SCIENTIFIC COMPUTING IN ELECTRICAL ENGINEERING (SCEE 2024)

CONFERENCE PROGRAM

Darmstadt, Germany
March 4-8, 2024

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Programme

SCEE 2024 Conference Schedule
Darmstadt, Germany, March 4–8, 2024

Registration is possible on Monday starting at 17:00, on Tuesday from 8:00 and on all other days from 8:30 onwards.

Monday, March 4, 2024

17:00–18:00	**Registration**	
Public lecture:		
18:00–19:30	Wil Schilders	**Public lecture:** *The key role of mathematics in the electronics industry*
19:30–21:00	**Welcome drink**	

Tuesday, March 5, 2024

8:00–8:45		**Registration**	
8:45–9:00		**Opening ceremony**	
Session A		**Computational Electromagnetics** **Multiphysics and multiscale modelling** Chair: Sebastian Schöps	
9:00–9:50	A1	Pilar Salgado	**Keynote:** *Multiphysics simulation of electrical upsetting processes: Focus on modelling and numerical analysis of the electromagnetic submodel*
9:50–10:10	A2	Louis Denis, Vincent Nuttens, Philippe Velten, Benoît Vanderheyden and Christophe Geuzaine	*A multi-scale approach within magneto-thermal FE simulations for the computation of AC losses in superconducting magnets*
10:10–10:30	A3	Revathi Appali, Dennie Supriatna, Jan Philipp Payonk, Lam Vien Che and Ursula van Rienen	*Current challenges in multiphysics and multiscale modelling of electrically active implants*
10:30–11:00		**Coffee break**	
Session B		**Mathematical and Computational Methods** **Simulation methods involving neural networks** Chair: Idoia Cortes Garcia	
11:00-11:20	B1	Ziqing Guo and Ruth Sabariego	*Physics-informed neural network for time domain 2D magneto-quasi-static simulation*

11:20–11:40	B2	Moritz von Tresckow, Ion Gabriel Ion, Herbert De Gersem and Dimitrios Loukrezis	*Neural subdomain solver for magnetostatic field computations of a quadrupole magnet*
11:40–12:00	B3	Paulo Machado, Giovanni Nastasi, L. Miguel Silveira and Ruxandra Barbulescu	*Efficient machine learning methods to predict the stationary electron density profile in a n+/n/n+ silicon diode*
12:00–12:20	B4	Steven Stroka, Norman Haußmann and Markus Clemens	*Efficient assessment of high-resolution low-frequency magnetic field exposure scenarios using reduced order models*
12:20–13:10		**Lunch**	
Session C		Chair: Wil Schilders	
13:10–14:00	C1	Giuseppe Alì	**Keynote:** *Semiconductor device models from the perspective of an applied mathematician*
Session D		**Posters** Chairs: Melina Merkel, Kersten Schmidt	
14:00–14:20		**Poster blitz (1 minute slides)**	
14:20–15:30	D1	Jan Wagner and Peter Thoma	*Semantic data structure for a digital twin of the EMC compliance testing domain*
14:20–15:30	D2	Idoia Cortes Garcia, Pratik M. Kumbhar and Jonas Pade	*Convergence of waveform relaxation for index 2 field/circuit coupled DAEs classified with generalized circuit elements*
14:20–15:30	D3	Petrus Wilhelmus Nicolaas van Diepen, Indy Pradyka Neerhoff, Roeland Johannes Dilz and Martijn Constant van Beurden	*The MOT-EFIE with loop-star decomposition*
14:20–15:30	D4	Siamak Pourkeivannour, Mitrofan Curti and Elena A. Lomonova	*A two-dimensional implementation of Darwin formulation to model resistive-inductive-capacitive effects in foil windings*
14:20–15:30	D6	Ara Abdulsatar Assim Assim, Aarno Pärssinen and Timo Rahkonen	*Modeling image frequency signal and its cancellation in complex downconversion circuit*
14:20–15:30	D7	Igor Tsukerman and Vadim Markel	*Bulk-boundary correspondence in topological electrodynamics: From 1D to higher dimensions*
14:20–15:30	D8	Jürgen Dölz, David Ebert, Sebastian Schöps and Anna Ziegler	*Shape uncertainty quantification of Maxwell eigenmodes and -spaces with application to TESLA cavities*

14:20–15:30	D9	Jonas Bundschuh, Yvonne Späck-Leigsnering and Herbert De Gersem	*Foil winding homogenization with consideration of capacitive effects*
14:20–15:30	D10	Markus Clemens, Marvin-Lucas Henkel, Fotios Kasolis and Michael Günther	*A port-Hamiltonian system perspective on electromagneto-quasistatic field formulations of Darwin-type*
14:20–15:30	D11	Alistair Muir, Ursula van Rienen, Erion Gjonaj, Paul Voltz, Frederik Quetscher and Atoosa Meseck	*Modelling the beam impedance of elliptical undulators using the coupled S-parameter calculation*
14:20–15:30	D12	Wei Chen, Thomas Henneron, Stéphane Clénet and Jun Zou	*Determination of an electrical equivalent circuit of a PCB using the Cauer ladder network method*
14:20–15:30	D13	Théodore Cherrière	*Toward multi-material topology optimization of doubly-excited electrical machines using recursive material interpolation*
14:20–15:30	D14	Francesco Ferranti	*Machine learning for wavelength-dependent responses in nano photonics*
15:30–16:00		**Coffee break**	
Session E		**Computational Electromagnetics Formulations** Chair: Martijn van Beurden	
16:00–16:20	E1	Herbert Egger, Felix Engertsberger and Bogdan Radu	*A scalar potential approach for magnetostatics avoiding the coenergy*
16:20–16:40	E2	Robert Hahn, Erik Schnaubelt, Mariusz Wozniak, Andrea Vitrano, Christophe Geuzaine and Sebastian Schöps	*Mortar thin shell approximation for transient analysis of superconducting accelerator magnets*
16:40–17:00	E3	Gabriela Ciuprina, Claudia Pacurar and Ruth V. Sabariego	*Electric circuit element boundary conditions for electromagnetic quasistatic models: A-ϕ potentials versus E-field based formulations*
17:15–19:00		**Touristic walk**	

Wednesday, March 6, 2024

Session F		**Coupled Problems and Modelling Applications** Chair: Peter Thoma	
9:00–9:50	F1	Martina Busetto and Christoph Winkelmann	**Keynote:** *Modelling, methods development and scientific computing at ABB*

9:50–10:10	F2	Karsten Müller, Andreas Wanke, Yves Burkhardt and Herbert De Gersem	*Comparison and analysis of skewing methods of PMSM in 2D and 3D FEA simulations*
10:10–10:30	F3	Albert Piwonski, Julien Dular, Rodrigo Silva Rezende and Rolf Schuhmann	*Electromagnetic modeling of power cables with large cross sections using coordinate transformations and homogenization techniques*
10:30–11:00		**Coffee break**	
Session G		**Mathematical and Computational Methods** **Optimization and inverse problems** Chair: Roland Pulch	
11:00-11:20	G1	Christian Bergfried, Leon Blumrich, Armin Galetzka, Yvonne Späck-Leigsnering and Herbert De Gersem	*Calibration of a squirrel-cage induction machine thermal model*
11:20–11:40	G2	Nepomuk Krenn and Peter Gangl	*Multi-material topology optimization of an electric machine considering demagnetization*
11:40–12:00	G3	Stefan Eijsvogel, Roeland Dilz and Martijn van Beurden	*Exploring the reconstruction of a finite dielectric frustum-shaped object by the parametrized spatial spectral volume integral equation*
12:00–13:30		**Lunch**	
13:30–17:30		**Excursion**	
18:00–22:00		**Conference dinner**	

Thursday, March 7, 2024

Session H		**Mathematical and Computational Methods** **Scalable solvers** Chair: Caren Tischendorf	
9:00–9:50	H1	Vandana Dwarka	**Keynote:** *Towards fast and scalable iterative solvers for indefinite systems arising in electromagnetic simulations*
9:50–10:10	H2	Frederik Quetscher, Erion Gjonaj and Herbert De Gersem	*Modal transmission condition for domain decomposition for guided wave problems*
10:10–10:30	H3	Herbert Egger, Felix Engertsberger and Bogdan Radu	*On the convergence of iterative solvers for nonlinear magnetostatics*
10:30–11:00		**Coffee break**	
Session I		**Mathematical and Computational Methods** **Model reduction and surrogate modelling** Chair: Ruth Sabariego	

11:00-11:20	I1	Christine Herter, Sebastian Schöps and Winnifried Wollner	*Eigenvalue optimization with respect to shape-variations in electromagnetic cavities*
11:20–11:40	I2	Anna Ziegler, Melina Merkel and Sebastian Schöps	*Spurious modes in reduced basis approximations for Maxwell's eigenvalue problem*
11:40–12:00	I3	Antonio Carlucci and Stefano Grivet Talocia	*Rational approximation for the solution of large-scale Lyapunov equations*
12:00–12:20	I4	Pascal Den Boef, Joseph Maubach, Wil Schilders and Nathan van de Wouw	*Reduced rank extrapolation for low-rank matrix sequences*
12:20–13:10		**Lunch**	
Session J		**Computational Electromagnetics** **Material modelling** Chair: Herbert Egger	
13:10–14:00	J1	Benoît Vanderheyden	**Keynote:** *Finite element models for type-II superconductors: constitutive laws and formulations*
Session K		**Posters** Chairs: Revathi Appali, Ruxandra Barbulescu	
14:00–14:20		**Poster blitz (1 minute slides)**	
14:20–15:30	K1	Alessio Cesarano and Peter Gangl	*Tracing pareto-optimal points in multi-objective shape optimization applied to electric machines*
14:20–15:30	K2	Herbert Egger, Felix Engertsberger and Klaus Roppert	*On the regularized H-field approach for nonlinear magnetostatics*
14:20–15:30	K3	Rodrigo Silva Rezende, Albert Piwonski and Rolf Schuhmann	*Recurrent neural networks as predictors of time signals from electromagnetic simulations*
14:20–15:30	K4	Leon Herles, Mario Mally, Melina Merkel, Jörg Ostrowski and Sebastian Schöps	*Frequency-stable full Maxwell using generalized tree-cotree gauging*
14:20–15:30	K5	Peter Förster, Idoia Cortes Garcia, Lennart Jansen, Wil Schilders and Sebastian Schöps	*Index-aware learning of circuits*
14:20–15:30	K6	Jonas Christ and Erion Gjonaj	*A self-consistent model for wakefield and space charge calculations*
14:20–15:30	K7	Sosoho-Abasi Udongwo, Shahnam Gorgi Zadeh, Piotr Putek, Rama Calaga and Ursula van Rienen	*Comparative analysis of sensitivity results between a 3D HOM coaxial coupler model and an equivalent circuit mode*

14:20–15:30	K8	Karthik Sridhar, Ursula van Rienen and Revathi Appali	*Understanding local field potential recordings by segmented deep brain stimulation electrodes: A computational study*
14:20–15:30	K9	Mario Mally, Leon Herles, Idoia Cortes Garcia and Sebastian Schöps	*Parallelization in space and time for parabolic problems in 3-D*
14:20–15:30	K10	Elias Paakkunainen, Jonas Bundschuh, Idoia Cortes Garcia, Herbert De Gersem and Sebastian Schöps	*Circuit consistency and structure of inductive foil conductor models*
14:20–15:30	K11	Herbert Egger and Vsevolod Shashkov	*A magnetic oriented approach to field-circuit coupling*
14:20–15:30	K12	Kersten Schmidt and Timon Seibel	*On a hybridized domain decomposition formulation*
14:20–15:30	K13	Tobias Karim Aouini, Ortwin Farle, Timo Euler and Sebastian Schöps	*Investigation of S-parameter evaluation for coupled meshes in hybrid solver scenarios*
14:20–15:30	K14	Kersten Schmidt	*Eddy current modelling with thin sheet basis functions*
15:30–16:00		**Coffee break**	
Session L		**Circuit Simulation & Coupled Problem and Modelling** Chair: Markus Clemens	
16:00–16:20	L1	Orazio Muscato, Giovanni Nastasi, Giorgia Vitanza and Vittorio Romano	*Optimized quantum drift-diffusion model for a resonant tunneling diode*
16:20–16:40	L2	Ricardo Riaza	*Some recent results involving homogeneous models of electrical and electronic circuits*
16:40–17:00	L3	Tommaso Bradde and Stefano Grivet-Talocia	*Certified stable LPV macromodels of mildly nonlinear circuits*

Friday, March 8, 2024

Session M		**Mathematical and Computational Methods** **Uncertainty quantification & stochastic models** Chair: Gabriela Ciuprina	
9:00–9:50	M1	Dimitrios Loukrezis	**Keynote:** *Reduced order modeling and uncertainty quantification for (electromagnetic) digital twins*
9:50–10:10	M2	Roland Pulch	*Stochastic Galerkin method for linear port-Hamiltonian differential-algebraic equations*

10:10–10:30	M3	Maximilian Schade, Nicolas Perkowski and Caren Tischendorf	*Coupled systems of SDEs and SPDEs with algebraic constraints*
10:30–11:00		**Coffee break**	
Session N		**Coupled Problems and Modelling** **Device modelling and simulation** Chair: Jörg Ostrowski	
11:00-11:20	N1	Clemens Etl, Mauro Ballicchia, Mihail Nedjalkov and Josef Weinbub	*Signed-particle Monte Carlo algorithm for Wigner transport in linear electromagnetic fields*
11:20–11:40	N2	Daniele Soccodato, Gabriele Penazzi, Alessandro Pecchia, Anh-Luan Phan and Matthias Auf der Maur	*Machine learned corrections to the Empirical Tight-Binding method*
Session 0		**Mathematical and Computational Methods** **Parallel-in-time methods** Chair: Jörg Ostrowski	
11:40–12:00	O1	Julian Sarpe, Andreas Klaedtke and Herbert De Gersem	*Parallel-in-time adjoint sensitivity analysis for time-periodic circuits*
12:00–12:20	O2	Erik Schnaubelt, Mariusz Wozniak, Julien Dular, Idoia Cortes Garcia and Sebastian Schöps	*Parallel-in-time integration of transient phenomena in no-insulation superconducting coils using parareal*
12:20–12:30		**Closing remarks**	
12:30–13:30		**Lunch**	

Keynote speakers

Wil Schilders (TU Eindhoven)

The key role of mathematics in the electronics industry

Wil Schilders obtained his MSc in mathematics, physics and astronomy from the Radboud University in Nijmegen (NL) in 1978, and his PhD in numerical mathematics from Trinity College Dublin, Ireland, in 1980. From 1980-2006 he worked in the Mathematical Software Group and the Applied Mathematics Group at the Philips Research Laboratories in Eindhoven (NL), and from 2006-2010 was the head of the Mathematics Group at NXP Semiconductors. His work at Philips and NXP Semiconductors was mainly concerned with the development of robust and efficient numerical methods for the simulation of semiconductor devices, electronic circuits and electromagnetics problems. In 1999, he became a full professor (part-time) of scientific computing for industry at Eindhoven University of Technology. Since 2010, he is both a professor at TU Eindhoven and the executive director of the Dutch Platform for Mathematics. He is active in organising workshops and international conferences (e.g. SCEE 2002, Preconditioning 2015, SCEE 2020, SCEE 2022, SIAM CSE 2023), also initiated and chaired the European network on Model Order Reduction (EU-MORNET, 2014-2018) with over 300 researchers. He has been president of the European Consortium of Mathematics for Industry (ECMI, 2010-2011) and the European Service Organisation of Mathematics for Industry and Innovation (EU-MATHS-IN, 2016-2020). In 2019, he was elected officer-at-large in the board of the International Council for Industrial and Applied Mathematics (ICIAM), and currently is its president till September 2027. Wil was the 4th Mittelsten-Scheid guest professor at the Bergische Universitaet Wuppertal in 2020-2021, and is a Hans Fischer senior fellow at TU Munich. In 2022, he was elected SIAM fellow and also received the Stairway to Impact award of the Dutch research funding organization NWO.

Guiseppi Alì (Università della Calabria)

Semiconductor device models from the perspective of an applied mathematician

Giuseppe Alì received a degree in mathematics from the University of Catania (IT) in 1990, and his PhD in mathematics from the same university in 1995, under the supervision of Prof. Angelo Marcello Anile. From 1997 to 2007 he worked for the Consiglio Nazionale delle Ricerche (CNR) as a researcher at the Neapolitan branch of the Istituto per le applicazioni del calcolo "Mauro Picone" (IAC). In 2007 he moved to the University of Calabria as a researcher (assistant professor) and, since 2011, as associate professor. His research interests include coupled problems in applied mathematics (theoretical and numerical study of partial-differential-algebraic equations), hyperbolic problems in applied mathematics (modelling of semiconductor devices, fluid dynamics and magnetohydrodynamics, general relativity, hydrodynamic models for plasmas), and more recently Model Order Reduction (MOR).

Martina Busetto (ABB Switzerland Corporate Research)

Modelling, methods development and scientific computing at ABB

Martina Busetto received the B.Sc. degree in Energy Engineering and the M.Sc. degree in Mathematical Engineering from the University of Padua in 2015 and 2018, respectively, and her Ph.D. in applied mathematics from Polytechnic of Turin and University of Turin in 2022. Since December 2022, she works as Computational Scientist for the ABB Corporate Research Center in Switzerland. Her research interests involve the development of mathematical models and numerical methods for engineering applications.

Vandana Dwarka (TU Delft)

Towards fast and scalable iterative solvers for indefinite systems arising in electromagnetic simulations

Vandana Dwarka obtained her MSc and PhD in Numerical Mathematics from the Delft University of Technology (TUD). Before her time in academia, she worked in various industry roles, as she also has a background in law and econometrics. Currently, she is an assistant professor in the Numerical Analysis group at TUD. Her research focuses on fast and scalable numerical solvers for electromagnetic wave equations, with a special focus on problems leading to highly indefinite linear systems. In particular, her work on the Helmholtz equation has solved some long-standing open problems. She focuses on a balanced approach between theoretical results and applications. Her research interests and interdisciplinary background moves her to collaborate with industry to see her methods validated and applied in practice.

Dimitrios Loukrezis (Siemens AG and TU Darmstadt)

Reduced order modeling and uncertainty quantification for (electromagnetic) digital twins

Dimitrios Loukrezis received his Diploma (M.Sc. equivalent) in Electrical and Computer Engineering from the National Technical University of Athens (Greece, 2012), his M.Sc. in Simulation Sciences from RWTH Aachen University (Germany, 2014), and his Ph.D. degree in Electrical Engineering from TU Darmstadt (Germany, 2019). Since 2019, he is post-doctoral researcher and research group leader at the Institute for Accelerator Science and Electromagnetic Fields, TU Darmstadt. Since 2021, he also works as Research Scientist for Modeling, Simulation, and Optimization of Digital Twins at Siemens AG. His research interests include the development of computational methods for uncertainty quantification, surrogate modeling, and scientific machine learning, for engineering applications.

Pilar Salgado (University of Santiago de Compostela)

Multiphysics simulation of electrical upsetting processes: Focus on modelling and numerical analysis of the electromagnetic submodel

Pilar Salgado is currently Associate Professor in the Department of Applied Mathematics at the University of Santiago de Compostela (Spain) and a researcher affiliated to the Galician Centre for Mathematical Research and Technology (CITMAga). From the beginning of her career her research has focused on the mathematical and numerical analysis of systems of partial differential equations mainly related to low-frequency electromagnetism. Her main contributions in this field are pioneer works related to the numerical analysis of magnetic field/scalar magnetic potential formulations for eddy current problems, theoretical support for eddy current models with electric ports, innovative strategies to accelerate the transient solution of periodic electromagnetic problems and development of advanced modeling techniques for multiphysics processes. The results obtained have been applied in various fields such as metallurgy (induction heating, forging, electrical arc furnaces), automotive industry (electromagnetic forming) and electrical machines. She has intensively participated in numerous technology transfer contracts related to the numerical simulation of industrial problems in metallurgy and electrical engineering with a wide range of companies: Ferrooatlántica R&D (now part of the FerroGlobe Group), Robert Bosch GmbH (Germany), ABB Power Grids Spain S.A.U., Altair Engineering France, Taranis Energy and Cie Galfor (Cie Automotive Group). She has also contributed to the development of the registered software MaxFEM and THESIF. She is co-author of the book "Mathematical models and numerical simulation in electromagnetism" (Springer) focused on modelling and numerical simulation in electromagnetism. She has been member of the organizing committee of several international research activities: 19th European Conference European Conference on Numerical Mathematics and Advanced Applications (ENUMATH 2005), the Workshop on Numerical and Electromagnetics and Industrial Applications (NELIA 2011) and the 19th European Conference on Mathematics for Industry (ECMI 2016).

Benoît Vanderheyden (Université de Liège)

Finite element models for type-II superconductors: constitutive laws and formulations

Benoît Vanderheyden was born in Belgium in 1969. He received the B.Sc. degree in electrical engineering (physical electronics) from the University of Liège, Belgium, in 1992. He received the M.Sc. and Ph.D. degrees in nuclear physics from the University of Illinois at Urbana-Champaign, IL, USA, in 1994 and 1998, respectively. From 1998 to 2000, he was a postdoctoral fellow at the Niels Bohr Institute, Copenhagen, Denmark. In 2000, he joined the Department of Electrical Engineering and Computer Science of the University of Liège, where he is currently a Full Professor. His current research interests include the numerical and physical modeling of superconductors and magnetic materials, in view of electrical engineering applications such as high-field magnets and magnetic shielding.

Christoph Winkelmann (ABB Switzerland Corporate Research)

Modelling, methods development and scientific computing at ABB

Christoph Winkelmann obtained his MSc in computational science and engineering from ETH Zürich (CH) in 2004, and his PhD in numerical mathematics from EPFL Lausanne (CH) in 2007. From 2008-2013 he worked at Philip Morris International R&D in Neuchâtel (CH) on the development of physical models, mathematical models and numerical methods for, and on their application to the simulation of aerosol formation, transport, evolution and filtration in tobacco products. From 2013-2016 he was a scientific software developer in a joint project between ABB Corporate Research and ETH Zürich on a high resolution simulation tool for power devices, focusing on magneto-hydrodynamic simulations of switching arcs and adaptive mesh refinement for electro-thermal applications. Since 2017, he has been a research scientist at ABB Corporate Research Switzerland in Baden-Dättwil (CH), in charge of maintaining and improving tailored simulation solutions for ABB-specific applications. Since 2018, he has been leading the development of the ABB arc simulation platform.

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