

Summer School In Geospatial Science & Technology (Level 2)

Theme: Developing Geospatial Solutions for Defence, Security
and Intelligence

27 May - 19 June 2024



Organized by
Multidisciplinary Centre
for Geoinformatics,
Delhi Technological
University,
New Delhi, India

Supported by
National Geospatial
Program,
Department of Science &
Technology,
Government of India,
New Delhi



Patron

Professor Prateek Sharma, Hon'ble Vice Chancellor,
Delhi Technological University, New Delhi

Principal Investigator

Dr. K.C. Tiwari, Professor, Multidisciplinary Centre of
Geoinformatics, Delhi Technological University, New Delhi

Summer/Winter School Capacity Building Program in Geospatial Science and Technology

Recently knowledge has been identified as the most important driving factor for India's sustainable economic growth. India has adopted a new information regime for sustainable economic growth through its 'Digital India' program to support good governance, sustainable development goals and empowerment of its citizens. Over the last three decades, the widespread adoption of geospatial technologies into various sectors have proven to be an effective enabler to meet these challenges. The capacity building program initiatives of the National Geospatial Program (NGP) erstwhile Natural Resource Data Management System (NRDMS) Department of Science and Technology, Government of India to develop national capacity for geospatial science and technology development through diverse programs in collaboration with various partner organizations. The three week program is being conducted at three levels, Level 1 (Standard), Level 1 (Spatial thinking) and Level 2. In addition there is a three day Geo Innovation Challenge Program. The objective of the program is to build knowledge and various levels of governance in collaboration with academia and user agencies and user agencies and foster innovation.

Level 2 Summer / Winter School In Geospatial Science and Technology

This three week program is a theme specific advanced training being implemented by eight institutions across the country. A one week online refresher session will be held prior to the commencement of the three week program. The 21-day summer/winter school in Geospatial Science and Technology (Level 2) supported by the Natural Resource Data Management System of the Department of Science and Technology, Government of India focuses on developing knowledge and capacity building in geospatial technologies through the use of geospatial software.

About the National Geospatial Program of the Department of Science and Technology, Government of India

In the heart of India's technological advancement lies the National Geospatial Programme (NGP) of the Department of Science and Technology, Government of India. The Geospatial Capacity Building Program initiated in 2010 has over the years flourished, fostering capacities in geospatial science, technology, solutions, and entrepreneurship. Its transformative journey initiated with a modest ambition has evolved into a robust program, igniting minds and expanding horizons.

For a decade, the Geospatial Capacity Building Program under DST has been a cornerstone, conducting 166 comprehensive three-week programs conducted as Summer and Winter Schools in Geospatial Technologies at a basic (Level 1) and advanced level (Level 2). The 2024 cycle includes a 11 three week Level 1-(Standard) programs, 4 three week Level 1-(Spatial Thinking) programs, 8 Level 2-(Advanced) three week programs and 7 Geo Innovation Challenge Programs being conducted by various Universities across India selected through a stringent process by the DST.

The sessions at these programs comprise classroom, lab, fieldwork, and mini-projects. Central to this success is a structured curriculum and the advocacy of open-source software. The dedicated portal, <https://dst-iget.in>, is a reservoir of learning materials, connecting educators, professionals, and scientists, and catalyzing India's geospatial domain. The NGP-DST's geospatial capacity building program is coordinated nationally by the Bharati Vidyapeeth Deemed University, Department of Geoinformatics, Institute of Environment Education and Research, Pune.

The Delhi Technological University, New Delhi, is one of the selected institutions for conducting the Level 2 Program.

Delhi Technological University, New Delhi

With a history stretching over 75 years, providing an academic milieu amid adequate space for ingenious research as an integral part of curriculum design, Delhi Technological University (DTU) is strongly identified with engineering education in India. The University has been a forerunner, and led the way in reform movement maintaining a compatibility with values and professional morality. DTU takes pride in being one of the major contributors in planning and construction of India's infrastructure. In DTU, we endorse and cultivate the purity of mind as the strongest currency, with an impressive resolve to renovate and upgrade our knowledge infrastructure. DTU aspires to be ranked amongst the leading universities globally. Consequently, DTU's mission is to edify individuals to be competitive not only in India, but all over the world. [Visit us on: http://www.dtu.ac.in/](http://www.dtu.ac.in/).

Department of Civil Engineering

Multidisciplinary Centre for Geoinformatics (MCG) was established at DTU on 5th March 2019 with a vision to excel in the field of Geospatial education, research and consultancy. It is currently running Ph.D and an AICTE approved M.Tech program in Geoinformatics. [Visit us on: http://www.dtu.ac.in/Web/Departments/MCG/about/index.php](http://www.dtu.ac.in/Web/Departments/MCG/about/index.php).



Delhi Technological University, New Delhi

Who can apply?

- Faculty members, scientists, technologists, researchers from academia, national institutions of research, smart city cells, municipal corporations and other government departments are eligible to apply.
- Personnel from non government organizations (NGO)
- School Teachers
- Only 2-3 seats are reserved for research scholars. Only candidates who have a high degree of experience with geospatial technologies should apply for these advanced programs.

No basics will be covered in the Level 2 program. Candidates who have no knowledge of geospatial technologies should apply for the Level 1 program.

How to apply?

- Interested candidates should fill the online application form through the web link available on <http://dst-iget.in>. Kindly keep a digital copy of your photograph, LinkedIn Id / ORCID Id / Researchgate Id / Google Scholar Id (atleast one is needed) and deputation letter (format available on <http://dst-iget.in> website) handy while filling in the form.
- For any further queries write to dst-iget@bharativedyapeeth.edu or call on 7559288803
- Address all queries regarding the program **once selected** to the PI, *Dr. K.C. Tiwari, kcchtphd@gmail.com. Dr Raju Sarkar, Professor (Coordinator), rajasarkar@dce.ac.in, 7678120434*

Theme of the Level 2 program: Developing Geospatial Solutions for Defence, Security and Intelligence

India got its Independence in 1947 and is a thriving democracy today with its geographical borders intact. But for the Defence Forces of this Country, this nation called India would have long disintegrated. The country has witnessed four major wars with its adversaries – namely Pakistan and China and several localized conflicts such as Kargil War. There have been long periods of secessionist movements in India such as Khalistan movement, ULFA movement, NSCN movement etc. The country has also witnessed numerous terrorists' incidents including hijacking. Recently, there has been an attempt to nibble away Indian territory at Galwan. It is the larger will of the citizens of this country and the sacrifice of soldiers which has kept the nation together. Fortunately in past few decades, the country has been witnessing a high trajectory of progress both economically and technologically.

This is the driving urge behind the proposed L2 Course on “Developing Geospatial Solutions for Defense, Security and Intelligence”. The objective of this course is not only to increase knowledge about the subject but also to involve the faculty, researchers, students and all other stakeholders to understand the gravity of security and intelligence of a nation fast growing in stature, and also to get them involved in developing solutions relevant to Defense Forces. The content of the course is designed to develop skills such that the participants can subsequently innovate and contribute to the requirements of those engaged in security and intelligence of the country.

Important Information

Last date for registration: 30 April 2024

Date of intimation of selection: 3 May 2024

Date of online orientation: 18 May 2024

Dates of the program: **27 May – 19 June 2024**

Mode of conduct: Offline

No. of seats: 25

Registration Fees: Nil

Principal Investigator: Dr. K.C. Tiwari, Professor, Multidisciplinary Centre for Geoinformatics, Delhi Technological University, New Delhi, India

Email: kcchtphd@gmail.com

For any queries contact

Dr. K.C. Tiwari, Professor, (PI), kcchtphd@gmail.com, Dr Raju Sarkar, Professor (Coordinator), rajasarkar@dce.ac.in, 7678120434 and Dr Rubeena Vohra (Coordinator), rubeena.vohra@gmail.com, 9971987291

Address

Multidisciplinary Centre for Geoinformatics, Delhi Technological University, New Delhi

Certificate

Certificate of participation will be awarded to each participant only after attending the full course.

Travel and Lodging

Each participant will be reimbursed with 3 AC train fare. Lodging and boarding on a double sharing basis will be provided by the host institution.

Infrastructure and Facilities

Laboratory

Well-equipped GIS Laboratory

Lodging and Boarding

The institute has twin-sharing boarding and lodging facilities. Breakfast and lunch will be arranged in the canteen.



Multidisciplinary Centre for Geoinformatics



Computer Lab



Guest Room

Program Schedule for 21 Days Summer School in Geospatial Science and Technology (Level 2)

Conducted by Delhi Technological University, New Delhi

Theme: **Developing Geospatial Solutions for Defence, Security and Intelligence**

27 May to 19 June 2024

Date and Day	Session	Time	Session details	
Week 1				
Day 1 27 May 2024	Morning Session	0900-1100	Registration and Inauguration	
		1100-1200	Session: Theory Why study TD (Target Detection) in the Indian context? Targets, target detection problem; the difference between natural and man-made targets; the difference between target detection and classification, HUMINT, COMINT, and GEOINT Resource Person: Prof KC Tiwari	
		1200-1300	Session: Theory Types of targets and different types of categorizations (based on RS, Location etc), Surface target detection, subsurface target detection, underwater and aerial target detection, camouflages target detection, change detection, and target detection process. Resource Person: Dr Rubeena Vohra	
		1300-1400	Lunch Break	
	Afternoon Session	1400-1530	Session: Hands-on Identification of data sets for TD. Review Registration and Acquisition of free satellite data from Bhuvan, USGS, ESA Resource Person: Ms Dyvavani	
		1530-1700	Session: Hands-on Acquiring topo-sheets from SOI, ordering of IRS data Resource Person: Ms Kamini	
Day 2 28 May 2024	Morning Session	0900-1100	Session: Theory Data, and Software	

			Datasets for target detection- Optical data (including hyperspectral data), thermal data, LIDAR data, SAR data, and Sources of data (satellites/aerial/UAV). Resource Person: Prof KC Tiwari
		1100-1200	Session: Theory Challenges and constraints in TD – challenges due to limitations of data acquisition, visualization, and interpretation, varied terrain, weather, lack of appropriate data, resolution of data, size of target, etc. Understanding imitations and exploiting the advantages of each dataset Resource Person: Dr Poonam Vishwas
		1200-1300	Session: Theory Review of QGIS interface and functions & ENVI/ ArcGIS. Review MATLAB/ Python Resource Person: Ms Shagun Jain
		1300-1400	Lunch Break
	Afternoon Session	1400-1530	Session: Hands-on Introduction to QGIS interface and functions Resource Person: Ms Dyvavani Krishna
		1530-1700	Session: Hands-on Georeferencing of images Resource Person: Ms P
		Day 3 29 May 2024	Morning Session
		1100-1200	Session: Theory Types of resolutions and spatial resolutions necessary for analysis, spectral variability, dimensionality reduction and loss of information Resource Person: Prof KC Tiwari
		1200-1300	Session: Theory Application areas – engineered surfaces and materials, urban applications, terrain studies, hydrological and environmental applications, thermal TD

			<i>Resource Person: Dr Rubeena Vohra</i>
			Lunch Break
	Afternoon Session	1400-1530	Session: Hands-on Dimensionality reduction using PCA, MNF <i>Resource Person: Ms Dyvavani</i>
	1530-1700	Session: Hands-on Dimensionality reduction using ICA <i>Resource Person: Ms Kamini</i>	
Day 4 30 May 2024	Morning Session	0900-1100	Session: Theory Common approaches and steps in TD Defining the specific problem, strategy formulation, selection of data and approaches, data pre-processing, selection of algorithms, fusion strategies, Fusion and use of morphological features in TD, AI/ML Algorithms <i>Resource Person: Prof KC Tiwari</i>
		1100-1200	Session: Theory TD in single images Target detection in Photos and Single Images/ PAN/ Multispectral Images / Optical Images (Feature selection and extraction methods, histogram manipulation <i>Resource Person: Dr Shalini Gakhar</i>
		1200-1300	Session: Theory Elements of Image Interpretation in different types of data <i>Resource Person: Dr Shalini Gakhar</i>
		1300-1400	Lunch Break
	Afternoon Session	1400-1530	Session: Hands-on Elements of image interpretation- Visual interpretation of surface features on optical imagery <i>Resource Person: Dr Shalini Gakhar</i>
		1530-1700	Session: Hands-on Visual interpretation of surface features on hyperspectral imagery <i>Resource Person: Ms Dyvavani</i>

Day 5 31 May 2024	Morning Session	0900-1100	Session: Theory Target classification Vs Target detection algorithms, Supervised and Unsupervised classification, Spectral matching and Anomaly detection: Resource Person: Prof Raju Sarkar
		1100-1300	Session: Theory Unsupervised algorithms: Deep learning methods (AI, CNN, SVM ML, autoencoder), thresholding etc performance evaluation parameters: confusion matrix, ROC, Kappa coefficient extraction targets and accuracy assessment Resource Person: Prof Raju Sarkar
		1300-1400	Lunch Break
	Afternoon Session	1400-1530	Session: Hands-on Supervised image classification-based TD on Hyperspectral data Resource Person: Ms Dyvavani
		1530-1700	Session: Hands-on Unsupervised image classification on hyperspectral data Resource Person: Ms Kamini
Day 6 01 June 2024	Morning Session	0900-1100	Session: Theory TD in Hyperspectral Data (Full Pixel) Introduction -hyperspectral remote sensing, Imaging spectroscopy–working principles of imaging spectrometers – hyperspectral sensors, _ detection spectra, applications of hyperspectral imagery, mineral and vegetation mapping. Resource Person: Dr Dwijndra Pandey
		1100-1200	Session: Theory Issues and problems of TD in hyperspectral data Spectral properties of materials, statistical models for spectral data Resource Person: Dr Dwijndra Pandey
		1200-1300	Session: Theory/ Hands-on Data preprocessing for TD in Hyperspectral Images Linear spectral transformations (Dimensionality reduction techniques: Principal Component Analysis (PCA), Maximum Noise Fraction (MNF) etc.) signal detection theory, hyperspectral data exploitation.

			<i>Resource Person: Dr Dwijndra Pandey</i>
		1300-1400	Lunch Break
	Afternoon Session	1400-1530	Session: Hands-on Spectral indices for land surface features <i>Resource Person: Dr Dwijndra Pandey</i>
		1530-1700	Session: Hands-on Hyperspectral data processing, spectral indices for extraction of engineered surfaces <i>Resource Person: Ms Dyvavani</i>
02 June 2024			Holiday
Day 7 03 June 2024	Morning Session	0900-1100	Session: Theory Sub-pixel target detection and enhancement: Subpixels, Mixed pixels and strategies to solve them <i>Resource Person: Dr Gopinadh</i>
		1100-1300	Session: Theory Linear mixture model, end-member determination techniques, least square computation, Spectral mixture analysis. <i>Resource Person: Dr Gopinadh</i>
		1300-1400	Lunch Break
	Afternoon Session	1400-1530	Session: Theory Spectral unmixing algorithms and functions <i>Resource Person: Ms Kamini</i>
		1530-1700	Session: Theory/ Hands-on Spectral unmixing algorithms and functions-II <i>Resource Person: Ms Prachi</i>
		Week 2	
Day 8 04 June 2024	Morning Session	0900-1100	Session: Theory Target Enhancement and Super-resolution Why target enhancement, strategies and algorithms for target enhancement, types of algorithms, usefulness in TD and classification <i>Resource Person: Dr Amrita Bhandari</i>

		1100-1200	Session: Theory Super-resolution techniques for target enhancement Resource Person: <i>Dr Amrita Bhandari</i>	
		1200-1300	Session: Theory Pixel swap and Euclidean distance algorithms for Target enhancement Resource Person: <i>Prof KC Tiwari</i>	
		1300-1400	Lunch Break	
		Afternoon Session	1400-1530	Session: Theory Super-resolution using Euclidean distance-based algorithm Resource Person: <i>Prof KC Tiwari</i>
			1530-1700	Session: Theory/ Hands-on Super-resolution using Euclidean distance-based algorithm (Continue) Resource Person: <i>Prof KC Tiwari</i>
Day 9 05 June 2024	Morning Session	0900-1100	Session: Theory TD using Thermal RS Thermal remote sensing; Introduction: Laws and definitions; Thermal emission characteristics, Physics behind thermal mapping (including thermal inertia); Errors, and assumption in thermal remote sensing; Modelling Thermal data; Processing and Analysis: Radiometric Calibration of Satellite and Airborne Thermal data; TIR Image processing; Emissivity; databases- visual and quantitative image interpretation of TIR data Resource Person: <i>Dr TB Rawat (DRDO)</i>	
		1100-1200	Session: Theory Data fusion, Applications of thermal imagery, UHI and coal mine fire mapping Resource Person: <i>Dr TB Rawat (DRDO)</i>	
		1200-1300	Session: Theory TD in Thermal images, challenges and steps Resource Person: <i>Dr TB Rawat (DRDO)</i>	
		1300-1400	Lunch Break	
	Afternoon Session	1400-1530	Session: Hands-on Land surface temperature and emissivity assessment	

			Resource Person: Ms Dyvavani
		1530-1700	Session: Hands-on TD in thermal images Resource Person: Ms Kamini
Day 10 06 June 24	Morning Session	0900-1100	Session: Theory Microwave remote sensing, _ Introduction: Active and passive microwave systems – basic principle, of Radar/SAR (Geometric and statistical properties and imaging geometry) –Radar Relief displacement (Foreshortening, Layover, Shadow & Speckle) Resource Person: Dr Poonam Vishwas
		1100-1200	Session: Theory SAR Processing and interpretation: Filters, Radar interferometry and Polarimetry Resource Person: Dr Kaustubh
		1200-1300	Session: Theory Applications of microwave remote sensing –flood mapping, TD in microwave issues. Resource Person: Mr Sanjay Singh
		1300-1400	Lunch Break
	Afternoon Session	1400-1530	Session: Theory TD using SNAP Microwave module Resource Person: Mr Sanjay Singh
		1530-1700	Session: Theory TD using ENVI Microwave module Resource Person: Dr Kaustubh
Day 11 07 June 24	Morning Session	0900-1100	Session: Theory TD in UAV Data Introduction: Principles and geometry, sensors and aerial platform; processing and interpretation- quality control, information extraction. Resource Person: Dr Shalini Gakhar

		1100-1200	Session: Theory DEM Applications Introduction; data acquisition and sources; resolution and scale, interpolation, 3D visualization, DEM derivatives Resource Person: <i>Mr Sebastian</i>	
		1200-1300	Session: Theory Terrain Intelligence Terrain analysis, terrain data sources, landform classification, military operations. Resource Person: <i>Mr Anmol</i>	
		1300-1400	Lunch Break	
		Afternoon Session	1400-1530	Session: Theory/ Hands-on UAV data processing Resource Person: <i>Ms Dyvavani</i>
			1530-1700	Session: Theory/ Hands-on Line of Sight assessment using DEM Resource Person: <i>Mr Anmol</i>
Day 12 08 June 24	Morning Session	0900-1100	Session: Theory Alternative Approaches/ Strategies Assess and exploit the impact of various parameters in target detection and identification of the most suitable spectral wavelengths for target detection. The exploitation of spectral indices such as NDVI, NDWI, MBI etc for target detection Data fusion at pixel, feature, and decision levels, shadowed target detection and identification using decision level fusion of Hyperspectral data with LiDAR data, Change detection strategies Resource Person: <i>Prof KC Tiwari</i>	
		1100-1200	Session: Theory Morphological features and its usage in TD Resource Person: <i>Dr Shalini Gakhar</i>	
		1200-1300	Session: Theory Comparison of TD algorithms Resource Person: <i>Dr Shalini Gakhar</i>	

	Afternoon Session	1300-1400	Lunch Break
		1400-1530	Session: Hands-on TD using spectral matching/ICA Resource Person: Dr Shalini Gakhar
		1530-1700	Session: Hands-on Terrain information extraction Resource Person: Mr Anmol
9 June 24		Holiday	
Day 13 10 June 24	Morning Session	0900-1300	Session: Theory TD Applications Spectral matching/Anomaly detection and ICA based Surface target detection and enhancement Resource Person: Prof KC Tiwari
			Session: Theory Camouflaged targets detection using ICA based detection in Hyperspectral data followed with LiDAR data processing Resource Person: Prof KC Tiwari
			Session: Theory Subsurface TD (Mine detection) in Microwave data using different methods and shape identification Resource Person: Prof KC Tiwari
	Afternoon Session	1300-1400	Lunch Break
		1400-1530	Session: Hands-on TD of camouflaged objects using visual image interpretation Resource Person: Ms Kamini
		1530-1700	Session: Hands-on TD of camouflaged objects in hyperspectral data Resource Person: Ms Dyvavani

Day 14 11 June 2024	Morning Session	0900-1000	Session: Theory/ Hands-on TD Applications Occluded targets using shape based contour methods on LiDAR data. Resource Person: Prof KC Tiwari	
		1000-1100	Session: Hands-on Detection and Identification of Engineered surfaces in hyperspectral data Resource Person: Prof Raju Sarkar	
		1100-1200	Session: Hands-on Morphological indices-based object urban features/object extraction Terrain studies and trafficability Resource Person: Prof Raju Sarkar	
		1200-1300	Session: Theory Future scope of TD studies Sensor development, underwater TD enhancement, automation Resource Person: Prof KC Tiwari	
		1300-1400	Lunch Break	
	Afternoon Session	1400-1700	Open- Discussion session	
Week 3				
Day 15 12 June 2024	Morning Session	9:00-13:00	Project Work- Minor projects to be done by the participants with data available (Groups of 4-5 students for each of the projects) Resource Persons: Prof KC Tiwari, Prof Raju Sarkar, Dr Rubeena Vohra. Dr. Dwijendra, Dr. Shalini Singh, Dr. Amrita Bhandari, Dr. Poonam Vishwas	
			Lunch Break	
	Afternoon Session	1400-1700	Project Work- Minor projects to be done by the participants with data available	
Day 16 13 June 2024	Morning Session	9:00-13:00	Project Work- Minor projects to be done by the participants with data available Resource Persons: Prof KC Tiwari, Prof Raju Sarkar, Dr Rubeena Vohra. Dr. Dwijendra, Dr. Shalini Singh, Dr. Amrita Bhandari, Dr. Poonam Vishwas	
			Lunch Break	

	Afternoon Session	1400-1700	Project Work- Minor projects to be done by the participants with data available
Day 17 14 June 2024	Morning Session	9:00-13:00	Project Work- Minor projects to be done by the participants with data available Resource Persons: Prof KC Tiwari, Prof Raju Sarkar, Dr Rubeena Vohra. Dr. Dwijendra, Dr. Shalini Singh, Dr. Amrita Bhandari, Dr. Poonam Vishwas
			Lunch Break
	Afternoon Session	1400-1700	Project Work- Minor projects to be done by the participants with data available
Day 18 15 June 2024	Morning Session	9:00-13:00	Project Work- Minor projects to be done by the participants with data available Resource Persons: Prof KC Tiwari, Prof Raju Sarkar, Dr Rubeena Vohra. Dr. Dwijendra, Dr. Shalini Singh, Dr. Amrita Bhandari, Dr. Poonam Vishwas
			Lunch Break
	Afternoon Session	1400-1700	Project Work- Minor projects to be done by the participants with data available
16 June 2024			Holiday
Day 19 17 June 2024	Morning Session	9:00-13:00	Project Work- Minor projects to be done by the participants with data available Resource Persons: Prof KC Tiwari, Prof Raju Sarkar, Dr Rubeena Vohra. Dr. Dwijendra, Dr. Shalini Singh, Dr. Amrita Bhandari, Dr. Poonam Vishwas
			Lunch Break
	Afternoon Session	1400-1700	Project Work- Minor projects to be done by the participants with data available
Day 20 18 June 2024	Morning Session	9:00-13:00	Project Work- Minor projects to be done by the participants with data available Resource Persons: Prof KC Tiwari, Prof Raju Sarkar, Dr Rubeena Vohra. Dr. Dwijendra, Dr. Shalini Singh, Dr. Amrita Bhandari, Dr. Poonam Vishwas
			Lunch Break
	Afternoon Session	1400-1700	Project Work- Minor projects to be done by the participants with data available
Day 21 19 June	Morning Session	0900-1300	Presentation and Evaluation of Projects
		1300-1400	Lunch Break
	Afternoon Session	1400-1700	Valedictory Session

