2-week Advanced FDP on Applications of GNSS/NavIC in Cost-efficient Solution Development

9-20 January, 2023

REPORT

2-week Advanced Faculty Development Program (FDP)

Applications of GNSS/ NavIC in cost-efficient Solution Development

Sponsored by
AICTE Training and Learning (ATAL) Academy

Organised by:
Department of Physics
The University of Burdwan
Burdwan 713 104
West Bengal

Date:
9-20 January, 2023
Contact: abose@phys.buruniv.ac.in

2-week Advanced FDP on Applications of GNSS/ NavIC in cost-efficient Solution Development
Organized by Department of Physics, The University of Burdwan, West Bengal
Sponsored by AICTE Training and Learning (ATAL) Academy
9-20 January 2023

A 2-week Advanced Faculty Development Program (FDP) on **"Applications of GNSS/ NavIC in cost-efficient Solution Development"** was organized by The Department of Physics, The University of Burdwan, West Bengal during 9-20 January 2023. The program was sponsored by AICTE Training and Learning (ATAL) Academy. This program is a sequel of the 5-day basic Faculty Development program (FDP) on "GNSS/ NavIC and Applications" held during 21- 25 September, 2022.

The uniqueness of the program is the **blended mode** of execution. Week 1 (9-14 January, 2023) was earmarked for introductory lectures on the topic from eminent experts in **ONLINE** mode. The second week of the program (16-20 January, 2023) was conducted in **Physical Mode** at the Department of Physics, The University of Burdwan, Burdwan, West Bengal. In the Physical part of the FDP other than talks from experts from academia, industry and research organizations the interesting features of the course were interactive discussion of the participants on 4 preselected sample papers on applications of GNSS as case studies, two hands-on sessions on GNSS hardware, software, data processing techniques, solution accuracy improvement techniques and come out with possible project ideas based on the experience gained through the theoretical and case study ideas. Total 10 experts from educational institutions, research organization, and Industry delivered lectures and helped in the discussions of case studies, two hands on training session was organized in the program by support of the group members of the GNSS Laboratory, Burdwan (GLB, http://bugnss.in). Out of all the experts, 8 experts were from India and 2 experts from Japan. There were total 14 technical sessions- 12 lecture sessions and 2 hands on session together with 4 Article discussion sessions, 1 inaugural, 1 valedictory, 1 project charter session and 1 Reflection Journal Session. On the final day online evaluation was also organized as shown in the complete program of the workshop in subsequent pages. Dr Anindya Bose of Department of Physics was the coordinator of the FDP and Dr Joydeep Chakravorty was the Co-Coordinator of the FDP.

The program was inaugurated on the first day of the Physical mode of the program (16 Januray, 203) by Professor S K Karforma, Dean, Faculty of Science, The University of Burdwan. Other dignitaries present in the inaugural session were Professor A C Mondal, Head, Department of Physics, The University of Burdwan, Dr P Banerjee and Dr D Banerjee, the expert speakers of the day. Dr Anindya Bose, Coordinator welcomed the participants and Prof P Mitra, Head,

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Department of Physics proposed the vote of thanks. Picture of the Inaugural Program is shown below.

The complete program schedule is shown in Pages 4 and 5.

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Program Schedule
(09-20 January 2023)

WEEK I (ONLINE- On Google Meet)

Time	Day 1 (09/01/2023)	Day 2 (10/01/2023)	Day 3 (11/01/2023)	Day 4 (12/01/2023)	Day 5 (13/01/2023)	Day 6 (14/01/2023)
07:00 - 07:50 pm	Session 1 (Part I) Introduction to GNSS/ NavIC (Dr Anindya Bose)	**05:30-08:00pm** Session 2 (Part I) GNSS Error Sources and Positioning Techniques (Dr Ivan Petrovski)	Session 3 (Part I) (Part I) GNSS based Time Transfer (Dr P Banerjee)	Session 4 (Part I) GNSS/ NavIC Applications (Dr Ashish K Sukla)	Session 5 (Part I) GNSS/ NavIC in Atmospheric Research (Dr Nirvikar Dashora)	**05:30-08:00pm** Session 6 GNSS Compact Modules (Dr Dinesh Manandhar)
			BREAK			
08:00 - 08:50 pm	Session 1 (Part II) Introduction to GNSS/ NavIC	Session 2 (Part II) GNSS Error Sources and Positioning Techniques	Session 3 (Part II) GNSS Compact Modules	Session 4 (Part II) GNSS/ NavIC Applications	Session 5 (Part II) GNSS/ NavIC in Atmospheric Research	Session 6 (Part II) GNSS based Time Transfer
			BREAK			
09:00- 09:30 pm	Discussions on Session 1	Discussions on Session 2	Discussions on Session 3	Discussions on Session 4	Discussions on Session 5	Discussions on Session 6

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WEEK II (PHYSICAL MODE)					
	Day 1 (16/01/2023)	**Day 2 (17/01/2023)**	**Day 3 (18/01/2023)**	**Day 4 (19/01/2023)**	**Day 5 (20/01)**
10:00-12:30	**10:00 – 12:00** Session 7 **GNSS and Society** **(P Banerjee)**	Session 9 **GNSS in Mobile Phones** **(Dr Anindya Bose)**	Session 11 **GNSS in GIS/ Mapping** **(Prof Biplab Biswas)**	Session 13 **GNSS Science Applications** **(Dr Saurabh Das)**	Project Charter
12:30-1:30	12:00-1:00 pm **Article 1 Discussion** "Multi-GNSS precise point positioning for precision agriculture", Guo, J., Li, X., Li, Z., Hu, L., Yang, G., Zhao, C., Fairbairn, D., Watson, D. and Ge, M., 2018, *Precision Agriculture*, 19(5), 895-911	**Article 2 Discussion** "Integrity monitoring for positioning of intelligent transport systems using integrated RTK-GNSS, IMU and vehicle odometer", El-Mowafy, A. and Kubo, N., 2018, *IET Intelligent Transport Systems*, 12(8), 901-908	**Article 3 Discussion** "GIS applications in forest operations and road network planning: An overview over the last two decades", Grigolato, S., Mologni, O. and Cavalli, R., 2017, *Journal for Theory and Application of Forestry Engineering*, 38(2), 175-186	**Article 4 Discussion** "On use of low cost, compact GNSS receiver modules for ionosphere monitoring Dan, S., Santra, A., Mahato, S., Koley, C., Banerjee, P. and Bose, A". 2021, *Radio Science*, 56(12), 1-11	MCQ
	1:00 – 1:30 pm **Inauguration**				
1:30-2:30	**LUNCH (would be provided by the Organizers)**				
2:30-5:00	Session 8 **GNSS and IoT/ ITS/ Robotics** **(Dr D Banerjee)**	Session 10 **GNSS Hardware: from geodetic Grade to Smartphones, data and software** **Hans on Session**	Session 12 **Satellite Technology Applications including GNSS and NavIC** **(Dr Tapan Mishra)**	Session 14 **GNSS data processing Hands on**	(2:30-3:30) Reflection Journal
					(3:30-4:30) Feedback
					(4:30-5:30) Valedictory

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Speakers and Brief Bio

Dr Ivan G Petrovski, iP Solutions, Japan

Dr. Ivan G. Petrovski has been working in the GNSS field for more than 35 years. He has experience and expertise both in the academic field and in industry. His academic experience includes teaching as Associate Professor at the Moscow Aviation Institute – Technical University, as Guest Professor at Tokyo University of Marine Science and Technology in Japan, and as guest lecturer at Embry-Riddle Aeronautical College in the USA. He was Japan Science and Technology Agency Fellow with the National Aerospace Laboratory (now JAXA), and has led GNSS R&D in DX Antenna Inc. and GNSS Technologies Inc.

He is an author of numerous papers (ION Best Paper Award), articles in the journals GPS World and Inside GNSS, as well as a number of patents. He is a member of the advisory board for the journal GPS World. He is author of two books published by Cambridge University Press. Currently, he leads GNSS product development at iP-Solutions Inc. for the benefit of academia and the research community.

Topic: GNSS Error Sources and Positioning Techniques

Dr P Banerjee, Former Head, Time and Frequency Section, National Physical Laboratory, New Delhi

- Dr. P Banerjee is currently visiting Research Consultant of Physics department of Burdwan University.
- Dr. P. Banerjee had been Professor in Department of Electronics and Communication Engineering in Amity School of Engineering & Technology (ASET), Amity University, NOIDA till December 2016.
- He joined NPL in 1976 and had retired as Senior Deputy Director, Scientist G in 2011. He served as the Head of Electrical and Electronics Standard and Time Frequency Section of NPL.
- Dr. P. Banerjee was officiating Director of NPL in 2009.
- Dr. P. Banerjee was a member of Seventh Indian Scientific Expedition to ANTARCTICA during 1987-88.
- He has more than forty years' experience in Design and Development of Analog and Digital Circuits, Microprocessors based system, Electronics instrumentations, Phase lock System, Time dissemination techniques via geostationary satellite, GPS,

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	GLONASS and GNSS system and Generation of Time Scale, Timing Measurement system and analysis etc. **Topic: (i) GNSS based Time Transfer and (ii) GNSS and Society**
	Dr Ashish Kumar Shukla, Scientist, SAC-ISRO, Ahmedabad He is working as a scientist in Space Applications Centre (SAC), ISRO, Ahmedabad, since May 2005. He received his Ph. D. Degree in Mathematics from Lucknow University, Lucknow, India, in the year 2003. He is working in the field of Satellite navigation for more than 17 years and has contributed significantly to Satellite navigation programs of ISRO. He had privilege to work in India's two most significant navigation programs: GAGAN and NavIC since their inception. He is member of the team which has developed NavIC user receiver and NavIC Payload Test Receiver. He also has done extensive work in Differential Positioning using GPS and NavIC and ionospheric modelling as well. Dr Shukla is the Deputy Project Director (DPD) of Reusable Launch Vehicle (RLV) project of ISRO for Pseudolite System and he is leading the team which has developed Pseudolite Based navigation System for precise landing of aerial vehicles such as RLV. His research interests include development of navigation algorithms for standalone and differential positioning and applications for NavIC, GAGAN, Pseudolite and LEO GNSS. He has more than 55 publications in peer reviewed journals and conferences. Dr Shukla is recipient of Team Excellence Award of ISRO and National Geomatics Award-Technology. **Topic: GNSS/ NavIC Applications**

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Prof Dinesh Manandhar, Associate Professor (Project), The University of Tokyo, Japan.

- Dr. Dinesh Manandhar is an Associate Professor at The University of Tokyo, Japan.
- He has been working in the field of GPS and GPS related applications for the last 20 years.
- He designed IMES signal based on GPS/QZSS for indoor navigation.
- Dr. Manandhar is working in the field of GNSS signal authentication for the last 10 years.
- Currently, he is developing new signal structure for QZSS/GNSS signal authentication.
- He is actively involved in promoting GNSS technology and its applications in Asia by conducting trainings, workshops, webinars and pilot projects in coordination with universities, government organizations and UNOOSA/ICG

Topic: i) GNSS Compact Modules and (ii) Jamming and Spoofing of GNSS Signals

Dr. Nirvikar Dashora, Scientist-SF at National Atmospheric Research Laboratory, Gadanki, Andhra Pradesh

- He joined NARL in year 2007 after his PhD. His PhD work has been one of the first from India on "Study of ionospheric TEC and Scintillation using GPS observations". He has been the first from India to publish the GPS TEC and scintillation study in year 2005. He is M. Sc. in Physics and M. Tech. in Space and Atmospheric Science.
- At NARL, he has been developing a ground network of GPS receivers for high resolution remote sensing and imaging of ionosphere. His main research interests are Space Weather effects and ionospheric variability over equatorial and low latitudes.
- He has published more than 40 papers in peer-reviewed international journals and presented more than 50 papers at various national/international conferences.
- With the advent of Indian NavIC system, he aims to develop scientific applications of this uniquely configured constellation along with GPS/GNSS using ground and Satellite based experiments.

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	• He has been convening a series of workshops on GNSS/NavIC applications and has delivered more than 30 invited lectures on this subject at various workshops/symposia. **Topic: GNSS/ NavIC in Atmospheric Research**
	Dr Saurabh Das, IIT, Indore • Dr. Saurabh Das received his Ph.D in Radiophysics and Electronics, University of Calcutta and M.Sc. in Physics from IIT Roorkee. • Currently he is an Assistant Professor at Discipline of Astronomy, Astrophysics and Space Engineering, IIT Indore. Earlier he worked as an Assistant Professor at University of Calcutta and as an INSPIRE Faculty at Center for Soft Computing Research, Indian Statistical Institute and IIT Indore. • He was recepient of two Young Scientist awards from International Union of Radio Science (URSI) in URSI-GASS, Beijing, China and AP-RASC, Seoul, South Korea. He has published 24 peer reviewed papers in reputed international journals. He also served as PI of three externally funded projects. • His current research interests includes GNSS, remote sensing, wave propagation, radar meteorology, and machine learning applications in atmospheric science problems. **Topic: GNSS Science Applications**
	Dr Tapan Mishra, Former Advisor, Chairman, ISRO and SISIR Radar. Kolkata • Dr Tapan Misra is an Indian scientist who has been the Director of Space Applications Centre and Physical Research Laboratory in ISRO. He later became Senior Advisor to the Chairman, ISRO. • In 2021, Dr Misra founded a space-tech startup called SISIR Radar, which manufactures Synthetic Aperture Radars (SAR), a technology that he pioneered in ISRO, for drones and satellites. • He started his career as a digital hardware engineer in SAC. He managed system engineering of Multi-frequency Scanning Microwave Radiometer (MSMR) payload for IRS-P4. He is widely known for design and development of C-band Synthetic Aperture Radar (SAR) of the RISAT-1. He was a guest scientist in the

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German Aerospace Agency in 1990. He led the development of high resolution C-band airborne DMSAR, airborne L&S band SAR and highly miniaturised X-band SAR for Airborne and UAV Applications. He was also associated with development of the multi-frequency scanning microwave radiometer instrument of Oceansat-1 and Scanning Scatterometer of Oceansat-2. He conceptualised and led development of highly miniaturised Dual Frequency (L and S band) SAR (DFSAR) for Chandrayaan 2 orbiter. He served as the deputy director of microwave remote sensing area of Space Applications Centre (SAC) before being appointed as the Director in February 2015.

- He also headed the Office of Innovations Management, ISRO, Bangalore.

- He received Vikram Sarabhai Research Award (2004) and ISRO Merit award (2008). He is a Fellow, Indian National Academy of Engineering, was elected Corresponding Member of International Academy of Astronautics (2008). He is also elected Fellow of IETE and ISRS. He chaired CGMS 2018 (Coordination Group for Meteorological Satellites) in Bangalore, represented India as Principal to CEOS (Committee on Earth Observation Satellites) in Paris (2017) and participated as team member of Indo-US Strategic Dialogue on Space Cooperation in Washington DC (2016 and 2018). He also taught at IIT Kharagpur and IIT Jodhpur as Adjunct Professor. He holds seven granted patents.

Topic: Satellite Technology Applications including GNSS and NavIC

Dr DEBAJYOTI BANERJI
Former Chief Scientist, CSIR-CMERI, Durgapur

- DR D Banerjee had completed B. E (Mechanical), M. Tech (Degin & Production Engg) and Ph. D. in Robotics. Have retired as the Chief Scientist from CSIR, Central Mechanical Engineering Research Institute (CMERI), Durgapur in 2020. There, he was the Principal investigator in many R&D projects of CSIR, DAE, Department of Oceanography and had taught Robotics & AI for 15 years to M. Tech students & had guided M. Tech theses as an Adjunct Professor of AcSir.

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	• Dr D Banerjee has 25 publications in different Journals, International Conferences & National Conferences, one Patent and 3 Copyrights to his credit. **Topic: GNSS and IoT/ ITS/ Robotics**
	Professor Biplab Biswas, Department of Geography, The University of Burdwan • Prof. Biplab Biswas has completed his Masters' in Geography from The University of Burdwan (1996), followed by M. Phil. degree in the Jawaharlal Nehru University, New Delhi (2000). In 2008, he was awarded the Ph.D. degree from The University of Burdwan. He joined the Department of Geography, The University of Burdwan in January, 2002 as a Lecturer in Geography. While in service, he carried out his Post-Doctoral Research (2014-15) under "Raman Fellowship" in The University of Miami, USA. • The title of his Post-Doctoral thesis was "Atmospheric Remote Sensing for Quantifying Air Pollution". He has about 30 published papers in different national and international books and journals. His research interests include Water resource for Sustainable Development, Atmospheric Pollution & Public Health and GIS. He has successfully guided 5 Ph.D. and 4 M.Phil. students. He has delivered about 70 Invited Talks in various National and International Forum. In his career he has received many financial grants from different funding agencies like University Grants Commission (UGC), Govt. of India, Department of Science and Technology (DST, Govt. of West Bengal), Natural Resource Database Management System (NRDMS, DST, Govt. of India), Science and Engineering Research Board (SERB, DST, Govt. of India) etc. Topic: GNSS in GIS/ Mapping

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Dr Anindya BOSE, Senior Scientific Officer, Department of Physics, The University of Burdwan

- M Sc, M Phil and Ph D from The University of Burdwan
- Alumnus of International Space University (ISU), Strasbourg, France
- Started research career at NPL, New Delhi, India
- Working as Senior Scientific Officer, Department of Physics, The University of Burdwan since 1996
- Recipient of URSI Young Scientist Award
- Fellow, IETE; Member, URSI
- Main research interest – GNSS, NavIC, low-cost GNSS/ NavIC based application development
- Consultant to Indian GNSS Industry

Topic: Introduction to GNSS and NavIC

Hands on Session Demonstration by

Dr Anindya Bose and

Ms Susmita Samanta, M Tech Project Fellow	**Mr Somnath Mahato, SRF**	**Mr Sukabya Dan, SRF**

GNSS Laboratory, The University of Burdwan (GLB): **http://bugnss.in**

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LINK OF YouTube Videos
of
ONLINE LECTURES
Week -I
(9-14 January, 2023)

Day # (Date)	Topic	Speaker	Part	Link
Day 1 09/01/ 2023	Introduction to GNSS/ NavIC	**Dr Anindya Bose** The University of Burdwan	1	https://youtu.be/wJ3_4zCN6_s
			2	https://youtu.be/CAQg3b1AFss
			3	https://youtu.be/iHpQtrIDyt0
Day 2 10/01/ 2023	GNSS Error Sources and Positioning Techniques	**Dr Ivan Petrovski** iP-Solutions, Japan	1	https://youtu.be/Pw-8EjP-3bk
			2	https://youtu.be/c1S3lddrTOM
			3	https://youtu.be/wNrkItmqs5Q
Day 3 11/01/ 2023	GNSS based Time Transfer	**Dr P Banerjee** Former CSIR-NPL, New Delhi	1	https://youtu.be/lVzyb4izywo
			2	https://youtu.be/r2-qMiXD3Qc
			3	https://youtu.be/e2J7u4t_ttI
Day 4 12/01/ 2023	GNSS/ NavIC Applications	**Dr Ashis Sukla** SAC-ISRO, Ahmedabad	1	https://youtu.be/aGDMUF8c2fI
			2	https://youtu.be/zA3O0P1MM5U
Day 5 13/01/ 2023	GNSS/ NavIC in Atmospheric Research	**Dr Nirvikar Dashora** NARL, DOS, Gadanki	1	https://youtu.be/EIKyAs6wi7w
			2	https://youtu.be/9sVNw5yRijw
Day 6 14/01 2023	GNSS small Modules	**Dr Dinesh Manandhar** University of Tokyo, Japan	-	https://youtu.be/NKf4ueVU4eY

The YouTube video links would also be available permanently on GNSS Laboratory Burdwan Website: **http://bugnss.in**

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Sample screenshots for each of the ONLINE session during the event are shown below

|	
Day 1 (9 January, 2023)	Day 2 (10 January)
Day 3 (11 January 2023)	Day 4 (12 January 2023)
Day 5 (13 January 2023)	Day 6 (14 January 2023)

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Offline Session pictures
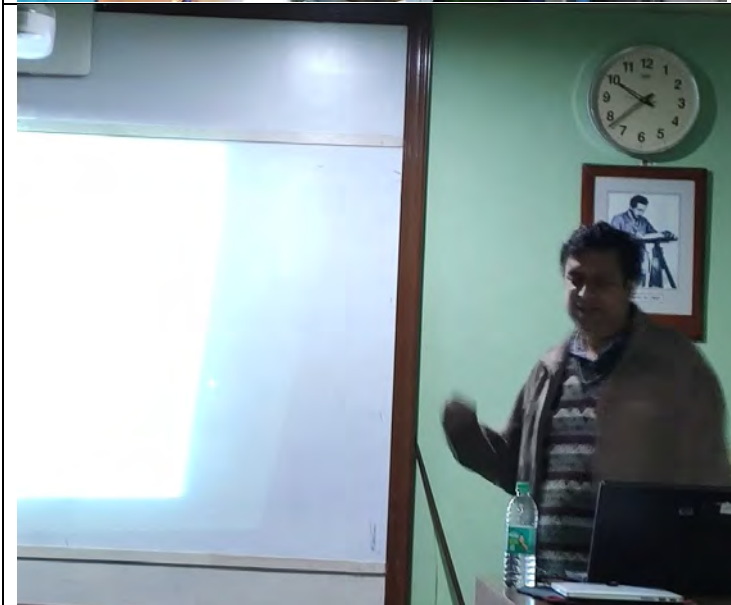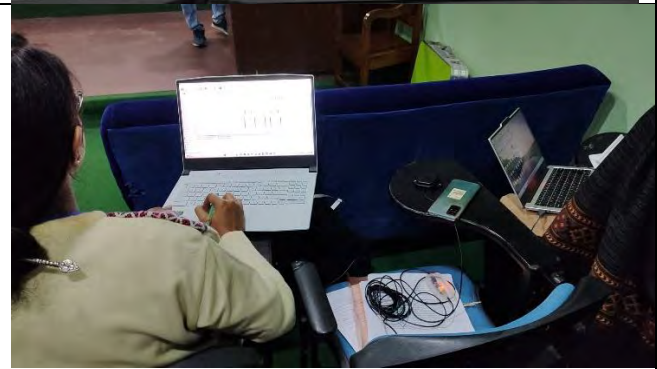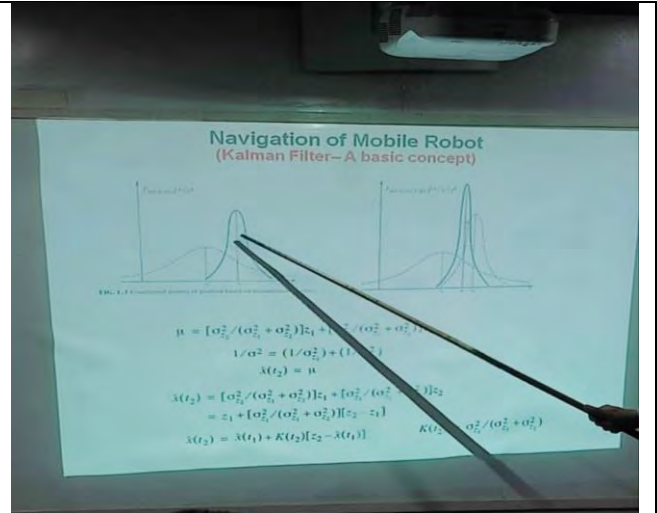
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Article Discussion Sessions

The following 4 articles were selected as case study for discussion among the paerticipants:

1. "Multi-GNSS precise point positioning for precision agriculture", Guo, J., Li, X., Li, Z., Hu, L., Yang, G., Zhao, C., Fairbairn, D., Watson, D. and Ge, M., 2018, *Precision Agriculture*, 19(5), 895-911
2. "Integrity monitoring for positioning of intelligent transport systems using integrated RTK-GNSS, IMU and vehicle odometer", El-Mowafy, A. and Kubo, N., 2018, *IET Intelligent Transport Systems*, 12(8), 901-908
3. "GIS applications in forest operations and road network planning: An overview over the last two decades", Grigolato, S., Mologni, O. and Cavalli, R., 2017, *Journal for Theory and Application of Forestry Engineering*, 38(2), 175-186
4. "On use of low cost, compact GNSS receiver modules for ionosphere monitoring Dan, S., Santra, A., Mahato, S., Koley, C., Banerjee, P. and Bose, A". 2021, *Radio Science*, 56(12), 1-11

Paper and soft copies of the articles were distributed with the participants and during week 2, for the first 4 days, all participants were subdivided into 4 groups to read, discuss the methods and findings of the articles with possible replication in case of India. Senior participants/ researchers were requested to lead each group with support from the present experts. Interaction with the participants revealed that, it was an unique experience for them to know about different possible applications and to come up with new possible ideas. Sample pictures of the Sessions are given below:

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Hands-on Sessions

Two hands-on sessions were organized in the FDP.

Session I: GNSS Hardware: from geodetic Grade to Smartphones, data and software: In this session, the participants were introduced to various GNSS/ NavIC hardware- from very costly geodetic grade CORS receivers, OEM receiver boards, compact and ultra compact, low-cost GNSS modules, Software defined Radio (SDR) GNSS front ends, GNSS record and replay systems. Various data types (NMEA, RINEX, proprietary and conversion techniques) were introduced inside the GNSS Laboratory Burdwan. They were also exposed to 'how to collect data' using these types of GNSS hardware. A free and open-source GNSS data processing software, RTKLib was introduced with the source of the software. The participants were encouraged to download and install the software for further work in the subsequent session.

After this, the following recent article was shared with the participants to have a general idea on what are the capabilities of the Android-based smartphones for GNSS data collection. Then, the participants downloaded few Android Apps from Google Play store and collected data in open-sky environment. They were introduced to data download from the phones using the cellular network. The collected data could be used during the subsequent session.

Article:

"Common Android Smartphones and Apps for Cost Efficient GNSS Data Collection: An Overview", Somnath Mahato, Debipriya Dutta, Moumita Roy, Atanu Santra, Sukabya Dan, and Anindya Bose, *IETE Journal of Research*, January 2023, DoI: https://doi.org/10.1080/03772063.2022.2164369

Sample pictures of the Android based data collection exercise is given below:

During Hands-on Session I, the participants were also exposed to examples of various low-cost, real-time, GNSS-GIS integrated, web-based application examples developed at GNSS Laboratory Burdwan in the fields of smart agriculture and environment monitoring.

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Session II: GNSS data processing Hands on

In this session, the participants were first trained how to use small compact GNSS modules and RTKLib for GNSS Single Point Positioning (SPP), differential GNSS (dGNSS), Real Time Kinematic (RTK) and Precise Point Positioning (PPP) techniques.

Then all the participants were subdivided into 4 groups. Each of the groups were provided one uBlox ZED M8T and F9P compact, low-cost GNSS receiver, commercial patch antenna and antenna stand. Then all the 4 groups took part in the exercise of SPP, dGNSS, RTK positioning. They were also taught how to perform online PPP from NRCan online PPP services. The participants were able to observe the differences in different GNSS based positioning techniques and the performance difference between single and dual-frequency compact GNSS modules. The results were also compared to those of the ultra-low cost, commercial (M6N) GNSS compact modules. Few sample pictures of the exercise is shown below:

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Project Charter and Reflection Journal Session

In this session, all the participants subdivided into 4 groups presented the takeaways from the article discussions and what each of the team members have contributed to reaching these findings. They also presented about the possible works in the Indian context and how the learning from the FDP would help them in designing their future research and works. While presentation from a group, the other team members were encouraged to interact with them.

In the subsequent Reflection Journal Session, individual participants talked about how the learning process – theoretical and hand-on would be beneficial for their future work and what is their individual takeaways from the article discussions vis-à-vis their branch of studies/ expertise.

The feedback and valedictory session was chaired by Prof A K Panigrahi, Hon'ble Pro Vice Chancellor, The University of Burdwan. He interacted with the participants about their learning experience and expressed his gratitude to AICTE for the opportunity. Dr Joydeep Chakravorty proposed the vote of thanks. Few pictures from the sessions are given below:

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List of participants

		Name
1	Biswabibek	Bandyopadhyay
2	Sohini	Biswas
3	MANAS	CHAKRABARTY
4	Meenakshi	Chakraborty
5	SATARUPA	CHATTERJEE
6	Sukabya	Dan
7	Arpan	Dawn
8	Joydeep	Dey
9	Debipriya	Dutta
10	Dr. Sk Samim	Ferdows
11	Supriya	Ghar
12	Arpita	Guha Bose
13	Ankita	Jaiswal
14	Santanu	Jharimuni
15	Subinita	Kamle
16	Dr. Mukul	Kamle
17	Taniya	Khatun
18	Sneha	Kour
19	Soumya	Kundu
20	Upanyas	Kushwaha
21	Rakesh	Madhra
22	Somnath	Mahato
23	Soumen	Maity
24	Seba	Maity
25	Rajkumar	Mandal
26	PRITAM	MAZUMDAR
27	Milan	Mondal
28	RAHUL	MONDAL
29	Bulti	Paul
30	Susmita	Samanta
31	Shreya	Sarkar
32	TAMAL	SARKAR
33	Avishikta	Singh
34	Ajay Kumar	Tiwari

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Some of the feedbacks obtained from the participants provided during the Feedback Session are given below:

Participant	Comment
Seba Maity	The workshop was very informative and helpful for creation of new project ideas in Engineering Colleges. I would definitely follow up the works. A very interesting part was the discussion on Articles.
Upanyas Kushwaha	It was a good international workshop. In future also kindly arrange this type of workshop. I would appreciate the efforts of the organizers in collection so much of resources and organizing the event with excellent time management.
Subinita Kamle	Being an educator in the field of geography and GIS, the new concepts and the instrumentation learnt during the FDP would be very useful for my teaching.
Debipriya Dutta	I liked the GNSS using Smartphones part.
Soumya Kundu	I have learnt how to use common smartphones as a geolocation sensor and would teach my students. I would be interested to participate in future events.
Sneha Kaur	As a student, I enjoyed the program, it would be useful for my future research works.

Many participants expressed their interest for more follow up programs on the topic.

The program was conducted through support from the following Local organizing Committee:

Patron	Prof N C Saha, Hon'ble Vice Chancellor, BU
Advisors	Prof A Panigrahi, Hon'ble Pro VC, BU Dr S K Chowdhury, Registrar, BU Prof S Karforma, Dean, FC (Sc), BU
Members	Prof A C Mondal, HoD, Physics, BU Prof P K Chakrabarti Prof P Mitra, Prof B Ghosh Prof S K Pradhan Prof Sourangshu Mukhopadhyay Prof S Das Prof U Chatterjee Prof S Mukhopadhyay Prof T Banerjee Prof A Dutta Dr A Chakraborty Dr R Das Dr R Kshestri Dr (Mrs) C Hansda DR A Chowdhury

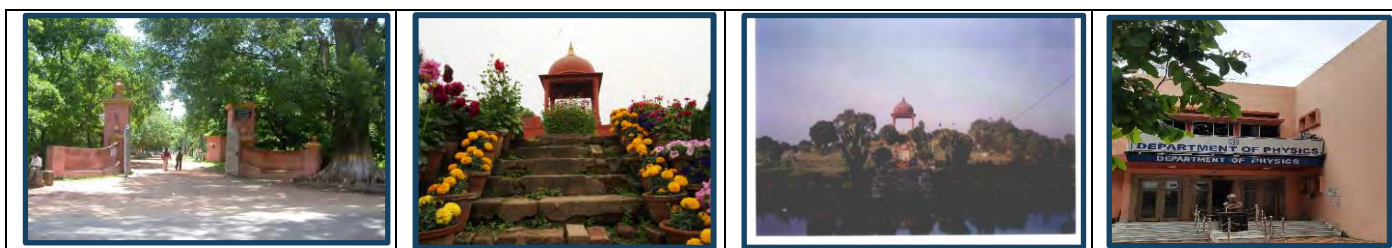# 2-week Advanced FDP on Applications of GNSS/ NavIC in cost-efficient Solution Development

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	Dr A Roy Mr T Sarkar **Coordinator:** Dr Anindya BOSE E: abose@phys.buruniv.ac.in **Co-Coordinator:** Dr J Chakravorty

The 2-week blended Advanced Faculty Development Program was a great initiative from the AICTE Training and Learning (ATAL) Academy. The LoC is thankful to AICTE for providing us the opportunity to conduct this Advanved FDP for the faculty members, researchers and PG students of technical institute of India and representatives from Industry completely free of cost. We got encouraging response as well as compliments of arranging the event, for proper management of the course, for the content and hands on session. The participants also expressed their interest to take part in similar events on the topic for more advance topic.