Applied Computational Electromagnetics Society

Around ACES

Many of us readily recognise the name Andy Drozd from his previous work with ACES, his work with other organizations and in his professional capacity with his company. In “Meet the ACESians”, we find out a little more about what makes Andy who he is. Giulio Antonini is also a name that regular readers of this Newsletter will recognise. Giulio works hard as an associate editor for this Newsletter and, in “Members Laboratories”, we find out a little more about where he works and what he works on.

Meet the ACESians

ANDY DROZD

Your Newsletter editor caught up with Andy Drozd and asked a few questions to find out a little more about the man.

Where were you born and brought up, where do you live now and what circumstances brought you there?

I was born in Vucht, Belgium at a very early age. I currently live in the Upstate New York Area (a.k.a. Central New York State, about 260 miles NW of New York City/Manhattan). My family and I emigrated from Europe (by way of Le Havre, France) to New York City in 1956. My family was displaced by WWII events and that's what brought us to America. My father had relatives who immigrated from Germany and Poland to the US prior to WWII. They took up residence in New York City, Buffalo and Rome, NY (Rome is currently where I reside and work with other family and friends).

What did you read at university, which university(ies) and why this (these) subjects?

I took up reading and studies at Syracuse University in Syracuse, New York in areas related to Physics and Mathematics. Prior to that while in High School, I was intrigued by the sciences, namely electrical science and themes related to advanced electromagnetics. That focused my interests on the four basic forces in nature (gravity, electromagnetic, weak and strong) and the attempts by pre-eminent scientists to unify them. My true area of interest early on in the university was on Einstein's Special and General Theory of Relativity and how it related to matter, energy, speed of light (ah ha! The electromagnetic part!!) and time-space relationships. As I got more involved and engrossed in EM waves, I developed a better appreciation for the EM aspects of this branch of science and that's what formed my foundation in my career and to a large extent, my personal side interests in reading up on this topic (string theory, etc.). As I conducted more in-depth research during the years that followed, I began to see how EM forces played a major role in our day-to-day lives and how it was so pervasive starting that the basic theoretical level on up through our computational EM work when we talk about *quadrature* mapping of Maxwell's equations for infinite space to a bounded, finite space problem. These processes have always intrigued me.

What is your current job and what does it entail? What are you most proud of achieving?

I am President and Chief Scientist for ANDRO Computational Solutions, LLC located at the Beeches Technical campus in Rome, NY with offices in Bowie, Maryland. Our focus has been on the development and application of state-of-the-art computational electromagnetics (CEM) integrated toolkits, computational frameworks, hybridized numerical solutions, and dynamic spectrum

optimization for large, complex system EM problems. I manage as well as contribute technically to our R&D work which is largely sponsored by the US Department of Defense (DoD) to develop new tools and techniques for modelling and simulating system-level EM problems. I am most proud of my achievements in developing the *E^{3}Expert* toolkit which is an integrated suite of tools that employ artificial intelligence/expert systems to solve, in a progressive manner, various electromagnetic environment effects (E^3) problems and applications. Expert system techniques are used to guide the analyst in the model generation process and how/when to apply certain numerical solutions based on time, frequency, and fidelity (accuracy) requirements. I am also proud to have been elevated to IEEE Fellow "*For the development of knowledge-based codes for the modelling and simulation of complex system Electromagnetic Compatibility (EMC)*".

If you weren't doing this job what would your ideal occupation be? What are your abiding passions?

I still have strong interests in research work related to EM wave theory and particle physics as applied to unifying the four fundamental forces. I have always been fascinated by the time-space relationships that Einstein and his contemporaries wrote about and how time and space can be warped to allow for forward and backward movement within these dimensions. Astronomy, cosmology, and subjects dealing with the meaning of life are collectively an abiding passion. If I had to do it all over again, I might consider doctoral work in these or related areas. I think many of the answers of life will be discovered in pursuing these topics. I think that time travel will one day be realized, not in our lifetime though!

If you were abandoned in an underground laboratory with no immediate chance of release and with the opportunity of only using one numerical technique, which technique would you want to use and why? What 'big problem' would you want to spend your time trying to solve with your modelling?

This is indeed an insane question, but a probing one. I'll provide a lunatic fringe sort of answer. I would like to be able to take a finite-difference time-domain solution to a new level and perhaps marry it with a multilevel fast multipole algorithm to study the effects of fields on and from the human body in near real time. I would like to analyze the effects of EM energy surrounding the human body and its interaction with surrounding media and other incident forces to see if medical/healing effects can be derived. In other words, use a *feng shui* approach to study how to exploit EM energy for humanitarian/medical purposes.

If you had a 'one shot' time machine to bring someone from any period of history to keep you company in the underground laboratory, who would you choose and why?

Well, Einstein would be an obvious choice, but I would also would like to bring Jesus Christ, Socrates, Newton and Descartes into the mix, in that order.

Any interesting stories or anecdotes?

I believe that our dreams are opportunities for our inner selves (say the soul) to migrate in time and space and explore or experience the possibilities of past and future lives. I think we are not here by accident but we are being constantly tested and challenged. In the long run, I think that makes us better beings. I find that dreams can come true if you believe and read the signs. However, I am also a firm believer in the power of probability and chance (Einstein would have disagreed with that!). I think that we can shape the future based on our past and our present experiences, but chance and fate play big roles in helping or hurting our attempts. We can all be prophets of one kind or another, but some are better at it than others.

Members Laboratories

The University of L'Aquila EMC Laboratory

The UAq EMC Laboratory is part of the Department of Electrical Engineering of the University of L'Aquila (L'Aquila, Italy). It is directed by Prof. Antonio Orlandi and coordinated by Prof. Giulio Antonini (ACES Member) and has more than 10 members including Faculty members, PhD and Masters students. The taught courses that are taught specifically by academics from the laboratory are Electromagnetic Compatibility (EMC) and Signal Integrity, these are taught in the School of Engineering.

The Laboratory has a long term research cooperation agreement with the EMC Laboratory at the Missouri University of Science and Technology (MS&T, Prof. J. Drewniak) formerly University of Missouri at Rolla (UMR) in the field of EMC and Signal/Power Integrity for high-speed digital boards.

The laboratory has received the IBM Shared University Research (SUR) grant for three years in a row and is the only laboratory in Italy to achieve this.

The main focus of the research activity of the UAq EMC Laboratory is numerical modelling and simulations. The aims are twofold: firstly, to develop advanced numerical techniques for the solution of challenging issues in EMC and Signal Integrity subjects and, secondly, to apply these techniques and strategies to support industry in the solution of real-world problems. In doing achieving this, it is considered that developing a detailed understanding of physical mechanisms using numerical modelling is fundamental to offering qualitative and quantitative design guidelines with scientific bases.

Some of the areas where this has been applied include:

- Systems level strategies to understand interaction of large systems with impulsive electromagnetic sources such as LEMP or EMP. In these cases parts of the systems are represented by three dimensional full wave models and parts are represented by 1- or 2D models. The connection between these models is the critical part. Ad hoc procedures have been developed but also research efforts are given over to devising approaches for commercial software (widely used in Industry) to perform these tasks.

- In the field of board design the goal is the quantification of the impact that passive structures such as vias, and materials have on digital signal and power quality. An on going project on large backplanes for 10 to 40 Gb/s data stream is used to steer the modelling research efforts. This is particularly challenging due to the combination of high frequencies and large geometrical dimensions involved.

- The power integrity issues related to digital boards focus on the cavity model approach that conjugates accuracy with light CPU and memory requirements. The use of this approach for multilayer structures and with a wide frequency range; from low frequencies, where the skin effect it is not well developed, to high frequencies are current research topic of the Laboratory's Researchers.

Among the projects in which the Laboratory is involved in cooperation with other international research institutions there is the development of the Feature Selective Validation (FSV) technique with Dr Alistair Duffy at the De Montfort University (Leicester, UK) the FSV technique is continuously improved and appropriate software tools are developed and made available for download at http://ing.univaq.it/uaqemc/ . The FSV technique is used to compare different datasets (such us those coming from numerical simulations, measurements, etc.) and aims to mimic the judgement of a group of experts when they perform the same comparison by visual inspection of the data. FSV has been identified as the preferred technique for data comparison by the IEEE Standard P1597.

The UAq EMC Laboratory has established a fruitful cooperation with Dr. A. Ruehli, the father of Partial Element Equivalent Circuit (PEEC) and Modified Nodal Analysis (MNA), at the IBM T. J. Watson Research Center (NY, USA). Over the years, the Laboratory has made significant contributions to the advancements of the PEEC method in the field of dielectric and magnetic material modelling, broadband PEEC models, non-orthogonal PEEC formulation. An on going project aims to develop a fast time-domain solver based on the waveform relaxation technique.

The rapid increase in operating speed and density of modern integrated circuits is a challenging problem for the transmission line modelling method. Its difficulty comes from the requirement to properly capture physical effects like reflection, dispersion, delay and attenuation which cannot be neglected when broadband signals propagate along the interconnect. The use of time-domain macromodels is mandatory when non-linear drivers and receivers are to be incorporated. The necessity to properly model lossy and dispersive effects, such as skin-effect and dielectric losses, makes the macromodeling a challenging task. Recently a new spectral formulation has been proposed for transmission line macromodeling. The open-end impedance matrix is expressed in a series form as an infinite sum of matrices of rational functions, The rational form of the open-end impedance matrix allows an easy identification of poles and residues and, thus, the development of a reduced-order system of the interconnect. The pole-residue representation can be synthesized in an equivalent circuit or converted into a state space model which can be easily embedded into conventional non-linear circuit SPICE-like solvers. Such a technique has been successfully applied to printed circuit board and on-chip interconnects. The same technique has also been adopted to model nano-interconnects.

The Laboratory has well established research collaborations with leading research institutions such as the Packaging Research Center of the Georgia Institute of Technology (Atlanta, GA, USA, Prof. M. Swaminathan), the EISLAB of the Lulea University of Technology (Lulea, Sweden, Prof. J. Delsing), the University of Ghent (Ghent, Belgium, Prof. T. Dhaene), IBM T. J. Watson Research Center (NY, USA, Dr. A. Ruehli), University of Washington (Seattle, USA, Prof. V. Jandhyala), the EMC Laboratory at the Katholieke Hogeschool Brugge-Ostende (Bruge, Belgium, Prof. J. Catrysse), IBM Research Triangle Park (NC, USA, Dr. B. Archambeault).

Members of the UAq EMC laboratory. Giulio Antonini (4th from right, front row) and Antonio Orlandi (4th from left, front row)