Combline Filter Simulation

1.   Description

Combline filters are a variety of filters that use wavelength capacitively-loaded rods as resonators offering a low loss, rugged and compact design. The rod is usually mounted between flat ground planes. This example deals with a combline filter operating in the frequency range around 880 MHZ. The filter could be used for GSM applications [1]. The simulation was relaized using HFWorks and results show great agreement with measurements.
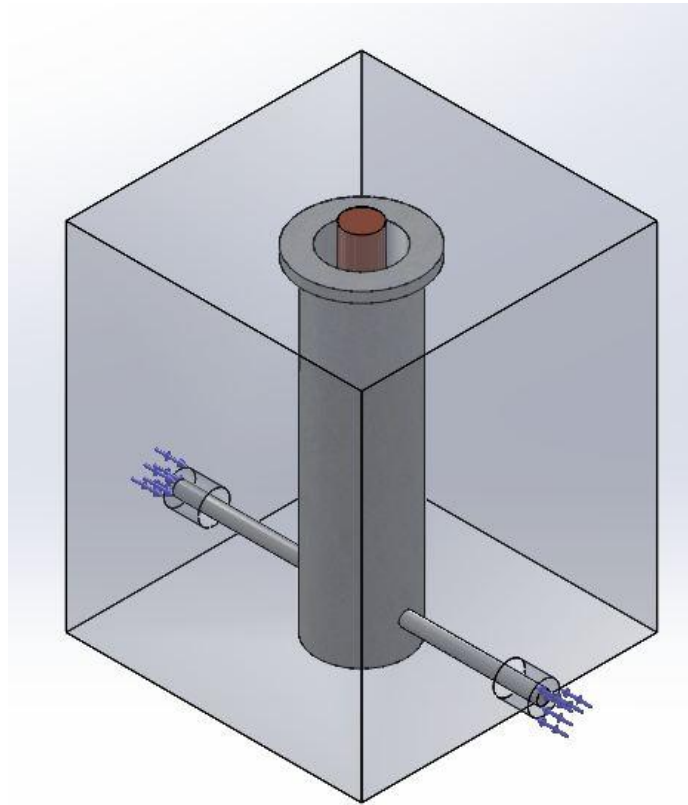

Figure 1: the structure's 3D view in SolidWorks

 The mesh of the structure is finer in the areas of the ports. We can resort to the default mesh of HFWorks which recognizes the dimensions of the structures and applies a pretty convenient mesh. Nevertheless the user has total control on the mesh global size and is able to define mesh controls for areas that he assumes more relevant to the structure.
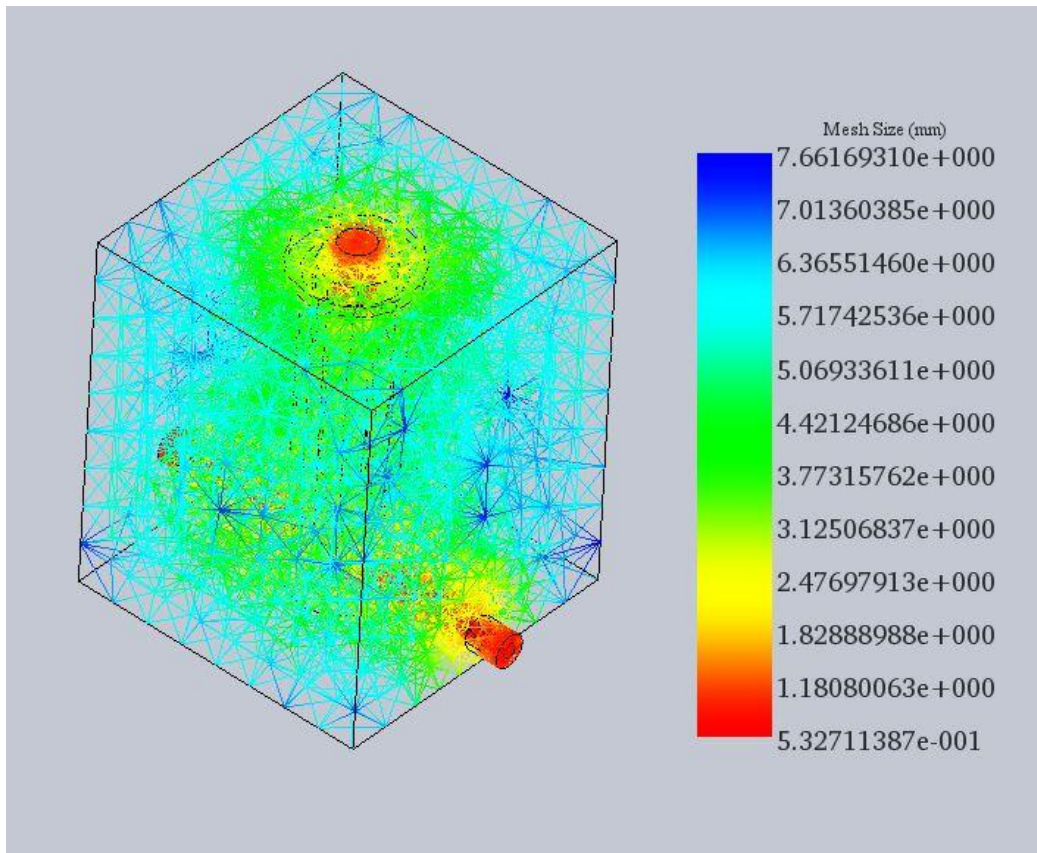
Figure 2: Mesh of the structure

2. Simulation

The first step in every HFWorks simulation is to create a study. In this example, we are interseted in the Scattering Parameters of the structure. The predicted results show that the filter must show good return loss at 880 MHz with a 7 MHz bandwidth. In such cases, it is more conveneient to use the fast sweep frequency plan centered at a frequency near 880 MHz. We can go for a any number of frequencies: The biiger the number is, the smoother the curves will be. We recall that a discrete frequency plan is always advantageous when it comes to accuracy but is certainly more time consuming.

The simulated study provides multiple choices and options to plot. They also offer the exploitation of electrical parameters calculated in Scattering parameters simulations (insertion, return losses...etc).

3. Load/ Restraint

We assign trivially the two ports. A port is always assigned to a surface between separating the ground and signal conductors, basically the dielectric. The rod is treated like a PEC as well as the filter's cylinder. The surfaces of the air box are assigned a PEC boundary condition.

4. Results

After the model is meshed and analyzed, we can take a look at the electric field distribution. We can animate the field in both its fringe and vectors format. We can mak e section clipping view in order to see the distrbution in the inner parts.
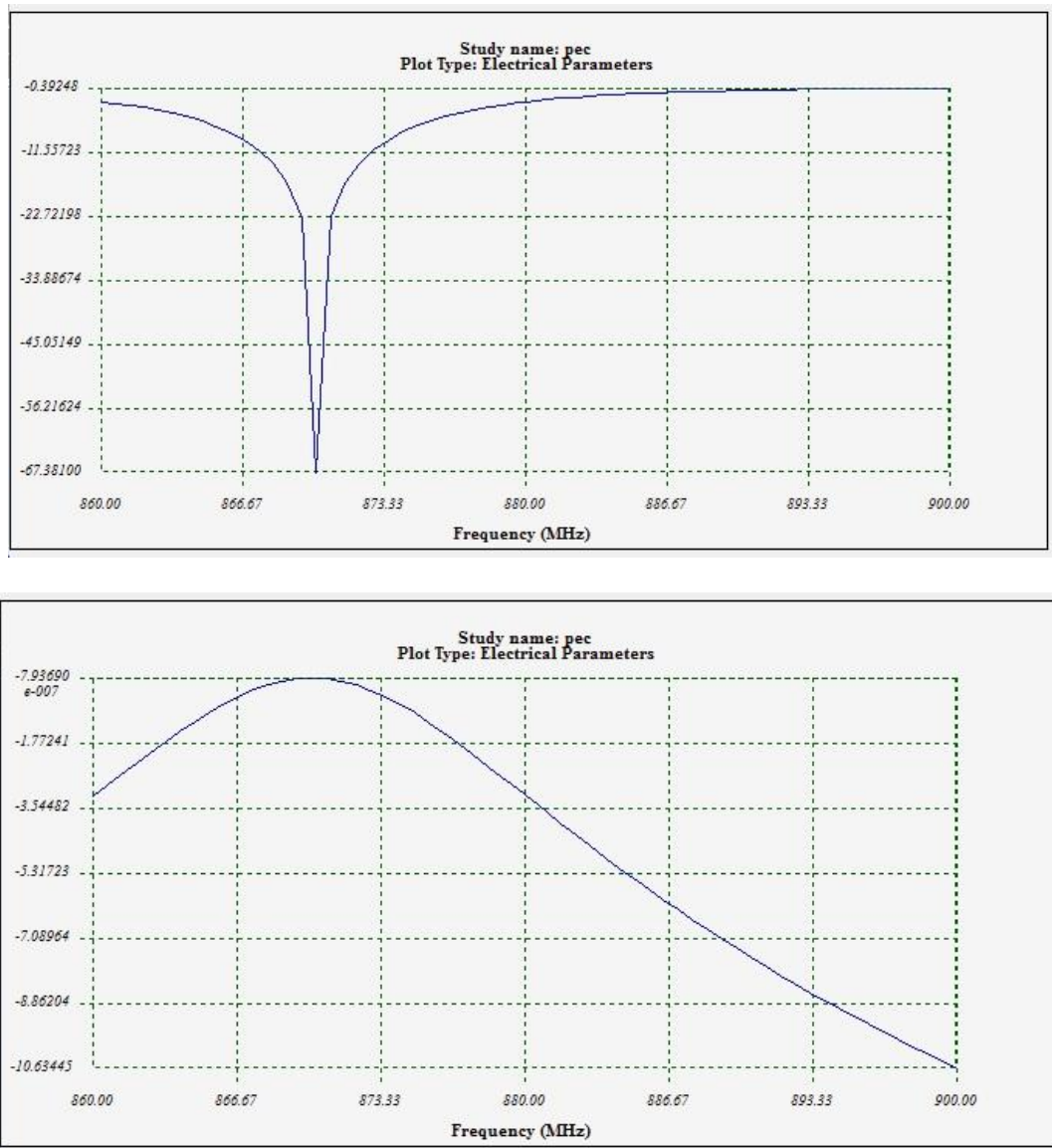

Figure 3: Insertion (Bottom) and return (Top) losses

For SP viewing, we use the Electical Parmeters results folder. We choose either a 2D or Smith Chart plot. We can explore the curve using a marker. We can plot other predefined curves like a circle (VSWR = constant) on the Smith Chart. The following figure shows the return loss and insertion loss of the filter.
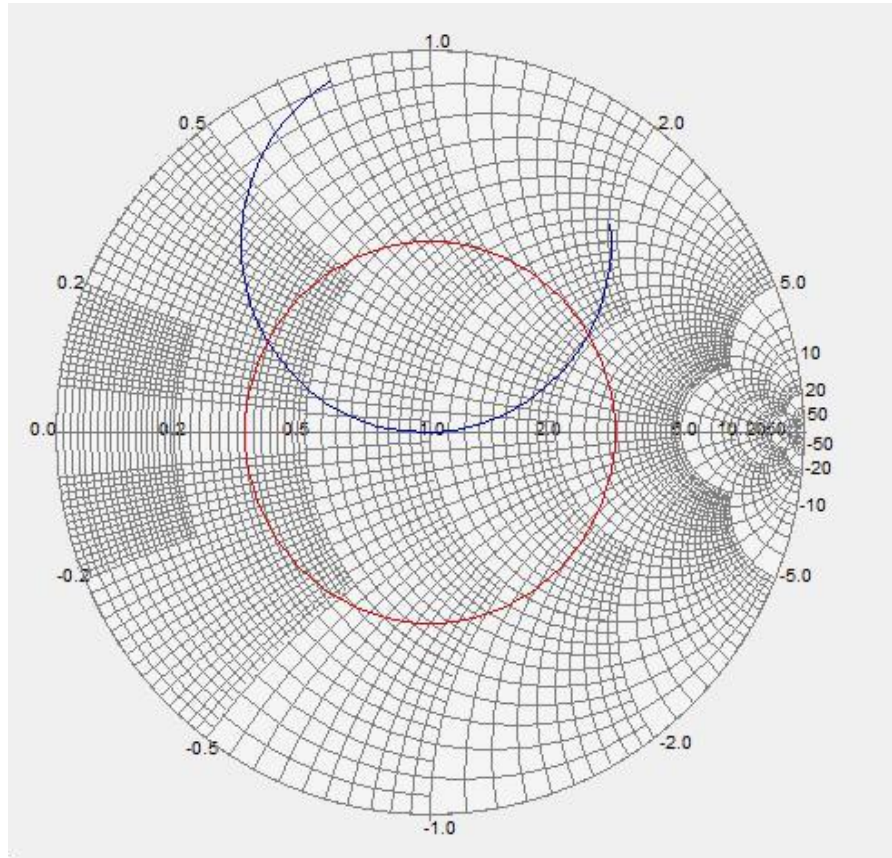

Figure 5: S11 plot on a Smith Chart (880 MHz)

5.   Conclusion

In this example, we were able to discover how to arrange an Scattering paramter study in pre and post simulation steps in HFWorks. The Scattering parameters is usually used whenever we deal with a filter analysis. The model being simulated shows good agreement with measurements. It also outputs different electrical parameters in 3D plots. The dimensions and materials used in the model have been optimized for the intended band of frequency. Further investigation of their roles can be tested by modifying the model or material assignments. For users who are familiar with Solidworks multi-configuration feature, HFWorks studies can be coupled with different scenarios.

6. References

[1] SPower-Handling Capability for RF Filters Ming Yu IEEE microwave magazine October 2007