INVITED TALKS

Key note Speaker: DR. MOTOYUKI SATO, TOHOKU UNIVERSITY, SENDAI, JAPAN
TITLE: HUMANITARIAN DEMINING SENSOR ALIS AND ITS DEPLOYMENT IN CAMBODIA

Abstract

Conventional landmine detection depends on highly trained and focussed human operators manually sweeping 1m2 plots with a metal detector and listening for characteristic audio signals indicating the presence of AP landmines. We are in the process of developing a high-resolution landmine scanning system which produces horizontal slices of the shallow subsurface for visualization of buried explosives and inert clutter. As many AP mines contain minimum amounts of metal, metal detectors need to be combined with a complimentary subsurface imaging sensor. Ground Penetrating Radar (GPR) is widely accepted for subsurface sensing in the fields of geology, archaeology and utility detection. The demining application requires real-time imaging results with centimetre resolution in a highly portable package. The key requirement for sharp images of the subsurface is the precise tracking of the geophysical sensor(s) during data collection. We should also notice that GPR system is a very wide band radar system, and equivalent to UWB radar, which has recently been developed for short-range high-accuracy radar. We are currently testing a dual sensor ALIS which is a real-time sensor tracking system based on a CCD camera and image processing. In this paper we introduce the GPR systems which we have developed for detection of buried antipersonnel mines and small size explosives. ALIS has been deployed in Cambodia since 2009 and have been used for mine clearance in real mine fields. 2 sets of ALIS systems have detected more than 8 mines. We also report the current status of ALIS in Cambodia.

Invited Talk -01
SPEAKER: WOLFGANG-MARTIN BOERNER PROFESSOR EMERITUS, UNIVERSITY OF ILLINOIS AT CHICAGO, USA
TITLE: FUTURE PERSPECTIVES OF SAR POLARIMETRY WITH APPLICATIONS TO MULTIPARAMETER FULLY POLARIMETRIC POLSAR REMOTE SENSING

Abstract
Invited State-of-the Art Plenary Overview on *"Polarimetric and Multi-Parameter SAR Remote Sensing*"
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 litho-sphere 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 aerosol and haze. Globally humidity, haze and aerosols next to cloudiness are increasing at a rather rapid pace, whereas only 20 years ago all of those covered 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 is already and will become ever more ineffective, and microwave remote sensing technology must now be advanced strongly and most rapidly hand in hand with digital communications technology because operationally it is more rapidly available especially for disaster mitigation assistance.

The basic radar technologies to do the job at day and night are the multimodal Synthetic Aperture Radar (SAR) sensors, first developed for air-borne sensing implemented as for example in 1978 with the first space-borne digital Sea-Sat L-Band SAR which had severe limitations in that it was of fixed wide swath-width at a single arbitrary polarization (HH) and of rather poor 25m resolution. In the meantime, fully polarimetric multi-modal high resolution SAR systems at multiple frequencies and incidence angles 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, the Canadian CCRS, the German DLR and the Japanese NASDA & CRL {now JAXA & NICT} took over introducing and steadily advancing the Convair-580, the E-SAR (now F-SAR) and Pi-SAR airborne highly advanced fully polarimetric sensors platforms, respectively.

These separate international multi-modal fully polarimetric and also interferometric airborne SAR developmental efforts culminated in a well coordinated group effort of three independent teams eventually

launching and operating Fully Polarimetric Satellite SAR Sensors at L-Band (ALOS-PALSAR launched by JAXA/Japan in 2006 January – and to be followed by ALOS-PALSAR-2 &3); at C-Band (RADARSAT-2 launched by CSA-MDA in 2007 December – to be followed by independent RADARSAT-3&4) and at X-Band (TerraSAR-X launched by DLR-Astrium in 2007 July with the follow-on tandem mission TanDEM-X launched in June 2010) . Thus, international collaboration on advancing day & night global monitoring of the terrestrial covers was demonstrated with the launch of the three fully polarimetric multi-modal SAR Satellites at L-, C-, X-Band and its first tandem satellite-pair update of the DLR TanDEM-X. Recently NASA-JPL is joining these global efforts again, and all of these efforts will be topped by the near-future joint DLR-JPL DESDynI/Tandem-L wide-swath, high-resolution fully polarimetric sensor implementation.

Invited Talk-02
SPEAKER: DR. PETER CULL, ICT INTERNATIONAL PVT. LTD., AUSTRALIA
TITLE: RECENT TRENDS IN ENVIRONMENT, PLANT SCIENCE AND FORESTRY RESEARCH INSTRUMENTATION AND APPLICATION

Invited Talk -03
Speaker: DR. SVS MURTHY, PRL, AHMEDABAD
TITLE: EXPLORATION OF MOON: RESULTS FROM CHANDRAYAAN-1 AND PLANS AHEAD

Invited Talk -04
Speaker: DR. SHIV MOHAN, SAC , AHMEDABAD
TITLE: STUDY OF LUNAR SURFACE USING MINI-SAR DATA

Abstract
The exploration of lunar resources using Synthetic aperture radar data had been one of the important scientific investigations since the launch of Chandrayaan-1 in October 2008 and subsequently Lunar Reconnaissance Orbiter (LRO) in April 2009. These two missions contributed significantly in studying the scattering properties of the materials in the lunar Polar Regions, which was less explored previously.

Mini SAR data from Chandrayaan-1 was examined for determining RF properties of lunar surface and investigation in craters covering lunar polar and equatorial region. The sensor operates at S-band in hybrid polarimetric mode. Radar signal is transmitted in Left Circular polarization mode and received in both horizontal and vertical polarization. The SAR sensor illuminates the lunar surface at 35-degree incidence angle with spatial resolution of 150 meter and 18 km swath. Typical image strip consisted of approximately 300 km by 18 km size. Each pixel in the strip consisted of 16 byte data in four channel of 4 bytes each as $|LH|^2$, $|LV|^2$, Real (LH LV^*) and Imaginary (LH LV^*). This data was used for deriving stokes vector for each pixel. Several useful quantitative measure follows from stokes vector. Some of the quantitative measures are: degree of polarization (DOP, representative of polarized and diffuse scattering), Circular polarization ratio (CPR, representative of scattering associated with planetary ice and dihedral reflection) and relative phase (PPD), an indicator of double bounce scattering. The use of m-δ based decomposition technique to resolve the high CPR ambiguity due to ice-regolith volume scattering and dihedral reflections from surface rocks were also demonstrated.

Lunar polar mosaic of intensity and value added product like ratio, CPR etc was also prepared (Fig.1 a). The regions of probable existence of water-ice were identified using CPR and the results were compared with that obtained by NASA (Fig. 1b). In addition, the scattering characteristics of various morphological features in the non-polar regions of lunar surface were also studied using Mini-SAR data. Various surfaces were characterized and a database of backscattering and other related properties was created for equatorial region. In continuation of above for improved understanding of scattering from lunar regolith, simulation of radar backscatter from various surface and sub-surface conditions with or without inclusion of various proportions of buried rocks and water-ice using quantitative theoretical scattering model was also done. Co-polarized radar backscatter coefficients were calculated as a function of incidence angle, regolith thickness, surface and subsurface roughness, surface slope, abundance and shape of buried rocks, and the $FeO+TiO_2$ content of the regolith. Simulation results showed that the co-polarized radar backscatter at L- and S- bands are mostly dominated by scattering from the rough surface and buried rocks. In order to explore the expected radar signature of water-ice in the polar permanently shadowed areas, two lunar regolith models were considered and a lunar polar ice

detection index (LPDI) was developed. This method would be one of the approaches for water ice detection procedure using Mini SAR in Chandrayaan-2 mission.

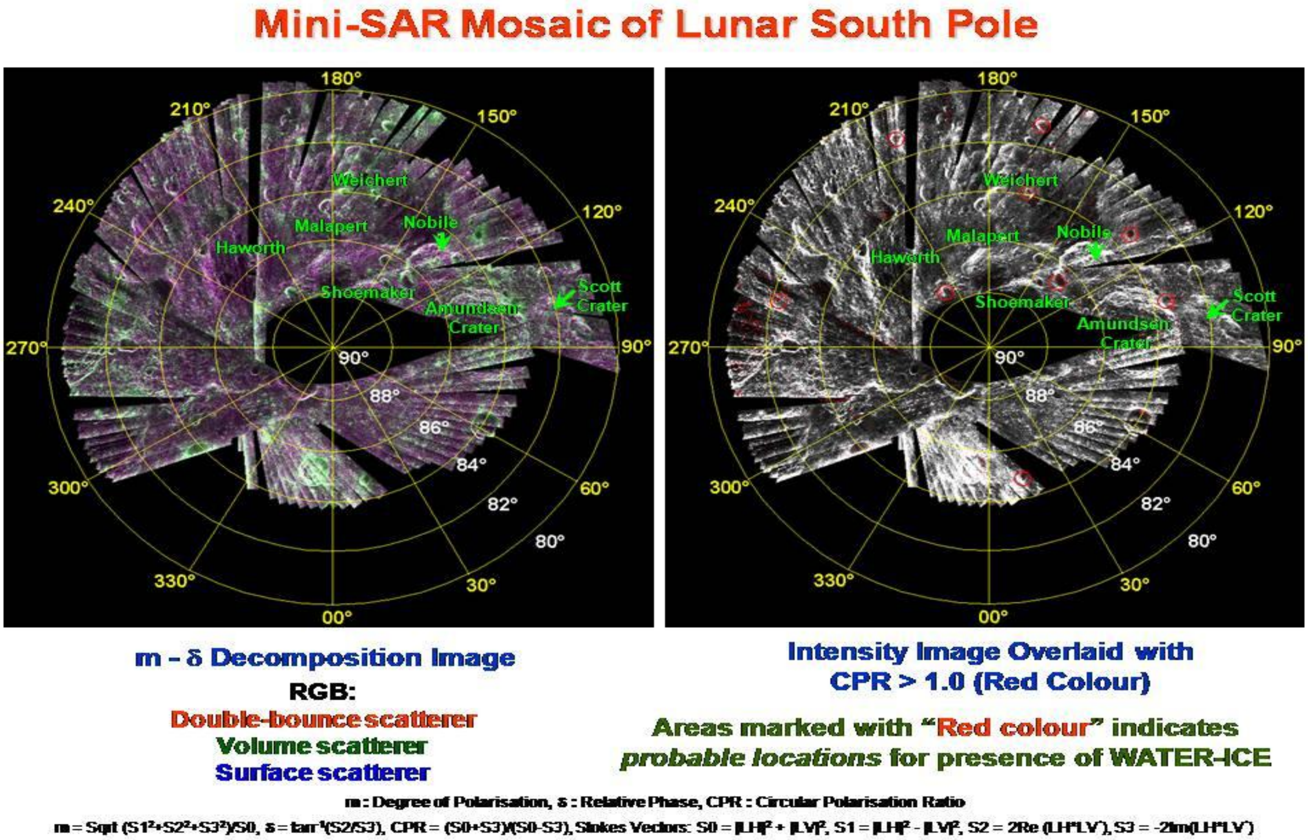

Fig 1: a) RGB of double bounce (R), Volume (G) and surface scattered (B)

b) Probable location of craters with expected water ice

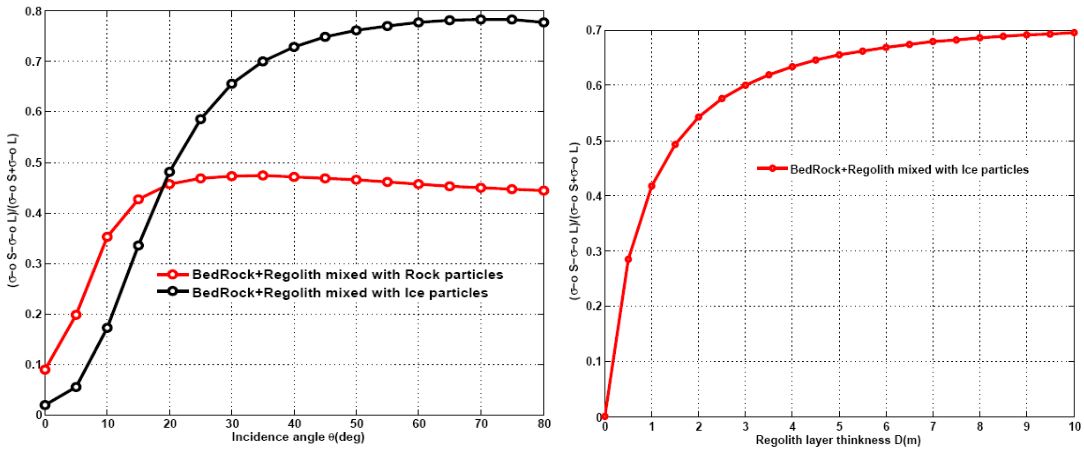

Fig 2 : a)Variation of LPDI as a function of incidence angle and b) regolith layer thickness

Invited Talk -05:
SPEAKER: DR. A.K. SINGH, LRDE, BANGALORE
TITLE: ACTIVE ELECTRONICALLY SCANNED ARRAYS: INDIAN PRESPECTIVE

Invited Talk -06:
SPEAKER: DR. MADHU CHANDRA, CHEMNITZ UNIVERSITY, GERMANY
TITLE: POLARIMETRIC WEATHER RADARS: FUTURE CHALLENGES

Invited Talk -07:
SPEAKER: DR. L. M. JOSHI, CEERI, PILANI
TITLE:HIGH POWER KLYSTRONS AND THEIR ROLE IN GREEN ENERGY GENERATION

Invited Talk -08:
SPEAKER: DR. SHIV MOHAN, SAC , AHMEDABAD
TITLE: RISAT UTILISATION PROGRAMME

Abstract

Synthetic aperture radar onboard Indian satellite mission is likely to be launched in early 2012 onboard Polar Satellite Launch Vehicle (PSLV) from Sriharikota, India. The satellite called radar imaging satellite (RISAT-1) would be carrying a Synthetic aperture radar payload operating at C-band in a variety on incidence angle, polarization and incidence angle. RISAT-1 will be a three axis body stabilized spacecraft to be placed into a near circular sun-synchronous orbit, at an altitude of 536 km with equatorial crossing time of around 6:00 am and 6:00 p.m. This orbit will have a revisit period of 25 days in nominal mode of operation. However, other modes of operation will allow systematic coverage with high repeat cycle up to 13 days. The satellite has many beam modes with swath varying from 10 km to 240 km. The SAR system is capable of providing data in single, dual and quad polarisation data acquisitions. Hybrid polarimetric data acquisition is one of the experimental modes of observation from this mission. Data users can have a choice of incidence angles and polarizations, resolution and swath. The SAR will operate in following basic modes: a) Fine Resolution Strip map Mode-2 (FRS-2): It provides single look 12 m resolution image over 30 km swath in quad or hybrid polarization. b) Medium Resolution ScanSAR Mode (MRS): It provides single look 25 m resolution image over swath of 120 km in either single, dual or hybrid polarization c) Coarse Resolution ScanSAR Mode (CRS): It provides two look 50 m resolution image over swath of 240 km in either single, dual or hybrid and d) High Resolution Spotlight Mode (HRS): It generates single look better than 2 m resolution image for a spot of 10 km (Azimuth) and 10 km (ground range swath) for either single or dual polarization.

The data from the satellite will be made available to the user community after necessary post-launch sensor characterization, which is expected to be completed within three to six months from the launch. The RISAT-1 utilisation programme (RISAT-UP) is dedicated for the development/demonstration of SAR based operational/ quasi-operational applications and development of techniques for the study of earth resources. The programme addresses the application development or demonstration based on experience in SAR remote sensing applications vis-à-vis Indian scenario. The application projects are grouped into ten themes namely agriculture, soil moisture, flood, forestry, snow/glaciers and polar science, topography and terrain, geology/geomorphology, environmental studies, oceanography and advanced techniques. Application themes have been further divided

into different categories like quasi-operational projects and technique development projects. These classifications have been done on the basis of our experience and maturity of the application in providing the expected information. As an example application like rice crop acreage, flood mapping etc constitute the quasi-operational class of projects. The projects, which require efforts for developing the technique in providing information, are being put under technique development project. Many of the application themes require large effort in understanding of the signal and its interpretation in terms of resources; therefore, such front research projects in microwave remote sensing have been grouped under advanced techniques development projects. This group of activity will mainly address application development from Hybrid polarimetric mode of operation of RISAT SAR, microwave signatures etc in which experience in terms of data analysis and information extraction has to be gained

At present, many projects pertaining to various applications have been defined. Projects are being executed by DOS centers in collaboration with various government departments and educational institutes. This provides a natural environment for the extension of users beyond DOS. Presently, about 70 organisations are taking part in this programme, In addition to above, there are four major activities namely SAR calibration, software development, Announcement of opportunity projects and capacity building, which form a major component of the programme. This presentation summarises the overall objective and plan of RISAT-UP. SAR calibration would be major activity during initial phase of the launch for charecterising the system and data. Announcement of opportunity projects for global users is likely to be released during early 2012. Under capacity building, about three to four training programmes are organized each year for catering the requirement of skilled manpower who would be handling the data. Till now, 212 scientists have been trained covering about 90 organisations spread over the country. Advanced training programme are also conducted advanced users of the data. The project expects a number of applications would be reaching to operational phase during the execution of the project. Major among them would be snow melt period assessment, crop inventory, flood etc. Advanced research would provide the approaches for handling hybrid polarimetry data and would provide expected accuracies and application potential for various themes.

Invited Talk -09:
SPEAKER: PROF. OPN CALLA, ICRS, JODHPUR
TITLE: MICROWAVE REMOTE SENSING USING ACTIVE SENSORS

Abstract

The electromagnetic spectrum has various windows which are used for different applications. For Microwave Remote Sensing the Microwaves which extend from 3 GHz to 30 GHz are used for different applications. There are two types of Sensors. They are passive sensors and active sensors. The imaging and non imaging passive sensors are the Radiometers. Where as the active sensors include side looking Radar (SLR) and synthetic Aperture Radar (SAR) are the imaging active sensors and Scatterometer, Altimeter are Non-imaging active sensors. The Active sensors operating are Microwave frequency band. Here the active sensors will be considered for different application on land, ocean and atmosphere. The land applications can be further subsided in soil moisture determination, flood mapping crop monitoring etc. these applications will be presented with Radarsat early 2012 and the proposed RISAT. Radar imaging satellite that will be launched.

In the talk the broad land, ocean and atmosphere application will be presented.

Land Application:

The spatial and temporal variation of soil moisture is of great importance for crop yield models, dry land farming, status of crop health, irrigation scheduling, etc. Microwave sensing is unique for soil moisture because of its penetration capability and because of the sensitivity of microwave energy to moisture.

Parameters of Land Applications

1. Soil Moisture Estimation
2. Crop Identification and condition assessment
3. Flood Mapping
4. Snow Mapping
5. Geological and Geomorphological Mapping
6. Forest cover and species identification
7. Urban land use / Land cover studies
8. Delineation of Hydrocarbon Bearing Structures

The active sensor RISAT operating at 5.3 GHz will provide wealth of information, but it will be better for India that ISRO should decide on series of such missions for land applications that could also be used for ocean and snow studies.

Invited Talk -10:
SPEAKER: DR V SRIVASTAVA, CEERI, PILANI
TITLE: HIGH EFFICIENCY HIGH LINEARITY MICROWAVE TUBES FOR COMMUNICATIONS

Abstract
Among high power microwave tubes, travelling-wave tubes (TWTs) and klystrons are used as high efficiency and high linearity broadband microwave amplifiers for TV & radio broadcasting, telecommunications, data transmission, multimedia applications (internet/HDTV), earth observation, navigation, and many scientific mission including deep space. But, TWTs are preferred over klystrons because of moderate output power requirements of few hundreds to kW output power for communications, and also, TWTs have large instantaneous bandwidth, high reliability, and small size and weight. At low frequencies up to C-band, and 100W of output power, Gallium Arsenide Field Effect Transistors (GaAs FET) are in competition with TWTs, but at higher frequencies and higher output power, TWTs are the only useful amplifiers for both space and terrestrial communications. For rapidly growing communications, advancements are being carried out for TWTs of higher and higher efficiency (>70%) with high linearity, small size and low weight in different frequency range from L-band to V-band. Microwave power module (MPM) is a new development for a compact amplifier that includes a combination of solid-state power amplifier and vacuum tube (TWT) amplifier.

For communications applications in multichannel power amplifiers (MCPAs), TWTs are required to have high linearity defined in terms of low intermodulation (I/M) distortion. Fig.1(a) shows two carriers of equal amplitude with 3rd order I/M products, and Fig.1(b) shows eight carriers of equal amplitude with 3rd order I/M products and 5th order I/M products. As shown in Fig.1(b), the I/M products are symmetrically decreasing away from the carriers, and these should be much less than 15dB below carrier.

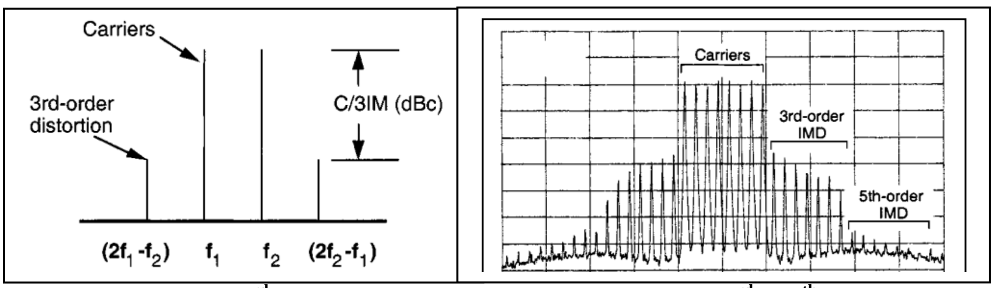

Fig.1: (a) 2 carriers with 3rd order I/M products, (b) 8 carriers with 3rd & 5th order I/M products

The linearity of the TWT can be greatly improved by operation of the tube significantly backed off from saturation and by optimization of the design of the helix circuit. Specially designed helix pitch profile and loss profile are used for improved linearity with high efficiency and high gain. Fig. 2(a) shows single tone output power and 2-tone I/M product power versus input power for saturation and 3-order interception point. Fig. 2(b) shows carrier to third-order intermodulation product level versus output power for a communication tube driven by 2 tones and by 8 tones. For two tone operation, intermodulation products are 10 to 20 dB below the carrier level, depending on the amount of back-off selected. However, operation backed off from saturation results in a greatly reduced efficiency of the TWT, which must be compensated by optimal circuit and collector design. A TWT of 60% efficiency at saturation may have an efficiency of over 45% at 6 dB back-off and only 30% at 10 dB back-off.

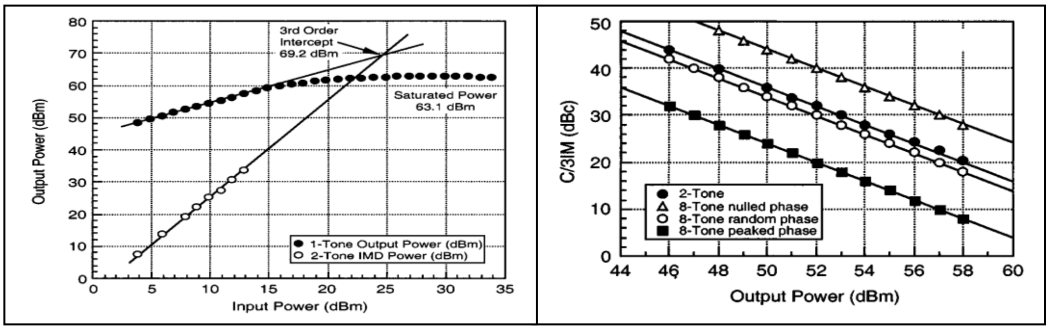

Fig.2: (a) 1-tone output power & 2-tone I/M power vs input power, (b) C/3IM vs output power

At CSIR-CEERI, Pilani, significant design and development work on high efficiency high linearity TWTs are going on in different frequency bands for satellite communication. Space TWTs in C-band for 3.6 to 4.2GHz, Ku-band for 10.9 to 11.7GHz, and Ka-band for 20.6 to 21.2GHz, have been designed with 4-stage depressed collector for TWT efficiency more than 60%, and high linearity (phase shift less than 30°, AM/PM factor <3deg./dB and intermodulation components <-10dBc). THz vacuum microelectronic devices for medical imaging and high speed communications are also being carried out. Vacuum microelectronic devices of output power even at 5-10W and at frequencies above 100GHz offer enormous applications for wide band communication, imaging radars, security, and many unexplored areas of scientific, industrial and medical applications. Such vacuum devices at frequency above 100GHz are very small in dimension and microelectronic technology is used for their fabrication. Successful development of THz vacuum microelectronic devices therefore needs fusion of vacuum tube technology with the semi-conductor technology. Significant efforts are being carried out to develop such compact vacuum devices.

CEERI designed C-band 60W space TWTA has been qualified by ISRO for space application. Desired RF and electrical specifications were achieved for C-band space TWT over an extended frequency range of 3.40 GHz to 4.20 GHz with an output power more than 60W, large-signal gain more than 50dB, overall efficiency more than 55%, AM/PM factor less than 4 degrees/dB, and harmonic components and intermodulation (I/M) components more than 12 dBc down. Agreements between the simulated and the experimental values of the output power, gain, efficiency, AM/PM factor, I/M products over the full frequency band have been achieved. Ku-band 140W short length TWT for MPM as required for satellite communication is under active development.

Invited Talk -11:
SPEAKER: DR S N JOSHI, CEERI, PILANI
TITLE: SLOW-WAVE VS FAST-WAVE MICROWAVE TUBES-INDIAN CONTEXT

Abstract

Microwave Tubes can generate or amplify rf signals over a wide frequency range of rf spectrum extending their availability even in the THz range. These devices got a major boost around World War II, when Magnetrons were extensively used by the British Army in their Radar System. Thereafter, new devices as well as new application areas cropped in extending their applications to other field like communication, biomedical, scientific research, heating industries etc. In addition to their applications in conventional areas, newer

application areas are emerging requiring very high power tubes extending to very high frequencies. These demands of user agencies have primary been possible to achieve by the tube designers due to many factors. These are (i) availability of sophisticated advanced CAD tools (ii) better understanding of analytical concepts (iii) advent of new materials including ceramics (iv) availability of high current density cathodes (v) advent of high energy magnets (vi) sophisticated manufacturing equipment and tools including micro fabrication technologies and (viii) better cooling technologies for efficient dissipation of thermal load.

Microwave Tubes can be briefly categorized in two types. One is the family of slow-wave devices, where an electron beam interacts with the slow rf waves propagating in the rf structure. The other category is the family of fast-wave devices, where a relativistic electron beam generated from a hollow cathode gyrates in presence of the magnetic field and interacts with the fast rf wave propagating in the waveguide type of cavity structure. Slow-wave devices like Magnetrons, Klystrons, TWTs, BWO's etc have limitation of power at higher frequencies, as the structure dimensions are directly related to the wavelength and due to small size at higher frequencies, they are not able to dissipate large power, restricting the available power from them. However, in the case of fast wave devices like Gyrotron, Gyro-klystron, Gyro-TWT, FEL etc, the restrictions on structural dimensions are less severe and due to that very large powers (1.0-2.0 MW CW/Long pulse) can be obtained up to very high frequencies (≈170 GHz). The most prominent device of the fast wave family is gyrotron, which have been developed up to 1.5 THz by Japanese.

India over the years has developed a strong design and development base in the case of slow-wave devices by perusing R&D at various centres. In this process, variety of devices have been successfully developed and are being used in various advanced systems including in the space sector. However, in the case of fast-wave devices, India has started the activities the quite late, though various other countries have been perusing their development for last few decades and have reached to an advanced stage. In India, a major programme has been launched with the support of Department of Science and Technology, New Delhi for design and development of a 42 GHz, 200 kW Gyrotron and is being executed as a multi-institutional project, with CEERI, Pilani acting as the Nodal Centre. Other participating agencies are IIT (R), Roorkee; IT, BHU, Varanasi; IPR, Gandhinagar and SAMEER, Mumbai. Similarly another programme has been initiated with the support of CSIR, New Delhi for design and development of 120 GHz, 1.0 MW (long pulse) Gyrotron. Institute for Plasma Research (IPR), Gandhinagar need such Gyrotrons for their SST and other programmes.

In addition to above, R&D of Gyro devices is also being undertaken at BHU, Varanasi; IIT (R), Roorkee and MTRDC, Bangalore. While MTRDC as well as IT,BHU have been associated with design and technology development of Gyro TWTs, IIT (R) have been working in the design of various Gyrotrons in collaboration with KIT, Germany.

Though fast-wave devices can meet the need of high power up to very high frequencies, even then, for certain applications in various sectors, slow-wave devices will remain in demand up to the foreseeable future. CEERI and other agencies are working continuously to further enhance the capabilities of these slow-wave devices. In addition, efforts are also being made to work for new concepts and devices including the area of vacuum microelectronics.

Invited Talk -12:
SPEAKER: DR. OS LAMBA, CEERI, PILANI
TITLE: DESIGN AND DEVELOPMENT ASPECTS OF 250 KW C-BAND HIGH POWER KLYSTRON

Abstract
Klystron is vacuum electron device operating in microwave range of frequencies. It is used as power amplifier in a variety of systems including radars, particle accelerators and thermonuclear reactors. With the availability of very reliable design codes, it is now possible to optimize the design and develop a tube with minimum iterations in fabrication. In the present case standard design codes like EGUN, CST Microwave Studio, AJDISK and MAGIC have been used to estimate and optimize different design parameters of klystron for desired tube performance. The paper presents the results of simulation and cold testing of 250 kW CW C-Band klystron with specifications as given in Table1 is under development at CEERI, Pilani,. The proposed klystron to be used as a RF source for ITER program.

Table1 Specifications of 5GHz klystron

Parameters	Specification
Operating frequency	5 GHz
Output power	250 kW, CW
Beam voltage	60 kV
Beam current	10 A
No. of cavities	6
Efficiency	>40%
Gain	>40dB

Invited Talk -13:
SPEAKER: DR. M RAVICHANDRAN, INCOIS, HYDERABAD
TITLE: RECENT SEA LEVEL TREND IN THE INDIAN OCEAN REVEALED FROM ARGO, ALTIMETRY AND GRACE

Invited Talk -14:
SPEAKER: PROF. OPN CALLA, ICRS, JODHPUR
TITLE: APPLICATION OF SMOS SATELLITE FOR STUDIES OF SNOW

Abstract
The SMOS Satellite carries MIRAS Radiometer operating at 1.4 GHz. This radiometer will give Brightness temperature (T_B) of the target surfaces. The snow covered areas will have different brightness temperature as compared to land or ocean. This is due to the fact that there is difference in dielectric constant of land, ocean and SNOW. The dry SNOW and wet Snow will have different é and this will Depew upon the wetness of SNOW. Due to different Є' the T_B will be different and so the variability of water content in the snow can be obtained. The extent of SNOW and delineation of SNOW-land bound and SNOW-water can be done using SMOS data. Thus using SMOS one can improve the characterization of the ice and SNOW this will help in study of glaciology. The changes are extent of ice could be measured. The Himalayan SNOW and seasonal variation will be studies. The SNOW water equivalent is Himalayan Snow can be studied using SMOS data. The data from other satellites like SMAP and Aquarius will be used for comparison the dielectric constant variability will be used for estimating SNOW Parameters using existing models. The data from SMOS and AMSRE could be used for comparison. The maps of SNOW covered areas will be generated. If possible the maps indicating the wetness of SNOW could be generated. Thus this application of SMOS will give the Veracity of the application of SMOS.

Invited Talk -15:
SPEAKER: DR. AK GWAL, SSL, BHOPAL
TITLE: STUDY OF THERMAL ANOMALIES ASSOCIATED WITH THE HAITI EARTHQUAKE OF JANUARY 12,2010 BY USING REMOTE SENSING TECHNIQUE

Abstract
By using thermal remote sensing technology we understand the earth's surface temperature distribution and its relationship with seismic activity. Satellite and ground based measurements of earth surface temperature may be provide the vulnerable information related to earthquake. On Tuesday, January 12, 2010 at 21:53:10 UTC a 7.0 magnitude earthquake strucked Haiti at a depth of 13 km. The epicenter was located 24 km from WSW of Port-Au-Prince, since then there have been 59 aftershocks observed so far. The effect of aftershocks is very strong; it ranged mainly from 4.2 to 5.9 magnitudes. The exact epicenter of the earthquake in Haiti was located at 18.443°N, 72.571°W. Haiti lies just to the south of the boundary between Caribbean and North American plates, Fig 1 illustrate that due to left lateral strike slip faulting on the Enriquillo- Plantain Garden fault system might be

responsible for disastrous Haiti earthquake. The Comprehensive Large Array-data Stewardship System (CLASS) is an electronic library of NOAA environmental data. It provides the SST data with spatial resolution of 100 km, CLASS is NOAA's premiere on-line facility to derive Polar-orbiting Operational Environmental Satellite (POES) data, and NOAA's Geostationary Operational Environmental Satellite (GOES) data. Advanced Very High Resolution Radiometer (AVHRR) instruments can observe the infrared signals with pixel resolution of 1×1 degree. On the basis of ground based technique, here we takeone metrological station just 31 km away from earthquake epicenter and it's provides many climatologically parameters. Presently we observed three years LST and maximum wind speed in the month of January. Simultaneously, we observed the three year SST data derived from the NOAA satellite, the SST point 164 km away from the epicenter. SST point comes under the radius of earthquake preparation zone. On the basis of LST and SST, we observed thermal anomalies by using special statistical technique and normalized the temperature data by standard deviation. On the basis of three year data of SST in the month of January, and LST during the month of earthquake, we find out the relation between SST and LST data under the influence of seismic activity. When we look at Fig 2 (a) red color line shows that increase in SST during the month of earthquake, SST of corresponding years indicates by blue and green lines. Clearly red line shows the anomalous nature of SST during the month of earthquake. But when we look at Fig 2(b), LST suddenly goes down just before the earthquake. The red line had shown the linear trend of LST, depletion (decrease) in LST will shown that the effects might be a seismogenic. At the same time maximum wind speed is also observed and shown in Fig 3 (a), we observed two prominent peaks just before and after the earthquake. Finally in Fig 3(b), definite enhancement in thermal anomaly shown the strong aftershocks effects. Finally, on the basis of observation we concluded that SST and LST data may provide strong relationship between surface temperature and earthquake. Increases in SST during the month of earthquake shown the large thermal flux deposited from the earth's crust in seismically active areas. Temperature reflects the thermal anomalies within the area of earthquake preparation zone, thermal anomalies showed the strong aftershocks effects. Above results indicate the lithosphere atmosphere coupling for seismo-electromagnetic phenomena. Surrounding surface temperature at the time of earthquake might be produced valuable information before and after the main-shocks.

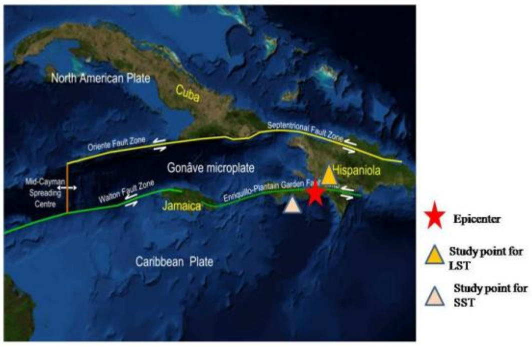

Fig 1

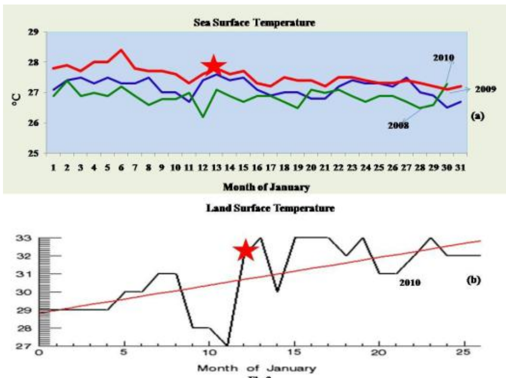

Fig 2

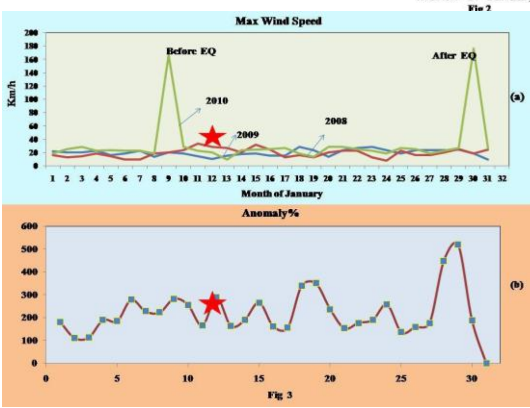

Fig 3

Invited Talk -17:
SPEAKER: PROF J P BANERJEE, INSTITUTE OF RADIO PHYSICS AND ELECTRONICS, UNIVERSITY OF CALCUTTA
TITLE: TERAHERTZ SOLID STATE SOURCES FOR TERRESTRIAL COMMUNICATION

Abstract
The Terahertz region of the electromagnetic spectrum popularly known as "THz gap" lies in between the traditional millimeter wave and optical bands in the frequency range of 0.1-10 THz and wavelength range of 3 mm to 0.03 mm. The generation of terahertz signal with appreciable power is a challenging area of research. In recent years the research and development of suitable solid state sources capable of generating high power in the Terahertz frequency regime (0.1-10THz) are underway throughout the world due to their important applications in different fields such as short range terrestrial and airborne communication, space based communication, bio-imaging, sensor and spectroscopy. Some THz sources such as electron beam sources, optically pumped far-infrared gas lasers, Semiconductor Quantum Cascade Lasers (QCL), Resonant Tunneling Diode (RTD), TUNNETT diode, Gunn diode etc. are reported in the literature. But these sources have several limitations as regards their compactness, cost, output power and efficiency. All these limitations can be overcome if IMPATT diodes are used as THz sources.

This has prompted the author and his co-workers to explore the potentiality of IMPATT devices as compact, low cost, efficient and powerful solid state sources at THz frequency band. IMPATT diodes have been practically realized at mm-wave and sub mm-wave bands. But scarcely any effort has been made to develop this source for operation at THz frequencies. With this objective in view the author and his research group in the Institute of Radio Physics and Electronics, University of Calcutta recently carried out modeling and design of Double Drift IMPATT diodes based on Si, 4H-SiC, GaN and InP as high power and high efficiency sources in the frequency band of 0.3 to 0.5 THz. The design is based on simulation of the dc and high frequency properties and performance of the device at THz frequency band. Various physical effects such as tunneling, diffusion, space charge at high bias current level, elevated junction temperature, parasitic series resistance and package resistance have been considered in the simulation program. The talk will cover the design methodology and the results obtained as regards the power and efficiency of the device. The author and his group have reported [1] that GaN DDR IMPATTS can deliver higher power (6.23 W) than its InP counterpart (2.81 W) at 0.3 THz .The effect of tunnel current on the DC and dynamic properties of DDR THz Si device in IMPATT and MITATT modes has been studied at 0.3 and 0.48 THz respectively. The results [2] show that the efficiency and output power density of IMPATT diode are 6.55% and $0.14 W/m^2$ while those of MITATT diode are 5.89% and $0.12 W/m^2$ respectively.

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[1]. "A Comparative Study On Indium Phosphide and α-Gallium Nitride based IMPATT oscillators for Terahertz Communication", Jayanta Mukhopadhyay, Soumen Banerjee, Moumita Mukherjee and **J.P.Banerjee**, Journal of Telecommunication, Vol.3, Issue 1, pp. 14-21 ,(2010).

[2]. "Influence of Tunnel Current on DC and Dynamic Properties of Silicon Based Terahertz IMPATT Source", Aritra Acharyya, M. Mukherjee and **J. P. Banerjee**, Terahertz Science Technology, vol. 4, no. 1, pp. 26-41, March,(2011).

Invited Talk -18:
SPEAKER: DR. ANJALI BHATIA, DLJ, JODHPUR
TITLE: RADAR CROSS-SECTION IMAGING

Invited Talk -19:
SPEAKER: DR ANIMESH MAITRA, INSTITUTE OF RADIO PHYSICS AND ELECTRONICS, UNIVERSITY OF CALCUTTA
TITLE: MICROWAVE SENSING OF ATMOSPHERE AT A TROPICAL LOCATION

Abstract

The tropical atmosphere is complex and much varying in nature compared to temperate region. The sensing of tropical atmosphere requires a variety of devices that operates at different wavelengths. The use of microwave techniques is proven to yield very valuable data on atmospheric phenomena because of its inherent advantages of the appropriate interactions with the different constituents of the atmosphere namely, rain, cloud, water vapour, atmospheric turbulence. Also, the study of the response of the atmosphere to microwave propagation generates valuable information that helps to assess the propagation effects for microwave communication links for both terrestrial and satellite paths.

At the University of Calcutta, a fairly extensive experimental set up has been in operation since June 2004. A number of microwave systems are included, namely: (i) Ku-band earth-space propagation system which can measure rain induced effects such as, attenuation, depolarization and scintillation. (ii) Micro Rain Radar (MRR) at Ka-band to study the vertical profile of rainfall parameters such as, drop size distribution (DSD), rain rate, radar reflectivity factor. (iii) Multiwavelength Microwave Radiometer to obtain the height profile of temperature and humidity, integrated water vapour content (IWV), liquid water content (LWC), cloud base height. (iv) Dual Frequency GPS receiver to study the integrated water vapour content.

Besides the microwave based systems, a set of other equipment is also running at the same location which includes: (i) Optical Raingauge (ORG), (ii) Tipping Bucket Raingauge, (iii) Joss-Waldvogel Disdrometer, (iv) Automatic Weather Station.

The interesting features of tropical atmosphere are revealed through the above mentioned microwave sensing of the phenomena. The rain attenuation and scintillations of Ku-band signal are often observed concurrently indicating that raining medium generates eddies that give rise to turbulence causing scintillations. The scintillation variance increases with attenuation up to a certain value after that scintillation intensity decreases as the large rain drops inhibits the turbulences causing a decrease in scintillation variance. The anisotropy of the propagation medium caused by spheroidal raindrops is responsible for the depolarization of the satellite signal. However, the differential phase, mainly responsible for depolarization, is mostly caused by large rain drops and, therefore, depends on DSD of raindrops.

MRR has been used to study the evolution of rain types in different phases of rain events. This monitoring of rain type is very effective in identifying the convective and stratiform phase and studying the associated physical phenomena such as, atmospheric turbulence and rain height.

Microwave radiometer provides a co-ordinated measurement of a host of atmospheric parameters. Radiometric observations on the vertical transport of water vapour, short term and long term variation of IWV and LWC, behaviour of cloud base height during convective processes, are very valuable in studying the tropical atmosphere.

The water vapour measurement with a ground based dual frequency GPS receiver provides an all-weather means to study the behaviour of water vapour which is not available with the radiometric and radiosonde measurements. The GPS measurements in the tropical region need to be compared with other measurements to establish the robustness of the GPS sensing of the atmosphere under high humid conditions.

Invited Talk -20:
SPEAKER: DR. P D LELE, PHYSICS DEPARTMENT, GUJARAT UNIVERSITY, AHMEDABAD
TITLE: SARAL SATELLITE AND EXPERIMENTS PLANNED

Abstract

SARAL-ALTIKA is a collaborative ISRO-CNES Program. The orbit of SARAL-ALTIKA is Sun-synchronous. It is polar orbiting, inclined at 98.38 Deg. & Altitude is ~800 km. The Repeat cycle is 35 days. The Pulse Repetition Frequency (PRF) is also high of the order of 4 KHz.

This SARAL Satellite is planned to be launched in March 2012. It will contain payloads which have following experiments:

1. Ka-band altimeter of frequency 35.5 GHz.
2. DORIS (Doppler Orbitography and radio positioning Integrated by Satellite) as receiver.
3. Laser Retro-reflector Array for POD (Perfect Orbit Determination).
4. Dual frequency radiometer of frequencies 23.8 GHz & 36.8 GHz.

AltiKa/SARAL program is a follow-on mission to RA-2/ENVISAT, with enhanced capabilities. It will allow data continuity between ENVISAT Jason1&2. Ocean meso-scale variability studies with an improvement of vertical and spatial resolution is possible with this mission. It will give high resolution altimetry for the better results.

Ka-band will enable better observation of ice, rain, coastal zones, wave heights, Sea surface height, geotropic currents, Marine Geoids & Study of the inland water.

AltiKa/SARAL data will be use for Operational oceanography, Coastal altimetry, Continental waters, Inland ice sheet monitoring, mean sea level, Sea state observation and forecasting.

Invited Talk -21:
SPEAKER: DR. AK SINHA, CEERI, PILANI
TITLE: DEVELOPMENT STATUS OF AN INDIAN GYROTRON

Abstract
Gyrotron, a high power, high frequency microwave tube, is continuously expanding its application domains throughout the world due to its sustained performance improvement in various fields covering plasma generation, energy production, material processing, human health, etc. A number of gyrotrons have been built up in various countries such USA, Russia, Germany, Japan, etc. And, now, India is also entered in this very specialised field of fast-wave microwave tubes. In this direction, Gyrotron has been recognized as an active activity through a "Multi-institutional" Project Sponsored by Department of Science and Technology. The participating institutes in this activity are CEERI-Pilani, IPR-Gandhinagar, BHU-Varanasi, SAMEER-Mumbai and IIT-Roorkee. The aim of this activity is to establish an indigenous design and development base of an Indian Gyrotron in general and 42 GHz, 200 kW gyrotron in particular. Present status is that the indigenous design base is established and development stage is in progress. First gyrotron gun namely magnetron injection gun is successfully fabricated and vacuum processed with the help of BEL, Bangalore. The complexity of MIG lies in its structure having a large number of piece parts of different types such as special vacuum grade metals, ceramics as well as cathode. The interaction structure named as cavity made of OFHC copper is also ready with the desired experimental eigen frequency and quality factor results. The fabrication of other components such as beam tunnel, nonlinear taper, collector, etc. are also in good progress. Besides the 42 GHz gyrotron, the activity around 120 GHz, 1 MW gyrotron is also in progress at CEERI under CSIR-Network scheme. The talk covers the present status of gyrotron research in general and development status of Indian gyrotron in particular related to both 42 GHz, 200 kW and 120 GHz, 1 MW gyrotron. The talk also includes design and development methodology, infrastructure for design and characterization of gyrotron and scope for further research.

Invited Talk -22:
SPEAKER: DR. T. TIWARI, SAMEER, MUMBAI
TITLE: DESIGN AND DEVELOPMENT OF HIGH ENERGY LINAC SYSTEM