Comprehensive Electromagnetic Solutions

FEKO

QUARTERLY: September 2009

Contents:



## Features in this issue

**FEKO Suite 5.5 was released in July 2009.** New features include a modelling method for windscreen antenna analysis and exciting improvements in ease-of-use to CADFEKO. The main focus of this issue is to highlight some of the most significant new features and extensions in FEKO Suite 5.5.

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.

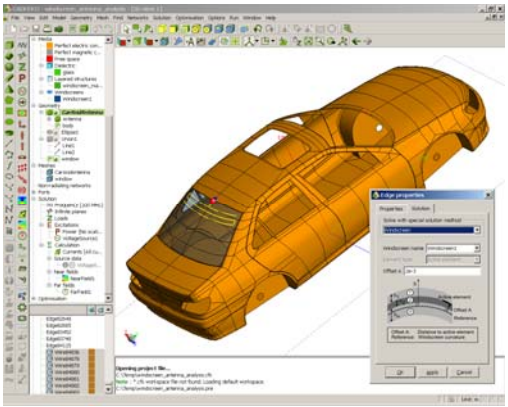
*quarterly@emss.co.za*

## FEKO Suite 5.5 release highlights

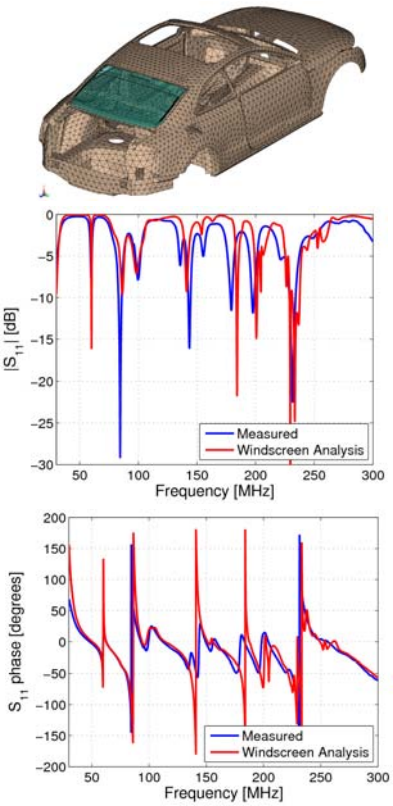
The release of FEKO Suite 5.5 occurred in July. It has a number of important new features as well as improvements to others. Apart from new computational features such as windscreen antenna analysis and modal ports with arbitrary cross section for the FEM solver, the extended workplane-based geometry creation and manipulation features within CADFEKO are anticipated to be of particular benefit to FEKO users. Here follows some feature highlights of the new release.

### Windscreen antenna analysis

Vehicle manufacturers are incorporating an increasingly wide variety of antennas into vehicles for AM, FM, television and GPS reception, for GSM communication, for automated tolling and so forth. To find a combination of antenna topologies and locations, which is both functional and aesthetically acceptable, is a very challenging task. Integration of antennas into windscreens has become a popular solution. Many FEKO users in the automotive industry face the challenge of modelling such integrated windscreen antennas, which requires the ability to analyse electromagnetic interactions between thinly layered dielectrics, thin embedded wires and the surrounding vehicle body. To address this need, the FEKO team has developed a specialised integrated windscreen antenna analysis feature for Suite 5.5. The new feature takes all physical features of windscreen antennas and their surroundings into account, including:



*Setting up an integrated windscreen antenna analysis in CADFEKO.*




*Comparison between measured and FEKO results for an integrated windscreen antenna in a car.*

- Finite sized windscreens
- Arbitrarily curved windscreens
- Multiple dielectric windscreen layers (glass, plastic, etc.)
- Mutual coupling between antenna elements
- Multiple windscreens in a vehicle
- The vehicle body
- The presence of a real ground

The analysis is based on the method of moments (MoM). Only the vehicle body and metallic windscreen antenna elements are included in the MoM mesh, which makes the analysis very efficient. On the left, an example is shown of a vehicle with a sophisticated, integrated windscreen antenna. Results show remarkable correspondence with a measurement for this complex geometry.

**"...the FEKO team has developed a specialised integrated windscreen antenna analysis feature for Suite 5.5."**

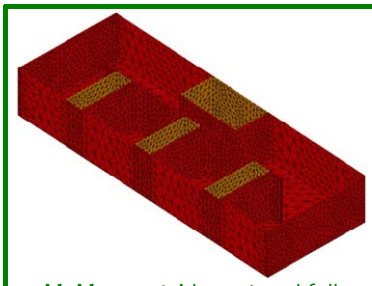
# FEKO Suite 5.5 release highlights... (continued)

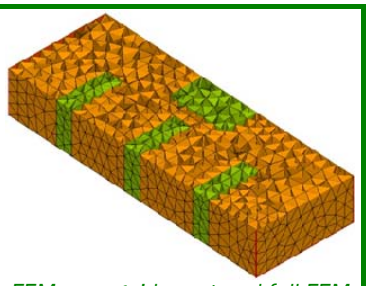
## FEM modal ports

FEKO provides users with a number of different numerical methods, as well as supporting a range of different excitation options. Modal ports, based on analytical modal functions, have been available for some time together with the MoM solver. This feature, based on numerical modal functions, is now available for the FEM solver. The benefits are that geometrically arbitrary transmission line apertures can be excited with their appropriate modal fields, e.g. hollow waveguides, microstrip lines, coplanar waveguides, etc. The ports also absorb all relevant modes as automatically determined by the solver, thus no de-embedding is required. For instance, waveguide junctions and filters can now be entirely solved with the FEM, which is ideally suited to such problems.

**"Modal ports, based on numerical modal functions, is now available for the FEM solver."**

An example of a waveguide filter with dielectric insets is shown, illustrating the dramatic benefits of treating such problems solely with the FEM. Of course, these ports can also form part of an open radiating FEM-MoM analysis.

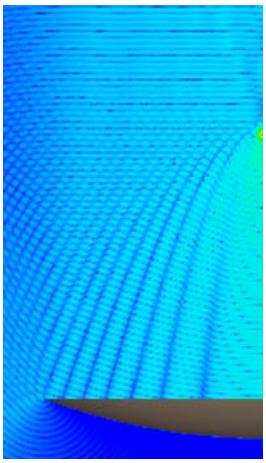


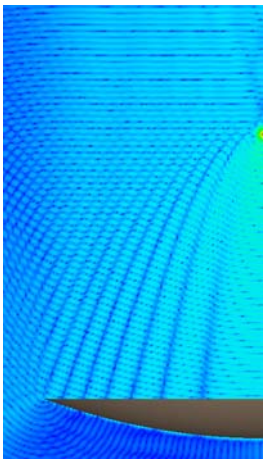


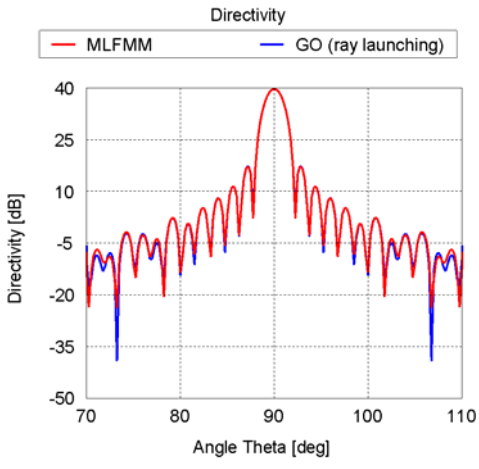
| *MoM waveguide port and full MoM analysis* | *FEM waveguide port and full FEM analysis* |
|---|---|
| *2.01 GBytes* | *0.03 GBytes* |
| *14 minutes* | *0.23 minutes* |

## Generalisation of GO analysis based on ray launching

In FEKO Suite 5.4, the asymptotic, geometrical optics (GO) method was only available for dielectric bodies. This is a ray launching method, where waves are launched from sources at evenly distributed angular increments and every time a wave hits an interface, equivalent sources are set up at that interface to model the reflection and transmission. The GO is mostly applicable to electrically very large structures. In Suite 5.5, the GO was extended, such that PEC surfaces can also be included in the analysis. This dramatically opens up its range of applicability. A typical application for the new, generalised GO would be reflector antenna analysis. Below, results are shown where the MLFMM and hybrid MoM-GO are compared, when a reflector is excited with a radiation pattern point source at its focus. Excellent agreement is obtained. In this case, the full-wave MLFMM required 5098 MBytes, while the GO only required 2.74 MBytes. Other asymptotic methods offered by FEKO are physical optics (PO) and the uniform theory of diffraction (UTD). PO is also very well suited to reflector antenna analysis.



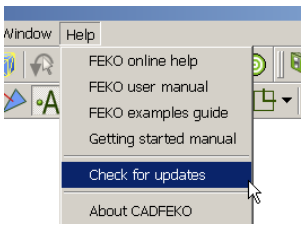





*On the left and in the middle, the reflector electric near fields obtained with MLFMM and GO, respectively, are compared. On the right, the radiation patterns are compared.*

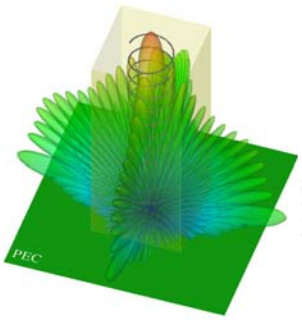
## Automatic updates

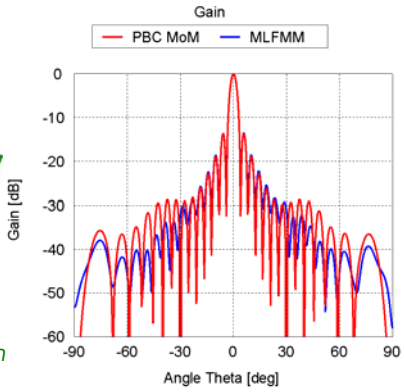
**"FEKO will notify the user if any updates are available, which the user can then choose to download and automatically install."**




With Suite 5.5, FEKO now boasts an automatic updates feature. This means that users with a maintenance and support agreement no longer need to visit the FEKO website to download updates. Instead, FEKO will periodically poll a server for updates and notify the user if any are available, which the user can then choose to download and automatically install. Should users work on a secured network, disconnected from the internet, then updates may be downloaded elsewhere and placed on a local server on the private network. The update tool can then be directed to this local repository instead of the internet.

## FEKO Suite 5.5 release highlights... (continued)



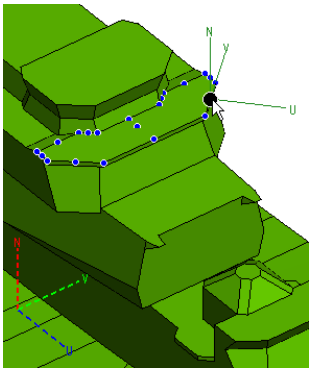

*Finite array results based on periodic analysis.*

### Generalisation of periodic structure analysis

In the new release, the periodic structure analysis capabilities of FEKO have been generalised. In Suite 5.4 only metallic surfaces were supported. Now dielectric objects as well as metallic wires can also be included in the periodic unit cell. Another new feature is that a radiation pattern may be requested which is calculated by superposition of the unit cell's radiation pattern for a specified array size. Clearly, this will be an approximation of the true pattern of such a finite array, but the approximation will be increasingly accurate as the array size is increased, while the computational cost remains the same (just the cost of solving the unit cell).

**"Dielectric objects as well as metallic wires can now also be included in the periodic unit cell."**

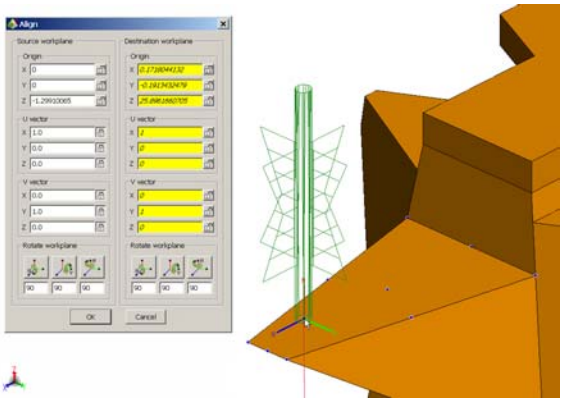
Above, an example is shown where the radiation pattern of a 21 x 21 helix antenna array is calculated based on a periodic unit cell analysis. The result is compared with a full-wave MLFMM analysis of the actual finite array. As can be observed, the periodic result is accurate down to the fifth side-lobe for this case, at a fraction of the computational cost.



*Snap point preview*

### Redesign of workplane methods in CADFEKO

Specification of geometric parameters when creating and manipulating geometry and when setting up solution options have been redesigned. Where workplanes previously only featured when requested, they now form part of any such a geometric specification. With a single mouse click, workplanes can now be snapped to existing geometry points, or placed conformal to existing geometry entities. All relevant snapping points are highlighted.

*In this example, an imported model of an omni-directional batwing antenna is being mounted onto a naval platform, using the Align Tool.*

With the new workplane features, a new tool for the manipulation of existing geometry parts has been added, namely the *Align Tool*. This tool allows the translation of a part from one workplane to another, keeping its position in terms of local coordinates fixed. The *Align Tool* will be a great help when placing antennas on a platform, or when constructing a complex CAD model in phases. (See demonstration video clips at www.feko.info.)

## New FEKO regional representative in Singapore

The FEKO team welcomes a new distributor responsible for Singapore and commercial customers in Malaysia into its ranks. In March 2009, Frontier Integrated Technology Pte Ltd became the local distributor of FEKO in the Singapore region. This move was motivated by a desire to bring high-quality support and representation to the doorstep of our valued, long-standing as well as new customers in that region.

**"Frontier Integrated Technology Pte Ltd became the local distributor of FEKO in the Singapore region."**

Frontier Integrated Technology provides world-class wired and wireless communication products and systems solutions, supplying both standard off-the-shelf and customized RF/microwave components, including amplifiers, synthesizers, oscillators, filters, cabling and antennas. Frontier Integrated Technology also offers design services in these areas as well as FPGA/CPLD and firmware design.

Frontier Integrated Technology has designed and customised many specialised antennas, including mounted and integrated multi-band and multi-mode antennas, low profile antennas, high gain satellite antennas, etc. With many years of collective antenna development experience among its staff as well as wide knowledge of the RF/microwave industry, Frontier Integrated Technology will be able to support FEKO users with expert knowledge.

**Exhibitions:** FEKO will be exhibited at many conferences this quarter, including those listed below.

| | |
|---|---|
| 29 Sept - 1 Oct '09 | European Microwave Week 2009, Rome, Italy |
| 20 - 23 Oct '09 | ISAP 2009, Bangkok, Thailand |
| 1 - 6 Nov '09 | AMTA 2009, Salt Lake City, USA |
| 22 - 26 Nov '09 | Compumag 2009, Florianopolis, Brazil |

## FEKO Student Competition

Win a notebook computer or a trip to an EM engineering conference of your choice

Submission deadline: September 25, 2009

**Who can enter?**

- Any under-graduate or post-graduate student working on a project in EM engineering and making use of FEKO
- If your institution does not have a FEKO licence then contact us — its never too late to start!

**Application procedure**

For further details, please visit

www.feko.info/educational

## FEKO Distributor Conference 2009

In May, the biennial FEKO Distributors Conference was again hosted by EMSS-SA in Stellenbosch, South Africa, which is the development headquarters of FEKO. At the conference, FEKO distributors shared their valuable knowledge on the EM simulation needs of their customers and their experiences with FEKO. Everyone also had the opportunity to familiarise themselves with the latest release of FEKO (Suite 5.5), of which an overview is also given in this edition of the FEKO Quarterly. Possible future developments were discussed, with the inputs from distributors being highly valued as it is crucial to maintain a feedback channel from users to developers in order to provide users with the best possible product.

A number of support engineers also attended the conference and made use of the opportunity to discuss support issues with the FEKO team and to make sure that forthcoming technical features will be well supported from the start.

In short, expertise from all over the world was shared in an effort to provide a better product and service to all users of FEKO. Distributors based in the USA, Germany, Japan, China, South Korea, Taiwan, India and Israel attended the conference. The new distributor from Singapore visited EMSS-SA in June.

*Attendees of the FEKO Distributors Conference 2009, at the EMSS building in Stellenbosch.*