



**Professor Hugh Durrant-Whyte** – recognised internationally as one of the most innovative researchers in field robotics

**Project:** Information fusion in autonomous systems

**Host Institution:** Department of Aerospace, Mechanical and Mechatronic Engineering, The University of Sydney

**Qualifications of Fellow:**

- Ph.D (1986) Systems Engineering, University of Pennsylvania, USA
- MSE (1985) Systems Engineering, University of Pennsylvania, USA
- B.Sc (1983) Nuclear Engineering, University of London, UK

**Recent positions held:**

- Director, Key Centre for Field Robotics, The University of Sydney, Department of Aerospace Mechanical and Mechatronic Engineering – commenced 1999 (current position)
- Professor of Mechatronic Engineering, The University of Sydney, Department of Aerospace Mechanical and Mechatronic Engineering – commenced 1995 (current position)
- Lecturer/Senior Lecturer, Oxford University, Department of Engineering Science, 1987 to 1995

**Project description:**

The aim of this fellowship is to explore and develop a family of powerful new Bayesian (probability-based) representations of sensory information and to demonstrate their application in perception and navigation of advanced robotic systems. These representations have the potential to revolutionize the field of intelligent autonomous systems and realize a whole new level of capabilities and applications for advanced robotics in complex and unstructured environments such as sub-sea exploration, mining, fire fighting and defence.

**International collaboration:** France and United States

**Major research fields:** Autonomous systems; probabilistic models; and sensor data fusion, real-world applications of robots

**National Benefit**

Australia has developed a leading international position in robotics research, especially in field applications such as mining, water-front automation and agriculture. The proposed research will extend the capabilities of systems currently used in semi-structured environments, such as cargo terminals or underground mines into applications in very unstructured environments, such as sub-sea exploration, fire fighting and defence. Industry interest in field robotics is very strong, both in Australia and overseas.



**Dr Ronald Ekers** – a highly esteemed astronomer who has led the Australia Telescope National Facility to being one of the world's leading observatories

**Project:** A clearer view of the evolving universe

**Host Institution:** Australia Telescope National Facility, CSIRO

**Qualifications of Fellow:**

- Fellow of the Australian Academy of Science (1993) (Astronomy)
- PhD (1967) Astronomy, The Australian National University
- BSc (Hons) (1963) Physics, The University of Adelaide

**Recent positions held:**

- President Elect, International Astronomical Union (current)
- Chair, International SKA Steering Committee (current)
- Foundation Director, Australia Telescope National Facility, CSIRO commenced 1988 (current position)
- Miller Professor, University of California, USA (Astronomy) 2001 to 2002 (on leave from CSIRO)
- Director for Very Large Array Operations National Radio Astronomy Observatory, USA 1980 to 1988

**Project description:**

The two complementary research objectives of this proposal are (i) a basic research program to understand star formation in galaxies through a study of the correlation between far infrared and radio continuum emission and (ii) a strategic research program to develop interference mitigation techniques to enable the next generation of radio telescopes which will study star formation in the early Universe. This programme of research innovation in radio astronomy will also promote the broad aims of furthering opportunities for Australian participation in international science and of gaining insight into ways in which Australia can exploit its niche advantages in the global economy.

**International collaboration:** Italy, The Netherlands, Taiwan, and the United States

**Major research fields:** Cosmic rays; galaxies; interference mitigation; radio astronomy; radio telescopes

**National Benefit**

The aim for the basic research component of the project is to not only add new knowledge of the cosmos but to develop new tools to exploit the next generation of optical/infrared and radio telescopes. The strategic research component will develop and demonstrate new and better interference mitigation techniques. These techniques will have application in other areas and appropriate companies will be invited to help develop the applications.



**Professor Terence Hughes** – regarded as one of the world’s leading coral reef ecologists

**Project:** Science for sustainable management of coral reef biodiversity: a multi-disciplinary approach to global-scale processes and patterns

**Host Institution:** School of Marine Biology and Aquaculture, James Cook University

**Qualifications of Fellow:**

- Fellow of the Australian Academy of Science (2001) (Biology)
- PhD (1984) Ecology & Evolution, The John Hopkins University, USA
- MA (1980) Ecology & Evolution, The John Hopkins University, USA
- BA (Mod. 1st class) (1978) Zoology Trinity College, Dublin Ireland

**Recent positions held:**

- Director, James Cook University Centre for Coral Reef Biodiversity, 2001 (current position)
- Professor (personal chair), James Cook University (Marine Biology) 2000 (current position)
- Associate Professor, James Cook University (Marine Biology) 1997 to 2000
- Visiting Professor, Trinity College, Dublin (Zoology) 1997 (10 month appointment)
- Senior Lecturer, James Cook University (Marine Biology) 1994 to 1997

**Project description:**

Professor Hughes will lead an international team to undertake a multi-disciplinary program of research that will quantify the processes underlying biodiversity patterns on coral reefs, focussing on ecological and evolutionary mechanisms of these complex systems at multiple scales in space and time. A novel modelling component will provide the mechanistic link between multi-scale processes and regional-scale patterns. This research will cement Australia's leading contribution to coral reef science, and will guide the management, sustainable use and conservation of coral reef biodiversity across international boundaries.

**International collaboration:** France, Japan, Panama, Taiwan, and the United States

**Major research fields:** Biodiversity; biogeography; conservation biology; coral reefs; and macroecology

**National Benefit**

The project will inform governments, the tourism and fishing industries, overseas development and environmental agencies on how to manage and protect coral reef diversity. The proposed regional-scale research program will place Australia’s reefs, their ecology and their condition into global perspective. The knowledge gained will underpin the management of Australian reefs and will be vital to the sustainable use of biodiversity goods and services (tourism, fishing and recreation). The goals of the project are consistent with Australia’s Ocean Policy and the Marine Sciences and Technology Plan.



**Professor Graeme Hugo** – has an international reputation in the field of population changes and mobility and their effects

**Project:** The new paradigm of international migration to and from Australia: dimensions, causes and implications

**Host Institution:** The University of Adelaide

**Qualifications of Fellow:**

- Fellow of the Academy of the Social Sciences in Australia (1987)
- PhD (1976) Demography, The Australian National University
- MA (1972) Geography, The Flinders University of South Australia
- BA (Hons) (1968) Geography, The University of Adelaide

**Recent positions held:**

- Director, The University of Adelaide National Key Centre for Social Applications of Geographical Information Systems, 1995 (current position)
- Professor of Geography, The University of Adelaide, Geographical and Environmental Studies, 1991 (current position)
- Lecturer in Geography, Senior Lecturer in Geography, Reader, The Flinders University of South Australia, Geography 1975 to 1990

**Project description:**

Population movement to and from Australia is undergoing a major transformation but much thinking about immigration in Australia remains based on paradigms of the past. Yet debates such as those on immigration's contribution to national population size and growth, the significance of skilled migration, the response to asylum seekers, undocumented movement and the role of temporary versus settlement migration have increased. This study identifies emerging trends of migration, examines global and domestic drivers of the movement in the context of developing migration theory, explores the economic, social and demographic consequences and draws out the implications for immigration and population policy.

**Major research fields:** Asylum seekers; economic and social change; emigration; immigration; population policy

**National Benefit**

Few contemporary nations have been as influenced by immigration than Australia. Post-war international migration has transformed the nation's demography and massively influenced the economic, social and political fabric of the nation and reshaped national identity. The project aims to make a significant contribution to the immigration policy debate, the results of which will be of crucial significance to the nation's future.



**Professor Yuri Kivshar** – an inspirational scholar and world leader in the study of the behaviour of light, particularly in the modern fields of nonlinear optics and solitons

**Project:** Nonlinear photonics and all-optical technologies

**Host Institution:** Research School of Physical Sciences and Engineering, The Australian National University

**Qualifications of Fellow:**

- Fellow of the Australian Academy of Science (2002) (optics)
- PhD (1984) Theoretical Physics; Condensed Matter Physics, The Institute for Low Temperature Physics and Engineering, National Academy of the Ukraine
- MSc (1981) Theoretical and Experimental Physics, Kharkov National University USSR

**Recent positions held:**

- Head & Professor, Nonlinear Physics Group, The Australian National University Research School of Physical Sciences & Engineering 2001 (current position)
- Associate Editor, Physical Review E, American Physical Society, USA Editorial Offices, New York 1999 (current position)
- Professor, The Australian National University Research School of Physical Sciences & Engineering, 1999 (current position)
- Fellow and Senior Fellow, The Australian National University Research School of Physical Sciences & Engineering, 1993 to 1999

**Project description:**

Information is playing an increasing role in the modern society. The future progress in the information data processing is associated with a new generation of compact nanoscale optical devices operating entirely with light. The research program aims to develop innovative concepts of all-optical communication and information technologies and to carry out both theoretical and experimental studies on the photonic-crystal physics and engineering, optical solitons, and nanoscale nonlinear switching devices. The research will help to promote the new field of photonic crystals, enhance its development in Australia and provide linkages between leading edge R&D and industry in an important emerging technology.

**International collaboration:** Denmark, Germany, Italy, Japan, the Russian Federation, and the United States

**Major research fields:** All-optical information technologies; complex systems and networks; nonlinear photonics and technology; optical switching devices; photonic crystals and waveguides

**National Benefit**

The outstanding contribution of Australian scientists to optical physics is already internationally recognised. The project has the aims to develop photonic crystal physics and technology to the stage where it can be commercially accepted in Australia. This will be done through established, and developing, links with industry (including Redfern Photonics, The Bandwidth Foundry and international partners) and the Australian Photonics Cooperative Research Centre.



**Professor Trevor Lamb** – a world leader in the field of sensory transduction - his research is noted for its innovative experimental approaches and quantitative rigour

**Project:** The first stage of vision: transduction and adaptation in retinal photoreceptors

**Host Institution:** The John Curtin School of Medical Research, The Australian National University

**Qualifications of Fellow:**

- Fellow of the Royal Society
- Sc D (1988) Physiology, University of Cambridge, UK
- Ph.D (1975) Physiology, University of Cambridge, UK
- M App Sci. (1972) Electrical Engineering & Physiology, The University of Melbourne
- BE (Elec) (1970) Electrical Engineering, The University of Melbourne

**Recent positions held:**

- Professor of Neuroscience, University of Cambridge, Physiology, 1994 (tenured)
- Reader in Neuroscience, University of Cambridge, Physiology 1991 (tenured)
- Lecturer in Physiology, University of Cambridge, Physiology 1984 to 1991

**Project description:**

The project aims to provide a detailed understanding of the molecular steps involved in the first stage of vision - the conversion of light into a neural signal in the photoreceptors of the retina. The significance of this is that it will explain the initial events that enable us to see, and will help explain the deficits that occur when the process fails. The outcome will be a comprehensive understanding of how our photoreceptors respond with extreme sensitivity, yet great rapidity, and over an enormous range of light intensities, thus endowing us with our remarkable sense of vision.

**International collaboration:** United States

**Major research fields:** Dark adaptation; G-protein cascades; light adaptation; photoreceptors; phototransduction

**National Benefit**

The research is likely to help in the treatment of retinal disease. A major impetus to this research is the close similarity between phototransduction and the signalling cascades employed in hormonal and synaptic systems, and also in olfaction. This could lead to a cross fertilisation of ideas into other research areas including taste and smell. A potential spin-off for this research is the development of electronic products for the coding of images obtained from optoelectronic sensors.



**Dr Catherine Stampfl** – an outstanding scientist with an international reputation for theoretical, multi-disciplinary investigations of the behavior of surfaces

**Project:** Application of first-principles theory in condensed matter physics, surface physics, chemistry, and engineering: coatings, catalysis, and devices

**Host Institution:** The School of Physics, The University of Sydney

**Qualifications of Fellow:**

- German Habilitation (2001 and current) Theoretical Condensed Matter Physics, Technical University, Berlin, Germany
- PhD (1991) Physics, La Trobe University
- BSC (Honors H1) (1985) Physical Science, La Trobe University

**Recent positions held:**

- Senior Research Associate, Northwestern University, Illinois, Physics and Astronomy, 1999 (current position)
- Research Scientist, Fritz-Haber-Institut der Max Planck Gesellschaft, Theory Department, 2001 to early 2002
- Staff Scientist, Fritz-Haber-Institut der Max Planck Gesellschaft, Theory Department, 1998 to early 1999
- Visiting Scientist, Xerox Palo Alto Research Centre, Electronic Materials, 1996 to 1997
- Staff Scientist, Fritz-Haber-Institut der Max Planck Gesellschaft, Theory Department, 1995 to 1996

**Project description:**

The project addresses areas of high technological interest, namely the development of nitride-based materials for hard-coatings, spintronic (control and use of electron spin) and optoelectronic (in the blue/UV energy range) devices - as well as the area of heterogeneous oxidation catalysis. Using state-of-the-art methods it will lead to the development of new materials and devices of relevance to industry.

**International collaboration:** Germany and the United States

**Major research fields:** Density functional theory calculations; magnetic phenomena; nanoscale systems: multilayers; nitrides; point defects

**National Benefit**

Surfaces are at the cutting edge of materials sciences. The processes that occur at surfaces play a critical role in the manufacture and performance of advanced materials (electronic, magnetic and optical devices, sensors, catalysts and hard coatings). The research methods developed and knowledge gained will have applications in a range of physical, chemical, biological, medical engineering and material science problems. There is scope to initiate collaborations with mining, petroleum, automotive, biotechnology and chemical industries.



**Professor David Trimm AM** – an outstanding researcher in the use of catalysis for fuel conversion - contributing to extracting maximum value from Australia's existing and future gas reserves

**Project:** The conversion of remote location natural gas to fuels and chemicals

**Host Institution:** The Division of Petroleum Resources, CSIRO

**Qualifications of Fellow:**

- Fellow of the Australian Academy of Technological Sciences & Engineering (1992)
- DIC (1963) Chemical Engineering, Imperial College, UK
- PhD (1961) Chemistry, University of Exeter, UK
- BSc (1958) Chemistry, University of Exeter, UK

**Recent positions held:**

- Science Leader, Gas Processing, CSIRO Petroleum, 2001 (current position)
- Scientia Professor, University of New South Wales 2001 (current position)
- Professor, University of New South Wales, Chemical Engineering & Industrial Chemistry, 1979 to 2001

**Project description:**

The objectives of the research program will be to develop novel science, engineering and technology that will allow cost efficient conversion of remote gas reserves to liquid fuels and/or chemicals with minimal greenhouse gas emissions. The significance of the proposal rests in the fact that Australia has large remote location gas fields that cannot be economically exploited with existing technologies. The development of new processes for gas to liquids conversion and new technology for existing processes is the essential aim of the proposed research.

**International collaboration:** India, Republic of Korea, and South Africa

**Major research fields:** Catalytic processing; conversion of stranded gas; gas to chemicals; gas to liquids (GTL); science and engineering GTL

**National Benefit**

The project has the potential to generate large export and import replacement earnings for Australia. If successful Australia will be able to export new gas-to-liquid conversion technology and unlock large reserves of 'stranded' gas for use.



**Professor Rodney Tucker** – a world leader in optical networking research - Australia's major figure in the field

**Project:** Towards an all-optical internet

**Host Institution:** Department of Electrical and Electronic Engineering, The University of Melbourne

**Qualifications of Fellow:**

- Fellow of the Australian Academy of Sciences (1998) (broadband networks)
- Fellow of the Australian Academy of Technological Sciences & Engineering (1993)
- PhD (1975) Electrical Engineering, The University of Melbourne
- BE (1970) Electrical Engineering, The University of Melbourne

**Recent positions held:**

- Professor, The University of Melbourne, Electrical and Electronic Engineering 1990 (current position)
- Department Scientist, Agilent Technologies Research Laboratories 1999 to 2001

**Project description:**

The Federation Fellowship will build on the applicant's established and highly successful research program into key technologies and architectures for the all-optical internet. Unlike the current internet, which relies heavily on electronics for switching and routing, the all-optical internet will use optics for these functions. The all-optical internet will provide a vast increase in capacity, and will change the the basic infrastructure of telecommunications. The research program will produce important innovations and will advance the Australian knowledge base in optical communications, photonics, and information networks. The research will assist Australia to capitalise on this new technology and to become a significant player in the next phase of the information revolution.

**International collaboration:** Japan, Republic of Korea, the United Kingdom, and the United States

**Major research fields:** Optical and photonic systems; optical communication; optical networks; telecommunications;

**National Benefit**

The optical internet is poised to replace the existing internet. The increased bandwidth and capacity of the optical internet will provide exciting opportunities in many areas including education, entertainment, medicine, business and industry. The project will play an important role in assisting in the development of the Australian telecommunications industry and building an export market in high-technology value-added component, systems, and software. The proposed research outputs, in the arena of applied research, are well matched to the needs of Australian companies.



**Dr Simon Turner** – a world leading developer of new methods to determine geological ages, whose highly cited work is published in *Nature*, *Science* and *Geology*.

**Project:** The time scales of geochemical cycles and earth processes

**Host Institution:** Department of Earth and Planetary Sciences, Macquarie University

**Qualifications of Fellow:**

- PhD (1991) Earth Sciences, The University of Adelaide
- BSC (Hons, 1st Class) (1986) Earth Sciences, The University of Adelaide

**Recent positions held:**

- Royal Society University Research Fellow & Lecturer, University of Bristol, Earth Sciences 2000 (current position)
- Royal Society University Research Fellow, Open University Earth Sciences 1995 to 2000 (fixed term)
- National Environment Research Council Post-Doctoral Research Assistant, Open University, Earth Sciences 1993 to 1995 (fixed term)
- National Environment Research Council Post-Doctoral Research Assistant, Open University Earth Sciences 1992 to 1993 (fixed term)
- ARC Post-Doctoral Research Assistant & Lecturer, The University of Adelaide, Geology and Geophysics 1990 (fixed term)

**Project description:**

Precise information on timescales and rates of change is fundamental to understanding natural processes and the development and testing of quantitative physical models in the Earth Sciences. Uranium decay-series isotope studies are revolutionising this field by providing time information in the range 100-10,000 years, similar to that of many important Earth processes. This project will establish a world-class Australian Uranium-series research group to investigate the processes of magma formation and transport, continental growth, rates of erosion and recycling. These methodologies can also constrain processes governing water flow and reservoirs, mineral resources, volcanic eruptions, carbon cycles and other environmentally important processes/systems/cycles.

**International collaboration:** New Zealand, United Kingdom, and the United States

**Major research fields:** Carbonates; geochronology; island arcs; isotope geochemistry; mantle melting

**National Benefit**

The magmatic problems to be addressed are key issues with far reaching implications, not only for our understanding of the planet but also for the design of better mineral exploration, and climate-change forecasting models.



**Professor Mark von Itzstein** – a pre-eminent Australian scientist in the area of carbohydrate science and one of the leading scientists who was involved in the development of the new anti-influenza drug Relenza (approved for treatment of influenza in Europe, the United States, Japan and Australia)

**Project:** Carbohydrates and carbohydrate-recognising proteins as drug discovery targets

**Host Institution:** Centre for Biomolecular Science and Drug Discovery, Griffith University

**Qualifications of Fellow:**

- PhD (1984) Chemistry, Griffith University, Queensland
- BSc (Hons) (1980) Biochemistry, Griffith University, Queensland

**Recent positions held:**

- Director/Professor of Medicinal Chemistry, Griffith University Centre for Biomolecular Science & Drug Discovery 2000 (current position)
- Associate Dean Research, Monash University, Victorian College of Pharmacy 1997 (fixed term)
- Professor of Medicinal Chemistry, Monash University 1996
- Professorial Fellow, Monash University Medicinal Chemistry 1995 (fixed term)
- Senior Principal Research Fellow, Monash University Medicinal Chemistry 1991 (fixed term)

**Project description:**

The significance and roles of carbohydrates in many biological processes, in particular those processes associated with disease, is now well-recognised. These new directions have captured the attention and imagination of not only academic research groups across the world, but also pharmaceutical and biotechnology companies and has restimulated their interest in the pursuit of carbohydrate-based drugs and drugs against carbohydrate-recognising proteins critical in disease processes. The current application seeks to use some of this information to facilitate the discovery of novel carbohydrate-based chemical entities as inhibitors of the spread of some cancers and diseases caused by pathogenic microorganisms.

**International collaboration:** Germany, the United Kingdom, and the United States

**Major research fields:** Carbohydrate chemistry; carbohydrate-based therapeutics; drug discovery; medicinal chemistry; and sialic acids

**National Benefit**

Relenza was the first designer glycotherapeutic drug to come to the world pharmaceutical market. The work associated with the Fellowship seeks to intensify the search for new glycotherapeutic drugs for use against important clinical diseases. The results could provide significant economic return to Australia through attracting commercial funding and other financial returns.