Comprehensive Electromagnetic Solutions

FEKO

QUARTERLY: June 2009

Features in this issue

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This edition of the FEKO quarterly is packed with exciting news and events. We introduce a new antenna design product, review exceptional work that was published at the ACES 2009 conference and take a sneak preview at forthcoming features of FEKO 5.5

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

quarterly@emss.co.za

Introducing Antenna Magus

AntennaMagus
Explore.Design.Deliver.

Antenna Magus is the first design tool of its kind. Its huge searchable collection of antennas can be explored to find, design and export models of designated antennas to FEKO.

Antenna Magus does not aim to replace electromagnetic analysis tools like FEKO. It reduces the time to find and assess feasible antenna topologies for any given application, providing reliable initial designs and validated simulation models.

"Its huge searchable collection of antennas can be explored to find, design and export models of designated antennas to FEKO."

Explore

- Searchable collection of more than 100 antennas.
- Collection updated regularly to provide users with confidence that all possible antenna designs are considered.
- Information on antennas are provided in a standardised format to simplify the comparison of different antennas.
- Quick summaries, as well as detailed information is provided for each antenna.

Design and Estimate Performance

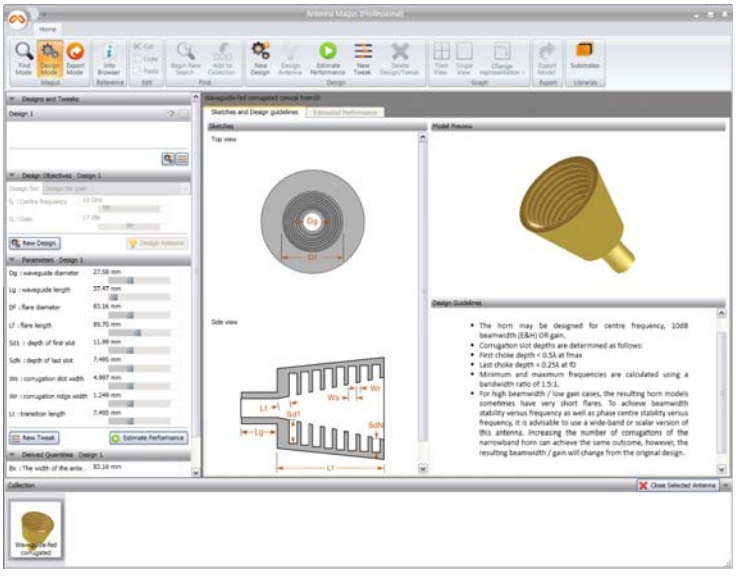
- Antennas are designed to meet performance specifications.
- Thoroughly tested design algorithms ensure that designs meet specified criteria.
- Performance of a designated antenna is rapidly predicted and applicable graphs are displayed, e.g. S-parameters, VSWR, gain.

Deliver and Export Models

- Easily and instantly generate "ready-to-run" FEKO models from designs.
- The latest FEKO simulation features are incorporated in exported models, making it easier for antenna designers to leverage the strengths of FEKO features.

FEKO distributors also act as distributors for Antenna Magus, so please contact your local FEKO distributor for more information on Antenna Magus, or visit the FEKO website's Antenna Magus area:

www.feko.info/antennamagus



Antenna Magus design mode

Review of FEKO Sessions at ACES 2009

The Applied Computational Electromagnetics Society (ACES) held its annual conference in March, once again including a large FEKO presence. Judging by the support that FEKO received at this conference, the product is growing in strength and stature every year. At this year's event there were 6 sessions dedicated to FEKO modelling and analysis where 28 papers were presented. The following is only a small collection of the outstanding work that was presented.

Accurate Simulation of Rotman Lens Using FEKO

Junwei Dong [1,2], Amir I. Zaghloul [1,3], Rensheng Sun [2], C.J. Reddy [2] and Steven Weiss [3] - [1]Department of Electrical & Computer Engineering, Virginia Polytechnic Institute and State University, VA 22043, USA, [2]EM Software & Systems (USA), 144 Research Dr, Hampton, VA 23666, USA, [3]U.S. Army Research Laboratory, Adelphi, MD 20783, USA

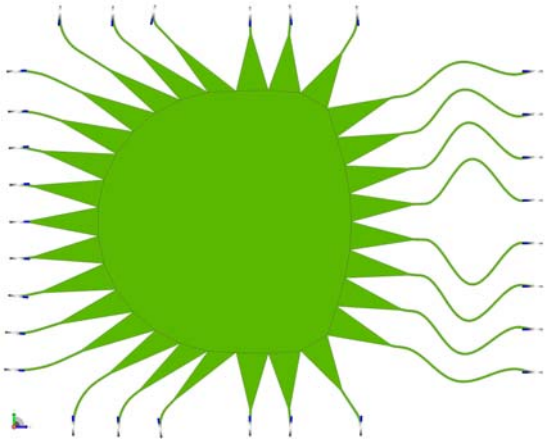
"The authors used FEKO's MoM planar media Green function formulation to model an 8 by 8 printed microstrip Rotman lens."

Applications such as satellite and radar antennas require Beam Forming Networks (BFN) to produce correct feeding phases and amplitudes for their phased arrays. The Rotman lens is an example of a BFN with wide bandwidth and wide scan angle. In this paper the authors used FEKO's MoM planar media Green function formulation to model an 8 by 8 printed microstrip Rotman lens.

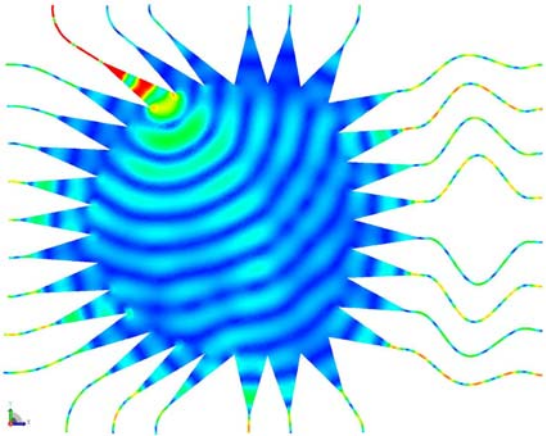
Typical BFN evaluation strategies measure performance as follows:

- Aperture: Amplitude and phase coupling when single ports are excited at a single frequency.
- Bandwidth: Port to port coupling in amplitude and phase.

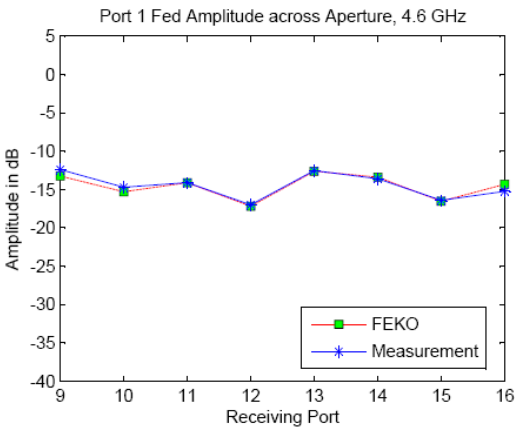
Examples comparing simulated to measured values for both strategies are shown here, with excellent agreement between simulated and measured values.



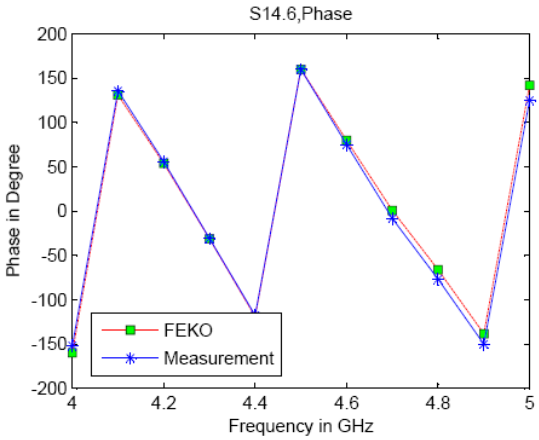
Rothman Lens port numbers



Surface currents with port 2 excited at 4.6 GHz



Amplitude distribution over aperture with port 1 excited at 4.6 GHz.



Port 6 to port 14 phase coupling for 4 - 5 GHz.

"A multistage simulation was developed to move the helicopter rotors; calculate the transmitted fields at a set radius; and mix the field modulation with audio samples."

Modelling of Audible Noise with DSB-AM due to Helicopter Rotor Modulation

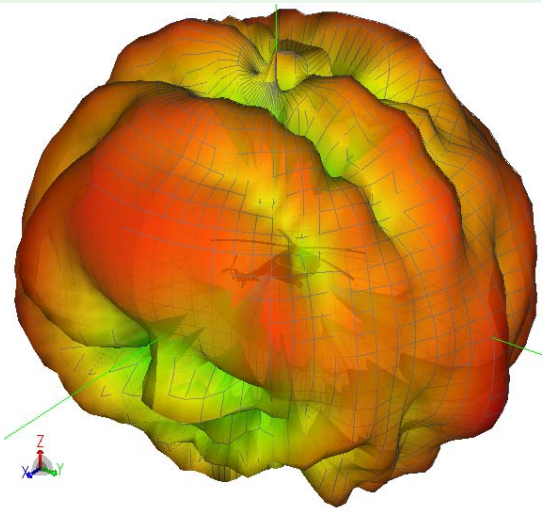
Terry R. Vogler - ARINC Engineering Services, LLC, 2551 Riva Rd, Annapolis, MD 21401, USA

ARINC's recent aircraft integration work required the installation of multiband radios that were not aircraft-certified. Other installation details were typical for helicopters, including the use of Sensor Systems wideband aircraft blade antennas. During installation tests, audible rotor modulation noise was noted when transmitting or receiving with the top-mounted antenna using DSB-AM in the air traffic control (ATC) frequency bands. This noise was not noticeable on a bottom-mounted antenna. Because changes to the radio circuitry were not feasible, an alternative mounting location for the top-mounted

Review of FEKO Sessions at ACES 2009... (continued)

antenna was desired. A simulation method was needed to compare the susceptibility of different mounting locations to rotor modulation. Using FEKO together with Rhinoceros (a CAD modeler) and Mat lab, a multistage simulation was developed to move the helicopter rotors; calculate the transmitted fields at a set radius; and mix the field modulation with audio samples. Field fluctuations are evaluated to provide insight on the modulation effect and the depolarizing effects needed in the propagating and receiving environment.

This work combined several tools and demonstrated the easy mixture of FEKO with other analysis tools. It also proves that the retention of the ASCII text based scripting interface provides users with substantial flexibility for integrating such third party software tools with FEKO.

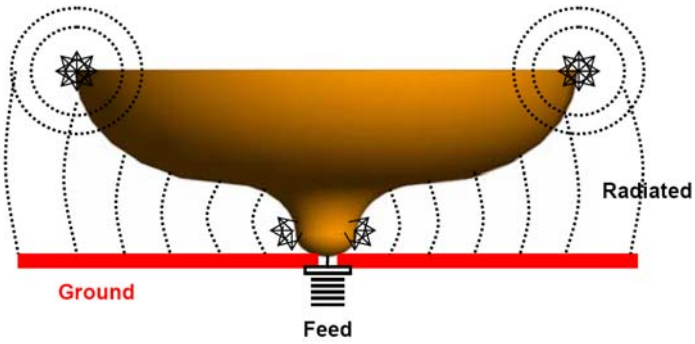


θ polarisation far-field patterns for rotors rotated to 46° .

"This work combined several tools and demonstrated the easy mixture of FEKO with other analysis tools."

Ultra-Wideband Triple-Ellipse Inverted-Hat Antenna for Aircraft Communications

Jing Zhao, Chi-Chih Chen, John L. Volakis - ElectroScience Laboratory, Department of Electrical and Computer Engineering, The Ohio State University, 1320 Kinnear Rd, Columbus, OH 43212, USA



Cross-section of the UWB TEIHA configuration.

The authors describe a design method for a monopole-type ultra-wideband triple-ellipse inverted-hat antenna (TEIHA) that operates from 50 MHz to 2 GHz. Using FEKO, the authors validate their design method to prove that the antenna can radiate towards its horizon with vertical polarisation and a 40:1 bandwidth.

New Japanese Support Engineer

FEKO and its distributors are continually striving to improve the service that is offered to users. It is with this goal in mind that Farad Corporation, the Japanese distributors of FEKO, recently appointed Toshiyuki Takahashi as support engineer for FEKO in Japan, responsible for support services to Japanese customers. Takahashi-san is an experienced computational electromagnetics (CEM) engineer who received the MS.E.E. degree from Hokkaido University, Sapporo, Japan in 1991. After graduation he engaged in research and design activities for antennas and RF circuits where he worked for 10 years. Between 1992 and 1995 he worked on assignment at the Advanced Telecommunications Research Institute in Kyoto on various optical and radio communication projects.

Toshiyuki Takahashi

"Farad Corporation, the Japanese distributors of FEKO, recently appointed Toshiyuki Takahashi as support engineer for FEKO in Japan."

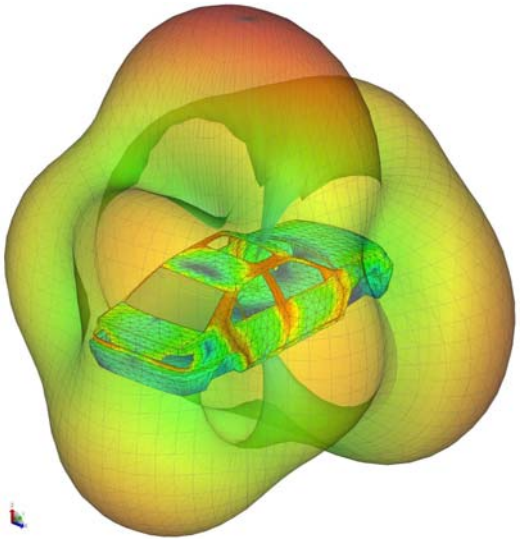
Takahashi-san is experienced in a wide range of technologies, having been involved in studies for the Japanese government on a variety of topics, e.g.

- Trends of regulation for the biological effects of electromagnetic fields.
- ICT policy, e.g. wireless and antenna technology trends.

Before joining Farad Corporation he worked as a senior technical support engineer for a commercial CEM software code based on TLM methods.

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

17 - 21 Aug '09	IEEE EMC 2009, Austin, Texas, USA
1 - 2 Sept '09	Antenna Systems Conference 2009, Philadelphia, Pennsylvania, USA
16 - 18 Sept '09	EMC Symposium, Adelaide, Australia

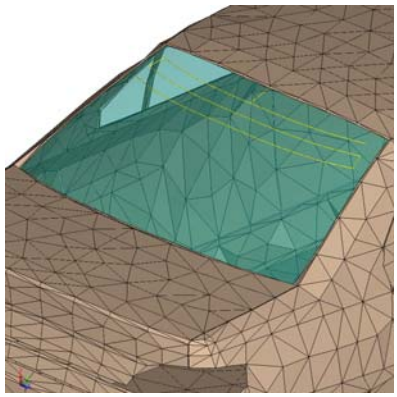


84 MHz windscreen antenna in POSTFEKO

Forthcoming features in FEKO 5.5.

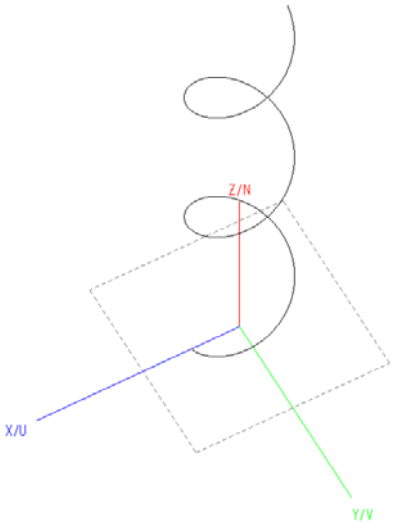
FEKO Suite 5.5 is due to be released soon and will bring the customer a range of new and improved features. Some of these features that customers can look forward to include:

- **Windscreen antenna modelling.** This new method is based on a MoM solution which meshes only the metallic elements in the windscreen. It takes into account boundary conditions on the dielectric interfaces of multilayered glass, coupling between closely spaced antenna elements, finite-size windscreens and curvature and rotation of the windscreen.



Windscreen antenna model visualisation

- **Periodic boundary conditions (PBC) with dielectrics in unit cell.** The PBC can now be used to model a much wider range of periodic structures, e.g. FSS. With proper postprocessing this feature may also be used to accurately estimate S-parameters and radiation patterns for large, but finite, phased array antennas.
- **New workplane methods in CADFEKO.** The CADFEKO development team is working through a process of user experience testing to improve the usability of the software. Modifications to the way that the workplane operates make the utilising of local coordinate systems for geometry creation much more intuitive.
- **Analytically defined curves in CADFEKO.** Users will have a method to analytically define a continuous curve in Cartesian, spherical or cylindrical coordinate systems.



(t, sin(t), cos(t)) in Cartesian coordinates with analytical curves

Comprehensive Electromagnetic Solutions

APPLICATIONS
- Antenna Design
- Antenna Placement
- EMC Analysis
- Scattering Analysis
- Biomedical

SOLUTION TECHNIQUES
- Method of Moments (MoM)
- Multi-level Fast Multipole Method (MLFMM)
- Finite Element Method (FEM)
- Physical Optics (PO)
- Geometrical Optics (GO)
- Uniform Theory of Diffraction (UTD)
- Planar and Periodic Green Functions
- True Hybridisation of MoM/FEM, MoM/PO and MoM/UTD
- MoM with Surface and Volume Equivalence Principle for Multiple Dielectric Bodies

FAST SOLUTIONS
- Parallel Processing
- Out-of-Core Solving

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
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- Engineering Consulting Services

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