

## ECE 546 HOMEWORK No 11 Due Friday, May 8, 2026

Latency Insertion Method (LIM) is an emerging circuit simulation algorithm. In this homework, we will use the LIM simulator for some signal integrity simulations.

In the report, you need to attach screenshots of simulation results and answers to the questions.

### 1. Get access to the LIM simulator

Open a browser, go to <https://csim.synclesis.com> and login with the credential the TA provides.

Below is the brief introduction to the interface with its most important features to get you started.

You can also follow the tour on the website as you visit it.

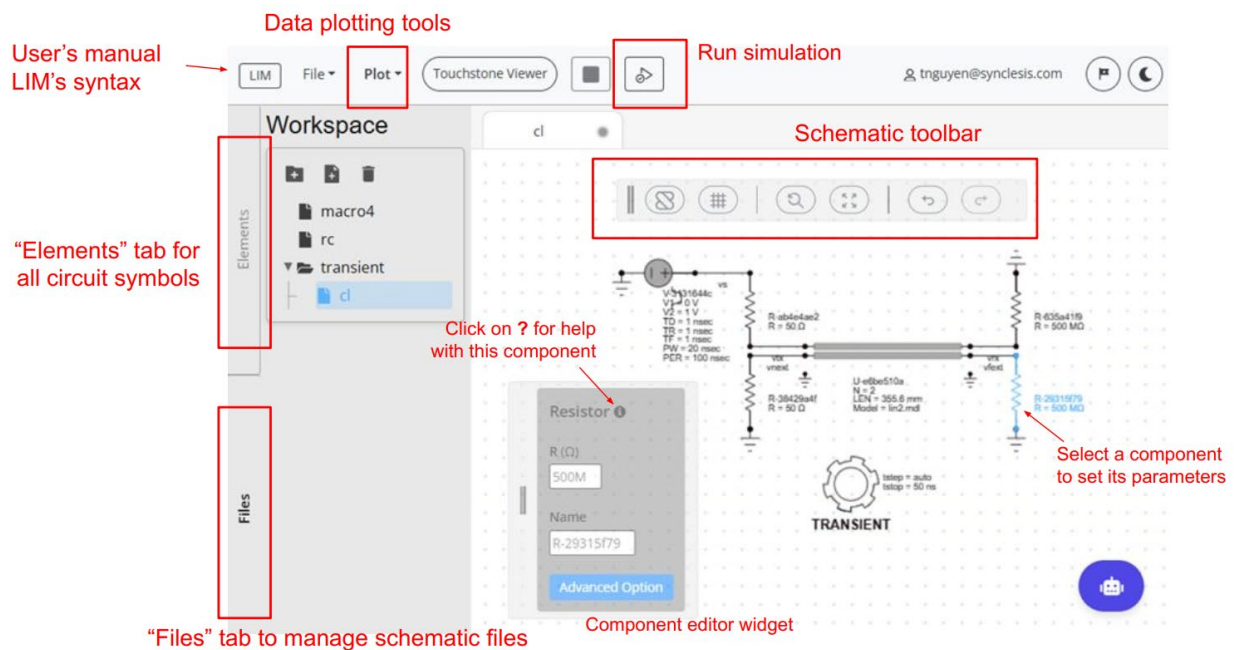


Figure 1 - CSIM interface

### 2. A coupled-line simulation

In this homework, we will verify the coupled-line response using LIM, a transient circuit simulator. Create a schematic as shown in Figure 2. The lossless coupled-line is a U-element in LIM. It can be found in the “**Transmission lines**” component group.

The coupled-line is 14-inch long and has its per-unit parameter given as:

$$L = \begin{bmatrix} 418 & 150 \\ 150 & 418 \end{bmatrix} (nH / m) \quad C = \begin{bmatrix} 0.118 & -0.022 \\ -0.022 & 0.118 \end{bmatrix} (nF / m)$$

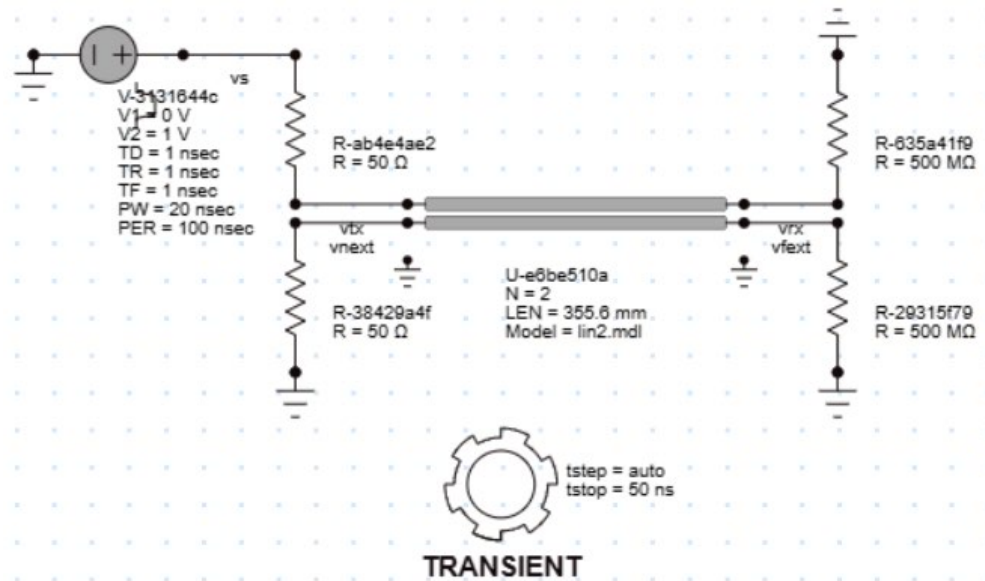


Figure 2. Schematic for couple-line simulation.

LIM receives this information through a model file. **Read the LIM user manual to find the format of this file.** Once you have the model file created, attach the model to the U-element component by uploading it in the “**Model**” section of the component in the *Component editor widget*. See Figure 3 for more information.

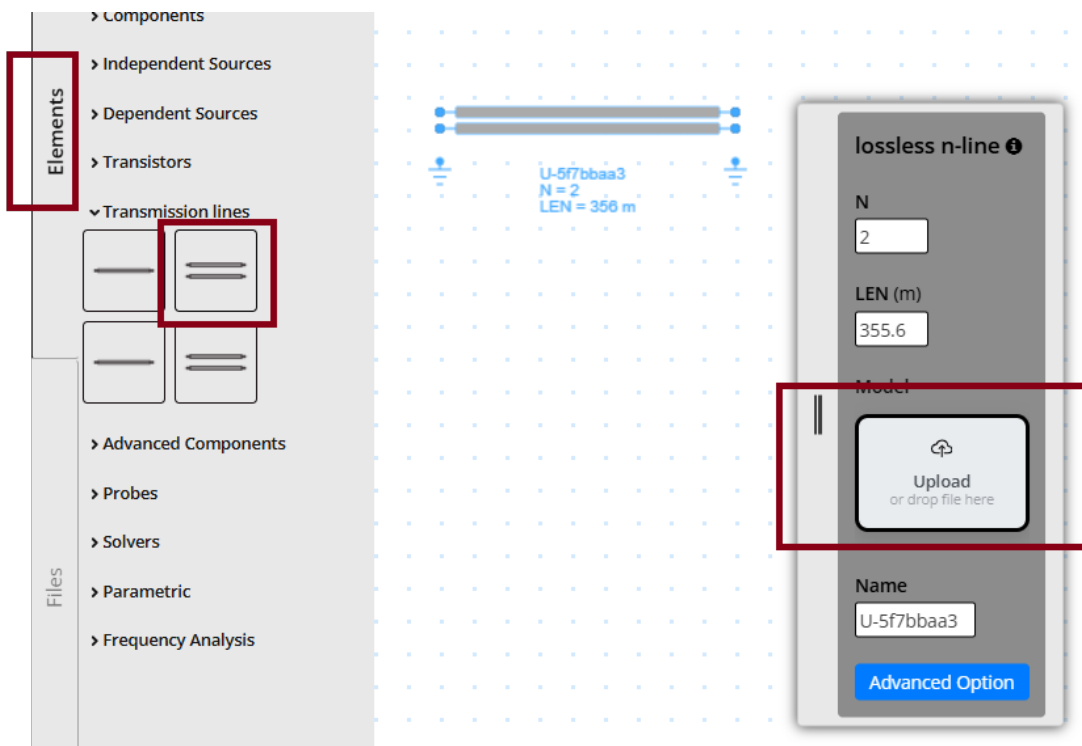


Figure 3 - U-element and its parameters in Component Editor widget

1. In Figure 2, the far ends of the lines are terminated with  $500\text{M}\Omega$  resistors. This is practically leaving the lines open. Simulate the circuit. Include a plot of the near-end cross-talk (NEXT) and the far-end crosstalk (FEXT) in your submission. They should match the result you get from your program in Homework 4.

2. Based on your understanding of coupled-lines and how traveling waves are formed on the victim line. Describe in words and sketch a rough waveform of what the NEXT and FEXT should look like if the lines are properly matched.

Next, we will run some experiments to verify your prediction above.

3. Terminate the far-ends of the lines with a  $\pi$ -network. In Figure 4, we use a **PARAM** element to define **Rm** and **Rg** resistors. **Rg** is the value of the shunt resistors (to ground), **Rm** is the value of the mutual resistor (connecting the two lines).

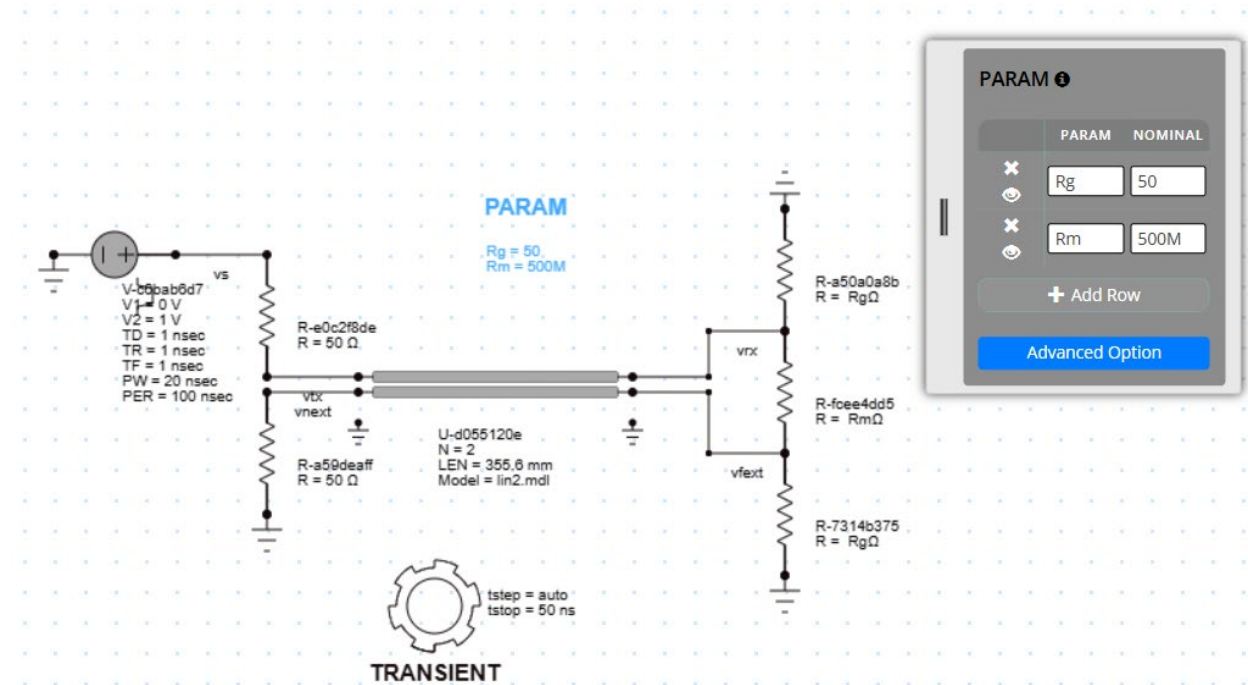


Figure 4. Terminated coupled-line with a parametric  $\pi$ -network

Figure 4 shows a naive termination,  $R_g = 50\ \Omega$ ,  $R_m = 500\text{M}\Omega$ . This is when you terminate the coupled-line as if they were non-coupled single lines. Show the NEXT and FEXT result in this case.

Next, we will perform a parametric sweep on **Rm**. We want to bring its value **down** in the sweep to represent that the coupling termination should be a finite number, not an open-circuit. To enable a parametric sweep on **Rm**, from the **PARAM**'s *Component editor widget*, click on **Advanced Option**. See details in Figure 5.

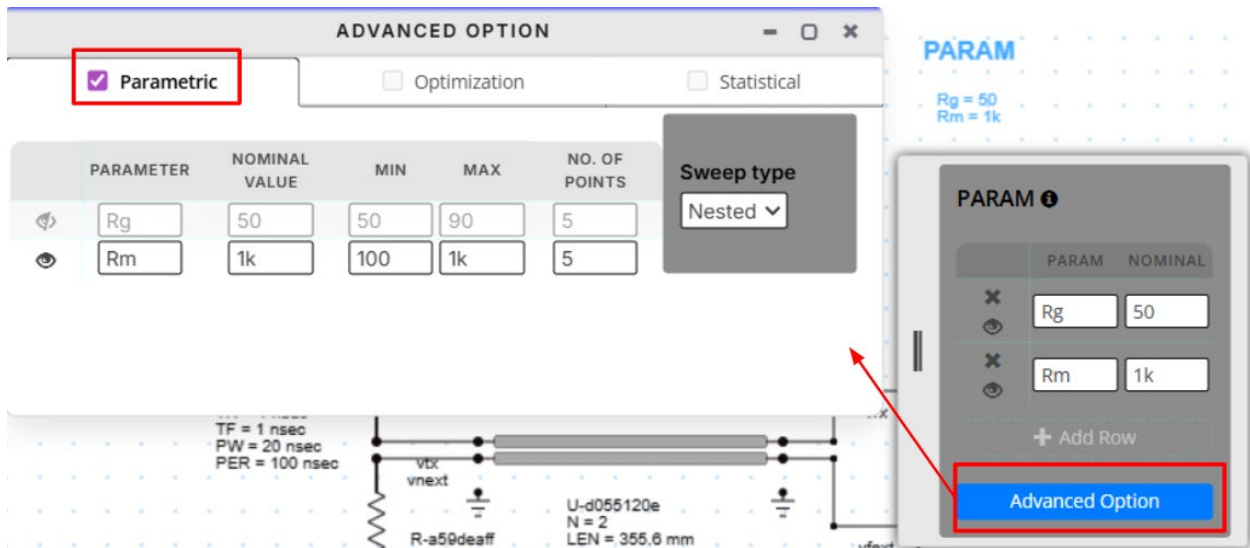


Figure 5. Advanced Option menu for **PARAM** component

Fill in the sweeping values for **Rm**: from 100 to 1k with 5 points. Disable the **Rg** sweep for now. This will keep its value at nominal value (50Ω) Remember to check the box **Parametric** to enable parametric sweep.

Show **NEXT** and **FEXT** response. You should get the results like Figure 6

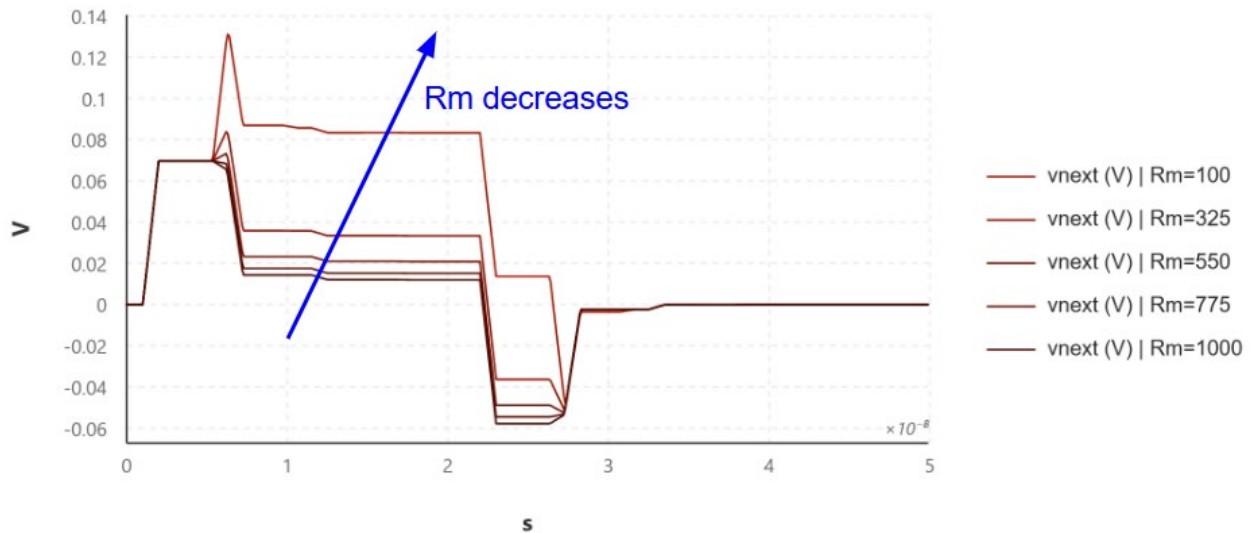


Figure 6. **NEXT** response for varying resistive coupling

Use the parametric **FEXT** responses (remember, so far we keep **Rg** = 50Ω and **Rm** was swept) to comment on the effectiveness of matching the coupled-line with this configuration.

4. Use the calculated value of **Rg** from Homework 4. Repeat the sweep of **Rm** and compare the results. Finally, show the result of all 4 voltages (**TX**, **RX**, **NEXT** and **FEXT**) when the coupled-line is properly matched.