CEM NEWS FROM EUROPE

MESSAGE FROM THE EUROPEAN NEWS EDITOR

This issue sees a change in the editorial desk for this column. Our long term news editor, Pat Foster , has hung up her word processor after many years undertaking this role. I would like to thank Pat for her exemplary effort .

For the future, the intention is use this space for both news and direct technical interest . The format is a short report on matters of interest to ACES and the CEM community followed by a ‘spotlight’ feature on different institutions working throughout Europe. The spotlight gives a forum for European CEM workers to highlight their work ,with the hope that this will encourage contact between those with like minded issues across the ACES community .

I would like to thank all the contributors to this issue for their support. I would also welcome comments, suggestions and contributions from all colleagues, especially those throughout Europe.

Tony Brown, a.brown@umist.ac.uk
Professor of Communication Engineering, UMIST,UK

GENERAL NEWS

ACES UK Chapter is cosponsoring two events headed by the Institute of Electrical Engineers (IEE) and of interest to the CEM community.

The first is entitled ‘Validation of Computational Electromagnetics’ to be held Monday 29th March 2004 at BAESystems Ltd, Farnborough UK (www.iee.org/events/validation.cfm) . The second event is the next in the IEE’s series of conferences on Computational Electromagnetics, to be held 19th to 22nd April 2004 at Stratford-upon-Avon , UK (http://conferences.iee.org/CEM).These are had at approximately 3 year intervals.

SPOTLIGHT FEATURE

This issue we are spotlighting the University of Manchester, England. As a background , the University is currently restructured and in Oct 2004 will become the largest in the UK. CEM is used widely throughout communications, microwave and power engineering departments. Space dictates we can only highlight a few of the many programs underway. Interested readers are invited to contact the contributors directly.

Analysis of Ferrite Components(Andy Gibson, a.gibson@umist.ac.uk)

Of particular importance in many applications non-reciprocal ferrite components present particular problems for analysis, particularly for high power applications were temperature profile is of considerable concern. Bias field selection, nonlinear losses, partial magnetization and the temperature sensitivity of ferrite materials pose significant problems for realistic device modeling. New numerical techniques, which model non-linear loss and coupled thermal/electromagnetic behavior are being developed at UMIST to aid the innovation process.

A finite element magnetostatic solver is used to solve the nonlinear Poisson equation in terms of the magnetic vector potential. The flux density, magnetic field intensity and magnetization are all evaluated using the magnetic potential and the material magnetization curve. These quantities are used to evaluate the microwave tensor permeability throughout the ferrite. The tensor permeability is substituted into a formulation written in terms of the transverse electric and magnetic microwave fields. Using Bossivit type edge elements an eigenvalue solver calculates the complex propagation constant and field components as a function of the material tensor permeability entries and signal frequency.

The microwave field solution is used to calculate the dissipated power and this acts as the source for the steady-state heat conduction equation. The thermal solution is obtained using an electrostatic type finite element solver. In the iterative process the intermediate solution is compared with the previous solution and a converged solution was reached when the temperature difference was less than 0.5°C. This was found to occur after two or three iterations.

FDTD analysis of Ultra Wide Band propagation in Lossy Media (Fumie Costen f.costen@cs.man.ac.uk)

Our research focuses upon the use of the frequency dependent finite difference time domain method (FD-FDTD) with consideration of the conductive loss to give us the waveform of UltraWideBand pulses in a lossy media. From the viewpoint of the computation of electromagnetics using FD-FDTD, memory and computational load reductions are the major concerns. In many situations, the voxel size required is much finer than the minimum allowed by FDTD calculation accuracy. In addition, the time step of the conventional explicit FDTD scheme has to satisfy the Courant-Friedrich-Levy (CFL) condition to ensure stability .Thus, the maximum time step is limited by voxel size. Obviously, this over time-sampling leads to an increase in the signal processing time. To eliminate the constraint of the CFL condition, a scheme called alternating-direction implicit (ADI) FDTD has been proposed.

The Debye model is often applied in FDTD schemes to incorporate frequency dependent material. Our work is novel in its application of the Debye model to ADI-FDTD to construct a frequency dependent ADI-FDTD including conductive loss. Our current problem is asymmetry in the implementation of this novel scheme. A tridiagonal matrix inversion is currently involved in the algorithm in the same way as ADI-FDTD. However, this matrix inversion, in our case to calculate the electric flux field (electric field values in the original ADI-FDTD) causes asymmetry. The symbolic expression of the result of matrix inversion does not match what theoretically happens in wave propagation, mainly because the calculation area is not infinite. Even when the symbolic expression shows symmetry, the numerical outcome is not symmetry due to rounding errors in the matrix inversion. The ideal solution for this would be an alternative method to avoid this matrix inversion. This issue is currently being investigated.

Ultra Wide Band Propagation using ray tracing techniques in the time domain (Yongwei Zhang yw.zhang@postgrad.umist.ac.uk, Tony Brown a.brown@umist.ac.uk)

The objective of our research is analyze the performance of a UWB system in a complex, potentially multi-room environment. The prime focus is the channel delay which in practice is a key parameter heavily influenced by multipath in the environment. A ray tracing technique has been adopted due to the size of the problem space. This is used with a impulse function source to develop a time domain transfer function for the problem so that the received signal from a complex, measured, input signal can be readily constructed via a complex convolution integral.

In a multi-room environment many hundreds of rays must potentially be traced . An algorithm has been developed to minimize the run time. So far the results of the program are extremely encouraging even for a multi-room scenario. The long term goal of the research is to provide a flexible tool which will give a physical insight into the propagation mechanisms and aid our research on UWB antennas and components . Our emphasis therefore is on computational speed within acceptable accuracy, rather than attempting a fully deterministic model. By linking this simulation with conventional TLM analysis of antenna and rf components, we aim to produce a end to end UWB link simulator for these complex environments.

Use of FE Software In High Voltage Group, UMIST (Ian Cotton ian.cotton@umist.ac.uk)

The electrostatic package of OPERA 3-D is used for a range of research tasks in our group. It is mainly used to obtain electric field distributions of basic geometries such as the rod-plane and rod-rod gaps, and more complex geometries involving profiled insulators, cable with clips and the fin of a wind turbine to name but a few. This has made it possible to determine inception fields and relevant field distributions for the study of partial discharges, streamer propagation and lightning attachment. In addition, energy calculations are obtained from this software and associated capacitance values estimated for the various geometries mentioned.