School of Information Technology and Mathematical Sciences

Research Newsletter

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A Few Words from the Acting School Research Coordinator.....

John Yearwood will be on long service leave from July 13th 1998 until October 18th 1998. Andrew Stranieri will be acting as Research, Higher Degrees and Ethics Coordinator during this period.

Mid-Winter's Night Dream From The Acting Research Coordinator.

A great deal has happened last month. Professor Binh Pham has returned from Germany bringing with her many experiences and possibilities for future research. Binh, joins the vast majority of people who spend some time outside this country, in yearning for its relaxed, multi-cultural nature and quiet humour. I expect John Yearwood, too is yearning for the same kind of thing aboard a yacht somewhere afloat in the Carribean.

Raouf Veliev has confirmed his PhD candidature and looks set to join the ranks of high quality PhD researchers within the School. Progress reports have largely been done. An impressive number of seminars have been held.

As an outsider to Ballarat, I cannot but help to notice that most things are done differently here. In Melbourne, cars blare their horns at the drop of a hat, here local drivers refrain at all costs. If in Melbourne, festivals are held in Summer and Spring, here they are held in Winter. If in Melbourne, thieves steal your wallet as you stand on a tram, here I leave my umbrella on the bus three times and three times find it handed in to the depot.

The quest to be different has extended to research. Here, at least within our school, the majority of research is initiated and guided by two professors, each with enormous experience in mentoring PhD and junior staff. Unlike Melbourne Schools, we leave them relatively free of administrative or teaching duties so that they can devote quality time to their students and more junior staff.

The vast majority of our PhD students are on full time scholarships. Unlike Melbourne Schools, we do not regard the PhD scholar as slave labour to be freely used for tutorials, lecture presentations, and marking. Unlike Melbourne schools, we genuinely attempt to meet their equipment and travel needs. Recent big city delegates at the Medical Imaging workshop found this last point very difficult to believe.

What is the upshot of all this? From what I have seen last month as acting research coordinator - world class PhD research. Our students cannot rest on the laurels of their predecessors as those in Melbourne Schools can, so actually come up with the goods. Lloyd Walker's thesis in computer vision is likely, in my view, to be adopted as a dramatically better way to represent and manipulate visual objects. Huifu Xu's PhD work, done in a country

foreign to him, in a language which was not his first and in less than three years is a tribute to himself, his supervisor and to the School. I mention only these two because they will be our first two cabs off the rank before the year is out and in a sense raise the bar for others to follow.

Projects in Progress.....

Greg Simmons is currently finishing work on two papers to be submitted to referee journals. Both papers are co-authored with Dr. Neil Diamond from Victorian University of Technology. Greg also recently attended the Statistical Society of Australia's 14th Biennial Conference on Gold Coast and intends to give a talk later this year on resampling techniques for data mining. Greg is also busy with consulting at the moment with experimental work for Commonwealth Serum Labs - Research and Development into the production of a more robust flu vaccine ongoing.

Over the past six months **David Stratton's** time has been largely taken up with developing the NetSim application which is a network simulator that will be used by students in the new Network Protocols and Services unit. NetSim allows students to experience network configuration issues without the overhead (for the teachers) of allowing manipulation of actual network hardware.
NetSim is a Java application with a client component that runs on a student's workstation and a server component that runs (currently) on krause. The server and client communicate using the Common Object Request Broker Architecture (CORBA) which is becoming a major focus in David's research.
David will be submitting a paper focussing on the technical aspects of NetSim to "TOOLS98" and a second paper that has more of a pedagogical focus to the ACM SIGCSE bulletin.

John Yearwood and **Marcello Bertoli** are, in collaboration with **Andrew Stranieri,** looking at means to compare and measure similarities in retrieved query cases in Refugee Law. One method used is based on Kelly's repertory grid techniques in psychology; the technique has been adapted for knowledge based systems.
Trials are also being made using CONCEPT; a software package developed by Eugene Aidman in the School of Behavioural, Social Sciences & Humanities which implements repertory grid techniques and the psychology of personal constructs.

Research & Development in Computer Graphics and Textile Simulation

(**Professor Binh Pham's** report from Germany, 9 July 1998)

As we have a couple of research projects related to textile (retrieval of fabric sample catalogue and computer graphics simulation of soft furnishings), I arranged to visit the Research Lab on Textile at the Fachhochule fur Technik Reutlingen which is reputed to have the best Textile Engineering School in Germany.
There are two types of tertiary institutions in Germany: Universitat and Fachhochule (often abbreviated as FH), which are funded from different sources under different criteria. In general, basic research is carried out at Universitat, while applied research and technology transfer are done at Fachhochule. The basic prerequisites for academic staff at both types of institutions seem to be quite demanding. To be employed at a Universitat, a person is required to have a Ph.D. and a Habilitation (which is a more advanced PhD with a good publication record to show that one is capable of carrying out independent research- often taking 5-10 years to finish!). To be employed at a FH, a person needs to have a Ph.D. and at least 5 years of work experience in industry. Technical areas are still very male-dominated in Germany in comparison with Australia. For example, at FHT (Fachhochule fur Technik) Esslingen, 2 out of 154 academic staff are female, whereas at FHT Reutlingen, 4 out of 125 are female.
Many R&D projects with industry involve academic staff from both types of institutions, to draw on different expertise and experiences. All collaborative projects that I have seen during my stay in Germany have this structure - staff at a FH seem to make arrangements with industry for projects, then contact appropriate staff at a Universitat for collaboration.
The FHT Reutlingen started out as a School for Textile, but it has since expanded to cover many areas, including an International Business Program which has the top ranking in Europe. (Everything seems to have a ranking order, within Germany and Europe). The School of Textile gives degrees in Textile Engineering. The courses cover both aspects: technical (machinery, simulation, analysis) and artistic (graphic and material design). I was shown a number of R&D projects which are collaborative initiatives between a local textile company and academic staff at FHT Reutlingen and at Universitat Tuebingen. All of these projects aim to devise appropriate techniques and produce software to provide computer-supported tools for the textile industry.

- Simulation knitting and weaving process using computer graphics to support the analysis of fabric tension, stretch and pull forces
- Graphical simulation of material drape and flow, based on an energy model
- Quality control of fabric using optical imaging
- Tools for fabric design: to manipulate colour; to design transparent fabric, fabric layers, fabric patterns and fabric pattern repeats.

The results and quality of the software seem to be quite good. Most of the software were written by

teams of textile engineering students and are being used by the textile company. The artistic design group works closely with the technical group to finetune the specifications and testing of software tools. A number of best design portfolios from students were also available for demonstration. Overall, the R&D environment appears to be productive and happy.

Research Profile.....

Alex Rubinov

Alex Rubinov graduated at Leningrad State University

in June 1962 and some months later he became a PhD student of this university. His supervisor was Professor Gleb Akilov. His "scientific grandfather", that is Akilov's supervisor, was a great Soviet mathematicianand economist, Leonid Kantorovich, who won Nobel Prize in 1968. Kantorovich was one of the founders of the Scientific Research Centre in Siberia, which was founded in the end on the fifties near Novosibirsk. He invited his former PhD student Akilov to work in his department at the research Institute of Mathematics at this centre, and Alex moved with his teacher.

Kantorovich's department was a group of young energetic and enthusiastic researchers and few wise experienced researches. Alex spent seven years in Siberia. In 1970 Kantorovich left this centre and Alex left half a year later.

Three main topics were worked out in the mathematical part of this department: optimization, mathematical economics and convexity. All these topics became the main directions of Alex's research.

For seven years in Siberia Alex obtained some results in these directions and prepared (with co-authors) three monographs. The first of the monographs (on optimization, with V.F. Demyanov) was published in 1968 and translated in English in 1970, second (on mathematical economics, with V.L. Makarov) was published in 1973 and translated in English in 1977, third (on abstract convexity, with S.S. Kutateladze) was published in 1976 (It took 6 years in order to publish a manuscript, which was written in 1970). Alex was also engaged actively in the area of mathematical education. Hundreds of thousands of copies of the book "Calculus for school teachers" by A. Rubinov and K. Shapiev were published in 1972.

Alex continues to work in the above mentioned three fields. More than 110 research papers and 14 monographs and textbooks were published in recent years.

Alex became a supervisor of PhD students exactly 30 years ago. He is a supervisor of 32 PhD students (which include Soviet students who are the equivalent of PhD students). Of these 32 students, 30 of them were successful in obtaining their PhD degree. Alex's first PhD student, Akram Jafyarov is now a "prorector" (DVC) of a large Siberian University. His former students have been from: Russia, Azerbaijan, Kazakstan, Israel, Germany. Many of them are now senior lecturers or senior researches. Some are heads or deputy heads of departments. Alex tries to keep in contact and communicate with them all.

Accepted papers....

The paper: "Minimizing increasing star-shaped functions based on abstract convexity" by **A. M. Rubinov and M. Yu. Andromonov** was accepted for publication in international "Journal of Global Optimization". The paper was submitted to this journal just five months ago.

Seminars and Workshops.....

Developing an Intelligent Control System for an Adaptive Information System
Presenter: Zhongwei Zhang
When: Mon 3rd August, 10.30 am
Abstract: Information visualisation is a process involving the display and navigation through information of interest. The use of the computer to achieve a better redisplay during the interaction creates a real time, complex problem. The problem arises because of the huge amount of computation that the system must do within the human visual processing cycle time.

One solution to this problem is the development of an adaptive information visualisation system that can intelligently degrade the quality of the redisplay as little as possible, while meeting the temporal requirements. Research and development into adaptive information visualisation systems has attracted a lot attention in recent years. In addition, the development of intelligent control systems has also obtained impetus. For decades, researchers have been seeking suitable control techniques for complex systems. A number of techniques have been found and these are playing a very important role in solving problems in application areas such as robotics, financial and stock markets, etc. Among these techniques, intelligent control has been recognised as the most powerful tool. One such intelligent control technique is neuro-fuzzy control. In this talk, the development of an adaptive information visualisation system will be addressed, and the design and implementation of an intelligent control system for the information visualisation system using neuro-fuzzy control technology will be discussed.

Prof. Michile Arbib from University of Southern California gave a presentation titled "Computing the Brain", reporting his USC Brain Project at University of Melbourne on 24th of July. **Zhongwei Zhang** has attended the seminar, and he learned that the

objective of USC Brain Project is to encourage synergies between empirical and computational neuro-science at all levels from the molecular, via the synaptic, neuronal and circuit levels, up to the systems neuroscience of the behaving organism. This project has a significant implication in several research projects in our school. In particular, it is very relevant to multimedia database construction, data mining and information visualisation. Readers can visit http://www-hbp.usc.edu/HBP/Home.html for more details.

Forthcoming seminars presented as a part of the School Seminar Series will include a combined conference report from a number of staff, and a talk from Professor Binh Pham about her experiences, research and contacts in Germany.

Conferences.....

Medical Image Workshop Puts Ballarat Under the Research Microscope.

Over fifty researchers from Australia and overseas attended the first Workshop on Automated Medical Image Analysis organised by Professor Anthony Maeder and Professor Binh Pham. The workshop, hosted by the University of Ballarat's School of Engineering united a stimulating assembly of researchers from disciplines as diverse as physics, psychology, computing, radiology, medicine and law. An address by George Kannourakis, head of the Cancer Research Center at the St John of God hospital, reminded all present that world class research can be conducted in regional centres. A prominant medical researcher at leading centres in Australia and the United States, Dr Kannourakis preferred to establish a research centre within the local community rather than opt for a more traditional, big city locale.

Professor Murray Loew from The George Washington University, Washington DC, in opening the workshop, summarised current directions in the analysis of medical images and took an active interest in all papers presented. The presentations ranged from issues concerned with the registration of images relative to fixed co-ordinate systems, the automatic identification of segments in images to the nature of reasoning with images.

Dr Leanne Bischof reported on a CSIRO study that used knowledge based system techniques to automatically determine the probablity that skin blemishes are melenomas. This system has the potential to reduce the vast number of blemishes that are unnecessarily removed from thousands of people each year.

The new X-ray technique Phase Contrast X-Ray, an Australian first was presented to the workshop by its developer, Stephen Wilkens. The very high resolution capacities of this new technique is a tribute to Australian science.

Professor Elisabeth Krupinski from the Universtiy of Arizona, identified important user interface issues that emereged from her studies of eye movements of radiologists as they scan images. Her work is sure to steer image analysis research toward the development of systems that will actually be used by radiologists.

Associate Professor Nick Vardaxis from RMIT demonstrated a new microscope that uses laser instead of light. Closer to home, Andrew Stranieri presented the benefits of applying data mining to the development of a case based reasoning system for the analysis of radiological images. The project, which is headed by Binh Pham involves John Yearwood and Andrew Stranieri received a major boost during the workshop when senior radiologist at the Royal Melbourne Hospital, Dr Ken Thompson, agreed to forward many hundreds of digitised radiograms to the team members.

Dr Golsha Naghdy from the University of Woolongong presented her work on the use of fuzzy logic and wavelet transforms for automating the inspection of mammograms. Dr Gary Egan, from Walter Eliza Hall demonstrated how new imaging techniques can be used to discover insights in the structure and function of the brain.

The theme of the workshop was informality and an openness to cross disciplinary ideas. In keeping with this, Professor Pham and Professor Maeder encouraged their post-graduate students to take an active part in proceedings. This proved to be an invaluabel experience for many.

In closing the workshop, Professor Maeder reminded delegates that this workshop was made possible by an ARC grant for the purpose won together with Professor Pham. Support for the continuation of a multi-disciplinary interaction similar to this inaugural event was very high. This delegate at least was excited at the prospect of reconvening in some future forum with the same community in order to present further findings.

The **Australian Optimization Day mini-conferences** have taken place every year during last five years. First of them was hosted by the University of Ballarat in 1994. This mini-conference was very successful and was repeated by leasing Australian universities: University of NSW (1995), The University of Melbourne (1996), RMIT (1997) and University of Western Australia (1998). University of Ballarat took an active part on the organisation of first three mini conferences. Proceedings of these conferences were published by the University of Ballarat. Proceedings of 4th and 5th mini conferences will be published by the International Publishing House Kluwer Academic Publishers. Barney Glover and Alex Rubinov have attended all five mini-conferences. Next year, Optimization Day conference will be held again at the University of Ballarat. We are expecting about 30 participants

The **5th "Optimization Day" mini conference** took place at the University of Western Australia (Perth) on 29th and 30th June. About 30 participants from different Australian Universities attended this conference. There were two invited speakers: Professor H. Tuy (Vietnam) and Professor Schittkowski (Germany). "Minimizing Lipschitz functions via abstract convexity" by Alex Rubinov and Michael Andromonov and "Non-linear unconstrained optimization methods" by Alex Rubinov, Xiao Qi Yang and Barney Glover (Curtin University, Perth) were presented for participants by Alex Rubinov and Barney Glover respectively.

Curtin University of Technology (Perth) hosted the **4th International Conference on Optimization: Technique and Applications (ICOTA)** from July 1st till July 3rd 1998. The conference was attended by more than 300 participants. One of the guest speakers was Professor Hoang Tuy (Vietnam). Two sessions on "Global Optimization" were organised by Alex Rubinov and Barney Glover (Curtin University, Perth). There were two sessions devoted to Global Optimization. Alex Rubinov presented two talks on these sessions; one of them was a survey of results obtained in Ballarat in the area of global optimization for the last two years (Authors of this talk were M.Andramonov, B. Glover, A. Rubinov and H. Xu). Four papers of our team have been published in the refereed Proceedings of ICOTA. The next ICOTA conference will be held in the year 2001 in Hong Kong.

Heather Mays attended the **Ed Tech 98 Conference** at Edith Cowan University in Perth from the 5th to the 8th of July. The conference brought together individuals and organizations with a common interest in using information technology to improve human learning. These included educators from both tertiary and secondary institutions as well as producers of educational technology. Heather presented a paper "The use of case-based reasoning in an intelligent diagnostic system for algebra". The paper was co-authored by **Binh Pham** and **Andrew Stranieri** and described the issues which have arisen in the design and implementation of an automated diagnostic system. Discussion with attendees focused on these issues as well as the variety of uses that the diagnostic system could have.

Dr Phillip Edwards, from Monash University (Clayton), presented his research on econometrics during July. Many people at the University of Ballarat know Dr Phillip Edwards well, as he was the Planning Officer for the University of Ballarat until five years ago. The presentation was keenly received and resulted in the extension of an invitation to participate in the Econometrics Forums held regularly at Monash University.

Visitors to the School.....

Professor Tuy (Vietnam) completed his visit to the the School of Information Technology and Mathematical Sciences on June 16th 1998. During this visit he discussed some problems of global minimization with Alex Rubinov. An algorithm for solving such problems of a special structure was proposed and the first draft of the theoretical part of the paper "Algorithm for a Non-convex Global Optimization Problem" by A. Rubinov and H.Tuy was prepared. Some numerical experiments should be fulfilled in order to find classes of problems for which this algorithm works efficiently. The approach developed should be extended for more general classes of problems. Alex intends to apply for a small ARC grant in order to continue this work, in particular to invite Professor Tuy for a month next year and to carry out numerical experiments.

Post Graduate News.....

ANU flies high flying honours students.

It takes something special to entice PhD students to Canberra. The ANU has struck on a novel way of enticing the most promising honours students to contemplate three years in the nations coldest city. Mid way through the honours year, they fly a dozen applicants to Canberra and host them to a weekend tour of facilities. The students get a chance to be mesmerised by facilities and researchers get a chance to look at the countries hottest PhD prospects before inviting two of them to a scholarship.

Q: What does Baku on the Caspian have in common with Ballarat on Lake Wendouree ?
A: Raouf Veliev.

Raouf Veliev has completed his confirmation of candidature and is well on the way to developing his model for the economies of countries making the transition from soviet style socialism to a more market based economy. It seems ironic that advances in the modelling of the economies of these countries is likely to occur so far away from them. Thanks to Professor Gerry Anderson (Information Services Branch), Dr Ram Karan (School of business), and Dr Phillip Edwards (Monash university) for assisting with the formalities of Raouf's Confirmation of Candidature.

Data Mining.....

Mining for data in Ballarat in 1990's: MineSet Data mining software

Professor Pham, Director of IVRIF, is pleased to announce that the data mining software, MineSet released by Silicon Graphics International has arrived and is available for use. This software is amongst the best (and most expensive) data mining software available. It is the flagship software used in the ANU's Centre for Data mining.

All IT&MS staff members and postgraduate students are encouraged to contribute to the next edition of the monthly ITMS Research Newsletter. Examples of newsletter items staff should consider are: projects in process, papers accepted, research in process, publications, grants, seminars, visitors, visits by ITMS staff and Post graduates, scholarships, reports from school research groups / centres, events, conferences, new discoveries, general items of interest, etc. All items should be received by Kirsty Broadbent no later than the 27th August 1998.

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