RNI: DELENG/2005/15153
Publication: 15th of every month
Posting: 19th/20th of every month at NDPSO

No: DL(E)-01/5079/11-13
Licensed to post without pre-payment U(E) 28/2011-13
Rs.100

ISSN 0973-2136

www.mycoordinates.org

Coordinates

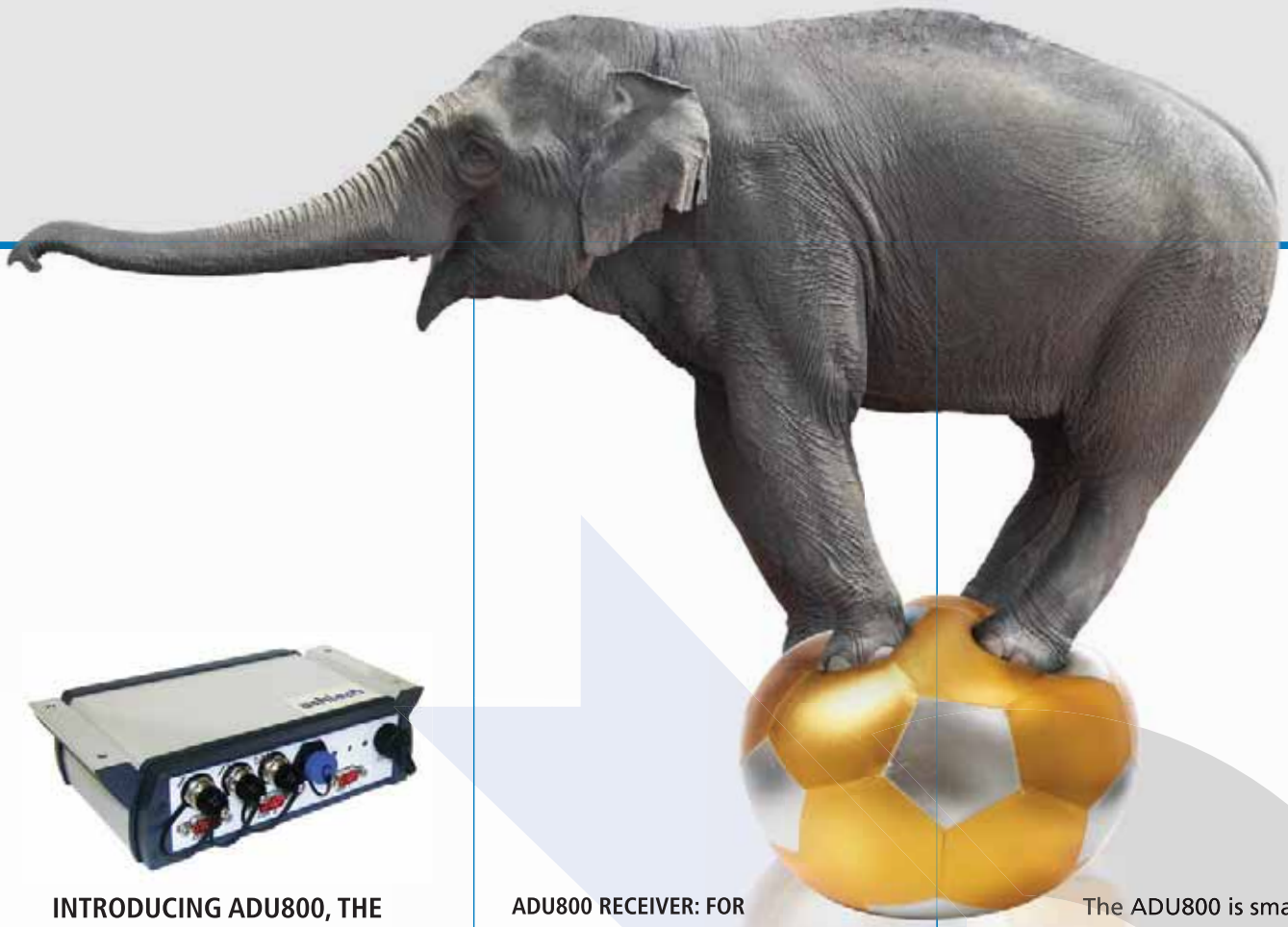
Volume IX, Issue 6, June 2013

THE MONTHLY MAGAZINE ON POSITIONING, NAVIGATION AND BEYOND

Tracking the prey rather than the predator

Land Administration • Surveying • Urban Planning

NEED TO CAREFULLY MONITOR YOUR ATTITUDE?



INTRODUCING ADU800, THE LATEST ASHTECH REAL-TIME, INSTANTANEOUS 6D GNSS POSITIONING SYSTEM

Providing real-time heading, pitch and roll measurements, with accurate position and velocity, at a standard update rate of up to 20 Hz, for static and dynamic platforms.

ADU800 RECEIVER: FOR REAL-TIME, HIGH-ACCURACY, ABSOLUTE 6D POSITIONING

- GPS/GLONASS/SBAS/QZSS with embedded Z-Blade™ technology
- Patented, multi-constellation signal processing
- Advanced multi-path mitigation and robust signal tracking
- Fast initialization and antenna set-up auto-calibration
- GNSS-centric operation.

The ADU800 is small, weatherproof, and rugged to allow operation in harsh environments. It is ideal for open-pit mining, seismic exploration, oceanographic research, and airborne applications. For a better attitude, explore the full scope of Ashtech's GNSS sensors at www.ashtech-oem.com

ashtech™
A TRIMBLE COMPANY

www.ashtech-oem.com
oemsales@ashtech.com

GNSS spoken here

[GPS/GLONASS/BeiDou/Galileo]

One family, many solutions. Trust Trimble GNSS OEM for all your high precision applications.

L1
BD910
GPS, GLONASS, BeiDou, Galileo

L1/L2
BD920
GPS, GLONASS

L1/L2/L5
BD970
GPS, GLONASS, BeiDou, Galileo

L1/L2 + Heading
BD982
GPS, GLONASS, OmniSTAR, Heading

L1/L2 + Communications
BD920-W3G
GPS, GLONASS, WiFi, 3G

Enclosure
BX982
GPS, GLONASS, OmniSTAR, Heading

Trimble®

www.trimble.com/gnss-inertial

In this issue

Coordinates Volume 9, Issue 6, June 2013

Articles

Columns

This issue has been made possible by the support and good wishes of the following individuals and companies Ayman M Ismail, Donatella Dominici, Elisa Rosciano, Hussam Bakr, Jouni Johannes Anttonen, Keranka Vassileva, Michail Elaiopoulos, Salma Anas and Volker Janssen and; Ashtech, CHC, Effigis, Foif, Geneq, GGS, Hemisphere GPS, HiTarget, Javad, Pentax, Navcom, NovAtel, Rohde & Schwarz, Sensonor, South, Techequip, Trimble, and many others.

Mailing Address
A 002, Mansara Apartments
C 9, Vasundhara Enclave
Delhi 110 096, India.
Phones +91 11 22632607, 98102 33422, 98107 24567
Fax +91 11 22632607

Email
[information] talktous@mycoordinates.org
[editorial] bal@mycoordinates.org
[advertising] sam@mycoordinates.org
[subscriptions] iwant@mycoordinates.org

Web www.mycoordinates.org

Annual subscription (12 issues) [India] Rs.1,200
[Overseas] US$80

Printed and published by Sanjay Malaviya on behalf of Centre for Geoinformation Technologies at A221 Mangal Apartments, Vasundhara Enclave, Delhi 110096, India.

Editor Bal Krishna

Owner Centre for Geoinformation Technologies

Designed at Spring Design (springdesign@live.com)

Printer Thomson Press India Ltd., B 315, Okhla Phase I, New Delhi - 110020, India

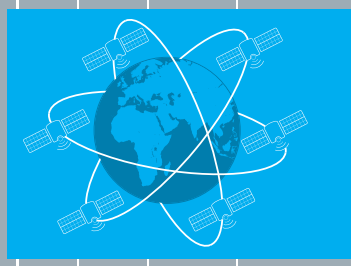
This issue of Coordinates is of 64 pages, including cover.

GPS/Galileo/Glonass simulation easier than ever.

The R&S®SMBV100A vector signal generator with GNSS software options

Expensive or inflexible simulation of GNSS scenarios is a thing of the past. Now you can easily and cost-effectively test your satellite receivers under realistic conditions.

- Realtime scenarios with up to 24 satellites, also in hybrid configurations
- A-GPS and GPS P code supported
- High dynamics for simulating very fast moving objects such as fighters or rockets
- Realistic signal modeling with moving profiles, multipath propagation, dynamic power control and atmospheric modeling
- Additionally the R&S®SMBV100A provides all relevant communications and broadcasting standards such as LTE, HSPA+, GSM/EDGE, HD radio™, and FM stereo



To find out more, go to
www.rohde-schwarz.com/ad/smbv-gnss

ROHDE&SCHWARZ

Convergence – The mantra

The mobile phone has it all.

Camera, music, LBS, Internet, wireless, TV,…

Many such functions were not imagined

When mobile was invented

As its mobility in itself was a major technological leap.

The positioning and navigation technologies

Appear to be following the similar logical transitions

Where in various positioning tools and functionalities

Not only of within the domain but from outside related domain as well

Are getting converged

Resulting in emergence of technological innovations.

Bal Krishna, Editor
bal@mycoordinates.org

TECH EQUIP ENTERPRISES

GAGAN DGPS SBAS RECEIVERS SINCE 2007
UNCHALLANGED POSITIONING ACCURACY (<2M) NOW AFFORDABLE FOR SCIENTIFIC COMMUNITY

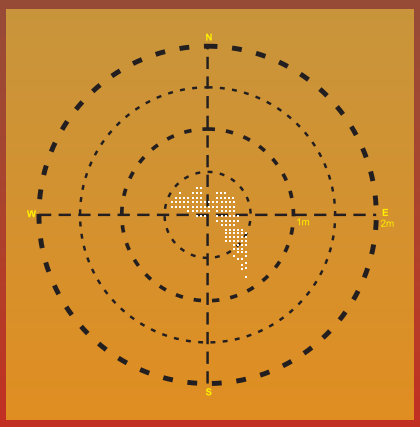
EXPERIENCE DGPS ACCURACY WITHOUT EXPENSIVE BASE AND ROVER POST PROCESSING CONFIGURATIONS
USE ISRO'S GAGAN SBAS DGPS SIGNAL TO GET
<1M ACCURACY PREMIUM RANGE **<2M ACCURACY STANDARD RANGE**

PREMIUM RANGE : - GAGAN SBAS +PPP Carrier phase measurement

WORLD'S FIRST & MOST ACCURATE GAGAN SBAS +PPP, IP 67 - PDA GPS

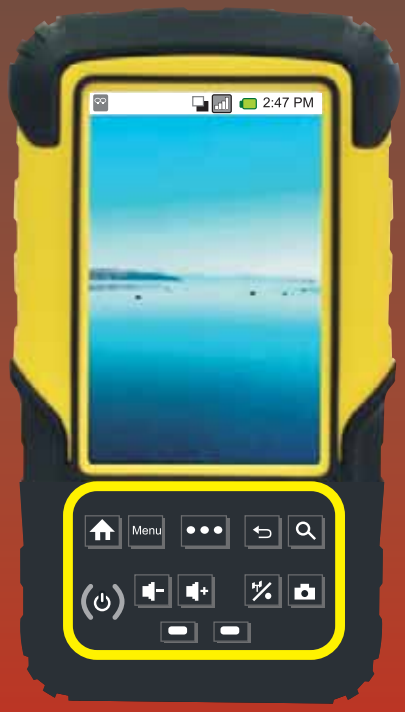
GAGAN +PPP

- Windows Mobile 6.5
- RAM / ROM - 512MB / 512MB
- Display 4.3", High brigtness 480x800 LED display
- 5 megapixel digital camera
- Battery 3.7V 5000mAh Li-Poly rechargeable battery
- WLAN Support 802.11 2.4GHz b/g/n mode
- Bluetooth 2.1+EDR (No audio profile)
- USB OTG
- 3G Optional
- Embedded with Micro SD card slot
- Designed for IP67 Dust & Water Protection
- Compliant with MIL-STD 810F Standard



WORLDS MOST PRECISE SBAS DATA COLLECTOR WITH <1M ACCURACY WITHOUT POST PROCESSING WITHOUT A BASE STATION

PARISHUD



Precise GAGAN Positioning
(SBAS+CARRIER PHASE MEASUREMENT)

+

SuperPad 3

a full-function mobile GIS application

Both together at just

= ₹. 60,000/-*

COST PERFORMANCE RATIO FAR AHEAD

STANDARD RANGE : - GAGAN

INDRA DHANUSH
USB MINIATURE
2m 2DMRS
₹. 5000/- *

SX BLUE
IP-67 BATTERY BUILT-IN
1m 2DMRS
₹. 1,00,000/- *

DHARTI
IP-54 GIS DATA LOGGER
1.5m 2DMRS
₹. 32,000/- *

TECH EQUIP ENTERPRISES

(SPEAR HEADING GAGAN BASED SOLUTIONS)

388, Street No. 8, East Marredpalli, Secunderabad - 500 026. (A.P.)
Contact : R. Mohan 9885975365, Email : techequipenterprises@yahoo.com

* - Approximate Price

Tracking the prey rather than the predator with GNSS

The paper presents an indirect GNSS-based method for the tracking of drop bears to effectively map the animal population, study animal behaviour and enhance conservation efforts.

Dr Volker Janssen
Honorary Research Associate, School of Geography and Environmental Studies, University of Tasmania, Hobart, Australia

Global Navigation Satellite System (GNSS) technology has revolutionised the way 3-dimensional positions are determined on and above the Earth's surface. GNSS-based positioning has become a vital tool for a wide range of applications in areas such as surveying, mapping, asset management, precision agriculture, engineering and construction. A lesser known application that has benefited immensely from the introduction of GNSS technology is animal tracking.

Australia is home to many unique animals. For about 50 years, the tagging and tracking of animals has been invaluable in the quest to better understand animal behaviour and ecology (the study of the relationships that living organisms have with respect to each other and their natural environment). Monitoring animal populations is also necessary for conservation purposes, particularly in an era of human expansion into traditional animal habitats. Several species, such as the Tasmanian devil, are currently declining. Others, such as the drop bear, are rarely seen. Too little is known about many indigenous species whose status may be threatened.

Over the last two decades, the use of GNSS technology has been responsible for significant advances in this field (Tomkiewicz et al., 2010). GNSS provides the ability to obtain accurate, regular and frequent estimates of the changing distributions of many rare animal species. However, employing conventional GNSS-based animal tracking methods to study drop bears and other tree-dwelling animals is extremely difficult due to their habitat. The dense tree canopy regularly causes extended periods of complete GNSS signal loss, and sensors are often damaged during attacks on prey.

This paper outlines an alternative, indirect GNSS-based approach for tracking drop bears. Rather than attaching sensors to the animals themselves, the prey is tracked in order to map the population. A case study demonstrates that this method can effectively estimate the number and spatial distribution of drop bears in the area. It also provides valuable insights into the animal's hunting behaviour.

GNSS-based animal tracking

Initially animal tracking relied on VHF (very high frequency) radio technology. The main disadvantages of this method are the requirement of receivers being close enough to the animals to triangulate animal positions and the low temporal resolution of position fixes. The arrival of GNSS technology has revolutionised animal tracking because it allows the continuous recording of accurate positions. Now it is possible to obtain animal trajectories, rather than having to rely on occasional snapshots of the animal's whereabouts. While the first attempts of employing GNSS for animal tracking appeared to be rather clumsy (Figure 1), the technology was quickly embraced and optimised for this application through the development of animal collars.

At first, only large animals such as elephants, camels and bears were able to

Figure 1: First attempts of GNSS-based animal tracking.

softmouse 3D™

Smooth, lightweight and accurate

SOFTMOUSE 3D-USB PHOTOGRAMMETRIC CONTROLLER

Experience unparalleled ease of use and comfortable two-handed operation with the softmouse 3D photogrammetric controller. If you require *precise digitizing and manipulation of elements in a 3D virtual environment*, softmouse 3D is the tool of choice. Smooth, lightweight and accurate, softmouse 3D is perfect for photogrammetric systems, for GIS and mapping applications, strategic military planning and many other 3D applications.

- Direct USB connectivity (no more interface box!)
- High-precision laser navigation (no more balls or encoders to clean)
- New high-reliability switches
- New, more comfortable silicone buttons
- Backward compatibility to existing software by means of serial port emulation
- Included in the package: high-performance Teflon® treated mouse pad
- Supports Windows 7 and XP in 32 and 64 bits
- Has been tested with the following applications*: Digi3D™, ImageStation™, Inpho's Match AT™ KLT Atlas™, PurVIEW™, Socet GXP™, Socet Set™, Stereo Analyst™, Summit Evolution™, LPS™, Virtuoso™, and others supporting the old Immersion™ mouse.

Exclusive offers available for Coordinates subscribers only!

Mention promo code COORDINATES when placing your order.

To learn more, visit **www.softmouse-3d.com**, email us at **softmouse3d@ggsnet.com** or call us at (US) **+1 303 223 4638**

GGS

GLOBAL GEO SUPPLIES, INC.

CERTIFIED USB

Compatible with Windows 7

Figure 2: Cattle wearing collars for automated animal control (Swain et al., 2009).

Figure 3: Drop bear (a) in its habitat and (b) attacking prey.

be tracked due to the considerable sensor size and the reliance on rather large, heavy battery packs (e.g. Schwartz and Arthur, 1999). Technology improvements and equipment miniaturisation then allowed the tracking of much smaller animals, including possums and pigeons (e.g. Dennis et al., 2010). Nowadays, research is being undertaken into automated livestock control via virtual fencing (e.g. Swain et al., 2009). This is achieved by employing animal collars that not only utilise GNSS to monitor position but also provide cue (audio) and control (mild electric shock) stimuli to deter animals from entering an exclusion zone (Figure 2).

Drop bears

The drop bear (*Thylarctos plummetus*) is a tree-dwelling, predatory marsupial that closely resembles the koala and is therefore hard to spot. Colloquially, it is often referred to as the carnivorous 'evil twin' of the koala because it is a vicious creature sharing a very similar habitat. The drop bear is a strongly built animal with powerful forearms and claws for climbing and holding on to prey. In stark contrast to the smaller koala, it has large canine teeth that are used very effectively as biting tools.

The drop bear generally hunts during the day by ambushing ground-dwelling animals from above, skilfully latching onto the victim's neck to kill its prey. Quietly waiting in a tree for several hours, it closely resembles a sleeping koala. Once prey is within striking range, the drop bear will plummet several metres out of the tree to pounce on top of the unsuspecting victim (Figure 3). The initial impact generally stuns the prey, allowing it to be bitten on the neck and quickly subdued. Medium to large mammals make up most of the animal's diet (Hosking, 2013), and often the prey is considerably larger than the drop bear itself. A nocturnal variation of the species (*Thylarctos plummetus vampirus*) has resorted to draining the prey of its blood rather than feasting on its flesh (Lestat, 2010).

The distribution of drop bears across Australia is quantified by the National Drop Bear Index (NDBI), which indicates the average population density per square kilometre. As illustrated in Figure 4, the drop bear is mainly found in coastal regions of eastern and southern Australia, stretching from the Cape York Peninsula to Tasmania. Populations also extend for considerable distances inland in regions with enough moisture to support suitable woodland not limited to eucalypts. Woodland is crucial since drop bears are not easily able to drop from spinifex bushes and desert plants. Furthermore, fewer victims in more arid environments reduce the ability to work downwards through the food chain and thus considerably lower survival rates. Reports of periodic attacks on opal miners in Coober Pedy are questionable and may be related to excessive consumption of cooling amber fluids in dry areas. Aboriginal dreamtime legends suggest that the drop bear was once much more widespread, hence the need for contemporary conservation.

Unlike other peculiar Australian animals such as the bunyip and hoop snake, which are rarely encountered in even thinly populated areas, the drop bear poses a considerable risk to unsuspecting bushwalkers (particularly tourists) because it looks very similar to the koala. While the Australian government has been accused of orchestrating a conspiracy to cover up the existence of drop bears in order to protect the tourist industry (Langly et al., 1999), these claims have never been substantiated.

Protection from drop bear attacks

Drop bears do not specifically target human beings. Yet there have been several cases where humans have fallen victim to drop bear attacks, resulting in serious lacerations and even death (Home and Away, 2011). Numerous disappearances may also be attributed to drop bear activity (e.g. Holt, 1967; Hussey, 1989; Mulder and Scully, 2000). Over the years, several methods have been suggested to protect humans from drop bear attacks, although their effectiveness often remains scientifically inconclusive (e.g. Janssen,

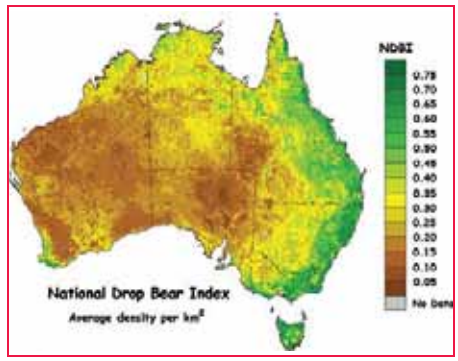


Figure 4: Distribution of drop bears in Australia, quantified by the National Drop Bear Index (NDBI).

2011). These methods include wearing forks in the hair, spreading Vegemite or toothpaste behind the ears or under the armpits, urinating on oneself, and avoiding talking in a foreign language or an accent other than Australian.

There is unmistakable evidence that tourists are much more likely to be attacked by drop bears than Australians. Genetic analyses suggest that this may be related to the Australian 'mateship' trait, which extends to animals unique to Australia (Crikey and Beauty, 2008). Furthermore, drop bears can detect foreign languages and are prone to target the origin of such sounds, while using the Aussie lingo may fool the average drop bear (Stewart, 2005). It has also been shown that by-products of the interaction between chemicals found in Vegemite and those found in human sweat repel drop bears (Honeydew, 2003). Most Australians and immigrants who have lived in Australia for long periods of time tend to eat Vegemite on a daily basis. Therefore they exude these chemicals through their skin permanently and are thus protected. Visitors, on the other hand, do not have this 'natural' protection and are therefore advised to apply a liberal amount of Vegemite to the skin. The most suitable area is just behind and towards the top of the ear because this area is prone to sweating and closest to the top of the head.

However, drop bear attacks on humans are rare. This is mainly because Australians are familiar with drop bear ecology, tourists are deliberately diverted, and reality TV survivor series are usually undertaken elsewhere. Extensive studies have revealed that the best protection against attacks is to wear a motorcycle helmet when bushwalking in drop bear territory, although this may be impractical in tropical regions (Skywalker, 2008). An accomplished method of determining whether a drop bear may be lurking in the flora canopy is to lie down beneath a tree and spit upwards. If a drop bear is sleeping above, it will most likely wake up and spit back (Young et al., 1981). It should be noted, however, that this approach includes some risk. The consequences can be devastating if drop bears are on the hunt for prey or in the middle of the mating season.

Indirect GNSS-based tracking of drop bears

Monitoring drop bears is essential to ensure that a sustainable animal population is maintained, while limiting the possibility of attacks on humans. Conventional GNSS-based animal tracking methods require the sensor to be directly attached to the animal of interest. This makes studying tree-dwelling species like the drop bear extremely difficult because the tree canopy regularly causes extended periods of complete GNSS signal loss. Due to the viciousness of the drop bear (even under sedation), there is a considerable risk of injury when the sensor is attached. The GNSS sensor is also prone to severe damage and loss during attacks on prey. The animal's habit of rubbing its body against tree branches further limits sensor life. This severely reduces the availability of meaningful tracking data and substantially increases the cost of drop bear tracking.

These drawbacks can be avoided by employing an indirect GNSS-based approach, which involves tracking the prey rather than the predator (Janssen, 2012). The animal population in a particular area is then mapped by pinpointing the location and timing of drop bear attacks. Drop bears are known to be very territorial. They do not stray far from a relatively small number of trees in close proximity that are used as hunting ground. The location of attacks therefore provides a good indication of where a drop bear resides.

Case study

To prove this theory, a case study was undertaken in the northern part of Morton National Park, located about 120 km southwest of Sydney. The indirect GNSS-based tracking approach was used to estimate the number of drop bears inhabiting this area. Several research assistants (mainly thrill-seeking international students in dire need of financial support) were equipped with GNSS sensors to track their position during bushwalks off the beaten track.

The differential GNSS positioning technique was employed to obtain high-quality real-time positioning solutions relative to a Continuously Operating Reference Station (CORS) nearby. All data gatherers were wearing heavy-duty bike helmets and neck protectors to guard against potential injuries. The field work took place on seven consecutive days starting on 1 April 2012. At times, dense tree cover caused some tracking problems and subsequent data gaps. However, coordinate solutions were generally accurate at the decimetre level or better.

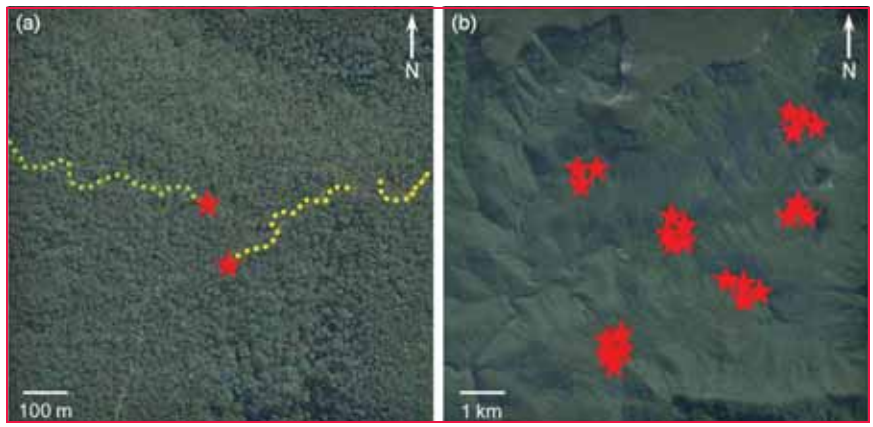


Figure 5: (a) Example of two GNSS trajectories ending with a drop bear attack (denoted by a star), and (b) summary of all drop bear attacks observed.

Photo: Sindre Lundvold

NORWEGIAN EXTREME ARTIST, ESKIL RONNINGSBAKKEN, DURING A BALANCING ACT AT PULPIT ROCK, 1982 FEET ABOVE THE LYSEFJORD, NORWAY, 2006.

AMAZING SKILLS OF THE WORLD

INSPIRE US ...

Location and size of the population

The GNSS trajectories of the bushwalkers were used to determine the location (and timing) of drop bear attacks. Figure 5a shows an example of two typical tracks culminating in an attack, while Figure 5b shows a map illustrating the spatial distribution of all drop bear attacks observed. It is evident that the attacks appear in distinct clusters, indicating that six drop bears were involved. This leads to the conclusion that at least six drop bears inhabit the study area. The timing of the attacks (data not shown) supports this result.

An examination of kill sites and animal droppings in the study area was conducted a month before and after the GNSS field work was undertaken. This provided an independent method of estimating the number of resident drop bears and confirmed the findings obtained using the indirect GNSS-based animal tracking approach.

Hunting behaviour

In an additional investigation, pairs of data gatherers bushwalked along the same path to examine whether foreigners were more prone to drop bear attacks than locals. In the first scenario, an Australian was followed at a distance of about 50-100 metres by an international research assistant. In the second scenario, the two data gatherers would swap positions. While the relatively small data sample collected precluded a rigorous scientific analysis, some general comments can be made.

In both scenarios, Australians were far less successful in being 'dropped on' than foreigners. Only 10% of Australians were targeted in the event of a drop bear attack. It was later discovered that those Australians were not fond of Vegemite, lending further weight to Honeydew's (2003) incisive study. The results further indicate that drop bears do not necessarily target the last person walking in a line. However, more research into the behaviour of drop bears is required to confirm these findings, which may reflect seasonality and the presence of alternative food sources.

> The arrival of GNSS technology has revolutionised animal tracking because it allows the continuous recording of accurate positions. Now it is possible to obtain animal trajectories, rather than having to rely on occasional snapshots of the animal's whereabouts.

It should be noted that no animals were harmed during this case study. Likewise, none of the bushwalkers were injured, with the exception of occasional bruising and a few minor lacerations that were graciously endured in the name of science.

Conclusion

This paper has presented an indirect approach for tracking drop bears using GNSS technology. Tracking the prey rather than the predator has proven to be effective in determining the number and spatial distribution of drop bears present in the study area. It has also revealed the animal's particular nutritional targeting preferences. This bush-path breaking study has begun to provide a much better understanding of the ecology of the drop bear. Bushwalkers should be vigilant when hiking along less frequented paths in Australia and take precautions in areas known to be inhabited by drop bears. In these areas, conservation practices can now be enhanced.

While GNSS positioning quality was generally at a sufficiently high level, occasional data gaps were encountered due to dense tree canopy (cf. Figure 5a). Following the deployment of additional satellite constellations currently under development (e.g. Europe's Galileo, China's Beidou and the Indian Regional Navigation Satellite System – IRNSS), a much larger number of GNSS satellites and frequencies will be available in the near future. This is expected to significantly enhance tracking performance, particularly in Australia which will be a 'hotspot' for global and regional navigation satellite systems. Additional benefits could be gained by combining the GNSS sensor with an Inertial Navigation System (INS) to bridge anticipated periods of GNSS signal loss in the forest.

It should be noted that this study was conducted entirely outside normal working hours and not funded by the taxpayer in any way, shape or form. All views expressed in this paper are those of the author and do not necessarily reflect the views of his employer. Prof. John Connell of the University of Sydney is gratefully acknowledged for providing invaluable comments and suggestions during the preparation of this paper.

References

Crikey O, Beauty U (2008) Genetic fingerprinting reveals mateship traits in Australian animals, *Budgie Smuggler* 31(5): 29-36.

Dennis TE, Chen WC, Koefoed IM, Lacoursiere CJ, Walker MM, Laube P, Forer P (2010) Performance characteristics of small Global-Positioning-System tracking collars for terrestrial animals, *Wildlife Biology in Practice* 6(1): 14-31.

Holt HE (1967) The art of disappearing without a trace, *Journal of Discoveries* 18(5): 116-125.

Home A, Away B (2011) It sounds crazy but we know what we saw, *Proc. of Discussions During the*

Fifth Test of the 2010-11 Ashes Test Series, Sydney Cricket Ground, Australia, 3-7 January, 666-681.

Honeydew B (2003) Understanding the chemical interactions between Vegemite and human sweat, *Journal of Irreproducible Results* 45(13): 407-419.

Hosking C (2013) Animal species: Drop bear, http://www.australianmuseum.net.au/Drop-Bear (accessed May 2013).

Hussey W (1989) What really happened during the picnic at Hanging Rock?, *Victorian Journal of Montane Mystery* 17(9): 246-251.

Janssen ME (2011) *Compendium of Australian and Filipino housewife logic*, Pinocchio Press, Sydney, 333pp.

Janssen V (2012) Indirect tracking of drop bears using GNSS technology, *Australian Geographer* 43(4): 445-452.

Langly R, Frohike M, Byers JF (1999) The truth is out there: A government conspiracy covering up the existence of drop bears in Australia, *The Lone Gunman* 12(7): 15-21.

Lestat V (2010) At dawn they sleep: Allies in the Australian animal kingdom, *Australian Vampire Chronicles* 219(7): 255-264.

Mulder FW, Scully DK (2000) Connections between alien abductions and drop bear attacks in Australia, *Journal of Paranormal Phenomena* 8(3): 52-68.

Schwartz CC, Arthur SM (1999) Radio-tracking large wilderness mammals: Integration of GPS and Argos technology, *Ursus* 11: 261-273.

Skywalker L (2008) May the force be with you: A study on the protection from drop bear attacks, *Clone War Chronicles* 22(4): 213-225.

Stewart A (2005) Stone the flaming crows: Drop bears and the Aussie lingo, *Journal of Australian Linguistic Anomalies* 7(3): 48-59.

Swain D, Bishop-Hurley G, Griffiths J (2009) Automatic cattle control systems – Grazing without boundaries, *Farming Ahead* 209: 70-72.

Tomkiewicz SM, Fuller MR, Kie JG, Bates KK (2010) Global Positioning System and associated technologies in animal behaviour and ecological research, *Philosophical Transactions of the Royal Society B: Biological Sciences* 365(1550): 2163-2176.

Young M, Young A, Johnson B (1981) For those about to spit (we salute you), *Rock Paper Scissors* 9(2): 33-41.

Integrating surveying methodologies to provide specific solutions

This paper aims to illustrate how the simultaneous use of various instruments can guarantee satisfying results even in apparently complex situations

Donatella Dominici
Professor of Cartography and Geomatics, Department of Civil, Environmental Engineering and Architecture, University of L'Aquila, Italy. Laboratory of Geomatics - Via Gronchi, L'Aquila, Italy

Elisa Rosciano
Environmental Engineer and PhD Student in Geomatics, Department of Civil, Environmental Engineering and Architecture, University of L'Aquila, Italy. Laboratory of Geomatics - Via Gronchi, L'Aquila, Italy

Michail Elaiopoulos
Civil Engineer and Master student in Civil Engineering, Department of Civil, Environmental Engineering and Architecture, University of L'Aquila, Italy. Laboratory of Geomatics - Via Gronchi, L'Aquila, Italy

Modern geomatic techniques have provided interesting advantages in a wide range of research areas. However, the traditional surveying methodologies continue remaining essential in order to ensure reliable and precise results of any kind. This paper aims to illustrate how the simultaneous use of various instruments can guarantee satisfying results even in apparently complex situations. The presented experiment regards the study of two antenna prototypes, developed to identify the presence of bodies buried under collapses in a post-earthquake scenario and/or other calamities. Numerous geomatic techniques and instruments have been integrated among them in order to determinate the position, dimension, orientation, precision and reliability of the two prototypes. The test area has been chosen near Onna, a small village unfortunately destroyed by the earthquake of April 6, 2009.

Introduction

Modern instruments as well as newborn software are able to acquire and process huge amount of data. In addition, the synergy with the traditional surveying permits achieving outstanding precision and accuracy of the final result; this was the reason that led us combining the advantages of both. The development of this radio prototype was born from the idea that the immediate and automatic identification of victims buried under collapses could decidedly reduce the number of deaths in such situations. Certainly, this would be possible through the recognition of signals produced by suitable devices.

A radio antenna uses a continuous wave system (CW) able to estimate the inbound direction of any kind of signal (Direction of Arrival principle - DoA). The reliability of this estimation directly

Figure 1: The test area evidenced in red on the left and the first prototype with a particular of its hardware on the right.

depends on the so-called "path loss" of the antenna; the path loss represents the reduction, in terms of power density (attenuation), of the electromagnetic wave during the path from the object to the receiver. This phenomenon is naturally amplified in presence of flat surfaces (such as buildings), that can reflect the signal (creating the also called multipath error).

The evaluation process for the DoA's evaluation for each prototype was divided into three parts:

- the reproduction of the test scenario using the laser scanning (described later);
- the materialization of a control surveying network using a total station in order to georeference the scenario reconstructed ;
- and finally, the observation with the same orientation of the surveying instruments of the two prototypes in order to estimate their position during the experiment.

Figure 1 illustrates the test area and one of the two prototypes.

Surveying methodology and test area

For this experiment, in order to simulate the emission of a signal coming from a collapsed building a radio emitter has been placed through a plastic pipe at the bottom of a pile of debris representing the collapsed structure. The position of the emitter was then measured by the total station using a prism placed on the heap. Thus the first prototype was placed in the vicinities of the rubbles; as it was gradually being rotated, a characteristic sound reproduced by an onboard speaker was indicating the reception of the signal.

The positioning and orientation of the prototype was made in these phases: firstly, the normal direction to the antenna has been calculated by observing with a total station the antenna's two extremities materialized with a couple of surveying prisms. Then the direction between the prototype and the signal's emitter was calculated. The deviation error

Figure 2: Placing the emitter under the pile collapses in order to simulate a trapped body that creates a radio wave.

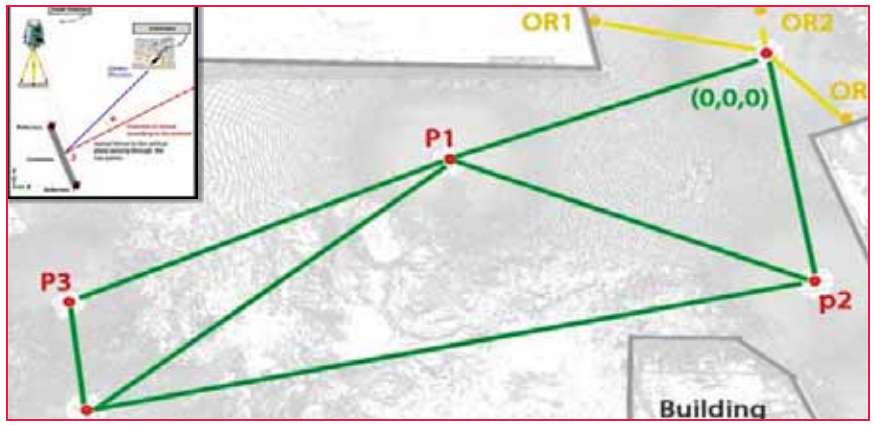


Figure 3: A scheme of the surveying methodology used to identify the position, direction and orientation of each prototype; also the materialized network of points.

Figure 4: Results of the georeferenced global point cloud. The 5 points where the instrument made stations are visible in black (absence of data).

was then estimated by the difference among them. This deviation represents the error with which each prototype failed to locate the signal's origin.

Using this geomatic procedure, the systematic errors in the receiving system of both prototypes has been identified. About 50 placements of both prototypes were made in the same way calculating position, orientation and errors for each one.

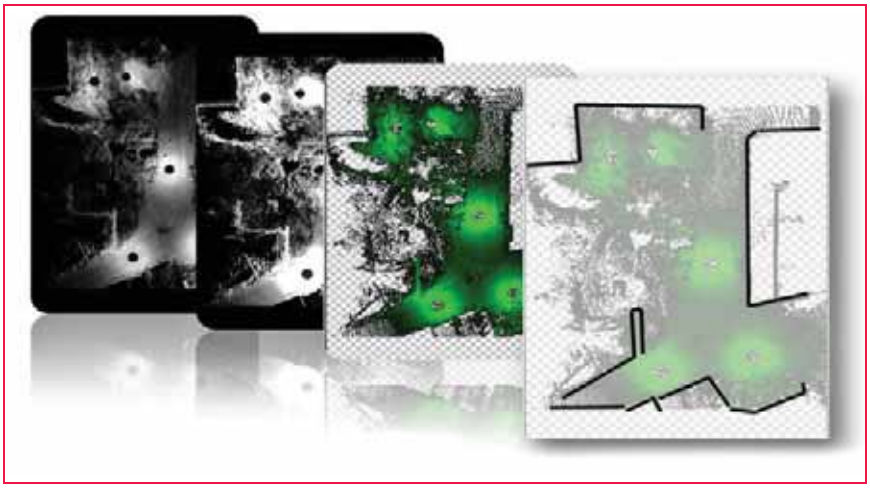


Figure 5: Editing the view-from- top orthophoto in order to evidence flat surfaces that can generate reflections. This adjustment was made using widely used software for image editing.

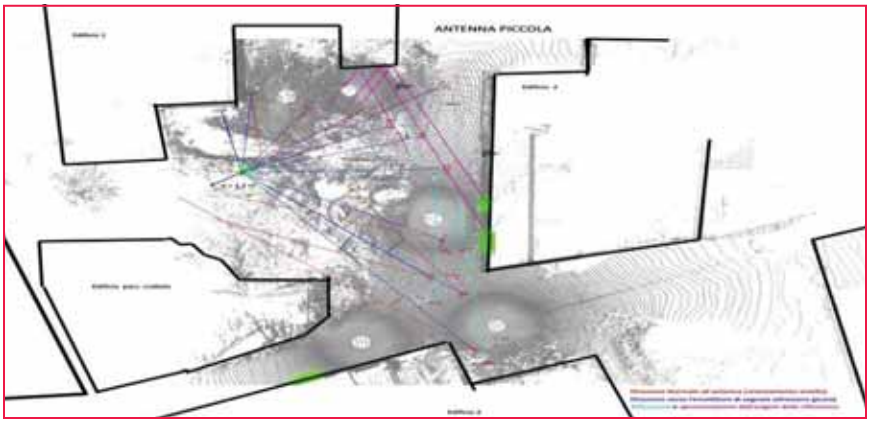


Figure 6: Overlapping the laser scanner orthophoto with the detected flat surfaces and the antenna's measurements. The detected direction are marked in blue, the deviations are marked in red, reflections and an estimation of their origin is plotted in light blue and magenta respectively.

Surveying execution

A 3D surveying network has been materialized using a total station (Leica TS30) in order to curry the described operations, thus five control points have been chosen to be used by the needed instruments. Figure three illustrates the control points in red; in green the baselines of this local network are also presented. The TS30 total station has been chosen for its elevated angle and distance precisions (0.5cc and 0.5mm+6ppm respectively). A terrestrial laser scanner campaign has also been curried in order to create an accurate overview of the whole area using a Leica HDS 3200 Laser scanner. Overall, five point clouds have been obtained by making station on each control point and thus covering, with the desired resolution, the whole test area. The final product of this surveying campaign is a georeferenced point cloud of 7.5 million points with the precision of 4.5 mm. the resulting point cloud is geo-referenced to the local reference system created by the total station ensuring the consistency between the corresponding points in the two reference systems. Figure 4 illustrates an orthophoto depicting the test area.

Having a three-dimensional representation was crucial in order to identify and quantify any obstacle in the path of propagation of the received signal. In this way, overlapping all the information extracted from all survey operations, the detection of any abnormal behavior was possible. Currying a detailed observation of the interested area about 40 elements of possible reflections (facades, metal elements like doors or windows and garages) were identified and localized using the topographic network in order to be used in the post processing. (Figure 5)

> The integration and the smart use of well-established techniques can meet the requirements of any situation, especially in problematic cases such as post-calamity emergencies

During the data elaboration, and, having measured both the angle between the total station and antenna's prism and the total station and the antenna during the signal's reception, the deviation error was expressed as the difference between them. As a further result, the probability of a correct identification of the signal's DoA and therefore, the antenna's success percentage, was also calculated. In figure 6 the error eclipse around the signal's origin is shown. The ellipse shows that in the 99.5% of cases the antenna has been able to locate the right direction of the signal within 1.2 meters of error.

Conclusions and discussion

The presented research illustrates a synergy among different techniques and instruments. The motivation of the paper is to highlight that there is no need of searching particular methods neither advanced technologies to overcome with apparently complex situations. The integration and the smart use of well-established techniques can meet the requirements of any situation, especially in problematic cases such as post-calamity emergencies. In future, the same methodologies could be ulteriorely enhanced by integrating GNSS receivers in RTK mode in order to continually track the position of the antenna's both extremities over time. The equations needed to elaborate these coordinates will be loaded in a model's routine able both to track these data and to calculate all results in real time. In this way both the testing, the evaluation and the application of similar prototypes will be possible.

HI-TARGET

ZTS Series Total Station

ZTS-120/120R

- Intelligent Calibration, USB Port&Bluetooth Optional
- Reflectorless Distance Measurement, Range Up To 350M
- Integrated Optical, Mechanical and Electrical Precision Ranging System, Accuracy: 2mm±2ppm
- High Efficient Absolute Encoder Angle Measuring System, Accuracy: 2″

Simply Powerful

Hi-Target Proudly Supports As Platinum Sponsor

See us at
12TH SOUTH EAST ASIAN SURVEY CONGRESS
To Be Held on June 18-20, 2013 at Philippine International Convention Center, Manila Philippines
www.seasc2013.org.ph

ZTS-120R

ZTS-120

CE

Hi-Target Surveying Instrument Co., Ltd

www.hi-target.com.cn
www.gnss-gps.com

ADD:10th Floor,Chuangxin Building,Tian'an Technology Zone, No.555, North of Panyu Road,Panyu District,511400, Guangzhou City,China Tel: +86-20-22883930 Fax: +86-20-22883900 E-mail:info@zhdgps.com

Improving land administration systems in developing countries

Lessons learnt from the Cambodian land management and administration project (LMAP)

Jouni Johannes Anttonen, M.Sc. (Surv.)
FM-International Oy
FINNMAP Team Leader, Land Administration Sub Sector Programme (LASSP), Ministry of Land Management, Urban Planning and Construction (MLMUPC), Phnom Penh, Cambodia

Khmer Rouge and Vietnamese Communist Periods (1979–89)

During the ultra-communist Khmer Rouge regime (1975-79) in Cambodia, the private ownership of land was abolished and it remained unrecognized also during the following 10-year long Vietnamese-backed Communist government (1979-89). All land-related documents, including the land register, maps and geodetic networks were systematically destroyed as well as most professionals and educated people eliminated during the tragic 1975-79 period.

The *'Year Zero'* (1979) was cold reality in Cambodia, both on paper and in practice in the land sector as well as in each and every other sector of the society. Only from 1989 onwards, the private ownership of land was re-introduced in Cambodia after decades of turmoil, anarchy, confusion and collective ownership (Anttonen, 2006).

Re-introduction of Private Land Ownership (1989) and Sporadic Land Registration (1990)

After the end of Vietnamese occupation and re-introduction of private land ownership in 1989, in the early- and mid-1990's the Royal Government of Cambodia (RCG) made an effort for a large campaign of registering privately possessed land parcels, but soon turned out to be technically, financially and practically unable to process effectively and efficiently the 4.5 million registration applications filed in the Cadastral Offices countrywide through the then existing sporadic land registration system.

The sporadic land registration procedure and the whole land registration system turned out to be too complex, lengthy, over-centralized, over-bureaucratic and expensive, especially for the majority of Cambodians who are poor. In addition, the manual paper-based system was technically inaccurate, if not all, as most parcels lacked geo-reference and coordinates, i.e., proper cadastral surveys and maps, which had a potential to lead to overlapping land claims, overlapping parcel boundaries and consequently land disputes. Insecure land tenure surely was not to contribute to the social stability and economic development of, then still fragile, post-conflict country.

During the first 10 years of private land possession and ownership, only around 550,000 land parcels were registered by the Land Titles Department (until 1998) and the following newly established General Department of Cadastre and Geography (GDCG) of the Ministry of Land Management, Urban Planning and Construction (MLMUPC, from 1998 onwards). It was generally concluded that without more effective and efficient system for land registration, the Cambodian Cadastre was to remain far from complete for ages (Anttonen, 2006).

Start of European Donor Support for the Land Administration System (1995, 1997)

In mid-1990's, the Royal Government of Cambodia (RCG) requested the Governments of Germany (1995) and Finland (1997) to support the development of the Cambodian Land Administration system, focusing first as the priority on a suitable and affordable systematic land registration system that could be applied countrywide for an effective and efficient covering systematic land registration program. The requests from Cambodia were accepted by both European donor countries, which till date still remain as the key Development Partners (DP) for the development and implementation of the Land Administration system of the country. Being still some 30 years behind many other countries in the region in all development due to its unfortunate tragic recent history, Cambodia cannot afford to have an inefficient, ineffective, inaccurate and costly old-fashioned and outdated cadastral system. A need for a successful modern Cadastre, as defined by FIG (1995), in Cambodia was obvious, and the long-term patient work for it started virtually from scratch (Anttonen, 2006).

Pre-LMAP Projects supported by the Governments of Finland and Germany

In Cambodia, the Government of Finland through technical assistance (TA) by FMInternational Oy FINNMAP has supported the policy, legal and technical development and implementation of systematic, sporadic and subsequent land registration, modern digital multi-purpose cadastre and the whole Cambodian Land Administration system continuously since 1997, coordinated in close co-operation with the 1995-started Land Management Project (LMP) financed by the Government of Germany through GTZ. The history of the coordinated Finnish and German TA support includes briefly so far the following phases

with their main focuses and results *(In this paper, the Finnish support is highlighted more than the also very important German and later also Canadian support, but only due to the author's history and institutional memory as the Team Leader of TA Finland)*.

1997-1999: Cadastral Mapping and Land Registration Pilot Project (CMLRPP)

The very first two years of the Finnish support (CMLRPP 1997-99) to the Cambodian Land Administration focused on resource reviews in the fields of land policies, land registration and land legislation as well as the system development. Special attention was paid to the development of locally applicable cadastral surveying and mapping, digital Cadastre and systematic land registration as well as training of the Cambodian Cadastral Administration staff. The system development resulted in the establishment of a local cadastral GIS based on simple software and then already locally available technology, method for the systematic parcel-by-parcel land registration supported by digital orthophotos and field surveys and the drafting of its legal provisions for a Sub Decree. FINNMAP delivered the TA support for all above fields of legal and technical expertise. The initial number of the local Cambodian counterpart staff in this very first pilot project was only six (6) (CCP, 2002A).

2000-2002: Cambodia Cadastral Project (CCP) and Land Management Project (LMP)

The overall objective of the second phase of the Finnish support, known as Cambodia Cadastral Project (CCP 2000-2002), was to facilitate and accelerate the introduction of security of tenure on land creating a cornerstone for the rehabilitation of the fragile society of Cambodia. The purpose of the project was to introduce a fair and just land registration system benefiting the poor majority of Cambodians. CCP facilitated the land policy and land legislation development, including the final drafting and official adoption of the *Sub Decree* on systematic registration, finalized the first stage of the development of systematic land registration system, planned and demonstrated its countrywide application by establishing two provincial 'Sub Offices'(Takeo and Sihanoukville). for the implementation, training their local staff and launching the systematic registration work as well as helped improve the technical performance of the sporadic land registration and human resources and technical capacities of the Cambodian Cadastral Administration in general. Also other important topics such as land valuation, cost recovery and outsourcing, socio-economic aspects and public awareness promotion were focused on during this project phase. Apart from starting the concrete systematic registration work, the project facilitated the start of a larger systematic registration campaign by carrying out new aerial photography in selected areas likely to face systematic registration in the near future. Simultaneously, the German-supported LMP financed the implementation of systematic registration in two other provinces *(Kampot and Kompong Thom)*, so the total number of pre- LMAP provinces was four.

In general, the concrete policy and legal development in the Cambodian land sector was rapid during this project phase and clearly showed that the country was committed to putting the land issues in order after three decades of turmoil, confusion and anarchy. The drafted *Sub Decree on Establishing Cadastral Index Map and Land Register (Systematic Land Registration)* was adopted in March 2000 by the Council of Ministers (CoM). The three key areas of the Cambodian Land Policy (Land Administration, Management and Distribution) were identified in July 2000 and The *Council for Land Policy (CLP)* was established in December the same year. The *Statement of Royal Government on Land Policy* was passed in May 2001. The enactment of the long-prepared new *Land Law* took place finally in August 2001 and the necessary *Sub Decrees on Systematic* and *Sporadic Land Registration* and *Cadastral Commission (Land Dispute Resolution)* to effectively implement the Land Law were drafted and passed in May 2002. In 2002, also the *Strategy of Land Policy Framework* was finalized.

In this project phase, FINNMAP delivered TA for all the main sectors of the Land Administration work involved; land policy and legal development, aerial photography and orthophoto production, geodesy and land surveying, IT and GIS, media, land valuation, cost recovery, outsourcing and socio-economic studies. Also, the technical quality of sporadic surveys was improved by a countrywide Province Office Training (POT) program, including delivery of new surveying equipment to the provinces countrywide. In the end of this project phase, 83,500 parcels were in the systematic registration process in the four Finnish- and German-supported provinces. The number of the local Cambodian counterpart staff with the Finnish TA had now increased to around 60, including the central level (GDCG) and the two established provincial 'Sub Offices'. As noted above, it is highlighted that the Finnish-supported work was closely coordinated with the parallel German-supported Land Management Project (LMP) supported by GTZ from 1995, which apart from supporting systematic land registration focused also on land management issues. The Finnish- and German-supported projects together had a total of around 100 local staff implementing systematic land registration in four provinces.

The successful CCP and LMP project implementation, among others, and the development in the fields of land policy and land legislation encouraged the Royal Government of Cambodia (RCG) to apply a development credit from the World Bank (WB) and start the preparations for a big *Land Management and Administration Project (LMAP)*. By June 2002, the Governments of Cambodia, Finland and Germany with WB had prepared together a comprehensive, originally five-year multi-donor LMAP, which continued the started development work and expanded the implementation of systematic land registration activities from the four pilot provinces to 11 provinces/ municipalities *(Phnom Penh, Kandal, Takeo, Kampot, Sihanoukville, Kompong Speu, Battambang, Siem Reap, Kompong Thom, Kompong Cham, Prey Veng.)* out of the total of 24, covering a big part of the most populated and fertile areas as well as the most important land market areas of Cambodia (CCP, 2002B).

Introduction to the multi-donor land management and administration project (LMAP)

The multi-donor *Land Management and Administration Project (LMAP)* (2002-2008) was the first phase of the larger *Land Administration, Management, and Distribution Program* (LAMDP) of the Royal Government of Cambodia as defined in the 2001 *Statement on Land Policy* (RCG, 2001). The overall goals of LMAP were to reduce poverty, promote social stability and stimulate economic development. The specific objectives of the project were to improve land tenure security and promote the development of efficient land markets. These objectives were to be achieved through:

a) Development of national policies, regulatory framework and institutions for land administration;
b) Land registration and issuance of titles in urban and rural areas; and
c) Establishment of an efficient and transparent Land Administration system (LMAP, 2001).

LMAP was divided into five components:

Component 1 - Development of land policy and regulatory framework;
Component 2 - Institutional development;
Component 3 - Land titling program and development of a modern land registration system;
Component 4 - Strengthening mechanisms for land dispute resolution; and
Component 5 - Land management (LMAP, 2001).

Component 3 was the core of LMAP, under which most of the concrete activities were carried out and tangible results achieved.

The major investments and operating costs of systematic land registration were financed by the World Bank (IDA credit) and technical assistance (TA) to the project was provided by the Government of Finland (through FM-International Oy FINNMAP, Component 3) and the Government of Germany (through GTZ, Components 1, 2, 4 and 5). It has been recognized that although the project was divided into five Components and responsibilities of several development partners and TA teams, LMAP was the only project implemented by MLMUPC through its existing Central and Provincial Departments without establishing parallel separate project structures *(The Central Project Management Office (CPMO) was the only project-based structure to support LMAP.TS09L - Land Administration and Sustainable Development)* and all interlinked Components both supported and were depending on each other for the project to be successful as a whole. Especially Component 3, which performed the main role of LMAP, which depended also on the successful functioning of the other four Components (Anttonen, 2006).

> A modern digital Cadastral Database and Geodatabase system was developed locally and established to support effective and efficient systematic, sporadic and subsequent land registration

The Component 3: Land titling program and development of a modern land registration system was divided into four Subcomponents:

A. Information dissemination and community participation;
B. Systematic land titling program;
C. Sporadic land titling program; and
D. Development of a modern land registration system.

The two key performance indicators of Component 3 were '*Land titles are issued effectively and efficiently*' and the '*Land registration system is functioning well*'. Among the various output indicators, there were expectations that one million land parcels would be systematically registered in the original five-year project period and that the average cost of a land title would be less than US$ 30 (LMAP, 2001).

The Subcomponent D, '*Development of a modern land registration system*' was supporting the 'development of a sustainable, efficient, transparent and effective land registration system that would ensure the security of titles and transactions, full participation in registration of land transactions, and efficient service delivery'. That included *Review of land registration system and operational procedures; Improved office facilities, equipment furniture and materials; and Establishment of land registration database* (LMAP, 2001). This Subcomponent especially involved a great deal of both legal and technical development work supported by TA Finland. In addition, in 2006 MLMUPC strongly emphasized the importance of land registration for the development of Cambodia and publicly announced land registration to be the most important sector of the Ministry's work at the moment and in the future. The official targets in registration were declared by MLMUPC to be 32% of all parcels by 2010 and up to 65% by 2015 (MLMUPC, 2006). It is clear that this kind of goals can be achieved only by a successful and modern, effective and efficient cadastral system in place.

Summary of the results and achievements of LMAP

As a brief summary, the main measurable indicators, targets and goals of LMAP were achieved and exceeded by the end of the project in 2009. More than one million land parcels were systematically adjudicated and surveyed (result: 1,689,639) and more than 800,000 land titles issued (result: 1,296,735) effectively and efficiently at a record low cost of less than US$ 10 per parcel. For the systematic registration campaign, around 1,000 Cambodian cadastral officers were trained, equipped and supervised by GDCG and TA Finland's Advisors in 14 provinces and municipalities to implement systematic land registration at the speed of 25,000-30,000 parcels per month, according to the developed and continuously improved comprehensive Land Registration Team (LRT) Manual. In addition, more than 8,000 Administrative Commission (AC) members were trained for legal local-level decision-making in land registration.

S320™

GNSS Survey Receiver Solution

Built Surveyor Tough

Includes:

XF2™ Data Collector

Carlson SurvCE Data Collection Software

Whether you are doing GIS, Construction, Mapping, Land or Marine Surveying, **Hemisphere GPS'** (now ***Hemisphere GNSS***) **S320™** can be tailored to your exact requirements.

SMS RTK & Texting • GNSS Configurable • SureTrack™ Intelligence • GSM Auto Corrections • 10-Hours Hot Swappable Battery Life • Includes XF2™ Data Collector and Carlson SurvCE Data Collection Software

www.S320Surveyor.com • Precision@HemisphereGPS.com

Hemisphere GPS®

Around 5,000 geodetic ground control points for cadastral surveying and orthophoto production were established. Around 60,000 sqkm of digital orthophotos were locally produced with the established modern digital orthophoto production line and also more than 190,000 sqkm of produced and procured orthophotos were quality controlled under the project.

To support the systematic land registration, a successful Public Awareness and Community Participation (PACP) and information dissemination concept was developed and established, resulting in the high landowners' participation rate of more than 99% in the systematic registration.

A modern digital Cadastral Database and Geodatabase system was developed locally and established to support effective and efficient systematic, sporadic and subsequent land registration and continues to be developed further according to the official legal and technical requirements.

The necessary land-related policies and regulatory framework were developed and established to officialize and legalize the development, establishment and implementation of the land titling program, modern land registration system and improving the whole Cambodian land administration system.

Institutional development resulted in the establishment of the new Faculty of Land Management and Administration (FLMA) at the Royal University of Agriculture (RUA) for increasing human resources for the whole land sector. By the end of LMAP, 150 new generation B.Sc's had graduated from the faculty and 199 were studying. MLMUPC recruited 74 of them to the Ministry, mainly to join the Land Registration Teams (LRTs). Lessons learnt, team building and training workshops, on-the-job and hands-on training, international study tours and continuous supervision and monitoring played an important role in the capacity building of the local cadastral staff. Mechanisms for land dispute resolution were strengthened by supporting the Cadastral Commissions (CC) in out-of-court dispute resolution. During LMAP, around 3,500 CC members were trained and 3,730 land disputes solved by them (LMAP, 2011).

The lessons learnt from the LMAP design and implementation are discussed briefly below.

Lessons learnt from the lmap design

Project Design Process

It can be concluded in general, that the design process of LMAP was well-coordinated in good co-operation between RGC, MLMUPC, WB and the Governments of Finland and Germany. Even years before the *Paris Declaration on Aid Effectiveness* (Paris, 2005), all development partners coordinated and agreed among themselves their planned inputs in order to avoid any overlapping and fill gaps in their support to the project (LMAP, 2011). While WB provided mainly the financing for major investments and operating costs of land registration, Governments of Finland and Germany (and later also Canada) provided technical assistance (TA) to the development and implementation of the various Components according to the agreed division of labor in the Project Appraisal Document (PAD) (LMAP, 2001).

LMAP built strongly on the legal and technical development, piloting, implementation and experiences of the two parallel and coordinated pre-LMAP land registration pilot projects supported by Finland (1997-2002) and Germany (1995-2002), expanding the coverage of systematic land registration and extending the scope of the work, so LMAP definitely did not start from the very scratch. This was a great advantage for continuing the improvement of the Cambodian land administration system under LMAP (CCP, 2002A, CCP, 2002AB).

Project Design in PAD

The final design of the five-Component project can also be concluded to be mostly appropriate and successful. Development and establishment of land policy and regulatory framework (Component 1) and institutional development (Component 2) were essential for the implementation of land titling program and development of a modern land registration system (Component 3).

Strengthening mechanisms for land dispute resolution (Component 4) was important for increasing the social stability and solving the remaining disputes after the systematic land registration process and disputes outside systematic adjudication areas. Land management (Component 5) was needed to support land registration/titling for clarifying the existing main land use and tentative land classification in the systematic adjudication areas. During the Mid-Term Review (MTR) mission, no major changes were seen necessary to the LMAP design neither by the Development Partners nor the Cambodian Government (LMAP, 2005, LMAP, 2011).

Indicators

However, while the achievement of PAD's quantitative indicators (land titling numbers and costs) were clear and easy to measure and monitor, some established indicators turned out to be much too abstract, unrealistic and impossible to measure. Some even fell outside the scope of land administration (agriculture) and in many cases, totally lacked the baseline data to compare with (investments, land disputes, land grabbing).

In the future land administration projects, more attention shall be put on more realistic and measurable indicators to be adopted, followed and monitored (LMAP, 2011).

Weakness of the Project Design

While the LMAP design covered most of the above key areas of the Land Administration Sub Sector, one important Component was left out by the project designers for one reason or another: Land valuation. By the end of LMAP, it had become clear that the lack of official land valuation system in Cambodia hinders official registration of land transactions and most landowners still prefer informal transactions in the absence of clear, fair, justified and transparent basis for transfer taxation and cadastral fees. For the technical and financial sustainability of the land registration system, development and establishment of an official land valuation system is now an urgent task. Finally from 2008 onwards, the Government of Canada started to support MLMUPC in this important work (LASSP, 2008, LASSP, 2010).

Lessons learnt from the LMAP implementation

General Project Implementation

Concrete and sustainable results in development co-operation through donor financing and technical assistance (TA) can be achieved with the recipient Government's leadership and full commitment, proper coordination and close co-operation with all donors and other stakeholders involved and by developing systems step-by-step based on real local conditions and circumstances, requirements, needs and capacities.

The implementation of LMAP through the existing MLMUPC Departments without creating parallel project structures *(The Central Project Management Office (CPMO) was the only project-based structure to support LMAP.)* strengthened the Ministry, its human resources, technical capacities and implementation of the land administration activities (Anttonen, 2010, LMAP, 2011).

Work Planning, Reporting and Supervision

In the multi-donor LMAP, the established unified system for work planning, reporting and supervision was an effective and successful concept in general. One LMAP Annual Work Plan (AWP) combined all Components' activities and Development Partners' (DPs) and MLMUPC's planned inputs. Quarterly and annually, one LMAP report combined all Components' results, achievements and financial information. Semi-annually one common multi-donor supervision mission monitored and supervised the project, resulting in one common Aide Memoire and agreed Action Plan.

If all Development Partners (DPs) had their own separate planning, reporting and supervision systems, it would have created an impossible situation to MLMUPC where much of the local counterparts' capacity, time and effort would have been wasted for unnecessary and uncoordinated bureaucracy, instead of effective project implementation (LMAP, 2011).

However, one major issue remained through LMAP, that project supervision could have been more effective, especially from the major financer, WB side. During LMAP, there were three different WB Task Team Leaders with quite different views on the project and its implementation. In addition, the WB consultants hired for the supervision usually changed from supervision mission to supervision mission. So there were seldom experts who had longer experience and wider understanding of the project, its issues and who could have had more fruitful inputs to help improve the project performance. In addition, WB carried out also other missions to LMAP, like the Enhanced Review Mission (ERM) shortly after one official supervision mission, which was experienced more or less confusing at least from the project implementors' point of view (LMAP, 2011).

Financing, Budgets and Procurement

Certain flexibility in the TA project budgets is required to meet the real needs, new challenges and rapid changes in the dynamic project implementation environment in Cambodia, especially in a project where the main financing is being done or supposed to be done through the complex, rigid and lengthy procurement procedures of WB.

During the sudden *unilateral* suspension by WB without prior notice neither to LMAP nor the other Development Partners (DP), it was extremely important that other DPs were able to fill the most urgent and necessary financing gaps for the continuation of the important project work. Due to the WB decisions, indecisions and its procurement procedures, e.g., new aerial photography and orthophoto production seasons were lost many times, which increased the amount of fieldwork and consequently the duration and costs of land registration. Also, the established Independent Procurement Agent (IPA) turned out to be mostly incapable of supporting LMAP in major procurement tasks (LMAP, 2011). For example, even though it was clearly agreed and reported during an LMAP supervision mission to replace the old malfunctioning computers and survey equipment as a top priority for the technical sustainability and performance of the project, no objection from WB and consequently no procurement took place during the last year of the project (WB, 2009).

Technical Assistance (TA)

An important lesson learnt is that committed long-term locally based technical assistance (TA) is essential for effective and sustainable transfer of knowledge from the technical advisors to the local counterparts (Anttonen, 2010, LMAP, 2011). With a TA concept of only short-term advisor missions, it is very difficult if not impossible, to achieve concrete and sustainable results. It can be concluded that at the LMAP project design, in Component 3 – Land Titling Program and Development of a Modern Land Registration System, TA for e.g., IT/GIS and modern surveying technology was clearly underestimated, but fortunately the needed additional advisor inputs could be arranged within the TA Finland budget. This also included the legal advisory in Component 3 scope, which turned out to be an essential and successful concept for ensuring the drafting of all necessary legal framework for the development and establishment of the land registration and whole land administration system.

Public Awareness and Community Participation (PACP) and Public Relations (PR)

The information dissemination and mobilisation of the landowners as well as training of the local legal decision-makers on land registration (Administrative Commissions) was highly successful internally for supporting the systematic land registration in LMAP. This resulted in a high landowners' participation rate of more than 99%. However, much more attention should have been paid to the project's external public awareness and public relations (PR) especially to the public, local mass media and NGOs, in order to avoid harmful misunderstandings about LMAP's scope and mandate (LMAP, 2011).

Systematic Land Registration

The established performance-based and team-based payment system with separate quality control (QC) mechanism turned out to be encouraging for the Land Registration Teams (LRTs) for achieving the quantitative registration targets of one million parcels of the project.

Decentralization and de-concentration of the legal mandate and responsibilities in land registration from the central to the provincial level made the land registration process much more effective, efficient and faster than before LMAP.

Utilizing modern digital orthophoto, surveying and information technology (IT) from the very beginning in land registration supports cost-effective and accurate land registration, reduces human errors and eliminates the need for lengthy, complex and expensive digitalization campaigns in the future as well as supports quality control of the legal and technical land information (LMAP, 2011).

Aerial Photography and Orthophoto Production

The establishment of a modern digital orthophoto production line at MLMUPC enabled the smooth local production of orthophotos for land registration and land management from the existing aerial photography according to the needs. Orthophoto interpretation has turned out to be a simple, easy and cheap method for parcel boundary identification and demarcation in rural areas.

Procurement of new aerial photography for up-to-date orthophoto maps, however, succeeded only once in LMAP, while the short annual photography season (December-February) was lost many times due to the WB's complex and slow procurement process or the suspension, even though all bidding documents were always prepared on time by the project (LMAP, 2011). Fortunately, Cambodia has a reasonably good reserve of aerial photography around the country, which could be used for orthophoto production in areas where new photography failed. Orthophotos are important also for the public display of adjudication records, where the landowners have to be able to identify their parcels for checking their data.

The open, public and transparent systematic land registration procedure has turned out to be successful in solving most of the land disputes already during the fieldwork, public display or the conciliation by the Administrative Commission

Cadastral Surveying and Mapping

Accuracy is money**.** The established cadastral survey accuracy standards for land registration in LMAP were concluded to be appropriate and reflected the land values in rural and urban areas. In rural areas, orthophoto interpretation in the field and digitizing boundaries from digital orthophotos in the office, supported by tape measurements and also total station surveys where orthophoto could not be used due to tree coverage or outdated orthophotos, meets well the accuracy requirements of first registration. In urban areas, where land values are high, total station surveys have to be carried out for the better accuracy requirements (LMAP, 2011).

Development of a Modern Land Registration System

According to the contemporary international standards, a modern land registration system is based on digital technology (FIG, 1995, FIG, 1998, Holstein, 1996). However, in a developing country like Cambodia it is essential that the system development has been based on local needs, official requirements and capacities, and can be developed and maintained locally according to the new legal and technical requirements and the available human resources.

The IT/GIS development work is continuous in Cambodia, so there does not exist any ready software that could be brought from outside the country. All countries' cadastral requirements are different, so any software must be customized to the local needs anyway. After LMAP, it has been proposed to move from commercial software to free open source software, which will not be a burden to the budget, will eliminate the dependency of only one commercial producer and can be developed further (LMAP, 2011).

Subsequent Land Registration

For the technical and financial sustainability of the cadastral system, the rate of official, formal registration vs., informal registration of land transactions shall be increased. For this, increased effort shall be put on public awareness on the legal roles, responsibilities and duties of the landowners, benefits of official land registration and making cadastral services more attractive and affordable for landowners by improving the cadastral service delivery. As mentioned above, at the project design, land valuation should clearly have been included in the scope of LMAP for supporting subsequent registration by clear, transparent and fair land-related taxation and cadastral fees (LMAP, 2011).

Land Dispute Resolution

The open, public and transparent systematic land registration procedure has turned out to be successful in solving most of the land disputes already during the fieldwork, public display or the conciliation by the Administrative Commission (AC). As a result, the number of cases remaining to be solved by the National Cadastral Commission (NCC) after the systematic registration remained very low (0.2-0.3 %) compared to all land disputes.

In LMAP, Cadastral Commissions (CC) focused mainly on dispute resolution outside systematic registration areas, but at the end of the project, a backlog of cases still remains to be resolved. The project designers are argued by MLMUPC to have had an "*unrealistic view of what the Cadastral Commissions could achieve during the project. There also was a failure to consider what the project as a whole was achieving in the area of land dispute resolution, meaning including the systematic land registration procedure itself and the ACs, which turned out to be able to solve 90% of land disputes successfully already during the registration process*" (LMAP, 2011).

Land Management

While systematic land registration produces valuable base data on land, land use and landownership for land management and land use planning, the lack of official clear land management and land use planning system in many cases hinders and slows down systematic registration, especially in urban areas without clear official land use plans and e.g., road corridors and other state land areas.

In LMAP, the implementation of the Component 5 – Land Management remained weak through the project and could not support the land registration as originally planned. However, in Land Registration Teams (LRTs), a Land Management Officer's post was established for clarifying the administrative boundaries, main land use, private and state land areas and existing land disputes for effective work planning and implementation of the LRTs. In the future, more effort shall be put on developing and strengthening land management activities to support land registration and establishing official linkages between land administration and land registration (LMAP, 2011).

LMAP's Scope, Role and Mandate in Land Administration vs., the Issues and Challenges of the Whole Land Sector

During the project implementation, there were cases in one municipality, capital city Phnom Penh, where forced evictions and following resettlement activities took place due to some urban areas' development projects and these cases were tried to be linked to LMAP in mass media, NGO reporting and also by WB itself. However, informal and illegal settlements, evictions and resettlement issues were neither within the scope of LMAP nor budget, and not within the legal mandate of MLMUPC. The occurred eviction cases were not primarily land registration and land administration issues, but mainly related to issues of Phnom Penh municipality's land management and urban planning, plan implementation, expropriation, land valuation and compensation, which were out of the official scope of LMAP. One case brought up by NGOs launched WB's Inspection Panel (IP), but MLMUPC/LMAP strongly stated and justified that LMAP followed strictly WB's Project Appraisal Document (PAD) and the Cambodian legislation, and the mentioned case is not legally linked to LMAP (MLMUPC, 2011). An important lesson learnt in this is that in the future, more effort shall be put to all land administration projects' external PR to the general public, media, civil society and NGOs in order not to

confuse the scope and mandate of the land administration project and the multiple, undeniably difficult issues and challenges of the complex land sector as a whole.

Conclusion

From project to program, from 'donorship' to ownership

Successful technical assistance (TA) and other support from Development Partners for sustainable knowledge and technology transfer and concrete results and impacts must be based on real local needs, local requirements and local capacities, mutual trust and understanding and be culture-sensitive, building heavily on the history, traditions and systems of the recipient country of the foreign aid (Anttonen, 2010). Exporting often inflexible western theories to dynamic eastern realities can easily be counter-productive, if done ignoring the local project implementation environment.

It is also clear that strong local ownership and commitment with proper coordination, cooperation and real team work with all land sector stakeholders and various Development Partners involved (In Cambodia, Technical Working Group on Land (TWG-L) coordinates donor efforts in the land sector.) is essential to maximize benefits, avoid overlapping and minimize the waste of effort, time, money and general confusion in the land sector.

By the end of LMAP, Cambodia started to be ready to move from a project to a program, from 'donorship' to real local ownership, to move further from vision to action, from action to results and from results to real impact for the social and economic development of the country. The Cambodian Government designed, led and mostly self-financed the next phase after LMAP, the on-going multi-donor Land Administration Sub Sector Programme (LASSP 2009-2012) which reflects this positive development in line with the *Paris Declaration on Enhancing Aid Effectiveness* (Anttonen, 2010, Paris, 2005).

Exporting often inflexible western theories to dynamic eastern realities can easily be counter-productive, if done ignoring the local project implementation environment

References

anttonen, 2006. Anttonen, Jouni. *Can a Successful Modern Cadastre Be Developed in South*-East Asian Developing Countries? - South-East Asian Experience with the Focus on *Cambodia*.

Anttonen, 2010. Anttonen, Jouni. *Successful Capacity Building of the Cambodian Land* Administration – Finnish Technical Assistance Combined With Local Khmer Expertise, Traditions and Culture.

CCP, 2002A. Anttonen, Jouni. *Combined Final Report of the Cambodia Cadastral Project (CCP) 2000-2002*.

CCP, 2002B. Anttonen, Jouni. *Combined Final Report of the Pre-Implementation Phase of* the Land Management and Administration Project (LMAP), November 2001-May 2002.

FIG, 1995. International Federation of Surveyors (FIG). *FIG Statement on the Cadastre*. FIG, 1998. International Federation of Surveyors (FIG). *Cadastre 2014: A Vision for a Future Cadastral System*. Kaufmann, Jürgen.-Steudler, Daniel.

Holstein, 1996. Holstein, Lynn. *Towards Best Practice From World Bank Experience in Land* Titling and Registration. LASSP, 2008. Land Administration Sub Sector Programme (LASSP). *Outline for LASSP* 2009-2012.

LASSP, 2010. Land Administration Sub Sector Programme (LASSP). *Reviewed Outline for LASSP 2009-2012*.

LMAP, 2001. Land Management and Administration Project (LMAP). *Project Appraisal Document (PAD)*.

LMAP, 2005. Land Management and Administration Project (LMAP). *Mid-TermReview Report*.

LMAP, 2011. Land Management and Administration Project (LMAP). Ministry of Land Management, Urban Planning and Construction (MLMUPC). *Borrower's Implementation* Completion Report (ICR) of LMAP. MLMUPC, 2006. Ministry of Land Management, Urban Planning and Construction (MLMUPC). *Annual Report on the 2005 Results and Achievements and Next Steps for 2006*.

MLMUPC, 2011. Ministry of Land Management, Urban Planning and Construction (MLMUPC). *Boeng Kak Is Not Legally Linked To LMAP, Safeguards Were Not Triggered For Boeng Kak*. Press Release by MLMUPC, March 2011.

Paris, 2005. *Paris Declaration on Enhancing Aid Effectiveness – Harmonisation, Alignment, Ownership, Mutual Accountability and Managing for Results.*

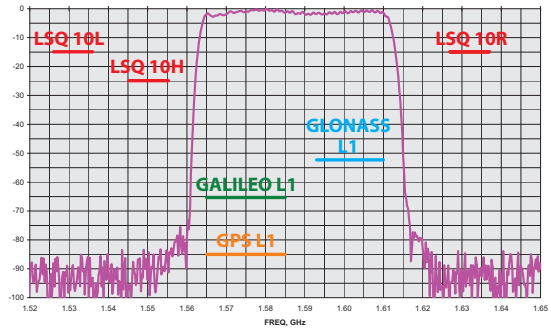
RCG, 2001. Royal Government of Cambodia. *Statement of the Royal Government on Land Policy*.

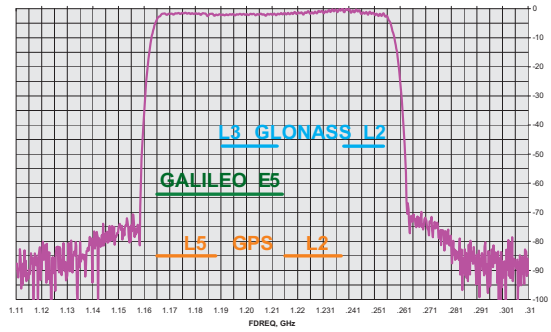
RCG, 2009. Royal Government of Cambodia. *Declaration of the Royal Government on Land Policy.*

WB, 2009. The World Bank. *Aide Memoire of the 11th LMAP Multi-Donor Supervision Mission, January 2009*.

Note that the opinions in this paper are those of the author's only and do not necessarily reflect those of the Governments, Development Partners, companies and other agencies involved in the project.

J-shield “Don’t Worry! … Be Happy!”





Don’t worry if FCC ever authorizes any broadband wireless near GPS L1 band. We already have proven technology to protect not only against this particular one, but against all similar systems in all GNSS bands. It is implemented and fully tested option in our GNSS antennas. Our nation can have full benefits of high precision GNSS (no performance degradation at all) and full benefits of broadband wireless.

Those who cannot innovate in Silicon Valley, lobby in Washington DC by misinforming the FCC and the Congress about the status of technology and about the status of existing receivers in the field.

TRIUMPH-1

Fully integrated package

An elegant, rugged, light, and hermetically sealed box accommodates **all GNSS and modem electronics and antennas.**

Spectrum

The unique

spectrum analysis

and

interference

detection/protection

features in our

GNSS receivers.

Visual Stakeout

Target point itself

View your target point on the
TRIUMPH-VS screen
and **walk towards it**
to stake it.

Each of our

6 Parallel RTK Engines

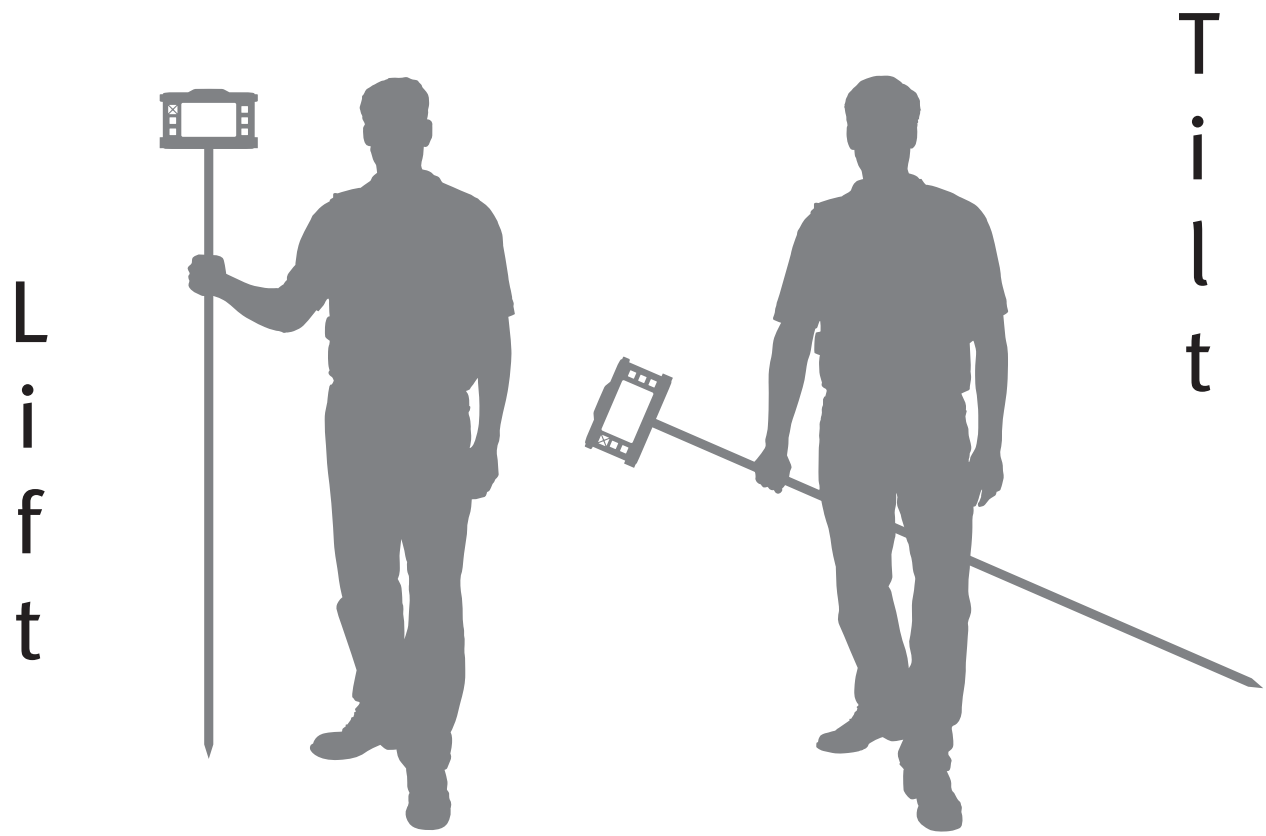
employs different algorithms
to calculate solutions

and

the weighted average of them
provides the **most robust, accurate**
and **fastest** results.

Survey with Lift&Tilt

You don’t need to look.
You don’t need to touch.



TRIUMPH-VS brings this new

revolution to surveyors

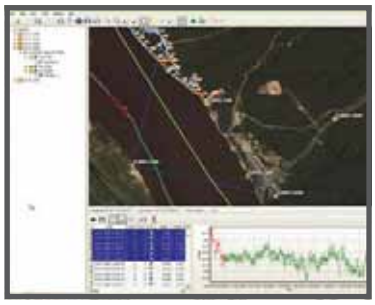
All-in-one

TRIUMPH-VS

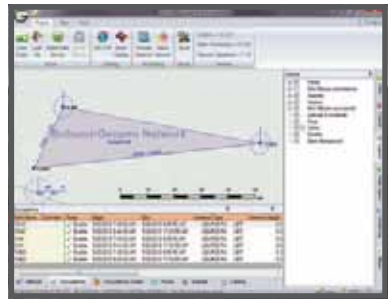
GNSS receiver that combines high performance **216-channel GNSS receiver,** all-frequency **GNSS antenna,** and a modern featured **handheld.**

Software

Complete software suite for survey, GIS and control.



Justin has full range of features for geodetic and surveying tasks.



Giodis is a sophisticated and easy to use geodetic software.

NetView is an application to easily control JAVAD GNSS receivers.

NetHub is a Windows® application for controlling GNSS receivers developed by JAVAD GNSS, INC.

see the latest at www.javad.com

Geodynamical study of the territory of Balkan peninsula

Geodynamic investigations have been accomplished on the base of GPS data of all free available GNSS permanent stations on the territory of the Balkan Peninsula within the time of four and five years in winter, spring summer and autumn seasons

Keranka Vassileva
National Institute of Geophysics, Geodesy and Geography, Bulgarian Academy of Sciences, Bulgarian

The territory of the Balkan Peninsula (BP) is one of the most active geodynamical regions in Europe. Numbers of publications are devoted to this problem. An important indicator in geodynamical point of view is an eventual station movement of GNSS network stations. Determination of the size and direction of the vectors of movement, their analysis and assessment is of significant importance for their further interpretation with a view to present the geodynamical picture of the region.

The purpose of the present study is a complete analysis and generalization of the behaviour of GNSS permanent stations on the territory of the Balkan Peninsula in all four seasons. This is the final step of the study of the seasonal movements of GNSS BP permanent stations. The investigated period covers the time span from 2006 till 2010. GPS one week data from free available GNSS permanent stations on the territory of the Balkans have been used in each season within each year. Station velocity vectors have been estimated from combined solutions for every season with Bernese software, Version 5.0. The estimated seasonal horizontal velocity vectors have been compared and analyzed. They have been also compared with results from other investigations.

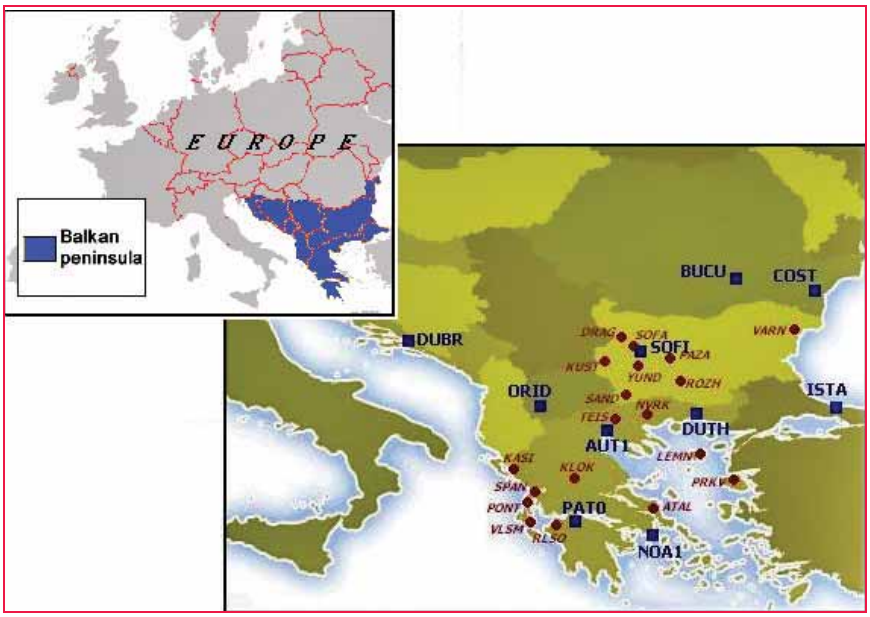


Figure 1: Location of the Balkan Peninsula GNSS permanent stations involved

Seasonal solutions

The geodynamic investigations have been accomplished by using GPS data from all free available GNSS permanent stations on the territory of the Balkan Peninsula within the time between 2006 and 2010. The stations are equipped with different types of receivers and antennas and for some of them the receiver or antenna have been changed within the period of the investigation. Location of the Balkan Peninsula permanent stations is shown in *Figure 1*. The number of Balkan Peninsula permanent stations increased during this period of five years from 6 in 2006 up to 29 in 2010.

Data from the same weeks of the respective season of the involved years have been used by the reason of comparability. The same general input parameters have been introduced in data processing of all weekly solutions and possibly almost the same IGS stations have been included for datum definition in all combined solutions. Station

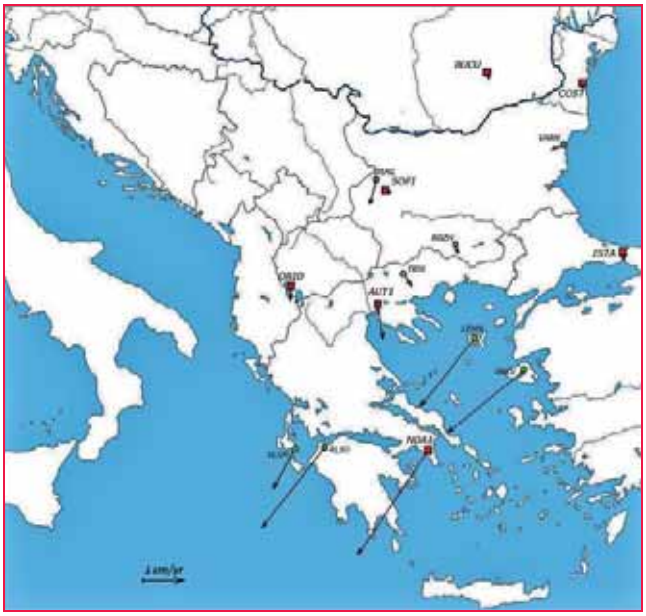


Figure 2: BP horizontal station velocity vectors in winter time with respect to the stable part of Eurasia

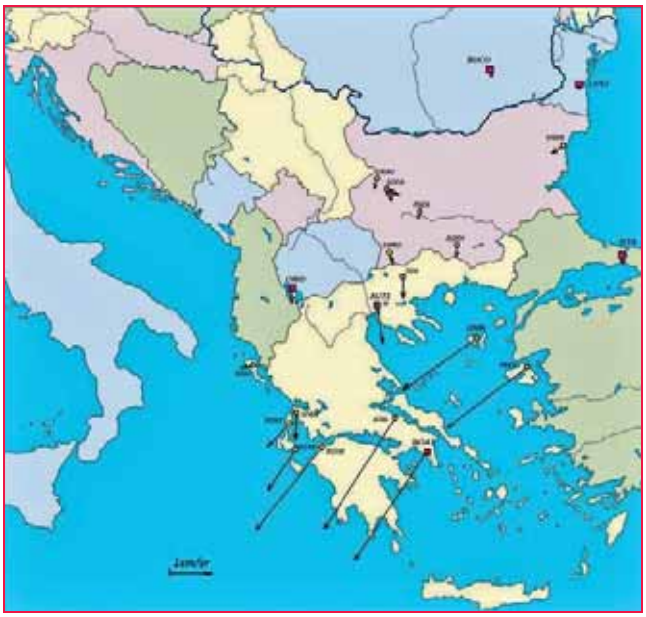


Figure 3: BP horizontal station velocity vectors in spring time with respect to the stable part of Eurasia

Figure 4: BP horizontal station velocity vectors in summer time with respect to the stable part of Eurasia

velocity vectors have been estimated in ITRF2005 from combined solutions of the particular four seasonal solutions.

Winter solution

GPS weekly data in January from four years – 2006, 2007, 2008 and 2009 of 18 GNSS stations have been processed. Estimations of station velocities have been obtained and analysis and comparison of the results has been accomplished [Vassileva, 2009b]. The obtained IRF2005 estimations of the velocity vectors are consistent with the IRF2005/EPN/CEGRN long-term velocity estimations within 1-2 mm/yr in all three components V_X, V_Y, V_Z. ETRF horizontal velocity vectors have been also obtained by using ETRF components of the Eurasia plate rotation pole to the obtained ITRF velocity vectors [*Boucher, Altamimi, 2008*].

Spring solution

GPS weekly data in April from four years – 2006, 2007, 2008 and 2009 of 21 GNSS stations have been processed and analyzed [*Vassileva, 2010*]. The spring velocity estimations obtained from all four years combined solution have been compared with the results from IRF2005/EPN/CEGRN long-term annual solutions. Comparison of the velocity estimations of the Balkan Peninsula stations shows differences within 0,1÷2,5 mm/yr with some exceptions. Higher discrepancies for some stations can be explained with shorter observation time span (only two years) and also with number of equipment alterations and subsequent offsets.

ETRF horizontal velocity vectors of the stations have been also obtained (*Figure 3*).

Summer solution

GPS one week data in July of 29 GNSS stations on the territory of the Balkans have been used. They cover a time span within five years – 2006, 2007, 2008, 2009 and 2010. Individual year solutions have been combined and station velocity estimations have been obtained. Results have been compared and analyzed [*Vassileva, 2011*]. All possible three and four years combinations and total five years solution of the obtained weekly solutions in 2006, 2007, 2008, 2009 and 2010 have been processed and station velocity estimations have been obtained in the system ITF2005. Velocity estimations in North and East components of all combinations show very good agreement. In Up component

Effective

X91 GNSS - The industry's performance and reliability standard

- ***TRACKING EVERY SIGNAL AND EVERY SATELLITE***
  Advanced 220-channel GNSS technology for state-of-the-art RTK accuracy and reliability
- ***FLEXIBLE AND SCALABLE***
  Internal UHF and Cellular data modems; bundled with Carlson SurvCE or CHC Landstar field software
- ***EFFICIENT***
  Small, lightweight and rugged design for the most demanding field work
- ***SUPPORT***
  Worldwide network of local service centers and dealers

www.chcnav.com

Figure 5: BP horizontal station velocity vectors in autumn with respect to the stable part of Eurasia

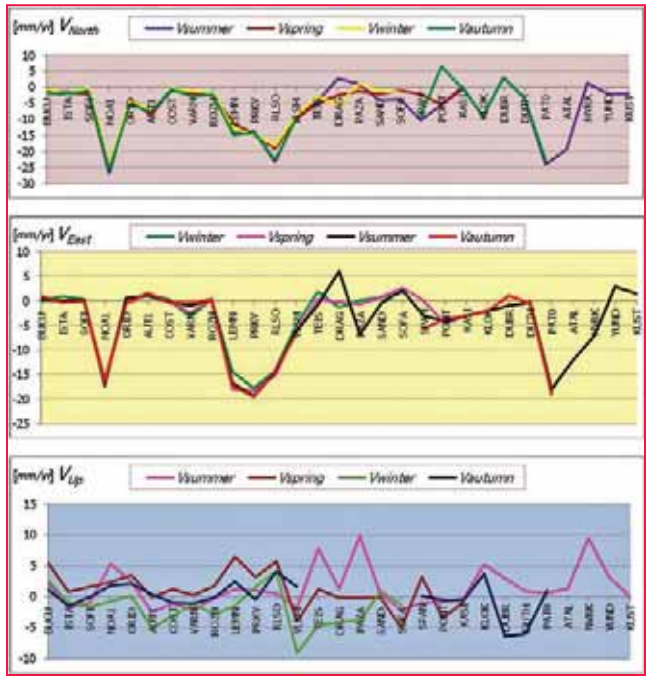


Figure 6: Comparison of ETRF2000 seasonal BP station velocity vectors in North, East and Up components

discrepancies are about 2 mm/yr and they can be considered mostly as impact of local phenomena. Only for stations LEMN, PRKV and VLSM differences are higher although their results are from four years. ETRF horizontal velocity vectors have been also obtained (*Figure 4*).

After analyzing the results from all combinations as most reliable velocity estimations have been accepted the estimations obtained from all five years observations. The obtained velocity estimations agree very well with results from other investigations [*Stangl et al., 2008*], [*Caporali et al., 2009, 2011*], [*Hefti, Igondova, 2009*], [*Becker et al, 2010]*.

Autumn solution

GPS one week data in October of GNSS stations on the territory of the Balkans have been used. They cover a time span within five years – from 2006 up to 2010. The total number of participated stations increased from 20 in 2006 up to 40 in 2010 including IGS/EPN stations. Eight Balkan Peninsula stations participated only in one year - BURG, DRAG, LOVE, MONT, NIS_, SHUM, STAR, YUND as they are very yang stations, which started operating in 2009. Seven stations – DUTH, KUST, NVRK, PAZA, PAT0, SAND and SOFA participated only in two years. All possible three and four years combinations and total five years solution of the obtained weekly solutions in 2006, 2007, 2008, 2009 and 2010 have been processed and station velocity estimations have been obtained in the system ITF2005. Results have been compared and analyzed [*Vassileva, 2012*].

The reduced horizontal velocities of the Balkan Peninsula stations to the stable Eurasia plate have been also obtained (*Figure 5*).

Velocity vectors have been estimated only for stations for which observations have been available in three and more years. The estimations agree very well with results from other investigations [*Hefti, Igondova, 2009*], [*http://www.epncb.oma.be/_dataproducts/products/timeseriesanalysis*], [*Milev et al., 2010*] [*http://itrf.ensg.ign.fr/ITRF_solutions*].

In all four seasons the main directions of the movement of all Bulgarian stations are south-east and they are in agreement with other investigations of this region [*Stangl et al., 2008*], [*Milev et al., 2010*], [Stangl, 2011]. The main direction of the movement of the most Greek stations is south-west and for some stations (LEMN, PRKV, ATAL, NOA1, PAT0, RLSO) the velocity gets to 20÷30 mm/y and they also agree with results from other investigations [*Stangl et al., 2008*], [*Caporali et al., 2009*], [*Hefti, Igondova, 2009*], *[Becker et al., 2010*].

Analysis of the seasonal solutions

The total number of participated stations is increased from 17 in 2006 up to 40 (including IGS/EPN stations) in 2010. 29 of them are located on the territory of the Balkan Peninsula. The velocity estimations are obtained in IRTF2005. The BP station velocity vectors relative to the Eurasia plate have been obtained taking into account the recommendations of the EUREF Technical Working Group [*Boucher, Altamimi, 2008*]. First the IRTF2005 velocity vectors have been transformed into ITRF2000 and then into ETRF2000. The ETRF2000 results in North, East and Up components are compared and shown in *Figure 6* for all four seasons.

Comparison of the velocity estimations in North and East components shows identical results for stations which are

Figure 7: Horizontal velocity vectors of BP stations in winter, spring, summer and autumn time

observed in all seasons and in every year within the respective season. Variations of the values in both components are within 0,3÷2,5 mm/yr. The main reason for the discrepancies could be explained with the slightly different datums used in the processing of the seasonal data and not with the seasonal variations. Six IGS stations have been used in winter and spring data processing, and three more stations have been used in summer and autumn data processing. Another reason for higher discrepancies obtained could be the short time interval of station data participated in the processing. Some young stations (KLOK, PAT0, ATAL, DRAG, YUND) participated within the every season only with two year's data or only in one or two seasons. Data availability is four and five years for the majority of the stations.

As it is expected the discrepancies in Up component are 3÷5 times higher than the discrepancies in North and East components.

ETRF2000 horizontal velocity vectors of BP stations have been also obtained for all four seasons and their trend is shown in *Figure 7*. The magnitude of the horizontal velocity vectors within the four seasons are kept the same for most of the stations (*Figure* 7). Only for some stations with two years data availability or for young stations directions agree not quite well.

The consistency of seasonal estimates of horizontal vectors is better than 0,2÷0,6 mm/yr for stations with small movements. Usually significant periodical seasonal variations are local phenomena with respect to the antenna monumentation, multipath and troposphere effects. Therefore it can be assumed that for the investigated period there is no significant impact of the seasonal variations on stations behavior and their movements are smooth and undisturbed within the four seasons. Higher differences of about 2,5÷4,0 mm/yr are obtained for stations with larger movements of about 10÷30 mm/yr (NOA1, LEMN, RLSO). The higher velocity differences obtained for stations DRAG, SAND, SOFA and TEIS cannot be assumed as effect of seasonal variations due to the shorter time span of observations within the seasons - only two years. Several stations are very young (ATAL, DUTH, KLOK, NVRK, PAT0) and their velocities are estimated only from processing of summer or autumn data and therefore they are not reliable.

Obtained velocity estimations from this study have been compared with available results from other data processings. Generally, components of the velocity

vectors or horizontal velocity vectors themselves agreWWe quite well. Nevertheless such a direct comparison is not a quite reliable approach for confirmation of the estimated velocities because different datum definitions and/or different ETRF realizations in GNSS data processing are used by different GNSS analysis centers or authors.

Conclusion

Geodynamic investigations have been accomplished on the base of GPS data of all free available GNSS permanent stations on the territory of the Balkan Peninsula within the time of four and five years in winter, spring summer and autumn seasons. The obtained velocity estimations agree very well with the ITRF2005 velocities within the particular seasons with some exceptions. Analysis of the obtained horizontal station velocity vectors relative to the Eurasia plate shows smooth, undisturbed linear trend of movement and it can be assumed that there is no significant seasonal impact on the station movements during the all seasons. Dominate linear motion is the behavior of the majority of the stations within all seasons. It is the reason to conclude that velocity estimations obtained from one week solutions in four or in five years time span are adequate with estimations obtained from long-term permanent observations. In case of non-permanently observed GNSS points this approach of estimation of horizontal station velocities shows reliable results which can be used for further geodynamical analysis and interpretations in other related geosciences.

Reference

Becker M., Caporali A., Stangl G., and the CEGRN Team. (2010). Update from Central Europe - The Improved Velocity Field from CEGRN Campaigns till 2009 and New Central European Research Initiatives. 15th General Assembly of WEGENER, 14-17 September, 2010, Istanbul, Turkey

Boucher, C., Z. Altamimi. (2008). Memo: Specifications for reference frame fixing in the analysis of a EUREF GPS campaign.

Caporali, A., C. Aichhorn, M. Barlik, M. Becker, I. Fejes, L. Gerhatova, D. Ghitau, G. Grenerczy, J. Hefti, S. Krauss, D. Medak, G. Milev, M. Mojzes, M. Mulic, A. Nardo, P. Pesec, T. Rus, J. Simek, J. Sledzinski, M. Solaric, G. Stangl, B. Stopar, F. Vespe, G. Virag. (2009). Surface kinematics in the Alpine-Carpathian–Dinaric and Balkan region inferred from a new multi-network GPS combination solution, Tectonophysics 474, 295–321.

Caporali, A., M. Barlik, M. Becker, L. Gerhatova, G. Grenerczy, J. Hefty, A. Krauss, P. Legovini, D. Medac, G. Milev, M. Mojzes, M. Mulic, O. Odalovic, T. Rus, J. Simek, J. Sledzinski, G. Stangl, B. Stopar, F. Vespe, and G. Virag. (2011). The CEGRN 2011 Campaign and the densification of ETRF2000 in Central Europe. Presentation at the EGU General Assembly, Session G6.3, Vienna, Austria, 2012.

Hefti, J., M. Igondova. (2009). Improved coordinate time series from reprocessing of permanent GPS stations in Central Europe. EUREF Annual Symposium, May, 2009, Florence.

http://www.epncb.oma.be/_dataproducts/products/timeseriesanalysis/residual.php
http://itrf.ensg.ign.fr/ITRF_solutions/

Milev, G., M. Becker, K. Vassileva, G. Stangl, I. Milev. (2010). Investigation of Geodynamics of Central and Eastern Europe, Balkan Peninsula and Bulgaria. In Monograph “Intelligent Data Analysis in Global Monitoring for Environment and Security”, ITHEA, Kiev-Sofia, 92-108.

Stangl, G., C. Aichhorn, S. Krauss. (2008). Potential Networks and New Velocity Estimations for South-East Europe and the Orient. 14th General Assembly of Wegener, September 15-18, Darmstadt, Germany.

Stangl, G. (2011).Velocity fields from geodesy to geodynamics. Presentation in the Seminar at the University Vienna, 04.12.2011.

Vassileva, K. (2008). CERGOP GPS Data Processing and Analysis of the Results Related to the Region of the Balkans. Mitteilungen des Bundesamtes für Kartographie und Geodäsie, Band 40, EUREF Publikation, No 16, 388-397.

Vassileva, K. (2009a). Processing and Analysis of GPS Data for Balkan Peninsula Permanent Stations. Proceedings of the International symposium on modern technologies, education and professional practice in geodesy and related fields Sofia, 05-06 November, 28-39.

Vassileva, K. (2009b). Velocity analysis of Balkan Peninsula Permanent Stations from GPS solutions. Proceedings of the International symposium on modern technologies, education and professional practice in geodesy and related fields Sofia, 05-06 November, 40-48.

Vassileva, K. (2010). Spring Behaviour of Balkan Peninsula Permanent Stations from GPS Solutions. Proceedings of the International symposium on modern technologies, education and professional practice in geodesy and related fields, Varna, Albena Resort, 23-24 September, 96-105.

Vassileva, K. (2011). Investigation of summer behaviour of Balkan Peninsula GNSS permanent stations from GPS solutions. Geodesy, Cartography, Land Management, 5-6, 14-19. (in Bulg.)

Vassileva, K. Analysis of the movements of Balkan Peninsula stations from GPS solutions in five autumn periods. (2012). International symposium on modern technologies, education and professional practice in geodesy and related fields Sofia, 08-09 November, 2012, 11 p.

Vassileva, K. (2013). Three Seasonal Behaviour of the Balkan Peninsula GNSS Permanent Stations from GPS Solutions. Comptes rendus de l’Académie bulgare des Sciences, 2013, Volume 66, Issue No1, 77-82.

PENTAX | STATE OF THE ART MEASURING TECHNOLOGY

TI Asahi Co., Ltd.
International Sales Department
Tel.: +81-48-793-0118
Fax. +81-48-793-0128
e-mail: international@tiasahi.com
www.pentaxsurveying.com/en/

Pentax Distributor for INDIA
LAWRENCE & MAYO PVT. LTD.
274, Dr. Dadabhai Naoroji Rd.
Mumbai 400 001, INDIA
tel: +91 22 22 07 7440
fax: +91 22 22 07 0048
email: instmum@lawrenceandmayo.co.in
www.lawrenceandmayo.co.in

Compatible with EZSurv Software

PENTAX FIELDGenius

A hybrid GIS space syntax methodology for prioritizing slums

This study has shown that prioritizing intervention on the local level should be clearly supported by a declared political vision as well as a scientific methodology that takes in to account different factors and indices

Ayman M Ismail
Professor of Planning
Fayoum University, Egypt

Hussam Bakr
Professor of Architecture,
Helwan University, Egypt

Salma Anas
Masters Candidate
Fayoum University, Egypt

Slums in Egypt – as in many developing countries - are considered as one of the most important problems in Egypt. There are about 1,100 slum areas hosting about 16 million inhabitants. Slums in Egypt vary considerably in their characteristics which make prioritization and intervention policy a debatable issue.

This paper highlights the importance of differentiating slum areas for the purpose of governmental intervention according to a certain methodology that takes into account different indicators varying from basic, socio-economic, demographic and morphologic data. The paper proposes a decision-support model using a decision-tree and a hybrid GIS and Space Syntax methodology. The underlying logic for the model is a new approach for assessing the utility of intervention called Coexistent Urbanism.

What is Coexistent Urbanism?

In dealing with theories of diverse city cultures, fabrics, classes and economic strata, one is faced with a limited number that relate to all four. Environmental determinism, for one, links behavior change with the built environment (Johnson, 1994). Space syntax on the other hand encompasses a set of theories and techniques to analyze spatial configurations of the urban area to associate economic or social performance of city areas by virtue of their street continuity (or discontinuity). Combining these theories to effectively and humanisticly deal with the informal area upgrading has not been tried. Conventional approaches consider slums as an urban disease that needs to be quarantined to avoid an epidemic. Others consider it as cancer cells or pockets within the healthy urban area that needs surgical intervention. Neither approach has proven effective.

Coexistent Urbanism is a new proposed approach that deals with informal areas in a different way. Rather than dealing with informal areas locally and through focused intervention, it seeks to gradually assimilate the community with its surrounding urban area socially, economically and physically by integrating its street fabric first until they become totally dissolved within the surrounded urban areas and become a harmonious part of the surrounded urban social and economic structure. In the long run, such assimilation combined with directing growth along a development axis could even be spared from strategic agricultural land. The primary tools used to analyze and diagnose the suitability of urban areas for this approach are Space Syntax and Geographic Information Systems.

It is the role of the planners and the stake holders to increase the integration of the slum with the surrounded urban area and to identify the right direction of that integration

Space syntax software and GIS

Space Syntax software such as Depthmap analyses the spatial configuration of a pattern as a set of axial lines measuring certain indicators such as the integration value and choice. Accessibility between street segments accordingly describes

Figure 1: Integration Measures

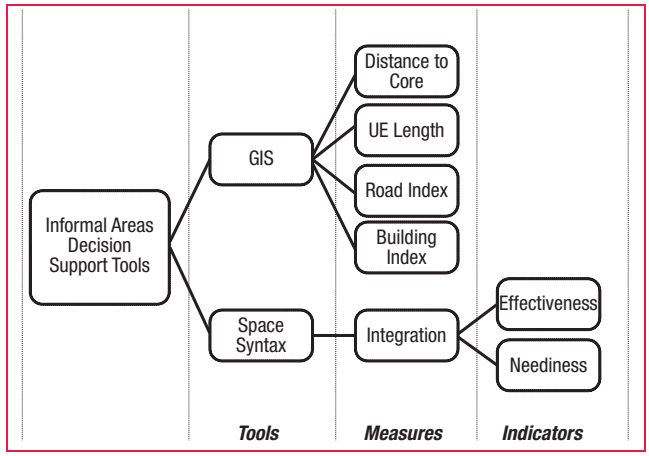


Figure 2 – Proposed DSS Methodology

how easily one navigates between streets and where obstructions are. Originally, it was conceived by Bill Hillier, Julienne Hanson and colleagues at The Bartlett, University College London in the late 1970s to early 1980s as a tool to help architects simulate the likely social effects of their designs. Now, it is applied to a wide array of applications such as crime, transportation, military and also informal/civil areas.

Primary space syntax measures

Integration: Is one of the most popular Space Syntax analysis methods of a street network. It measures how many turns one has to make from a street segment to reach all other street segments in the network, using the shortest paths (Figure 1).

The street segments that require the least amount of turns to reach all other streets are called 'most integrate' and are usually represented with warmer colors, such as red or yellow. If an integration radius is identified; it could be in local scale or at a certain radius.

One limitation of the Depthmap is that it ignores wide, situation and degree of streets. It does not consider street properties that are not measured by pure physical continuity. Factors such as street width, pavement, condition and vehicular-pedestrian mix are impediments to connectivity but are not included in the analysis. That is why Space Syntax integrated with GIS in a Coexistent Urbanism development approach may be useful to produce a complex index that would contribute to determine the priority of intervention to upgrade a slum area. Depthmap may be used to measure direct integration measures, and on the other hand GIS may be used to get the indices such as Building Index (percentage of deteriorated buildings in each slum), Roads Index (percentage of unpaved and less than 6m wide roads), Urban Edge length (length of slum borders adjacent to the urban edge) and finally, the distance between the centre of gravity of each slum to the centre of gravity of the city, which is located inside the core of integration 10%.

Methodology

In order to differentiate between slums using a comprehensive approach, we propose that one has to consider three groups of factors: basic and socio economic factors, urban analysis factors and fabric morphologic factors. Basic data include conventional indicators such as area, population size, poverty level,

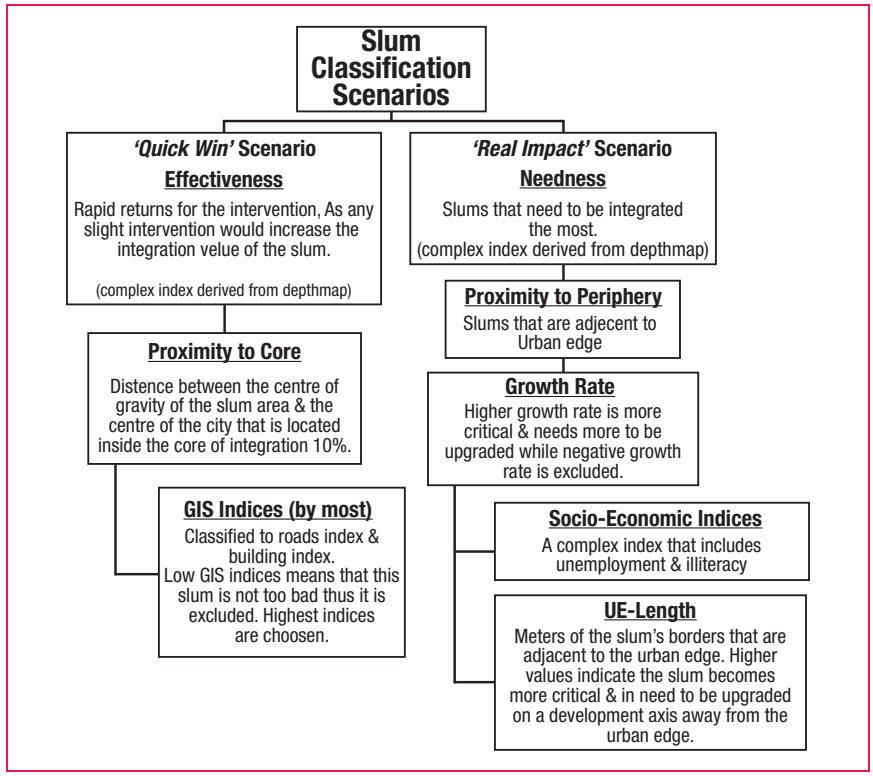


Figure 3 - Decision making chart for prioritizing intervention

Table 1- : Basic data of the ten slums in Fayoum city

Name	Dar al Ramad	Hakora	Allawy	Shefa	Kohafa	Sahel	Gebali	Hadka	Kialen	Saifeia
Established	1800	62-76	31-96	62-76	76-07	76-86	62-76	53-62	53-62	86-96
Pop 2011	10,977	4,681	14,124	18,818	12,544	2,348	5,241	6,272	2,741	7,841
Area (fd)	53	33	38.4	29.9	30.45	5.6	11.43	9.9	3,79	32.7
Density p/fd	**208**	**141**	**368**	**630**	**412**	**416**	**458**	**632**	722	**239**
Growth rate	-1.548	-0.8	0.92	3.7	0.914	1.6	1.36	3.14	3.9	0.914
Informal Type	C	P	P	P	P	P	C	C	P	P
Urban Edge		UE	UE	UE	UE	UE			UE	UE

C: Core P: Periphery

Source: ITC Fayoum governorate

unemployment, crime rates, etc. Urban analysis factors present the decision-maker with key spatial information on locations of deteriorated buildings, specific street conditions, distance to core, etc. Morphologic factors include street fabric connectivity and integration. A compounded index is designed and tested for each of these components. The final decision is based on a tree chain of elimination rather than a mathematical equation of quantitative addition.

Space Syntax is applied to the slums network with an appropriate buffer to get integration values for each slum. Then, they are classified by a devised normalized index called Coexistence Potential index that measures two critical measures called Effectiveness and Neediness for intervention.

Effectiveness is achieved by those slums having close proximity to the center of the city and high GIS building and roads indices. Thus, effectiveness is a measure of how well the slum intervention will produce notable impacts to the slum. Neediness, on the other hand, considers proximity to the periphery and higher

Table 2: Socio-economic indices

	Kohafa (2006)	Allawy (1998)	Saifeia (1998)	Shefa (QU 2013)
Unemployment (%)	5.35 ↑	10.68 ↑	12.82 ↑	23.53 ↑
Illiteracy (%)	36.43 ↑	45.65 ↑	33.33 ↑	35.29 ↑
4 SE Total	0.25	1.29	0.411	1.16

↑ Above city average. source: Fayoum City Strategic plan 2006 – Research study 1998- QU Authors survey in 2013
Fayoum city mean unemployment rate (2011): 4.3% Illiteracy rate (2011): 21.7%

slum growth rate. Thus, it is a measure of how badly the slum requires intervention. In a tree decision structure, it is optional to choose the slum that has the worst socio-economic index or the slum having the longest common borders with the urban edge. The used methodology can be summarized by the chart of intervention (Figure 2).

The methodology is applied to the slums of Fayoum city to classify and rank each against the intervention policy depending on a series of complex indices derived from GIS and Space Syntax as shall be shown (Figure 3).

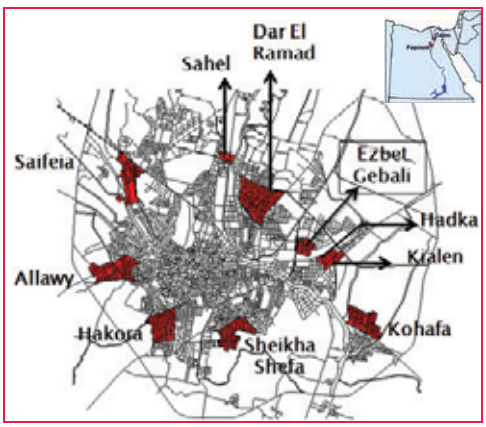


Figure 4 - Slums in Fayoum city

Case Study: Fayoum – the city of 10 slums

Fayoum is a city 130 km southwest of Cairo. It contains ten slums classified by the Informal Sector Development Fund (ISDF), hosting nearly about 12% of its total urban area (Figure 4).

Some of these slums were formed over a long period of time; even since before 1800. While others sprawled on the urban edges over agricultural land. The different nature of these slums, their formation nature, their current location within the city, their size and population decomposition, makes comparing them a complicated task without a guiding theory (Table 1).

The guidelines proposed are in tune with the purpose of intervention. Under the policy of coexistent urbanism, a chosen slum area should be selected so that it brings about the fastest and most sustainable path to gradual self-assimilation within the city structure and fabric, so that in a few years one can no longer identify a statistically significant variation within its key indicators. Within the methodology described above, two scenarios are offered to the decision-maker. Both use Depthmap and GIS. Fayoum city street geo-database is analyzed to get the integration values for each of the ten slums (for the whole city and including the ring road).

The outcome is then divided into two groups; the first group contains slums that need slight improvement to yield a measurable improvement (*quick win*), while the second contains slums that are in real bad shape and shall improve considerably by intervention (*real need*).

The following equations were used to compute Effectiveness and Neediness.

ION GNSS+ 2013

The 26th International Technical Meeting of the Satellite Division of The Institute of Navigation

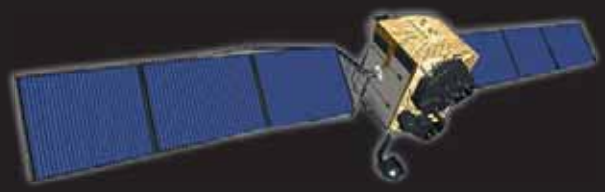
September 16–20, 2013

Show Dates: Sept. 18 – 19

Tutorials: Sept. 16 – 17

Nashville Convention Center

Nashville, Tennessee



The world's largest technical meeting and showcase of GNSS technology, products and services.

- Advanced Inertial Sensing and Applications (A)
- Advances in Military GNSS Systems and Applications (A)
- Algorithms and Methods
- Alternatives and Backups to GNSS
- Aviation Applications (A)
- Clock Technologies
- Emerging GNSS (Galileo, COMPASS, QZSS, IRNSS)
- Future PNT and Its Applications (A)
- Geodesy, Surveying and RTK for Civil Applications (C)
- GNSS Algorithms and Methods
- GNSS and the Atmosphere
- GNSS Compatibility, Interoperability, and Interchangeability
- GNSS Ground Based Augmentation Systems (GBAS)
- GNSS Simulation and Testing
- GNSS Space Based Augmentation Systems (SBAS)
- GNSS-MEMS Integration
- GPS and GLONASS Modernization
- Indoor Navigation and Timing
- Interference and Spectrum Issues
- Land Based Applications (A)
- Marine Navigation and Applications (A)
- Multi-Constellation User Receivers (C)
- Multi-Sensor and Integrated Navigation in GNSS-Challenged Environments
- New Products and Commercial Services (C)
- Next Generation GNSS Integrity
- Non Traditional PNT Applications (A)
- Portable Navigation Devices (C)
- Precise Point Positioning
- Receiver/Antenna Technology
- Remote Sensing with GNSS and Integrated Systems
- Safety Critical Applications (A)
- Software Receivers
- Space Applications (A)
- Standalone GNSS Services in Challenging Environments
- Timing and Scientific Applications (A)
- Urban Navigation Technology

(C) Commercial Session

(A) Application Session

Exhibitors — Reserve your booth today. Space is limited.

NASHVILLE

REGISTER TODAY! www.ion.org

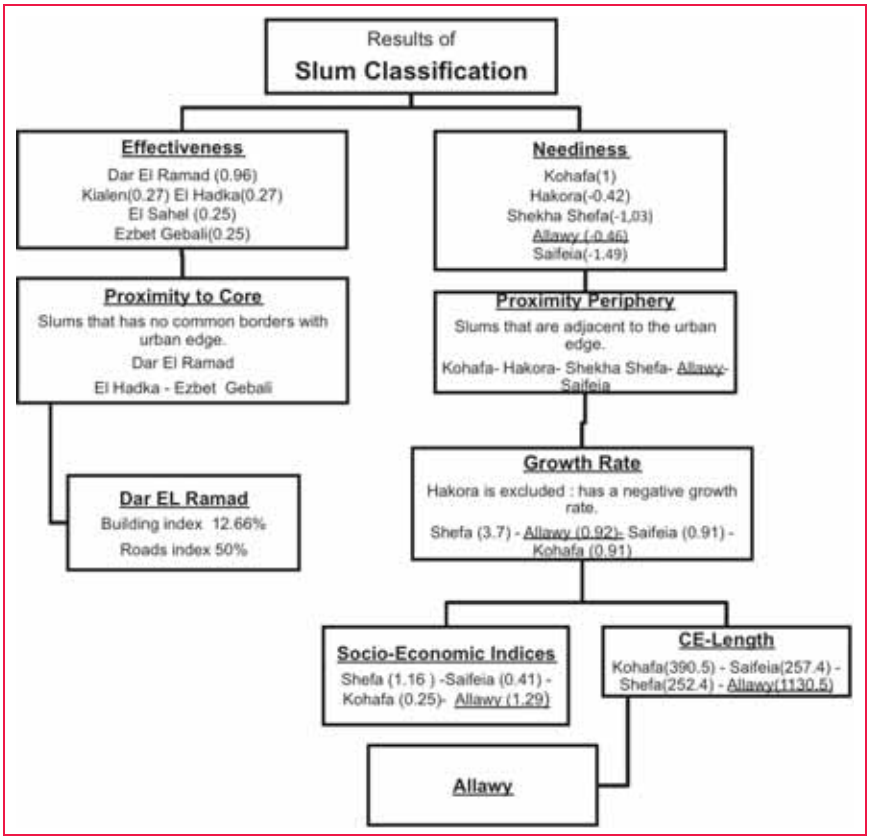


Figure 5: Applying the Methodology on Fayoum Slums

Figure 6 – Core of integration 10% Fayoum city

Figure 7: Axial map of Fayoum city within the ring road

$E_i = A_i - B_i + D_i - X_i$ $N_i = X_i - A_i - B_i - D_i$

A_i=Integration value for slum (i) roads' network with surrounding streets.

B_i= Integration value for slum (i) roads' network without surrounding streets.

D_i= Integration value for surrounding streets only (boundaries of each slum).

X_i= Distance from centre of mass of each slum (i) to centre of mass of urban area in Fayoum city (also located in the core of integration 10%).

The 'Quick-Win' Scenario (Effectiveness)

Following the computations of Effectiveness by the previous equation, the second iteration is to choose slums that have close proximity to the core (center of the city). Thus Sahel and Kialen are excluded.

In the final round, slums with the highest GIS indices are chosen (BI and RI).

The "Real Impact" Scenario (Neediness)

The other scenario that followed the neediness equation yields 5 slums (Hakora- Kohafa- Saifeia- Allawy- Sheika Shefa). All five need to be integrated the most to achieve a real impact from intervention.

Neediness considers proximity to the periphery and high growth rate as indicators of neediness. All five mentioned slums satisfy proximity to the periphery condition, but since Hakora has a decreasing growth rate (-0.8), it is excluded. The length of the common borders of the slums with the urban edge is obtained from GIS and the results are shown in Table 6.

The Neediness scenario branches in to two; either choosing slums having the worst socio-economic indicators, or slums having the longest common border with the urban edge (thus presenting threat of expansion over agricultural land). Fortunately, both branches result in Allawy as the slum that achieves the real impact from intervention.

Results

The proposed Decision Support methodology allows a logical decision-making framework to be followed. Without claiming an optimal decision, it leaves the politician with two clear cut and practical scenarios. One - if he needs a quick-win and the other - if he needs to make a real impact on the ground. This is achieved through passing the 10 slums by a number of filters. Dar El Ramad is the slum that would match the necessary conditions of the quick win scenario. This means that any slight intervention would improve the integration value of its roads' network. However, using effectiveness only neglects socio-economic indices as it deals with Depthmap and GIS indices only.

As the first scenario is useful for a politician in election conditions, it was avoided in favor for the second one. Allawy passed all filters, having the highest socio-economic indicators in addition to having the longest borders with the urban edge (Figure 5).

Table 3: Depthmap indices

	Dar al Ramad	Hakora	Sahel	Gebali	Kialen	Kohafa	Allawy	Shefa	Saifeia	Hadka
Effectiveness	0.961	-0.519	0.249	0.209	0.267	-1	-0.641	-0.136	-0.237	0.274
Needness	-2.116	**-0.422**	-2.068	-1.822	-2.267	1	-0.465	-1.025	-1.49	-1.827

Table 4 – Building index

Name	Dar El Ramad	Hakora	Sahel	Gebali	Kialen	Kohafa	Allawy	Shefa	Saifeia	Hadka
% Deteriorated Buildings	12.66	3.75	8.33	8	10.7	1.96	5.5	1.44	1.92	8.4

Table 5: Roads Index

Name	Dar El Ramad	Hakora	Sahel	Gebali	Kialen	Kohafa	Allawy	Shefa	Saifeia	Hadka
Unpaved and < 6m	6592	1205	108.37	0	0	3639.8	2508.4	1858.85	2532.6	40.39
Percentage Unpaved	50 %	15.69%	12.69%	0%	0%	49.38%	29 %	26.99%	44.5 %	2.2%

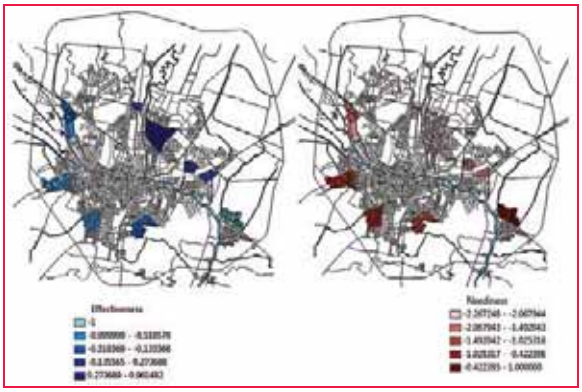


Figure 8: Effectiveness and Needness Indices using GIS

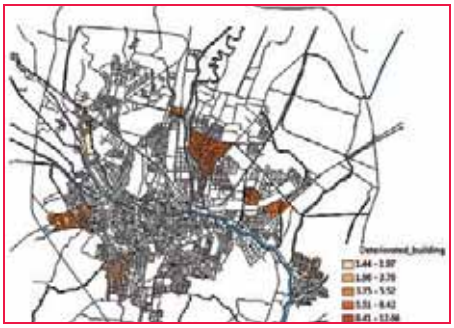


Figure 9 – Building index using GIS

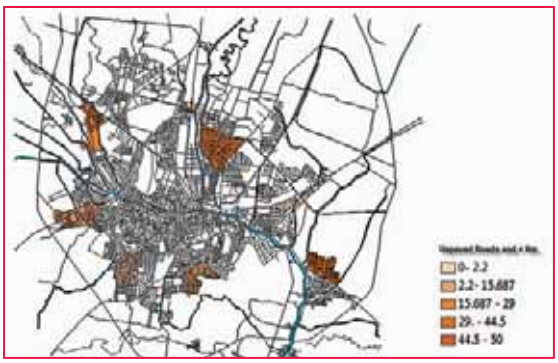


Figure 10 – Roads index GIS

Table 6: Urban Edge Length (m)

Name	Kohafa	Allawy	Saifeia	Shefa
UE. Length (m)	390.5	1130.5	257.4	252.4

Once a decision is made for a slum to begin with, the methodology can be tested to verify the utility of intervention. The quickest and simplest test is to begin making physical and road plan modifications to test whether there was a measurable impact of integration.

This was indeed tested in the case of Allawy (Figure 11 and Figure 12).

Allawy is a critical slum located adjacent to the city's urban edge with the borders extending 1,130 m representing nearly about 52% out of its total perimeter. The borders include several agricultural pockets and extend south-west along a road linking the city to the ring road. Thus, Allawy sprawl direction is detrimental to the future of fertile agricultural land. One way of thinking of upgrading Allawy's future plans should be regarded through integrating roads with the surrounding urban areas and towards the center of the city and away from the agricultural land (Figure 12).

Integrating Allawy with the surrounding urban area should be in the north and the east direction. Roads added in the northeast direction have high integration values (0.935 and 0.933). Making these simple modifications would improve the average value of the whole network, as well as improving the east borders of Allawy. The integration value of these eastern roads will increase from 0.79 to 0.90, and improving a road in the east and extending it will change its integration value from 0.692 to 0.919.

These modifications together increased the integration value of the whole network of Allawy from 0.78 to 0.8. Although a slight change, it shows how closely selected minor modifications could change the integration value by more intervention.

Conclusion

This study has shown that prioritizing intervention on the local level should be clearly supported by a declared political vision as well as a scientific methodology that takes in to account different factors and indices.

This methodology proposed follows a theoretical approach called coexistent urbanism in which the chosen slum

Figure 11: Google Earth image of Allawy

Figure 12: Proposed solution of Allawy

area would be selected according to the policy of intervention.

It is the role of the planners and the stake holders to increase the integration of the slum with the surrounded urban area and to identify the right direction of that integration towards the center of the city in order to limit urban sprawl detriment along the urban edge. This was demonstrated by adding new roads and improving some of the existing ones to increase the integration value of the slum network.

To be more effective, this methodology has to be integrated with a computerized GIS Decision Support Model to be easily applicable to other slums and to offer a comprehensive view as it contains variant data derived from different software.

There is also a need to reclassify slums in Egypt and to reconsider their factors of classification. It was noticed that some slums according to official classification are so well urbanized areas and their indices are not too bad. On the other hand, this classification ignored many degraded areas that need to be mentioned as slums in order to again stakeholders' attention.

References

Hillier, Bill (1996) Space is the Machine. Press Syndicate of the University of Cambridge.

Hillier, Bill and Hanson, Julienne (1984) The Social Logic of Space. Cambridge University Press.

Satterthwaite, David and Bicknell, Jane (1989) Environment and Urbanization. SAGE Publications

GTZ (2009).Cairo's Informal Areas between Urban Challenges and Hidden Potentials

Johnson, Paul (1994). The Theory of Architecture: Concepts, Themes, and Practices.

The paper was presented at The Eighth National GIS Symposium in Saudi Arabia during 15-17 April 2013.

Intel buys ST-Ericsson's GPS business

ST-Ericsson has sold its GPS mobile business to Intel.ST-Ericsson, which focuses on mobile and wireless chips, announced the sale without naming the buyer. An Intel spokesman later said the US chipmaker bought the assets. *http://articles.timesofindia.indiatimes.com/*

Exelis unveils Remote Geospatial Mobile Data Platform

ITT Exelis has debuted a new platform that aims to connect users to geospatial information on mobile devices when operating in remote or hostile locations. It created Jagwire Mobile for warfighters to capture and disseminate tactical images and data in areas with limited bandwidth coverage. The new platform offers similar functions as the company's Jagwire offering for enterprises. Jagwire's mobile version is also designed to process videos and images into a searchable database that users can access through shared networks. *http://blog.executivebiz.com/*

TomTom pairs with TrafficLand

TomTom is looking to beef up its location based services portal by joining forces with TrafficLand to bring real time traffic video to its developers. Its LBS will now incorporate TrafficLand's network of over 13,000 roadside webcams, enabling developers to integrate live footage into their location-enabled apps via the Traffic Camera API. For right now, TrafficLand covers only the US, UK and Canada, and it's not clear if the company plans to expand beyond those three countries anytime soon. *www.engadget.com/*

The installed base of container tracking systems grew 54 percent in 2012

According to Berg Insight, the number of active remote container tracking units deployed on intermodal shipping containers was 137,000 in Q4-2012, up from 89,000 a year earlier. Growing at a compound annual growth rate (CAGR) of 49.1 percent, this number is expected to reach 1.0 million by 2017. *www.berginsight.com*

New Generation RTK---A30

- ★ Professional GNSS satellites tracking (GPS,GLONASS,Galileo,Beidou...)
- ★ Built-in sensor technology, automatic centering and data collecting while pole is tilting in ±30 degree
- ★ Industry standard GNSS engine (Trimble, Novatel..)
- ★ Super bright display& Voice message
- ★ One button base setup
- ★ FOIF PRS technology,compatible, with other brands GNSS products
- ★ 3.5G WWAN module option

FOIF Since 1958

It's professional

Suzhou FOIF Co.,Ltd.

For more information please visit our website:
www.foif.com
or email to: internationalsales@foif.com

Or India distributor JANAK

JANAK POSITIONING&SURVEYING SYSTEMS PVT.,LTD

E-mail:janakji@vsnl.com Website: www.janaksurvey.com

Tel: 011-23515400,23515399 Fax: 011-23682185

TÜV CE ISO-9001 DNV

Russia to Launch South Korean Satellite in August

A Russian rocket will launch South Korea's latest multipurpose Arirang-5 satellite on August 22, Seoul's science ministry said. A backup launch date has also been set for August 23. The Arirang-5 is South Korea's first satellite with a synthetic aperture radar, which enables observation of the Earth's surface and also helps monitor natural disasters and the environment. *RIA Novosti*

China's satellite data network reaches South China Sea

A satellite data receiving station was launched enabling China to now obtain observation information about the South China Sea.The station, in Sanya in south China's island province of Hainan, was launched by the Institute of Remote Sensing and Digital Earth under the Chinese Academy of Sciences.

China will now be able to obtain satellite remote sensing data of the country's southern territorial waters for civil use directly from its ground-based receiving facilities, according to an institute statement. *http://news.xinhuanet.com/*

ISRO's geoportal Bhuvan turns 3-dimensional

ISRO's geoportal Bhuvan, that helps in geo-mapping and navigation across India, has turned 3-dimensional. This is an attempt to bring the portal at par with Google Earth, say scientists.

"The new 3D feature of the portal is ISRO's attempt to bring Bhuvan at par with Google Earth. The geoportal also includes Pocket Bhuvan. It is accessible on all smartphones and functions like Google Navigation," said Himanshu Pandya, a scientist at the Space Application Centre (SAC), an important city-based arm of ISRO that provides regular updates to the portal regarding natural disasters and water bodies.

The 3-D features will enhance the experience of portal users. Bhuvan, launched in 2009 to mark the 90th birth anniversary of Vikram Sarabhai, is maintained by the SAC and Hyderabad-based National Remote Sensing Centre. *www.indianexpress.com/*

Astrium delivers first VNREDSat-1 images just 48 hours after launch

The pictures show Hanoi's Red River (Vietnam) and the city of Melbourne (Australia) at a resolution of 2.5 metres. *www.astrium.eads.net/en/*


Red River, Hanoi (Vietnam)


Melbourne (Australia)

Ecuador satellite hits Soviet-era space junk

A tiny Ecuadoran satellite that collided in space with the remains of a Soviet rocket survived the crash, but was damaged and is not transmitting, Ecuador's space agency EXA had warned that a space fender-bender was likely between its "Pegaso" (Pegasus) nanosatellite and the remains of an S14 rocket launched by the Soviet Union into space in 1985, in the midst of the Cold War. *http://www.spacewar.com/reports/*

GMES and data, like geese and golden eggs

A recent study brings forward the idea that data from the upcoming Sentinel series of satellites should be regarded as Public Sector Information, increasing their value for money.

Through the Global Monitoring for Environment and Security (GMES) programme, decision-makers will have access to reliable, timely and accurate information services to manage the environment, understand and mitigate the effects of climate change and ensure civil security.

The programme will rely heavily on data provided by the Sentinel family of satellites – the first of which is due for launch later this year.

The potential of these data and information to be 'reused' both for commercial and non-commercial purposes recently came into focus in an ESA-commissioned study. In the final report, the authors outlined how reusing the data could potentially generate new businesses and jobs, and provide consumers with more choice and more value for money.

The report notes: "GMES may well be Europe's goose capable of laying golden eggs. But how can we ensure a steady sustainable business model: do we take one egg (direct returns from sales of data) or do we allow the egg to hatch, hoping more golden-egg-laying geese will follow?" *http://www.esa.int/*

Nigeria: FG to Curb Insurgence with Satellite Imageries

President of Nigeria has declared that the country was prepared to curb insurgency in the country with the use of high resolution imageries to locate any suspicious changes on the landscape. He further said high imageries like Geo-Eye, Quick Bird, Ikonos or digital globe would be deployed to tackle the challenge of insecurity. *http://allafrica.com/*

INTERGEO®

Conference and Trade Fair for Geodesy, Geoinformation and Land Management

www.intergeo.de

Knowledge and Action for Planet Earth

8 – 10 October 2013
Essen, Exhibition Grounds

INTERGEO®

along with

2nd National INSPIRE Conference 2013

Sponsors:

esri Deutschland

HEXAGON

Trimble.

DVW

Host: DVW e.V.
Conference organiser: DVW GmbH
Trade fair organiser: HINTE GmbH

Galileo update

Spain to host new Galileo Satellite Service Center

Europe has inaugurated its newest Galileo GNSS service center. Located in Torrejón de Ardoz, Spain, the Loyola de Palacio GNSS Service Center will be dedicated to providing constellation information to companies that want to use satellite-sourced data for products and services in sectors such as agriculture, transport and mapping.

The center will serve as an interface between the Galileo navigation system and user communities of the open and commercial services. Additionally, developers of applications that use Galileo's satellite data will be offered support through consultancy, certification services and quality stamps for their final products. *www.satellitetoday.com/*

First Galileo FOC Satellite heads to testing

The satellite, assembled by OHB System AG, is now headed for Noordwijk in the Netherlands, where it will undergo an environmental testing campaign and further system testing at the ESTEC's Test Center on the premises of the European Space Agency (ESA). Before the satellite was shipped, it had successfully completed integration and system testing, according to OHB System. Its twin FOC satellite is in the final phase of completion at OHB System. Over the next few weeks, it will also be integrated and tested, after which it will be shipped to Noordwijk. The two satellites are to be placed in orbit on board a Soyuz launcher, which will is planned to lift off from Kourou in French Guyana this fall. *www.gpsworld.com/*

Galileo and GPS Synchronise Watches

To ensure the early interoperability of Europe's satellite navigation with GPS, the four Galileo satellites have begun broadcasting the 'offset' between the parallel navigation systems' timings, accurate to a few billionths of a second. With satellite navigation based around the highly accurate measurement of signal times, both Galileo and GPS have their own internal reference time systems used to synchronise all system clocks and signals.

The problem is that these time systems are not quite identical, with Galileo System Time being around 50 nanoseconds or less apart from GPS time.

A nanosecond is only a billionth of a second, corresponding to the time light takes to travel 30cm, explained Jörg Hahn, Galileo System Engineering Manager. But this soon adds up, and anyone attempting to use the two systems together might find this 'offset' accounting for up to 15m of error, causing an unacceptable contribution to user performance.

Instead, this time offset needs to be known or estimated by the receiver itself. The dissemination of the GPS to Galileo offset can help in constrained environments such as city centres, where only a few satellites are visible in the sky, added Hahn. *http://www.hydro-international.com/*

First authorized UAV flight in a urban environment in Italy !

ANTEOS RPA of the Italian AERMATICA is the only one UAV that obtained the permission to fly in not segregated airspace from the Italian Civil Aviation Authority (ENAC).

AERMATICA and GEOMATICA_LAB from the University of L'Aquila – led by its Chief Scientist Prof. Donatella Dominici – agreed a collaboration regarding photogrammetric surveys. The first survey has been of one of the most important churches damaged during last earthquake: the ***Basilica di S.M. di Collemaggio*** (Unesco Heritage).

The aim of this study is to create a three dimensional models of both the building and its roofs using photogrammetric dedicated techniques. *http://www.suasnews.com/*

Bihar, India launches aerial survey of revenue land

Bihar government in India has launched an aerial survey of revenue land in the state. The survey, estimated to cost Rs 579 crore, would be completed by 2015 and thereafter, the state would have updated, computerized record of land holdings. Three private agencies have been engaged for the project. *http://articles.timesofindia.indiatimes.com/*

3D-enabled spatial data model for the Kingdom of Bahrain

The Kingdom of Bahrain has taken a step closer to developing a new 3D enabled spatial data model of the nation following a new partnership between Ordnance Survey International and the Survey and Land Registration Bureau (SLRB). The SLRB is the government organisation responsible for land, aerial and hydrographic survey services and the registration of real estate properties in the Kingdom of Bahrain. As part of the recently signed agreement, the SLRB will call upon the expertise of Ordnance Survey International to design and build a new 3D-enabled national spatial data model. *www.ordnancesurvey.co.uk*

Congress cuts funding for updating flood maps

Congress has cut funding for updating flood maps by more than half since 2010, from $221 million down to $100 million this year. And the president's latest budget request would slash funding for mapping even further to $84 million — a drop of 62 percent over the last four years.

In a little-noticed written response [3] to questions from a congressional hearing, FEMA estimated the cuts would delay its map program by three to five years. The program "will continue to make progress, but more homeowners will rely on flood hazard maps that are not current," FEMA wrote.

The cuts have slowed efforts to update flood maps across the country. *www.propublica.org*

1Spatial to raise £18m and purchase Star-Apic

1Spatial is to raise £18 million, €5.1m (£4.4m) of which will go on the partial acquisition of GIS firm, Star-Apic. Star-Apic's software is used to create, manage, analyse and display geospatial data, which 1Spatial says makes it an important and highly complementary bolt-on acquisition, enhancing the its capability in the rapidly growing big data market. *www.cabume.co.uk*

Pakistan promulgates Surveying and Mapping Ordinance

President of Pakistan has promulgated an ordinance to regulate and implement Surveying and Mapping standards in the country and to enable Survey of Pakistan (SoP) effectively assume its role of National Mapping Organization. *http://www.app.com.pk*

Flood Disaster: NEMA Undertakes Mapping of Vulnerable Areas

The National Emergency Management Agency (NEMA), Nigeria has said it had carried out mapping of all the communities likely to be affected by the predicted 2013 flood as part of its preparedness against disaster occurrence in the country.

According to NEMA's Director General, the organisation had carried out vulnerability capacity assessment of seven communities to determine the existing capacity in each community and its level of resilience. *www.thisdaylive.com*

Rolta Wins Second Major Project from NSA, Oman

Rolta Middle East, a wholly owned subsidiary, Rolta India has been awarded a multi-million Dollar project by Oman's National Survey Authority (NSA). The project, which is the second phase of a multi-dimensional map production and workflow system, will result in a number of deliverables. These include enhanced workflow designs for improving map production, archival and distribution systems, in addition to the generation of a nationwide coverage of 1:50,000 and 1:100,000 scale maps to be stored as a vector database as well as in a GeoPDF format. *www.rolta.com*

New Land Surveying System Underway in Tanzania

A new land surveying and mapping system is in pipeline and will significantly bring down the costs of carrying out the exercise, according to the Minister for Lands, Housing and Human Settlement Development, Prof Anna Tibaijuka.

Currently, an insignificant part of the country is surveyed, keeping people from using their land as capital. Yet it is well established in law that a title deed is conclusive evidence of ownership. It makes one an absolute and indefeasible owner of land in question. *http://allafrica.com/*

Norway will open its topographic datasets to the public!

The Norwegian Mapping Authority has announced they will open its topographic datasets to the public, free of charge. Norway will follow progressive countries like Denmark, Finland and New Zealand, considering geographic data as a public good. The topographic datasets at 1:50,000 scale will be freely available later this year, together with address, road and cadastre data. *http://blog.thematicmapping.org*

University of Massachusetts Boston Honors Esri President

Jack Dangermond, founder and president of Esri, was presented with an honorary Doctor of Science degree at the University of Massachusetts, Boston's commencement ceremonies on May 31, 2013.

A landscape architect by training, Dangermond is one of the world's pioneers in the creation and practice of geographic information systems (GIS); technology used for managing, analyzing, and sharing location-based information for better decision making. www.esri.com

GIS to guide pilgrims, worshippers in Makkah

The Saudi Commission for Tourism and Antiquities (SCTA) branch in Makkah said that SCTA is developing an application for a GIS to guide pilgrims to places of their lodging and how to move around to perform the religious rituals.

Abdullah Al-Sawat, executive director of the branch, said during a training session that targeted 20 employees of the branch, that these courses aim to develop the skills of workers in the tourism sector to

achieve the visions of Prince Sultan bin Salman, president of SCTA, to educate and develop the staff and promote local tourism. *www.arabnews.com*

Obama Administration releases Historic Open Data Rules

The Obama Administration has taken groundbreaking new steps to make information generated and stored by the Federal Government more open and accessible to innovators and the public, to fuel entrepreneurship and economic growth while increasing government transparency and efficiency.

An Executive Order signed by the President and an Open Data Policy released by the Office of Management and Budget and the Office of Science and Technology Policy—declare that information is a valuable national asset whose value is multiplied when it is made easily accessible to the public. The Executive Order requires that, going forward, data generated by the government be made available in open, machine-readable formats, while appropriately safeguarding privacy, confidentiality, and security. *www.whitehouse.gov*

Blue Marble Releases Global Mapper 14.2

Blue Marble Geographics has released Global Mapper version 14.2. This update to the company's popular desktop GIS software offers many new and improved features and functions, which includes several scripting updates, improved volume measurement tools etc.

Drones provide humanitarian aid in Haiti

senseFly's drones have accomplished their second mission in Haiti to map areas around Port-au-Prince and Cap Haitien, including areas damaged by hurricane Sandy in October 2012. After a first successful mission in Haiti with the UNITAR using senseFly's swinglet CAM, the IOM recently teamed up with Drone Adventures for a mission using its latest drone, the eBee.

ISRO Navigation Centre near Bangalore unveiled

Indian Space Research Organisation has unveiled its Navigation Centre in Bangalore Rural District for the proposed Indian Regional Navigation Satellite System (IRNSS), a constellation of seven spacecrafts that will enable users to know their location and time accurately. *http://articles.economictimes.indiatimes.com/*

Cost of modernized ground control system for GPS satellites has increased

The Defense Department added the GPS Next Generation Operational Control System to its annual Selected Acquisition Report, which summarizes the latest estimates of cost, schedule and performance status for key military programs.

The report did not detail the reasons for the cost increase to the GPS Operational Control System, which Raytheon Co. has been developing since February 2010, when it won an initial contract valued at $888.4 million.

Russia's NIS GLONASS, India's TechMahindra sign cooperation agreement

Russia's NIS GLONASS has signed an agreement on cooperation in the sphere of navigation with India's TechMahindra. Both the parties intend to pool efforts to develop services based on the use of GLONASS / GPS signals in India. In particular, the partners plan to jointly develop such projects as the monitoring of all types of transport, navigation solutions for the police, as well as intelligent transportation systems for large cities. In addition, NIS plans to provide advisory services to Indian companies in the sphere of marketing research. *http://indrus.in/news/*

Smartphone Technology Inspires Design for Smart Unattended Ground Sensor

DARPA's Adaptable Sensor System (ADAPT) program aims to transform how unattended sensors are developed for the military by using an original design manufacturer (ODM) process similar to that of the commercial smartphone industry. The goal is to develop low-cost, rapidly updatable intelligence, surveillance and reconnaissance (ISR) sensors in less than a year, a marked improvement to the current three-to-eight year development process.

The program has developed the core ADAPT hardware and software package using a customized Android Operating System (OS) to provide capabilities common to all ISR sensors. The program recently completed its first reference design and developed application-specific software for an unattended ground sensor (UGS) that uses the ADAPT core. This new UGS could provide users with a cost-effective ground sensing capability. *http://www.darpa.mil/NewsEvents/Releases/2013/05/29.aspx*

NUDT makes high-performance satellite navigation receiver

A new-type high-performance satellite navigation receiver, which was developed by the College of Electronic Science and Engineering under the National University of Defense Technology (NUDT) of the Chinese People's Liberation Army (PLA), made its debut recently. The satellite navigation receiver can simultaneously receive signals of BeiDou, GPS, GLONASS with a positioning accuracy of 10 meters. *http://www.ecns.cn/military/*

Thailand's GPS market tends to grow to reach Bt4 bln this year

Thailand's National Science and Technology Development Agency (NSTDA) said the country's GPS is growing, with its overall value expected to reach Bt4 billion this year.

Passakorn Prathombutr, NSTDA Service Research and Innovation Program Director, spoke of a recent study revealing the value of the GPS market in the country that last year

alone some 305,000 GPS devices were sold for more than Bt3.5 billion.

Mobile GPS devices were most sold, while those to be installed in vehicles were most expensive.

He predicted that this year's market share would realise 23 per cent more than last year's at Bt4.2 billion, or around 378,000 devices. *http://www.pattayamail.com/*

Big earthquakes create global scale GPS errors

Thirteen years of supersized earthquakes have contaminated GPS sites around the world, a new study finds. Except for spots in Australia, western Europe and the eastern tip of Canada, every GPS site on the ground underwent small but important shifts since 2000 because of big earthquakes, according to a study published May 6 in the Journal of Geophysical Research: Solid Earth.

The research confirms that great earthquakes, those bigger than magnitude 8.0, can have far-reaching effects on the Earth's crust. And because GPS is critical for everything from calculating satellite orbits to sea level rise to earthquake hazards, scientists can't ignore these tiny zigs and zags, the researchers conclude. *http://www.livescience.com/*

Pakistan signs up for Beidou

Beidou is expected to add yet another customer after Pakistan signed up to host ground stations for the service. Pakistan will follow Thailand, Laos and Brunei in becoming a Beidou customer later this month. *http://www.theregister.co.uk*

China invests $810M to create Beidou product ecosystem

China is hoping to expand the usefulness of its Beidou navigation satellite system by investing 5 billion yuan (US$810 million) to create an industrial park meant to house companies developing products using Beidou's technology. The industrial park will be situated in the city of Tianjin and is expected to be fully operational in two years' time. *http://www.zdnet.com/*

Sri Lanka to monitor road safety with GPS

The National Transport Commission (NTC) launched recently a pilot trial of its project which aims to monitor the driving capabilities of inter-provincial buses by using GPS.

The system provides information on the location of the buses and can monitor the behaviour of the conductors and drivers of the buses at whatever location.

According to NTC chairman, the initiative is a response to an increasing number of complaints about reckless driving, violation of road rules, disregard of the provided timetable and route, and unruly behaviour. *http://www.futuregov.asia/*

German robots sent to Oz to make GPS millimetre-perfect

Industrial robots from Germany will be spending their life in Australia's great outdoors, helping to improve the accuracy of the country's GNSS positioning knowledge. The project, a GNSS robotic calibration facility, has been switched on in Canberra, and will ultimately be part of a nationwide calibration network.

The robots are designed to track passing positioning satellites and scan the antennas, collecting information about slight deviations in the position of the antenna as satellite signals enter it from various points (referred to as bias).

"The aim is to calibrate the biases of different antennas," explained Dr John Dawson, section leader of the National Geophysical Reference System. Different antennas from different manufacturers exhibit different biases, he explained, mainly due to very small manufacturing inconsistencies. This, however, is a problem for agencies like Geosciences Australia, which want to get sub-millimetre measurements of the deformation of the Earth's crust due to plate tectonics. *http://www.theregister.co.uk/*

GPS solution provides 3-minute tsunami alerts

Researchers have shown that, by using GPS to measure ground deformation caused by a large underwater earthquake, they can provide accurate warning of the resulting tsunami in just a few minutes after the earthquake onset. Most tsunamis, including those in offshore Sumatra, Indonesia in 2004 and Japan in 2011, occur following underwater ground motion in subduction zones, locations where a tectonic plate slips under another causing a large earthquake. To a lesser extent, the resulting uplift of the sea floor also affects coastal regions. There, researchers can measure the small ground deformation along the coast with GPS and use this to determine tsunami information.

"High-precision real-time processing and inversion of these data enable reconstruction of the earthquake source, described as slip at the subduction interface. This can be used to calculate the uplift of the sea floor, which in turn is used as initial condition for a tsunami model to predict arrival times and maximum wave heights at the coast," says lead-author Andreas Hoechner from the German Research Centre for Geosciences (GFZ).

"Japan has a very dense network of GPS stations, but these were not being used for tsunami early warning as of 2011. Certainly this is going to change soon," states Hoechner.

The scientists used raw data from the Japanese GPS Earth Observation Network (GEONET) recorded a day before to a day after the 2011 earthquake. To shorten the time needed to provide a tsunami alert, they only used data from 50 GPS stations on the northeast coast of Japan, out of about 1200 GEONET stations available in the country. *http://esciencenews.com*

R330™ GNSS receiver by Hemisphere GNSS

Hemisphere GNSS has launched the new R330 GNSS receiver, a versatile, fully featured positioning system. It delivers accurate and robust positioning through a variety of differential correction methods including SBAS, L-Band, Beacon and RTK. The wide range of functionality and ease of use makes R330 an ideal fit for a variety of land and marine applications. It combines the functionality and front panel display of all previous R-series products. To provide the most reliable solutions, R330 is capable of tracking multiple frequencies and multiple constellations including GPS and GLONASS. *www.HemisphereGPS.com*

NovAtel SPAN-CPT Receiver supports OEM6 GNSS platform

NovAtel's single-box SPAN-CPT GNSS/INS receiver now supports the company's next-generation OEM6 GNSS technology platform. The OEM6 GNSS engine significantly improves positioning performance through its support of GPS and GLONASS, all-in-view satellite tracking and intelligent measurement selection. The upgraded SPAN-CPT integrates NovAtel's precision receiver technology with fiber optic gyro and MEMS accelerometer inertial components from KVH Industries in one compact unit.

Spectra Precision speeds Athens Metro Tram Extension

The Athenian port of Piraeus will soon be served by the Athens Tram. A contract to perform civil engineer studies for the new extension went to 2KP, an Athens-based consulting engineering firm. 2KP had recently purchased a fully robotic Spectra Precision FOCUS 30 total station and Nomad data collectors from JGC Geoinformation Systems S.A. It chose the FOCUS 30 for its speed, accuracy, full exchange of data between field and office and its ability to run software identical with the company's many legacy GNSS receivers, as well as its newest ProMark 800 receivers.

Leica News

Co-op agreement with Aibotix

Leica Geosystems has entered into a cooperation and distribution agreement with Aibotix, manufacturer of multicopter unmanned aerial systems (UAS) to create end-to-end solutions for the professional inspection and mapping market.

Updated version of Zeno Connect launched

A new version of Leica Geosystems' Zeno Connect application will support the output of local grid coordinates, as well as the already-supported output of WGS84 coordinates.
The new capability will allow Leica Zeno GIS users who have used a third-party GIS application to still reap the benefits of the high-precision projection and transformation engines developed by Leica Geosystems. It manages and configures the Zeno GNSS sensors - including the GS05/06, GG03 and CS25 GNSS.

'future-proof' enhancements to GR25 server

Leica Geosystems has enhanced its GR25 GNSS Reference Server with a standard on-board WLAN module to extend its Ethernet and mobile wireless internet connectivity options.
As well as the WLAN module, the device has also been given new RefWorx on-board firmware v3.00, which means that other computers or network devices connected to Ethernet or WLAN can directly access the Internet through the server's new routing capability.
www.leica-geosystems.com

Chinese company to invest $294 mn in mapping firm AutoNavi

Alibaba Group, China's largest e-commerce firm, will take a 28% stake in digital mapping company AutoNavi Holdings Ltd, part of Alibaba's move to boost its competitiveness by beefing up its product lineup. *Chicago Tribune*

Northrop Grumman delivers 8,000th INS

Northrop Grumman has delivered its 8,000th LN-100 inertial navigation system (INS), which provides primary and backup navigation information for a variety of airborne and shipboard platforms. It is a non-dithered GPS-aided INS that utilises Northrop Grumman's Zero-lock gyro (ZLG) technology. AZO Sensors

Trimble adds photogrammetry module to surveyors software

Trimble has debuted its Business Center version 3.0 office surveying software featuring photogrammetry enhancements, including the ability to process images from the Gatewing X100 unmanned aerial system (UAS). Version 3.0 helps surveyors, engineers and geospatial data managers increase their productivity, efficiency and quality of deliverables through the software's increased visualization and aerial data processing capabilities.

OHB contract for European Data-relay Satellite

Satellite manufacturer OHB AG has signed a final contract for the construction of a data-relay satellite that will use laser communications to speed delivery of European Earth observation data to users. It has been working on the European Data Relay Satellite System (EDRS) for about two years under a preliminary contract with Astrium Services, which is managing the EDRS system as a public-private partnership with the 20-nation European Space Agency (ESA). *www.spacenews.com*

New dual-antenna GNSS INS

Advanced Navigation has released Spatial Dual, its new dual antenna GNSS/Inertial Navigation System. It is a ruggedised, miniature GPS-aided INS and AHRS that provides accurate position, velocity,

SOUTH
Target your success

High Precision Handheld GPS

India GAGAN era comes

* Work mode and accuracy

SBAS differential mode
(Satellite Based Augmentation System)
(GAGAN / WAAS / EGNOS / MSAS)

----submeter level (with India GAGAN)

Static and Fast Static mode

----mm level

PPK mode
(Post-processed Kinematic)

----cm level (at good condition)
----submeter level (at common condition)

CORS network mode
(Continuous Operation Reference System)

----≤0.5m (Single frequency)
----≤0.2m (Dual frequency)

** Accuracy and reliability may be subject to anomalies due to multipath, obstructions, satellite geometry and atmospheric conditions.*

SBAS differential mode

Static and Fast Static mode

PPK mode

CORS network mode

For More Details Contact Us:

India Headoffice

SOUTH PRECISION INSTRUMENT PVT.LTD.
Add: 1108-09-10-11, 11th Floor, RG Trade Tower,Plot No-B-7,
Netaji Subhash Place, Pitam Pura, New Delhi-110034
Tel: +91-11-49995999, 9999999255 Fax: +91-11-45605999
Http://www.southinstrument.com Http://www.southprecision.in

Customer Support Center

Delhi:	+91 9990561049	Ahmedabad:	+91 9971800986
Mumbai:	+91 9766329600	Kolkata:	+91 9007002404
Hyderabad:	+91 9573325063	Chennai:	+91 9650797606

acceleration and orientation under demanding conditions. It contains the Trimble BD982 GNSS receiver, which is a triple frequency dual-antenna RTK GNSS receiver. *www.advancednavigation.com*

Support & training for Canadian forces

The Canadian government will award a British Columbia company an $11 million contract for support and training for a new system that allows the Canadian Forces to obtain data from commercial satellites. The government in November 2011 had awarded MacDonald Dettwiler of Richmond, BC a $31 million contract for two mobile ground stations that will allow military commanders to download imagery from commercial satellites, including Radarsat-2. The ground stations, called Unclassified Remote-Sensing Situational Awareness systems, will be fully operational later this year. *http://blogs.ottawacitizen.com/*

RTKLIB software supports NV08C Receiver Series.

RTKLIB, a developer of open source software for standard and precise GNSS positioning, has recently released its latest RTKLIB software (version 2.4.2), which fully supports NVS Technologies' BINR proprietary binary protocol and the NV08C GNSS receiver series. It is a powerful combination which enables GNSS system designers and OEMs to develop highly accurate, low cost and compact Precision Grade positioning and navigation equipment. *www.nvs-gnss.com*

An Improved Step in China's 3D Geological Mapping

3D geological mapping is a major innovation of geological survey work. It has broken the limitation that geological data can only be used to generate traditional 2D maps.MapGIS 3D Geological Mapping Tool is professional software served for better visualized geological mapping. It contains complete 3D geological mapping oriented modeling process with integrated data management, 2D mapping and 3D modeling, which realizes the digitization and visualization of complex geological information. *www.mapgis.com*

Medicare Mapper Now Available

LLC along with partners Social & Scientific Systems, Inc., and Esri, has developed an informative Medicare application called Medicare Mapper. It is a free download for the iPad. Based on a publicly available data set from the U.S. Department of Health & Human Services' Centers for Medicare & Medicaid Services (CMS), the application allows consumers to see where people in their area are going for Medicare services, and service providers to see where their patients live. *www. critigen.com*

Mapping Solution by AeroMetric

AeroMetric new High Accuracy Mapping Solution is designed to obtain tight vertical accuracy and highly detailed imagery using a helicopter based sensor system mounted on a drift-control platform. The sensor system includes a Riegl VQ-480i LiDAR sensor, a Phase One iXA 80 MP digital camera and is controlled through Track'Air's Flight Management System. *www.aerometric.com*

F4Devices Announces Partnership with Laser Technology, Inc.

F4Devices has announced a new partnership with Laser Technology, Inc (LTI). F4Devices will provide LTI with a custom version of its Flint handheld for use as a controller and data collector for its Mobile GIS lasers as well as Public Safety divisions. It will be branded under BAP Precision. *www.f4devices.com.*

Get Big Answers from Big Data

Perhaps the greatest untapped IT resource available today is the ability to spatially analyze and visualize Big Data. As part of its continuing effort to expand the use of GIS technology among web, mobile, and other developers, Esri has launched GIS Tools for Hadoop. The toolkit removes the obstacles of building map applications for developers to truly capitalize on geoenabling Big Data within Hadoop—the popular open source data management framework. Developers now will be able to answer the *where* questions in their large data stores. *www.esri.com*

MAVinci Desktop 3.0

MAVinci has recently released MAVinci Desktop. Along hundreds of minor improvements it has especially worked on expanded assistance while planning your missions. Effects of the terrain on the expected ground coverage can possibly be enormous – especially when working with small overlap values or low flying altitudes. Not considering the terrain could result in large uncovered gaps. Now it will be able to forecast the ground coverage and further optimize the flight planning before the flight!

MagicSBAS integrated into the IGS Real Time Service

The GMV proprietary SBAS testbed, magicSBAS, has been successfully upgraded to connect to RTCM real time service (RTS) providers broadcasting precise satellite orbit and clock corrections. The integration and performance tests have been conducted with both a server of the magicGNSS suite and with the International GNSS Service (IGS) RTS IGS01/IGC01 server, which was launched recently on April 1st. magicSBAS is a state-of-the-art, multi-constellation, operational Satellite Based Augmentation System (SBAS) testbed developed by GMV to offer SBAS regional differential corrections and non-safety critical integrity augmentation to any interested region. *www.gmv.com*

Ladybug Camera for Lynx Mobile Mapper by Optech

Optech has recently releasd the Ladybug® spherical imaging camera from Point Grey Research Inc. as a new option for the Optech Lynx Mobile Mapper™. It is completely integrated within the Lynx system, offering full control and calibration with the Optech Lynx Survey software, local recording of image data, seamless integration into the Lynx processing workflow, and full operational and processing support. *www.optech.com*

Maximize Your Uptime

StarFire Rapid Recovery Keeps You Going

Worksite conditions are seldom perfect and GNSS signal outages can cause costly delays, but NavCom will help get you up and running again with StarFire Rapid Recovery.

NavCom's new StarFire Rapid Recovery feature helps you bridge GNSS signal interruptions by allowing you to quickly regain StarFire accuracy up to 5cm once the GNSS signal is reacquired. NavCom's StarFire Network, a Global Satellite Based Augmentation System, provides five centimeter horizontal accuracy worldwide. It offers 99.999% uptime, a seven satellite constellation, and StarFire over IP (SFoIP) delivery for redundancy to ensure system availability and position accuracy.

We understand that in order to do the job right, you need the right tools and NavCom's suite of StarFire productivity tools including StarFire Rapid Recover, StarFire Over IP delivery and RTK Extend help users reduce costs, and maintain maximum uptime.

www.navcomtech.com

NAVCOM

A John Deere Company

EnsoMOSAIC v7.5 released

MosaicMill Ltd. has released EnsoMOSAIC 7.5 for aerial triangulation and orthomosaicking with new management of coordinate systems, which allows user to freely define and set map projections. Simultaneously a new data transfer function from EnsoMOSAIC to Espa 3D (EnsoMOSAIC 3D) was released to enable use of camera self-calibration for high-accuracy elevation points and terrain models. Also a new version of NavCam flight control software for manned flights was released with support for Novatel GPS with Omnistar corrections.

RIEGL Speeds up Accident Investigation

RIEGL has launched RiSOLVE software package that allows the speed and ease needed to simplify the 'field to office' exchange and provides the fastest workflow for true-color 3D Scene Scanning. The stream-lined process of RiSOLVE is the fastest and most efficient solution to acquire, register, and colorize outdoor 3D scan data through its fully automatic registration and colorization. The 3D virtual environment created in RiSOLVE can be used as a reconstruction tool for accident investigations that will re-create the point of impact virtually and at any angle for collision analysis and visualization that can be revisited repeatedly. *www.riegl.com*

CHC introduces the X+ GNSS Receiver Series

CHC has recently released the X+ GNSS Receiver Series bringing enhanced positioning features to surveyors and construction professionals without the conventional cost associated with advanced GNSS receivers. It encompasses the highly integrated X91+ GNSS and X900+ GNSS receivers, providing superior solutions to any real-time kinematic (RTK) surveying projects as well as the X90+ and X20+ GPS receiver for cost-effective static surveying. *www.chcnav.com*

MARK YOUR CALENDAR

July 2013

ISR Asia 2013
1 - 4 July 2013
Kuala Lumpur, Malaysia
http://mycoordinates.org/isr-asia-2013/

GI Forum 2013
2 – 5 July
Salzburg, Austria
www.gi-forum.org

Survey Summit
6 – 9 July
San Diego, USA
www.esri.com/events/survey-summit/index.html

CASLE International conference on Management of Land and Sea Resources
7-10 July
Glasgow, Scotland
www.casle.org

Esri International User Conference
8 – 12 July
San Diego, USA
www.esri.com

ESA International Summer School on GNSS 2013
15 - 25 July
Davos, Switzerland
www.congrexprojects.com/13m07

IGNSS 2013
16-18 July
Gold Coast, Australia
www.ignss.org

International Geoscience and Remote Sensing Symposium (IGARSS 2013)
22-26 July
Melbourne, Australia
www.igarss2013.org

August 2013

International Summer Seminar on GNSS
19-24 August 2013
Tokyo , Japan.
http://www.gnss-pnt.org/summer_seminar/index.php

8th International Symposium on Digital Earth 2013 (ISDE 2013)
26-29 August
Kuching, Sarawak, Malaysia
http://isde2013.utm.my/

September 2013

Multi-GNSS environment for sustainable development
9 - 13 September 2013
Hoi An, Vietnam
http://navis.hust.edu.vn

Geo-Empower Middle East Summit
16-18 September
Dubai, UAE
www.fleminggulf.com/All-Categories

ION GNSS 2013
16 – 20 September
Nashville, Tennessee, USA
www.ion.org

GDI APAC 2013: Geospatial Defence & Intelligence 2013
17-18 September
Singapore
www.geospatialdefenceasia.com

International Symposium & Exhibition on Geoinformation (ISG 2013)
24 - 25 September
Kuala Lumpur, Malaysia
www.voronoi.com/isg2013

October 2013

Intergeo 2013
8 – 10 October
Essen, Germany
http://www.intergeo.de/en/index.html

34th Asian Conference on Remote Sensing
20 – 24 October 2013
Bali, Indonesia
www.acrs2013.com/

ISGNSS 2013
22-25 October
Istanbul, Turkey
http://mycoordinates.org/isgnss-2013/

November 2013

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

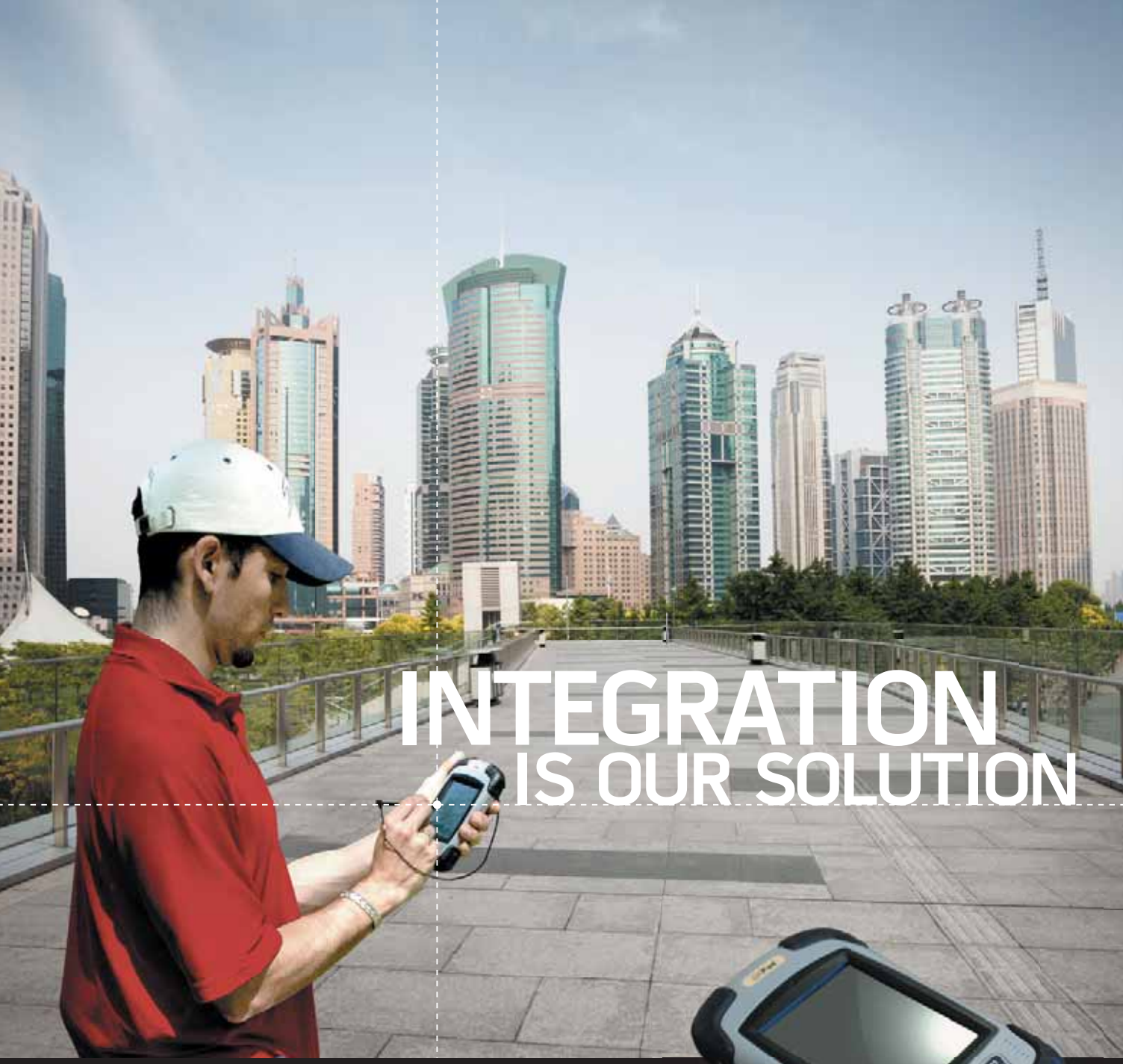
ICG-8: Eighth Meeting of the International Committee on GNSS
10 – 14 November
Dubai, United Arab Emirates
www.oosa.unvienna.org/oosa/en/SAP/gnss/icg.html

December 2013

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/



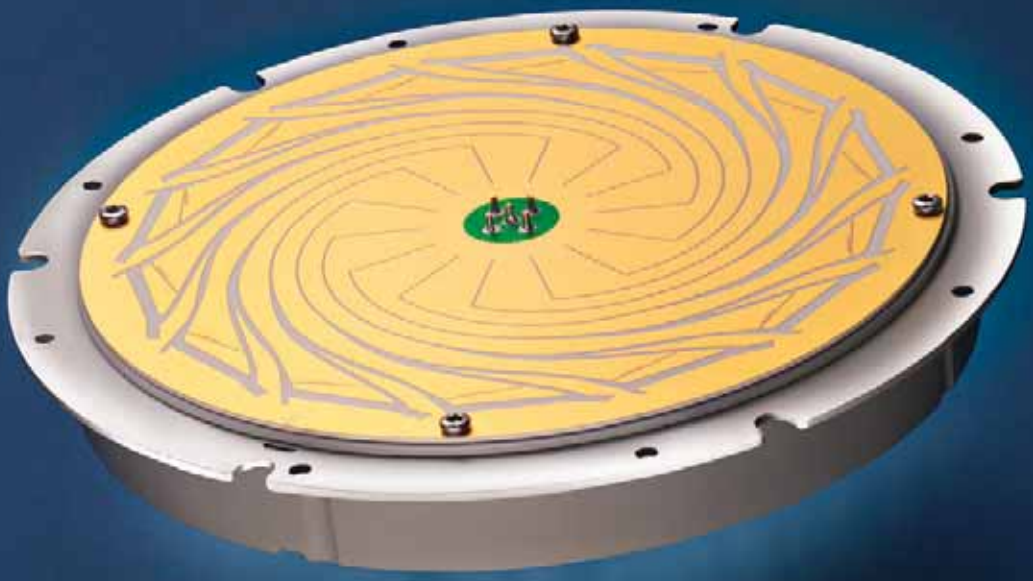
INTEGRATION IS OUR SOLUTION

SX**Pad**
by Geneq inc.

High Accuracy GIS Device

- Integrated high sensitivity SIRFstar III GPS receiver and antenna
- Microsoft Windows Mobile 6.5 Pro and Win Mobile Office
- Sunlight readable touch screen
- Mini USB
- Bluetooth, Wi-Fi, Wireless GSM/GPRS
- Integrated 3MP camera, speaker and microphone.

sxbluegps.com
info@geneq.com
+1 514 354 2511



Possibly the greatest saucer shaped technology since Roswell.

Aperture coupled slotted array. Sounds alien, but it is the technology behind NovAtel's legendary Pinwheel™ antenna which is now available as an OEM module. With superior multipath rejection and a highly stable phase center, the Pinwheel OEM provides choke ring antenna like performance at a fraction of the size and cost. Best of all, only you will know it is from NovAtel. Success has a secret ingredient. Discover more at novatel.com/antennas

NovAtel

Integrate success into your [redacted].