Institution: University of East Anglia

Unit of Assessment: 10 – Mathematical Sciences

a. Overview

All staff being returned in this UOA are members of the School of Mathematics, which forms part of the Faculty of Science at the University of East Anglia (UEA). The number of mathematicians in the School has grown from 16 to 24 during this assessment period, with 22 submitted to UOA 10 and 2 to UOA 7. These new appointments have enriched all of the research groups and opened up new research directions. The School also hosts a fledgling engineering programme, with a long term strategy to develop a separate School of Engineering. Over this REF evaluation period we have published over 250 peer-reviewed publications, involving external co-authorships from over 30 different countries. We have been awarded £3.7million of external funding for research activities.

Research in the School is divided into four groups: **Fluid and Solid Mechanics**, **Algebra and Combinatorics**, **Logic**, and **Number Theory.** There are many overlaps between the groups and members of different groups interact via joint working seminars and study groups, joint publications and co-supervision of PhD students.

The School is part of the Faculty of Science which leads the development of Science-wide research strategy through its Dean, Associate Dean for Research and its Executive and Research Committees. Within the School, research strategy is developed by the Executive Committee led by the Head of School. The School's Director of Research is a member of the School's Executive, the Science Faculty Research Committee and is Chair of the School's Research Committee, which takes responsibility for implementing strategic decisions and managing the internal peer review of research grant applications.

The School benefits from Faculty and University-wide provision of research-related services such as support and management for grant applications, postgraduate admissions, personal and professional development programmes and enterprise services. The School has strong research links with the School of Environmental Sciences and the *Institute of Food Research* and the *John Innes Centre*, which form part of the Norwich Research Park.

b. Research strategy

Our research vision is built upon a firm commitment to both fundamental and applied Mathematics, representing themes and topics of international importance, as outlined below. Having established a strong research base in a number of key subject areas, our aim is to sustain and grow these areas to create a dynamic and diverse research environment that encourages new connections and collaborations. This is supported by our collegiate atmosphere with a culture of interaction between faculty members and research groups. The Centre for Interdisciplinary Mathematical Research (CIMR), within the School, promotes research collaborations between mathematicians and scientists in other fields, and facilitates contact with academic and non-academic partners through joint seminars and joint research projects.

International collaborations and visits are supported by School funds and staff are encouraged to apply for study leave on a regular basis. Collaborations within the School comprise joint projects, joint students, co-authored papers, and joint pure and applied research seminars. There is an upward trend in research income and (crucially for sustainability) a steadily increasing number of Mathematics undergraduates.

Research in the School is monitored annually through individual reviews performed by the Director of Research and the Head of School, and reports are made available to the Science Faculty Research Executive and the pro-Vice Chancellor for Research.

Our research is divided into four main groups described below:

Fluid and Solid Mechanics
(Blyth, Cooker, Hammerton, Korobkin, Parau, Proment, Purvis, Ryan, Salman, Scott, Whittaker)

This group has seen a flurry of new appointments over the return period (4 new lecturers), which

has brought new expertise in low Reynolds number viscous flows (Whittaker), vortex dynamics (Proment and Salman), and higher order numerical methods for Computational Fluid Dynamics (Ryan). Research in the group is wide in scope and involves many interactions between group members. We benefit from close research ties with other centres on the Norwich Research Park, notably the School of Environmental Sciences, the *Institute of Food Research* and the *John Innes Centre*. This includes joint publications and co-supervision of PhD students. Our research uses a broad range of analytical and numerical techniques. We study both linear and nonlinear problems where forcing is due to air flow, impact forces, capillarity, electric fields, ultrasound, surfactants, ship motion, and elastic forces. Research within this group falls broadly into the following four areas:

1. Environmental Mathematics: Environmental modelling is one of the grand challenges in science, with the potential for huge impact on the global society and economy. Here we contribute mathematical models and techniques to a vibrant and exciting environmental science community on the Norwich Research Park, including the School of Environmental Sciences. Our work in this area covers buoyant flows in the Earth's interior, rogue ocean waves, ice-sheet dynamics, data assimilation, breaking-wave impact and sediment transport in coastal zones, and lava domes. A research highlight is *'Triggering of a volcanic dome collapse by rainwater infiltration'.* Other *Environmental Mathematics* research in the School into the atmosphere, ocean and climate system, by A. Matthews and D. Stevens, is submitted to UOA 7.

2. Industrial Mathematics: Our diverse research in this area demonstrates the power of applied mathematical methods to solve real-world problems. We study problems drawn from the aeroindustry (ice formation on wings, water droplet impact and air-cushioning effects, wing-in-ground effect, aircraft ditching on water) and the marine and coastal industry (offshore floating structures, sloshing and slamming in liquid natural gas tanks, violent wave impact on coastal defences), the chemical and manufacturing industries (liquid coating on complex surfaces, flow in collapsible tubes, thin-film flow over topography, multi-layer flows, and stress-softening of rubber vulcanizates), as well as other application areas (landmine detection by radar). A research highlight is '*Semi-analytical models of hydroelastic sloshing impact in tanks of liquefied natural gas vessels*'.

3. Mathematical Biology: Our flourishing research activity in Mathematical Biology is supported by a strong interaction with the School of Biological Sciences, the Norwich Medical School, the *Institute of Food Research* and the *John Innes Centre*. Ongoing research includes modelling digestion in a prototype model gut, softening of muscle tissue, and denitrification in soils. A long-term strategic collaboration with the *John Innes Centre* for plant sciences through R. Morris, an Honorary Professor in the School, aims to model cytoplasmic streaming in plant cells. A research highlight is '*Motion of a two-dimensional elastic capsule in a branching channel flow*', which serves as a model of red blood cell migration through a capillary bifurcation.

4. Mathematical Physics: A newly-established research direction since RAE2008, our work in this area includes the application of wave turbulence theory in three-dimensional Bose Einstein Condensates, finite temperature effects in multi-component Bose Einstein Condensates, non-equilibrium phenomena in trapped Bose gases, and quantized superfluid vortices. A research highlight is '*Breathers on quantized superfluid vortices*'*,* which for the first time generalises the nonlinear excitations discovered in optical systems and ocean rogue waves to superfluid vortices.

The appointment of Korobkin in 2007 spearheaded a new drive towards fluid-structure interaction problems, which had been highlighted as a priority area in our RAE2008 return. School activity in fluid-structure interaction has intensified in the intervening period (shown in the categories 1-3 above), and forms a core part of the group's strategic vision for research going into the future. Other projects identified in our RAE2008 return include ship slamming, the bio-fluid mechanics of the stomach, and red blood cell dynamics. Substantial progress has been made on all of these topics leading to successful PhD awards (Woolfenden, Brocklehurst, Rickett, Reinhard) and published papers (Woolfenden & Blyth 2010; Brocklehurst *et al*. 2011; Reinhard *et al*. 2013**).**

A key component of our strategy has been to engage with a range of researchers from other academic disciplines and industry. A selection of existing partnerships with industry is described in our impact statement and case studies, and new links are actively sought. For example, we hosted

the EPSRC-funded European Study Group with Industry in April 2012. Knowledge Transfer activity includes student placements with *Airbus Industrie* (logistics) and *Cobham* (landmine detection) and an EPSRC Industrial Mathematics Knowledge Transfer Network CASE award with the Atomic Weapons Establishment.

Looking to the future, two principal goals are to support the further development of Mathematical Physics (see 4 above), and to grow the emerging research interest in Computational Fluid Dynamics (CFD) initiated by the appointment of Ryan in 2012; the next faculty appointment to the group will be targeted to CFD.

Algebra and Combinatorics
(Evans, Gray, Lyle, Miemietz, Siemons, S. Stevens)

The Algebra and Combinatorics group has grown with two new appointments (Gray and Miemietz), giving extra interconnectivity within the group as well as enhancing international collaborations and profile. Research in the group can be roughly divided into two areas.

1. Representation Theory: We study numerous aspects of representation theory, using combinatorial and homological methods, with particular strength in the representation theory of Hecke algebras, as well as applications to number theory. Highlights have included: a recursive 2-functorial construction of the category of rational representations of GL(2), including a theory of Koszul duality of the relevant 2-functors; a classification of the smooth representations of p-adic central simple algebras; and a classification of the irreducible Specht modules for Hecke algebras of type A when $q \neq -1$ and one direction of a conjectured classification when $q = -1$.

2. Combinatorics and Group Theory: We study subjects including geometric and combinatorial semigroup and group theory, finite and infinite permutation groups, combinatorial reconstruction, and incidence geometries. Highlights have included: the refutation of a thirty-year-old conjecture by showing that every abstract group arises as the maximal subgroup of a free idempotent generated semigroup over a biordered set; and establishing minimal conditions to guarantee unique reconstruction in terms of error graphs, a new invariant in reconstruction theory.

We will pursue our thriving international collaborations, which include: developing a solid theoretical foundation for the newly emerging subject of 2-representation theory; classifying blocks for l-modular representations of p-adic groups; investigating the representation theory of generalised blob algebras and related diagram algebras; studying topological finiteness properties of string rewriting systems and applications of methods from combinatorial semigroup theory to study the word problem; and applying combinatorics and finite group theory to coding theory and in particular to normal form problems.

Furthermore, we aim to take advantage of the exciting new links brought through Gray and Miemietz, exploring, for example, endomorphism monoids of homogeneous structures, partition algebras as twisted semigroup algebras, and structures of categorification on blocks of representations of p-adic groups.

Logic
(Aspero, Džamonja, Evans, Kirby)

The Logic group has doubled in size during the assessment period, with the appointment of Aspero and Kirby. There are two main strands to the activity.

1. Set Theory: Aspero is widely recognised as one of the top young set theorists in the world and complements Džamonja to jointly lead the largest team in the country working in Set Theory (2 faculty members, 1 postdoc, 6 research students). Aspero specialises in forcing axioms and iteration theorems, including a recent work on the possibility of a forcing axiom preserving the continuum hypothesis, which is one of the oldest and hardest problems in the theory of iterations. Aspero has devised a new method of iteration, which produces models of new forcing axioms. Džamonja specialises in set theory and its connections with other subjects of mathematics including measure theory, model theory, and the theory of orders. She is in general interested in classification problems. In measure theory, she classified the Boolean algebras that support a uniformly regular finitely additive measure as the subalgebras of the Jordan algebra and showed that the classification by the separability number is probably unachievable; in the theory of linear

orders she classified partial orders with the finite antichain condition. In pure set theory she developed forcing axioms at the successor of a singular cardinal (funded by EPSRC).

2. Model Theory: Evans works in model theory and its interactions with areas of algebra and combinatorics, particularly permutation groups. He is known for his work on Hrushovski-style constructions and during the assessment period his work included a solution to a question of Hrushovski from 1993 concerning the nature of the combinatorial geometries arising from these constructions. Further work answers a question which arose from Zilber's work on model theory and non-commutative geometry. Work on infinite permutation groups included an EPSRC-funded project on highly arc transitive digraphs and an application of group-theoretic methods to a problem arising in model theory. Kirby was appointed during this assessment period and he works in the development of the algebra and model theory of abstract exponential fields, where exponentiation, addition and multiplication are allowed as operations. He showed that there is a well-defined notion of dimension in exponential fields, extending the notion of transcendence degree for fields. He developed the algebra in detail and addressed the notion of types, obtaining applications to transcendence theory and algebraic number theory.

Future research in set theory will focus on forcing axioms and their applications. Aspero will work on various problems in forcing, large cardinals, combinatorial set theory and axioms of generic absoluteness. Džamonja plans to further develop forcing axioms at successors of singulars and to collaborate with Aspero on applications of an iteration technique to preserve the Continuum Hypothesis. Within model theory, a strategic aim will be to develop and apply ideas from stability theory and its generalisations in algebraic, number-theoretic and combinatorial settings. Evans plans to work on geometric properties of forking-independence, on higher amalgamation properties, and to collaborate with Gray on infinite permutation groups.

Number Theory
(Baier, Ghosh, Kirby, S. Stevens)

The Number Theory group has seen major change since RAE2008, with four appointments (Baier, Feigon, Ghosh, Kirby) and three departures (Everest, Feigon, Ward). Research in the group now ranges from Analytic Number Theory to the Local Langlands Programme, from Ergodic Theory to Model Theory. Highlights from the assessment period include: a proof of Manin's conjecture for a particular Del Pezzo surface of degree 2; establishing measure rigidity for actions of semisimple groups on homogeneous spaces in high characteristic, extending Ratner's theorems; and a construction of types for every block for *p*-adic classical groups (as planned in RAE2008).

Future research activity by individual group members includes: studying Diophantine approximation on homogeneous varieties using ergodic theory, and connections to the generalised Ramanujan conjectures; establishing at least a lower bound of the correct order of magnitude for Manin's conjecture for a Del Pezzo surface of degree 1; and making the tame local Langlands correspondence effective for classical groups.

In addition to striking individual plans, there are already substantial collaborative links within this group. Complementary strengths across the number theory spectrum, and a shared interest, puts us in a strong position to make a major contribution to prominent Diophantine problems. To help cement links between members of the group we will recruit another member of faculty in the area of global automorphic forms.

c. People, including:

i. Staffing strategy and staff development

The School has seen a growth in mathematics faculty of 50% since RAE2008. Responsibility for strategic staffing rests with the Head of School and the School's Executive (comprising the Directors of Research, Enterprise, Postgraduate Study, Teaching, Admissions and Employability). The Executive uses new appointments to realign the School's research priorities, to develop or pursue new directions, and / or to respond to new research initiatives and funding opportunities. We have made, and will continue to make, high quality appointments in areas that complement rather than duplicate existing research effort, growing outwards from existing areas and making further links between them. New faculty are only appointed if they are judged to be producing

research that is internationally-leading in quality.

A key aspect of our staffing strategy is to appoint the best early career mathematicians on higher lecturer grades. We provide support and training to allow staff to develop their research and careers. A workload model promotes and rewards research and enterprise activity. We implement a rigorous internal review of all research grant applications (demonstrated by a success rate of 58% for EPSRC research grant applications), which strongly supports and nurtures less experienced investigators. The School has a discretionary strategic research investment fund (typically around £20K per annum) with which to fund both incoming and outgoing research visits and pump-prime research activities.

The new appointments in the School are: Aspero (set theory), Baier and Ghosh (number theory), Gray (combinatorial group and semigroup theory), Kirby (model theory), Miemietz (representation theory), Proment and Salman (quantum fluids and environmental mathematics), Ryan (numerical methods), and Whittaker (fluid mechanics). Two of our recent appointments came with EPSRC Fellowships: Ghosh and Kirby. In addition S. Stevens, an established member of faculty, was awarded a prestigious EPSRC Leadership Fellowship in 2009.

Internal promotions have been those of Džamonja and S. Stevens to Chairs; Blyth to Reader; and Hammerton, Lyle, Parau and Purvis to Senior Lecturer. Since RAE2008, we lost G. Everest (who retired through ill health) and T. Ward (who took an executive position at the University of Durham). We had also appointed B. Feigon (in 2010) who left after a year to accept a post at the City University of New York.

An important aspect of our environment is the large number of visiting scholars, from many countries and for visits from a few weeks to several months. These include mathematicians with considerable international reputation, such as Prof. Istvan Juhasz (Hungarian Academy of Sciences) and Prof. Manfred Einsiedler (ETH Zürich).

The School runs two weekly research seminars series, a number of smaller informal seminars and reading groups, and an occasional interdisciplinary seminar run by CIMR. All research staff and students participate in at least one of the weekly seminar series, and in a number of the others.

Early Career Researchers: Early Career Researchers (ECR) are given a dedicated research fund (£1500 per annum) for two years and a reduced teaching load for three years and are mentored by senior staff. Appraisals are annual for ECR (and annual or biennial for more established staff). All Lecturer appointments are required to pass the Certificate in Higher Educational Practice (run by UEA's Centre for Staff and Educational Development), which includes research development and encourages research-led teaching. The University uses an on-line research management system to assist with individual research planning. The School's promotion committee contributes to the University's confirmation of appointment and the promotion of academic staff – which requires assessment of performance across the four areas of research, teaching, enterprise and engagement – as well as overseeing study leave applications.

During the assessment period the School employed 17 **Research Associates** (RAs), with a diversity of nationalities and genders**.** In addition to collaborating on research, Project Supervisors act as mentor to RAs, overseen by the Research Staff Coordinator. To support the *Concordat to Support the Career Development of Researchers*, the University has established a Research Staff Working Group that steers the strategy for career development and monitors implementation of activities, as ratified by the School's Research Staff Co-ordinator. In September 2012 UEA was awarded the *HR Excellence in Research Award* from the European Commission, recognising UEA's commitment to support the personal, professional and career development of research staff, particularly through alignment with the principles of the European Charter for Researchers, Code of Conduct for Recruitment and the UK Concordat. During the REF period, *Roberts Funding* (allocated via RCUK) has supported the career development of RAs and PGR students, by increasing their employability through enhanced personal, professional and career management skills. All staff members are encouraged to attend development courses covering a range of research, teaching and management topics.

International Appointments - Incoming: Aspero (from Austria), Baier (from Germany), Feigon (from Canada), Proment (from Italy) and Ryan (from Holland). **Outgoing**: Feigon (to USA).

Equality and Diversity: Our commitment to equality and diversity is demonstrable at all levels. All our committees have female representation and three of the ten recent faculty appointments are female. The School's faculty members are from a diverse range of cultural backgrounds and a variety of countries. The University has a contact, support and information network *(RESNET)* for female research staff from across the Norwich Research Park. RESNET runs events to promote career development and raise awareness about equal opportunities. UEA's *Single Equality Action Plan* identifies policies on equality and diversity issues, which are proactively delivered by the Equality and Diversity Committee. Information on staff and student populations helps to raise awareness and inform decisions from an equality perspective. In 2012, UEA was awarded a *Bronze Award* from *Athena SWAN*, recognising its solid foundation for eliminating gender bias and development of an inclusive culture that values all staff. The School is a supporter of the London Mathematical Society *Good Practice Scheme* for embedding equal opportunities for women within its working practices.

ii. Research students

Postgraduate research (PGR) students play a vital role in the School. In total, 33 doctorates were awarded in the REF period. Of these 11 were funded by UEA fellowships, demonstrating the commitment of UEA to PGR students. As staff numbers have increased, so have the number of PhD students. The current cohort of 35 PGR students consists of 63% from the UK, 23% from the EU and 14% from further overseas. Our PhD completion rates are generally high (94% within the assessment period, with the remaining students gaining MPhil degrees). The School hosts and supports an EPSRC doctoral prize holder, a scheme that aims to improve retention of the best EPSRC-funded PhD graduands in research careers.

The School attracts high-quality PGR students, with the vast majority of competitively-awarded PhD studentships going to students with a first class Integrated Masters degree, MSc or equivalent. The PGR recruitment process is rigorous, with potential students identified initially by application to advertised projects, then interviewed by at least two academics, with decisions on funding made by the Research Committee. Academic ability is paramount, but UEA funding is also used strategically to encourage PhD students to specific areas, and to support new faculty.

Postgraduate supervision and training: We place great importance on the training and development of PGR students. This is pursued with a view to training the brightest and the best mathematicians for the future, whilst also providing them with opportunities for personal development that will equip them for a variety of careers. PGR students have a supervisory team comprising at least two members of faculty. All supervisors must undertake a training course on PhD supervision, covering best practice and PhD regulations. This also provides a forum for discussion of the role of the supervisor. In addition mentoring is provided by a senior member of faculty for all staff new to PGR supervision.

Within the School, the Director of Postgraduate Studies oversees the recruitment of students, monitors progress, welfare and ensures timely completion. Student progress is monitored closely via three standard progress reports each year. Intervention occurs at the first indication of limited progress. If a report highlights any issue impacting a student's progress (e.g. computational constraints), the issue is investigated and resolved.

Our overall PGR student training is organised via a Faculty-wide *Science Graduate School,* which was set up in 2009 and has successfully brought together all elements of PGR training in the Faculty. In addition to the research skills that students gain directly from their project, research training is delivered by a *Personal and Professional Development (PPD)* programme. Founded on the *RCUK Researcher Development Statement*, generic and technical elements are delivered by external trainers and faculty members from all Science Schools. The PPD programme continually evolves in response to student feedback and requests from students, staff and funding agencies. In 2013-14 182 courses are on offer. A component of the PPD programme for our students is the requirement to take 100 hours of postgraduate mathematics lectures, which are mainly delivered through the EPSRC-funded MAGIC network. MAGIC comprises 20 universities, which deliver joint postgraduate courses in mathematics via a dedicated video conferencing network. The School is an active participant in MAGIC and currently provides two courses. Funding is also available to our PGR students for attendance at specialised summer schools or workshops, which are incorporated

into the student's PPD programme via 'reflective reports'.

The School facilitates a lively and ambitious environment for its students. They attend and present talks in the main research seminar series, and also run their own seminar series. We also recommend and fund their participation in conferences and workshops, and actively encourage them to write up their research for publication. Our students are recognised for their excellence, for example, Reinhard won the international Tuck Fellowship.

d. Income, infrastructure and facilities

External recognition of research excellence across the School is evidenced by the award of competitive research funding of over £3.7million during the assessment period. The School has a relatively small income from consultancy, mostly because of the culture of free exchange of scientific ideas with both academic and non-academic partners. While this culture is important to us, we are increasingly aware of the possible income that can be generated. Policies are now in place to encourage (through the workload model) staff to engage in paid consultancies that benefit other aspects of our research, including its impact. UEA is committed to supporting the School through faculty appointments (as evidenced by our growth) and research studentships that supplement the EPSRC Doctoral Training Grant.

The School is housed in a contiguous area of the Science Building. To maintain an atmosphere conducive to high quality collegiate research, we continually invest in infrastructure through office re-modelling and refreshing, and the purchase of new computer software and hardware. All computer hardware is a on a three/four year replacement cycle. Every faculty member has a private office in the School. Maintaining this, and the unity of the School with an increasing number of staff, has required investment in the infrastructure to obtain new offices. Research associates have large shared offices and research students have a single large, communal office with individual desks and computers for each student. UEA has an Access Grid Room that can be used for giving and attending MAGIC lectures, and we have also created a room for attending MAGIC lectures next to the research student office. Staff and research students also have access to a dedicated Mathematics Library/Meeting/Refreshment Room, which was refurbished in 2010 at a cost of £28,500.

The University supports a suite of state-of-the-art High Performance Computing (HPC) facilities for the use of all research staff. We are amongst the largest users of these facilities. The University has invested over £3.5million in HPC facilities since 2008. The current HPC cluster comprises 302 nodes (4148 cores) and has a theoretical peak performance of 65 TFlops. The HPC services are supported by a team of specialist technicians who install and optimise the running of new software, as well as plan our future upgrades. The University library, extended in 2005 and refurbished in 2010, subscribes to over 7000 journals and operates a public digital repository with some 25,000 UEA-authored articles.

In 2012 the Treasury made a £26million investment into the Norwich Research Park. This money is invested into infrastructure, including a new 'Centrum Building' for innovation and a £14million Enterprise Centre, which will act as a one-stop-shop for business interactions.

e. Collaboration or contribution to the discipline or research base

Our researchers collaborate widely with other academics and with industrial partners. These collaborations are actively encouraged by the School's positive approach to winning and carrying out research awards, by our strategic decisions and our internal management. During the assessment period, we have published with researchers in more than 30 countries, at numerous UK Universities, and in other Schools at UEA or institutes within the Norwich Research Park.

International relations

Members of faculty have made many invited long term (>1 month) research visits to universities in various countries, including Austria, Australia, China, France, Germany, Netherlands, Japan, Sweden and Taiwan. We have a strong network of international collaborations, including coauthors on every continent with the exception of Antarctica. Several faculty have been visiting professors overseas, such as to the Universities of Delft, Milan, Ljubljana, Paris 1-Sorbonne and Shanghai.

Editorial Positions
Members of the School are, or have been, on editorial boards of prestigious journals including *Journal of Combinatorial Designs*, *Journal of Engineering Mathematics*, *Journal of Fluids and Structures* and *Proceedings of the American Mathematical Society*. The Editorship of the *Bulletin of London Mathematical Society* has been based in the School since 2009.

Scientific Societies
Members of the School hold executive positions in a number of scientific societies, for example: Džamonja is the President of the *European Set Theory Society* and Chair of the *European Committee of the Association of Symbolic Logic*; Džamonja is on the *European Mathematical Society* Council; S. Stevens is a member of several *London Mathematical Society* committees; and Evans has recently been elected to the *London Mathematical Society* Council.

EPSRC
Džamonja, Evans and S. Stevens have served on the *Peer Review College* and various panels; S.Stevens presented to one of the *International Review of Mathematical Sciences* sub-panels, as well as attending the subsequent strategic *Pure Mathematics Workshop* in 2012.

Plenary Lecturers and Invitations
We have given many plenary lectures at international conferences, including at *European Mathematical Society* Special Session in Amsterdam 2008; *Mostowski 100* conference in Warsaw; 2013; and *Solstice* conference in Paris, 2011. In addition, invited lectures have been presented at top overseas institutions including *Institute of Mathematical Sciences* in Chennai, *Sorbonne* in Paris and University of Yale. Members of faculty have been invited to various research institutes around the world, including *Banff International Research Station*; *Mathematical Sciences Research Institute* – Berkeley; *Fields Institute* – Toronto; *Max Planck Institute for Mathematics* – Bonn; Centre International de Rencontres Mathématiques – Luminy; *Mathematisches Forschungsinstitut Oberwolfach*.

Awards
In 2009 Korobkin was awarded the prestigious Weinblum Memorial Lectureship, the highest award in ship hydrodynamics. He is only the fourth academic from the UK to receive this award, alongside G.E. Gadd, National Physical Laboratory, 1982; F. Ursell, University of Manchester, 1985; E. Taylor, University of Oxford, 2005.

Research Networks and Organisational Activities
The School hosted a large European FP6 Network MODNET in model theory until the end of 2008, and then became an Associate Member of the FP7 network MALOA on Mathematical Logic and Applications. UEA Mathematics is a member of the European Science Foundation INFTY network, where Džamonja is on the Executive Group.

Members of the School have served on national and international committees including Purvis being on the Scientific Committee of the *Industrial Mathematics Knowledge Transfer network*. We have organised a number of conferences, including *Mathematical Challenges in Hydroelasticity* (Korobkin and Parau, Edinburgh 2010) which was followed by a Special Issue of *Philosophical Transactions of the Royal Society*, and *Mathematics of splashing* (Korobkin, Edinburgh 2012). The School hosted the *European Study Group with Industry* in April 2012 (organised by Purvis), which brought together 89 researchers and 17 industry representatives from 10 countries. Blyth will co-organise an *International Union of Theoretical and Applied Mechanics* symposium/EUROMECH colloquium on capsule and vesicle dynamics at the Université de Technologie de Compiègne, France in July 2014.

Researchers from the School have been actively involved in the work of the Newton Institute in Cambridge, including Ghosh co-organising the *Dynamics of Group Actions and Number Theory* programme from June - July 2014 and Džamonja co-organising a four month programme on *Mathematical, foundational and computational aspects of the Higher Infinite*, August - December 2015. In addition Parau and Korobkin have formally proposed a research programme on ice sheet dynamics to be held in 2016.