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## EDITORIAL

This issue welcomes Professor Juan Monzó-Cabrera, the Secretary of AMPERE's Management Committee, who describes the activities with microwaves at the ETSI Telecomunicación at the Technical University of Cartagena in Spain.

We also report of the recent death of Steve Ottaway who had a long and distinguish career with the use of radio frequency energy for industrial processing. His obituary appears on page 4.

### Ricky Metaxas

Editor  
EUG St John's College  
Cambridge UK

## RESEARCH ACTIVITIES WITHIN ELECTROMAGNETISM AND MATTER RESEARCH GROUP (GEM)



**Juan Monzó-Cabrera**  
GEM member  
Associate Professor at  
ETSI Telecomunicación  
Technical University  
of Cartagena  
[www.upct.es/gem](http://www.upct.es/gem)

### Introduction

Cartagena is located at the south east of Spain at around 100 Km from Alicante and besides the Mediterranean Sea. This ancient city had important Punic and Roman settlements due to its privileged natural defenses and sea port. Therefore, lots of history bits are still hidden below its streets such as a Roman theater, an amphitheater, Roman streets and houses and much more.

Nowadays, the city is a very important industry base. Navy and plastic industries, agricultural and bio-pharmaceutical firms, and even Hispania Racing Formula-1 Team are located very near Cartagena. Silver mines were also located very near this city although they were closed some years ago. More than 200.000 inhabitants enjoy the sun, history and beaches surrounding this city. Due to this

industrial environment, the Technical University of Cartagena was born in 1998 and the Telecommunication School was created in 1999. The *Electromagnetics and Matter Research Group (GEM)* was created at the Polytechnic University of Cartagena in 2004 with members from this and other universities. Currently it is formed by five doctors in telecommunication engineering and three telecommunication engineers.

GEM is specialized in the study of communication and industrial systems with profitable characteristics thanks to the behaviour of the materials in the system versus the electromagnetic radiation. Among these systems, we can list microwave-heating processes, shielding of electronic equipment, structures for minimizing the radar cross section or filtering and, in general, any process of energy transmission by means of electromagnetic waves. Next, we present an outline of the main research activities being developed within our Research Group.

### Microwave-heating Activities

GEM has, since its very beginning, dedicated numerous efforts towards microwave heating research as an alternative to conventional



energy use. Nowadays industries employ traditional technologies that, in many cases, may be substituted and/or combined with more efficient microwave energy techniques. GEM is confident of the enormous possibilities of microwaves and therefore has focused its main research line towards industrial application processes where microwaves could represent a competitive alternative to more conventional heating sources.

Some examples of our research interest in this line are:

- Energy efficiency optimization of microwave heating ovens.
- Analysis and optimization techniques for obtaining uniform electric field patterns within the dielectric sample.
- Microwave-assisted drying modeling.
- Analysis and optimization of all kind of industrial applications of microwave energy such as:
  - Microwave-assisted rubber curing.
  - Microwave-assisted drying of leather and clay.
  - Microwave-assisted packaged food sterilization.
  - Microwave-assisted curing of marble resin coatings.
  - Microwave manufacturing of abrasive pieces for marble polishing.
  - Rice and soil microwave disinfection
  - Micro-manufacturing of metallic and ceramic parts.

Figure 1 shows a 10 kWatt microwave oven prototype completely designed by GEM researchers for the Technologic Centre of Marble and Natural Stone in Cehegín (Spain). This prototype is being used right now at this centre for showing the characteristics of the microwave-assisted curing of marble resin coatings [1].

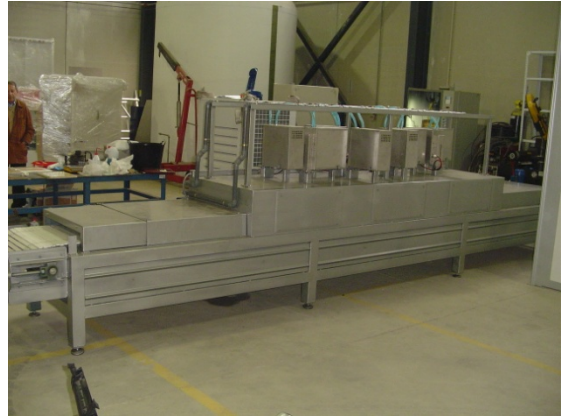


Figure 1. Microwave heating oven designed for demonstrations to the marble industry.

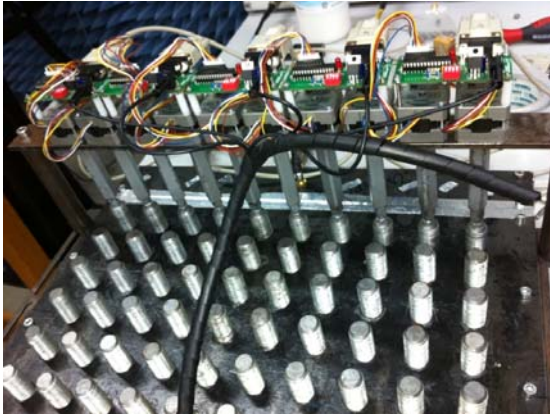
### **New Filter Geometries and Configurations**

GEM is also working with the aim of bringing ideas from other scientific fields to microwave-heating devices. In this way, GEM members have patented [2] a new kind of filters capable of adapting their configuration to different materials and situations.

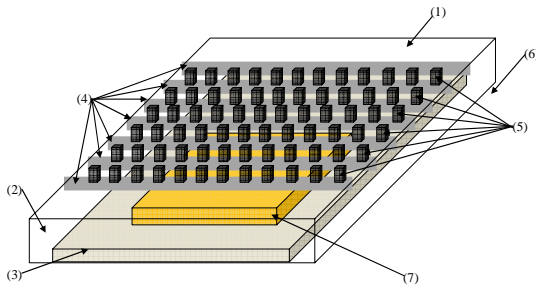
The main idea of these “intelligent” filters is to place power sensors at the outer port of the corrugated filters so that the measured radiation is minimized by adapting the corrugation lengths of the filter posts. Therefore, the same filter structure can optimize itself its structure for different materials and situations.

New filter configurations are also being developed and patented [3] in order to overcome the limits of conventional doubly corrugated filters. In this way the combination of metallic iris and corrugations seems to be a promising configuration for situations where conventional filters are inefficient [4]. These patents [2,3] are now being used by a Spanish firm in their microwave-heating applicators.

Figure 2 shows a picture of the “intelligent filter” being developed at GEM installations where as Figure 3 shows the novel configuration of filters combining iris and corrugations.



**Figure 2.** New patented reconfigurable corrugated filters being developed at GEM installations



**Figure 3.** New patented filter combining iris and corrugations. (1) input and (2): output ports of the filter, (3) carrying system, (4) metallic irises, (5) metallic corrugations, (6) waveguide containing the filter, (7) sample within the filter.

### **Complex Permittivity Estimation**

New waveguide permittivity measurement techniques are being developed and tested at GEM. Inverse techniques are our main concern in order to solve non-canonical situations by taking profit of commercial and self-made EM codes. Several publications can be found in this field regarding permittivity measurements and waveguide calibration procedures [5].

Also, high temperature permittivity measurement techniques are being developed right now at our installations.

### **Application of Numerical Methods to Electromagnetic Problems**

An important research area for GEM is the understanding of multimode microwave-heating applicators. In this case, mode stirrers [6], efficiency [7] and uniformity optimization

[8] have been studied by means of commercial EM software and experimental validations.

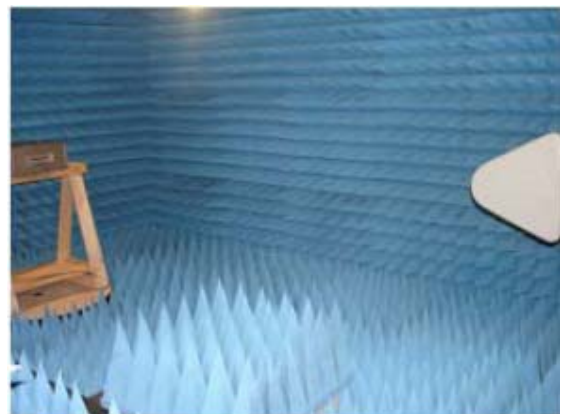
This has allowed GEM researchers to provide some light to very important issues regarding microwave heating applicators.

FEM meshing and solving procedures are also another field where GEM is still working. In this way, we have developed our own codes in order to be more efficient than conventional EM solvers.

### **Other research lines**

GEM has also experience at other fields such as Neural Networks, Data acquisition and signal processing, Radar Cross Section (RCS) measurement and reduction, Electromagnetic Compatibility (EMC), Microwave devices and calibration procedures

Figure 4 shows the anechoic chamber available at our installations for EMC and RCS measurements.



**Figure 4.** Anechoic chamber for RCS and EMC measurements.

### **Conclusions**

GEM is a young research group located at Technical University of Cartagena. Our main research interests are related to microwave-heating although we also have worked on numerical methods, communication and signal processing fields.

All AMPERE members and colleagues are welcome to Cartagena. I hope we see you



soon here.

## REFERENCES

1. Patent Number, P200401298, "Procedimiento de polimerización de resinas aplicadas sobre el mármol mediante el uso de microondas"
2. Patent Number, P200900734, "Filtro autoconfigurable para horno microondas de procesado en línea, proceso de filtrado autoconfigurable para hornos microondas de procesado en línea y horno de microondas de procesamiento en línea."
3. Patent Number, P200930476, "Filtro de microondas abierto en tecnología de guía de onda mediante la combinación de postes e iris para hornos de calentamiento por microondas".
4. Juan Monzó-Cabrera et al., Analysis of conventional open waveguide filters for use in microwave-heating applicators, HES-10, Padua, Italy, 2010.
5. M.E. Requena-Pérez, et al., "Combined Use of Genetic Algorithms and Gradient Descent Optimization Methods for Accurate Inverse Permittivity Measurement", IEEE Trans. on Microwave Theory and Techniques, Vol: 54(2), pp 615-623, 2006
6. P. Plaza-González, et al, "Effect of Mode Stirrer Configurations on Dielectric Heating Performance in Multimode Microwave Applicators", IEEE Trans. on Microwave Theory and Techniques, Vol. 53(5),pp 1699-1706, 2005
7. M. E. Requena-Pérez, et al., "Multimode Microwave-heating Applicator Optimization by optimum load location: experimental approach", IEEE Trans. on Microwave Theory and Techniques, Vol. 53 (6), pp. 2114-2120, 2005.
8. J.L. Pedreño-Molina, et al., "Sample Movement Optimisation for Uniform Heating in Microwave Heating Ovens", International Journal of RF and Microwave Computer-Aided Engineering, Vol. 17(2),pp. 142-152, 2007

## OBITUARY



**Steve Ottaway**  
Eletrothermal Engineering,  
UK

With sadness, I report the death from our community of Steve Ottaway 52, who had been suffering from a terminal illness. Despite this Steve had a characteristic 'positive outlook' on the future and was determined to make the most of the time he had left.

Steve's work and passion from an early age was electronics. Following a short time working for Gill Tech, he moved to IDM Electronics and then for many years to Radyne (now part of the Inductotherm Group), the

early pioneers in the UK of Dielectric and Induction heating equipment, before starting his own business Electro Technical Engineering that he ran with his wife Sally.

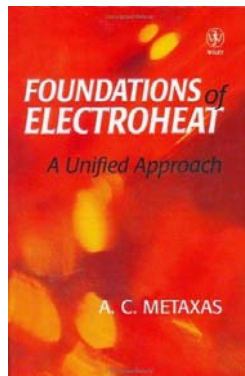
Steve's work took him all over the world - one of his favorite destinations was the United States and he wasn't far off completing his 50th trip there. There is where he met Ted Johnson CEO of Comdel, who became a special person in Steve's life, referring to him as his Yanky second-Dad. It was whilst sitting in airports and hotels around the world that Steve would indulge in one of his many passions, writing poetry.

**Mark Marshall**  
Strategic Surgical Ltd, UK



# TRANSLATION OF FOUNDATIONS OF ELECTROHEAT: A UNIFIED APPROACH

## TRANSLATION OF FOUNDATIONS OF ELECTROHEAT: A UNIFIED APPROACH, JULY 1996, J. WILEY AND SONS UK



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<http://www.amazon.com/Foundations-Electroheat-Approach-C-Metaxas>

## EVENTS

### SEMINAR ON MICROWAVE APPLICATIONS

NCIMP Nottingham University 22 March 2011  
PhD and MSc student presentations of their work

Details from IET London UK or e-mail Dr C Dodds at [chris.dodds@nottingham.ac.uk](mailto:chris.dodds@nottingham.ac.uk)  
Tel: +44 782 4591685 and Fax: +44 115 9514115  
[www.nottingham.ac.uk/ncimp](http://www.nottingham.ac.uk/ncimp)

### PIERS 2011

29th PIERS meeting  
Marrakesh, Morocco, 20-23 March, 2011.  
The conference information can be found at <http://directevent.net/piers/>  
PIERS OFFICE: [tpc@piers.org](mailto:tpc@piers.org)

Inquiry about paper submission, registration, and program schedule  
PIERS 2011 General Chair  
Prof. Said Zouhdi  
LGEP-SUPELEC  
Plateau deMoulon  
91192 Gif-sur-Yvette Cedex  
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Fax: +33-169418318  
E-mail: [said.zouhdi@supelec.fr](mailto:said.zouhdi@supelec.fr)

### ACES

Williamsburgh, Virginia, USA, March 27-31, 2011  
27th International Review on Progress of Applied Computational Electromagnetics  
For more information contact:  
<http://aces.ee.olemiss.edu/conference/>

### EHE 2011

4th International Conference on  
**Electromagnetic Fields, Health and Environment**  
Coimbra, Portugal, 26-28 May, 2011.

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or  
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### IMS 2011

IEEE MTT-S International Microwave Symposium  
Baltimore, MD USA, June 5-11, 2011  
<http://www.ims2011.org>  
The list of technical areas of the IMS 2011 includes:  
Topic 33 – High Power Industrial Application:



Design of microwave industrial and laboratory applicators, multiphysics modeling/optimization of microwave heating systems, physics of microwave processing of materials, NDE. NDT and dielectric property measurements, systems for microwave chemistry, plasma processing, microwave sintering, microwave-assisted comminution, microwave processing of wood and food.

For details, contact: Dr. Malgorzata Celuch, e-mail: [m.celuch@ire.pw.edu.pl](mailto:m.celuch@ire.pw.edu.pl), or Dr. Vadim V. Yakovlev, e-mail: [vadim@wpi.edu](mailto:vadim@wpi.edu).

## **IMPI's 45<sup>th</sup> SYMPOSIUM**

### **Annual Power Symposium**

Doubletree Hotel Canal Street  
New Orleans June 8-10, 2011.

for further details visit <http://www.impi.org/>

## **COUPLED 2011**

Island of Kos, Greece, 20 - 22 June, 2011.

Fourth conference on Computational Methods for Coupled Problems in Science and Engineering (Coupled 2011).

For more information contact  
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skype [guarnierimax](https://www.skype.com/partners/guarnierimax)  
or visit the conference website:  
<http://congress.cimne.com/coupled2011/>

## **ICMAT 2011**

Suntec, Singapore, 26 June-1 July 2011

Materials Research Society of Singapore will be organizing International Conference on Materials for Advanced Technologies (ICMAT) 2011. One of the symposiums will be on "Microwaves in Science and Engineering Applications" chaired by Profs Dinesh Agrawal and Manoj Gupta.

For details please contact Mr Kenneth Tan ([icmat@dawnyx.com](mailto:icmat@dawnyx.com)) or visit <http://www.mrs.org.sg/icmat2011/s37.htm>

## **PACRIM9**

Cairns Convention Centre, Cairns Australia, 11-14 July 2011

Symposium 17 Microwave and RF Processing of ceramics

For more information e-mail guest editors:  
[cristina.leonelli@unimore.it](mailto:cristina.leonelli@unimore.it) or  
[m.la.robina@tpg.com.au](mailto:m.la.robina@tpg.com.au)  
(See also issue AMPERE Newsletter 66 for further details)

## **CEM 2011**

Sydney, Australia, 12-15 July 2011.

18th International Conference on  
The Computation of Electromagnetics Fields

More information can be found in  
[www.compumag2011.com](http://www.compumag2011.com)

For conference organisation visit  
[secretariat@compumag1011.com](mailto:secretariat@compumag1011.com)

## **13TH INTERNATIONAL AMPERE CONFERENCE 2011**

5-8 September 2011,  
Toulouse, ENSEEIHT, France

The Management Committee of AMPERE is pleased to announce that the 13th International AMPERE conference on Microwave and High Frequency Heating will be staged in Toulouse during Monday to Thursday September 2011. The conference will be held at the Ecole Nationale Supérieure d'Electrotechnique, d'Electronique, d'Informatique, d'Hydraulique, et des Telecommunications

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or visit [www.ampereurope.org](http://www.ampereurope.org)



## **PIERS 2011**

### **30<sup>th</sup> PIERS meeting**

Suzhou, China, 12-16 September, 2011.

The conference information can be found at <http://piers.org/>

Please use [ON-LINE registration](#) or to

PIERS OFFICE

Suite 207

777 Concord Avenue,

Cambridge, MA 02138, USA

**Fax:** +86-571-87952380

**E-mail:** [tpc@piers.org](mailto:tpc@piers.org)

## **MS&T'11**

Columbus, Ohio, USA, 16-20 October 2011

Materials Science and Technology Conference and Exhibition

Microwave Processing of Materials Symposium

Abstract submission deadline 15 March 2011

For more information visit

<http://www.matscitech.org>

## **EURODRYING'2011**

Palma de Mallorca (Spain) 26-28 October 26-28, 2011.

**The conference themes are:**

Fundamentals, physical properties, modeling, simulation.

Drying processes.

Industrial processes and equipment.

Energy and environmental issues.

Additional information can be found on the conference web site:

<http://www.eurodrying2011.org>

## **GCMEA 2012 MAJIC 2st**

Global Congress on Microwave Energy

Applications

Long Beach California USA

Organised by Microwave Working Group

International Committee Chairperson B Krieger

Cober Electronics USA

<http://www.jemea.org./majic2012/>

## **SCEE 2012**

Scientific Computing in Electrical Engineering

ETH, Zürich Switzerland, 11-14 September 2012

Topics

1. Computational Electromagnetics
2. Circuit and Device Modelling & Simulation
3. Coupled Problems
4. Mathematical and Computational Methods

Last SCEE 2010 to browse through

<http://sites.onera.fr/SCEE2010/node/1>

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