CEM HW2 – 1 dimension FDTD

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# How to Execute:

1. Environment: Unix-like system.
2. Language: core function in c++ and matlab for data processing.
3. How to use:
   1. Use “make” to compile the c++ code.
   2. Running the execution file “FDTD”. How to set the parameter is explained below. You can also use FDTD –h to see the usage. The program will directly output the simulation data, redirect them to file by “./FDTD > file”
4. Parameter explanation:

|  |  |  |  |
| --- | --- | --- | --- |
| Format:  time | Type | Meaning | Default value |
| -C | Double | Capacitance of line | 1 |
| -L | Double | Inductance of line | 1 |
| -f | Double | Maximum interesting frequency | 1 |
| -X | Double | length of simulation | 2.5 |
| -N | int | Split how many section per lambda | 15 |
| -t | double | Simulation time | 10 |
| -s | Double | source impedance | 1 |
| -l | double | Load impedance | 1 |
| -S | string | Name of source(available: single frequency, gaussian) | Single |

1. Make chart:

Since this program is write in c++, and difficult to write graphic interface. The chart in this report are produced by excel parsing the dump out data.

At the beginning of dump data list the time/delta\_t/x/delta\_x, and then the simulation data. Open file with excel using space as delimiter. The row stand for time, and column stand for position on transmission line.

1. Fourier transform:

The fileparser.m in the folder allows matlab to parse the dump data.

$ [info source data] = fileparser(‘file’)

Then data will store the simulation data, with x as first index, time as second.

For example, to see the load voltage data, you can use:

$ plot(data(end,1:end))

# Execution result:

1. Single frequency:

Simulation response on source impedance=0.6, load impedance=2, max interest frequency=4Hz single frequency source. The chart plot the voltage status when time = 10 sec.

1. Gaussian source:

Simulation response on source impedance=0.6, load impedance=2, max interest frequency=4Hz Gaussian source.

The Gaussian pulse arrive load at 2.5sec, and reflect wave arrive at 7.5sec. This chart shows a little effect of numerical dispersion.

1. Gaussian source with matched load:

Since the load impedance is now matched to impedance of transmission line, the reflect wave at 7.5 sec is disappear.

# Discussion:

1. Stable condition:

I found that, sometimes even though delta\_t within courant limit, the solution still can’t converse. Usually it occurs when Rs or Rl is less than character impedance of transmission line. Since the term in update equation:

Might explode when Rs, Rl is too small.

Theoretically, this problem can be fixed by choosing smaller delta\_t. However, I set up limit on delta\_t, so that between -1 to 1. The simulation result will still diverse. Currently I didn’t find any way to stabilize the simulation if either one resistor is less than about 0.5.