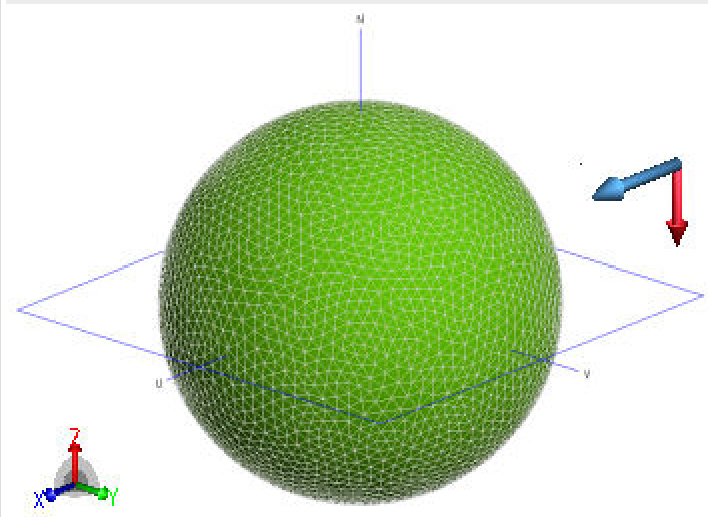
Shielding effectiveness of a finite conductivity metallic sphere

An example of how FEKO may be used to compute EMC shielding factors.

Problem description

EMC engineers often design a shielding environment for circuitry or people and have to estimate the shielding effectiveness of the structure before producing a prototype. This example shows how FEKO may be used in such cases. A simple example is chosen of a hollow sphere with finite conductivity, illuminated with a plane wave. The sphere is made of silver, with conductivity 6.1×10^7 S/m, with wall thickness 2.5 nm. The CADFEKO model of the sphere, with illuminating plane wave indicated is shown in Figure 1. The sphere has a radius of 1m.

Figure 1: CADFEKO model of hollow sphere

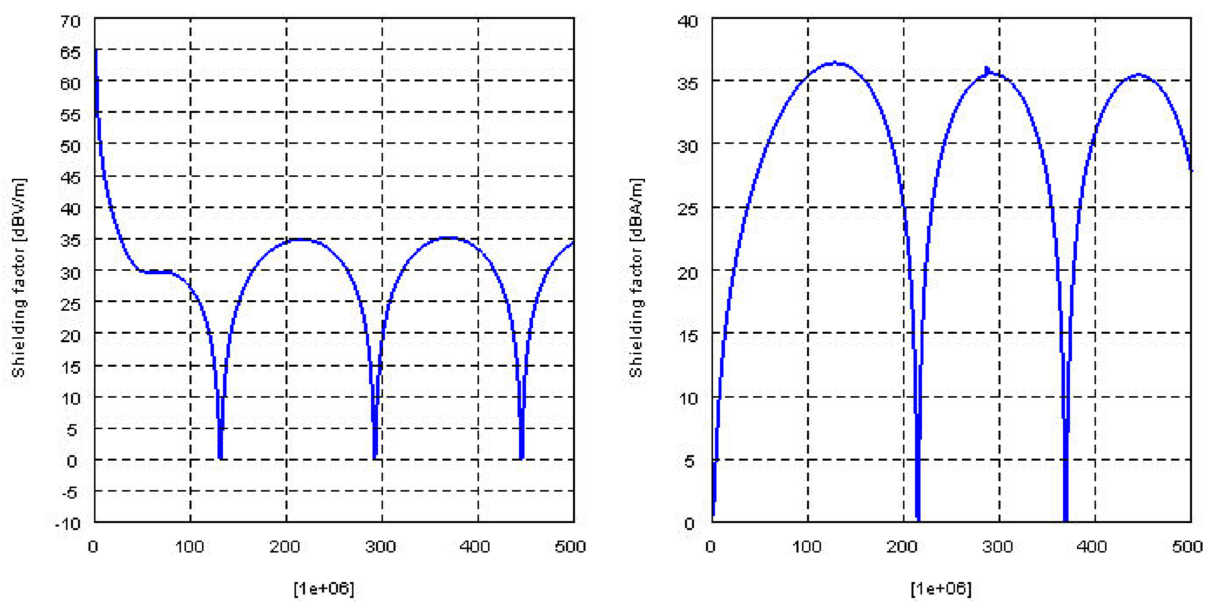


Simulation results

Shielding is defined for both electric and magnetic shielding effectiveness and for any given field point is the ratio between the unshielded field strength and the shielded field strength. In this example the point for comparison was the centre of the hollow sphere. A simple run was done to measure the electric and magnetic field strength for the point without the shield in place and a second run was then done with the shield in place. The ratios were drawn from the gathered data and plotted in dB. The results are presented in Figure 2 and compares well to analytical formulations for the same problem. These results clearly point out that internal resonances occur at higher frequencies, resulting in almost no shielding.

Figure 2: Shielding effectiveness of a silver sphere

(a) Electric shielding factor | (b) Magnetic shielding factor



Comments on Numerical Accuracy

Regarding shielding computations with the MoM one normally suffers from the cancellation effects when adding

E_total = E_incident + E_scattered (complex vectors). If the MoM solution has an error of say 0.1% (very accurate!!), then the maximum shielding factor that one would be able to get is as follows:

- say E_incident is 1 V/m
- for a perfect shield (e.g. PEC body closed) one would need E_scattered = -1 V/m
- with a 0.1% error in the currents due to mesh discretisation etc., also E_scattered might have an error of 0.1%, i.e. instead of -1 V/m we might have -0.999 V/m
- then E_total is not zero, but rather (1 - 0.999) V/m = 0.001 V/m
- this 0.001 V/m corresponds to a shielding factor of 60 dB