esa

EGNOS NEWS

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SPECIAL ISSUE – LEARNING EGNOS

Editorial

This time we concentrate on the contributions that EGNOS is making to the training and education of future GNSS professionals. In particular, the high-tech tools, techniques and information resources which are (or will shortly be) available both to the educational and wider communities with an interest in GNSS.

An important component of EGNOS is the Signal-In-Space through the Internet (SISNeT). SISNeT provides the EGNOS wide-area differential corrections and integrity information, as well as other added value services, to users over the Internet. ESA provides a number of tools designed to make the exploitation of this and related resources as straightforward as possible for new users.

For example, ESA has recently started to supply a new version of the SISNeT User Application Software (UAS) tool. This tool allows real time download of the EGNOS broadcast messages and supplies a range of graphical interfaces to analyse their contents.

In addition, the complementary SISNeTlab tool gives access to the historical EGNOS broadcast message data stored on the EGNOS Message Server (EMS). These two free tools enable new users to quickly grasp the fundamentals of SBAS systems and the information they broadcast.

A third tool shortly to be released by ESA is SBAS TeACHER. This will provide a very user-friendly introduction to the subject of the SBAS message definitions with practical experience of decoding and encoding SBAS messages on screen via a graphical interface in real time.

The real time monitoring network for EGNOS continues to be provided via the web. ESA are keen that this network be expanded so that, for examples, more universities may contribute to this invaluable educational resource.

A recent innovation in the performance analysis of SBAS systems has been the introduction of the Stanford-ESA Integrity diagrams. This technique provides additional information on the performance of SBAS systems for safety critical applications in a way that is much easier for new users to grasp.

ESA, in cooperation with Industry, is planning to create the "EGNOS Book" as a valuable resource for SBAS students, teachers and other GNSS professionals.

To round out our look at the resources EGNOS provides to the educational community, we also feature some comments from current users.

And finally, now that EGNOS is in its initial operational phase, we cannot resist the temptation to provide just a quick look at some examples of the many exciting field trials and demonstrations of the system which are ongoing for a broad range of applications.

Contents

Getting The Message Across

SISNeT is an important part of EGNOS. It provides users with the messages in the EGNOS SIS via the internet in real time.

The UAS tool interfaces with SISNeT and enables straightforward graphical analysis of the EGNOS messages. In the class room, user-friendly access and graphical display of real-time EGNOS broadcast messages are considerable aids in the understanding of EGNOS.

The very latest version 3.1 of the SISNeT UAS tool, recently released by ESA, supports real time analysis of all the message types currently broadcast by EGNOS. In addition, version 3.1 users benefit from receiving messages from all three EGNOS GEOs.

SISNeT UAS 3.1 makes the EGNOS SIS real time broadcast messages and their analysis available to a wide range of users, including those not already experienced in SBAS. It is now available as a free download from the internet, at http://www.esa.int/navigation/sisnet.

Analysis of Real Time EGNOS Messages From The Internet

Playing With EGNOS

An important part of the rationale for SISNeT is to make the service it provides accessible to inexperienced users, especially those in schools and universities. Aside from students, SISNeT can also benefit research scientists, Small and Medium Enterprises and other GNSS engineering staff. The SISNeTlab tool provides these users with hands-on experience of the information broadcast by SBAS systems.

The SISNeTlab tool allows selection and download of historical SBAS broadcast messages from the EMS server. This tool complements the download of real time EGNOS broadcast data by the SISNeT UAS tool.

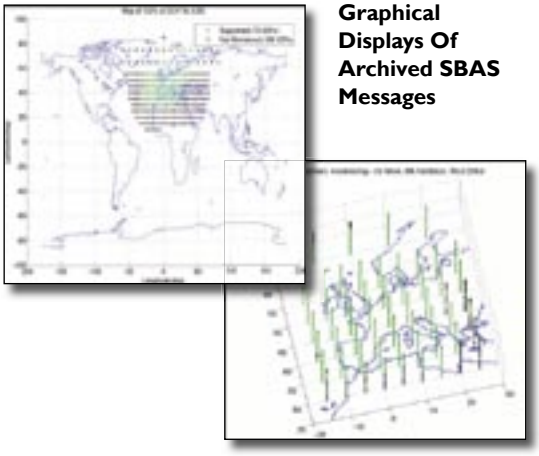
SISNeTlab is designed to be very user-friendly, allowing quick and easy performance assessments of the various SBAS systems. The user inputs a desired time period, SISNeTlab then downloads the data from that interval. SISNeTlab presents that analysis in easily understood graphs and diagrams.

For any given SBAS satellite, SISNeTlab enables post-processing and analysis of:

- Occurrence distribution of message types.
- Message refresh rate.
- Message loss analysis.
- Ionospheric analysis.
- User Differential Range Error (UDRE) and fast corrections analysis.
- Satellite monitoring status.
- Satellite long term corrections
- Fast correction degradation factors
- Fast corrections timeout analysis
- Ionospheric error analysis
- Tropospheric error analysis
- Residual error analysis
- Total corrections analysis
- XPL analysis
- Safety Index analysis

ESA conceived SISNeTlab as a modular tool, so any users wishing to expand the capabilities by programming their own applications (in any programming language able to generate a Windows executable program) should contact ESA.

To download SISNeTlab software, visit http://www.esa.int/navigation/sisnetlab.



Graphical Displays Of Archived SBAS Messages

A Picture Is Worth A Thousand Words

SBAS message definitions are highly optimised in terms of low bandwidth requirements – they have to be because of the relatively low data bandwidth in the EGNOS SIS broadcast. But this means that for the uninitiated, deciphering what a message actually means for the first time is an uphill struggle.

Now, imagine if you could take an SBAS message and display it as a geographic plot giving the area affected and the values broadcast. Or if you could define what you wanted to broadcast via a geographic "point and click" interface and then just press a button to generate the correct message content. Either of these features would be a huge boost for students struggling to understand the SBAS message definitions.

The really good news is that very soon both of these features will be available in a free-to-download ESA tool called the SBAS TeACHER. This tool is currently undergoing testing and will be released as soon as testing is complete. It will soon be available through the ESA "EGNOS for Professionals" website at http://www.esa.int/navigation/egnos-pro.

EGNOS Real Time Monitoring Network

Previously, we told you about the "EGNOS for Professionals" portal and the real time EGNOS performance monitoring it provides. This performance information is continuously measured by a European network of fourteen monitoring stations. The information provided for all fourteen stations includes: HNSE, VNSE, HPL, VPL graphs vs. time, horizontal and vertical Stanford diagrams and APV-I availability figures.

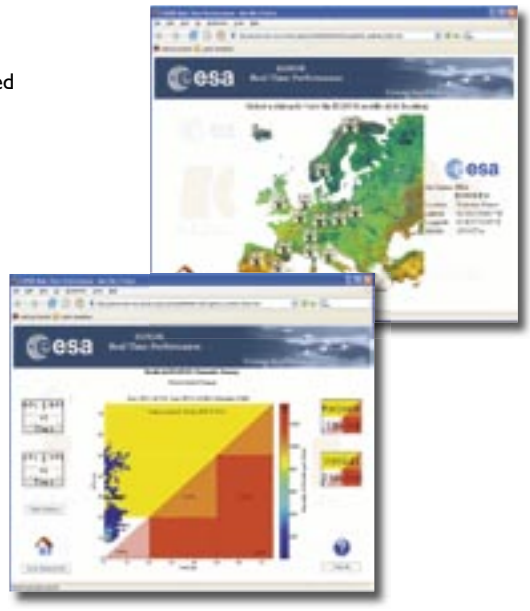
For the system as a whole the information includes for all three EGNOS GEO PRNs:

- Messages broadcast
- IGP monitoring status
- GPS monitoring status
- Availability for Europe in the most recent hour.
- Mean vertical and horizontal protection levels over Europe in the most recent hour

The resulting graphical performances are updated in quasi-real time and so are excellent tools for performance monitoring.

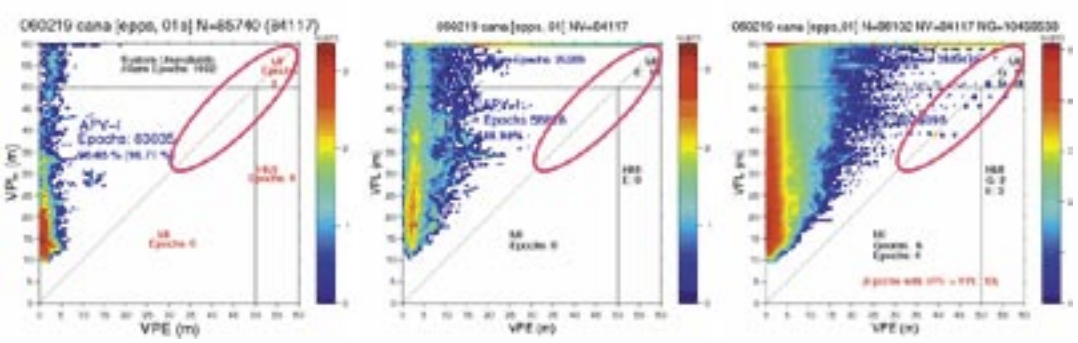
The information from the monitoring stations is provided by the EGNOS Real Time Partners. These include ESA, universities and industrial organisations. We invite any interested organisation who would like to contribute performance monitoring data to contact ESA.

For more information see http://www.esa.int/navigation/egnos-perfo.



Monitoring EGNOS In Real Time Across Europe

ESA Innovation In SBAS Integrity Analysis



A Comparison of Stanford, Stanford-ESA "Worst Case" & "All Geometries" Diagrams

At ION GNSS 2006, ESA won a best paper award for work on their innovative Stanford-ESA diagrams. The Stanford-ESA diagrams display large amounts of EGNOS performance data on easy to comprehend 2D charts that highlight safety issues. They are a very significant tool for anyone wanting to gain a deeper understanding of EGNOS.

The Stanford-ESA diagram is a modification of the Stanford diagram that is a standard tool for SBAS performance evaluations. The Stanford diagram is a two-dimensional histogram plotting accuracy performance of an SBAS system for each epoch (x axis) verses the Protection Limit (y axis). For the users to remain safe, all performance plots must lie above the leading diagonal, ie the actual error must be less than the protection limit broadcast in the SBAS SIS. Any below the diagonal are at best cases where the users are being misled (believing that the accuracy performance is better than it actually is) or at worst positively dangerous (because the accuracy performance is unacceptably bad but no warning is given).

ESA's innovative modification concerns which GNSS satellite constellation geometries are assumed. In the first of the new Stanford-ESA diagrams, only the worst geometry of a number of satellites as a sub-set from "all in view" is assumed. In the second new diagram all possible combinations of sub-sets from "all in view" satellites are plotted. Also, where a geometry is detected to be a case of misleading information for an epoch, all other geometries for that epoch are labelled and colour coded so that they can be easily identified in the diagram. This provides an excellent tool for identifying clusters of events and so is a big help in diagnostic analysis.

As you can see from the examples in the figure, the Stanford diagram (left) does not detect any problems, compared with "worst case" (centre) and particularly the "all geometries" (right) Stanford-ESA diagrams, as highlighted by the red ellipses. So the Stanford-ESA diagram detects potential events that may threaten the users safety when the original Stanford diagram does not. All in all, a well-deserved award for a very good idea!

Writing The Book On EGNOS

GNSS generally and SBAS in particular are large, complex and highly technical systems with a long history of research and development. Key information describing the development and implementation of SBAS systems is widely scattered over numerous journals, conference proceedings, presentations etc. So if you are a new student wanting to learn all about EGNOS where do you start? Soon you will very likely start with the "EGNOS Book" produced by ESA, in cooperation with Industry. ESA and Industry will exercise joint editorial control of the project which will include contributions and articles covering all the key EGNOS features. These will be based on various contributions and articles from invited authors spanning the complete range of EGNOS technical features.

The "EGNOS Book" will be an invaluable resource for SBAS students, teachers and other GNSS professionals.

Frequently Asked Questions

Q1 – What is SISNeT?
A1 – SISNeT is an important component of EGNOS which provides the Signal-In-Space messages of EGNOS GEO satellites over the internet.

Q2 – What is SISNeTlab?
A2 – SISNeTlab is a user-friendly tool which enables download and analysis of historical EGNOS messages from the EGNOS Message Server (EMS).

Q3 – What languages can I use to program SISNeTlab expansion modules?
A3 – Any, provided the end result is a Windows executable program (see for details the Module Development Guide which will be provided with SISNeTlab 2.0).

Q4 – What is the EGNOS Message Server (EMS)?
A4 – The EMS is an FTP archive containing historical SBAS messages broadcast in the SIS.

What Do You Think?

We asked some users for their opinions on the ESA tools described above and here's what they had to say:

"A more 'visual' way to show the student how the system works. The student can "visualize and analyze the SBAS messages in a very easy and direct way."
Dr. Jaume Sanz Subirana, Polytechnic University of Catalonia

"I consider of particular interest the usage of the ESA SISNet Lab v.1 tools … The Tool permits … analyses on the EGNOS messages that improve the knowledge and a better understanding of their contents. The graphics are effective, easy to understand and permit the students to evaluate the real status of the system. As regards the SISNeT UAS I'm analysing it for research purposes. I appreciate in particular the possibility to visualize the detailed contents of the broadcast messages and their associated parameters and the logging functionalities. Furthermore I highly appreciate the completeness of the User Manuals and all the links and the enclosed material."
Prof. Raffaela Cefalo, Trieste University

"The user interface is very simple and auto-explanatory" and "very easy to manage for a non expert user."
Pere Ramos, Polytechnic University of Catalonia

"SISNeT User Application 3.1 is a powerful and user-friendly tool that enables the users to monitor in real time the data coming from the SISNeT service. This tool has been used in our laboratory to check the validity of our binary decode of the MOPS standard in the framework of the SISNeT driver that we are developing for our activities. One positive aspect of the tool is that no prior knowledge is required to start using it."
Fabrizio Dominici and Antonio Defina, NavSAS Group, Instituto Superiore Mario Boella.

"The SBAS tools provided by ESA are being used at the French Institute of Higher Eduction, SUPAERO, in the Satellite Navigation Course and the graphical explanation helps the students to better understand the different concepts and performance drivers. On the whole I would strongly recommend the professors of Satellite Navigation to use these tools during their courses."
Prof. Michel Bousquet
Director of Aeospace Communications & Navigation programmes, SUPAERO, Toulouse

As you can see, some very positive feedback!

EGNOS In Action

Left to right: Rider with receiver, a new view of "Le Tour" and MOMO on the street

Now that EGNOS is in its initial operational phase, a large number of field trials and demonstrations of applications are either underway or planned. In this article we give a short update on a selected few.

EGNOS Revolutionises "Le Tour"
For the third year running, riders in the "Tour de France" were tracked using EGNOS, including the time-trial from Le Creusot to Monceau-les-Mines.

This year, EGNOS receivers were placed on nearly twenty riders. As in previous Tours, but with improved devices and communications links, it was possible to keep track of these individual riders. Real time display of positions and speeds added a new dimension for the spectators and teams. In the time trial where 3 riders were inside a margin of 32 seconds in the overall ranking, it was therefore possible to know continuously who was winning the yellow jacket.

This provided a glimpse of the many uses for EGNOS beyond navigation that ESA are keen to explore. For "Le Tour" itself, future benefits include possible improvements in safety and security and valuable performance monitoring resources for team directors.

GIANT Flight Trials in Valencia
The GIANT project, "GNSS Introduction in the AviatioN secTor", aims to demonstrate the benefits of both EGNOS and Galileo for various aviation applications. Part of this project is a series of flight trials, to demonstrate to the aeronautical industry the benefits of the EGNOS services. EGNOS flight trials, coordinated by AENA -the Spanish Air Navigation Service Provider- were successfully conducted in Valencia in October 2006 by the major Spanish regional airline Air Nostrum. These were the first in Europe to be conducted by a regional airline aircraft using the EGNOS signal. Further flight trials demonstrating the benefits of using EGNOS for LPV approaches are planned during 2007 in other European airports, both with stand-alone avionics installation in a Dash-8 (as the case of Valencia), and what is major leap forward, with GNSS integrated avionics in a CRJ-200. These trials also include Rotorcraft demonstrations in Switzerland and in North Sea oil rigs.

GIANT is a 6th FP project, coordinated by INECO, a leading engineering and consulting company in Spain and managed by the Galileo Joint Undertaking, supported by EUROCONTROL, acting as technical manager.

HeliCity Trials
The aim of the HeliCity project is a helicopter positioning system based on EGNOS for safety critical applications. The benefits expected from the HeliCity system include reducing navigational errors and resulting accidents in marginal flight conditions.

The first flight trials of the prototype system installed on a helicopter were successfully carried out in Lisbon during July 2006.

MOMO
MOMO aims to develop a mobile phone based satellite navigation system based on EGNOS and SISNeT as an aid to vision-impaired pedestrians. The use of EGNOS messages sent via SISNeT to support this application is a necessity since a positioning accuracy at the one metre level is the difference between being on the path or in the road!

The prototype system integrates a positioning receiver, a mobile phone and a voice synthesiser. Measurements from the receiver are transmitted via the mobile phone to a central computer which sends positioning information back. This information is then converted into audible instructions via the voice synthesiser. What the user experiences is a 'talking map' with instructions such as "turn to the left", and "continue straight ahead". This means the user can walk confidently through unfamiliar surroundings or even give directions to a taxi driver!

The prototype for the MOMO device was recently demonstrated successfully in the streets of Madrid.

Forthcoming Events

NAVITEC 2006, ESTEC, Noordwijk, The Netherlands, 11-13 December 2006

ION NTM 2007, San Diego, California, USA, 22-24 January 2007
http://www.ion.org/meetings/meetings.cfm#ntm

GEOMATIC WEEK 2007, Barcelona, Spain, 20-23 February 2007
http://www.setmana-geomatica.org/front/en

ION 63rd AM and Bio Navigation Workshops, Cambridge, Mass., USA, 23-25 April 2007
http://www.rin.org.uk/pooled/articles/BF_EVENTART/view.asp?Q=BF_EVENTART_209148

ENC GNSS 2007, Geneva, Switzerland, 29 May – 1 June 2007
http://www.timenav07.org/index.php

GPS World Conference & Expo, Rosemont, Illinois, USA, 11-13 June, 2007
http://www.gpsworldexpo.com/gpsworldexpo/v42/index.cvn

ION GNSS 2007, Fort Worth, Texas, USA, 25-28 September, 2007
http://www.ion.org/meetings/meetings.cfm#ntm

Links and Contacts

ESA Navigation Web Page:
http://www.esa.int/navigation

ESA EGNOS Web Page:
http://www.esa.int/EGNOS

ESA EGNOS for Professionals Web Page:
http://www.esa.int/navigation/egnos-pro

ESA EGNOS Real Time Performance Web Page:
http://www.esa.int/navigation/egnos-perfo

ESA EGNOS Help Desk:
Egnos@esa.int

ESA RIMS Entities Assistance Desk:
Egnos-read@esa.int

EGNOS News:
EGNOS-News@esa.int

EGNOS Operations User Support:
http://www.asqf-gnss.com

ESA Galileo Web Page:
http://www.esa.int/Galileo

ESA Artemis Web Page:
http://www.esa.int/artemislaunch

EC Galileo Web Page:
http://www.europa.eu.int/comm/energy_transport/en/gal_en.html

European Satellite Services Provider:
http://www.essp.be

FAA GPS Product Team:
http://gps.faa.gov

USCG Navigation Center GPS Page:
http://www.navcen.uscg.gov/gps/default.htm

Galileo Joint Undertaking:
http://www.galileoju.com

Help Us To Help You

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The Editorial Team welcomes your comments, inputs and suggestions for the next issue. Please send emails to EGNOS-News@esa.int.

Disclaimer

The EGNOS system is under development and a Signal in Space (SIS) is already available. A stable SIS is expected to be made throughout 2006 and certified for safety critical usage by 2007/8. The EGNOS SIS (irrespectively of either MT 0 or MT 0/2 is transmitted) is currently provided without any warranties regarding availability, continuity, accuracy, and reliability. The EGNOS SIS is provided on an "as is" and "as available" basis. Until further notice, messages associated with the EGNOS SIS are not certified for Civil Aviation or other safety critical purposes.

The use of the EGNOS SIS is therefore at the user's own risk. ESA expressly disclaims all warranties of any kind (whether express or implied), including, but not limited to the implied warranties of fitness for a particular purpose. ESA makes no warranty that the EGNOS SIS messages will meet the requirements of users. No advice or information, whether oral or written, obtained by a user from ESA shall create any warranty.

By using the EGNOS SIS, the user agrees that ESA shall not be liable for any direct, indirect, incidental, special or consequential damages, including but not limited to, damages for interruption of business, loss of profits, goodwill or other intangible losses, resulting from the use of, misuse of or the inability to use the EGNOS SIS.

Note for Civil Aviation
The Certification process of the EGNOS SIS for Civil Aviation use is still under development. Until further notice, the EGNOS SIS is broadcasting a Type 0 or the equivalent Type 0/2 ("Do not Use") message as specified in ICAO SARPS. Civil Aviation Users should therefore not use the EGNOS SIS for safety critical purposes and should consult the relevant ICAO SARPS.