Two-wire transmission lines

Outline:

- What is the purpose of this study?
- What and how was done in the study?
- What are possible future directions for the study?

Why study it?

- Two-wire transmission lines are most common today
- Have a simple structure
- Therefore there are not so many dependencies for the parameters
- However, due to the first point, this topic is of great interest and is not extremely complex as a result

What we get from this study

- Understanding of how parameters of the line affect it's characteristics
- Can we use analytical formula in case parameters of the line are equal to certain value?
- Basic skills of using simulation software

  (COMSOL, for instance), although that was not the main point of the study

Example:
Two plate transmission line

- Problems:
  - Plates are infinitely thin
  - Simulation mesh might get very big
- Solutions:
  - Define boundaries of inner square (or rectangle) as conductors
  - Pick appropriate size by trial and error, so that the simualtion results do not change drastically, compared with previous values

Calculating impedance

- We need L and C of the line
  - They are the part of the energy equations
  - Calculate them using these equations:

$$L=\frac{2W_m}{I^2}$$

$$U=\frac{2W_e}{U^2}$$

- Optimization: set 1 for current and voltage in the simulation parameters

Calculating impedance...

- The only step that is left now is:

$$Z = \sqrt{\frac{L}{C}} = \sqrt{\frac{2W_m}{2W_e}} = \sqrt{\frac{W_m}{W_e}}$$

- Then we can calculate the analytical function and compare the plots of two solutions
- In the formula above we consider I = 1A and U = 1V

Two parallel plates

- Consider following:
  - We have two infinitely thin plates of width *w*
  - They are separated by *b* meters of insulator
  - Let insulator be air
  - How impedance of such structure can be calculated?
  - Analytic formula:

$$Z \approx \eta \frac{b}{w}$$

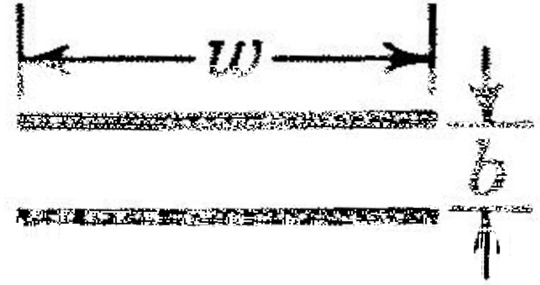

Fig. 1: Cross section of the line

Calculation results

Simulation screens

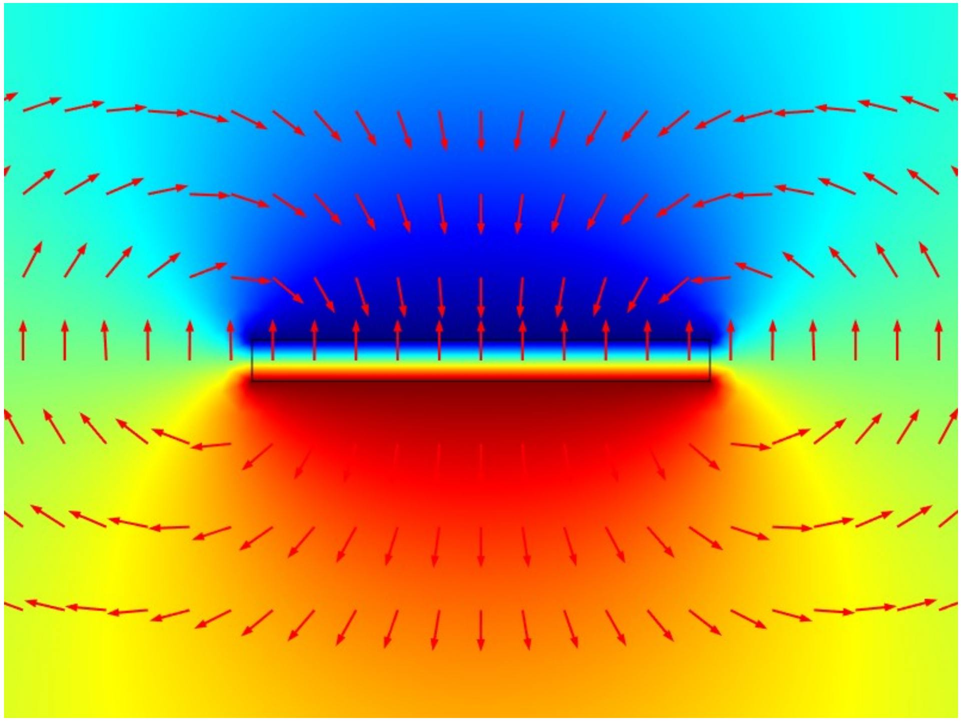

Fig. 2: Electric potential and its density in the two plate transmission line.

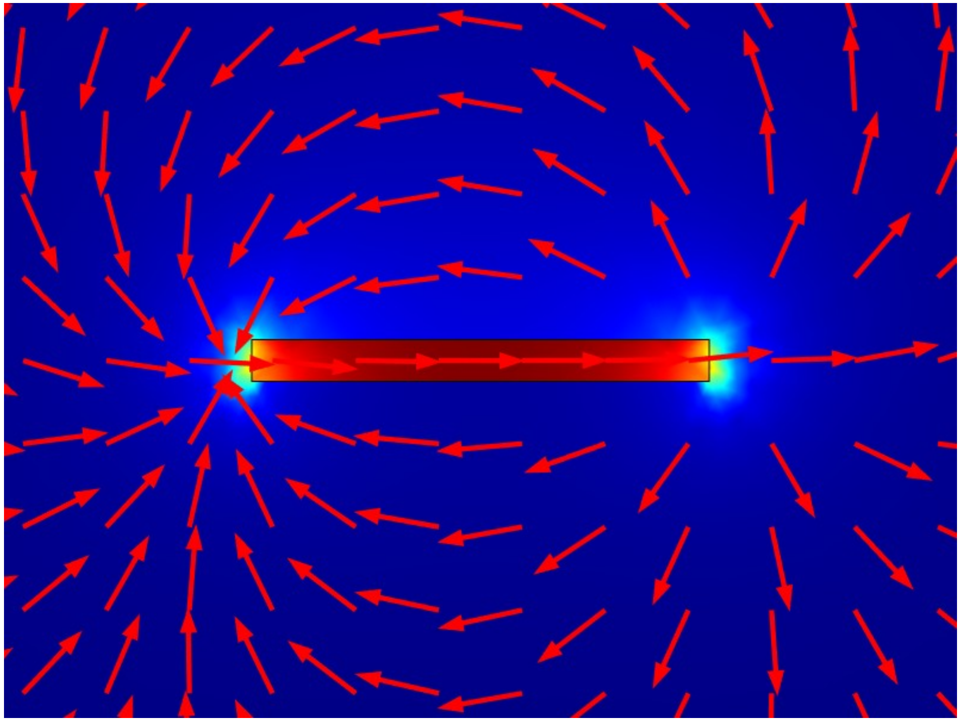

Fig. 3: Magnetic flux and its density in the two plate transmission line.

Some conclusions on case

- It can be seen from plot that the analytical formula is not always correct
- The bigger the plate width gets, the more accurate our estimation is
- The analytical formula approaches values of simulation, meaning that the error is decreasing and consequently getting closer to actual value

Future directions

- Fix simulations that were done improperly
- Make a proper report
- Reviev other cases (Shielded pair, for instance)
- Review different dielectrics (polyethylene, rubber)

COMSOL TIME

- Show some parts of the models in COMSOL
- Questions?