

# Development of a Transmission Line Simulation Tool in Matlab

Semester project, ETH Zürich, D-ITET, MWE laboratory (Prof. Bolognesi)  
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Studies: Master in Electrical Engineering and Information Technology  
Project: Semester project: 250 - 300 hours, 8 credit points (description [here](#))  
Office location: To be defined  
Office requirements: To be defined  
Starting date: To be defined

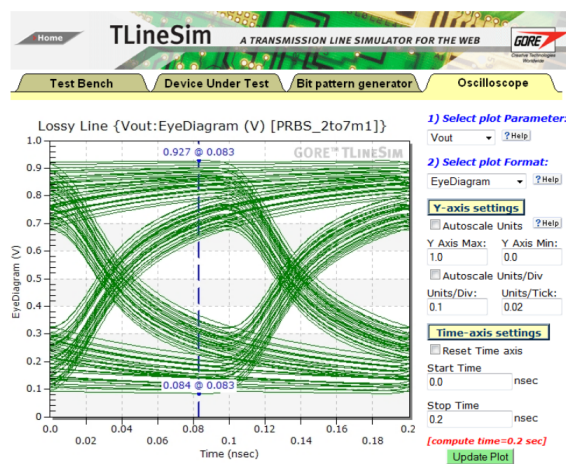
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## 1 Project Description

This semester project aims to implement a graphical MATLAB tool which can simulate a multitude of signal lines in various configurations. Focus lies on flexibility and visualization. It is intended to be used as a learning aid to intuitively understand transmission line behavior in RF-domain. The tool should replace the TLINE SIM [2] network simulation tool which is no longer available [1].



Screenshot of TLINE SIM [2] source: Lecture Slides Prof. C.R. Bolognesi[3]

The user first builds a cascade of transmission lines on the test bench and defines the parameters for the respective transmission line models. Afterwards, he can either study the setup in time or in frequency domain.

### Test Bench

The user defines a series of elements which can be of physical nature, such as coaxial cables, micro-strip lines, or of abstract nature, such as S- or A-matrices, general transmission lines with parameters  $C'$ ,  $R'$ ,  $L'$ ,  $G'$  or lumped  $R$ ,  $L$ ,  $C$  -elements. The respective parameters can be changed by entering numbers or with sliders (e.g. skin effect, length, dielectric constant, transverse dimensions).

## Vector Network Analyzer (VNA)

The VNA can visualize the S-Matrix of the cascaded network in several different formats, such as 20logMag, Polar, Real, Imaginary and Smith chart.

## Time Domain Analysis

For a transient analysis, a multitude of input signals can be chosen. Pseudo-random bit pattern, sine and square wave, and step function are available. To visualize the respective output, multiple oscilloscope functions are available. Especially informative is the combination of random bit input and Eye-diagram output, or the transient response of a step function.

## References

- [1] TLINE SIM, *TLineSim has stopped working*, Tom Clupper  
<http://www.tlinesim.com/>
- [2] GORE, *TLineSim Network Simulation Tool; Provides Virtual Test Bench Capability*, GORE  
<http://www.gore.com>
- [3] Lecture Slides: *High-Speed Signal Propagation*; Course 227-112-00 Fall 2015,  
Prof. C. R. BOLOGNESI

## 2 Project Time line

- **Command Line Interface:**
  - Data structure to represent DUT
  - Transient analyzer
  - Vector Network Analyzer
- **User Interface:**
  - workbench
  - VNA
  - Input Signal
  - Output Signal
- **Supplement:**
  - Report
  - Presentation