AMPERE NEWSLETTER

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EDITORIAL

It is sad to announce that this is the last issue that I act as editor. Juan Monzó-Cabrera, AMPERE's General Secretary has kindly offered to take over the editorship of this Newsletter. After nearly 20 years and 78 issues I think it is time for a younger person to take over. However, I will, for the foreseeable future, be able to assist Juan in his endeavours to take the Newsletter forward to new pastures.

This issue is delighted to present David McLean's report on the 14th International AMPERE conference on Microwave and High Frequency Heating held during 16-19 September 2013 at the National Centre for Industrial Microwave Processing, which is based at Nottingham University, UK. This conference followed the usual format of the first day devoted to a short course with the remaining three days highlighting the current status quo of R&D in this area.

Last May the seminar on Computer Modelling in Microwave Engineering Applications was held in Padua, Italy. This was the 15th in the series of such seminars and formed part of the HES-20213 on Heating with Electromagnetic sources which took place in in Centro Congressi Padova "A. Luciani", in Padua during 21-24 of May 2013. Sairem and QWED Sp offered sponsorship and was endorsed by AMPERE, IMPI and the University of Modena & Reggio Emilia.

The Afterthought piece in this issue concentrates on a novel way which allows low frequency electromagnetic signals to penetrate steel casings of up to 15 mm in thickness.

Editor
AC (Ricky) Metaxas
St John's College
Cambridge UK

MANAGEMENT COMMITTEE ELECTIONS

We welcome five new members that were elected to the Management Committee of AMPERE at the OGA at Nottingham.

Birgitta Raaholt

Guido Sturm

Bala Vaidhyanathan

Georgios Dimitrakis

Paolo Veronesi

14TH INTERNATIONAL CONFERENCE ON MICROWAVE AND HIGH FREQUENCY HEATING

by **David McLean**
Advanced Microwave Technologies Pty Ltd, Australia

It was with great anticipation that I arrived at Nottingham in time for the 14th Ampere conference. The opportunity to renew friendships, interact with likeminded people and sample ale from some of England's oldest pubs were all great motivations for enduring the 36 hour journey from my home in Australia to a Nottingham hotel. On stepping out of the train it was wet and cold, but that wasn't enough to subdue the excitement of an event that I look forward to every couple of years. Strange as I may seem, the event also provides a rare opportunity to meet my Australian colleges whose company I enjoy very much.

Delegates enjoying some local Ale in England's oldest pub

The conference was organised by the National Centre for Industrial Microwave Processing based at Nottingham University, and I knew that if their ability to pull off major industrial projects was any indication, the conference was going to be well organised and very systematically run.

I have often wondered what were the impressions gained by those attending the conference for the first time, and so thought the inclusion of some raw and unvarnished comments from a few select "First Timers" would be appropriate. What really struck me was the enthusiasm of those I asked to comment and the positive impression the conference had on them.

The event began on Monday the 16th September, with over fifty attendees at the conference precursor workshop and short course which covered almost all the basics one needs to know to engage and use MW and RF heating. Isabel Pinto attended the short course as a First Timer and remarked " ... my background is in chemical engineering so I learned numerous new concepts about microwave processes and heating. I found really interesting the focus given on scale-up and industrial applications ..." The Short course was followed by a Drinks Reception on the Jubilee Campus which, as expected, was well attended.

Day 1. The main conference began on the Tuesday, with most of the 154 registered delegates in attendance. Dr. Trevor Cross (E2V) gave the opening Plenary on "The Potential for High Power Microwave use in the Process Industries" using the incredibly huge project with mining giant Rio Tinto as the basis for his talk and offering E2V's multi-head technology as a possible solution for capital cost reductions.

As one of the key note speakers was unable to make the conference, Dr. Gary Bond graciously stepped in at the last minute with

a talk on Dielectric Polarisation Basics and demonstrated his thorough understanding of the subject, with a slick presentation delivered in a very relaxed manner.

The Technical sessions were divided into three parallel sessions covering “Industrial and Food”, “Fuel and Environmental” and “Materials”. The end of the day was rounded off with a panel discussion involving academics, suppliers and end users, once again focusing on scale–up and industrial applications. For the First Timers this type of discussion had a very positive impact. J.A. Menendez (First Timer) commented “ ... we are quite impressed to find that there is a conference meeting that meets designers, theorists, builders, researchers and end users. This should be the perfect structure of all scientific conferences, but unfortunately it is not usual. The idea of involving companies in panels and workshops is also very motivating ...”

Panel discussion chaired by George Dimitrakis

Other First Timers such as Guido S.J. Sturm said “A very serious attempt by all parties to communicate, but the subject matter is just very complicated so it is necessary to keep up the effort to bring greater understanding to first timers“ and Loris Dovico commented that she hoped “... the round table panel discussions could focus more on basic concepts for all the newbies like me …”.

Day 2. opened with a Plenary from the very capable Dr. Marilena Radoiu on “Microwave–assisted extraction of natural products.” The parallel technical sessions were divided into “Materials II”, “Polymers and Composites”, “Medical applications” and “Chemicals and Synthesis”. The conference day was concluded with the Ampere OGA chaired by Prof. Cristina Leonelli.

AMPERE's classic brief encounter photo

That evening the much anticipated gala dinner was held at Chatsworth House and after a 75 min bus ride the magnificent grounds and house come into view. As we alighted from the buses the clouds burst forth and we had to dash several hundred meters to the stables where a wonderful dinner was had by all. On leaving the dinner, I had the clear impression that something was not quite right. That something was surely the exclusion of speeches and award presentations. These official activities always provide a welcome excuse to break a conversation and, if needed head back to your seat with the remote hope of picking up an award. The awards, I was to discover later, were left to the final day. Another noticeable activity, although clearly not meant to be noticed, was the Nottingham organisers making a concerted effort to recover any undrunk wine and take it back to be enjoyed another day.

Gala dinner reception area

Day 3. The Plenary was given by Prof. Jose Catala-Civera on "Overview of Dielectric Properties" and the Keynote by K. Van Reusel on "The latest developments and applications in the field of induction heating." The parallel technical sessions were "Systems Design", "Modelling, Dielectric and MW Measurement" and "Materials Interactions". The diversity of microwave applications made a significant impression on many first timers as expressed by Jeremy Kernon "The Ampere Conference helped me realise the wide range of applications that microwave technology has. As a chemist my knowledge was focused on improving synthesis. It was interesting to see microwaves used for various purposes such as mineral extraction and food processing".

The conference finished with an awards presentation where attendants like Roberto Rosa (University of Modena), Ei Leen Deng (University of Nottingham) and Hussein Hammoud (EMPA of Switzerland) were honoured for their talks. Two members of the organisation committee received flower bouquets for their effort to run the conference.

I will leave the final comment on the conference to a passionate and very experienced microwave engineer Rupert Steiner "Even though some of the presentations were heard before at similar conferences, scientific and technical information given in most of the talks was valuable for a microwave engineer designing heating equipment for laboratory, commercial and industrial use. Topics like "future trends in rf and mw heating" addressed during plenary discussion have been discussed the years before – again the conclusions were poor, our community still waits on the so called "killer app". An alternative to waiting is maintaining AMPERE's network and taking care of small and moderate application volumes, as well – like a squirrel collecting nuts in autumn to survive winter times. Besides near perfect organization done by our friends in Nottingham, meeting colleagues and exchanging thoughts and ideas was the highlight of this conference and reason to look forward to meeting again in Krakow in 2015 " ... I couldn't agree more.

15TH SEMINAR "COMPUTER MODELING IN MICROWAVE ENGINEERING AND APPLICATION

Cristina Leonelli
MW Application Group
Department of Engineering "Enzo Ferrari"
University of Modena & Reggio Emilia
Modena, Italy

Vadim Yakovlev
Industrial MW Modeling Group
Worcester Polytechnic Institute
Worcester, MA, USA

The 15th Edition of the Seminar "Computer Modeling in Microwave Engineering and Applications" was held in Padua, Italy, 23-24 of May, 2013. As all previous meetings in this series, it was an endeavor of the Industrial Microwave Modeling Group (IMMG) of Worcester Polytechnic Institute, Worcester, MA, USA, and its leader, Vadim Yakovlev. The event was organized in cooperation with Society for Industrial and Applied Mathematics (SIAM) and in partnership with the National Secretariat of GIMAMP (Italian Group for Microwave Application to Materials and Processing) which is currently resided with Microwave Application Group (MAG) of University of Modena & Reggio Emilia, Modena, Italy. The seminar was made possible due to sponsorship by two industrial companies, QWED Sp. Z o.o., Poland, and SAIREM SAS, France. Endorsement was provided by AMPERE, IMPI and the University of Modena & Reggio Emilia, Modena.

At one of the seminar technical sessions.

The Seminar was carried out as a satellite event of a major event – the International Conference "Heating by Electromagnetic Sources (HES-2013) which took place in Padua, in Centro Congressi Padova "A. Luciani", 21-24 of May 2013. The meeting benefited from extensive technical assistance provided by HES-13's Organizing Committee and its Chairman, Fabrizio Dughiero of University of Padua.

Similarly to the 14th Seminar held in March 2012 in University of Bayreuth, the meeting in Padua was focused on multiphysics modeling in microwave power engineering. This topic continues to be of a strong interest for the modelers and researcher developing new applications of advanced multiphysics modeling techniques as well as engineers and designers of microwave applicators. Twenty two attendees from Belgium, Germany, France, Italy, Poland, Switzerland, and the US shared their experience with their counterparts, presented their latest findings and discussed major conceptual and technical issues in development of adequate and accurate algorithms and their implementations.

Winners of the Student Contest – Andrea Facchini (up) and Kanat Kyrgyzbaev (down) with Vadim Yakovlev and Cristina Leonelli.

Nine oral papers of the seminar program were presented in three technical sessions. Five talks discussed models developed for particular applications, such as microwave ablation of concrete, thermal inertization of asbestos containing materials, pyrolysis of lignocellulosic biomasses, and electrochemical power devices. Four other papers were concerned with new developments of the techniques; these presentations reported original modeling and optimization technologies for microwave-assisted chemistry and a practical tool for analysis and visualization of simulation results.

Prior to HES-13, a one-week long Intensive Ph.D. Course on Induction and Microwave Heating was organized by University of Padua with support of UIE. The course attracted 18 graduate students from Checz Republic, Denmark, Germany, France, Italy, Poland, and Russia who, after the course, attended the conference. A group of students from the course participated also in the work of the Seminar. During a special Panel Session, these students shared their views of outstanding issues of microwave power engineering and whether modern modeling techniques could be helpful in their resolution.

To further support student involvement, the Seminar conducted a Student Contest for the best paper. The recipients of two awards (sponsored by AMPERE and intended to partially cover students' travel expenses) were announced at the closing of the Seminar. Andrea Facchini of University of Pavia got his award for the paper "Studies on the microwave-induced pyrolysis of lignocellulosic biomasses and sewage sludge" and Kanat Kyrgyzbaev of University of Bayreuth was recognized for his contribution "Numerical simulation of induction heating of a high speed rotating cup and its experimental verification". This meeting has shown that nowadays more and more young researchers choose to use computer modeling in their studies and project design.

We have seen once again an important feature of this seminar series of being particularly open to student works and providing them with a special environment for in-depth technical discussions of general and practical aspects of their modeling activities.

The Seminar program was concluded by two special presentations: the industrial sponsors of the event gave extended reviews of their current products and services. It was interesting to see kind of "cross-references" in their presentations: apparently, nowadays, SAIREM, one of the world leaders in manufacturing of industrial equipment for microwave and RF heating, extensively uses computer modeling to facilitate the design of their systems, whereas QWED, the developer of QuickWave-3D, one of the most popular and efficient pieces of software for microwave power engineering, maintains close links with the industry and implements new modeling functionality on demand and following the feedback from the users.

At the Seminar Dinner at Osteria dei Fabbri in Padua.

Seminar participants in Centro Congressi Padova "A. Luciani"

Plans for the next Seminar were announced in the end of the event. The 16th meeting will be held on 10-11 March, 2014 in Karlsruhe Institute of Technology (KIT) in Germany. The next year event will be sub-titled "Multiphysics Models and Material Properties" and co-organized by the KIT's Institute for Pulsed Power and Microwave Technology (IHM). Guido Link was named as a co-chair of the 2014 Seminar.

The papers presented at the 15th Seminar in Padua are published in the Seminar Proceedings and on the web http://www.wpi.edu/+CIMS/IMMG/Seminars. For more information on this and previous seminars/workshops in computer modeling, contact the Seminar Founder and Chair, Vadim Yakovlev (mailto:vadim@wpi.edu) or visit the IMMG web pages at www.wpi.edu/+CIMS/IMMG/ .

PROCEEDINGS BOOK OF 2GCMEA

The book associated with the 2nd Global World Congress on Microwave Energy Applications held Long Beach near Los Angeles in July 2012 has been published and can be purchased from Amazon. The editors, R.L Schulz and D.C. Folz, have done abrilliant work putting this volume together. The order form can be found here:

http://www.ampereeurope.org/Download/2GCMEA_Proceedings_Order_Form_fillable.pdf

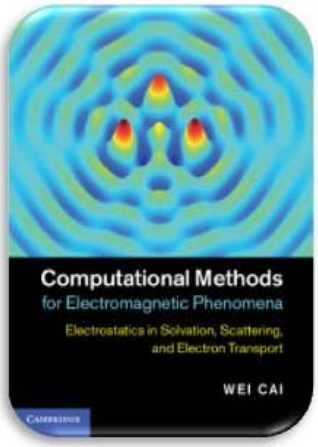
You can also browse through the Amazon website to purchase a copy

NEW BOOK:
COMPUTATIONAL METHODS FOR ELECTROMAGNETIC PHENOMENA
ELECTROSTATICS IN SOLVATION, SCATTERING, AND ELECTRON TRANSPORT

A unique and comprehensive graduate text and reference on numerical methods for electromagnetic phenomena, from atomistic to continuum scales, in biology, optical-to-

micro waves, photonics, nano-electronics and plasmas. The state-of-the-art numerical methods described include:

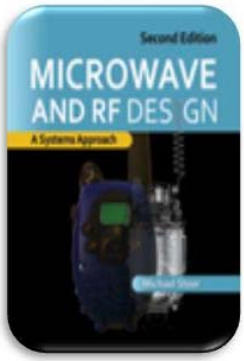
- Statistical fluctuation formulae for the dielectric constant
- Particle-Mesh-Ewald, Fast-Multipole-Method and image-based reaction field method for long-range interactions
- High-order singular/hypersingular (Nyström collocation/ Galerkin) boundary and volume integral methods in layered media for Poisson–Boltzmann electrostatics, electromagnetic wave scattering and electron density waves in quantum dots
- High-order discontinuous Galerkin (DG), Nedelec edge ele¬ment, and Yee finite difference methods
- NEGF (Non-equilibrium Green's function) and Wigner kinetic methods for quantum transport
- High-order WENO and Godunov and central schemes for hydrodynamic transport
- Vlasov-Fokker-Planck and PIC and constrained MHD transport in plasma



by **Wei Cai** University of North Carolina, USA
Cambridge University Press, UK:

The book can be obtained from:
www.cambridge.org/us/9781107021051

COMPUTATIONAL MICROWAVE AND RF DESIGN: A SYSTEMS APPROACH, 2ND EDITION



Although primarily this book is intended for communication engineers some chapters will be applicable to those designing microwave systems for industrial usage.

by **Michael Steer**
SciTech Publishing 2013
ISBN 9781613530214

EVENTS

RUSTUM ROY MEMORIAL SYMPOSIUM
October 27-31, 2013, Montreal, Quebec, Canada.

The "Rustum Roy Memorial Symposium: Processing and Performance of Materialsusing Microwaves, Electric and Magnetic Fields, Ultrasound, Lasers, and Mechanical Work" at **Materials Science & Technology Conference and Exhibition (**MS&T`13).

Organisers: Morsi Mahmoud and Guido Link at Karlsruhe Institute of Technology, Dinesh Agrawal Penn State University, Motoyasau Sato, Chubu University, Japan and Rishi Raj, University of Colorado at Boulder.

This is a Special topic in the list of topics for presentation at the Conference. Visit http://www.matscitech.org for details

16TH SEMINAR ON "COMPUTER IN MICROWAVE POWER ENGINEERING" MULTIPHYSICS MODELS AND MATERIAL PROPERTIES
March 10-11, 2014 Karlsruhe, Germany
Organised by the Industrial Microwave Modeling Group (IMMG), Department of Mathematical Sciences, WPI, USA, and Institute for Pulsed Power and Microwave Technology (IHM), Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany in cooperation with Society of Industrial and Applied Mathematics (SIAM) For more information visit:
http://www.wpi.edu/+CIMS/IMMG/Seminars/

Contact: Vadim Yakiovlev <vadim@wpi.edu> or
Guido Link <guido.link@kit.edu>

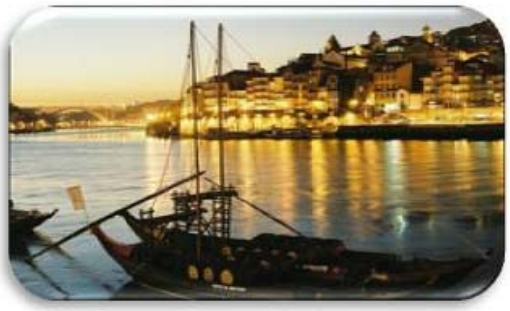
THE 2ND RADIO AND ANTENNA DAYS IN THE INDIAN OCEAN, 2014
Sugar Beach Resort, Mauritius, 7-10, April 2014

The aim of the conference is to discuss recent developments, theories and practical applications covering the whole scope of radio frequency engineering, including radio waves, antennas, propagation and electromagnetic compatibility.

Although this conference is primarily intended for researchers in the field of communication, topics of interests to AMPERE members may include: medical and industrial applications of em fields; modelling, simulation and CAD; high power devices and techniques; biological effects

For more information please contact:
radio2014@radiosociety.org
Website:
http://www.radiosociety.org/radio2014

EHE2014
International Conference on Electromagnetic Fields, Health and Environment
Porto, Portugal 24th to 26 April, 2014.
Deadline for abstract submission, 15th Nov 2013. For more information browse at: www.apdee.org/conferences/ehe2014



Or contact: Carlos F. R. Lemos Antunes
Professor at Universidade de Coimbra
EHE2014 General Chairman
chairman@apdee.org

AN AFTERTHOUGHT : A WAY OF PENETRATING UP TO 15 MM THICK STEEL USING LOW FREQUENCY WAVES

AC Metaxas
AC Metaxas and Associates
Cambridge UK

The Faraday cage effect, first observed by Michael Faraday in 1836 (some would argue it was Benjamin Franklin in 1755 who discovered it first, however be that as it may), is an effect we are all familiar with and is used, for example, when wishing to shield a system that generates electromagnetic waves, for example the electrodes of an RF applicator, from escaping into the outside environment and disturbing sensitive instruments in the communication, military and allied fields. The photo alongside shows a box made of metal which when sealed affords complete isolation of electromagnetic signals penetrating from outside into the box or, conversely, signals generated from within to escape into the exterior of the box.

The photo below shows a person within a perforated Faraday cage being shielded by strong arcs and its ensuing electromagnetic radiation emanating from a nearby Van de Graaf source.

A recent report by the Cambridge Network, a member organisation based in the technology cluster of Cambridge, UK, has reported some fascinating developments which enable to penetrate a Faraday cage made up of steels between 5-15 mm in thickness with frequencies which are optimum around 400-500 Hz.

This system, called Fluxor, was developed by the Technology Partnership (TTP), a member of the Cambridge Network, which creates a 'window' for electromagnetic transmission of power and data by applying a strong DC magnetic field, which lines up the magnetic dipoles in the material to 'saturate' a small area of the metal screen. This reduces the permeability and increases penetration to make it possible to transfer electromagnetic power and signals.

In a typical operating scenario, a portable interrogator unit with a permanent magnet or electromagnet could be placed on top of a fixed sensor through a steel metal wall. A Fluxor window is "created" to transmit power to trigger the sensor and transmit some information back, without having to open the casing at all. TTP is already using the technology for monitoring fluid levels in steel pipes, sensing recordings from medical implants and monitoring data from inside high-performance F1 engines. Work continues at TTP to enable the Fluxor technology to reach other markets within the next few years.

Could this effect be used to reach and energise sensors within a Faraday cage of an RF or microwave applicator and thus monitor various parameters?

For more information regarding TTP products visit www.ttp.com