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MATLAB IS USED TO ANALYSE A FREQUENCY DEPENDENT TRANSMISSION LINE MODEL

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Abstract

Transmission lines, such as coaxial lines, strip lines, and two wire lines, typically have two or more conductors.The analysis of transmission lines necessitates the use of electromagnetic theory in order to establish the transmission line parameters. Take a long transmission line, such as a coaxial wire, for example. Several parameters, such as resistance, inductance length of wire, and so on, are required to analyse its properties. Regardless of the actual structure, a segment of uniform transmission line (i.e., a transmission line with constant cross-section over its length) can be modelled. The following are the primary constants: As a result, resistance, inductance, conductance, and capacitance per unit length are sometimes referred to as R, L, G, and C. (Per unit length is sometimes abbreviated as p.u.l.)In the metric system, we utilise ohms per metre (/m), henries per metre (H/m), siemens per metre (S/m), and farads per metre (F/m).This paper builds a frequency-dependent transmission line model to quantify its performance at high frequencies of 10 KHz. Using the given model, the output voltage for the pi-section transmission line is also be compared.

Using Matlab software, a frequency dependent transmission line model is created in the work. The frequency-dependent resistance, reactance, is used to generate the characteristic admittance and propagation function. Radio frequency toolbox is used to apply the calculated values. The transmission line parameters is then be used to create the Universal Line Model (ULM).

Keywords: Transmission line, Universal Line Model, Pi-Section Transmission Line.

INTRODUCTION

Two conductors are commonly used in transmission lines. Transmission lines are electromagnetic systems that can be examined with a circuit-theory tool, albeit electromagnetic theory is necessary to calculate transmission-line characteristics. Underwater power AC cables are crucial in offshore wind generating. Furthermore, the undersea cables are the major differential between offshore and onshore wind farm transmission systems.As a result, evaluations of the offshore wind farms collection and transmission systems require a good undersea model. As a result, the various options for modelling a submarine cable are assessed.An accurate and validated submarine cable model is then used to analyse reactive power management in undersea power transmission cables. For three different reactive power management alternatives, a reactive power compensation approach is proposed that takes into account active power losses, reactive power generated in the transmission system, and voltagedrop.

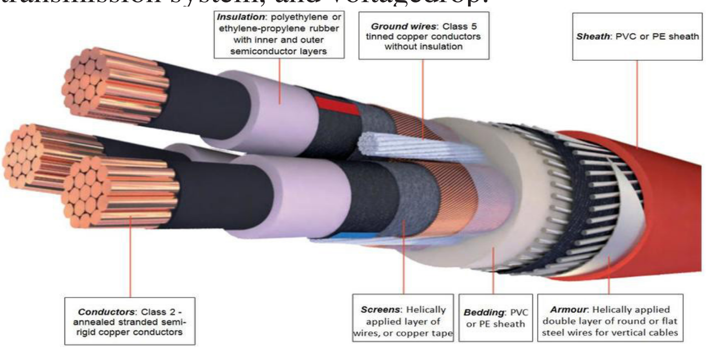

Figure 1 A generic illustration of an electric power cable is shown

Current and voltage descriptions work well for defining the state of a circuit at a specific point along a TEM or quasi-TEM line, which is fortunate. This is an approximation, and the designer must be aware of where it falls short.The following chapter will have to wait for such awe-inspiring effects. Once the problem of transmission line descriptions has been simplified to current and voltage, R, L, and C models of transmission lines can be developed.Transmission lines use a number of models depending on the desired level of accuracy and frequency of operation. To simulate uniform interconnects, transmission line parameters (e.g., Z0 and against frequency) or arriving at a distributed lumped-element circuit might be employed (with regular crosssection). In EM modelling software, planar interconnects are represented as having zero thickness (Figure 2). This is appropriate for microwave interconnects since the thickness of a planar strip is usually much less than the width of the connector. Many analytic formulations have been proposed for the attributes of uniform interconnects. These formulas are critical in the development of synthesis formulas for design (i.e., arriving at the physical dimensions of an interconnect structure from its required electrical specifications). They also offer details on the impact of materials and shape. Simplifying the geometry of the kind depicted in Figure 2 for microstrip can lead to substantial errors in rare instances. Even more complex computer algorithms must simplify the real world in order to capture true geometry.Density fluctuations in the dielectric, for example, cannot be considered. As a result, many RF and microwave structures necessitate observations in order for simulations to be "calibrated."

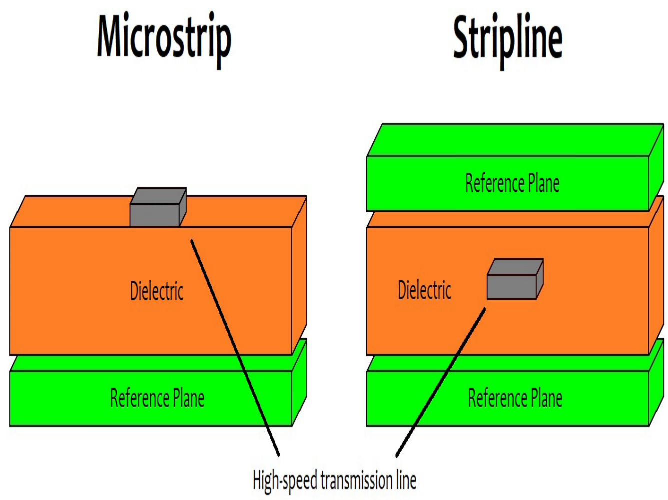

Figure 2 A Microstrip

Unfortunately, taking measurements at microwave frequencies is similarly difficult. As a result, one of the principles in RF circuit engineering is that self-consistent models of transmission lines and dispersed elements must be developed through measurements and simulations.

2. Transmission Line Theory

A segment of uniform transmission line (i.e., a transmission line with constant crosssection along its length) can be described by the circuit depicted in Figure 3. The primary constants are as follows: As a result, resistance, inductance, conductance, and capacitance per unit length are sometimes referred to as R, L, G, and C. (Per unit length is sometimes abbreviated as p.u.l.) In the metric system, ohms per metre (/m), henries per metre (H/m), siemens per metre (S/m), and farads per metre (F/m) are used.The R, L, G, and C values. G and C are almost exclusively determined by dielectric properties, whereas R is primarily determined by metal loss. Because most transmission line materials have r = 1, L is largely a function of geometry. Because most transmission lines have low series resistance and shunt conductance, the effects of L and C tend to dominate. The line's propagation characteristics are described by its loss-free, or lossless, equivalent line, despite the fact that some information about R or G is necessary to calculate actual power losses.The lossless idea is a practical and accurate approximation. The lossless approximation is invalid for tiny on-chip connectors due to their high resistance.

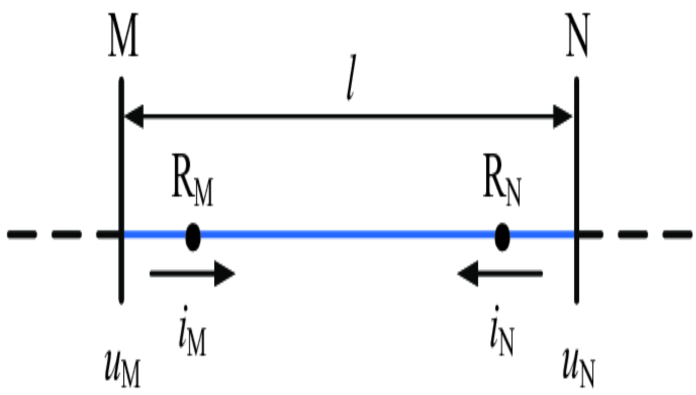

Figure 3: The transmission line is uniform.

3. Transmission Line Model with Frequency Dependence

Using Matlab software, a frequency dependent transmission line model was created in the submitted work. The frequency-dependent resistance, reactance, is used to generate the characteristic admittance and propagation function. Radio frequency toolbox is used to apply the calculated values. The transmission line parameters are then used to create the Universal Line Model (ULM).The frequency-dependent transmission line model is described and contrasted with the classic pi-section transmission line.

In the study that was submitted, the simulation findings for two different frequency levels, 60 Hz and 50 Hz, were presented.60 Hz frequency signals are used to transfer energy in the same way that they are used to transport data in countries in the West.The voltage source generates a 60 Hz sine wave, and the simulation results are shown in graphical form.The RLC on the Pi-Section Transmission Line in use is set to 60 Hz, which matches the frequency of the voltage supply. In steady state, the input and output terminal voltages of the transmission line for both types exhibit good agreement, as shown in the figure. According to simulation results, the voltage source provides a 60 Hz sine wave with a 10 kHz modulation. The Pi-Section Transmission Line's RLC parameterization is still based on a 60 Hz input. The pi-section model is only good for extremely narrow band signals, but the bespoke frequency-dependent transmission line model is clearly better for broader band signals.The results for frequency 50 Hz have also been shown. It has been noticed that the system performs in a similar fashion to that of 60 Hz. The frequency-dependent transmission line model, as shown in the results at 50 Hz, is acceptable for larger band signals.

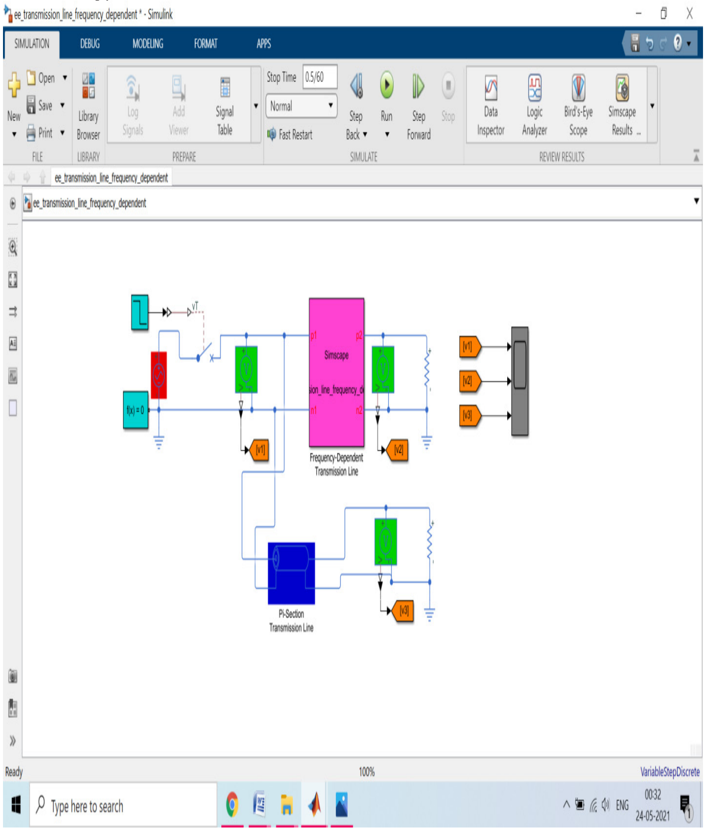

Figure 4 The model for the proposed transmission line is shown.

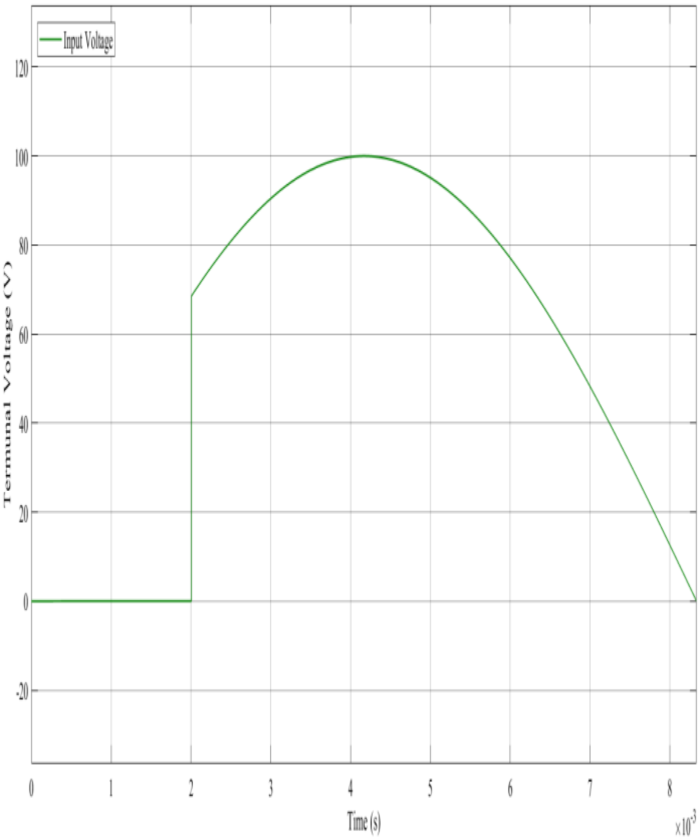

Figure 5 shows Input voltage to system

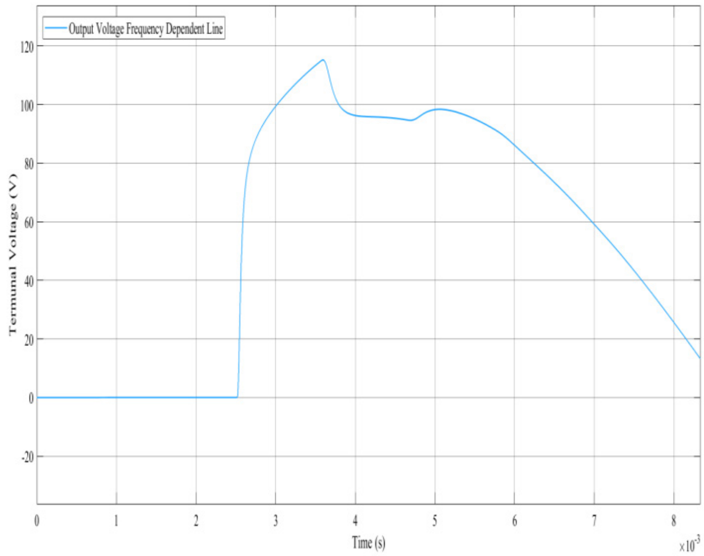

Figure 6 Shows a frequency-dependent output voltage line.

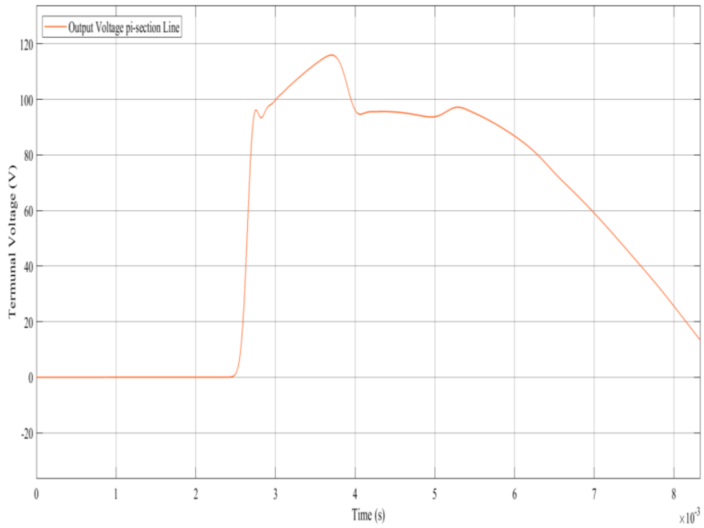

Figure 7 Output voltage pi-section linear is shown.

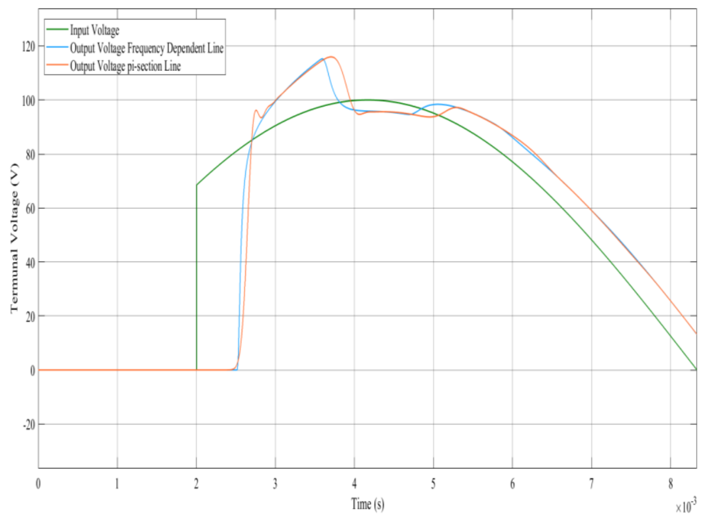

Figure 8 With a 60Hz frequency, compare the input and output.

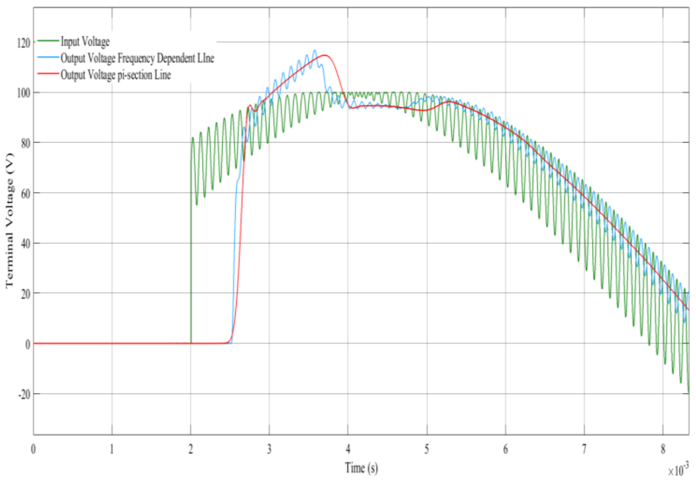

Figure 9 With modulation at 60 Hz to the system, a comparison of the input and output is made.

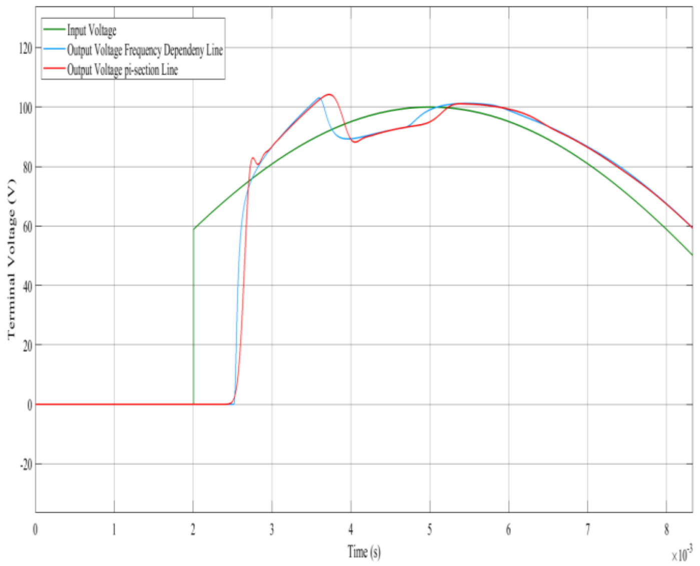

Figure 10 With a frequency of 50Hz, compare the input and output.

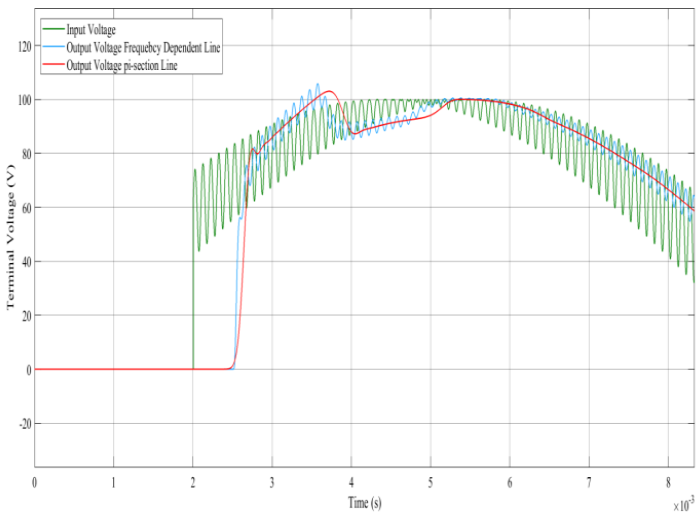

Figure 11 With modulation at 50 Hz to the system, a comparison of the input and output is made.

4. Conclusion

A transmission line, also known as a coaxial line, strip line, or two wire line, is an electromagnetic structure made consisting of metal formed into wires. Electromagnetic theory is required for the analysis of transmission lines in order to determine the transmission line parameters. To examine the characteristics of a lengthy stretch of transmission line, such as a coaxial cable, various metrics are required, such as resistance, inductance length of wire, and so on. For easier analysis, the results are given in a graphical format.

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