

Appendix 5.2

[Research and development for precise positioning with Artificial Intelligence (AI) during ionospheric disturbances in low-latitude region in ASEAN] [Traveling to Field Test Sites for GNSS receiver installation and Workshop for RTK application experiments] Report Form

I. Proposer:

Name:	Dr. Lin Min Min Myint
Position:	Assistant Professor
Institution:	King Mongkut's Institute of Technology Ladkrabang, Thailand

II. Objective:

To install a new GNSS receiver system at the Institute of Technology of Cambodia (ITC), Phnom Penh, Cambodia, and provide a training workshop for Real Time Kinematics (RTK) position application and experiments.

The project aims to set up a GNSS receiver system at the Institute of Technology of Cambodia (ITC), Phnom Penh, Cambodia, and to provide a training workshop for developing and testing Real Time Kinematics (RTK) position systems, for various applications in Cambodia.

Firstly, the receiver system will be jointly installed at ITC, by project members from KMITL, Thailand, and ITC Cambodia. Before its transport to Cambodia, the receiver system underwent thorough inspection and testing by KMITL project members as shown in Figure 1. The vendor company, Repco Corporation is now processing the transport to ITC before our arrival. ITC project members will handle the preparation for installation, including installing the cable and setting up the antenna pole.



Testing GNSS receiver and antenna

Fig. 1. Inspecting and testing the equipment at KMITL, Thailand before sending to CADT, Cambodia
The installation process, including antenna and receiver setup, configuring receiver and computer setting for data collection, conducting on-site testing for full-day data on positioning and ionospheric monitoring will be carried out by project members from KMITL and ITC. Additionally, discussions regarding

maintenance plans and future collaborative research based on the collected data among KMITL, ITC, CADT, and NOUL are scheduled. Figures 2 and 3 illustrate the ITC building intended for the receiver system installation and the locations of ASEAN-IVO project GNSS receivers at ITC (new) and CADT (existing).



Fig. 2. ITC's building the GNSS receiver system will be installed.

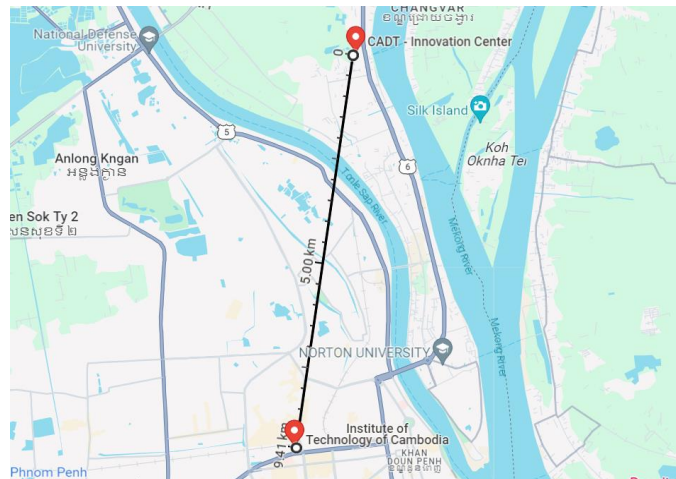


Fig. 3. The locations of the new ITC GNSS receiver system and existing CADT GNSS receiver system (credit: Google Map)

Furthermore, we'll assess the accuracy performance of the RTK by conducting tests using two GNSS receivers—one stationed at the new ITC location and the other at the existing CADT site, situated 9.3 km apart. Additionally, a training workshop on RTK receiver applications, employing low-cost RTK receiver modules and the two GNSS stations, will be conducted for researchers from ITC and CADT in Cambodia, as well as NOUL in Laos. This trip will facilitate the project members in developing and implementing the RTK system across diverse applications, including drones and agriculture.

III. Schedule:

Date	Location	Work	Person in charge
1/2/2023 9:00-11:00	ITC, Phnom Penh, Cambodia	Setting up GNSS antenna, receiver & Computer	Prof. P. Supnithi, Mr. S. Kaing, Dr. L. Myint Dr. J. Butho, Dr. P. Thammavongs Dr. S. Sophan
1/2/2023 11:00-12:40	ITC, Phnom Penh, Cambodia	Checking and Calibrating the GNSS system and collecting data for testing and RTK experiment	Prof. P. Supnithi, Mr. S. Kaing, Dr. L. Myint Dr. J. Butho, Dr. P. Thammavongs Dr. S. Sophan
1/2/2023 14:30-16:30	CADT, Phnom Penh, Cambodia	Checking and Calibrating CADT's GNSS system and Discuss on the project progress and plan	Prof. P. Supnithi, Dr. P. Kong Dr. L. Myint Dr. J. Butho, Dr. P. Thammavongs Dr. S. Sophan
2/2/2023 9:00-11:00	ITC, Phnom Penh, Cambodia	Setting up GNSS antenna, receiver & Computer (reinstalling the receiver system in a cabinet rack)	Prof. P. Supnithi, Mr. S. Kaing, Dr. L. Myint Dr. J. Butho, Dr. P. Thammavongs Dr. S. Sophan
2/2/2023 11:00-12:00	ITC, Phnom Penh, Cambodia	Meeting for GNSS receiver maintenance and further plan	Prof. P. Supnithi, Mr. S. Kaing, Dr. L. Myint Dr. J. Butho, Dr. P. Thammavongs Dr. S. Sophan
2/2/2023 13:00-16:30	ITC, Phnom Penh, Cambodia	RTK application training workshop (13:00-13:15) Lecture on Space Weather and ASEAN-IVO project by Prof. P. Supnithi (13:15-14:00) Lecture on GNSS and RTK position technique using U-blox RTK modules by Dr. J. Butho, Mr. Napat. (14:00-14:20) Coffee break (14:20-16:30) hand-on experience	All

		periments facilitated Dr. L. M yint, Dr. J. Butho, Dr. Dr. Thammavongsy, Mr. S. So phan.	
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IV. Participants:

No.	Name	Organization
1	Prof. Pornchai Supnithi	(Project leader) KMITL, Thailand
2	Dr. Lin Min Min Myint	KMITL, Thailand
3	Dr. Jirapoom Budtho	KMITL, Thailand
4	Dr. Somkit Sophan	KMITL, Thailand
5	Dr. Phimmasone Thammavongsy	NOUL, Laos
6	Mr. Sainglong Kaing	ITC, Cambodia
7	Dr. Phutphalla Kong	CADT, Cambodia
8	Mr. Soklay Heng,	CADT, Cambodia

(Note: List of participants in the training workshop is attached)

V. Summary of the activities corresponding to the objectives

The trip had two main objectives: to install new GNSS receivers at ITC, Phnom Penh, Cambodia, and to conduct a training workshop on the topic of GNSS real-time kinematic (RTK) positioning. Additionally, the team visited the CADT campus to inspect the GNSS receiver system installed during a previous ASEAN-IVO project and discuss current project progress and plans. Led by Prof. P. Supnithi (Project leader), the team comprised three project members from KMITL, Thailand, and one project member from NOUL, Laos. The list of responsibilities is as follows:

1. Prof. Pornchai Supnithi (Project leader)- Overseeing project management and discussion for project plan. Delivery a lecture on the Introduction of Space Weather and ASEAN-IVO project during the workshop
2. Dr. Lin M.M. Myint (KMITL Project member) – Assisting the project leader for project management and plan discussion at ITC and CADT as well as in the setup of GNSS receiver system. Facilitating hand-on experiments during the workshop
3. Dr. Jirapoom Budtho (KMITL Project member) – Conducting the setup of the GNSS receiver system at ITC. Delivery a GNSS and RTK lecture during the workshop
4. Dr. Somkit Sophan (KMITL Project member) – Assisting in the setup of the GNSS receiver system at ITC and Facilitating hands-on experiments during the workshop.
5. Dr. Phimmasone Thammavongsy (NUOL Project member) –Conducting RTK experiments at ITC and CADT. Assisting in the setup of the GNSS receiver system at ITC and Facilitating hands-on experiments during the workshop.

During the week before our trip, Mr. Sainglong Kaing (ITC project member) oversaw the construction and preparation processes, including setting up the GNSS antenna pole on the rooftop of the building, installing the cable pipe from the antenna pole location to the room and installing the internet cable in the room.

The KMITL and NOUL team arrived in Phnom Penh, Cambodia by flight on Wednesday (January 31st, 2024) and checked in the hotel.

On Thursday, February 1st, 2024, the team arrived at the ITC campus at morning 9:00 AM, where Mr. Kaing warmly welcomed us. We proceeded to the room at the F building, where the receiver system was planned to be installed. It is a classroom located on the rightmost side on the fourth floor, which

is very suitable for the receiver installation. Upon arrival, we checked the GNSS antenna pole and the cable pipeline on the rooftop. Then we commenced the setup process of GNSS receiver system with Mr. Kaing's assistance. The team was divided into two groups: one group climbed up to the rooftop area to carry out the cable installation into the pipeline and attach the GNSS antenna to the stand. At the same time, another group inside the room initiated the hardware setup process with the GNSS receiver, computer, CPU, and other equipment. At noon, the installation process was completed. We proceeded to test and calibrate the system. Then the system was configured to collect the data from the receiver continuously and save it in the computer before sending it to the server at the KMITL, Thailand. Concurrently, we tested the low-cost GNSS RTK receiver systems using the existing CADT GNSS station and the new ITC station. Due to safety concerns for students and the system, given that the receiver system, including the receiver, computer, UPS, and cable, were on a table without protection, the team and Mr. Kaing decided to place all equipment into a server cabinet rack. Subsequently, we sought permission from the ASEAN-IVO secretariat, Ou-san, to purchase a cabinet rack with the project's budget via email. We departed from the ITC campus at 12:45 PM for lunch.

Following lunch, our team proceeded to visit the CADT campus, while Mr. Kaing returned to the ITC campus to assess the availability and cost of a server cabinet rack with the required specifications within the given timeframe. Upon our arrival at the CADT, we were greeted by Dr. Phutphalla Kong and Mr. Soklay Heng. Then, our team engaged in discussions with Dr. Cheab Sovuthy (Director, CADT), Dr. Kong, and Mr. Heng regarding research ideas related to the ASEAN-IVO project. Prof. Supnithi (Project leader) explained an overview of the current research trends in Ionospheric studies and possible applications of the RTK positioning technique. The CADT members expressed interest in RTK positioning techniques, particularly in conjunction with drones and robot cars. After the meeting, the team, together with CADT's members, visited the GNSS antenna location at the rooftop. We consulted with the CADT project members to install additional support at the antenna stand base for better stability. We then proceeded to the CADT's server room, where the GNSS receiver system is located, to assess if any hardware improvements are required. After concluding the discussion with CADT project members, we returned to the hotel from the CADT campus at 4:00 PM.

On Friday, February 2nd, 2024, Mr. Kaing kindly arranged to deliver the required server cabinet rack to the ITC campus after receiving the purchase approval email from Ou-san in the morning. Our team arrived at the ITC campus at 9:00 AM to prepare for replacing the equipment of the receiver system from the table to the cabinet rack. Upon the rack's arrival, we transported it to the room and started moving all equipment into the rack and arranging the cables. The whole process was completed at 11:00 AM. Subsequently, our team discussed receiver maintenance and future project activities with Mr. Kaing. We then proceeded to the ITC's conference room where the training workshop was scheduled and made the preparation until 12:00 noon before going for lunch.

The workshop started at 1:00 PM with Mr. Kaing delivering welcome remarks. Prof. Supnithi provided an introductory presentation about the ASEAN-IVO project and its research activities, followed by a lecture from Dr. Budtho on the GNSS RTK positioning technique. A 20-minute coffee break was taken before the hands-on demonstration. Six sets of low-cost RTK receiver systems purchased by the ASEAN-IVO project budget were used in this hands-on demonstration. During the demonstration experiment, participants were divided into six groups, each group providing each set of the receiver system. The participants learned and tested the RTK positioning technique using the receiver system attached first to their computer and then to their mobile phone. The workshop concluded at 4:00 PM. At the end of the workshop, one RTK receiver system was allocated to Mr. Kaing (ITC) and another was given to Mr. Soklay Heng for further research activities and learning purposes.

Following the workshop, Prof. Supnithi and Dr. Lin departed from Phnom Penh to Bangkok on the same day evening. Other team members returned from Phnom Penh on Saturday (Feb 3rd, 2024) after verifying one day of data collection from the new GNSS station.

Currently, the GNSS receiver system at the ITC station, located in the F building on the ITC campus, Phnom Penh, Cambodia is operational. Data is collected and saved in the KMITL's main data center daily. As a result, the data are available for GNSS and space weather monitoring applications, and other research works.

VI. Others



Fig. 4. The main entrance of Building A at CADT campus



Fig. 5. Carrying equipment and tools to Building F (receiver site)



Fig. 5. GNSS antenna stand pole at the rooftop.



Fig. 6. Preparing in classroom where GNSS receiver room was installed (Prof. Supnithi, Mr. Kaing, Dr. Budtho, Dr. Sophan, and Dr. Phimmasone).



Fig. 7. GNSS cable installation at the rooftop (Mr. Kaing and Dr. Phimmasone).



Fig. 8. GNSS cable installation inside the room (Dr. Lin, Dr. Budtho, Dr. Sophan).



Fig. 9. Setting up processes inside the room and at the rooftop (Dr. Budtho, Dr. Sophan).

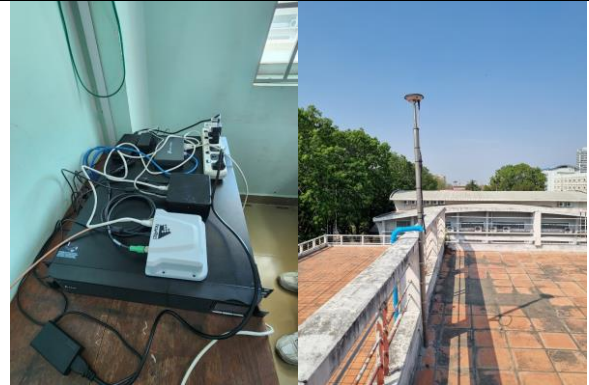


Fig. 10. GNSS receiver system and antenna after installation on the first day.



Fig. 11. GNSS receiver system installation inside a server cabinet rack on the second day.

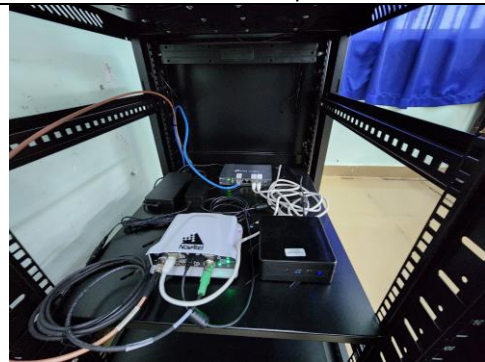


Fig. 12. GNSS receiver system inside a server cabinet rack.

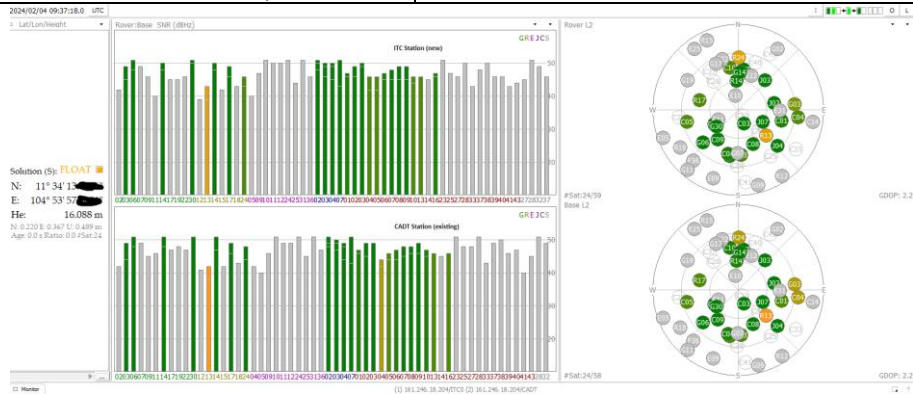


Fig. 13. Checking the performance of the ITC GNSS receiver station compared with that of the CADT station (using RTKLIB software)



Fig. 14. GNSS receiver system inside a server cabinet rack and Project members.



Fig. 15. Inspecting GNSS receiver system and antenna at the CADT and discussion research ideas (Prof. Supnithi, Dr. Sovuthy, Dr. Kong, Dr. Budtho).



Fig. 16. Project member group photo at the CADT campus and the GNSS receiver room.



Fig. 17. Testing low-cost RTK receiver system using the new ITC and existing CADT stations as base stations on the first day. (Dr. Sophan, and Dr. Phimmasone).



Fig. 18. Attendance registration before the workshop.

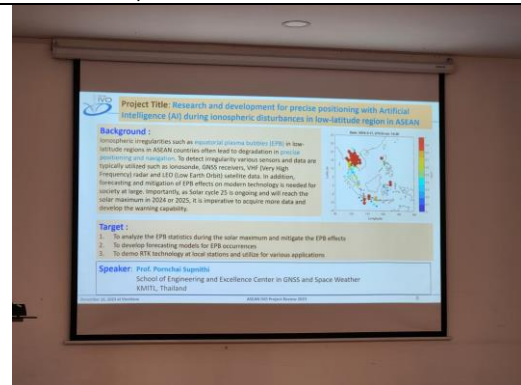


Fig. 19. ASEAN IVO project information.



Fig. 20. Presentation on the ASEAN-IVO project and research ideas on space weather by Prof. Supnithi



Fig. 21. Lecture on GNSS RTK positioning technique by Dr. Budtho



Fig. 22. Hands-on experiment activities with the low-cost RTK receiver system outside the building.



Fig. 23. Hands-on experiments activities with the low-cost RTK receiver system outside the building.



Fig. 24. Hands-on experiment activities with the low-cost RTK receiver system outside the building.



Fig. 25. Workshop participants during Coffee break.



Fig. 26. A low-cost RTK receiver system handed over to Mr. Kaing (ITC) by Prof. Supnithi.



Fig. 27. A low-cost RTK receiver system handed over to Mr. Heng (CADT) by Dr. Budtho.



Fig. 28. A group photo of the training workshop's participants and project members.

Attachments

1. Workshop announcement poster
2. Workshop training agenda
3. Workshop attendance registration list
4. Questionnaire and feedback from workshop participants