ncaf Natural Computing Applications Forum

Networks

Neuroimaging in York

York University 18–19 May 2005

The GE 3 Tesla machine is the first of a new generation of MRI devices with powerful gradient amplifiers that allow unique opportunities for studying brain anatomy and chemistry.

Natural Computing is very much the focus of NCAF's spring meeting to be held in York at its Neuroimaging Centre (YNiC).

This year's meeting will offer new and exciting opportunities. The reception and dinner will be held in the Great Hall of the National Railway Museum in the centre of York and the YNiC is offering the opportunity to see how 'GRID-enabled' computing can be exploited to solve large-scale computational problems on the YNiC 130 node Apple G5 based processor system.

The primary focus of YNiC is how the human brain achieves its remarkable capabilities and what happens when this is disrupted in disease. YNiC is a new venture for the University of York and is the outcome of a strategic collaboration between many of the University's top research departments. These departments include Psychology, Chemistry, Computing Science, Electronics and Health Sciences. The aim is to develop integrated research in areas such as targeted imaging agents, neurocomputation, image processing, the dynamics of neural processing, novel computational devices and cognitive neuroscience. YNiC has strong links to the Hull-York Medical School, industry and the health services, so applied research, exploiting non-invasive imaging in clinical practice is also a key component of its activities. There are clear overlaps with the interests of NCAF.

The University of York has invested £4M of their Science Research Infrastructure Fund in the Centre. As a result the YNiC is now equipped with state-of-the-art magnetic resonance (MRI) and magnetoencephalography facilities in purpose built extensions to the Biocentre in York Science Park. The GE 3 Tesla machine is the first of a new generation of MRI devices with powerful gradient amplifiers that allow unique opportunities for studying brain anatomy and chemistry.

The magnetoencephalography (MEG) facilities were purchased following a generous award of £1.2 million from the Wolfson Foundation. MEG allows direct measurement of neuronal activity with fine temporal resolution. The manufacturers of the YNiC MEG facilities, 4D Neuroimaging of San Diego, have generously provided sponsorship for the York NCAF meeting. The MEG machine is routinely used to study where and when brain activity occurs during cognitive tasks. Recent users of the Centre include York psychologist Andrew Young, who is using the facility to investigate face and emotional expression recognition. Similarly, Andrew Ellis and his team (York University) are examining neural mechanisms involved in language understanding. Others have used MEG to investigate memory, visual and auditory perception, motor function and attention.

Both MEG and MRI generate very large data sets and one of the bottlenecks in conventional analysis of such data is created by a lack of computational tools to handle both signal analysis and visualisation of the 3D information. An initiative between York computer scientists and YNiC has been established to tackle the data analysis problem. Projects include the modelling of brain connectivity and function, new tools for examining 'faults' or indicators of disease states in MRI images and MEG time series, and the investigation of how neural mechanisms can be interpreted and abstracted so that new algorithms, based on natural computing, can be formulated. One particular investigation is exploiting a technique for analysing dynamics that was discussed at a recent NCAF meeting when Andrew Batchelor from Newcastle University gave a talk on the use of a Bayesian method for finding the coefficients of a Fliess series fit to a nonlinear dynamic system.

The York meeting will follow the standard practice of themed talks on day one, with day two available for talks of general interest to NCAF. Day one will be on 'Cognitive Systems – from Neural Imaging to Neurocomputing'. Invited speakers include psychologists, computer scientists, experts in non-invasive imaging and industrialists but there are still spare slots available. With the recent announcement by the Research Councils of their particular interest in Cognitive Systems and the call by the DTI for interest in imaging technologies this could be a good opportunity to meet others interested in forming a consortium to apply for funding.

Prof Gary Green
York University

INSIDE

BACK PAGE

Biopatterns, baltis and burglars in Birmingham

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The January meeting of NCAF, sponsored by the Biopattern Network of Excellence, had a theme of biopatterns on its first day, with general papers being presented on the second day. After a welcome from Ian Nabney, the first paper concerned the application of neural networks in a Holter ECG analysis system, and was presented by James Pardey of Oxford Instruments Medical. An overview of the workings of the heart was followed by an outline of the limitations of most commercial Holter systems. The way in which neural networks have been used to produce improved algorithms and then incorporated into the latest software (Medilog Darwin) was explained. Finally, the advantages and disadvantages of using a feedback system were presented.

The second paper, presented by Nick Hughes from the University of Oxford, continued the theme of ECG analysis, this time from the perspective of interval analysis (specifically the QT interval). The motivation for this work has come from the Food and Drug Authority (FDA) which wants to see QT interval analysis as part of phase I clinical trials for new drugs, due to the fact that some medication can increase the QT interval which, in turn, can cause health problems and even death. An accurate and reliable automated technique is therefore required to replace the current manual QT interval analysis. Nick described his approach involving supervised learning and the provision of confidence measures and the use of hidden Markov models for ECG segmentation.

The final paper before lunch, presented by Lingfen Sun from the University of Plymouth, concerned bioprofiling over the grid. An explanation of a bioprofile was provided together with its role in preventing and treating disease. Then the usefulness of the grid for collecting and analysing the huge amount of data from various sources was demonstrated.

Prognostic accuracy

After a buffet lunch in the Wolfson informatics laboratory, the conference resumed with a presentation from Elia Biganzoli from the Instituto Nazionale per lo Studio e la Cura dei Tumori. This concerned the development and evaluation of prognostic criteria for breast cancer based on traditional and genomic tumour markers. It was explained that prognostic accuracy needs to be improved to avoid the over-treatment of low risk patients and that cluster analysis had been employed to this end in order to detect cancer sub-types. NCAF is very grateful for the sponsorship provided by the Biopatterns Network of Excellence that allowed the meeting organiser, Ian Nabney, to invite an overseas speaker.

Paulo Lisboa then presented a paper concerning the use of neural networks in clinical trials based on his work at Liverpool John Moores University. Neural networks are being increasingly used in the analysis of clinical trials although the vast majority of papers describe poorly designed trials. The problem of the clinical plausibility of models produced by neural networks was also described. Paulo commented that software could be posted on the web that can be used to assist the clinician in his or her diagnoses. However, this software may not have been through any rigorous testing and need not be approved by any of the regulatory authorities.

The last paper of the day was on cellular automata and discrete dynamical networks and was given by Andy Wuensche from the University of the West of England. A demonstration of the computer software used to model systems in nature was given together with an explanation of its working and its possible use as an encryption tool.

Finally Fenella the Rottweiler presented the two solutions to Puzzle Corner with the aid of 'volunteers' from the audience and a computer program in MATLAB.

For the evening's entertainment, the local organiser Vicky Bond had arranged a traditional Birmingham night out at a Balti restaurant. After meeting in the bar at the Nelson Building the party set out in a taxi and a minibus. The taxi arrived first to find that the police had blocked off the road to the restaurant due to another Birmingham tradition: the armed robbery! Luckily the road was soon cleared and, after stocking up on alcohol at the off licence next door, a very enjoyable meal was had by all.

Various stages of recovery

The second day's programme began, aptly some might say, with a paper on recovery from alcoholism by Kathryn Burn-Thornton from Aston University. The use of data mining classification methods was explained in the context of the various stages of recovery from alcoholism and in the prediction of recovery timescales. There was too much qualitative data for data mining to be completely successful. However, a model was developed, similar to that used in predicting the mean time to failure of a laser, in which the mean time to recovery of the addict could be predicted.

The second paper involved latent space modelling in collaborative filtering and was presented by Peter Tino of Birmingham University. An application in the classification of ratings for films was demonstrated, which made use of information such as 'I went to see a film because you liked it'. Information like this is difficult to utilise, but very important in the areas of market research and airtime scheduling.

In the last paper before lunch Jort van Mourik from Aston University informed those present about physics inspired optimisation algorithms. In particular algorithms concerning the physics of glass were presented, especially in relation to the quenching and annealing (fast and slow cooling) of glass. Insights gained from physics could be applied to develop new algorithms.

NCAF: an essential part of anyone's education

My NCAF education began as a result of joining the Rolls-Royce Strategic Research Centre in 1999, working for Professor Peter Cowley. As many people will be aware, Rolls-Royce has supported NCAF for a considerable period of time and, as well as being my team leader, Peter was also NCAF Chairman at that point. As someone with a physics background, I had an interest in natural computation, but had little experience in computational intelligence techniques. NCAF was therefore used as part of my training to improve my knowledge and understanding in this area. NCAF represented a relatively cheap route for the company to provide the type of experience I needed as a young researcher. Combining the knowledge of the latest techniques with my understanding of the business put me in a position to encourage technology transfer and to identify potential application domains. What I found very useful was the application context provided by presenters at meetings. The challenge of producing and delivering a winning technology is far more than solving the technical problem. Particularly in safety critical domains such as healthcare, the external factors that influence product development are an enormous challenge. Coming from an engineering company, I was able to derive similar lessons for my own applied research. Based on my experience, I would encourage all industrial members of NCAF to consider the value of involving young researchers in meetings to provide them with access to the wealth of knowledge and experience that the community has to offer. The regular nature of the meetings allows relationships to be established that can lead to beneficial collaboration. It certainly helps young people to meet a variety of people with a shared interest and begin the process of establishing a network that spans the academic and industrial divide.

Having attended meetings for a couple of years, I was invited to join the Committee. Graham Hesketh, my second successive team leader to hold the office of Chairman, asked me to get involved in the co-ordination of meetings. Initially this was on a co-opted basis, but this soon became a full position. NCAF was undergoing a major revamp at this point, moving from a traditional paper based organisation into a fully electronic one. In order to achieve this, it was decided that the Chairman and Secretariat should be co-located in order to maintain an efficient service to members. As a result, I became Secretary and was tasked with instigating the transition of NCAF into a company driven by electronic information. So began the second half of my NCAF education, running a distributed organisation. I had no management experience and virtually no understanding of how a company works. Now I was a Director implementing whole scale changes to virtually every process within the organisation. As a voluntary group, serving a community of members, NCAF offers a relatively safe environment, but the opportunity to help run a limited company is still highly beneficial. As a registered company, NCAF still has to log official documents with Companies House, prepare formal accounts and comply with the standard set of rules that apply to any company in the UK. Thanks to the efforts of a highly motivated committee, NCAF as an organisation was transformed, during my time as Secretary, and brought into the 21st century at the same time considerably reducing the costs incurred by members. This experience in running a company taught me some important lessons in how people work together and the level of effort required to keep an organisation like NCAF sustainable.

Testament to strength

It is a testament to the strength of the community that the organisation has managed to survive for over ten years. The current committee is maintaining this impetus and I am pleased to see that the diversity of topic areas has been maintained. Running three meetings a year in different locations, with different speakers and themes each time is no mean feat. I would encourage all young members to consider getting more involved in the running of NCAF. There really is great benefit in working with people from different organisations and a great deal to learn.

Mark Cheeseman
Rolls-Royce Group plc

After a leisurely lunch, for those not involved in the NCAF annual general meeting, there was a change to the advertised programme when Iead Rezek from the University of Oxford talked about monitoring the depth of anaesthesia. This is currently measured using EEG in the hypnotic state and the drawbacks of using a bispectral index were shown. A model using Bayesian estimation was both faster and more robust.

The final paper of the day was presented by Davide d'Alimonte from Aston University and dealt with classification with incomplete information. The specific case where data points are drawn from different processes but only the probability density function of one of these processes can be defined was considered, both on synthetic and real life data. The method has been applied to gene chip data, and has been shown to be better than novelty detection. However, the drawback is that it is not based upon the minimisation of a cost function.

The conference then closed. Thanks are due to the local organisers, Ian Nabney and Vicky Bond, and to the Biopatterns Network of Excellence, both for enabling an overseas speaker and for subsidising the costs of some student attendees.

Steven D'Aguiar and Thomas Bermudez
Aston University

PUZZLE CORNER

Number 29

During her recent trip to Princeton, Lisa got embroiled in a game of 'Mafia'. In this game the Forces of Light (Civilians) do battle with the Forces of Darkness (Mafia) in a small Italian village. The Mafia members are made aware of each other but the Civilians do not know who belongs to the Mafia. Every night the Mafia secretly meet to select and assassinate one of the remaining Civilians. At daybreak the non-playing Game Moderator names the victim who is then removed from the game and takes no further part. The surviving villagers (Civilians and secret Mafia together) then have an open debate during which anyone can be accused of being a member of the Mafia. If the majority of villagers vote in favour of the indictment, the accused is summarily executed and removed from the game, and their true status (Civilian or Mafioso) is then revealed. A maximum of one villager per day can be executed, after which the night/day cycle continues with the next nocturnal assassination. The game ends when one faction is in sole control of the village. Obviously the game must terminate (given a finite number of villagers).

Lisa joined a group of five other players. The Moderator declared that amongst the six villagers there would be two Mafia, and the random role assignment via a short deck of six cards put Lisa in the Civilian camp. On the opening night the Mafia fortuitously assassinated one of the other Civilians. Left with only the barest majority, the future looked bleak for the Forces of Light (FoL).

What were the chances of winning for the FoL, *and how did Lisa manage to improve them? How many Civilians would you need against two Mafiosa to make the game favour the* FoL?

The answers will be given at the next NCAF meeting (18–19 May 2005, York University). For full game details see http://www.princeton.edu/~mafia/rules.htm. Note the 'Angel' (a special type of Civilian gifted with limited powers of divination) is conspicuously absent in this puzzle.

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

Edited and Produced by:
Chris Hawthorne
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 York meeting.
Preview of Autumn meeting.

'Bert Bullen looks back

A personal retrospective of my time involved with, and on the committee of, the Natural Computing Applications Forum... by 'Bert Bullen, aged 47 and three quarters.

It is fair to say that there have been enough memorable moments in the period during which I have been involved in NCAF to almost justify putting up with the idiosyncrasies of its chairman. Some have even been enjoyable. I have been privileged to see a man write with his stomach[1], and another balance precariously on a contraption that, in the time of the Inquisition would have been burned at the stake and then drowned for being heretical[2]. I have been witness, during the realisations of many Puzzle Corners, to such heights of theatrical prowess to which Shakespeare himself could not have aspired, even in such classics as 'Oliver Twist' or 'The Marriage of Figaro'.

It all started back at the turn of the century. I had just completed a year with the Neural Computing Research Group, barely surviving on a diet of ships biscuits and statistical algorithms. I had been taken in by BAE Systems, a charitable organisation devoted to the care of waifs and strays with neither talent nor observable means of supporting themselves. During this time, I was mistaken for a scientist and asked to serve on the committee of NCAF and, to this day, the deception is intact.

NCAF sits nicely. It maintains a nice balance between the dusty cloisters of academe (Does academe still have dusty cloisters? Where are the cleaners? Have they taken the day off to go to the seaside or visit an elderly relative?) and the thrusting engine of British industry. It embraces a wide variety of disciplines and domains: from genetic algorithms to generative models and from pills to 'planes. It is very accessible – a utopian society in which all are equal and elitism is banished like a lost pizza delivery motorcycle into the night.

Although I have now forsaken the hurly-burly of committee life in order to fulfil my ambition of some time to emigrate to Gaul and keep chickens, I will certainly make it my business to maintain a connection with this worthy organization and its colourful members. I would like to wish NCAF many more years of flourishmentization (as a certain American head of state would say) and pass on my thanks to all those who have not been nasty to me in my time associated with it.

1 *The Dasher interface, demonstrated by David Mackay (University of Cambridge) at the Cambridge meeting in September* 2003.
2 *The Segway Human Transporter, demonstrated at the Bath meeting in January* 2004.

'Bert Bullen
BAE Systems

COMMITTEE NEWS

Mandy Bradley and 'Bert Bullen stepped down from the Committee at the recent AGM. Two new directors filled the resulting vacancies: Vibhu Walia (Birmingham University) and Rajesh Ransing (Swansea University). The Committee wish to thank Mandy and 'Bert for their valuable support over the last few years.

At the Committee meeting following the AGM it was resolved that Graham Hesketh should continue as Chairman and Armin Stranjak should continue as Secretary. Ian Nabney will be relinquishing his role as Treasurer as soon as we appoint a replacement.

Nick Granville, Editor

DIARY DATES 2005

27–29 April – ESANN: 13th European Symposium on Artificial Neural Networks, Bruges, Belgium.
http://www.dice.ucl.ac.be/esann/

18–19 May – NCAF Meeting on Cognitive Systems – from Neural Imaging to Neurocomputing at York University. For information, email enquiries@ncaf.org.uk or telephone +44 (0)1332 246989

8–10 June – IWANN: 8th International Work-Conference on Artificial Neural Networks, Barcelona, Spain.
http://iwann2005.ugr.es

29 June – 1 July – CIMED: 2nd Computational Intelligence in Medicine and Healthcare, Lisbon, Portugal. The 'Biopattern' Conference.
http://www.uninova.pt/cimed2005/

30 July – 5 August – IJCAI: 19th International Joint Conference on Artificial Intelligence, Edinburgh, Scotland.
http://ijcai-05.org

2–5 September – CEC2005: Congress of Evolutionary Computing, Edinburgh, Scotland. It includes a session on the applications of evolutionary computing to business, organised by CERCIA.
http://www.cec2005.org

September – NCAF Meeting (Theme and location to be announced). For information, email enquiries@ncaf.org.uk or telephone +44 (0)1332 246989

12–14 December – AI-2005: 25th SGAI International Conference on Innovative Techniques and Applications of Artificial Intelligence, Cambridge, England.
http://www.bcs-sgai.org.uk/ai2005/

MEMBERS' NEWS AND VIEWS

Deadline for contributions for the next edition – 1 July 2005. Please send to Managing Editor – Nick Granville, e-mail: Nick.Granville@smith-nephew.com