Report on GNSS Training

Course ID: T141-30

Afghanistan, Australia, Austria, Bangladesh, Bhutan, Cambodia, India, Indonesia, Japan, Maldives, Mongolia, Nepal, The Philippines, Sri Lanka, Tajikistan, Thailand, The United States of America, Vietnam

Hosted by GIC/AIT, Thailand

23 – 26 JAN 2018

Part A

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1. COURSE NAME

Training on GNSS

2. COURSE ID

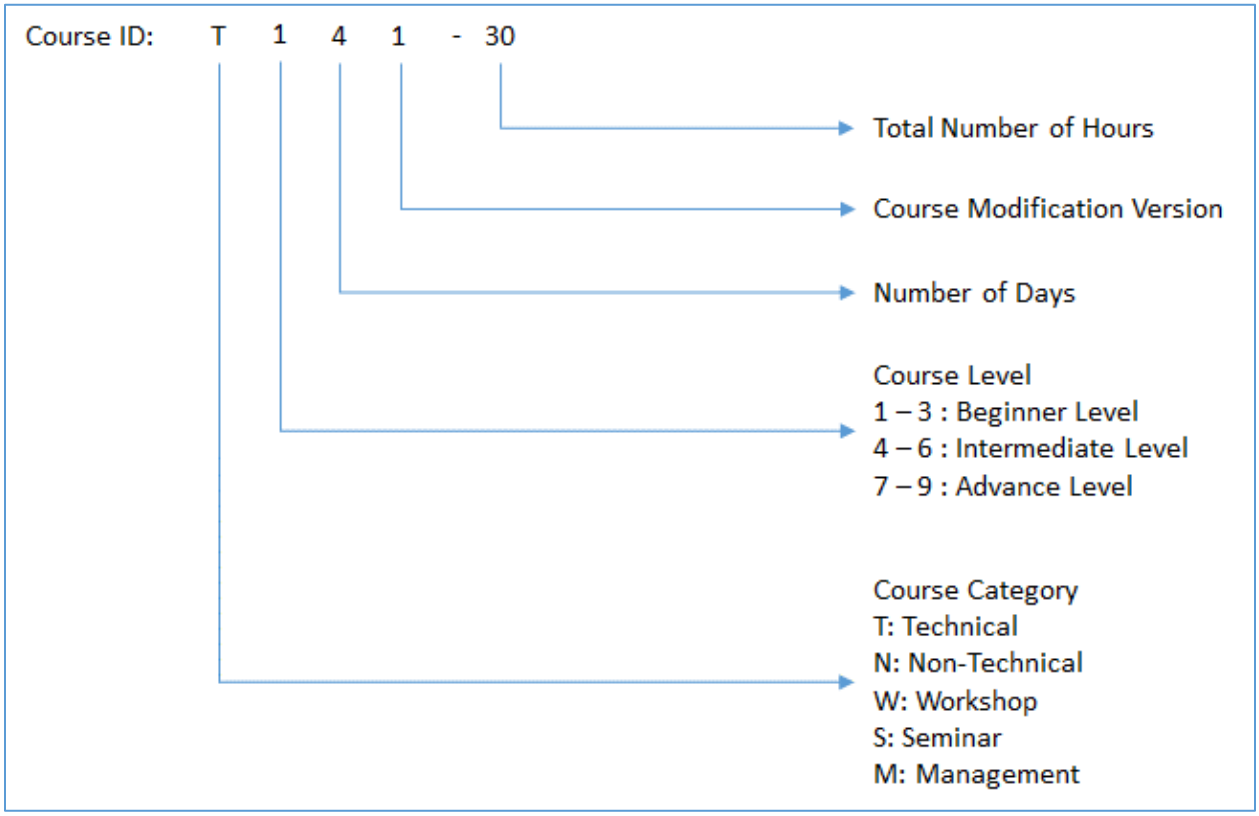

Figure 1: Course ID Coding

3. COURSE INTRODUCTION

The Global Positioning System (GPS) is widely used in almost all systems that require absolute position and time. It is due to its accuracy, availability, reliability. In addition to GPS of the United States, several other systems such as GLObal Navigation Satellite System (GLONASS) of the Russian Federation, the European global navigation system (Galileo) of the European Union, the BeiDou Navigation Satellite System (BDS) of China, the Indian Regional Navigation Satellite System (NavIC), India and the Quasi-Zenith Satellite System (QZSS), Japan are now available. Collectively, they are called GNSS (Global Navigation Satellite System). GNSS can provide centimeter level accuracy with a low-cost receiver, if an error correction technique is used. Thus, availability of low-cost and high-accuracy receivers will eventually increase GNSS related applications and its market. In order to keep the pace with these new applications and developments, it is necessary to develop human resources and skills. Geoinformatics Center of the Asian Institute of Technology (GIC/AIT) together with the Center for Spatial Information Science at the University of Tokyo (CSIS/UT) and with the support of the International Committee on GNSS (ICG), are taking an initiative to create awareness on GNSS and its applications in Asia and the Pacific region. This training course is a part of this initiative.

4. Objectives of the Training

- Introduction to GNSS, comprised of GPS, GLONASS, GALILEO, BDS, NavIC and QZSS. The course primarily focuses on GPS and QZSS.
- General overview of signal processing in receiver, receiver performances (low-cost receiver vs. high-end receiver).
- Introduction to PPP, RTKLIB and SW Maps
- Field Survey using Low-Cost receiver for High-Accuracy positioning

5. Benefits of the Training Course

Upon completion of this course, participants will be able to understand about how a GNSS receiver works, its signal structures as well as its applications including survey methods for obtaining higher accuracy.

6. Funding

Co-organizers have provided limited travel only financial assistance for eligible participants and preference given to participants from the developing countries.

7. Co-organizers:

- UNOOSA/ICG, Vienna
  - United Nations Office for Outer Space Affairs
  - International Committee on GNSS
- S4D/CSIS/UT, Japan
  - Space for Development
  - Center for Spatial Information Science
  - The University of Tokyo
- IC/AIT, Thailand
  - Geo-Informatics Center
  - Asian Institute of Technology

8. Training Host

GIC/AIT, Thailand

9. Training Duration

23 – 26 JAN 2018, 30 hours

10. Resource Persons

1. Sharafat Gadimova, UNOOSA/ICG, Austria
2. Dinesh Manandhar, Associate Professor, The University of Tokyo, Japan
3. Yuichi Hayakawa, Associate Professor, The University of Tokyo, Japan
4. Nobuaki Kubo, Associate Professor, Tokyo University of Marine Science and Technology, Japan
5. Suelynn Choy, Associate Professor, Royal Melbourne Institute of Technology (RMIT) University, Australia
6. Thomas Stansell, Stansell Consulting, USA (online lecture)
7. David Turner, State Department, USA (online lecture)
8. GIC/AIT resource persons and staffs

11. Summary of Participants and Resource Persons

Table 1: Summary of Participants & Resource Persons

Total Participants	67
International Participants	25
Funded International Participants	14
Self-funded International Participants	11
Thai Participants	24
AIT Students and Researchers	18
Number of Countries	15 Afghanistan, Bangladesh, Bhutan, Cambodia, India, Indonesia, Japan. Maldives, Mongolia, Nepal, The Philippines, Sri Lanka, Tajikistan, Thailand, Vietnam
Number of Resource Persons (International)	7 (Australia: 1, Japan: 3, UNOOSA: 1, USA :2)
GIC Resource Persons	7

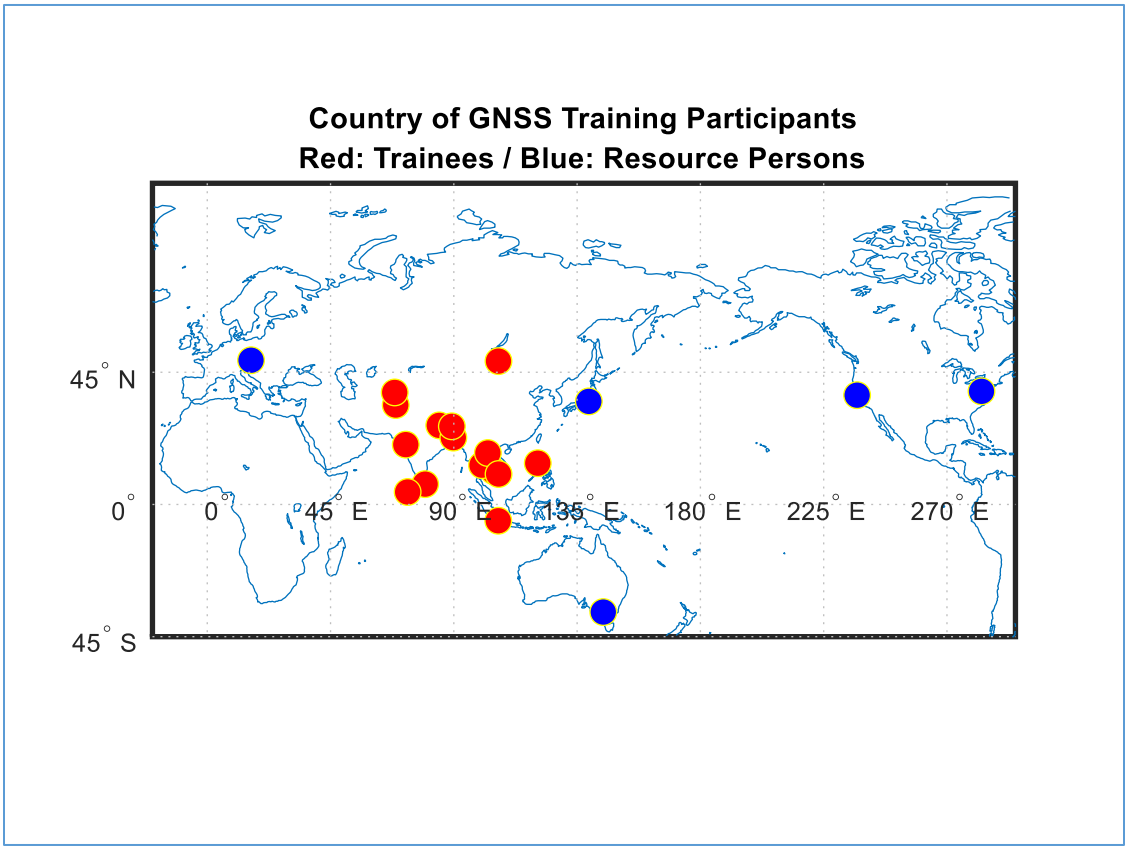

Figure 2: Countries represented by the training participants, RED: Resource Persons, BLUE: Trainees

12. Lecture Materials and Data

http://www.unoosa.org/oosa/en/ourwork/icg/activities/2018/ait-gnss.html

http://www.csis.u-tokyo.ac.jp/~dinesh/

13. AIT News Media Link

https://www.facebook.com/pg/AITasia/photos/?tab=album&album_id=10156033923604709

14. Key Activities

The participants were given lectures as per the course schedule in Appendix 1. The participants were divided in to 11 teams with 6 members in each team. Each team was provided with a low-cost GNSS receiver to log data. The participants were also asked to log data using android mobile phone device.

On day2, each participants logged GNSS data as they liked. They were not provided any instructions on how to setup the antenna or other necessary arrangements to log data except the procedure to save the data in computer. Since, it was the first time for most of the participants to log GNSS data by themselves, they tried their best to log data. But, the way they hold the antenna or set the antenna was not a proper way for GNSS surveying. Though they could log GNSS data, the results they get is not good at all. The participants were also given lectures on UAV Applications with GNSS, Operation of UAS, UAV Case Studies and High-precision GNSS for UAS.

On day 3, the participants were taught how to conduct GNSS survey, how to set antenna for good data etc. Also, they were taught the types of errors in GNSS and how these errors can be removed by using a reference station data for higher accuracy. The participants logged data again on this day with proper handling of antenna or setting the antenna on a tripod.

The participants learnt how to perform PPP and RTK (post-processing) to get high accuracy of few centimeters. The results clearly show how accuracy improved from Day 2 to Day 3 as well as the centimeter level accuracy achievement from various signal processing methods like PPP and RTK.

On day 4, the participants learnt how to use real-time RTK processing by using RTKLIB. Finally, each team presented their results from PPP and RTK processing.

During this training course, the participants learned various methods of signal processing like PPP, RTK (post-processing and real-time) for high accuracy using data from survey-grade and low-cost GNSS receivers.

15. Key Findings

- This type of training is very effective to teach practical methods of how to process GNSS data for high-accuracy. The training does not focus much on theoretical aspects. After the training, the trainees will be able to perform survey themselves and understand the output results.
- Many participants have feeling that high-accuracy GPS receivers are very expensive so they don't think about using GPS in other applications beyond survey.
- Some participants thought that GPS is only for surveying, mapping and navigation. So they never thought about using it in agriculture, traffic analysis, timing applications etc
- Due to GNSS, users are now confused which combination of satellites are good for their applications.
- GNSS receiver with all satellite and all signals are expensive. Thus, it is necessary to make a guideline on GNSS receiver selection based on applications, required accuracy and working site.
- A GNSS survey procedure guideline is also necessary based on applications, required accuracy, working site, mode of operation (real-time, post-processing, static or dynamic)
- Need to teach what type of data are provided by GPS receivers and how those data can be used in various applications.

16. Recommendations

- This type of training shall be continued in future as well.
- Training shall be focused to give more practical solutions.
- If possible, sample low-cost devices shall be provided to trainees so that they can practice and teach the know-how to their colleagues back home.
- Training at various levels targeting various groups shall be conducted. For example, training targeting policy and decision making level is equally important so that GNSS technology itself could be understood at decision and policy making level.

17. Course Schedule

Appendix 1

18. List of Participants

Appendix 2

19. Course evaluation

Appendix 3

Training participants are requested to submitted course evaluation form as shown in Appendix 3.

20. Pictures of the Program

Appendix 4