# Compact Antenna Simulation with CST MICROWAVE STUDIO®

This article demonstrates the simulation of an electrically large antenna. The design and numerical results are courtesy and permission of Chelton Antennas, France. The antenna operates at 8 GHz and was simulated using the CST MICROWAVE STUDIO® (CST MWS) Transient Solver which is, as a result of its efficient memory scaling, ideal for such electrically large structures. In this case, the antenna diameter is approximately 20 wavelengths in size.
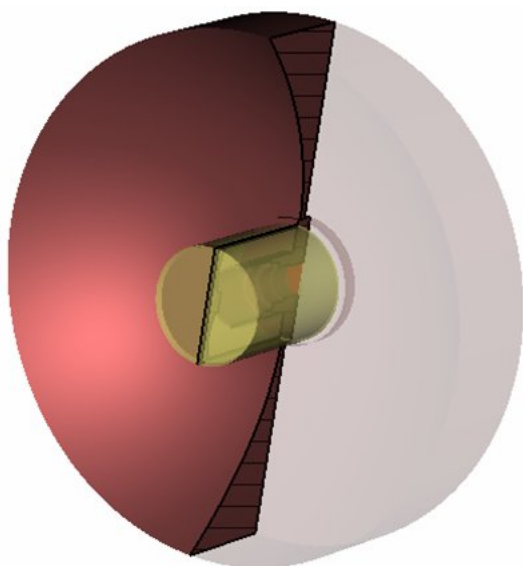

Figure 1:   Cut-away view of the antenna showing the feeding structure

Figure 1 shows the geometry of the antenna. This is modeled by defining a cross section using a parabolic equation which is then swept 360 degrees to form the dish section. The feed component is created via the solid modelling tools in CST MWS namely, the cylinder tool. A Teflon cylinder with a permittivity of 2 is embedded in the feed section. At the base of the feed, a waveguide port is defined to accurately calculate the mode pattern supported by the cylindrical waveguide. This mode pattern is automatically calculated using the in-built 2D port eigenmode solver. The antenna itself consists of PEC and is cut from air. The model exhibits a quarter symmetry which reduces the simulation time by a factor of 4.
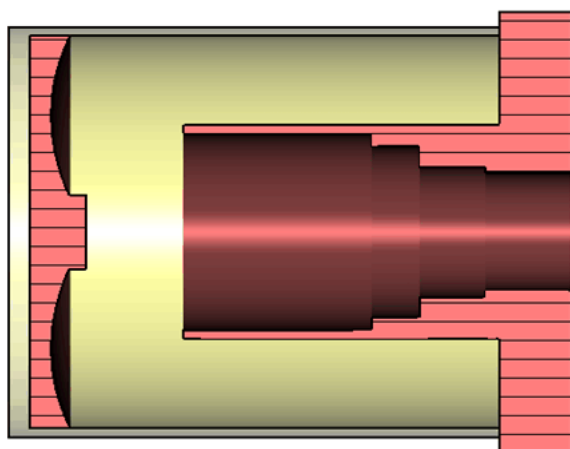
Figure 2: Cross sectional view of the antenna feed

A cross-section of the feed arrangement is shown in figure 2. The stepped converter section can be seen as well as the reflector element in front of it. This is embedded in the teflon cylinder.
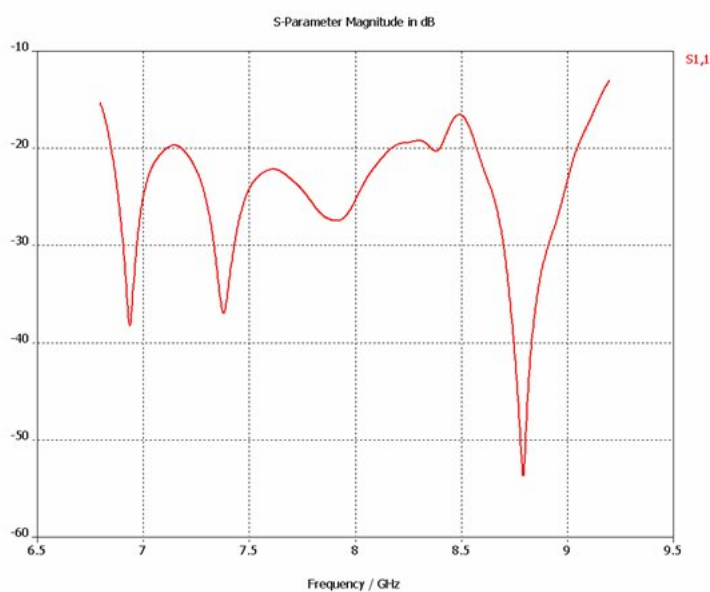

Figure 3: Broadband S-Parameters obtained in CST MWS

The S-Parameters from 6.5 to 9.6 GHz are displayed in Figure 3 and were obtained via the Fast Fourier Transform of the time response of the antenna in just one simulation.
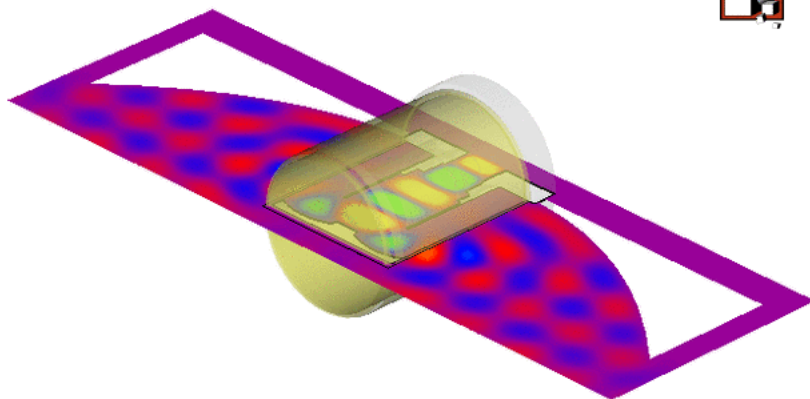
Figure 4: Animated plot of the Electric Field, Y-Component

CST MWS allows the user to easily create animations from any defined frequency and time-domain field monitors. Figure 3 shows the nearfield Y-component of the electric field at 8GHz on a cuplane through the antenna. Please note that some browsers deactivate animations as default. To display the animation please check the advanced settings in your browser and refresh the current view.
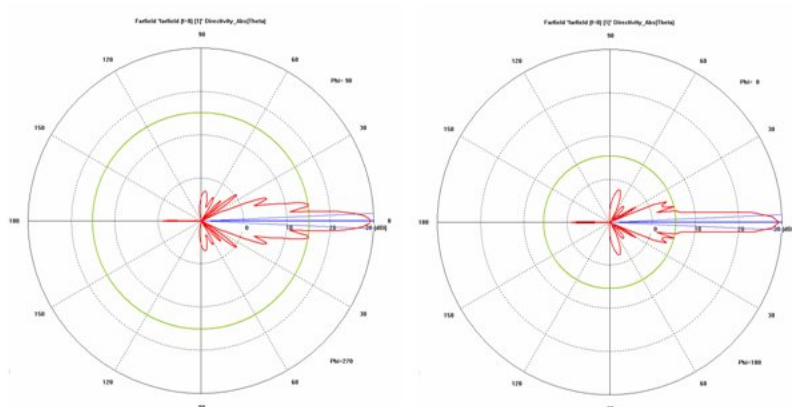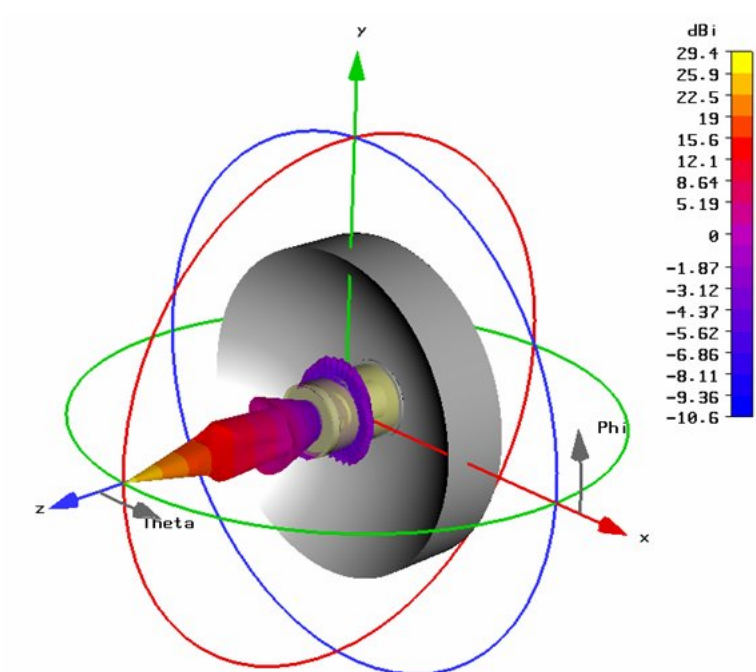

Figure 5: Directivity at 8GHz E- and H-Planes respectively

Polar plot views of the farfield data are given in Figure 5 for the directivity in the E and H planes.
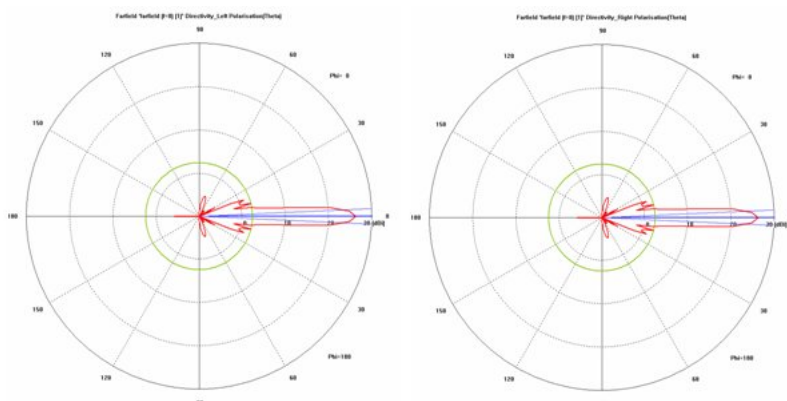
Figure 6: Left and Right Polarisation at 8GHz respectively

Similarly, polar plots are shown in Figure 6 for the left- and right-hand polarisation.

Figure 7: 3D Farfield plot with structure view

Figure 7 shows the 3D farfield plot superimposed on the antenna view. It is also possible to display the farfield results in the Ludwig 2 and 3 coordinate systems for co- and cross-polarisation analysis.

This article demonstrates the ability of CST MWS to simulate an electrically large antenna corresponding to 20 wavelengths in diameter. The simulation time is just 28 minutes on an Athlon 2800+ 32 Bit PC. The installed memory of 1GB was sufficient for this simulation consisting of 400,000 Mesh cells highlighting the excellent memory scalability of the CST MWS Transient Solver.