

Design and development of cassegrain antenna with wide and narrow coverage

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Abstract : A single antenna that can realize the performance of contradictory requirements of wide and narrow coverage over a band of frequency is to be designed. A novel technique of axial defocused cassegrain antenna system is presented in this paper with wide and narrow beam coverage. Antenna fabrication and testing is presented. A comparison of simulated and tested results is also presented.

Keywords : Cassegrain antenna.

PACS No. : 84.40.Ba

Radiating aperture on cylindrical surfaces for end fire applications

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Abstract : This paper describes an aperture type antenna mounted on cylindrical structure for end fire application. This type of structure is suitable for command links with ground from space-crafts and command guided weapons. This polarization of the antenna is perpendicular to the cylindrical surface. There is not much change in H-plane pattern. For E-plane calculations, an equivalent monopole is replaced for the antenna. Uniform theory of diffraction is used to calculate radiation patterns of the antenna in lit and shadow zones. For calculations an infinite length of the cylinder is considered. However, for measurements limited length of the cylinder is taken which is dictated by the quiet zone of the antenna test facility. Measurements are carried out in E-plane, and intermediate cuts of interests. The experimental and the theoretical results are presented for these cuts.

Keywords : Aperture type antenna, cylindrical structure, end fire application.

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Microstrip miniaturised antennas

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Abstract : This paper deals with the various techniques for reduction in the size of the antennas. A small microstrip patch antenna is presented. The probe-fed microstrip patch incorporates a single shorting post which significantly reduces the overall size of the antenna. Theoretical impedance behaviour and radiation characteristics of the modified patch are given.

Keywords : Microstrip antennas, design and simulation results.

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Ferrite loading effects on electromagnetically coupled patch antenna

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Abstract : The composition and thickness dependent effects due to ferrite loading (overlay) on electromagnetically coupled rectangular patch antenna is reported in this paper. The effect of variation in feed position is also studied. The long side feed and diagonal feed positions show different behaviour due to ferrite loading as compared to short side feeding position. The resonance frequency decreases and peak transmittance increases dramatically due to ferrite pellet overlay.

Keywords : EMC patch antenna, ferrite, feedline.

PACS Nos. : 78.70.Gq, 75.50.Gg

Rectangular active microstrip patch antennas : few experimental observations

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Abstract : This paper gives an experimental verification of a recent work by the authors to verify the location of the active device on the microstrip patch antenna for the highest possible radiated power. At the patch design frequency location (l_1) of the device on the patch has been found theoretically for the highest possible radiated power by considering a modified transmission line model and device-antenna non-linear interaction. Experimental results show very good agreement with theory. Patches are designed at two frequencies of 9.5 GHz and 9.0 GHz and an X-band 50 mW Gunn diode is used as an active device. Diode placed at the desired location, power output of the active antenna is 64.0 mW and its dc-to-RF conversion efficiency is almost comparable to that of its waveguide tuned version. Due to proper matching of the device and antenna impedances, radiation pattern of the active antenna improves greatly in addition to the lowering of its cross polarisation level.

Keywords : Microstrip antennas, observations.

PACS No. : 84.40.Ba

Mutual coupling between slots in planar waveguide slotted array antenna

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Abstract : Planar waveguide slotted array antennas offer extremely low sidelobe and controlled aperture excitation. Lightweight, geometric simplicity and reliability make such arrays very useful for airborne radar application. In large arrays with number of slots placed close to one another, the effect of mutual coupling is predominant. Mutual coupling between slots affects the slot performance and antenna pattern. In this paper an attempt is made to characterize a slot in the neighbourhood of a large number of longitudinal shunt slots in a Ka-band array. Improved array performance with better input match is achieved by minimization of mutual coupling effects by finding new slot lengths and offsets.

Keywords : Mutual coupling, slotted array antenna.

PACS Nos. : 84.40.Ba, 84.40.Az

Ku-band monopulse dielectric groove lens—A new avenue in tracking class antenna

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Abstract : Modern trends in radar technology very often emphasize the use of monopulse technique for airborne applications. In this paper, a new avenue is paved through the design and development of a spherical-ellipsoidal grooved dielectric lens system at Ku-band for monopulse operation. Besides lens, the system consists of a multimode conical corrugated feed integrated with compact clusters of four square horns and short-abrupt transitions followed by a monopulse comparator. The lens so designed and developed is an excellent combination of microwave network and lens philosophy. The fabrication of total system involves the usage of precision CNC and conventional machines, deft handling of the process parameters to maintain strict control on tolerances, specially for the corrugated grooves over lens surface and feed. Probably for the first time grooves with definite periodicity, similar to corrugated feed, have been transferred to an outer surface of an ellipse from a cylindrical polystyrene rod. Test results reveal a beautiful monopulse pattern with Gain of 25 dBi, Sidelobe level of -25 dB and Null depth of the order 30 dB.

The classic feature and philosophy of this type of antennas may further be explored for design and development of seeker or tracking class antenna in millimeterwaves.

Keywords : Monopulse, dielectric lens, antennas.

PACS Nos. : 84.40.Ba, 85.50.-n

Multilayer planar array radiators compatible with digital beam forming array

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Abstract : Multilayer planar array radiators are well suited as part of a digital beam forming antenna, because they can be easily integrated, with active elements in multilayer structure. This forms the basis for futuristic highly integrated circuits to be used in terminals for satellite communication system. In these antennas feeding network should be capable to efficiently transfer the signal from radiator to the underneath RF circuit in multilayer configuration or vice-versa. 5×5 array of circularly polarized aperture coupled radiators is designed and developed in L-band. Feeding network to generate circular polarization is realized in tri-plate configuration. Symmetric tri-plate configuration is used in order to provide efficient coupling to radiator as well as underneath RF circuit. Digital beam forming antenna configuration, detail design of tri-plate fed aperture coupled patch antennas and tri-plate to microstrip aperture coupled transition along with their analyzed and test results are presented in this communication.

Keywords : Planar array antenna, digital beam configuration.

PACS No. : 84.40.Ba

Compact antenna system for dual beam application in GSAT-1 satellite

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Abstract : The indigenously developed Geo-Stationary Launch Vehicle (GSLV) will launch GSAT-1 communication satellite. The antenna is catering uplink service for two different coverages : Indian region and South African countries. The antenna configuration is 0.4 m single offset reflector antenna with two feed horns system. The frequency band of operation is 5.850-6.370 GHz with gain requirement of 21 dBi over the very wide two separate coverages of the order of 8.0° . The paper deals with the design and analysis considering various factors such as EOC gain requirement over the dual wide coverages, with constraint of volume and feed inter-element spacing, focal length to reflector diameter ratio (f/d), offset angle, offset distance. The scope of this paper is limited to dual coverage antenna design and analysis, where a single offset parabolic is used as an aperture.

Keywords : Compact Antenna, dual beam application, GSAT-1 satellite.

PACS Nos. : 96.35.-j, 84.40.Ba

Development of microstrip antenna array for monopulse application

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Abstract : The radiation and impedance properties of a microstrip patch antenna array have been investigated experimentally. The antenna structure consist of four cornerfed square patch array which are arranged properly to fit four quadrants of a circle. This type of configuration is choosen to use it with monopulse comparator. The antenna is matched with its feed line by impedance transformer. Experimentally observed results are comparable to that obtained theoretically.

Keywords : Microstrip antenna, corner fed square patch array radiation and impedance properties.

PACS No. : 84.40.Ba

An experimental investigation on the effect of planar and curved conducting surfaces on the radiation, polarization and impedance properties of microstrip antennas

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Abstract : The performance of a microstrip patch antenna in the presence of a conducting ground plane has been evaluated through experimentation and computer simulation. In particular, the changes in the antenna characteristics such as input impedance, radiation pattern, beam width, axial ratio *etc.*, of a diagonally fed almost square microstrip patch antenna have been investigated, the antenna being mounted perpendicular to a conducting plane. Effect of both planar and cylindrical conducting plane has been considered. Remedial measure has also been proposed for improving performance.

Keywords : Microstrip antenna, conducting plane, VSWR bandwidth.

PACS No. : 84.40.Ba

Linearly polarized wide-band microstrip antenna

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Abstract : A new patch geometry, originally proposed for compact microstrip patch antenna, has been investigated experimentally and through computer simulation for broadband operation. It has been found that for a given feed position the antenna offers a 2 : 1 VSWR bandwidth of 6.76%, which is greater than three times the bandwidth of a conventional rectangular microstrip patch antenna. The antenna is linearly polarized with 3 dB beamwidth $\sim 75^\circ$.

Keywords : Microstrip antenna, VSWR bandwidth, computer simulation.

PACS No. : 84.40.Ba

RF field analysis and equivalent circuit analysis of conducting strips in rectangular waveguide

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Abstract : Symmetric capacitive and inductive waveguide windows have been analysed using variational technique. The normalised susceptance for those two types of windows have been found out both theoretically and experimentally. Results obtained theoretically shows better agreement than standard results available with experimental results. Using waveguide windows a waveguide filter has been designed and experimentally verified. Finally, a switch has been designed using the filter which shows an isolation of over 40 dB.

Keywords : Waveguide, conducting strips, RF field analysis.

PACS No. : 84.40.Az

Waveguide T junction circulator at Ka-band

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Abstract : Even though design aspects of circulators [1,2] have been described in detail by many authors, there was still a need to evolve a simple and direct approach by examining various advantages and disadvantages of these methods. This paper is a step in this direction. The paper also gives the practical performance of circulators designed at Ka-band of frequencies adopting the methodology described.

Keywords : Power divider, Ka-band, design of phase and gain.

PACS No. : 84.40.Az

Design of a mm-wave 1 : 3 waveguide power divider using E-plane bifurcated waveguide

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Abstract : A new design of mm-wave waveguide power divider is presented here. The waveguide used is WR28 rectangular waveguide. The concept of bifurcated waveguide is used to divide the input waveguide into three standard height waveguide outputs. In general, an E-plane bifurcated waveguide consists of a rectangular waveguide and a thin metal plate that effectively converts the guide into two reduced height waveguides. Since the plate is perpendicular to the TE_{10} electric field, the field and current patterns are unchanged and hence no reflections are created. This assumes that the metal plate is negligibly thin compared to the guide height. The electric field is same in all the guides and the voltage in the output guide is proportional to the height of the guide. The currents in all the waveguides remain same, which means that the E-plane bifurcation represents a series connection. On the same concept of the bifurcated waveguide, the waveguide is divided into three reduced height guides of equal height by putting two thin metal plates. Since the voltage in the guide is proportional to the height of the guide, E-field bifurcated is same in all the three branches resulting into equal power division in all the three outputs. Chebyshev waveguide impedance transformers are designed to step up the reduced height guide impedance to the standard WR28 waveguide impedance. The structure is simulated using Ansoft's High frequency Structure Simulator. The results are presented graphically. The amplitude imbalance among the three outputs centered at 34.25 GHz is less than ± 0.4 dB and the input return loss is better than 30 dB with 20% bandwidth.

Keywords : Rectangular waveguide, power divider.

PACS No. : 84.40.Az

Near infrared diode laser spectroscopy for atmospheric molecules

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Abstract : Near infrared semiconductor diode lasers are used for high resolution and high precision measurements on atomic and molecular physics. General characteristics of diode lasers and a diode laser spectrometer based on commercial diodes are presented. Line shape measurements on small atmospheric molecules have been carried out to obtain line broadening, narrowing and line strength parameters.

Keywords : Laser spectroscopy, atmospheric molecules.

PACS Nos. : 42.55.Px, 92.60.Ta

Calculation of base transit time in Si HBTs with incorporation of C in SiGe base

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Abstract : A generalized analytical expression for the calculation of base transit time, t_b , for Si HBTs with the $\text{Si}_{1-x-y}\text{Ge}_x\text{C}_y$ base has been derived for small amounts of substitutional C. It is observed that t_b becomes smallest for triangular material (Ge and C) profiles as compared to box-like and trapezoidal profiles. The problems of B outdiffusion and of lattice mismatch in a SiGe base can be mitigated by incorporating C in the SiGe base. Our calculation shows that for the same value of strain between Si and SiGe and between Si and SiGeC, the latter device yields the smallest value of t_b .

Keywords : Base transit time, heterojunction bipolar transistor, SiGeC base.

PACS Nos. : 85.30.Pq, 85.30.De

Transient dynamic response of transferred electron microwave oscillators

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Abstract : Transient dynamic response (TDR) of the ternary alloy $\text{Ga}_{0.47}\text{In}_{0.53}\text{As}$ has been studied. Transferred electron devices made of $\text{Ga}_{0.47}\text{In}_{0.53}\text{As}$ are found to be superior compared to those made of GaAs due to larger negative differential mobility (NDR) and lower threshold field of the former. The velocity overshoot in the alloy occurs within 0.1–0.25 ps satisfying the criterion needed for microwave oscillation. The TDR study of the author in this paper has established that larger pulse powers can be obtained in the limited space-charge accumulation (LSA) mode at microwave frequencies from integrated circuit chips made of GaInAs as compared to those made of GaAs.

Keywords : Transient dynamic response, negative differential mobility, limited space-charge accumulation.

PACS No. : 72.20.Ht

Computer design of silicon Ka-band SDR impatt diode and a study on the effect of package parameters on the high frequency admittance characteristics

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Abstract : Computer design of a silicon single drift region (SDR, $p^+n n^+$ type) IMPATT diode for Ka-band operation around 35 GHz window frequency is reported in this paper. D.C. and high frequency small signal analyses are carried out for the design of the diode. Also, the effect of parasitic series resistance on the high frequency admittance characteristics of the SDR diode, embedded in a suitable device package, is studied and the results are reported.

It is found that the parasitic resistance and package parameters change the admittance characteristics (G-B plots) of the diode. Increase in series resistance generally lowers the negative conductance (G). The package inductance tends to decrease the diode negative conductance, while the package capacitance increases the susceptance (B) of the device. The frequency for peak negative conductance (f_p) of the diode is also found to shift downward due to presence of package parameters.

Keywords : Silicon Ka-band, IMPATT device, series resistance, numerical simulation.

PACS Nos. : 72.30.-z, 85.30.+q, 07.05.Tp

Investigations on frequency selective characteristics of a dielectric slab

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Abstract : In microwave frequency region, electromagnetic waves of different frequencies are propagated through a certain distance in free space and then incident normally on the surface of a finite three dimensional dielectric slab. The software "ANSOFT" in "SILICON GRAPHICS COMPUTER" then investigates the characteristics of the transmitted waves. The software utilises the finite element method. The propagation of an electromagnetic pulse through a finite three dimensional dielectric slab has already been investigated [1]. In that paper reflection characteristics of the electromagnetic wave when incident on a dielectric slab has been analysed in the frequency domain with the help of Finite Difference Time Domain method. Now in this paper transmission characteristics of the electromagnetic wave have been analysed with the help of HFSS software from ANSOFT keeping all the dimensions and conditions same as [1]. Studying the reflection and transmission characteristics of the electromagnetic waves, an idea about the frequency selective property of the dielectric slab can be obtained.

Keywords : Frequency selection, dielectric slab.

PACS No. : 52.25.Os

Single-mode graded index fiber directional coupler : analysis by a simple and accurate method

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Abstract : We present simple and accurate analysis of coupling characteristics of identical single-mode graded index fiber directional couplers. Based on the recently developed simple series expression for the fundamental mode of such a fiber involving Chebyshev technique. Analytical expressions of the relevant parameters are presented and the concerned calculations are executable with much less computations. With examples of step and parabolic index fiber directional couplers we show that our estimations match excellently with the exact results.

Keywords : Single-mode fibers, directional couplers.

PACS No. : 42.81.Qb

Shift of conventional millimeterwave window with variation of atmospheric parameters and applications

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Abstract : The atmospheric constituents oxygen and water vapour mainly controls the clear air absorption of millimeter waves. Both of these constituents have certain resonance absorption frequencies. In between the resonance frequencies of O_2 and H_2O contents of atmosphere there are certain window frequencies where the absorption of millimeter waves are minimal. All round the World Scientists, technologists, Industrialists and users of millimeterwave communication Radar and Remote Sensors presume the millimeterwave window frequencies at 35, 94, 140 and 220 GHz, to utilize the lowest atmospheric attenuation and lowest equivalent thermal emission noise at the window frequencies. However, the window frequencies are subject to shift with variations of the atmospheric water vapour content and temperature. We, therefore, studied the millimeterwave window shift by using the theoretical Liebe model, which is the best one of the variety of theoretical models. We, in fact, started the estimates of atmospheric windows for the Tropical regions in India and subsequently estimated the window frequencies in the temperate regions of the World, finding that the conventional window frequencies is shifted down sufficiently in tropical region countries.

Keywords : Millimeterwave window shift, atmospheric parameters, applications.

PACS Nos. : 84.40.-x, 92.60.-e

Millimeterwave secure communication link and Radar around the oxygen absorption line and applications

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Abstract : In the oxygen absorption line at 60 GHz the attenuation may be as high as 12–15 dB per km. Due to such high attenuation rate with distance it may be easily possible to limit the communication range by controlling the transmitter power, so that the signal may not reach beyond that limiting distance to a level that can be received by any receiver. In this way high security of communication is possible for communication up to desired distance in the boundary layer of a country or to a boundary layer of a group of specific workers in defence, police and industries. At the same time one can also think of developing a cordless telephone system at 60 GHz band in every base station without any problem of mutual interference between the stations because of the high attenuation rate at 60 GHz. Besides these, the 60 GHz LOS link can also be used for computer LAN, that will allow the computers to be shifted in position, which is not easy in case of LAN with cables. Such a 60 GHz LAN is, in fact, been used in Japan.

As the bandwidth available around 60 GHz is quite broad, we can additionally, use broadband spread spectrum communication technology at 60 GHz for high security and antijam operation.

Doppler Radar at 60 GHz may have another important application for monitoring the speed of Cars on roads, being used widely, with proper range being controlled.

Inter satellite communication at 60 GHz is also very good, as oxygen density is quite low at the satellite height, producing low attenuation between satellite communications, while any interference from the ground at 60 GHz will be highly absorbed by the atmospheric oxygen producing security of inter satellite communication.

Keywords : Oxygen absorption at millimeterwave, LOS link, Doppler Radar at 60 GHz.

PACS No. : 84.40.-x

Development of a collision avoidance system at infrared wavelength

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Abstract : To avoid collision of two moving systems, a collision avoidance system was developed using Infrared digital coded communication system. The Transmitter power of the Infrared source is adjusted so that the communication will be possible at a distance between the moving systems at which collision avoidance is required.

Keywords : Collision Avoidance system, digital code generator (ROM), infrared LED driver.

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Modes of radiowave propagation : neural learning

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Abstract : Modes of radiowave propagation depends upon the radiorefractivity gradient of the medium through which it is propagating. Radiosonde data collected from Dum-Dum Airport, Kolkata is analysed to calculate the radiorefractivity gradient. The estimated value can be divided into four categories namely subrefraction, normal refraction, superrefraction and ducting. In this paper, we have used a multilayer perceptron (MLP) to learn the relationship between atmospheric parameters (T , P , e etc) and the output classes which helps in predicting the mode of radiowave propagation. Studies have been made using different network topologies. The results are presented for various number of hidden layers and nodes, using different size of training sets. The trained network is used for subsequent rule generation.

Keywords : Electromagneticwave propagation, radiorefractivity, multilayer perceptron (MLP).

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On the structure of horizontal wind flow in the surface layer of Maitri, Antarctica

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Abstract : Wind field in Antarctica has been studied with the help of data, collected during XV-th Indian Scientific Expedition to Antarctica 1995-97. Based on the data of wind velocity measured at the surface layer of Indian Antarctic station Maitri (70.76°S, 11.73°E), a simple model on wind direction pattern is presented. Analysis of the daily/monthly/seasonal (3 month/season) and yearly variation of such wind velocity is made from the statistical point of view. Various aspects of the model, presented here are discussed.

Keywords : Wind velocity, log-normal distribution, Antarctica.

PACS Nos. : 92.70.Cp, 93.30.Ca, 92.60.Gn

Sudden rise in amplitude of 40 kHz radio signal in relation to solar radio flux

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Abstract : The paper reports the experimental observations of isolated short period enhancements in amplitude of 40 kHz radio signal transmitted from Sanwa, Japan to Kolkata, India in relation to solar radio bursts having peak flux greater than 1000 in the unit of $10^{-22} \text{ Wm}^{-2} \text{ Hz}^{-1}$. The delay between commencements of signal amplitude and solar radio bursts lies between 3 and 12 minutes. The signal enhancement in dB exhibits linear increase with increase of solar radio flux up to 8000 flux unit. The emission of hard X-rays associated with solar radio bursts can cause extra ionization in the D-region of ionosphere. As a result, conductivity parameter in wave guide mode theory is changed to allow better reflection. This fact is the cause of enhancement of signal amplitude.

Keywords : Solar radio emission and X-rays, radio propagation, ionosphere.

PACS Nos. : 94.20.Ee, 96.60.Tf

Acoustic remote sensing of LPBL over Antarctic environment

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Abstract : Acoustic sounding experiment and meteorological observations were carried out on simultaneous basis at the Indian Antarctic station Maitri (70.76°S, 11.73°E) during XV-th Indian Scientific Expedition to Antarctica from January 1995 to January 1997. The entire Antarctic zone is very prone to the sudden occurrence of blizzards during different month and seasons. This stormy activity brings drastic changes in the planetary boundary layer over Antarctica. In order to understand the dynamics of LPBL over this region, all meteorological parameter before onset of blizzard, during and after blizzard have been studied. Impact of these blizzards on sodar structures is also highlighted. The effect of various other phenomena such as katabatic wind, forced convection, *etc.* are also visualized.

Keywords : LPBL, acoustic sounder, Antarctic environment.

PACS Nos. : 43.30.-p, 43.50.+v, 93.30.Ca

Better analysis and depiction of monsoon systems through satellite microwave remote sensing

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Abstract : In this study, various algorithms developed by global community have been applied to DMSP-SSM/I data. Those algorithms which were found most suitable and appropriate have been used for the analysis and proper depiction of monsoon systems over the Indian region. It is found that prior to the formation the monsoon depressions, there was strengthening of surface wind speed to the south of the low pressure area. This wind speed was of the order of $12\text{--}15\text{ ms}^{-1}$. The strengthening of wind speed was in association with the low-level jet present over that region. Higher values of integrated water vapour ($60\text{--}70\text{ kg m}^{-2}$) were observed over the central and head Bay throughout the life cycle of monsoon depression. Highest values of integrated cloud liquid water (0.7 kg m^{-2}) were found to be associated with major convective activity in the southwest sector of the monsoon depression. Windspread precipitation ($2\text{--}16\text{ mm hr}^{-1}$) was found to be associated with low pressure system over the northwest Bay and the precipitation was further found to be concentrated more in the southwest sector of the monsoon depression with maximum precipitation rates of the order of $>20\text{ mm hr}^{-1}$. Results of our study suggest that estimated geophysical parameters obtained from SSM/I data can be used with some confidence as an input to various weather forecast models.

Keywords : DMSP-SSM/I, geophysical parameters, depression.

PACS Nos. : 42.68.Wt, 92.60.Hp

Millimeterwave CW Doppler radar for vibration remote sensing

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Abstract : Doppler radar sensors have been heavily utilized at millimeter wavelengths. They are currently in use for a variety of applications including commercial and industrial uses in level sensing, motion detection, speed measurement and collision warning sensors. Their relative simplicity and low cost production potential make them attractive for these applications. A millimeter wave Doppler radar development is described in this paper with the off-line DSP techniques to convert the time to frequency conversion from which the velocity of the moving target can be predicted. A simple experimental set up has been described where a vibrating metal reed is used as vibrating object. One application area of the 94 GHz Doppler radar for the measurement of rain drop size distribution is highlighted.

Keywords : Doppler radar, moving target indicator (MTI).

PACS Nos. : 84.40.-x, 07.07.Df
