Zooming into the Near-Field

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The near-field analysis in small-scale device modelling is notoriously complicated and often a major source for instability and inaccuracy of the numerical results. In this connection often experts talk about alienating concepts such as hyper singularities, ill-conditionedness, regularization techniques, renormalization and conditioning of algorithms. Exactly three decades ago I was confronted with the near-field problem for the first time when I got involved in an industry-related challenging engineering project. Since then I have been looking at the cause of this problem by investigating various phenomena in the fields of electromagnetic radiation, scattering, interference and crosstalk, acoustic wave excitation and propagation, and in the last decade photonics, quantum optics and quantum electrodynamics. In the course of these investigations commonalities were discovered and various practical strategies were proposed to resolve problems associated with the near-field calculations. Noteworthy are the reduction of the so-called “interaction elements” to “self-action elements” and the development of the so-called Universal Functions. However, only recently (October 2008) I was able to find the missing link and fully grasp what is computationally going on in the near-field: The computations can now be carried out easily, confidently and systematically. A book with the title of this short course is scheduled to go to the print later this year/early next year. In this short course the highlights of the underlying theory will be presented logically and coherently. You will be introduced to a few simple but carefully and consistently designed concepts which will allow you to answer a myriad of challenging questions in connection with the near-field phenomena. After briefly discussing the way how the near-field is commonly accounted for in the finite element method, boundary element method, and conservative finite difference method, the following topics will be covered: a recipe for the diagonalisation of the equations in mathematical physics, the calculation of the interaction and self-action elements, construction of Green’s functions and Universal functions, 2D and 3D electrostatic fields, 2D and 3D electromagnetic fields, and 2D and 3D acoustic and piezoelectric fields. Thereby, a unified symbolic form will be introduced to automatically calculate the near-fields in various field types. Numerous examples shall make this course a rewarding experience to the novice as well as experts. A comprehensive manuscript will be made available to the course participants. Come along and experience the joy of zooming into the near-field!

The short bio of the course instructor:

The instructor is currently Professor of Electronic and Computational Engineering at the Royal Melbourne Institute of Technology (RMIT) University, School of Electrical and Computational Engineering, Melbourne, Australia. He is Head of the Discipline Electronic and Biomedical Engineering. During 2007-2008 he was Director of the Electronics program at The Sir Laurence Wackett Centre, Melbourne. He received his MSc and PhD (both in Telecommunication Engineering), and DSc (Doctor of Science in Physical Electronics) in 1984, 1987 and 1994, respectively, from Vienna University of Technology, Austria. In 2003 he was awarded DSc (Doctor of Science in Quantum Electronics and Materials Science) from Helsinki University of Technology Finland. Prior to joining the RMIT in March 2005 he was 1979-2005 with Vienna University of Technology: Associate Professor (1997-2005); Assistant Professor (1994-1997); Research Assistant (1984-1994); Research Associate (1979-1983). He has extensive experience both in academia and industry on four continents: Since 2004 he has been a Principal Engineering Consultant to EPCOS, Germany. He was Visiting Professor at Helsinki University of Technology for one-and-a-half year (1999, 2000, 2004, and 2009). In 2000 he was awarded a Nokia Fellowship. Furthermore, he has been Visiting Professor at the Institute of high Performance Computing, and a Senior Member of the Institute for Mathematical Sciences, in Singapore for 4 months (2003) – He was awarded three time the prestigious Kurt Gödel Fellowship enabling him to serve at the University of California Irvine USA for a total of 10 months (1990, 1991, 1992) - Adjunct Professor in the Department

of Statistics and Mathematics, Arizona State University, USA (1995-2004) - Principal Engineering Consultant with Motorola in Arizona USA – Principal Engineering Consultant with CTS Wireless Technologies in Albuquerque, USA (1994-1999) - Principal Engineering Consultant with Siemens Matsushita, Austria (1990-1994) - Consultant with Siemens in Germany (1983-1990). He is a senior member of the IEEE, an honorary member and a Fellow of The Electromagnetics Academy (EMA), Massachusetts, and is listed in Who's Who in EMA. He is also listed in Marquise Who's Who in the World 2009 (26th Edition). He has more than 150 publications in refereed journals and conference proceedings and is the owner of one patent in USA. Since 1994 he has instructed 18 very well received short courses at the IEEE-sponsored international conferences. He has given more than 60 invited presentations worldwide. He is on the roster of experts for United Nations. Since 1997 he has been an associate Editor for IEEE UFFC Transactions. In 2005 and 2007 he served as IEEE UFFC Transactions guest editor for two special issues on modeling, simulation, design, and optimization of micro-acoustic devices. Since 1984 he has continuously secured governments and industrial sponsored grants for pursuing cutting edge physics-based fundamental research.