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Coordinates

Volume V, Issue 5, May 2009

THE MONTHLY MAGAZINE ON POSITIONING, NAVIGATION AND BEYOND

High precision UAS navigation

NLRMP: Mission Possible

Adding GRACE to GNSS

GPS Attitude Determination Algorithm

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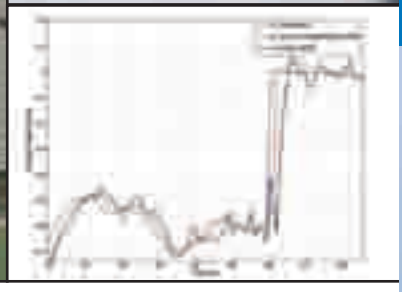

In this issue

Coordinates Volume 5, Issue 5, May 2009

Articles

Adding GRACE to GNSS 8 **National Land Records Modernisation Programme: Misson Possible** 14 **Flight Evaluation of a GPS Attitude Determination Algorithm** Dr Nelson Paiva Oliveira Leite and Prof Dr Fernando Walter 17 **A sensor architecture for high precision UAS navigation** Luca Garbarino, Vittorio Di Vito, Ettore De Lellis, Carmine Marrone, Federico Corraro 30

Columns

My Coordinates Editorial 6 **His Coordinates** Steve Berglund 12 **News** GIS, LBS 34 GPS 36 Remote Sensing 37 Galileo update 38 Industry 40 **Mark your calendar** May 2009 to December 2009 42

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Land records.

Never have been easy to deal with in many countries.

Despite their importance.

Technology has advanced considerably.

Could be a great support to address issues.

Only, if issues are technical.

But issues are economic.

At times emotive, and most of the time political.

Ground realities are different and difficult.

The National Land Records Modernization Programme by Government of India deserves attention (page no 14).

An ambitious initiative.

Bal Krishna, Editor
bal@mycoordinates.org

Adding GRACE to GNSS

Starting out as an exclusive military tool, SatNav technology has over the last few years permeated into many spheres of our lives. From live saving Search and rescue to the convenience of tracking pets, the spectrum of applications is vast. Users have the pleasure of being offered new products and solutions using the Global Satellite Navigation System (GNSS) technology on a regular basis. The base for all this advancement has been dedicated research and development by various teams. Currently with several new navigation satellite systems in the process of being commissioned, research and development take on a completely new meaning and role.

At the moment the US operated Global Positioning System (GPS) is the only fully operational GNSS, but GLONASS from Russia, EU's Galileo and COMPASS from China are expected to become fully operational in the next few years. As these systems move towards completion, another race is on – to develop products and applications that will utilize the capabilities of these systems. The final success of these GNSS will be measured by the extent to which they are ultimately utilised.

GRACE

The GNSS Research and Application Centre of Excellence (GRACE), is a cross disciplinary centre providing cutting edge research, high calibre teaching, and business support services to the GNSS community. In October 2009 GRACE will move into its own state-of-the-art purpose built centre. A ground breaking ceremony took place on the 11th of November 2008, and construction of the centre is underway at the University of Nottingham Innovation Park (UNIP) on the Jubilee campus of the University of Nottingham.

It will be the only facility in UK dedicated to the development of downstream applications and services using GNSS. The European Union has estimated the market for downstream applications and services to be worth in excess of £230 billion by the year 2025.

Supporting the University of Nottingham in this venture which will have an investment of £9.2m is the East Midlands Development Agency (EMDA), one of the nine regional development agencies in England. EMDA was established in 1999 with the primary goal to increase the economic growth of the East Midlands region.

"More than 120,000 people in the East Midlands are already employed in industries closely related to GNSS and telematics. This cutting-edge facility will really boost the sector, putting the region on the map as a highly-skilled and innovative area where technology is driving business growth. We are delighted to be working so closely with The University of Nottingham on the GRACE project which is the first of its kind in the UK." Said Jeff Moore, EMDA's Chief Executive.

Professor David Greenaway, Pro-Vice Chancellor for Research said, "With EMDA we are investing not only in the University and region, but in a national asset. There is enormous potential here and I expect significant benefits to follow, not only in terms of support for the business community, but also in visibility for our region."

Bringing expertise together

The newly formed team of GRACE will synergise with the staff, research students and the research and training facilities of two institutes of the University of Nottingham - the Institute of Engineering Surveying and Space Geodesy (IESSG) and the Centre for Geospatial Science (CGS). Both institutes are coming together to occupy the new GRACE building.

Research at IESSG encompasses fields such as Photogrammetry, Remote Sensing, Sensor Integration and GIS besides the traditional focus around satellite navigation and positioning systems. CGS is a cross disciplinary research centre focussing its research efforts in geospatial techniques and how they can augment other fields.

World class research and development

Occupying an area of over 2,000 sq m the GRACE centre will provide regional, national and international business access to facilities that will include customised incubation units, project offices, latest testing equipment, secure research and development laboratories and dedicated training suites.

"GRACE provides a one of a kind springboard for businesses operating in the GNSS sector in the UK providing incubation services, access to business support and state of the art test and simulation services. Our aim is to become the focal point for downstream GNSS activity in the UK" said Paul Bhatia, General Manager of GRACE.

Infrastructure and services at GRACE

- GNSS Research Laboratory and Training Services
- GNSS simulation, test-bed and testing facilities
- Business Incubation Units
- Supported Consultancy Activity
- GNSS Applications Development
- Dedicated Training Suites
- Business Support Services
- Potential Venues for National Project Offices

The GRACE building will have a series of geospatial laboratories, each focussing on a specific area – from GNSS activities to Image Processing to Location Based Services and GIS. An innovative feature will be the state of the art laboratory designed into the roof of the building. It will have a series of stable monuments which are supported through the whole of the building and into the foundations. These will provide high tolerance platforms for continuously operating GNSS receivers used for both earth movement research and to provide support to the RTK Network project.

A unique facility of the "roof lab" will be a stable track system which will allow experiments of a kinematic nature over a know trajectory. This will be a wireless controlled system with high precision repeatability. The roof will be surfaced with a multipath reducing surface and obstructions have been designed to be at a minimum.

The Mobile laboratory

The Integrated Positioning Vehicle or the GRACE Mobile Laboratory is capable of providing centimetre level accuracy of position in all road environments. The vehicle will be used to support both systems testing and systems integration. It is hoped that these advanced facilities will stimulate industry to develop and test applications and services in the UK by providing an environment in which researchers and developers can conduct repeatable tests in controlled envelopes and real-life environments.

Making its presence felt

A feather in the cap for the GRACE team was to host the UK 'Growing Galileo' event earlier this year in conjunction with the Location and Timing Knowledge Transfer Network. The event was held in the Sir Colin Campbell building adjacent to the new GRACE site. In the second call for proposals for the EU's 7th Framework Programme, about €40m is available for GNSS research and development projects. The UK 'Growing Galileo' event focussed on access to new funding from the European GNSS Supervisory Authority (GSA) for collaborative projects under the FP7. With over 100 registrations and 80 attendees the event was a great success. Professor Terry Moore, Director of GRACE and Professor of Satellite Navigation said: "This seminar has been hugely beneficial to all taking part and it represents a real signal of intent for GRACE. We aim to make GRACE a true centre of excellence in the East Midlands and that work begins with opportunities like this."

Shaping the future

The GRACE team has provided an important tool in the form of the feed back form on their website to receive information from their target markets. This information will help to shape the direction of GRACE.

The website (http://www.grace.ac.uk/index.php) says "We are busy shaping the future of GRACE and would welcome your thoughts on how GRACE could help you." So, as they prepare for the future the GRACE team is leaving no stone unturned to make sure that all is perfect at their innovative new centre.

“GRACE has been created to serve the requirements of the GNSS industry”

Paul Singh Bhatia, General Manager GRACE on initiative, focus and plans of GRACE

Paul Singh Bhatia initially qualified as a Mechanical Engineer and holds a Masters in Engineering Business Management from the University of Warwick. He has well over 15 years of experience working with industry including 5 years attracting technology driven international investment into the East Midlands region of the UK.

How did the idea of setting up GRACE come up?

The East Midlands region in the UK has always been a strong player in the development of GNSS solutions and the IESSG (Institute of Engineering Surveying and Space Geodesy) based at the University of Nottingham and headed by Professor Terry Moore is the leading university based research centre in the UK (if not Europe) in the downstream applications of satellite technology. Independent forecasts predict that the growing market for downstream GNSS could lead to the creation of up to 140000 knowledge driven new jobs by 2025 through the creation of Galileo and the UK needed to act in order to attract its fair share of these jobs. GRACE was created through a partnership between the East Midlands Development Agency, the University of Nottingham and the private sector to further stimulate the regional and national GNSS sector as a result of a major research study and stakeholder consultation that commenced in 2006.

There seem to be three separate entities coming together to form GRACE – The IESSG, CGS and a new GRACE team itself. How will the synergy between the three be achieved?

The IESSG has traditionally focussed on the development of GNSS signal and applications technology whereas the bias of the CGS has been on utilising PNT in mapping applications for LBS. GRACE can essentially be regarded as the glue that sticks the two together. GRACE is effectively the front door to the PNT and the LBS activities carried out within the University of Nottingham and will work to attract projects that further integrate the traditional activities of the 2 schools.

Will the Institute of Engineering Surveying and Space Geodesy (IESSG) and the Centre for Geospatial Science (CGS) continue to work as separate entities under GRACE?

GRACE has been conceived to provide business assistance to both the users and the developers of GNSS technology. IESSG has traditionally concentrated on the processing of GNSS signals and the CGS on the utilisation of positioning data in mapping applications. The 3 centres will for the first time be co-located in a new state of the art facility called the Nottingham Geospatial Building. GRACE will serve as the one-stop contact point for organisations operating in the domain of geospatial sciences.

Many companies are also doing GNSS research with reference to their products, how will research at GRACE be different from research being done by individual companies?

GRACE has been created to serve the requirements of the GNSS industry. So our services and product research can effectively be tailored to satisfy the needs of our stakeholders. Some major reasons for its conception have been to act as a portal for industry to collaborate together and to provide resources to organisations to access national and international research and development funds. Our intention is to invest in development tools that may otherwise be out of the reach of SMEs or that provide our stakeholders access to state of the art facilities on a project by project basis. For example we have recently partnered with Spirent to install a full Galileo/GPS signal simulator within GRACE. Not only will this equipment be used for scientific research purposes, it will also be made available to industry for use on a project by project basis. This allows SMEs in particular to develop their applications and test their services in a cost-effective and competitive way.

What areas of research are being planned at GRACE?

GRACE is currently in close discussion with its stakeholders regarding collaborative projects that will strengthen the GNSS sector in the UK. These are primarily linked to the strengthening of the industrial base and include the development of advanced testing and certification

capabilities. Our clear focus is on the development of downstream services and applications. We are open to all manner of collaborations in this domain although we maintain a strong focus on ubiquitous location, combined technology platforms and solutions for PNT (Position, Navigation and Timing) provision, novel uses of GNSS including environmental applications and preparations for future GNSS. We will do this principally in conjunction with our partners whether they be regional, national or international in nature.

Will the focus of research be on GPS and Galileo, or will it include other GNSS systems as they become operational?

Right now the focus is on processing GPS, because those are the signals that exist in the sky. However GRACE was conceived to position the UK in readiness for GALILEO and other existing and forthcoming GNSS i.e. GLONASS and COMPASS. As well as SBAS and GBAS including of course EGNOS. The IESSG manages a major pan regional array of NRTK reference stations that it continues to develop in conjunction with its partners so we are starting from a strong base from which we can develop world-class AGNSS solutions. GRACE also aims to play a major role in co-ordinating international activity and we already have strong international links including with China and India. For example the Nottingham Geospatial building will host a Compass reference station.

What kinds of training courses are being planned at GRACE?

GRACE will be offering all manner if GNSS training courses from short introductory sessions on the fundamentals of GNSS, its utility and applications right through to specialised residential courses covering specialist areas such as Kalman Filtering and atmospheric scintillation. We are in the process of designing our course portfolio and welcome discussions with individuals and organisations with specific training requirements..

Would the training spectrum cover training for students as well as professionals?

GRACE will be running both in-house and client designed courses for major UK and multinational organisations. Masters level materials and teaching can also be integrated with client provided content and resources in a client designed structure. Practical sessions can be integrated into this structure, giving hands-on exposure to the latest technology available, through our up-to-date range of equipment and data processing packages. In addition, GRACE is currently assessing the demand for residential summer schools based in Nottingham and would welcome enquiries from interested parties.


Paul Bhatia with Jeff Moore, Chief Executive, *emda* and Prof. Terry Moore, Director, GRACE

Could you please tell us more about the exciting new rooftop laboratory at GRACE?

The GRACE building will have a series of geospatial laboratories, each concentrating on a specific area of interest from GNSS activities through image processing to location based services and GIS. The roof of the GRACE building has been designed to create a state of the art laboratory. It will have a series of stable monuments which are supported through the whole of the building and into the foundations. These will provide high tolerance platforms for continuously operating GNSS receivers used for both earth movement research and to provide support to the RTK Network project. The roof will be surfaced with a multipath reducing surface and obstructions have been designed to be at a minimum.

Though the new GRACE building will be ready only later this year, GRACE has already made its presence felt by hosting the 'Growing Galileo Event' earlier this year. What is the next event being planned at GRACE?

We have a strong schedule of events planned that GRACE will operate either by itself or in conjunction with its partners. Our next major event is the Vista conference planned for June 11. Vista is an initiative that investigates improved sensing technology, cm accurate positioning, and techniques for ensuring that assets buried in the future can be found more easily. We are also proud to be jointly hosting the Royal Institute of Navigations NAV09 Conference & Exhibition. The event will be looking at the changing landscape of positioning and navigation systems over the next 20 years. The conference will be addressed by internationally leading experts from a variety of backgrounds directly involved in this changing environment. A full events programme is being formulated so keep watching our website which is in the process of being developed into a valuable resource for industry.

University of Nottingham has campuses in various countries; would GRACE also eventually have branches in other countries as well?

GRACE is international in its outreach and the GRACE model is exportable. We will be happy to open dialogues with other nations. As you mention UON has international campuses in China and Malaysia and we have a joint venture operation in New Zealand called the Geospatial Research Centre (GRC).

"Continued innovation is a primary driver for us"

Says Steve Berglund, president and CEO of Trimble in an exclusive interview with Coordinates

Can you describe some defining moments for Trimble in its 30 year journey from the vision of Charlie Trimble in 1978 to the Trimble of today?
Trimble was the first GPS company to go public, offering stock on the NASDAQ (TRMB) in 1990.

In 2000, Trimble acquired the Spectra Precision Group, a leading provider of positioning solutions for the construction, surveying and agricultural markets. Through the acquisition, Trimble gained significant resources in positioning technology complementary to GPS, including laser and other optical devices. The purchase of Spectra Precision doubled the size of Trimble.

Trimble's revenues have grown from approximately $270 million in 1990 to over $1.3 billion in 2008.

More than 30 years of innovation has also continually defined Trimble. We were listed in the top innovative companies within the Electronics & Instruments industry in the Patent Scorecard of the Wall Street Journal in 2009. Trimble is ranked 37th in technology strength. We currently have more than 850 U.S. and International patents. To date, Trimble has acquired 36 companies.

With you various acquisitions and alliances can it be said that the focus of Trimble is still on 'positioning and navigation'?
Trimble's focus has shifted over time away from defining ourselves in the context of a technology or set of capabilities. Instead, we define ourselves within the context of the markets we serve – such as construction, surveying, agriculture, and etc.

None the less, positioning remains a key element in our solutions. We integrate a wide range of positioning technologies including GPS, laser, optical and inertial technologies with application software, wireless communications, and services to provide complete commercial solutions, which allow customers to collect, manage and analyze complex information faster and easier, making them more productive and efficient.

Continued innovation is a primary driver which allows Trimble to grow organically. For example, we invested 11 percent of our 2008 revenues for research and development and currently our IP portfolio includes over 850 U.S. and International patents. Acquisitions have played a role in our strategy, principally as mechanisms to establish beachheads in new market spaces, fill in product line gaps, or add new technologies to our solutions portfolio. Trimble has also developed significant strategic alliances or joint ventures in our market areas. For example, Trimble has an alliance with Case New Holland in agriculture, two joint ventures with Caterpillar in construction and a joint venture with Nikon in survey. We also have a cooperative licensing deal with Nokia for our GNSS patents related to designated wireless products and services involving location technologies, such as GPS, assisted GPS or Galileo. We also have a licensing agreement with Marvell Semiconductors for our full GPS DSP software as well as tools for development support and testing. We expect that we will continue to establish new partnerships as another key element of our strategy.

Trimble is changing the way work is done by linking positioning to productivity, can you please elaborate on this statement for our readers.
Trimble is transforming the way work is done through the application of innovative positioning technologies. Trimble combines GPS, lasers, optical, and inertial technologies with wireless communications and application-specific software to provide complete solutions. These solutions enable professionals in engineering and construction, surveying,

agriculture, fleet management and field service, public safety and mapping to be more productive by revolutionizing their work processes and coupling the field to the office.

Today, Trimble engineers are working on cutting-edge positioning applications that no one could have imagined a few years ago. Trimble technology can be found in commercial vehicles, construction equipment, farm machinery, computers, personal digital assistants (PDAs) and more. Innovative applications include dispatching and managing fleets, surveying and building roads, monitoring and mapping earthquake damage, recording and synchronizing international financial transactions, and improving the efficiency of wireless communications networks.

What solutions is Trimble focusing on for the emerging markets in China, India and Eastern Europe where infrastructure projects are pushing the demand for positioning technology?

Generally, we intend for most of our solutions to be worldwide. When it comes to India, China, and other emerging economies there is often a need to localize the worldwide solution to meet specific needs. We are establishing local capabilities in our markets. For example, we now have approximately 200 employees in Chennai, both a software development center and factory in Shanghai, and a number of software centers around Europe.

Trimble is said to be committed to making available Galileo compatible products to the users well in advance of the system availability, what about compatibility with other GNSS systems?

It is an exciting time for GNSS with multiple systems in the operating, deployment, modernization and planning stages. GNSS signal interoperability is a testament to the cooperation among the international scientific and engineering community supported by governments. Adoption of GNSS signals is fundamental to Trimble's technology strategy as demonstrated by our history. Plans to utilize new elements of GNSS include modernized GPS and GLONASS, and future Galileo and Compass signals. We plan to have Galileo and Compass compatible products available well in advance. Our goal remains: to offer solutions that meet customers' needs by utilizing the best technology available, now and in the future.

How effective has the recycling of Trimble products program been?

Being eco-conscious isn't just good for the planet. It's good for business as more customers seek out companies dedicated to sustainability.

We recognize the importance of minimizing the environmental impacts of our products and believe our recycling program is going well thus far. That is why Trimble is actively pursuing, and will continue to pursue, the expanded use of environmentally friendly materials in all its products, and why we established a convenient recycling program for Waste Electrical and Electronic Equipment (WEEE). We have a recycling facility located at our Trimble Europe B.V. European Regional Fulfilment Center (ERFC) in Eersel, The Netherlands, for our customers, distributors and subsidiaries.

The European Union defined a group of six compounds as restricted hazardous substances under its Restriction of Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) Directive. They are: mercury, cadmium, lead, chromium VI, polybrominated biphenyl (PBB), and polybrominated diphenyl ether (PBDE).

We redesigned our products to remove these materials where they exist, and are actively working to abide by the EU restrictions. As of July 2006, our products in the European market met the requirements of the RoHS Directive. In addition, Trimble is working toward applying these same standards to all of our products wherever we sell or distribute them.

In addition to recycling and using environmentally friendly materials, our solutions are being used by customers to help minimize their impact on the environment. For example, farmers are using our agriculture solutions to reduce the use of fertilizer while in the field. Our fleet and mobile resource management solutions are helping organizations to better manage mileage, idle time and fuel usage in an effort to reduce CO2 emissions. And finally, green investment funds are investing in Trimble.

Key acquisitions in engineering & construction and mapping & GIS industries include:	
2000	Spectra Precision Tripod Data Systems (TDS)
2003	Applanix Corporation
	MENSI, S.A.
2004	GeoNav GmbH
2005	Pacific Crest Apache Technologies, Inc.
2006	Intellectual property assets from The XYZs of GPS Inc. Quantm Assets of BitWyse Solutions, Inc. XYZ Solutions, Inc. Meridian Systems, Inc. Spacient Technologies
2007	@Road, Inc. INPHO GmbH Ingenieurburo Breining GmbH UtilityCenter assets from UAI, Inc.
2008	Crain Enterprises, Inc. HHK Datentechnik GmbH Geo-3D Inc. SECO Manufacturing Company RolleiMetric assets from Rollei GmbH TopoSys GmbH FastMap and GeoSite software assets from KOREC
2009	Callidus Precision Systems GmbH assets QuickPen International

NLRMP: mission possible

The Government of India has recently come out with Draft Guidelines on implementation of National Land Records Modernization Programme (NLRMP). We present here the abridged version of the same for discussion. The complete guidelines can be seen at www.dolr.nic.in. We request our readers to share their views with us on this. Your views will be published in the next issue of Coordinates

On August 21, 2008 the cabinet approved the proposal of the Department of Land Resources (DoLR), Ministry of Rural Development to merge two existing centrally sponsored schemes and replace them with the modified scheme of National Land Records Modernization Program (NLRMP). The two schemes being merged are the Strengthening of Revenue Administration & Updating of Land Records (SRA&ULR) and Computerization of Land Records (CLR).

Objective

The main objective of the NLRMP is to develop a modern, comprehensive and transparent land records management system in the country with the aim to implement the *conclusive land-titling system with title guarantee*.

Scope

All the components and activities under NLRMP shall be taken up in a systematic, ladder-like manner. Two kinds of ladders have been formed.

The primary ladder covers activities for reaching the stage of conclusive titling, and the secondary ladder covers archival purposes and strengthening of the revenue administration.

I. Computerization of land records

a. Data entry/re-entry/data conversion of all textual records including mutation records and other land attributes data
b. Digitization of cadastral maps
c. Integration of textual and spatial data
d. Tehsil, sub-division/district Computer centers
e. State-level data centers
f. Inter-connectivity among revenue offices

II. Survey/resurvey and updating of the survey & settlement records (including ground control network and ground truthing) using the following modern technology options:

a. Pure ground method using electronic total station (ETS) and global positioning system (GPS)
b. Hybrid methodology using aerial photography and ground truthing by ETS and GPS
c. High Resolution Satellite Imagery (HRSI) and ground truthing by ETS and GPS.

III. Computerization of Registration

a. Computerization of the sub-registrar's offices (SROs)
b. Data entry of valuation details
c. Data entry of legacy encumbrance data
d. Scanning & preservation of old documents
e. Connectivity to SROs with revenue offices

IV. Modern record rooms/land records management centers at tehsil/taluk/circle/block level.

V. Training & capacity building

a. Training, workshops, etc
b. Strengthening of the Survey and Revenue training institutes

VI. Core GIS

a. Village index base maps from satellite imagery, for creating the core GIS
b. Integration of three layers of data:
c. Spatial data from aerial photography or high-resolution satellite imagery;
d. Survey of India and Forest Survey of India maps; and
e. Cadastral maps from revenue records.

VII. Legal changes

a. Amendments to the Registration Act, 1908
b. Amendments to the State Stamp Acts
c. Other legal changes
d. Model law for conclusive titling

VIII. Programme management

a. Programme Sanctioning & Monitoring Committee in the DoLR
b. Core Technical Advisory Group in the DoLR and the States/UTs
c. Programme Management Unit (PMU) in the DoLR and the States/UTs
d. Information, education and communication (IEC) activities
e. Evaluation

Implementation

The district will be taken as the unit of implementation, where all activities under the programme will converge. It has been

decided to cover the entire country by the 12th Plan period. Outsourcing to the extent necessary for meeting the critical gaps in technological resources shall be permissible, and the States/UTs may go for the public-private partnership (PPP) models in the nonsensitive areas. Initial funding will be provided to the States/UTs based on their perspective plan and annual plan for the first year. However, continued funding will be conditional upon the States/UTs signing the Memorandum of Understanding (MOU) with the DoLR and following its stipulations.

Content management: All textual data shall be updated and computerized. All spatial data shall also be updated and digitized.

Digitization of maps: The village maps/ sheets, ladder data or gat maps/tippans/ FMB's will be considered as the basic input for digitization and mosaicing of the cadastral maps in the States/ UTs.

Survey/Re-survey & Updation of Survey & Settlement records: For fresh survey, in areas where cadastral maps are not available, the following options are suggested: (i) ETS + GPS (ii) Aerial Photographs + ETS + GPS

For resurvey, aerial photography (wherever possible) and ETS + GPS for ground truthing is recommended.

Core GIS: Seamless integration of spatial data sets, GIS-based queries, MIS integration and imagery overlay to create core GIS for micro and macro-planning and other relevant applications may be undertaken at the Centre level.

Computerization of the Registration Process: Under this component all the SROs will be fully computerized with adequate hardware, software, process re-engineering, staff training and connectivity with the revenue records maintenance system, banks, treasuries, etc.

Encoding Standards: UNICODE should be used for data storing and local language display and support. Any database created using ISCII or any other fonts based solution should also be converted to UNICODE.

Modern Record Rooms/Land Records Management Centers: Support for upgrading modern records/land records management centers with

a. Storage area with compactors for physical storage of records and maps
b. An operational area with computers, storage area network (SAN), printers, etc.
c. Public services area for waiting/reception, etc.

Software development: In order to have uniformity, standardization and integration, the software development and software maintenance support may be provided by National Informatics Centre (NIC). The source code will be made available to the States/UTs if required. The software may be developed using "open standards and open source systems".

Authentication Mechanism: Digital data have given rise to new concerns related to security of the vital database in terms of authentication, access control, roles and responsibilities of various users in affecting changes in the database etc. These need to be appropriately addressed and all the States/UTs must adopt and implement security management system as per ISO/IEC 27001.

Risk Resolution Plan: State/UT Governments will document a proper risk resolution plan with the help of NIC to handle issues covering hardware/ system failure, short circuit, database crash, irregular backup, system hang, un-readable CD formats, data loss while porting of data, back up media, etc.

Horizontal & Vertical Connectivity: All the land records offices at tehsils or equivalent locations, registration offices, subdivisions, divisions will be connected via local area network and wide area network in an appropriate configuration based on function and technical requirements in order to integrate the entire land records and registration system.

Technical Support to the States/ UTs and Implementing Agencies: The necessary technical guidance and hand holding support to the States/UTs and the implementing agencies shall be arranged through the Core Technical Advisory Group created for the NLRMP in the DoLR with members from the national level technical agencies.

Role of the Panchayati Raj Institutions & NGOs: Gram Panchayats can play a significant role in updation of land records and identification of property owners in the course of settlement operations. Gram Sabha could be involved to facilitate survey/re-survey, wherever necessary.

Monitoring and review mechanism

Monitoring and review committees at the District and Sate level will have to be constituted. At the national level, for sanctioning of projects and monitoring and reviewing of the programme, a Committee has been set up under the chairpersonship of the Secretary, DoLR. The Committee will monitor and review progress of work in the country.

Evaluation

To get the impact assessment and feedback about the actual implementation of the Programme at field level, the DoLR will get the Programme evaluated by reputed organizations.States/UTs are also advised to carry out concurrent evaluation and impact done by in-house teams/experts to assess the on-site progress vis-à-vis deliverables of the sanctioned projects and suggest the measures for improving the system.

Funding

NLRMP will be a demand driven scheme. The assistance of Central Government will be restricted to its share based on the estimated cost approved by the EFC.

Training and capacity building

States are required to draw up a comprehensive training programme to develop their human resources for effective maintenance and sustenance of the NLRMP.

Flight evaluation of a 'GADA'

The development and the evaluation of GPS attitude determination algorithm (GADA)'s static and dynamic characteristics are presented and the results are considered satisfactory for the application.

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pd@geev.cta.br

Prof. Fernando Walter
Instituto Tecnológico de Aeronáutica (ITA)

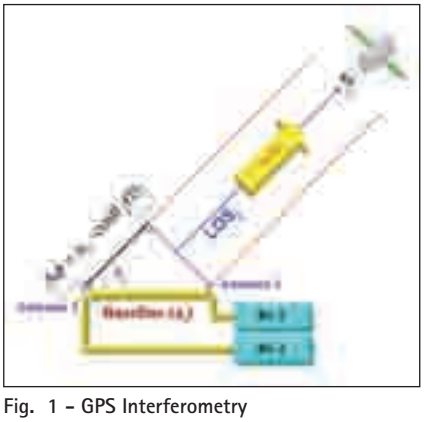


Fig. 1 – GPS Interferometry

For the final evaluation of a GPS attitude determination algorithm (GADA), it was determined its true performance in terms of its accuracy, reliability and dynamic response. To accomplish that, a flight test campaign was carried out at the Brazilian Flight Test Division (GEEV) to validate the attitude determination algorithm. In this phase, the measured aircraft attitude was compared to a reference attitude, to allow the determination of the errors. The flight test campaign was carried out at the Brazilian's Flight Test Division T-25C 1956 Basic Trainer aircraft manufactured by EMBRAER. The performance and accuracy of the system is demonstrated under static and dynamics tests profiles, which are fully compliant with the Federal Aviation Administration (FAA) Advisory Circular (AC) 25-7A. Dynamic response of the system is evaluated. Data reduction analysis of more than 12 hours flights showed that GADA errors are satisfactory for attitude determination. Also it is presented that its static accuracy is highly dependable of the Attitude Dilution of Precision (ADOP) while the dynamic accuracy depends upon the GPS receiver PLL model and coefficients.

Introduction

The aircraft attitude is the angular relationship between the aircraft body reference system $\mathbf{S_B}$ and the Earth-fixed reference system $\mathbf{S_R}$, expressed by the Euler angles: θ (pitch), ϕ (roll), and ψ (yaw). Using three sequential rotations over the Euler angles in the following sequence: $[\psi\ \theta\ \phi]$ it is possible to express the transformation matrix [1], from $\mathbf{S_R}$ to $\mathbf{S_B}$ as:

$$L_{GR} = \begin{bmatrix} c\theta c\psi & c\theta s\psi & -s\theta \\ s\phi s\theta c\psi - c\phi s\psi & s\phi s\theta s\psi + c\phi c\psi & s\phi c\theta \\ c\phi s\theta c\psi + s\phi s\psi & c\phi s\theta s\psi - s\phi c\psi & c\phi c\theta \end{bmatrix} \quad (1)$$

Where: $c\theta \equiv \cos(\theta)$; $s\theta \equiv \sin(\theta)$; $c\phi \equiv \cos(\phi)$; $s\phi \equiv \sin(\phi)$; $c\psi \equiv \cos(\psi)$; and $s\psi \equiv \sin(\psi)$.

The basic measurement for GPS attitude determination is the phase difference (Δϕ) between the signals received by two antennas that define a baseline (Fig.1), as:

$$\Delta\phi_{i,j} = a_i \cos(\theta_j) \quad (2)$$

Where: a_i = is the ith baseline length, θ_j = is the angle between the baseline ai and the line of sight to the jth GPS Satellite Vehicle (SV_j).

The GPS attitude determination algorithm uses two baselines (a_1, a_2) plus a computed baseline (a_3) to define a Cartesian coordinate system S_G. The S_G axes (x_G, y_G, z_G) are fixed on the aircraft body, and defined by the placement of three antennas (***Ant***$_1$; ***Ant***$_2$ and ***Ant***$_3$) [2].

Given an aircraft attitude, it is possible to express the relationship between $\mathbf{s_{iR}}$, a unit vector in the direction of $\mathbf{SV_i}$ in $\mathbf{S_R}$, and B_{jj}, the projection of $\mathbf{s_{iR}}$ on the baseline a_j [3], as:

$$B_{ji} = a_j^T L_{GR} s_{iR} \quad (3)$$

Considering that there may be errors in the measured Euler angles, eq.3 is not fully satisfied. So a known published solution (i.e. REQUEST algorithm) [4] defines a cost function (ρ), which depends on the transformation matrix (L_{GR}):

$$\rho(L_{GR}) = k \sum_{i=1}^{n} p_i \sum_{j=1}^{3} \left| B_{ji} - a_j^T L_{GR} s_{iR} \right|^2 \quad (4)$$

Where: k is a given coefficient, n is the number of **SV** being tracked, and pi is a fixed weight value attributed to $\mathbf{SV_i}$.

The attitude determination algorithm, using least-square fit techniques, searches for the transformation matrix L_{GR} that minimizes ρ.

Several algorithms (e.g REQUEST)

have been developed to solve this problem [6], where the estimation of the z-axis is given by:

$$B_{3i} = +\sqrt{\left(1 - B_{1i}^2 - B_{2i}^2\right)} \qquad (7)$$

GPS attitude determination

To avoid undesirable perturbations, a GPS receiver does not track the signal from a **SV** when its Elevation Angle (**EL**) is below a certain angle (e.g., **EL** < 15º). When the aircraft is maneuvering, the Line of Sight Angle (**LOS**) of a given **SV** (considering **EL** > 15º), could be momentarily below the GPS Horizontal Antenna Plane (**HAP**). In this case, the true value of the single difference measurement is given by choosing the negative value of eq. 7.

The use of the positive roots of eq. 7 at the above condition results in a divergent solution, rendering this algorithm unreliable for all flight conditions.

In fact Ground Based Augmentation System (GBAS) applications [8] and [9], report that an airborne GPS receiver is capable of tracking signals from Pseudolites (PL), using only a top mounted antenna.

Therefore a new GPS Attitude Determination Algorithm (GADA) was developed [10] and compared against REQUEST. The main difference between both algorithms is the fact that REQUEST uses the positive value of eq.7, while GADA searches for its true signal.

The GADA development comprised three phases:

1) Simulation;

2) Ground Tests; and

3) Flight Test.

The simulation process was developed with Matlab® 6.1 with the Satnav® Toolbox and used the REQUEST algorithm as a reference for cross evaluation. The resulting REQUEST errors were ±3.463º in θ, ±4.891º in ϕ, and ±3.513º in ψ while the GADA errors were, respectively, ±0.179º, ±0.199º, and ±0.131º, at 1σ.

The ground tests were a preview of the real flight environment and provided data to certify that the algorithm works properly. Then a swivel base for the antennas was designed and a data acquisition system was integrated (Fig. 2).

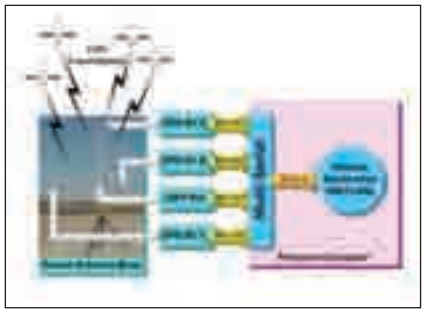


Fig. 2 – Ground test set

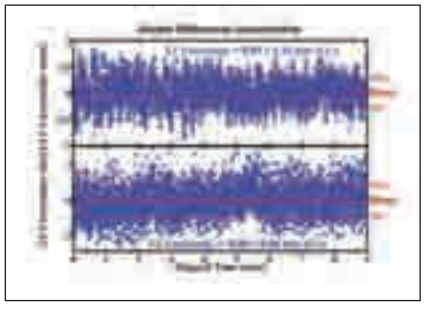


Fig. 3 – GPS L2 double differences uncertainties

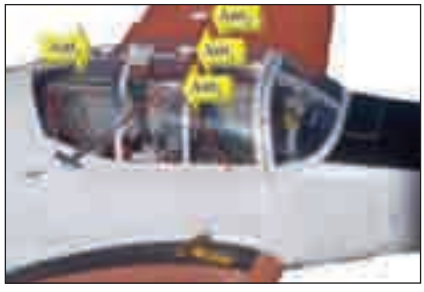


Fig. 4 – T-25C test bed for the flight tests campaign, with the GPS antenna array installed on the canopy top

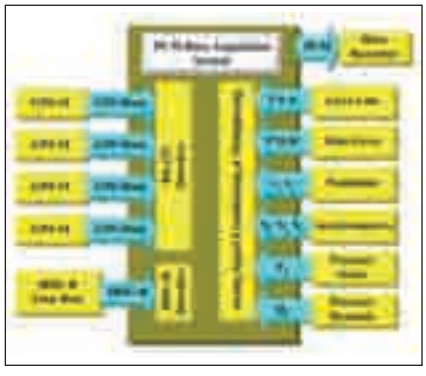


Fig. 5 – FTI block diagram. P, Q, and R and Nx, Ny, and Nz are respectively the x, y and z axis angular speed (º/s) and load factors (m/s2); Pb is the static pressure (mb), Qb the dynamic pressure (mb); IRIG-B is the Inter Range Instrumentation Group (IRIG) time format B time base; πx and πy are respectively the x and y axes pendulum inclination (º).

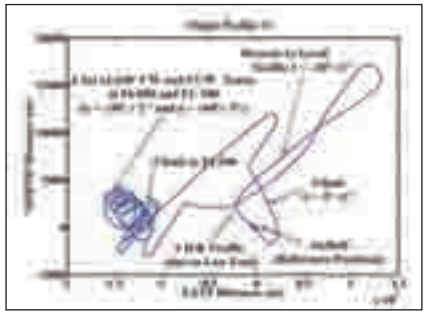


Fig. 6 – Static test profile

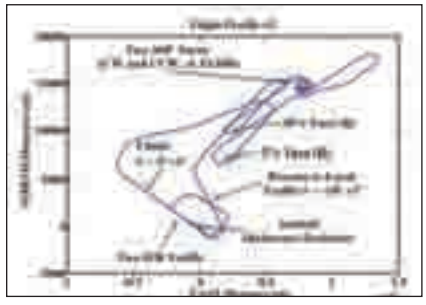


Fig. 7 – Dynamic test profile

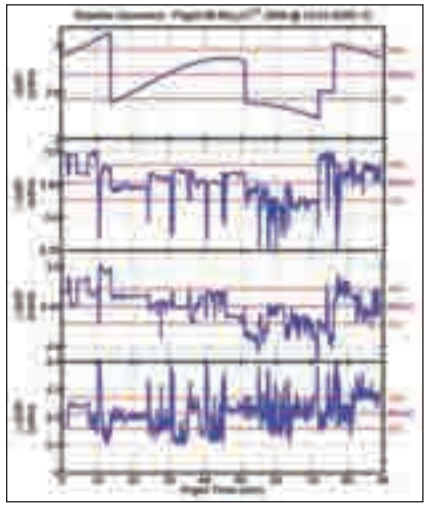


Fig. 8 – Flight #8 Satellite Geometry

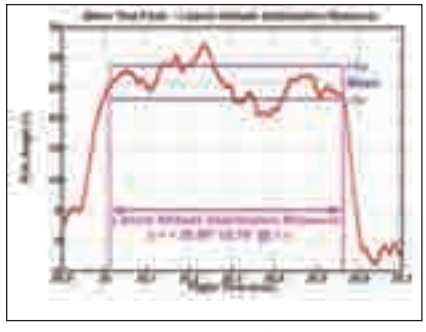


Fig. 9 – Flight #2 Test Point (Lateral Stabilization)

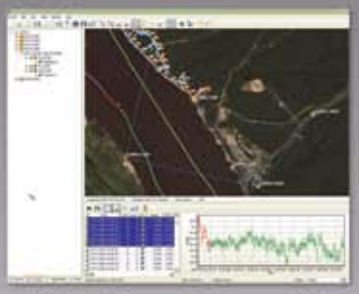
TRIUMPH-1

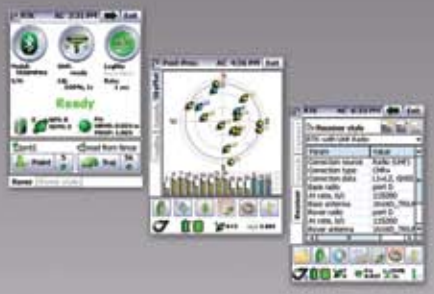
TRACY JUSTIN GIODIS

versatile and comprehensive survey systems

Justin in focus

Software solutions for all tasks





Justin
A comprehensive Survey and GIS software

Tracy
A versatile and powerful field software

Giodis
Full-featured office post-processing software

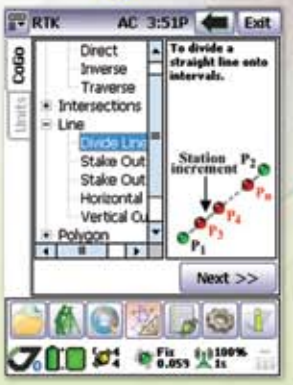
Victor

is pre-loaded with our Tracy field software. When turned on, Victor automatically connects to GISmore, TRIUMPH-1 or TRIUMPH-4X via its internal Bluetooth and guides you through field operations. It manages the GNSS receiver and modem operations automatically.

- **Lightweight** (17 ounces; 482 grams)
  magnesium case with easy-to-grip over-molding
- **Operating temperature**
  -22°F to 122°F (-30°C to 50°C)
- **Connectivity via built in Bluetooth, USB Host and Client, plus 9-pin RS-232 and optional WiFi and Modems**
- **Rechargeable, field replaceable, Li-Ion battery**
  It operates for more than 20 hours on one charge (3 to 5 hours of charging time)

Tracy

software for Windows Mobile OS to control ourreceivers,automate GNSS post processing surveying tasks (Static, Fast Static, Stop&Go, Data Acquisition), and to perform RTK survey and stakeout tasks



Support for survey and

Static, Fast Static and

Configuration of all

Geodesy & Surveying

Adjustment

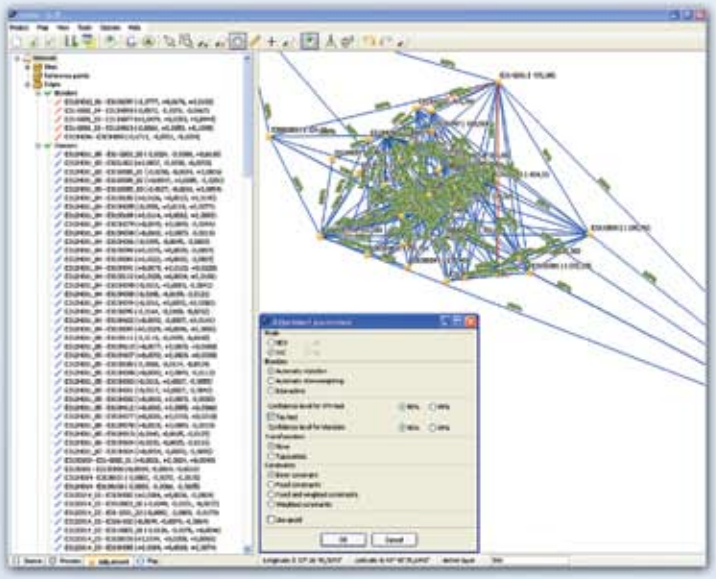
- Full covariance modelling
- Internal and external constrains (solutions and control points variances)
- XYZ/NEU mode and transformation

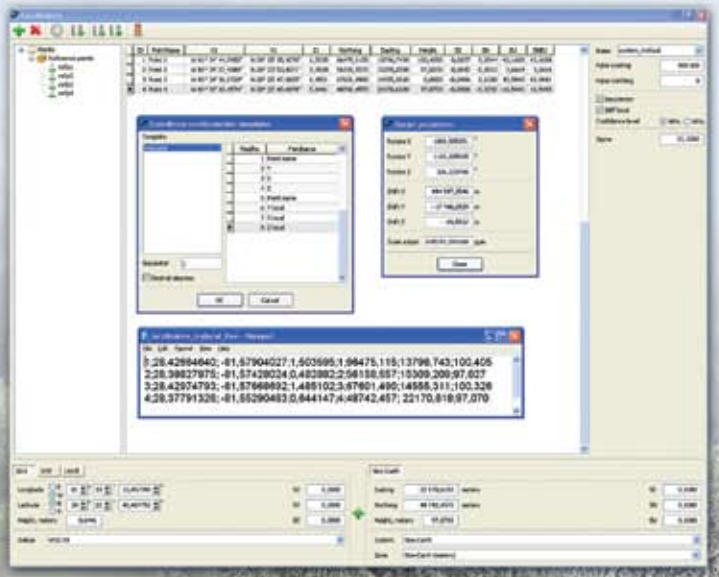
Localization

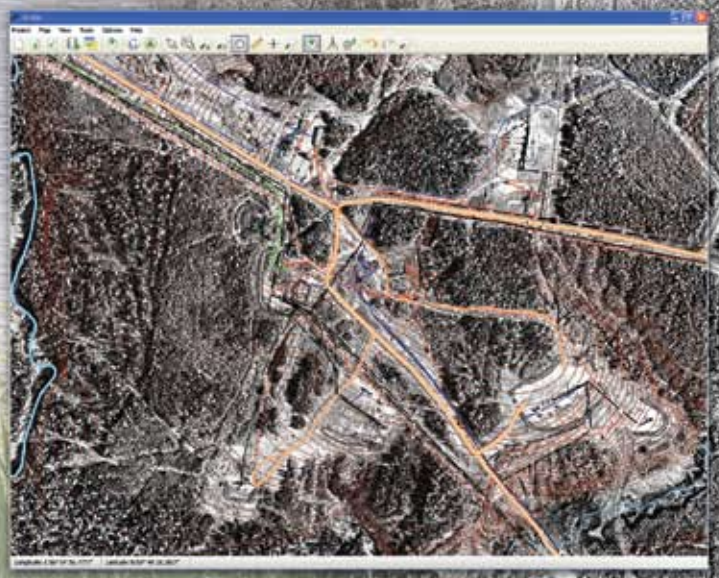
- Export/import parameters into ASCII file
- Compatibility with Tracy, Giodis and other surveying software
- Powerful transformation and adjustment features
- Blunder detection

Surveying

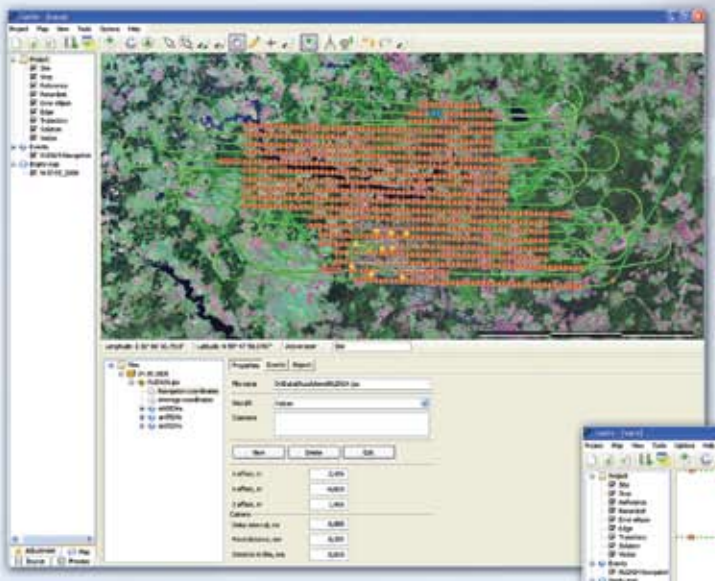
- Static, kinematic, stop&go GPS and GLONASS data processing
- Single epoch processing
- Static or kinematic processing mode for Stop points
- Interactive static processing with time line and vertical profile

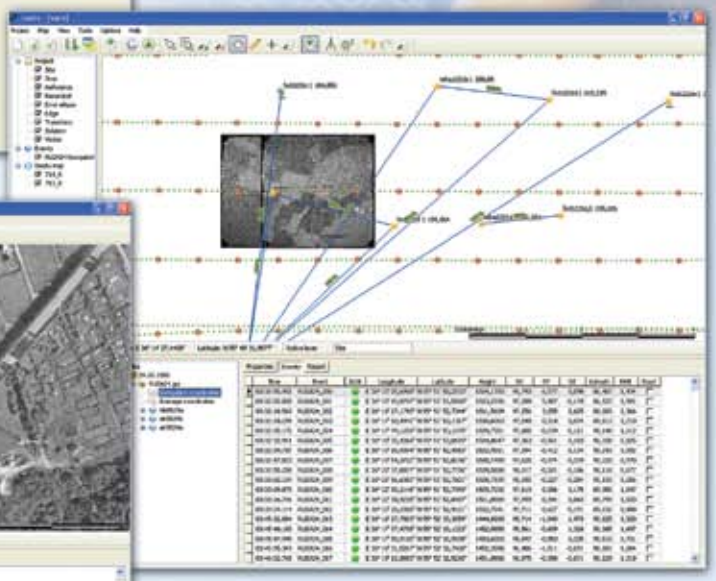


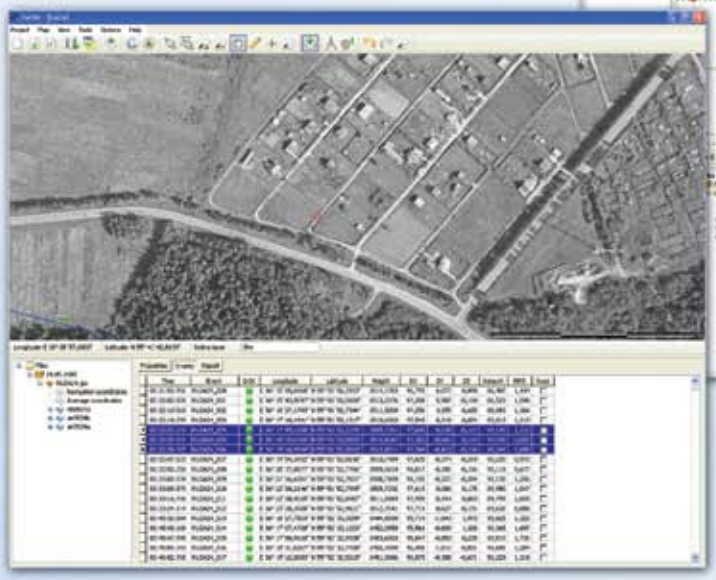


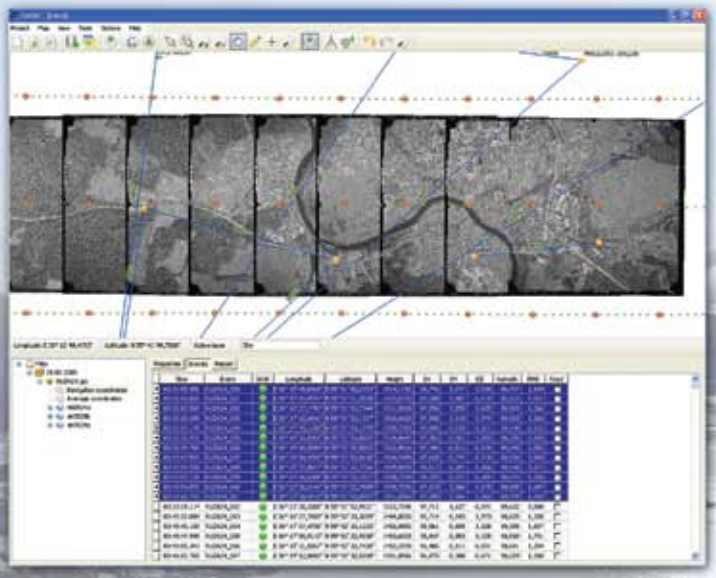


Aerial Photography



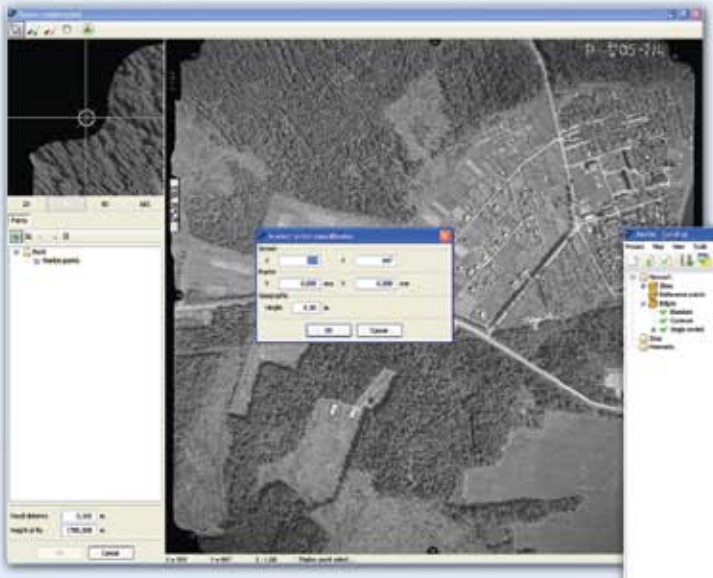


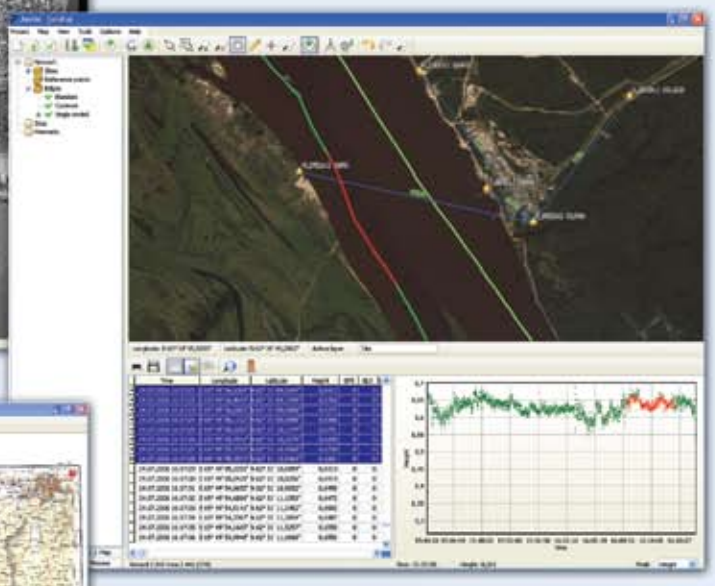




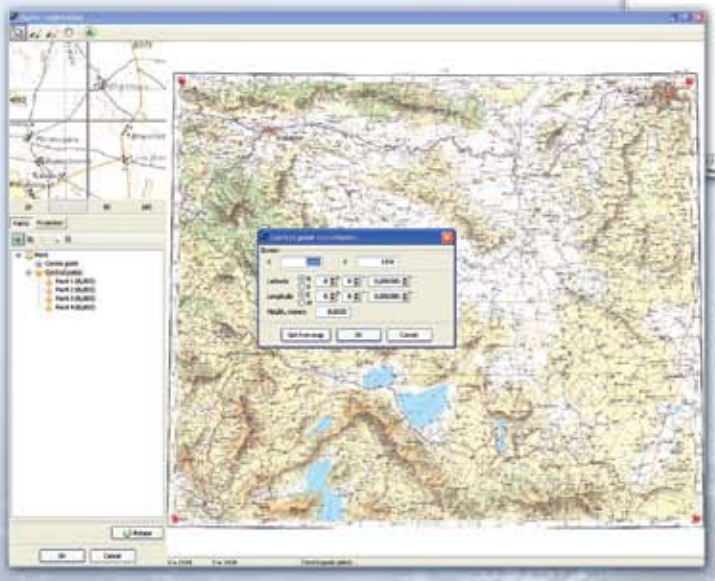
- Import Ashtech.dat and Leica.ev event files
- Interactive assignment of event mark position to picture
- Manual event labeling
- Seamless mosaic with Gtopo model
- Automatic and manual event processing
- Aircraft and camera parameter setup data base
- Trajectory adjustment

GIS Feature

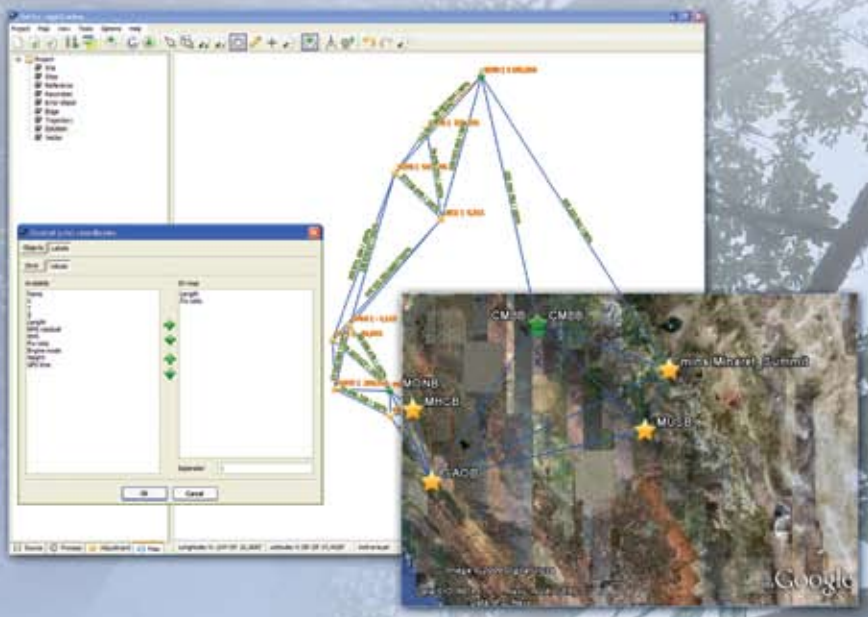




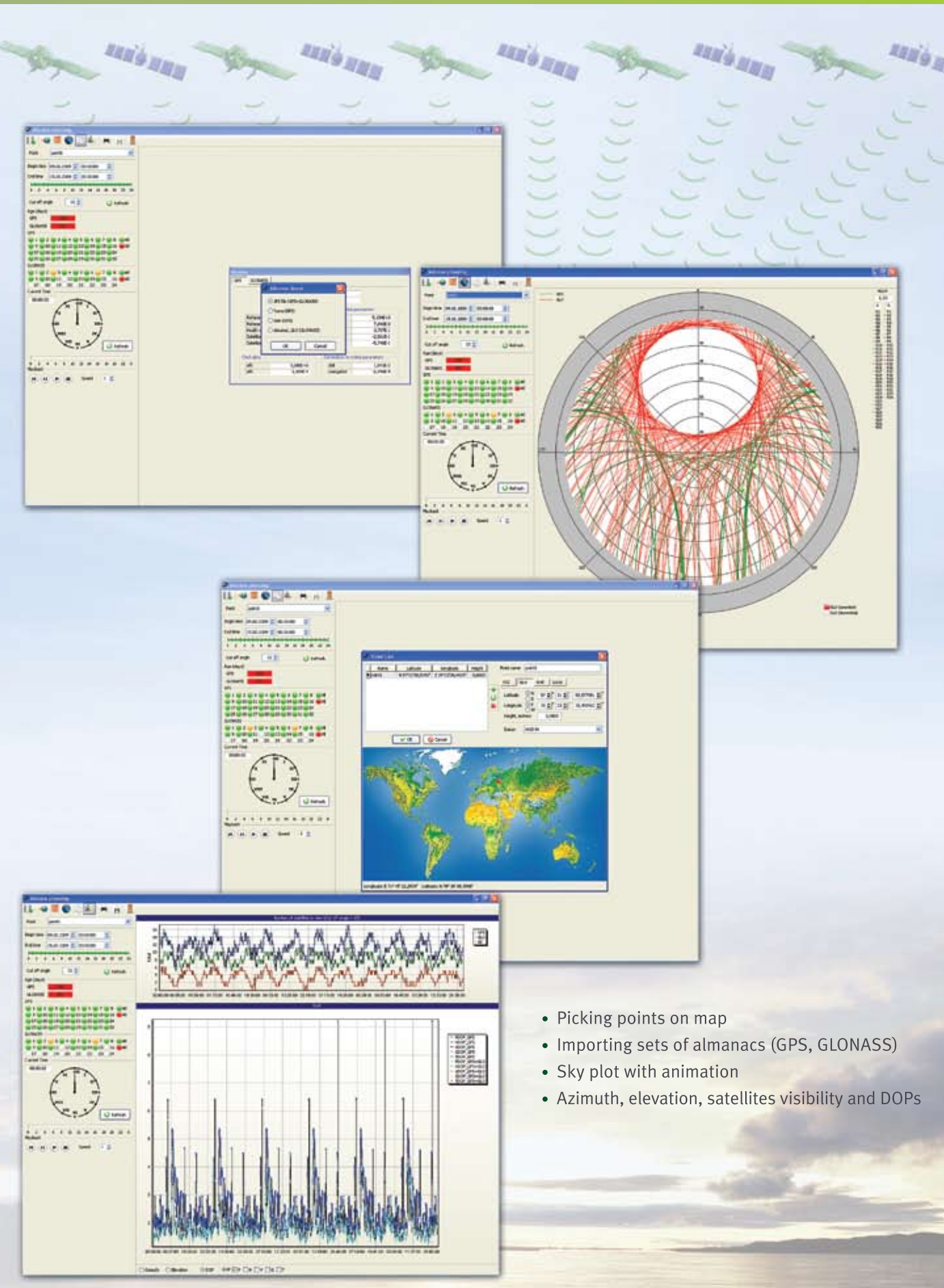
- GIS interface
- ESRI and MapInfo compatibility
- Raster background (MrSID, GeoTiff, bmp, jpg, tiff, png)



- Raster transformation and georeferencing
- Cartographic layers control (color, labeling) with data parameters
- Google Earth viewer



Mission Planning

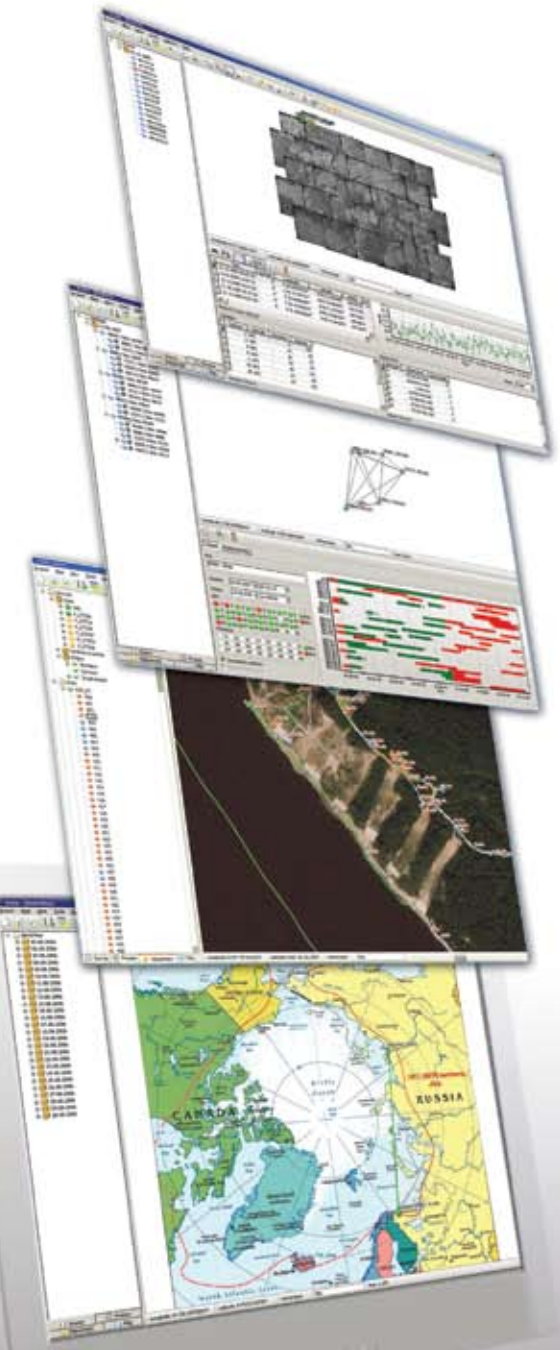


- Picking points on map
- Importing sets of almanacs (GPS, GLONASS)
- Sky plot with animation
- Azimuth, elevation, satellites visibility and DOPs

Justin software

Justin has integrated native tools to use ESRI or MapInfo cartography windows.

It can import data files as well as whole folders. Justin employs special technique to process high rover data rates (up to 100 Hz) using low base data rates. Other features include single epoch static solution, manual postprocessing with time line chart, using vertical profile to filter out suspected data and scientific data analysis and viewer.



- **Baseline processing up to 1000 km**
- **Adjustment geodetic networks up to 3000 sites**
- **Trajectory adjustment for multibase solutions**
- **Automatic data processing with Scenario**
- **Coordinates, Datum, Localization calculator**
- **Mission Planning**
- **Event Processing for aerial photography**
- **Enhanced Geoid Model**
- **Vertical Profile**
- **Vector maps**
- **Export project to dxf**
- **3D and Google Earth viewer**
- **Raster georeferencing**
- **Map printing**
- **Multilingual**

GrAnt-G3T/G3

GrAnt-G3T
is a versatile high performance antenna with GPS L1/L2/L5; Glonass L1/L2; Galileo L1/E5

GrAnt-G3
Have similar case as GrAnt-G3T.
With GPS L1; Glonass L1; Galileo E1

Snow Cone options

- Protection Against ESD
- Have good vibration and shock resistance
- Possible options:
  N-type connector
  TNC on center
  Snow Cone

TyrAnt-G2T/G3

TyrAnt is our GrAnt antenna integrated with our TR-G3 or TR-G2T OEM board. It is the first and only smart antenna with triple frequency GPS with Galileo option

140x140x62 mm,
0.6 kg

GyrAnt

GyrAnt is the GrAnt antenna integrated with Inertial Measurement Unit (IMU) consisting of three accelerometers and three gyros on three axes

140x140x62 mm,
0.6 kg

- Communication is provided via RS422 or CAN interface via M12 8 pin connector

AirAnt

AirAnt is designed to be mounted on aircrafts and applications where low profile and aerodynamic shape are desired. GPS L1/L2/L5; Glonass L1/L2; Galileo L1/E5

120x74x44.5 mm,
0.32 kg

- Overload protection
- Improved rejection out-of-band signal rejection

TriAnt

TriAnt is small, thin, and rugged high performance GNSS antenna. It is ideal for applications like navigation and surround antennas of TRIUMPH-4X. With GPS L1/L2/L5; Glonass L1/L2; Galileo L1/E5

128x128x55 mm,
0.47 kg

- 2 different mounting options:
  female thread 1”-14
  3 holes M5 ϕ50

RingAnt-G3T

is our GrAnt antenna mounted on our own choke ring ground plate. With GPS L1/L2/L5; Glonass L1/L2; Galileo L1/E5

RingAnt-DM

traditional choke ring with Galileo option and Dorne-Margolin element.
With GPS L1/L2/L5; Glonass L1/L2; Galileo L1/E5/E6

So it was possible to measure the double differences uncertainties (Fig. 3) and to evaluate the attitude of the swivel antenna base.

The Flight Tests Campaign was carried out with the Universal Trainer T-25C 1956 (Fig. 4). To allow redundancy, an additional baseline (i.e -y-axis, Ant4) was merged to the antenna array (Fig 4).

Along with the GPS receivers, it was integrated a Flight Tests Instrumentation System (FTI) which provided attitude reference and flight dynamics parameters (Fig.5).

The uncertainties of all FTI parameters were determined using SALEV® system [11] that is fully compliant with EA-4/02 Standard [12].

The correlation of the aircraft attitude solutions provided by both FTI and GADA requires:

1. Time synchronization of all observables [13] provided by the FTI and the GPS receivers; and

2. The determination of the misalignment angles [14] between all reference systems:

The Flight Tests Campaign was carefully planned to best characterize GADA's performance. To accomplish it was designed two tests profiles.

The first profile (Fig. 6) was aimed for static attitude determination where semi-static attitudes maneuvers were employed to check the system capability to determine the correct attitude.

The second profile (Fig. 7) employed dynamic maneuvers to check the system response.

In total it was executed 11 flights, 2 for FTI shakedown, 5 with the static profile and the remaining 4 with the dynamic profile, totaling almost 12 flight hours. To improve the statistical analysis, all flights were scheduled accordingly to keep a uniform Geometric Dilution of Precision (DOP) factor [15].

In fact the measured DOP for all fights was 3.05 ± 0.274 @ 1σ, and the resulting Attitude Dilution of Precision (ADOP) components [16] for θ, ϕ and ψ were respectively 0.454 ± 0.035; 0.447 ± 0.022 and 0.239 ± 0.031 @ 1σ.

As reference Fig. 8 depicts the DOP and the ADOP components of flight #8 on may 21st, 2004 at 13:33 Greenwich Mean Time (GMT).

Flight Tests results

Static Points

In all static tests points GADA's performance was satisfactory.

As example for the lateral attitude stabilization maneuver with ϕ = +25.86º ± 2.76º @1σ (Fig. 9), it is possible to verify that SV #14 LOS were mostly bellow HAP (Fig. 10).

As results it is also possible to verify that in this flight condition GADA kept its accuracy while REQUEST diverged (Fig. 11 to 13).

Dynamic Points

The analysis of the dynamic maneuvers it was noticed that GADA's errors increased with the angular speed. When the aircraft is performing the capture of the longitudinal attitude maneuver (Fig. 14) with a roll rate ≅±55º/s, it is possible to notice the error build up between the FTI reference attitude and the GADA's computed attitude (Fig. 15 to 17).

Dynamic error analysis

The functional analysis of the Phase Locked Loop - PLL (Fig. 18) of a GPS receiver [17], could explain these dynamic errors (Fig. 15 to 17). When the aircraft is maneuvering, the rate of change of the Doppler shift may result in a difference between the real phase (i.e. the input at the PLL) and the corresponding NCO phase measurement (i.e. output measurement).

Considering the topology presented

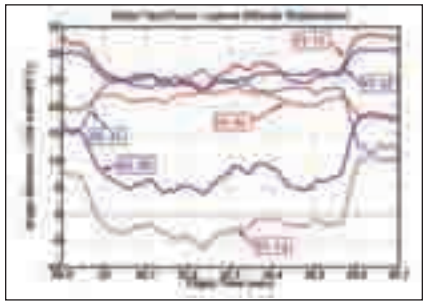


Fig. 10 – Angle between satellite LOS and HAP during the Lateral Attitude Stabilization Maneuver.

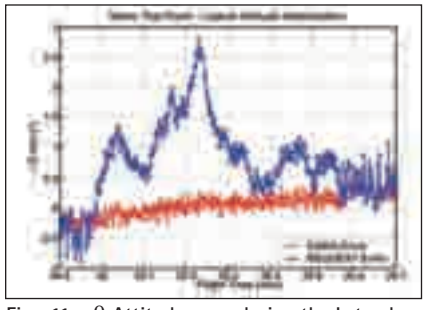


Fig. 11 – θ Attitude error during the Lateral Attitude Stabilization Maneuver.

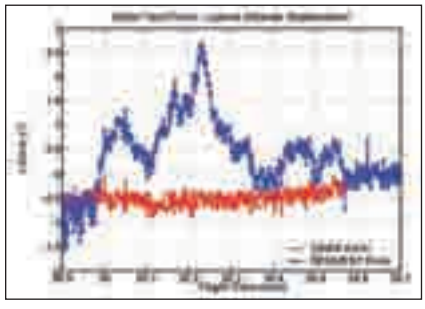


Fig. 12 – ϕ Attitude error during the Lateral Attitude Stabilization Maneuver

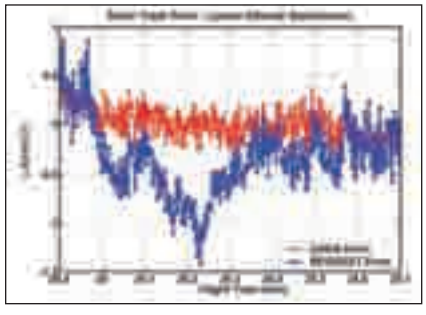


Fig. 13 – ψ Attitude error during the Lateral Attitude Stabilization Maneuver

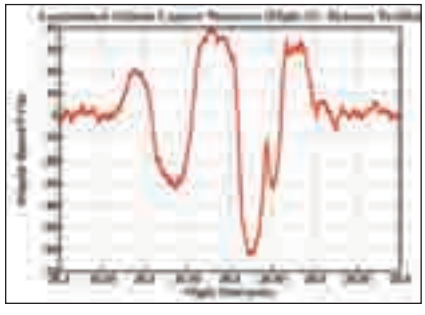


Fig. 14 – The Longitudinal Attitude Capture Maneuver

in fig. 18, the transfer function of the PLL is expressed by:

$$H_e(s) = \frac{2\xi\omega_N s + \omega_N^2}{s^2 + 2\xi\omega_N s + \omega_N^2} \quad (8)$$

Where: ζ is the damping factor (adm); and ω_N is the natural frequency (rd/s). In dynamic conditions there is a phase delay error between the true phase (i.e. what we want to measure) and the NCO generated phase (i.e. the resulting measurement provided by the receiver). The capture of the longitudinal attitude maneuver increases the phase rate (Fig. 19) and the associated phase error.

To investigate this effect it would be necessary to:

1. Simulate the same flight condition in order to get the true phase measurement;
2. Apply the simulated phase to the receiver PLL model;
3. To compute GADA attitude solution with the PLL resulting phase; and
4. To compare the resulting GADA attitudes (i.e. Simulated and the flight tests ones).

But the true characteristics of a commercial off the shelf GPS receiver PLL is proprietary and the manufacturer does not disclosures such information. So alternatively it was employed a system identification process (Fig. 21) to best estimate the PLL coefficients and topology for each GPS receiver.

Then it was possible to compare the dynamic errors measured at the flight tests campaign with the simulated errors. The resulting analysis presents an acceptable DPLL modeling (Fig. 22 to 24).

Conclusions

The development and the evaluation of GADA's static and dynamic characteristics are presented and the results are considered satisfactory for the application.

The results show that GADA's accuracy is dependent of the receiver DPLL characteristics.

Future works should use a software GPS receiver, where the setup of the DPLL coefficients and topology, allows:

1) The validation of the dynamic behavior of an off-the-shelf GPS receiver; and

2) The design of customized GPS receivers, for specific high dynamics applications.

Also GADA should be evaluated in other test beds, that flies over an extended envelope and thus in a higher dynamic range.

Acknowledgments

We wish to thank the partial support given by the Flight Test Group, for supporting the measurement and the flight tests campaigns. Also we like to tank FINEP under agreement 01.07.0663.00 and 01.07.0540.00 that respectively funded the telemetry system used for the flight tests campaign and its spares parts.

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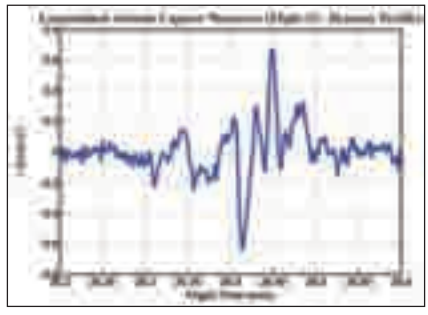

Fig. 15 – θ Error at the Capture of Longitudinal Attitude Maneuver

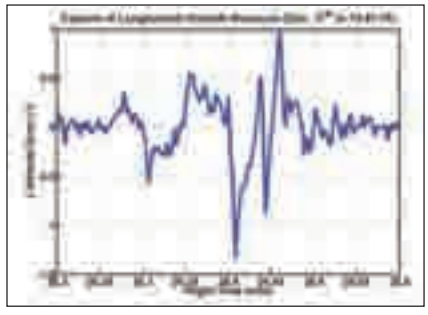

Fig. 16 – ϕ Error at the Capture of Longitudinal Attitude Maneuver

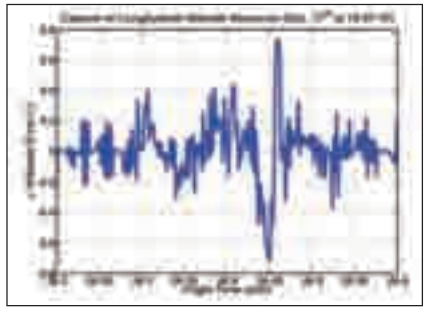

Fig. 17 – ψ Error at the Capture of Longitudinal Attitude Maneuver

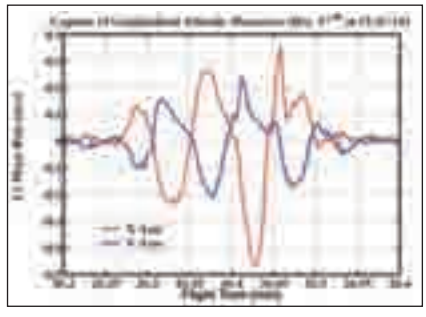

Fig. 19 – L1 Phase Rate during the Capture of Longitudinal Attitude Maneuver.

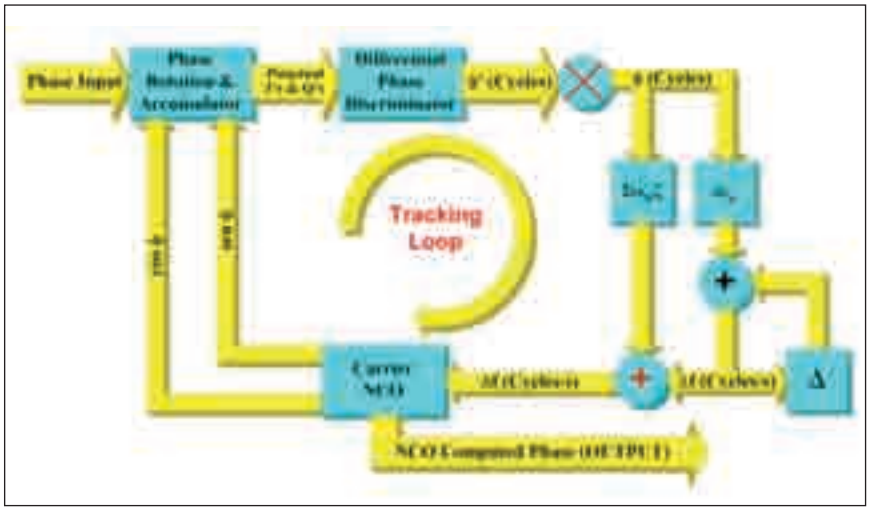

Fig. 18 – GPS receiver phase tracking loop block diagram

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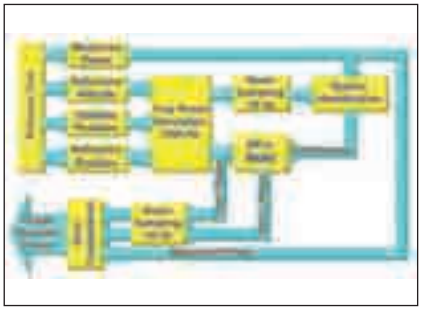

Fig. 21 – Block Diagram of the DPLL Coefficients Identification Process.

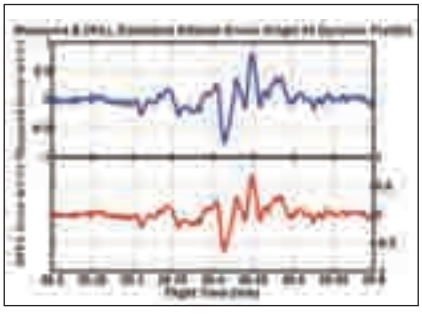

Fig. 22 – θ Dynamic Errors (Flight Tests and Simulated)

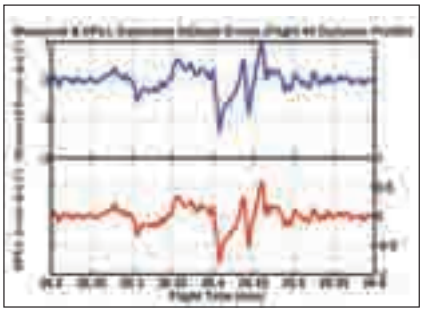

Fig. 23 – ϕ Dynamic Errors (Flight Tests and Simulated)

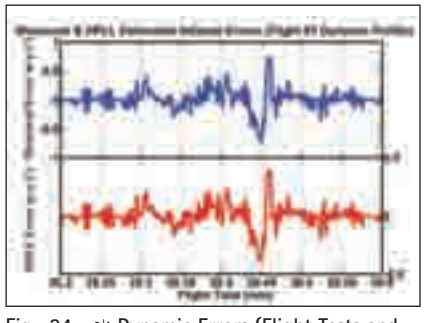

Fig. 24 – ψ Dynamic Errors (Flight Tests and Simulated)

A sensor architecture for high precision UAS navigation

This paper presents the CIRA's flying test facility for autonomous mid-air flight and landing on runways instrumented by Differential Global Positioning System base station. Readers may recall that in April 09, we published the first part of this paper. The first part focussed on system architecture and navigation algorithm. Here we present the concluding part that details the algorithm validation procedure and results.

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The performances of the complementary filter earlier described have been tested by means of both simulated and real world flights.

With references to off-line testing, the simulator values of the relevant variables have been assumed as real and compared with the values obtained from complementary filter and GPS. The values obtained from GPS are filtered through a first order low-pass filter, whose cut-off frequency has been chosen in order to reduce as much as possible the noise, but without attenuating the aircraft dynamic. Based on these requirements, the cut-off frequency used for GPS has been set to 1 Hz.

In order to emphasize the performances and the usefulness of the complementary filter, in the next some figures are shown which present a comparison among measures obtained by complimentary filter (red line), measures obtained by GPS (black line) and real value (blue line) of some inertial parameters of interest. The figures refer to an autonomous landing off-line simulation and are representative of the several off-line simulations performed in the validation stage of the autonomous guidance algorithms and, as a consequence, of the complementary filter too.

In particular, Figure 2 shows the comparison among the above mentioned values with reference to the altitude measure during an autonomous landing, while Figure 3 shows this comparison regarding the vertical speed during the same manoeuvre.

Both figures show that by using the

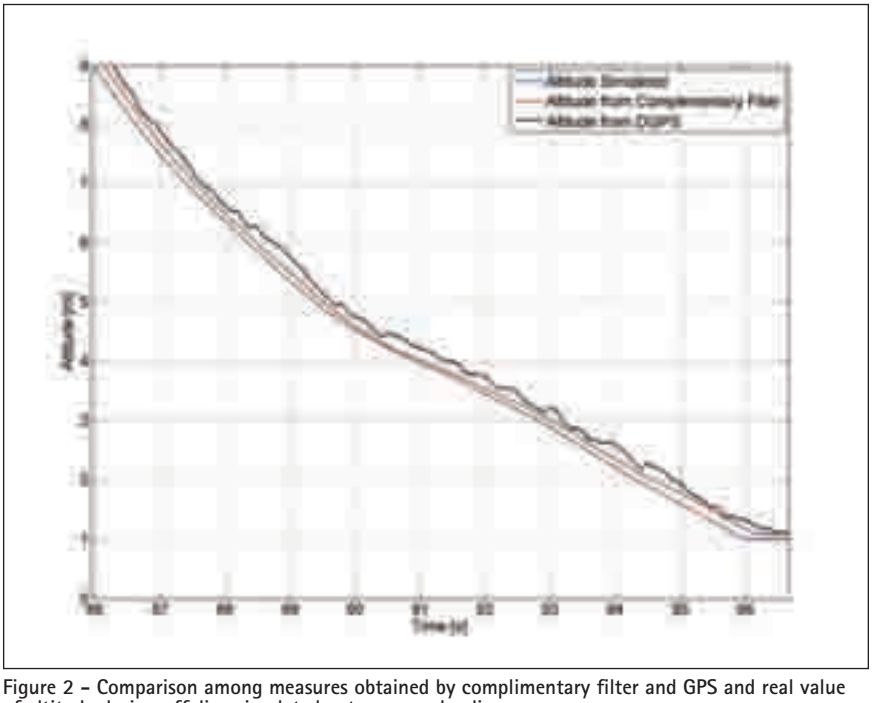

Figure 2 – Comparison among measures obtained by complimentary filter and GPS and real value of altitude during off-line simulated autonomous landing

complementary filter here proposed two advantages can be obtained:

- complementary filter is able to attenuate the noise more than the first order low-pass filter;
- measures obtained from complementary filter have more accuracy than the ones obtained by filtering the GPS measures.

For what concerns real world in-flight testing, in all flights performed in order to validate advanced guidance algorithms developed in the framework of TECVOL project, as previously described, the behaviour of complementary filter fully confirmed results obtained in off-line simulations. For instance, this is shown in the figures reported in the next, referred to different in flight tests and selected to emphasize the performances of the complementary filter with regard to altitude (see Figure 4, referred to a real world autonomous landing manoeuvre) and to vertical speed estimations (see Figure 5, which refers to a real world mid-air flight phase).

The complementary filter has a further feature: it is able to delete the frequency content due to a sudden GPS precision loss. This is shown in the figures reported in the next, which refer to GPS precision loss cases experienced during real flights. In particular, these figures show altitude (see Figure 6) and XNEU position (see Figure 7) measures when the GPS precision decreases (as confirmed by increasing value of GPS measure standard deviation).

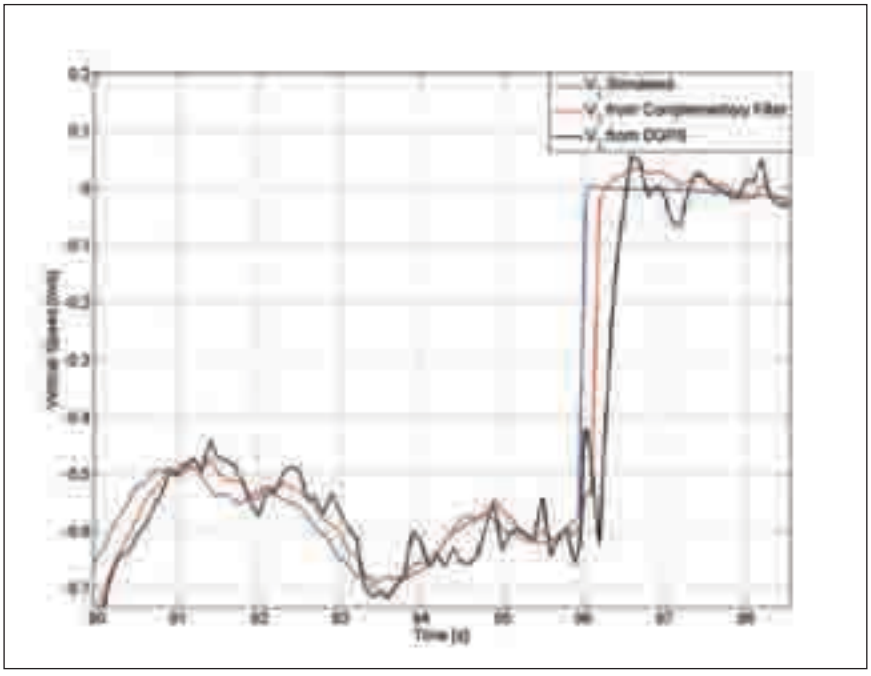

Figure 3 – Comparison among measures obtained by complimentary filter and GPS and real value of vertical speed during off-line simulated autonomous landing

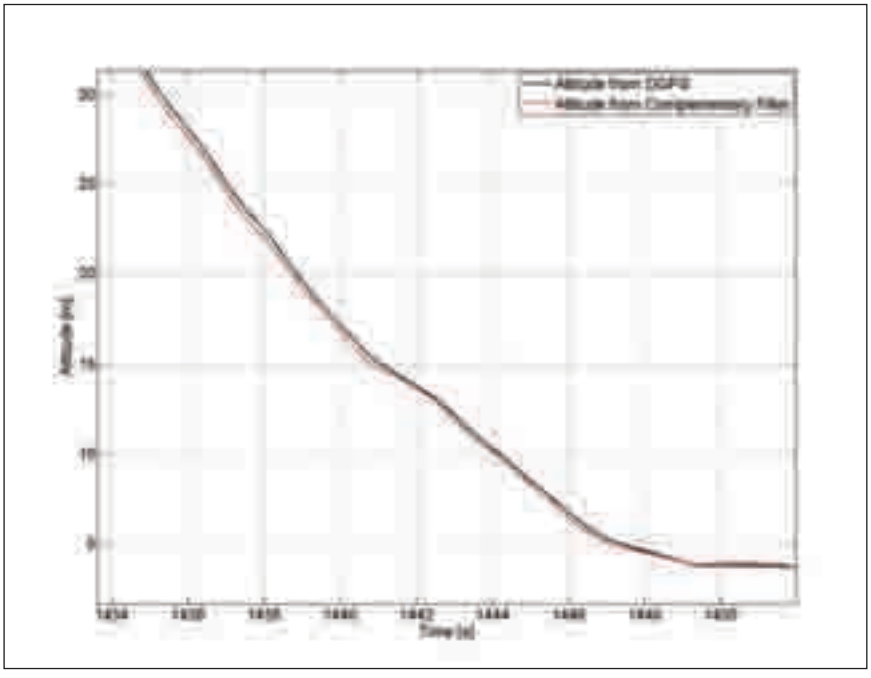

Figure 4 – Comparison among altitude measures obtained by complimentary filter and GPS during real world autonomous landing manoeuvre

Conclusions

In this paper a new algorithm has been described for the integration of measures provided by satellite navigation system with the ones provided by other sensors, such as ADS, AHRS and laser altimeter, in order to allow a more accurate determination of vehicle position and speed, in both no-failure and GPS failure conditions. The effectiveness of the proposed algorithm has been demonstrated by means of both off-line and real world in-flight tests, referred to an aeronautical application. It must be emphasized yet that the proposed algorithm is not limited to aeronautical use only but it can be implemented in all satellite-based navigation applications.

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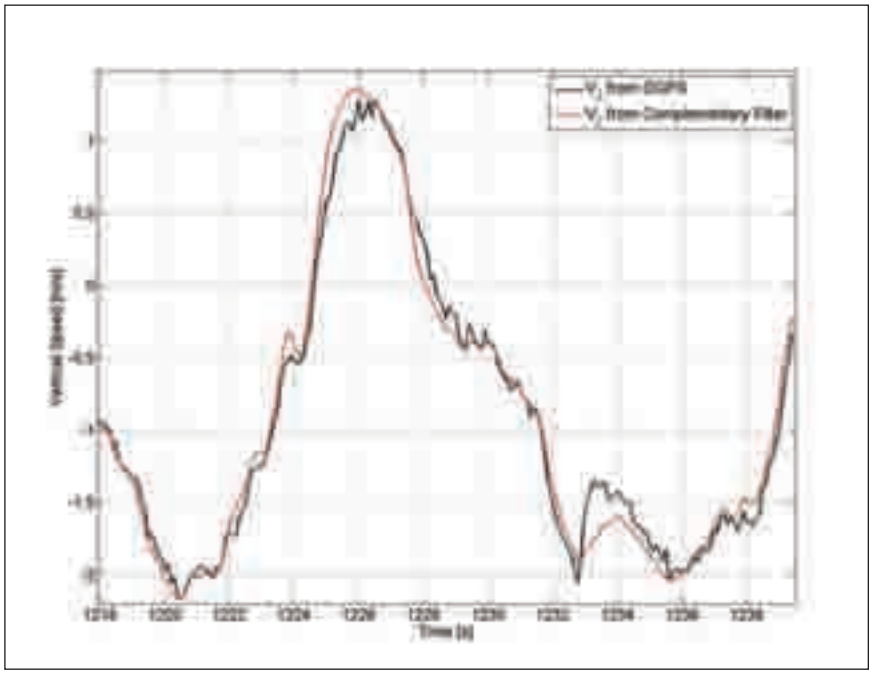

Figure 5 – Comparison among vertical speed measures obtained by complimentary filter and GPS during real world autonomous landing manoeuvre

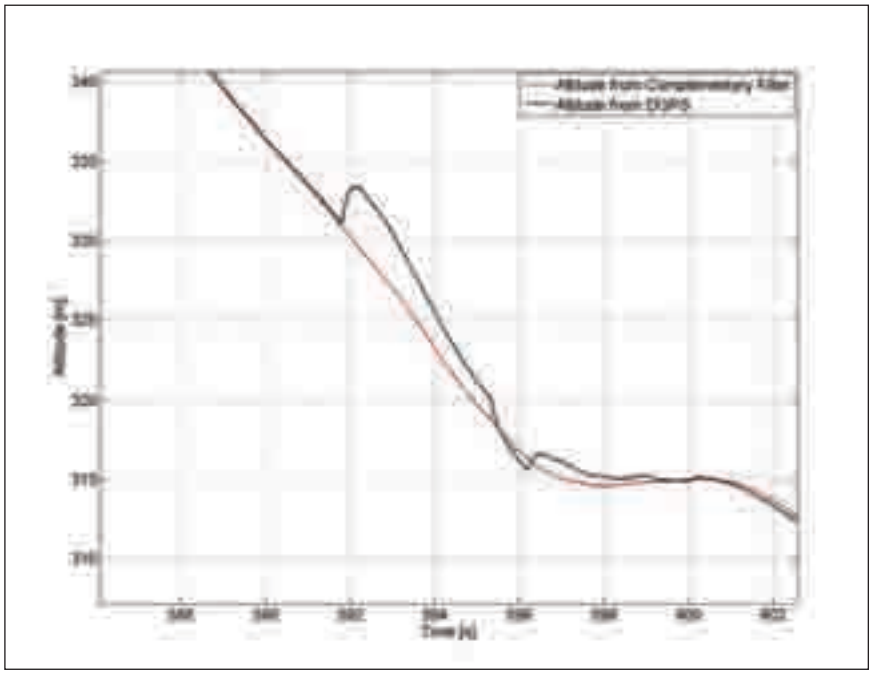

Figure 6 – Comparison among altitude measures obtained by complimentary filter and GPS during real flight in case of GPS precision loss

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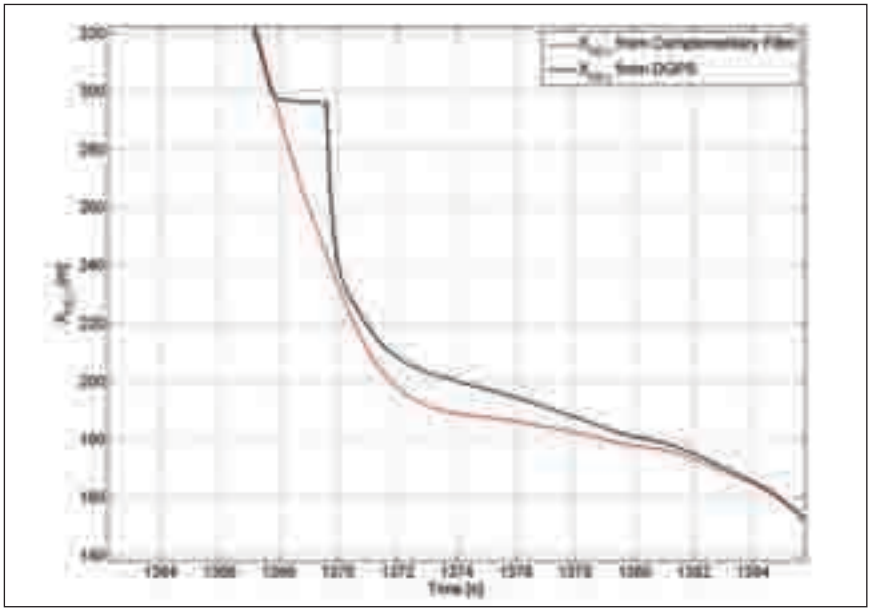

Figure 7 – Comparison among XNEU position measures obtained by complimentary filter and GPS during real flight in case of GPS precision loss

EXPRESSMaps delivers detailed maps in 6 hours

Spot Image and Infoterra are launching www.express-maps.com to deliver detailed basemaps covering over three quarters of the Earth's land surfaces. This service creates 1:50000 basemaps, which can be delivered electronically in just 6 hours. It is mainly aimed at civil protection agencies, military and humanitarian aid teams in crisis management situations. *www.infoterra.fr*

New GIS Field Guide to Humanitarian Mapping

MapAction published the first edition of its Field Guide to Humanitarian Mapping which will help aid organisations to use geospatial tools and methods in their work in emergencies. There are tutorials for Google Earth and open-source GIS software. *www.mapaction.org*

eSpatial Web GIS as Software as a Service (SaaS)

eSpatial announced the full-function Web GIS as a SaaS, an intuitive, easy to use application to organize and understand complex business processes, answer questions etc. by looking at data in a way that is quickly understood and easily shared as digital maps. *www.espatial.com*

Geochemical workflow added to ArcGIS

Geochemistry for ArcGIS is available from Geosoft Inc. It will add a geochemical workflow to ArcGIS, enabling geoscientists to efficiently conduct their geochemical QA and analysis inside ESRI. *www.geosoft.com*

CDC Taiwan develops Disease Control GIS

Centre for Disease Control (CDC), Taiwan has developed a GIS system to monitor and control diseases and offer information to all medical organisations and the public. The system aims to present disease information through electronic maps for display and manipulation, and also includes the analysis of clustering diseases, which displays the regions and degrees of clustered infections for the work of disease prevention. *www.prlog.org*

GeoSage's new mosaic map

GeoSage, Australia has announced the release of near-global imagery mosaics on shaded relief and natural-colour satellite imagery. Each mosaic map is a single large-sized, GIS-ready JPEG2000 file. *www.geosage.com*

Fully automated crime analysis and visualisation solution

Pitney Bowes Business Insight has launched MapInfo Crime Profiler™ - which automates much of the statistical legwork that sits behind crime analysis and visualisation, allowing users to perform sophisticated analyses more quickly and easily. It is expected to play a major role in helping improve policing effectiveness in the UK. *www.pb.com*

Xeric Design releases EarthDesk 4.6 for Windows

Xeric Design, Ltd. released the EarthDesk 4.6 for Windows, its real-time dynamic desktop map. It replaces the static desktop with an image of the Earth showing current sun, moon and city illumination, as well as real-time global cloud coverage. *www.xericdesign.com*

Montgomery selects Sidwell to update its cadastral data

Montgomery Central Appraisal District (MCAD) has selected The Sidwell Company to convert their cadastral-based GIS data to an ArcGIS Geodatabase platform and to provide an ESRI-based software solution for maintaining the cadastral GIS. *www.sidwellco.com*

Geolocation to the web

Opera Software and Skyhook Wireless to partner in bringing geolocation to the Web. With Skyhook's Wi-Fi Positioning System (WPS), any computer or mobile phone with a wireless adapter can take advantage of its positioning technology and locate a user. Users can now simply choose to share their location with any Web site and get a range of information. *www.opera.com*

Locr introduces location-enabled travel photo book

Locr has announced its photo book editor with which content is automatically generated from various professional and user generated sources and aggregated into a travel photo book. Photo locations are marked on maps; descriptions and maps are sorted chronologically and according to locations and arranged to create the book. *www.locr.com*

Garmin, carComp deliver SatNav in rearview mirror

Garmin and carComp partner to sell a rearview mirror that integrates a 3.5 inch display navigation system. It will be available in soon. *www.carcomp.com*

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Cheetah Software Systems, Inc. and Turnpike Global Technologies together shall offer an integrated logistics intelligence solution to transportation companies. The solution injects real-time vehicle performance data into a dynamic, intelligent, and predictive LTL and delivery software solution. *www.cheetah.com*

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China launches navigation satellite

China launched Beidou-2 (or Compass-G2) - their second geostationary navigation satellite recently. The Compass constellation comprises 31 satellites - 27 MEO satellites and 4 geostationaries. BeiDou-2 is reported to have a lifespan of 8 years. The first phase of the project will provide coverage for Chinese territory - ultimately giving global cover. *www.nasaspaceflight.com*

China's SatNav worldwide 'by 2020'

China will provide free global navigation and positioning services with its Compass system by 2020. Chief Engineer of the China Electronics Technology Group Corp said that Compass would cover all of China and its adjacent regions by the end of 2010 or early 2011 - and expand into a global network by 2020 providing a civil accuracy within 10 m without charge. *www.news.xinhuanet.com*

GPS transmits on new frequency

The latest-launched GPS satellite - GPS IIR-20(M) - has started to transmit on L5, the proposed third civil signal - 1.17645 GHz - which will eventually support safety-of-life applications for aviation and provide improved availability and accuracy. This broadcast confirms the ITU filing of the frequency in the co-allocated Radio Navigation Satellite Service (RNSS) and Aeronautical Radio Navigation Service (ARNS) band. Without this actual transmission, the reservation of the frequency could be lost. *www.nasatech.net*

Septentrio offers Dual-Constellation live L5 tracking

Septentrio Satellite Navigation GNSS receivers are now successfully tracking the new L5 signal from GPS satellite SVN49. Researchers and specialists interested in evaluating and monitoring GPS and Galileo signals on two common frequencies can now perform tests with live signals from both constellations on L1 and L5/E5a. *www.septentrio.com*

Iridium used to track vehicles in the Middle East

Iridium reseller Fleet Management Systems (FMS) has deployed its GPS and all-satellite fleet tracking and monitoring system for KGL Transportation Company in Kuwait. The solution includes tracking and monitoring devices, one on the tractor and another on the trailer and in addition to position coordinates, direction, and speed, it transmits details about the load and driver, route, time of departure, time of arrival etc. *www.fleetms.com*

EGNOS handed to the EC

The European Commission (EC) became the owner of the European Geostationary Navigation Overlay Service (EGNOS) infrastructure - and entrusted the company ESSP SaS with its operation. EGNOS was developed by the European Space Agency (ESA) under the aegis of a trilateral agreement between the EC, ESA and Eurocontrol. ESSP SaS will be under contract to the Commission to manage the operations and maintenance of EGNOS. ESA will maintain the role of design and procurement agent. EGNOS is based entirely on GPS, using the same format as the US Wide Area Augmentation System (WAAS) - receivers can use both systems interchangeably. *www.europa.eu*

Iridium-based Vessel Monitoring Systems approved for commercial fisheries

The Faria WatchDog VMS is a dual-mode transceiver product that uses the Iridium satellite network for position reporting and GSM data links when working in range of shore towers. It received type approval from the Pacific Island Forum Fisheries Agency (FFA) for its 16 member countries and is also type approved by the NOAA for all U.S. fishery regions.*www.iridium.com*

GOCE's electric ion propulsion engine switched on

GOCE's electric ion propulsion system has been switched on and confirmed to be operating normally, marking another crucial milestone in the satellite's post-launch commissioning phase. The Flight Control Team is now working from the GOCE Dedicated Control Room at ESOC, and has continued with a series of operational checks since the end of the critical Launch and Early Orbit Phase on 20 March. *www.esa.int*

At a Glance

Miscellaneous

- Google Maps project raises privacy concerns in Finland
- Google camera car blocked by residents of Buckinghamshire, UK.
- 4CTechnologies has added GIS services to their suite of professional service offerings.
- The Australian Spatial Information Business Association (ASIBA) will be known as the Spatial Industries Business Association (SIBA).
- ASPRS Announces Nicole Wayant as 2009 Winner of The Abraham Anson Memorial Scholarship
- Boundary Solutions, Inc. has been issued "Change Layer" patent 7,516,156.
- Leica TS30 High Precision Total Station by Leica Geosystems
- Leica GeoMoS software upgraded to version 5.0.
- Symmetricom's SyncServer S300/S350 SAASM NTP Network Time Server meets GPS security requirements of the U.S. DoD.
- The Egyptian National Telecommunication Regulatory Authority (NTRA) lifts ban on consumer GPS products.
- ODTMaps.com acquired WorldEagle.com

RISAT – ISRO's SAR satellite, launched

ISRO's Polar Satellite Launch Vehicle (PSLV-C12), on April 20, 2009 successfully placed two satellites - RISAT-2 and ANUSAT - in the desired orbit. RISAT-2 is a Radar Imaging Satellite with the capability to take images of the earth during day and night as well as cloudy conditions. This satellite will enhance ISRO's capability for earth observation, especially during disaster management. ANUSAT, built by Anna University, Chennai is the first experimental communication satellite built by an Indian University under the guidance of ISRO and will demonstrate the technologies related to message store and forward operations. *www.isro.org*

New web service to resolve land disputes

Bluesky has launched a new web service designed to help resolve boundary, rights of way, and other land related disputes. Visitors to www.oldaerialphotos.com can now identify and acquire photographic evidence from the past to support their claim. In addition to millions of aerial images dating back as far as the 1917, a range of professional services are also available including Letters of Authenticity, Statutory Declaration and even appearance in court by a professional photographic interpreter. *www.bluesky-world.com*

Satellites show moving earth during Italy quake

Studying satellite radar data from ESA's Envisat and the Italian Space Agency's COSMO-SkyMed, scientists have begun analysing the movement of Earth during and after the recent earthquake in L'Aquila, central Italy. The scientists are using the SAR Interferometry (InSAR) technique, a sophisticated version of 'spot the difference'.

It involves combining two or more radar images of the same ground location in such a way that very precise measurements – down to a scale of a few millimetres – can be made of any ground motion taking place between image acquisitions. *www.esa.int*

Canadian air force to map Afghanistan

The Canadian air force is to digitally map southern Afghanistan and especially the province of Kandahar for NATO and Afghan pilots and ground troops. An Aurora reconnaissance aircraft with sensors and cameras will be dispatched to undertake this major mapmaking project Canwest News Service, *www.canada.com*

Snow maps to help reindeer herders

International Centre for Reindeer Husbandry (ICR) has partnered with ESA-backed Polar View initiative to obtain satellite based snow melt maps for Norway and Sweden and Eurasia. It will help the Arctic reindeer herders who are facing the challenges of adapting to climate change. *www.esa.int*

Galileo update

Norway joins Galileo project

The Norwegian government will give a boost by providing 68.9 million euros (92.5 million dollars) towards the 3.4 billion euro project. While Norway is not a member of the 27-member bloc, the country's economy and business minister Sylvia Brustad said it was important that Oslo took part in Galileo's development. "The project will be of huge importance for the development of the European space industry and it is therefore important that Norwegian businesses are now able to compete," Brustad said in a statement. In September, the European Commission and the European Space Agency, which includes Norway as a member, shortlisted 11 European firms which are bidding for future contracts connected to Galileo. *www.news-about-space.org/story/157986254.html*

Ukraine hopes to join Galileo project

Ukraine has aired interest to join the European navigation satellite project Galileo. The project however is facing increasingly competition, EE Times reported. According to the National Ukrainian broadcast organization NRCU, the president of the Ukrainian national space agency, Olexandr Sintchenko, aired interest in a closer collaboration with the European Space Agency ESA. Besides participating in the Galileo project, he also offered collaboration with regard to the European launch vehicle `Vega`. Vega`s first launch is scheduled for late in 2009. Sintchenko announced to travel to Paris in May in order to meet ESA representatives to discuss the matter. *www.unian.net/eng/news/news-312755.html*

EU plans to track cars raises hackles

The EU is planning to install sinister spy devices in all new cars that will constantly transmit the location, speed, and heading of the car to a central database. ABD spokesman Nigel Humphries said: "This nightmarish level of intrusion into people's private lives was something even George Orwell did not imagine. It is something the secret police of communist and fascist countries would have relished, so why is it being proposed for a supposedly 'free' Europe?"

Officially known as the Cooperative Vehicle-Infrastructure Systems (CVIS) project, the plan is being supported by some car manufacturers and some telecomms companies. Why some car manufacturers are aiding and abetting such government spying in these times of financial difficulties is unclear, it is certainly going to discourage anyone in their right mind from buying a new car. Involved telecomms companies will, as usual, simply want to make money with scant regard to the consequences to society, including their own shareholders, employees, and customers.

The project is believed to be dependent upon the EU's hugely expensive 'Galileo' satellite navigation system. Although the world already has a perfectly good satellite navigation system, it is run by the USA, and that hurts the EU`s ego, so they`re spending 3 billion euros on their own (at the last count --- it's already 2 billion euros over budget). To recoup the cost of this you can be sure they intend to use it to introduce road charging and blanket speed enforcement. It is also tied in with a massive IT project that will link traffic lights and motorway gantries. *Source:ABD/Motoring4Media*

At a Glance

Mergers and partnerships

- Digital Geographic Technologies, Inc. acquires Gunther Engineering, Inc.
- NAVTEQ and TeleNav to expand their relationship to supply global digital maps.
- ESRI, UK has acquired Digital Worlds International Ltd.
- NOAA has become a Principal Member of the OGC.
- Intergraph Corp has renewed its partnership agreement with Rolta India to market and support Intergraph software in India.
- Vexcel Imaging GmbH has appointed GeoToolBox Ibérica S.L. for all aspects of the Vexcel Imaging scanner business.
- Surveylab appoints DDSB (M) Sdn Bhd as the authorised reseller of ikeGPSTM products and services in Malaysia.
- Autodesk's Location Services business unit transferred to LocationLogican an entity of Hale Capital Partners.
- NAVTEQ and TeleNav sign multiyear map deal.
- Pitney Bowes Business Insight teams with Netezza Corporation.

Contracts Awarded

- GIS maintenance contract for NAVTEQ by the New York State Office of Cyber Security and Critical Infrastructure Coordination.
- ESA chooses SciSys to undertake a proof-of-concept investigation into an innovative technique for securely partitioning on-board satellite software.
- $11.3 Million contract for Intermap Technologies to provide 3D digital elevation data and orthorectified radar imagery for an international project.

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EVC named authorized reseller of DigitalGlobe products

East View Cartographic (EVC) has signed an agreement with DigitalGlobe to be an Authorized Reseller of DigitalGlobe's high resolution commercial imagery. *www.cartographic.com*

Geodexy available for BlackBerry

Spatial Networks has released its mobile data collection Web service, Geodexy. It is a Web service for gathering information about one or more locations where users can quickly create custom forms, download them to any Windows Mobile™ or Blackberry™ device and collect information quickly. *www.spatialnetworks.com*

RapidEye partners with Sovzond, agreement with MDA

RapidEye has partnered with Sovzond, Moscow who will be their distributor for satellite imagery in Russia, Belarus, Armenia, Azerbaijan, Georgia, Republic of Kazakhstan, Tajikistan, Uzbekistan, Kyrgyzstan, and Turkmenistan.

MacDonald, Dettwiler and Associates Ltd. (MDA) will be the sole supplier of direct downlink solutions for RapidEye's international ground station customers. *www.rapideye.de*

APS 7.2 released

Groupe Alta has released version 7.2 of its professional Alta Photogrammetry Suite (APS) with new and improved functionalities. *www.groupealta.com*

GPS-enabled GSM/WCDMA handsets jumped 178.6% in '08

According to Berg Insight, global shipments of GPS-enabled GSM/WCDMA handsets jumped 178.6 % in 2008 to 78.0 million units. It is forecasted to reach 770 million units in 2014. *www.berginsight.com*

STAR-APIC launches Elyx Mobile

The STAR-APIC Group has launched Elyx Mobile, the PDA solution that enables a user to integrate, consult and update vector and raster data directly in the field. It will be of interest to local authorities, public services, scientists, utility network managers, police and emergency services and those working in agriculture. *www.star-apic.com*

Hemisphere GPS introduces the A21™ GPS Antenna

Hemisphere GPS has released A21 Antenna, designed to maintain its tracking of GPS and differential correction signals even in environments of electrical "noise" and interference which can compromise the performance of an antenna. *www.hemispheregps.com.*

Magellan ships 3 new PNDs

Magellan announced the release of three PNDs: RoadMate 1470, RoadMate 1440 and RoadMate 1340. *www.magellangps.com*

Leica TM30 High Precision Sensor

The Leica TM30 Sensor by Leica Geosystem is designed for high precision measurements to ensure that even the smallest movement in all monitoring applications is detected. It integrates seamlessly with Leica GeoMoS software to create a proven monitoring system. *www.leica-geosystems.com*

JAXA opens new STAR office

The Japanese space agency, JAXA, has opened a new office on its Sagamihara Campus for its STAR (Satellite Technology for the Asia Pacific Region) program. The office will be used to develop small satellites with researchers and engineers of space organisations in the Asia Pacific. The program of work calls for a scoping survey for a 300-500 kg satellite called EO-STAR, and the development of a 50 kg experimental satellite called Micro-STAR. *www.jaxa.jp*

DigitalGlobe announces Singapore Ground Station

DigitalGlobe has signed an agreement with the National University of Singapore to allow the Centre for Remote Imaging, Sensing and Processing (CRISP) to receive high-resolution imagery from its WorldView-1 satellite and WorldView-2 upon its launch in 2009. *www.digitalglobe.com*

SeaZone marine data software

SeaZone has launched GeoTemporal, a software solution for the management of marine information by allowing easy import, processing and presentation of marine data from multiple sources and creating standard formatted data. *www.seazone.com*

Maponics releases International Neighbourhood Boundaries data

Maponics LLC has launched Maponics International Neighbourhood Boundaries. First released in beta earlier this year, this specialised spatial dataset will include neighbourhoods for approximately 100 cities in over 15 European Union countries by the end of 2009. *www.maponics.com*

1st Touch Enterprise Platform

1st Touch has launched an enterprise application platform that can create, manage and synchronise mobile applications across an organisation. It is aimed at any company that needs to control and support the activities of field-based or remote operatives such as salespeople, knowledge workers, service engineers or field teams. *www.1sttouch.com*

ERDAS releases new products

ERDAS Inc. has released ERDAS Software 2009, Version 9.3.2, featuring the

complete portfolio of Geospatial Business Systems. This includes new releases of ERDAS IMAGINE®, LPS, ERDAS ER Mapper, and ERDAS Extensions for ArcGIS, ERDAS APOLLO and ERDAS Image Web Server. *www.erdas.com*

SOKKIA adds RTK functionality to GSR1700 CSX L1 GNSS receiver

SOKKIA TOPCON has added RTK functionality on the GSR1700 CSX L1 GNSS Receiver. The AdVanceTM L1-RTK engine achieves initialization in seconds. It uses of all available single-frequency satellite signals—GPS, GLONASS, and SBAS. *www.sokkia.com*

Topcon Reference Station Network Equipment for Shandong in China

Topcon Positioning Systems (TPS) shall supply GNSS receivers and software for Shandong Province Continuously Operating Reference Station Network (SDCORS). The network shall provide full coverage of Shandong Province of China with network RTK capability thereby improving and modernizing its surveying infrastructure. *www.topconpositioning.com*

TPS to provide receivers for CMONOC

Topcon Positioning Systems (TPS) shall supply GNSS receivers for the Crustal Movement Observation Network of China (CMONOC). The project was established by the China Earthquake Administration to monitor crustal deformation and to predict earthquakes using GNSS technology. *www.topconpositioning.com*

Land Nav Systems for South Korean infantry vehicle

Northrop Grumman Corporation has been awarded a contract by Korean military systems and vehicle manufacturer Doosan DST Co., Ltd. to deliver inertial navigation units for the Republic of Korea's new K21 infantry fighting vehicle. *www.northropgrumman.com*

OnPOZ introduces ArcPad extension for post-processing GNSS receivers

OnPOZ Precision Positioning has released a free ArcPad extension that allows GNSS post-processing. The free GNSS Driver seamlessly logs real-time positions, metadata, and all GNSS observations to increase the reliability and accuracy of GNSS positions by post-processing ESRI Shapefiles. *www.onpoz.com*

Search and Visualization Capabilities for the DOD and Federal Customers

NCI, Inc., Google Inc. and Next Tier Concepts it has been awarded an extension to its technology demonstration task order for the US Strategic Command to develop search and geospatial visualization capability for key Federal customers. *www.ntconcepts.com*

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May 2009

International Conference on Integrated Navigation Systems
25-27 May
Saint Petersburg, Russia
www.elektropribor.spb.ru

Defence Geospatial Intelligence Middle East
10 - 13 May
Dubai
enquiry@iqpc.ae
www.geospatialdefence.com

3rd UN sponsored PCGIAP Land Administration Forum for the Asia and Pacific Region
24-26 May 2009
Tehran, Iran
www.csdila.unimelb.edu.au

June 2009

GSDI 11 World Conference
15-19 June
Rotterdam, The Netherlands
http://gsdi.org/gsdi11/

TRANS-NAV 2009
8th International Navigational Symposium
June 17-19
Gdynia, Poland
http://transnav.am.gdynia.pl

July 2009

ESRI International User Conference
13–17 July
San Diego, USA
www.esri.com

August 2009

SEASC 2009,
4-7 August
Bali, Indonesia
www.bakosurtanal.go.id/seasc2009/04

2009 IMTA Asia Pacific Conference & Trade Show
7-8, August
Darwin, Australia
http://www.maptrade.org/events/upcoming.php

September 2009

ISDE 2009
9-12 September
Beijing, China
www.digitalearth-isde.org

ION GNSS 2009
22-25 September
Savannah, Georgia, USA
www.ion.org

INTERGEO 2009
22-24 September
Karlsruhe, Germany
www.intergeo.de

2nd GNSS Vulnerabilities and Solutions Conference
2- 5 September
Baska, Krk Island, Croatia
http://twitter.com/BaskaGNSS2009

October 2009

ACRS 2009
19-23 October
Beijing, China
http://www.aars-acrs.org/acrs

November 2009

WALIS International Forum 2009
11-13 November
Perth Convention Exhibition Centre, Australia
www.walis.wa.gov.au

December 2009

IGNSS Society 2009
1- 3 December
Holiday Inn Gold Coast, Queensland, Australia
www.ignss.org

Middle East Spatial Technology Conference & Exhibition
7 - 9 December
Kingdom of Bahrain
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