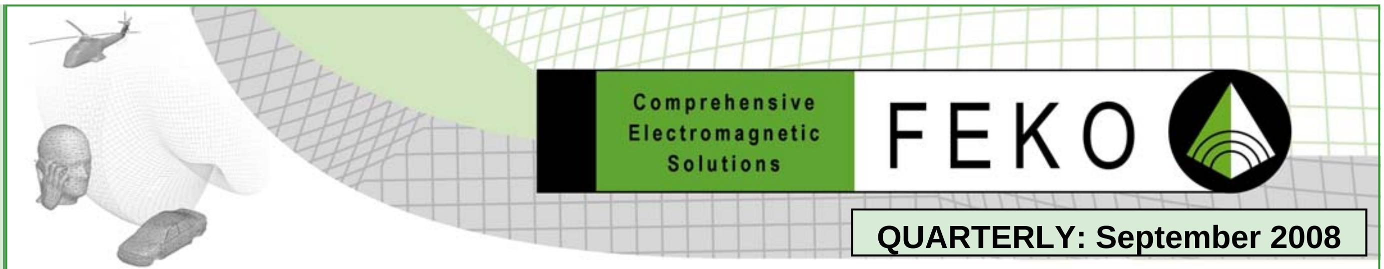


QUARTERLY: September 2008

Contents:

"Specifying symmetry planes can have significant computational benefits"

Features in this issue

The FEKO team recently announced the new release of FEKO Suite 5.4, with significant new features and functionality. New releases occur on a regular basis. This issue of the FEKO quarterly highlights features in the new release and provides some tips on how to use them effectively.

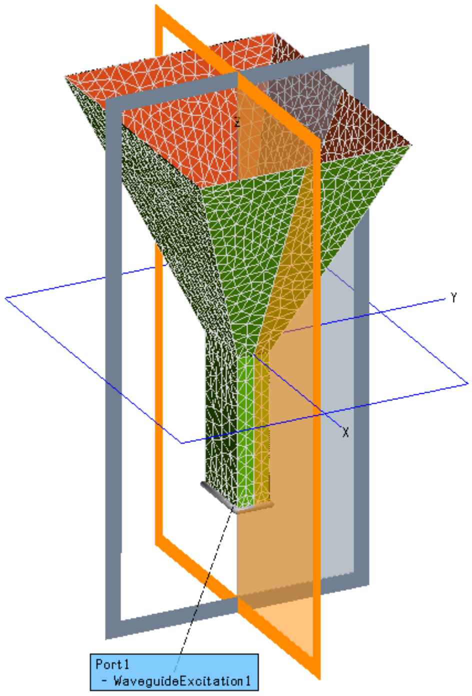
As always, your comments on the quarterly are welcome. If you would like to contribute an article, please contact us.

quarterly@emss.co.za

FEKO Suite 5.4 feature highlights

Symmetry specification in CADFEKO

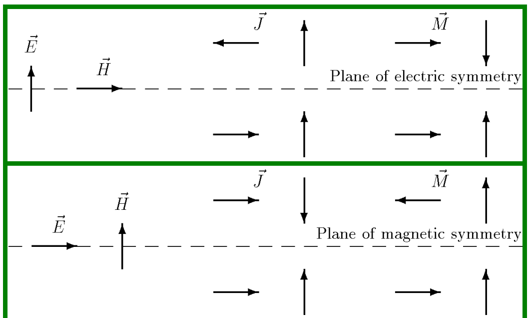
Three types of planar symmetry are possible: geometric, electric and magnetic. In CADFEKO, these properties can now be assigned to the planes {x = 0; y = 0; z = 0} (previously only in EDITFEKO). The type of symmetry is determined by the geometry of the structure and sources. The whole symmetric model should be created. This makes it very easy to switch between a solution with symmetry and one without. It also allows CADFEKO to verify model symmetry during meshing. Specifying symmetry planes can have significant benefits, as this information is exploited to reduce computational costs. With multiple symmetry planes, the computational benefits are compounded. Symmetry can be invoked together with the MoM and the FEM/MoM, but not with the MLFMM.



CADFEKO visualisation of symmetry planes for a typical horn antenna

Geometric symmetry: The geometry of the structure must be symmetric, while the sources may be arbitrarily located. This leads to non-symmetric current distributions and thus all unknown coefficients must be solved. No memory reduction is obtained, but matrix set-up time is reduced.

Electric symmetry: In addition to geometric symmetry, the requirements on the sources shown to the right, must hold. Physically, an electric symmetry plane is a plane which can be replaced by a perfect electrically conducting wall without changing the field distribution. In this case the number of unknown coefficients is reduced by a factor two. The impact for the MoM is a reduction by a factor four in memory requirement. The impact for the FEM is a reduction by a factor two in memory requirement. These reductions also lead to much faster matrix equation solution times.



Requirements on sources for planes of electric symmetry (top) and magnetic symmetry (bottom)

Magnetic symmetry: Again geometric symmetry with additional source requirements must hold. Physically, this is a plane which can be replaced by a perfect magnetically conducting wall. The same computational benefits result as in the case of an electric symmetry plane.

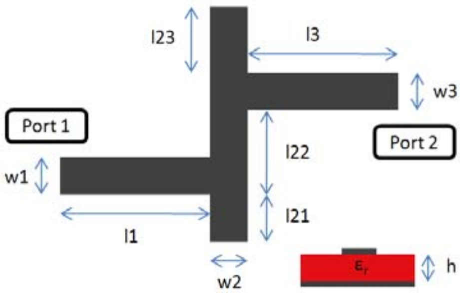
Example of a symmetric antenna structure: Consider the horn antenna shown, excited with a dominant mode, rectangular waveguide port. The plane y = 0 is an electric symmetry plane, since the incident wave is electrically polarised in the y-direction. The plane x = 0 is a magnetic symmetry plane, as the incident magnetic field is normal to it. The solver can exploit this information to use 16 times less memory (the benefits of multiple symmetry planes compound!).

FEKO Suite 5.4 feature highlights (continued)

"Mask goal objectives can be used to optimise arrays of output data"

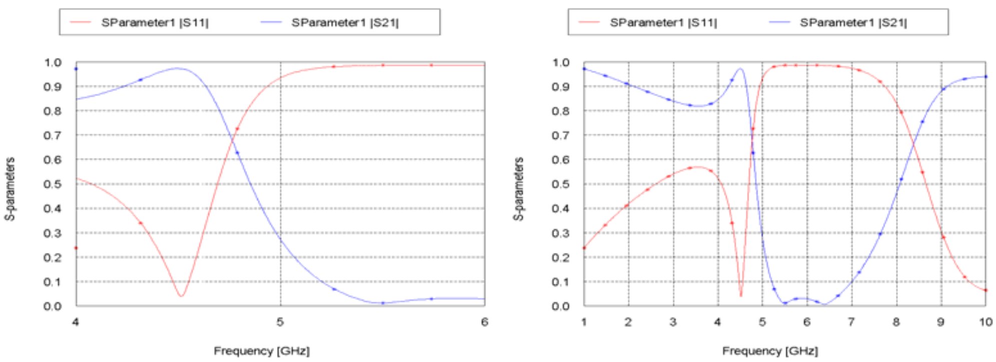
Optimisation masks

A new feature has been introduced which allows for the comparison of an output data array with a predefined array (the mask), in the evaluation of the fitness of an optimisation step. A mask optimisation goal objective would typically be used when a quantity that varies with position (e.g. a set of near field points), observation angle (e.g. a radiation pattern) or frequency (e.g. input impedance) is to be optimised. The mask array need not be of the same length as the computed data array, as the optimiser will use piece-wise linear fitting to determine values at appropriate locations.



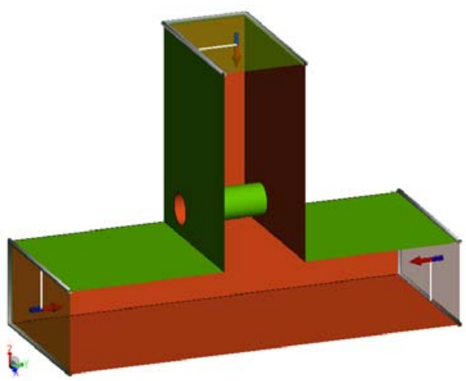
Microstrip line structure:
w1 = w3 = 2.413 mm; w2 = 2.54 mm
l1 = l3 = 12 mm; h = 0.794 mm; ε_r = 2.2

Example of masks used to realise a low-pass filter: Consider optimising the transfer coefficient (S_{21}) of the microstrip line structure shown, in the band 4 to 6 GHz. The optimisation variables are {l21; l22; l23}. A mask is set up which specifies the rejection band behaviour from 5 to 6 GHz, below which the response must lie. Another mask is set up, specifying the pass band behaviour from 4 to 5 GHz, above which the response must lie. These two sub-goals are combined with relative weightings of 10 and 1. The optimised response is shown below. Observe the typical low-pass filtering behaviour. Note that goals may not always be exactly satisfied, as combined goals may force the optimiser to a compromise. Also, one must realise that a given goal may not be exactly realisable within the specified parameter space.

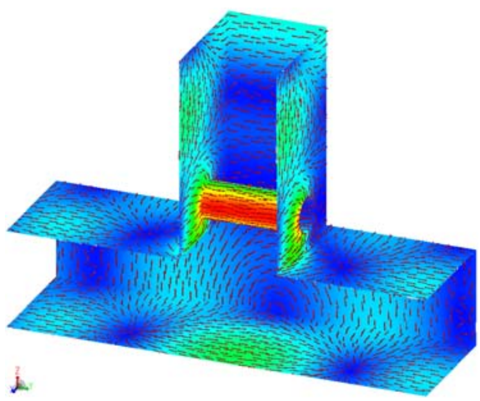


S-parameters of the optimised filter: 4 to 6 GHz range of optimisation (left); 1 to 10 GHz range (right)

"Waveguide ports are now fully specifiable in CADFEKO"



Cut-away CADFEKO view of a three-port junction



Junction current distribution

Waveguide port specification in CADFEKO

Waveguide ports can now be specified within the GUI (previously only in EDITFEKO). Three types of ports are supported: coaxial, rectangular and circular. Ports can be applied to faces of the appropriate shapes, which do not constitute a boundary of a conducting or dielectric region and on which no special solution settings are in place. When a face is selected, a propagation direction and reference direction for the port are automatically chosen and displayed. These can be changed, if desired. FEKO will automatically determine the maximum number of modes to consider at each port; alternatively, this can be specified by the user. Waveguide ports may also be applied directly to mesh faces.

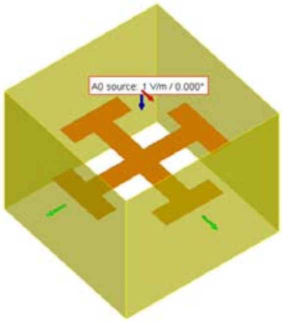
Periodic boundary conditions

This is a new feature to FEKO Suite 5.4. The option to analyse scattering or radiation by infinite, metallic, periodic structures is now available. Both 1- and 2-dimensional periodicity is supported. In the 2-dimensional case, skewed lattice vectors are allowed. The MoM is used for this type of analysis, employing a periodic version of the free space Green function. Only the unit cell needs to be modelled in CADFEKO. Applications include frequency selective surface characterisation, large array analysis, etc.

FEKO Suite 5.4 feature highlights (continued)

A selection of other new features

- Non-radiating networks and transmission lines can now be interconnected or connected to wire segments, vertices or edges in the model
- Loads and excitations can be applied to network ports
- New CAD import and export filters (see product details on the back page)
- Waveguide excitations can be used in the same model as PO
- Parallelisation of the FEM and GO techniques
- A new interface to CRIPTE from ESI Group (see article below)
- Changes to the licencing policy: licencing is now based on the number of CPUs as opposed to the number of cores or processes
- Improved efficiency when computing near- and far-fields in parallel



Modelling a frequency selective surface unit cell

"Licencing is now based on the number of CPUs as opposed to the number of cores or processes"

New partnerships

EMSS joins Altair HyperWorks Partner Solutions Program

www.hyperworkscommunity.com

www.altair.com

EMSS has joined Altair's innovative HyperWorks Partner Solutions Program. The new program provides HyperWorks customers with on-demand access to a wide range of partner applications, of which FEKO now forms a part. These applications complement Altair's own suite. HyperWorks customers can use their existing licences to tap into partner applications via the HyperWorks Partner Solutions Community, without additional costs or licencing agreements. This partner program is a fundamentally new approach to how businesses purchase their applications. It delivers services that were previously only available to larger companies due to licencing, procurement and administrative costs.

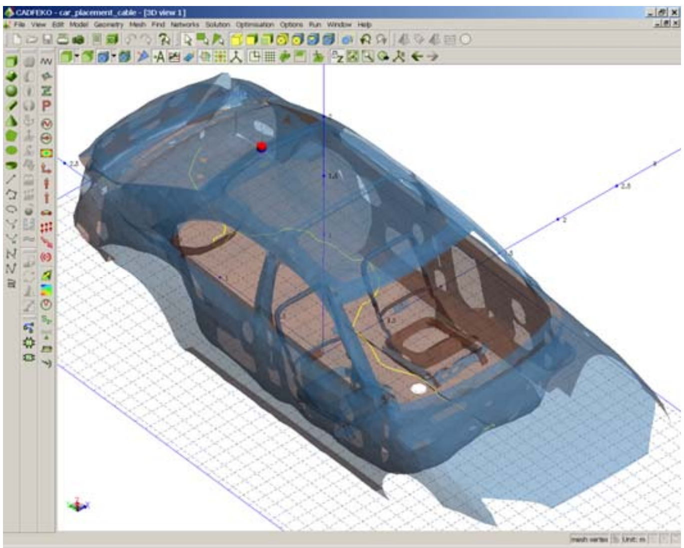
"Altair is excited to have EMSS join our new HyperWorks Partner Solutions Program," said Michael Humphrey, vice president of partner programs at Altair. "EMSS is a highly respected company and their FEKO suite is the industry leading electromagnetics solution. The inclusion of FEKO in the HyperWorks Partner Community expands our product offering and creates a win-win-win situation for our mutual customers."

"EMSS is pleased to be an inaugural partner in the HyperWorks Partner Solutions Program," said Ulrich Jakobus, FEKO Product Manager. "Manufacturing companies are including more electrical components into their products increasing the demand for electromagnetic simulations and visualisations with our FEKO software. EMSS plans to leverage the global Altair sales team to expand market share and accelerate recurring revenues through participation in this program. We are excited to be part of this innovative on-demand software distribution model."

EMSS and ESI Group join forces for complex cable coupling analysis

www.esi-group.com

Analysing the EM coupling between complex cable bundle networks and their surrounding environment poses a great challenge to EM simulation tools. No single tool is currently capable of a complete integrated solution and a combination, or hybrid, of solver techniques is required. With this cooperation and specifically through the interface between their respective solvers CRIPTE and FEKO, ESI Group and EMSS will provide their customers with a better solution to such challenging EM compatibility (EMC) problems.



Automotive cable analysis with FEKO

CRIPTE determines multi-conductor transmission line characteristics with a 2-D field solver, the results which is then used within a network simulator to analyse the full 3-D system of cable bundles. FEKO in turn is used to analyse the coupling between structures and sources surrounding the cable bundles (e.g. a vehicle chassis, mounted antennas, incident fields, etc.).

ESI Group and EMSS look forward to bringing this solution to the marketplace.

"An interface between FEKO and CRIPTE is now available for complex cable coupling analysis"

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

8 - 12 September	EMC Europe 2008, Hamburg, Germany
26 - 31 October	11th EuMW 2008, Amsterdam, The Nether-
2 - 6 November	ISAPE 2008, Kunming,
16 - 21 November	30th AMTA Symposium 2008, Boston, Massa-
16 - 20 December	APMC 2008, Hong Kong and Macau, China

New FEKO team members

The FEKO team is proud to introduce two new members

Dr Matthys Botha at EMSS headquarters

Dr Matthys Botha joined EMSS SA as an Application Engineer within the team responsible for FEKO distribution in Australasia, South America and Africa, as well as technical marketing worldwide.

Dr Botha received a Bachelor's degree (cum laude) in electrical and electronic engineering and a Ph.D. from the University of Stellenbosch, South Africa, in 1998 and 2002, respectively. As a post-graduate student he received a Young Scientist Award from the International Union of Radio Science in 2001. In 2003 he joined the Center for Computational Electromagnetics and Electromagnetics Laboratory (CCEML) at the University of Illinois at Urbana-Champaign, USA, as a Post-doctoral Research Associate. Towards the end of 2004 he returned to South Africa, where he worked as a Research Fellow at the University of Stellenbosch until mid-2008, at which point he joined EMSS as part of the FEKO team.

Dr Botha's primary research interests are finite element and boundary element methods in CEM. He has published many papers in journals and at international conferences, he regularly acts as a reviewer, and has been invited to act as a session organiser or chair on numerous occasions. He was a co-author of the chapter on "Finite element analysis" in the "Encyclopedia of RF and Microwave Engineering", 2005. He was the Technical Program Chair for the 8th International Workshop on Finite Elements for Microwave Engineering in 2006, and has acted as guest co-editor of a special issue of the journal "Electromagnetics" in 2008.

Mr Gopinath Gampala, Application Engineer for North America

Mr Gopinath Gampala joined EMSS USA as an Application Engineer to support FEKO customers in North America. Mr Gampala has a B.S. degree in Electronics and Communications Engineering from the Jawaharlal Nehru Technological University, Hyderabad, India. He attended the University of Mississippi, working as a Research Assistant towards his Master's degree, until August 2007. The topic of his research was "Analysis and Design of Artificial Magnetic Conductors for X-Band Antenna Applications." He also has experience in numerical methods for electromagnetics.