



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 known 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 feedback 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 of 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.

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). ▴



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