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 example, 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.

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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
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 SISNeT tool provides these users with hands-on experience of the information broadcast by SBAS systems.

The SISNeT 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.

SISNeT 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, SISNeT then downloads the data from that interval. SISNeT presents that analysis in easily understood graphs and diagrams.

For any given SBAS satellite, SISNeT 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 SISNeT 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 SISNeT software, visit http://www.esa.int/navigation/sisnetlab.

Playing With EGNOS

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.

A Picture Is Worth A Thousand Words

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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
- IGF 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.
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) versus 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!
**EGNOS In Action**

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 a new dimension for the spectators and teams. The benefits expected from EGNOS are: multiday event tracking; under-the-radar in-transit tracking; and real-time performance monitoring resources for team directors.

**GIANT Flight Trials in Valencia**

The GIANT project, “GNSS Introduction in GIANT Flight Trials in Valencia” has been exploring the capabilities of EGNOS for safety critical purposes, both with stand-alone avionics installation and with GNSS integrated avionics in a CRJ-200. These trials also include Rotorcraft demonstrations in Switzerland and in North Sea oil rigs.

**GIAN**T is a 6th FP project, coordinated by INECCO, 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”, “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.

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**Forthcoming Events**

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

**ION NTM 2007**, San Diego, California, USA, 22-24 January 2007


**ENC GNSS 2007**, Geneva, Switzerland, 29 May – 1 June 2007

**GPS World Conference & Expo**, Rosemont, Illinois, USA, 11-13 June, 2007

**ION GNSS 2007**, Fort Worth, Texas, USA, 25-28 September, 2007

**ION GNSS+** 2007, Fort Worth, Texas, USA, 25-28 September, 2007

**European Satellite Services Provider**:

**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.

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**Disclaimer**

The EGNOS system is under development and a Signal in Space (SIS) is broadcast. Until further notice, the EGNOS SIS is 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 of any kind, express or implied, regarding the EGNOS SIS messages that may be received by a user. The inability to use the EGNOS SIS will meet the requirements of users. No advice or information, whether oral or written, obtained by a user from ESA shall create any warranty.

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