FEKO Quarterly ● www.feko.info ● September 2011

Contents

About this issue

FEKO Suite 6.1 was released on 18 July 2011. In this issue, we will take a look at some of the new features and introduce the new branch of EMSS that has been established in China.

If you would like to comment or ask questions about the content of this issue, please send us an email, or contact your local distributor.

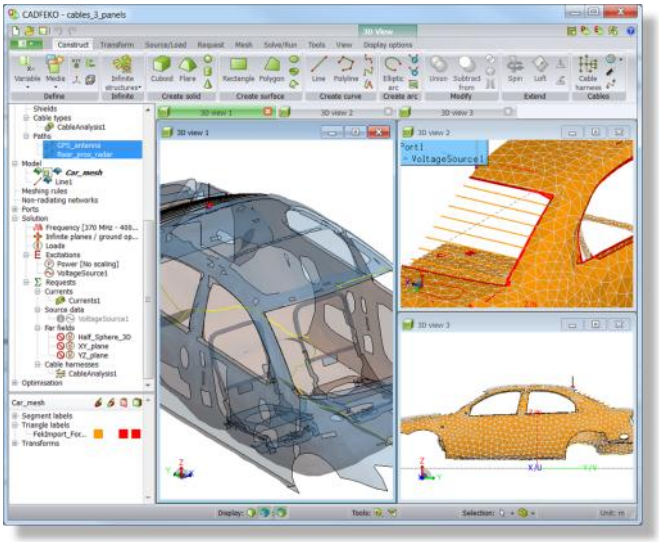
quarterly@emss.co.za

New features in FEKO Suite 6.1

The latest version of FEKO introduces a completely revised user-interface for CADFEKO and many new features — including over 300 smaller extensions! Users may consult the latest release notes in the FEKO installation folder for a complete list of changes and extensions or visit the Suite 6.1 download area on the FEKO website for more information.

USER INTERFACE FEATURES

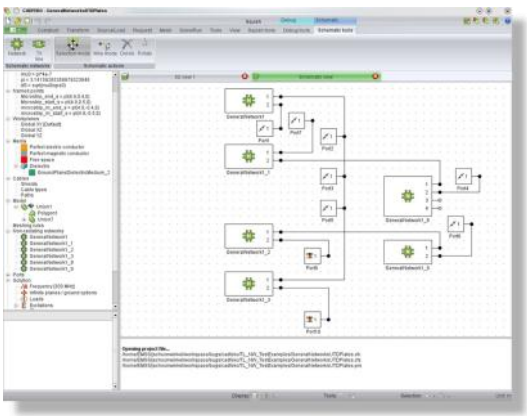
The **new CADFEKO user interface** boasts a ribbon style menu that reduces clutter and supports the typical FEKO workflow. Several toolbars in addition to the ribbon, namely the quick access, quick launch, quick tools and interactive status bar, allow more features to be readily available to the user. Other features such as auto-selection through multiple mouse clicks (available as selection type from the quick tools toolbar at the bottom of the screen) and the addition of numerous shortcut keys are aimed to increase the ease-of-use for both novice and advanced users.



CADFEKO Suite 6.1 user interface

A new concept in CADFEKO is that of the **simulation mesh.** This type of mesh cannot be edited and is created for simulation purposes.

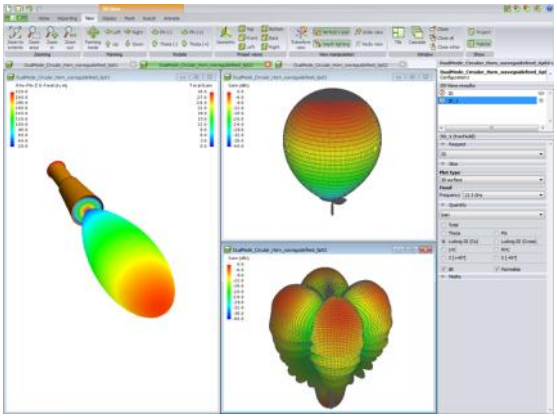
A new concept in CADFEKO is that of the **simulation mesh**. This type of mesh cannot be edited and is created for simulation purposes from an editable geometry or mesh model. A geometry model can be built in CADFEKO by defining and performing various operations on a variety of curves, surfaces (including **NURBS surfaces**) and geometry objects. Various materials may be loaded from or added to the **material library** which contains roughly 100 pre-defined materials and **layered anisotropic materials** can be defined. Both geometry or mesh models may be imported using industry standard CAD models and can be re-meshed once imported. **Local mesh sizes can be applied to mesh faces** and to geometry faces, edges, wires and regions. **Automated meshing** that takes into account the frequency, media properties, size and curvature of a model as well as the solution method quickly provides the user with a standard, coarse or fine mesh. This is available in addition to custom meshing and advanced mesh control. **Adaptive mesh refinement** can be used to refine a mesh based on pre-calculated error estimates and user-defined **point and polyline mesh refinement rules** can be set.



CADFEKO Suite 6.1 schematic editor

Other CADFEKO extensions include the support for **UTD cylinders in the CADFEKO interface**, a **power optimisation goal** and a new **schematic editor** for connecting non-radiating networks and transmission lines.

In POSTFEKO **report generation** has been made available for automatically exporting graphs and images to Microsoft Word, Microsoft PowerPoint and PDF files. **Advanced post-processing** of results can be performed by writing scripts in POSTFEKO's **scripting environment** using the Lua scripting language.



Far fields of a circular horn antenna visualised in POSTFEKO using Ludwig III coordinates.

Realised (effective) gain results are readily available for any single source antenna model and **mismatch loss** is available as a plotting quantity. Far fields can be plotted in **Ludwig III** components. The **radiated power** is available for all far field requests and the **power that flows through the surface of a near field** is available for all coordinate systems. The reference impedance has been extended to accept complex values, allowing the calculation of reflection coefficients for **complex impedances**. **Cursors** have been extended to snap to maximum or minimum trace values on 2D graphs and **measurement annotations** can be added to 2D graphs to indicate values such as beamwidth, bandwidth and side lobe levels. A model outline display feature allows for the visualisation of a model to look more like the original CAD model. **ISO surface annotations**, showing values and coordinates, have been implemented. Numerous other extensions include the support for **multi-line headers and footers** on 2D graphs**,** the ability to **plot imported data** (2D and 3D), a 3D view legend option to **scale to the vector magnitude** of all components even when looking at only one or two, and the option to **round 3D view legend values** for better legibility.

In POSTFEKO **report generation** has been made available for automatically exporting graphs and images to Microsoft Word, Microsoft PowerPoint and PDF files.

Two measurement tools, namely a distance measurement tool and a new **angle measurement tool,** are available in both CADFEKO and POSTFEKO to easily determine dimensions from the 3D view.

ELECTROMAGNETIC SOLVER FEATURES

The **Numerical Green's function domain decomposition technique** allows for large Method of Moments (MoM) problems with predominantly static geometry to be solved rapidly once the solution to the static part of the problem is known. The model is first solved and the static part of the solution saved, after which changes can be made to the dynamic domain. Subsequent simulations will re-use the static solution, saving on resources. (See more details in the Feature Focus on page 3.)

Cuboidal mesh elements (used before) and tetrahedral mesh elements (available in Suite 6.1) for the VEP solution of dielectrics.

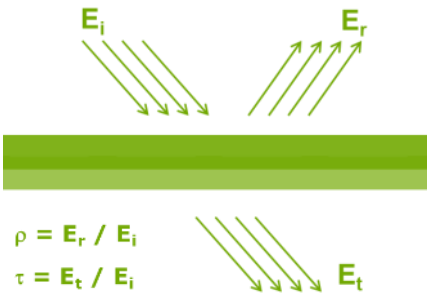
In addition to the Finite Element Method (FEM), **tetrahedral mesh elements** are available in CADFEKO **for the solution of dielectrics with the Volume Equivalence Principle (VEP)**. The VEP formulation is very stable at low frequencies and high permittivity values. It shows good stability and fast convergence in iterative solutions such as the multilevel fast multipole method (MLFMM). Tetrahedral elements can better represent geometry than cuboidal elements (available in EDITFEKO only).

Special basis functions have been implemented to keep the matrix condition number low over frequency. The use of these basis functions should be activated for **low frequency analysis** to stabilise the MoM solution.

Special basis functions have been implemented for **low frequency analysis**.

Transmission and reflection coefficients for incident plane waves are available as a solution request and are no longer only available by means of post-processing. These coefficients are often used in conjunction with periodic boundary conditions (PBC), multilayer planar Green's functions or infinite planes to calculate the properties of frequency selective surfaces (FSS) or multilayer scattering.

Incident plane wave excitations can be defined with local workplanes. This can be useful to perform radar cross section (RCS) calculations over an oblique cut, without having to rotate the geometry. Near- and far-field calculations can also be requested using local workplanes.

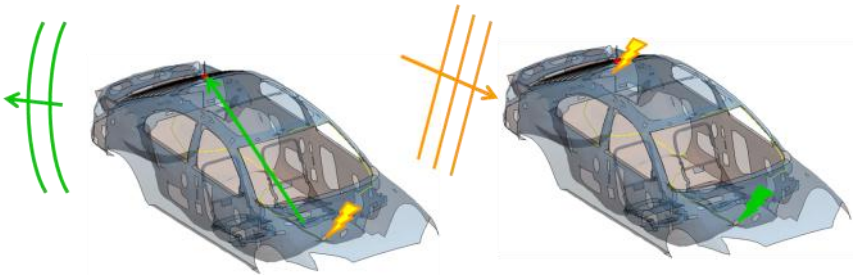


Incident (E_i), transmitted (E_t) and reflected (E_r) fields. A reflection coefficient (ρ) and transmission coefficient (τ) solution request is now available.

The currents and error estimation requests now allow for label ranges, not only single labels. Quantities to be taken into account for continuous data generation may be specified when using adaptive frequency interpolation, potentially speeding up convergence. The spherical modes excitation imported from a TICRA (*.sph) file optionally allows an amplitude scaling factor and the orientation of the modes may be specified using Kardan angles. FEKO ASCII file formats — electric and magnetic near field (*.efe and *.hfe), far field (*.ffe), current output (*.os) and charge output (*.ol) files — have been extended to allow for user comments, empty lines and a more complete description of the file contents.

New features in FEKO Suite 6.1 (continued)

Major extensions have been made to FEKO's **integrated cable modelling.** Standard Multi-conductor Transmission Line (MTL) theory, a well established numerical method for simulating electromagnetic coupling between cable bundles and external structures, can be used to solve arbitrary complex cable bundles and any of the numerical solution techniques in FEKO may be used to compute the external fields and currents. FEKO's new and unique **combined MoM/MTL technique** can be used to solve shielded cable problems where the standard MTL technique is not applicable. Such problems include those where the assumption cannot be made that the current return path is in the ground plane directly below the cable, as would be required by MTL theory. Both **radiation and irradiation** problems are supported in FEKO, with cables being excited by voltage sources (radiation) or external fields (irradiation). Loads can be connected to terminate cables. A 2D static Finite Element Method (FEM) solver is used to calculate the per unit length cable parameters (resistance, inductance, capacitance and conductance) of user-defined cables.



Cable radiation and irradiation problems can be solved in FEKO with MTL theory or with FEKO's unique combined MoM/MTL method.

FEKO's new and unique **combined MoM/MTL technique** can be used to solve shielded cable problems where the standard MTL technique is not applicable.

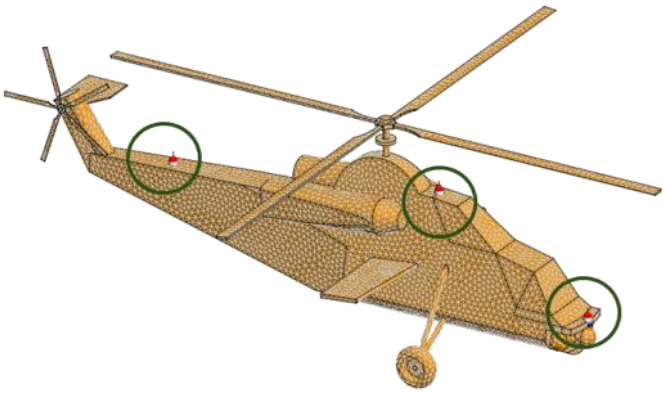
Feature Focus: Numerical Green's Function Domain Decomposition

The Numerical Green's Function (NGF) is a domain decomposition method that can be used to avoid repetition of the same calculations for problems with largely static geometry.

When solving a problem consisting of a dominant, fixed static part and a smaller, changing dynamic part with the Method of Moments, the solution for various dynamic domains can be obtained efficiently by re-using the factorisation of the static interaction matrix. This factorisation of the static sub-domain is termed the Numerical Green's Function (NGF) and is stored to an NGF (*.ngf) file.

This method is useful for performing antenna placement studies on large platforms, such as buildings, ships and aircraft. The large, fixed platform can be defined as static geometry, re-using its solution in subsequent simulations where the antenna is mounted in various locations.

In one such example where a simple antenna (40 unknowns) was placed onto a static platform (14844 unknowns) and solved at a single frequency, the NGF file written to disk was 3 GByte in size and reduced the runtime of subsequent simulations by a factor of eighteen. The main memory usage is the same for solving a problem with or without the NGF, while the trade-off for the decrease in runtime is an increase in the required disk space. This trade-off should be well worth it, as hard disks have been dramatically increasing in capacity while decreasing in cost.



Dynamic Geometry: *Monopoles at various placements (encircled).*
Static Geometry*: The helicopter.*

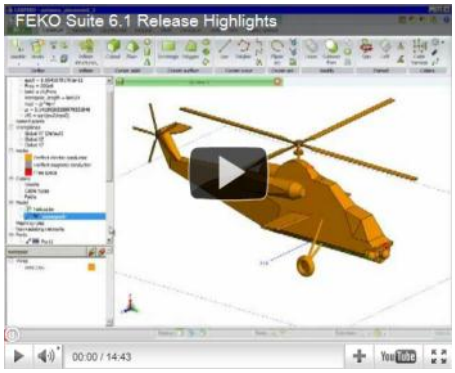
The NGF is useful for performing antenna placement studies on large platforms, such as buildings, ships and aircraft.

Other applications where the NGF may be useful, include the investigation of various aperture sizes and for the exploitation of symmetry in largely, but not entirely, symmetric structures.

Watch the Video: FEKO Suite 6.1 Release Highlights

The FEKO Suite 6.1 Release Highlights video is shared on **emssfeko**'s YouTube channel and is available through the FEKO website at http://www.feko.info/product-detail/videos. This video gives a short overview of the major new features in Suite 6.1, with quick demonstrations in CADFEKO and POSTFEKO to show users where to access these features and to illustrate how they may be used.

Users who have technical questions regarding these new features are invited to contact their FEKO Support Team (see http://www.feko.info/support/support-contacts for regional contact details).



The FEKO Suite 6.1 Release Highlights video is shared on **emssfeko**'s YouTube channel.

EMSS opens branch in China

EMSS is pleased to announce the establishment of a new branch in Shanghai, China. EMSS China is responsible for distribution of FEKO in China and will be providing technical support to users in China. They will be exhibiting FEKO at the 2011 PIERS and National Conference of Antenna (see dates below).

The EMSS China team consists of (from left to right) Ting Shi (Administrative Assistant), Dr Jinping Tao (Vice General Manager), Guanghua Fang (General Manager), Yunhui Xiao (Product Manager), Jinlong Jiao (Technical Support Team Leader), Xiaofeng Wang (Senior Application Engineer), Chen Wang (Senior Application Engineer) and Dr Yuan Liu (Chief Representative).

EMSS China will be exhibiting FEKO at the 2011 PIERS and the National Conference of Antenna.

Exhibitions in 2011

FEKO will be exhibited at many conferences this year. For a complete list of events, including short courses and user meetings, and for more information about these events, visit www.feko.info/about-us/events.

12 – 14 Sept	Progress in Electromagnetics Research Symposium (PIERS), Suzhou, China
12 – 15 Sept	8th Military Antennas Summit, Washington, DC, USA
12 – 16 Sept	International Conference on Electromagnetics in Advanced Applications (ICEAA), Torino, Italy
13 Sept	FEKO Seminar, Tokyo, Japan
15 – 16 Sept	Emerging Wireless Technologies Week, Sitges, Spain
20 – 21 Sept	Antenna Systems 2011, Nashville, TN, USA
26 – 30 Sept	EMC Europe, York, UK
5 – 6 Oct	FEKO Training Course, Los Angeles, CA, USA
9 – 14 Oct	EU Microwave Week (EuMW), Manchester, UK
16 – 21 Oct	Antenna Measurement Techniques Association Annual Symposium, Englewood, Colorado, USA
18 – 21 Oct	National Conference on Antenna, Nanjing, China
25 – 28 Oct	International Symposium on Antennas and Propagation (ISAP), Jeju, Korea
14 – 15 Nov	Loughborough Antennas & Propagation Conference (LAPC), Loughborough, UK
16 – 17 Nov	FEKO Training Course, Boston, MA, USA
30 Nov – 2 Dec	Microwave Workshops & Exhibition (MWE), Yokohama, Japan
5 – 8 Dec	Asia Pacific Microwave Conference (APMC), Melbourne, Australia

About FEKO

Applications

- Antenna Design
- Antenna Placement
- EMC Analysis
- Scattering Analysis
- Biomedical
- Microstrip circuits
- Waveguide
- Cable Analysis

Fast Solutions

- Parallel Processing (Multi-Core CPUs, Clusters)
- GPU Computing
- Fast Frequency Sweep
- Out-of-Core Solving

Solution Techniques

- Method of Moments (MoM)
- Multi-level Fast Multipole Method (MLFMM)
- Finite Element Method (FEM)
- Physical Optics (PO)
- Ray-Launching Geometrical Optics (GO)
- Uniform Theory of Diffraction (UTD)
- Planar and Periodic Green's Functions
- True Hybridisation of MoM/FEM, MoM/PO, MoM/GO, MoM/UTD, MoM/MTL
- MoM for Multiple, Complex Dielectric Bodies

Model Formats

- Solid Models (Parasolid, DXF, ACIS, CATIA, Pro-E, IGES, STEP, Unigraphics)
- Meshes (CADFEKO, FEMAP, NASTRAN, AutoCAD DXF, STL, PATRAN, ANSYS CDB, ABAQUS, ASCII data format, GID)

Services

- Extended Service Contract
- On-site Training (Short Course)
- CAD Preparation
- Runtime Solutions
- Engineering Consulting Services

Follow us on Twitter!

@emss_feko

twitter

FEKO Comprehensive Electromagnetic Solutions