

Summary of Discovery Projects Applications for Funding to Commence in 2006

New South Wales

The University of Newcastle

DP0665254 Ms LA de Beuzeville; A/Prof TA Johnston

Approved Project Title **The linguistic use of space in Auslan (Australian Sign Language): semantic roles and grammatical relations in three dimensions**

2006 : \$85,000

2007 : \$79,000

2008 : \$80,000

Primary RFCD 3802 LINGUISTICS

APD Ms LA de Beuzeville

Administering Institution The University of Newcastle

Project Summary

Research into the structure of Auslan provides information for the production of assessment and teaching tools for practitioners to use in adult education settings (for second language learners of Auslan and Auslan interpreters) and in special education for signing deaf children. It will also serve as a basis for further research into the acquisition of grammatical use of space by native signing deaf children. These outcomes will further benefit the deaf community, improving deaf people's access to education, health, government services and the employment sector.

DP0667265 Prof BZ Dlugogorski

Approved Project Title **Self-heating of porous lignocellulosic and coal particles**

2006 : \$65,000

2007 : \$50,000

2008 : \$50,000

Primary RFCD 2999 OTHER ENGINEERING AND TECHNOLOGY

Administering Institution The University of Newcastle

Project Summary

This project develops models for spontaneous heating of materials, which have substantial value to Australian economy, and whose self-heating behaviour have led to loss of life and significant material losses in industries processing these materials. The results will be immediately applicable to evaluate risks of spontaneous ignition in process plants in a more rigorous manner than performed presently. Furthermore, findings of this investigation will allow considerable improvement in estimating green house gas emissions as a consequence of spontaneous combustion.

DP0666620 Dr AJ Fleming

Approved Project Title **Analysis, Optimization, and Control of Scanning Atomic Force Microscope Micro-Cantilever Probes**

2006 : \$128,996

2007 : \$95,000

2008 : \$80,000

Primary RFCD 2301 MATHEMATICS

APD Dr AJ Fleming

Administering Institution The University of Newcastle

Project Summary

Atomic Force Microscopes (AFM's) are widely used for the examination of samples smaller than can be observed with an optical microscope. A tiny 'finger', only a few atoms wide at its sharpest point, is used to 'feel' the surface of a sample. This project aims to increase the resolution of AFM images by actively controlling the sensor probe dynamics.

Better quality AFM images would allow scientists to further investigate the atomic and molecular structure of such samples as: metals, polymers, cells, and proteins.

This research will contribute to the design of an Australian made Scanning Probe Microscope. Development of local expertise will provide a valuable resource for Australian scientific and industrial research.

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DP0665656 Prof M Fu; Dr P Schreier

Approved Project Title **The Interplay of Feedback Control and Digital Communications**

2006 : \$118,000
2007 : \$108,000
2008 : \$110,000

Primary RFCD 2903 MANUFACTURING ENGINEERING

Administering Institution The University of Newcastle

Project Summary

This project deals with two research topics in digital communications and control. The first is concerned with feedback communications for control systems, aiming to develop new design methods for network-based automation and control. The second studies new decoding and detection algorithms for digital communications. Applications of the proposed research work include network-based industrial control, wireless communication devices, and high density digital storage media. The cross-fertilisation of control systems and digital communications will help strengthen Australia's research expertise in the National Research Priority area "Information and Communications Technology" (ICT).

DP0664921 Dr L Gan

Approved Project Title **New Signal Transforms for Multimedia Applications**

2006 : \$62,000
2007 : \$25,000
2008 : \$25,000

Primary RFCD 2802 ARTIFICIAL INTELLIGENCE AND SIGNAL AND IMAGE PROCESSING

Administering Institution The University of Newcastle

Project Summary

This project targets at important yet challenging problems for reliable transmission and efficient processing of digital multimedia. The solutions to these problems will not only contribute to our fundamental understanding of digital visual information, but also lead to new commercial opportunities. Hence, the project is clearly within the ARC priority research area 3: Frontier Technologies Frontier Technologies for Building and Transforming Australian Industries. Also, as multimedia market is one of the highest growth segments within the information technology industry, the project is directly in the information and communication technologies (ICT), whose national importance was recognized by the Federal Government.

DP0663082 Prof GC Goodwin

Approved Project Title **Parsimonious Quantization in Signal Processing and Control**

2006 : \$178,945
2007 : \$115,000
2008 : \$112,000
2009 : \$131,000
2010 : \$133,000

Primary RFCD 2301 MATHEMATICS

Administering Institution The University of Newcastle

Project Summary

In today's society there is an abundance of data. Indeed, it could be argued that we suffer from data 'overload'. Thus to turn 'data' into actions, the need for parsimony in signal processing and control arises. For that purpose, the data must be sampled (in time) and quantized (in space). Within this context, the current project is aimed at understanding aspects of sampled parsimonious quantization. The results have widespread practical uses including digital cameras, video compression, audio quantization, control over communication networks, switching of electronic devices and many others.

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DP0664149 Prof GJ Jameson; A/Prof AV Nguyen; Dr S Ata

Approved Project Title **Extending the range of the flotation process for particle separation**

2006 : \$250,000
2007 : \$180,000
2008 : \$200,000
2009 : \$170,000
2010 : \$150,000

Primary RFCD 2907 RESOURCES ENGINEERING

Administering Institution The University of Newcastle

Project Summary

The minerals industry is a significant contributor to Australia's prosperity. Flotation is an important process for upgrading low-grade ores to high-grade concentrates, and for recovering fine coal from tailings. This project is aimed at solving a long-term problem in current flotation practice, the difficulty in recovering ultrafine and coarse particles, currently lost from production. We will pursue two new discoveries recently made by us, relating to the recovery of ultrafines and coarse particles. Benefits to Australia are of the order of \$500 million a year in increased exports, education of high-quality graduates, export income from license fees and equipment.

DP0665742 Dr SJ Johnson

Approved Project Title **Construction methods and analysis tools for repeat-accumulate error correction codes**

2006 : \$50,128
2007 : \$32,000
2008 : \$30,000

Primary RFCD 2805 DATA FORMAT

Administering Institution The University of Newcastle

Project Summary

Error correction codes play an integral role in digital communications systems, enabling technologies such as compact-disk players, hard-disk drives, high-speed modems, digital audio broadcasting and deep-space communications. This project develops the techniques which underlie the success of next-generation error correction technologies and thus addresses an important and fundamental problem in the area of information and communications technology (ICT). The nature of the project presents significant potential for project outcomes to be beneficial to the Australian telecommunications industry in a wide range of application areas including wireless networks, mobile communications, and data storage.

DP0665059 Dr M Kibby

Approved Project Title **Exploring Internet Induced Changes in Youth Music Consumption**

2006 : \$53,000
2007 : \$20,000
2008 : \$20,000

Primary RFCD 4203 CULTURAL STUDIES

Administering Institution The University of Newcastle

Project Summary

Music consumption is the basis of both a key Australian industry with wide reaching economic impact, and a social practice closely tied to identity formation, relationship development and mood management. This project has significant community and national benefit, in that it will further our understanding of contemporary popular music consumption. In documenting the range of online music products, young consumers' attitudes towards them, and their personal music acquisition habits, the project will lead to an understanding of how having access to almost unlimited, personalised music-file collections will affect the role music plays in their lives and the follow-on impact in social, cultural and economic terms.

Summary of Discovery Projects Applications for Funding to Commence in 2006

DP0666166 A/Prof EH Kisi; Dr JS Forrester; Dr CJ Howard

Approved Project Title **Structural Origins of the Giant Piezoelectric Effect in Relaxor Ferroelectrics**

2006 : \$80,000

2007 : \$75,000

2008 : \$75,000

Primary RFCD 2914 MATERIALS ENGINEERING

Administering Institution The University of Newcastle

Project Summary

This project addresses fundamental questions about the origins of the Giant Piezoelectric Effect. The solution of these questions will be will raise the profile of Australian science in this area as well as allowing new directions to be explored both in modifying existing materials and seeking new ones. It will expand the pool of personnel with experience in the synthesis and diffraction based study of these materials which are slated for inclusion in large numbers of 'Smart' technologies. The training of personnel in advanced diffraction methods is important in the lead up to the new Australian research reactor OPAL in 2006 and the new Australian synchrotron in 2007.

DP0663410 Prof GA Lawrance; A/Prof M Maeder

Approved Project Title **Assembly and Interactions of Helical Supramolecular Structures**

2006 : \$80,000

2007 : \$50,000

2008 : \$50,000

Primary RFCD 2502 INORGANIC CHEMISTRY

Administering Institution The University of Newcastle

Project Summary

The project in advanced materials is significant in probing an exciting topology in nanostructural assemblies - helicates - the understanding of the interactions of which will assist the development of optically pure molecules that are the key to high-value drugs, thus contributing to enhanced development in the specialty chemicals and pharmaceuticals industry. The research may result in economic benefits for Australia, since it will develop synthetic materials with the potential to perform tasks in high optical purity essential drug synthesis. Further, it will enhance the knowledge and skills base within the country through training of highly applicable scientists for a growing national priority area.

DP0664370 Dr PJ Lewis; Dr R Griffith; Dr RJ Lewis

Approved Project Title **Structural analysis and functional inactivation of bacterial transcription complexes**

2006 : \$103,000

2007 : \$85,000

2008 : \$85,000

Primary RFCD 2703 MICROBIOLOGY

Administering Institution The University of Newcastle

Project Summary

RNA polymerase is an essential enzyme in all living cells. Its role is to convert the genetic information stored in genes into a message that can be converted into protein. As such, the bacterial RNA polymerase represents an ideal target for the development of new antibiotics which will be important in maintaining the health of the Australian community and also in protecting the community from the very real threat of bioterrorism organisms such as anthrax. This project is designed to identify molecules for development as new antibiotics that are effective against RNA polymerase.

Summary of Discovery Projects Applications for Funding to Commence in 2006

DP0664992 Mr C Ling

Approved Project Title **Fast Decoding for Multi-Input Multi-Output Wireless Communications**

2006 : \$83,040

2007 : \$77,000

2008 : \$77,000

Primary RFCD 2917 COMMUNICATIONS TECHNOLOGIES

APD Mr C Ling

Administering Institution The University of Newcastle

Project Summary

This project focuses on the core technology on the physical layer of broadband wireless telecommunications. The outcomes of the research have the potential to influence the design and implementation of new generation wireless systems, thereby stimulating the growth of the Australian telecommunications industry. The research of this project is of fundamental importance to telecommunications engineering. It contributes to the maintenance of Australia's international research profile. This project falls within the Research Priority 3: Frontier Technologies for Building and Transforming Australian Industries. It addresses the goals of Breakthrough Science and Frontier Technologies.

DP0666551 Dr AV Lyamin; Dr K Krabbenhoft

Approved Project Title **Optimization Based Finite Element Procedures for Geotechnical Applications**

2006 : \$90,000

2007 : \$90,000

2008 : \$90,000

Primary RFCD 2908 CIVIL ENGINEERING

Administering Institution The University of Newcastle

Project Summary

Although this project is predominantly a fundamental study it is expected to lead to a class of new methods for accurate and efficient modelling of complex geotechnical applications. Ultimately, this will result in cheaper and safer designs of both standard and non-standard geotechnical structures. The project builds on and extends the tradition which has been established in Australia over the past 15-20 years of applying mathematical programming methods to geomechanical problems. This work has received world wide recognition and the numerical methods developed in Newcastle are currently being commercialized for the benefit of practising engineers and geotechnical researchers.

DP0663454 Dr GR MacFarlane

Approved Project Title **Biomarkers of Heavy Metal Stress in Mangrove Ecosystems**

2006 : \$70,000

2007 : \$70,000

2008 : \$70,000

Primary RFCD 3008 ENVIRONMENTAL SCIENCES

Administering Institution The University of Newcastle

Project Summary

Australia has the third largest area of mangroves internationally and these systems are highly productive as primary producers, habitat and nursery area for many juvenile commercial fish species. The consequences of local destruction of mangroves through human impacts are lower fish productivity and loss of water quality. The validation of predictive early warning biomarkers of heavy metal stress in mangroves would provide a powerful management tool that would enable evidence of pollutant exposure and accurate 'early-warning' indication of biological/environmental effects, allowing effective remedial action and protection of estuarine waters and resources both nationally and internationally.

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DP0666130 Dr BP McGrath

Approved Project Title **Improved Capacitor Voltage Balance for Multicell Power Electronic Converters Controlled by Spectrally Optimal Modulation**

2006 : \$45,922

2007 : \$25,000

2008 : \$25,000

Primary RFCD 2909 ELECTRICAL AND ELECTRONIC ENGINEERING

Administering Institution The University of Newcastle

Project Summary

There is a growing demand for high power and medium voltage energy conversion systems in a wide range of applications, including Rail, Renewable Energy, Defence and Electricity Distribution. Multicell-type multilevel converters are a very attractive means of satisfying this demand, but only if the cell voltages can be precisely regulated so as to ensure protection of the converter while simultaneously ensuring the synthesis of switched waveforms with the required spectral quality. This project offers the potential to eliminate this barrier to the use of Multicell converter technology. In addition this project emphasises the development and training of people skilled in the design and development of this technology.

DP0666255 A/Prof SO Moheimani

Approved Project Title **Advanced Control of Dual-Stage Hard Disk Drives**

2006 : \$148,000

2007 : \$123,000

2008 : \$125,000

Primary RFCD 2301 MATHEMATICS

Administering Institution The University of Newcastle

Project Summary

The project is of significant scientific merit, resulting in solutions to open problems in control of dual-stage hard disk drive systems. This will contribute to the maintenance of Australia's international research profile, help maintain its internal research vitality and also enhance the advanced engineering base of the country. An important benefit of this research is the direct application of developed ideas to the next generation data storage systems. The completion of this project will directly benefit Australia's developing high-tech industries.

DP0663643 Dr SK Morley

Approved Project Title **Polar Cap Region Boundary Dynamics**

2006 : \$85,000

2007 : \$77,000

2008 : \$77,000

Primary RFCD 2606 ATMOSPHERIC SCIENCES

APD Dr SK Morley

Administering Institution The University of Newcastle

Project Summary

Geomagnetic storms have the potential to severely impair critical technology infrastructure. Consequences of strong geomagnetic activity can include power failures, pipeline corrosion, satellite failures, inaccurate GPS positioning and radio navigation. Knowledge of how, where and under which conditions this activity occurs is therefore crucial. The primary aim of this project is to extend our knowledge of the mechanisms by which this activity occurs. This work will consolidate Australia's international space profile and provide excellent training in this field, helping Australia's future technology development.

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DP0663688 A/Prof AV Nguyen; Prof GM Evans

Approved Project Title **Effect of Saline Water on Flotation Processes**

2006 : \$150,000
2007 : \$175,000
2008 : \$175,000
2009 : \$155,000
2010 : \$155,000

Primary RFCD 2907 RESOURCES ENGINEERING

Administering Institution The University of Newcastle

Project Summary

The Australian mineral and coal industry is valued at \$40 billion in export income per year. This significant component of the Australian economy will benefit from this research into the increased use of highly saline water to improve coal and mineral flotation recovery. The project will keep Australia at the leading edge of flotation research, research training and development for the coal and mineral industry. With direct relevance to the National Research Priorities: Water - a Critical Resource, this project will make contributions to the development of a more environmentally sustainable coal and mineral processing industry.

DP0666955 A/Prof BM Ninness

Approved Project Title **New Approaches for the Estimation of Complex Dynamic System Models**

2006 : \$118,000
2007 : \$108,000
2008 : \$110,000

Primary RFCD 2903 MANUFACTURING ENGINEERING

Administering Institution The University of Newcastle

Project Summary

This project lies within an ARC defined Research Priority Area. Namely, "Frontier Technologies". It is directed towards taking available data records from physical and other processes, ranging from petrochemical plant outputs to share market values, and using them to determine equations that allow for the prediction, diagnosis, and control of the underlying determining systems. As such, it lies within the ARC identified area of "Smart Information Use", but has further potential to foster new approaches and new technologies, by way of the improved system modelling, prediction and diagnosis capabilities it will provide.

DP0665131 Dr DA Pask; Dr AD Sims

Approved Project Title **Pictures for Operator Algebras: higher rank graphs**

2006 : \$101,000
2007 : \$88,000
2008 : \$90,000

Primary RFCD 2301 MATHEMATICS

Administering Institution The University of Newcastle

Project Summary

The runaway success of graph C*-algebras pioneered at the University of Newcastle places Australia at the forefront of an exciting new research field. Higher-dimensional graphs and their algebras are a promising new direction, and this project will keep Australian researchers at its cutting edge.

This project will involve and train talented young researchers who will contribute to the Mathematical outcomes of the current project. Their involvement will train them in the techniques of modern Mathematics and furnish them with important international research connections. In doing so we shall be laying a strong foundation for the future of Australian Mathematical research.

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DP0664626 Prof JW Patrick; Dr DW McCurdy; A/Prof CE Offler

Approved Project Title Induction of Plant Transfer Cells - Discovering Regulatory Networks

2006 : \$130,000

2007 : \$96,000

2008 : \$96,000

Primary RFCD 2704 BOTANY

Administering Institution The University of Newcastle

Project Summary

This project seeks molecular understanding of regulatory mechanisms responsible for inducing formation of specialized plant cells that are of central importance in controlling nutrient transport. These so-called "transfer cells" play pivotal roles in determining crop nutrition and hence yield under normal and stressful environments such as soil nutrient deficiencies and salinity. Discovering regulatory mechanisms that control formation of these specialized cells will maintain Australia's international reputation in this field of research. In addition, the information platform generated may provide technological opportunities to optimise nutrient flows in healthy plants, combat certain environmental stresses and control pathogen attack.

DP0664365 Dr P Schreier

Approved Project Title Space-time and time-frequency applications of improper complex processes

2006 : \$99,515

2007 : \$72,000

2008 : \$79,000

Primary RFCD 2917 COMMUNICATIONS TECHNOLOGIES

Administering Institution The University of Newcastle

Project Summary

This project addresses an issue of fundamental importance to many areas in science and engineering. It is thus expected that the results will be disseminated in high-quality journals and receive widespread attention and recognition. This will advance Australia's research profile in the world.

The project can also be expected to have an immediate impact on the design of next generation communications technologies, thus aiding Australian industries in the development of frontier technologies.

Australia will also benefit economically and socially by the specialised engineers and researchers in signal processing and communications that will be trained in the course of this project.

DP0666828 Dr JS Welsh

Approved Project Title New System Identification Techniques Utilising Misspecified Models

2006 : \$90,388

2007 : \$25,000

2008 : \$25,000

Primary RFCD 2909 ELECTRICAL AND ELECTRONIC ENGINEERING

Administering Institution The University of Newcastle

Project Summary

National benefits of the proposed research project will result from improvements in control due to a better, more complete understanding of the models obtained by the newly proposed system identification technique. The resulting effect on industrial practice will be an increase in efficiency, by reduced waste, lower pollution levels and increased throughput. Also, the techniques developed will be directly applicable to current research in the areas of complex systems, such as smart structures and biological studies of the dynamic effects of drugs and hormones on genes.

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DP0667093 Prof GR Willgoose; A/Prof PJ Binning; Dr ST Lancaster; Em/Prof MJ Kirkby; Prof PM Bishop

Approved Project Title **TERRESIM: A simulation system for understanding and managing the interactions between runoff, vegetation, soils and climate in a changing environment**

2006 : \$250,000

2007 : \$200,000

2008 : \$200,000

2009 : \$200,000

2010 : \$170,000

Primary RFCD 2601 GEOLOGY

APF Prof GR Willgoose

Administering Institution The University of Newcastle

Project Summary

The landforms around us evolve in response to the processes of hydrology, erosion, climate and vegetation that develops on them. Likewise, the past behaviour of these processes (thus historical climatic fluctuations) is written in the deposited sediment. To study these interactions will be develop a state-of-the-art landform simulator (TerreSim). We will use it to explore the evolution, development and sustainability of soils, vegetation, and hydrology (e.g. water supply) so as to better understand their response to climatic changes. We will also study rates of cliff retreat and debris flow in steep landscapes to better understand cliff stability.

DP0665550 Dr NE Wright; Dr TV Davis; Dr B Collins-Gearing

Approved Project Title **Working Together: Indigenous and Non-indigenous Collaboration in Australian Film and Literature**

2006 : \$112,000

2007 : \$20,000

2008 : \$67,000

Primary RFCD 4203 CULTURAL STUDIES

Administering Institution The University of Newcastle

Project Summary

As the first, comprehensive study of Indigenous and non-indigenous collaboration in film and literature this project will make an important contribution to Australian cultural history. It will provide filmmakers, educators and publishers with expanded theoretical findings about the nature of collaboration. In the most general sense, this critical analysis of one of the ways in which Indigenous and non-indigenous Australians have and continue to 'work together' will contribute to the national project of Reconciliation.