

Research Newsletter

JULY 1998

Edition 2.

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

The last month has seen a flurry of discussion on research policy and directions within the university. The School Research Day was held on Monday June 15 and was led by Professor Ray Over. The day consisted of three sessions:

- *Developing a research culture within a new university*
- *Research issues for individuals*
- *Individual consultation sessions*

Many staff made use of the day and some clear issues for school dialogue and policy were identified. The evaluations of the day indicated that it was beneficial, interesting and positive.

The University research planning day was held on Wednesday June 24 and provided a forum for all stake-holders to contribute and interact. Many of the ideas will go towards planning the research direction and strategies for the university.

I will be on long service leave from July 13 until October 18 and Andrew Stranieri will be acting as Research, Higher Degrees and Ethics Coordinator for that period.

Projects in Progress.....

Prof. Binh Pham and her postdoctoral research fellow, **Zhongwei Zhang** have completed an implementation of a prototype system which uses genetic algorithms to correct the reflection lines in the car styling. The significance of their research has been reaffirmed by her recent visit to the Daimler-Benz car company in Germany. Below is a report received from Professor Binh Pham whilst in Germany, regarding research and development news on car design.

R & D news on Car Design (By Binh Pham, visiting Germany)

I know nothing about cars and car design because my work in the area of geometric modelling and aesthetic factors has been basic research and not focussed on any application in particular. I thought before I have discussions with professionals and experts on car design, I should try to gain some knowledge by visiting the Mercedes-Benz Museum, one of the two car museums in Stuttgart (the other

one is Porche). The Mercedes Benz company was found by Daimler with the support of a wealthy businessman under the condition that the company was named after his daughter Mercedes. The company's name was later changed into Daimler-Benz and will change again into Daimler-Chrysler after the recent merge with Chrysler. The Museum displays a range of real models from 1885 onward. Contrary to my preconceived ideas of the conservative styles of MB cars found in Australia, I found to my surprise many diverse styles, including sport cars, airplanes, and even ships. As our current project concerns reflection lines on cars, I also took the opportunity to observe the shape variations of reflection lines on these models from different view points. They are quite prominent on these well-polished cars, and displayed to their advantage in show room lighting conditions.

Let me tell you about two R & D projects that I was shown here, the first one is at the Fachhochschule fur Technik Esslingen and the second one is at Daimler-Benz.

1. Integration of car design processes using a digital mockup

This project which was initiated by two bright students, is being carried out by 6 teams of final year students at the Faculty of Car Technology. Its aim is to perform all stages from start to finish for the design and construction of a car using a digital model stored in a computer which can be accessed by all team members. This is an important development because up to now, the normal practice in car industry is still to use a digital model only in a small number of steps. The sketch is done manually, from which a full-sized model is built (in plastic, foam or clay). The model is then digitised to get sufficient 3D points to construct a CAD model used for some manipulation of shape and analysis (e.g. dynamic flow, aesthetic styling, etc.). I was told that some designers still do not want to use CAD model for styling and analysis. Information on car parts are stored in a number of formats - some digital, some manually on files. Some part assembly is done by computer, some manually. Some data are in the form ready for numerical controlling machines, some are not. The students first built a 1/10 clay model from which they digitised to get initial 3D points. The styling and designing team then used the

visualisation package Alias to construct the model and refine its shape. The computing and engineering teams perform required computation and analysis on the model. All these steps are done iteratively until all requirements are satisfied. The work so far is of a very good standard, and IBM has given the department a grant of 250,000DM because they want to use the whole process as a demonstration on their roadshow. The only weak part in the project is that they have not been able to do styling in any extensive way, because of their lack of knowledge in styling and the limitations of the software they use. The Professor who supervised the project said they are currently looking for a sponsor to fund the actual construction of the designed car.

2. Car styling by correction of reflection lines

Daimler-Benz (DB) was the first car company which used the technique for car styling by smoothing the reflection lines on a car surface. These reflection lines are generated from a parallel set of light tubes. Different sets of reflection lines are obtained from different viewpoints. The surfaces which form a car model are first constructed from 3D digitised points, using free-form surface representations such as Bezier or B-spline surfaces, or NURBS (non-uniform rational B-splines). Although these surfaces appear sufficient smooth visually, many local irregularities and discontinuities on some parts of each surface are only shown up when lights are shown on them. The kinks or dents on the reflection lines on cars or airplanes are not only ugly, but also make customers feel that the surface is going to break, hence they need to be removed. The CAD package SYRKO developed by DB has capabilities to do that task interactively by solving non-linear differential equations. One question is whether it is worthwhile to incorporate some deliberate aesthetic intents to these reflection lines (e.g. degree of symmetry or harmony between reflection lines, converging to a point or slanting in certain orientation, repetition of some patterns, etc.). As expected, the practitioners say that is not the usual way they do their work - they only want to smooth out those reflection lines. The researchers (also as expected) say we should be able to do better. This is where I fit in.

Data Mining

There are a number of projects emerging in the area of Data Mining. It is interesting that from some early projects in mining text cases and legal databases a much wider range of data mining projects now needs to be supported. In fact it may be interesting to suggest that the university is expanding its historical association with the mining industry and mining of minerals to that of mining the repositories of data and information for knowledge.

IVRIF (Image & Video Research Infrastructure Facility) is supporting the purchase of the Data mining software MindSet and HummingBird X-server

software with OpenGL capability. The software will be used to support a number of projects in Data mining. Many of these are still in the early stages of development and some indicate a collaborative effort.

- Andrew Stranieri has been working on "Discovering Legal Knowledge by data mining legal cases in Family Law".
- John Yearwood & Andrew Stranieri are looking at text mining in Refugee Law.
- Rauf Veliev, Alex Rubinov & Andrew Stranieri are working on "Data mining techniques to predict economic indicators for countries making the transition from Socialism to market economies".
- Dora Pearce and Binh Pham are considering the use of data mining techniques for epidemiological studies.
- Andrew Skabar & Anthony Maeder are working on "Predicting gold deposits in the Ballarat region using data mining techniques".
- Dennis Arne & Andrew Stranieri are involved in a project to "Discover Geological knowledge from GIS data".
- Scott Hebbard & Paul Kelly are looking at "Mining for knowledge on Occupational Health and Safety in the coal mining industry".
- Greg Simmons & Jack Harvey are interested in "Data Mining Techniques".

Accepted papers....

The paper "A generalization of the Perron - Frobenius theorem" by P.Kloeden and **Alex Rubinov** has been accepted for publication in the international Journal "Nonlinear Analysis: Theory, Methods and Applications". The paper was submitted to this journal in January 1997.

The paper " Reformulation of a model of economic equilibrium " by **Alex Rubinov** and Barney Glover has been submitted for publication in the Proceedings of the section "Reformulation: Nonsmooth, Piecewise Smooth, Semismooth and the Smoothing methods" of the 16th international Colloquium on Mathematical programming in Lusanne. Proceedings will be published by Kluwer Academic Publishers.

Proceedings of the fourth Optimization day, which was held in Melbourne in 1997, entitled " Progress in Optimization: Contribution from Australasia" will be published by Kluwer Academic Publishers. The following papers were accepted for publications in Proceedings:

- **A.M. Rubinov**, Supremal generators of spaces of homogeneous functions.
- **A.M. Rubinov** and A.Zaffaroni, Continuous approximation of nonsmooth mappings.

- **M.Yu. Andramonov** and A. Ellero, Generalized convexity properties of marginal functions.
- **M.Yu Andramonov**, A parametric approach to global optimization problems of a special kind.
- **H.Xu, A. Rubinov** and B. Glover, Approximations to the Clarke generalized jacobians and nonsmooth least-square minimization.

Seminars and Workshops.....

Dora Pearce attended the Second Symposium on GIS and Health – “Developments in the Application of Geometric Information Systems Within the Health Sector”. The symposium was held at the Civil Engineering and Geomatics building, University of Melbourne on the 10th of June 1998. The usefulness of the application of GIS capabilities to health and population data in order to identify resource needs and optimise allocation has been recognised. A highlight was the presentation by Professor Gerald Rushton, from the University of Iowa USA, which described a GIS methodology for spatial analyses of mortality rates at the individual level and for aggregated data in small areas. Discussion took place regarding the need for a basic standard spatial unit that could facilitate spatial boundary alignments, and hence comparisons and analyses of geographically coded data, both spatially and over time.

Alex Rubinov presented the opening lecture on a workshop “Generalized convexity and monotonicity in economic modeling” (June 4-6, 1998), organized by the Center for the Study of Organization and Decisions in Economics at the Universitat Autònoma de Barcelona. The title of the lecture was “Abstract convexity with applications to optimization and economics”. The workshop jointed together 33 leading experts in the area from Spain, France, Australia, USA, Canada, Germany, Norway, Greece, Hungary, Netherlands and Italy. The main goal of workshop was to discuss the development of new mathematical tools and their applications to Economic Theory. Alex presented one more lecture on the workshop entitled “Equilibrium with restriction on exchange”

Conferences.....

During his visit to Barcelona **Alex Rubinov** attended the Third Spanish meeting on Game theory and Applications. There were many interesting talks devoted to game theory in the conference. Mathematical models of conflict situations and (mainly) of cooperation are studied by means of different types of games.

The fourth International Conference on Optimization: Techniques and Application (ICOTA) will be hosted by Curtin University of Technology in Perth, July 1-3.

Barney Glover and **Alex Rubinov** were invited to organise the section on “Global Optimization “ at this conference. Alex Rubinov and **Michael Andromonov** plan to present three talks in this section (one of them co-authored by Barney Glover and **Huifu Xu**).

M. Andramonov has been invited to organize and chair the session “Local search algorithms in nonlinear optimization” in the LOCAL SEARCH ALGORITHMS cluster for the IFORS'99, 15th World Conference on Operational Research, which will be held in Beijing, China, August 16th –20th, 1999. This conference is a triennial meeting of the International Federation of Operational Research Societies -- IFORS, hosted by the Operations Research Society of China.

The International Conference on Nonlinear Programming and Variational Inequalities will be held in Hong Kong on 14 -17 December 1998. **Alex Rubinov** has been invited to organise and chair the sessions “Nonsmooth optimization” and “Generalised convexity” at this conference. Alex plans to present three talks from different areas of optimization at the conference. **Huifu Xu** also is going to attend this conference and give three talks on different sessions.

The fifth Optimization Day (optimization miniconference) will be held at University of Western Australia on June 29-30. (The first Optimization day took place in Ballarat in 1994). **Alex Rubinov** and **Michael Andramonov** are going to present three talks on this miniconference (one of them coauthored by Barney Glover and Xiao Qi Yang). These talks will be different from the talks which will be given on ICOTA.

Visits by ITMS Staff Members.....

Alex Rubinov was invited by CODE (Center for the Study of Organization and Decisions in Economics ; The Universitat Autònoma de Barcelona) to spend two weeks in Barcelona. The main goals of the visit: to attend CODE workshop (Alex gave an opening lecture) and find points of mutual interest with CODE's members. After some fruitful discussions two projects have been chosen:

1. To study some classes of abstract convex functions (with Professor Juan Enrique Martinez Legaz);
2. To study an economic equilibrium with imperfect competition : monopoly and restriction on exchange (with Professor Isabel Fradera). Professor J E Martinez Legaz has been invited to visit University of Ballarat later this year.

Visitors to the School.....

Professor Hoang Tuy from the Institute of Mathematics of the Vietnam academy of Sciences will visit SITMS for three weeks in June -July. Professor

Tuy is a prominent expert in the area of global optimization. He is the author and co-author of the main textbooks and research monographs in the area. A special issue of the international "Journal of Global Optimization" dedicated to Professor Tuy's seventieth anniversary will be published this year.

Dr. Leonid Churilov (Monash University) visited the school for a day in May. Leonid presented a long seminar (more than two hours) and had a fruitful discussion with members of the optimization group.

Post Graduate News.....



Zhongwei Zhang has been informed of positive results from the examiners of his PhD thesis. His PhD research at Monash University (Gippsland) was about the intelligent control of time-critical complex systems, in particular, the control of

an adaptive information visualisation system. The adaptive information visualisation system can display a distorted map of Australia and any region of interest as a magnifier does. This system can present the details and preserve the context at the same

time, which the conventional zoom-in systems usually cannot do. In order to achieve the objective of displaying as much information as possible, a control system which is capable of learning and reasoning is required. The design and implementation of such a control system used some soft computing techniques such as neural networks, fuzzy logic and genetic algorithms. The control system significantly improves the performance of the visualisation system in terms of the amount of information. He is currently working on a large ARC research project in the School of ITMS under supervision of Prof. Binh Pham. The project is about the design for aesthetics using an evolutionary approach.

Research & Professional Development Group News.....

The Publications data collection for 1997 has been completed and overall there has been an increase from 1996. Thanks to staff for meeting the deadlines and thanks to Kirsty for putting it all together. Please remember to file publications data with Kirsty as it becomes available so that the collection for 1998 will only be a small task at the end.

The meetings on the Honours year have proceeded well and a structure has been developed which allows students to enter an honours stream at the end of the second year of their course. The current second year students will be involved soon.

Some of the issues and concerns raised at the School research day will be items for discussion at the coming RPDG meetings.

Ballarat and Western Victoria Regional Information Bureau (BRIB)

Newcomers to ITMS may be either unaware of or mystified by the name Ballarat and Western Victoria Regional Information Bureau (BRIB). BRIB is a statistical information and consultancy agency of the school which was set up in 1984 with **Jack Harvey** as Co-ordinator and **Shani Clark** as project officer, to promote and facilitate the use of data from the Australian Bureau of Statistics and various other sources at a time when such data was not easily accessible to potential regional users such as local government and community organisations. A second major focus which quickly developed was the design, management and analysis of sample surveys. It is perhaps a measure of the success of BRIB (together with the impact of technological change) that the need for the first function has greatly diminished, and with the establishment of the university, much of the energy formerly devoted to BRIB activities is now directed towards research support and collaboration within the university, through the more recently established Statistical Consultancy Centre. However, because of its well established profile in the regional community, the BRIB "masthead" is still used for much of the survey-related consultancy work undertaken by statistics staff. Most recently, BRIB has been engaged by the Victorian Mineral Water Committee to design and conduct a major survey of Visitors to mineral springs reserves during the second half of 1998. The Committee was set up in 1996 to advise the Minister for Conservation and Land Management on matters related to the protection and management of the state's mineral water resources. The survey is intended to provide baseline data on what sorts of people visit mineral springs and why they do so, and will also seek opinions about existing facilities and suggestions for improvements and enhancements. The project will be jointly undertaken by **Jack Harvey** and **Robyn Pierce**, and is likely to involve students in interviewing and data analysis roles.

All IT&MS staff members and post graduate 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 Wednesday 29th of July 1998.



University of Ballarat



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