

Research Newsletter

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

It has been a busy start to the year with many activities on the research front:

- the Centre in Applied Optimisation(CIAO) changed name to the Centre for Informatics and Applied Optimisation (CIAO)
- The centre now contains three groups, the Data Mining and Informatics Research Group (DMIRG), the Mathematical and Statistical Analysis Research Group (MaSARG) and the Distributed Simulation Laboratory (DSL)
- Five ARC Discovery grant applications have been prepared and submitted
- The second short course in the High Level Architecture was run in February by the DSL
- CIAO was prominent as one of the four University designated Research Centres at the launch of the Institute for Regional and Rural Research (IRRR)
- On March 6 Premier Steve Bracks launched the IRRR
- CIAO was again on display for the Governor's visit to Ballarat

The School welcomes

Dr. Adil Bagirov who has been employed as a Post Doctoral Research Fellow in CIAO. Adil has already been very active by being involved in two ARC Discovery grant applications. We wish Adil ever success in his new position.

CIAO News**Visitor to the CIAO ..**

Professor Dietchard Pallaschke from the University of Karlsruhe, Germany visited CIAO for two weeks for joint research with Professor Alex Rubinov. Professor Pallaschke is an outstanding expert in the area of Theoretical Optimization, he is the Editor-in-Chief of the International Journal *Optimization* .

Name Change

At the University of Ballarat Council meeting held on February 13, 2001 a change of name was approved for the Centre to Applied Optimisation to Centre for Informatics and Applied Optimisation (CIAO).

CIAO is one of four designated research centres within the University of Ballarat. It will carry out basic research in the broad area of Informatics and in particular Optimisation. The work in Optimisation focuses on the development of new numerical optimisation algorithms, as well as the application of these techniques to problems in data mining, telecommunication networks, engineering, computational chemistry and decision support in many areas such as health and business. Currently, the work in Informatics focuses on structured reasoning, knowledge discovery and decision support in law and health as well as the area of distributed simulation.

Centre Structure

Director Professor Alex Rubinov
Deputy Director Associate Professor John Yearwood
Industry Education Liason Mr. Peter Martin

The Centre contains three Research Groups...

1. Data Mining and Informatics Research Group (DMIRG).

Leader – A/Prof. J. Yearwood

Members: Dr. Adil Bagirov, Dr. Jack Harvey, Mr. Frank DeLuca, Prof. Sid Morris, Prof. Alex Rubinov, Mr. Greg Simmons, 8 PhD students;

2. Mathematical and Statistical Analysis Research Group (MSARG)

Leader – Prof. S. Morris

Members: Dr. Adil Bagirov, Mr. Jason Giri, Dr. Jack Harvey, Dr. Chris Turville, Ms Robyn Pierce, Prof. Alex Rubinov, Mr. Peter Martin, 5 PhD students.

3. Distributed Simulation Laboratory (DSL)

Leader - Mr. David Stratton.

Members Dr. Phil Smith, Dr. E. Barker

Research Students:

Simon Barty, Zari Dzalilov, Jason Giri, Long Jia, Musa Mamedov, Michelle O'Brien, Gary Saunders, Nadya Soukhoroukova, Jaipu Zhang, Faezi Afshar, Tunde Meikle, Brent Ferguson, Sasa Ivkovic

Some Current Research Projects

Monotonic analysis (A.M. Rubinov)

1. Numerical methods for nonsmooth and global optimization. (Bagirov, A. Rubinov, N. Soukhoroukova, J. Zhang)
2. Dual methods for the solution and computational analysis of structured optimization problems (A.M. Rubinov, A. Bagirov, J. Giri)) (ARC Large Grant, 1999-2001, \$151,223)
3. Clustering and Classification. (Bagirov, A. Rubinov, J. Yearwood, M. Mamedov, N. Soukhoroukova)
4. Mapping argumentation structures to narrative for eCommerce Dialogue Support (J. Yearwood and A. Stranieri), ARC Discovery Grant (2002 - 2006, \$ 320 000)
5. Enhanced Prescribing Decision Support: Data mining the Australian Adverse Drug reactions Database and providing On-line access to information (ARC SPIRT grant, 2001-2003, \$220 500 (K. Harvey, A. Rubinov, J. Yearwood, J. Harvey)
Industry Partners: Therapeutic Goods Administration (TGA), Ballarat and District Division of General Practice, Medical Software Industry Association, Therapeutic Guidelines Pty.Ltd.

6. Iso-resource grouping for acute health care: An optimization based clustering approach (A. Bagirov; in collaboration with Monash University).

7. Optimisation of Capital and Operational Expenditures for a Telecommunication Network. (A. Rubinov, L. Jia; in collaboration with Telstra Research Laboratories)

8. Dynamic configuration of the telecommunication networks (ARC SPIRT grant, 2001-2003, \$ 66 876) (A. Rubinov, Z. Dzalilov; in collaboration with Telstra Research Laboratories)

9. Application of optimisation to data mining and computational chemistry (A. Rubinov, N. Soukhoroukova, J. Zhang; in collaboration with Deakin University and Monash University) VPAC grants, (2001, \$22 575, 2002, \$ 60 000)

10. FOM Agility in the High Level Architecture for Distributed Simulation (D. Stratton and P. Smith)

11. Reasoning with knowledge represented as arguments for the development of refugee law intelligent decision support systems. (J. Yearwood and A. Stranieri) Industry Partner: The Refugee Review Tribunal of Australia.

12. Algorithms for text categorization using non-smooth optimisation techniques. (J. Yearwood and A. Bagirov).
Application of spatial regression models to the problem of estimating small-area populations from orbitally acquired remote sensing imagery. (J. Harvey and C. Turville)
eConsent: Consumer Consent in Electronic Health Care Data Exchange (R. Davey and G. Simmons)

Memorandum of Understanding

A Memorandum of Understanding between CIAO and WACEIO (The Western Australian Centre of Excellence in Industrial Optimisation at Curtin University of Technology) has been recently signed. Through this memorandum the two Centres agree to collaborate in every possible way and work towards the realisation of the goal to establish a National Cooperative Research Centre in Industrial Mathematics/Optimisation. Some particular aspects of this collaboration are:

- A joint focus on fundamental research in optimisation.
- Joint R&D projects.
- Sharing of optimisation technology.
- Joint organization of Workshops/Symposiums.
- Promotion of the combined expertise of both Centres.

- Sharing of Tender opportunities.
- Joint consulting activities.
- Joint running of short courses.
- Joint supervision of post graduate students in optimisation focussed projects.
- Joint Competitive Grant Applications as detailed below.

The Centres agree to pursue opportunities for successful applications for Competitive Grants such as:

- ARCC Discovery
- ARC Linkage
- ARC Infrastructure.
- Grants and Tenders from other government and industry funding bodies.

For 2002 we have agreed to pursue an application for an ARC Infrastructure Grant for the establishment of a major computing facility within WECEIO with CIAO having access.

Computational Chemistry Group Meeting and Workshop at Monash University (Gippsland).

The meeting of computational chemistry group was held at Monash University (Gippsland) on Sunday, February 17. The delegation from Ballarat included A. Rubinov, G. Saunders, A. Bagirov, N. Souhoroukova, Z. Dzalilov. Applications for a discovery grant have been discussed. Next day, Monday February 18, members of the group took part at Workshop on Optimisation and Classification. Alex Rubinov presented a lecture: "Successful classification: how it depends on classification methods and on the structure of database". This talk was based on a joint paper with Nadya Souhoroukova and John Yearwood.

Congratulations

Congratulations to **Robyn Pierce** on the acceptance of her PhD thesis. *An Exploration of Algebraic Insight and Effective Use of Computer Algebra Systems.*

Grants

The Collaborative Centre for eHealth (CCeH) has won **Commonwealth Department of Health & Aged Care, Tender RFT 5/102** for about \$250,000. The project is called "e-Consent: Consumer Consent in Electronic Health Care Data Exchange". This is a joint effort of CCeH and the School of Information

Technology & Mathematical Sciences. The key staff involved are:

- Project Director - R Davey (CCeH)
- Project Leader - P Veeken (CCeH)
- Research Supervisor - Prof Sidney Morris (ITMS)
- Senior Researcher/Investigator - G Simmons (ITMS)
- Senior Technical Officer - Gerry Marthe (CCeH)
- Technical Officer - Sasha Ivkovic (CCeH & ITMS)
- Clinical Consultant - Dr Peter Schloeffel (OpenEHR Foundation)
- Consumer Consultant - Heather Grain (LaTrobe University)

It is intended to design, develop and test an eConsent Object and its supporting mechanisms that will:

"Test the implementation of a data structure that has sufficient complexity to support patient consent requirements.

Test the implementation of the eConsent object:

- Within a workable transmission framework
- Within a context that satisfies security requirements

Display the contents of the eConsent object on the device that receives an electronically transmitted record and its associated eConsent object."

The project is to be completed within 7 months.

A UB Small Grant for 2002 has been awarded to **Dr C Turville** and **Dr J Harvey** for a project entitled *Application of spatial regression models to the problem of estimating small-area populations from orbitally acquired remote sensing imagery*. The basic methodology for population estimation which has been developed by Dr Harvey is currently being applied in ongoing joint research with colleagues at the University of Leicester in the UK. This research was supported by a small ARC grant in 2001. The newly funded project is focused on further theoretical developments and refinements to the methodology. It is important because, whilst the existing type of model can be tuned to enhance performance, similar ceilings in accuracy levels have now been demonstrated in Australian and English contexts. It is hoped that the use of more sophisticated statistical methods, in which spatial patterns and correlations are explicitly modeled, will lead to further increases in the accuracy of the population estimates obtained.

Dr John Yearwood and **Dr Adil Baghirov** received a \$10,000 grant for their project 'Algorithms for text categorization using non-smooth optimisation techniques'.

The project will investigate applying classification techniques based on non-smooth optimisation techniques developed at Ballarat to the important problem of classifying texts.

Accepted papers....

A.M. Bagirov, *A method for minimization of quasidifferentiable functions*, *Optimization Methods and Software*.

A paper called *Monitoring Algebraic Expectation* authored by **Lynda Ball**, **Kaye Stacey** and **Robyn Piece** (Lynda and Kaye are from University of Melbourne) has been submitted for refereeing for the Psychology of Mathematics Education Conference to be held in July 2002.

Chris Turville, **Robyn Pierce**, **Ewan Barker**, and **Jason Giri** have had an abstract accepted for the Second International Conference on the Teaching of Mathematics in Crete. The paper entitled '*Changes of Names, Contents and Attitudes to Mathematical Units*' is currently being reviewed.

John Yearwood and **Andrew Stranieri** have had the paper entitled '*An Argumentation Shell for supporting the Development and Drafting of Legal Documents*' accepted for publication in *Information and Communication Technology Law*.

John Yearwood, **Sasa Ivkovic** and **Andrew Stranieri** have had the paper entitled '*Discovering Interesting Association Rules from Legal Databases*' accepted for publication in *Information and Communication Technology Law*.

Published papers....

The following papers have recently been published:

V.F. Demyanov, **A.M. Bagirov** and **A.M. Rubinov**, have had a paper '*A method of truncated codifferential with applications to some problems of cluster analysis*' published in *Journal of Global Optimization*, 2002, Volume 23, Number 1, pp. 63-80.

A.M. Bagirov and **A. M. Rubinov**, *Numerical analysis of nonlinear penalty functions method*, Proceedings of the 5-th International Conference on Optimization: Techniques and Applications, Hong-Kong, 2001, 88-95.

A.M. Rubinov and **J.S. Giri**, *A comparison of non-linear Lagrange and penalty functions for problems with a single constraint*, Proceedings of the 5-th International Conference on Optimization:

Techniques and Applications, Hong-Kong, 2001, 360-366.

A. M. Rubinov and **R. N. Gasimov**, *The equivalence of nonlinear convolution functions*, Proceedings of the 5-th International Conference on Optimization: Techniques and Applications, Hong-Kong, 2001, 389-396.

A.M. Rubinov and **A. Uderzo**, *On global optimality conditions via separation functions*, *J. Optimization Theory and Applications*, vol. 109 (2001), 345-370.

Yu.G. Evtushenko, **A.M. Rubinov** and **V.G. Zhadan**, *General Lagrange-type functions in constrained global optimization. Part 1: Auxiliary functions and optimality conditions*, *Optimization Methods and Software*, vol. 16 (2001), 193-230.

Yu.G. Evtushenko, **A.M. Rubinov** and **V.G. Zhadan**, *General Lagrange-type functions in constrained global optimization. Part*

2: *Exact Auxiliary Functions*, *Optimization Methods and Software*, vol. 16 (2001), 231-256.

A.M. Rubinov and **I. Singer**, *Topical and sub-topical functions, downward sets and abstract convexity*, *Optimization*, vol. 50 (2001), 301-357.

A. Bagirov, **A. Rubinov** and **J. Yearwood**, *Using global optimization to improve classification for medical diagnosis*, *Topics in Health Information Management*, Vol. 22 (2001), 65-74.

A. Rubinov, **X.Q. Yang** and **B.M. Glover**, *Extended Lagrange and penalty functions in optimization*, *JOTA*, vol. 111 (2001), 381-405.

A.D. Ioffe and **A.M. Rubinov**, *Abstract Convexity and Nonsmooth Analysis. Global Aspects*, *Advances in Mathematical Economics*, Vol. 4 (2002), 1-23.

V. F. Demyanov, **A.M. Bagirov** and **A. M. Rubinov**, *A method of truncated codifferential with application to some problems of cluster analysis*, *Journal of Global Optimization*, vol. 23 (2002), 63-80.

A.M. Bagirov, **A.M. Rubinov** and **J. Yearwood**, *A heuristic algorithm for feature selection based on optimization technique*, *Heuristic and Optimization for Knowledge Discovery* (H. Abbass and R. Sarker, eds), Idea Group Publishing, pp. 13-28.

Seminars and Workshops.....

Workshops:

Robyn Pierce and **Chris Turville** assisted **Lyn Roberts** with an on-line workshop at OZCOTS-4 Statistics Education. The conference was held in December at Swinburne University.

Seminars

Recent Seminars ...

13/3/02 –

John Redfern – *Web Engineering*

Tim Pokorny – *Advanced Topics in IDL-based Application Distribution.*

17/3/02 –

Professor Terry Mills (Latrobe University) *Patient flows in hospitals.*

26/3/02

Michelle O'Brien *A consumer electronic medical record fro the early detection and prevention of adverse drug reactions (ADRs).*

27/3/02

Summer Project Presentations by Rosemary Hay and Lessan Vaezi.

Forthcoming Seminars ...

10/4/02

Glenn Auld (University of Ballarat)
CALL with ANT.

17/4/02

Professor Terry Mills (Latrobe University)
Patient flows in hospitals

Conferences.....

5th International Conference on Optimization: Techniques and Applications, Hong Kong, December 15-17, 2001.

Dr Adil Bagirov, **Professor Alex Rubinov** and **Jason Giri** attended this conference. The following papers were presented:

1. **A.M. Bagirov**, *Discrete gradient method in nonsmooth optimization.*

2. **A.M. Bagirov** and **A.M. Rubinov**, *Numerical analysis of nonlinear penalty functions method.*

3. **A.M. Rubinov** and **J.S. Giri**, *A comparison of non-linear Lagrange and penalty functions for problems with a single constraint.*

4. **A.M. Rubinov** and R.N. Gasimov, *The equivalence of nonlinear convolution functions.*

5. **A. Rubinov** *Penalization and Reformulation in Constrained Non-smooth and Nonconvex Optimization.*

Dr Jack Harvey was the sole Australian delegate in a group of around 200 from 18 countries on all continents, who presented some 75 papers at an *IEEE/ISPRS Conference on Urban Applications of Remote Sensing* in Rome in November 2001. Dr Harvey's joint paper with Dr Mitchel Langford of the University of Leicester, UK was entitled *The Use of Remotely Sensed Data for Spatial Disaggregation of Published Census Population Counts*. Whilst this was one of only a few papers concerned with population estimation *per se*, many other papers concerned current research in related fields, where new methodologies, particularly pertaining to image classification and texture analysis, are potentially applicable to Dr Harvey's work on population estimation. As well as networking and enjoying some of what Rome had to offer, Dr Harvey and Dr Langford also did some work on two journal articles in preparation.

Dr Harvey also visited Dr Victor Mesev at the University of Ulster in Coleraine, Northern Ireland. A likely outcome will be collaborative research into the use of geocoded postal address files in conjunction with remotely sensed imagery for the purpose of refining and updating residential land use and population density maps between censuses. While at Ulster Dr Harvey also presented a seminar to GIS masters students and staff on some of his past work.

Report on Research Projects...

2000 ARC SPIRT APA(I). Enhancing prescribing decision support: data mining the Australian adverse drug reactions database and providing on-line access to information. K. Harvey/Rubinov/Yearwood/J.Harvey

Three PhD students have been recruited for each of the three projects:

1. Identification of adverse drug reactions
Doctoral student, Simon Barty commenced in July 2001. A probability filtering tool (PROFILE) has been developed and applied to the ADRAC database. Results from this analysis have been accepted for publication. A tool for analysis based on Bayesian modeling is being adapted and incorporated into the PROFILE software. A comprehensive study has been

designed to compare the performance of seven statistical criteria (including various ratios, p-values and Bayesian shrinkage estimators) on selected slices of the Australian adverse drug reactions database.

2. Characterisation of adverse reaction scenarios

Doctoral student, Gary Saunders commenced in September 2001. Having selected an appropriate subset of the database relating to the cardiovascular Systems Organ Class, the concept of a vector of degrees of association (with a reaction class) for each drug was found to be useful in the prediction of groups of reactions. Work has also been carried out on predicting patient outcomes on the basis of combined evidence from real observed reactions. The results are now being discussed with one of the major industry partners, the Therapeutic Goods Administration, Canberra.

3. Clinical decision support from the ADRAC database

Doctoral student, Michelle O'Brien commenced in March 2001. A study of the characteristics of adverse drug events as they appear to GPs revealed that their occurrence for any particular GP may be quite infrequent and that GPs are often not aware that they have played a part in an individual event. Currently a more complex study involving piecing together a full picture of a medical record surrounding an event is being designed and approved with the help of the industry partners. This study should inform the development of a patient centered medical record to support a software intermediary for improving the quality of the doctor patient interaction with the specific goal of preventing ADRs.

ADRAC Video Conference Report

On Wednesday 20 February 2002, a video conference was held to discuss the progress of the **Adverse Drug Reactions Advisory Committee** (ADRAC) database research projects between representatives of the Therapeutic Goods Administration (TGA), Commonwealth Scientific and Industrial Research Organisation (CSIRO), University of Ballarat and La Trobe University. The video conference was conducted using three locations in Canberra, Ballarat and Melbourne and proved to be a very successful means of communication.

The primary purpose of this video conference was to update all representatives particularly the TGA representatives who are looking to the various researchers to provide a solution to the long term question "which drug is causing which adverse reaction?" During the video conference each of the researchers made a 10 minute presentation which informed all representatives of their progress to date and future directives for their research. There was also an opportunity for representatives to provide

feedback and suggestions or improvements to the researchers about their work.

Chris Turville and **Jason Giri** presented a paper entitled '*Con-Templating Graphs*' at the 38th Annual Conference of the Mathematics Association of Victoria in December.

Post Graduate News.....

The School welcomes the following Post Graduate Research students:

Sergei Dymkaou who will be engaged in the study of Applied Optimization.

Julien Ugon who will be engaged in the study of Applied Optimization.

Sasa Ivkovic who will be engaged in the study of Association Rules for his Masters degree.

Brent Ferguson who will be engaged in the study of Extracting knowledge from Neural Networks for his PhD.

Adil Mamed Baghirov has completed the requirements for the award of Doctor of Philosophy.

Congratulations to **Michelle O'Brien** whose proposal to proceed to full candidature was accepted by the Confirmation Panel on Tuesday 26th March 2002. Michelle presented a comprehensive seminar 'A Consumer Electronic Medical Record Managed by Intelligent Software Agents to Prevent, Detect and Manage Adverse Drug Reactions' and fielded questions most competently.

A Healthy Cohort of Honours Students....

Continuing from 2001

David Andrews
Evan Dekker
Wendy Turnbull

John Avery
Amy Davidson

2002 Honours Students:

The School welcomes the following Honours students:

Neroli Sawyer
John Redfern
Tim Pokorny
Andrew Rayner
Paul Feely

Darren Lierkamp
David Newbury
Lessan Vaezi
Michael Enright

Scholarships/Awards

Sasa Ivkovic and **Brent Ferguson** both received research scholarships to support their candidature.

IBM Scholarships ...

IBM scholarships are awarded to first year computing students who achieved a high TER score in 2001 for their VCE. Recipients for this years scholarships are: William Mioch; David Russell; Tristan Wilkinson; Matthew Polson; Josh Stewart and Chris Ware.

Summer Scholarships...

Summer scholarships to the value of \$2,400 provide students with an opportunity to be involved in project work over summer that will enhance their learning opportunities and provide an introduction to research work.

Summer Scholarships were awarded to Lessan Vaezi, Tim Pokorny, Wendy Rodgers, Rosemary Hay and John Redfern.

Research Reports

01/16	A method for minimization of quasidifferentiable functions	Adil M. Bagirov	August 2001
01/17	The Equivalence of Nonlinear Convolution Functions	A.M. Rubinov and Rafail N Gasimov	October 2001
01/18	Lagrange-type functions in constrained optimization	A.M. Rubinov and J.S. Giri	October 2001
01/19	On Global Minimiser Conditions based on Separability by a cone	A.P. Shveidel	October 2001
01/20	Lagrange-type Functions in constrained Optimization	A.M. Rubinov, X.Q. Yang, A.M. Bagirov and R. Gasimov	October 2001
01/21	The zero duality gap property and lower semicontinuity of the perturbation function	A.M. Rubinov, X.X. Huang, and X.Q. Yang	October 2001
01/22	Continuous subdifferential approximations and their applications	A.M. Bagirov	November 2001
01/23	On minimization of max-min functions	A.M. Bagirov and A.M. Rubinov	November 2001
01/24	Clustering for studying the structure and quality of datasets	A.M. Rubinov, N.V. Soukhoroukova, J. Yearwood	November 2001
02/01	An Analysis of Adverse Drug Reactions from the ADRAC Database Part 1: Cardiovascular group	M.A. Mamedov and G.W. Saunders	February 2002
02/02	Asymptotical Stability of Optimal Paths in Nonconvex Problems	Musa A. Mamedov	February 2002

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 the Research Administrative Officer by 20th June 2002.



University of Ballarat



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