Plenary presentations

Keynote Lecture -1
Thermal Management Simulations within Power Engineering at ABB
Prof. Rebei Bel Fdhila, ……..... 0zz

Keynote Lecture -2
Modelling and Simulation of the Electric Arc Furnace Processes
Assistant Professor Vito Logar…….....…. 0zz

Keynote Lecture -3
Situation Awareness and Early Recognition of Traffic Maneuvers
Dr Galia Weidl .....…..... 0zz

Keynote Lecture -4
Simulating the Composition of the Atmosphere
Adjunct Professor Harri Kokkola …….....0zz

Keynote Lecture -5
Using the Power of Simulation to bring Bottom Line Benefits to the Mining, Minerals and Metals Operations
Roy Calder, …….....0zz

Keynote Lecture -6
Online Simulation Platform for Biophotonic Applications
Dr Alexey Popov ….....….....0zz

Plenary 1

Thermal Management Simulations within Power Engineering at ABB

Prof. Rebei Bel Fdhila

ABB Corporate Research
Sweden
Email: rebei.bel_fdhila@se.abb.com

The area of thermal management is driven by miniaturization in industry e.g. power electronics, motors or transformers. It is a natural response to size restrictions as in automotive and robotics, to space excessive costs e.g. offshore applications or simply to industrial or comfort requirements. Besides that, unceasing market and technology demand for higher currents, higher voltages or higher power is inevitably leading to a substantial power density increase justifying large losses and generating important amounts of heat. Confined electrical systems, enclosures containing electrical components and other apparatus and devices can generate a lot of heat able to significantly reduce the life time of an installation if no appropriate thermal solutions were adopted. Cooling is also needed to provide the appropriate process or product quality with minimizing energy consumption and environmental impact. An ever-increasing power density drives the need for more effective thermal management solutions where several phenomena e.g. electromagnetic, thermal and/or mechanical can be simultaneously taken into account. ABB is a leading company within power and automation technologies and to maintain its product quality and market penetration has always invested in acquiring state-of-the-art hardware and software tools to cope with its technology needs and ambitions. We are also building our own integrated multiphysics simulation methods able to develop accurate thermal solutions that account for the major interacting physical phenomena. This presentation can introduce you to our know-how in terms of numerical predictions of coupled systems and will also provide you with several examples of solutions where advanced simulations have been used.

Biography

Rebei Bel Fdhila (male), Adjunct Professor in Process Modelling and Computational Fluid Dynamics at Mälardalen University since 2006. Got a PhD in 1991 from the National Polytechnic Institute of Toulouse, France “INP Toulouse/ENSEEIHT” within multiphase flows and worked as a post-doc with EDF and CNRS in France followed by Twenty University in Holland. Since 1995 he joined ABB Corporate Research in Sweden first as a researcher and today acting in his global role as a Corporate Research Fellow in Thermal Management. He has a large experience within the advanced modeling and simulation world. 30+ publications and 9 active patent families.

Plenary 2

Modelling and Simulation of the Electric Arc Furnace Processes

Assistant Professor Vito Logar

Laboratory of Modelling, Simulation and Control,
Faculty of Electrical Engineering, University of Ljubjana, Slovenia

Email: vito.logar@fe.uni-lj.si

Current market demands on steel quality, price and production times dictate the introduction of several technological innovations regarding the electric arc furnace (EAF) steelmaking. One of the fields, which is rapidly developing and has significant potential is related to the advanced software support of the EAF operation, which combines data acquisition, advanced monitoring and proper control of the EAF. This paper briefly presents the idea and development of all key EAF-process models, which are together with measured EAF data used to estimate the unmeasured process values. The models are based on fundamental physical laws and are implemented mainly using nonlinear, time-variant ordinary differential equations. The validation results that were performed using operational EAF measurements indicate high levels of estimation accuracy and the final outcome of the study results in a fully operational EAF model, describing all crucial steel-recycling processes. The accuracy of the presented models is in the range of +/- 15 K for steel temperature and +/-10 % for steel composition. Therefore, the versatility and accuracy of the models allows the usage of the models in broader software environments in a form of soft sensors for process monitoring, process optimization and operator decision support.

Biography

Vito Logar is an Assistant Professor at the Faculty of Electrical Engineering, Univ. of Ljubljana. He is working on the described area for many years in several projects. So his research interests include modelling and optimization techniques regarding the electric arc furnace steel recycling processes. In 2013 he received the award for outstanding scientific achievement for the year 2011 from the Slovenian Research Agency (ARRS). In 2014 he received the award for outstanding scientific and pedagogic achievements from the University of Ljubljana. He is currently also the president of the Slovenian society for modelling and simulation SLOSIM.

More info on EAF modelling and simulation: EAF Simulator: http://msc.fe.uni-lj.si/eaf.asp
More info on the research: ResearchGate: https://www.researchgate.net/profile/Vito_Logar

Plenary 3

Situation Awareness and Early Recognition of Traffic Maneuvers

Dr Galia Weidl

Daimler AG, Germany

Email: galia_weidl@hotmail.com; galia.weidl@daimler.com

We outline the challenges of situation awareness with the early and accurate recognition of traffic maneuvers and how to assess them. This includes also an overview of the available data and derived situation features, handling of data uncertainties, modelling and the approach for maneuver recognition. An efficient and effective solution, meeting the automotive requirements, is successfully deployed and tested on a prototype car. Test driving results show that earlier recognition of intended maneuver is feasible on average 1 second (and up to 6.72 s) before the actual lane marking crossing. The even earlier maneuver recognition is dependent on the earlier recognition of surrounding vehicles.

Keywords – bayesian networks, massive data streams

Biography

Galia Weidl obtained the MSc.degree in physics and mathematics from St.Petersburg State University, Russia, in 1993, and Fil.Lic. degree in theoretical physics from the University of Stockholm, Sweden, in 1996, and a Tekn.Dr. doctoral degree in process engineering from Mälardalen University, Sweden in 2002. Until 2006 she held a postdoctoral appointment at Stuttgart University, Germany. She has held appointments with the research teams at ABB Sweden (1997-2002), Bosch (2006-2008) and Daimler (since 2008). Her current research topic focuses on Bayesian networks in the area of autonomous driving. Galia Weidl was appointed in June 2015 by the European Commission as invited independent expert for Horizon2020.

Plenary 4

Simulating the Composition of the Atmosphere

Adjunct Professor Harri Kokkola

Atmospheric Research Centre of Eastern, Finland
Finnish Meteorological Institute, Finland.

Email: harri.kokkola@fmi.fi

Climate models are an essential tool when estimating how climate will change in the future. The atmospheric core of these models simulates the circulation of the atmosphere by solving fundamental physical equations of conservation of motion, mass, and energy as well as the equation of state. However, climate is affected also by several other processes than the atmospheric circulation and to get an accurate projection of future climate, it is necessary to incorporate all these processes in the model. Such processes include cloud formation (warm clouds, ice clouds), cryosphere (ice/snow), land surface (soil, reflectance), biosphere (ecosystems, agriculture), ocean (heat transport). These processes are calculated with individual submodels which are coupled to the core atmospheric model and they are also coupled to each other so that they interact. However, machine learning methods and emulator techniques are emerging in the climate science. We have investigated the potential of these methods to decrease the error coming from simplifications of aerosol processes in global aerosol models. Our results show that machine learning methods can significantly increase the accuracy of coarse aerosol models without significantly increasing their computational burden.

Biography

Harri Kokkola is the group leader of Atmospheric Modeling group at the Research Centre of Eastern Finland, Finnish Meteorological Institute. He is working on atmospheric modeling and aerosol-cloud interactions. The main focus in his research is global scale aerosol-climate modeling and has been one of the main developers of the aerosol-chemistry-climate model ECHAMHAMMOZ. His research group has developed an aerosol microphysics module SALSA which has been implemented in a cloud scale model, an air quality model as well as regional and global climate models. They are also actively involved in AeroCom project which is an open international initiative of scientists interested in the advancement of the understanding of the global aerosol and its impact on climate.

Plenary 5

Using the Power of Simulation to bring Bottom Line Benefits to the Mining, Minerals and Metals Operations

Roy Calder

Director, Technical Sales, Global Solutions
SimSci by Schneider Electric, Warrington, United Kingdom

Email: roy.calder@schneider-electric.com

While today's economic climate for the Mining, Metals and Minerals (MMM) industries may not be at its best; the industry is still faced with the need to deliver products cost effectively, at the correct specification, while maintaining a high level of safety for the plant and the personnel. For many years the MMM industry has lagged behind the Hydrocarbon Processing Industry (HPI) with regard the use of Simulation, however as the level of investment has grown over the years the need to ensure cost effective design, allied to improvements in delivery time the use of Simulation has become an integral part of the design, construction and commissioning of new plants across the globe. One area Simulation applications are proving themselves is in the area of Operational Safety. The HPI has long used Simulation based Operator Training Simulators to ensure safe operations and this is being carried over with increasing uptake happening in the MMM industry. In the future as the MMM industry becomes increasingly sophisticated at the same time facing the difficulties of shrinking bottom lines it is clear that Simulation will become fundamental in delivering the tools and solutions that will enable the industry to ensure growth in its bottom line in years to come. Schneider-Electric has had a long history in the MMM industry and this paper will highlight how the acquisition of Invensys has brought a completely new perspective to the industry and, most importantly, allows MMM companies to grow their Bottom Line.

Biography

BSc in Chemical Engineering, 1984, University of Strathclyde, Glasgow, then wide ranging industrial experience as: 1) in South Africa as a Metallurgist on Westonaria Gold mine, 2) SASOL in Rosebank as a Process Engineer, 3) L'Air Liquide, 4) INHER SA as Divisional Head, Process Engineering in 1991, where he managed the SULZER Chemtech Agency delivering process plant in multiple industries, 5) Process Sales Director, BHR, UK, 6) SimSci Division of INVENSYS, now Schneider-Electric. Currently Director of Technical Sales, SimSci regional team, 80 strong, on Simulation in engineering and operations community of industries as varied as Oil Production, gold and coal mining and the power industry. The team directly serve the EURA (Europe, Russia and Africa) activities of SimSci. Written numerous papers and presented at World Petroleum Congress, ERTC, SAICHE, AICHE, IChemE & DECHEMA events as well as numerous industrial symposiums. He is joint holder of a patent on the application of Structured Packing in Wax Separation.
He is devoted to Rugby, though no longer playing, and heads the Mini and Junior Section of his local club of some 300 budding young players.

Plenary 6

Online Simulation Platform for Biophotonic Applications

Alexey Popov [1] , Alexander Bykov [1] , Alexander Doronin [2] , Hannu Sorvoja, and Igor Meglinski [1]

[1] Optoelectronics and Measurement Techniques Laboratory, University of Oulu, Oulu, Finland
[2] Computer Graphics Group, Department of Computer Science, Yale University, New Haven, USA

Email: popov@ee.oulu.fi

Currently optical methods are gaining ground for biomedical applications such as cancer and cardiovascular diagnostics, dermatology, ophthalmology, pharmaceutical research, cosmetics and healthcare industry. Benefits of optical techniques are their non-invasiveness, ability for remote monitoring and access to biological objects from cell to body level, to name a few.

The light irradiation dose, measurement volume, sensitivity of optical modalities are of crucial importance in biomedical diagnostics before implementing the developed techniques in in vivo research and clinical trials. An essential part of the preliminary studies is the use of phantoms and simulations for the optimal configuration of the setup and refining the measurement procedure. Up to now, such simulations were performed in every lab using own codes and local resources.

We report about the next step in the computational diagnostics, an online computational platform for the needs of biomedical optics and biophotonics. The platform serves as a tool for calculation of a sampling volume, fluence rate, skin spectrum, skin colour, and a number of optical techniques including optical coherence tomography, polarization, coherent backscattering, pulse oxymetry, confocal microscopy, fluorescence, and diffuse wave spectroscopy.

We used the inheritance feature of Object-oriented programming (OOP) to create a 'smart' hierarchical structure of the Monte Carlo (MC) code to avoid having multiple classes for similar tasks. The hierarchy allows 'allied' objects to share variables and members, significantly reducing the amount of source code and paving the way to extend and generalize the MC. Depending on the application, objects can be tuned to an appropriate state of light-tissue interaction and to a particular optical diagnostic technique.

To achieve optical simulation performance, we employed a developed parallel computing framework known as Compute Unified Device Architecture (CUDA), introduced by the NVIDIA Corporation. Specially designed for professional 3D graphics applications, this technology allows each graphic chip to be logically divided into hundreds of cores, turning the graphics processing unit into a massive co-processor for parallel computations. This capability enables the simulation of thousands of objects, i.e. the simultaneous propagation of photons in the medium - that speeds the process of simulation up to 103 times.

The computational solution utilizes recent developments in HyperText Markup Language (HTML) 5, accelerated by the graphics processing units (GPUs), and therefore is convenient for the practical use at the most of modern computer-based devices and operating systems. Figure 1 shows the interactive user interface for selecting a particular MC application. The results of imitation of human skin reflectance spectra and the corresponding skin colors are presented in Figure 2.

The platform can ease research in a number of areas and can be used for professional and educational purposes.

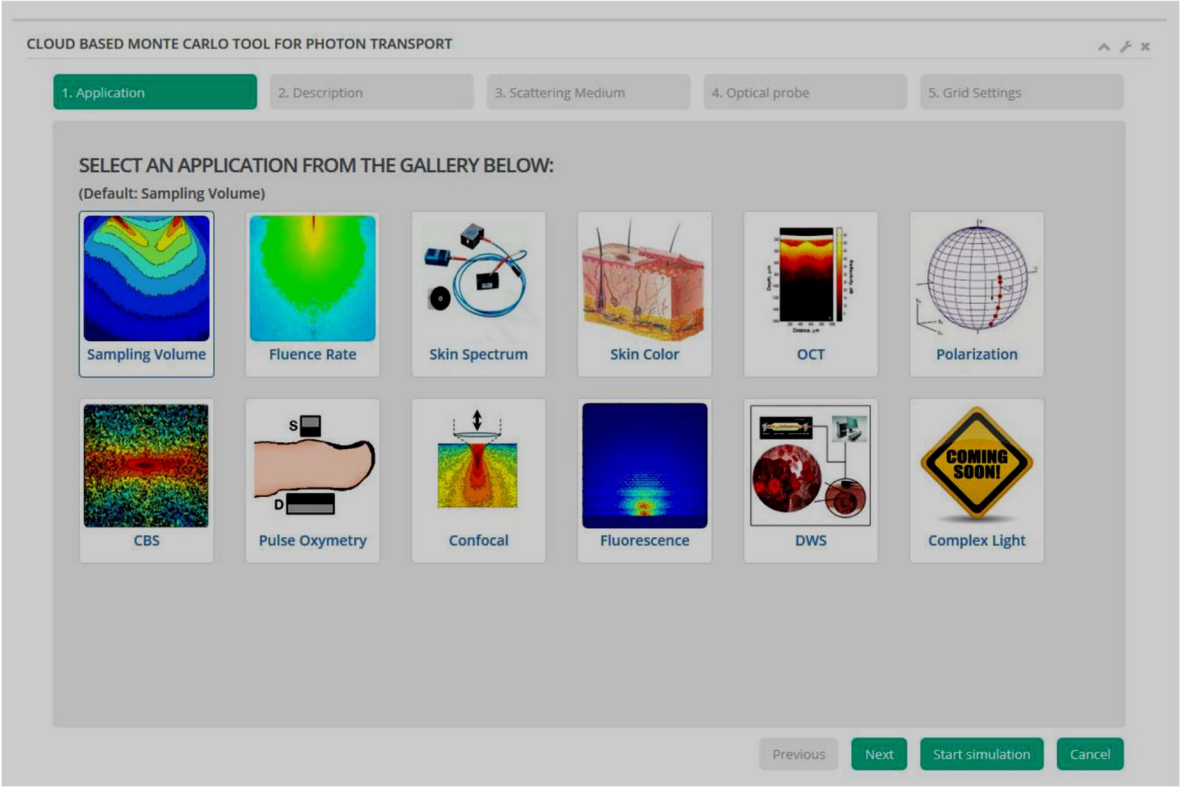

Figure 1. A variety of options offered by the online platform (www.biophotonics.fi).

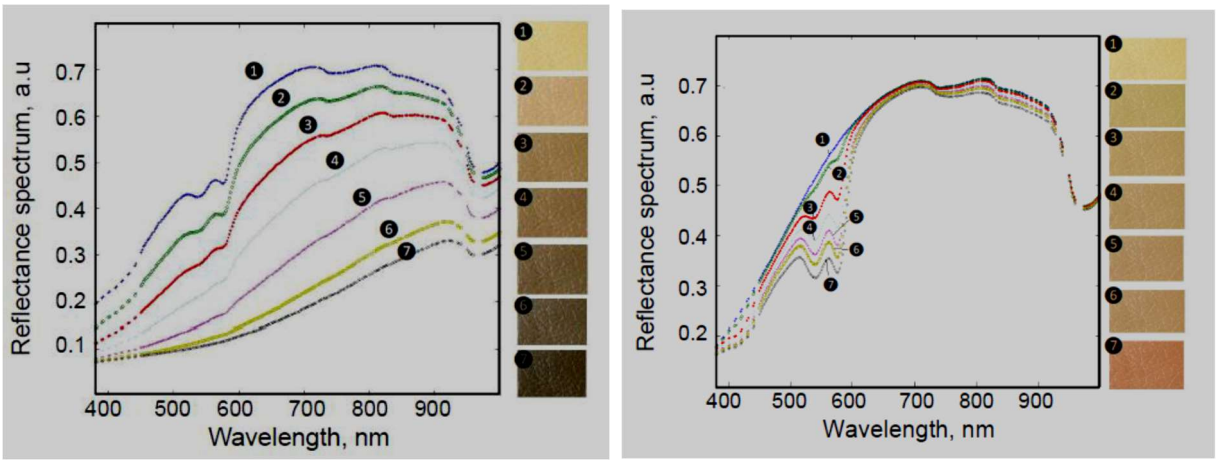

Figure 2. Results of MC simulations of human skin spectra and corresponsing colors while varying the melanin content in living epidermis (left): (1) – 0%, (2) – 2%, (3) – 5%, (4) – 10%, (5) – 20%, (6) – 35%, (7) – 45%; and while varying the blood concentration (right) in the layers from papillary dermis to subcutaneousl tissue: (1) – 0%, (2) – 2%, (3) – 5%, (4) – 10%, (5) – 20%, (6) – 35%, (7) – 45%, respectively.

References:

1. A. Doronin and I. Meglinski. Online object oriented Monte Carlo computational tool for the needs of biomedical optics, Biomed. Opt. Express 2(9): 2461-2469, 2011.
2. A. Doronin, H. Rushmeier, I. Meglinski, and A. Bykov. Cloud-based Monte Carlo modelling BSSRDF for the rendering of human skin appearance. In Proc. SPIE 9719, Biophysics, Biology, and Biophotonics: the Crossroads, 97190F, 2016. doi:10.1117/12.2214512.

Biographies of the authors

Alexey Popov, D.Sc. (Tech.) is a Senior Researcher and Docent in Optoelectronics and Measurement Techniques Laboratory at the University of Oulu, Finland. He graduated from the Physics Department of M.V. Lomonosov State University (Russia) with M.Sc. degree in 2003 and was awarded with PhD degree in 2006. He received his D.Sc. (Tech.) degree from the Faculty of Technology of the University of Oulu (Finland) in 2008. He is an author of 90 papers in international peer reviewed journals and SPIE proceedings and ca. 100 presentations at major international conferences, symposia and workshops including 15 invited lectures. Currently, he is a Senior Researcher and Docent in the Optoelectronics and Measurement Techniques Laboratory at the University of Oulu; a member of SPIE and a Faculty Advisor of the SPIE Student Chapter of the University of Oulu, Northernmost and 1st in Finland.

Alexander Bykov, Ph.D. (Phys.) and D.Sc. (Tech.), born in 1981, is curently a Postdoctoral Researcher at the Optoelectronics and Measurement Techniques Laboratory, University of Oulu. He has over ten-year experience in research in the fields of photonics and biomedical optics. He received M.Sc. diploma in Physics at the M.V. Lomonosov Moscow State University in 2005 and Ph.D. in 2008 from the same university. In 2010, he received D.Sc.(Tech.) degree from the Faculty of Technology at the University of Oulu and continued as a postdoctoral researcher at the Optoelectronics and Measurement techniques laboratory. He is an author and co-author of over 60 scientific papers published in refereed international journals and book chapters, cosupervisor of undergraduate and postgraduate students.

Alexander Doronin is a Postdoctoral Associate in Computer Science working in Computer Graphics Group, Yale University, USA. His research interests are interdisciplinary and lie at the interface between Computer Science, Physics, Optics and Biophotonics focusing on Physically-Based Rendering, Development of realistic material models, Monte Carlo modeling of light transport in turbid media, Color Perception, Translucency, Appearance and Biomedical Visualization.

Hannu Sorvoja, D.Sc. (Tech.), born in 1966, is currently a Laboratory Manager at the Optoelectronics and Measurement Techniques Unit, University of Oulu. He has over twenty-year experience in research in the fields of biomedical engineering. He received M.Sc.(Tech.) in Electrical Engineering 1993, Lic.Sc.(Tech.) in 1998, and D.Sc.(Tech.) 2006, all from the Faculty of Technology at the University of Oulu, and continued as a professor and a postdoctoral researcher. He is an author and co-author over 40 scientific papers published in refereed international journals or conferences and three patents. In addition, he has supervised over 30 M.Sc.(Tech.) and Lic.Sc.(Tech.) theses.

Professor Igor Meglinski, Ph.D. is Head of Optoelectronics and Measurement Techniques Laboratory, Faculty of Information Technology and Electrical Engineering, University of Oulu. He has over 20 years experience in biomedical optics, biomedical engineering, medical physics, and sensor technologies. He is an author and coauthor of over 200 research papers in the peer reviewed scientific journals, proceedings of international conferences and book chapters, and over 400 presentations at the major international conferences and symposia, including over 200 invited lectures and plenary talks. His research interests lie at the interface between physics, medicine, and biological sciences, focusing on the development of new non-invasive imaging/diagnostic techniques and their application in medicine and biology, material sciences, pharmacy, food, environmental monitoring, and health care industries. For the last ten years, he has been a Principal Investigator and/or Coordinator for over 60 research projects, supported by various funding bodies, including UK NHS trust, NATO, Royal Society, U.S. CRDF, New Zealand Ministry of Business, Innovation & Employment, Maurice Wilkins Centre (MWC), New Zealand Ministry of Foreign Affairs and Trade, A*STAR (Singapore), Federal Agency for Science and Innovations (Russia), Weizmann Institute of Science (Israel) and industrial partners including Procter & Gamble, Philips, General Electrics, Unilever and other (with a total cumulative budget of over $16M). Prof. Meglinski is a Fellow of the Institute of Physics (London, UK) and Fellow of SPIE.