Institution: Aston University

Unit of Assessment: 11 : Computer Science and Informatics

a. Overview

The two research groups in this UOA develop solutions to the challenges of analysing and computing with large datasets, decision making, and complex systems: the **Non-linearity and Complexity Research Group (NCRG)** focuses on pattern analysis, probabilistic methods, non-linear dynamics and the analysis of complex systems; and the **Computer Science Research Group (CSRG)**, which develops novel algorithms in computational intelligence, software engineering, visual information processing, and cognitive science.

b. Research strategy

The total headcount of academic staff in the UOA is 26, including four Professors, one Reader, eleven Senior Lecturers and nine Lecturers (including 5 ECRs): this is an increase from 21 staff in RAE 2008. There are seven postdoctoral researchers and 26 PhD students. The core of the strategy is to form an Institute of Big Systems Analytics (see Future Vision below) that will unite the two research groups, so it is logical that they are submitted as a single unit to REF2014.

Current Position compared with RAE 2008

In RAE 2008 the groups in this UOA formed part of a single submission from the whole of the School of Engineering and Applied Science (EAS) to the General Engineering panel. At that time, the two groups were Information Processing and Pattern Analysis (IPPA) and the Knowledge Engineering Group (KEG). The establishment of 'Research Institutes', centres with international research leadership and critical mass, means that the School's research is now increasingly focussed. Therefore, in contrast to RAE 2008, the School has submitted as 3 UOAs spanning four themes. This submission addresses the theme of 'Complexity and Informatics'.

In 2008, IPPA consisted of the Neural Computing Research Group (**NCRG**) and additional activities in applied mathematics: the latter are being submitted to the General Engineering sub-panel in REF 2014. The NCRG's plans were to grow three additional research directions linked to various aspects of complexity, complementing the existing strengths in pattern analysis of data, by studying inference and optimization in large systems.

- *the study of cooperative behaviour in complex systems.* New appointments (some submitted to sub-panel 15) and a change of research focus for some existing staff have enabled the broadening of research in complexity. Research highlights include the use of message-passing inference for decentralised supply-chain formation and novel swarm algorithms for distributed task allocation which are analysed theoretically and empirically.
- *inference in telecommunication networks and computational complexity.* This strand of work, based on methods from statistical physics, has been very successful, with significant theoretical analyses that also have major practical implications. A recent advance in applying an understanding of the physics of polymers has led to a simple, generic, global route-optimization algorithm published in PNAS.
- *biomedical information analysis.* This area has been strengthened by the appointment of *Little*, with his high-profile successes in diagnosing Parkinson's disease from mobile-phone voice recordings (c. 580 citations since 2008; TED Fellowship; VRApp online voice symptom monitoring).

The NCRG changed its name (though retained the same initialism) to the Non-linearity and Complexity Research Group to signify its greater breadth. **NCRG** is headed by **Prof D Saad**.

KEG has broadened the range of its research, and this is reflected in the change of name to the Computer Science Research Group (**CSRG**). The CSRG, now headed by **Prof H Zhuge**, brings together expertise and resources from a number of computing domains, including knowledge engineering, computational intelligence, formal methods, HCI, visual information processing and autonomic computing. The theory and tools developed by the group are used in application domains ranging from health informatics to geoinformatics and cloud computing. The plans were:

- *to develop further the group's specialisms in health informatics, knowledge engineering and software engineering.* The GRiST system for mental health risk assessment is now in use in several NHS trusts and third-sector organisations (over 2,000 clinicians have provided 285,426 completed patient risk assessments for 52,334 patients). *Bencomo's* work in autonomous

systems (models@run.time) has established the research agenda in this domain (748 citations of two road-map papers).

- *to exploit opportunities for IP impact.* The GRiST and UncertML impact case studies provide evidence for successful IP exploitation. Research in computer vision for the creation of photo-realistic assets has industrial take-up in the development of the 'Call of Duty' computer game.
- *to pursue research in ontologies and the semantic web in order to classify, organise and share knowledge stored in diverse forms and a distributed environment.* New appointments have supported a significant growth in our activities in ontologies and the semantic web. The recent arrival of *Zhuge* promises to integrate this strand of research into applications across a very wide range of domains, with his leadership in the study of cyber-physical society (2000 citations since 2008).

Future Vision

The overall School strategy is integrated by the Research Strategy Committee, constituted by representatives of the groups including PhD students. Regular group meetings are used to review research directions, share ideas and technical developments. This Unit is launching a new Research **Institute in Big Systems Analytics,** led by **Prof I Nabney**, conceived in the broadest terms, which will incorporate both the research groups within this UOA and build on their existing close collaboration: indeed several of the highlights mentioned above have come about through joint work from both groups. The aim of the Institute is to become a leading international centre for research in *applicable* methods for modelling and controlling large-scale systems and extracting exploitable knowledge from huge amounts of uncertain, interconnected, multi-scale and multi-variable data. The fundamental goal is to empower non-statistically trained users to understand and control their domain. This requires a truly multi-disciplinary approach: system modelling using a combination of data analysis, simulation, and physical models; semantic models and probabilistic inference to integrate multiple sources of information; and innovative methods of presenting uncertain information to end users and supporting rational decision making.

Big Systems Analytics is a domain where industrial interest and need is expanding rapidly: a recent e-skills UK report predicted demand for professional expertise will rise by 92% in the next five years. It is recognised as strategically important by EPSRC (Digital Economy directly and applications in Digital Healthcare, Energy, Global Uncertainty) and EU Horizon2020 (Big Data, smart cities, human-centric digital age).

The University is investing in the establishment of the Institute, but its strong external focus and partnerships will sustain it in the future. The Institute will reinvest research income surpluses in pump-priming activities (e.g. proof-of-concept projects to support external funding applications and to demonstrate viability to industry), and will have strongly integrated end-user governance and collaboration with industry, the NHS and other public organisations, and professional institutions: more than 20 partners have already committed to supplying challenging data-intensive problems, internships, pilot projects and research workshops. An External Advisory Board will align the Institute's activities with the user need for skilled expertise, the international nature of the demand, and the multidisciplinary nature of the research. The Institute will initially comprise about 30 academic staff and more than 35 PhD students. It will work closely with other groups in EAS (particularly the Institute of Photonic Technologies), the School of Life and Health Sciences (Aston Research Centre in Healthy Ageing, Aston Brain Centre, bioinformatics (genomics, proteomics etc.)), the School of Languages and Social Sciences (forensic linguistics), and Aston Business School (forecasting, semantic web etc).

A key part of establishing this centre is to **develop a large-scale international and industrially-focused research training programme** to train an annual cohort of at least 15 PhD students. The programme will have a particular emphasis on industrial applications (every student will undertake an industrial pilot project), entrepreneurship (linked to the neighbouring Science Park), and bilateral international exchanges (building on existing partnerships such as IIT Ropar, Hong Kong Polytechnic University, Kaliningrad and RIKEN). We are proposing to create an EU-funded Innovation Training Network (ITN) in omnivariate data analytics in 2014. Complementing this, Aston is leading in the establishment of a new research-led university in Vietnam (VN-UK in Danang) for which we shall be providing PhD training for their staff in computing and informatics: the first three students will start in early 2014. More studentships (4 per year) will be funded as

Teaching Assistants on innovative industry-based degree programmes.

We shall **increase international collaborations for staff and students** using both internal funding and more applications to organisations such as the Leverhulme Trust, Royal Society and the Daiwa Foundation (the Institute has 6 overseas visitors in the current year). The UOA has recently recruited several international staff (*Vogiatzis*, *Little, Bencomo, He, Zhuge*) who bring their own international networks that will enhance the Institute.

We shall further develop our existing strengths in **multidisciplinary research and industrial collaboration**. The number of KTP projects continues to grow, and the use of paired academic supervisors will enable us to provide a broad and rich set of expertise to each project. We will also develop further our funding stream from the EU, broadening from the Framework programmes (e.g. the ADVANCE project funded under the Big Data call) to Marie Curie (Fellow and ITNs) and FET. The Institute will increase its currently successful industrial engagement activity by further partnering with companies in national, EU and US funding programmes with application and technology-transfer focus, such as TSB calls and the Centre for Defence Enterprise (the UOA has recently won grants from both schemes).

We shall increase the **direct industrial exploitation** of our research as a means of creating more impact and diversifying our revenue stream. Strands that are ready for exploitation include cloud computing management (using an autonomic computing framework) and 3D model reconstruction methods (with games and multimedia companies in the UK and USA). Aston Interactive Media (AIM) Lab (Section d) is attracting companies to carry out directly funded research and evaluation. In addition to collaborating with industry, we will exploit directly through spinouts and licensing, particularly in healthcare informatics (GRiST), spatial computing (IGI Ltd.), topographic visual analytics, inference and data-mining algorithms (building on the wide takeup of the Netlab toolbox).

c. People

i. Staffing strategy and staff development

Relationship to research strategy

Academic appointments are made where there is clear synergy with several existing researchers, and the research domain has clear applicability, in line with national strategic priorities. The level of experience and responsibilities for each post are also set to balance existing members of the group, to ensure that there is an appropriate mix of experienced and earlier career staff. This has enabled us to build a genuinely collaborative and multi-disciplinary research environment across both groups. Vacancies are advertised as well as notified within personal networks to maximise the potential of recruiting top quality candidates. Short-listed applicants are interviewed by a small panel, against specific criteria required for the role, so ensuring equality of opportunity. All new academic staff are initially on a 5 year contract with the expectation that these will normally be renewed without end date. Induction and mentoring is provided for new staff, with online and more personal support. There have been a significant number of new appointments: in CSRG seven since 2008, of whom four have been promoted from Lecturer to Senior Lecturer, including a Professor and a Senior Lecturer; in NCRG one Lecturer in this UOA and four more in applied maths who will be joining the Institute. These appointments have strengthened our activities in biomedical signal analysis, software engineering, and the semantic web. The collaborative environment is enhanced by the co-location of academic staff on adjacent floors of Aston's Main Building, a joint seminar space, and mixing research students from both groups in two large open-plan offices. This existing synergy will help promote the establishment of the Institute.

Career development support and the Researcher Development Concordat

The University Action Plan implementing the Concordat (first set out in 2009, reviewed and updated in 2012), won an HR Research Excellence Award from Vitae in 2010 (one of the first to receive the award) and renewed in 2012. Activities include: improving information and training for managers on recruitment and supporting researchers; participating in and developing actions from PRES, PIRLS and CROS surveys; monitoring and mentoring research staff; applying for Athena Swan awards. The University Performance Development Scheme is used for all academic staff (including RAs and Fellows) and includes an annual review by managers and plans for research, with training and support as appropriate for each individual. All staff are encouraged and supported to achieve promotion, with University criteria considering achievements in research alongside generating impact and teaching.

The Research Support Office (RSO), through the EAS Research Development Manager (RDM), provides specialist support for research proposal development. The RSO provides advice from initial training on the range of schemes available for research, to intensive support for multi-national multiple partner proposals; they support the Aston PI when preparing bids.

In the UOA staff development has focussed strategically on: 1) developing Early Career Academics; 2) increased bidding for EU funding; 3) support for developing impact from research.

1) All newly appointed staff have £10k start-up fund and a school-sponsored PhD student to support their research programme. This has led to research awards for ECRs, particularly Royal Society Research Grants and Royal Academy of Engineering Distinguished Visiting Fellowship. Current awards to ECRs include:

- A highly prestigious Welcome Trust MIT Fellowship;
- An award from the Michael J Fox Foundation;
- A Royal Academy of Engineering UK-China Research Grant.

All ECRs develop a five-year research plan with the RDM that is reviewed every six-months. All ECRs have an experienced research mentor from within the UOA, who advises on and reviews proposals before submission, introduces ECRs to research networks, etc.

2) Bids for EU funding have increased significantly. This has been achieved through intensive training, targeting of specific calls, promoting success and sharing best practice. The impact has been profound; with successes in Framework programmes (5 and 6), and a steep increase in awards, mainly from the Marie Curie programme.

3) The UOA has supported staff involved in generating impact: *Buckingham* had a reduced teaching load to enable him to establish an online system for "GRiST" and develop an income stream from end users; *Cornford* works part-time while establishing a software development company within IGI (see impact case studies submitted). Industrial impact and spinouts are an important part of the Institute's plans, and it will be investing in staff time to make these a reality.

The RSO is planning a strategic approach to Horizon 2020 opportunities and assistance with 5-year research planning extended to all academics; the aim is to link group and individual strategies closely. Briefings on Horizon 2020 have been held. The RSO also supports targeting of the 'gold standard' funding streams for leading academics, such as the European Research Council, Leverhulme and EPSRC Fellowships.

Personal Research Fellowships

Research Fellowships are a way of bringing new skills into the research group either through incoming visitors or by Aston staff studying in other centres (and thus creating additional external impact). *Little* has been awarded a Welcome Trust-MIT Fellowship: he was a TED Fellow in 2012, which was very valuable in building a higher profile for his work and recruiting other researchers in collaborations. *Zhuge* is an RAE Distinguished Visiting Fellow which enabled him to promote the concepts of the Knowledge Grid and Cyber-Physical Society across the UK. *Bencomo* was a Marie Curie Fellow before joining Aston. *Bastin* carried out a year's Fellowship on secondment at JRC Ispra. This has enabled her to put fundamental work in modelling uncertainty in web services into real-world environmental systems.

International Staff

Both groups contain a significant number of international staff, which helps to support international collaborations: the NCRG has 7 academic staff from overseas, while the CSRG contains 9 international academic staff. Links are also maintained with former students and PDRAs who have moved to international academic appointments or returned to their home country having been sponsored for their Aston research qualifications (e.g. Woon – UAE, Csato – Romania, Herzallah – Jordan). The groups have hosted upwards of 35 international scholars during the period, including Prof. Makoto Taiji group leader at the RIKEN Advanced Institute for Computational Science (RAEng Distinguished Visiting Fellow).

Equality and Diversity

The University has a well-established equality and diversity policy and code of practice that is adopted by all research students and staff. The Equality Action Plan is reported on and published annually. At UOA level, for example, meetings and events are organised considering personal needs especially part-time workers, and returners after longer absence are updated appropriately. The University has the Athena Swan award at bronze level and EAS is applying for a silver award:

most of the case studies are drawn from this UOA. For example, **Lumsden** established the Aston Interactive Media (AIM) Lab – she says *"…would not have been possible without the encouragement and support of the group. The lab has enabled me to establish my research group at Aston which didn't exist before."*

The gender mix of academic staff in Computer Science is 50:50. Five of the eight senior lecturers in the group are women. **Ekart** has been selected for the **New Leadership Foundation "Developing Women Leaders for HE"** programme. The mix in the NCRG is more imbalanced; we are working to improve this and by following the best practice of the LMS report on Women in Mathematics we have recently recruited a second female academic.

ii. Research students

Recruitment

Specific research studentships are advertised mainly through electronic fora. Speculative enquiries are also received from potential students. The EAS student recruitment team first check the essential qualifications of applicants, before academic judgements are made though interview of those short-listed by the potential supervisor and another appropriate member of academic staff. Students are assessed to ensure they have the academic potential and personal qualities needed to succeed in research.

Training and Support

All research students in EAS are enrolled with a primary supervisor and an associate supervisor, who may be from a different research group or School. This provides students with a broader context for their work (often increasing its multidisciplinary nature) and also means that there is a second staff member available if there is a break in the main supervisory relationship (for example, if the primary supervisor leaves the university, as was the case for two PhD students during the census period: both have been awarded their doctorates). Supervisors are (re)trained every 3 years. Supervisors have the key responsibility of introducing PhD students to the international academic network in their chosen specialism and wider technical and professional stakeholders.

All research students at Aston are members of the University's "Graduate School". Established in 2010, this now provides a supportive environment for research students across the University, to widen and enrich their experience. It also brings together the responsibility for maintaining the Quality Assurance of research studies and training in core research and transferable skills, thus enabling all research students studying at Aston to realise their full potential, whichever career path they choose. The Graduate School runs an induction session for new research students and provides a comprehensive "handbook" that covers both formal University requirements and practical help for students new to Aston and the City of Birmingham.

To help first-year research students become familiar with their new environment, each has the option of a peer mentor. EAS holds induction events quarterly, that provide information about the School, research groups, training opportunities, research skills development, progress monitoring and personal support from the School and University. As part of this induction, new students meet key University staff including School Associate Dean for Research, Director of Research Degrees, research administrators and Research Student Society representatives.

Training of research students is fully compliant with the Researcher Development Framework. At the start of their studies, each student meets their primary and associate supervisors to agree their personal "Learning Agreement", which includes their research objectives and "Training Needs Analysis", as well as defining mutual responsibilities and ownership of research outputs. Training needs may be modified according to the project progress and development of the student. Training activities are recorded and reviewed in annual progress reports. Research students are required to complete at least 90 skills/training hours by the time of thesis submission. EAS requires all research students to pass a three-day intensive Research Skills module in their first year and prior to the student being registered as a full PhD student. This includes basics such as literature review, academic writing and teamwork.

Research students can access a variety of transferrable skills and personal development courses through the "*ResearcherPlus*" facility provided by University. Not only do these help them conduct research more effectively and succeed in their degree programme but they also build up ability and skills that will prepare them for future employment. These courses cover areas relating mainly to the Personal Effectiveness and Research Governance aspects of the Framework: Personal Skills

and Effectiveness; Professional and Career Development Skills; Working with Others; Communication Skills; Business Skills; Academic Writing Skills; IT Skills. Towards the end of their PhD, students are supported in finding employment either in academia or elsewhere, to match their individual interests, eg with CV preparation and interview skills appropriate to PhD level people.

Domain-specific knowledge is provided mainly through Master's level courses; research groups and Schools provide subject-specific postgraduate training and development, and additional technical training can be met through courses run by the University (e.g. software packages) or externally (e.g. the Academy for PhD Training in Statistics).

PhD students have the option to work as laboratory demonstrators or teaching assistants; if they do so, they undertake training to help them interact effectively with students. In addition, they are encouraged to take further training through the Aston Certificate in Learning & Teaching; this is particularly valuable for those who progress to academic careers. Students in the UOA have also supported outreach courses (e.g. Headstart) by writing software and leading lab sessions.

English courses, run by the School of Languages & Social Sciences, are available for applicants who wish to improve their English and the University-wide Language Programme offers foreign language training which particularly useful for students collaborating internationally.

The Research Student Society was established (in 2008) by a PhD student in the NCRG with the support of *Lowe*. The Society promotes both formal and informal events that bring all EAS research students together on a regular basis; this has been so successful that the Graduate School is developing similar societies in the other three Academic Schools. Students have invited high profile speakers to Aston, for example, Prof Kevin Warwick from Reading University.

Progress Monitoring

Guided by University regulations and policies, supervisors monitor their students and degree programmes regularly and vigorously to ensure that research students are progressing satisfactorily and receiving sufficient support to reach their full potential. Supervisors meet with students at least weekly, often more frequently, and formally have a recorded meeting at least quarterly. In the few cases where problems arise, these are investigated by the Associate Dean for Research and the Director of Research Degrees.

Before the end of the first year (second year for part-time students), all students are required to submit a Qualifying Report (approximately 6,000-10,000 words) to their primary supervisor and associate supervisor: this report must include a literature review, a methodology section, a description of research already completed and a detailed plan for the remainder of their research. The report is critically assessed by a viva examination. Together with passing the Research Skills module, successful completion of the report and viva permits the student to transfer to the PhD degree programme, or progress to the second year for MPhil.

The Graduate School has introduced a new progression monitoring policy requiring all second year students to prepare either an article for submission to a peer-reviewed journal or to give a conference paper to members of their academic subject group. Critical feedback on the paper or presentation is provided by the supervisory team.

d. Income, infrastructure and facilities

The two groups are co-located in Aston's main building with a mix of individual offices and shared workspace for group discussions. PhD students (from both research groups in shared rooms), RAs and staff are all integrated in contiguous space. The groups use high-performance computing facilities on a local network, including three computer clusters (one of 234 cores), two shared clusters (both of 256 nodes: an IBM x3750 cluster with 256 nodes (£118k) established in 2013, and an SGI cluster with 256 nodes established in 2007), and an Informatics Laboratory with its own dedicated LAN, data storage and archiving facilities separate from the University facilities. In the more specialised domain of visual and interactive computing, the University has invested £100k to establish the AIM (Aston Interactive Media) Lab for the design and evaluation of novel (typically mobile) interaction technologies, computer vision and video data capture. Further University investment is planned for the Institute with an additional cluster computer (particularly to support increased numbers of research students and industrial projects) and a cave/motion capture system (for joint research with the School of Life and Health Sciences). The University is funding a £1.75m refurbishment of the physical infrastructure in 2014.

Research funding portfolio and plans

Funding for research comes mostly from the European Commission (£1.67M to Aston) and also the EPSRC, BBSRC, RCUK, TSB and direct industrial sponsorship. The unit's good international network and strong focus on external impact has made European funding particularly successful. Projects have ranged over a range of domains, including sustainability (green networks, global earth observation), logistics decision support, and human interface technologies.

The diverse theoretical and practical applications of our research are reflected in the variety of funding sources, which include the UK research councils, the National Health Service, industry (through Knowledge Transfer Partnerships and CASE studentships), charities, the EU, and direct industrial funding. Most of the research projects run by the CSRG are multidisciplinary and bring together two or more group members to form a team with the necessary skills. Evidence for this can be found in the large number (7 since 2008) of KTP projects carried out by members of the group for SMEs across the region, in sectors as diverse as manufacturing scheduling, traffic and spatial information management, health informatics systems, and football scouting. In addition, there have been 5 CASE studentships and 4 students directly funded by industry.

The Institute will have considerably more devolved authority over its funding: a significant fraction of the indirect costs will be retained by the Institute (£150k in 2013-4), which will enable it to be more strategic in its approach. This will be used to **support additional research students** (in line with the research training focus), **pump-prime new multi-disciplinary research collaborations**, and **establish a group of industrial sponsors** who will benefit from the new technology developed, specially designed training courses and research students carrying out mini-projects. 20 external partners have already expressed the intention of collaborating with the Institute. The University has funded 4 new lectureships and one new Chair in this domain, and we will be making at least three further appointments, in the management of "Big Data", in the next year.

Consultancies and professional services

Consultancies and "business assists" play an important role in the UOA's strategy for engaging with end users. In many analytics problems, there is value in a pilot stage to assess the feasibility of an approach or to gauge the likely value of providing a solution. A short consultancy project (involving an academic together with a PhD student or PDRA) is frequently the best way to answer these questions, and is particularly suited to engagement with SMEs. Many of these projects lead on to larger activities, either directly funded or co-funded through CASE, TSB etc. *Nabney* worked with Select Research to provide the statistical underpinning to the Body Volume Index, a principled replacement for the BMI obesity measurement. Other consultancies include WheelRight, ForensicPathways, and Daden. To pump-prime these activities the UOA has used direct industrial funding, INDEX (Innovation Delivers EXpansion) innovation vouchers for SMEs and ERDF (TouchDigital for interaction technologies).

e. Collaboration and contribution to the discipline or research base

The strategic focus of the new Institute on multidisciplinary, international and applicable research follows logically from the nature of the research domain and our past success in working internationally and with industrial end users.

Much of our research is **collaborative** with both national and international partners. Academic collaborations include: Coordinator of EC FP7 project UncertWeb (2010-2013, 8 partners, worth €3M, £600K to Aston); ADVANCE FP7 project (£1.8M, £500K to Aston); PI and part of management team of the EC FP6 project INTAMAP (2006-2009, 8 partners, worth €2.5M, £250K to Aston; PI on the EC FP7 project GeoViQua (2011-2014, 9 partners, €3.5M, £275K to Aston); RCUK-funded MUCM and MUCM-2 projects (5 university partners with many industrial collaborators, over £3M, £400K to Aston); PI and leader of EPSRC funded VISDEM project on advanced methods for data assimilation (2006-2010, 3 universities, total grant c. £1M).

We also encourage collaborative research links via **staff secondments** and research visits with international groups such as: RMIT University, Melbourne, Australia (*Bastin*); Joint Research Centre of the European Commission (*Bastin*); University of Queensland, Australia (*Bastin*); Department of Sustainability and Environment, Victoria, Australia (*Bastin*), MIT Media Lab (*Little*), Johns Hopkins Medical Institute (*Buckingham*, *Little*), American Foundation for Suicide Prevention (*Buckingham*), INRIA Bordeaux (*Little*), University of New Brunswick (*Lumsden*), Hong Kong University of Science and Technology (*Saad*).

In addition to consultancy projects, *Cornford*, *Little* and *Lowe* are Directors of research-oriented SMEs (IGI Ltd, NumericAnalysis Ltd, TFL Ltd respectively). In addition to our strong record in

industrial collaborations through KTP and CASE awards, our strategic focus on the **transfer of research into the discipline user-base** is evidenced by a large number of industrial collaborators, including: Pfizer, Rolls-Royce, Agusta Westland, IGI, E.On, Daden, Forensic Pathways, Factory Master, Black Pepper, Wheelright (*Nabney*); Dunstall Design Consultancy, Bubblequest (*Bastin*); Mayden, Raphael Healthcare, Priory Hospitals, Mental Health Matters (*Buckingham*); Palletways (*Buckingham*, *Ekart*); Intel Corporate Research, British Geological Survey, Home Office Scientific Development Branch, Hydro-GIS Ltd, HR Wallingford, PatientsLikeMe, Twilio, (*Little*); Thales, Dstl, McLaren (*Lowe*). This strong network forms the basis of our strategy for the industrially focused activities in the Institute.

The collective **contributions to the scientific community** are exemplified by the Netlab suite of pattern processing and machine intelligence software under the leadership of *Nabney* (http://www1.aston.ac.uk/eas/research/groups/ncrg/resources/netlab/) distributed under the Creative Commons licence with over 40000 downloads, and *Rebollo-Neira's* Encrypted Image Folding Software (http://www.nonlinear-approx.info/code/index.html). Individual staff contributions to the academic community include: Chair Natural Computing Applications Forum (*Nabney*), Advisory Panel member to the Leverhulme Foundation (*Lowe*), Member of Quality Assurance for Earth Observation Group (*Cornford*), Steering Committee International Spatial Accuracy Research Association (ISARA) (*Bastin*). Contribution to academic review bodies, includes: EPSRC College (*Nabney, Saad)*; Irish Research Council for Science, Engineering and Technology (*Nabney*); Medical Research Council (*Bastin, Buckingham*); Natural Sciences and Engineering Research Council of Canada (*Bastin, Lumsden*); EU FET-OPEN (*Chli*); Kyoto Prize (*Zhuge*); Academy of Finland (*Nabney*). We also contribute to the community through journal editorships: Associate Editor of Quarterly Journal of the Royal Meteorological Society (*Cornford),* BMC Medical Informatics and Decision Making (*Buckingham*), Journal of Neural Computation and Applications, Genetic Programming and Evolvable Machines (*Ekart*), International Journal of Agent Technologies and Systems; International Journal of Communications in Information Science and Management Engineering (*He),* Editor-in-chief, Journal of Mobile HCI (*Lumsden),* Associate Editor: IEEE Intelligent Systems; Knowledge and Information Systems, Guest Editor: World Wide Web Journal; Future Generation Computer Systems (*Zhuge*). The academic quality of contributions to discipline development is seen in individual **awards**: Wellcome Trust-MIT personal fellowship; UNESCO Netexplo 2013 award; TED fellowship 2012 (*Little*), best paper 2010 GIS Research UK Conference; 2012 Outstanding Reviewer Award for Environmental Modelling and Software; 2013 OpenMI award at the International Environmental Modelling and Software Society; 2012 Outstanding Publication award from the Academy of Management (*Bastin*), ACM Distinguished Scientist, BCS Fellow and IEEE Senior Member (*Zhuge*).

Individual contributions to supporting the discipline base through **involvement in conferences** are exemplified by: *Bencomo* Programme Chair SEAMS2014, co-organizer of 15 international workshops, including Dagstuhl seminar models@runtime; *Cornford* organiser and session chair of EGU, 2011-2013; and on the organising committee UCM2010; *Chli* Program Committees of AAMAS, EUMAS and IJCAI conferences; *Ekart* co-chairing EuroGP 2010, EvoNum event, 2008-2012, GECCO GP track 2012-13, Programme Committees of GECCO, PPSN, EUROGP; *He* Program Committees of AAMAS, IJCAI, PRICAI, and ICAART; *Wang* Programme Chair 7th International Symposium on Theoretical Aspects of Software Engineering; *Zhuge* Co-chair and Program co-chair of the International Conference on Semantics, Knowledge and Grids (2008-2013), International Conference on Cooperative Information Systems 2009, and senior Programme Committee Member – ACM CIKM 2010, ISWC2012.

The UOA has a strong record in **public dissemination by staff and research students**, from lectures to the British Science Festival, to individual talks: Royal Society public talk 2013, TED conference speaker 2012 and 2013 (*Little*), and TEDxBrum 2013 (*Bastin*). Several keynotes have been presented at influential academic meetings, e.g.: the Microsoft New Faculty Summit for Computer Vision 2012 (*Vogiatzis*), Dept. of Veterans Affairs, USA (*Buckingham*), Royal Meteorological Society National Meeting (*Cornford*), Grid Computing: the Next Decade; IEEE Conference on Collaboration Technologies and Infrastructures; IEEE Conference on Advanced Information Networking and Applications (*Zhuge*), Dagstuhl in data visualisation 2012 (*Nabney*), and 8 conference keynotes (*Saad*).