Networks 29 – November 2000

It's time for Aston

Aston University, 24 - 25 January 2001

The January meeting of NCAF will take place at Aston University in Birmingham with a first day theme of time series analysis. The focus of the morning is on particle filters, a method for performing on-line Bayesian inference that can be applied to non-linear and non-Gaussian models. Daunting as that may sound, the method is surprisingly simple to understand and implement. Keith Copsey (DERA Malvern) will give a tutorial on the technique with illustrations from tracking problems, while Bill Fitzgerald (Cambridge University), who was one of the original developers of the method, will be surveying a range of signal processing applications that use particle filtering. The keynote talk is from David Lowe (Aston University) who will discuss a range of applications of modern time series analysis and challenging us to unify the wide range of different approaches to analysis in his usual thought provoking style.

In the second half of the day Neep Hazarika (Econostat) will talk on predicting equity and bond indices - news from the leading edge of commercial forecasting. Following this, Xin Yao (Birmingham University) will speak about some of the recent industrial applications of genetic algorithms. The day concludes with a talk by Tom Harris and Ian Nabney (Cardionetics) about past work in electrocardiogram analysis (which has led to the C.Net2000 monitor) and what future trends and product developments might lie ahead. Following this, there will be a reception (generously sponsored by Cardionetics) to mark the inauguration of the new Institute of Bioinformatics (see article elsewhere in this issue), with the evening social event being ten-pin bowling. Those who remember the last meeting at Aston will be relieved to hear that these events will be indoors!

As usual, the second day contains a wider range of talks. First up is David Saad (Aston University) who will be talking about new results in error correcting codes. Rather surprisingly, these can be mapped to spin glass systems and studied using methods of statistical physics. This analysis has yielded new insights, including codes that are much closer to the Shannon bound (the optimal possible code) than previously achieved, and a better understanding of the decoding process. Chris James (Aston University) will be continuing the biosignal theme from day one with a talk on the latest results in EEG and MEG analysis. Peter Tino (Aston University) will be bringing us up to date with recent developments in visualisation methods and showing how they can be applied to pharmaceutical data. The Annual General Meeting of NCAF will be held after lunch, chaired with his usual efficiency, by Graham Hesketh. This is your opportunity to give the committee feedback on the organisation and running of NCAF.

Hujun Yin (UMIST) will give a tutorial on Independent Component Analysis, an important technique that has several advantages over Principal Component Analysis, together with applications to image noise reduction. Finally, David Barber (Aston

University) will be talking about using graphical models to generate music. It is a particularly nice illustration of the relationship between architecture of the model and the data that it generates.

Ian Nabney
Aston University

EPSRC-sponsored Southampton meeting reviewed

Review of Southampton meeting, 26 - 27 September 2000

NCAF commemorated its 10th anniversary with a welcome return to Southampton, scene of the first ever NCAF meeting. In a very nice introduction by Chris Satchwell, the distinguished history of Southampton, with its strong marine and aviation traditions, was eloquently recounted.

John Vickers (neusciences) then gave a detailed beginner's introduction to decision trees. He outlined the main implementation problems and their solution using dynamic memory allocation methods. The methods are delivered in Java beans (an example of which was dynamically created by John on the white board, only to be unceremoniously wiped by the garbage collection process at the coffee break).

Unfortunately, the programme was again disrupted by speakers dropping out at the last moment, a decidedly worrying trend from recent meetings. We are very grateful for speakers giving up their time to make presentations, especially those asked at relatively short notice. However, last minute cancellations are very disappointing for the delegates and something of a headache for the organisers.

Ian Nabney (Aston University) stepped into the breach at short notice to talk about lag detection in non-linear, non-stationary time series. The method involves training Hidden Markov Models to maximise the mutual information between delayed time series.

Richard Everson (Exeter University) talked on clustering non-stationary data (http://www.dcs.ex.ac.uk/academics/reverson/). He is looking to minimise overlap in clusters by minimising the entropy of the partition posteriors (e.g. achieve a crisp separation). This work has much in common with particle filters (cf. CONDENSATION algorithm by Isard & Blake).

Tony Dodd (Southampton University, http://www.ecs.soton.ac.uk/~tjd) described a framework for regularisation using Reciprocating Kernel Hilbert Space methods to solve ill-posed problems. This was an interesting but highly technical presentation.

Nigel Allinson (UMIST) gave a typically frenetic but very entertaining talk, strong on applications. He emphasised that signal processing not Artificial Intelligence was the key to success in these projects. Overall, the engineers constraints were succinctly put by Edison who described an engineer as 'someone who can design something for one buck that any fool can do for five'. Currently a big research area is real-time video coding, as there is a strong market pull from, amongst others, on-line horse race betting.

Chris Satchwell and Mike Wynne-Jones (both former Committee members) described the early years of NCAF. The original group got together to describe successes but mainly failures, and it was from that frank exchange that much progress was made particularly in the development of very useful heuristics. Of course, neural networks now live in the 'principled' world of statistics and probabilities, but we should not forget the pioneering spirit of a decade ago in encouraging the search for new paradigms and new enterprises.

The first day was rounded off with a well-attended social event. It began with a trip to Ocean Village where some of the yachts from the Round-the-World Challenge were moored. It then moved on to the Hall of Aviation where many interesting exhibits took us back in time whilst we enjoyed an excellent hot buffet.

Day two

The second day was kindly sponsored by the EPSRC and was themed on the future of natural computing and the role of directed research. The opening speaker, Richard brook (SIRA), talked enthusiastically about the Faraday Partnerships. He was concerned that the UK under exploits research and that one of the key factors is good communication. His view was that virtual networking, emails, webs etc. are only so good - you can't beat getting people together at meetings and discussing problems, issues and solutions. Of course, NCAF has espoused these same principles for a decade now. Hopefully continued support will allow us to deliver these benefits for the foreseeable future, providing the conduit for 'technology translation' from innovation to application.

Andrew Starr (Manchester University) ably stepped in at extremely short notice and described the data fusion aspects of INTErSECT, one of the flagship projects of the Faraday Partnership.

Mahesan Niranjan (Sheffield University) gave a wonderful talk explaining why 'What can we learn from biology to build better computers?' has been replaced by 'How can we help biologists to understand the natural computer?' In it he covered pattern recognition, classification, feature selection and kernel methods such as SVM. Following Vapnik's principles, 'Don't solve a problem by solving an intermediate problem of greater difficulty', he argued that we shouldn't attempt to do density estimation if all we are interested in is classification.

Peter Cowley (Rolls-Royce) gave an overview of an industrial perspective of directed research, showing how direct funding of University Technology Centres throughout the UK has successfully underpinned Rolls-Royce's long-term research programme.

Jim Fleming (EPSRC) gave a rundown on the results of the Key Questions programme and highlighted the areas for future work, such as more effort on using neural networks for data fusion.

At the start of the open workshop, Peter Herdman (Arjo Wiggins) gave a brief introduction to the EC programme 'The Disappearing Computer', more details of which can be found at http://www.cordis.lu\ist\fetdc.htm and http://www.i3net.org/. What ensued was a very lively debate with strong views presented from all sides.

The meeting concluded early enough to accommodate most people's travel requirements;

a feature that we will aim to incorporate in all future meetings. The attendance at Southampton was disappointing, especially for a 10th Anniversary. However, it was yet another useful and enjoyable meeting. With the continued, and much appreciated, support of the ESPRC we look forward to providing many more in the challenging years to come.

Graham Hesketh
Rolls-Royce plc

Evaluation of the EPSRC Neural Computing - The Key Questions

An evaluation of the 'Neural Computing - The Key Questions' (NCTKQ) managed programme was carried out in October 1999, under the Chairmanship of Professor Peter Cowley, following the completion of all its projects. The evaluation exercise aimed to gain an understanding of the quality and impact of the work funded under the programme, to demonstrate accountability in the use of public funds and to contribute to the forward planning of EPSRC's IT and Computer Science Programme. Though neural computing had been a field of research for decades, there was an 'explosion of interest' in the late 1980's. At a rough estimate, the number of UK researchers increased more than tenfold between 1985 and 1995, and the growth rate was much larger in the USA. It was in the context above that SERC launched its Neural Computing Co-ordination Programme in 1993.

Between January and May 1994, the views of industry and academic researchers were widely sought on the directions in which funding for neural computing research should be focused by the programme co-ordinator, Professor David Bounds. This became one of the strengths of this process in that it did focus the minds of the research community on what research really needed to be done. This was a positive result for researchers whether or not they were subsequently successful in their grant applications to the programme.

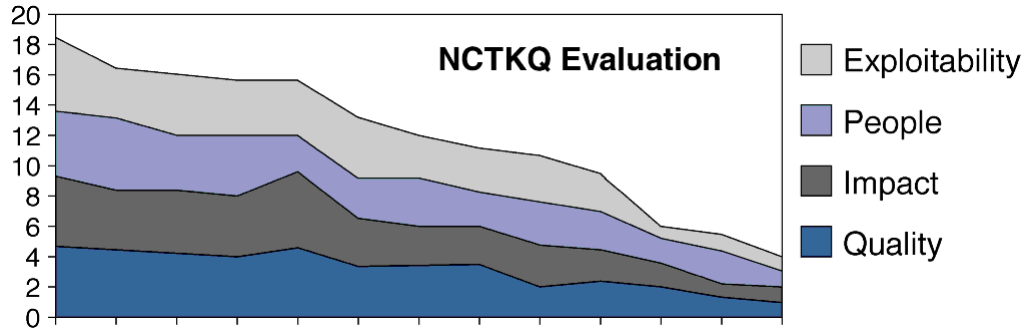
The consultation process identified five key questions that were widely seen as essential areas of research, focusing on neural computing software; hardware was not included in the remit.

- What is the optimum strategy when applying neural computing to a given set of static data?
- What is the optimum strategy when applying neural computing to time-varying data?
- What is the best representation of data for neural computing?
- How can neural computing be used for data fusion?
- What does neural computing have to offer for optimisation and constraint satisfaction tasks?

All projects had to address one or more of these five Key Questions and had to demonstrate a significant end-user involvement. The Call generated 116 two-page outlines, from which 58 full proposals were received.

Of the five Key Questions, only the first two were significantly addressed in the proposals received. It was recognised by the original prioritisation panel that it was unlikely that all five questions would be equally covered in the call given the need for industrial partners.

The majority of the projects funded also concentrated on the first two questions. The NCTKQ programme was evaluated in accordance with the EPSRC QPIE framework: where 'Q' represents quality of the research in world terms; 'P' represents the extent to which the output of trained people meet the needs of employers in terms of quality and quantity; 'I' represents the potential for the research to impact on other research; and 'E' is exploitability and represents the potential for the research to contribute to UK wealth creation and quality of life. Since NCTKQ was a managed programme, it was also assessed against its original programme objectives. The scores are summarised in Fig.1 below.



Conclusions

Of the 13 NCTKQ projects, one project stands out as being truly world-leading research. Whilst being more a technological (rather than theoretical) breakthrough, the application of neural network techniques to a real problem was extremely successful. The results were generic and have been used in other application areas.

Another four projects have delivered significant results on a national and international level. Over the whole programme, the whole was more than the sum of the parts. The managed programme environment set the scene by focusing the programme on questions that were of real interest to both industrialists and academics. This was reinforced by the monitoring process, which was incorporated into NCAF meetings.

The successes of the process of the NCTKQ programme were firstly the consultation of the academic and industrial communities by the programme co-ordinator in the establishment of the programme, and secondly the involvement of NCAF in the monitoring procedure.

Neural computing remains an important area. The NCTKQ programme has begun to make an impact and encouraged researchers in this area, particularly in the area of statistically-based neural computing, but there is still much more research that needs to be done in a number of application areas.

The full version of this report can be found at: http://www.epsrc.ac.uk/documents/programmes/Evaluation/ITCS/NCTKQREP_NW0.htm or contact Dr Jim Fleming (j.fleming@epsrc.ac.uk).

Jim Fleming
EPSRC

PUZZLE CORNER

Number 15

Monsoon season came unexpectedly to the British Isles. Honest Joe was stumped - every single race meeting was washed out and he had a hoard of eager punters desperate to back a winning horse (or donkey as the bookies like to call them).

"Why not run a race with a pack of cards?" suggested Lisa. "Take out the four aces, one suit per horse, and put them side by side in the stalls. Shuffle the remainder and deal out nine cards face down in a line to form a track. After all the bets are on, deal one card at a time face up and place it in front of the horse of the same suit, building outwards from the stalls, and the winner is the first horse to get nine cards."

"Great idea", said Joe, "but I'll have to look at the track cards in order to work out the race odds." He followed the procedure, checked the contents of the track and, after some furious calculations, offered SPADES at 1/4 (heavy favourite) and 14/1 bar that one.

"You really are honest", said Lisa somewhat incredulous. "But it's a bit boring isn't it?" Joe agreed and swapped one card from the track with another from the remaining deck. He then offered SPADES at 4/6 (still odds on favourite), HEARTS at 7/2 and 10/1 bar those two.

"Still pretty fair," said Lisa, "but I know where my money's going!"

Was Joe really honest, and were the odds sensible? Where was Lisa's money going and what was her expected return (averaged over many repeated random games)? The answers will be given at the next NCAF meeting (24-25 January 2001, Aston University).

Fenella the Rottweiler

The level playing field of UK universities revealed

Simple ranking tables of multi-dimensional data fail to reveal the inherent relationships between the table items. The seven weighted dimensions from the Sunday Times 2000 League Table for all UK universities (17 September 2000) are reproduced here as a two-dimensional Sammon mapping. The definite water between the pre- and post-1992 institutes is clearly visible. The Binary Divide exists and it's linearly separable! Only Nottingham Trent appears to be trying to swim across. The high-ranking outliers (Cambridge, Imperial, LSE, St Andrews and York) are as different from one another as they are from the rest of the pack. The most typical pre-1992 university is Royal Holloway and the most typical post-1992 is Teesside. Academic members of NCAF can now entertain their Senior Common Room colleagues as to their own institute's standing and who are its nearest competitors. From several runs, this mapping appears to be very stable - which is perhaps more than can be said of the UK HE sector.

Link to the 2-D Sammon map

Nigel Allinson and Hujun Yin
UMIST

New Bioinformatics Research Institute

In an initiative worth half a million pounds over the next three years, Cardionetics have established a new Research Institute in Bioinformatics at Aston University. The research programme will develop technologies for advanced pattern analysis of ECG and other clinical biosignals, web-enablement to allow remote monitoring of patients over extended periods and the analysis of large bodies of clinical data.

Cardionetics is a UK company that has produced the world's first fully automatic portable electrocardiograph machine specifically for GP use. The Research Director is Dr. Tom Harris, who was Secretary of NCAF for many years. Their main product is the C.Net2000, the first fully automatic portable ECG machine for GP use. It won a Millennium award and was runner up in the 2000 BBC Tomorrow's World Awards.

The C.Net2000 is used by GPs to make better informed patient referral decisions where cardiac arrhythmia are suspected. Currently, all suspected patients have to be referred for specialist tests at hospital, even though less than half have anything wrong with them. The effect on waiting lists, patient anxiety, and resources is obvious. A recently completed clinical evaluation across six GP practices, involving over 200 patients, showed a reduction in cardiac referrals of 67%.

The aim of the Institute is to develop the technology that will underpin the next generation of products. It is located alongside the Neural Computing Research Group, which has a worldwide reputation in practical and theoretical aspects of information analysis. The research programme will be carried out by two Research Fellows and a Director (Dr. Ian Nabney). We are currently looking to fill one of the Fellowships. More details may be found at http://www.cardionetics.com or http://www.ncrg.aston.ac.uk.

Ian Nabney
Aston University

DISAPPEARING COMPUTER PROJECTS

Peter Herdman's compilation of project abstracts can be obtained here.

DIARY DATES 2001

January 24-25 NCAF, Aston University

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UPDATED **April 10-11 NCAF**, York University

Contact: Safia Hussain +44 (0)161 275 4315, e-mail: ncafsec@man.ac.uk

June 13-15 Workshop on Self-Organising Maps, Lincoln, UK
http://wsome01.ee.umist.ac.uk

NEXT EDITION

Preview of the York meeting
Review of the Aston meeting
Deadline for contributions for the next edition 15 February 2001