

NCAF smoothes out the peaks in Sheffield

NCAF Summer meeting, Ranmoor Hall CTC, Sheffield, 28 – 29 May 2002

The theme of the meeting will be Regularisation – a discipline which has not penetrated as deeply into the armoury of neural computing practitioners as it perhaps should.

After a break of several years, NCAF is returning to Sheffield for its Summer meeting, 2002. This time, since NCAF meets during the University term, the venue will not be at the University as is our tradition, but will take place in the splendid surroundings of Ranmoor Hall Conference and Training Centre, Belgrave Road, Sheffield, on the edge of the Peak District National Park (URL: <http://www.ranmoorhall.co.uk/index.html>).

The theme of the meeting will be Regularisation – a discipline which has not penetrated as deeply into the armoury of neural computing (NC) practitioners as it perhaps should. But what actually is regularisation, and why should it apply to neural computing? It is defined as a mathematical technique for obtaining a stable (computationally reliable) solution to an unstable equation – which is just what NC practitioners are dealing with.

A number of extremely interesting topics are lining up for our consideration. Dr. Joab Winkler will introduce the basics of regularisation in a talk on the mathematical basis of the technique, such that by the end of the meeting, the topic will be perceived as a science (with a theoretically robust foundation) rather than as an art that is subject to interpretation.

Other topics to be discussed include:

Jaz Kandola from Royal Holloway will discuss kernel target alignment, whereby the problem of measuring the degree of agreement between a kernel and a learning task will be addressed, and a quantity to capture this notion, which is referred to as Alignment, is proposed.

Jim Stone from Sheffield University will consider the neocortical principles of neuronal computation, asking whether there are any, and what they are good for. An overview of the development of his ecological approach to neural computation, and its application to unsupervised

learning and blind source separation, will be provided.

Randa Herzallah of the Neural Computing Research Group, Aston, will examine uncertainty modelling in neural networks applied to control, and outline a framework directly exploiting uncertainty information allowing us to constrain the more complex dynamic programming problem and construct more robust inverse non-linear control laws.

Marta Milo, Sheffield University, presents her current findings regarding cDNA microarrays, or “genes on a chip”. She will provide an overview of the most common normalisation methods for cDNA microarrays and present some experimental results on real biological data.

... plus many more.

Our traditional social evening will reflect the nature of our surroundings. We have arranged for a visit to the Magna Centre, located in a redundant steel-works between Sheffield and Rotherham. Sounds boring? Not a chance! A review said of Magna “The Magna centre is everything that the Millennium Experience at the Dome was not: an existing building ingrained with a long and steely memory, transformed into what is generally agreed to be a science experience that tells visitors something new and worthwhile.” Definitely not to be missed!

This will be followed by a meal in the depths of the spectacular Peak District, in the region of Grindleford – and there will be a coach to chauffeur our party, so drink-drive laws will not be infringed.

All in all, a meeting for the connoisseur. Ensure you do not miss out on such an exciting schedule, and book early. Numbers must be finalised a week before the meeting, so remember: book before 21 May to guarantee your place!

**Joab Winkler
Sheffield University**

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Going Global at Exeter

A Review of NCAF's 23-24 January meeting at Exeter University

*Can an agent be trained on a smaller problem and then used on a larger one?
Can an agent be used to control a GA in an on-line fashion?*

The NCAF meeting at Exeter was lively and challenging, and a great success. An engaging workshop chaired by Richard Everson set the tone for the conference. In this, various speakers imparted their opinions on the recent key developments in Global Optimisation (GO) and discussed its limitations, many of which were addressed over the two days.

The next speaker, Ian Parmee of UWE looked at Evolving the Problem Space, taking a refreshingly business-orientated approach to solving real-world problems utilising GO techniques. After this, Xin Yao of Birmingham University gave a demonstration and a clear message that if solving complex problems is difficult, it is often possible to convert complexity into much easier problems.

A talk on Evolutionary Computation (EC) in Bioscience by David Corne of Reading University gave an interesting picture of the benefits of EC to this field, and examined some of its successes in DNA sequence determination. The next presentation was given by Jonathan Fieldsend of Exeter University on Multi-Objective Genetic Algorithms, and the benefits of using Elite Sets in this field together with possible solutions to its problems.

The final talk of the day was by Dragan Savic of Exeter University on Global Optimisation for Water Pipelines, and demonstrated that the evolutionary approach to designing water provision routes is potentially very profitable.

Day one ended on a high note, with the usual entertaining solution to Puzzle Corner No 19.

Stick & carrot

The second day began with James Pettinger of Exeter University taking the stage to present the results of research included in his Master thesis. Learning to learn (it has nothing to do with his experience, gained in pursuing his Master degree) was the title of his presentation and was dedicated on improving genetic algorithms (GA) performance using reinforcement learning (RL). He showed how a 'stick & carrot' approach could be used in training his agent to 'ride' a bicycle. Results from testing the proposed hybrid RL - GA model for learning when training an agent to solve a combinatorial problem (travelling salesman - 40 cities). He still has to answer some questions, in his future research, such as: Can an agent be trained on a smaller problem and then used on a larger one? Can an agent be used to control a GA in an on-line fashion? Can these techniques be applied on other problems, etc?

The next presenter, Sean Holden of University College London introduced the combinatorial drug design process from a machine learning point of view. The Support Vector Machines (SVM) used in his research are a relatively new addition to the available machine learners for supervised training. He introduced the SVM technique, emphasising

important requirements for the application area and showed that successful discovery of new drugs might be a result of refinement of the search process through the space of chemicals, and that SVM could be very helpful in this process. Finally, he reported an example of application of the SVM on some relevant data in combinatorial chemistry (the SVM proves to produce very good results when trained with balanced data sets) and compared the results with those of several architectures of Artificial Neural Networks (ANN).

Humane problems

After the break, Ajit Narayanan from the hosting university started his presentation with a pacifist appeal to the computer scientists to concentrate their efforts and research on humane problems and not on developing hi-tech sophisticated weapons. In his view, there is an urgent need for the computer science community to bring knowledge and expertise to molecular biology research, which can result in an improvement of the quality of life for thousands and perhaps millions of people.

He reported a case study in bioinformatics: how ANN can be used for predicting viral protease cleavability. The beginning of his presentation was more like a lecture in biology - HIV, AIDS and how the immune system works (no wonder, there were hardly any biologists in the audience). With the employed ANN (back-propagation learning) for predicting HIV protease cleavage sites in protein, he managed to replicate the results of Cai and Chou (92% accurate prediction). In the reported case study he has also employed symbolic learning. The analysis shows that the decision tree approach of this learning cannot take into account long-distance relationships, which suggests the relatively poor results achieved so far. In conclusion, his presentation was a good example of how methodologies, tools and techniques from the computer science field could aid biological research.

Just before the lunchtime, Mike Denham of Plymouth University gave a very extensive talk on the role of back-propagating action potentials and short-term synaptic dynamics in long-term plasticity and learning. In his introduction he stressed the well-known fact that the ANN are very simplified models of the complexity and functionality of the human brain. He also reviewed recent knowledge in the field of experimental neuroscience, concerning both, temporal and spatial characteristics of biological connections between neurons and their modification under 'pairing', the experimental equivalent of Hebbian learning. His remarks were restricted to the case of chemical synapses, although other connections, such as electrical gap junctions are also extensive and important in processing in the biological neural network. He described briefly some of the

Artificial Intelligence and Air Traffic Control

National Air Traffic Services (NATS) provides control services to aircraft flying in UK airspace and over the eastern part of the North Atlantic. Safety is NATS' first and foremost priority, but it also aims to provide its service in an efficient and expeditious way. Controlling one of the most complex airspace regions in the world puts NATS at the leading edge of air traffic control technology. NATS carries out technical research to find new ways of safely handling the rising volume of traffic.

Over the next ten years, air traffic management in Europe and the rest of the world will change dramatically, bringing both challenges and opportunities. The biggest of those challenges is the continuing rise in traffic volumes. Improving the current systems will provide a short-term solution. However, beyond 2006, increases in capacity require investment in new automated systems and infrastructure.

These automated systems are expected to provide support to air traffic controllers by:

- Increasing productivity
- Automating routine tasks, releasing the controller to handle strategic tasks
- Providing additional safety checks to maintain current safety levels in the face of increasing flight numbers

NATS believes that Artificial Intelligence (AI) applications have an important role in these future automated systems. For this reason, as part of the Research and Innovation (R&I) programme, we maintain awareness of technological developments in the AI field and investigate potential opportunities. Through R&I we research new techniques, undertaking small projects to demonstrate them within our specialist environment.

recently investigated computational models of these biological phenomena. Everyone agreed that a greater understanding of how to represent and exploit these characteristics computationally is important and could lead to ANN architectures that might achieve a similar level of performance and complexity as the biological networks. Time just for few questions, the lunch was approaching, but the discussions continued in the Refectory and Mike proved to be a very interesting companion as well.

Stephen Roberts from the Pattern Analysis & Machine Learning Research Group, University of Oxford, looked into Hidden Markov Models (HMMs). HMMs are a graphical technique which combine graph and probability theory in order to model function(s) that produce data, not the data itself. This allows application to diverse problem areas; from explaining pigeon flight path

One such project was the application of AI to automated Flight Plan correction at the Scottish and Oceanic Area Control Centre. Flight plans are submitted for all Trans-Atlantic flights and contain information pertaining to expected arrival times at specific points along the route. Sometimes these times are incorrect or missing, and an assistant has to manually check and insert approximate times, using their own experience and knowledge. This is a fairly simple, but specialist and time-consuming task.

A Case Based Reasoning model was developed to check the filed flight plan and predict incorrect or missing arrival times and also provide updates in the event of changing conditions. The system was developed from a model of human memory and used previous occurrences of similar problems to solve current problems. The model showed promising initial results.

This project is one example of NATS' interest in AI applications. Others include:

- Flight Plan Optimisation
- Conflict Detection
- Separation Monitoring

NATS is also interested in the issue of validating and verifying AI techniques to meet NATS' high safety standards.

NATS' business is very specialist, with challenging requirements regarding certification and reliability. It is crucial to address these issues now, and essential to continue to receive guidance from AI technologists leading the way in this field.

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National Air Traffic Services

characteristics to modelling Brain Computer Interfaces. The power of the technique to deterministically combine time and data information was clearly demonstrated.

The finale to the valuable two days on optimisation was provided by Peter Herdman from Arjo Wiggins who showed that even the humble pen and paper could be improved! Judging by the enthusiasm of the audience for the leap-pad toy from the USA, intelligent paper will become widespread. Coupling this with pens that input as well as write, the way people interact with paper (including *Networks*) will change dramatically in the near future.

Richard Edens, Exeter University
Stephen Hart, Exeter University
Ivan Jordanov, De Montfort University
Will Brown, Reading University

PUZZLE CORNER

Number 20

Following a slump in bearings, the Big Ball Bearing Company of Leeds decided to branch out into CHANCE – Chaotically Haphazard Assembly for Numerically Challenged Engineers. This simple manufacturing recipe requires nothing more than a large number of containers holding bolts of two different types: metric and imperial. Whenever a bolt is required, the engineers are expected to employ the primary QA procedure:

- 1 Pick a non-empty container at random and pick a bolt at random from it.
- 2 If the container isn't already labelled, label the container with the type of bolt found, and then use the bolt.
- 3 If the container has a label, check the type of the bolt found. If it matches the label, use the bolt. Otherwise, replace the bolt in the container and remove the label, then go back to selecting a non-empty container at random.

This procedure guarantees finding a bolt, unless all the containers are empty. So the recipe has a secondary QA procedure:

- 4 When you take the last bolt out of a container, put in a requisition for another carton of similar bolts.

Today the company has 20 unlabelled containers, each one holding a mixture of imperial and metric bolts, with an overall ratio of 4 imperial bolts for every metric bolt. Their senior engineer, Mick Jeelson, told Lisa they expect to use all their available bolts today on a big order of custom Zimmer frames. What he couldn't predict was how many cartons of each type they would be likely to re-order.

Assuming they followed their QA procedures, how many cartons of imperial bolts did Lisa predict they are likely to order today?

The answer will be given at the next NCAF meeting (28 - 29 May 2002, University of Sheffield).

Fenella the Rottweiler



COMMITTEE NOTES

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Rolls-Royce plc

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Patient Monitoring and Physiological Measurement Network

A new EPSRC funded, Life Sciences Interface Network has been launched which will focus on patient monitoring and physiological measurement.

Current research into patient monitoring and physiological measurement is fragmented due to its multi-disciplinary nature. Workers in the field come from a variety of disciplines and institutions and have to have to draw on methods and solutions gathered from a wide range of physical and computing sciences.

The Patient Monitoring and Physiological Measurement Network will provide a focus for individuals and organisations involved in patient monitoring and non-invasive physiological measurement, to discuss development and research needs and obtain state of the art advice.

The Network objectives are to:

- Hold a series of strategic research workshops where groups of researchers and potential users identify areas for generic research.
- Provide cross-platform implementations of measurement and signal processing techniques for rapid evaluation by industry.
- Provide certified data-sets so new methods can be evaluated quickly and easily.

- Offer distance learning for education in new techniques.
- Produce literature reviews in specific areas to help disseminate novel techniques rapidly and encourage discussion.
- Facilitate interdisciplinary collaboration and networking between industry professionals.

Membership of the Network is FREE and applications are welcomed from academics, clinicians, student researchers and workers in the medical engineering industries.

The first workshop will be held at the 'Chancellors Conference Centre' in Manchester, 18-19 June 2002. Themes will include: anaesthesia and critical care monitoring, cardiac monitoring, processing and interpretation technologies, and home and outreach monitoring.

Further information about the Network, including how to join and details regarding the workshop are on the website at: <http://www.pmpm-network.org> or you can contact Dr Paul Beatty on 0161 275 5714.

Pamela Griffiths
Manchester University

DIARY DATES 2002/03

2002

16-18 April Fifth International Conference on Adaptive Computing in Design and Manufacturing (ACDM 2002) University of Exeter, UK.
<http://www.ad-comtech.co.uk/ACDM2002.htm>

28-29 May NCAF
Sheffield University - Regularisation
Contact: Mark Cheeseman
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24-26 July HPDC'02 The International Symposium on Grid Computing, Edinburgh International Conference Center
<http://www.extreme.indiana.edu/~gannon/hpdc/hpdc11.html>

10-11 September NCAF
University of Durham - Data Mining
Contact: Mark Cheeseman
e-mail: enquiries@ncaf.org.uk
Tel: +44 (0) 1332 246989

22-25 September Computers in Cardiology, Cook Convention Center - Memphis, Tennessee.
Contact: CINC Committee University of Memphis, Biomedical Engineering Dept., 330 Engineering Technology, Memphis TN 38152.
Tel: 901-678-3733 E-mail: cinc2002@ccmemphis.edu

2003

25-28 June CARS 2003: Computer Assisted Radiology and Surgery, London, UK.
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NEXT EDITION

Review of Sheffield Meeting
Preview of Durham Meeting

MEMBERS' CONTRIBUTIONS WELCOME

Deadline for contributions for the next edition - 5 July 2002. Please send to: Managing Editor, Inspector Rick Adderley, e-mail: Insp1908@aol.com or r.adderley@westmidlands.police.uk