ncaf
Natural Computing Applications Forum

Networks

Clifton Suspension Bridge
Photo: Paul Townend

Imaging by the Avon

University of Bristol, 12–13 September 2006

We will also be hosting the first NCAF student paper competition – open to all students who are expecting to submit a Masters thesis (MSc, MPhil, MRes or MEng) in any area of Natural Computing in 2006…

The next NCAF meeting will be held in Bristol, and hosted by BAE Systems' Advanced Technology Centre. The theme is image processing. We have put together a programme that captures a snap-shot of current trends in both academia and industry.

The speakers include:

- Simon Coupe from the University of Manchester who will talk about model matching with the TINA computer vision system.
- Carsten Rother from Microsoft Research who will present on Markov random fields for computer vision applications.
- Mark Williams from the ATC who will talk about complexity measures for tracking people through crowds.
- Piotr Dudek from the University of Manchester School of Electrical and Electronic Engineering will demonstrate his small-scale image processing chip.
- Paul Lepper from the Underwater Acoustics Group at Loughborough University will talk about dolphin sonar.
- Valerie Leung from the image processing group at the University of Kingston.

The conference will be at Badock Hall, a part of the University of Bristol that is situated pleasantly on the Bristol Downs, close to town, and Brunel's suspension bridge. Bristol also has a thriving music scene and was the birthplace of English hip-hop with bands like Portishead and Massive Attack. One of the local attractions is Bristol Zoo Gardens where the meeting's social event will be held, including a chance to visit the denizens beforehand. We have been assured that dinner at the zoo means we are eating and not being eaten! The social event has been generously sponsored by BAE Systems.

As part of BAE Systems, the Advanced Technology Centre delivers frontline research and technology into its parent company, its joint venture organisations and its customers. Our role is to identify and develop technologies, systems, concepts and processes that will maintain BAE Systems' position as a leading edge organisation and enable future growth. As our position entails sitting between research and academia, collaboration with UK universities is vital to us, and some of the fruits of these partnerships can be seen in the presentations over the two days.

We will also be hosting the first NCAF student paper competition – open to all students who are expecting to submit a Masters thesis (MSc, MPhil, MRes or MEng) in any area of Natural Computing in 2006, or did so in 2005. The NCAF committee hope to make the competition a yearly event to give students the opportunity to get their papers published in a journal, and gain experience presenting in a relatively informal environment. Further details of the competition are on the NCAF website. The finalists' papers will be presented and judged on the second day, giving an interesting insight into the activities of postgraduate students in natural computing.

We look forward to seeing you all at Bristol in September, with an interesting technical programme, an opportunity to see the first ever NCAF student paper competition and a *wild* social event!

Felicity Dormon
BAE Systems

INSIDE

- Back to nature in Birmingham
- Inspiration from NCAF meetings
- Puzzle Corner No. 33

BACK PAGE

- Innovation support for complex computational technologies
- Diary Dates

Inspired by nature in the University's botanic gardens

Back to nature in Birmingham

Evolutionary algorithms can derive complex control systems that are now far too complicated for humans to design unaided.

The second NCAF meeting of 2006 was organised by Andy Pryke and colleagues at Cercia, in the School of Computer Science, University of Birmingham. The venue for this two-day event was Hornton Grange conference centre within the University conference park, which has pleasantly rural surroundings. It was an ideal setting given that the focus for this meeting was the use of nature-inspired techniques in industry and applied academic research.

Our first talk was from within the University, in the School of Mechanical Engineering, where Dr Jianguo Lin is using evolutionary methods to determine the value of constants used within numerical and analytical models of finite element simulations of metal forming processes. Dr Lin's work highlights a classic example of evolutionary computation used to model another natural process – albeit a physical one – which clearly has substantial industrial relevance.

The second talk continued this theme, as Dr Ian Stott from Unilever described a genetic algorithm-based approach to identify and patent bactericidal peptides. This was a classic data mining application, starting from a hypothesis about the physical action of such chemicals, which allowed a broad group of scientists to derive classifier systems that were able to identify active peptides. It also allowed Unilever to patent large blocks of peptide space by (controversially, some would claim) specifying not the peptides themselves, but rather the classifier models that identified them.

There followed a fascinating and energetic talk by Professor Dave Cliff from the University of Southampton. He is a close friend of Cercia, as a member of our advisory board. He is also a well-known expert in a wide range of subjects from cutting-edge financial research to DJ-ing and pretty much everything in between. We were introduced to a number of research projects that Dave worked on during his time at HP and, for a short while, at Deutsche Bank in London. This provided an excellent background for the rest of the conference, illustrating how natural computation techniques are increasingly being used to great effect in industry.

After lunch, we had a tour of the University's botanic gardens and, apart from the obvious botanic interest shown by some members of the group, this gave an excellent opportunity for networking and discussing the morning lectures.

The afternoon started with a talk from Dr Leonardo Giovanini from the University of Strathclyde, who introduced us to the uses of evolutionary algorithms in control systems and fault detection, including a general overview of a number of other areas where these techniques are playing an increasing role. He showed how evolutionary algorithms can derive complex control systems that are now far too complicated for humans to design unaided.

Dr Adrian Murphy from the School of Mechanical and Aerospace Engineering in Queen's University, Belfast, then presented his work on using evolutionary techniques to improve design processes in the aerospace industry. He demonstrated how such an approach could maximise the efficiency of the preliminary stage of aircraft design through a combination of optimisation and hierarchical analysis methods.

In the final lecture of the day, Dr Andy Pryke presented us with an overview of the work of Cercia in the fields of natural computation and evolutionary data mining.

Only one task remained for the first day's formal activities, and that was another confusingly complex explanation of the latest Puzzle Corner, with Fenella the Rottweiler instructing a selection of the country's foremost academic figures to imitate furniture, complete with sound effects. As ever, the demonstration was spiced up somewhat by the usual problem that only a minority of those in the room had actually read the puzzle definition. (*So read Puzzle Corner now, in the right hand column. Editor*)

Aside from the externally obvious academic merits, NCAF is also renowned, at least amongst regular attendees, for its infamous social events. This time, delegates were taken to the notorious Broad Street, home of Birmingham's most vivid night life, where they visited a Chinese-Indian fusion restaurant before wandering over the road to a nearby bowling alley. Experienced bowlers were then thoroughly beaten by people who had never picked up a bowling ball before. Such is the NCAF tradition.

Protein Folding

Thursday began with a detailed talk from Dr Roy Johnston from the University's own School of Chemistry, concerning the use of evolutionary methods for modelling protein folding and bimetallic nanoalloy clusters. Yet again, natural computation methods proved invaluable for their ability to search efficiently through high dimensional, high complexity solution spaces. He also introduced work carried out by his group in identifying and visualising the solution space for complex optimisation problems.

Dharmesh Maniyar of Aston University then gave a talk on visualisation methods in data analysis. Numerous novel visualisation methods were used to explore datasets in the sphere of chemoinformatics, allowing domain experts to extract subsets of the data exhibiting interesting properties for further analysis. He was followed by another bioinformatics-inspired talk from Dr Vasile Palade from the Computing Laboratory at the University of Oxford on multi-classifier systems for gene identification in DNA sequences. His talk focused on the generation of multiple neural network classifier systems for the identification of promoter strings within the DNA of E*scherichia coli* and segments of human genomic data.

Photo: Delia Sexton, Cercia

Inspiration from NCAF meetings

In the last edition of *Networks*, Andy Pryke from Cercia promised that I would "go away (from the Birmingham meeting) buzzing with new ideas", and that's exactly what I did.

I have never used genetic algorithms, but have always hoped that I would get the chance some day. I work for a very small group within the Warwick Manufacturing Group, interested in automotive sound quality in particular, and product perception in general. To date, we have only tried to apply neural networks to predict certain automotive test results.

The first application was to predict the result of the pass-by noise test (the noise of vehicles during acceleration), which is required by legislation. This rather artificial test (2nd gear, wide-open throttle) is taken once production vehicles are available, by which time it is far too late to change the design. Any problems have to be corrected by expensive and time-consuming remedial work. The prediction uses vehicle parameters available early in the design process, and gives a designer some confidence that the test will be passed.

The second application was concerned with customer perception of sound quality. Automotive manufacturers, particularly those in the luxury sports car market, are keenly aware of both the importance of brand identity, and the effect on the customer of the sounds their products make. When they design a new model, they like to set a target sound that will appeal to customers. Company experts are not perfect at selecting sounds that customers like, so they spend considerable time and expense on subjective customer evaluations of sound quality. Testing produces considerable data that we hoped could be used to train a neural network.

These applications use back-propagation multi-layered perceptrons (MLP) and it was difficult to determine what parameters to use as inputs. In both cases, experts and customers were questioned, correlations were sought and experiments made to find sets of inputs suitable for the problem. I came across the neat idea of the ensemble of neural networks at an earlier NCAF meeting, and a simple ensemble that averaged the predictions of the six best networks beat the single best network at predicting the automotive sound quality attribute 'powerfulness'. Two networks, for 'powerfulness' and 'refinement', will be tested in real vehicle programmes in the near future.

In both these projects, regardless of the performance of the neural networks, we learned a lot about other unexpected things just by posing the problems in suitable forms. An unusual example concerns the pass-by noise test, where we discovered that, other things being equal, longer cars are louder than short ones! Why should that be so? They travel further (the length of the test area plus their own length), so their engine speed is higher when they leave the test area, hence they are louder. We incidentally developed a vehicle performance MLP that worked for both naturally aspirated and turbo-charged cars; the latter had not been achieved hitherto. In the sound quality work, we also discovered that, by applying Bayes' theorem to the traditional paired comparison tests, and presenting the results differently, we could save juror effort and make better target selection decisions.

So, what did I learn from the Birmingham meeting? Did I find the inspiration I hoped for? Well, perhaps one potential (but not really original) application of genetic algorithms might be to circumvent the sound quality design-test-select-build cycle altogether. Customer evaluation could exert the selection pressure on an evolving population of acoustically realistic vehicle designs to produce appealing and achievable sound quality targets. It just remains to:

- encode the genes (a brand-typical sound plus a variable set of digital filters, or some hierarchical combination of actual component recordings perhaps?),
- use our Noise & Vibration Simulator (NoViSim) to generate the sounds in real-time as the customer drives,
- and wrap the application in a nice user interface (like the BT/Tate Carousel example).

I may report on progress – if ever such a project gets going.

Jeff Fry
Warwick Manufacturing Group,
University of Warwick

After many talks on biology, it made a change to listen to a talk by Professor Edward Tsang of the Centre for Computational Finance and Economic Agents, in the University of Essex, who discussed the work that he and his PhD students had been developing using genetic programming. These techniques had been used for the identification of arbitrage opportunities in the London Stock Exchange. These are opportunities where money can be made risk free for those who are fast enough to spot them. Unfortunately the sums under consideration are only hundreds or sometimes thousands of pounds, and not large enough to interest the major banks in the methodology. Genetic programming models were able not only to spot arbitrage opportunities when they arose, but also to predict them slightly ahead of time, allowing for potentially greater profit opportunities.

The final external talk came from Richard Tateson of BT, who introduced a selection of projects that the Pervasive ICT Group has investigated over the last few years. This included information visualisation using a flocking paradigm, selection of artworks using a human-driven evolutionary search, and the now-infamous Flyphones project. In this last work, frequency selection for adjacent mobile phone base stations was determined based on the process by which cells on a fly's back regulate hair growth. This most obscure of natural inspirations leads to a highly efficient, decentralised agent-based model, which allows rapid and conflict-free frequency allocation.

Finally, Professor Xin Yao, Director of Cercia, covered a development project that involves the optimisation of routing plans for road salting trucks. In marginal winter weather, where some roads become icy and others do not, it becomes advantageous to generate the most efficient routes for a fleet of trucks, whereby the roads can be salted as rapidly as possible whilst minimising wastage. Evolutionary methods have been shown to reduce the total journey length by over 13%, translating to significant cost savings for individual councils.

It is easy to see why Natural Computation methods are becoming so popular across academia and industry. They are widely applicable to a huge number of complex challenges, and provide dramatic, measurable improvements. They are simpler to implement than most traditional methods, and are endlessly adaptive. The message to take away from this meeting was that, after so many years confined to academia, natural computation techniques are at last beginning to enter the mainstream.

Colin Frayn
Cercia

PUZZLE CORNER

Number 33

After consummately upstaging the Great Enchilada in PC#23, Guacamole was fired and began looking for another job. He registered his CV with a repertory agency, Dooey, Cheetham and Howe, and was pleased to be told that 17 offers had been received. The agency, however, had a curious policy whereby they would only pass on one offer at a time, in the order in which they had received them. The client would have to accept or reject the offer without any knowledge of what was in the remaining offers. If they accepted an offer, all the other unseen offers would be withdrawn. If they rejected an offer they would be sent the next one in the sequence, but they would never be able to go back and change their mind about an offer they had rejected.

Lisa had taken a summer job in the agency and had seen the list of bids waiting to be sent to Guacamole. She remembered the magician's aid and considered him to be a 'good egg', so she decided to help him get the best job available. The sequence of salary offers (in kiloPounds) was 5, 41, 19, 33, 47, 25, 11, 67, 29, 73, 14, 16, 8, 55, 66, 22, 10.
Lisa knew that Guacamole would correctly reason out the optimal way to maximise his likelihood of finding the largest offer, but also knew that the strategy would not succeed in this particular case. However, Lisa had one mechanism available to her that would make a difference. She could advise her client on a minimum salary, below which he should automatically reject an offer. Lisa carefully considered the sequence and settled on a recommendation that allowed Guacamole to land his dream job.

What are the highest and lowest minimum salary recommendations which still permit Guacamole's strategy to settle on the 73 kP offer?

The answers will be given at the next NCAF meeting (13–14 September 2006, University of Bristol)

Fenella the Rottweiler

ncaf
Natural Computing Applications Forum

COMMITTEE NOTES

Please contact NCAF through Graham Hesketh, Chairman – NCAF
PO Box 5944
Derby DE24 8ZD U.K.
Tel: +44 (0) 1332 246989
Fax: +44 (0) 1332 247129
e-mail: enquiries@ncaf.org.uk
http://www.ncaf.org.uk

MEMBERS' NEWS AND VIEWS

Deadline for contributions for the next edition – 1 November 2006.
Please send to Managing Editor – Nick Granville, e-mail:Nick.Granville@smith-nephew.com

Edited and Produced by:
Forum Communications
Westgate House, Old Ivy Lane
West End, Southampton
Hampshire SO30 3RX
Tel/Fax: 023 8047 6888
e-mail: info@forum-pr.co.uk

NEXT EDITION
Review of Bristol meeting
Preview of London meeting

Innovation support for complex computational technologies

The Government is providing two services that may be of interest to NCAF members. The first, DTI Global Watch Service, provides support dedicated to helping UK businesses improve their competitiveness by identifying and accessing innovative technologies and practices from overseas. The second is the recently established Grid Computing Now! Knowledge Transfer Network with a mission to secure UK commercial leadership in the provision and exploitation of grid computing.

DTI Global Watch Service

The DTI Global Watch Service (www.globalwatchservice.com) comprises information sources, overseas mission activity and direct assistance with technology partnering and licensing agreements.

Information services are delivered through *Global Watch Online* – an internet service providing up-to-date worldwide business and technology information to UK companies. The website provides unique coverage of UK and international research, business initiatives, collaborative programmes and funding sources.

Information is also communicated in *Global Watch* magazine, available via a free electronic subscription. The magazine features innovation in action by showcasing overseas technologies which have potential value to UK industry. It features the latest technology developments and practices gleaned from Global Watch Service activities around the world with opportunities for adoption by British businesses.

Technology partnering and benchmarking is supported by two related activities. The first is *Global Watch Missions* – providing funding and support to enable small teams of UK experts to investigate innovation and its implementation at first hand by visiting centres of excellence and organisations which typify best practice in overseas markets. The technology focused missions allow UK sectors and individual organisations to gain international insights to guide their own strategies for success.

The second is *Global Watch Technology Partnering* – providing direct assistance from specialists to raise awareness of, and provide access to, technology and collaborative opportunities overseas. It is delivered to UK companies by International Technology Promoters, who provide support ranging from information and referrals to more in-depth assistance with licensing arrangements and technology transfer.

Grid Computing Now!

Another DTI activity to encourage promote high performance computing and complex computational technologies is the *Grid Computing Now!* Knowledge Transfer Network. Grid Computing Now! (www.gridcomputingnow.org) is a collaborative project involving Intellect, the UK hi-tech trade association, the National e-Science Centre in Edinburgh and CNR Ltd, a consultancy. Its mission is to secure UK commercial leadership in the provision and exploitation of grid computing. The project is aimed specifically at exploiting the benefits of grid computing technologies in selected UK public and private sectors through the establishment of a Knowledge Transfer Network.

The activities of Grid Computing Now! are driven by its four major objectives:

1. To establish wide understanding of the potential of grid computing technologies particularly among the IT user community. The project increases awareness of the potential for key technologies through the development and publishing of a set of web-based resources using the DTI's Knowledge Transfer Network web platform. These resources include the publishing of relevant industry news, standards updates and case studies. The platform also offers a Knowledge Transfer Network membership database, tools for conferencing and access to reference information.
2. To accelerate the recognition of requirements and issues for grid computing. The project develops networks of enthusiastic and qualified IT professionals from its targeted industry sectors and together they work with key representatives of the supply community to understand the business potential of grid computing technologies, highlighting issues and obstacles which inhibit their successful adoption.
3. To prepare the UK ICT industry, users and government for grid computing through the use of awareness raising and networking activities. The project seeks to raise the debate and demand for incorporation of these technologies in targeted industries embracing both public and private sectors.
4. To follow through the e-Science Core Programme vision in which demanding scientific research stimulates significant advances in grid technology which are then transferred to UK industry, healthcare and government. The project provides event platforms at which research and technology supply leaders can bring their knowledge and experience to target organisations.

The project seeks to engage end-users, service providers, developers, innovators, grid computing specialists, UK e-Science centres, companies that can capitalise on grid computing technologies and any policy makers either in government or its agencies. Please contact me if you require more information.

Adrian Rowland,
PERA
adrian.rowland@pera.com

DIARY DATES 2006–07

4–7 December – NIPS2006: Neural Information Processing Systems. Vancouver, Canada.
http://www.nips.cc/
11–13 December – AI-2006: 26th SGAI International Conference on Innovative Techniques and Applications of Artificial Intelligence. Cambridge, England.
http://www.bcs-sgai.org/ai2006
Mid-January – NCAF meeting (provisional theme: visualisation of complex data) at the DTI, London. For information, email enquiries@ncaf.org.uk or telephone +44 (0)1332 246989
12–14 February – AIA2007: Artificial Intelligence and Applications. Innsbruck, Austria.
http://iasted.org/
12–14 March: BIRD'07: The first international conference on Bioinformatics Research and Development. Berlin, Germany.
http://www.birdconf.org/