Satellite Navigation and Location Based Services Training Course of African Regional Centre for Space Science and Technology Education in English (ARCSSTE-E) Ile-Ife, Nigeria

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From 2001, the United Nations Office for Outer Space Affairs (UNOOSA) has organized a series of regional workshops and international meetings to promote the use of Global Navigation Satellite Systems (GNSS) through the indigenous capacity building of relevant professionals in member countries. This is especially important due to the recognition of the fact that satellite navigation and positioning data are now used in a wide range of areas including mapping and surveying, monitoring of the environment, precision agriculture and natural resources management, disaster warning and emergency response, aviation ,maritime and land transportation and research areas such as climate change and ionosphere studies. This paper therefore presents the activities of the 2010 training course on \Satellite Navigation and location Based Services" organized by the African Regional Centre for Space Science and Technology Education in English (ARCSSTE-E), which is the last to be organized in the series for all the regional centers of UNOOSA. During the one-month 30 participants from 9 different countries attended this course lectures provided by seasoned faculties from various institutions, within and outside Nigeria. Participants were given extensive hands on training on various aspects and types of Satellite Navigation systems and demonstration of location based services. The paper also presents some recommendations for future use.

1.0 INTRODUCTION

The use of the signals received from the existing global navigation satellite systems (GPS of the United States of America and GLONASS of the Russian Federation) has become a cross cutting tool to support high-level research and sophisticated applications whose results are greatly enhanced by accurate determination of timing and position of events [1,2]. With the advent of two additional global navigation satellite systems (GNSS) that are currently under development (Galileo of the European Union and Compass/Beidou of China), the number of satellites that will be visible to a user at a given time will greatly increase.

For developing countries, GNSS applications offer a cost-effective way of pursuing sustainable economic growth while protecting their environment. Satellite navigation and positioning data are now used in a wide range of areas that include mapping and surveying, monitoring of the environment, precision agriculture and natural resources management, disaster warning and emergency response, aviation, maritime and land transportation and research areas such as climate change and ionosphere studies[3]. Users of this service include common people, corporate, and the scientific community.

In this regard, since 2001, the United Nations Office for Outer Space Affairs has organized a series of regional workshops and international meetings to promote the use of GNSS. The courses are part of the

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work that the Office is conducting to develop an in-depth GNSS curriculum that can be introduced at all the Regional Centres and other institutions of higher-level education. As a further step in this process, the African Regional Centre for Space Science and Technology Education in English (ARCSSTE-E) has organized this training course on GNSS with the support of the United Nations Office for Outer Space Affairs.

The overall objective of this training course is to make the participants aware of the potential of Satellite Navigation technology and its applications with an emphasis on location based services. The participants are exposed to relevant technologies, so as to get an in-depth understanding of how these technologies can be used in an operational scenario.

With the training received it is expected that the participants will have adequate skills to apply the knowledge acquired in their country to support organizations/managers involved in providing value added services in addition to the basic satellite based navigation service.

2.0 THE PARTICIPANTS

Thirty participants from nine different African countries i.e., Uganda, Cameroun, Nigeria, Kenya, Sudan, Mozambique, Botswana, Zimbabwe and Zambia attended the training workshop (Fig.1). These individuals will include practitioners and policymakers, as well as experts from the following groups: international, regional, national and local institutions, research and academic institutions, multi-lateral and bilateral development agencies, non-governmental organizations, and private industry.

3.0 COURSE IMPLEMENTATION

The course was designed to provide the basic principle and applications. The syllabus was balanced between theory, practical and field visits. The Training Course schedule was covered in two modules:

Module 1

The following topics were covered under this module

Satellite Navigation Principles

Satellite positioning

The Global Positioning System

GNSS Receiver Architecture

Augmentation systems

GNSS Applications

Module 2

Applications of satellite navigation with special emphasis on location based services: Following topics were covered under this module. Applications of satellite navigation in land survey and aircraft navigation. Application of satellite navigation in precision agriculture Existing LBS services; applications in vehicle tracking, tourism, disaster management marine services etc.

Designing a location based service

GNSS markets

GNSS regulations and Law

3.1 Lectures and Practical's

The lectures were conducted in the class room with multimedia projection system (Fig.2). The subjects were covered by different lecturers in 62 hours. The lectures were generally conducted during first half of each day. Practical exercises and demonstrations were conducted generally during the second half of the day (Fig.3). Experiments with different types of GNSS receivers in

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stand alone mode and integrated with communications systems were conducted. Computer based exercises using MATLAB simulation was conducted.

Session One

1. Familiarization with GPS receivers/coordinate system conversions
2. Familiarization with single frequency handheld receivers
3. Understand its operations and features
4. Observe performance in open space and under shadow.
5. Learn how to convert readings in different coordinate systems.

Session Two

1. Familiarization with standard GPS file formats and their use
2. Use of standard formats such as rinex (receiver independent exchange formats to explain the RINEX format for Navigation and observation files.

Session Three

1. Experiment to demonstrate the operation of Dual frequency GPS receivers
2. Understand operations of dual frequency GPS receivers/advantage over single frequency.
3. Post processing to show different capabilities of such kind of receivers
4. GPS Calendar and Ephemeris Data i.e in ionospheric delays and estimation of scintillation index.

Session Four

1. Comparison of position difference between single frequency GPS receiver and DGPS receiver.
2. Experiment to make participants learn to use DGPS receiver s and understand its benefits and use.
3. Post processing of DGPS data using a processing software.

Session Five

1. SATNAV aided precision estimation of distance
2. Introduction to matlab
3. Estimation of satellite position, user position and ionospheric delays in the file using matlab.
4. Generation of a scatter plot out of the derived position to verify accuracy of position estimate.

3.3 Tutorial

Tutorials were conducted to give clarity and insight into the content of the course especially for those participants who needed a brush up of certain fundamentals during the course

3.4 Evaluation

Lecturers gave assignments to the students to assess their understanding. Separate evaluation was conducted for overall assessment of performance and certificates were presented to all participants at the end of the training (Fig.4).

4.0 ACADEMIC VISITS AND EXCURSIONS

Part of the activities scheduled for this training program include excursions and visits to some important GNSS facilities spread around the country. The details of the visits are as given below.

4.1. Visit to FUTA

Part of the activities scheduled for this training program is an excursion to some important GNSS facilities in the country. The participants visited the Federal University of Technology (FUTA), Akure on the 18th of November 2010. The team was warmly received by the Deputy Vice Chancellor

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and other principal officers of the institution. An awareness creation lecture on the role of GNSS for Sustainable Development in Africa was delivered by Dr. Joseph Dodo at the Centre for Space Research and Applications. The lecture was also attended by both the participants, staff and students of the University and questions were asked after the interactive session. The participants were later taken around to inspect the GNSS CORS facility at FUTA before their departure.

4.2 Visit to NigComsat Ground Station, Abuja

On the 25th of October, 2010, the participants visited the National Space Research and Development Agency (NASRDA), Abuja (Fig.5). The purpose was to visit the NiGCOMSAT-1 ground station and NigComsat-1R satellite both of which were designed to carry the L band transponder for GNSS augmentation in Africa. The participants also visited the Nigeriasat-1 and NigeriaSat-2 ground stations and they were able to interact with scientists and engineers at NASRDA during the inspection of those facilities. Foreign participants expect that this visit will enhance the regional initiative of cooperation in space activities in Africa.

4.3 Visit of GNSS facility at OSGOF, Abuja

Finally the participants also visited the GNSS CORS facility at the Office of the Surveyor General of the Federation (OSGOF) on the 25th of November 2010 (Fig.6). The participants were warmly received by the Surveyor General's Office in Abuja. OSGOF is also the national mapping agency responsible for the coordination of the African Reference Frame Project (AFREF) in Nigeria. After a round table conference with the principal officers of the agency, the participants were taken around to inspect the GNSS CORS facility and the data reception and processing station at OSGOF.

5.0 Resource Persons

The topics identified in this course were taught to the participants by resource persons drawn from Academic Institutions, Satellite Navigation System Operators, Government agencies, Industries and other experts.

6.0 SPONSORSHIP

The course was jointly sponsored by UN OOSA, ICG, National Space Research and Development Agency (NASRDA) and African Regional Centre for Space Science and Technology Education in English (ARCSSTE-E). The contributions of the following organizations namely, Regional Centre for Training in Aerospace Surveys (RECTAS), Obafemi Awolowo University (OAU), Federal University of Technology (Akure), Federal School of Surveying, Oyo and the Office of Surveyor General of the Federation (OSGOF), are highly appreciated.

7.0 CONCLUSION AND RECOMMENDATION

The International training course on Global Navigation Satellite Systems and Location Based Services organized by ARCSSTE-E, Ile-Ife was part of attempt to promote sustainable application of GNSS. The training has enhanced the teachings and training at the centre and improve public awareness about usefulness GNSS in Africa. This training also have created a successfully platform for collaboration with some organizations. It is believed that more of such training would be organized to further improve capacity development in area of GNSS in Africa.

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Fig.1 : Participants from 9 different African countries

Fig.2 : Course participants during outdoor practical

Fig.3 : Participants during outdoor practical

Fig.4 : Presentation certificate to participants

Fig.5 : Visit to the Nigcomsat-1ground station

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Fig.6 : Visit of GNSS facility at OSGOF, Abuja

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