EXPLORING THE TRANSMISSION LINE THROUGH MATLAB SIMULINK

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***Abstract*: A transmission line having its length less than 80 km is considered as a short transmission line. In short transmission line capacitance is neglected because of small leakage current and other parameters (resistance and inductance) are lumped in the transmission line. This thesis has two part of simulation one contains the perturbation theory and second is simulink model of short distance transmission line modeling. It consider the non- uniform transmission line. For obtaining result we consider the resistance, inductance and capacitance per unit length (R(z),L(z), C(z), G(z)) are assumed that they are slowly variable parameter along the distance (Z), the distance along the line from the source end. In perturbation theory it is applied to the solution of inhomogeneous transmission line equations. It considers the distributed parameters of the line. In the simulink model the short transmission line has been simulated on which perturbation theory can be performed. As per this analysis this thesis found the transmission line linearity analysis of signal at sending end and receiving end that resemble that the output graph of frequency becomes linear just after the simulation starts. It has clear that the transmission line has stable output and very less distortion.**

***Keywords*: Perturbation theory, Simulink, Short Transmission Line, MATLAB Simulink 2013**

1. INTRODUCTION

In communications and electronic engineering, a transmission line is a specialized cable or other structure designed to conduct alternating current of radio frequency, that is, currents with a frequency high enough that their wave nature must be taken into account. Transmission lines are used for purposes such as connecting radio transmitters and receivers with their antennas, distributing cable television signals, trunk lines routing calls between telephone switching centers, computer network connections and high speed computer data buses. This article covers two-conductor transmission line such as parallel line (ladder line), coaxial cable, strip line, and micro strip. **1.1 The Four Terminal Models**

For the purposes of analysis, an electrical transmission line can be modelled as a two-port network (also called a quadripole), as follows:

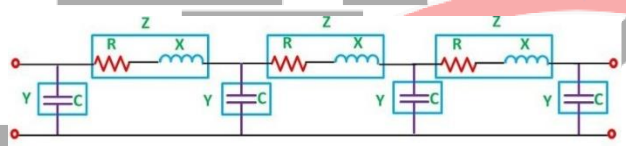

Fig 1.1: Transmission line diagram

In the simplest case, the network is assumed to be linear (i.e. the complex voltage across either port is proportional to the complex current flowing into it when there are no reflections), and the two ports are assumed to be interchangeable. If the transmission line is uniform along its length, then its behavior is largely described by a single parameter called the characteristic impedance, symbol Z_0.

2. Literature Survey

In **[1]** This report explain the two major source of loss in high voltage. AC transmission lines: resistive loss and corona loss. The first loss occurs due to non zero-zero resistance of the wire. Corona loss occurs because of the ionization of the air that occurs when the electric fields around a conductor exceed a specific value. The amount of resistive loss in a system can be calculated by using corona free transmission line equation to find the amount of power delivered to any point along the wire and subtracting the initial amount of power. Corona loss is occurred due to the ionization of air molecules near the transmission line conductors. Corona loss only occurs when the line to line voltage exceed the corona threshold.

In[2] In this paper an analysis of lumped- distributed branch –line couplers for coplanar waveguide(CPW) branch line couplers suitable for GaAs MMIC design is given. In this paper the author consider the degree of coupling, impedance transformation and the level of miniaturization in order to provide greater design flexibility for integration with unipolar monolithic circuits. The results shows that an amplitude balance of 4.7×0.3 dB, Input and output return losses of better than 12 and 15dB respectively, and an isolation of better than 20 dB over the range of 14-16 GHz.

In[3] For the various non uniform transmission lines, the exponential line and the binomial line's analysis based on the rigorous solution of the telegraph equation. Up till now, there is no systematically solution for the binomial line. So, in this paper, the rigorous solution of telegraph equation for 2nd order binomial lines is derived and its equivalent circuit is constructed by a cascade connection of uniform distributed parameters lines, lumped reactance elements and the ideal a high pass filter consisting of the series lumped capacitance and uniform distributed- parameters line is constructed by the quadratic lines and lumped capacitance.

In[4] silicon Radio Frequency Integrated Circuits (SiRFICs) have matured greatly over the past five years and are now found in multimode of commercial products. The use of silicon Radio frequency integrated circuits is to reduce the insertion loss and decrease the circuit size. The author performed the experimental measurements and use the Finite Difference Time Domain (FDTD) analysis are used to show that embedded inverted micro strip lines are not suitable for use above a few GHz.

In[5] In this paper a new method for the simulation of fast transmission line is given. The method is based on the method of characterization of partial equation theory.

This method include resistive losses and the wave speed variations. For this purpose, we have to proposed a Norton equivalent for transmission line. At any given time, the Norton equivalent of each transmission line end is independent of the line's interior behavior at that time, therefore the model can readily be included into any electrical network transients simulation program. The author apply this method to two problems. The first one consists of analyzing the effects of non uniformities caused by the sagging of conductors on an aerial line. The second of application consist of the simulation of a fast impulse propagating along a transmission tower modeled as a network of vertical and horizontal transmission lines.

In[6] In this paper a fast analysis of aperture- coupled reflect arrays is given in terms of transmission line model. The circuit approach is used to drive the phase design curve as a function of the current flowing on the equivalent impedence of the single radiating element. Computational cost is suddenly reduced as compared to the standard full wave methods. Numerical and experimental calculations are based on slot coupled reflectarry configurations which is working at different operating frequencies.

In[7] In this paper the author combined the hybrid finite- element/ boundary –integral method (FEBI) with the multilevel fast multiple algorithm (MLFAI) and applied it to the three dimensional scattering problems of inhomogeneous media. Numerical results show that the proposed method can greatly improve the efficiency of (FEBI) for scattering problems of inhomogeneous media. The finite element method (FEM) is a very successful method with the wave transmission problems owing to its strong ability for simulating arbitrary geometric structures and in homogenous media.

3. DISCRETIZATION OF NON-UNIFORM TRANSMISSION LINE

Figure 3.1, shows the basic differential equations governing the voltage and current along a transmission line that's distributed parameters R, L, G and C which are varying along the line. The differential equations of non-uniform transmissions line are given in equations (3.1) and (3.2)

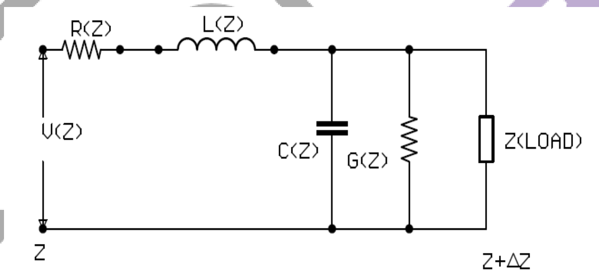

Figure 3.1: Discretization model of non-uniform transmission line

$$-\frac{dV(z)}{dz} = (R(z) + j\omega L(z)I(z) \qquad 3.1.$$

$$-\frac{dI(z)}{dz} = (G(z) + j\omega C(z)V(z) \qquad 3.2.$$

4. SIMULATED RESULTS OF DISCRETIZATION METHOD

Voltage variations with distance (z) when $\omega = 1, \omega = 3, \omega = 6, \omega = 10, \omega = 12$.

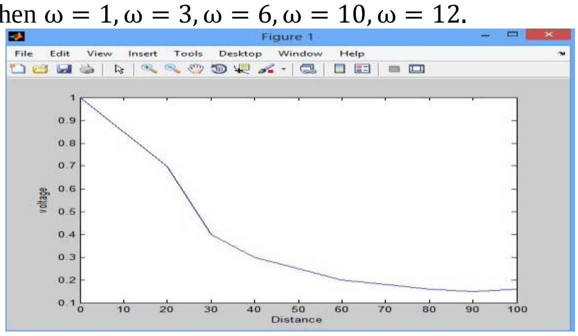

Figure 4.1: Voltage variation with normalized distance (z) for fixed frequency but varying primary constants.

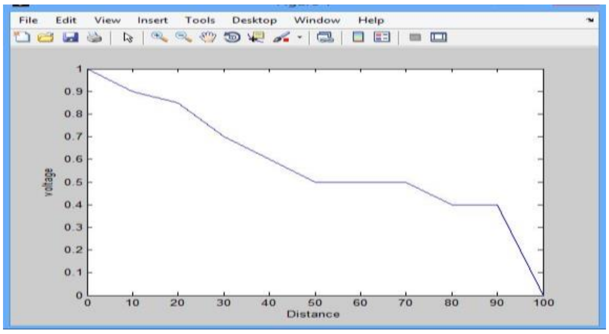

Figure 4.2. Voltage variation with normalized distance (z) for fixed frequency and primary constants.

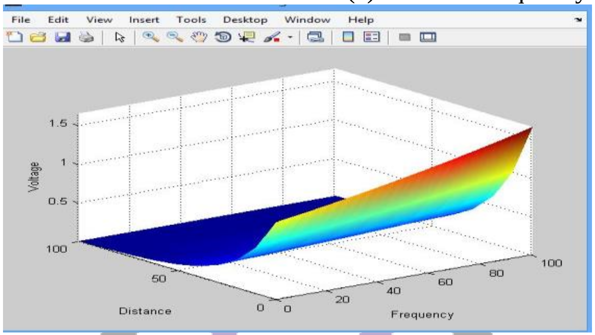

Figure 4.3. Voltage variations with normalized frequency and distance for the variable primary constants ($1/RC \gg 1/LC$).

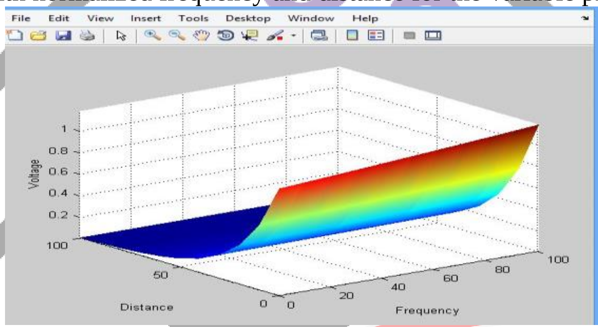

Figure 4.4 Voltage variations with normalized frequency and distance for the variable primary constants ($1/R=1/LC$).

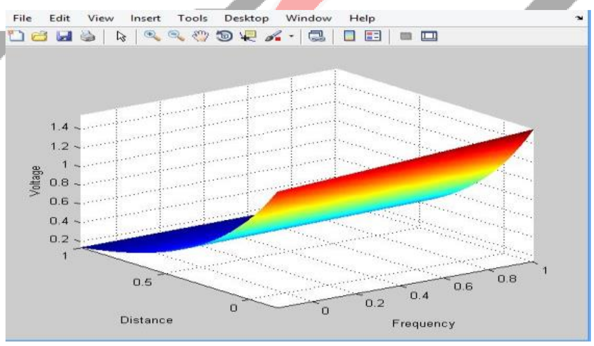

Figure 4.5 Voltage variations with normalized frequency and distance for the variable primary constants ($1/RC \ll 1/LC$).

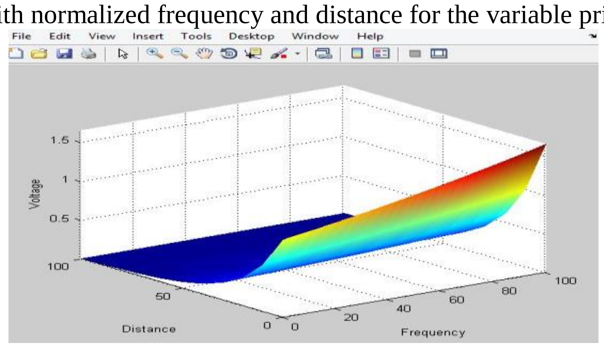

Figure 4.6 Voltage variations with normalized frequency and distance for the fixed primary constants ($1/R=1/LC$).

4.1 MODELING OF SHORT TRANSMISSION LINE

A transmission line can be represented as a two-port circuit using ABCD parameters which determine the relationship between voltage and currents in sending and receiving ends. The accurate representation of an actual transmission line may be done only in terms of uniformly distributed parameters r (series resistance), l (series inductance), and c (shunt capacitance). For short lines (less than 80 km) and medium lines (between Power flow or load flow in an ac power system deals with the calculation of bus voltages and their phase angles as well as the flow of active and reactive power through various network elements under steady-state conditions. This provides a systematic mathematical approach, which is an essential source of engineering information for planning, design, and operation, as well as an important tool for several other fields of power system analysis such as stability, symmetrical and asymmetrical faults, and system harmonic studies.

5. Simulation Layout

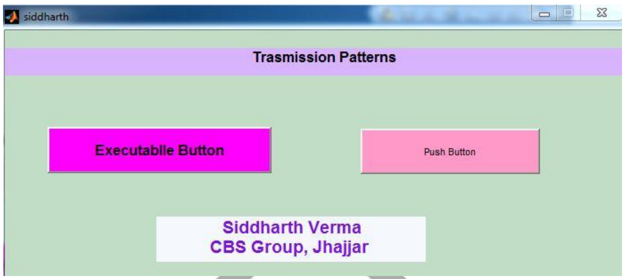

Fig 5.1: Basic layout designed in MATLAB 2010b that contains two button. Earlier is for perturbation theory and proposed is for modeling of transmission line.

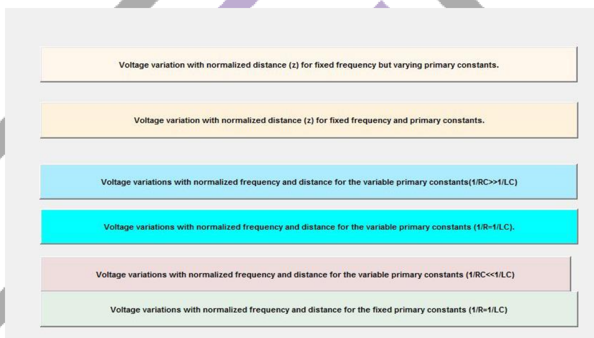

Fig 5.2: Simulation of Transmission line using MATLAB-2013a

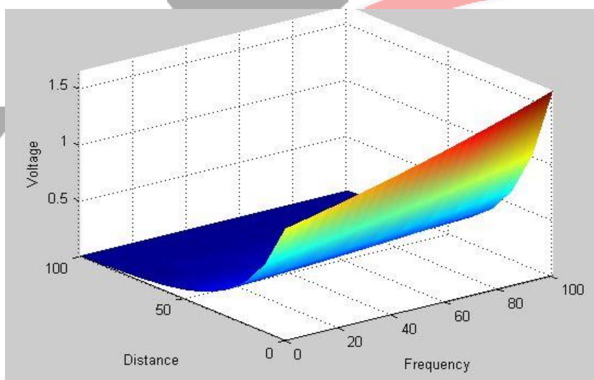

Fig 5.3: Simulation in running time for transmission (voltage –Distance- Frequency)

6. CONCLUSION AND FUTURE SCOPE

In this paper the technique that has been developed for the analysis of a transmission line in which the distributed line parameters per unit length are non constant. In this thesis we consider the transmission line having the inhomogeneous distributed parameters. And the transmission line is infinitesimal line. Here is a method for the analysis of non uniform transmission line by using the perturbation method. The starting point for the method is the KCL and KVL of the line for the infinitesimal line length. The most far reaching generalization of the work is carried out in this paper is the following. The distributed parameters along the line are nonlinear function of voltage and current histories up to time t. Models for these dependencies can be obtained by

(a) By considering the B-H hysteresis curve which gives the inductance as a functional of the past current values.

(b) By considering ohmic heating of the resistances cause the temperature changes in the resistances there by affecting the resistance values. Since ohmic temperature increment depends on the past $i^2(t)$ values it follows that the resistance are also functional or the past current values. The transmission line equations then become a set of non linear integral differential equations and perturbation methods are need to be developed to solve these equations.

(c) Non uniform Transmission lines with randomly fluctuating parameters.

In Modeling file it is been created a short transmission line which has parameter as discussed above. It has three output graphs that have relation of voltage vs. time line and current vs. time line at send end and receiving end. It has clearly shows that the output graph of frequency becomes linear just after the simulation starts. It has clear that the transmission line has stable output and very less distortion.

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