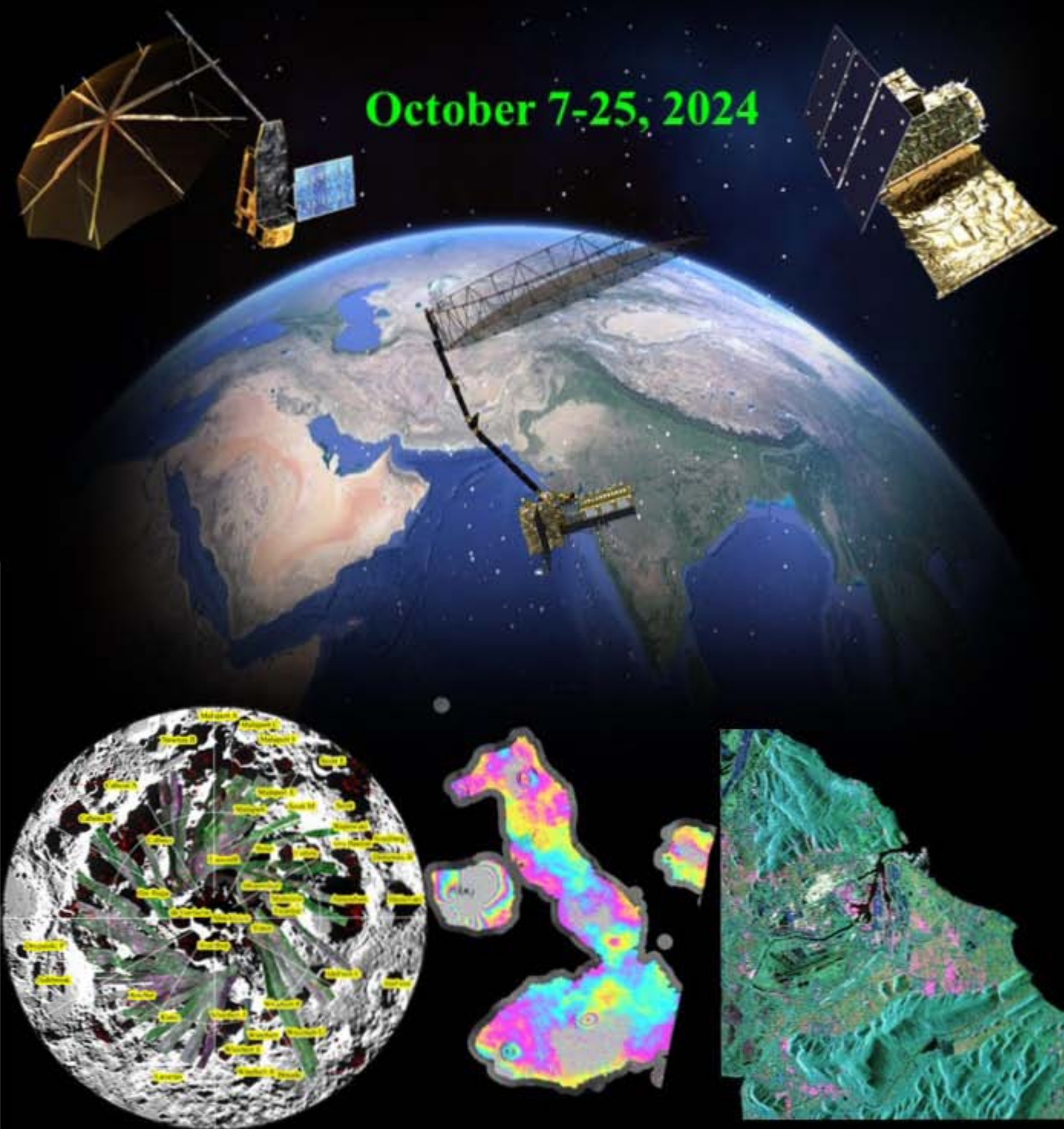
iirs

# SAR Remote Sensing Technologies and its Applications



**October 7-25, 2024**

**Organised by**

**Indian Institute of Remote Sensing**

Indian Space Research Organisation

Department of Space, Govt. of India Dehradun

***www.iirs.gov.in***

# About IIRS

The Indian Institute of Remote Sensing (IIRS) is a constituent unit of Indian Space Research Organisation (ISRO), Department of Space, Govt. of India. Since its establishment in 1966, IIRS is a key player for training and capacity building in geospatial technology and its applications through training, education and research in Southeast Asia. The training, education and capacity building programmes of the Institute are designed to meet the requirements of Professionals at working levels, fresh graduates, researchers, academia, and decision makers. IIRS is also one of the most sought after Institute for conducting specially designed courses for the officers from Central and State Government Ministries and stakeholder departments for the effective utilization of Earth Observation (EO) data. IIRS is also empaneled under Indian Technical and Economic Cooperation (ITEC) programme of Ministry of External Affairs, Government of India providing short term regular and special courses to international participants from ITEC member countries since 2001.

**Fig. 1. IIRS Main Building**

IIRS hosts headquarters of Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP), affiliated to the United Nations and provides support in conducting the Remote Sensing and GIS training and education programmes. IIRS also plays a key role in the activities of Indian Society of Remote Sensing (ISRS), which is one of the largest non-governmental Scientific Societies in the country. To widen its outreach, IIRS has started live and interactive Distance Learning Programme (DLP) since 2007. IIRS has also launched e-learning course on Remote Sensing and Geo-information Science since August, 2014.

IIRS is located in Dehradun and well connected to major cities via, air/rail/road. The city is famous for its picturesque landscape, pleasant climate, high quality school education and several scientific organizations of national & international repute. Places of religious & tourist importance like Haridwar, Rishikesh and Mussoorie etc. are located in the vicinity of Dehradun.

## About the Course

This course is on SAR remote sensing technologies and its applications in various domains. SAR remote sensing offers unparalleled benefits that extend across various domains. Its all-weather, day-and-night imaging capabilities, high spatial resolution, and penetration abilities make it a powerful tool for environmental monitoring, disaster management, urban planning, agriculture, and military applications. The consistency and integrative potential of SAR data further underscore its value, solidifying its role as an essential technology in modern remote sensing. SAR provides consistent and repeatable data, which is essential for long-term monitoring and trend analysis. This reliability makes SAR an integral part of scientific research and operational applications. Furthermore, SAR data can be integrated with other remote sensing technologies, such as optical imagery and LiDAR, to comprehensively understand the Earth's surface and its changes. This multimodal approach enhances the accuracy and depth of analysis, supporting better decision-making processes

Synthetic Aperture Radar (SAR) remote sensing technology has revolutionized the way we observe and analyze the Earth's surface. Its unique capabilities provide significant advantages over traditional optical remote sensing methods, making it an indispensable tool in a wide array of applications.

**All-Weather and Day-Night Imaging**: One of the most significant benefits of SAR is its ability to operate in all weather conditions and during both day and night. Unlike optical sensors, which rely on sunlight and are often hindered by cloud cover, haze, and other atmospheric conditions, SAR systems emit their own microwave signals. This ensures continuous, reliable data collection irrespective of external environmental factors, which is particularly valuable in regions with frequent cloud cover, such as tropical areas.

**High Spatial Resolution**: SAR achieves high spatial resolution through a process known as aperture synthesis, where the radar signals collected over time are combined to create detailed images. This capability allows SAR to detect and analyze small-scale features on the Earth's surface, making it ideal for monitoring infrastructure, mapping terrain, and conducting detailed environmental studies.

**Penetration Capabilities**: SAR's ability to penetrate through vegetation, snow, and even the upper layers of soil provides a distinct advantage in various fields. In forestry, SAR can monitor deforestation and changes in forest biomass even under dense canopy cover. In agriculture, it can assess soil moisture levels and crop conditions beneath the vegetation. This penetration capability also extends to geological applications, where SAR can be used to study underlying rock formations and other subsurface features.

**Surface Deformation Monitoring**: SAR is particularly renowned for its ability to monitor surface deformation with high precision. Techniques such as SAR Interferometry (InSAR) and Persistent Scatterer Interferometric Synthetic Aperture Radar (PSInSAR) allow for the detection and measurement of ground displacement over time. This is invaluable for assessing seismic activity, volcanic movements, land subsidence, and infrastructure stability. These techniques provide critical data for disaster management and mitigation, helping to predict and respond to natural hazards effectively.

**Versatility in Applications**: The versatility of SAR remote sensing spans a wide range of applications:

**Environmental Monitoring**: SAR is used to track deforestation, monitor wetland areas, and measure glacier dynamics. Its ability to provide consistent data is crucial for understanding environmental changes and implementing conservation strategies.

**Disaster Management**: SAR plays a key role in detecting and assessing the impact of natural disasters such as floods, landslides, volcanic eruptions, cyclones, and earthquakes. It helps in rapid response and recovery efforts by providing timely and accurate information.

**Urban Planning**: In urban areas, SAR is used to monitor the stability of buildings and infrastructure, detect ground subsidence, and track urban expansion. This supports sustainable development and urban management.

**Agriculture**: SAR aids in precision farming by monitoring crop health, estimating soil moisture, and optimizing irrigation practices. This leads to improved agricultural productivity and resource management.

**Military and Surveillance**: SAR's ability to provide high-resolution imagery under all conditions makes it a valuable asset for reconnaissance, border security, and detecting illegal activities.

In conclusion, SAR remote sensing offers unparalleled benefits that extend across various domains. Its all-weather, day-and-night imaging capabilities, high spatial resolution, and penetration abilities make it a powerful tool for environmental monitoring, disaster management, urban planning, agriculture, and military applications. The consistency and integrative potential of SAR data further underscore its value, solidifying its role as an essential technology in modern remote sensing.

**Fig. 2.** This polarimetric decomposition-based RGB image of EOS-04 over Visakhapatnam, India, highlights distinct scattering phenomena: red represents double-bounce scattering, blue indicates single-bounce scattering, and green denotes volume scattering elements

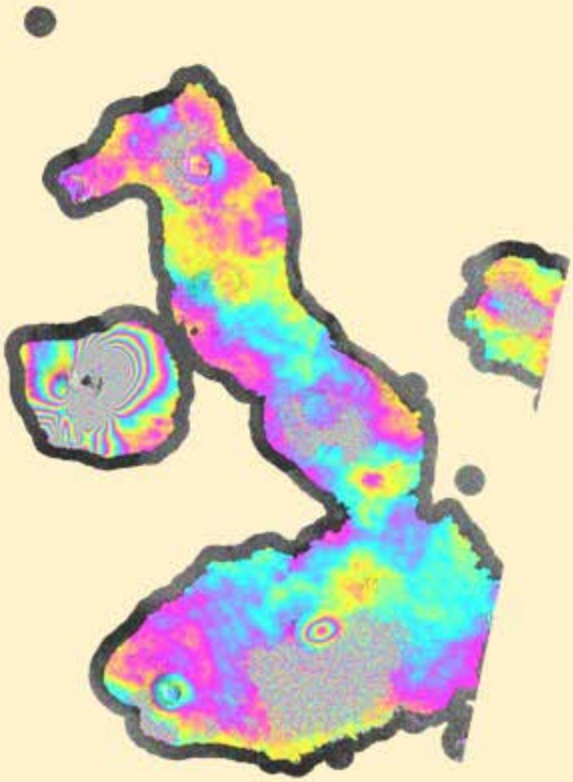


**Fig. 3.** This image displays the interferometric phase derived from Sentinel-1 spaceborne SAR data specifically generated for the Galapagos Islands, a UNESCO World Natural Heritage Site

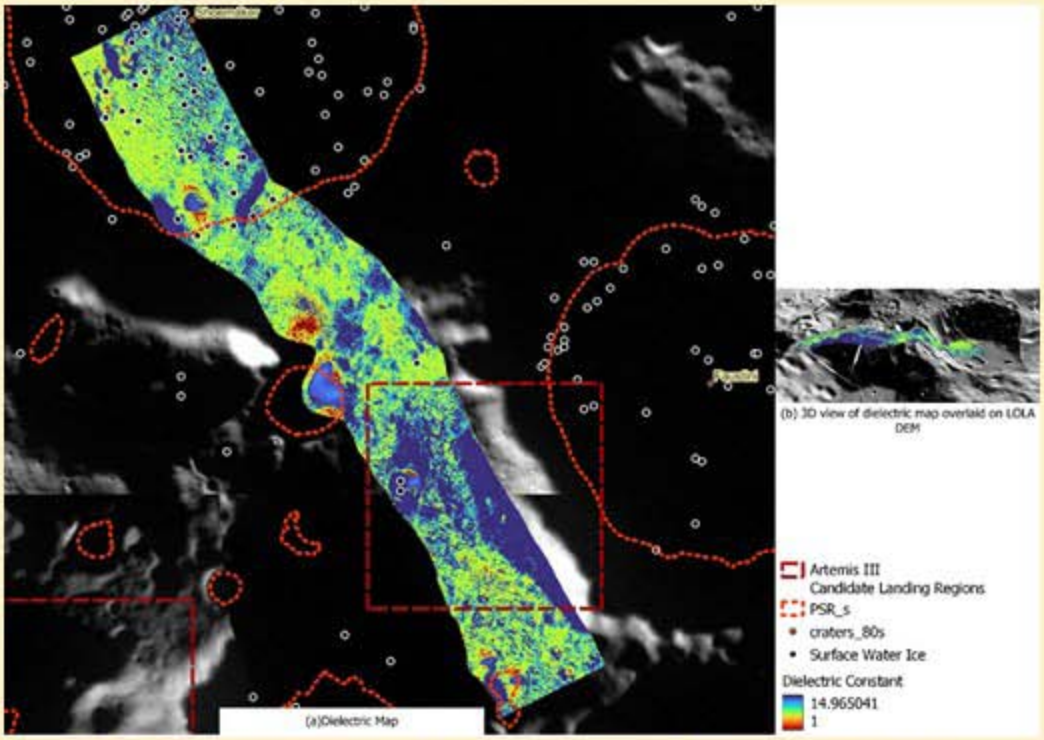



**Fig. 4.** Dielectric map of Shoemaker crater using Chandrayaan-2 DFSAR data

Figures 2, 3, and 4 showcases: the polarimetric decomposition-based RGB image of EOS-04 over Visakhapatnam, India; the interferometric phase derived from Sentinel-1 spaceborne SAR data specifically generated for the Galapagos Islands; and Chandrayaan-2 mission's DFSAR-based dielectric map of the lunar south polar crater Shoemaker.

## The objective of the Course

The primary objective of this training is to raise awareness among users, researchers, and professionals about the concept and advancements in SAR Remote Sensing, and to disseminate knowledge and practical applications of SAR data.

## Eligibility

The training is designed for professionals, faculty, scientists, and researchers (JRF/SRF/RA) in working geospatial technologies. Candidates nominated by government organizations & professionals working in related fields will be given preference for admission. This short-term special training will be conducted for Indian nationals only. In the case of a large number of applications being received, the selection will be done based on the criteria decided by IIRS.

**Essential Qualification**: a) Postgraduates in Science or Bachelors in Engineering, b) Bachelors in Science for working profession.

**Note**: All Candidates should have basic knowledge of Remote Sensing and GIS/ Geo-informatics/ Geomatics

## Curriculum

The following topics will be covered in this course

- **Basics of Synthetic Aperture Radar (SAR) remote sensing**
  - Overview of SAR remote sensing
  - An overview of airborne & spaceborne SAR sensors
  - SAR systems, image acquisition modes, and data formats
  - Future Trends in SAR Remote Sensing
  - SAR missions to explore the hidden structures and properties of planetary bodies
- **Interferometric SAR (InSAR) Remote Sensing**
  - Interferometric SAR (InSAR) principles and theory
  - InSAR data processing for the formation of interferogram and phase unwrapping
  - Emerging Trends in SAR Interferometry: A Comprehensive Overview of PSInSAR, SBAS, and Advanced Algorithms for Time Series Analysis
  - InSAR for environmental monitoring and disaster management
  - Real-world examples of SAR interferometry applications
- **Polarimetric SAR (PolSAR) Remote Sensing**
  - Polarimetric SAR (PolSAR) principles and advantages
  - Current and future PolSAR missions of ISRO and other space agencies
  - Polarimetric Scattering and Decomposition
  - Polarimetric Calibration of SAR data
  - Polarimetric SAR Interferometry (PolInSAR)
  - Tomographic Imaging Fundamentals
- **Applications of Polarimetric SAR Remote Sensing**
  - Thematic applications of SAR Remote Sensing.
  - Group Case Study

## Training Course Duration and Location

The training course will be conducted at Indian Institute of Remote Sensing (IIRS), ISRO, Dehradun, India from October 7-25, 2024.

## Language

The course will be conducted in English. Proficiency in both written and spoken English is essential. Participants should have a good working knowledge of English.

## Registration Fee

Rs. 15,000/- (Rs. 6,000: Tuition Fee + Rs. 9,000: Registration & Other Charges). Boarding & lodging charges in IIRS Golden Jubilee Hostel are extra and will have to be paid by the candidate as per the IIRS hostel rules & regulations.. Food (Breakfast, Lunch, and Dinner) will be available in the IIRS student mess on a payment basis. Participants will have to make a payment for their food. A list of selected candidates will be uploaded on the IIRS website www.iirs.gov.in by **September 09, 2024**.

Both government-sponsored and self-financed candidates are required to pay the full course fee on or before the specified date by IIRS to confirm their seats. Failure to do so will result in seats being offered to wait-listed candidates

## Important Dates

- Start Date of Online Application: **April 01, 2024**
- Last Date of Online Application: **August 08, 2024**
- List of Shortlisted/Selected Candidates: **September 09, 2024**
- Course Start Date: **October 07, 2024**
- Course Completion date: **October 25, 2024**

## Application Procedure

Aspiring participants are encouraged to complete the online form available on the IIRS website (https://admissions.iirs.gov.in/) by August 8, 2024. It is advised to submit applications well before the deadline.

For complete course information, applicants can refer to course code SP-PR at sl. No. 40 in the IIRS course calendar (https://admissions.iirs.gov.in/coursecalender). Participants can also download the PDF, where course information is available on Page 11, Code SP-PR at sl. No. 31, from the link:

https://admissions.iirs.gov.in/documents/AcademicCalendar.pdf

## Contact Details

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