EM Insights Series
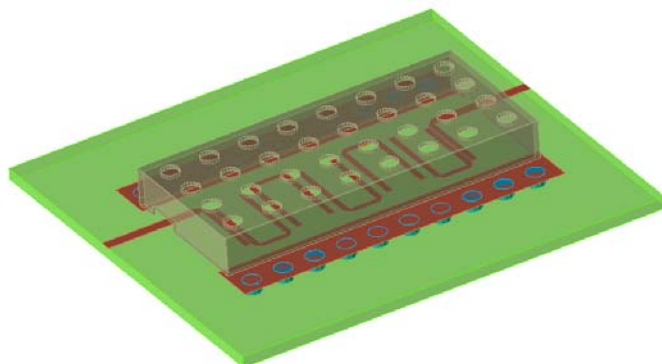
Episode #10:

Mechanical Shield for RF/MW Circuit Designs with 3D EM Components

Agilent EEsof EDA
June 2009

Application Overview

Typical situation

Many RF/MW circuit designs are enclosed with mechanical shields for isolation and preventing radiation. These shields affect the circuit's performance due to inevitable parasitics. In order to take parasitics into account, designers often take extra steps to characterize them in a 3D EM tool. Typically engineers export the circuit design to a 3D EM tool and combine it with the mechanical structure for EM simulations. These additional steps can be very error prone and tedious.
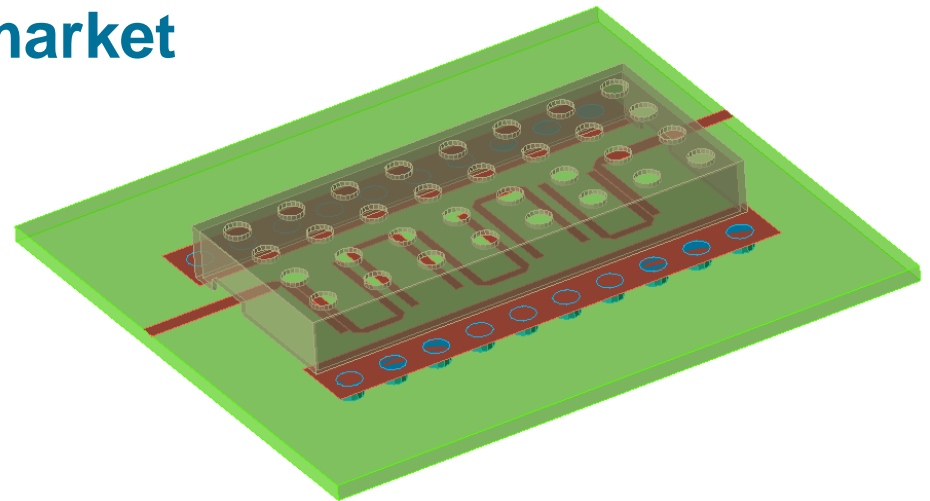
Potential users and targeted market

- RF/MW module, board design engineers
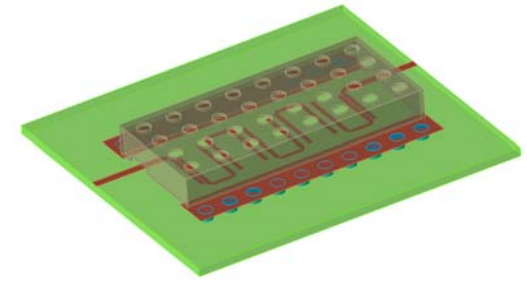- RF/MW boards, Aerospace Defense markets

EM product used

EMDS G2 for the 3D EM simulation

EMPro UI for generating 3D components

Design Challenges

Design challenges

Typical RF/MW shields can induce problems such as frequency shifting after the circuit is enclosed, or situations where the circuit works in an open space but not in closed space, or even generating parasitic resonance when a shield is added. These real problems cause product introduction delays by requiring design re-spins and trial and error inefficiencies. Many designers are now using 3D EM simulations in order to solve these problems. However, it is always a tedious and error prone process to export/import the geometry from circuit/layout design tools and also hard to draw microwave circuit layouts in 3D EM tools.

Problem solved

Now you can accurately predict the performance of your design with a shield by using custom 3D EM components in ADS without export/import designs to 3D EM tools.
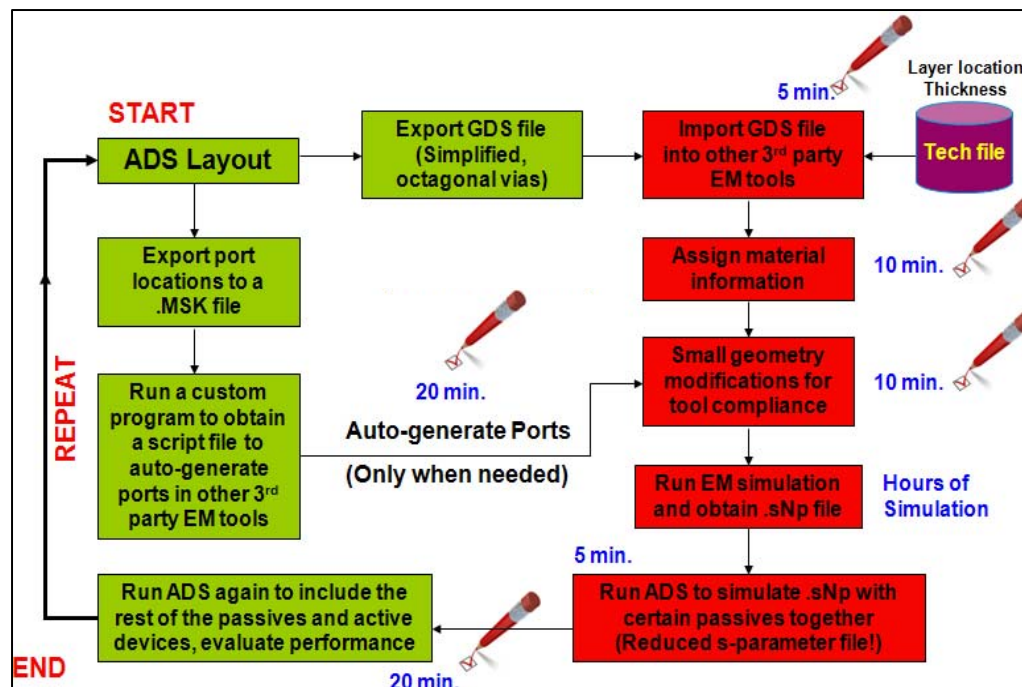
Value delivered

Increased simulation accuracy by bringing 3D mechanical designs into ADS

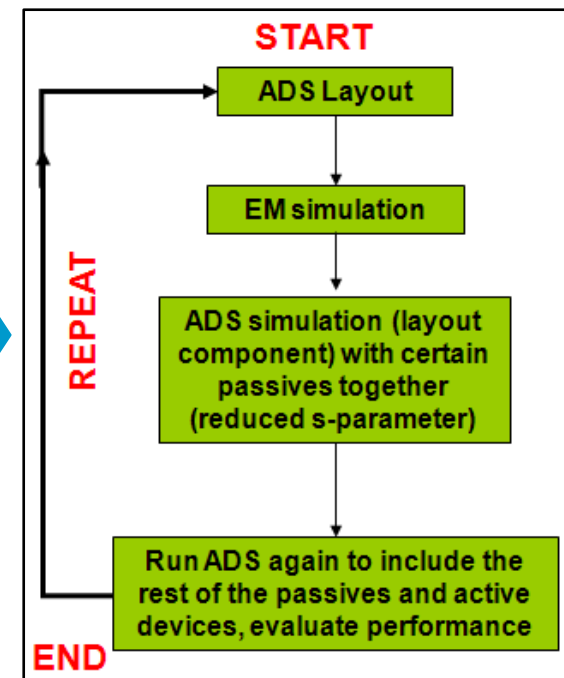Minimized design translations between multiple design tools

Integrated 3D EM Saves Cycle Time

Integrated 3D EM also saves cycle time on the EM front-end process

Reducing "EM front-end process", the process from entering the design geometry to being ready for the simulation, could save hours of simulation setup time (1 hr +) and also on CAD resources
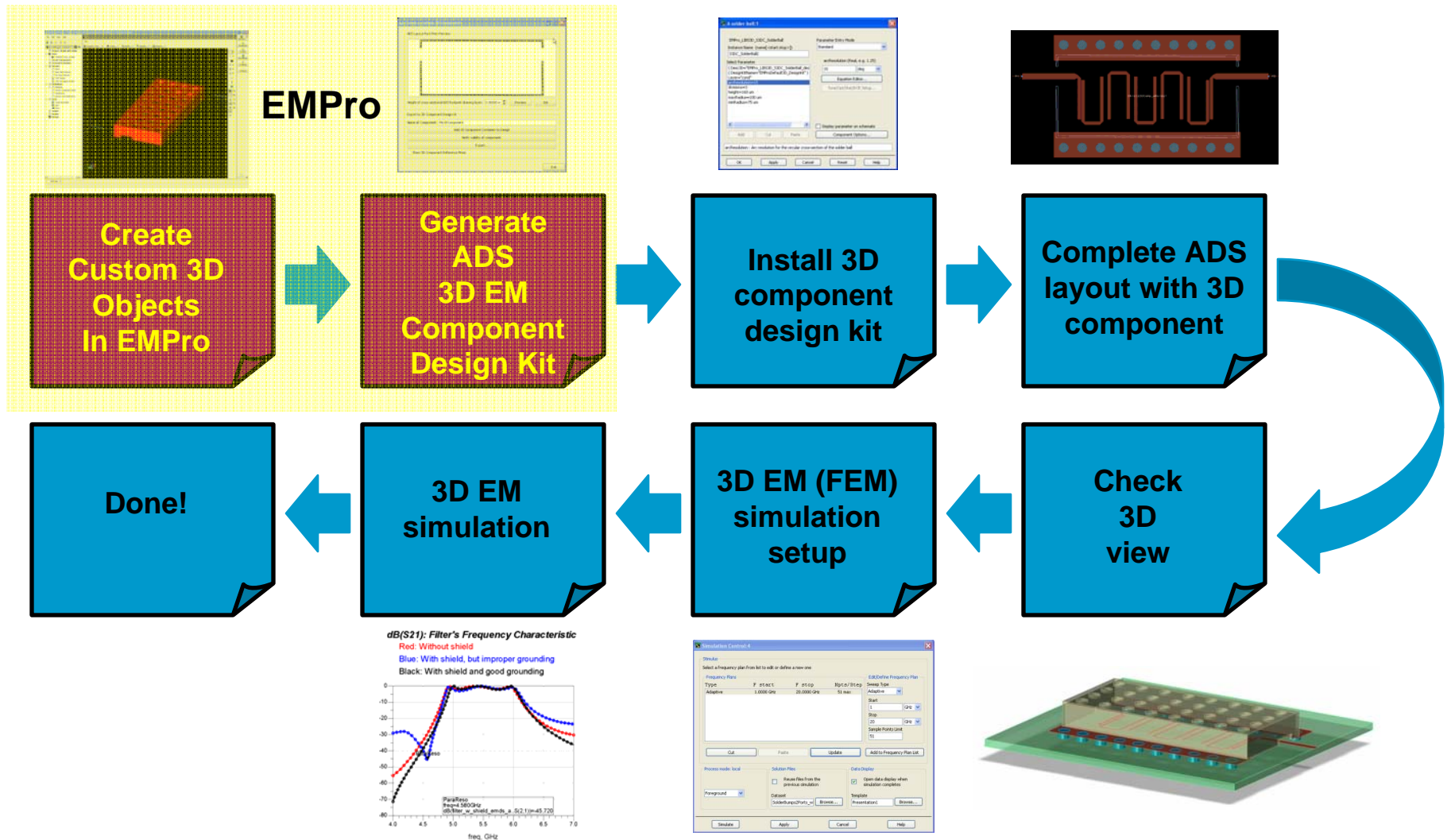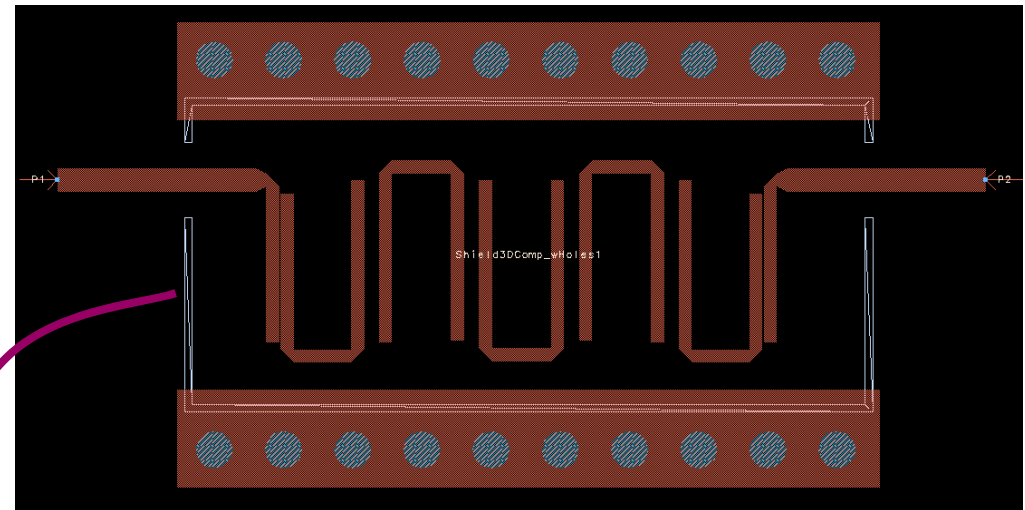

Non-integrated EM flow

Integrated EM flow

3D EM Design Flow with Custom 3D Components in ADS

EMPro

Create Custom 3D Objects In EMPro → Generate ADS 3D EM Component Design Kit → Install 3D component design kit → Complete ADS layout with 3D component →

Done! ← 3D EM simulation ← 3D EM (FEM) simulation setup ← Check 3D view

dB(S21): Filter's Frequency Characteristic
Red: Without shield
Blue: With shield, but improper grounding
Black: With shield and good grounding
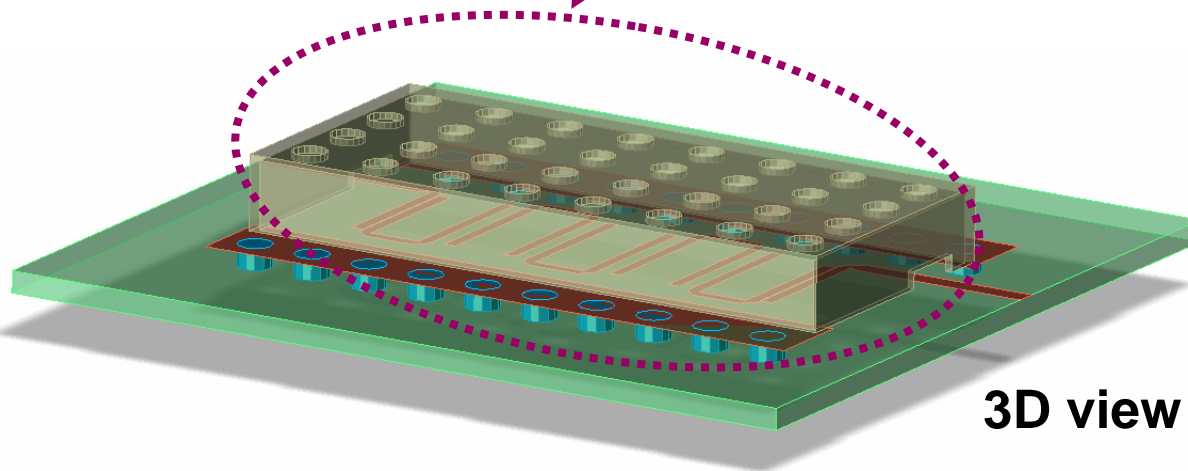
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Hairpin Filter ADS Layout with 3D EM Shield Component

3D EM shield component in ADS

ADS layout with 3D EM shield component

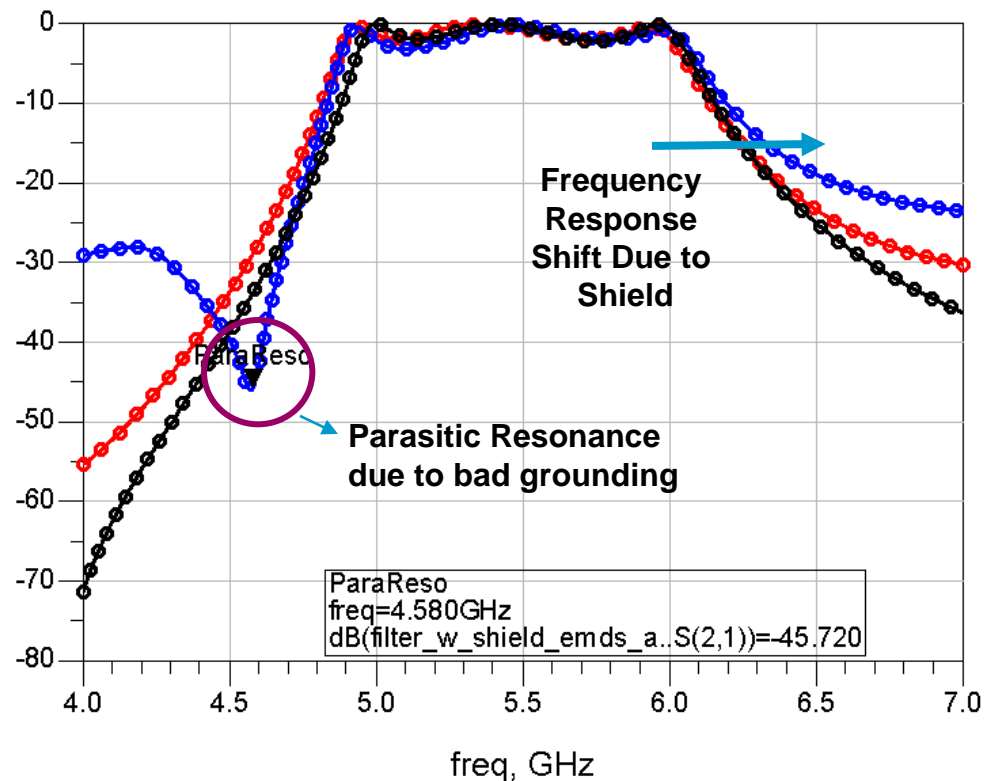**3D view of ADS layout**

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Filter's Performance Change With The Shield

dB(S21): Filter's Frequency Characteristic

Red: Without shield

Blue: With shield, but improper grounding

Black: With shield and good grounding

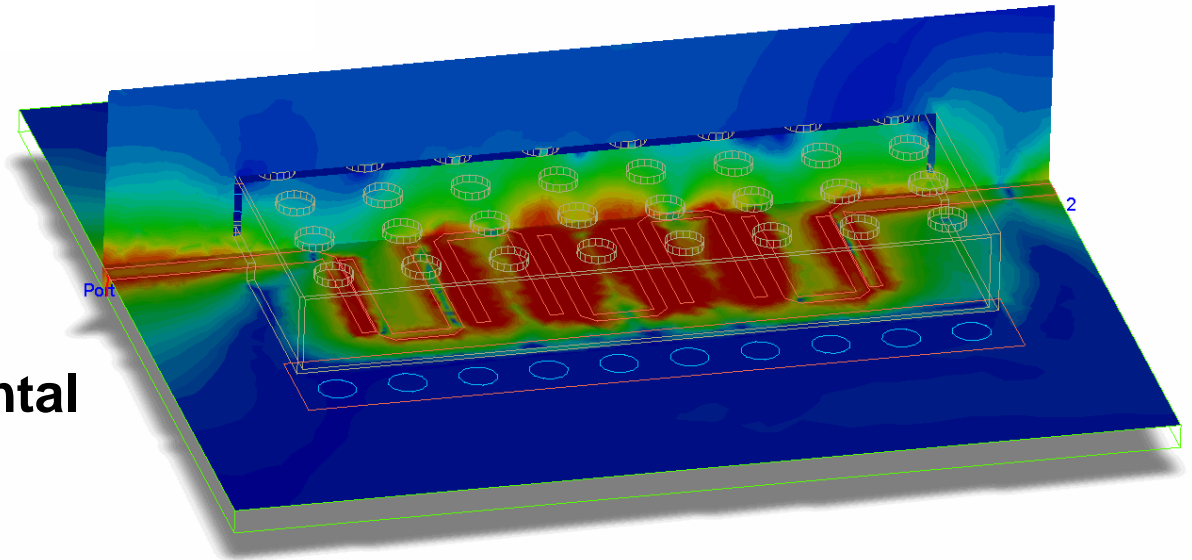Frequency Response Shift Due to Shield

ParaReso

Parasitic Resonance due to bad grounding

ParaReso
freq=4.580GHz
dB(filter_w_shield_emds_a..S(2,1))=-45.720

freq, GHz

No more approximation! What you see is what you get (WYSIWYG)

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3D Meshes and Field Plot
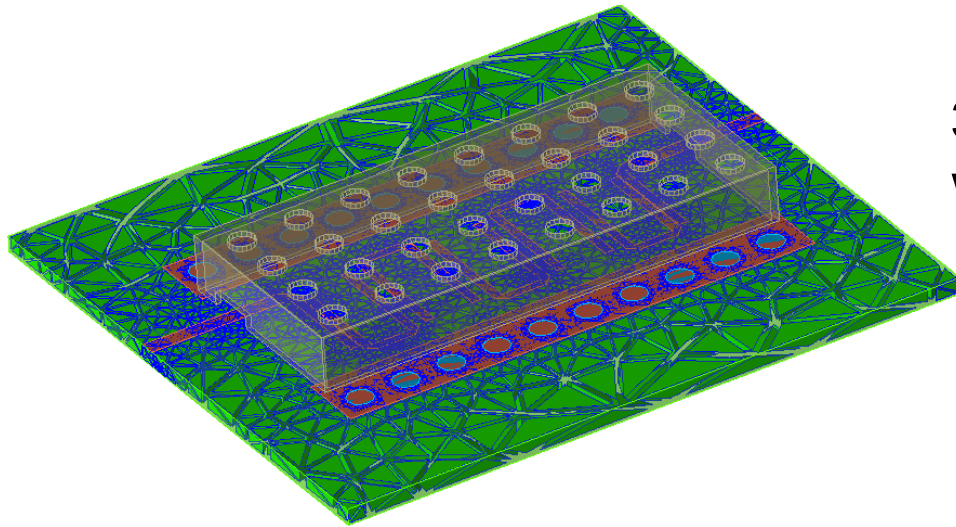
3D volume mesh for the filter with shield

E-field plot on both horizontal and vertical planes

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Episode #10 summary

As demonstrated, frequency characteristics of a design can shift after the circuit is enclosed in a shield. By expanding the simulation space to include 3D mechanical designs by 3D EM components, you can increase your simulation accuracy. EM integration into ADS provides:

- Easy construction of RF/MW layouts such as spiral, helical inductors, microstrip lines in ADS layout with macros
- Simple and easy 3D shapes drop-ino ADS for a complete EM simulation

Interested in learning more about this application?

- Request an evaluation copy of EMPro at:

  http://www.agilent.com/find/eesof-empro-evaluation
- Request a demo of EMPro at: http://www.agilent.com/find/eesof-contact

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