Institution: University of Chester

Unit of Assessment: 11: Computer Science and Informatics

a. Overview

Research in computer science and informatics is undertaken within the School of Computer Science and Mathematics which has recently been incorporated into the new Faculty of Science and Engineering and is led by AVIS. Computer Science and Informatics staff and research students are co-located with colleagues from Mathematics under a single Head of School with shared computer, technical support and administrative services. Within the overall University Research Strategy, computer science and informatics research is regarded as a focus for growth and the University has committed to support and invest in the work of the School, as evidenced by its move from the Faculty of Applied Sciences to the new Faculty of Science and Engineering and the recent appointment of additional researchers. From 2013-14, the new Faculty will be based at the Thornton Science Park (the former Shell Thornton Research Centre). This will lead to a growth in the strength of computer science and informatics research at Chester and is reflected in our future plans. New collaborative developments with Science and Engineering faculty members alongside existing joint work with colleagues from Mathematics, and strengthened R&D activities taking place on the Thornton Science Park play a key part in these future plans.

b. Research strategy

Research in computer science and informatics at Chester is applied in nature and encompasses the broad themes of a) User Generated Content, b) Optimisation and c) Human in the Loop systems. These broad themes interact at their boundaries and are underpinned by research into various supporting infrastructures such as ontologies and remote rendering. Whilst the submitted team is small, their individual contribution in their chosen fields is strong and with direct application. The work of the Informatics Centre within the School represents just one way in which our research work is applied through interactions with local businesses. The aim is to expand this core of research active staff to include a focused group of researchers who work together and who collaborate with other research groups within Chester, the rest of the UK and from around the world taking full advantage of the opportunities presented by the University's acquisition of the Shell Thornton Research Centre and the recent establishment of the Faculty of Science and Engineering.

User generated content

AVIS is one of the architects of COSMOS (Collaborative On-Line Social Media Observatory), designed to promote closer collaboration between computer and social scientists in the area of social media data analytics and visualization, which has been identified as a key area of innovation in social research. This system allows the harvesting, analysis and visualization of publically available social media data such as Twitter tweets with applications in monitoring social tension and hate speech. The system was recently used to monitor events surrounding the funeral of Baroness Thatcher and identified events ahead of reporting on national broadcast networks such as the BBC. The COSMOS system is supported by grants from JISC, ESRC and sponsorship by Google.

KERINS has researched novel forms for information retrieval associated with user generated content via the use of ontologies with applications in image retrieval and developed information system frameworks to support teaching and learning within modern language departments. This interest in teaching of foreign languages has recently extended to include computational discourse modelling techniques in collaboration with Ramsey from Manchester. These techniques have resulted in a novel system capable of capturing key elements of written narratives and prompting learners' awareness of language use, particularly tense and aspect in a visual form.

Using Higher Education Innovation Funding monies KERINS has established the School's Informatics Centre which provides a sandpit for education research as well as providing a physical environment to support academic–industrial exchange.

Human in the Loop systems
STEWART has researched means of reducing F16 fighter pilot fatigue in combat situations by the application of fuzzy logic techniques to assist pilots' performance. Trials were successfully completed in a high fidelity flight simulator with RAF test pilots. Computational demands and latency issues were explored and linked to flight dynamics models to inform aircraft control surface deployment. This work won the Charles Sharpe Beecher Prize from the IMechE Aerospace Division for best paper in 2010.

AVIS led the successful Research Aware Visualization Environment (RAVE) project whilst at Cardiff and has undertaken research related to visualization ontologies to allow automatic processing of datasets and his recent research has centred around visualization, presentation and displays to support decision making and collaborative working.

AVIS has been researching novel visual and haptic displays for pharma, surgical and medical simulators and has previously worked with the Chief Scientific Advisor to the Welsh Government's Health Minister to improve the training of therapeutic radiographers in Wales via the use of large scale immersive passive stereo 4K Ultra High Definition displays.

Patients and ultrasound practitioners worldwide are benefitting from new innovative computer based training methods arising from research conducted by AVIS and via a university spin-out company MedaPhor Ltd (AVIS is Scientific Director). Benefits achieved include improved training procedures, better patient experience and cost savings for hospitals. MedaPhor Ltd, through commercialising this research has recorded year-on-year increases in sales to leading hospitals in Europe, the USA and Australasia with over 120 systems sold, creating growth in turnover and creating new jobs.

Optimisation
STEWART has undertaken research in the use of multi-objective optimisation techniques in a number of application areas. Insights from this research have resulted in shape optimisation of compressor impellors to improve efficiency and extend their operational envelope using differential evolution multi-objective (DEMO) techniques.

MORGAN's research ranges from network planning and optimisation through to logistics with expertise in combinatorial optimisation and heuristics. He has worked with TATA Steel on packing issues and logistics, including investigating algorithms for efficient loading of steel tubes. MORGAN's PhD thesis, entitled "Optimisation Techniques for Wireless and Optical Networks", was nominated for the BCS/CPHC "Distinguished Dissertations" award in 2010 on the basis that the developed algorithms significantly outperformed any previously published alternatives for the minimum k-connected m-dominating set problem, thereby minimising the implementation cost of network backbones by optimising the location of more expensive hardware.

AVIS has researched techniques to accelerate applications using multicore architectures and feature the use of machine learning and optimisation techniques to allow the automatic porting and refinement of legacy code to GPGPUs and ASIC multicore processors, achieving c. 80% of speedups achieved by experienced parallel programmers on the same computational platform.

Vision
Research in the Unit is led by the Executive Dean of the Faculty of Science and Engineering (AVIS). The overarching aim over the next five years is to develop a research centre with critical mass, with at least two areas of research focus with recognised outputs of international excellence, and to build on the world-leading facilities at the Thornton Science Park to develop strong interactions with industrial and commercial users.

The mechanisms that will be used to achieve this include:
- the new group, chaired by Ford (the University's Executive Dean of Research and Director of the Mathematics Research Group), to explore and encourage collaborative research between existing researchers and new members of the Science and Engineering Faculty;
- developing a transparent, facilitative structure for research, including specific support for

conference participation and collaborative research visits;
- increasing the numbers of research active staff through new appointments and through funded research projects;
- increasing research and consultancy income;
- increasing research student activity through a focused campaign to attract students to the Thornton Science Park;
- further strengthening and supporting the development and research capability of the Informatics Centre to ensure it can maximise the opportunities that arise from developments at the Thornton Science Park and the establishment of the new Faculty of Science and Engineering;
- working closely with colleagues from the Mathematics Research Group in developing mutually beneficial collaborations.

c. People, including:

i. Staffing strategy and staff development

This is the first submission of staff from Chester to this Unit of Assessment. Within the current REF census period there has been on-going research activity by a core of existing staff. Going forward a key strategy in the appointment of new academic staff is how their appointment will contribute to the research work of the School of Computer Science and Mathematics. The acquisition of the former Shell Thornton Research Centre provides the base to develop and grow the new Faculty of Science and Engineering and the inclusion of both computer science and mathematics in the new Faculty has provided the opportunity for further growth in computer science and informatics research. Appointments to the new areas of work have taken account of existing areas of research interest and strength and recent appointees to the new Faculty are included in this submission. AVIS, MORGAN and STEWART undertake work on optimisation, on modelling and on parallelisation, which complements existing strengths in the Mathematics Research Group, where the research focus is on modelling using differential and integral equations and developing efficient and reliable computational simulations. This demonstrates the strong prospect for future joint work between these groups.

The School and the University are strongly committed to the development of all staff of the University. This was recognised externally by the recent award to the University of the HR Excellence in Research Award which demonstrates a commitment to implementation of the *Concordat to Support the Career Development of Researchers.*

All new academic staff of the University are supported through an accredited programme leading to a Fellowship of the Higher Education Academy. A particular feature of the Chester programme is that the compulsory core modules provide developmental support, helping and encouraging newly appointed staff to understand the demands and opportunities of research supervision, and encouraging them to study a further optional module that develops skills in supervision to an even higher level.

The probationary and induction programmes are interlinked and ensure that all new members of staff are introduced to a wide range of facilities and policies. These include access to colleagues from the Research and Knowledge Transfer Office (who can provide assistance in applying for grants and setting up R&D contracts), and colleagues in the Graduate School who can help to advertise research projects and to interview and admit potential research students.

There is a formal and annual Performance and Development Review (PDR) process which involves a paper-based preparation exercise and then a detailed discussion of objectives with a line manager. The objectives established through this process can lead to further training and development opportunities and frequently provides access to funding for research collaborations, for conference travel and encouragement to advertise PhD and other project opportunities on the University web site.

The University has established (through the Research Committee) a forum for early-career staff to enable networking across subject and discipline boundaries and to help identify and address

common problems and allow issues to be raised at policy-making level. There is also a new group, chaired by the Executive Dean of Research, to explore and encourage collaborative research between existing researchers and members of the new Faculty of Science and Engineering.

The University's Annual Staff Conference is an all-day event held each year and attended by a majority of academic staff. Research is featured within the conference through several parallel sessions which showcase successful projects, explore opportunities to develop impact, and a sharing of good practice in grant applications and management, collaborative initiatives, and understanding good research governance.

The University has also established the International Research Excellence Awards (funded through the Santander Universities scheme), which offer grants to encourage international research collaborations. These can help support short-term and long-term research visits between University staff and collaborating universities. The scheme has been a very welcome and effective development for the School of Computer Science and Mathematics and has been used to support and develop ongoing collaborative links, including international co-supervision of both post-doctoral fellows and PhD students. The School also provides its own separate budget to support research visits, conferences and other opportunities that might fall outside of the International Research Excellence Awards, so that researchers in computer science and informatics are able to pursue effective research collaborations.

Erasmus exchange programmes have also been established within the School to enable research students and supervisors to undertake exchanges with the School's regular collaborating partners.

Staff development weeks are held twice per year and seek to address needs identified through the annual PDR process, as well as to introduce new systems and policies. Research grant applications processes, mentoring and supervision skills feature regularly in the programmes.

The University of Chester supports activities promoting equality and diversity. There is a long-established annual University Diversity Festival to which all staff and students are invited. The University has a Disabled Staff Group that has been active since 2007 and provides a safe and supportive environment in which to discuss issues relating to disability. The Human Resources Department monitor regularly for equality issues as part of the recruitment process for staff and funded research students, and the University is currently working towards an Athena Swan award.

ii. Research students

The School of Computer Science and Mathematics has a regular population of PGR students studying on the MPhil/PhD programme. Since the School does not currently qualify for a DTA allowance from EPSRC, students are predominantly from overseas, or self-supporting part time home students. The School's approach to recruitment is to focus on publicising its research focus to potential students to ensure that there is a close match between applicants' and supervisors' research interests. Applicants who meet the entry requirements are interviewed by at least two members of the School's staff, and a decision as to whether a place should be offered is made based on their experience, quality, and the fit of their research interests.

The University meets the requirements of Chapter B11 of the QAA Quality Code: training and support for PGR students is a shared responsibility at Chester, between the Graduate School (with responsibility for providing generic training and support) and the subject department, which provides supervision and specialist training and support. PGR students are offered face-to-face training sessions by the Graduate School, supported by a Moodle site providing on-line access to training materials written and contributed by academic staff from across all subjects and faculties. Students experience both a central University induction, and a local induction within their department, so that they have a full understanding of the regulations and services provided by central support departments as well as of the local support staff and facilities in the building where they are studying. All students undertake a skills audit to help them to identify their training needs, and they are welcome to attend taught sessions from within the postgraduate curriculum, as well as seminars and training sessions specifically designed for PGR student needs. Students who will be involved in

teaching are expected to undertake specific training to prepare them for this activity, and may, if they wish, undertake modules leading to Associate Fellowship of the Higher Education Academy, which provides a good basis for future applications for academic posts.

Data collected as a result of the Postgraduate Research Experience Survey indicates a significant level of satisfaction with the service and support provided to PGR students. In previous surveys, an action point was noted to improve preparation for viva examinations. Further training sessions with this focus have been offered recently, and in the most recent PRES survey 100 per cent of students responding to the survey considered that they had been well-prepared for their examination, which we believe demonstrates the University's and School's commitment to providing an excellent environment for PGR students.

Every student is supported by a team of at least two approved supervisors, one of whom is designated Director of Studies, and who has supervised at least one student to successful completion of the award. Supervision meetings take place frequently, with at least one meeting per month being recorded with outcomes and targets. Following a probationary period of 6-9 months, student progress is reviewed formally. If the student's registration is confirmed at the probationary review, a termly meeting of the full supervisory team reviews progress with the student subsequently and a Progress Review (chaired by an independent academic staff member and held in every year of study) reviews progress against objectives and expectations on an annual basis before the Annual Progress Board meeting. Students must submit a report, give a seminar and attend an interview before their upgrade from MPhil to PhD status can be confirmed. There is a similar rigorous process to consider applications to transfer to 'writing up' status. Each faculty has at least one Faculty Postgraduate Tutor who is available to see PGR students by appointment and to resolve any issues or questions they may have. Postgraduate Tutors represent their faculty and its students at the regular Graduate School meetings and also represent the Graduate School as appropriate in their faculty.

The University recognises the value of conference participation for all PGR students and has established a fund to provide a contribution to conference attendance. Each year applications are invited and all successful applicants are provided with financial support.

d. Income, infrastructure and facilities

The University of Chester Seaborne library is a key resource for computer science and informatics research. We subscribe to over 1,000 printed journals and more than 13,000 electronic journals which can be accessed online. There are approximately 260,000 printed volumes and 15,000 e-books. In the library, there is 24/7 access to computers, printing and quiet study space throughout the year

The IT infrastructure provides all the usual facilities for staff and students, including office-based and open access computer facilities with relevant software, including Latex, Matlab and SPSS. A Remote Desktop facility means that all the software can be accessed by users remotely as well as when present at the University campus.

At the new Thornton site, which will be a major base for the University's Faculty of Science and Engineering, there will be an investment of £22 million over the next 3 years in a site with an existing value of in excess of £120 million. The arrival of major companies on the new science park adjacent to the Faculty, and the significant investment in new facilities on the site presents an exciting opportunity for the computer science and informatics team to grow, to engage in new collaborations with researchers from engineering and technology and to develop new areas of research impact. With this in mind, the University Senate has established a working group, chaired by the Executive Dean of Research, to promote and develop these collaborative links.

e. Collaboration or contribution to the discipline or research base

Support for collaborations lies at the heart of the Unit's resource planning. Work with long-term collaborators is supported through a research support fund maintained by the School. The fund can be used to support travel for collaboration and conference attendance, and is augmented through the University funding provided through the International Research Excellence Awards, for example. The most significant current collaborative links are those between KERINS and Ramsay (Manchester) on NLP, AVIS and Rana (Cardiff) on social media data analysis and visualization, and STEWART and Stewart (Hull) and Gladwin (Sheffield) on generalised parameter-free optimisation and search methods (currently being developed into a cross disciplinary project with Fernig (Liverpool) on the modelling of gold nano-particle motion within living cells).

Among contributions to the discipline, we identify the following:

AVIS

- Chair of e-science/e-research visualization workshop at the IEEE/ACM International Symposium on Clusters, Clouds and Grid Computing in May 2009; EG-UK 2010 (short paper co-chair) and IEEE DS-RT (2011);
- EPSRC Peer Review College member;
- Previously lay partner member of the General Medical Council (GMC) and before that the Postgraduate Medical Education Training Board (PMETB) in recognition of his successful and innovative use of technology in medical teaching and training;
- Deployed and managed a number of world class large scale immersive visualization and virtual environment installations and is currently involved with a JANET trial of Ultra High Definition video content between Cardiff, Bristol, Essex and Glasgow universities in the UK and Posnan Supercomputing and Networking Centre in Poland;
- Secured donations and other gifts to assist research activities in the current REF census period from Sun Microsystems Limited, Sony Europe, Nvidia Corporation and the British Museum;
- Worked with the Chief Scientific Advisor to the Welsh Government's Health Minister to improve the training of therapeutic radiographers in Wales.

STEWART

- Chair of Special Session on Complex Networks in Signal Processing and Communication Systems, IET 8th International Symposium CSNDSP, 18-20 July 2012;
- Editorial Board for the AETN monographs (Springer) to be published in 2014;
- Advisory Board, IMechE Academic Standards Committee;
- Worked as Principal Investigator and Co-Investigator on a range of projects with Siemens Industrial Turbomachinery Ltd since 2010;
- Co-Investigator on the EU 7th Framework Programme project, ACHEON – Thrust Vectoring for Advanced UAVs from 2012;
- Worked on a KTP with Napier Turbochargers: Aerodynamics Design of a Novel Wide Operating Map Compressor from 2011.