

Short Course „The ABC of Small Antennas“ at EuCAP 2011, Rome

1. Course header

1a. Course title

The ABC of small antennas

1b. Course type

Full day (two half-days)

1c. Contact person

Professor Dr. Matthias Hein

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2. Course description

2a. Who should attend and why (short abstract)

This short course addresses young engineering scientists with a research interest in antennas as well as advanced antenna engineers. The short course includes both tutorial sections and presentations of latest results in antenna research and development.

Small antennas are of utmost relevance for such diverse applications as communications, navigation, sensing, and biomedical diagnostics. Antenna engineers are more and more experiencing the conflict between small form factors and high performance. This dilemma pertains not only to single electrically small radiating elements (e.g., for sensors) but also to compact arrays (e.g., for smart antennas). In addition, as the operating frequencies reach into the millimeter wave range, further challenges arise due to the small physical size of the antennas.

This short course covers these urgent topics in a comprehensive way through selected and aligned contributions from European experts. Individual radiating elements and array aspects are addressed as well as issues of design and modeling, implementation, characterisation, and application, both for electrically and physically small antennas.

The attendees will be given a unique opportunity to widen their scientific background knowledge and join a lively exchange and discussion of latest developments in this specific and increasingly important field.

2b. Course schedule, topics and names of instructors

Sunday, 10. April: Fundamentals, design strategies, measurements

1400-1420 Overview and introduction (M. Hein, Germany)

1420-1500 Fundamentals of small radiating elements (G. Vandenbosch, Belgium)

1500-1540 Fundamentals of small arrays (Per-Simon Kildal, Sweden)

- 1540-1620 Design strategies for small radiating elements (A. Skrivervik, Switzerland)
- 1620-1640 Coffee Break
- 1640-1720 Measurement of small antennas (Yi Huang, Great Britain)
- 1720-1800 Design strategies and measurement of small antenna arrays (B.K. Lau, Sweden)

Friday, 15. April: Implementation issues and selected applications

- 1400-1440 Applications of small antennas at millimeter waves (Z. Raida, Czech Republic)
- 1440-1520 Integration and characterisation of millimeter wave antennas (T. Zwick, Germany)
- 1520-1600 Applications of physically small and low-profile antennas for personal RFID (M. Polivka, Czech Republic)

2c. Means of instructions

The presentations will be based on animated presentations (data projector). Hardware demonstration using a vector network analyser is an option, depending on the logistical efforts required. The use of a software is not planned.

3. Course instructors (affiliations and short CVs of all lecturers)

Professor Dr. Matthias Hein

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Matthias A. Hein (Member of the German Physical Society from 1987 until 2006, IEEE M'06-SM'06) received his diploma and doctoral degrees with honours from the Bergische Universität Wuppertal, Germany, in 1987 and 1992, respectively. While at the Bergische Universität Wuppertal, he was involved in the research of metal and oxide superconductors for microwave applications, e.g., in mobile communications and satellite systems. In 1999, he received a British Senior Research Fellowship of the EPSRC at the University of Birmingham, Birmingham, U.K. From 1998 until 2001, he headed an interdisciplinary research group of applied physics and electrical engineering, focusing on the microwave engineering of passive microwave devices. Meanwhile, he has authored and coauthored about 340 publications or proceedings, provided more than 30 invited talks and several tutorials at international conferences. He has supervised more than 60 Diploma and Doctoral students and acts as a referee for high-ranking scientific journals and international funding agencies. In 2002, he joined Ilmenau University of Technology as the Head of the RF and Microwave Research Laboratory. In 2010, he rejected a call on the chair for RF techniques at another high-ranking University in Germany. At Ilmenau University of Technology, he presently leads the Institute for Information Technology, formed by eight professors (full chairs) and about 100 scientific researchers. His current research interests concern device, system, and measurement aspects of antennas, high-efficiency amplifiers, and sensors for various applications (<http://www.tu-ilmenau.de/init>).

Prof. dr. ir. Guy A. E. Vandenbosch

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Guy A. E. Vandenbosch was born in Sint-Niklaas, Belgium, on May 4, 1962. He received the M.S. and Ph.D. degrees in Electrical Engineering from the Katholieke Universiteit Leuven, Leuven, Belgium, in 1985 and 1991, respectively.

He was a research and teaching assistant from 1985 to 1991 with the Telecommunications and Microwaves section of the Katholieke Universiteit Leuven, where he worked on the modeling of microstrip antennas with the integral equation technique. From 1991 to 1993, he held a postdoctoral research position at the Katholieke Universiteit Leuven. Since 1993, he has been a Lecturer, and since 2005, a Full Professor at the same university. Guy Vandebosch has taught or teaches courses on "Electrical Engineering, Electronics, and Electrical Energy", "Wireless and Mobile Communications, part Antennas", "Digital Steer- and Measuring Techniques in Physics", and "Electromagnetic Compatibility".

His research interests are in the area of electromagnetic theory, computational electromagnetics, planar antennas and circuits, electromagnetic radiation, electromagnetic compatibility, and bio-electromagnetics. His work has been published in ca. 110 papers in international journals and has been presented in ca. 200 papers at international conferences. Mr. Vandebosch has convened and chaired numerous sessions at many conferences. He was co-chairman of the European Microwave Week 2004 in Amsterdam, and chaired the TPC of the European Microwave Conference within this Week. He was a member of the TPC of the European Microwave Conference in 2005, 2006, 2007, and 2008.

Guy Vandebosch has been a member of the "Management Committees" of the consecutive European COST actions on antennas since 1993, where he is leading the working group on modeling and software for antennas. Within the ACE Network of Excellence of the EU (2004-2007), he was a member of the Executive Board and coordinated the activity on the creation of a European antenna software platform.

Guy Vandebosch is holder of a certificate of the postacademic course in Electro-Magnetic Compatibility at the Technical University Eindhoven, The Netherlands.

Since 2001 he has been President of SITEL, the Belgian Society of Engineers in Telecommunication and Electronics. Since 2008, he is a member of the board of FITCE Belgium, the Belgian branch of the Federation of Telecommunications Engineers of the European Union.

In the period 1999-2004, he was vice-chairman, and in the period 2005-2009 secretary of the IEEE Benelux Chapter on Antennas en Propagation. Currently he holds the position of chairman of this Chapter. In the period 2002-2004 he was secretary of the IEEE Benelux Chapter on EMC.

Professor Jan Carlsson

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Jan Carlsson (IEEE M'98) was born in Sweden, on May 6, 1962. He received the M.S.E.E. and Ph.D. degrees from Chalmers University of Technology, Göteborg, Sweden, in 1986 and 1998, respectively. From 1986 to 1990, he was an EMC-Engineer with Ericsson Radar Electronics AB, Mölndal, Sweden. Currently he is the Head of Research at the Electronics Department at SP Technical Research Institute of Sweden. He is also an Adjunct Professor of Computational Electromagnetics in the Department of Signals and Systems, Chalmers University of Technology. His research is in the area of computation techniques for electromagnetic problems, especially for applications in EMC and antennas. Since 2009 he is assistant centre manager of Chase, Chalmers Antenna Systems VINN EXcellence Centre at Chalmers University of Technology. He is one of the authors of the EMMA Handbook (EMC handbook issued by the Swedish Defence Material Administration). Dr. Carlsson has been a reviewer for several international journals. From 2002-2004 he was the Chairman of the Swedish IEEE EMC Chapter. Dr. Carlsson is a Member of the Swedish National Committee for Radio Science (SNRV), Section E.

Professor Anja Skrivervik

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Anja Skrivervik obtained her electrical engineering degree from Ecole Polytechnique Fédérale de Lausanne in 1986, and her PhD from the same institution in 1992, for which she received the Latsis award. After a stay at the university of Rennes as an invited Research Fellow and two years in the industry, she returned part time to EPFL as an Assistant Professor in 1996, and is now a Professeur Titulaire at this institution. Her teaching activities include courses on microwaves and antennas. Her research activities include electrically small antennas, implantable and on body antennas, multifrequency and ultra wideband antennas, numerical techniques for electromagnetics and microwave and millimeter wave MEMS. She is author or co-author of more than 100 scientific publications.

She is very active in European collaboration and European projects. She is currently the chairperson of the Swiss URSI, the Swiss representative for COST action 297 and a member of the board of the Center for High Speed Wireless Communications of the Swedish Foundation for Strategic Research.

Dr. Yi Huang, FIET, SM-IEEE, CEng

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Dr Yi Huang received BSc in Physics (Wuhan), MSc in Microwave Engineering (Nanjing), and DPhil in Communications and Electromagnetics from the University of Oxford. He has been conducting research in the areas of applied electromagnetics, communications, radar, radio propagation and positioning, and antennas over the past 20 years or so. His experience includes 3 years spent with NRIET (China) as a *Radar Engineer* and various periods with the Universities of Birmingham, Oxford, and Essex as a member of research staff. He worked as a *Research Fellow* at British Telecom Labs. He has published over 200 refereed international journals and conference papers, and is the principal author of *Antennas: from Theory to Practice* which was ranked one of the best-sellers in antenna books by Amazon.com in 2008. Dr Huang has received many research grants from research councils, government agencies (DTI and TSB), charity, EU (FP6) and industry, acted as a consultant to various companies, and served on a number of national and international technical committees (such as the UK Location & Timing KTN, IET, EPSRC, European ACE, and TPC Chair of IEEE WiCom2005 and iWAT2010) and been an Editor/Guest Editor of three international journals. He was an invited speaker at many conferences/workshops (including Oxford Engineering Programmes) and is a Fellow of IEE (now IET), *Senior Member* of IEEE, and the *Leader* of Focus Area D (broadband antennas) of European COST-IC0603. He is now the Head of High Frequency Engineering Group at the University of Liverpool

Associate Professor Buon Kiong Lau

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Buon Kiong Lau (IEEE S'00–M'03–SM'07) received the B.E. degree (with honours) from the University of Western Australia, Crawley, and the Ph.D. degree from Curtin University of Technology, Perth, Australia, in 1998 and 2003, respectively, both in electrical engineering. During 2000–2001, he took a year off from his Ph.D. studies to work as a Research Engineer with Ericsson Research, Kista, Sweden. From 2003 to 2004, he was a Guest Research Fellow at the Department of Signal Processing, Blekinge Institute of Technology, Sweden. Since 2004, he has been with the Department of Electrical and Information Technology, Lund University, Sweden, where he is now an Associate Professor and the Director of Postgraduate Studies. During 2003, 2005 and 2007, he was also a Visiting Researcher at the Department of Applied Mathematics, Hong Kong Polytechnic University, China, the Laboratory

for Information and Decision Systems, Massachusetts Institute of Technology, and Takada Laboratory, Tokyo Institute of Technology, Japan, respectively. His research interests include array signal processing, wireless communication systems, and antennas and propagation.

Dr. Lau is an Associate Editor of the IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION and is an active participant of EU COST Action 2100, where he is the Co-Chair of Subworking Group 2.2 on "Compact Antenna Systems for Terminal." He has been invited on several occasions to present guest/keynote lectures on the topic of compact antenna arrays, including the COST2100 training school on "MIMO: From Theory to Implementation" in 2009 which attracted well over 100 participants. He has also contributed a book chapter on the subject.

Professor Dr. Thomas Zwick

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KIT – Universität des Landes Baden-Württemberg und nationales Großforschungszentrum in der Helmholtz-Gemeinschaft

Thomas Zwick (S'95-M'00-SM'06) received the Dipl.-Ing. (M.S.E.E.) and the Dr.-Ing. (Ph.D.E.E.) degrees from the *Universität Karlsruhe (TH)*, Germany in 1994 and 1999, respectively. From 1994 to 2001 he was research assistant at the *Institut für Höchstfrequenztechnik und Elektronik (IHE)* at the *Universität Karlsruhe (TH)*, Germany. In February 2001 he joined IBM as Research Staff Member at the IBM T. J. Watson Research Center in Yorktown Heights, NY, USA. From October 2004 to September 2007, T. Zwick was with Siemens AG, Lindau, Germany. During this period he managed the RF development team for automotive radars. In October he became appointed as full professor at the Karlsruhe Institute of Technology (KIT), Germany. T. Zwick is director of the *Institut für Hochfrequenztechnik und Elektronik (IHE)* at the KIT.

His research topics include wave propagation, stochastic channel modeling, channel measurement techniques, material measurements, microwave techniques, millimeter wave antenna design, wireless communication and radar system design. He participated as an expert in the European COST231: Evolution of Land Mobile Radio (Including Personal) Communications and COST259: Wireless Flexible Personalized Communications. For the Carl Cranz Series for Scientific Education he served as a lecturer for Wave Propagation. He received the best paper award on the Intern. Symp. on Spread Spectrum Techn. and Appl., ISSSTA 1998. In 2005 he received the Lewis award for outstanding paper at the IEEE International Solid State Circuits Conference. Since 2008 he is president of the Institute for Microwaves and Antennas (IMA). T. Zwick is author or co-author of over 100 technical papers and over 10 patents.

Professor Zbynek Raida

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Zbynek Raida has graduated at Brno University of Technology (BUT), Faculty of Electrical Engineering and Communication (FEEC). Since 1993, he has been with the Dept. of Radio Electronics FEEC BUT. In 1996 and 1997, he was with the Laboratoire de Hyperfréquences, Université Catholique de Louvain, Belgium, working on variational methods of numerical analysis of electromagnetic structures. Since 2006, he has been the head of the Dept. of Radio Electronics.

Zbynek Raida has been working together with his students and colleagues on numerical modeling and optimization of electromagnetic structures, exploitation of artificial neural networks for solving electromagnetic compatibility issues, and the design of special antennas.

Zbynek Raida is member of IEEE Microwave Theory and Techniques Society.

Dr. Milan Polivka

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Milan Polivka received his MSc. and Ph.D. degrees from the Czech Technical University in Prague (CTU) in 1996 and 2003, respectively. He joined the Department of Electromagnetic Field as an assistant professor in the same year. His research interests include RF and microwave antennas, application of artificial electromagnetic materials in antenna technology, and RFID. Dr. Polivka is author or co-author of over 60 technical papers, 2 book chapters, 3 patents, and several utility models.

Milan Polivka is a member of IEEE. He served as MTT/AP/ED/EMC joint chapter chair in 2007-9, since 2010 he has been serving as Czechoslovakia section chair, and IEEE R8 VCF Coordinator.

4. Additional information

The instructors selected for this short course all have a strong international standing in antennas and propagation. All of them are members of the Working Group "Small Antennas" of the European Association for Antennas and Propagation, EurAAP. Accordingly, the short course reflects the state of the art of research in this field and is optimally suited for this European conference.

The majority of instructors has experiences with delivering tutorials and short courses, including presentations at the European Conference on Antennas and Propagation, EuCAP. The constellation of the short course as proposed in this document has not been presented before.