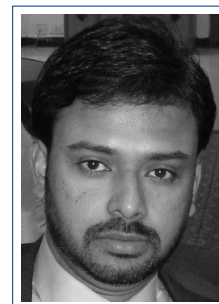


# Avik Bhattacharya

## *Curriculum Vitae*



### Personal Data

Name Avik Bhattacharya  
Birth Date 6 April 1976  
Birth Place Kharagpur, India  
Citizenship Indian  
Family Spouse: Smriti and Daughters: Malena and Aishlina  
Residence B-8, Building. No. 2, IIT Campus, Powai, Mumbai 400076, India  
Home Tel. +91-9867225384  
Home Email avik.bhattach@gmail.com

### Business Affiliation

Associate Professor  
Microwave Remote Sensing Lab  
Center of Studies in Resources Engineering  
Indian Institute of Technology Bombay  
Powai, Mumbai – 400076, India  
E-mail: avikb@csre.iitb.ac.in; avikb@ieee.org  
Tel (Office): 022-2576 7677  
URL: mrslab.in

### Education

- 2004–2007 **Ph.D.**, *Télécom ParisTech, Paris, France & INRIA, ARIANA Project Group, Sophia Antipolis-Méditerranée, France.*  
Satellite Image Processing and Analysis
- 1998–2000 **M.Sc.**, *Indian Institute of Technology Kharagpur, India.*  
Mathematics
- 1995–1998 **B.Sc.**, *Indian Institute of Technology Kharagpur, India.*  
Mathematics



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## Professional Experience

- 2015– Present **Associate Professor**, *Centre of Studies in Resources Engineering (CSRE), Indian Institute of Technology (IIT) Bombay, India.*
- 2011–2015 **Assistant Professor**, *Centre of Studies in Resources Engineering (CSRE), Indian Institute of Technology (IIT) Bombay, India.*
- 2008–2011 **Postdoctoral Research Fellow**, *Canada Centre for Remote Sensing (CSRE), Natural Resources Canada, Ottawa, Canada.*
- 2001–2004 **Research Assistant**, *Fraunhofer Institute (ITWM), Kaiserslautern, Germany.*
- 2000–2001 **Research Assistant**, *Department of Ocean Engineering and Naval Architecture, Indian Institute of Technology (IIT) Kharagpur, India.*

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## Research Interests

Radar Polarimetry Theory, Supervised and Unsupervised Polarimetric SAR Classification, Change Detection, Polarimetric SAR Interferometry, Statistical Methods in SAR images analysis, Applications of Radar Remote Sensing in Agriculture, Cryosphere, Urban and Planetary studies.

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## Professional Biography

Dr. Bhattacharya received the B.Sc and M.Sc degrees in Mathematics from the Indian Institute of Technology Kharagpur, India in 1998 and 2000 respectively. He then worked as a research assistant for a short duration at the Department of Ocean Engineering and Naval Architecture, Indian Institute of Technology Kharagpur, India, Fraunhofer-Institut für Techno- und Wirtschaftsmathematik (ITWM), Kaiserslautern, Germany and Blue-Order, tecmath AG, Kaiserslautern, Germany from 2000 to 2004 respectively. In 2007 he obtained his Ph.D. degree from Département Traitement du Signal et des Images, Télécom ParisTech, Paris, France. A part of his doctoral research was conducted by him in the ARIANA research group at the Institut National de Recherche en Informatique et en Automatique (INRIA), Sophia Antipolis, France. His Ph.D. thesis was funded by Centre National d'Études Spatiales (CNES), France.

Dr. Bhattacharya has pursued postdoctoral research at the Canada Centre for Mapping and Earth Observation (CCMEO) (formerly, Canada Centre for Remote Sensing (CCRS), Natural Resources Canada, Ottawa, Canada) from 2008 to 2011. He was awarded the Visiting Fellowship in Canadian Government Laboratories (VF) by the Natural Sciences and Engineering Research Council of Canada (NSERC). During his 3-year tenure at CCRS, he had the opportunity to work with the pioneers in the field of radar polarimetry and interferometry. At CCRS, his work primarily comprised of the analysis of probability distribution models for single and multi-look Synthetic Aperture Radar (SAR) images, parameter estimation from the family of distribution models for SAR data and urban area texture analysis. He has also worked exten-

sively on polarimetric decomposition techniques, especially in the development of the methodology and the application of the multi-resolution target scattering vector model for characterizing scattering mechanisms from urban areas.

Dr. Bhattacharya's other research work included the analysis of texture dependency on polarization in polarimetric SAR (PolSAR) images and polarimetric SAR interferometry (PolInSAR) coherence and phase analysis for characterizing building structures and height estimation in urban areas. Along with this, his other research interest includes image processing and machine learning. In this context, he has worked on machine learning techniques for feature extraction and selection using information theoretic methods for urban area classification using PolSAR data. He was also involved in a project utilizing SAR data for wetland classification.

Dr. Bhattacharya joined the Centre of Studies in Resources Engineering (CSRE), Indian Institute of Technology Bombay (IITB), India in 2011 as an Assistant Professor. He currently serves as an Associate Professor since December 2015. At CSRE he offers courses on Principles of Remote Sensing, Data Analysis Methods for Geospatial Applications, Microwave Remote Sensing and Advanced Concepts in Polarimetric SAR Image Analysis. He leads the Microwave Remote Sensing Lab ([www.mrslab.in](http://www.mrslab.in)) at CSRE, IITB. He is involved in various research related to the developments of scattering power decomposition models using SAR data. He is extensively involved in the application of his research to many different aspects of Earth observation. Predominantly, understanding the physics of scattering from targets and extraction of relevant information from SAR data using novel mathematical and statistical models plays a vital role in his research endeavours. Furthermore, Dr. Bhattacharya is also actively involved in research related to machine learning with a particular interest in deep learning using SAR data for ecosystem studies.

He supervises research on these topics within the frameworks of many national and international projects. Dr. Bhattacharya is the Principal and Co-principal Investigator of numerous projects sponsored by the Department of Science and Technology (DST), Government of India, Defense Research and Development Organization (DRDO), Government of India and Indian Space Research Organization (ISRO). He has authored 28 scientific publications in refereed international journals and 49 papers in conference proceedings. Dr. Bhattacharya has been invited to present several lectures in reputed universities and institutions in India and abroad.

Dr. Bhattacharya is the founding chairperson of the IEEE Geoscience and Remote Sensing Society (GRSS) chapter, Bombay section, India. Since 2017, he is serving as an associate editor of IEEE Geoscience and Remote Sensing Letters (GRSL). He was one of the four guest editors of the special issue on "Applied Earth Observations and Remote Sensing in India" in IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (JSTARS), 2017. He is one of the four guest editors of the ongoing special stream on "Advanced Statistical Techniques in SAR Image Processing and Analysis" in IEEE Geoscience and Remote Sensing Letters (GRSL).

## Research Highlights

### PolSAR Data: Statistics and Scattering Physics

- (R-1) Polarization Orientation Angle Estimation Using a Stochastic Distance
- (R-2) PolSAR Decomposition Scattering Powers Modification Using a Stochastic Distance (BF4)
- (R-3) Compact PolSAR Decompositions ( $S - \Omega$  and modified  $m - \chi$ )
- (R-4) Adaptive Generalized Four Component Decomposition with Unitary Transformation (AG4U)
- (R-5) Enhance Target Characterization with Optimized Degree of Polarization (AGU-DoP)
- (R-6) Relative Decorrelation Measure in PolSAR Decomposition (RD-Y4O)
- (R-7) PolSAR Scattering Power Factorization Using a Geodesic Distance

### PolSAR Data: Classification and Change Detection

- (R-1) Urban Area Classification Using Auto-Encoder Network
- (R-2) Urban Area Classification Using Random Forest
- (R-3) Unsupervised Classification of PolSAR Data Using a Geodesic Distance
- (R-4) Change Detection in PolSAR Data Using a Geodesic Distance
- (R-5) Tensorization and Classification Using Auto-Encoder Network
- (R-6) Radar Built-up Index Using a Geodesic Distance

### PolSAR Data: Cryosphere Applications

- (R-1) Snowpack Parameters (Wetness & Density) Estimation
- (R-2) Snow Cover Mapping Using Polarimetric Descriptors
- (R-3) Glacier Velocity Estimation Using Stokes Vector

### PolSAR Data: Vegetation Applications

- (R-1) Multi-temporal Crop Classification
- (R-2) Analysis of Simulated Compact-Pol SAR Data
- (R-3) Crop Biophysical Parameters Estimation from Polarimetric SAR Data
- (R-4) Phenology Based Feature Subset Selection using Random Forest for Multi-temporal PolSAR Crop Classification



## Lunar Surface Study

(R-1) **Dielectric Constant Estimation from Compact PolSAR Data over Lunar Surface**

### Research Projects

Dr. Bhattacharya is the Principal and Co-principal investigators of numerous projects sponsored by the Department of Science and Technology (DST), Government of India, Defense Research and Development Organization (DRDO), Government of India and Indian Space Research Organization (ISRO).

(P-1) **Polarimetric Synthetic Aperture Radar (SAR) Data Analysis for Earth Observation (EO) Applications**

**Financial Support:** ISRO-IIT(B) Space Technology Cell, IIT Bombay (Indian Space Research Organisation)

**Year:** 2017-2019

**Responsibility:** Principle Investigator (PI)

(P-2) **Development of Bistatic Radar Remote Sensing Techniques for Snow Water Equivalent (SWE) Retrieval**

**Financial Support:** Department of Science and Technology (DST), Government of India.

**Year:** 2015-2018

**Responsibility:** Co-Principle Investigator (Co-PI)

(P-3) **Glacier Mapping and Velocity Estimation Using Satellite Images**

**Financial Support:** Department of Science and Technology (DST), Government of India.

**Year:** 2014-2017

**Responsibility:** Principle Investigator (PI)

(P-4) **Advanced Methods for The Analysis of Optical and Radar Remote Sensing Images Acquired by Last Generation Satellite Systems**

**Financial Support:** Department of Science and Technology (DST), Government of India and Trento Program for Advanced Research, Italy (ITPAR- Phase III).

**Year:** 2013-2016

**Responsibility:** Principle Investigator (PI)

(P-5) **Development of Methodologies for Snowpack Characterization Using SAR Polarimetry and Interferometry**

**Financial Support:** Department of Science and Technology (DST), Government of India (DST) - Japan Society for the Promotion of Science (JSPS).

**Year:** 2013-2015

**Responsibility:** Principle Investigator (PI)

(P-6) **Development of Methodology for Snow Pack Characterization and Glacier Movement Studies Using Multi-Frequency SAR Time Series Satellite Data**



**Financial Support:** Department of Science and Technology (DST), Government of India.

**Year:** 2011-2014

**Responsibility:** Co-Principle Investigator (Co-PI)

(P-7) **Monitoring Snow and Glaciers of Himalaya Region Phase II**

**Financial Support:** Space Application Centre (SAC), Indian Space Research Organization (ISRO).

**Year:** 2011-2015

**Responsibility:** Co-Principle Investigator (Co-PI)

(P-8) **Combining Passive and Active Microwave Observations for Improving Snow Parameters Estimation over Himalaya**

**Financial Support:** Space Application Centre (SAC), Indian Space Research Organization (ISRO).

**Year:** 2012-2014

**Responsibility:** Co-Principle Investigator (Co-PI)

(P-9) **Chandrayaan-1 Mini-SAR Data Analysis of Lunar Polar Region**

**Financial Support:** Space Application Centre (SAC), Indian Space Research Organization (ISRO).

**Year:** 2012-2014

**Responsibility:** Co-Principle Investigator (Co-PI)

(P-10) **Microwave Remote Sensing and SAR Tutor with Virtual Laboratory**

**Financial Support:** Indian Space Research Organization (ISRO).

**Year:** 2012-2014

**Responsibility:** Co-Principle Investigator (Co-PI)

## Other Professional Activities

Before moving on to pursue his doctoral studies, Dr. Bhattacharya has worked on diverse field ranging from image processing and analysis of microstructures and hydrodynamics simulation.

(O-1) **2001-2004:** Dr. Bhattacharya was a research assistant at the Blue-Order, tecmath AG in Kaiserslautern, Germany.

(O-2) **2000-2001:** Dr. Bhattacharya has worked as a research assistant at the Department of Ocean Engineering and Naval Architecture, Indian Institute of Technology (IIT) Kharagpur.

## Thesis Supervision/Examiner

### Ph.D. Thesis Supervision – Ongoing

(1) Dikshya Ratha (2017 - ): PolSAR Image Analysis Using Kernel Methods



- (2) Dipankar Mandal (2017 - ): Crop Biophysical Parameter Retrieval and Yield Forecasting using Polarimetric SAR Data (Co-Guide)
- (3) Debanshu Ratha (2017 - ): Mathematical and Statistical Methods in SAR Data Analysis
- (4) Gaurav Dashondi (2016 - ): Marine Vessel Detection Using SAR and High-Resolution Optical Images (Co-Guide)
- (5) Akshay Patil (2016 - ): Monitoring Snow Water Equivalent in the Indian Himalayas. (Co-Guide)
- (6) Swinky Dhingra (2013 - ): Lunar Surface Properties Characterization Using Hybrid Polarimetric SAR Data

### **Ph.D. Thesis Supervision – Completed**

- (1) Siddharth H. Kalpagam (2011 - 2018): Random Forest Based Feature Selection and Classification for Earth Observation Applications (Submitted)
- (2) Shaunak De (2014 - 2018): Development of Auto-Encoder Based Methods for Synthetic Aperture Radar Image Analysis (Submitted)
- (3) Arnab Muhuri (2013 - 2018): Algorithms for Remote Earth Observation of Snow Cover by Satellite SAR Images (Submitted)  
★ Awarded the Alexander von Humboldt Post-doctoral Research Fellowship, 2018
- (4) Surendar Manickam (2012 - 2016): Snowpack Characterization Using PolSAR Techniques (Defended April 2016)  
★ Awarded the IIT Bombay Excellence in Ph.D. Thesis Award, 2016.  
★ Awarded the Alexander von Humboldt Post-doctoral Research Fellowship, 2016

### **M.Tech Thesis Supervision – Completed**

- (1) Sambuddha Saha (2015 - 2017): SAR Image Classification Using Deep Learning Algorithm.
- (2) Anjaly Vashistha (2015 - 2017): Analysis of Electromagnetic Scattering from Multi-layered Structure of Snow.
- (3) Asmeet Ahluwalia (2014 - 2016): Urban Area Mapping from PolSAR Data Using Fuzzy Inference System.
- (4) Khusboo Parakh (2014 - 2016): Application of Random Forest and other Machine Learning Algorithms for Geological Mapping from Remotely Sensed Hyperspectral, Multispectral and Elevation Data.
- (5) Debaditya Acharya (2013 - 2015): Geological Structural Mapping Using SAR Imagery.



- (6) Mohini Kargaonkar (2013 - 2015): Hierarchical Classification for SAR Images.
- (7) Kratika Yadav (2013 - 2015): Ship Detection using SAR Data.
- (8) Shilpa Phukan (2012 - 2014): Understanding the Microstructure and Metamorphism Evaluation of Snow.
- (9) Swinky Dhingra (2011 - 2013): Chandrayaan-1 Mini-SAR Data Analysis for Water-Ice Detection at Lunar Poles.
- (10) Arnab Muhuri (2010 - 2012): Statistical Modeling of Multi-Band Polarimetric Synthetic Aperture Radar Image.

### **Ph.D. Thesis Internal Examiner**

- (1) Ansari Rizwan Ahmed Mohammed Nafees (2017): Multiresolution Analysis Based Noise Filtering and Textural Segmentation of Remotely Sensed Satellite Images.
- (2) G. G. Ponnurangam (2016): Retrieval of Soil Moisture using Polarimetric SAR Remote Sensing.
- (3) S. S. Shithole (2015): Processing and analysis of Synthetic Aperture Radar Images for Speckle Reduction.

### **Teaching**

UG Course (Minor):

- (1) **GNR401:** Remote Sensing and Image Processing

PG Course:

- (1) **GNR647:** Microwave Remote Sensing
- (2) **GNR603:** Principles of Remote Sensing
- (3) **GNR618:** Remote Sensing and GIS Application to Cryosphere
- (4) **GNR653:** Data Analysis Methods for Geo-Spatial Applications
- (5) **GNR805:** Advanced Concepts in Polarimetric SAR Image Analysis
- (6) **GNR792:** Communications Skills

### **Publications**

#### **Edited Special Issues of Journals**

- (S-1) **Foreword to the Special Issue on Applied Earth Observation and Remote Sensing in India**  
Avik Bhattacharya, Lorenzo Bruzzone, B. S. Daya Sagar, Paul A. Rosen





### **Papers in Refereed Journals**

- (J-1) **Snow Cover Mapping Using Polarization Fraction Variation with Temporal RADARSAT-2 C-Band Full-Polarimetric SAR Data Over the Indian Himalayas**  
Arnab Muhuri, Surendar Manickam, **Avik Bhattacharya**, Snehmani  
*IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 2018,  
(Accepted)
- (J-2) **Tensorization of Multi-Frequency PolSAR Data for Classification Using an Auto-Encoder Network**  
Shaunak De, Debanshu Ratha, Dikshya Ratha, **Avik Bhattacharya**, Subhasis Chaudhuri  
*IEEE Geoscience and Remote Sensing Letters*, vol. 15, no. 4, pp. 542-546, 2018
- (J-3) **Unsupervised Classification of PolSAR Data Using a Scattering Similarity Measure Derived from a Geodesic Distance**  
Debanshu Ratha, **Avik Bhattacharya**, Alejandro C. Frery  
*IEEE Geoscience and Remote Sensing Letters*, vol. 15, no. 1, pp. 151-155, 2018
- (J-4) **A Novel Technique Based on Deep Learning and a Synthetic Target Database for Classification of Urban Areas in PolSAR Data**  
Shaunak De, Lorenzo Bruzzone, **Avik Bhattacharya**, Francesca Bovolo, Subhasis Chaudhuri  
*IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol. 11, no. 1, pp. 154-170, 2018
- (J-5) **Seasonal Snow Cover Change Detection Over the Indian Himalayas Using Polarimetric SAR Images**  
Arnab Muhuri, Debanshu Ratha, **Avik Bhattacharya**  
*IEEE Geoscience and Remote Sensing Letters*, vol. 14, no. 12, pp. 2340-2344, 2017
- (J-6) **Temporal Response of Scattering from Crops for Transmitted Ellipticity Variation in Simulated Compact-Pol SAR Data**  
Vineet Kumar, Heather McNairn, **Avik Bhattacharya**, Y. S. Rao  
*IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol. 10, no. 12, pp. 5163-5174, 2017
- (J-7) **Change Detection in Polarimetric SAR Images Using a Geodesic Distance Between Scattering Mechanisms**  
Debanshu Ratha, Shaunak De, Turgay Celik, **Avik Bhattacharya**  
*IEEE Geoscience and Remote Sensing Letters*, vol. 14, no. 7, pp. 1066-1070, 2017
- (J-8) **Random Forest Based Prospectivity Modeling of Greenfield Terrains using Sparse Deposit Data: An Example from the Tanami Region, Western Australia**

S. Hariharan, S. Tirodkar, A. Porwal, **A. Bhattacharya**, A. Joly  
*Natural Resources Research*, vol. 26, no. 4, pp. 489-507, 2017

- (J-9) **Scattering Mechanism Based Snow Cover Mapping Using RADARSAT-2 C-Band Polarimetric SAR Data**  
Arnab Muhuri, Surendar Manickam, **Avik Bhattacharya**  
*IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol. 10, no. 7, pp. 3213-3224, 2017
- (J-10) **Improvement of PolSAR Decomposition Scattering Powers Using a Relative Decorrelation Measure**  
D. Ratha, M. Surendar, **A. Bhattacharya**  
*Remote Sensing Letters*, vol. 8, no. 4, pp. 340-349, 2017
- (J-11) **Estimation of Snow Surface Dielectric Constant from Polarimetric SAR Data**  
M. Surendar, **A. Bhattacharya**, G. Singh, Y. Yamaguchi  
*IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol. 10, no. 1, pp. 211-218, 2017
- (J-12) **Qualitative and Quantitative Assessment of TanDEM-X DEM over Western Himalayan Glaciated Terrain**  
P. Pandey, M. Surendar, **A. Bhattacharya**, A. L. Ramanathan, G. Singh, G. Venkataraman  
*Geocarto International*, vol. 32, no. 4, pp. 442-454, 2017
- (J-13) **Remote Detection of Geological Lineaments: An Application to the Aravalli Region, Western India**  
Debaditya Acharya, Alok Porwal, **A. Bhattacharya**  
*Geocarto International*, vol. 32, no. 3, pp. 257-273, 2017
- (J-14) **PolSAR Wet Snow Mapping With Incident Angle Information**  
N. Usami, A. Muhuri, **A. Bhattacharya**, A. Hirose  
*IEEE Geoscience and Remote Sensing Letters*, vol. 13, no. 12, pp. 2029-2033, 2016
- (J-15) **Enhanced Target Characterization and Improved Scattering Power Decompositions Using the Optimized Coherency Matrix from Full-Polarimetric SAR Data**  
**A. Bhattacharya**, M. Surendar  
*Remote Sensing Letters*, vol. 7, no. 11, pp. 1073-1082, 2016
- (J-16) **A New Compact Polarimetric SAR Decomposition Technique**  
**A. Bhattacharya**, S. De, A. Muhuri, M. Surendar, G. Venkataraman, A. K. Das  
*Remote Sensing Letters*, vol. 6, no. 12, pp. 914-923, 2015
- (J-17) **An Adaptive General Four-Component Scattering Power Decomposition with Unitary Transformation of Coherency Matrix (AG4U)**  
**A. Bhattacharya**, G. Singh, M. Surendar, Y. Yamaguchi  
*IEEE Geoscience and Remote Sensing Letters*, vol. 12, no. 10, pp. 2100-2114, 2015

- (J-18) **Polarimetric SAR Decomposition Parameter Subset Selection and their Optimal Dynamic Range Evaluation for Urban Area Classification Using Random Forest**  
S. Hariharan, S. Tirodkar, **A. Bhattacharya**  
*International Journal of Applied Earth Observation and Geoinformation*, vol. 44, pp. 144-158, 2015
- (J-19) **Estimation of Snow Density Using Full-Polarimetric Synthetic Aperture Radar (SAR) Data**  
M. Surendar, **A. Bhattacharya**, G. Singh, G. Venkataraman  
*Physics and Chemistry of the Earth*, vol. 83-84, pp. 156-165, 2015
- (J-20) **Remote Estimation of Dielectric Constant of Lunar Surface Regolith using Compact Polarimetric Synthetic Aperture Radar Data**  
**A. Bhattacharya**, A. Porwal, S. Dhingra, S. De, G. Venkataraman  
*Advances in Space Research*, 56, pp. 2439-2448, 2015
- (J-21) **Development of a Snow Wetness Inversion Algorithm Using Polarimetric Scattering Power Decomposition Model**  
M. Surendar, **A. Bhattacharya**, G. Singh, Y. Yamaguchi, G. Venkataraman  
*International Journal of Applied Earth Observation and Geoinformation*, vol. 42, pp. 65-75, 2015
- (J-22) **Modifying the Yamaguchi Four-Component Decomposition Scattering Powers Using a Stochastic Distance**  
**A. Bhattacharya**, A. Muhuri, S. De, M. Surendar, A. C. Frery  
*IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol. 8, no. 7, pp. 3497-3506, 2015
- (J-23) **Local Contrast Based Adaptive SAR Speckle Filter**  
S. Shitole, M. Sharma, S. De, **A. Bhattacharya**, Y. S. Rao, B. K. Mohan  
*Journal of the Indian Society of Remote Sensing*, vol. 45, no. 3, pp. 451-462, 2017
- (J-24) **A New Self-Training-Based Unsupervised Satellite Image Classification Technique Using Cluster Ensemble Strategy**  
B. Banerjee, F. Bovolo, **A. Bhattacharya**, L. Bruzzone, S. Chaudhuri, B. K. Mohan  
*IEEE Geoscience and Remote Sensing Letters*, vol. 12, no. 4, pp. 741-745, 2015
- (J-25) **A Graph Based Cross Domain Cluster Mapping Technique for Domain Adaptation- An Application to the Land-Cover Classification of Remote Sensing Data**  
B. Banerjee, F. Bovolo, **A. Bhattacharya**, L. Bruzzone, S. Chaudhuri, B. K. Mohan  
*IEEE Transactions on Geoscience and Remote Sensing*, vol. 53, no. 7, pp. 4045-4062, 2015
- (J-26) **A Generic Land-Cover Classification Framework for Polarimetric SAR Images Using the Optimum Touzi Decomposition Parameter Subset: An Insight on Mutual Information Based Feature Selection Techniques**  
B. Banerjee, **A. Bhattacharya**, K. M. Buddhiraju

*IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, Special Issue in Machine Learning*, vol.7, no.4, pp. 1167-1176, 2014

- (J-27) **Support Vector Machine Classification of Urban Area with Touzi Polarimetric SAR Decomposition Parameters Selected by Information Theoretic Criteria**  
A. Bhattacharya and R. Touzi  
*Canadian Journal of Remote Sensing*, 37(4): 323-332, 2012
- (J-28) **Computing Statistics from Man-Made Structures on the Earth's Surface for Indexing Satellite Images**  
A. Bhattacharya, M. Roux, H. Maitre, I. Jermyn, X. Descombes, J. Zerubia  
*International Journal of Simulation Modelling, Special issue on CompIMAGE*, vol. 6, no. 2, pp. 73-83, 2007

### Papers in Conference Proceedings

- (C-1) **Snow Cover Mapping with Poincaré Sphere Parameters from PolSAR Images Using an Auto-Encoder Network**  
Shaunak De, Arnab Muhuri, Surendar Manickam, Avik Bhattacharya  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2018, Valencia, Spain (Accepted)
- (C-2) **Crop Biophysical Parameters Estimation with a Multi-target Inversion Scheme Using the Sentinel-1 SAR Data**  
Dipankar Mandal, Vineet Kumar, Avik Bhattacharya, Y. S. Rao, Heather McNairn  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2018, Valencia, Spain (Accepted)
- (C-3) **Change Detection Using Curvelet and Contourlet Transforms Using Multitemporal SAR Imagery**  
Rizwan Ahmed Ansari, Krishna Mohan Buddhiraju, Avik Bhattacharya  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2018, Valencia, Spain (Accepted)
- (C-4) **A Scattering Power Factorization Framework Using a Geodesic Distance in Radar Polarimetry**  
Debanshu Ratha, Avik Bhattacharya, Alejandro C. Frery  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2018, Valencia, Spain (Accepted)
- (C-5) **Temporal Analysis of Touzi Parameters for Wheat Crop Characterization Using L-Band AgriSAR 2006 Data**  
Soumyashree Kar, Dipankar Madal, Avik Bhattacharya, J. Adinarayana  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2017, Fort Worth, USA

- (C-6) **A Novel Change Detection Framework Based On Deep Learning for the Analysis Of Multi-Temporal Polarimetric SAR Images**  
Shaunak De, Davide Pirrone, Francesca Bovolo, Lorenzo Bruzzone, **Avik Bhattacharya**  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2017, Fort Worth, USA
- (C-7) **Unsupervised Change Detection In Built-Up Areas By Multi-Temporal Polarimetric SAR Images**  
Davide Pirrone, Shaunak De, **Avik Bhattacharya**, Lorenzo Bruzzone, Francesca Bovolo  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2017, Fort Worth, USA
- (C-8) **Snow-Cover Mapping with Insight into a Sparse Representation Approach using Polarimetric SAR Data**  
S. De, A. Muhuri, M. Surendar, **A. Bhattacharya**  
*IEEE Young Professionals Remote Sensing Conference*, 2016, Oberpfaffenhofen, Germany.
- (C-9) **Snow Surface Characterization from Polarimetric TerraSAR-X Data**  
M. Surendar, A. Verma, S. De, **A. Bhattacharya**, G. Singh  
*TerraSAR-X/TanDEM-X Science Team Meeting*, DLR, 2016, Oberpfaffenhofen, Germany.
- (C-10) **Scattering Power Decomposition and its Applications**  
Yoshio Yamaguchi, Yi Cui, Gulab Singh, **Avik Bhattacharya**  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2016, Beijing, China.
- (C-11) **Proposal of Wet Snow Mapping with Focus on Incident Angle Influential to Depolarization of Surface Scattering**  
Naoto Usami, Arnab Muhuri, **Avik Bhattacharya**, Akira Hirose  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2016, Beijing, China.
- (C-12) **Mass Change of Gangotri Glacier Based on TanDEM-X Measurements**  
P. Pandey, M. Surendar, **A. Bhattacharya**, P. K. Champati Ray, G. Singh, G. Venkataraman  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2016, Beijing, China.
- (C-13) **Unsupervised Hidden Markov Random Field Based Segmentation of Polarimetric SAR Images**  
B. Banerjee, S. De, M. Surendar, **A. Bhattacharya**

*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2016, Beijing, China.

- (C-14) **Urban Area Mapping from Polarimetric SAR Data Using Fuzzy Inference System**  
A. Ahluwalia, M. Surendar, **A. Bhattacharya**, A. Porwal  
*SPIE Asia-Pacific Remote Sensing Symposium*, 2016, New Delhi, India.
- (C-15) **Machine-Learning and Spectral Techniques for Lithological Classification**  
K. Parakh, S. Thakur, B. Chudasama, S. Tirodkar, R. P. Amrutkar, A. Porwal, **A. Bhattacharya**  
*SPIE Asia-Pacific Remote Sensing Symposium*, 2016, New Delhi, India.
- (C-16) **Surface Roughness Measurements and Crater Statistics for Aristillus Impact Crater**  
S. Dhingra, **A. Bhattacharya**  
*47th Lunar and Planetary Science Conference*, 2016, Abstract No. 2041, The Woodlands, Texas, USA.
- (C-17) **Remote estimation of dielectric properties of palaeochannel-fill sediments in Tubas Area, Namibia: implications for surficial uranium exploration**  
Sanchari Thakur, Bijal Chudasama, Surendar Manickam, Alok Porwal, **A. Bhattacharya**  
*GRSG 26th Annual Conference 'Challenges in Geological Remote Sensing*, 2015, ESA, ESRIN, Frascati, Italy.
- (C-18) **An Adaptive General Four-Component Scattering Power Decomposition With Unitary Transformation of Coherency Matrix**  
**A. Bhattacharya**, G. Singh, M. Surendar, Y. Yamaguchi  
*Asia-Pacific Conference on Synthetic Aperture Radar (APSAR)*, 2015, Singapore.
- (C-19) **Glacier Surface Velocity Estimation Using Stokes Vector Correlation**  
A. Muhuri, R. Natsuaki, **A. Bhattacharya**, A. Hirose  
*Asia-Pacific Conference on Synthetic Aperture Radar (APSAR)*, 2015, Singapore.
- (C-20) **Classification of PolSAR Data with Insights into a Deep Learning Approach**  
S. De, **A. Bhattacharya**  
*Asia-Pacific Conference on Synthetic Aperture Radar (APSAR)*, 2015, Singapore.
- (C-21) **Scattering Helicity for Snow Cover Mapping**  
A. Muhuri, M. Surendar, **A. Bhattacharya**, G. Singh  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2015, Milan, Italy.
- (C-22) **Urban Classification Using PolSAR Data and Deep Learning**  
S. De, **A. Bhattacharya**  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2015, Milan, Italy.



- (C-23) **Crop Information Extraction by Using ALOS-PALSAR/PALSAR-2 Measurements**  
G. Singh, Y. Yamaguchi, U. Khatti, **A. Bhattacharya**  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2015, Milan, Italy.
- (C-24) **A New Target Decomposition Technique for Compact Polarimetric SAR Data**  
**A. Bhattacharya**, A. Muhuri, S. De, M. Surendar, G. Venkataraman  
*46th Lunar and Planetary Science Conference*, 2015, Abstract No. 1065.
- (C-25) **A Modified  $m - \chi$  Decomposition for Compact Polarimetric SAR Data**  
S. Dhingra, **A. Bhattacharya**  
*46th Lunar and Planetary Science Conference*, 2015, Abstract No. 1837.
- (C-26) **Variable Importance and Random Forest Classification Using Radarsat-2 PolSAR Data**  
S. Hariharan, S. Tirodkar, S. De, **A. Bhattacharya**  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2014, Quebec City, Canada.
- (C-27) **Snow Wetness Estimation From Dual Polarimetric Coherent TerraSAR-X Data**  
**A. Bhattacharya**, M. Surendar, G. Singh, S. De, G. Venkataraman  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2014, Quebec City, Canada.
- (C-28) **Orientation Angle Estimation From PolSAR Data Using a Stochastic Distance**  
**A. Bhattacharya**, A. C. Frery, A. Muhuri, S. De  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2014, Quebec City.
- (C-29) **Evaluation of Various Polarimetric Parameters for Soil Moisture Inversion using Polarimetric SAR Data**  
G. Ponnurangam, Y. S. Rao, **A. Bhattacharya**  
*European Conference on Synthetic Aperture Radar (EUSAR)*, 2014, Berlin, Germany, pp. 1–4.
- (C-30) **Improved Snow Wetness Estimation From Fully Polarimetric SAR Image**  
M. Surendar, G. Singh, **A. Bhattacharya**, G. Venkataraman, P. A. Bharathi  
*Asia-Pacific Conference on Synthetic Aperture Radar (APSAR)*, 2013, Tsukuba, Japan, pp. 31–34.
- (C-31) **Region Growing Based Improved SAR Speckle Filter For Hybrid Polarimetric Data**  
S. S. Shitole, S. De., **A. Bhattacharya**, Y. S. Rao, K. M. Buddhiraju  
*Asia-Pacific Conference on Synthetic Aperture Radar (APSAR)*, 2013, Tsukuba, Japan, pp. 517–520.

- (C-32) **Cornered Difference Weighted Mean SAR Speckle Filter**  
S. S. Shitole, M. Sharma, **A. Bhattacharya**, Y. S. Rao, K. M. Buddhiraju  
*Asia-Pacific Conference on Synthetic Aperture Radar (APSAR)*, 2013, Tsukuba, Japan, pp. 400–403.
- (C-33) **A Qualitative Analysis Of Backscattered Radar Waves From The Lunar Surface**  
A. Muhuri, S. Dhingra, **A. Bhattacharya**, G. Venkataraman  
*Asia-Pacific Conference on Synthetic Aperture Radar (APSAR)*, 2013, Tsukuba, Japan, pp. 350–353.
- (C-34) **Snow Wetness Estimation From Polarimetric SAR Image**  
M. Surendar, G. Singh, **A. Bhattacharya**, G. Venkataraman, P. A. Bharathi  
*Progress In Electromagnetics Research Symposium (PIERS) Proceedings*, 2013, Stockholm, Sweden, pp. 678–682.
- (C-35) **Characterization Of Backscattered Radar Waves From The Lunar Surface**  
A. Muhuri, S. Dhingra, **A. Bhattacharya**, G. Venkataraman  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2013, Melbourne, Australia.
- (C-36) **Snow Wetness Estimation Based On Pol-SAR Decomposition Techniques**  
M. Surendar, G. Singh, **A. Bhattacharya**, G. Venkataraman  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2013, Melbourne, Australia.
- (C-37) **Radon Transform Based Edge Detection For SAR Imagery**  
S. Varma, B. Banerjee, A. Muhuri, **A. Bhattacharya**, K. M. Buddhiraju  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2013, Melbourne, Australia.
- (C-38) **Comparitive Analysis Of Classification Accuracy For RISAT-1 Compact Polarimetric Data For Various Land-Covers**  
V. Turkar, S. De, Y. S. Rao, S. Shitole, **A. Bhattacharya**, A. K. Das  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2013, Melbourne, Australia.
- (C-39) **Glacier Elevation Study Using TanDEM-X**  
P. Pandey, G. Venkataraman, **A. Bhattacharya**  
*TerraSAR-X/TanDEM-X Science Team Meeting*, DLR, 2013, Oberpfaffenhofen, Germany, <https://tandemx-science.dlr.de/pdfs/>
- (C-40) **Glacier Velocity Estimation Using Offset Tracking Method**  
M. Surendar, **A. Bhattacharya**, G. Venkataraman  
*TerraSAR-X/TanDEM-X Science Team Meeting*, DLR, 2013, Oberpfaffenhofen, Germany, <https://tandemx-science.dlr.de/pdfs/>



- (C-41) **A Virtual Lab for Web Based Training for Optical/Infrared and SAR Imagery**  
Krishna Mohan Buddhiraju and Avik Bhattacharya  
*TerraSAR-X/TanDEM-X Science Team Meeting*, DLR, 2013, Oberpfaffenhofen, Germany, <https://tandemx-science.dlr.de/pdfs/>
- (C-42) **Optimization of the Application of the Touzi Decomposition for Wetland Classification Using Polarimetric Radarsat-2**  
G. Gosselin, R. Touzi, A. Bhattacharya  
*33rd Canadian Symposium on Remote Sensing*, June 2012, Ottawa, Canada, Canadian Symposium on Remote Sensing; 2012; p.12, Earth Sciences Sector, Contribution Series 20140075
- (C-43) **Investigation of Polarimetric ALOS and Radarsat2 for Peatland Characterization**  
R. Touzi, G. Gosselin, J. Li, A. Bhattacharya  
*PolInSAR*, Frascati, ESA, Italy, 2011, <https://earth.esa.int/web/guest/-/polinsar-2011>
- (C-44) **Classification of wetland and urban area with Touzi polarimetric SAR decomposition parameters selected by information theoretic criteria**  
A. Bhattacharya, R. Touzi  
*31st Canadian Symposium on Remote Sensing-The Prairie Summit*, 2010, Regina, SK, [http://uregina.ca/prairies/assets/PrairieSummit\\_Proceedings.pdf](http://uregina.ca/prairies/assets/PrairieSummit_Proceedings.pdf)
- (C-45) **Multi-resolution target scattering decomposition for urban feature characterization using polarimetric SAR**  
R. Touzi, A. Bhattacharya, K. Mattar  
*IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, 2009, Cape Town, S. Africa.
- (C-46) **Indexing of Mid-Resolution Satellite Images with Structural Attributes**  
A. Bhattacharya, M. Roux, H. Maitre, I. Jermyn, X. Descombes, J. Zerubia  
*XXI ISPRS Congress*, 2008, Beijing, China, Vol. XXXVII, Part B4, pp. 187–192.
- (C-47) **Indexing Satellite Images with Features Computed from Man-Made Structures on the Earth's Surface**  
A. Bhattacharya, M. Roux, H. Maitre, I. Jermyn, X. Descombes, J. Zerubia  
*Fifth International Workshop on Content-Based Multimedia Indexing (CBMI 2007)*, Bordeaux, France, pp. 244-250.
- (C-48) **Computing Statistics from a Graph Representation of Road Networks in Satellite Images for Indexing and Retrieval**  
A. Bhattacharya, I. H. Jermyn, X. Descombes, J. Zerubia  
*CompIMAGE - Computational Modeling of Objects Represented in Images: Fundamentals, Methods and Applications*, Coimbra, Portugal, October 2006, pp. 97–100.
- (C-49) **Shape Moments for Region-Based Active Contours**  
P. Horvath, A. Bhattacharya, I. H. Jermyn, J. Zerubia, Z. Kato

*Hungarian-Austrian Conference on Image Processing and Pattern Recognition, Szeged, Hungary, May 2005, pp. 187–194.*

### **Conference/Workshop without Proceedings**

- (N-1) **Monitoring Snow Cover Extent with Satellite Synthetic Aperture Radar for Snow Hydrological Applications**  
A. Muhuri, **A. Bhattacharya**, L. Menzel  
International Conference on Snow Hydrology (SnowHydro), 12-15, 2018, Heidelberg, Germany.
- (N-2) **Geometrical and Statistical Information Theoretic Methods in PolSAR Data Analysis**  
**A. Bhattacharya**, D. Ratha  
Special Session: SAR Polarimetry: Methods & Applications, Asian Conference on Remote Sensing (ACRS), 2017.
- (N-3) **Snow Parameter Estimation Using Advanced PolSAR Techniques**  
M. Surendar, **A. Bhattacharya**, G. Venkataraman  
NISAR Science & Applications Workshop, SAC, ISRO, Ahmadabad, India, November 19–20, 2015.
- (N-4) **Classification of PolSAR Data with Insights into a Deep Learning Approach**  
S. De, **A. Bhattacharya**  
NISAR Science & Applications Workshop, SAC, ISRO, Ahmadabad, India, November 19–20, 2015.
- (N-5) **Snow pack parameter estimation and glacier movement studies using SAR Polarimetry Data**  
G. Venkataraman, **A. Bhattacharya**, Snehmani  
The 1st PI workshop for ALOS-2 Science Program in Tsukuba, Japan, September 19–20, 2013.
- (N-6) **Snow Surface Wetness Estimation Using SAR Polarimetric Decomposition Techniques**  
M. Surendar, **A. Bhattacharya**, G. Singh, G. Venkataraman, A. Bharthi  
8th International Conference on Microwaves Antenna Propagation and Remote Sensing (ICMARS), 2012, Jodhpur, India.
- (N-7) **Non-Gaussian Statistical Analysis of Synthetic Aperture Radar Image**  
A. Muhuri, **A. Bhattacharya**  
8th International Conference on Microwaves Antenna Propagation and Remote Sensing (ICMARS), 2012, Jodhpur, India.
- (N-8) **Unsupervised Classification of Dual-Band Polarimetric SAR Image Using Non-Gaussian Statistical Models**  
A. Muhuri, **A. Bhattacharya**

International Symposium on Space Geodesy and Earth System, August 18–20, 2012, Shanghai, China.

(N-9) **Statistical modeling of dual-band quad-pol SIR-C SAR image**

A. Muhuri, **A. Bhattacharya**

Geomatrix'12, International Conference on Geospatial Technologies and Applications, 26–29 February, Mumbai, India.

(N-10) **Interpretation of change in quantization level in ENVISAT ASAR image using grey level co-occurrence matrix elements**

K. Datt, **A. Bhattacharya**

Geomatrix'12, International Conference on Geospatial Technologies and Applications, 26–29 February, Mumbai, India.

(N-11) **Speckle Filtering of SAR Images and a Comparative Analysis of Various Despeckling Techniques and a Proposed Filter**

M. Sharma, N. Agarwal, **A. Bhattacharya**

Geomatrix'12, International Conference on Geospatial Technologies and Applications, 26–29 February, Mumbai, India.

(N-12) **Extraction of Structural Primitive Features from Satellite Images for Indexation and Retrieval**

**A. Bhattacharya**, I. H. Jermyn, X. Descombes, J. Zerubia

1st Symposium of the CNES/DLR/ENST Competence Centre on Information Extraction and Image Understanding for Earth Observation, Paris, France, 2007.

(N-13) **Computing Statistics from Man-Made Structures on the Earth's Surface for Indexing Satellite Images**

**A. Bhattacharya**, I. H. Jermyn, X. Descombes, J. Zerubia

7th CNES/DLR Workshop on Information Extraction and Scene Understanding for Meter Resolution Images, DLR, Oberpfaffenhofen, Germany, 2007.

### **Publications of General Interest**

(G-1) **Maximization of the Degree of Polarization to Estimate the Polarization Orientation Angle from PolSAR Data: An Insight into the Real and Complex Rotation of the Coherency Matrix**

**A. Bhattacharya**

arXiv:1704.07372, 2017.

### **Invited Technical Talks**

(T-1) **PolSAR Data Analysis for Target Characterization**

Workshop on Remotely Sensed Big Data Analysis and Mining (RSBDAM'18): IEEE GRSS-Chapnet Programme, Indian Statistical Institute (ISI) Kolkata, 23-24 January, 2018.



- (T-2) **Remote Sensing: Principles and Perspectives**  
Second National Symposium on Recent Advances & Challenges in Engineering & Management (RACEM-2017), VIT, Mumbai, 22-23 December, 2017.
- (T-3) **PolSAR Image Decompositions**  
IV JIAAIS Interdisciplinary Workshop on Advanced Signal and Image Analysis, Federal University of Alagoas, Maceió, Brazil, 10-15 November, 2017.
- (T-4) **Polarimetric Synthetic Aperture Radar (PolSAR) Data Analysis and Its Applications**  
India-Trento Program for Advanced Research (ITPAR Phase - III), Fondazione Bruno Kessler, Trento, Italy, October 2016.
- (T-5) **Recent Developments in the Microwave Remote Sensing Group (Cryosphere & Planex)**  
India-Trento Program for Advanced Research (ITPAR Phase - III), University of Trento, Italy, August 2015.
- (T-6) **Orientation Angle Estimation from PolSAR Data using a Stochastic Distance**  
Department of Information Engineering, Niigata University, Niigata, Japan, 2014.
- (T-7) **Microwave Remote Sensing Lab: Research in Cryosphere and Planex**  
Department of Electrical Engineering and Information Systems, The University of Tokyo, Tokyo, Japan, 2014.
- (T-8) **SAR Remote Sensing Image Analysis: Polarimetry, Interferometry And Polarimetric SAR interferometric applications**  
Snow and Avalanche Study Establishment (SASE), Defense Research and Development Organization (DRDO), Chandigarh, India, 2011.
- (T-9) **Graph Representation of Road Networks in Satellite Images for Indexation**  
École Supérieure des Communications de Tunis (Sup'Com), Tunisia, under Action Concertée Incitative Massés de Donnes (ACI) QuerySat Project, 2006.
- (T-10) **Features from Graph Representation of Road Networks in Satellite Images for Indexation Cross-Seminar**  
(ARIANA/MAESTRO) research groups, INRIA, Sophia Antipolis, France, 2005.
- (T-11) **Features from Graph Representation of Road Networks in Satellite Images for Indexation**  
IMEDIA research group, INRIA Rocquencourt, France, 2005.

## Invited Non-Technical Talks

- (1) **IEEE Geoscience and Remote Sensing Society (GRSS): Awareness and Education**  
Second National Symposium on Recent Advances & Challenges in Engineering & Management (RACEM-2017), VIT Mumbai, 22-23 December, 2017.



- (2) **IEEE Geoscience and Remote Sensing Society (GRSS)**  
Exhibitor Plenary talk at Asian Conference on Remote Sensing, 2017 (ACRS-2017).
- (3) **IEEE Geoscience and Remote Sensing Society (GRSS)**  
IEEE Geoscience and Remote Sensing (GRSS) Event on “Remote Sensing and GIS in Rural Agricultural System”, Geo-informatics Research Centre, Department of Computer Engineering, Don Bosco Institute of Technology, Mumbai, 22-23 September 2017.

## **Tutorials/Workshops**

- (1) **Lecture: Basic and Advanced SAR Polarimetry**  
2-Week QIP Short Term Course on Satellite Image Processing Basic to Advanced, CSRE, IIT Bombay, 24 Nov. – 05 Dec. 2014
- (2) **Lecture: Basics of SAR Polarimetry**  
QIP Short Term Course on Advanced Techniques for Satellite Image Analysis, CSRE, IIT Bombay, 10 – 14 Feb. 2014
- (3) **Lecture: Basics of SAR Polarimetry**  
QIP Short Term Course on Principles and Applications of Satellite Image Processing, CSRE, IIT Bombay, Mar. 25 –29, 2013

## **Academic/Professional Awards**

- (1) Australian Government Endeavour Executive Fellowship Award, 2016
- (2) Best Poster Award: National Symposium on Recent Advances in Remote Sensing and GIS with Special Emphasis on Mountain Ecosystems & Annual Conventions of Indian Society of Remote Sensing & Indian Society of Geomatics, Dehradun, India, 7–9, December, 2016
- (3) Best Paper Award: Geomatrix’14, National Conference on Application of Geoinformatics in Rural, Urban & Climatic Studies, Indian Institute of Technology Bombay, 6–7, June, 2014
- (4) Best Paper Award: Geomatrix’12, International Conference on Geospatial Technologies and Applications, Indian Institute of Technology Bombay, 26–29 February, 2012
- (5) Best Paper Award: 8th International Conference on Microwave Antenna Propagation & Remote Sensing, Jodhpur, 10–15 December, 2012
- (6) Young Faculty Award, Indian Institute of Technology Bombay, 2011–2014
- (7) Natural Sciences and Engineering Research Council of Canada (NSERC) Visiting Scientist Fellowship at the Canadian National Laboratories, 2008–2011.  
(Visiting Scientist at the Canadian Centre for Remote Sensing, Ottawa, ON, Canada)



- (8) Ph.D. fellowship award by CNES, Centre National d'Etudes Spatiales (French Space Agency), 2004–2007

## Professional Memberships

- (1) **Senior Member:** IEEE Geoscience and Remote Sensing Society (IEEE-GRSS)
- (2) **Life Member:** Indian Society of Remote Sensing (ISRS)

## Journal Editorship

- (1) **Associate Editor:** IEEE Geoscience and Remote Sensing Letters (GRSL)
- (2) **Guest Editor:** Special issue on “Applied Earth Observations and Remote Sensing in India” in IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (JSTARS), 2017
- (3) **Guest Editor:** Special Stream on “Advanced Statistical Techniques in SAR Image Processing and Analysis” in IEEE Geoscience and Remote Sensing Letters (GRSL), 2018 (Ongoing)

## Synergistic Activities

- (1) **Chairman:** IEEE Geoscience and Remote Sensing Society (GRSS), Bombay Chapter (2017–)
- (2) **Joint Secretary:** Indian Society of Remote Sensing (ISRS), Bombay Chapter (2014–)
- (3) **Journal Reviewer:** Canadian Journal of Remote Sensing, IEEE Transactions on Geoscience and Remote Sensing (TGRS), IEEE Geoscience and Remote Sensing Letters (GRSL), IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (JSTARS), Journal of the Indian Society of Remote Sensing, International Journal of Applied Earth Observation and Geoinformation (JAG), International Journal of Remote Sensing (IJRS), Remote Sensing Letters (RSL).
- (4) **Associate Member:** JECAM: Joint Experiment of Crop Assessment and Monitoring, Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada, 2018.
- (5) **Session Co-Chair:** Special Session: SAR Polarimetry: Methods & Applications, Asian Conference on Remote Sensing (ACRS), 2017.
- (6) **Chairperson:** IEEE Geoscience and Remote Sensing (GRSS) Event on “Remote Sensing and GIS in the Service of India’s Development”, June, 2017.
- (7) **Chairperson:** International Workshop on Remote Sensing Image Analysis, India-Trento (Italy) Program for Advanced Research (ITPAR), April 2016.



- (8) **Reviewer:** IEEE International Geoscience and Remote Sensing Symposium: Valencia, Spain, 2018; Fort Worth, Texas, USA, 2017; Beijing, China, 2016; Milan, Italy, 2015; Quebec, Canada, 2014
- (9) **Technical Program Committee (TPC) Member:** National Conference on Application of Geo-informatics in Rural, Urban and Climatic Studies (Geomatrix14), IIT Bombay, 2014.
- (10) **Technical Program Committee (TPC) Member:** 8th Indian Conference on Computer Vision, Graphics and Image Processing (ICVGIP), IIT Bombay, 2012.
- (11) **Technical Program Committee (TPC) Member:** International Conference on Geospatial Technologies and Applications (Geomatrix12), IIT Bombay, 2012.
- (12) **Expert Reviewer:** Swiss National Science Foundation (SNSF) grant application under Mathematics, Physical and Engineering Sciences Division on High Resolution Radar Imaging of Snow Avalanches, 2011.
- (13) **Associate Member:** CNES-DLR-ENST Centre of Competence on Information Extraction and Image Understanding for Earth Observation, Paris, France, 2005-2008.
- (14) **Organizing Committee:** Urban Remote Sensing Joint Event, URBAN/URS, Paris, France, April 2007.
- (15) **Participant:** 3rd British Computer Society Summer School on Pattern Recognition, Portland Square, Plymouth, UK, July 2005.
- (16) **President:** Mathematics Colloquium of the Department of Mathematics, IIT Kharagpur, 1999-2000.

A. Bhattacharya  
April 7, 2018

