

**Institution: Brunel University**

**Unit of Assessment: 10 Mathematical Sciences**

**a. Overview**

With its location to the west of London providing easy access to arterial transport routes, and with its attractive modern self-contained campus, Brunel University presents as an ideal hub for national and international research activity. Within this setting the Department of Mathematical Sciences thrives, forming a flourishing, research focused component of the School of Information Systems, Computing and Mathematics (SISCM).

Since 2008, the 26 members of staff contributing to this UOA have published, or had accepted for publication, 366 distinct refereed papers in over 150 leading journals. These articles have a total (Scopus) citation count of 1130 (3.1 citations per paper) and the average journal impact factor per paper is 1.10. In particular, the 100 papers submitted for this UOA have a total (Scopus) citation count of 419 (4.19 citations per paper) and an average journal impact factor per paper of 1.95.

During the REF period, the average number of research students within the Department was 59 per year, which equates to 2.5 students per FTE staff member. The Department graduated a total of 47 (see REF 4A) doctoral students, (an average of 9.4 per year) which equates to 1.81 students per FTE staff member over the REF period. The Department is a partner in 2 EPSRC funded doctoral training projects. NATCOR (National Taught Course Centre in Operational Research) provides advanced training in the Mathematics underpinning Operational Research. A residential module on Convex Optimisation was developed for NATCOR by Brunel staff and is regularly delivered. LTCC (London Taught Course Centre) provides advanced training for research students in Mathematics and Statistics. In 2012-2013, 3 of the courses offered were taught by Brunel staff.

The declared research expenditure for the period 2008-2013, as reported in REF4b/c, is £2229k: £1774k (80%) from UK research councils; £150k (7%) from EU government bodies. The Department also had 8 EPSRC doctoral studentships. The total value of the research grants awarded (including DTGs) was £3.1 million.

Research within the Department falls naturally into 3 broad areas and staff belong to the corresponding groups. The Departmental Vision is to be a world-class unit with all 3 research groups continuing their high quality fundamental research, embracing interdisciplinary collaboration and further expanding their international impact. With these aims in mind, there is particular focus towards increasing collaborations and connections between the groups, with eminent external scholars/groups and with industry.

The **Computational and Applied Mathematics (CAM)** group (Lawrie, Maischak, Mikhailov, Nolde, Pichugin, Rawlins, Shaw, Whiteman, Winter) takes problems of real biological or engineering importance and investigate the underlying mathematical and phenomenological processes. There is a strong emphasis on the development of innovative analytic, asymptotic, computational and hybrid methods. The diverse applications considered by the group include problems from acoustics, elastic and electromagnetic wave propagation as well as the modelling of viscoelasticity, fracture, damage and fatigue in solids. Another focus is the theory of finite and boundary element methods and their applications to problems involving differential, integral and integro-differential equations. This includes error analysis and the development of both robust algorithms and specialised software for problems in solid mechanics.

The **Finance, Operational Research and Statistics (FORS)** group (Beasley, Brody, Date, Hughston, Lucas, Mladenovic, Roman, Vinciotti, Yu) develops and applies advanced mathematical, probabilistic and optimisation approaches to problems in Financial Mathematics (FM), operational research (OR) and applied statistics (AS). Within FM such problems include asset/derivative pricing, enhanced indexation, exchange-traded funds, index tracking and portfolio optimisation. In AS there is particular strength in quantile regression and its application in

**Environment template (REF5)**

bioscience and other areas. OR activities are driven by a range of applications and typically include the analysis of combinatorial optimisation problems which are formulated as linear, quadratic, integer or mixed-integer programs and solved using both metaheuristic and exact approaches. Significant contributions have been made here with respect to variable neighbourhood search (Mladenovic) and quantile regression (Yu).

The **Mathematical Physics and Combinatorics (MPC)** group (Brody, Hall, Krasikov, Meier, Noble, Rodgers, Savin, Smolyarenko, Virmani) specialises in the rigorous analysis of mathematical models arising in the natural/physical sciences. Research is carried out at the intersection of algebraic geometry and quantum theory, in quantum information theory, random matrix theory and its applications, and the dynamics of complex networks. There are complementary strengths in graph and matroid polynomials, and structural matroid theory. Significant contributions include the development of non-perturbative techniques for quantum transport in microstructures and bounds on discrete and continuous orthogonal polynomials and polynomial inequalities.

In addition, the Department hosts 3 research centres to which members of staff may also belong. The purpose of these ranges from providing an interface between the academic research and its external users to promoting interdisciplinary and collaborative research within Brunel. The centres are: the *Brunel Institute of Computational Mathematics (BICOM)*; the *Centre for the Analysis of Risk and Optimisation Modelling Applications (CARISMA)* and the *Brunel University Random Systems Research Centre (BURSt)*.

**b. Research strategy**

The overarching aim of the departmental research strategy is the facilitation and promotion of world leading research with particular emphasis on the mathematical formulation of fundamental problems inspired by real-world physical, engineering, financial and biological phenomena, and the development of associated advanced solution methodologies. Whilst the department is intent on supporting and promoting high quality fundamental research, it actively encourages collaboration between the groups, interdisciplinary research and the establishment of stronger links with industry. These aims are closely aligned with School/University strategies which place high value on engaging in innovative and cross-disciplinary research activities in line with national agendas.

The Department underwent a rapid expansion just before RAE2008 and the intervening years have represented a period of consolidation. The needs of each group are regularly assessed and appropriate investments made. For example, CAM has experienced low staff turnover and departmental support has focused on the provision of high performance computing equipment, travel opportunities and the facilitation of research leave. This has enabled the group to develop new solution methodologies and robust algorithms with which to investigate the phenomenological processes underpinning problems of real engineering importance. The quality of the ensuing research has been acknowledged through, for example, an individual prize (Pichugin) for work on a "Michell structure for a uniform load over multiple spans". In contrast, support for MPC and FORS has been provided through strategic appointments. Professor Brody has brought fresh direction to MPC whilst simultaneously, through his interest in the use of Levy processes for asset/derivative pricing, providing a keystone in Financial Mathematics (FM). The appointments of Virmani and Meier further bolster the MPC group whilst that of Hughston consolidates FORS strength in FM. The increase in expertise in applied probability and stochastic processes, topics which link with each of the existing research groups, has increased cohesiveness, broadened opportunities for inter-group collaboration, facilitated the establishment of a new MSc in FM and enabled the department to organise industrial outreach workshops in this subject.

The success of these strategies is clear: all 3 groups are thriving and the total research income/consultancy for the REF period (including DTGs) totals £3.1 million. Of particular note are the recent research council grants awarded for: gene network models (Vinciotti, £192,283); detecting artery stenosis (Shaw, £341,660); noisy quantum computation (Virmani, £188,649); boundary-domain integral equations (Mikhailov, £202,144).

During the next 5 years the Department aims to expand the world leading research of the existing groups: the emphasis is on ensuring a continued and increasing contribution to cutting edge topics

in science and engineering. The importance of developing and maintaining productive collaborations between the groups, with eminent external scholars/groups and with industry is recognised. To this end the department holds regular mini-workshops to promote discussion and inter-group collaboration. Similarly, the annual Inter-School Discovery Event brings together researchers with common interests from across the university. In view of their potential for facilitating closer links with end users, strong support is given to both existing and new inter-school collaborations. The Department has also introduced a series of industrial outreach workshops as a further means of forging new industrial links, strengthening the existing ones and expediting future impact. The most recent (on FM), held in September 2013, attracted around 40 delegates from 7 universities and 6 companies.

Statistical and mathematical/computational biology is an emerging strength within the Department and its interdisciplinary nature is consistent with the aims outlined above. Several members of staff are actively involved in modelling biological systems and advancing bioscience technology. Topics of recent interest include metabolic pathways (Beasley), gene regulatory networks (Vinciotti), cooperative consumer chains (Winter) and viscoelastic effects in human tissue (Shaw, Whiteman). New appointments within SISCM in Systems Biology complement these interests and are expected to generate further successful interdisciplinary collaborations.

Current departmental strategy also includes plans to maintain the population of doctoral students and expand the population of research assistants and international visitors. The expansion will be financed by an anticipated increase in inter-disciplinary funding driven by carefully targeted applications to a range of funding bodies supporting the mathematical formulation and investigation of real world problems. Staff who succeed in obtaining significant funding will be rewarded with a generous allowance of research time.

The attractive campus, central location, excellent working environment and vibrant research culture continue to make the Department an attractive place for conferences, workshops and long term visitors. The Department regularly hosts high profile international meetings and conferences. These include the triennial, internationally acclaimed MAFELAP conferences on the Mathematics of Finite Elements and Applications and a highly successful advanced workshop series on Random Matrix Theory (RMT) which is hosted alternately by Brunel and Bielefeld (Germany). These activities, linked respectively with CAM and MPC, will continue.

The departmental research strategy is accessible to all staff via the intra-net. Progress is monitored every September when the research strategy is updated and a report presented to the School Management team.

### **c. People, including:**

#### **i. Staffing strategy and staff development**

The Department seeks to further raise its national and international profile by appointing outstanding staff: those who demonstrate research excellence that fits with existing strengths or desired areas of expansion within the department, who have the potential to attract funding and who can teach effectively at both UG and PG levels. Appointments at professorial/readership level are expected to have a strong track record in obtaining funding and supporting PhD students. At lecturer level the Department seeks candidates whose research interests are closely identified with the interests of at least one of the 3 groups. All candidates are expected to have well formed plans for developing their research, establishing interdisciplinary collaborations and making funding applications.

The Department has initiated a dual presentation system whereby candidates first present an overview of their research and then give a short lecture on a UG topic of their choice. This enables the Department to assess both the calibre of the candidate's research and their effectiveness at UG teaching. The presentations are followed by an interview which enables the panel to explore the candidate's future plans for research and teaching in greater detail. Since 2008, there have been 4 new appointments (Brody, Virmani, Meier, Hughston) in research areas that have been carefully selected with a view to enhancing communication and the cross-fertilisation of ideas between the groups. In the near future 2 professors (Beasley, Rawlins) will retire. The Department

recognises the importance of replacing these leading staff members and plans to appoint two new professors each with an associated lectureship.

Staff induction and career development is one of the Universities priorities and, in 2011, Brunel was awarded the European Commission's "HR Excellence in Research" badging in recognition of its commitment to the *Concordat to support the Career Development of Researchers*. The University has a publically accessible Concordat Action Plan and a Concordat Working Group. In 2012 Brunel received an Athena SWAN Bronze award for its efforts towards promoting equal opportunity for women in science-related subjects (of which Mathematical Sciences is a major part at Brunel). Athena SWAN Research Awards are awarded to staff who are returning from maternity, adoption or paternity leave (longer than 4 months). These are competitive awards given on the basis of a submitted proposal, and can be used to support the researcher during a period of leave or to fund research-related activities and expenses, such as purchasing equipment or employing research assistants.

The University ethos, as recognised through the awards mentioned above, is strongly evident within the Department which is committed both to the development and support of staff in line with the Concordat and to equal opportunity for women - the latter being evidenced through the relatively high proportion of female PhD students (34% since 2008) and academic staff (19% of the submitted staff are female). This commitment extends to all staff, from contract research staff, early career researchers and newly recruited staff to more established faculty members. Less experienced recruits, such as early career researchers, are assigned a senior academic as a mentor and care is taken to ensure that all new staff are well integrated into the Department. This is achieved by creating opportunities for them to meet personally with key departmental figures, and via regular input from their mentor and/or other staff as appropriate. A Staff Handbook detailing Departmental/University policies and procedures is provided and induction courses are run centrally by the University. In addition, the Department has a friendly and collegiate atmosphere which, coupled with the facilities offered by a comfortable departmental common room, ensures that ample opportunities exist for informal interaction and integration. Core Skills development and on-line Research Training is available to all contract research staff.

In order to help them establish their research, newly appointed staff are assigned lighter teaching and administrative loads. Financial support for conferences/equipment is provided, and a wide range of development courses covering various aspects of research, teaching and administration are offered (attendance at some of these being obligatory). Less experienced recruits, such as early career researchers can also apply to a competitive university-wide Brunel Research Initiative and Enterprise Fund scheme for a centrally funded grant. Since 2008, 3 staff have been awarded a total of £44k under this scheme.

Support for career development of more established staff is directed towards increasing their available research time and providing conference support. To this end, extensive use is made of full/part-time teaching-only staff in UG teaching roles. Research students are employed as paid Graduate Teaching Assistants (GTAs) to provide tutorial support at the UG level. Staff can also apply to the University-wide Research Leave (Sabbatical) Scheme and 5 members of staff have taken such leave between 2008 and 2013. Winter, for example, spent several months at the Chinese University of Hong Kong finalising (with Prof J Wei) a monograph "*Mathematical Aspects of Pattern Formation in Biological Systems*" which has subsequently been published by Springer (Applied Mathematical Sciences, Vol. 198).

Great importance is attached to both staff and research students attending conferences in order to present their research and network with professional colleagues. Conferences are financed either from departmental funds or from money accumulated by staff as a result of the Brunel Research Incentive Scheme. All academic staff are provided with funding to attend at least one national and one international conference per year. Members of the Department have presented talks at, for example: the joint ASA-Noise-Con meeting (2010) in Baltimore, USA and the World Congress on Structural and Multidisciplinary Optimization (2011) in Japan. Pichugin was awarded the prestigious Springer Prize for his presentation at the latter congress.

All lecturers/senior lecturers in the Department are appraised annually by a professorial colleague. Readers/Professors agree their research targets for the coming year with the Head of Department. Both systems of appraisal work in parallel with the departmental research strategy and yearly individual staff targets are closely linked to the strategy aims. The annual performance management and appraisal processes are regularly reviewed and revised, most recently in 2010. The promotion process is subjected to an annual Equality Impact Assessment and the University organises workshops, led by the University Equality and Diversity Champion, to support women intending to apply for promotion. Promotion procedures place a strong emphasis on international research excellence. Since 2008, 6 members of the Department have been promoted.

## ii. Research students

The Department attracts a large number of national and international applications from potential research students of diverse ethnicities (the doctoral students currently studying in the Department come from 13 different countries). The application process requires all prospective students to write a brief research plan which enables the Department to match students to supervisors with appropriate interests. Candidates of appropriate calibre are interviewed either in person or via Skype. Since 2008, research student numbers have averaged 59 per year providing both a critical mass and a thriving community for current and incoming students. Forty-seven PhDs have been awarded in this period (of which approximately 34% were to women). A tribute to the high calibre of these students is the number of prizes and/or awards that they have received: one student was supported by a full University (Isambard) scholarship; 2 were awarded a VC Travel Prize; 3 were awarded a University Doctoral Research Prize and one received a prestigious Certificate of Merit for a paper submitted to the 2013 International Conference of Applied & Engineering Mathematics.

Approximately 60% of research students occupy shared two-person offices; the remainder are allocated to larger rooms accommodating a maximum of 6 students. Library and computing facilities are excellent: essential software is purchased from departmental funds and a wide range of relevant journals are available electronically both on and off campus. The Department is committed to providing the best possible support and training for all its students. Students are strongly encouraged to take advantage of the *Researcher Development Programme* which is organised on a university-wide basis by the Brunel Graduate School (BGS) and offers a comprehensive programme of personal and professional skills development (<http://www.brunel.ac.uk/services/graduate-school/training-development-and-support/research-students/researcher-development-programme>). An impressive range of courses are offered including: new researcher induction (for all new PhD students); intermediate/advanced researcher development; presentation skills; viva preparation; making the most of conferences and employability skills (covering entrepreneurship, interview skills, personality assessment). All workshops/seminars are focused towards the acquisition of the essential skills, attributes and behaviours highlighted in the *Researcher Development Framework*. In addition, mandatory training courses are run for research students wishing to gain experience of UG teaching and one-to-one skills coaching is available on request. Working in parallel with BGS, the library provides excellent research engagement training for students covering topics such as: exploiting e-journals; making an impact and managing references and bibliographies.

In addition to the university-wide training outlined above, the Department offers a range of both technical and skills training. FORS research students are required to attend NATCOR courses and, for non-EPSRC students, attendance is fully funded from departmental resources. All other research students attend pertinent LTCC courses as directed by their supervisor. Doctoral students participate in at least 100 hours of technical training during the first 18 months of their studies and in many cases the taught material is examined at the end of the academic year. Further, the Department organises 2 one-day fully funded research student symposia per year. These offer the students the opportunity to present their research, discuss ideas and share best practice. Participation is strongly encouraged and doctoral students are required to make presentations both to support the development of appropriate personal/professional skills and in preparation for talking at conferences and other external fora.

All research students are allocated 2 supervisors from the full-time academic staff. This allows

them to draw directly on complementary academic skills and supports the spread of best practice. Students meet regularly with their supervisors and at least 8 such meetings per annum are formally recorded. This enables a student's progress to be closely monitored. Progression is a formal process that takes place annually in the summer term. Each student submits a written report which forms the basis for an interview with their first supervisor together with one independent member of staff. Outcomes from the previous year are assessed and appropriate new targets are agreed. The process is fully documented and, should the progress of any student provide cause for concern, appropriate support is implemented.

The programme of training/support provided for research students is closely monitored through regular meetings of the postgraduate Staff Student Liaison Committee and by the Director of Research. Its success is evidenced both through the popularity of the programme which continues to attract a large student population and by the high number of PhD graduates attaining good careers in industry/academia. Recent examples include: Dr N. Jobst, Head of Portfolio Analytics, Lloyds Banking Group; Dr M. Phillips, Lecturer, Mathematical Sciences, Queen Mary, London; Dr F. Planes, Lecturer, CEIT & TECNUN, Navarra, Spain; Dr D. Roman, Lecturer, Mathematical Sciences, Brunel; Dr B. Gashi, Lecturer, Mathematical Sciences, Liverpool.

#### **d. Income, infrastructure and facilities**

The University has a well-developed research infrastructure incorporating the graduate school (discussed above), the library and the *Research Support and Development Office (RSDO)*. Brunel has a University Open Access mandate and an Open Access Publishing Fund has been established. Members of staff thus have an excellent support network to draw upon for their research needs and ample means of global dissemination for their outputs.

Brunel University library holds over 560,000 books and subscribes to approximately 35,000 unique journal titles, over 95% in electronic form. All major research journals relevant to the Department are freely available electronically (both on and off campus). These are supplemented by a print collection of back issues of journals. Within the entire University collection there are approximately 34,000 books, 2,300 e-books and 1,500 journals of direct relevance to the Department. Of particular significance to the Department is that Brunel hosts the *UK Operational Research Society Library* which contains over 1,500 books and 80 journals in print form.

The library provides dedicated space for postgraduate (PG) and academic researchers including the Research Commons (an area incorporating Special Collections) and a PG IT room that is open 24 hours a day, 7 days a week. The library provides access to an impressive range of specialised databases including financial and statistical ones such as: Bankscope, Bloomberg, Datastream, FAME, IFS online, Reuters 3000Xtra and OSIRIS. More generally, it offers access to, for example, the Web of Science (WoS), Scopus, BRAD and BURA. BRAD (Brunel Research Database) is University's research database which provides a comprehensive record of the publications for all staff. BRAD automatically finds new publications from databases such as WoS/Scopus and updates staff research profiles/web pages on the University website. BURA (Brunel University Research Archive, <http://bura.brunel.ac.uk>) is the University's open-access repository which holds copies of research outputs/doctoral theses and provides an effective means of dissemination.

RSDO provides university-wide support in negotiating contracts and planning/preparing research proposals and knowledge transfer partnerships. Further, through its e-Newsletters and tri-annual internally published research magazine, RSDO promotes funding opportunities and circulates Brunel research news and key achievements.

In addition to the university-wide facilities outlined above, all departmental staff and research students have their own state of the art PC with internet access and shared access to a number of laser printers. A range of appropriate software (e.g. C++, Latex, Microsoft Word/Office) is provided as standard. Specialised packages are provided either as an individual licence or via a shared licensing system. The main statistical packages are S-PLUS, R and SPSS whilst Mathematica and MatLab are extensively used by the applied mathematicians. Mathematical programming is facilitated by: modelling languages AMPL and MPL; solvers Cplex, FortMP, SNOPT, FortSP and an ILOG OPL integrated development environment. For computationally intensive applications, the

Department also has a dedicated GPU based high performance computing cluster. The well-known *OR-library* website (<http://people.brunel.ac.uk/~mastijb/jeb/info.html>) is hosted by the Department. This site holds test data for a wide variety of OR problems and is used by researchers world-wide. The full-time Departmental Computing Officer maintains the equipment and provides user support.

The research of each group is supported by seminar programmes encompassing the interests of all members of the groups and incorporating a broad selection of outstanding international/UK speakers. Each group meets regularly to discuss their seminar programme, select potential international visitors, discuss future direction and appropriate funding applications. There is a strong group culture of supporting/promoting each other's research, and sharing ideas for workshops and collaboration.

All academic staff are accommodated in individual offices. The Department has a rolling programme of refurbishment, and new academic staff are allocated a freshly refurbished office. Between 2008 and 2013, over £1.2 million has been spent on refurbishment, a component of which was allocated to updating disabled access to the Mathematics building.

#### **e. Collaboration or contribution to the discipline or research base**

Three University Research Centres play key roles in promoting interdisciplinary and collaborative research within the Department and in forging links with industry. These centres are:

- *Brunel Institute of Computational Mathematics (BICOM)*;
- *Centre for the Analysis of Risk and Optimisation Modelling Applications (CARISMA)*;
- *Brunel University Random Systems Research Centre (BURSt)*.

In addition, the Department is actively involved in a fourth centre:

- *Brunel University Centre for Systems and Synthetic Biology (BUCSSB)*.

BICOM generates research within the broad area of Computational Mathematics with a focus on the computational modelling and analysis of problems arising in industry. For example, pioneering work in the computational modelling of the behaviour of starch-based thermoplastics during thermoforming processes was undertaken by members of BICOM in collaboration with Pactiv LLC.

CARISMA promotes interdisciplinary research in the analysis of risk, decision and optimization. Operating as portal at the interface between university research and industry, its activities include securing practical experience for FORS PhD students and industrial collaboration. For example, Kidde Plc required a method for computing the residual risk of failure of an explosion protection system on an industrial process plant. CARISMA was approached and Date designed a novel algorithm which has been implemented by the company and has led to an impact case study.

BURSt promotes and supports research in the theory of random systems. The EU funded NET-ACE project supported in excess of 10 PhD students (2005-2009) and the BURSt Seminar Series in Random Systems provided funding for outstanding national/international researchers to present their work at Brunel. These activities, together with the RMT workshop (organised by members of BURSt), have initiated several new international collaborations.

Five staff (Beasley, Maischak, Shaw, Vinciotti, Winter) are members of BUCSSB. This centre is strongly interdisciplinary, bringing together the expertise needed to address major challenges of biological sciences in the 21<sup>st</sup> century. An exciting recent EPSRC funded (Shaw) project, undertaken in collaboration with Barts Health NHS Trust (and others), connects computational applied mathematics to biotechnology through a proof of concept investigation into the development of non-invasive techniques for detection of coronary artery disease.

On an individual basis, Noble's work with the Heilbronn Institute for Mathematical Research (HIMR), Bristol has resulted in an impact case study submitted for this UOA.

The Department has a truly international profile, employing staff from 11 countries including the UK. This offers a tremendous base for international communication, collaboration and conference organisation all of which ensure that research is informed by the latest international findings/trends.

The strong international flavour of the Department is evidenced through the authorship of the 100 papers submitted for this UOA: 52% involve at least one international (non-UK) co-author; of the total number of authors for all the papers, 38% are international and 10% are from the UK (excluding Brunel). In addition, members of staff regularly give invited Keynote/Plenary lectures at prestigious international conferences, for example: Date (WSEAS Conference on Systems Theory & Scientific Computation, Moscow, 2009); Roman (Stochastic Programming School, Bergamo, 2009); Rawlins (St Petersburg's Days of Diffraction, 2011; Progress in Electromagnetics Research Symposium, Moscow, 2012); Maischak (Valparaiso's Mathematics & its Applications Day, 2011).

The international prowess of the Department is further evidenced through its organisational activity on the international conference scene. Hughston was a key organizer for the *Quantitative Finance Retrospective Workshop* held at the Fields Institute for Research in Mathematical Sciences, Toronto, in October 2013 (<http://www.fields.utoronto.ca/programs/scientific/13-14/finance/>), and, since 2008, a total of 10 international workshops and conferences have been organized by the Department and hosted at Brunel.

- 2008: John Crank legacy conference organised by BICOM with LMS support\* - over 50 participants from 10 countries.
- 2008, 2009, 2010 & 2012: MPC hosted 4 highly successful advanced workshops on Random Matrix Theory and its applications. The 2012 workshop attracted the support of the Institute of Physics\* and brought together over 60 participants from 11 countries. This 2 day event is organised jointly with Bielefeld (Germany) and was held there in 2011 & 2013.
- 2008: CAM organised a 2 day meeting of the Guided Waves subgroup of the CNRS funded Groupe de Recherche 2501 - approximately 35 French/British participants.
- 2009 & 2013: BICOM hosted 2 of the internationally acclaimed MAFELAP conferences on the Mathematics of Finite Elements and Applications. MAFELAP 2013 attracted approximately 350 participants from 36 countries. Both events received LMS and IMA funding\*.
- 2011: FORS held a LMS funded\* workshop on the Mathematics of Filtering and its applications - around 40 participants.
- 2012: FORS organised a LMS funded\* workshop on Lifetime Data Analysis - approximately 30 participants.

\*Further to the income listed in section 5a and in REF4b,c, staff have successfully sought small grants to support conferences/travel, the total awarded in 2008-2013 being in excess of £18,000.

The Department also features prominently in terms of international editorial activity. Hughston is Editor-in-Chief of *Int. J. Theor. Appl. Finance* whilst 6 other members of staff hold prestigious editorial roles: Brody (*Int. J. Theor. Appl. Finance*); Date (*IMA J. Man. Math.*); Lawrie (*J. Acoust. Soc. Am.*); Vinciotti (*J. Roy. Stat. Soc., Series C*); Whiteman (*Numer Meths PDEs*) and Winter (*Int. J. Comp. Math. and ISRN Math. Anal.*). Beasley and Rawlins are members of the editorial boards for *Comp. & OR* and *Q. J. Mech. Appl. Math.* respectively. Further, 2 special issues have been edited by members of staff: Lawrie (*Math. Mech. Solids* 17(1) 2012); Maischak (*Num. Math.* 59(11) 2009).

In addition, staff have high h-indices, reflecting their lifelong impact on and contribution to the discipline. The highest WoS h-index is 32, with 2 staff having h-indices in the range 20-29 and 10 in the range 10-19. The Department is also delighted to report the following individual successes:

- Pichugin: awarded the ISSMO Springer Prize (2011);
- Rodgers: Elected to Fellowship of the Institute of Physics (2008);
- Brody: Elected to Fellowship of the Institute of Physics (2012);
- Noble: Academic Consultant to HIMR (full-time secondment 2006-2008; occasional basis 2009 – present);
- Savin: External Expert to Conacyt, Mexican Federal Research Agency, (2011-2013).