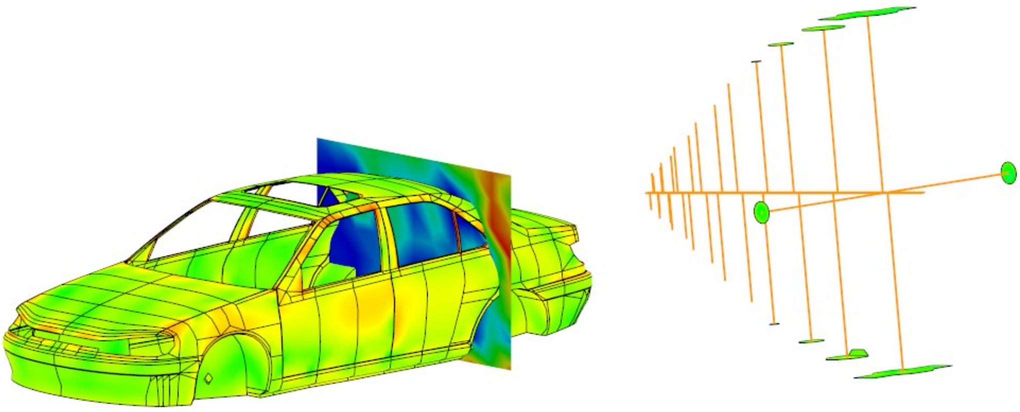
FEKO
Comprehensive Electromagnetic Solutions

EMC/EMI Applications

FEKO is well suited for the analysis of a variety of electromagnetic compatibility (EMC) and electromagnetic interference (EMI) problems.

ANTENNA ANALYSIS

Wideband antennas are typically used in EMC test setups. These can be designed and analysed using FEKO. The Method of Moments (MoM) is an efficient technique for the solution of antennas like log periodic dipole antennas, since only the regions where currents flow (i.e. metallic surfaces and wires or surfaces of dielectric bodies) must be discretised. The radiation into open space is inherently, yet accurately, taken into account in the MoM formulation without having to introduce special absorbing boundary conditions.



Visualisation of currents and near fields for a car geometry illuminated by a log periodic antenna.

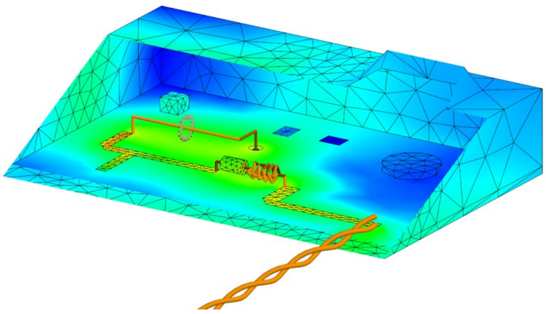
SIMULATION OF ELECTRICALLY LARGE STRUCTURES

Solving a whole car geometry with the MoM may require several GByte of memory when simulating at a frequency where the structure becomes electrically large, for instance at 900 MHz where the wavelength is about 33 cm. However, with FEKO's Multilevel Fast Multipole Method (MLFMM) this model can be solved using a few hundred MByte. In addition, FEKO's industry leading windscreen antenna solver allows for the inclusion of windscreens with embedded or printed glass antennas without adding significantly to the computational resources.

FEKO offers high frequency approximation techniques (Physical Optics, Geometrical Optics and Uniform Theory of Diffraction) with low memory requirements, all of which have been hybridised with the accurate MoM, for the solution of electrically huge problems. The FEKO solver is also fully parallelised and can make efficient use of multicore CPUs, multi-CPU machines or distributed multiple node systems to improve performance, which is especially helpful when dealing with electrically large structures. FEKO has been certified as Intel Cluster Ready and is often used on large-scale clusters.

SHIELDING

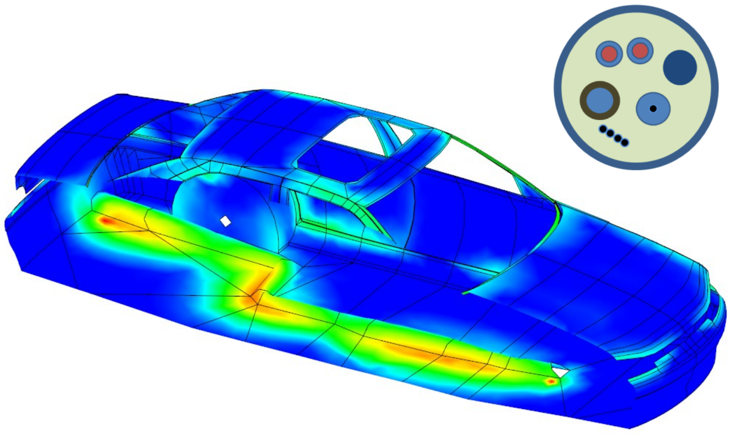
Electric and magnetic shielding factors of metallic or dielectric enclosures of arbitrary shape, with slots or other openings, can be computed with FEKO. A plane wave can be used as excitation to calculate the near fields inside the enclosure (or the induced currents in wires if the shield is to screen a wire configuration). These fields can be compared to those that would exist in the absence of a shielded enclosure. Alternatively, the dual problem of having internal sources (e.g. elementary dipoles or the excitation of a wire) can be solved and the radiated near fields or far fields outside the enclosure can be investigated. It is also possible to account for non-perfect screening materials and take into account the skin effect or the effect of penetration through walls of finite conductivity. FEKO uses a special technique for metallic enclosures where shielding factors of 200dB or more can be computed.



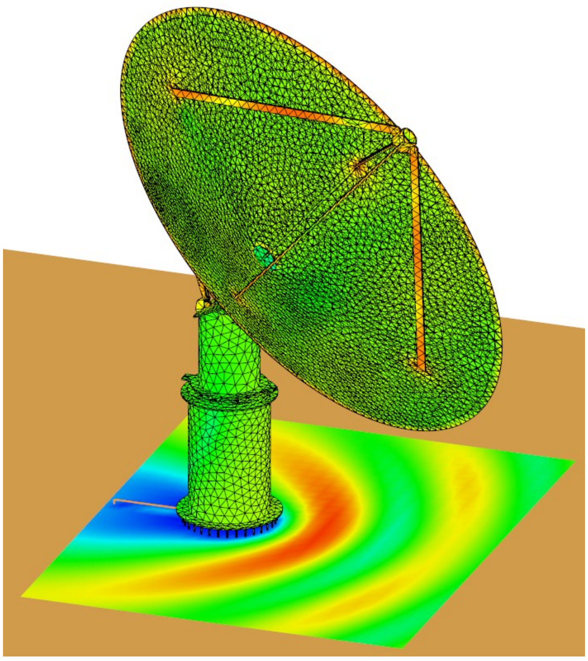
The currents induced on a printed circuit board within an enclosure. The voltage to the PCB is supplied via a twisted pair of cables.

CABLE MODELLING

FEKO features two specialised techniques for the analysis of cable coupling (both radiation and irradiation problems). Standard Multi-conductor Transmission Line (MTL) theory is a well established numerical method for simulating electromagnetic coupling between cable bundles and external structures. In FEKO the MTL can be used for arbitrary complex bundle cross sections and any of the numerical solution techniques (MoM, MLFMM, FEM, etc.) may be used to compute the external fields and currents that couple to these cable bundles. In cases where the standard MTL technique cannot be applied due to the assumption that the current return path is in the ground plane directly below the cable, FEKO's unique combined MoM/MTL technology can be used.



Surface currents caused by a radiating cable running along the inside of a car's bodywork and an example of a cable that can be modelled in FEKO.



Surface currents and nearfields during an indirect lightning strike on a scale model of the KAT-7 radio telescope (model courtesy of P.G. Wiid).

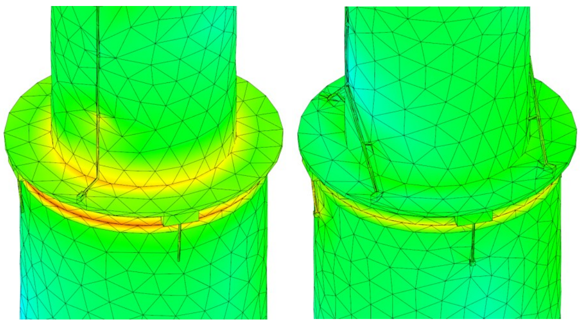
OTHER APPLICATIONS AND FEATURES

In addition to these applications, FEKO has many features which make it attractive for a variety of other EMC simulations.

For wideband applications, FEKO's adaptive frequency sampling (AFS) can dramatically reduce the number of required frequency points to be evaluated, thereby also cutting down on the associated runtime. AFS is based on sparse sampling with intelligent interpolation and yields continuous frequency response data.

Several methods are available to model dielectric or magnetic bodies, including thin dielectric sheets and dielectrically coated wires and surfaces. Dielectric or magnetic bodies of arbitrary shape can be modelled by the surface and volume equivalence principles (SEP and VEP). These two techniques are respectively based on the discretisation of surfaces (mainly for homogeneous bodies) and volumes (mainly for inhomogeneous bodies). The Finite Element Method (FEM) and hybrid MoM/FEM are suitable for the solution of highly complex dielectric structures. The FEM can also be hybridised with the rigorously parallelised MLFMM to solve larger structures and Ray-Launching Geometrical Optics (Shooting-and-Bouncing-Rays) is an asymptotic high frequency technique that may be used for the evaluation of dielectric structures.

FEKO was used as part of lightning protection and RFI studies performed on the Karoo Array Telescope [1]. An indirect lightning strike was modelled using a plane wave excitation. The shielding offered to conducting cables running along the struts of the dish to the feed horn, the bonding of cabling and the effect of different barriers at the base of the pedestal were investigated. The lightning down conductor (LDC) was re-designed after looking at the surface current densities at the interfaces between parts of the telescope, as capacitive coupling can cause unwanted surface currents to flow on the inside of the structure.



Original (left) and altered (right) LDC design for the KAT-7 radio telescope [1].

[1] P.G. Wiid, H.C. Reader and R.H. Geschke, "Radio Frequency Interference and Lightning Studies of a Square Kilometre Array Demonstrator Structure", IEEE Transactions on Electromagnetic Compatibility, Vol. 53, No. 2, May 2011, pp. 543-547.

Copyright © 2011 EM Software & Systems - S.A. (Pty) Ltd