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Using the one layered TLM approach, we analyzed RLC circuits with lumped boundary damping examples

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ABSTRACT

Uses one-dimensional TLM technique to study transient behavior of a lumped parameter RLC circuit in this work under varied damping conditions A stub model of the procedure described above is used to obtain the algebraic iterative equation from the circuit model. As a consequence of this, the model equations developed using the TLM approach are organized systematically for ease of implementation into the current MATLAB program. Classical analysis was evaluated using a differential equation as a reference approach for comparison. We also compare our findings with those obtained by the conventional assessment approach. PSCAD's Bergeron model is used to simulate transmission line geometry. Single line to ground failures may only trip the defective phases using an innovative, non-iterative approach for addressing under-reach in the fundamental distance relaying system. In the event of a line-to-ground failure, COMTRADE files contain a time series of phase current generated by PSCAD/EMTDC software. Use this data in the non-iterative MATLAB code.

I. INTRODUCTION

Protection Relaying: Its Goals and Necessities

For the most part, transmission cables are safeguarded by distance relays [7]. When there is a significant difference in impedance between a relay and the fault site, they are able to detect the problem. Due to the relatively constant transmission line impedance, these relays can detect how far away a transmission line defect is. They isolate abnormal or fault situations in transmission networks by delivering trip signals to the relevant circuit breaker, which then shuts down.

Distance Relay in Power System

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To begin with, [1] explains the TLM approach, and from there, [2-7] go on to elaborate on it. For electromagnetic structures, they explained that it is a mechanism for discretizing space and time. For both numerical and creative electromagnetic issue analysis, the TLM approach is a powerful tool, and it also offers a potent way for solving lumped parameter electric circuits analytically. Being lumped refers to anything that is concentrated rather than dispersed.

An arbitrary frequency dispersive barrier [9-10] and nonlinear electromagnetic structures [11-12], and materials [12-13] have been used to the TLM approach. [8-12]. For lumped parameter RLC circuits with various damping cases, there seems to be no documented work on the subject.

The TLM technique is used to investigate an RLC circuit with various damping levels. So, there were two steps to take into account [3]. When deriving the fundamental algebraic equations, one must first construct an analogous TLM system by adding a suitably lumped network.Iterative methods are utilized to solve the network at a second step of the analysis process. As a result, the next portions of this document are arranged as follows: We go into detail about the project's conception and implementation in Section 2 of our report. There are transients covered in Section 3. Section 4 presents the statistical results, while Section 5 wraps up the discussion."

2. METHODOLOGY AND FORMULATION

Following is an example of how we may represent capacitors based on the "Stub" paradigm. In Fig.1 at the point in time k[6]:

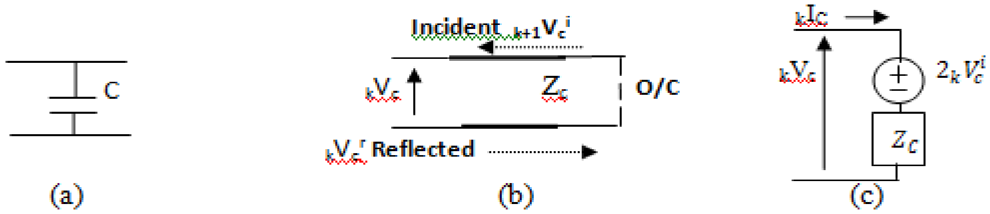

Fig. 1. (a) Capacitor, (b) Stub model, (c) Thevnin's equivalent of the stub model .

Ld and Cd are the error inductance and pure capacitance of the stub model illustrated above. The line is l in length and takes t to complete a round trip.

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From the Fig. 1.(b) => $C_d \Delta l = C$

Velocity of propagation, $u = \frac{\Delta l}{\Delta t/2} = \frac{1}{\sqrt{L_d C_d}}$

$$\Rightarrow L_d = \frac{(\Delta t)^2}{4C\Delta l} \quad (1)$$

So its characteristics impedance,

$$Z_C = \sqrt{\frac{L_d}{C_d}} = \Delta t \quad (2)$$

$$Cd \ \ 2C$$

From Fig. 1. (c) => we can write for k+1 step,

$$k+1Vc^{i} = kVc^{r} \qquad (3)$$

Choosing open circuit termination with a reflection coefficient of 1 is a fair option. The 'Stub' model of inductor is shown in Fig.2 at time step k from [6] for comparison:

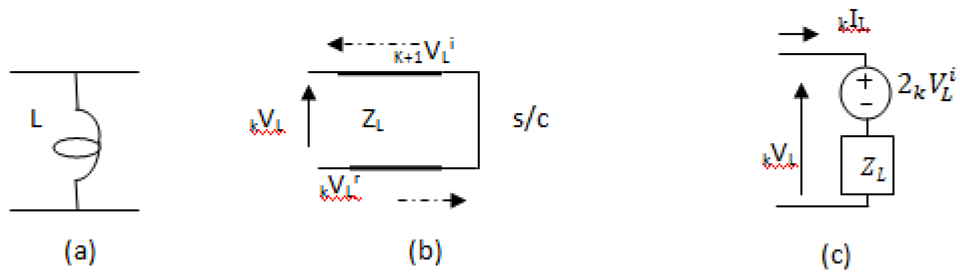
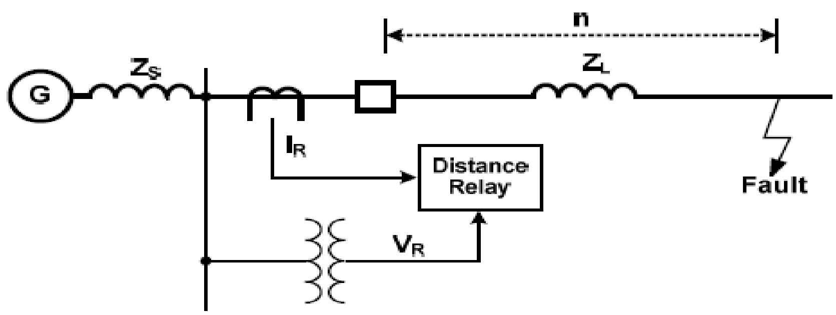


Fig. 2. (a) Inductor (b) Stub model (c) Thevnin's equivalent of the stub model.

Operation of distance relay

Instrument transformers are used to connect the power line to the distance relay as indicated in Figure 2. For nZ1L ohms away from the fault, VR will be equal to IrnZL's reduced resistance due to the distance the relay is from the fault.



Therefore, the impedance of the distance relay is:

$$Z_R = \frac{V_R}{I_R} = \frac{I_R nZ_{1L}}{I_R} = nZ_{1L}$$

3. TRANSIENT ANALYSIS WITH DAMPING

Analysis of circuit activity shortly after an independent source has been switched on or turned off, known as transient analysis. As the oscillations of a circuit become more stable, the damping factor is the degree by which this stability decreases.

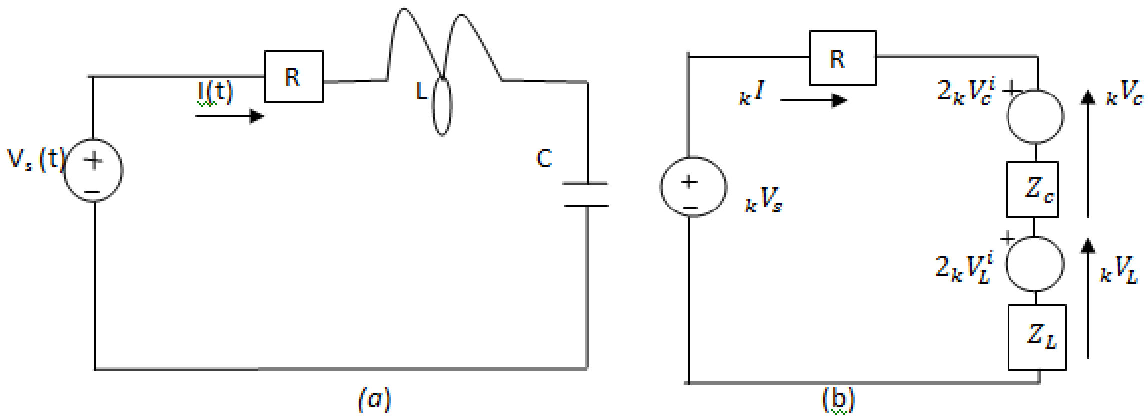


Fig. 3 . (a) Series R-L-C Circuit (b) TLM equivalent using stub model.

4. NUMERICAL RESULTS

Fig. 3 shows the circuit with a time step of k=201 and a total duration of t=(201-1)*0.1=20 s. This is a situation with excessive damping (L=1 H, R=3, and C=1 F), critical damping (R = 2 , L=1 H and C=1 F), a damping value of 1, L = 1 H and C=1 F, and an applied voltage of Vs(t) of 10V. Analytical data are provided here for various round trip times t:

CONCLUSION:

To remove under-reach correction of distance relays in both single and double circuit transmission lines, the suggested method works effectively. Above, the findings and simulation have been validated and demonstrated. When a problem occurs, just the affected relays are turned on. Using this approach, no relays fail. TLM's validity was tested by comparing the findings of circuits with lumped elements to those obtained using classical analysis. Analysis findings from both traditional and TLM approaches were equal in form, regardless of the method used. The TLM method's analytical outcome degrades dramatically as the round-trip duration increases.. When we assumed a round trip duration of 0.1 seconds, we received an overlapping form. Actually, TLM is a really easy strategy that anybody can pick up and use without any difficulty. You may skip specifying an initial value for the necessary amounts. Only if all of the initial incident voltages are zero should this assumption be made. If you're looking to solve both distributed and lumped parameter electric circuits, then the TLM technique is a good option. A study of how the round trip timings of TLM method electric circuits impact further lumped parameters may be conducted in the future.

REFERENCES

1. R.N. Mukerjee and Mohd Faris Bin Abdullah, "Under-reach correction in twin circuits without residual current input from parallel lines," *IEEE Trans. Power Del.,* vol. 23, no.3, pp. 1359-1365,Jul.2008.
2. Chandrasekhar Reddy Atla, S.G. Srivani, and K.P.Vittal, "Comparative Evaluation of Adaptive and Conventional Distance Relay for Parallel Transmission Line with Mutual Coupling," *Proceedings of world academy of science, engineering and technology*, vol. 32, pp. 572-578, August 2008 ISSN 2070-3740.
3. Bin Su, Jianping Wang, Ying Yang, Weixing Gong, and Yongsheng Xu, "Setting Considerationsof Distance Relay for UHV/EHV Long Transmission Lines," *IEEE 2007.*
4. Ching-Shan Chen, Chih-Wen Liu, and Joe-Air Jiang, "Application of combined adaptive Fourier filtering technique and fault detector to fast distance protection," *IEEE transactions on power delivery,* vol. 21, no.2, pp. 619-626, April 2006.
5. S.H. Horowitz, and A.G. Phadke(2006), " Third Zone revisited ,"*IEEE Trans. Power Del.,* 21(1), 23-39.
6. J.A. Jiang, C.S. Chen, and C.W. Liu, "A new protection scheme for fault detection, direction discrimination, classification, and location in transmission lines," *IEEE Trans. Power Del.*, vol. 18, no. 1, pp. 34–42, Jan. 2003.
7. P. Russer, *The transmission line matrix method, in Applied Computational Electromagnetics, ser. NATO ASI Series* (Springer, Berlin, 2000), pp. 243–269.
8. D.G. Swanson, W.J. Hoefer, *Microwave Circuit Modeling Using Electromagnetic FieldSimulation* (Artech House, London, 2003) .
9. C. Eswarappa, W.J. Hoefer, One-way equation absorbing boundary conditions for 3-D TLM analysis of planar and quasi-planar structures. *IEEE Trans. Microw. Theory Technol.*Vol. 42, no. 9, 1994, pp. 1669–1677.
10. C.H. Kim, M.H. Lee, R. K. Aggarwal, and A. T. Johns, "Educational use of EMTP models for the study of a distance relaying algorithm for protecting transmission lines," *IEEE Transactions on Power Systems,* vol. 15, no.1, pp. 9–15, Feb 2000.
11. V. Paniraj, and A. G. Phadke, "Modeling of circuit breakers in the EMTP," *IEEE Transactionson Power Systems*, vol. 3, no. 2, pp. 799–805, 1999.

ISSN- 2394-5125 VOL 8, ISSUE 05, 2021

12. M.I. Gilany, O.P. Malik, and G.S. Hope, “A digital protection technique for parallel transmission lines using a single relay at each end,” *IEEE Trans. Power Del.*,vol. 7, no.1, pp. 119-123, Jan.1997.