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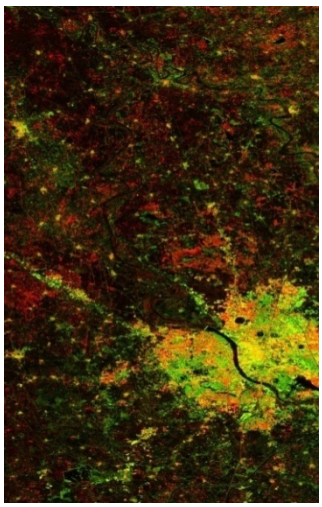
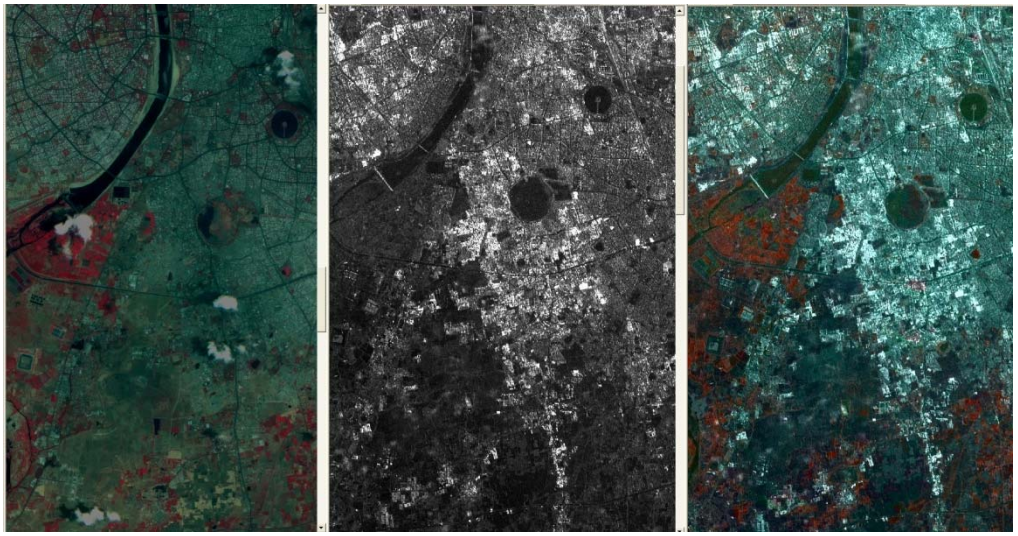
IEEE Gujarat Section
Geoscience and Remote Sensing Society- Chapter Newsletter

Inside This Issue

We have created a silent watchful microwave eye in space assisting us in analyzing our biosphere in which we live or in other words microwave remote sensors are becoming the radiological tools for providing input for assessing the health of Mother Earth.

Prof. W. M. Boerner





About Newsletter

The IEEE Gujarat Section Geoscience and Remote Sensing Society - Chapter Newsletter is intended as an information resource for members of the GRS Society, the IEEE community at large and the global community of individuals interested in the science and engineering of remote sensing of the Earth's land, oceans, and atmosphere. Current scenario and future of Remote sensing is taken up. Various events and lectures have been covered.

New Year Greetings -2014

IEEE Gujarat Section GRSS Chapter
Wishes all Members & their Families
A Happy, Healthy and Prosperous
New Year 2014

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INTRODUCING OUR FIRST NEWSLETTER

With rapid advancement in various disciplines of Geo-sciences and in the science of Remote Sensing, there is substantial expansion in their societal and industrial applications. This has resulted in considerable growth in scientific and commercial interest among academia and industries. Besides, a large students' community is attracted to these and allied disciplines. It is in this background, the Gujarat Chapter of IEEE GRSS is born. An essential element of a professional society is a scientific magazine or a Newsletter, which can serve the role of a platform for exchanging new thoughts and dissemination of information. We expect members will actively contribute interesting pieces for publication in subsequent issues of the Newsletter. We have so far not given any name to our Newsletter. We will be happy if you suggest one. As the activities of the Chapter started in April 2013, well before the Chapter was formally formed, the present issue relates to the period April–December 2013.

Heartiest Congratulations For The First Issue !

Dr. Abhijit Sarkar
Editor, IEEE GUJARAT SECTION -GRSS CHAPTER

IEEE- Gujarat Section GRSS Chapter Members' Meet at Aashray Restaurant, Ahmedabad on 28th December 2013

Cover Page Image: Ahmedabad Region as seen from optical (Resourcesat-2) and Microwave (RISAT-1) sensors from space

Message from the Chairman's Desk

Dr. Shiv Mohan.

Remote sensing of Earth and Planetary Sciences in India was started in Ahmedabad more than 40 years back. Space Applications Centre and Physical Research Laboratory are two main government institutes initiating many remote sensing programmes for India. Indian satellites payload development, data processing and applications for natural resource management had been successfully carried out since late seventies. While PRL is conducting fundamental research in planetary, earth and atmospheric sciences, academic institutes like CEPT University, PDP University (PDPU), Nirma University, Indian Institute of Technology and others are conducting advance research in earth and planetary sciences. A number of industries in Ahmedabad region are contributing towards commercialization of space technology. Thus, Ahmedabad chapter forms a hub of space technology involving sensor system, signal processing and application of data. All these activities have to be further sharpened through interactions with experts at various national and international platforms. The IEEE GRSS Gujarat Chapter has a unique environment with members as senior researchers, academician and a large number of middle level and young researchers. Additionally, students' community of doctoral (PhD), graduates in engineering & technology and graduates in science (M Sc course) forms a large number of aspirants working in space technology. All these activities involving young and senior researchers provide a platform to form IEEE-GRSS Gujarat Chapter. The Chapter aims towards bringing together the professionals, students, researchers, academicians and corporate sector of this region on a common platform to exchange and coordinate their ideas, and through collaboration with other Indian and International societies and Institutes and to promote professional collaboration by focusing the need for science and operational applications. Based on these aspects, Ahmedabad IEEE-GRSS Chapter is formed to facilitate the promotion and exchange of ideas and networking among professionals at regional and international level. IEEE GRSS Gujarat Chapter thus specifically aims at

i) Bringing the professional, researchers, academicians, students from remote sensing discipline of the region on a common platform under the banner of IEEE GRSS;
ii) Interactions with international experts to propose the new techniques of studies keeping in view of the special needs of the region; make best use of the available resources for a comprehensive study in the area of earth and planetary science;
iii) Attract more young students/researchers to get involved in the field and IEEE GRSS activities through awareness programs;
iv) Develop special lectures on remote sensing for earth and planetary purpose with case studies from the region;
v) Involve industry to arrange roundtable for dialogue on remote sensing for earth and planetary science.

With these aims in mind, IEEE GRSS Gujarat Chapter was formed on 3rd May 2013. The Chapter with strength of 23 members is distributed among various institutes of Gujarat. Members are from Institutes like Space Applications Centre/ISRO, Physical Research Laboratory, CEPT University, NIRMA University, Gujarat University, M S University, St Xavier's College, M G Science College, Nascent Info technology and independent professionals. Thus, a large number of community's representations make the Chapter most lively in its performance. In a short span of time, Chapter has organized three technical lectures from Space Technology experts, One National Conference and One International Conference. The present newsletter is the first of our efforts in popularizing the space Science and applications. I congratulate all our members for their significant contribution towards excellent activities and growth of Chapter.

Dr. Shiv Mohan
Chairman
IEEE Gujarat Section Geoscience and Remote Sensing Society- Chapter
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Event Reports

REPORT ON THE LECTURE ON "METEORITES – MESSENGERS FROM COSMIC SPACE"(APRIL 2013)

SES and IEEE Geoscience & Remote Sensing Society, Gujarat Chapter jointly organised the SES Foundation Day Lecture on "Meteorites – Messengers from Cosmic Space" by Dr Sambhunath Ghosh, Ex-Dy. Director General, Geological Survey of India / Visiting Scientist, Physical Rese arch Laboratory (PRL), Ahmedabad and M G Science College, Ahmedabad. Prof S V S Murthy, Coordinator, Planetary Exploration Programme, PRL, Ahmedabad chaired the session. Prof R D Shah, Head, Geology Department, M G Science College welcome the participants. Dr Ajai, Group Director, SAC (ISRO) briefed about SES and about Foundation Day. Dr Anup Das, SAC gave the vote of thanks at the end. The event was organised by Dr Shiv Mohan, PLANEX, PRL, Ahmedabad. Scientists, Faculty, Researchers and Students from PRL, SAC, Gujarat University, CEPT University and PDP University and members of Corporate Sector actively participated in the event.

REPORT ON THE LECTURE ON REMOTE SENSING OF THE PHYSICAL QUALITIES OF FRUITS (SEPTEMBER 2013)

Dr. Monai Krairiksh taking Lecture

An invited lecture on "*Remote Sensing of the Physical Qualities of Fruits*" by Dr. Monai Krairiksh of King Mongkut's Institute of Technology, Ladkrabang, Bangkok (Thailand) was organized by IEEE Geoscience and Remote Sensing (GRSS) - Gujarat, IEEE MTT/AP- Gujarat, Indian Society of Geomatics (ISG) - Ahmedabad Chapter and the CEPT University on 24th September 2013. The prime motivation behind selecting this theme is the fact that both India and Thailand have similar climatic conditions and both these countr ies match in high fruit production. The main objective was to timely detection of the ripen fruits so as to prevent rotting. The speaker explained the techniques for both post-harvest and pre-harvest seasons. The proposed techniques are expected to be beneficial for fruit merchants who otherwise face heavy losses because of lack of timely information. The main focus of the work was on a fruit named Durian found in Malaysia and Thailand. Durian is liked by people in South Asian countries and has great economical value as well. Dr. Monai Krairiksh showed how measurement of dielectric constant of a fruit sample using radiation in microwave region can be helpful to determine the current state of the fruit, and thus leading to determination of optimum harvest time. The main advantage of this technique is that by simulating the spectral response of a fruit, its quality parameters like ripeness, sugar content, thickness of the skin etc can be found out without destroying the fruit. By this method a large number of fruits in the orchard can be individually harvested at the time when they are in a state most suitable for export. Other fruits included were Mango, Watermelon, and Orange. Researchers are working on development of a hand held user-friendly device.

In the organization of the event, students played an active role (it is remarkable that as many as 57 students and Research scholars from CEPT and LDRP-ITR, Gandhinagar took part). Senior scientists, engineers and faculty from Space Applications Centre, Physical Research Laboratory, PDPU and GU were also present.

REPORT ON THE NATIONAL SEMINAR - NEW CHALLENGES IN REMOTE SENSING WITH EMPHASIS ON MICROWAVE DATA (OCTOBER 2013)

IEEE Geosciences and Remote Sensing Society, Gujarat in collaboration with the Indian Society of Geomatics and the Indian Women Scientists Association, organized a National Seminar "New Challenges in Remote Sensing with Emphasis on Microwave Data" at M S University, Baroda in October 2013.

Inauguration of Workshop by IEEE Chair, Gujarat

Chairman emeritus of Excel Industries Limited, G Narayana was the Guest of Honor. MSU Vice-Chancellor, Professor Yogesh Singh presided over the function. There were more than 100 participants representing various educational institutes, research institutes and Industries. The seminar had 5 invited lectures and 15 oral and poster presentations. The themes which were touched upon during the seminar discussions are 'monitoring and management of natural resources', 'sensor technology and associate development', 'potentials and applications of spatial technology', 'remote sensing for regional development' and 'commercialization of remote sensing'. The speakers elaborated different aspects of how remote sensing science has become a critical and universal tool for natural resource managers and researchers in government agencies, conservation organizations and industries, during these sessions.

Audience during the event

The seminar provided deep insights on the utility of optical and microwave data to undertake inventory of land, as well as, the temporal information required to monitor sustainable land management practices. It brought out various types of remote sensing data and how each type plays a significant role in the ability to analyze an area without directly coming in contact with it.

Four prizes including two for best poster presentations and two for best oral presentations were selected. The prizes were sponsored by the Indian Women Scientist Association, Bombay Main Branch

Based on the feedback received throughout the day, and specific requests and demands received during the 'Open Session', it was proposed that a one-day exposure session and a one-week training course should be organized by IEEE GRSS- Gujarat by drawing experts from global IEEE Community.

Release of Proceeding of Symposium

Report on the International Experts Meet on Microwave Remote Sensing (16-17 December 2013, Ahmedabad)

IEEE-GRSS Gujarat Chapter in association with CEPT University, Ahmedabad organized two days "International Experts Meet on Microwave Remote Sensing" at Gujarat University Convention Centre, Ahmedabad during 16-17 December 2013. The event was supported and co-sponsored by PLANEX, Physical Research Laboratory; IEEE Gujarat Section APS/MTT joint chapter; Indian Society of Geomatics – Ahmedabad chapter; Indian Space Research Organization (ISRO); International Center for Radio Science (ICRS) Jodhpur; Scanpoint Geomatics Limited, Ahmedabad and Radar System & Solutions, New Delhi.

The meeting was attended by nearly 70 participants from various institutions including an array of dignitaries from India and abroad. The prominent among them were:

1. Prof. Wolfgang-Martin Boerner (Univ. of Illinois at Chicago (USA) and IEEE-GRSS Asia-Pacific Liason)
2. Dr. Gerhard Koeing (President, ISPRS, Germany)
3. Dr. F.J. Behr (Stuttgart Univ. of Applied Sciences, Stuttgart, Germany)
4. Dr. Dietrich Schroder (Stuttgart Univ. of Applied Sciences, Stuttgart, Germany)
5. Prof. O.P.N. Calla (Chairman, IEEE-GRSS Delhi Chapter and Director, ICRS, Jodhpur)
6. Dr. Shiv Mohan (Chairman, IEEE-GRSS Gujarat Chapter and Visiting Scientist, PLANEX, PRL)
7. Dr. Ajai (Prof. Brahma Prakash Chair, SAC, ISRO)

Students, Researchers, Scientists, Faculty and executives from different institutions and industry were participated in the Meet. The institutional participation includes:

1. Space Applications Centre (ISRO), Ahmedabad
2. Indian Institute of Remote Sensing (ISRO), Dehradun
3. Physical Research Laboratory, Ahmedabad
4. CEPT University, Ahmedabad
5. University of Illinois, USA
6. University of Applied Science, Stuttgart, Germany
7. Italian National Research Council, Italy
8. International Centre for Radio Science, Jodhpur
9. Nirma University, Ahmedabad
10. Gujarat University, Ahmedabad
11. Pandit Deendayal Petroleum University, Gadhinagar
12. M.S. University, Vadodara
13. St. Xaviers' College, Ahmedabad
14. Anna University, Chennai
15. M.G. Science College, Ahmedabad
16. Indian Institute of Technology-Bombay, Mumbai
17. Indian Institute of Technology-Kharagpur,
18. Jawaharlal Nehru University, New Delhi
19. Dr. BAM University, Aurngabad, Maharashtra
20. Bangalore University, Bangalore
21. Indian Geomatics Research Institute, Ahmedabad
22. Nascent Info Technologies Pvt. Ltd., Ahmedabad
23. Scanpoint Geomatics Limited, Ahmedabad
24. Radar System & Solutions, New Delhi

The inaugural function of the International Experts meet on Microwave Remote sensing was held jointly with International Conference on Geospatial Momentum for Society and Environment (AGSE 2013). The

expert meet was started with plenary talk by Prof. W-M Boerner, the Guest of Honour and release of proceeding of the International Meet by the dignitaries. The expert meet provided the students, researchers, scientist and academicians an opportunity to interact with top leaders and experts of microwave remote sensing applications. There were total 10 invited talks on various aspects of Microwave Remote Sensing Applications for Earth and planetary sciences. In addition, ten contributory technical papers (07 on Earth sciences and 03 on planetary sciences) were presented. There were two presentations by corporate sector. The Expert Meet concluded with a high note to spread knowledge sharing through more such activities and developing IEEE-GRSS regional chapters.

Following are some of the important issues discussed in the meeting:

1. Availability of data and advanced technology to researchers
2. Common platform for Indian GRSS chapters
3. Organize regional workshop on specific theme.
4. Organization of training course at different level
5. Frequent Interaction with experts in the field of interest.
6. Wider coverage for popularizing the science and technology

Participants and Members of IEEE-GRSS International Experts Meet

Dignitaries Inaugurating joint session of AGSE'2013 and IEEE-GRSS International Experts Meet

Release of Proceeding of International Experts Meet at the joint inaugural session

Presentation of Technical Papers

Discussion during a Technical Session

Felicitation of the Guest speakers

Felicitation of Guest speaker

Panel Discussion on Microwave Remote Sensing applications for Earth Sciences

Cultural Evening at the end of Day 1

INTERVIEW SECTION

An Interview with Prof. W.M. Boerner

We were very fortunate to have Prof Wolfgang-Martin Boerner at Microwave Experts' Meet of GRSS during December 2013 at Ahmedabad amidst us. Prof Boerner is a renowned scientist, familiar to the entire Microwave Remote Sensing fraternity. Dr. Boerner is presently at the University of Illinois at Chicago, Department of Electrical Engineering and Computer Science, as Professor and Director of its Communications, Sensing & Imaging and Navigation Laboratory, where he serves now as Professor Emeritus and Distinguished Research Scientist. He is currently involved actively in international outreach programs in Europe, Oceania and Pacific Asia.

We had extremely interesting discussions on various aspects of Remote Sensing interspersed with his views on society and life in general during the IEEE GRSS Meet here in Ahmedabad. The Editor had difficulty in composing and copy-editing the text of the discussions. Prof Boerner came to our rescue by mailing us elaborate responses to our questions. We wish to reproduce them in our Newsletter in parts. The present issue carries the first part.

Q: 1 Microwave Sensors are seen to be increasingly used in Remote Sensing in research mode. Please throw some light on new microwave sensors in this and the coming decade.

A: 1 With the un-abating global population increase our natural resources are stressed as never before, and the global day/night monitoring of the terrestrial covers from the mesosphere to the lithosphere becomes all the more urgent. Microwave radar sensors are ideally suited for space imaging because those are almost weather independent, and microwaves propagate through the atmosphere with little deteriorating effects due to clouds, storms, rain, fog and haze. Globally humidity, haze, and cloudiness are increasing at a rather rapid pace, whereas only 20 years ago all of those covered only 48% of the globe, today those have increased to about 62% and within another 20 years may exceed 80% for irreversible reasons; thus optical remote sensing from space especially in the tropical and sub-tropical vegetated belts including India will become rather ineffective, and microwave remote sensing technology must now be advanced strongly and most rapidly because operationally it is more rapidly available especially for disaster mitigation assistance.

The basic radar technologies to do the job are the multimodal SAR sensors, first developed for air-borne sensing implemented as for example in 1978 with the first space-borne digital SeaSat SAR which enjoyed great popularity and implementation until these days. However, the NASA SeaSat L-Band SAR had severe limitations in that it was of fixed wide swath-width at a single arbitrary polarization (HH) and of rather poor 25m resolution. SeaSat SAR was followed by several non-polarimetric space SAR sensors such as the ESA ERS-1 (C-Band, 1991–2000), NASDA JERS-1 (L-Band, 1992–1998, CSA RadarSAT-1 (C-Band, 1995–ongoing), ESA ERS-2 (C-Band, 1995–ongoing) and the polarimetrically limited Dual-Pol ESA ENVISAT/ASAR (C-Band, 2002, 0ngoing).

In the meantime, fully polarimetric multi-modal high resolution SAR systems at multiple frequencies were introduced first with the multi-band AIRSAR of NASA-JPL culminating in the once-only pair of SIR-C/X-SAR shuttle missions of 1994 April and October, which laid the ground work for true day/night space remote sensing of the terrestrial barren and vegetated land and ocean covers using multi-band polarimetric SAR. Thereafter, NASA suspended further development of the basic need for further advancing airborne and space-borne multi-modal SAR imaging techniques except for the SRTM shuttle mission of 2000 February; swiftly the Canadian CCRS, the Danish EMI, the German DLR, the French ONERA and the Japanese NASDA & CRL {now JAXA & NICT} took over introducing and steadily advancing the Convair-580, the EMI-SAR, the E-SAR, the RAMSES and the Pi-SAR airborne highly advanced fully polarimetric sensors platforms, respectively.

Hitherto we were not able to carry out comparative assessments of the performance capabilities of fully polarimetric POLSAR sensors at various bands, which have now been made possible with the completion of the design and calibration of the newly configured airborne F-SAR replacing the once well performing airborne E-SAR which no longer satisfies international performance requirements. The F-SAR instrument is designed to operate fully polarimetrically at P-, L-, S-, C-, X-bands with a K_u-Band POLSAR to be added shortly. At all bands repeat-pass POLinSAR is standard, and single-pass polarimetric interferometric capabilities are available. Furthermore F-SAR makes possible simultaneous POLSAR image data acquisition at any three bands excluding S- and C- Band together at 12.5 km swath-width for maximum bandwidth. Whereas simultaneous polarimetric-interferometric POLSAR image data acquisition is operational since February 2012. Therewith we are now provided with a most essential multi-band fully polarimetric POLSAR test bed system for assessing vegetation and geo-physical scatterer types for different local regions spread over the entire globe. This added multi-frequency comparative POLSAR remote sensing capability for the P-, L-,-S-, C- and X-Bands is vital for determining the most suitable bands for remote sensing, especially in sub-tropical and tropical environments such as encountered in South, Southeast, East and Pacific Asia for which representative results using the F-SAR instrument hopefully within the near future.

These separate international Canadian, German and Japanese multi-modal fully polarimetric and also interferometric SAR developmental efforts culminated in a well coordinated group effort of these three independent teams eventually launching and operating Fully Polarimetric Satellite SAR Sensors at L- (ALOS-PALSAR launched by JAXA/Japan in 2006 January), at C- (RADARSAT-2 launched by CSA-MDA in 2007 December) and at X-Band (TerraSAR-X launched by DLR-Astrium in 2007 July). During the past twelve years the development of these satellite SAR sensors had been discussed during the annual IEEE IGARSS meetings, the bi-annual EUSAR conferences and were reviewed most recently in detail during the bi-annual ESA-ESRIN POLinSAR Workshop at Frascati, Italy (also see POLinSAR 2003, 2005, 2007, 2009, 2011, 2013), most recently during 2013 January 28 to 31, http://earth.esa.int/workshops/polinsar2013

The impressive images obtained, represented the greatest advancement in space remote sensing since the launch of the NASA/JPL Sea-Sat Mono-polarization SAR of thirty years ago. All of these three satellite sensors provide high-resolution images at close to or better than 1 meter, respectively, and are fully polarimetric in order to be able to differentiate next to shape and scatterer orientation also dielectric parameters of vegetated natural and/or man-made scatterers. Such detailed 3-D images cannot be achieved even with the most sensitive highest-resolution Mono-polarization SAR sensors as for example with Cosmo-Sky-Med or the SAR-Lupe, possessing only very limited or no polarimetric capabilities, respectively. Thus, it is now possible to provide high resolution accurate images and simultaneous in-situ characterization of the terrestrial vegetated overburden by implementing the three fully polarimetric Space-SAR sensors which is of direct use in agriculture, forestry, nature preservation and in coastal region fisheries, ocean surface mapping, and so on.

ALOS was launched on January 24, 2006, and far exceeded its design life of three years. During this, JAXA-EORC has conducted the science programs with all the principal investigators of ALOS research announcements, Cal/Val and science teams, Kyoto and Carbon Initiatives, etc. Four ALOS Science workshops were held successfully at the different places and achieved a lot of research results of highest performance satisfaction. ALOS has been playing important roles in the international community in many application fields. Although new data will not be available, the data already acquired but not released may contribute to earth science research and to promote earth observation practically and internationally.

Q: 2 What are the research challenges which are expected to be addressed by the scientific-academic community? Please enlighten us with a few examples, in short.

A: 2 Since the launch of ALOS-POLSAR in 2006, a large number of fully polarimetric (Quad-Pol.) data sets have been acquired from space. Although the fully polarimetric mode was hitherto an experimental one, it has provided us with precious data sets of various places spread over the planet earth. The total number of scenes exceeded more than 210,000 by March 2010. There exist various image analysis methods for quad-pol. The representative and fundamental methods are based on ensemble averaging of several pixels

bearing the second order statistics of polarimetric information: i) The HV basis imaging, ii) The Pauli basis imaging, iii) H-Alpha-Anisotropy imaging, and iv) Various Power decomposition imaging. The resulting three-component or four-component decomposition scheme decompose polarimetric data of imaging pixel area into surface scattering, double bounce scattering, volume scattering, and helix scattering components.

It turned out that the fully polarimetric ALOS-PALSAR L-Band image data sets were especially well suited together with implementation of the advanced Four-scatterer Decomposition methods introduced by Yamaguchi and co-workers for natural hazard detection and ensuing disaster assessment for both volcanic eruptions and very strong earthquakes and seaquakes generating disastrous tsunami such as the terrible 9.0 Off-Tohoku Coastline Seaquake of 2011 March 11 and the ensuing disastrous tsunami for which the fully polarimetric repeat-pass pairs are used

The TerraSAR-X originated from the German X-SAR experiment on the US/German Shuttle Imaging Radar Project (SIR-C/X-SAR). Being at that time the first high precision X-band SAR processor for a Space-Shuttle platform. The success of the SIR-C/X-SAR missions in 1994 led to the design of the SRTM, which then resulted in the for the development of the TerraSAR-X SAR processor, providing high resolution interferometric and polarimetric images mainly of urban scenarios. Based on the combined success of SRTM and of TerraSAR-X in a next step TanDEM-X was developed at DLR together with ASTRIUM.

T. TanDEM-X is characterized by numerous unique innovations and opens a new era in space-borne radar remote sensing. One example of its original accomplishments was the invention of the Helix satellite formation that forms now the basis for TanDEM-X formation flying. This formation, which combines orbits with different ascending nodes and eccentricities, has the advantage that it provides suitable interferometric baselines for global DEM generation such cross-track, along-track and bistatic-track, and that it enables at the same time safe formation flying without the need for autonomous formation control.

TanDEM-X is a highly innovative interferometric SAR mission that employs two formation flying satellites to generate a global DEM of the complete landmass of the Earth with unprecedented accuracy

Some of these new technique will be applied to and tested with the novel L – Band DESDynI/ Tandem-L mission with DLR operating one and JAXA the other of these two novel SAR satellite systems (where a similar reflector antenna technique had earlier on be proposed), marking the most remarkable, definite breakthrough since the advent of SeaSat in 1978; and this drastic advancement comes precisely at a time when it is now required more than ever before. It will now be possible to register instantaneously, characterize and provide measures for reducing catastrophes following such natural or manmade hazards like the volcano eruption of Pinatubo and more recently of Eyaflallajökul; the earthquakes in Sichuan province; the Irrawaddy floods of Myanmar; the rapid movement of the Antarctic glaciers, mudslides and Mega-cyclonic floods in the Philippines and major avalanches in the Alps; or the precise detection of oil-spills by tankers illegally cleaning their containers on open sea or of the catastrophic Gulf Oil Spill of April 2010, and the assessment of the sources of the recent tragic fires in SE-Victoria, Australia; urban sprawl all around the globe and with it wetland destruction; and so on.

Thus by avoiding such ridiculous sensor destruction, the next step in the advancement for true polarimetric-interferometric satellite imaging is the development of tandem POL-SAR-Satellite interferometer operations,

Here, a sincere word of caution is appropriate towards a sort of warning of short-sighted implementation of decrepit so-called Compact or Hybrid POLSAR sensor implementations which is most regressive and will cause serious destruction as well as stoppage of advancing fully polarimetric POL-IN-SAR sensor technology and associated image processing.

and because of the required baseline, it is at this state of satellite development not possible to place two SAR antennas with sufficient separation on one and the same platform (space, weight, data-transfer) which was possible for shuttle operation, especially with the extended parasitic antenna boom for SRTM. The first satellite tandem pair is that of DLR-Astrium launching the TerraSAR-Tandem X-Band (TanDEM-X) towards the end of 2009; to be followed by the ALOS-PALSAR-2 in summer of 2010 by forming the ALOS-

PALSAR-Tandem 1&2; and then to be complemented with the RADARSAT-3 by forming the RADARSAT-Tandem 2/3 in late 2010. In order to cover the total globe, all of these three satellites and/or pairs are operated in polar orbits with finite swath-width and such that every other orbit is shifted so that after a few days the entire globe is covered by connected image-swaths. The higher the resolution and the more complete the polarimetric scattering matrix acquisition becomes towards Quad-SAR operation, the smaller the swath-width because of the currently available antenna and electronic image data take limitations. For example, operating at only one polarization and with very low resolution of about $100m^2$ may allow a swath-width of about 400km similar to SeaSat, whereas for full Quad-Pol operation at highest resolution of less than $1m^2$ the swath-width my reduce well below 10 km, and make this mode impractical for continuously covering the terrestrial covers.

In essence, we have created a silent watchful microwave eye in space assisting us in analyzing our biosphere in which we live or in other words microwave remote sensors are becoming the radiological tools for providing input to the diagnosticists for assessing the health of Mother Earth. Without question, we will continue suffering from natural hazards, which are unavoidable as long life on Earth exists, but the resulting natural disasters are avoidable, and by discovering and assessing the hazards in time, will assist in mitigating the ensuing catastrophes due to these new fully polarimetric microwave SAR sensors more than ever before for the benefit of sustaining the health of the biosphere in which we reside. Furthermore, continual coverage of earth/sea-quake prone regions before and after major stress-releases with such high-resolution fully polarimetric and multi-band satellite SAR sensors will aid most effectively in disaster assessment and the identification of major impact regions such as have occurred recently at Chile, Christchurch, New Zealand and with the Off-Tohoku 2011 March 11 9.0 seaquake with ensuing tsunami in Japan. For these most recent tragic events some most impressive imagery will be shown next for the Christchurch, NZ also for the Off-Tohoku coastal devastations.

All of these past dreams of early almost instantaneous monitoring with implementation of near future tandem multi-band fully polarimetric POLSAR satellite and high-altitude sensors are now within our grasp, and are indeed disparately in need and required.

Q: 3 Many research sensors and concepts are likely to be promoted to the category of Operational civilian use. Which according to you are such potential sensors and concepts of this decade?

A: 3 YES, there are a great many SAR remote sensing sensors available today which may be gleaned at by visiting the pertinent websites of ESA, NASA, JAXA, CSA, and so on as well as ISRO, and many more. No further details are necessary in that those web-sites are self explanatory and rather complete.

Yet, as regards advancing the supreme method of remote sensing using microwave technology, fully polarimetric POL-IN-SAR sensors must be further developed such as the Canadian CSA/MDA RADARSAT-C-2, German DLR TerraSAR/TanDEM-X constellations, the Japanese JAXA ALOS-PALSAR-2, the DLR/JAXA DESTynI-L TanDEM constellation, and also most desirably a fully polarimetric Indian ISRO S-Band satellite sensor of the hopefully nearer future.

(To be continued)

ARTICLE CORNER

RADAR REMOTE SENSING FOR EARTH AND PLANETARY SCIENCE

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1.0 INTRODUCTION:

Remote sensing in microwave region of electromagnetic wave encompasses both active and passive sensing techniques. Microwave portion of the electromagnetic spectrum covers the range from approximately 1cm to 1m in wavelength. Because of their long wavelengths, compared to the visible and infrared, microwaves have special properties that are important for remote sensing. Due to long wavelength, microwave signal can penetrate through cloud cover, haze, dust and heavy rainfall. This property of microwaves helps in acquiring data in almost all weather and environmental conditions so that data can be collected at any time. Active microwave sensors provide their own source of microwave radiation to illuminate the target. Active microwave sensors are divided into two class namely imaging and non-imaging. Among imaging sensors, RADAR, an acronym for **RA**dio **D**etection **A**nd **R**anging, is generally used in different modes. The radar system transmits a microwave signal directing towards the region of interest and detects the signal backscattered by the surface. The strength of returned backscattered signal is a function of surface parameters like dielectric constant and surface roughness. Due to variability of these parameters, radar returns are different for different targets. The resolution is achieved by time delay and aperture synthesis technique. Radar altimeters, scatterometers and surface penetrating radar are in the class of non-imaging radar. In most cases these are profiling devices which take measurements in one linear dimension, as opposed to the two-dimensional representation of imaging sensors. Radar altimeters transmit short microwave pulses and measure the round trip time delay to targets to determine their distance from the sensor. Generally altimeters look straight down at nadir below the platform and thus measure height or elevation, sea surface height. Altimeter is radio wave allows information in subsurface region because of penetration of signal below the surface of a planet. Scatterometers are also generally non-imaging sensors and are used to make precise quantitative measurements of the amount of energy backscattered from targets. The amount of energy backscattered is dependent on the surface properties (roughness) and the angle at which the microwave energy strikes the target. Scatterometry measurements over ocean surfaces can be used to estimate wind speeds based on the sea surface roughness. Ground-based scatterometers are used extensively to accurately measure the backscatter from various targets in order to characterize different materials and surface types. Passive microwave sensors called radiometers, measures the emissive properties of the earth's surface. A microwave radiometer is a sensitive receiver capable of measuring low levels of emitted microwave radiations from the surfaces under observation.

An important extension to single-channel SAR remote sensing is the utilization of polarized waves. One special characteristic of SAR polarimetry is that it allows a discrimination of different types of scattering mechanisms. This becomes possible because the observed polarimetric signatures depend strongly on the actual scattering process. In comparison to conventional single-channel SAR, the inclusion of SAR polarimetry consequently can lead to a significant improvement in the quality of classification and segmentation results.

SAR interferometry is another new emerging tool that uses information on phase derived by recording the phase difference between two SAR images acquired from slightly different sensor positions. Different sensor positions, called the baseline, can be achieved by a temporal shift (repeat-pass interferometry) or spatial shift (also known as single-pass interferometry).

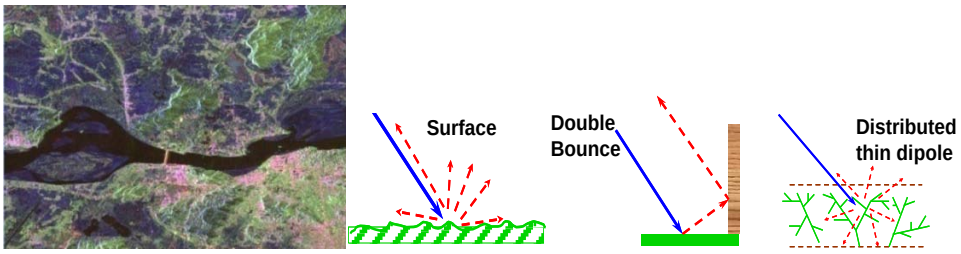


Fig.1: L-band polarimetric SAR decomposition over parts of Assam including various elements of scattering mechanism (B: surface, R: Double bounce, G: Volume).

The phases of the backscattered waves from the two positions are measured. The phase information of the two image data files is then superimposed and interference pattern is formed. The phase difference is related with the height of object through imaging geometry. The interferometric coherence or correlation is also a measure of the phase properties of SAR image pairs and indicates displacement and change of the scattering elements. Radar interferometry offers a unique means of mapping ground movements. Development of new techniques in this direction needs evaluation of Synthetic Aperture Radar (SAR) interferometry technique for Digital Elevation Model (DEM) generation and geological hazards assessment.

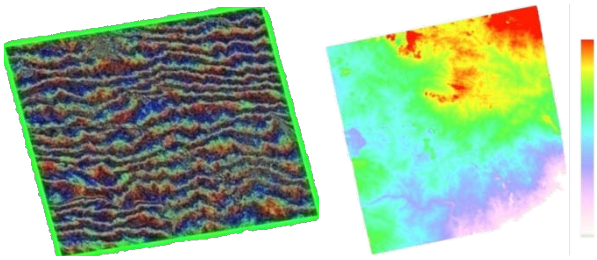


Fig 2: A typical SAR interferogramme over parts of Jharia and corresponding height variation from 117 to 319 m (Input: Radarsat data of 21st Nov and 15 Dec) 117 to 319m

2.0 APPLICATIONS:

AGRICULTURE:

The sensitivity of SAR to canopy geometry and moisture provide complementary information for crop growth models and condition assessment hence SAR has the potential to improve crop discrimination and parameter retrieval. Polarimetric and interferometric studies provide unique information on cropping pattern changes, agricultural land use and plantation conditions. In India, the major component of economy is agricultural crops. About 48% of the geographical area is under cultivation, which is highest in the world. Rice, wheat, sorghum, pearl, millet and maize are some of the important cereals. The other important crops are oil seeds (groundnut, rape seed/mustard), fiber crops (cotton, jute), cash crops (sugarcane, potato, tobacco) and horticultural crops like tea, coffee, mango, apple etc. The first systematic experiment on crop monitoring using microwave sensor was attempted by space applications centre and a systematic crop growth profile was observed (Fig 3). Subsequently, the profile was used for crop growth stage and crop monitoring. This has given thrust to radar remote sensing programme with emphasis on crop monitoring. The entire methodology of operational rice acreage estimation has been designed based on the Radarsat data. One SAR image at given frequency, polarization and incidence angle, is often inadequate to attain the required accuracy of classification. Improvements are expected by multi-temporal and/or multi-polarization and/or multi-angle SAR images. Experiments are conducted with different techniques, frequency, polarization etc.

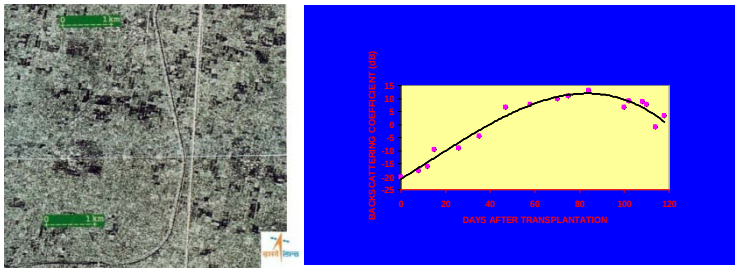


Fig 3(left) shows typical paddy fields at different growth stage). Fig 3 (right) shows a typical curve for radar backscatter at C-band.

SOIL MOISTURE:

SAR systems show a relatively high sensitivity to soil moisture due to the large contrast in the dielectric constants of dry and wet soils at microwave frequencies especially below 10 GHz. Much hope has been put in the capability of SAR to retrieve soil moisture. A shift in volumetric moisture content between approximately 2.5 to 50 per cent can cause a variation of 3 to 30 in relative dielectric constant and 8 to 9 dB rise in backscattering coefficient (depending upon frequency and soil texture) for vv polarization. Future research should be dedicated to refining the approaches that meet the requirements at field level. However, there are many obstacles yet to be overcome for a truly operational application for watershed management. Fig 4 shows soil moisture mapping of India's first large area mapping of soil moisture.

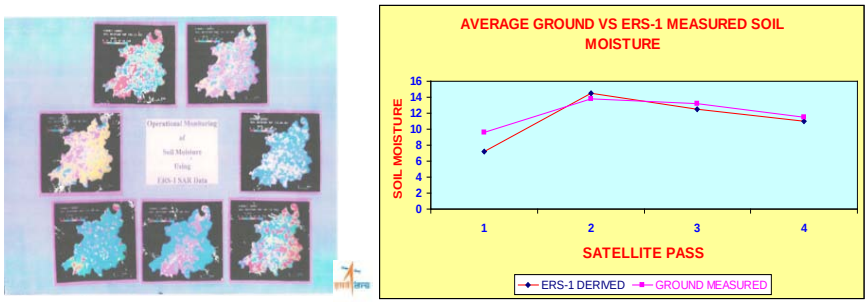


Fig 4: Temporal variation of soil moisture using ERS SAR data (Agra)

SNOW AND GLACIERS :

Snow is in general, a mixture of ice crystals, liquid water, and air. The ice crystals are deposited on the earth's surface as result of atmospheric precipitation or wind or mechanical deposition. If the snowpack is below 0º C, it is unlikely to contain any liquid water. This state is termed as dry snow. However at temperatures above 0º C, significant quantities of liquid water may also be present. This is called wet snow. Snow when metamorphosed to ice and slides down on the mountain slopes or in a valley becomes a glacier. Fig 5 shows an image of snow covered area.

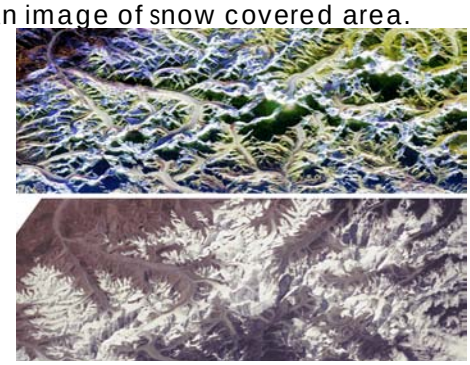


*Fig 5: Peak of mount Everest (8848 m) at centre of image(28 Degree N , 86.9 Degree E)(70 Km * 38 Km) R:Lhh,G:Lhv,B:Chv.Curving and branching feature of both images are Glaciers (blue, purple, red, yellow, white: due to variability in roughness and water content)*

FLOOD :

SAR has the potential to provide near real time wide area coverage required for flood event assessment and monitoring and delineation of flood hazard zone. Water surface reflects very little radiation back in the direction of the radar antenna, thus flooded areas and other water features can be easily distinguished from the surrounding land. SAR has the potential to provide near real time wide area coverage required for flood event assessment and monitoring and delineation of flood hazard zone. Water surface reflects very little radiation back in the direction of the radar antenna, thus flooded areas and other water features can be easily distinguished from the surrounding land. Several experiments on mapping of floods have been performed

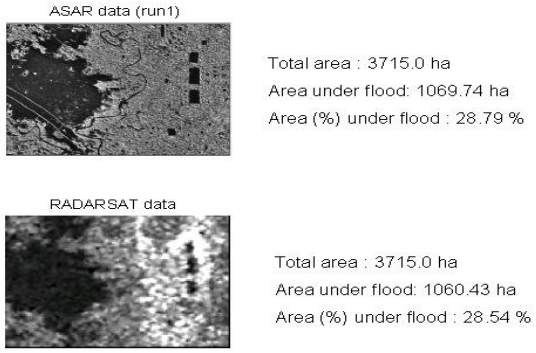


Fig 6: Typical signature of floods in SAR image (parts of Darbhanga)

FORESTRY :

The role of multi-frequency and multi-polarization SAR data in forestry applications has gained momentum in recent years with substantial amount of studies ranging from forest vegetation characterization to forest biophysical parameter retrieval. Most of these studies have demonstrated potential of P-, L- and C-band SAR in forestry applications. Microwave are sensitive to the roughness and physical geometry of forests This, when combined with the ability of microwave radiation to penetrate forest canopies results in a sensitivity of SAR backscatter to key biophysical variables such as tree density and above ground biomass). In India, various attempts have been made to establish the relationship between radar backscatter in C-, L- and P-bands and forest stand variables. (Tree height estimation in Tundi forest region, Jharkhand, India has also been attempted using SAR interferometric data). The study has demonstrated the potential of multi-date coherence SAR data for the estimation of canopy height in forest area.

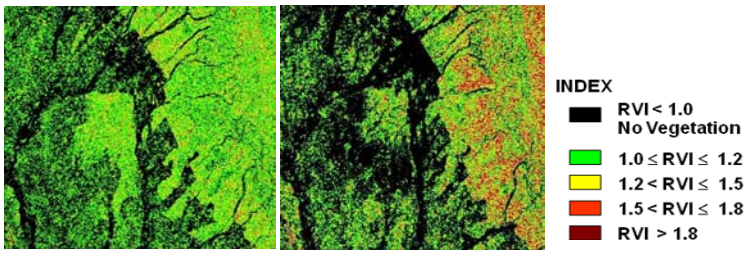


Fig7: C-and L-band SAR images over parts of Tarai region displaying radar vegetation index

GEOLOGY/ GEOMORPHOLOGY & LANDUSE :

Radar can penetrate the surface micro-layer in the soil-covered areas. Lineaments are extremely well manifested on SAR images, and on several occasions structural features; for example, fractures, folds, faults etc. have been detected, as well as extended in SAR imageries. Also, look angle and direction have a major impact on the response and manifestation of surfacial features in SAR imageries. Earlier results have shown that RADARSAT-1 C-band horizontally polarized images have been very useful for geomorphology, geological structures and rock units mapping. The SAR image is more effective than optical imagery for studying features such as surface roughness and topography. This is due to variation in radar backscatter as a function of wavelength (C-band, 5.6 cm), incident angle and polarization. Useful information on terrain morphology and surface relief (related to geological structure) is provided

by SAR imagery, due to effect of radar backscatter sensitivity to slope angle and to shadow effects caused by topographic relief.

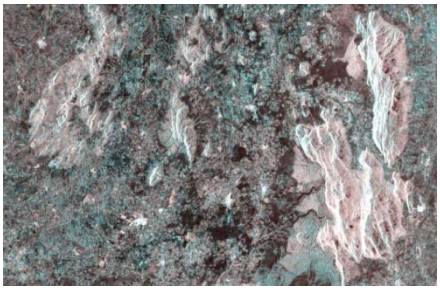


Fig 8: L-band SAR FCC showing Rocky Hills (Granite) over parts of Jalore Dist., Rajasthan (B: HH, G: HH, R: HH)

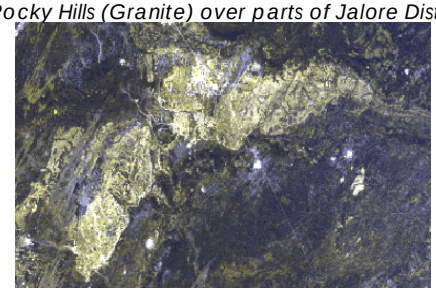


Fig 9: Sub- surface lime stone (bright color) at L-band near Ramgarh- Sanu region, Rajasthan

For various regional studies, radar scatterometer has shown some potential in monitoring the resources and its variability. Fig 10 shows regional microwave data derived from scatterometer at C-band.

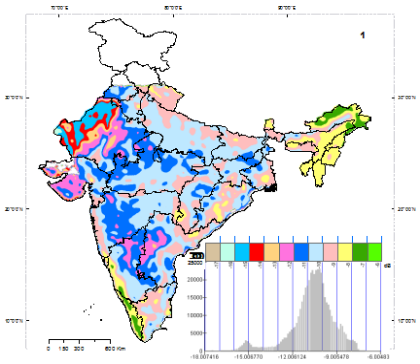


Fig 10: C-band scatterometer data for regional variability

PLANETARY SCIENCE :

Radar systems for planetary remote sensing had been used since early 1972 with the first altimeter in venera-8 for the measurements. Various planetary science experiments were conducted using radar instrument Venus was the first planet where radar sensors was used extensively because of thick atmosphere. The thick clouds of Venus are composed mostly of toxic carbon dioxide. The atmosphere of Venus is made up mainly of carbon dioxide, and thick clouds of sulfuric acid completely cover the planet. Pioneer provided first global height of lunar surface using altimeter data. Height of Venus surface was found to be -2 to 12 km. SAR images of whole Venus surface were acquired at resolution of 100 m. This helped in knowing many details of Venus surfaces. It was discovered that 85 percent of Venus surface is covered by Volcanic flow. Further, there is no water thus lacking in degradation. On Mars surface, there were two radars mainly for detecting sub surface buried ice. The two instruments namely Sharad (SHallow RADar) from NASA and MARSIS (Mars radar surface and ionosphere sounder). Both the instruments have detected a large area ice buries in north polar region of Mars. Cassini radar, capable of altimeteric and SAR mode of operation, provided detailed map of Titan (Moon of Saturn) and data of many other moons of Jupiter and planetary bodies.

For lunar surface studies, SELENE was the first sensor carried surface penetration radar for studying the subsurface structures below the surface of moon. The SELENE mission was launched by JAXA on 14th

Sept 2007 for the study of sub surface structure. The Lunar Radar Sounder (LRS) on-board the KAGUYA (Selene) lunar orbiter had provided data of subsurface stratification and tectonic features in the shallow part (several km deep) of the lunar crust, by using an FM/CW radar technique in HF (~5MHz) frequency range. Knowledge of the subsurface structure is crucial to better understanding, not only of the geologic history of the moon, but also of the moon's regional and global thermal history of the moon and of the origin of the Earth-Moon system.

SAR imaging of lunar surface was done first time by Channdrayaan-1 Mini SAR. The main purpose of instrument was to detect water ice signature in lunar polar region. Chandrayaan-1 was the first lunar orbital satellite carrying a SAR payload. The Mini-SAR was flown on Chandrayaan-1 mission on 22nd October 2008 with an objective to gather data on the scattering properties of terrain in the polar regions of the Moon. Additionally, the SAR was designed to collect information about the scattering properties of the permanently dark areas near the lunar poles at optimum viewing geometry, which are invisible to normal imaging sensors and thereby detect the presence of water ice in the permanently shadowed regions on the lunar poles up to a depth of a few meters. The Mini SAR sensor operated at S-band (2.38 GHz frequency) with transmission in left circular polarization (LCP) and reception in linear horizontal (H) and vertical (V) polarizations. The instrument illuminated the surface of moon at 35-degree incidence angle with a ground range resolution of 150 meter and 18 km range swath. Typical image strip consisted of approximately 300 km by 18 km size. Lunar surface properties at both polar and equatorial regions were investigated using data from the miniaturized synthetic aperture radar (Mini-SAR) onboard ISRO's Chandrayaan-1. The investigation showed that circular polarization ratio (CPR), which is an important parameter that represent scattering associated with planetary ice as well as dihedral reflection was anomalously high inside some of the craters in the polar regions. Other stokes parameters such as degree of polarization (m) and LH-LV relative phase (δ) also showed distinctly different types of scattering mechanisms inside and outside the craters on lunar surface. Fig 11 shows craters in south pole region indicating presence of water ice.

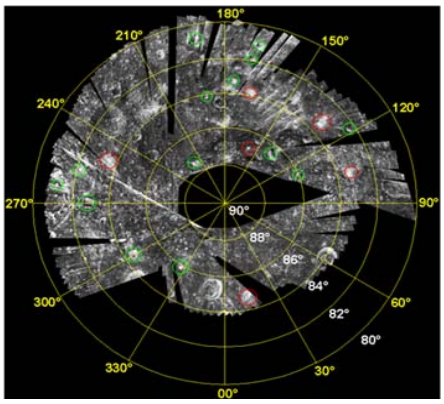


Fig 11: Lunar Craters in the south polar region: Green circle indicating presence of water ice

Lunar reconnaissance Orbiter (LRO) in 2009 also carried Mini-RF instrument is dual-polarized synthetic aperture radar, which transmits in circular polarization (left-hand polarization for both instruments) and receives two coherent orthogonal linear polarizations (H and V). LRO mission reconfirmed the availability of water ice in polar region of lunar surface. In order to further independently confirm such signatures, dual frequency SAR in Chandrayaan-2 is planned.

3.0 CONCLUSION:

In general, radar sensor has shown its potential for many of earth and planetary science applications. In most of cases, SAR has shown its utility for applications required to be done under cloudy conditions. For example, disaster monitoring, kharif crop monitoring and monitoring areas consistently covered under clouds. Unique applications like soil moisture and snow wetness monitoring have been attempted using region specific models. Research for forestry, Geology and land use has proven the unique role of radar sensors. For planetary surface studies, radar has shown its potential for the study related lunar water ice detection, buried ice in Jupiter, sub surface reflector mapping etc. In view of unique advantages, new mission definitions are being taken up for earth and planetary surface with added knowledge on interferometry and polarimetry.

Members Biographies

Dr. Shiv Mohan (Senior Member, 2013) – Chairman, IEEE-GRSS-Gujarat Section

He is a Visiting Scientist in PLANEX, Physical Research Laboratory and former Senior Scientist in Space Applications Centre (ISRO), Ahmedabad. He has pioneered the microwave remote sensing applications for terrestrial and lunar sciences in India. He had initiated multi-frequency based experiments using ground based scatterometer, X/C-band Airborne SAR, DM SAR, DLR E-SAR. He was also PI of several AO projects from ESA, JAXA, and ASI He was the Project Director of RISAT utilization programme of ISRO during 2009-2011. He is a recipient of ISRS National Remote Sensing Award (1995)

Dr Aishwarya Narain (Member 2013) – Vice Chairman, IEEE-GRSS-Gujarat Section

He is a Vice-President in Nascent Info Technologies Private Limited, Ahmedabad and former Senior Scientist in Space Applications Centre (ISRO), Ahmedabad. He had an illustrious career in SAC, ISRO during which he developed techniques for natural disaster mitigation using space-borne data and fishery forecasting using the thermal remote sensing data. Presently he is involved in organizing web-based applications in various domains like demography, power, hospitality and crime management using open source tools like Java and map services like WFS and WMS.

Dr-Eng. Anupam K. Singh (Member 2013) – Secretary, IEEE-GRSS-Gujarat Section

He is a Professor and Head of Department of Civil Engineering, Pandit Deendayal Petroleum University, Gandhinagar. He has over 23 years of professional experience in industry, research and academia. He is a staunch researcher and have research interest in the area of rainfall modeling and climate impact assessment, Urban flooding and storm water management, Rainfall-runoff process understanding, Coastal aquifer interaction, Remote sensing in water systems, and Planning and policy issues in water resources systems.

Dr. Anup Das (Member, 2013) – Treasurer, IEEE-GRSS-Gujarat Section

He is a Scientist /Engineer in Space Applications Centre (ISRO), Ahmedabad. His research interests include applications of SAR polarimetry and interferometry techniques for vegetation and land parameter retrieval, and radar observations of the Moon. He was a co-investigator of AO projects from JAXA, and ASI and presently he is a principal investigator of RISAT-utilization programme and Chandrayaan-1 Mini-SAR data analysis project. He is also a science team member for forthcoming lunar mission Chandrayaan-2 dual-frequency SAR and terrestrial mission NASA-ISRO dual-frequency SAR (NI-SAR).

Dr. Abhijit Sarkar (Member, 2013)

He is a freelance Science Writer / Consultant based in Ahmedabad. Earlier, he worked as a Senior Scientist at the Space Applications Centre, ISRO for thirty years He has been 'Prof Brahmprakash Scientist' at SAC during March 2010 - February 2012. He had been actively involved in the research activities on satellite oceanography and meteorology and held the position of Group Head of the Meteorology and Oceanography Group at SAC and Project Director of Oceansat Utilization programme. His research interests are in the applications of space-based microwave data for various societal and scientific objectives in the areas of oceanography and meteorology.

Mr. Arup Dasgupta (Senior Member)

He is the Honorary Managing Editor of GIS Development magazine and an Independent Director on the Board of Scanpoint Geomatics Ltd. He is also a Distinguished Professor of the Academy of Geoinformatics at the Bhaskaracharya Institute of Space Applications and Geoinformatics, Gandhinagar. He is M.E. in Electrical Communications Engineering from the Indian Institute of Science, Bangalore, India and has worked in the Space Applications Centre, Indian Space Research Organisation, Government of India, from November 1970 to March 2005. His areas of research interest include Spatial Data Infrastructure, Standards and Interoperability, Information Systems, GIS, Image Processing, Technology Transfer and Operationalisation of Space Applications. He is a Fellow of the Indian Society of Geomatics (ISG) and the Institution of Electronics and Telecommunications Engineers, India. He is a Senior Member of the Institute of Electrical and Electronic Engineers, Inc., USA and a member of several other professional societies.

Dr. G. Sandhya Kiran (Member, 2013)

She is a Professor in Botany Department, M.S University of Baroda, Vadodara. She has more than 20 years of teaching experience and so far, guided 7 doctoral students. Her research interests include Eco-Physiology, Geomatics, Ecology, Biodiversity conservation, Forestry, Agriculture, and Urban studies. She is recipient of several awards including Hardikar gold medal (1984) awarded by M.S University of Baroda, Boys Cast Fellowship (1995-96) awarded by DST and UGC Research award (2002-05) given by UGC.

Dr. Anjana Vyas (Member, 2013)

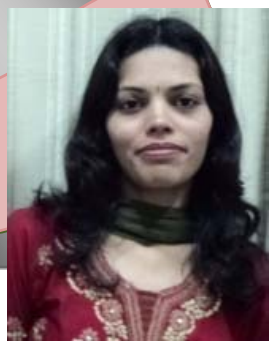
She is a Professor in Faculty of Planning and Public Policy & Programme Coordinator (Geomatics), Faculty of Technology, CEPT University, Ahmedabad. She was the Dean of Faculty of Geomatics and Space Applications, CEPT University from 2007 to January 2013. She hails more than 30 years of teaching and research experience in multidisciplinary field of Urban and Regional Planning, Urban Management and Governance, Remote Sensing and GIS. She is a guide and reviewer for several Ph D scholars & M Tech students. She is a life member of several international and national professional societies.

Dr. Alpana Shukla (Member, 2014)

She is an Associate Professor and Head of Department of Botany, M.G. Science Institute, Ahmedabad. She is a pioneer in grassland mapping using remote sensing technology. She has been responsible for popularizing activities related to dissemination of knowledge of Plant Sciences and Applications of Geomatics technology in various schools, colleges, NGOs and government Departments. Her areas of interest include Marine and Coastal Management, Soil moisture, Plant Ecosystems and Biodiversity Conservation.

Dr. Dipanwita Haldar (Member, 2013)

She is a Scientist /Engineer in Space Applications Centre (ISRO), Ahmedabad. She is involved in active research in Agriculture under various operational and research projects of ISRO predominantly in microwave remote sensing. She is co-investigator of the operational FASAL project and principal investigator of many FASAL R&D components. Her research interests include the study of biophysical parameters modeling of crops and relationships between backscatter, canopy structure and moisture in multi-parametric SAR.



Ms. Maneesha Gupta (Member, 2013)

She is a Scientist /Engineer in Space Applications Centre (ISRO), Ahmedabad. She is an excellent experimental Physicist who has synthesized and characterized various doped perovskite materials in bulk as well as in nano domain and tuned them for Cancer Treatment as a Biomedical Application. She initiated Quality Evaluation and Monitoring of Microwave SAR data. She has been involved in both Active (RISAT-1 and Scatterometer) and Passive (Meghatropiques) microwave projects. She has been involved in calibration and validation activities of Resourcesat-2 and RISAT-1 data. Her research interests include SAR polarimetric and interferometric data calibration, developing and designing Nano-materials for space applications. She is a Life member of IndianSociety of Remote Sensing (ISRS)and Indian Meteorological Society (IMSA).

Dr. Dharmendrakumar Govindlal Trivedi (Member, 2013)

He is an Associate Professor in Electronics and Physics Department in St. Xavier`s College, Ahmedabad. He started his carrier as a quality control inspector in steel factory. He also worked as an engineer in All India Radio and Doordarshan Centre (GOI) for maintenance and operation of electric and electronic instruments. He has presented and published a number of research papers in various National and International conferences and won several awards. He is life member of Indian Association of Physics Teachers. He is a reviewer for several national and international journals.

Mrs. Suchit Purohit (Member, 2013)

She is a Lecturer in the Department of Computer Science, Gujarat University, Ahmedabad. Presently, she is pursuing her Ph.D. from Department of Computer Science, Gujarat University. Her area of research is object recognition applied to planetary images. She has 13 years of teaching experience in computer science and she has been associated with several reputed academic institutes in Gujarat for teaching at under-graduate and post-graduate levels. She is a life member of Indian Society of Geomatics (ISG).

Mr. Nirzar Lakhia (Member, 2013)

He is the Director of Indian Geomatics Research Institute (IGRI), Ahmedabad. He has over 13 years of professional experience in Industry, Academia and Research. He started and coordinated Masters Level program in Geomatics at (SERI) Scanpoint Education Research Institute in 2007. He has been delivering lecture on Geomatics as a guest faculty to the graduate and post graduate students of CEPT University, Nirma University and DAIICT, Gandhinagar. Since 2004 he holds the position of an Empanelled Expert to several environmental Consultants in Land Use, Geology and Hydrology.

Mrs. Nilima Rani Chaube (Member, 2013)

She is a Scientist /Engineer in Space Applications Centre (ISRO), Ahmedabad. She has been responsible for developing algorithms for data products generation for Active (Scatterometer Oceansat-2, RISAT-1) and Passive (Multi Scanning Microwave Radiometer, MSMR onboard Oceansat-1) microwave sensors. Earlier She worked in the Institute for Plasma Research (IPR), Gandhinagar during 1993-1999 and was responsible for the design and development of multi-channel Superheterodyne Radiometer (60-75 GHz) for Electron Cyclotron Emission diagnostic of Aditya tokamak Plasma.

Dr. Saroj Maity (Member, 2013)

He is a Scientist /Engineer in Space Applications Centre (ISRO), Ahmedabad. His research interests include development of techniques for applications of polarimetric SAR data for crop monitoring, biophysical parameter retrieval and soil moisture estimation. He was investigator for AO projects of Envisat, Radarsat-2, ALOS-PALSAR and COSMO-SkyMed. Presently he is a principal investigator of RISAT-UP project.

Dr. Pravin Chaudhari (Member, 2013)

He is an Associate Professor in Electronics at Zulal Bhilajirao Patil College, Dhule, Maharashtra. He has more than 30 years of teaching experience at UG and PG level. His research interest includes dielectric properties of materials at microwave frequencies in X- and C-band regions. He has several publications in peer-reviewed Journals, National and International Conferences. He has worked as Chairman of Board of Studies in Electronics, Member of Academic Council and BUTR at North Maharashtra University, Jalgaon.

Dr. D.V. Ahire (Member, 2013)

He is an Associate Professor in Physics at Jai Hind Educational Trust's Z.B. Patil College, Dhule, Maharashtra. His research interest includes dielectric properties of materials at microwave frequencies in X- band and C-band and Atmospheric Physics. He has authored/co-authored 9 text books at degree level. He has received "Silver Jubilee Award" from the Indian Institute of Tropical Meteorology, Pune for the Year 1989 for best paper of the year. He is also a recipient of "Best Teacher Award" by North Maharashtra University, Jalgaon in 2012.

Dr. Panjabao Pawar (Member, 2013)

He is the Principal and Head of Electronics Department in Zulal Bhilajirao Patil College, Dhule, Maharashtra. He has more than 28 years of teaching experience at UG and PG level. His research interest includes material science i.e. thin films of group II, IV, V and VI elements and their application in solar cell and temperature sensors. He is a Management council member of North Maharashtra University, Jalgaon. He is also working as Chairman of Board of Studies in Electronics, Member of Academic Council and BUTR at North Maharashtra University, Jalgaon.

Dr. Parul Patel (Member, 2013)

She is a Professor in Civil Engineering Department, Institute of Technology, Nirma University, Ahmedabad. She has more than 23 years of teaching experience Her research interests include GIS and GPS applications, Surveying and Geodesy. At present she is associated with research project on "RISAT Calibration and validation and Soil Moisture Measurement" with SAC, ISRO, Ahmedabad. She has also carried out consultancy work in the field of surveying, GPS and GIS.

Dr. Ami Desai (Member, 2013)

She is a Post Doctoral Fellow in PLANEX, Physical Research Laboratory, Ahmedabad. She is currently involved in Mars and Lunar science projects. Earlier, she worked in the Space Applications Centre, ISRO as a research scholar and worked in various research projects dealing with optical as well as microwave data handling and analysis. She worked on national level projects related to "fluvio geomorphological studies of Brahmaputra and Ganga River" and obtained her Ph.D. degree on the same. She is a life member of the Indian Society of Remote Sensing (ISRS).

Mr. Sriram Saran (Student Member, 2013)

He is a Senior Research Fellow in Space Applications Centre (ISRO), Ahmedabad. He is actively involved in the radar observations of the Moon using both ground-based and orbital radar datasets. He has also dealt with the analysis of datasets from optical and Thermal Infrared sensors of various planetary missions. His research interests include investigation of scattering properties of the lunar surface, water-ice deposits at the lunar poles, and applications of SAR polarimetry and compact/hybrid polarimetry techniques over terrestrial and lunar surfaces. He is life member of Indian Society of Remote Sensing and Indian Society of Geomatics.

Mr. Ankit Vinod kumar Patel (Student Member)

He is currently pursuing B.E. degree in Electronics and Communication from LDRP-ITR, Gandhinagar (GTU). He received Diploma degree in Electronics and Communication from Government polytechnic, Ahmedabad (GTU) in 2008. He is student member of IEEE from last two years. For 2013, he works as IEEE LDRP Student Branch representative. He had organized many workshops, seminars, expert lecture and industrial visits under the IEEE banner. He works on different projects and also support to other students for projects. His work of interest is VLSI and EMBEDDED System. He is a recipient of IEEE Gujarat Section award (2013) for his outstanding contribution towards IEEE activities as a student volunteer.

IEEE-GRSS members' signing the petition

Upcoming Events

- **Distinguished Lecture Programme:** **29 Jan 2014**

  Dr. Lorrenzo Bruzzone
  Department of Information Science Engineering & Computer Science
  University of Trento
  Italy
- **National Remote Sensing Seminar- Gujarat Region**
- **One week Specialised Training Programme on Microwave Remote Sensing at Nirma University, Ahmedabad** **May 2014**
- **One Day Exposure Programme**
- **Technical Lectures**
- **International Training Programme**

Contact for Feedback & Queries

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January 2014

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March 2014

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