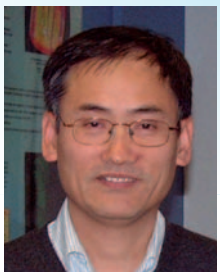
The Royal Academy of Engineering

Distinguished Visiting Fellowship Scheme
Case Study

Dielectric and magnetic measurements



Host:
Professor Wuqiang Yang
The University of Manchester

Distinguished Visitor:
Professor Markus Zahn
Massachusetts Institute of Technology (MIT)
USA

Professor Markus Zahn from Massachusetts Institute of Technology (MIT) in USA visited the UK as a Royal Academy of Engineering Distinguished Visiting Fellow.

Professor Zahn is the Thomas and Gerd Perkins Professor of Electrical Engineering at MIT and Director of the VI-A Internship Program, which is a cooperative program with industry. Following his education at MIT he was appointed as a professor at University of Florida until 1980 when he joined MIT. He currently carries out research into electromagnetic field interactions with materials and devices in the Electromagnetic and Electronic Systems and High Voltage Research laboratory. He is the recipient of numerous awards for excellence in teaching and is a Fellow of IEEE for his 'contributions to the understanding of the effects of space charge and flow electrification on the conduction and breakdown properties of dielectrics.

Professor Zahn's research interests range from electro-optical field and charge mapping measurement, high-voltage charge transport and breakdown phenomena in dielectrics, flow electrification phenomena in electric power apparatus, development of capacitive and inductive sensors for measuring dielectric and conductivity profiles, to the measurement of magnetic as well as related physical properties of media. These research topics were presented at the University of Manchester, Honeywell in Motherwell, and Schlumberger Cambridge Research and Strathclyde University.

Professor Wuqiang Yang is a Chartered Engineer, Fellow of the IET, and Senior Member of IEEE. He received his degrees from Tsinghua University. Since he joined UMIST in 1991, he has been working on industrial process tomography, and specifically on electrical capacitance tomography (ECT). His current research projects include 'Online pharmaceutical granule moisture distribution measurement and feedback control of fluidised bed dryers' supported by EPSRC Follow-on-Fund, University of Manchester Intellectual Property (UMIP) Ltd, GEA Process Engineering, AstraZeneca, and DuPont, 'Quantifying wet-gas liquid production to improve productivity and reservoir management' supported by TSB, Schlumberger Cambridge Research and TUV-NEL, and 'Shoe scanner for homeland security' supported by ICIR and KonsultEurope.

Statement from the Host

"As the Head of School, I am very pleased with the outcome from Professor Zahn's visit. The University of Manchester has the stated ambition to be recognised as one of the world's leading universities by 2015, and as such it is very important for us to connect with those universities, which are clearly already in that category. MIT is the world's foremost engineering university, and we are delighted with the link now established as a result of the visit. Professor Zahn has an established international reputation in the fields of ferrofluid dynamics, dielectrometry, electric insulation and electrical energy conversion. His research closely matches current research activities within this School, and he has been able to interact with several members of our staff. I fully expect that a meaningful collaborative relationship with MIT will now evolve, bringing a significant step in the promotion of our international reputation."

Professor Stephen Williamson DSc, FREng, FIET, FIEEE
Head of School of Electrical and Electronic Engineering

Professor Yang has also been involved in commercialisation of ECT systems, which have been demonstrated on a wide range of challenging applications. He has published 200 papers, and holds 9 patents. For his contribution to the development of ECT technology, he was awarded the 1997 IEE/NPL Wheatstone Measurement Prize, the 1997 Honeywell Prize and the 2000 IEE Ayrton Premium. In 2006, he was granted a Global Research Award from the Royal Academy of Engineering and took his sabbatical leave in the Laboratory for Electromagnetic and Electronic Systems at MIT as a visiting professor.

The University of Manchester was formed in 2004 by merging two research-led universities: The Victoria University of Manchester and UMIST. It is one of the largest universities in the UK and can claim 23 Nobel laureates amongst its current and former staff and students. It was selected "Higher Education Institution of the Year in 2005" by the Times and "University of the Year in 2006" by Sunday Times. The School of Electrical and Electronic Engineering originated from the Department of Electrical Engineering and Electronics at UMIST, which was ranked Grade 5 in the 2001 RAE. The research activities of its staff cover a wide range in electrical and electronic engineering including: (1) Sensing Imaging and Signal Processing, (2) Microwave and Communication Systems, (3) Microelectronics and Nanostructures, (4) Electric Energy and Power Systems, (5) Power Conversion, and (6) Control Systems. Professor Wuqiang Yang is associated with the Sensing Imaging and Signal Processing research group.

Why a visit?

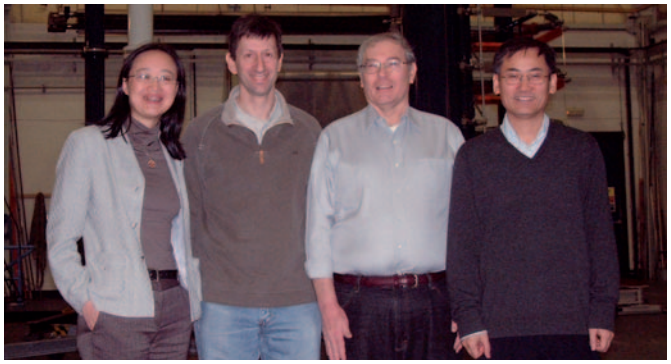
The aim of the visit was to combine Professor Zahn's and Professor Yang's expertise and skills in dielectric and magnetic measurements, and to strengthen links and collaboration between The University of Manchester and MIT. The objectives of the visit were:

- To meet researchers working in similar research areas.
- To find common research interests and to identify collaboration opportunities.
- To disseminate research outcomes.
- To establish a long-term collaborative relationship between The University of Manchester and MIT.

Visit outcomes

Professor Zahn gave three seminars at The University of Manchester:

1. Ferro-hydrodynamic and electro-hydrodynamic flow phenomena.
2. Detection, discrimination, and identification of hidden materials using inter-digital dielectrometry and magnetometry.
3. A model for the initiation and propagation of electrical streamers in transformer oil and transformer oil based nanofluids / Optical, electrical, and electro-mechanical measurement methodologies of electric field, charge, and polarization in dielectrics.



Left to right: Dr Zhongdong Wang, Dr Simon Rowland, Professor Markus Zahn and Professor Wuqiang Yang in the National Grid High Voltage Research Centre

Statement from the Distinguished Visitor

"This Fellowship was a success from technical, social and tourism point of view. I thank The Royal Academy of Engineering for supporting this valuable visit. This Fellowship is the first step towards joint research and collaboration between The University of Manchester and MIT. Because of Professor Yang's careful planning, I met many academics and students and established relationships and plans for future collaborative proposals and research. I am pleased with the opportunities for the discussions with Honeywell in Motherwell and Schlumberger Cambridge Research, which could lead to collaboration with industry. In addition, the social, friendship, and tourism activities that Professor Yang arranged greatly increased my enjoyment of the visit to the UK."

Professor Markus Zahn
Massachusetts Institute of Technology

Professor Zahn also visited Honeywell in Motherwell, Schlumberger Cambridge Research and Strathclyde University, where he gave seminars and took part in discussions about opportunities in collaborative research. With Schlumberger, the aim was to establish a four-corner relationship between The University of Manchester, Schlumberger Cambridge Research, MIT and Schlumberger-Doll Research Center next to MIT, with a suggested topic "Stabilisation of Saffman-Taylor fingering instability using magnetic fluids". With Honeywell in Motherwell, a wide range of possibilities was identified for joint research, especially in the area of capacitance sensors.

Professor Zahn's seminars, lectures, and discussions provided valuable information on the latest developments and research activities at MIT as well as on MIT's cooperation programmes with industry. Professor Zahn was informed of the latest research results at The University of Manchester. Common research interests and complementary skills were identified for future joint research projects.

Future links and collaboration

- With Professor Zahn's involvement, Dr Zhongdong Wang in the Electric Energy and Power Systems Group and Professor Wuqiang Yang are currently working on a proposal entitled 'Vegetable oil with nano-particle suspensions for improved transformer insulation'.
- Work is in progress to identify EPSRC, The Royal Academy of Engineering, the Royal Society and the US Government programmes for supporting joint research between USA and the UK.
- Work is also in progress to identify opportunities for collaboration between The University of Manchester, MIT, Schlumberger and Honeywell.
- During Professor Zahn's visit, a link was established between Professor Zahn, Professor Yang and Professor Mohd Zaid Abdullah, who is an alumnus of UMIST and the Dean of School of Electrical and Electronic Engineering, Universiti Sains Malaysia.

For further information please contact

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