School of Information Technology and Mathematical Sciences

Research Newsletter

March 2000 Edition 12

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

The School of ITMS farewells Verna Barry who retired from her administrative position in the School on 31st January 2000 after thirty-nine years of service. As Administrative Officer Verna has been a key member of the Research support team in ITMS. Verna undertook all administrative duties related to research and worked tirelessly with great care and precision. Thank you Verna for your assistance and all the best for your retirement.

Visitors to the school.....

The project "Dual methods for the solution and computational analysis of structured optimization problems" supported by an ARC Large Grant. The research team for this project consisted of the chief investigator Professor Alex Rubinov and seven associate Investigators. Four of them visited the School of ITMS in January-February 2000.

Professor Yuri Evtushenko, Director of the Computing Centre, Russian Academy of Science, and **Professor Vitali Zhadan**, Head of Department of this Centre visited the School of ITMS for two weeks in January 2000. The Computing Centre is one of the leading Russian scientific research institutes. It has a total 450 staff of which 320 are scientific staff. Yuri and Vitali are well-known experts in optimization theory. Yuri is the Editor-in-Chief of the international journal "Optimization Methods and Software" and Vitali is an associate editor for this journal. This is the second visit to Ballarat for both of them. Yuri and Vitali discussed with Alex Rubinov and Adil Bagirov numerical methods for solving problems of global optimization. These methods are based on the so-called cutting angle approach, which was developed in Ballarat over the last three years.

The third visitor was **Professor Vladimir Demyanov** from St Petersburg State University who visited the School of ITMS for two weeks in January-February. Vladimir is a well-known expert in the area of nonsmooth analysis and optimisation. He is and has been Alex's friend for more than 40 years. Many papers and 4 books have been written jointly by Vladimir and Alex in the past. Alex and Adil discussed the possible applications of the so-called co-differentiable approach to Cluster Analysis. The first draft of the joint paper (by Adil, Vladimir and Alex) was prepared during this visit. Adil has carried out some numerical experiments which confirm the efficiency of the proposed approach.

Professor Franco Giannessi from The University of Pisa and his wife Rita visited the School of ITMS in February. Franco is a world-known expert in the area of optimization and discussed with Alex some possible generalizations of the so-called Lagrange and penalty functions, which form a base for dual methods. The first draft of a joint paper has been discussed.

The 5th visitor to the school, **Professor Ivan Singer** from the Institute of Mathematics, Romanian Academy of Sciences, visited the school in conjunction with the other large grant project: "Star-shaped Analysis with application to global optimization and dynamical systems". He spent the second half of February in Ballarat. Ivan is a world-known expert in the area of functional analysis, in particular, abstract convex analysis. Last year Alex had fruitful collaboration with Ivan, relating to monotonic analysis. Two papers have been prepared and submitted in leading international journals. During this visit Ivan discussed with Alex some results related to the so-called (max,+)-algebra. (There are some papers on this topic written by Mr. Max Plus). Some plans of joint research have been worked out. The draft of the paper related to downward sets has been prepared.

Jack Harvey: Research Trip 1999

During 1999, Jack Harvey took a period of long service leave during which he firstly completed his PhD thesis entitled 'Estimation of Population Using Satellite Imagery', then travelled overseas for some months. Jack also took associated short periods of sabbatical leave in order to forge collaborative links relating to his PhD research, in line with the strategic plan of ITMS. He visited colleagues at three universities in the USA and UK, and presented papers at three key peak conferences in the USA, Finland and Latvia.

Visit to the University of Georgia, Athens (UGA), Georgia, USA, April 1999.

The primary purpose of this visit was to meet Professor C.P. Lo in the Department of Geography, who was one of the pioneers and longest-active researchers in the field of population estimation from satellite imagery, and whose 1986 book on remote sensing was the genesis of Jack's interest in the problem. Jack arranged to obtain some of Prof. Lo's Asian data for the purpose of comparative analysis, and was also put in touch with researchers applying these methods in a rural area of South Africa.

Whilst at UGA, Jack also met with Dr Steve Rathbun, Director of Statistical Consulting in the Department of Statistics, and Dr Jim Bason, Director of the Survey Research Center of the UGA Institute for Behavioural Research, where he also inspected their state of the art CATI (computer-aided telephone interviewing) centre.

Annual Conference of the American Society for Photogrammetry and Remote Sensing, Portland, Oregon USA, May 1999.

This conference was attended by several hundred remote sensing practitioners from universities, government agencies and corporations, mostly from the USA but with a smattering of international participants. Jack presented a contributed paper, entitled *Modelling Population Associated with Individual TM Pixels*, in a session on local and urban remote sensing and geographic information system (GIS) applications. He also attended two one-day workshops on topics relevant to his research area and to areas of potential collaboration with staff of other sections of UB such as the Centre for Environmental Management*: Land use/land cover change detection analysis*, and *Assessing the accuracy of GIS information created from remotely sensed data*.

52nd Session of the International Statistical Institute, Helsinki, Finland, August 1999.

This is arguably the peak meeting on the international statistical calendar, and was attended by almost 2000 participants from 97 countries, including many of the statistical "household names". Jack's contributed paper about the statistical methodology at the centre of his remote sensing research, *An EM-like Algorithm for Regression with Incompletely Specified Data,* was presented in a session devoted to the theory and applications of EM (expectation-maximisation) methodology.

Among the many parallel sessions, Jack focussed mainly on statistical education, including developments in instructional methodologies, and on the opportunities and

threats (many would put them in reverse order!) in the uneasy relationship between the traditional discipline of statistics and IT-based methodologies such as machine learning and data mining. Applied statisticians in ITMS, where the tradition of collaboration and blurring of disciplinary boundaries is well established, are probably more open to these developments than many academic statisticians in departments of statistics, who have tended to be more isolated in their disciplinary purity.

International Association of Survey Statisticians - Satellite Conference on Small Area Estimation, Riga, Latvia, August 1999.

The IASS satellite conference had around 90 participants from around 35 countries. Jack presented one of 14 invited papers, entitled *Application Of Satellite Remote Sensing to Small Area Population Estimation* which, as both Jack and the conference organisers had anticipated, was very different in tenor from all of the other papers. As the name of the organisation and conference suggests, most papers in the intensive 2-day schedule were reporting research into techniques for obtaining estimates for small geographical areas from the sparse data of large-scale official surveys. Jack expected that most interest in his work might come from underdeveloped nations lacking in demographic infrastructure, and so he was disappointed when the presenters of the only two other listed papers which alluded to remote sensing (from Africa and India) did not make it to the conference. He was subsequently surprised when the most interest in his methodology came from the other extreme of the development continuum, in the person of Dr William Bell, a senior statistician in the Statistical Research Division of the US Census Bureau. Dr Bell is interested in the potential of remote sensing methodologies to provide ancillary information in the pre-census planning process, specifically in the preparation phase for the 10-yearly US census of 2010, which will get into full swing in 2-3 years time. During 2000, Jack and Dr Bell will explore the opportunities for future collaborative work.

Visit to Leicester University, Leicester, England, October 1999.

The primary purpose here was to visit Dr Mitchel Langford and Professor Peter Fisher in the Department of Geography at Leicester, who have published a number of papers on "dasymetric mapping", in which ancillary information (in their case land cover/land use classifications based on remote sensing) is used to redistribute census population figures and hence produce population estimates for smaller areas than are available from the census. This is important work because publication of such figures by census agencies is precluded by confidentiality restrictions, and yet there is a great demand for them by geographers, planners, epidemiologists etc..

Jack gave a seminar on his work attended by staff, PhD students, and students just beginning a Coursework Masters in GIS. He also met with Dr Nick Tate, who has been doing joint work with Dr David Martin of Southhampton University, on an alternative approach to small area estimation based on a distributional re-allocation of population around census district centroids. Dr Langford, Dr Tate and Jack have laid out the groundwork for some comparative analyses of their methodologies and his. Dr Langford is currently preparing some Leicestershire data for this purpose.

Visit to University of Wales, Cardiff, Wales, October 1999.

At Cardiff Jack visited Dr Chris Webster in the Department of City and Regional Planning, who like himself had investigated the use of measures of image texture for estimating population from remote sensing images. He undertook to put Jack in touch with some of his contacts in the People's Republic of China, where population estimation methodology remains a very live issue. Jack also met Dr Gary Higgs, another co-reseracher of Dr David Martin (see Leicester visit above), who briefed him on their most recent work in geo-referencing population.

Summary of main outcomes

1. Presentation of papers and networking at three key conferences.
2. Initiation of joint work with researchers in the Department of Geography, Leicester University (1st priority).
3. Establishment of a potential research contact in US Census Bureau (2nd priority).

4. Establishments of a number of other potential research contacts (lower priority).
5. Updating of knowledge, skills and access to resources in a number of areas, including statistical education and data mining.

Congratulations....

To **Jack Harvey** who has successfully been awarded a PhD on his thesis on 'Estimation of Population Using Satellite Imagery' from the University of Ballarat.

Accepted papers....

ITMS has two items accepted for The ITiCSE 2000 Conference (Innovation and Technology in Computer Science Education) which takes place in Helsinki in July:

i) A paper entitled "Data Driven Perfomance Based Testing" co-authored by Tony Greening, Glenn Stevens and David Stratton. The content of this paper was presented to the school last year in a seminar and concerns steps we are taking to automate delivery and marking of certain assessment tasks.

ii) A poster entitled "Network Protocols and Services - a Non-Specialist Approach to Teaching Networking" authored by David Stratton. This presents an overview of the innovations involved in the NPS unit.

In addition Tony has had a paper accepted describing work in the design of Java assignments.

Book Accepted for Publication ...

Alex Rubinov has completed his book "Abstract convexity and global optimization". This large book (about 500 pages) has been accepted for publication by Kluwer Academic Publishers (Netherlands- USA). The main part of this book contains results which were obtained by Alex and also jointly with one of his 11 co-authors over the past 4 years.

Here is an extract of Acknowledgments, from the book:

"Many principal ideas, which appear in this book have been discussed with Dr Barney Glover and many results from this book have been obtained jointly with him. Barney and I had a very fruitful and useful collaboration, which favoured the preparation of the book. Alex is grateful to Barney for his invaluable advice and help.

Special thanks to Mikhail Andramonov and Adil Bagirov, who took part in the preparation of some sections of Chapter 9. Also thanks to the Australian Research Council for its financial support of this project. To the School of Information Technology and Mathematical Sciences, University of Ballarat, for the support of this project and for providing the facilities for preparation of a camera-ready copy of the book.

As english is not Alexs' native language he would like thank Allan Adair and Beata Wysocka for their valuable suggestions concerning aspects of the english presentation of the work.

The preparation of such a book is very time-consuming. I am deeply indebted to my wife Zari and sons Eldar and Michael for their understanding and patience.

Published papers....

The following papers have recently been accepted for publication:

The paper "A Story-Based Phenotype for Self-Interested Affective Agents" by Richard Hall, Binh Pham and John Yearwood has been accepted for publication in the Second International Conference on Engineering of Intelligent Systems EIS'2000.

The paper "Extended Lagrange and penalty functions in continuous optimization", by A. M. Rubinov, B. M. Glover and X.Q. Yang was published in international journal Optimization, vol. 46 (1999), pages 326-351.

The paper "P-functions, quasiconvex functions and Hadamard-type inequalities" , by C.E.M. Pearce and A.M. Rubinov was published in international Journal of Mathematical Analysis and Application, vol. 240 (1999), pages 92-104.

The paper "Increasing convex-along-rays functions with applications to global optimization", by A.M. Rubinov and B. M. Glover

was published in international Journal of Optimization Theory and Applications, vol. 102 (1999), 615-642. The first version of this paper was prepared in 1996 (Research Report 96/21).

Conferences.....

Robyn Pierce presented a paper on the possibilities offered by computer algebra systems at the Mathematics 2000 Festival, held at the University of Melbourne from 10-13th January. This was a key event in Australia's celebration of the 'World Mathematical Year'. The event attracted over 600 participants, aged 8 - 80, with presentations on topics ranging from juggling, maths murder mysteries, and bushfires to hierarchies of learning.

Peter Martin has been invited to speak at a three day quality control conference on Best Practice In Six Sigma to be held in Sydney from 24th to 26th May. Specifically I have been asked to address the issue of integrating corporate training programs with certification programs such as the Grad Cert in Stat Process Management we have at this University.

Post Graduate News....

Our PhD cohort for 2000 will be:
Jinglan Zhang and **Ross Brown** have moved to QUT with their principal supervisor Professor Binh Pham.
Lloyd Walker has submitted his PhD thesis.
Richard Hall is writing up his PhD thesis and is moving to England.
Adil Bagirov will be enrolled full-time.
Tunde Meikle will be enrolled full-time.
Michael Amdramonov will be enrolled full-time
Glenn Auld will be enrolled part-time.
Dora Pearce is converting to part-time to complete her Masters of Information Technology.
Heather Mays is converting to part-time status and writing up her PhD thesis.
David Stratton is returning from leave from studies.
Scott Hebbard is on leave from studies.
Bruce Riding is on leave from studies.
Jack Harvey has successfully completed his Doctor of Philosophy.
Raouf Veliev has submitted his PhD thesis.

Scholarships/Awards....

IBM Scholarships IBM scholarships are awarded to first year computing students who achieved a high TER score in 1999 for their VCE. Recipients for this years scholarships are Liana Kelly, Paul Rogan, Skye Johnson, Michael Fraser, Michael Cody, and Lucinda Hateley.

1999 ACS Student Award. ACS offer a number of awards to top 1999 students in their final year of a course accredited by ACS as a Level 1 or Level 2 course. Brendan Keyhoe has been offered an award of $150 and ACS membership for 12 months. Congratulations Brendan

White Paper ....

Below is a summary of John Yearwoods White Paper on Research:

Some Points from the White Paper on Research and Research Training: Knowledge and Innovation

1. **The Role of the ARC:**

- A new independent body within ETYA supported by an ARC act to provide:
  - Strategic advice to Government on research in the university sector
  - Responsibility for the administration of research funding programmes
  - A governance that will link university research to the innovation system
  - Emphasis on transparency and performance
- Use programme managers:
  - To oversee the peer review process
  - Liaise with the research community and research users
  - Identify emerging disciplinary and cross disciplinary approaches of benefit

2. The **National Competitive Grants Programme (NCGP)** will have two elements, *Discovery* and *Linkage*. This will provide grants to individuals, teams and centres for investigator-initiated proposals through an open national competitive process. A *Centres of Excellence* Scheme will span *Discovery* and *Linkage* elements to support research requiring significant national and international collaboration.

3. **The Institutional Grants Scheme (IGS)** will provide support for the general fabric of institutions research and research training activity. Funding under IGS will be based on:

   - success in attracting research students, (Weight **30%**)
   - attracting research income (all sources equally weighted) (**60%**) and
   - the *quality* and output of research publications (**10%**)

   Institutions must have a Research and Research Management Plan

4. **Research Training** will be funded through HECS-exempt scholarships on a performance basis. (PhD scholarship will be 4 years max and Masters will be two years.)
   All Commonwealth funded commencing students from 2001 will be offered HECS exempt scholarships and institutions will be funded to their current levels.
   Performance will be based on:
   - completions (50%)
   - research income (40%)
   - publications (10%)

5. **Research Infrastructure Block Grants** will be retained as a second block grant scheme to fund infrastructure. Will be allocated through performance based block grants rather than individual research projects. Allocation is based on research income performance in NCG alone rather than from all sources.

6. Regional Support

- Regional package of $10 million for collaborative research programmes on issues of benefit to regional and rural communities. This will form part of the SPIRT scheme and amended guidelines for 2000 SPIRTs will be available.

- $6 million over three years to ensure no regional institution suffers a deterioration in its research funding from its starting position.

Research Reports

00/1	A Genetic Search for Rules of the Fuzzy-Neural Hybrid System	Raouf Veliev	January 2000
00/2	A Story-Based Phenotype for Self-Interested Affective Agents	Richard Hall [1], Binh Pham[2], John Yearwood[1]	January 2000
00/3	Typical behaviour in scalar delay differential equations.	Zari Dzalilov, Anatoli F. Ivanov and Alex Rubinov	March 2000
00/4	Estimating Human Population from Satellite Imagery	Jack Harvey	March 2000
00/5	Equilibrium Mechanisms and Their Rates of Growth	A. M. Rubinov, Ghatkanbaev E.B and Utembaev E.M.	March 2000

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 Maxine Kingston no later than the 20th May 2000.

School of Information Technology & Mathematical Sciences, University of Ballarat.