International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 10 | Oct 2020 www.irjet.net p-ISSN: 2395-0072

Electromagnetic Scattering from Arbitrary Shaped Lossy Dielectric Bodies

Dr. KUMAR SANJAY

PhD. (Physics) , Babasaheb Bhimrao Ambedkar Bihar University, Muzaffarpur

---

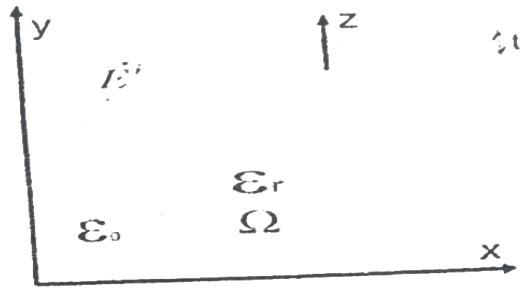
Abstract - : *With the advancement of communication engineering the techniques of microwaves and millimetre waves have developed to a great extent. Now a days the microwave and millimetre waves are being widely used in various diverse applications such as radars, terrestrial communications, etc. The use of radars are in many forms such as missile guidance radar; weather detection radar, missile tracking radar, etc. It may be mentioned that the strong revival of research and development in the millimetre wave region during the past several years is attributed to the urgent need for the new technology and inherent superiority of millimetre wave region during the past several years is attributed to the urgent need for the new technology and inherent superiority of millimetre waves system over optical and infrared systems for penetration of smokes, dust clouds fog, haze and other adverse environments .This has resulted in tremendous advances in the development of requisites components and their use in system applications in various diverse fields.*

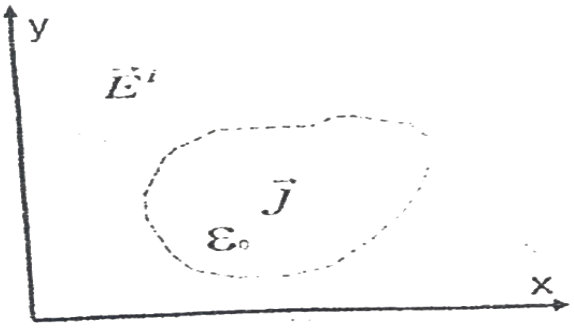
1. INTRODUCTION-

The characteristic feature of smaller beam width and higher gain associated with the millimetre wave frequency antenna have further stimulated the development resulting into many important system applications where the size and weight of hardware are constrained such as missile guidance, seekers, and air borne, surveillance seasons. It may be noted that the atmospheric propagation effects dominate the design considerations relating to microwave and millimetre wave systems. In addition to this the rain, cloud, fog, hail, etc. may cause significant signal attenuation and back scatter. The attenuation caused by various types of precipitations such as rain, cloud, snow, smoke, fog, hails etc. present in atmosphere is due to the fact that under the influence of incident wave these particles oscillate as ions and radiate energy in all directions. This results in appreciable amount of attenuation depending on size and concentration of particles. The mechanism of scattering and back scattering further change the polarization which produces the depolarization and related attenuation of wave. Further absorption of incident energy by these particles and its conversion into heat is one of the major problem in the utilization and space communication, where there is a significant loss of energy of the wave. In spite of the several advantages of millimetre wave sensors over their electro—optical counterparts and enhanced propagation characteristics through dust, smoke, clouds and naturally occur obscurant such as sand and dust storms, very limited definitive data exist to specify the signal attenuation and back scatter under adverse atmospheric conditions . The phenomena of depolarization and cross polarization have received very little attention of the researchers particularly for the sand and dust storms at millimeter wave range. It was therefore, though useful to take up the problem of propagation of microwave and millimeter wave under adverse atmospheric condition a natural phenomenon usually occur in all over the country.

2. THEORY-

Further because of the typical interaction of the electromagnetic energy with the various atmospheric constituents, it is a 130 necessary to assess the capabilities and limitation of the microwave and millimetre wave systems. In the present work an attempt will confined to estimate the attenuation of microwave/ millimetre wave due to different phenomena such as polarization, depolarization etc. which will be extremely useful in the area of communication.

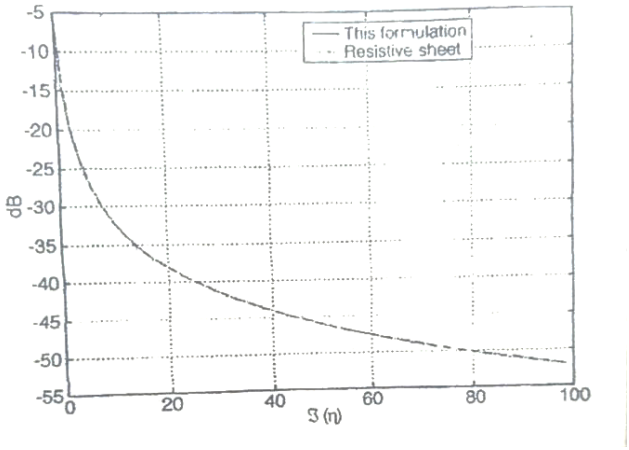




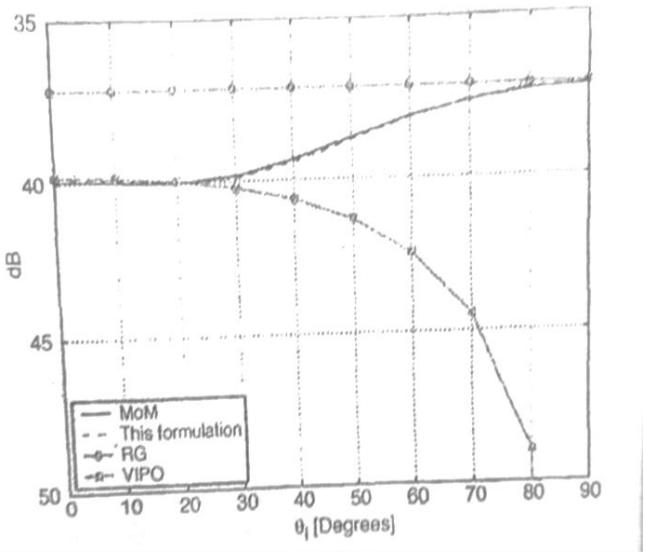
However in the next phase of the present investigation an attempt will be made to measure the complex dielectric constant of soil sample in bulk concentrations leads the information about the electrical properties of the soil particles which will be useful in the field of electrical engineering. Further the consistent and quantitative analysis with sufficient experimental data on the various phenomena occur during the course of electromagnetic wave propagation under adverse atmospheric condition may essential be needed for the continued improvement in able design of communication systems, utilized in the de fence of country. With a view to explore the propagation characteristics of microwave/ millimeter wave energy in adverse atmospheric condition and to assess the capabilities and limitations of the microwave/ millimeter wave systems used in communication , several investigations both analytical and experimental will be carried out extensively for various parameters associated with the propagation. Some useful numerical technique will be utilize for the theoretical analysis of the problem.

The study of the propagation characteristics of microwave/ millimetre wave energy in adverse atmospheric condition and the assessment of the capabilities and limitations of the microwave/ millimetre wave systems used in communication represent significant contribution to the national technology base and establish international reputation in microwave/ millimetre wave research and development. The advantages of millimeter wave include their ability to provide accurate excellent image identification and resolution. They also provide remote measurements while operating through smoke, dust, fog or rain. Research in millimeter waves for measurements in radio astronomy, satellite-based studies of the upper atmospheric, climate, rainfall and vegetation patterns, and a host of other environment concerns.

The details of these entire investigations reflect the national and international status of the study of propagation characteristics of microwave/millimeter wave under adverse atmospheric condition.



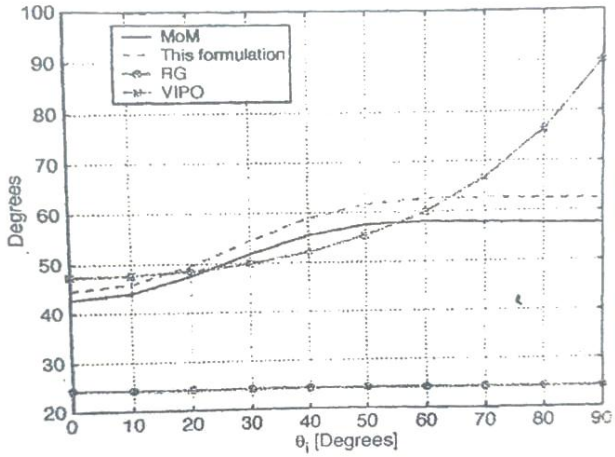
It will be observed that there is lack of consistent and quantitative analysis with sufficient experimental data on the various phenomena occur during the course of electromagnetic wave propagation under adverse atmospheric condition that may-essentially needed for the continued improvement in reliable design Of communication systems. With these views, it ma Y be mentioned that the theoretical and experimental study of the propagation characteristics of electromagnetic radiation adverse atmospheric condition at microwave millimetre wave frequency range (1 GHz—IOO GHz) is relevant to present day problems.



With the advancement of communication engineering, the scattering from a thin dielectric object has a number of useful applications, Recently a thin dielectric disk is widely adopted to model broad leaves of deciduous trees. Two approximate scattering solutions such as volumetric integral physical optics (V IPO) and Rayleigh Gans have been used. A new approximate formulation for scattering by a thin homogenous planar dielectric structures has been adopted. Apart from the thin dielectric

approximation, the formulation has been obtained replacing a shape related convolution with a simple multiplication which is valid for small t. For thin dielectric half planes, a closed form solution for back scattering has been formulated for edge of include cases and compared with known solutions for resistive half planes.

The theory of scattering from arbitrary has been produced. For arbitrary structure a as relation a numerical method such as relation between co-relation function and frequency ha tm been obtained. Theoretical investigation out considering the layers of spherical and spherical dielectric bodies. In order to consider the scattering effect of main constituents of layers of spherical and non-spherical dielectric bodies, the profile structure of these particles in atmosphere has been taken into account..



To find the variation in attenuation with frequency and visibility, some computational works have been carried out. The attenuation calculations are based on the Rayleigh scattering. Further, estimation of loss due to scattering from dielectric bodies has been found using transmission loss equation. A new approximate formulation for scattering by a very thin homogeneous planer dielectric structures is presented. This formulation is derived based on a for the induced polarisation current. Using the spectral domain—representation of free space-dydic GREEN'S function, the polarization current inside arbitrary shaped thin dielectric disk is expressed in a closed form equation the spectral domain. Apart from the thin dielectric the formulation is obtained by replacing a related convolution with the multiplication which is shown to be for small t (r-1) /X where t is the thickness dielectric constant of the dielectric sheet. The validity of the formulation is examined using several structures. For an infinite dielectric slab, it is shown that the exact solution can be obtained using thin slab approximation. For 2D and 3D problems, thin dielectric half planes and finite strips and circular and square disks of wide range of size at different incidence angles are investigated respectively. For thin dielectric half planes, a closed form solution for back scattering is formulated for edge of incidence cases and compared with known solution for resistive half planes.

Theory of scattering from arbitrary scattered has been taken into consideration scattered from thin dielectric. The phenomena of depolarization have received vary little attenuation of the researchers part for the sand and dust storms at millimetre range .It was therefore, thought useful take up the problem of prorogation of microwave and millimetre wave under adverse atmospheric condition. Here attempt has been to estimate the attenuation of micro wave / millimetre wave due to different phenomena such as polarization and depolarization. This is extremely useful in the area of communication. During the investigation an attempt has made to measure the complex dielectric constant of soil sample in bulk concentrations which leads the information about electrical properties of the soil particles. This will be useful in the field of electrical engineering to explore the propagation characteristics of micro wave / millimetre wave energy in adverse atmospheric condition and to assess the capabilities and limitations of the micro wave / millimetre wave systems used in communications several investigations both analytical and experimental have been carried out extensively for various parameters associated with the propagation. Some useful numerical technique was utilised for the theoretical analysis of the problem.

Research in millimetre wave for measurements in radio astronomy, satellite based studies of the upper atmospheric climate, rainfall and vegetation patterns and host of other environment concerns.

3. CONCLUSION-

In this way we can develop the Radar system on the surface of the earth. By making interaction of electromagnetic waves (microwave) with obstacles in earth atmosphere. We can estimate attenuation change energy. For example, in case of train moving on 'the earth's surface attenuation of wave can be detected by the millimetre wave. The details of these entered investigations reflect the national an ad international status of the study of propagation characteristics of microwave/millimetre wave under adverse atmospheric condition.

REFRENCES:

[1] R. W. P. King and C. W. Harrison, "Scattering by imperfectly conducting spheres," AFCRL-70-0483, Cruft Lab. Rep. by Harvard Univ., 1970.

[2] M. G. Andreasen, "Scattering from bodies of revolution," ZEEE Trans. Antennas Propugat., vol. AP-13, pp. 303-310, Mar. 1965.

[3] V. A. Erma, "Exact solution for the scattering of electromagnetic waves from bodies of arbitrary shape, 111, Obstacles with arbitrary electromagnetic properties," Phys. Rev., vol. 179, pp. 1238-1246, Mar. 1969.

[4] T. K. Wu, "Electromagnetic scattering from arbitrarily-shaped lossy dielectric bodies," Ph.D. dissertation, Univ. Mississippi, University, MS, May 1976.