ELEC ENG 2CF3

Assignment 6

Voltage and Current Traveling Waves in Transmission Line Equivalent Circuits

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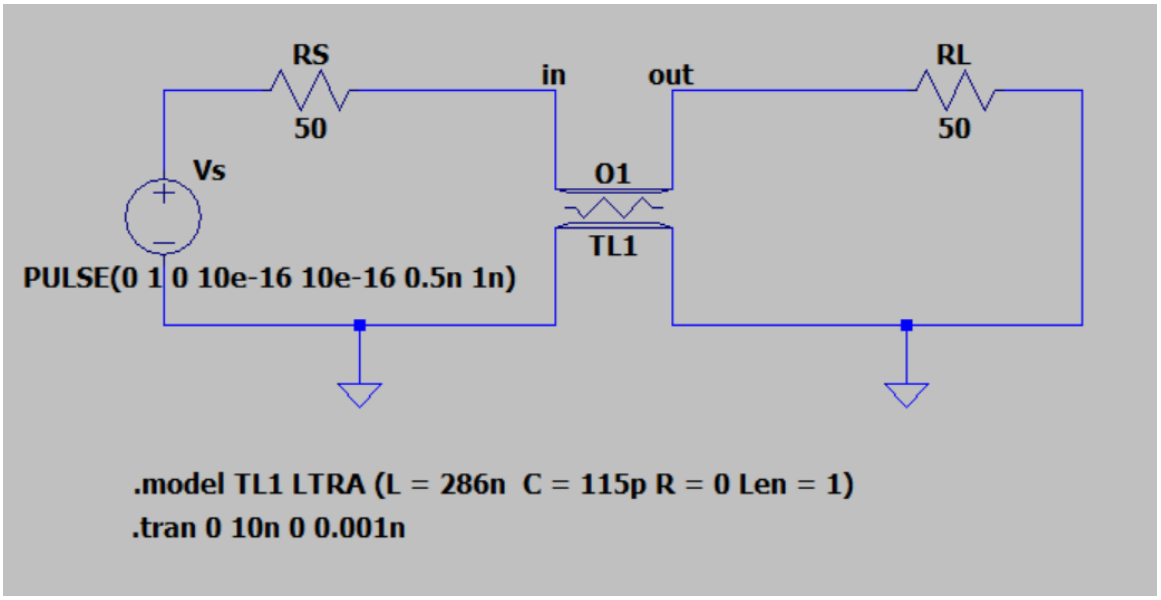
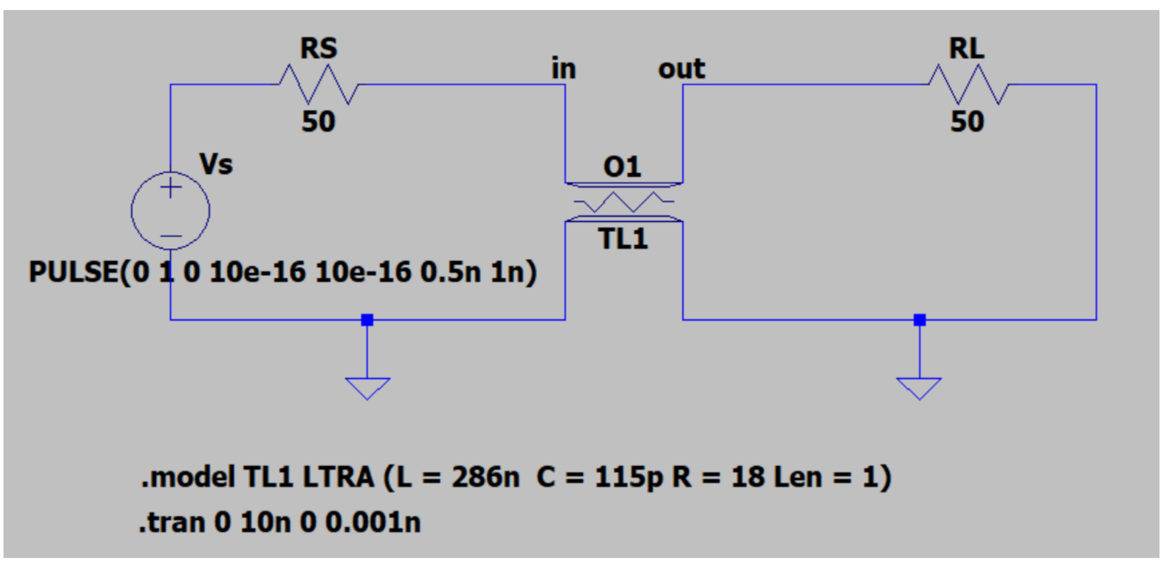
EXERCISE 2: LOSSY TRANSMISSION LINE

1. Include the complete LTspice schematic for both loss-free and lossy TL

Loss-free TL



Lossy TL



2. Include the complete LTspice netlist for both loss-free and lossy TL (View→SPICE Netlist).

Loss-free TL

```
* C:\Users\Areeba\Desktop\winter 2023\2CF3\Assignmet
6\exercise2_lossfreeTL.asc
O1 in 0 out 0 TL1
RL 0 out 50
RS in N001 50
Vs N001 0 PULSE(0 1 0 10e-16 10e-16 0.5n 1n)
.model TL1 LTRA (L = 286n  C = 115p R = 0 Len = 1)
.tran 0 10n 0 0.001n
.backanno
.end
```

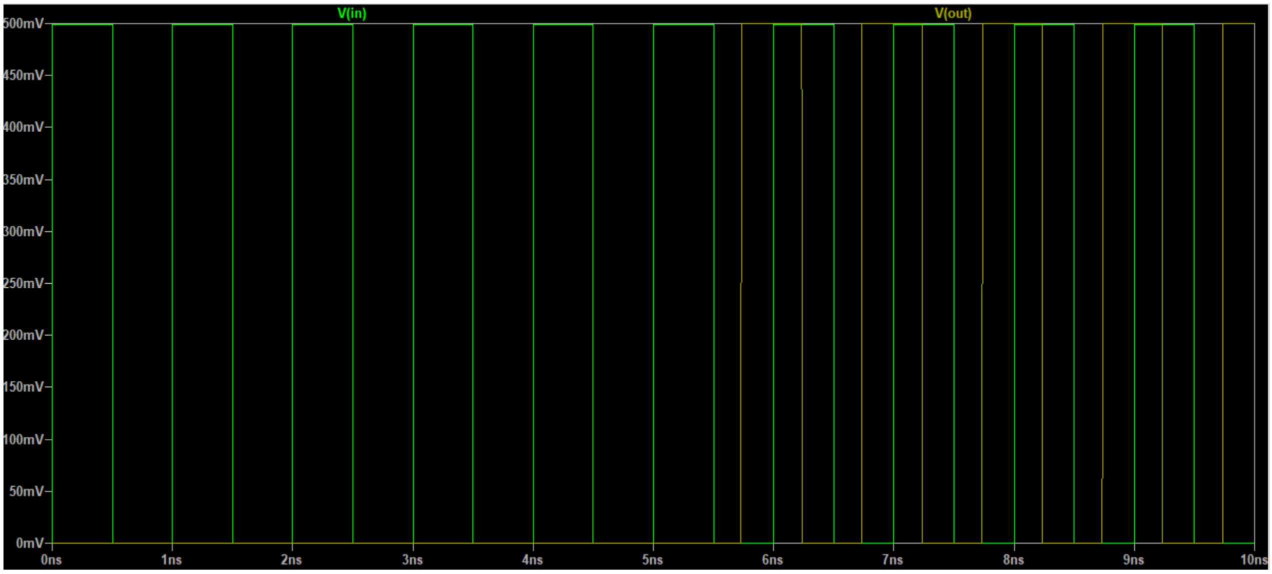
Lossy TL

```
* C:\Users\Areeba\Desktop\winter 2023\2CF3\Assignmet 6\Draft4.asc
O1 in 0 out 0 TL1
RL 0 out 50
RS in N001 50
Vs N001 0 PULSE(0 1 0 10e-16 10e-16 0.5n 1n)
.model TL1 LTRA (L = 286n  C = 115p R = 18 Len = 1)
.tran 0 10n 0 0.001n
.backanno
.end
```

3. Include the LTspice (*.asc) file for both loss-free and lossy TL, named properly, e.g., Exercise2_lossfreeTL.asc and Exercise2_lossyTL.asc.

The name of the files are exercise2_lossfreeTL and exercise2_lossyTL

4. Include the plot of the vin(t) and vout(t) waveforms from the loss-free TL simulation (single plot).



5. Include the plot of the vin(t) and vout(t) waveforms from the lossy TL simulation (single plot)

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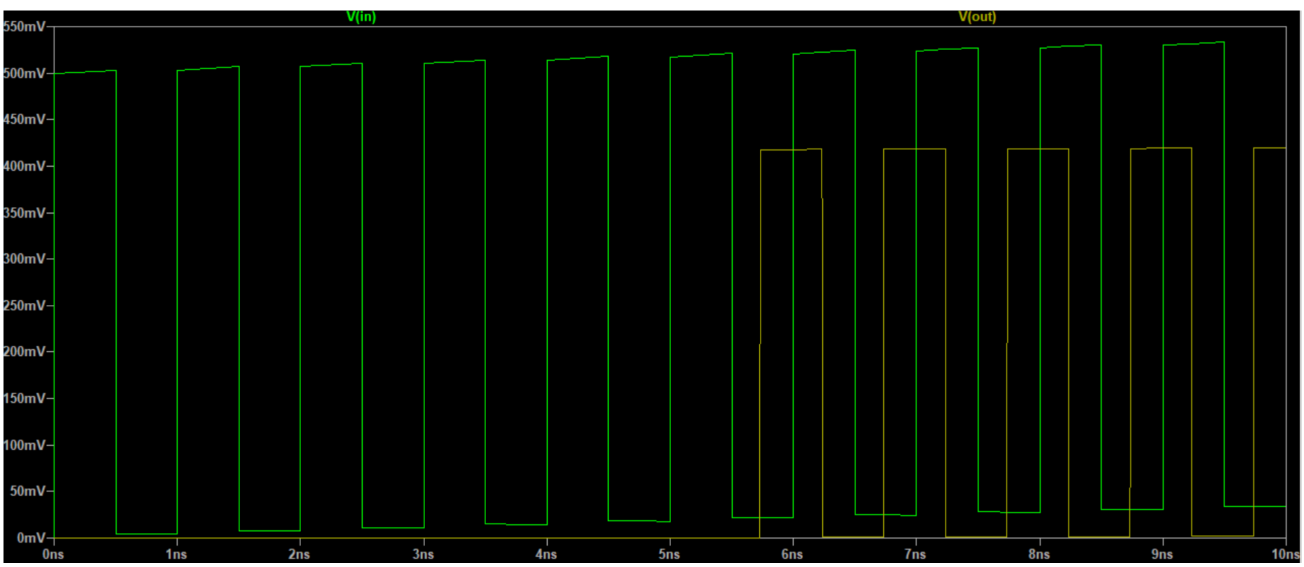

6. Compare the magnitude vout(t) in the loss-free TL compared to the magnitude vout(t) in the lossy TL. Based on these two values, calculate the attenuation of the lossy TL in dB/m. You do not need to compare this calculation with analytical calculations.

The magnitude of vout(t) for the loss-free TL is about 500mV while the magnitude of vout(t) for lossy TL is about 418.22mV. Since the first circuit is loss-free TL it retains the vin(t) while the lossy TL loses from the vin(t).

Calculation:

Attenuation constant = [20log(500mV/418.22mV)] / 1

= 1.5513 dB/m

The attenuation constant of the lossy TL is 1.5513 dB/m

7. What is the time delay td between vin(t) and vout(t) in the lossy TL?

The time delay between vin(t) and vout(t) in the lossy TL is about 5.74 ns. This can be observed on the graph.

8. Calculate the phase velocity vp in the lossy TL using the time delay td found in Question 7. The length of the TL is 1 m.

Calculation:

Vp = 1 / td
= 1 / 5.74 ns
=1.74×10^8 m/s

The phase velocity in the lossy TL in 1.74×10^8 m/s

9. Compare the obtained phase velocity vp with the analytical value, which you can compute using your MATLAB code at the repetition frequency 1 / T where T = 1 ns. Is there a good agreement? Please, state clearly the values of the simulation-based and the analytical phase velocities.

Based on values from the simulation, the calculated vp came out to be 1.74×10^8 m/s. This can be compared to the analytical phase velocity on MATLAB. On MATLAB, the phase velocity is about $1.74116888.5 \times 10^8$. As it can be seen, these values are very close to each other and are in good agreement.