**Advanced_Frequency_Sweep**

**Where To Find This Example**

AWR Version 14
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AWR Version 13
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**Design Notes**

**Advanced Frequency Sweep**

The AFS feature is an intelligent approach to ElectroMagentic simulation. The structure of interest is a ring resonator with two closely spaced resonances. The structure also has some resonances due to the enclosure settings used for simulation.

**Overview**

This example is a ring resonator build on 25 mil thick ceramic substrate with a relative dielectric constant of 10. The line is a 50 ohm line. The ring structures near the line will cause a line resonance at a frequency where the effective length of the ring is a full wavelength. The two rings are slightly different in size so two distinct resonances can be seen. This project was setup to minimize the mesh points so the simulation will run fast to easily see the benefit of the new AFS feature. The frequencies for this simulation are from 0.01 to 20 GHz in steps of 0.1 GHz (total of 200 frequencies). We are using so many frequencies to go over a wide band but also see the sharp resonances in this structure.

This project is saved such that both simulations will run. If you don’t want to wait for the “Ring Resonator” simulation to run, please right mouse click on it in the project browser and select “Toggle Enable”.

**Results**

The results from this simulation are shown in the various graphs. You can see S11 and S21, magnitude and phase on rectangular plots. S11 is shown on a smith chart. Note on the smith chart that all of the traces that are near the edge of the chart are due to the resonances. It will appear on the graphs, there is only one trace, but the results from both structures are there. You can also disable any measurement on any graph to prove to yourself there are two results on each graph.

The "Difference" graph is using a built-in AWR measurement that will calculate the difference between two simulations. You can see from this graph that the results between AFS and no AFS are very close indeed.

**What is AFS**

AFS is a technique that can help speed up simulation time for an EM simulator when there are many frequencies of interest. The basic description of the algorithm is this:

1. Simulate the structure at the lowest (f_high), lowest (f_low) and the middle ((f_high - f_low)/2) frequency.
2. From this data, generate an equation that represents this network over the specified frequencies.
3. Simulate a few more frequencies and generate a new equation based on all the frequencies simulated.
4. Evaluate both equations from f_low to f_high at the number of grid points specified in the AFS options.
5. Calculate the difference from the two equations.
6. Iterate:
   a. adding more frequency points where the difference between the two is the largest.
   b. create equation
   c. evaluate equation
   d. calculate difference from last iteration
7. Continue until error from pervious iteration is below the tolerance set.

**How To Use AFS**

To turn on AFS for an EM structure, right click on the EM Structure in the Project Browser, and select **Options**, then select the **Axiem** tab and you will see a checkbox for **Advanced Freq Sweep**. You should click on the checkbox to turn on the AFS option if it is not enabled. The rest of the options can be found from the help.
In the example as is setup, there are 200 frequencies in the setup. So without AFS, this project would need to simulate at that many frequencies. However, with AFS turned on there are only 18 frequency points that need to be simulated, a reduction by 91%!
Graph - S21 Magnitude
Graph - S21 Phase