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About this issue

This edition reports back on the results of the recently completed FEKO student competition and considers selected new features in FEKO Suite 6.0 in more detail. Details of the 2011 International FEKO User Meeting are also presented.

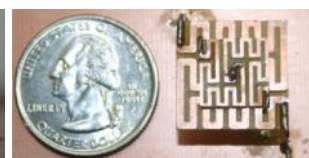
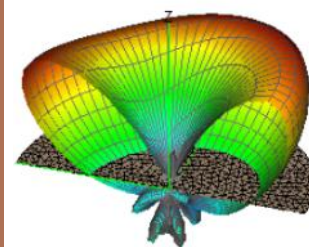
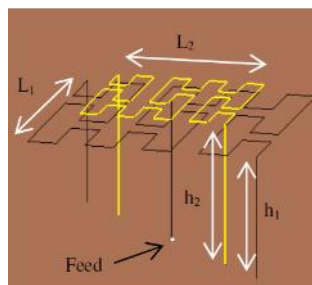
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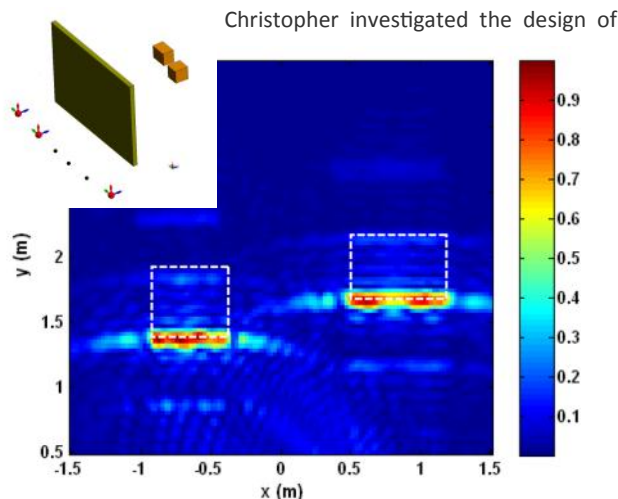
Student Competition 2010

The 2010 FEKO Student competition drew entries from across the globe. The entries were not judged on the complexity of the EM problem solved, but rather on the clarity by which the EM problem was defined, consideration of computational electromagnetics (CEM) principles in the application of FEKO, the innovative and apt use of FEKO features as well as the verification, effective representation and correct interpretation of results.

This year's winner is Christopher Thajudeen with his entry entitled "From Electrically Small Ultra-Wideband Antennas to Large Scale Building Imaging; Using FEKO to synthesize Full Building Through-the-Wall Radar Imaging Scenarios". Christopher is a PhD student studying under the supervision of Dr. Wenji Zhang at Villanova University in Pennsylvania, USA. He receives prize money to the value of US\$2000 to spend on a computer of his choice.



Christopher Thajudeen's design of a Dual Stacked Peano Top-Loaded Monopole. The figures show his schematic, the radiation pattern calculated using FEKO and photos of the antenna prototype (side and top view).

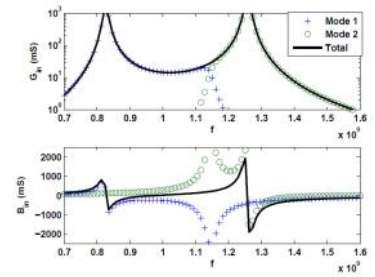
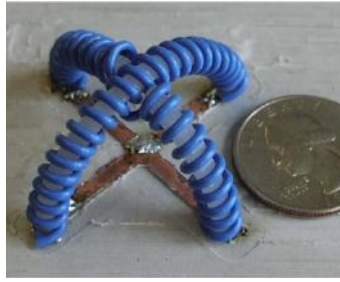


Model of a wall concealing two targets, showing point sources used to model a Synthetic Aperture Radar and the Through-the-Wall Radar Imaging result, with true locations of the targets indicated by dashed outlines, by Christopher Thajudeen.

Christopher investigated the design of ultra-wideband electrically small antennas for Through-the-Wall Radar Imaging (TWRI). These antennas are of interest in the development of through-wall imaging systems for mobile platforms. Space-filling Peano curves have been used as top loads for electrically short dipoles, achieving a bandwidth of about 10%. To increase the bandwidth to 35%, Christopher employed a dual stacked configuration of Peano Top-Loaded Monopoles. The simulated antenna radiation pattern was used as a radiation point source to model the use of the antenna for a mobile Synthetic Aperture Radar (SAR) TWRI scenario. The Multilevel Fast Multipole Method (MLFMM) was used to analyse the antenna placed on an electrically large, but finite, ground plane and Geometric Optics (GO) for the forward modelling of TWRI, in addition to the full wave Method of Moments (MoM) solution. To simulate the monostatic radar system, a grid search was performed using OPTFEKO.

"The simulated antenna radiation pattern was used as a radiation point source to model the use of the antenna for a mobile Synthetic Aperture Radar (SAR) TWRI scenario."

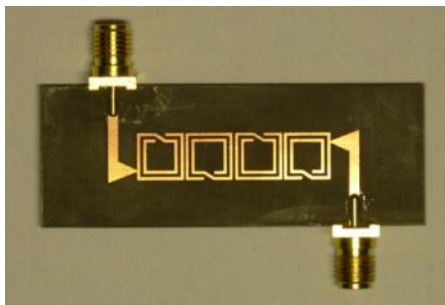
A second prize was awarded to Jacob Adams, a PhD student supervised by Prof. Jennifer Bernhard at the University of Illinois at Urbana-Champaign, USA. Jacob receives honorary mention and an Amazon gift voucher for his entry on the application of Characteristic Mode Theory. His entry is entitled "Analysis of a Low Q, Electrically Small Spherical Antenna Using Characteristic Modes".



A photo of the TM_{10} monopole that was analysed by Jacob Adams using Characteristic Mode Theory and a graph showing the calculated admittance of the antenna's significant characteristic modes.

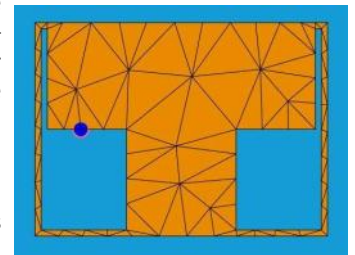
Other interesting entries were also received. Theunis Beukman from Stellenbosch University in South Africa submitted an entry on microstrip narrowband filters.

He designed a linear and a cross-coupled spiral resonator filter as well as a tuneable combline filter in FEKO.



Theunis Beukman's linear coupled spiral resonator filter.

Mohd Khairul Hisham Ismail from the Universiti Teknologi Malaysia entered his analysis of a microstrip patch antenna with two stepped slots for dual frequency operation, which he designed for GPS and GSM frequencies.



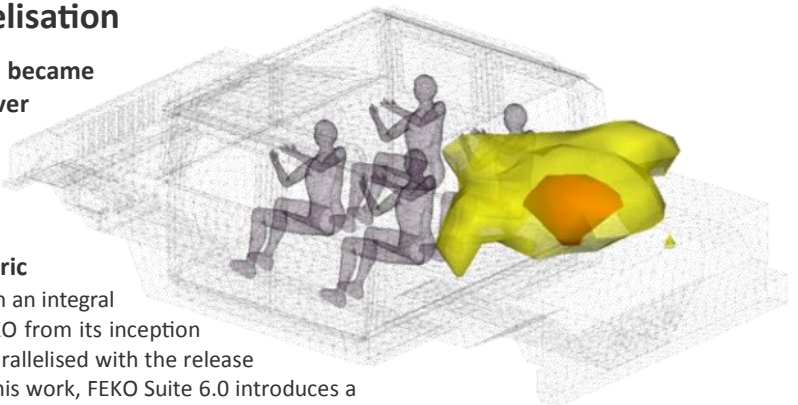
FEKO model of Mohd Khairul Hisham Ismail's stepped slot patch antenna.

Focus on FEKO Suite 6.0 Features

MLFMM-FEM Parallelisation

FEKO Suite 5.0 (July 2005) became the first commercial EM solver to implement a MoM-FEM solver, enabling the optimal solution of metallic structures in close proximity to complex dielectric objects.

This feature has been an integral part of the hybrid solvers in FEKO from its inception and even more so after being parallelised with the release of FEKO Suite 5.4. Building on this work, FEKO Suite 6.0 introduces a hybrid MLFMM-FEM solver which leverages FEKO's MoM-FEM hybridisation legacy to now provide a solution method that support very large metallic regions, closely coupled with complex dielectric regions.



MLFMM-FEM solution of a Hummer with vehicle mounted TETRA radio

Examples of application where the MLFMM-FEM hybrid method is the ideal solver include the investigation of radiation hazard problems involving human phantoms in and around vehicles that are fitted with various high powered radio transmitters or the simulation of antenna placement problems, where a complex dielectric antenna has to be mounted on a large metallic platform, e.g. an aircraft.

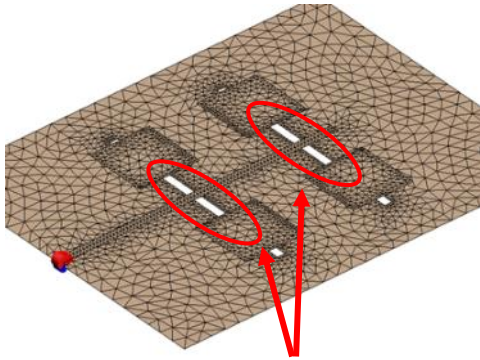
The MLFMM-FEM solution method can be instantly activated for any MoM-FEM models, by simply switching on the MLFMM solution option. No changes to model setup is required and the MLFMM will be applied where the MoM was applied in the past.

The power of the MLFMM-FEM hybrid method is easily illustrated by considering a radiation hazard investigation where a TETRA radio (382.5MHz, 3.3W transmitted power) is mounted on a military vehicle with four passengers inside. The MLFMM-FEM method solves the problem in 84% less time than is required to solve the same problem with the MoM-FEM method and uses 57% less memory.

	MoM-FEM	MLFMM-FEM
Solution time	15.4 hours	2.4 hours
Memory required	32.8 GByte	13.9 GByte

"The MLFMM-FEM solution method can be instantly activated for any MoM-FEM models, by simply switching on the MLFMM solution method."

Planar Green's Function Aperture Modelling with Magnetic Currents



Conventional slot meshing

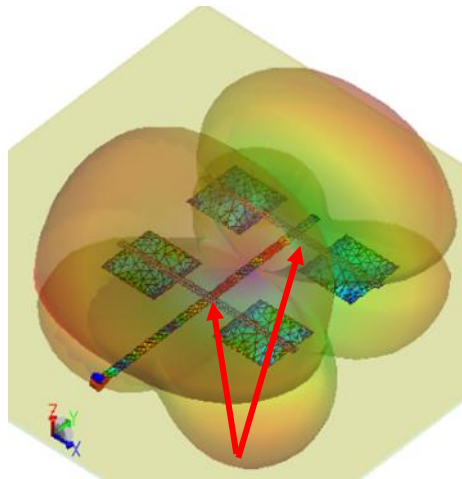
much less mesh elements in the model, which implies significantly shorter simulation times with positively frugal memory requirements.

The magnetic slots modelling feature can be accessed by drawing the aperture with any of the CADFEKO geometry primitives and setting the solution properties of that face to request that the FEKO solver consider this face as a magnetic slot.

	Memory	Runtime
Aperture modeling	1.7 MByte	7 sec
Finite ground plane	207.6 MByte	631 sec

Resource scaling for microstrip-slot-microstrip transition with aperture modelling

The planar Green's function is the optimal method to use for the modelling of planar microstrip antennas, filters, couplers, etc. Up to now, the difficulty in using this method for coplanar and aperture type structures was that a large ground plane around the slot had to be modelled to ensure that the field distribution across the slot was accurately modelled. FEKO Suite 6.0 introduces an extension to the planar Green's function method that allows slotted microstrip structures to be modelled efficiently with magnetic current slots. Instead of meshing the ground plane around a slot, the slot itself can now be meshed with the new mesh elements modelling magnetic currents, rather than the standard electric currents. Experienced users will immediately recognize that this feature will result in

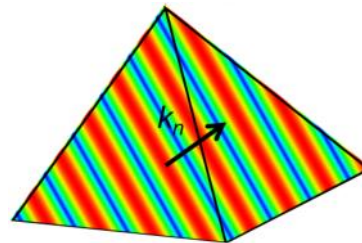


Magnetic slot mesh solution in FEKO Suite 6.0

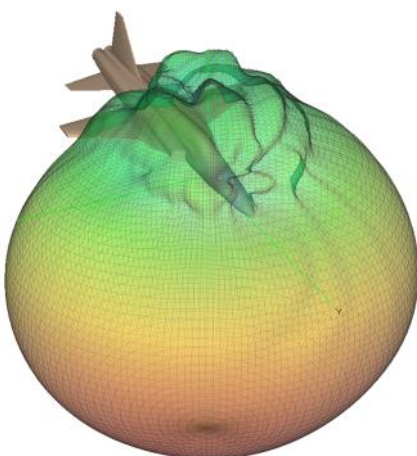
"...the slot itself can now be meshed with the new mesh elements modelling magnetic currents, rather than the standard electric currents."

Large Element PO (LE-PO)

FEKO's industry leading hybrid MoM-PO formulation enables the solution of very large structures with the asymptotic, high frequency PO (Physical Optics) method, while treating small, electrically complex elements of the same model with the full-wave MoM. FEKO Suite 6.0 extends this ability much further with the introduction of the large element PO (LE-PO) modelling method. The key difference between the traditional PO formulation and the new LE-PO formulation is that LE-PO uses an analytical basis function to model the phase variation of currents on the surface of a mesh element, where traditional PO used limited order basis functions. The new LE-PO method thus enables users to mesh structures with triangular mesh elements up to 2 lambda in size (arbitrarily large if only far-fields involved), keeping in mind that the mesh should still accurately represent the physical geometry. Memory and runtime requirements will be reduced significantly for the new model. E.g. a microstrip antenna placed on an aircraft (4.3 GHz) is solved by the LE-PO in less than 10% of the time and memory required by traditional PO for the same simulation.



Phase variation of currents on LE-PO mesh elements



Predicting radiation patterns of microstrip antenna installed under nose of fighter aircraft using MoM-PO

The LE-PO solution method can be requested by setting the solution properties of the relevant face. A local mesh size specification that adequately meshes the face with as large triangles as possible (while maintaining geometric fidelity) should also be specified via the face properties dialog.

	Traditional PO	LE-PO
Solution time	~ 24 hours	0.5 hours
Memory required	560 MByte	27 MByte

Computational resources required to solve a microstrip antenna on an airframe at 4.3 GHz

"...LE-PO uses an analytical basis function to model the phase variation of currents on the surface of a mesh element..."

“EMSS regards ACES as a very important event for the CEM community...”

The Applied Computational Electromagnetics Society (ACES) is hosting the 2011 edition of its annual showcase event from between 27 and 31 March, 2011, in Williamsburg, Virginia, USA. This international symposium serves as a forum where developers, analysts and users of computational electromagnetics (CEM) methods over all frequency ranges and relating to diverse applications can engage in vigorous debate about the merits and application of numerical methods to real-world problems. EMSS regards ACES as a very important event for the CEM community and contributes to the event as Platinum sponsor, while the director of EMSS USA, Dr. C.J. Reddy, serves as general chair to assist in the organisation of the conference. Please visit aces.ee.olemiss.edu/conference for more information on the event.

A special session on EM modelling with FEKO will be hosted at ACES 2011. These sessions are typically very popular and attendees are sure to learn of new ideas or implementation concepts that will benefit their simulation work.

As in the past, an International FEKO User Meeting is being organised at the same location as ACES. The International FEKO User Meeting will be held on April 1, 2011. This meeting includes presentations to highlight some of the latest FEKO features (Suite 6.0, released September 2010) and users that present their work, facilitating the exchange of ideas and knowledge within the FEKO community. Users will have the opportunity to interact with the FEKO product manager, to discuss their use of FEKO and to request future extensions. Please visit www.feko.info for more information.



Colonial Williamsburg Gardens
(Image courtesy of www.gardenvisit.com)

Exhibitions

FEKO will be exhibited at many conferences this quarter, including those listed below. For a complete list of events and for more information, visit www.feko.info/about-us/events.

6 December '10	Japanese FEKO User Meeting, UDX, Tokyo International Forum, Tokyo, Japan
7 - 10 December '10	APMC 2010, Yokohama, Japan
27 - 31 March '11	ACES 2011, Williamsburg, Virginia, USA
1 April '11	International FEKO User Meeting, Williamsburg, Virginia, USA

About FEKO

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)
- Ray-Launching Geometrical Optics (GO)

- Uniform Theory of Diffraction (UTD)
- Planar and Periodic Green Functions
- True Hybridisation of MoM/FEM, MoM/PO, MoM/GO and MoM/UTD
- MoM for Multiple, Complex Dielectric Bodies

Fast Solutions

- Parallel Processing (Multi-Core CPUs, Clusters)
- Fast Frequency Sweep
- 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
- On-site Training (Short Course)
- CAD Preparation
- Runtime Solutions
- Engineering Consulting Services

