National Administration of Surveying, Mapping and Geoinformation, the ministry statement said China's geomatics industry involves more than 23,000 organizations and 400,000 employees. *http://english.peopledaily.com.cn/*

GNSS providers to expand and improve GNSS service

In the recently held ION 2013 meeting in Nashville, Tennessee, USA, each of the world's five major satellite navigation providers were pushing to upgrade and expand their systems with nine satellites set for launch by the end of next year and 20 to be placed on orbit by the end of 2017. The United States plans to launch four GPS IIF satellites by the close of 2014 with the first launch currently scheduled for October 17, according to Col. Bill Cooley, the new director of the GPS Directorate. The first of the new generation of GPS III satellites, which has an additional civil signal, could be launched as early as 2015. Those satellites are part of the overall GPSmodernization plan that will expand the number ofcivil signals, improve the locks, and replace the groundcontrol system.

GLONASS

Russia, which suffered a serious launch failure in July that cost it three satellites, plans to launch four satellites by the end of this year and four more in the latter half of 2014. This is part of an overall plan to place a total of 12 satellites by the end of 2015, according to Sergey Revnivykh, of the Corporation JSC ISS Reshetnev. That schedule too may change, because Russia has now adopted the U.S. approach to launch and will keep spare satellites on the ground, only putting them into orbit when needed.

QZSS

The Japanese are working to expand their Quasi- Zenith Satellite System (QZSS) with plans to build on the success of their experimental satellite named "Michibiki." They expect to launch three more spacecraft in 2017 — one of which will be a geostationary satellite. The initial system, which is expected to begin operation early in 2018, will be managed by QZS System Services Inc., a commercial operation charged with promoting its use, improving and managing the ground system from now through 2032, according to Yoshiyuki Murai of QZS System Services Inc.

BeiDou

China also plans to launch a new test satellite in 2014 as part of the beginning of the third 'global' phase of its development, according to Xianchen "Hunter" Ding of the China Satellite Navigation Office. The system has grown from where it provided an initial regional service to Full Operational Service as of December 27 of last year. The planned launch will be part of the "startup of the third step of construction." The spacecraft is a test satellite and will, like a number of the BeiDou satellites already in place, be in a MEO orbit.

Galileo

According to Eric Châtre of the European Commission, the European Union has 22 satellites ordered and has contracts to launch 14 satellites on seven Soyuz launch vehicles (incuding a 2011 launch) and three launch contracts to loft 12 satellites on Ariane five rockets. The system currently has four satellites and its ground segment in place and is working to reach initial operating capability by the end of 2015. Full operational capability with a constellation totaling 30 satellites is anticipated by the end of 2018.

www.ion.org

Nanosatellite CUSat to launch from California

After eight years of planning, submitting, winning, building and waiting, Cornell University's CUSat – a nanosatellite designed and built by engineering students to help calibrate GPS with pinpoint accuracy – will be launched from Vandenberg Air Force Base, Lompoc, Calif. Once in space, the satellite will move into low orbit to help calibrate GPS accuracy to within 3 millimeters. *www.news.cornell.edu/*

Trimble News

MEO satellite data for accurate positioning

Trimble Navigation Ltd. has released a preview of its CenterPoint RTX cloud-based, post-processing service, enabling GNSS observations using available Galileo and BeiDou middle-earth-orbit satellites, which provide timing, positioning and navigation signals worldwide. The free CenterPoint RTX post-processing service is powered by Trimble RTX technology, a GNSS correction technology that combines real-time data with positioning and compression algorithms.

New compact OEM module with triple frequency GNSS support

Trimble® BD930 module is as part of its GNSS OEM portfolio. This small module features triple-frequency support for GPS and GLONASS plus dual-frequency support for BeiDou and Galileo constellations. Capable of receiving a wide range of commercially available GNSS signals, the 220 channel BD930 takes advantage of all available signals to provide optimal and reliable RTK centimeter positioning. The triple-frequency Trimble BD930 (measuring 41mm x 51mm) is a small, yet powerful GNSS module specifically designed for applications requiring high accuracy in a compact package. *www.trimble.com.*

Demo of GPS 3 and OCX Satellite launch and early orbit operations

Lockheed Martin and Raytheon have completed the third of five planned launch and early orbit exercises to demonstrate the launch readiness of GPS III satellite and Operational Control System (OCX). Successful completion of Exercise 3 recently was a key milestone demonstrating Raytheon's OCX software meets mission requirements and is on track to support the launch of the first GPS III satellite, currently being produced by Lockheed Martin. *www.spacedaily.com*

BDS to navigate China-ASEAN co-op

Beidou Navigation Satellite System (BDS) will play a bigger role in building the "diamond decade" of China-ASEAN cooperation, as hi-tech information technology will be applied in more areas of cooperation. Ran Chengqi, director of the administration center of Beidou Navigation Satellite System, said the system will be widely used in disaster relief, tourism and transportation as an effective way to tap a new cooperative area and new energy. Laos has signed on to apply Beidou in its agriculture and forestry. Thailand chose Beidou because of its wide usage and reasonable price, and the price might be lowered as China-ASEAN cooperation grows. *http://africa.chinadaily.com.cn*

S Korea develops advanced GPS to reduce errors

South Korea has developed a technology which will enable it to use an advanced GPS in digital multimedia broadcasting devices such as car navigation systems. The country's Ministry of Oceans and Fisheries said that the differential GPS (DGPS) will be made available to the public as early as next year. The new technology enables ordinary devices with a multimedia broadcasting system to receive and use information from the DGPS with only a change of the GPS chip to a multipurpose chip. It also reduces the margin of error down to just 1 meter, compared to conventional GPS which has a margin of error of up to 37 metres.

Microsoft to acquire Nokia's devices & services business

Microsoft and Nokia have decided to enter into a transaction whereby Microsoft will purchase substantially all of Nokia's Devices & Services business, license Nokia's patents, and license and use Nokia's mapping services. Microsoft will pay EUR 3.79 billion to purchase substantially all of Nokia's Devices & Services business, and EUR 1.65 billion to license Nokia's patents, for a total transaction price of EUR 5.44 billion in cash. *www.nokia.com*

Joingo Places uses in-venue marketing

By partnering with major wireless network technology providers, Joingo Places allows any brand to directly communicate with their customers, delivering mobile messages and offers that are based on the customers' interests and location. Brand marketers will be able to create multiple indoor and outdoor geofences, send messages to customers within those defined areas, either immediately or when triggered by an entry or exit event. Indoor location capabilities can help customers search for and find specific locations or points of interest while in the venue. *www.joingo.com*

Loctronix's ASR-2300 SDR module

Loctronix® Corporation has announced the availability of its new software-defined radio (SDR) module, the ASR-2300, for developing high-performance positioning, navigation and timing (PNT), and communication applications. It is a multiple-input and multiple-output (MIMO) transceiver module incorporating two wideband Field Programmable RF(FPRF) transceivers (300 MHz to 3.8 GHz) from Lime Microsystems,10-axis accelerometer/gyro/compass/barometer sensors, and a large programmable FPGA capable of over 300 MiB/sec sustained communications with a host processor via USB 3.0 interface. *www.loctronix.com*

Congressman in US takes ride in a driverless car

Rep. Bill Shuster (R., Altoona) made a 33-mile trip from Cranberry Township to Pittsburgh International Airport in a computer-operated car. The so-called driverless Cadillac SRX was designed by Carnegie Mellon University researchers who have been working on the project since 2008. The car uses inputs from radars, laser range finders, and infrared cameras to maneuver in traffic. He said he can now imagine a future where such vehicles enter the mainstream, potentially reducing accidents, fatalities and congestion on roads. Raj Rajkumar, the leader of the project, said the biggest design challenge for driverless vehicles is managing unpredictable events. *www.philly.com*

Maps for self-driving cars

Nokia is teaming up with Mercedes-Benz with the goal of designing 3D maps for self-driving cars. The mapping feature will be provided by Nokia's Here, a)_ cloud-based service that offers drivers real-time traffic updates, road closures, and recommendations based on their location. Gearing up now for Internet-connected cars, Here will ultimately take on the challenge of directing self-driving cars. *http://news.cnet.com*

Realtime traffic info by MapmyIndia

MapmyIndia has launched realtime traffic updates on its free MapmyIndia app on Windows Phone, Windows 8 and Android platforms. It claims that the service will deliver accurate, comprehensive and realtime traffic information, and allow users to look at traffic situation in real time and plan routes accordingly. *http://gadgets.ndtv.com*

Japan eyes new air traffic control rule for introduction of drones

The Government of Japan plans to devise a new air traffic control rule to prepare for the Self-Defense Forces' introduction of unmanned reconnaissance aircraft The Ministry of Land, Infrastructure, Transport and Tourism will start studying similar rules in other countries next month to work out a new rule in fiscal 2014 from April. The current aviation law may be revised since it only applies to manned aircraft. *www.globalpost.com*

Egypt plans national space agency

According to head of the National Agency for Remote Sensing, Medhat Mokhtar, Egypt is planning to set up a national agency for space. It will be an independent entity from the remote sensing authority. The new agency will directly answer to the presidency of the republic and will allow it to carry out vital and strategic activities that are important to the State. *http://allafrica.com/*

New satellite imagery for Google Maps and Google Earth by Astrium

Astrium has entered into an agreement with Google Inc. to provide satellite imagery in support of Google Maps, Google Earth and other Google products and services. Under this agreement, Astrium Services will provide newly acquired imagery from its Pléiades and SPOT satellites. *www.astrium-geo.com*

Vietnam takes over control of first remote sensing satellite

Control of Vietnam's first remote sensing satellite, VNREDSat-1, has been officially handed over to the Vietnam Academy of Science and Technology (VAST) four months after its launch. VNREDSat-1 was sent into orbit on May 7. It is capable of capturing images from all around the world, which will help in assisting emergency services during flooding, forest fires, oil overflow and other serious incidents. http://news.xinhuanet.com

New Photogrammetry Software adapted for UAS-Mounted Sensors

SimActive Inc has launched a new UAS version of its Correlator3D product. It supports all non-metric small-format sensors. SimActive has taken its extensive photogrammetry expertise, where medium and large-format sensors were used for large mapping projects, and adapted it to small-format sensors. *www.uasvision.com*

Drone test flights planned for Newquay air space

Newquay Cornwall Airport and West Wales Airport have struck a deal to operate the world's first private facility that allows companies to develop pilotless planes of all sizes.Under the joint banner of the National Aeronautical Centre (NAC), bosses at the two airports believe the move will allow the UK to capitalise on "one of the world's major economic opportunities". *www.cornishguardian.co.uk*

RapidEye takes imagery to a higher level with Esri ArcGIS

Users will now have access to RapidEye's newly launched premium content services including RapidEye Mosaics, RapidEye Living Image Multispectral, and RapidEye Living Image Basemaps. These products are now available through ArcGIS Marketplace which makes finding and buying premium content more convenient than ever before. *www.rapideye.com*

LT400HS GNSS Handheld – Accurate, Productive, and Versatile Surveying & Mapping Solution

- ***RELIABLE AND EFFECTIVE***
  The LT400HS Handheld GNSS is a rugged GPS+GLONASS data collector designed to achieve sub-meter to centimeter accuracy in adverse mapping conditions with or without the external antenna.

- ***COMPETITIVE SURVEY SOLUTION***
  Bundled with Carlson's SurvCE software, the LT400HS is the perfect cost-effective GNSS RTK Survey Solution for survey and construction professionals.

- ***POWERFUL GIS SOLUTIONS***
  Combined with DigiTerra Explorer7 Mobile GIS software, the LT400HS GNSS handheld offers feature-rich solution for accurate GIS field data collection and maintenance.

OS uses OS OpenData to create a Minecraft map of GB

Ordnance Survey have created a Minecraft world representing over 224,000 sqkms of Great Britain using two of their OS OpenData products. The Minecraft GB terrain was created using OS Terrain 50, a 3D model of the bare earth surface known as a Digital Terrain Model delivered as a grid with a resolution of 50 metres. The raster version of OS VectorMap District, a mid-scale contextual or backdrop map product, was then used to extract surface features based on pixel colours and densities. *www.ordnancesurvey.co.uk*

"Geotechnical Characterisation" of 30 cities in India

The Ministry of Earth Sciences (MoES) of India has planned "Geotechnical Characterisation" of 30 cities in the country. MoES is mandated to provide the country with best possible services in weather/climate, ocean state, earthquakes, tsunamis and other phenomena related to earth systems through well integrated programmes. The Ministry has planned to take up Seismic Hazard Microzonation (SHM) of urban agglomeration of 30 targeted cities spread over the county on 1:25000/50000 scale during the 12th Five Year Plan period.

Jack to receive Top UN Award

Jack Dangermond, an environmental scientist and entrepreneur who revolutionized the use of geo-spatial technology for conservation is to receive the 2013 Champions of the Earth Award, the UN's highest environmental accolade. He founded ESRI with his wife Laura in 1969 – pioneered the use of GIS. *www.un.org*

European geo-information networks disclose Copernicus benefits

EUROGI, the European Umbrella Organisation for Geographic Information, federating Geographic Information communities in over 20 European countries, has been awarded a contract by the ESA to explore the acceptance and potential of COPERNICUS, the European Earth Observation Programme, within the European GI community. Focused on products and services based on the COPERNICUS space infrastructure ("Sentinels" and other satellite missions), the activity aims at bridging the gap between the supply of products and services on the one hand and private service industry and individual consumers of location-based services on the other.

GIS mapping in polls in Nepal

For the first time in Nepal, the Election Commission (EC) has done GIS mapping of all the polling stations. The election body has recorded information about the road accessibility, state of infrastructure, means of communications, possibility of helicopter landing and the geographical details in around the polling stations. The EC obtained satellite maps from Google Earth and managed to record all the details concerning the polling stations in the new system by mobilising its staff. *http://ekantipur.com*

Malaysia launches geospatial services portal

The Malaysian Centre for Geospatial Data Infrastructure (MacGDI) recently launched MyGOS (Malaysia Geospatial Online Service), which serves as a single integrated portal for crucial geospatial services and information. It allows users to create groups and invite others to work together on projects, and to share maps, data, and other content. Furthermore, users can also create public groups so that they can share data outside of their organization. *www.futuregov.asia/articles*

Datanet India launches Geospatial Election Analysis

Datanet India has revamped and re-launched its web portal www.electionsinindia.com recently. This web portal now offers free access to summary results of all the parliamentary and assembly constituencies in India, since independence. Besides, the major service now added is to provide geospatial analysis of election results with the help of GIS maps. The GIS based analysis, on one hand, provides a relevant technology to analysis the outcomes of elections so far as post-election analysis is concerned and, on the other, provides the essential inputs for pre-electioneering processes & strategic planning etc. *www.equitybulls.com*

Victorian Government geospatial data on target

The Victorian Coalition Government of Australia has achieved another milestone as part of its Information and Communication Technology (ICT) Strategy by making more than 1,000 datasets available to the public online at www.data.vic.gov.au. Also known as geospatial data, these datasets identify the geographic location of the features and boundaries of Victoria; both natural or constructed. *www.data.vic.gov.au*

JUPEM planning for a comprehensive underground utility map of Malaysia

The Survey and Mapping Department of Malaysia (JUPEM) is planning to map all the underground utilities. JUPEM has decided to collect data from all the local government authorities and the private sector companies involved in development projects that require digging. It will include data from companies like Tenaga Nasional Berhad (the largest electric utility company in Malaysia), Telekom Malaysia and Syabas (the Selangor water works company). The data will help in developing a comprehensive underground utility map of the country. *www.nst.com.my*

EVG to be source for English-Japanese Bilingual Map Production

After successfully delivering a Japanese to English translation of topographic maps over the tsunami-affected areas in the Sendai region in 2011, East View Geospatial (EVG) has been granted the exclusive rights to produce and distribute current English-Japanese bilingual topographic maps of 1:25,000 for the remaining areas of Japan by the Geospatial Information Authority of Japan (GSI). Topographic maps in English covering the entirety of Japan at this level of detail have not previously been available. This agreement increases the availability of bilingual maps from eighteen to a full country coverage series of 4,350 sheets. *www.eastview.com*

Leica Zeno GG03

Leica Zeno GG03 SmartAntenna is the only IP68 certified SmartAntenna for GIS applications. IP68 represents the top rating for protection against dust, moisture and water. Meeting the tough standards for Ingress Protection (IP), it is the most rugged GNSS SmartAntenna for GIS Asset Collection and Management tasks. *www.leica-geosystems.com/zeno*

PolaRx2 receiver orbits the Earth

PolaRx2 receiver by Septentrio has reached more than 330 hours of successful operation on-board "Technologie-Erprobungs-Träger 1" (TET-1), the first satellite of the German On-Orbit-Verification program. The receiver is the backbone of the Navigation and Occultation Experiment (NOX) developed by German Aerospace Center (DLR). The purpose of the experiment is to prove the suitability of commercial-off-the-shelf (COTS) technology for use in space missions. The receiver provides GPS observations on the L1 and L2 frequencies, which are used for precise orbit determination and atmospheric sounding. *www.septentrio.com*

New geospatial intelligence capability by Lockheed Martin

A new development in battlefield geospatial intelligence (GEOINT) that will provide significantly improved situational awareness for the British Army has been delivered by Lockheed Martin UK Information Systems & Global Solutions (IS&GS) and its industry team, Team SOCRATES. The team has developed a coherent set of deployable GEOINT capabilities and services under the Future Deployable GEOINT (FDG) programme, which will be provided to the UK's Joint Force Intelligence Group (JFIG). The TIGAS (Tactical Information and Geospatial Analysis System) technology consolidates, enhances and extends existing battlefield GEOINT capabilities and upgrades digital geoservers, initially introduced under Urgent Operational Requirements (UORs), with new virtualised variants. *www.lockheedmartin.com*

PAR lands $85 million contract

U.S. Rep. Richard Hanna, R-Barneveld has announced that the Pentagon has awarded a three-year, $85 million contract to PAR Government Systems Corporation. The contract is to provide advanced full motion video, geospatial information systems and intelligence surveillance and reconnaissance related software and hardware technologies for collecting battlefield intelligence and analysis. *www.uticaod.com/news*

GNSS solutions in emerging markets by Skyworks

Skyworks Solutions has announced that its highly integrated, low noise amplifier front-end modules are being leveraged by various OEMs to enable GPS and GNSS in smartphones, tablets and other mobile devices in emerging markets. The modules offer high linearity, excellent gain and an integrated filter, providing manufacturers with cost-effective, high performance solutions in a compact footprint. *www.skyworksinc.com*

Secure software defined radio GNSS receiver capability by Rockwell Collins

Rockwell Collins has received a $2 million contract from the Air Force Research Laboratory (AFRL) to develop and demonstrate a secure software defined radio (SDR) GNSS receiver capability. Hosted in a software defined radio, this AFRL program will develop the security architecture required for the receiver equipment certifications. The arrival of modernized GPS signals and other constellations is changing the way the U.S. military accomplishes GNSS-based positioning, navigation and timing. *www.rockwellcollins.com*

Racelogic launches of the LabSat3

LabSat3 is a low cost, stand-alone, battery powered, multi-constellation, RF record and replay device, designed to assist GNSS engineers in the development and testing of their products. With its small size and all-in-one design, it makes it easier than ever to collect raw satellite data in the same environment that end users experience in everyday use. This enables repeatable and realistic testing to be carried out under controlled conditions.

LabSat3 can be single or dual channel, and each channel can be tuned to one of 3 user selectable frequencies; GPS + Galileo + QZSS + SBAS, Glonass or Beidou. For precise control over replayed data, satellite signals can be artificially generated using the optional SatGen simulation software, which re-creates GPS, Glonass and Beidou constellations. *www.labsat.co.uk*

Quad-Constellation Global Reference Network by Rx Networks

Rx Networks Inc is upgrading its GPStream GRN™ (Global Reference Network) to include support for the BeiDou and Galileo constellations alongside it GPS and GLONASS assistance services. GPStream GRN is the foundation on which Rx Networks' and third party real-time and predictive Assisted-GNSS products operate, as used by over 700 million smartphones worldwide. *www.prweb.com*

Digital Yacht launch GPS150 Sensor

The new GPS150 DualNav positioning sensor from Digital Yacht combines a 50 channel GPS with GLONASS. This "smart" sensor will automatically switch between the systems or the the user can manually select the most appropriate for their activity. The GPS150 will also be able to utilise Galileo positioning system. *www.openpr.com*

New FARO® Edge ScanArm ES with Enhanced Scanning Technology

FARO Technologies has released of the new FARO Edge Laser Line Probe ES. The power of the new Laser Line Probe combined with the flexibility of the FaroArm creates the world's smallest, lightest, and most affordable contact/non-contact portable measurement system. It is the latest advancement in FARO's

Laser Line scanning sensors, featuring Enhanced Scanning Technology (EST). EST is the combination of multiple hardware and software improvements designed to boost performance by improving the ability to scan challenging surfaces. *www.faroasia.com/Edge/in*

Tactical Grade IMU by Sensenor

STIM300 is a small, lightweight and low power ITAR free high performance Inertial Measurement Unit (IMU). Among being non-GPS aided and insensitive to magnetic fields, it offers 12 times less weight, 10 times less volume and 5 times less power consumption over existing solutions with similar performance.

STIM300 offers 0.5°/h gyro bias instability, 0.15°/√h angular random walk, 10°/h gyro bias error over temperature gradients, 0.05mg accelerometer bias instability, and axis misalignment of 1mrad. The weight is <0,12 lbs (55g) and volume is <2 cu. in. (33cm3). STIM300 is in regular production

RIEGL VMX-450-RAIL mobile mapping solution

The main tasks of railway mapping include geo-referencing of railway infrastructure, clearance monitoring in order to detect natural obstacles like vegetation, or determine infrastructural limits for special load transportation. Other applications of railway scanning include track and base terrain inspection, as well as supervision and registration of changes in train station structures, such as thresholds between platform and wagon due to renovation works in train stations.

SNCF, the national French railway society, has taken delivery of a RIEGL VMX-450-RAIL intended for the sole purpose of railway mapping. The system is a proven, fully integrated and high speed mobile laser scanning system, including a lifting frame for crane installation. Technet-rail's SiRailScan is a 3D data-processing software solution, customized to the specific requirements of SNCF.

EnsoMOSAIC UAV Mini for multirotors

MosaicMill has introduced a new software license of its EnsoMOSAIC software series for UAV image processing. It is an economical option for aerial triangulation and orthomosaicking of flights up to 50 frames within 5 km2. It is especially suitable for multirotor operators as many jobs on quarries and stock piles carried out with helicopter type UAVs fall within the license limits.

Multi-Constellation GNSS Antennas by Tallysman

Tallysman Wireless Inc., has announced the addition of the three new antennas to its catalogue of high performance dual feed antennas: the TW2710, TW3710, and TW4821.

The TW2710 and TW3710 each cover BeiDou B1, Galileo E1, GPS L1, and GLONASS G1 frequencies. The TW4821 covers BeiDou B1, Galileo E1, and GPS

L1 frequencies. All the antennas use wideband dual feed patch antennas and exhibit low axial ratios, high multipath rejection, and excellent gains.

New GNSS enclosure product by NovAtel

NovAtel has released ProPak6 enclosure. It is NovAtel's most sophisticated GNSS enclosure product, offering meter-level to centimeter-level positioning in a ruggedized, water-resistant IP67 housing. Standardized software and hardware connections include multiple RS-232/RS-422 serial ports, CAN Bus, USB host and device, as well as Bluetooth, Wi-Fi and optional cellular radio. The ProPak6 provides an enclosure option for integrators seeking positioning flexibility, multiple communication options, and Ethernet support for remote configuration and access of data logs, while the ProPak6 is designed for reference station, timing, and general positioning applications.

JAVAD GNSS launches news kinematic survey system

JAVAD GNSS has launched Triumph-LS, a complete real-time kinematic survey system including an 864-channel receiver capable of receiving and processing all available GNSS signals, antenna, radio modem, controller, and collapsible pole. The system runs on a chip that includes three microprocessors and six parallel RTK engines, with 24 MB of memory and up to 100 channels that can be used to scan GNSS bands for interference. Other new features include the capability to perform offset surveys with photogrammetry using either the Triumph-LS system's internal camera or an external camera. Survey or GIS stakeout can be accomplished using the unit to navigate visually to stake locations with the aid of the internal camera. The 2.5-kilogram system can operate for up to 25 hours in RTK rover mode with full-screen brightness.

MARK YOUR CALENDAR

October 2013

UN GGIM AP
28 – 30 October
Tehran, Iran

November 2013

GSDI World Conference (GSDI14) and the AfricaGIS 2013 Conference
4 - 8 November
Addis Ababa, Ethiopia
www.gsdi.org/gsdiconf/gsdi14/

WALIS Forum 2013
7-8 November
Crown Perth, Australia
http://www.walis.wa.gov.au/forum

ICG-8: Eighth Meeting of the International Committee on GNSS
10 – 14 November
Dubai, United Arab Emirates
www.oosa.unvienna.org/oosa/en/SAP/gnss/icg.html

SPAR Europe/European Lidar Mapping Forum
11-13 November
Amsterdam, The Netherlands
www.sparpointgroup.com/Europe/

ISPRS: Serving Society with Geoinformatics
11 – 17 November
Antalya, Turkey
www.isprs2013-ssg.org

Esri Asia Pacific User Conference
12–14 November, 2013
Singapore
www.esri.com

Geospatial EXPO 2013 Japan
14 -16 November
Tokyo, Japan
www.g-expo.jp

December 2013

5th Asia Oceania Regional Workshop on GNSS
1 - 3 December 2013
Hanoi, Vietnam
www.multignss.asia/workshop.html

ION Precise Time and Time Interval Meeting (PTTI)
2 – 5 December
Bellevue, WA, United States
www.ion.org

Fourth ESA Colloquium on Galileo
4 – 6 December
Prague, Czech Republic
www.congrexprojects.com/13c15/

6th European Workshop on GNSS Signals and Signals Processing
5- 6 December
Munich, Germany
http://ifen.bauv.unibw.de/gnss-signals-workshop/

Esri India UC
11-12 Dec 2013
Delhi
http://www.esriindia.com/Events/UC2013_files/index.html

January 2014

ION International Technical Meeting
27-29 January
San Diego, California, USA
www.ion.org

March 2014

Munich Satellite Navigation Summit 2014
25 – 27 March
Munich, Germany
www.munich-satellite-navigation-summit.org

April 2014

Locate'14
7 – 9 April 2014
Canberra, Australia
www.asiera.org.au/rl14

ENC-GNSS 2014
14 – 17 April
Rotterdam, The Netherlands
www.enc-gnss2014.com

2014 International Satellite Navigation Forum
23 – 24 April
Moscow, Russia
http://eng.glonass-forum.ru

May 2014

IEEE/ION Position Location and Navigation Symposium
May 5-8, 2014
Monterey, CA
www.ion.org

Annual Baska GNSS Conference
7 - 9 May, 2014
Baska, Krk Island, Croatia
renato.filjar@rin.org.uk

GEO Business
28 - 29 May 2014
London, UK
www.geobusinessshow.com

June 2014

ION Joint Navigation Conference 2014
16 – 19 June
Orlando, United States
www.ion.org/jnc

XXV FIG Congress
16 – 21 June
Kuala Lumpur, Malaysia
www.fig.net

July 2014

Esri International User Conference
14–18 July 2014
San Diego, USA
www.esri.com