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## **Networks 20 – August 1998**

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### **Return to Oxford in the Autumn**

NCAF is visiting Oxford for its autumn meeting. We shall be based at St. John's College this year, following Lionel Tarassenko's move there. The general theme of the meeting is that of analysing and modelling time series data, with a wide range of applications from finance to process control.

Oxford is famous as the city of dreaming spires. However, in the light of the work carried out by Lionel Tarassenko's Medical Engineering group, it should perhaps be known as the city of sleep disorders. Mayela Zamora will be talking about the latest instalment of this work, which analyses EEG signals to detect arousals. Earlier work was the basis of a product now sold by Oxford Medical. Tim Corbett-Clark will discuss a problem that faces many people trying to convince sceptics of the value of neural computing - that of interpreting the results. He has developed a method for extracting rules, from a neural network, which are guaranteed to perform the same classification as the original network, thus improving understanding without degrading accuracy.

The invited speaker is Professor Chris Harris from the University of Southampton. He is well known for his work interpreting RBF networks in a fuzzy logic framework, and will be speaking on the application of this approach to modelling and controlling dynamical systems.

David Lowe's talk will be looking at time series from an unusual angle. Much effort is spent on predicting time series when often different information, the degrees of freedom or knowledge about turning points, is more valuable in applications. David will show how useful features can be extracted for these other purposes, and the talk will be illustrated with examples from financial time series, EEG data and load forecasting.

The tutorial (given by Ian Nabney) will be about the Netlab pattern recognition software recently discussed in 'Networks'. This talk will show how Netlab can be used to develop applications with a principled methodology (such as the one proposed in Tarassenko's book 'A Guide to Neural Computing Applications'). It will also cover special features of Netlab (such as the good support for Bayesian techniques) and how Netlab can be extended to develop new models. The software will be available at the meeting for delegates to try it out.

Recently, the DTI has started a new initiative (more broadly focused than the neural computing campaign) called 'SMART Software for Decision Makers'. Two regional technology clubs, based at ERA Technology and the University of Sunderland, have been set up to give club members a hands-on understanding of the technology through the development of demonstrators using member's data. Chris Kirkham will be talking about the ERA club and the progress that has been made on their demonstrators.

The social event will involve boats and water and, if the weather is right, there are few more pleasurable ways of spending an evening than gently punting along the Cherwell amongst the willows. For the cynics there are some good pubs not too distant from our starting point. The Oxford meeting is always a

popular event, so early booking is advised.

*Ian Nabney  
Aston University*

## Review of Derby Meeting

Rolls-Royce at Derby provided the venue for the second meeting of 1998. This gave NCAF Chairman, Peter Cowley, the opportunity to give the welcome address and to outline the role of computational intelligence in the overall research strategy of the company.

The first presentation on the first day was by Andrew Starr of the University of Manchester on 'Condition Monitoring Using Kernel Density Estimation' (KDE). The essential idea behind the KDE approach is to model the probability density function for data from a machine in normal condition and use the model to examine the likelihood of subsequently measured data. The occurrence of significantly improbable data signals a change in the condition of the machine. The approach was illustrated using data from an electrical motor in various states of phase imbalance.

The second presentation was the, now well-established, tutorial. Rachel Pearce of the Computational Intelligence group in the Rolls-Royce Strategic Research Centre talked on 'Genetic Algorithms - An Evolutionary Tale'. This proved a welcome introduction to evolutionary approaches to optimisation. The genetic algorithm is a robust and versatile approach to optimisation based on the Darwinian principle of survival of the fittest. Rachel first explained the biological background of the methods and introduced the terminology, then explained how the method was implemented, with a number of case studies for illustration. Applications ranged from design to scheduling to system model optimisation. A lively discussion followed and the morning session was concluded.

### Support Vector Machines

The afternoon session began with the invited talk. This rounded off a trio of presentations which took us away from mainstream neural network applications and was delivered by Professor Alex Gammerman of Royal Holloway College. The subject of the talk was 'Support Vector Machines', a contemporary approach to classification and modelling problems originated and developed by Professor Vladimir Vapnik. The philosophy of the approach is simply stated: the idea is to embed the data non-linearly in a space of high enough dimension to allow a linear solution to the problem. In the case of a classifier, this means a linear separating hyperplane can be found; for modelling, a linear regression function exists. Professor Gammerman explained the basis of the method and described how to overcome the problem of the very large number of parameters involved. The presentation provoked an interesting discussion.

After tea, the first day concluded with two application based-talks. In the first, Paul Zanelli of the University of York spoke on 'Cleaning Aircraft Data'. Operational Load Monitoring of aircraft produces vast amounts of data for analysis. Unfortunately, the data is not always reliable; sensor drift and failure can produce anomalous results. The presentation showed how a statistical approach to the problem (implemented as a Radial Basis Function Network)

could identify the anomalies and allow the data to be corrected. The second talk of the session was by Phill Thompson of DERA Rosyth on 'Neural Network Applications in Ship Survivability'. This was not so much a presentation of existing results as an indication of where neural networks could, and perhaps should, be used to assess ship survivability during sea battles. The talk was illustrated with a video which left the audience in no doubt as to the severity of the problem.

The social event associated with the meeting was a ghost walk through the streets of Derby followed by a 'ghosthunters supper'. Unfortunately, the reviewer cannot comment on its success due to an unfortunate clash with England's World Cup second phase match with Argentina. This actually spawned an alternative social event which was held in front of the large-screen television in the Rolls-Royce social club. As we all know, it all ended in tears.

## **Applications**

The second day of the meeting began with an informal post-mortem on England's previous-day performance. The heroes were identified and praised, the villains were identified and vilified.

The first session proper of the second day brought together two speakers with a medical background. Firstly, Gary Green of the University of Newcastle presented 'What Can Neurons Compute'. This summarised in non-mathematical terms a highly mathematical approach to neuronal dynamics based on non-linear systems theory. The second presentation was by Paul Beatty and David Asbridge with the intriguing title 'Time and Relative Dimensions in Space with ANN'. Despite its science fiction title, the talk discussed a concrete and important problem, namely how to detect anomalies in a system when the normal condition is changing with time. The talk was illustrated with data from a blood gas analyser.

After coffee, Wieslaw Staszewski of the University of Sheffield spoke on 'Wavelet Feature Extraction for Pattern Recognition'. The presentation introduced wavelet analysis and showed how it offers real advantages over Fourier analysis in many situations. The main illustrations were concerned with fault detection in machines and structures where spectral analysis would normally be used, although the important subject of data compression was touched upon. This was followed by Puzzle Corner, in which David Lowe reprised his role as Lisa and Graham Hesketh picked up a new nickname.

After lunch, the presentations concluded with two talks on applications. In the first, Doug Hird of Abbey National spoke on 'Case Studies in Finance'. In fact, the talk was an overview of computational intelligence approaches to finance. The applications are manifold, from customer profiling and targeting to fraud detection to prediction of share prices. The session concluded with Brian Kett of Neural Computer Sciences describing recent applications studies by the company. These were wide-ranging from biometrics in security to the extremely profitable area of drug discovery.

After coffee, the delegates were invited to browse the Rolls-Royce Advanced Technology Exhibition, which illustrated well the breadth and depth of Rolls-Royce's interests in aerospace technology and neatly ended the meeting where it began.

*Keith Worden  
Sheffield University*

## NEUframe Evaluation

I downloaded the evaluation copy of NEUframe v3.022 from Neural Computer Sciences' web site, and was provided with a temporary unlock key for the purpose of this review. NEUframe appears on first impression clear and accessible, with a drag and drop graphical interface.

NEUframe has a range of user selectable objects, including different styles of neural networks and neuro-fuzzy logic algorithms, encoders, and graphing tools, which can be connected to data source components within the workspace. This enables rapid system build and design. For the beginner, however, there are a set of template workspaces, which include automatic data scaling and data text processing facilities.

Also available from NCS is a complimentary tool set called DATAtools. This uses a strong suite of visual data manipulation tools, which assist data selection for training, test, and validation set creation. This helps to make data preparation a more straightforward process, and is especially useful for manipulating time series data, significantly reducing the data pre-processing time.

NEUframe offers a choice of approaches to problem solving - pure neural networks, rule based, or combined neuro-fuzzy - the heart of the software package. The neuro-fuzzy architecture allows the system to develop a model and extrapolate its own fuzzy rules, and build a model from these. The software allows you to review the rules and apply your own 'expert knowledge' to make modifications where necessary.

Another attractive feature is the ability to run and display multiple networks and hybrid models simultaneously, which can be very useful during the testing and validation stage of model development.

As with most current software development tools, NEUframe provides the option to generate the C++ code for the model, to embed the solution into your own custom applications.

NEUframe is a highly graphical approach to model development, which helps to reduce the learning curve for the package, with plug-in modules assembled on-screen to form a solution, enabling the development of the most common architectures: MLP, RBF, and Kohonen. The software can be used equally well by novice and advanced users, by providing the opportunity to modify the network parameters as desired. Its strength lies with its neuro-fuzzy capabilities for deriving model rules. NEUframe is a modular package - you purchase the extra functions as required - thereby tailoring the package to your needs, which helps to provide a more cost effective desktop development tool.

For details contact: NCS Tel: 01703 667775 <http://www.ncs.co.uk>

*Adrian Long  
CNCA, Brunel University*

## Ain't Misbehavin' - a biometric update

Up until now we have relied on signatures, photographs and various documents to verify individual identity. Unfortunately, these can all be falsified. We need an identifier which is both unique and bound to the individual, whilst being easily read by automated processes. Actually, we do have such identifiers and we call them biometrics.

Biometric parameters include fingerprints, hand geometry measurements, retinal and iris scans, facial recognition and voice recognition. They seek to match a live biometric sample with a previously registered template, a reference for the individual concerned. The template may reside on a database, or may be carried by the user.

Many people ask 'which biometric is best?' There is no universal answer to this. Practical, political or cultural considerations may preclude the use of certain systems. Sometimes ease of integration into an existing system will be a deciding factor.

So how have biometrics been used to date? Often for physical or logical access control, time and attendance monitoring, canteen systems and voting. Larger scale applications have been for benefits payment, border control, the Olympic games and prison systems with both hand geometry and fingerprint verifiers utilised widely in this context.

We can expect increasing use of biometrics for financial transactions via ATM terminals. Similarly, using a biometric to log on to your computer may be closer than you think, with many devices already being marketed including the Sony 'Puppy' system which interfaces directly with Windows NT. No doubt biometrics will find their way to point of sale and other widespread everyday applications in time.

What of the individual products? Established fingerprint devices from companies like Fingerscan/Fujitsu are joined by new devices from lesser known entities, plus some such as CRL/Thorn and Sony which lend themselves particularly well to the systems integrator or OEM scenario. The IriScan joins EyeIdentify in using elements of the human eye as the biometric. However, the two devices work quite differently. Hand geometry offers an easy to use 'off the shelf' proven solution in the form of the ID3D from Recognition Systems (in the USA) whilst the Digi 2 provides a variation on the theme. Signature verification and voice verification continue to appeal and facial recognition has been developing rapidly at Siemens in particular.

In conclusion, biometric verification technology is now well proven as a concept and has provided benefits across a wide spectrum of applications. With the promise of lower cost components, and new and independently created software, things are looking good for biometrics.

*Julian Ashbourne  
British Airways*

### About the author

Julian Ashbourn is Deputy Chairman of the Association for Biometrics and has a long history in the design and application of biometric systems. He is also creator of the BioTrack software applications which have often been used in the

evaluation of this technology. He may be contacted via the AFB or by e-mail on [jsoft@aol.com](mailto:jsoft@aol.com) or at British Airways on 0181 738 8086.

## PUZZLE CORNER - Number 6

After her exploits in Brooklyn, our intrepid student, Lisa, went for a well deserved safari holiday with some friends. At the end of the trip, Lisa and her three colleagues, Tom (a science student), Dick (an arts student) and Harry (a Professor of Egyptian Archaeology), were in a hurry to catch a train that was leaving in an hour. Unfortunately, they had two rivers to cross on their way to the station.

The first river they came to had a rope bridge which could only take the weight of two people at a time. Further, since the bridge was perilously close to a crocodile infested river, whoever was crossing it needed to have the group's only rifle with them. It was also complicated by the fact that, although Lisa could cross the bridge in just one minute, Tom would require two minutes, Dick would need five, and poor Harry needed ten.

Ten minutes after safely crossing the bridge, Lisa and her comrades met another two Professors (Paleoanthropic Morphology and Mystic Engineering) at the side of the second river. They also wanted to catch the same train and they had a two-man canoe, but neither of them could paddle it. All of Lisa's party could paddle, but they couldn't allow the Professors to outnumber the students at any point (even whilst loading or unloading the canoe). [If you can't see why, just ask any student who has been to a Faculty wine and cheese function.]

Given that the two new Professors had now effectively joined Lisa's group (rather than going off on their own), and that crossing the second river took two minutes with one person paddling and one minute with two, and that the train station was ten minutes from the second river, how did Lisa organise all the crossings (bridge and canoe) so that everyone caught the train at the appointed time?

Full answers will be given at the next NCAF meeting 22-23 September 1998, St. John's, Oxford.

*Fenella the Rottweiler*

## COMPUTATIONAL INTELLIGENCE: THE IMPORTANCE OF BEING LEARNABLE

Wednesday 9 September 1998  
Royal Holloway, University of London

In response to requests from the NCAF meeting at Rolls-Royce, guest speaker Professor Alex Gammerman offers the following information about a one day research seminar at the Computer Learning Research Centre, Department of Computer Science Royal Holloway, on 9 September

The seminar is the fourth of a series of one-day colloquia organised by the research groups in the department. The programme includes invited lectures on key research topics in this rapidly developing field with the main themes of

Machine Learning and Inductive Inference.

Hosted by Professor Gammerman, Head of Department of Computer Science, Royal Holloway, University of London the provisional programme is as follows:

- Professor Jorma Rissanen, Almaden Research Center, IBM Research Division, San Jose, CA, U.S.A: Stochastic Complexity (provisional title)
- Professor Ray Solomonoff, Oxbridge Research Inc, Cambridge, Mass, U.S.A.: How to Teach a Machine
- Professor Vladimir Vapnik, AT&T Labs - Research, U.S.A. and Professor of Computer Science and Statistics, Royal Holloway, University of London: Learning Theory and Problems of Statistics
- Professor Chris Wallace, Univ of Monash, Victoria, Australia: and Visiting Professor in the Dept of Computer Science, Royal Holloway, University of London: Brevity is the Soul of Science
- Professor Alexei Chervonenkis, Institute of Control Sciences, Moscow: The History of the Support Vector Method

All welcome - advance booking essential - for further information and to book a place contact:

**Janet Hales,**

Departmental Events Co-ordinator,  
Dept of Computer Science,  
Royal Holloway, University of London

Tel: 01784 443432 Fax 01784 439786  
e-mail: [J.Hales@dcs.rhbnc.ac.uk](mailto:J.Hales@dcs.rhbnc.ac.uk)

Location maps, info etc.: [www.cs.rhbnc.ac.uk/location/](http://www.cs.rhbnc.ac.uk/location/)  
Further information is also available from:  
[www.dcs.rhbnc.ac.uk/events/compintday.shtml](http://www.dcs.rhbnc.ac.uk/events/compintday.shtml)

## COURSES INFORMATION

NCAF often receives queries regarding courses, and therefore would like to develop a list of courses in Neural and related technologies, of any duration, on its Web site.

If you are involved in, or know of any courses, please could you forward the details (duration, dates, prices, contact information, etc) and a brief content description to: Chris Kirkham, NCAF Secretary, e-mail:  
[Christopher.Kirkham@brunel.ac.uk](mailto:Christopher.Kirkham@brunel.ac.uk)



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