Research Newsletter

The School of Mechanical, Aerospace and Civil Engineering

Issue 3 - Spring 2012

Spotlight on:
• Nuclear Research at Manchester
• Our leading nuclear researchers

In this issue

Page 2  Message from the Head of School
                  Nuclear Research News

Page 3  Spotlight on:
                Nuclear research in the School
                Hall of Fame

Page 5  EDF Collaboration
                Climate change Question Time
                Shale Gas research

Page 6  Grants & Awards

Page 7  The bigger picture
Editorial

This third newsletter again has a strong energy theme. Major new grants are reported on nuclear manufacturing from EPSRC and on graphite moderator bricks from HSE. An important new framework agreement with EDF for the Modelling and Simulation Centre has been signed. The software company CD-ADAPCO is collaborating with the School on computational fluid dynamics.

The leadership of the Bioenergy Supergen Hub is a great achievement for Patricia Thornley of the Tyndall centre. A major grant has also been awarded as part of the Supergen Marine Challenge. Tyndall is also very active in assessing the impact of shale gas for several bodies.

The School will have hosted two major conferences this year: ACME and MATADOR. This is all very healthy. And the Hall of Fame adds to the picture.

On a personal note I am standing down as Head of School on 1st June after three demanding years to concentrate more on marine energy. This is tinged with regret but I hand over to Professor Gibson who has had considerable success in running the School of Electrical and Electronic Engineering and I am sure we will prosper.

Professor Peter Staseny, FREng
Head of School

NUCLEAR GRANTS

New Nuclear Manufacturing (NNUMAN)

A joint project between the universities of Manchester and Sheffield for a New Nuclear Build and Manufacturing (NNUMAN) programme has been awarded £4m funding by the Engineering and Physical Sciences Research Council (EPSRC) to research innovative manufacturing for the future of the UK’s nuclear power supply.

There are three manufacturing research themes: innovative joining methods, advanced machining and near-net-shape manufacture. These will be underpinned by a fourth theme relating manufacturing processes to product performance. The most improved manufacturing processes will be taken forward to prototype in the Nuclear Advanced Manufacturing Research Centre (www.namrc.co.uk) and the National Nuclear Laboratory (www.nnl.co.uk). UK manufacturing companies will be able to apply the new methods by making high quality nuclear components and fuels in a cost-effective manner. At Manchester, the project is led by Professor Michael Burke. Co-investigators from the School of MACE are Prof Bob Ainsworth FRS, Prof Tim Abram, Prof Lin Li and Dr John Francis.

FUSION Doctoral Training Centre

Funded in part by the Research Councils UK Energy Programme, the £2.5M Fusion Doctoral Training Network is a collaboration of Durham, Liverpool, Manchester, Oxford and York universities and government research institutes that integrates postgraduate training in fusion science and technology with related disciplines. Two 4-year studentships per year are available at Manchester.

The network provides world-leading expertise in a range of fusion-relevant disciplines: materials science, plasma physics, nuclear physics, technology, laser physics, instrumentation etc.

Students have access to a range of fusion energy facilities, including the MAST and JET tokamaks at Culham in Oxfordshire, the Central Laser Facility at the Rutherford Appleton Laboratory, and high performance computing facilities. Manchester projects for 2012-13 include: Design with non-ductile metals for fusion power plant components; optimization of creep properties of irradiated vanadium alloys; effects of irradiation damage on mechanical behaviour of first wall materials.

Health and Safety Executive (HSE)

The Health and Safety Executive (HSE) have commissioned a contract worth around £500,000 for ‘the Development of a Mechanically Based Statistical Model for Predicting the Structural Integrity of AGR Graphite Moderator Bricks’ to Dr Graham Hall, Prof Barry Marsden, Prof Paul Mummery and Dr Derek Tsang. This work builds on an existing collaboration of specialist expertise from the Health and Safety Laboratory, The University of Birmingham and The University of Manchester.

Graphite is a primary nuclear component, acting as moderator and major structural component for 90% of the UK’s current nuclear capacity and future international High Temperature gas-cooled Reactors (HTRs).

Further information:

www.namrc.co.uk
www.nnl.co.uk

graham.n.hall@manchester.ac.uk
Ernest Rutherford (1871–1937)

NUCLEAR RESEARCH at Manchester

where it started...

“The energy produced by the breaking down of the atom is a very poor kind of thing. Anyone who expects a source of power from the transformation of these atoms is talking moonshine.”

Ernest Rutherford, 1st Baron Rutherford of Nelson, OM, FRS, 1933

For most people, when they are having a leisurely chat with one of their friends, the topic of conversation will not be quantum theory. However, when Albert Einstein met Niels Bohr in 1925 they actually discussed quantum theory.

In 1912 the same Niels Bohr (1885 – 1962) had met and later joined Ernest Rutherford at the Victoria University of Manchester, where on and off he spent four fruitful years in association with the physics professor.

Nuclear research in the School

Leading nuclear research in a wide variety of specialist areas is currently being carried out in the School. The research is divided into the following expert groups:

• Computational Fluid Dynamics
• Energy and Multiphysics
• Nuclear Graphite
• Reliability, Availability, Maintenance and Safety
• Turbulence Mechanics.

The Dalton Nuclear Institute brings together the full breadth of nuclear research in an interdisciplinary manner, encompassing all nuclear research in the University.

Further information:  http://www.dalton.manchester.ac.uk/

Distinguished Alumni

Professor Yoo Sang CHOO is the Lloyd’s Register Educational Trust Chair Professor in National University of Singapore. He served as the 106th President of The Institute of Marine Engineering Science & Technology (IMarEST), and IMarEST’s first President from Asia. He is presently the President of Society of Naval Architects and Marine Engineers Singapore. Professor Choo graduated from the University of Manchester with B.Sc. First Class Honours in 1977, and was supervised by Professor Michael R. Horne for his M.Sc. and Ph.D. projects. He worked on strength of plate girders subjected to combined loads, and structural behaviour of deep-sea production systems. He then joined VO Offshore (U.K.) as Senior Structural Engineer to design floating and fixed offshore structures. He returned to Singapore in 1984 and worked for McDermott South East Asia on the design, analysis and installation of offshore platforms. He joined the National University of Singapore in 1987, and served as Director of CAE/CAD/CAM Centre from 1995 to 1999.

Further information:  http://www.eng.nus.edu.sg/ civl/people/brevys/fyc.html
OUR NUCLEAR RESEARCHERS

Professor Bob Ainsworth FRS  
Professor of Structural Integrity

Prof Bob Ainsworth is leading the Nuclear Research Group in MACE. After leaving British Energy Generation, he joined The University of Manchester in early 2011. He has worked with Peter Budden of EDF Energy to develop a failure assessment diagram for defect assessment under strain-based loading.

Bob has also been examining the impact of combined primary and secondary loading on creep crack growth. Here, a framework has been developed that allows the relaxation of the secondary loading as a result of both creep straining and crack growth to be calculated.

Dr John Francis  
Senior Lecturer in Welding Technology

John’s research interests focus on welding technologies for power generation and in particular on developing an understanding of the relationship between the choice of welding (or cladding) process, the choice of welding parameters, and the performance of the resulting weld or clad layer when it is in service operation. In nuclear manufacturing, this means developing an understanding of the way in which the design of welded joints influences the development of microstructure, residual stresses (i.e. those that are introduced by the welding process itself) and the tendency for the resulting weld to undergo degradation during service through mechanisms such as stress-corrosion cracking and irradiation embrittlement.

Dr Abbie Jones  
Lecturer in Nuclear Engineering Decommissioning

Dr Abbie Jones’ research specialism is in decommissioning and the treatment of irradiated graphite waste. She is trying to develop an understanding of irradiation damage processes to nuclear graphite and to validate new treatment methods for irradiated nuclear graphite post-closure. She is looking into ways to reduce irradiated graphite waste using treatment methods to remove isotopic content. This includes researching the mechanism of isotope production and isotope removal from irradiated graphite waste for UK decommissioning.

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HSE Professor of Nuclear Materials

Prof Paul Mummery has got a DPhil in Materials Science from the University of Oxford. He left the National Physical Laboratory to join the University of Manchester in 2000 and he was appointed as Professor of Nuclear Materials in October 2011.

Paul’s work has focussed on the relationships between microstructure and mechanical behaviour of materials, primarily fracture. He is particularly interested in the development and application of novel experimental techniques to characterise damage. He is using X-ray tomography to develop microstructurally-faithful models of material behaviour.

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Our PhD student has attended Parliament to present her research

A University of Manchester engineering student has attended Parliament to present her science to a range of politicians and a panel of expert judges.

As part of SET for Britain, Azadeh Dindarian presented her research poster and was judged against dozens of other scientists in the only national competition of its kind.

This work is co-authored by her supervisor, Professor Andrew Gibson, and Dr Joao Quariguasi Frota Neto.

Azadeh was shortlisted from hundreds of applicants to appear in Parliament for her research into electronic waste; specifically the 2.5 million microwaves thrown away every year in the UK.

She found that there is huge potential for the repair and reuse of microwaves - 85% of these could have been easily repaired or were disposed of for cosmetic reasons. Her research also looks at the benefits of re-designing microwave ovens to ensure they have a longer life and can be easily reused.

Further information: john.broderick@manchester.ac.uk

Climate Change Question Time

As part of the Museum Meet programme, the Manchester Museum organised a public meeting with a panel of experts around the theme of Climate Change. The panel included Kevin Anderson, professor of energy and climate change at Tyndall Manchester. Other panellists included Jason Kirby, physical geographer from Liverpool John Moores University; Jonathan Gregory, climate scientist from Reading University; Celine Gemond-Duret, of the Centre for Sustainable Development at the University of Central Lancashire and marine physicist Professor John Huthnance.

Eight other speakers from business, academia, government and campaign groups attended the workshop, each sharing their perspective on main impacts of shale gas extraction and how we should manage them. John was able to expand on the topic further when he was invited to talk to the BBC Radio Lancashire Breakfast Show.

Further information: http://www.tyndall.manchester.ac.uk/

Shale Gas Research

Dr John Broderick, Knowledge Transfer Fellow at Tyndall Manchester, presented recent findings to an audience of MEPs, academics and industry representatives at a workshop of the Committee on the Environment, Public Health and Food Safety at the European Parliament.

Eight other speakers from business, academia, government and campaign groups attended the workshop, each sharing their perspective on main impacts of shale gas extraction and how we should manage them. John was able to expand on the topic further when he was invited to talk to the BBC Radio Lancashire Breakfast Show.

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A collaborative team with academics from the University of Plymouth, the University of Edinburgh, the Scottish Association for Marine Science and led by our own Prof Peter Stansby and his MACE colleagues Dr Tim Stallard, Dr Ben Rogers, Dr David Apsley and Dr Alistair Revell, has been awarded a £1.1 M EPSRC grant to investigate the Extreme Loading of Marine Energy Devices. The team will investigate the extreme loading on tidal turbines and wave energy devices. Numerical methods for predicting extreme loads will be evaluated against experimental studies. The methods evaluated include Edf opensouce CFD software Code SATURNE, the mesh-free numerical method Smooth Particle Hydrodynamics and commercial CFD software Star-CCM. Experimental studies will be conducted at several scales at University of Manchester, the new University of Edinburgh Flowave TT and the new Ocean Basin at University of Plymouth.

A unique aspect of this research project is that it incorporates research into the impact of flotsam and marine mammals and sharks on tidal stream turbines. Finally, the results of the experiments and modelling, including identification of design load cases, will be used for design guidance.

Further information: http://gow.epsrc.ac.uk/NGBOViewGrant.aspx?GrantRef=EP/J010235/1

SUPERGEN BIOENERGY HUB

Bioenergy already provides a significant proportion of the UK’s low carbon energy supply for heat, transport fuel and electricity but there is scope for bioenergy to provide much higher levels of low carbon energy in future. This requires appropriate development of key enabling technologies and strategic management to make the best use of the valuable, but finite, biomass resource. Dr Patricia Thornley, Senior Research Fellow at Tyndall Manchester, has secured £3.5 million from the EPSRC to create a Supergen Bioenergy Hub for the UK. This five year project will bring together industry, academia and other stakeholders to focus on the research and knowledge challenges associated with increasing the contribution of UK bioenergy to meet strategic environmental targets. Therefore the Hub’s focus will be on evaluating the ecological, economic and social aspects of the bioenergy chains being developed.

Further information: www.mace.manchester.ac.uk/aboutus/news/index.html

Go with the flow

CD-ADAPCO, the world’s largest independent C+U-focused provider of engineering simulation software, support and services, has agreed to sponsor a 3-year £360K research project into RANS/LES Modelling & Validation Methods for Aerodynamic and Industrial Flows and Individual Flow. Dr Alistair Revell and his co-investigator Prof Dominique Laurence will be working with a PDRA and a PhD student on this project.

Further information: http://www.mace.manchester.ac.uk/aboutus/staff/academic/profile/index.html?staffId=420

AWARDS

Technology and Innovation AWARDS 2011

Dr Bill Crowther’s group picked up First Prize in the Aerospace category of “The Engineer” magazine’s Technology and Innovation Awards 2011 for their FLAVIIR project. This project was a collaboration between BAE Systems and a number of UK universities.

The FLAVIIR collaboration provided the flapless flight control technologies based on circulation control and fluidic thrust vectoring that enabled the vehicle to fly in “flapless” mode. The work was done by a total of 6 PhD students over a 5 year period. The JAVA demonstrator aircraft that was built by the team and which flew prior to the main DEAMON aircraft (see article in “The Engineer”) is now on permanent display in the Manchester Futures Gallery in the Museum of Science and Industry in Manchester.

Further information: http://digital.centaur.co.uk/theengineer/techawards-2011/

APPOINTMENTS

CIOB Research & Innovation Panel

Dr. Paul W Chan has recently been appointed member of the Research and Innovation Panel of the Chartered Institute of Building (CIOB). The CIOB Research and Innovation Panel has a remit to facilitate dialogue and collaboration between practitioners, researchers, policy makers and education providers to enhance the status of innovation and research within the construction sector. Dr. Chan will serve on this panel for a term of three years.

Further information: www.mace.manchester.ac.uk/aboutus/news/index.html

Research Fellowship from the Sustainable Consumption Institute

Ruth Wood has won a Research Fellowship from the Sustainable Consumption Institute. The fellowship will enable her to continue her research into the impacts of consumption on climate change and explore the sustainable consumption of energy services.

Further information: www.mace.manchester.ac.uk/aboutus/news/index.html

www.tyndall.manchester.ac.uk/projects/resnet/
The 37th International MATADOR Conference will be held in Manchester on 25th – 27th July, 2012. The MATADOR Conference was established in 1959, which makes it one of the longest running conferences in the field of manufacturing. It is a truly international conference, which attracts high quality peer reviewed papers and delegates from countries all over the world. The Proceedings of the MATADOR conferences are published and held in libraries worldwide. The 37th International MATADOR Conference will provide a forum for the presentation and discussion of original contributions to the principles, techniques and applications in the areas of Manufacturing Processes, Technology, Systems Design and Integration, Metrology and Management.

Impact and Blast Effects: Theory, Analysis & Design is a three-day course designed for professional engineers, consultants, researchers and graduate students, who may be involved in analysis, testing, modelling, design and the assessment of structures against impact and blast loads. It will cover basic and theoretical concepts, analytical, modelling and design methods and practical applications for structural protection against impact and blast effects.

Turbulence Modelling is a three-day course which will address the modern approaches to the subject of turbulence modelling. The uses of different turbulence models and their applications to the solution of industrial problems including; external and internal aerodynamics, heat transfer, combustion and aero-acoustics.

Around 40 academic researchers and practitioners working in the field of airport operations gathered at the Concorde Centre (Manchester Airport Runway Visitor Centre) on 1 and 2 February 2012 to discuss progress made in a suite of EPSRC-funded research projects aimed at improving the efficiency of airport operations. Entitled “Searching for Impacts”, the meeting sought to identify possibilities for exploiting early findings derived from these projects. Researchers in MACE are involved with a collaborative project with Cambridge University and University College London to examine how investment decisions made by airport operators can be enhanced to account for sustainability (see EP/H004505/1).

Four invited plenary lectures were given by:
- Prof Guirong Liu from Cincinnati, USA on smoothed finite element methods,
- Associate Prof Chongmin Song from Sydney, Australia on scale boundary finite element method,
- Prof Kenneth Morgan from Swansea, UK on adaptive remeshing of CFD problems,
- Prof Rene de Borst from Glasgow, UK on multiscale fracture modelling.

A total of 88 papers are published in the conference proceedings.

Four best paper awards were presented to young researchers. Prof Carlo Sansour, the President of UK ACME, commented that “the meeting was a great success”.

The Management of Projects Expert Group has organised a research seminar entitled “Building Cultural Alliances in Projects” in the Staff House on Thursday 17 May 2012. This seminar was funded under the auspices of the Economic and Social Research Council (ESRC) Research Seminars Competition. The focus of this seminar was to explore the practices, politics and positions taken when building a cultural identity in collaborative projects.
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