



DESIGN OF A SOFTWARE TOOL FOR MICROWAVE TRANSMISSION LINE ANALYSIS

Bektaş SIVRİ  
Supervisor: Dr. Özlem ÖZGÜN

**Project Description:** The aim of the project is to develop a software which is able to analyse the features of various transmission lines. The chosen transmission line types to analyse are coaxial lines, microstrip lines and waveguides. The software is created by using MATLAB tools.

### The Software Structure for Coaxial Lines

This section is to add delete ports and assign impedances to ports

At this section, the user can determine dimension and material types of coax

The user can observe the results by using these buttons

Optionally, the user can add a stub by using this section

The GUI structure of coaxial line section of the software is shown in left figure. The user must enter the dimensions of the coaxial line and if needed, can add a stub (open or short stub) and define the ports and assign the values of RLC circuit, so that ports were defined as containing a RLC circuit. After then, the user can observe the results from result section of software. The results of software are calculated according to some formulas obtained for transmission lines.

### Display Voltage Values on Patch of Microstrip Line

Rotate on Rotate off

Select voltage source type

Amplitude

Frequency

Phase

Resistance

The software provides the opportunity which is to observe the change of voltage values on patch to the user. The voltage source may have sinusoidal or gaussian waveform.

### The Software Structure for Microstrip Lines

Symbolic representation of microstrip line

This section is used to ports

To determine frequency range, start simulation and observe voltage signal on patch, the buttons are used

At this section, the user can determine the dimensions and material type of line

The user can observe the results by using these buttons

Optionally, the user can add a stub by determining the dimensions and location

While developing the software for microstrip lines, Finite-Difference Time-Domain method was used. Hence that, the simulation operation take a long time. Furthermore, the software calculates the characteristic impedance of microstrip line and assign the value as port impedance. As the other feature of the software, the user can add a stub and create a microstrip filter.

### Display H- or E- Fields Inside of Waveguide

Rotate on Rotate off

The valid wave mode is dominant TE10 mode

Wave Amplitude

Wave Frequency

View Field

The software provides the opportunity which is to observe the change of H- or E- fields inside of waveguide in time.

### The Software Structure for Waveguides

To enter dimensions of waveguide

Symbolic representation of waveguide

To define frequency range, start simulation and display fields step by step

Warning about wave mode

To observe simulation results

To enter prism dimensions and add a rectangular prism

The FDTD method was used for waveguide section of the software. For waveguide, the user can create a rectangular prism inside of waveguide and can be observe S-parameters. However, the waveguide is working only in dominant wave mode i.e. TE10 mode. Furthermore, the user can observe the cut off frequency of waveguide on simulation of free waveguide and by observing S-parameters.

### Compare HFSS Results with The Software for a Microstrip Line

S21 software result

S21 HFSS result

The figure shows two plots comparing the S21 results. The top plot is labeled 'S21 software result' and shows a curve of S21 (dB) versus Frequency (GHz) for a microstrip line. The bottom plot is labeled 'S21 HFSS result' and shows a similar curve, demonstrating a close match between the software results and the HFSS simulation results.