Programme

Tuesday August 29th

08.30 – 10.00 Registrations & Welcome Coffee

10.00 – 10.15 Opening Speech

André Nicolet (Aix-Marseille Université, France)

10.15 – 11.15 Invited Speech by Anne-Sophie Bonnet-Ben Dhia (ENSTA Paris, France)

Time-harmonic electromagnetism in sign-changing materials

For about fifteen years, we have been interested in POEMS in the propagation of time-harmonic electromagnetic waves in a medium where the dielectric permittivity ε and/or the magnetic permeability μ are real-valued sign-changing functions. This is motivated by applications to plasmonics and to negative-index metamaterials.

Due to the presence of sign-changing coefficients, several difficulties occur, whose degree depends on the geometry of the interface where the sign-change happens.

When the interface is smooth, if the contrast of sign-changing coefficients is different from −1, we prove that usual results of well-posedness are almost recovered. In addition, we prove the convergence of finite elements, provided that the mesh is designed carefully close to the interface. This is no longer true when the interface has geometrical singularities like edges or tips. For instance, in presence of a tip of a negative material, the boundary value problem may be ill-posed in the usual finite energy space for contrasts different from −1. This is due to a very strange behavior of the electromagnetic field at the tip: so-called black-hole waves propagate towards the tip slowing down, without ever reaching it.

This phenomenon cannot be handled with standard finite elements methods, which generate spurious reflections of the blackhole waves. In 2D configurations, we have shown that these spurious reflections can be removed by using Perfectly Matched Layers at the corners.

During my talk, I will give a review of the mathematical and numerical results obtained with several collaborators, mainly Patrick Ciarlet, Lucas Chesnel, Camille Carvalho and Mahran Rihani.

11.15 – 12.35 Oral Session 1

115 *Analysis of the TE band structure in high contrast honeycomb photonic crystals*

Cassier, Maxence (1); Weinstein, Michael I. (2)
1: Aix Marseille Univ, CNRS, Centrale Marseille, Institut Fresnel, France; 2: Columbia University, New-York, United States

117 *On the numerical coupling for laser-quantum metamaterial interaction models*

Jourdana, Clément; Bidégaray, Brigitte
Univ. Grenoble Alpes, CNRS, Grenoble INP, LJK, France

130 *Reconstruction of Optical Observables with Quasi Normal Modes*

Betz, Fridtjof (1); Binkowski, Felix (1); Hammerschmidt, Martin (2); Zschiedrich, Lin (2); Burger, Sven (1,2)
1: Zuse Institute Berlin, Germany; 2: JCMwave GmbH, Germany

162 *An Improved 2D (2,4) FDTD Method for Lorentz Dispersive Media*

Zygiridis, Theodoros T. (1); Amanatiadis, Stamatios A. (1); Kantartzis, Nikolaos V. (2)
1: University of Western Macedonia, Greece; 2: Aristotle University of Thessaloniki, Greece

12.35 – 13.35 Lunch break

13.35 – 15.15 Oral Session 2

123 *Construction of transparent conditions for electromagnetic guides*

Bonnet-Ben Dhia, Anne-Sophie; Fliss, Sonia; Chesnel, Lucas; Parigaux, Aurélien
ENSTA Paris, France

124 *Eigenvalue Optimization with respect to Shape-Variations in Electromagnetic Cavities*

Herter, Christine (1); Wollner, Winnifried (1); Schöps, Sebastian (2)
1: Universtiät Hamburg, Germany; 2: Technische Universität Darmstadt, Germany

131 *Eigenmode computation of VCSELs with MHCG applying a Riesz projection eigenvalue solver*

Kuen, Lilli (1,2); Hammerschmidt, Martin (2); Zschiedrich, Lin (2); Betz, Fridjof (1); Binkowski, Felix (1); Burger, Sven (1,2); Janczak, Mikołaj (3); Gebski, Marcin (3); Czyszanowski, Tomasz (3); Reitzenstein, Stephan (4)
1: Zuse Institute Berlin, Germany; 2: JCMwave GmbH, Germany; 3: Lodz University of Technology, Poland; 4: Technische Universität Berlin, Germany

157 *Spectral expansions of disperive-media response functions*

Stout, Brian; Ben Soltane, Isam; Bonod, Nicolas
Aix Marseille Université, France

119 *Modelling of light scattering in resonant multilayered stacks*

Toumi, Yousra (1); Lemarchand, Fabien (1); Allard, Valentin (1); Favard, Cyril (2); Lumeau, Julien (1); Demesy, Guillaume (1); Lereu, Aude (1)
1: Aix Marseille Univ, CNRS, Centrale Marseille, Institut Fresnel, France; 2: Institut de Recherche en Infectiologie de Montpellier, CNRS, Univ of Montpellier, France

15.15 – 15.45 Coffee break

15.45 – 17.05 Oral Session 3

147 *Multiharmonic Multiscale Modeling in 3-D Nonlinear Magnetoquasistatics*

Ruuskanen, Janne (1); Marteau, Antoine (2); Niyonzima, Innocent (2); Tarhasaari, Timo (1); Halbach, Alexandre (3); Meunier, Gérard (2); Rasilo, Paavo (1)
1: Tampere University, Finland; 2: Univ. Grenoble Alpes, CNRS, Grenoble INP, G2Elab, France; 3: Quanscient Oy, Finland

143 *A ROW-Type Method for GPU-Accelerated Large-Scale Finite Element Simulations of Nonlinear Eddy Current Problems*

Kähne, Bernhard; Clemens, Markus
University of Wuppertal, Germany

120 *Hybrid Cartesian/unstructured numerical method for efficient resolution of Maxwell's equations in time domain: Application to buried object detection from airborne remote sensing platforms*

Mazzolo, Lisa-Marie (1); Angelliaume, Sébastien (2); Ferrieres, Xavier (3)

1: DEMR, ONERA, France; 2: DTIS, ONERA, France; 3: ONERA / DEMR, Université de Toulouse, France

151 *Efficient Substructured Domain-Decomposition in Inverse Problems using Krylov Subspace Recycling*

Martin, Boris G.; Gabriel, Tim; Geuzaine, Christophe
University of Liège, Belgium

17.05 – 18.05 Oral Session 4

135 *Finite Element Modelling of a fully integrated graphene-based compact plasmon coupler*

Renversez, Gilles (1,2); Natarajan, Aswani (1,2); Demésy, Guillaume (1,2)
1: Aix-Marseille Université, France; 2: Institut Fresnel UMR CNRS 7249, France

164 *Voltage-controlled Adjustment of Graphene Scatterer Plasmon Coupling for Intelligent Metasurface Design*

Amanatiadis, Stamatios A. (1); Zygiridis, Theodoros T. (1); Kantartzis, Nikolaos V. (2)
1: University of Western Macedonia, Greece; 2: Aristotle University of Thessaloniki, Greece

101 *Design and Optimization of Multilayered Microwave Absorber Structures for X-band Frequencies: Application on Composite Materials Comprising Ceramic, Polyaniline/Magnetite, and Carbon Nanotubes*

Benzaoui, Karim (1); Achour, Ales (1); Abdelhalim, Zaoui (2); Youcef Amine, Medjaouri (1); Fethi, Benyoubi (1)
1: EMP/Algiers, Algeria; 2: ENST/Algiers, Algeria

18.05 – 19.30 Welcome Reception

Programme

Wednesday August 30th

08.30 – 09.30 Invited Speech by François Henrotte (University of Liège, Belgium)

Iron losses and local forces in electrical machine modelling

Since fields, Joule losses and torque are routinely computed with good accuracy, one may feel finite element (FE) modelling is now a mature technique for the industrial design of electrical machines. Still, two multiphysics coupling terms remain hard to introduce in the models with a satisfactory accuracy, namely the iron losses in ferromagnetic cores and the local magnetic forces. Despite their having only a secondary importance in the functioning of the device, these coupling terms are a serious matter of concern in modern design, as they significantly impact the overall efficiency and the acoustic nuisance of the developed products.

The hassle is however of a different nature for the two issues at hand.

As of iron losses, the difficulty resides in resolving the tight interaction between skin effect and magnetic hysteresis occurring in the bulk of thin stacked laminations, and then to homogenize it out appropriately. We propose for this to represent the stack at the macroscopic level by a parametric irreversible material law, the parameters of which are obtained from a neural network trained to best-fit detailed mesoscopic simulations made at the lamination level with the same magnetic field waveform.

As of local forces, we shall reconcile the Maxwell stress tensor with the Virtual work principle approaches by means of a short excursion into tensor analysis. On that ground, we recall how to compute local forces systematically in the presence of saturable or permanent magnet materials, and show how much more natural and efficient it is to evaluate them from within a structural FE formulation, than by post-processing a magnetic FE formulation.

For both issues, we advocate for approaches that avoid brute force analysis but, on the contrary, astutely combine heterogeneous pieces to build up a model offering a controllable accuracy, but whose size is still adequate for efficient daily design.

09.30 – 10.30 Oral Session 5

145 *Effective Material Modelling for Laminated Iron Cores with a Magnetic Vector Potential Formulation and Magnetic Hysteresis*

Hanser, Valentin; Schöbinger, Markus; Hollaus, Karl
Technische Universität Wien, Austria

149 *Numerical modeling of dynamic hysteresis using a vector extension of the Loss Surface model*

Mikula, Léopold (1,2); Ramdane, Brahim (2); Valdivieso, Carlos (1); Kedous-Lebous, Afef (2); Meunier, Gérard (2)
1: Altair engineering, France; 2: Université Grenoble Alpes, CNRS, Grenoble INP, G2Elab, France

153 *Numerical modeling of antiferroelectric and antiferroelectric-like actuator*

Nguyen, Binh; Rochus, Veronique
imec, Belgium

10.30 – 12.00 Poster Session 1 & Coffee break

Topic 1 : Mathematical models and associated discretization methods

111 *Use of Higher Order Base Functions to Represent Current Distributions in Grounding Electrodes*

Schroeder, Marco Aurélio de Oliveira; Silva, Gabriel Carlos Pena da ; Moura, Rodolfo Antônio Ribeiro de
Federal University of São João del-Rei (UFSJ), Brazil

133 *Lumped-Parameter Modeling of Magnetic Components in High Frequency Applications for Practical Test Cases*

Davister, Nicolas Pierre; Geuzaine, Christophe; Frébel, Fabrice
ULiège, Belgium

144 *Multiscale Modelling of a Transient 3D Nonlinear Magnetoquasistatic Problem with a B-conforming Formulation*

Marteau, Antoine (1); Niyonzima, Innocent (1); Meunier, Gérard (1); Ruuskanen, Janne (2); Chadebec, Olivier (1); Galopin, Nicolas (1); Rasilo, Paavo (2); Tarhasaari, Timo (2)
1: Univ. Grenoble Alpes, CNRS, Grenoble INP, G2Elab, France; 2: Tampere University, Finland

Topic 2 : Material modelling

Topic 3 : Efficient computational techniques

Topic 4 : Design and optimisation

161 *Evaluation of Uncertainty of Electric and Magnetic Field Calculation Results in the Vicinity of Transmission Overhead Power Lines*

Grbic, Maja; Pavlovic, Aleksandar
Nikola Tesla Institute of Electrical Engineering, Serbia

168 *The Sensitivity Analysis Using Adjoint Method In Numerical Modelling of Electric Potential Distribution of the Transmission Lines*

Paganotti, André Luiz (1); Saldanha, Rodney Rezende (2); Lisboa, Adriano Chaves (2); Afonso, Márcio Matias (1); Duane, Isabela Abrão Marques (1)
1: CEFET-MG, Brazil; 2: UFMG, Brazil

12.00 – 13.00 Lunch break

13.00 – 14.20 Oral Session 6

152 *Application of a Nonlinear Circuit-Field Coupled Volume Integral Formulation to a Current Transformer with Thin Air Gaps*

Hernandez Alayeto, Mayra (1,2); Meunier, Gerard (2); Rondot, Loic (1); Favre, Matthieu (1); Chadebec, Olivier (2); Guichon, Jean-Michel (2)
1: Schneider Electric, Global Technology, Eybens, France.; 2: Univ. Grenoble Alpes, CNRS, Grenoble INP, G2ELab, France

107 *Combination of Boundary Elements and the Ellipsoidal Method to Optimize the Electromagnetic Fields of Overhead Power Lines*

Duane, Bell (1); Afonso, Marcio Matias (1); Paganotti, Andre Luiz (1); Schroeder, Marco Aurelio (2); Saldanha, Rodney (3)
1: CEFET-MG, Brazil; 2: UFSJ, Brazil; 3: UFMG, Brazil

118 *Calculation of Transmission Line Parameters of Bundles of Wires Using the Boundary Element Method*

Berrospe Juarez, Edgar; Sirois, Frederic
Polythecnique Montreal, Canada

150 *Boundary Integral Equation Method for Photonic Crystal Fibers*

Ayela, Marc (1); Poirier, Jean-René (1); Surre, Frederic (2); Seat, Han-Cheng (3)
1: LAPLACE, INP-Toulouse, France; 2: James Watt School of Engineering, University of Glasgow,UK; 3: LAAS, CNRS, INP-Toulouse, France

14.20 – 15.50 Poster Session 2 & Coffee break

Topic 5 : Applications

104 *Research on a Novel Mechanical and Power Electronic Hybrid DC Breaker Based on Current Commutation Method*

Ahn, Hyun-Mo (1); Park, Jun-Kyu (1); Jang, Hyun-Jae (1); Oh, Yeon-Ho (1); Hahn, Sung-Chin (2); Song, Ki-Dong (1)
1: Korea Electrotechnology Research Institute, South Korea; 2: Korea Electrical Manufacturers Association, South Korea

105 *An Efficient Modeling Method of Radiative Absorption Coefficient for Ablation-Dominated Arc Plasma in Gas Circuit Breaker*

Ahn, Hyun-Mo (1); Jang, Hyun-Jae (1); Park, Jun-Kyu (1); Song, Ki-Dong (1); Hahn, Sung-Chin (2); Oh, Yeon-Ho (1)
1: Korea Electrotechnology Research Institute, South Korea; 2: Korea Electrical Manufacturers Association, South Korea

112 *CO2 Detector Powered by a Rectenna*

Resende, Ursula Do Carmo; Ramalho, Fagner Fernandes dos Santos; Oliveira, Willian Araújo; Carvalho, Túlio Carvalho de Oliveira
CEFET-MG, Brazil

128 *Comparing Wireless Power Transfer Efficiency of Bessel Beams from Axicons and Planar Apertures*

De Miranda Pimenta, Ravel Carlos (1); Soriano, Gabriel (1); Paschaloudis, Konstantinos D. (2); Bertrand, Matthieu (3); Ettorre, Mauro (2); Zerrad, Myriam (1); Amra, Claude (1)
1: Aix Marseille Univ, CNRS, Centrale Marseille, Institut Fresnel, France; 2: Univ Rennes, CNRS, IETR, France; 3: Thales Research & Technology, France

129 *Rotor optimization for speed range extension of an IPMSM*

Ogrizek, Pavel; Petrun, Martin
University of Maribor, Maribor, Slovenia

134 *Electromagnetic Simulation of a 6-Phase HTS Excited Medium Speed Wind Generator*

Köster, Robin; Binder, Andreas
Technical University Darmstadt, Germany

15.50 – 17.30 Oral Session 7

136 *A hybridizable discontinuous Galerkin method with characteristic variables for time-harmonic problems*

Modave, Axel (1); Chaumont-Frelet, Théophile (2)
1: POEMS, CNRS, Inria, ENSTA Paris, Institut Polytechnique de Paris, France; 2: Université Côte d'Azur, Inria, CNRS, LJAD, France

169 *FETI-DP method for 3D magnetostatic simulations*

Ghenai, Mohamed Ibrahim (1); Perrussel, Ronan (2); Chadebec, Olivier (3); Vi, Frederic (1); Guichon, Jean-Michel (1); Meunier, Gerard (3); Siau, Jonathan (1)
1: Altair Engineering France, France; 2: LAPLACE, Université de Toulouse, France; 3: Univ. Grenoble Alpes, France

138 *Numerical simulation of an electric upsetting process based on Lagrangian formulations*

Salgado Rodríguez, María Pilar (1); Benítez, Marta (2); Bermúdez, Alfredo (1); Fontán, Pedro (3); Martínez, Iván (1)
1: Galician Centre for Mathematical Research and Technology (CITMAga) and Universidade de Santiago de Compostela, Spain; 2: Galician Centre for Mathematical Research and Technology (CITMAga) and Universidade da Coruña, Spain; 3: Repsol Technology Lab, Spain

132 *Comparison of three methodologies to simulate induction heating in carbon fiber reinforced polymer*

Pierquin, Antoine (1); Trichet, Didier (1); Chadebec, Olivier (2)
1: Nantes Université, IREENA, France; 2: Univ. Grenoble Alpes, CNRS, Grenoble INP, G2Elab, France

127 *Harmonic Balance Applied to a 2D Non Linear Finite-Element Magnetic Model with Motion and Circuit Coupling*

Scolaro, Elia (1); Alberti, Luigi (1); Sabariego, Ruth Vazquez (2); Gyselinck, Johan (3)
1: University of Padova, Italy; 2: KU Leuven, Belgium; 3: Université Libre de Bruxelles, Belgium

19.00 – 22.00 Gala Dinner at Fort Ganteaume

Programme

Thursday August 31st

08.30 – 09.30 Invited Speech by Benjamin Vial (Imperial College London, United Kingdom)

Topology optimization of electromagnetic devices: numerical implementation and applications

In the past two decades, gradient-based topology optimization has become a widely used tool in computational electromagnetism and has allowed the inverse design of a broad range of devices such as invisibility cloaks, metamaterials and metasurfaces to name a few.

I will detail the development of software libraries with automatic differentiation capabilities [1]: a Finite Element Method (FEM) based code for 2D scattering problems, an implementation of the Fourier Modal Method (FMM) for stacked bi-periodic structures and a Plane Wave Expansion Method (PWEM) to compute the eigenmodes of 2D photonic crystals. After describing the methods, the automatic differentiation and topology optimization tools, I will give examples of application for each: the design of super-scattering structures with the FEM, of a metasurface optimized to transmit maximally in a given diffraction order with the FMM and maximization of bandgap and dispersion engineering in dielectric photonic crystals using the PWEM.

The availability of open-source codes for solving Maxwell's equations is of paramount importance in the growing field of metamaterials and photonics. Our implementation those three numerical methods is freely available as Python packages: https://gyptis.gitlab.io (FEM), https://nannos.gitlab.io (FMM) and https://protis.gitlab.io (PWEM).

[1] Benjamin Vial and Yang Hao. Open-Source Computational Photonics with Auto Differentiable Topology Optimization. Mathematics, 10(20):3912, January 2022.

09.30 – 10.30 Oral Session 8

125 *Space-time shape optimization of rotating electric machines*

Cesarano, Alessio (1); Dapogny, Charles (2); Gangl, Peter (1)
1: Johann Radon Institute of Computational and Applied Mathematics (RICAM), Austria; 2: Laboratoire Jean Kuntzmann - Université Grenoble Alpes, France

139 *Adjoint Method using a Volume Integral Method for 3D Magnetic Structure Optimization*

Michel, Sophie; Messine, Frédéric; Poirier, Jean-René
Laboratoire LAPLACE, France

170 *Gradient based Topology Optimization to 3D Magnetic Circuits*

Messine, Frederic; Houta, Zakaria; Huguet, Thomas
LAPLACE-Toulouse INP, France

10.30 – 11.00 Coffee break

11.00 – 11.40 Oral Session 9

121 *FEM design and optimisation of a Magnetorheological actuator*

Vizjak, Jakob; Jesenik, Marko; Hamler, Anton
University of Maribor, Slovenia

122 *Cauer ladder network method applied to reduce electro-quasistatic problems*

Chen, Wei (1); Clenet, Stephane (1); Henneron, Thomas (2); Zou, Jun (3)
1: Arts et Metiers Sciences and Technology, France; 2: University of Lille, France; 3: University of Tsinghua, China

11.40 – 12.40 Lunch break

12.40 – 14.00 Oral Session 10

116 *Transfer Learning for Neural Network-Based Surrogate Modeling in Magnetostatics*

Lippert, Jonathan Rainer; von Tresckow, Moritz; De Gersem, Herbert
TU Darmstadt, Germany

156 *Effective electromagnetic properties of composite material computed from neural network approach*

Kameni, Abelin; Palessonga, Den; Semmoumy, Zahraa; Bensetti, Mohamed
Group of electrical engineering of Paris, France

103 *Machine Learning Application in Power Cable Accessories Design*

Raicevic, Nebojsa (1); Jevtic, Dusan (2); Vuckovic, Ana (1); Peric, Mirjana (1)
1: University of Nis, Serbia; 2: FAZI DOO Company, Serbia

146 *Simulation of Electromagnetic Shielding Using Effective Interface Conditions*

Schöbinger, Markus; Hollaus, Karl
TU Wien, Austria

14.00 – 14.30 Coffee break