2007

Development of an E-Learning Module For Global Navigation Satellite SystemsTraining

Eugene McGovern
Technological University Dublin, eugene.mcgovern@tudublin.ie

Audrey Martin
Technological University Dublin, audrey.martin@tudublin.ie

Kevin Mooney
Technological University Dublin, kevin.mooney@tudublin.ie

Recommended Citation

McGovern, E, Martin, A. and Mooney, K. Development of an E-Learning Module For Global Navigation Satellite SystemsTraining. *International Technology, Education and Development Conference (INTED)*. Valencia, Spain. March 7th -9th, 2007. doi:10.21427/nxna-4e51

DEVELOPMENT OF AN E-LEARNING MODULE FOR GLOBAL NAVIGATION SATELLITE SYSTEMS TRAINING

Eugene McGovern, Audrey Martin and Kevin Mooney
Department of Spatial Information Sciences, Dublin Institute of Technology,
Dublin 1, Ireland.
eugene.mcgovern@dit.ie, audrey.martin@dit.ie, kevin.mooney@dit.ie

Abstract

The Global Positioning System (GPS) has been operational since the early 1990's. The system is constantly being upgraded while the Russian GLONASS and the European GALILEO systems will complement GPS in the next few years. Generically, these satellite-based positioning systems are referred to as Global Navigation Satellite Systems (GNSS). Previously, a part-time evening course in GPS was run at the Dublin Institute of Technology (DIT) by the Department of Spatial Information Sciences (DSIS). This is now being replaced by two e-learning modules in GNSS designed for distance-based, on-line delivery. The first module covers GNSS for navigation and Geographical Information Systems (GIS) applications and the second module will cover GNSS for high-accuracy applications such as surveying and geophysics. This paper describes the development of the first GNSS module.

The challenge for the course designers was to develop a module that, in the context of the spatial information industry, maximized the advantages of e-learning while addressing identified issues and maintaining a sound pedagogical approach. Potential users were identified as those engaged in continuous personal/professional development (CPD), organizations providing in-company training and academic institutions providing undergraduate and postgraduate modules in GNSS. An individual taking the module could, therefore, be based at home, in an office, in a classroom or in a remote work location. The advantages were identified as convenience, flexibility, facilitation of communication, tailoring and a varied learning experience. The issues were identified as no "hands-on" experience with GNSS field equipment and observing procedures, the difficulty of presenting complex software, learner isolation and the technical problems of delivering large files. To address these issues, as far as possible, a variety of presentation, delivery, contact and assessment approaches is being used. Content is presented in various formats including text, 2D and 3D graphics, animations with animation control, use of proprietary GNSS software with sample data and video with voiceover. Interaction between the parties is facilitated by email, discussion board and desktop videoconferencing. Self-assessment is included as a series of self-tests throughout the content in the form of multiple choice questions (MCQs) while written assignments are required at the end of each section, or theme, within the module. WebCT® is used to provide a consistent e-learning platform and environment. Quality assurance is provided for by questionnaires during the module and a feedback report by each participant after completion.

Keywords
E-learning, satellite positioning, GNSS

1. INTRODUCTION

Satellite positioning is a remarkable technology that provides geographic positioning anywhere on earth, at anytime, and in any weather conditions. Currently, the only fully-operational satellite positioning system is the Global Positioning System (GPS) which has been provided and maintained by the United States since the early 1990's. Although designed primarily for military purposes, GPS is also used in recreational and commercial activities including hill-walking, in-car navigation, vehicle fleet monitoring, utilities management and topographical surveying. There is much activity in satellite positioning service provision at present with GPS currently undergoing significant modernization while the equivalent Russian GLONASS system is being restored and the European Galileo system is currently being developed with full operational capability scheduled for 2010 [1]. GLONASS and Galileo will complement GPS and together will provide much improved positioning performance to end-users. Meanwhile China is reported to be developing a similar global satellite positioning system having previously agreed to support the Galileo project [2]. Generically, these satellite-based positioning systems are referred to as Global Navigation Satellite Systems (GNSS). Depending on the required positional accuracy, and the type of satellite receiver used, the operation of the hardware and associated software can range from very straightforward, with no specialist knowledge required, to highly complex with an underlying knowledge of the subject area necessary if reliable results are to be expected.

Previously, a part-time evening course in GPS was run at the Dublin Institute of Technology (DIT) by the Department of Spatial Information Sciences (DSIS). This course provided continuing personal/professional development (CPD) for those working with GPS and for those with an interest in the subject. The course was delivered as a three hour evening class over ten weeks with one full day of practical field work. The part-time course ran successfully for six years but it was clear that attendance after work at a city-centre campus was inconvenient for many while many others who expressed an interest were precluded from attending because of distance. At the same time, the e-learning approach to learning and teaching was being promoted within DIT while DSIS had successfully set-up and pilotted an on-line, e-learning course on coordinate systems and transformations [3]. Accordingly, the previous part-time GPS course is now being replaced by two e-learning modules in GNSS designed for distance-based on-line delivery. The first module will cover GNSS for navigation and Geographical Information Systems (GIS) applications and the second module will cover GNSS for high-accuracy applications such as topographical surveying and geophysics. This paper sets out the design philosophy of the modules and outlines the development to-date of the first GNSS module.

2. DESIGN

The design philosophy was to develop a module that, in the context of the spatial information industry, maximized the advantages of e-learning while addressing identified issues and maintaining a sound pedagogical approach. Potential users were identified as persons engaged in CPD, organizations providing in-company training and academic institutions providing undergraduate and postgraduate modules in GNSS. An individual taking the module could, therefore, be based at home, in an office, in a classroom or in a remote work location. The advantages were identified as convenience, flexibility, facilitation of communication, tailoring and a varied learning experience. The issues were identified as no "hands-on" experience with GNSS field equipment and observing procedures, the difficulty of presenting complex software, learner isolation and the technical issues of delivering large files. To address these issues as far as possible, a variety of presentation, delivery, contact and assessment approaches are used with WebCT®, DIT's on-line course management system, used to provide a consistent e-learning platform and environment.

3. CONTENT

Content is presented in various formats including text, 2D and 3D graphics, animations with animation control, use of proprietary software with sample data and video with voiceover. Examples of typical content are shown in the following extracts. Figure1 shows the layout of the standard graphical interface used in the module with an example of text content. Studies have shown that users do not like reading large blocks of text from computer screens and particularly when it is necessary to scroll down to view content. Accordingly, a clean, easy-readable style is used with all text presented concisely and, where possible, without the need for scrolling.

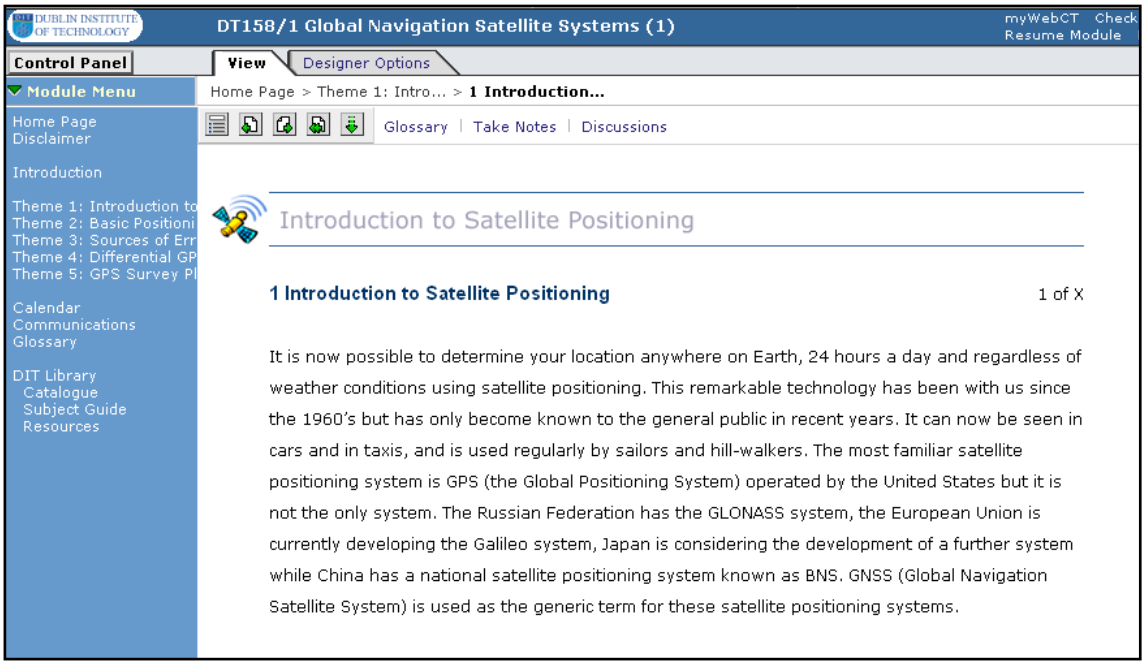

Figure 1. Example of standard graphical interface.

Figure 2 shows an example of a slideshow-style presentation used to develop underlying mathematical principles. Simple 2D graphics are used for clarity. The student can control the progression of the pages using the control buttons at the bottom-left of the screen and voice can be included if it considered helpful. Note the use of FYI tabs to provide supplementary information. This device allows the student to choose between concentrating on the core issue or learning about related issues without too much information being presented on screen simultaneously.

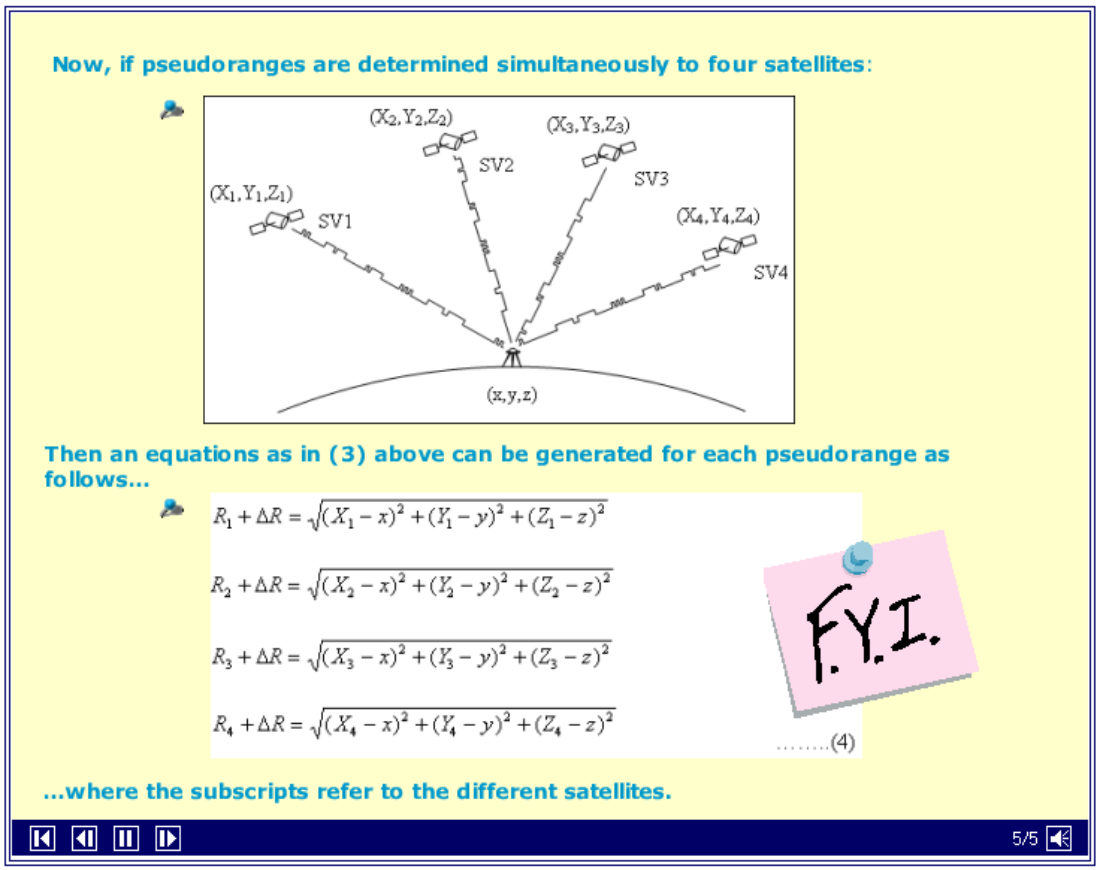

Figure 2. Example of standard slideshow-style presentation.

GNSS is a 3D technology and it is sometimes necessary for students to visualize a situation in 3D to follow an argument or explanation. Accordingly, 3D graphics and animation software was used to create 3D models of different GNSS scenarios. Although time-consuming initially, once the models are completed they can be used to easily recreate different scenes from which images can be extracted and animations produced. Figure 3 shows an example of the high-quality, rendered graphics images used in the module to support explanations where the 3D element of the situation is important.

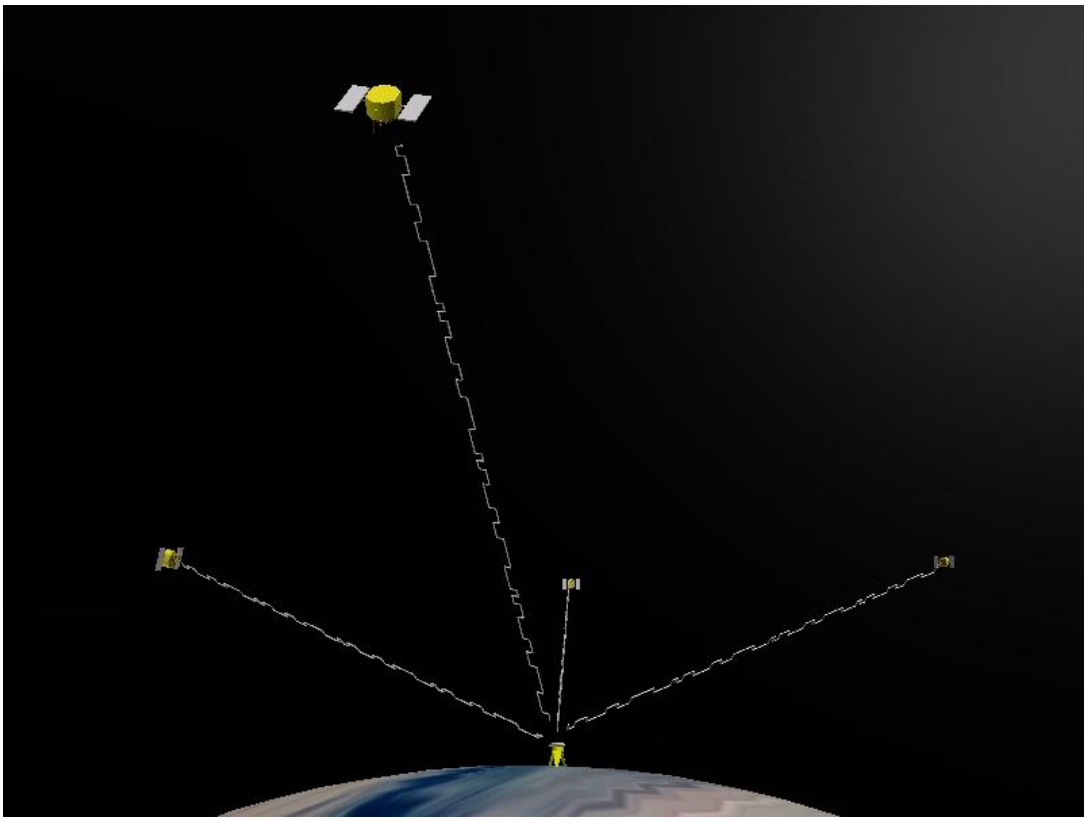

Figure 3. Example of high quality 3D graphics images.

Video is used to demonstrate the practical procedures involved in GNSS receiver set-up, data collection and data downloading. Individual video clips last no longer than ten minutes to maintain interest and to allow for ease of review. Video is hosted on the HEAnet server. HEAnet is Ireland's National Education and Research Network and provides high quality Internet Services to Irish third-level colleges and other educational and research organisations. Fast Streaming from the HEAnet server delivers instant start, fast playback with speeds automatically optimized for the student's network, automatic reconnection in the event of interruption and immediate playback from any portion of a clip.

Interaction between the parties is facilitated by email and discussion boards within WebCT® and desktop multi-point videoconferencing through the HEAnet network. Assessment is included as a series of self-tests and written assignments. The self-tests are in the form of multiple choice questions which provide instant feedback and can be redone by the student at any time. Figure 4 shows an example of a typical self-test. Written assignments are required at the end of each section, or theme, within the module. These are graded by the lecturer and written feedback is provided to each student. Quality assurance is provided for by questionnaires during the module and a feedback report by each participant after completion.

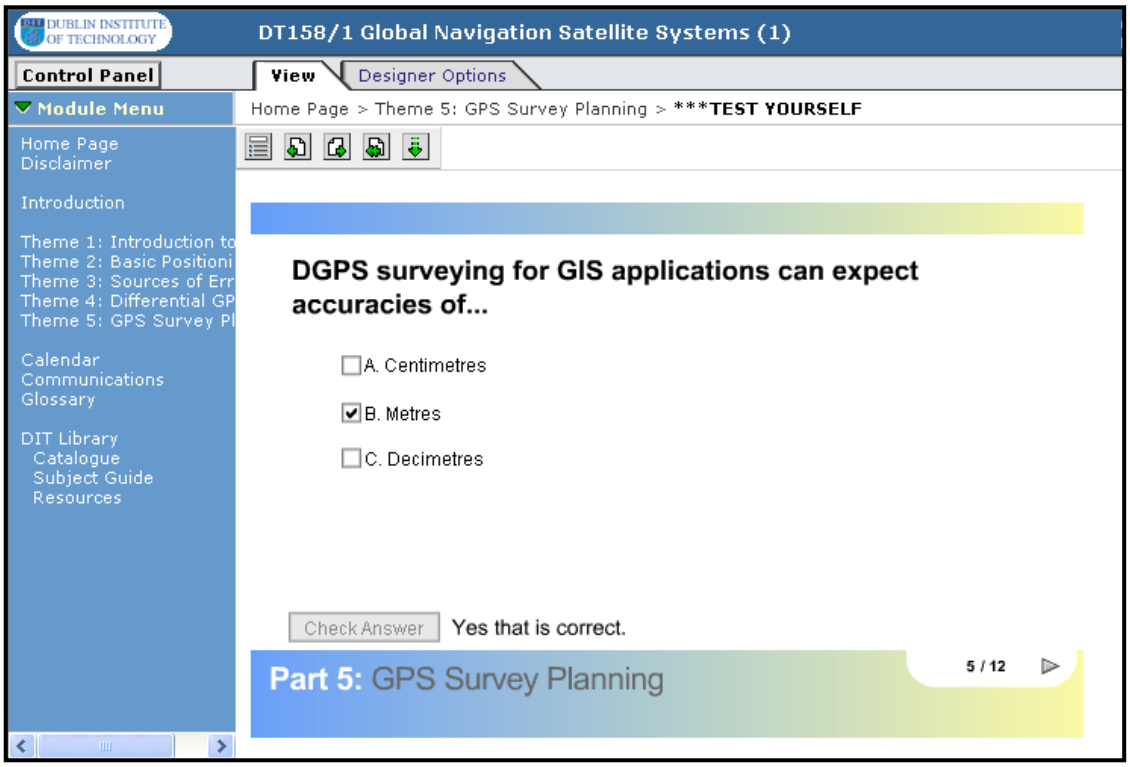

Figure 4. Example of on-line self-test.

4. CONCLUSION

The DSIS at the DIT is developing two e-learning modules in GNSS for on-line delivery. The first module will cover GNSS for navigation and GIS applications and will be completed by the end of April 2007. It will then be piloted before forming a taught module in the new DIT Masters in Spatial Information Management course that is scheduled to begin in September 2007. Thereafter, the module will be offered nationally and internationally by DIT under it's extensive CPD programme. The module represents a significant development for teaching and learning in the GNSS area where the technology is ever-changing, new applications appear daily and practitioners require a combination of underlying knowledge and up-to-date field practice and data processing skills.

References

[1] Roberts, C. 2006. GNSS and the Convergence of Geodesy and the Cadastre in Australia. Shaping the Change, XXIII FIG Congress, Munich, Germany, October 8-13.

[2] Marks, P. 2006. China's satellite navigation plans threaten Galileo. NewScientist.com news service November 2006

[3] Mooney, K & A .M. Martin. 2003. The Potential of Distance e-Learning in the Spatial Information Sciences – An Evaluation of a Pilot Programme at the Dublin Institute of Technology. Computer Based Learning In: Science (CBLIS). July 5th – 10th 2003, Cyprus.