

REVIEW ARTICLE



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## FUNDAMENTALS AND COMPUTATION ON ELECTROMAGNETIC THEORY

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### ABSTRACT

The paper organized as follows .In Section I we will discuss the importance of electromagnetics. Section II explains and presents the interference and section III which presents about the basic laws to be used in EM. In the Section IV the concepts of electromagnetics understanding allow us to make clear knowledge about all the physical phenomena in EM. Section V which explains and presents the technique to design and predict the types of antennas by using computational methods. In the last section it is discussed about the computational electromagnetics.

Key Words: Space mapping technique, Interference, Computational electromagnetics

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### I.INTRODUCTION

Maxwells'sequation are based for Electro-Magnetics. The design flexibility in Electro-Magnetics is achieved by the technique known as transformation-Electromagnetics or transformation-Optics. There are some softwares to compute the Electro-Magnetics effectively. Some more new methods used are

- Space mapping technique.
- Parasitic influence.
- Frequency sampling technique.
- Asymptote technique.
- Neural network technique.

The research areas in Electro-Magnetics are EMC, MIC, MCM, Scattering. The techniques to be computed as finite difference, FDTD, FEM, MOM. There are many sources of Electro-Magnetic emissions.

### II.INTERFERENCE

High voltage power transmission lines which generate Electro-Magnetic emission. There are some disturbances in electrical and electronic devices interference. There are two types of receivers which are termed as

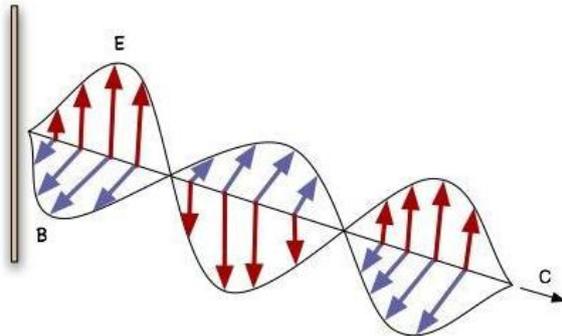
- Intentional
- Unintentional

A system is electromagnetically compatible with its environment if it satisfies three criteria

- It does not cause interference with other system.
- It is not susceptible to emissions from other system.
- It does not cause the interference itself.

### III. BASIC LAWS

James Maxwell is the father of Electro-Magnetic waves. James Maxwell states that Electro-Magnetic waves which are governed by the interaction of Electric and Magnetic fields. The electric field which changes in turn generates the Magnetic field and that changing Magnetic field which generates an Electric field.



#### A. Coulomb's law

Charles Augustin de Coulomb (1736-1806) who refers a law as the force between any two point charge and inversely proportional to the square of the distance between them and directed to the line joining the charges.

$$F = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2}$$

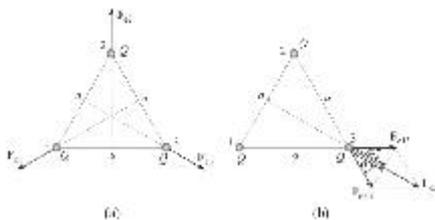


Fig : 1 Coulombs electricfield[1]

#### B. Maxwell's law

It is derived on the basis of Ampere's law, Faraday's law and Gauss law. These equation are based on differential and integral form. These which describes the properties of field vectors and relation between them.

#### C. Ampere's law

According to Ampere's law, a line integral of H around a closed contour is equal to the current enclosed.

#### D. Lenz laws

There is an induced current in a closed conducting loop if and only if the magnetic flux through the loop is changing. The direction of the induced current is

such that the induced magnetic field always opposes the change in the flux.

### IV. VECTOR ANALYSIS

To study the theory of Electro-Magnetics the prerequisite is only vector knowledge. Signal is the physical quantity that varies with time space or any other independent variables. Thus the physical quantity which can be represent as Scalar or Vector quantity. Scalar which has magnitude and vector which has both magnitude and direction.

### V. ELECTRO-MAGNETIC CONCEPTS

Charge is the fundamental property of matter. It is actually the characteristics of matter force exists between any two particles due to charges are known as Electro-magnetic force. Thus there are two types of forces as Electrostatic force and gravitational force. Potential difference between any two points in static Electric field which depends on the location of the points and independent of path of integration.

Polarization in which there are two classes of dielectric materials. In the first category the positive and negative elements in uncharged condition are close to each other and hence their action are neutralized. By apply the Electric field charges shift slightly within the molecules which are termed as dipole.

### VI. TECHNIQUES

The FDTD method which is used to analyze the transformation mechanics. These are many techniques which are used to derive the Electro-Magnetic theory.

#### A. Space mapping technique

The space mapping technique which establishes a mapping between two spaces, coarse model and fine model space. To design the micro-strip patch antenna, the structural parameter analyzed which replaces the coarse model in the mapping process.

#### B. Extra port method

Here the used method is method of moments (MOM) to analyze the particular problem with the basic pulse function and matching point. By the theory of generalized network, each segment is considered as shorted-circuit part except the excitation which are termed as extra port method [4].

- C. Extrapolation and interpolation methods Basic for this method is Taylor's expansion. In the interpolation method the Adaptive Frequency Sampling(AFS) technique is used as delay. The general S-B algorithm is employed here.
- D. Synthetic asymptote technique It is a novel technique used for microwaves. Two regular asymptotes of a function which are analytically known. The near limit is zero, far limit is infinity. This synthetic asymptote leads to the desired formula.
- E. Artificial Neural Network(ANN) Technique It is the neural network which has fast accurate and flexible roof to Radio Frequency (RF) and microwave modeling, simulation and design.
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#### VII. Computational electromagnetics and geometrical approach

This which replaces paper and pencil and nowadays. There are modern technologies such as electromagnetic simulation tools are used which tests and perform prototype also. In geometrical approach the electric flux which passes through Gaussian spherical surface with the spherical symmetry which is solved by applying gauss law in integral form which is Maxwell's third equation where the magnitude of vector E times the area of the sphere. This geometrical approach which also helps to solve volume and surface integrals arising in Electro-magnetic analysis. The mathematical concepts to be followed are Gradient, Divergence, Curl and Laplace as well line surface and volume integrals[2].

#### VIII. Conclusion

In this proposal the basics of Electro-Magnetics various laws and techniques are discussed for the clear reference of Electro-Magnetics. This paper presented in such a way to understand the concepts of electromagnetics. According to this work it is able to gain easy knowledge and concept orientation on Electromagnetics. From earlier till software based techniques are discussed properly.

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