Computer science and informatics research at the University of Westminster is focused within five research groups: **Computer Vision and Imaging Technologies**; **Data and Knowledge Management**; **Distributed and Intelligent Systems**; **Centre for Parallel Computing**; and **Theoretical and Scientific Computing**. During the period 2001-2007 the groups have attracted a combined total of £1.5 million in research funding from international and national bodies such as EU, EPSRC, DTI and industry. They published 169 refereed journal and 226 conference proceedings articles, 12 monographs and edited books as well as 218 book chapters (listed in full at http://westminsterresearch.wmin.ac.uk/). 18 PhD and MPhil students have completed successfully. There are currently 6 research fellows and 28 PhD students, of which 10 started Sept 2007.

Infrastructure, facilities and administrative support

Research is hosted and supported by the Harrow School of Computer Science and the School of Informatics, who manage the physical resources (research laboratories and related infrastructure), and staff (academic, research, technical and local administrative). There is also joint research activity in the area of imaging technology with staff from the School of Media, Art and Design (Triantaphillidou). The Schools have a research group structure which transcends department and school boundaries. Each School has a Research Director, to coordinate research administration within the school, manage research quality, liaise with central units and other schools, and chair school research committees. The University centrally provides general research administration, including research student registration, management of research grants and intellectual property. Schools are represented on the University Research Committee which determines the overarching strategy for research and knowledge transfer.

Resource allocation at School level is managed by the Deans and the Research Directors. Schools provide dedicated laboratories and office space for research staff and students. Schools are allocated recurrent annual funding for teaching and research, according to performance and strategic criteria.

Research groups employ a variety of collaborative strategies to secure funding and achieve sustainability. Infrastructure funding (eg. HEIF/SRIF) has been used to establish collaborative relationships and seed new activities as well as the development of new facilities. These include: two computing clusters (25-node, and 96-node) with 12TB data storage (£450K); a human behaviour and machine interaction laboratory; and an experimental HCI and interactivity laboratory (£175K).

HEIF funding of £200K has been used to support the development of collaborations within the WestFocus consortium of seven universities within the London region. HEIF funding also contributed to the establishment of WestFocus Grid, in collaboration with Brunel and Kingston universities.

Knowledge Transfer projects have been a very effective means of developing staff and becoming more active in research. Existing collaborations have been

leveraged to secure joint research funding from sources such as the EU. Our submission rate of project proposals to external funding bodies has been increasing, resulting in seven awards (£450K) during the academic year 2006/2007.

Developing and Supporting Staff

The Schools are committed to the recruitment and retention of high quality research-active staff. Notable staff appointments in key areas since the last RAE submission include: grid computing (Kiss), virtual environments (Jin), active data repositories (Chountas), interactive and communication systems (Economou); agent technology (Paurobally), knowledge management (Kapetanios), and software maintenance (Black). There have been promotions: two Professors (Getov and Xanthis); and one Reader (Terstyanszky).

On appointment staff are assigned mentors for a year, and join established research groups, where they can contribute to existing PhD supervisory and project teams. Annual workshops organized by the University include briefings on research opportunities, research grant guidance, PhD supervision practices and regulations etc. Funding is available to all staff for various activities such as conference attendance, seeding academic collaborations, or preparing grant proposals. New staff are eligible for developmental projects seed funding.

Students

Students are accommodated in offices attached to the research laboratories of the research groups, and have excellent access to generic and specialist facilities, such as high-performance computing clusters, computational grids, imaging equipment and multimedia systems. A student's supervisory team comprises a minimum of two staff, jointly providing both supervisory experience and relevant subject competence. Students can bid for training and conference support through their supervisors. The University provides a programme of specialised training sessions for students to support their studies and career development. Research students participate in research events such as presentations at research seminars, and external activities including competitions and conferences.

The University offers a range of student support, including fee waivers, and up to three years' maintenance bursaries (it holds the 2005 Times Higher award for scholarships). The workshop for PhD/MPhil students is organised annually. Students present end-of-year reports and discuss results and ideas with peers and academic staff, and proceedings are published.

Research Groups

Under UoA 23 we submit five groups: Computer Vision and Imaging Technologies; Distributed and Intelligent Systems; Data and Knowledge Management; Centre for Parallel Computing; and Theoretical and Scientific Computing.

We host a number of other research groups who are submitting under UoA 08 (Health and Social Care Modelling), UoA 24 (Digital Signal Processing and VLSI Systems, and RF, Microwave and Wireless Communication Systems), and Psychology UoA 60 (Cognitive Science). We invite the panel to consult our submissions in these units to obtain a complete picture of the research culture of the Schools.

Computer Vision and Imaging Technologies Group (Jin, Konstantinou, Psarrou, Triantaphillidou, Attridge, Jacobson)

The Computer Vision and Imaging Technology Research Group carries out original, high quality research into three main areas a) the study of statistical and probabilistic learning methodologies and their application in visual perception of human identities and behaviours, b) the content-based search of image and video databases, c) digital image quality. Research is funded by the European Commission, private companies and EPSRC studentships. Since the last RAE the group attracted income exceeding £621,000. During the same period eight students have completed their PhDs supervised by members of the group. Six students are currently working on their thesis.

The group has developed "the human behaviour and machine interaction laboratory" which hosts a Vicon 6 system used for real-time multi-view behaviour capturing using optical tracking. The system is also available for commercial R&D activities (such as our recent application on animation capture for online Second Life avatars). The laboratory provides equipment for carrying out experiments in modelling and interpreting human behaviour, gestures and face expressions.

Work on statistical and probabilistic learning has led to the development of algorithms for modelling the underlying spatial and temporal structures of dynamic visual phenomena arising from activities such as gestures and face recognition through a continuous sequence of face movements. In collaboration with the vision group at Queen Mary, (University of London), the group developed face tracking and modelling algorithms from very large view variations using Kernel PCA (**Psarrou 1**) and the automatic clustering and incremental learning of gestures (**Psarrou 2**). In collaboration with the University of Alicante (Spain) related work combined with growing neural networks is now applied to automated 2D and 3D shape modelling (**Psarrou 3**).

The group's past work on content image-based search algorithms developed as part of the HISTORIA project (reported in RAE 2001), funded under the European Commission's LIBRARIES initiative has led to the research currently being undertaken in content analysis for video databases (**Psarrou 4**) and the non-destructive image-based analysis of inks and colours used in medieval manuscripts (**Konstantinou 1-4**). The latter work has been supported by two further European Commission projects, diARTgnosis (Culture 2000) and NOESIS (INCO – Framework 6). The University of Westminster is the project coordinator of the NOESIS project and has pioneered the image-based analysis of inks and the development of regional

specialist laboratories around the Mediterranean region (with partners in Egypt - CULTNAT, Lebanon – University of Balamand, Greek Orthodox Patriarchate of Jerusalem, Museum of Kykkos Monastery – Cyprus) for the study of valuable manuscripts.

Konstantinou is also a member of the Brussels based European Internet Foundation programme committee. The Foundation is led and governed by elected Members of the European Parliament (MEPs) to provide European political leadership for the development of European multilateral public policies responsive to the political, economic and social challenges of the worldwide digital revolution.

Jin is a new member of staff whose participation considerably strengthens the virtual reality and visualisation expertise within the group. Jin's research is centred on novel interactive ICT approaches for the development of an intelligent agent toolkit supporting the creation of believable characters in real-time 3D virtual environments. This work is based on establishing credible and empathic relations with child users, thus creating a feeling of 'social presence' (**Jin 1-4**). Jin has also explored and proposed efficient VR solutions for Web-based interactive applications such as cultural heritage preservation and online education. One of her projects, the Web-based Interactive Virtual Tour of Heritage - Temple of Heaven, allows worldwide users to explore the famous cultural heritage in real time with a sense of presence through the WWW (First Prize —*Most Creative and Immersive Web-based Virtual World* by Adobe). Her work is presented by Stuart Dredge (editor) in the book "Web 3D" (Laurence King Publishing, 2002, ISBN: 185669-283-3). Most recently Jin won a London Development Agency Secondment to Knowledge grant to experiment with capturing and modifying real life gestures and motion sequences for the Second Life virtual world in collaboration with Inition Ltd.

Triantaphillidou, **Jacobson** and **Attridge** produce internationally recognised research work in the area of imaging science and are mainly concerned with the quantification of imaging systems and imaging processes. Their work has benefited from close links and joint research projects with the Royal Photographic Society in Bath, Kodak Ltd in Harrow, Hewlett Packard research laboratories in Bristol, the Home Office Police Scientific Branch in St. Albans, Unilever, Colorite, Weetabix, the Darriford Hospital, Bristol, and the Philips research laboratories, Redhill.

Most notable is the collaborative project with the Royal Photographic Society (RPS) which involved the digitisation of one of the oldest photographic collection in the world, the collection of Henry Fox Talbot, the "father of modern photography", that was housed at the RPS (**Triantaphillidou 1,2**). The aims of the project included an investigation into the implications of digital archiving along with data transfer and migration strategies and led to the establishment of universal guidelines for the characterisation and calibration of the imaging chains involved in the digitisation and display of such collections.

In collaboration with Unilever, Colorite and Weetabix, the group undertook research, funded by a LINK scheme, on the 'Colour Appearance of Food on Computer Displays' (**Attridge**). The project explored and established methods for using digital cameras as colorimetric instruments for the faithful colour reproduction of food and its packaging. The necessary gamut for accurate colour reproduction on computer displays was modelled and objectively quantified while the food colour appearance on such displays was investigated. The work produced a very useful insight in the understanding of perceived colours on soft displays.

In collaboration with Kodak Ltd, the group investigated: a) Methods for the quantification of the sharpness characteristics of digital cameras (PhD research project co-funded by Kodak and EPSRC -**Jacobson**). The research helped the evaluation and established the limitations of the measuring method proposed by the 12233 SFR. b) objective quantification as well as the perceptibility and acceptability of distal image artefacts,such as contouring produced by reduced bit-depth, blocking produced by the Discrete Cosine Transformation used in the JPEG image compression, and ringing produced by digital 'over-sharpening'.

Prizes and Awards

Jin: Adobe First Prize Most Creative and Immersive Web-based 3D Virtual World (£2500) 2002.

Professional Societies

Attridge: Chairman Colour Group of Great Britain, 2001-2003.

Attridge: Chairman Imaging Science Group, The Royal Photographic Society, 2000 to date.

Jacobson: President of the Royal Photographic Society, UK, Oct.2005-Oct.2007.

Jacobson: Raymond C. Bowman Award, by the Society of Imaging Science and Technology, USA, 2004.

Jacobson: Fellow of the Society for Imaging Science & Technology, USA, 2007.

Triantaphilidou: Fellow of the Royal Photographic Society.

Triantaphillidou: Vice Chairman Imaging Science Committee, Royal Photographic Society, 2005 onward.

Conference Organisation

Triantaphillidou: Co-Chair Programme Committee, SPIE/IS&T Electronic Imaging: Image Quality and System Performance Conferences, from March 2007.

Konstantinou: Organising/Programme Committee, IEEE Intelligent Systems Conference 2006, 2008.

Psarrou: Programme Committee, International Conference on Visual Information Retrieval, 2004-2007

Invited Keynote Speaker

Jin: Virtual Heritages and Architecture in Virtual Environments, International Workshop on Virtual Heritage, Chongqing, China, 2002.

Research Coordination

Psarrou and **Konstantinou:** NOESIS EU, Framework 6 project (8 partners €1.5m), DCE - University of Westminster, 2004-2008.

Konstantinou: DTI-Teaching Company Scheme for the development of intelligent multimedia servers.

Data and Knowledge Management Group (Black, Chountas, Courtenage, El-Darzi, Kapetanios, Revett)

The group aims to combine fundamental research and system development that can serve as proof of research concepts as well as to provide inputs to industrial practices and directly applicable solutions in specific end-user Data and Knowledge management domains such as Health Care (**El-Darzi**, **Revett**), Digital Libraries and more recently the Social Web and Web 2.0 (**Kapetanios**, **Courtenage**). The research income of the group stands at £86,600. In addition, 2 research students have completed their PhDs.

Research in the area of Aspects Oriented Software Development and Programming and Software Metrics (**Black**) has been conducted in collaboration with King's College London. Research in software fault proneness funded by EPSRC is expected to start later this year in collaboration with Hertfordshire, Brunel and Durham Universities.

Kapetanios's work focuses around the development of new query languages to assist databases and web search engines to provide support for multi-lingual semantic queries. Recent work includes, laying the theoretical foundation (model and algebra) for "flexonomies", an emerging ontological model for the Web 2 and the Semantic Web as a response to the drawbacks of the OWL and Folksonomies based models.

Courtenage's research work concentrates on P2P systems and Architectures for Content-Based Publish/Subscribe Networks and it has been funded by EPSRC. Publish/subscribe networks are generally classified on how they match publications to client interests, and the project specified a language that would allow clients to specify their information interests in a user-centred fashion, that could be used to configure routing paths through the publish/subscribe network for, as well as transformations on, the information the user required. A prototype system based on this approach, was successfully developed, which Courtenage believes is the first to offer composite event matching and routing.

Chountas' research work is concentrated on the presentation and querying of imprecision in new generation DBMS. Research work has been conducted in collaboration with UMIST-University of Manchester and the Bulgarian Academy of Sciences.

Revett's work focuses around both Health care informatics using rough sets and neural network models for classification of electroencephalogram (EEG) signals and modelling of viral and bacterial meningitis) and more recently Biometrics (using keystroke dynamics as a secure login access mechanism).

El-Darzi's research work is concentrated mainly on the development and the application of intelligent systems and simulation modelling with particular emphasis on health care systems. El-Darzi is a member of the editorial board of the International Journal of applied systemic studies, Inderscience.

Professional Societies

Black: Member, BCS Council 2003 – present, nominations committee, qualifications and standards board.

Conference Organisation

Black: Programme Committee Co-Chair, IEEE International Astrenet Aspect Analysis (AAA) Workshop, 2006.

Chountas: General Co-Chair for: 3rd IEEE International Intelligent Systems Conference, 2006

El-Darzi: Programme Committee Chair of the International Conference on Health and Social Care Modelling and Applications: HSCM2006, 2006.

El-Darzi*:* Member Programme Committee, IEEE International Symposiums on Computer-Based Medical Systems – CBMS, 2005-2007.

Kapetanios: General Chair of the NLDB 2008 Conference.

Chountas: Member Programme Committee, IEEE International Conference on Data Engineering, ICDE 2007.

Revett: Member Programme Committee, Workshop on Rough Sets and Soft Computing at IEEE/WIC/ACM International Joint

Conference on Web Intelligence and Intelligent Agent technology, 2005.

Prizes and Awards

Black: National Endowment for Science, Technology and the Arts (NESTA) Crucible award recepient in 2006.

Kapetanios: Best paper award at the International NLDB Conference, 2003 and 2006.

Editorships

Courtenage: Guest editor of special issue of the Elsevier journal Computer Networks 51(16) November, 2007.

El-Darzi: Guest Co-Editor of Special Issue on Modelling the Process of Care of Health Care Management Science 4(1), 2001.

Kapetanios: Member of the Editorial Board, Int. Journal for Technology and Human Interaction (IJTHI).

Revett: Associate editor, International Journal of Electronic Security and Digital Forensics.

Invited Keynote Speaker

Revett: Data Mining Techniques in Computer-Aided Medical Diagnosis, Third International Conference on Intelligent Computing and Information Systems – ICICIS, 2007.

Distributed and Intelligent Systems Group (Bolotov, Economou, Getov)
The Distributed and Intelligent Systems Research Group conducts original, high quality research in intelligent and complex distributed systems focusing on Grid and Web services and collaborative environments. The group has been participating in two EU FP projects. It has attracted nearly £400K of funding, produced five books and over fifty articles in international journals, conference proceedings, and book chapters. Six research students are currently working on their PhD thesis while two have completed.

CoreGRID (**Getov**) is an EU-funded (€8.2m, UoW £150K) Network of Excellence (119 researchers, 165 PhD students, 42 institutions) aiming to strengthen and advance Grid and Peer-to-Peer technologies. The project (total budget of €8.2M) brings together a critical mass of well-established researchers (119 permanent researchers and 165 PhD students) from 42 institutions. The research group was awarded up to £150K over 4 years for its part in CoreGRID.

GridComp (**Getov**) is an EU RTD project to develop a new generation component-based and dynamically reconfigurable Grid computing platform. The project runs from 2006-8 and brings a grant of approximately £220K to the University. The project has a total budget of €2 Million, with partners from France, Italy, Spain, Switzerland, China, Australia, and Chile including IBM, Atos Origin, and Grid System.

Bolotov's work is in the area of formal specification and automated verification of complex distributed and reactive systems. He pioneered the development of the clausal resolution technique for computation tree logics and natural deduction techniques for temporal logic and worked further on their extensions (**Bolotov 1**), automation (**Bolotov 3**) and the applicability of temporal resolution (**Bolotov 2, 4**).

Bolotov has served on the Organising Committee of the UK Workshop on Automated Reasoning: Bridging the Gap between Theory and Practice (from 2007) and the Programme Committee of the 20th Australian Joint Conference on Artificial Intelligence, 2007. Dr Bolotov has given Invited Lectures in the area of Formal Specification and Verification in the Branching-Time Setting such as the Keynote Lecture *Clausal Resolution in the Framework of Normative Agency* at the Lomonosov's Readings, *Moscow State University, April 2004.*

Economou is one of the inventors (with Jian-Rong Chen and Daniel Wilson) of a patent the development of a packet-based network switch for multiple receivers for uploading audio/visual material. The network switch allows the recipient to link to the network of multiple receivers and manage the terms of the linkage. The patent entitled "Video/Audio Network" (European Patent Office; Date of Filing: 16/01/2004; Patent No: 06076427.1-1244, accepted April 2007) has been the basis for the development of a range of new broadcasting services by SONY.

Getov is Steering Committee Member of the GridCOMP EU Project and the IEEE John V. Atanasoff Initiative. He is in active collaboration with the Performance and Architecture Lab, Computer and Computational Sciences Division, Los Alamos National Laboratory, U.S.A. Professor Getov is Co-Editor of the CoreGRID series of volumes (Springer), and Member of Editorial Board of *Scientific Programming, International Journal of Computational Science and Engineering*, and *IEE Software (2002-2005)*. In 2001 he was Guest Editor, Java in High-Performance, *Future Generation Computer Systems Journal* 18(2). Professor Getov has been Member of the Program Committees of *IEEE International Computer Software and Applications Conference – COMPSAC, IEEE International Symposium on Cluster Computing and the Grid – CCGrid, International Conference on Parallel Processing – ICPP,* and other international scientific meetings and events. He has given several invited presentations and tutorials at venues such as IBM Research, IEEE HPDC, ACM Java Grande, JavaOne, and SIAM PPSC Conferences.

Research Coordination

Getov: Member Executive Committee and Leader of Grid Systems, Tools, and Environments Institute, CoreGRID European Network of Excellence, 2004-2008.

Conference Organisation

Getov: Programme Committee Chair and Steering Committee Member, IEEE JVA 2006 International Symposium on Modern Computing, 2006.

Getov: Member Programme Committee, IEEE/ACM Supercomputing Conference, 2003, 2007, and 2008.

Economou: Member Programme Committee, ACM VRST Conference, 2001.

Bolotov: Member Programme Committee, IEEE International Symposium on Temporal Representation and Reasoning – TIME, 2007-2008.

Bolotov: Member Programme Committee, IEEE International Symposium on Modern Computing, 2006.

Invited Keynote Speaker

Getov: Computational Grid and Web Services: Concepts, Functionalities, and Comparisons, ICCC Conference 2004, Beijing, China.

Theoretical and Scientific Computing Group (Lancaster, Ovtchinnikov, Xanthis)

The Theoretical and Scientific Computing Group carries out theoretical work in the interdisciplinary boundary between Computer Science and science and engineering. This is a productive group with over 30 articles in international peer-reviewed journals or conference proceedings. Research funding of approximately £90K has been obtained from the Royal Society and the EPSRC. One PhD student has successfully completed.

Ovtchinnikov was invited as a visiting professor by Prof.Knyazev of the University of Colorado at Denver, USA, to join his team developing high-performance library (HYPRE) for solving large, sparse linear systems of equations on massively parallel computers, 2003-2004. A new algorithm for solving large-scale eigenvalue problems is being implemented as part of the HSL software library in collaboration with Rutherford Appleton Laboratory and included in the 2007 library release. The HSL software library has been used by more than 2000 organizations worldwide with its packages being incorporated under licence into over 90 commercially available software products.

Xanthis works on challenging multidisciplinary problems addressing questions and issues underlying the efficient computation of large-scale (eigenvalues, fast adaptive DDM algorithms), multi-scale and stochastic problems of fluids and structural mechanics by novel algorithms and methods (he pioneered the generalised method of arbitrary lines). He obtained a visiting grant from the Royal Society in 2003 to host for one month Professor Kesavan, Member of the Indian National Science Academy (INSA) for research on 'theoretical, modelling and simulation aspects of new (smart, piezoelectric) materials and structures'. He has published papers on this subject on approximation theory with his post-doctoral researcher Dr N. Sabu (Hermis, vols. 5 and 6, 2005) and on modelling and simulation of piezocomposites with his PhD student P. Bondarev (Computers & Structures , vol. 84, 2006) and has co-organised a minisymposium within the international conference HERCMA (Athens, 2003). Professor Xanthis was invited (Oct. 2006) by the Chinese Academy of Sciences, State-key Laboratory of Scientific/Engineering Computing and Peking University to deliver lectures on topics of computational mathematics and mechanics (new wavelet-based methods for multi-scale problems, computation of 3D thin elastic structures). He is on the editorial board of International Journal Computer and Experimental Simulation in Engineering and Science.

Lancaster has used statistical physics techniques on a range of problems mainly focusing on geometric combinatorial optimization problems like assignment and the travelling salesman problem. In collaboration with co-workers in France, significant new results on the average path length for the stochastic travelling salesman problem have been obtained. This work resulted in the award of an EPSRC grant, which allowed him to devote his time to a promising approach to Travelling Salesman (TSP) type problems in 2005-2006. The award was termed "Discipline Hopping" since the approach was interdisciplinary, being based on a technique from statistical physics. The goal was to compute the average path length for randomly distributed cities - an open problem since seminal work in the 1950's. Key technical results from the period of the award consist of a generalization of the formalism to multi-index matching and complexity phase transitions in the centred TSP visible though the use of this technique. Besides the publication of these results, wider dissemination of results to computer scientists took place to a broad audience at the 9th International Symposium on Artificial Intelligence and Mathematics as well as to several more specialized computer science events. Some of the work was collaborative involving colleagues from L'Ecole Normale in Paris, and from the Universities of Cambridge, Rome and Toulouse. As evidenced by the Bell Labs journal club selection in March 2005 this work has a high profile of international research significance.

d'Inverno published over 55 books, journals, chapters and conference papers whilst at the University of Westminster. He also secured an EPSRC grant entitled: Designing Physical Artefacts from Computational Simulations and Building Computational Simulations of Physical Systems-Designing for The 21st Century. He was general chair of the UKMAS2001 at St Catherine's College, sponsored by EPSRC. He established the University as a member of AgentLink, the European Network of Excellence for Agent-Based Computing

and was a founding member of the UK Special Interest Group on Multi-Agent Systems.

Conference Organisation

Xanthis: Organiser of Minisymposium on Multilevel stabilised methods or other methods for convection-dominated problems by finite elements and/or wavelets at the World Congress on Computational Mechanics (WCCM VII), 2006.

d'Inverno: General Chair, First European Workshop on Multi-Agent Systems, EUMAS, 2003.

Invited Keynote Speaker

Xanthis: First Int. Conf. on Modelling and Simulation in Polymer Engineering and Science, Zhengzhou University, China, 2006.

Xanthis: International Symposium on Multi-Physics and Multi-Scale Computation of Materials (MPMSCM), in Xi'an, Shaanxi Province, China, 2006.

Centre for Parallel Computing (Kacsuk, Kiss, Paurobally, Terstyanszky, Winter)

The research focuses on providing seamless access to high-performance computing resources for academic and business users. Across the group £150K of external grants has been received (EU and EPSRC); over 50 items have been published. Six research students have completed their studies (5 PhD, one MPhil).

The FP5-funded Open Framework for Simulation of Transport Strategies and Assessment (OSSA) project (£130K, Winter), delivered a distributed open simulation architecture, based on the Hipertrans road traffic micro-simulator developed in the FP5-funded Hipertrans project. OSSA provides open interconnectivity, between Hipertrans, visualisers, traffic instrumentation/control systems, and a range of other simulators and analytical tools.

The EPSRC-funded project, "Evaluation of GT3/OGSA on a UK Multi-Site Testbed" (£20K, **Kacsuk**, **Terstyanszky**, **Kiss**), established the first UK implementation of an OGSA-based (GT3) Grid test bed. It evaluated GT3 by deploying E-Science applications and derived recommendations for a production version. Emerging from the project was GEMLCA (Grid Execution Management for Legacy Code Applications), a Grid service for deploying legacy code applications on the Grid without significant user effort or any modification of the legacy source code.

GEMLCA is running as a live service on several large production Grid systems worldwide, including the UK National Grid Service (NGS), the

European EGEE Grid, the US Open Science Grid (OSG) and TeraGrid (US).Several large applications from chemistry, biology and engineering have been successfully ported to the Grid utilising GEMLCA. The group has filed for a US Patent in 2006 (**Kacsuk**, **Kiss**, **Terstyanszky**, **Winter**).

The Westminster site supports a number of grid portals based on the combined PGrade/GEMLCA technologies developed in the CPC, that enable users to quickly develop, submit and manage complex computational workflows on a wide range of grid platforms.

The group recently started the GEMLCA Globus Incubator Project (**Terstyansky**, **Kiss**) to extend the Globus stack with support for exposing legacy codes as Grid services. Terstyanskzy has participated in the "Grid Interoperability Now" (GIN) workgroup of OGF He served on 6 program committees of international conferences. Kiss's research addresses data staging and interoperability issues in grid computing.

Paurobally's work includes the development of negotiation and interaction protocols for multi-agent applications (**Paurobally 1-4**).

Kacsuk has a fractional (0.25) position at the University of Westminster, and is also Head of the Laboratory of Parallel and Distributed Systems at the Computer and Automation Institute of the Hungarian Academy of Science. He is also Editorial Board Member of 2 national and 3 international journals. He has served on 11 national scientific societies and boards, including: Member, Scientific Advisory Board of the Hungarian CERN Committee (2000-2); and Chairman, Performance Monitoring Working Group of European Grid Forum (2000-) Kacsuk has been the principle investigator of 12 national projects and 7 EU-funded projects in grid computing including EGEE: Enabling Grids for E-science, EU FP6 (2004-6).

Winter is a Member of Euromicro PDP Workshop Technical Committee since 1993. He was also Member of Working Group of Deans of Engineering, to analyse the state of engineering in London's universities, supported by Universities UK, and HEFCE, 2000-0.

National Professional Bodies

Terstyanszky: Member Technical Board, National Grid Service.

Winter: Member, Foresight ITEC (Information Technology, Electronics and Communications) Group, 1999-2001.

Conference Organisation

Kacsuk: Member Programme Committee, Euromicro Conference on Parallel, Distributed and Network-based Processing, 1993-2008.

Kacsuk: Programme Committee Co-Chair, EuroPVM/MPI, 2002, 2004.

Kiss: Organising Chair of the GELA workshop: Grid-Enabling Legacy Applications and Supporting End Users Workshop, at IEEE HPDC'15, Paris, 2006.

Terstyanszky: Member Programme Committee, Euromicro Conference on Parallel, Distributed and Network-based Processing, 2007-2008.

Paurobally: Member Programme Committee, Autonomous Agent and Multi-Agent Systems Conference – AAMAS, 2004-present.

Editorships

Kacsuk: Co-editor-in-chief, Journal of Grid Computing, Springer, 2002 – present.

Academic & Industrial Collaboration

The research groups between them have a large number of industrial collaborators (including Symbian, IBM, ORACLE, CISCO, Orange, Microsoft, Inition Phillips), many of whom are actively engaged in joint projects and PhD studentship schemes and sit on our industrial advisory boards.

The University of Westminster is a partner site of the UK National Grid Service – one of nine sites comprising the NGS. The facility supports NGS users and university researchers in application areas such digital signal processing, road traffic traffic simulation, and video rendering and streaming. The CPC group also engages with a number of end-user academic groups in Europe and the USA, through its active collaborations with major grids such as EGEE (the European Grid), OGF and TeraGrid in the USA. More recently CPC has established W-GRASS (Westminster Grid Application Support Service) to support academic and business users in the development of grid applications.

Seminars organised by the regional groups of IET and BCS are also hosted at the University. They provide a forum for promoting our research activities and an excellent networking opportunity for networking engaging the professional bodies and the industry. The Prestige Lectures series at Harrow has attracted distinguished speakers from the academia and industry. Recent lectures include: Riding The Explosive Third Wave Of Mobile Phones (David Wood, Symbian); Innovating Your Business With The Grid (John Easton, IBM); The Past, Present and Future of Computer Games Development (Nick Burton, Rare Limited); The Science, Engineering and Medical Applications of Computerised Tomography, (Jamshid Dehmeshki, Medicsight Plc).

The 3rd IEEE Conference on Intelligent Systems, was hosted in 2006 at Harrow. Two more conferences,the 13th International Conference on Applications of Natural Language to Information Systems and 13th International Conference on Functional Grammar, are scheduled for summer-autumn 2008

Future Plans

In the next five years, our main aim is to build on our current success in order to further improve and expand our research activities. To achieve this, we will be applying the following strategies:

- Improve the rate of research grant success by further developing internal and external collaborations with leading groups in academia, industry and the community.
- the Computer Vision and Imaging Technologies group will a) employ its well-equipped motion capture laboratory to address security issues and simulation applications in virtual worlds, interactive multimedia, and augmented reality, b) expand its image-based ink recognition work into forensic applications for modern documents and c) combine the computer vision and imaging technologies expertise for addressing issues on image and video quality broadcasting and medical imaging. Target academic collaborations include the University of Alicante and the Institute of Biometrics Identification Systems in Germany, and industrial partners include the Bank of England, Inition Ltd, VoxIQ, Darriford Hospital, Bristol and the Philips research laboratories in Redhill.
- The Distributed and Intelligent Systems group will develop further its strong international collaboration focusing on new integrated generic design methodology for "invisible" by the end users, intelligent, service-oriented, and component-based platforms for both grid and peer-to-peer distributed systems.
- In cluster and grid computing, the Centre for Parallel Computing will actively support interdisciplinary research in both ICT and end-user disciplines, within and outside the university, with a view to establishing more collaborative, particularly interdisciplinary, research activities. New research in this area includes the FP7 project Enabling Desktop Grids for e-Science (€347,000 for the University), which commences in 2008.
- In Scientific Computing, ongoing and future work involves the numerical simulation and analysis of stochastic PDEs by polynomial chaos expansions and reduction to deterministic methods using the generalised method of arbitrary lines with applications to air/water pollution and composite materials.
- Expand industrial knowledge transfer collaborations through the development of a “fast response consultancy board” with membership drawn form the research groups and our industrial advisory board.
- Expand interdisciplinary research, by combining existing technical strengths (e.g. cluster/grid computing,imaging technology, intelligent systems) to further develop existing collaborations in: Psychology (Cognitive Science and study of human machine interfaces), Instrumentation with particular applications in Health

(development of new ubiquitous sensors in association with Hammersmith hospital), Media (development of an experimental augmented reality laboratory for interactive media applications), and Transport.