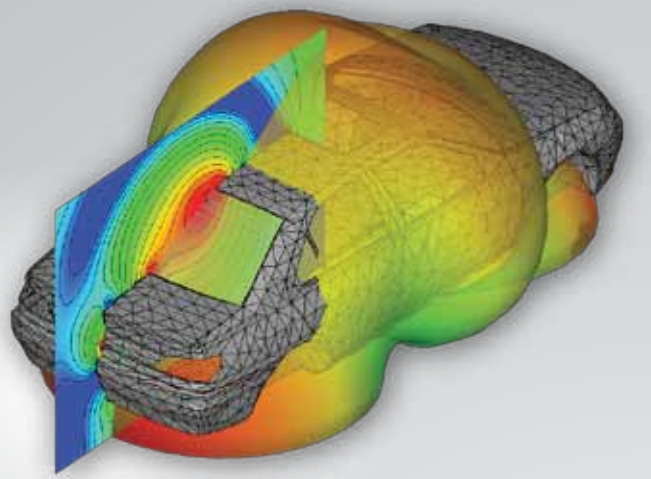
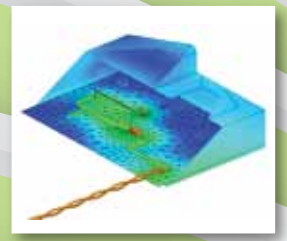
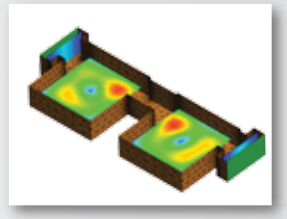


Comprehensive Electromagnetic Simulation Software

FEKO

Comprehensive Electromagnetic Solutions





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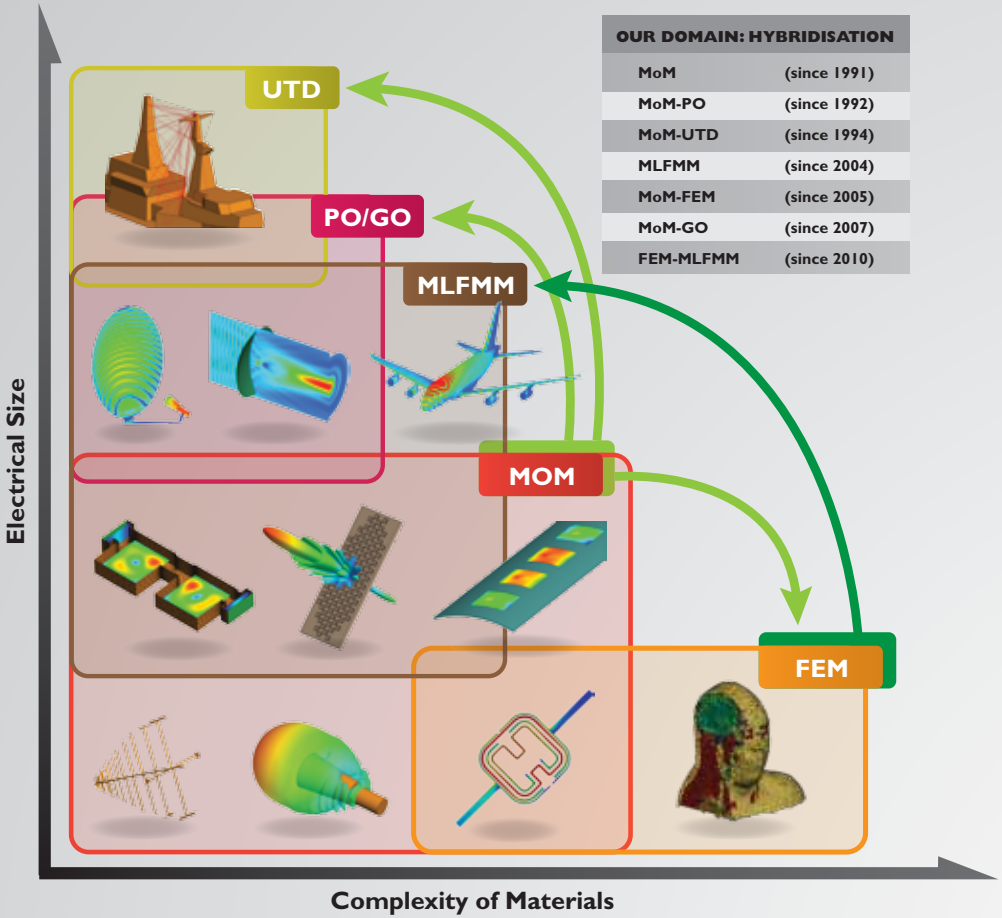
FEKO is a product of EM Software & Systems - S.A. (Pty) Ltd

Simulation Technology

Applications requiring electromagnetic simulation vary in geometrical complexity and electrical size (i.e. in terms of wavelength). No single numerical method is capable of handling the entire range efficiently. For this reason, FEKO offers several numerical methods, which can be used separately or together. Such hybridisations allow the most applicable techniques to be used simultaneously in a single efficient solution. The EM simulation map assists to visualise the range of applicability of the different methods available in FEKO.

Hybridisation allows the solution of large and complex problems.



OUR DOMAIN: HYBRIDISATION	
MoM	(since 1991)
MoM-PO	(since 1992)
MoM-UTD	(since 1994)
MLFMM	(since 2004)
MoM-FEM	(since 2005)
MoM-GO	(since 2007)
FEM-MLFMM	(since 2010)

- Methods for geometrically complex problems (MoM, FEM): The method of moments (MoM) and finite element method (FEM) are suitable to solve problems with detailed geometric features, e.g. antennas and waveguide components.
- Methods for electrically large problems (MLFMM, PO, GO, UTD): The multi-level fast multipole method (MLFMM) is equivalent to the MoM, but with dramatically improved efficiency for multi-wavelength sized structures. Physical optics (PO), geometrical optics (GO) and the uniform theory of diffraction (UTD) are asymptotic methods for electrically huge problems, e.g. RCS, antenna placement and large reflectors.
- Hybrid methods (FEM-MLFMM/MoM, MoM-PO/GO/UTD): These methods combine the beneficial characteristics of different methods to enable the solution of problems which are both geometrically complex and electrically large, such as antenna placement and EM exposure problems.

Solver Performance Features

- The FEKO solver is fully parallelised
- Multi-core CPU support is a standard feature
- FEKO is optimised to fully exploit multi-CPU, distributed memory resources (often used on large-scale clusters)
- GPU-based solution acceleration
- Optimised out-of-core solver to deliver solutions even when RAM limits are reached

Productivity Features

- Optimisation
  - Parametric models can be optimised using several algorithms
  - Any calculated result can be used as part of the goal function
  - Real-time monitoring of the optimisation process
- Adaptive frequency sampling (AFS)
  - FEKO is a frequency domain solver yielding a frequency response by sampling over a frequency range. AFS is based on sparse sampling with intelligent interpolation, which dramatically reduces the number of required samples
  - Yields continuous frequency response data
- Circuit co-simulation
  - Lumped, linear circuit models can be included in a simulation
  - SPICE models, S-, Z-, and Y-parameter blocks are supported as well as Touchstone file import/export
  - Often used for matching networks

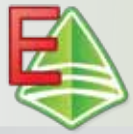
- Cable coupling analysis
  - Evaluate radiation and irradiation of cable bundles, taking into account the effect of surrounding structures
  - External fields are rigorously modelled with the MoM or MLFMM
  - Cable bundles are modelled with multi-conductor transmission line (MTL) theory and the MoM
- Periodic structure analysis
  - Analyse infinite periodic structures by solving only the unit cell
  - Infinite linear and planar arrays
- Solution decomposition
  - EM problems can often be decomposed, based on physical insight, to reduce computational cost
  - Many options are provided to do this
  - For example, this can be used to analyse a reflector antenna by first solving the feed horn radiation pattern and subsequently solving the reflector, excited by a radiation pattern point source

Graphical User Interface

FEKO offers a GUI with easy workflow, running on Windows or Linux. The GUI has three components: CADFEKO, EDITFEKO and POSTFEKO.

- **CADFEKO** is used for geometry modelling, mesh generation, and solution setup. It has comprehensive, parametric modelling features. CAD models and meshes can be imported from and exported to several standard formats.

- **POSTFEKO** is used for the visualisation of results (both 2D and 3D) and offers advanced post-processing feature (e.g. scripting and animations)



- **EDITFEKO** is aimed at advanced users, offering a scripting interface to the FEKO solver. Various programming features are supported.

Applications and Solution Methods

The table below is a guide to the suitability of different electromagnetic solution methods, available in FEKO, for different applications. Choosing an appropriate method will be dictated by various considerations such as the electrical size of the problem, geometrical complexity, available computational resources, etc.

● Technique is very suitable ○ Technique could be used but there is normally a better alternative, depending on the specific problem	MoM	FEM and FEM-MoM	MLFMM	FEM-MLFMM	PO, GO, MoM-PO and MoM-GO	UTD and MoM-UTD
Wire antennas	●		○			
Microstrip antennas	●	●	○	○		
Aperture antennas	●	○	○	○		
Reflector antennas	○	○	●	○	●	
Windscreen antennas	●		●			
Conformal antennas	●	●	●	●		
Broadband antennas	●	●	●	●		
Array antennas	●	●	●	●		
Lens antennas	○	○		●	●	
Antenna placement (radiation pattern)	●	○	●	●	●	●
Antenna placement (coupling)	●	○	●	●	○	○
SAR (Bio-EM)	○	●	○	●		●
RADHAZ zones	●	○	●	○	●	○
Periodic structures: FSS, metamaterials	●	○	○	○		
Scattering with plane wave source (RCS)	○	○	●	○	○	
Scattering with localised source	○	○	●	○	○	●
EMC/EMI shielding and coupling	●	●	●	○		
Propagation environment		○	○	○	○	○
Cable bundle coupling	●		●			
Waveguide components	●	●		○		
Connectors	●	●				
Radomes	○	○	○	●	●	
Microstrip circuits	●	●	○	○		

Methods for geometrically complex structures

Methods for electrically large structures