



ARC Research Networks on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP)

2006 Annual Report

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CHAIRMAN'S REPORT

I am delighted to present the report of our achievements for 2006.

This has been a very productive year for the Network, due very much in large part to the high energy level and talents of the Convenor, and the Executive Board and our supporting Committees. I wish to publicly thank them for making such an excellent contribution.

In particular the Network has had to move from a standing start and build further on establishing the frameworks and networks necessary to bring it to life. That so much has been achieved is testament to its value and place in the overall research community in Australia.

In the past year, growth of this capability with the assistance of the Research Network has enabled the great potential of Sensor Networks technologies to be recognised and is placing Australian researchers at the forefront of this development.

With Sensor Networks offering the ability to accurately and reliably gather vast amounts of information at low cost across a wide variety of disparate environments, both large and small, the development of this technology is opening up previously unforeseen opportunities in the areas of environment, security and health. Other opportunities are sure to be found to make a significant contribution to many of the major problems now confronting modern society more generally.

We look forward to another very productive year and I commend this Annual Report to you.

Dr D. (Nanda) Nandagopal
Chairman, Executive Board
ARC Research Network
Intelligent Sensors, Sensor Networks and Information Processing
February 2007

CONVENOR'S INTRODUCTION

Sensor networks with a large number of diverse interconnected sensors have the potential to make a huge impact on many areas of society. The area of sensing technologies and sensor networks is now considered by international funding agencies such as the European Commission, DARPA and NSF to be one of the top five emerging technologies that will shape the future of human kind.

The Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP) research network harnesses the great strengths of its highly qualified multi-disciplinary participants in a national co-operative effort which:

- Provides an urgently needed national focus and identity for Australian research in the rapidly emerging and highly significant area of sensor networks.
- Provides Australian researchers with strong linkages and exchange opportunities with the major international sensor networks research efforts in the USA and Europe.
- Links Australian industry with world class research programs.
- Significantly enhances the relevance and quality of Australian post-graduate education and training in the broad area of sensor networks.
- Builds a national collaborative framework to grow and support the essential industry/research co-operation.

ISSNIP participants are being linked with many of the very best overseas researchers in the core disciplines and to the world's best sensor networks research groups. Participants also generate new collaborative multi-disciplinary proposals for ARC Centres of Excellence, and Linkage/Discovery grants in a major national collaborative effort to solve the key underlying scientific problems facing sensor networks.

ISSNIP provides an unprecedented opportunity for Australia to become a world leader in sensor networks by supporting and assisting co-operation and collaboration amongst existing world class research activities in relevant disciplines.

It is with much sadness that I advise you of the passing of one of our prominent members Professor Alex Rubinov from the University of Ballarat (1940-2006). He has been very much an inspiration to all of us and we will apply our best endeavours to ensure his work is built upon in our future research.

I would like to welcome new partner organisations and researchers from diverse backgrounds, as this provides great opportunities to develop new programs of immense value to Australia.

I have very much enjoyed the challenge of Convening the Network and am keen to progress further in this coming year. Thus, I present this annual report, approved by the Executive Board. I thank all of those who have made this possible.

Associate Professor M. Palaniswami
Convenor
February 2007

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1 ISSNIP VISION AND STRATEGIC APPROACH

NATIONAL BENEFIT

The establishment of a world class national research and industry capability in sensor network technology is of great national importance. The growth of this capability with the assistance of the Research Network is enabling the great potential of Sensor Networks technologies to be realised and placing Australian researchers at the forefront of this development.

With Sensor Networks offering the ability to accurately and reliably gather vast amounts of information at low cost across wide variety of environments, both large and small, the development of this technology is opening up previously unforeseen opportunities in the areas of environment, security and health.

The Research Network is therefore providing the framework for the critical interdisciplinary collaborations necessary to address the technical challenges in this area. As such, ISSNIP is assisting in the more effective utilisation of technical and human resources available in Australia and internationally. In doing so, ISSNIP plays a valuable role in advancing Frontier Technologies for great national benefit, not only in terms of the application of the technology being developed but also in the potential commercial gains for Australian industry associated with its development.

Through its various programs, ISSNIP is aiding the continuing development of technical expertise within the country by providing education programs as well as access to world leading researchers and technology from around the world.

Expanding upon the activities of the Department of Education, Science and Training – International Science Linkage (DEST-ISL) grant on Distributed Sensor Networks, ISSNIP is playing a role in the deployment of environmental sensor networks through the involvement of key members in the newly awarded National Collaborative Research Infrastructure Strategy (NCRIS) funding for an Integrated Marine Observing System (IMOS). This further enhances the capabilities and resources for the Great Barrier Reef monitoring projects. Together with the new DEST-ISL project on grid computing and e-research, ISSNIP researchers continue to successfully advance national interests in the development of Frontier Technologies.

Ongoing research collaborations with DSTO on defence related applications, including geo-location, sensor fusion and unmanned aerial vehicle development serve to enhance the nation's defence capabilities with respect to the challenge of monitoring Australia's vast border regions. New collaborative partnerships are presently being explored with some of ISSNIP's international research partners for the advancement of these technologies.

Growing international involvement in the ISSNIP Research Network is also testament to the profile given to Australian researchers. This interest has been

generated through the many locally run ISSNIP events that successfully attract, high calibre international visitors, but also international events supported by ISSNIP and its participating members. The international standing of ISSNIP members is also being recognised through new appointments to Journal editorial boards and international societies, together with continued invitations for plenary/keynote talks. Australia's position at the forefront of sensor technology development is made stronger with the support of the ARC Research Network on ISSNIP.

VISION

Our vision is to create the collaborative research foundations which support a world leading Australian sensor networks and information processing industry.

We will achieve this vision by establishing strategic themes, against which we will develop strategies and initiatives to grow our capabilities.

STRATEGIC THEMES

We have identified five strategic themes, around which we develop strategies to ensure their success in attaining our vision.

1: NATIONAL COLLABORATION AND IDENTITY

To build a fertile and effective national collaborative environment for undertaking innovative multi-disciplinary research in sensor networks and to create a strong Australian sensor networks research identity.

2: INDUSTRY LINKAGE

To work with Australian sensor network researchers and relevant industry sectors to explore opportunities for the application of sensor network technology.

3: INTERNATIONAL LINKAGES

To create opportunities and an environment for linking Australian sensor network researchers with the premier sensor networks research groups around the world.

4: EDUCATION

To actively pursue the expansion of sensor networks related post-graduate student research opportunities in Australian Universities and raise the public awareness of the emerging sensor networks science and explore undergraduate and secondary school educational opportunities.

5: FUTURE FUNDING

To build co-operative multi-disciplinary research teams and industry linkages that will generate a future stream of collaborative multi-disciplinary research activities including new multi-disciplinary proposals for research funding.

STRATEGIES

We have developed five primary strategies that can be applied in an integrated manner to assist in delivering our strategic themes. They are:

- 1: CREATING AWARENESS OF THE NETWORK**
- 2: GROWING TECHNICAL KNOWLEDGE**
- 3: BUILDING THE NETWORK**
- 4: BUILDING OUR REPUTATION**
- 5: DELIVERING INDUSTRY OUTCOMES**

SUMMARISING OUR APPROACH

Our approach is summarised in Figure 1.

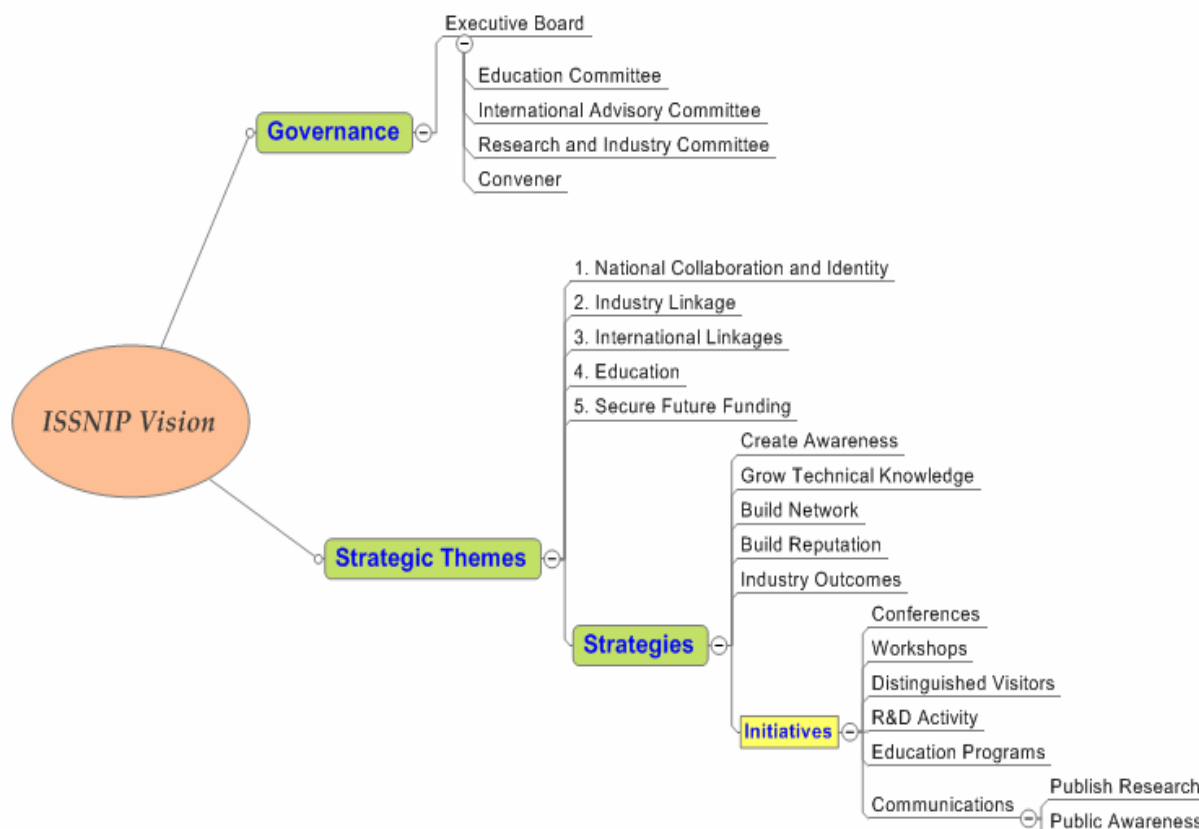


Figure 1: Achieving the ISSNIP Vision

2 GOVERNANCE OF ISSNIP

MOTIVATION

The ARC Research Network on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP) was formed in 2005. Its founding purpose is to:

- ***Address networked multi-sensor problems to develop intelligent, economically viable solutions of value to defence, homeland security, health sciences and the environment.***

We will use an interdisciplinary approach to explore this technology.

ISSNIP is assisting in the more effective utilisation of technical and human resources available in Australia and around the world. In doing so, ISSNIP plays a valuable role in advancing frontier technologies for great national benefit, not only in terms of the application of the technology being developed, but also in the potential commercial gains for Australian industry associated with its development.

Through its various programs, ISSNIP is aiding the continuing development of technical expertise within Australia by providing education programs as well as access to world leading researchers and technology from around the world.

GOVERNANCE STRUCTURE

Governance arrangements for the ARC Research Network on ISSNIP are designed to ensure that maximum value is derived from the extremely talented people and constrained resources we have available to us. The overarching arrangement is summarised in Figure 2.

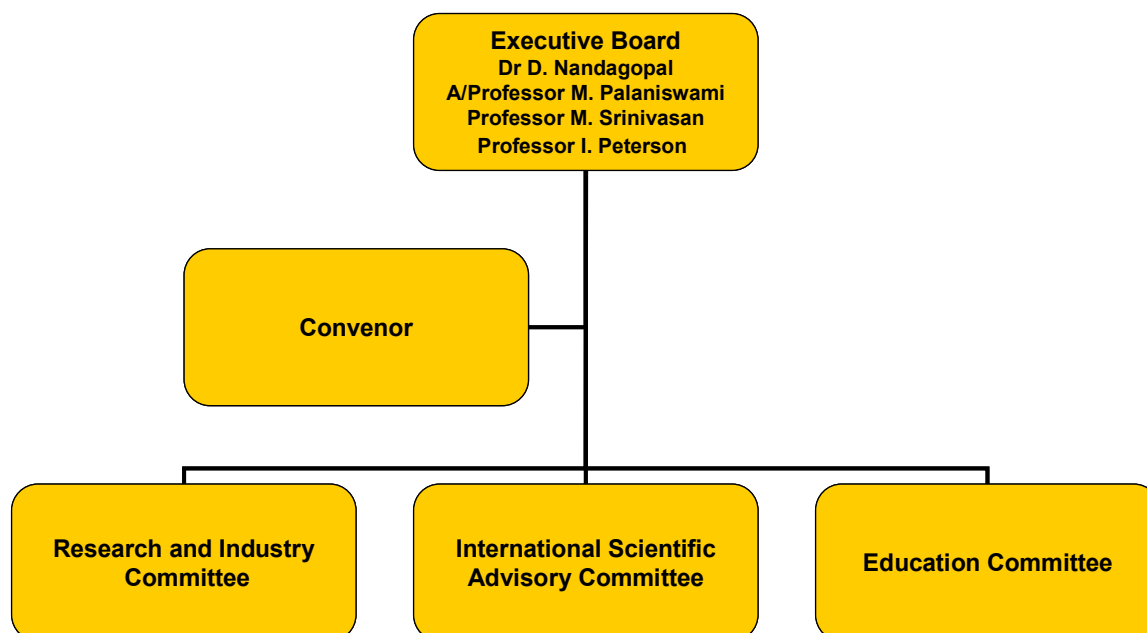


Figure 2: ISSNIP Senior Governance

EXECUTIVE BOARD

The Executive Board is chaired by Dr. D. Nandagopal, a renowned scientist with unmatched experience in this field who is presently the Deputy Chief Defence Scientist (Corporate) in the Defence Science and Technology Organisation.

The Board membership is well balanced by the presence of A/Professor M. Palaniswami (Research Network Convenor), Professor M. V. Srinivasan (ANU, Inaugural ARC Federation Fellow, 2006 Prime Minister's Prize for Science winner) and Professor I. Petersen (ADFA-UNSW, UNSW Scientia Professor, former Executive Director of Mathematics, Information and Communication for the Australian Research Council).

COMMITTEES

The Board is supported by the extremely hard working Convenor and three effective Committees of highly industrious people who have worked very diligently over this period to deliver excellent results.

More detail about the membership and work of the Board and Committees can be found at Appendix B.

3 ACHIEVEMENTS FOR 2006

OVERVIEW

ISSNIP has made a substantial contribution to sensor networking and information processing knowledge during this period and some of those achievements are described here.

We have designed and conducted initiatives to create the action necessary to deliver on our challenge. Significant progress has been made in each of the five strategic priority areas:

- The ISSNIP Research Network has established an international presence for Australia by creating an ISSNIP International Conference series. Two such conferences have been successfully conducted, each bringing together 250 local and international delegates. Several other workshops and foundation conferences were conducted focussing on the key Network project themes. Funding for a sensor network deployment has been granted to network partners (Australian Institute of Marine Science, University of Queensland, James Cook University and the University of Melbourne), that will see the development of research infrastructure and enable important collaborative work (*Strategic Priority 1*).
 - ISSNIP has successfully created new industry linkages with cash and in-kind contributions (Iomniscient, Intersystems, RTA-NSW, QPSF, AIMS, to name a few) (*Strategic Priority 2*).
 - ISSNIP has enabled a large and active international collaboration program with demonstrable outcomes from partner organisations such as Caltech, University of Twente, Cambridge, Helsinki University of Technology, University of Missouri-Rolla, University of Texas-Arlington, Kent University, City University of Hong Kong, University of Maryland, University of Southern California, amongst others. The collaborations are in the form of joint grants, visits, publications and conference/workshop organisation (*Strategic Priority 3*).
 - ISSNIP has successfully created partnerships with host Universities for enhancing sensor networks awareness among undergraduate and postgraduate students. Several postgraduate and early career researcher workshops were successfully conducted including short courses and the ISSNIP Summer School. The ISSNIP Awards program has also been established, with 20 education oriented awards underway for educational linkages (*Strategic Priority 4*).
 - ISSNIP has successfully utilised the collaborative framework of the Research Network to attract new research funding. For every dollar that the ARC has provided to ISSNIP, the ISSNIP group has been able to raise a minimum of two and half dollars, demonstrating the successful outcome for building collaborative international project work (*Strategic Priority 5*).
-

Our achievements against our five strategic themes and strategies are aggregated and shown in the following summary of activities. Our overall approach is shown in Figure 1 on page 10.

Initiative	Number
Active participants	70
Events conducted/supported	
- Conferences	6
- Workshops	7
- Education Programs (includes ISSNIP Seminar Series as single program)	7
International visits	41
Significant Publications	
- Books/Book Chapters	11
- Journal articles	14
- Conference Papers	33
Targeted activities (including education programs)	11
Media Reports	11
New Grants	5
Universities Receiving Funding	12

Table 1: Summary of Initiatives for 2006

More details of our activities can be found following the summary shown in Table 2. More details of ISSNIP support provided for researcher travel funding is provided in Appendix C. A detailed listing of publications and other media exposure is given in Appendix F.

CONFERENCES
Nikola Tesla 150th Anniversary Conference - Tesla Legacy 1st European Conference on Smart Sensing and Context MIDDLEWARE 2006 - ACM/IFIP/USENIX 7th International Middleware Conference ASOR Recent Advances in Operations Research 2006 ATNAC 2006 - The Australian Telecommunication Networks and Applications Conference ICISIP 2006 - International Conference on Intelligent Sensing and Information Processing
WORKSHOPS
Workshop on Wireless Sensor Networks in Biomedicine 5th Ballarat Workshop on Global and Non-Smooth Optimization DEST-ISL Workshop on Distributed Sensor Networks 5th Workshop on Defence Applications of Signal Processing Sensors, Signals and Scheduling Workshop
EDUCATION
Workshop on Bio-Signals and Classification ISSNIP Early Career Researcher Workshop on Sensor Networks Short-course on Introduction to Sensor Networks (prelude to Summer School) ISSNIP Summer School 2006 ISSNIP Seminar Series The Autonomic Sensor and Mobile Computing Lab
DISTINGUISHED VISITOR SEMINARS
Professor T Dallessio, University de Roma, Rome, Italy Professor H Weghorn, University of Stuttgart BA, Germany Associate Professor K T Ko – City University of Hong Kong Professor Mihaela Ulieru – University of New Brunswick, Canada Professor Stuart Milner – University of Maryland, USA Professor Mohan Kumar – University of Texas, Arlington, USA Dr Alison Burdett, Toumaz Technologies, UK Professor Sushil K Prasad, Georgia State University, Atlanta, USA

Table 2: Main ISSNIP Activities**CONFERENCES**

Conferences are an important method of sharing knowledge and enabling a wide range of researchers to contribute to new discoveries. Furthermore, these events form part of a key strategy that has been very successful in generating new collaborative relationships and new funding proposals. The following overview is provided of those arranged or co-arranged by ISSNIP.

NIKOLA TESLA 150TH ANNIVERSARY CONFERENCE - TESLA LEGACY: FROM ELECTRICAL LIGHT TO SENSOR NETWORKS

Held 31st July 2006, The University of Melbourne, Australia.

The anniversary conference paid tribute to Nikola Tesla, one of the giants of modern electrical engineering.

After a short introductory speech by Dr Darko Musicki, the conference was formally opened by the Dean of Engineering of the University of Melbourne, Professor Jannie van Deventer. With an attendance of 40 people, the conference linked some of the Tesla's foundational work with current technological developments and practices.

Invited speakers:

- Mr Paul Pokorny, Power Systems Technology National Measurement Institute, NSW
- Dr Dean Cvetkovic, School of Electrical and Computer Engineering, RMIT University
- Associate Professor Peter Farrell, Department of Electrical and Electronic Engineering, The University of Melbourne.
- Dr Milan Simic, Programs Manager, Computer Systems and Telecommunications, RMIT University

1ST EUROPEAN CONFERENCE ON SMART SENSING AND CONTEXT

Held: 25th-27th October 2006, Enschede, The Netherlands.

The 1st European conference on Smart Sensing and Context sought to explore the underlying techniques, protocols, architectures and algorithms for smart surroundings with intelligent, networked and co-operating objects. Wireless sensor networks and smart objects are two particular instances of such networked embedded sensing systems, which have the potential to realise the ubiquitous computing vision.

As the field progresses, the most important research challenge is the move beyond prototypes toward sustainable systems for the implementation of this vision.

In response to this aim, the conference chair (Havinga, ISSNIP CI) brought together designers, engineers and researchers from around the world to explore two complementary viewpoints:

- A device-centric, technology-driven view: concerning intelligent sensors, sensor networks and information processing for a new generation of networked devices and environments.
 - A service-centric, user-driven view: exploring architectures, techniques, and algorithms for context-aware and pro-active applications made possible by the diffusion of ambient communication, cooperating objects, and interaction technologies.
-

The conference accepted 29 papers (at an acceptance rate of 27%), from researchers across Europe, Asia and North America, and was attended by approximately 100 researchers. The success of the event and ISSNIP researcher involvement has prompted organisers to hold a symposium on the same area at the ISSNIP 2007 conference in Melbourne.

Conference co-chairs:

- Paul Havinga, University of Twente (ISSNIP CI)
- Maria Lijding, University of Twente
- Nirvana Meratnia, University of Twente
- Maarten Wegdam, Lucent Technology

Keynote speakers:

- Professor Kevin Warwick, University of Reading, UK
- Dr. Anind Dey, Carnegie Mellon University, USA



Figure 3: Enschede

MIDDLEWARE 2006 – ACM/IFIP/USENIX 7TH INTERNATIONAL MIDDLEWARE CONFERENCE

Held: 27th November – 1st December 2006, Grand Hyatt, Melbourne, Australia

The ACM International Middleware conference is the premier conference on middleware research and technology. The broad scope of the conference encompassed the design, implementation, deployment, and evaluation of distributed systems platforms and architectures for future computing environments.

The Middleware conference served as a forum for the discussion of important innovations and recent advances in the design and construction of middleware, the distributed-systems software that resides between the applications and the underlying operating systems, network protocol stacks, and hardware.

Both the MidSens Workshop and the Middleware 2006 were highly successful with a total of 162 participants from around the world converging to Melbourne (27 were MidSens only participants).

Following are the highlights of the event:

- High quality technical programs
- Two keynote speakers in Middleware 2006
- A panel with 5 experts in the area
- Seven Workshops including MidSens
- Doctoral Symposium
- Tutorial given by Michi Henning, Chief Scientist, ZeroC, Inc, on "Design Trade-Offs for Middleware"

Workshops and symposiums conducted at the conference included:

- MGC 2006 – 4th Int. Workshop on Middleware for Grid Computing
- ADPUC 2006 – 1st Int. Workshop on Advanced Data Processing in Ubiquitous Computing
- MODDM 2006 - Model Driven Development for Middleware
- ARM 2006 – 5th Workshop on Adaptive and Reflective Middleware
- MPAC 2006 – 4th Int. Workshop on Middleware for Pervasive and Ad-hoc Computing
- MidSens 2006 - Int. Workshop on Middleware for Sensor Networks
- MW4SOC 2006 - Middleware for Service Oriented Computing
- MDS 2006 - Middleware Doctoral Symposium

General Chairs:

- Joe Sventek (University of Glasgow, UK)
- Shanika Karunasekera (University of Melbourne, Australia)

Conference keynote speakers:

- Dr John Wilkes, Hewlett Packard Laboratories, USA
- Dr Sean Baker, IONA, Ireland

ASOR RECENT ADVANCES IN OPERATIONS RESEARCH 2006

Held: 1st December 2006, ICT Building, The University of Melbourne, Australia.

The ASOR mini-conference was dedicated to the memory of Professor Alex Rubinov (1940-2006) (ISSNIP CI). The conference was organized by the Melbourne Chapter of the Australian Society for Operations Research (ASOR) and held on the campus of the University of Melbourne.

With the aim of providing a forum for the exchange of ideas, presentation of research results and professional networking, the main themes of the conference were:

- Decision Making Under Uncertainty
- Networks, Sensor Nets and Scheduling
- Efficient Utilization of Human and Natural Resources

The conference, organised by Moshe Sniedovich (University of Melbourne) and sponsored by ISSNIP, was attended by approximately 50 local researchers (of which 10 were ECR's and a further 20 students). The technical program consisted of 13 presentations. The opening welcome was given by Mark Burgman, Director ACERA and the closing session by the ISSNIP convenor, M. Palaniswami.

The following speakers presented to the conference:

- Gad Abraham (University of Melbourne)
 - Leon Au (University of Melbourne)
 - Tristan Barnett and Alan Brown, (Swinburne University)
 - Leonid Churilov, Zoe Zhuang, and Ken Sikaris (Monash University)
 - Bruce Craven (University of Melbourne)
 - Cindy Hauser (University of Melbourne)
 - John Hearne (RMIT University)
 - Kim Levy (University of Melbourne)
 - Dina Neiger, Leonid Churilov, Kristian Rotaru (Monash University)
 - Moshe Sniedovich (University of Melbourne)
 - Marcus Volz (University of Melbourne)
 - Rene Weiskircher (CSIRO)
 - Jiapu Zhang (CSIRO)
-



Figure 4: Delegates at ASOR 2006

ATNAC 2006 - THE AUSTRALIAN TELECOMMUNICATION NETWORKS AND APPLICATIONS CONFERENCE

Held: 4th-6th December 2006, Langham Hotel, Melbourne, Australia.

ATNAC 2006 sought to expand on the traditions of previous ATNAC conferences by bringing together telecommunication researchers and industry representatives together to discuss the latest developments in telecommunications around the world.

ATNAC 2006 focused on broadband delivery and wireless sensor networks. Over 100 papers were presented by speakers from a dozen countries. Included within the conference was a tour of the new National ICT Australia Victoria Node Terabit Networking Laboratory and a half-day workshop on wireless sensor networks.

ISSNIP funded a keynote speaker Professor Stuart Milner from the University of Maryland. Support for the conference was also provided by CUBIN and NICTA.

Speakers included:

- Lixia Zhang (Professor of Computer Science, UCLA, USA; IEEE Fellow)

-
- Bruce Hemingway (Department of Computer Science and Engineering, University of Washington, USA)
 - Lars Rasmussen (Research Professor, Telecommunications, University of South Australia; Network Convenor, ACoRN)
 - Rao Kotagiri (Professor & Head of Department, Computer Science & Software Engineering, The University of Melbourne)
 - Stuart Milner (Research Professor & Director, Centre for Networking & Infrastructure Sensors, University of Maryland, USA)
 - Hugh Bradlow (Chief Technology Officer, Telstra)
 - Toshiaki Kuri (National Institute of Information and Communications Technology (NICT), Japan)
 - Geoff Huston (Chief Scientist, APNIC, and Centre for Advanced Internet Architectures, Swinburne University)
 - Rod Tucker (Director of the ARC Special Research Centre for Ultra-Broadband Information Networks)
 - Rob Evans (Director Victoria Research Laboratory, NICTA)
 - Colin Goodwin (Vice-President, FTTH Council Asia-Pac)
 - Stan Skafidas (Program Leader Sensor Networks, NICTA)
 - Ray Owen (Director, Motorola Asia Pacific)
 - Kim Byung-Whi (Electronics and Telecommunications Research Institute, Korea)
 - Eric Hamilton (Chief Technical Officer, Unwired Australia)
 - Tony Coyle (Senior Solutions Manager, Ericsson Australia/NZ)
 - Phillip Stevens (Siemens Ltd Communications)
 - Simon Curry (Intel Australia Pty Ltd)
 - Hugh Bradlow (Chief Technology Officer, Telstra)





Figure 5: ATNAC 2006 in Melbourne

ICISIP 2006 - INTERNATIONAL CONFERENCE ON INTELLIGENT SENSING AND INFORMATION PROCESSING

Held: 15th-18th December 2006, The Capitol, Bangalore, India.

This interdisciplinary conference, co-sponsored by University of Melbourne, integrates several advanced research themes such as intelligent sensing and adaptive learning with a view towards solving problems in smart systems. Attended by 150 participants, the conference saw 43 high quality papers presented (an acceptance rate of 36%).

General Chair: M Palaniswami (University of Melbourne, Australia) (ISSNIP CI)

General Co-Chair: LM Patnaik (Indian Institute of Science, India) (ISSNIP NR)

Program Co-chairs: Mohan Kumar (UT Arlington, USA) (ISSNIP NR), Svetha Venkatesh (Curtin University, Australia) (ISSNIP CI)

Special Session on Biomedical Informatics - Chair: A/Professor Arcot Sowmya (UNSW) (ISSNIP CI)

Invited speakers:

- Ramesh Jain (Fellow of ACM, IEEE, IAPR, AAAI, and SPIE Donald Bren Professor in Information & Computer Sciences at University of California, Irvine)
- Mohan Kankanhalli (School of Computing, National University of Singapore)

- Vasant Honavar (Director of the Artificial Intelligence Research Laboratory and the Centre for Computational Intelligence, Learning, and Discovery, Iowa State University)
- Nevenka Dimitrova (Philips Research, Bangalore, India)
- Cauligi Raghavendra (Professor of Electrical Engineering and Computer Science and Senior Associate Dean for Strategic Initiatives, Viterbi School of Engineering, University of Southern California, Los Angeles)

Best Paper awards:

- Soft Computing and Dynamic Tunneling Paradigms in Network Security Attacks, Nalini N, et al., Siddaganga Institute of Technology, Tumkur, India;
- Security For Pervasive Health Monitoring Sensor Applications, Sandeep Gupta, et al., Arizona State University, Scottsdale, USA.



Figure 6: Bangalore Conference

WORKSHOPS

Workshops provide a more intimate way of sharing knowledge and deepening the ability of participants to understand the concepts and technologies involved in the very broad spectrum covered by ISSNIP. A summary of our workshops is provided in the following paragraphs.

MIDSSENS 2006

Held: The first International Workshop on Middleware for Sensor Networks took place on November 28, 2006 in Melbourne, Australia.

The aim of this workshop was to stimulate research in the specific domain of middleware for sensor networks, to collect current expertise, and to further refine and integrate different approaches.

In particular, investigations were conducted on how middleware architectures can relieve programmers from the lowest level sensor details, while still enabling them to exploit a sensor's resource capabilities in the most optimal way.

This workshop aimed to trigger and guide research efforts to create an integrated middleware vision, which is required to handle the challenges inherent to developing and deploying complex sensor applications in an efficient way.

WORKSHOP ON WIRELESS SENSOR NETWORKS IN BIOMEDICINE

Held: Tuesday 21 November 2006, National ICT Australia, Australian Technology Park, Sydney, Australia.

This one-day workshop was targeted towards researchers and practitioners in wireless sensor networking for biomedical applications. By bringing together experience in biomedical applications with expertise in wireless devices and networking protocols, this workshop aimed to foster inter-disciplinary research collaborations. The program featured talks by leading experts from academia and industry, a panel discussion, as well as presentations by early career researchers and Ph.D. students.

Workshop Chair/Organiser: Dr Vijay Sivaraman (UNSW)

Invited speakers:

- Dr. Alison Burdett, (Toumaz Technologies, UK)
- Professor Branko Celler (Medcare Systems, Australia)
- Dr. Dinesh Kant Kumar (RMIT University)
- Dr. Ahsan Khandoker (University of Melbourne)
- Professor Nigel Lovell (UNSW/NICTA)
- Dr. Stan Skafidas (NICTA)
- Dr. Slaven Marusic (University of Melbourne)
- Professor Sanjay Jha (UNSW)
- Dr. Athanassios Boulis (NICTA)
- Dr. Bjorn Landfeldt (University of Sydney)
- Professor Doan Hoang (University of Technology, Sydney)

5TH BALLARAT WORKSHOP ON GLOBAL AND NON-SMOOTH OPTIMIZATION: THEORY, METHODS AND APPLICATIONS

Held: 28th-30th November 2006, University of Ballarat, School of ITMS, Australia

The workshop brought together experts from Australia, the Pacific region and around world in the area of optimization theory, methods and applications the

workshop fostered the exchange of recent research findings and discussion exploring potential collaborations.

Topics included different areas of optimization, optimal control and their applications, with an emphasis on theory, numerical methods and applications of global and non-smooth optimization. The workshop also incorporated a one day focussed meeting on global and non-smooth optimisation problems in data analysis and engineering. Designed as a concentrated event, the workshop was attended by 40 researchers. This was also dedicated to the memory of Professor Alexander Rubinov.

Workshop Chair/Organiser: Adil Bagirov (University of Ballarat, Australia – ISSNIP partner organisation)

Workshop Keynote Speakers:

- Professor Terry Rockafellar (University of Washington, USA) for the workshop;
- Professor Bulent Karasozen (Middle East Technical University, Turkey)

Invited Speakers

- Adil Bagirov (University of Ballarat, Australia)
 - Gleb Beliakov (Deakin University, Australia)
 - Leonid Churilov (Monash University, Australia)
 - Bruce Craven (University of Melbourne, Australia)
 - Regina Burachik (University of South Australia, Australia)
 - Andrew Eberhard (RMIT, Australia)
 - Jerzy Filar (University of South Australia, Australia)
 - Masao Fukushima (Kyoto University, Japan)
 - Vladimir Gaitsgory (University of South Australia, Australia)
 - Phil Howlett (University of South Australia, Australia)
 - Yalcin Kaya (University of South Australia, Australia)
 - Alexander Kruger (University of Ballarat, Australia)
 - Musa Mammadov (University of Ballarat, Australia)
 - Juan Enrique Martinez Legaz (University Autonoma, Barcelona, Spain)
 - Angelia Nedich (The University of Illinois at Urbana-Champaign, USA)
 - Iradj Ouveysi (University of Ballarat, Australia)
 - Asuman Ozdaglar (MIT, United States)
 - Jiri Outrata (CAS, Czech Republic)
 - Marimuthu Palaniswami (University of Melbourne, Australia)
 - Diethard Pallaschke (Karlsruhe University, Germany)
-

- Xiaoling Sun (Shanghai University, China)
- Peter Taylor (University of Melbourne)
- Gerhard-Wilhelm Weber (Middle East Technical University, Ankara, Turkey)
- Zhiyou Wu (University of Ballarat, Australia)
- Xiaoqi Yang (Hong Kong Polytechnic University, China)
- David Yost (University of Ballarat, Australia)
- Alberto Zaffaroni (University of Lecce, Italy)
- Liansheng Zhang (Shanghai University, China)

DEST-ISL WORKSHOP ON DISTRIBUTED SENSOR NETWORKS

Held: Thursday 7th December 2006, Rydges Hotel, Melbourne.

The Workshop on Distributed Sensor Networks, though not directly funded by ISSNIP, was run and attended by ISSNIP members to further project objectives and also to expose visiting participating environmental monitoring researchers to the potential value of collaboration within the framework of the Research Network.

Timing of the workshop, with respect to other Research Network events, provided the opportunity to take advantage of the visits of leading marine environment and sensor networks researchers by having them also participate in these related events, in particular, the ISSNIP Summer School. The workshop was an invitation only event attended by 18 researchers (of which 8 were ECRs).

The workshop also served to strengthen ties between the ISSNIP Research Network and the Coral Reef Environmental Observatory Network (CREON), with the exploration of potential collaborative research opportunities featuring heavily on the agenda.

Workshop Chair: M Palaniswami (The University of Melbourne, Australia).

Invited Speakers:

- A/Professor M Palaniswami (The University of Melbourne, Australia).
 - Professor Stuart Milner (University of Maryland, USA)
 - A/Professor Mohan Kumar (University of Texas, Arlington, USA)
 - A/Professor Paul Havinga (University of Twente, The Netherlands)
 - Avinash Sridharan (University of Southern California, USA) representing Professor Bhaskar Krishnamachari (USC)
 - Stuart Kininmonth (Australian Institute of Marine Science)
 - Dr Andrew Brooks (University of California, Santa Barbara, USA)
 - Dr Tung-Yung Fan (National Museum of Marine Biology and Aquarium - NMMBA, Taiwan)
-

- Mr Pi-Jen Liu (NMMBA, Taiwan)
- Dr Alistair Shilton (The University of Melbourne, Australia)
- Dr Yee Wei Law (The University of Melbourne, Australia)



Figure 7: Building Distributed Networks

5TH WORKSHOP ON DEFENCE APPLICATIONS OF SIGNAL PROCESSING

Held: 10th – 14th December, Kingfisher Bay Resort, Fraser Island, Australia.

The Defence Applications of Signal Processing Workshops are supported by the US and Australian Departments of Defence. They represent a successful effort to bring together academic, industry, and government researchers together for an intensive workshop between defence-oriented signal processing researchers in Australia, the UK, the USA and Canada.

A particularly valuable outcome of the workshop (in addition to the printed proceedings) is a special DASP issue of the Elsevier journal Digital Signal Processing.

As an invitation only event the workshop was attended by 69 leading researchers from around the world. ISSNIP co-sponsorship of this event and enabled the provision of travel support for 21 nominated researchers. A list of these is provided below.

Workshop Co-chairs: Dr Vaughan Clarkson (University of Queensland) (ISSNIP CI) and Harry Schmitt (Raytheon – ISSNIP partner organisation) (ISSNIP International Science Advisory Committee member)

ISSNIP supported participants:

- Peter Bartlett (University of California, Berkeley, USA) (ISSNIP CI)
- Robert Calderbank (Princeton University, USA)
- Edwin Chong (Colorado University, USA)
- Vaughan Clarkson (University of Queensland, Australia) (ISSNIP CI)
- Doug Cochran (Arizona State University, USA)

-
- Iain Collings (CSIRO, Australia)
 - Zhi Ding (University of California, Davis, USA)
 - Doug Gray (University of Adelaide, Australia) (ISSNIP CI)
 - Paul Hassler (Georgia Tech, USA)
 - Peter Kootsookos (United Technologies)
 - Jeff Krolik (Duke University, USA)
 - Barbara La Scala (University of Melbourne, Australia) (ISSNIP NR)
 - Mike Larimore (Applied Signal Technology)
 - Alan Lindsey (Austral Engineering)
 - Gavin Thoms (University of Melbourne, Australia) (ISSNIP NR)
 - Sylvie Perreau (University of South Australia, Australia)
 - Barry Quinn (Macquarie University, Australia)
 - Mark Rice (DSpace)
 - Louis Scharf (Colorado State University, USA)
 - Jim Schroeder (University of Adelaide, Australia)
 - Stuart Milner (University of Maryland, USA)

SENSORS, SIGNALS AND SCHEDULING WORKSHOP

Held: Simultaneously in both Adelaide and Melbourne on 18 – 20 December 2006.

The workshop took advantage of the visits to Australia (particularly for the DASP workshop) of a number of senior signal processing experts from the USA to provide world class seminars for students and other researchers from the Australian signal processing community. These invited researchers, at the forefront of research in signal processing and sensor management also gave a short series of seminars.

Using teleconferencing facilities at the South Australian Virtual Reality Centre, The University of Adelaide and at the Fritz Loewe Theatre, The University of Melbourne, sessions of 2-3 hours each from 7 world class researchers were provided, with half of them located in each of the two venues.

The audience consisted of research scientists, mathematicians, and engineers working in signal processing and related areas. The content was intentionally made accessible to graduate students in science and engineering. Total attendance across both venues was 75 researchers (of which 18 were students).

Workshop co-chairs: Bill Moran (University of Melbourne) (ISSNIP CI) and Bevan Bates (University of Adelaide), Melbourne - Fritz Loewe Theatre

The University of Melbourne:

- Professor Robert Calderbank (Princeton University)
- Professor Ingrid Daubechies (Princeton University)
- Professor Margaret Cheney (Rensselaer Polytechnic Institute)
- Professor Louis Scharf (Colorado State University)

University of Adelaide - South Australian Virtual Reality Centre

- Professor Edwin Chong (Colorado State University)
- Professor Doug Cochran (Arizona State University)
- Professor Larry Carin (Duke University)
- Dr Stephen Howard (DSTO)

WORKSHOP ON BIO-SIGNALS AND CLASSIFICATION

Held: Friday 22nd September 2006, RMIT University, Melbourne, Australia.

Hosted by the RMIT University Bio-signals Lab and sponsored by ISSNIP, this workshop focussed on signal classification recognising it as a very important research area. The tutorial style workshop explored various classifiers and discussed their applications and limitations.

It was attended by 20 people from universities around Melbourne and posed new problems and elicited valuable discussions. The outcomes of the workshop included the formulation of new collaborative relationships with a view to answering some of those ongoing research questions. Further outcomes included the agreement of an exchange of visiting researchers to participate in future seminars.

Workshop Chair: Dinesh Kant Kumar (RMIT University) (ISSNIP CI)

Invited Speakers:

- Professor Dinesh Kant Kumar (RMIT University)
 - Vijay P. Singh (RMIT University)
 - Wai C. Yau (RMIT University)
 - Sridhar P. Arjunan (RMIT University)
 - Professor Andrew Jennings (RMIT University)
 - Ganesh Naik (RMIT University)
 - Shern C. Yau (RMIT University)
-

EDUCATION

Education in ISSNIP concepts and technologies is critical to the furtherance of understanding of the very advanced opportunities possible by breakthroughs in this important field.

In particular, ISSNIP is paying great attention to Early Career Research candidates. A summary of our Education activities is shown in the following paragraphs.

ISSNIP EARLY CAREER RESEARCHER WORKSHOP ON SENSOR NETWORKS

Held: Wednesday 6th December, Langham Hotel, Melbourne, Australia.

The ISSNIP Early Career Researcher (ECR) Workshop on Sensor Networks was held in conjunction with The Australian Telecommunication Networks and Applications Conference ATNAC 2006 (also sponsored by ISSNIP).

The ECR Workshop targeted PhD students and recent PhD graduates with a view to generating new research collaborations in the themes of ISSNIP.

As the timing of the Workshop coincided with other ISSNIP events (Summer school and Short course), this also enabled visiting researchers to participate in these, along with the ATNAC conference. Additionally, visiting researchers were able to utilise this opportunity to not only further discuss their work with local attendees, but also over the ensuing days participate in research collaborations with researchers located at other Universities in the greater Melbourne area.

Speakers:

- Sayeed Ahmed (University of Western Australia)
 - Bharat Sundaram (University of Melbourne)
 - Babak Pazand (University of Western Australia)
 - Dr Khalid Aboura (University of Technology, Sydney)
 - Rajib Chakravorthy (University of Technology, Sydney)
 - Sophie Kaplantzis (Monash University)
 - Mohammad Momani (University of Technology, Sydney)
 - Michael Liu (University of Technology, Sydney)
 - Giang Nguyen (University of Wollongong)
 - Dr Fok Hing CHI Tivive (University of Wollongong)
 - Dr Daniel Lai (University of Melbourne)
-

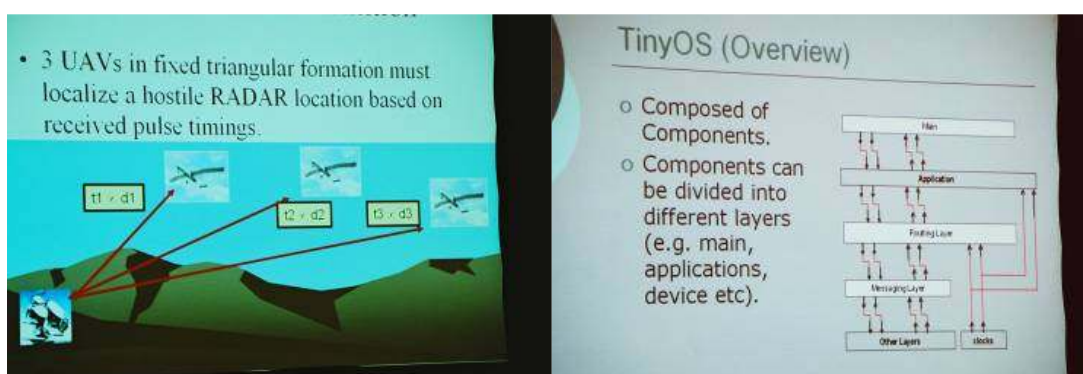


Figure 8: Early Career Research Program

SHORT-COURSE ON INTRODUCTION TO SENSOR NETWORKS (PRELUDE TO SUMMER SCHOOL)

Held: Thursday 7th December 2006, Department of Electrical and Electronic Engineering, The University of Melbourne.

As a prelude to the ISSNIP Summer School program, a short introductory course to sensor networks was conducted by Bruce Hemingway lecturer & Manager of the Baxter Computer Engineering Laboratory, from the Department of Computer Science and Engineering, University of Washington.

Professor Hemingway also presented one of the Plenary Talks at the ATNAC conference. His insights were timely preparation for those attending the subsequent Summer School.

ISSNIP SUMMER SCHOOL 2006

Held: December 8th-9th 2006, Department of Electrical and Electronic Engineering, The University of Melbourne, Australia.

The ARC Research Network on ISSNIP presented a two day summer school encompassing different areas of sensor networks research. These ranged from technical aspects addressing security and middleware to application issues in environmental sensing and infrastructure sensors. This offered a unique

opportunity to hear a number of invited Australian and international experts in these respective areas giving lectures.

The event was entirely provided and funded by ISSNIP, including registrations, catering, expenses for invited speakers, as well as travel and accommodation expenses for selected participants from around the country.

Attended by 56 researchers from around the country (Victoria, NSW, Queensland, WA), of which 32 were ECRs, the event was well received and demonstrates the role ISSNIP is playing in providing access to world class researchers to the Australian research community, as well as utilising such events to generate further interest in the emerging field.

Invited speakers:

- Professor Paul Havinga (University of Twente, The Netherlands)
- Dr Yee Wei Law (The University of Melbourne, Australia)
- Professor Mohan Kumar (The University of Texas at Arlington, USA)
- Avinash Sridharan (University of Southern California, USA)
- Stuart Kininmonth (Australian Institute of Marine Science (AIMS))
- Dr Andrew Brooks (University of California, Santa Barbara, USA)
- Professor Stuart Milner (University of Maryland, USA)



Figure 9: Delegates Enjoy Summer School

ISSNIP SEMINAR SERIES

Held: The University of Melbourne, Coordinator: Dr Daniel Lai.

The introduction of the ISSNIP Seminar Series in 2006 presented a regular forum for local and visiting Australian and international researchers to present current research.

Interspersing such seminars with tutorial based presentations gives new researchers an opportunity develop their understanding of the fundamental research questions and common methodologies applied in sensor network research.

The series is regularly attended by researchers from diverse fields such as electronic engineering, computer science, geomatics and mathematics. This program has served to further encourage interdisciplinary collaborations by demystifying the large range of technical issues encountered in this field.

The ISSNIP seminar series is growing into a focal point for the broader sensor network research community, through the exposure given by distinguished international researchers making presentations via this forum.

Based upon the success of these activities, it is intended to replicate this program at other major centres around the country.

THE AUTONOMIC SENSOR AND MOBILE COMPUTING LAB

Coordinated by: Dr L. Kulik, Dr E. Tanin, Professor R. Kotagiri, A/Professor M. Palaniswami

Held: The University of Melbourne, Department of Computer Science and Software Engineering and Department of Electrical and Electronic Engineering.

Ad-hoc networks such as mobile networks, sensor networks or vehicular ad-hoc networks are key technologies that will drive computing in the next decade. The Department of Computer Science and Software Engineering as well as the Department of Electrical and Electronic Engineering have established a lead role in this area over the last several years.

The purpose of new Automatic Sensor and Mobile Computing Lab is to provide students with a unique opportunity to program software and hardware for the latest generation of devices: sensor nodes, personal digital assistants, and smart phones. The lab will support two types of postgraduate students: coursework students and research students who aim at a PhD. This project has the following two objectives:

- Coursework students will develop a deeper understanding of how to develop programs for sensor and mobile computing devices. Students will gain hands-on experience on the latest computing technologies, which gives them a competitive advantage.
- Research students will have the unique opportunity of testing and evaluating algorithms and techniques in a realistic setting. The lab will thus play a key role in the research projects of the Research Network's Ph.D. students

BIGNET – INITIAL FIELD SURVEY

Conducted by Dr. A. Overmars, Department of Electrical and Electronic Engineering, The University of Melbourne

The aim of this survey was to set out suitable locations for the establishment of BigNet. BigNet is a large scale sensor network to be deployed around the University of Melbourne to further develop the sensor networks research infrastructure available to University of Melbourne and ISSNIP researchers. A

number of sites have been considered for the integration and possible extension of BigNet to be included as outlined in the objectives.

Based upon the testing results a possible topographically layout will be proposed to allow the interconnection of all of the sites. Currently being considered for the integration into the BigNet infrastructure rollout are seven sites around the Parkville campus of the University of Melbourne.

Recommendations for the BigNet Topology

It was concluded that the type of network that would be ideal for the BigNet ZigBee Network would be the Mesh network as this provides for the highest level of integration and reliability in terms of data transmission robustness. Ultimately at least 100 Nictors are expected to be deployed and this should be more than adequate to implement a Mesh Network Topology outlined above.

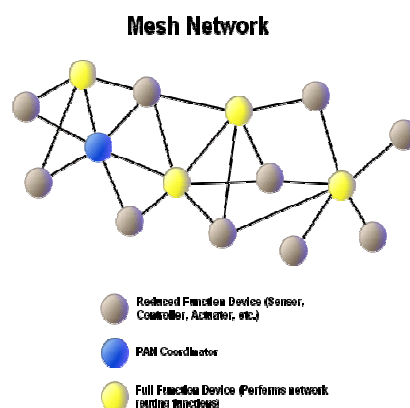


Figure 10: BigNet Topology

DISTINGUISHED VISITOR SEMINARS

The ISSNIP Research Network continued to attract and support the visits of distinguished international researchers. These consisted of a combination of extended research visits as well as specific event related visits where these international scholars were invited to give presentations including keynote and plenary talks.

Detailed here are but a selection of the ISSNIP supported visits. The remainder are listed amongst the numerous ISSNIP sponsored events described earlier.

PROFESSOR T DALLESSIO - UNIVERSITY DE ROMA, ROME, ITALY

Professor Dallessio visited Melbourne during January 2006 as guest of A/Professor Dinesh Kant Kumar (RMIT University) funded by the University of Roma Tri, Italy. The visit included the presentation of a seminar on 'Human Movement Sensing without Markers'. The seminar took place at RMIT University and was attended by 12 PhD students and 3 academics.

A valuable outcome of this visit included the production of a Joint ARC discovery application. Also, Dinesh Kumar was provided with a Visiting Scholarship to University of Roma Tri as well as a Joint editorial for a special edition of Journal of Neural Engineering.

PROFESSOR H WEGHORN - UNIVERSITY OF STUTTGART BA, GERMANY

Visiting Melbourne during April 2006 as a guest of A/Professor Dinesh Kant Kumar (RMIT University) jointly funded by University of Stuttgart BA and ISSNIP, Professor Weghorn presented a seminar titled 'Wireless sensors from simple mobile phones'. The seminar took place at RMIT University attended by over 25 PhD students and 10 academics.

A hands-on tutorial for J2M for mobile devices was also conducted. The tutorial was run over 4 days at RMIT University. Attended by 10 PhD students and 4 academics, the event capitalised on the unique expertise of Professor Weghorn.

ASSOCIATE PROFESSOR K T KO – CITY UNIVERSITY OF HONG KONG

Professor Ko undertook an 8 week study visit at The University of Melbourne from 3rd July to 24th August 2006, sponsored by ISSNIP. The main collaborators were Professor Zukerman of The University of Melbourne together with NICTA researchers.

The main tasks accomplished during this study leave were:

- Co-operation in research grant applications in both Hong Kong and Australia.
- Finalised and submitted the paper entitled "Stability Effects of Two-way Traffic" to Journal of Computer Communications.
- Presentations to The University of Melbourne, The University of Adelaide and DSTO.

PROFESSOR MIHAELA ULIERU – UNIVERSITY OF NEW BRUNSWICK, CANADA

Professor Ulieru is a Canada Research Chair, Professor in the Faculty of Computer Science and Director of the Adaptive Risk Management Laboratory at The University of New Brunswick, Canada. As an invited guest of A/Professor Dinesh Kant Kumar (RMIT University), Professor Ulieru undertook collaborative research during her December visit, networking with researchers and students in Melbourne and Sydney giving invited lectures and seminars on Risk issues and risk management for sensors and sensor networks.

Her visit was also utilised for the benefit of the Research Network, through the following events:

- A 'hands on' full day tutorial on Risk Management was also provided at RMIT University and attended by 14 researchers.
-

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- A seminar at the University of Melbourne titled "Synopsis on Adaptive Risk Management" attended by 15 researchers as part of the ISSNIP seminar series
 - A seminar at UNSW, Sydney, where she met with number of researchers. The outcome of this event was the planning of a joint research project.

Another outcome of this visit is planning of a joint application between Professors Ulieru, Kumar and Palaniswami for an international linkage research project.

PROFESSOR STUART MILNER – UNIVERSITY OF MARYLAND, USA

Professor Stuart Milner is visiting Australia as a guest of A/Professor Palaniswami at the University of Melbourne, during December 2006 and January 2007. Supported by ISSNIP, this visit has produced a number of collaborative exchanges with joint funding applications expected as an outcome of the visit.

In addition to research collaboration, Professor Milner also made valuable contributions ISSNIP events as an invited speaker at ATNAC 2006, the Workshop on Distributed Sensor Networks, the ISSNIP Summer School, the DASP conference as well as offering feedback and guidance to young researchers at the ECR Workshop on Sensor Networks.

Collaborative exchanges took place with other research colleagues at the events as well as with researchers at the University of Melbourne. Further research exchanges took place with visits to Adelaide, AIMS and planned visits with Sydney researchers and ISSNIP commercial research partners.

PROFESSOR MOHAN KUMAR – UNIVERSITY OF TEXAS, ARLINGTON, USA

Professor Mohan Kumar also visited Australia as a guest of A/Professor Palaniswami, as key speaker at the Workshop on Sensor Networks and also the ISSNIP Summer School.

In addition Professor Kumar also attended the ISSNIP ISAC meeting. A significant outcome of Professor Kumar's visit was the planning of a Symposium on Middleware for Sensor Networks to be conducted at the ISSNIP 2007 conference. Associated with this Symposium will be a related Journal Special Issue. Following meetings at Curtin University of Technology with Prof. Svetha Venkatesh, a proposal was developed for ongoing collaborative work to be undertaken in 2007. An extended research visit to Australia is also planned for late 2007 and continuing into 2008.

DR ALISON BURDETT - TOUMAZ TECHNOLOGIES, UK

Dr Alison Burdett visited Australia as a guest of Dr Vijay Sivaraman (UNSW) as keynote speaker for the Workshop on Wireless Sensor Networks in Biomedicine.

The visit also encompassed additional time spent undertaking collaborative research. Representing a UK-based company that manufactures ultra-low-power body-worn wireless sensor devices and with expertise in the design of wireless integrated circuits, Dr Burdett provided the workshop with a valuable insight into the commercial concerns and potential of wireless sensor networks research for

continuous non-intrusive medical monitoring. The exploration of potential research collaborations also served to provide ISSNIP with yet another valuable addition to its growing industry based network.

PROFESSOR SUSHIL K. PRASAD - GEORGIA STATE UNIVERSITY, ATLANTA, USA

Prof Prasad undertook a two-month research visit to the University of Melbourne, Australia, during summer 2006 to collaborate with Prof. Buyya on Grid and Mobile Computing research, with Prof. Palaniswami on Sensor Networks, and with NICTA. Prof. Prasad gave a series of talks to the Grid Computing group at University of Melbourne on Parallel Algorithms and Data Structures, and on Middlewares. A joint proposal to National Science foundation was submitted entitled with Prof. Buyya and Prof. Palani. This also resulted in international collaborations with sensornet group at Oak Ridge National Lab and Acenet group at University of New Brunswick, Canada.

BRUCE HEMINGWAY, THE UNIVERSITY OF WASHINGTON, USA

Bruce Hemingway was an ISSNIP visitor during December 2006, giving a keynote talk at ATNAC where he presented an overview and demonstration of his novel, project based, undergraduate learning program about Wireless Sensor Networks. He also conducted an ISSNIP workshop "Introduction to Sensor Networks" also going through designs being undertaken with a prototype mote under development by Intel. He also participated in a Department of Primary Industry "Agriculture and Environment Sector Initiative Group Meeting" of ten Department researchers and twelve industry participants, discussing the potential applications of sensor networks to the primary industry sector. Finally Bruce visited ACID (the Australian CRC for Interaction Design) in Brisbane, to discuss the application of Wireless Sensor Networks in the creative industries.

CONTRIBUTION TO KNOWLEDGE

Expanding upon the activities of the DEST-ISL grant on Distributed Sensor Networks, ISSNIP is playing a role in the deployment of environmental sensor networks through the involvement of key members in the newly awarded NCRIS-IMOS funding. This further enhances the capabilities and resources for the Great Barrier Reef monitoring projects.

Together with the new DEST-ISL project on grid computing and e-research, ISSNIP researchers continue to successfully advance national interests in the development of Frontier Technologies.

Ongoing research collaborations with DSTO on defence related applications includes geo-location, sensor fusion and unmanned aerial vehicle developments to enhance the nation's defence capabilities with the challenge of monitoring Australia's vast border regions.

New collaborative partnerships are presently being explored with some of ISSNIP's international research partners for the advancement of these technologies.

Links between ISSNIP and the Research Network for a Secure Australia have been established through ISSNIP convenor Palaniswami and Secure Australia convenor Priyan Mendis. The establishment of further cross Network programs are to be investigated in the coming year.

Development of programs under the ISSNIP framework in the area of healthcare is continuing. Specific projects are underway and more are being planned, including continuing work on medical diagnostics and condition monitoring.

ISSNIP has achieved significant growth through increased activity within the Network, newly funded research programs, growing local and international collaborative links, ISSNIP supported events, new research proposals and planned activities.

Together with an ever increasing profile, the momentum being generated by ISSNIP related research is expected to lead to an increase in the demand for ISSNIP funding support by Australian research groups.

INTERNATIONAL OUTREACH

Many international visits were made as the result of and with the assistance of the Research Network. The Convenor A/Prof. Palaniswami visited Singapore, UK, India and USA for international collaborations in Sensor Networks. A significant number of overseas researchers visited Australia for activities relating to the network, particularly as part of ISSNIP supported Conferences and Workshops. In addition 6 world leading overseas researchers delivered lectures at the ISSNIP Summer School. As an indication of international recognition for Australian work, the convener of the network was invited by various forums abroad (see below)

1. Member of External Advisory Board, CRUISE Consortium, European 6th Framework funded centre, Denmark. (From 2006)
 2. Member of NSF Review Panel for Sensor Networks, National Science Foundation, USA.
 3. Publicity Chair, IEEE World Congress on Computational Intelligence, Vancouver, Canada, 2006.
 4. Program Committee member for several sensor network conferences.
 5. Invited speaker, CREON Workshop March 29th-31st, 2006 Townsville, Australia
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Figure 11: CREON Workshop - Townsville

Keynote talks were given by a number of ISSNIP members at various conferences and workshops. In addition to those at ISSNIP supported events, the following invited talks were also given:

1. "Convergence of Intelligent Sensors, Sensor Networks and Information Processing," 5th Ballarat Workshop on Global and Non-Smooth Optimization: Theory, Methods and Applications, University of Ballarat, School of ITMS, Ballarat, Victoria, Australia, November 28-30, 2006.
2. "Grid Computing and the Gridbus Middleware: Making the Global Cyberinfrastructure for e-Science and e-Business a Reality," Keynote Talk, 11th International CSI Computer Conference (CSICC 2006), Computer Society of Iran, Tehran, Iran, Jan. 24-26, 2006.
3. "Grid Computing: Emerging Trends," International Conference on Computing and Informatics (ICOCI 2006), June 6-8, 2006, Kuala Lumpur, Malaysia.
4. "Gridbus Middleware: Building Utility Grids for Powering e-Science Applications," National e-Science Congress, Santiago, Chile, Sept. 6-7, 2006.
5. "The Gridbus Middleware for Utility-Oriented Grid Computing," 3rd International Conference on Mobile, Ubiquitous, and Pervasive Computing (ObCom 2006), Vellore, India, Dec. 17-19, 2006.
6. "Autonomic Grids and the Gridbus Toolkit," 14th International Conference on Advanced Computing and Communications (ADCOM 2006), Dec. 20-23, 2006, Surathkal, India.

The DEST-International Science Linkage project on Distributed Sensor Network continued to provide valuable link to world leading researchers for ISSNIP, with visiting project partners also taking part in ISSNIP events as described earlier. Further more, the extended network of research colleagues is also being

leveraged by ISSNIP by providing reciprocal exposure of Australian and international researchers to the respective groups. These links also provided access to other large international research networks with which strong links to ISSNIP have now been forged. One particular example is CREON, where at the CREON workshop in March 2006 the ISSNIP convenor was an invited speaker.

ISSNIP researchers were also successful in obtaining new DEST-ISL funding worth over \$1 million for a grid computing and e-research project, further expanding the international linkages now accessible to ISSNIP partners.

Research exchanges were undertaken by a number of ISSNIP members, notably Associate Professor Dinesh Kumar to Germany, Italy and Brazil leading to the development of ongoing research collaborations and further planned exchanges. IEEE Fellow and leading scientist Professor Pramod Varshney, head of a major application project in Wireless Sensor Networks in Syracuse University, visited the NeST Lab at UTS leading to a reciprocal visit by Professor Subhash Challa. These exchanges resulted many new collaborative activities and practical applications between researchers from Australia and the USA.

The growing number of international linkages is evidence of the success achieved through the profile and momentum generated by the ISSNIP Research Network. The ability to leverage the expertise and resources gathered with the ISSNIP framework is proving to be an invaluable tool in creating new opportunities by facilitating the interactions between different research groups.

INDUSTRY LINKAGES

The level of industry involvement in Research Network projects continues to grow through the existing industry connections of Network participants as well as newly formed relationships.

There are presently eleven major industry linked projects underway by ISSNIP researchers. These continue to form the foundation of both ongoing and emerging industry linkages for the Research Network. These include two DEST-ISL projects (one newly awarded), a number of ARC Linkage Projects spanning healthcare, transportation, defence and environment, in addition to the establishment of a start-up company. While providing further exposure to industry for ISSNIP researchers, these projects also demonstrate the importance of ISSNIP research activities in their ability to address critical problems and produce practical solutions. Further details on these projects are provided in Appendix B under the Research and Industry Committee report.



Figure 12: Sensor deployment – Bateman’s Bay Bridge

RESEARCH NETWORK COLLABORATION

As one of its core objectives, ISSNIP supported the collaborative research activities of a number of groups both nationally and internationally. Additionally, ISSNIP forged strong links with international research networks, enabling Australian researchers to not only leverage the technical resources and contacts available with the ISSNIP Research Network, but also access a much larger network of experts through the international network links. Much of this activity was supported through the large number of ISSNIP coordinated or sponsored events already described. In addition a number of student and researcher collaborative exchange visits were undertaken by ISSNIP researchers to Germany, Italy, Brazil, and the USA, among others. In addition, the collaborative efforts amongst the members and affiliates of the research network have been strong and continue to grow. These are summarised in collaboration matrix of Appendix E.

RESEARCH NETWORK PROFILE

A significant objective of the ARC Research Network on ISSNIP is to continually raise the profile of Australian researchers both locally and internationally, and also to raise the mainstream profile of ISSNIP related work.

This was achieved through international media coverage of ISSNIP events as well as important publications of research emanating from the Network. Added to these is the continually improving website which is successfully serving as the first point of access for ISSNIP activities and information. These items, while increasing the profile of the ISSNIP, will simultaneously provide an opportunity for new research collaborations.

Details of media coverage and publications related to ISSNIP are shown at Appendix F.

RESEARCH NETWORK WEBSITE

The network website is www.sensornetworks.net.au. The ISSNIP website has become the central source for dissemination of information throughout the network, but also a valuable tool to showcase ISSNIP to the broader research community. Providing up to date information concerning upcoming events, together with post-event reports and selected presentation materials, the ISSNIP website gives some indication of the level and diversity of activity undertaken with the Research Network framework.

The website is now also being utilised to advertise employment opportunities within the Research Network and on ISSNIP related projects of Network members.

GRANT APPLICATIONS

Significant progress has been made in keeping with the Research Network objective of attracting further research funding for Australian researchers.

A number of applications for funding have again been successful with more in preparation resulting from ISSNIP collaborative activities (noted throughout the report). Described here are some of the more significant funding programs involving ISSNIP members.

DEST-ISL - THE UTILITY GRID PROJECT: AUTONOMIC AND UTILITY-ORIENTED GLOBAL GRIDS FOR POWERING EMERGING E-RESEARCH APPLICATIONS.

The University of Melbourne, together with major partners in this project, Intrepid Geophysics, Swinburne University, Adelaide University, as well as a number of other partners (making smaller contributions) have obtained funding consisting of a cash amount totalling more than \$1.0 million.

NCRIS - IMOS

A funding proposal was undertaken as part of the National Collaborative Research Infrastructure Strategy (NCRIS) for an Integrated Marine Observing System (IMOS) of which a number of prominent ISSNIP members were involved.

Building upon the environmental sensing objectives of ISSNIP and the projects already underway by ISSNIP members, the proposal was successful, with cash funding of approximately \$50M and over \$7 Million allocated for 2006-2007 alone. As part of the Facility for Automated Intelligent Monitoring of Marine Systems (FAIMMS), the IMOS part of the program is concerned with infrastructure development for the infrastructure to monitor the Great Barrier Reef (GBR).

ARC LIEF GRANT PROPOSAL

An ARC LIEF grant proposal was submitted for the creation of a large Wireless Sensor Network test-bed (BigNet) in The University of Melbourne, Deakin University, James Cook University and in the Great Barrier Reef (St. Davis Reef).

Due to a technical issue the proposal was initially unsuccessful. However, an appeal has been lodged and a result is expected in March.

ARC LINKAGE GRANT PROPOSAL

A new ARC Linkage grant was awarded to A/Prof DK Kumar (RMIT University) for Approved Smart Task Allocation Support for Small-Scale Printing Factory. The outcomes will provide the potential for the Australian small-scale printing industry the capability to be competitive and cost-effective through the understanding of complex relationships between various tasks in associated environment to improve the wellbeing of workers. The smart computer system will result in a cutting edge technology that is applicable to other similar industries.

ARC DISCOVERY GRANTS

Dr R. Buyya

A new ARC Discovery grant was awarded to Dr R Buyya (University of Melbourne) on the Quality of Service-based Scheduling of e-Research Application Workflows on Global Grids, worth over \$300,000. This work will strengthen the presence of e-research in the ISSNIP research profile. The work has the potential to offer Australia significant economic and social benefits as it enables researchers from different disciplines and organisations to engage in collaborative scientific investigation. It will explore issues such as secure access to remote resources, access negotiation with respect to time, duration, and the level of quality of service.

Prof S Challa

A new ARC Discovery Grant was also awarded Prof Subhash Challa (UTS) with Dr M. Morelande on Generalized Information Fusion and Scheduling for Effective Situational Awareness. The research proposes to take the significant first step to develop a consistent and unified method to manage and fuse uncertain information from human and non-human sources by drawing on the recent advances of the generalized theories of information & uncertainty. The outcomes of this research will enable modern networked information systems consisting of heterogeneous information sources like sensors, knowledge data bases and human information to deal with open-ended and changing concepts and environments.

SENSOR NETWORKS FOR DEFENCE APPLICATIONS FUNDING

The ISSNIP program fosters links between researchers and industry within Australia and internationally in the area of defence applications of sensor networks. Linking the Melbourne Systems Lab (MSL), different divisions of DSTO and Raytheon, USA, funding has been obtained from a variety of sources including the US Defense Advanced Research Projects Agency (DARPA). Together with ISSNIP support, this program has generated significant collaborative research largely between the University of Melbourne and DSTO.

- Distributed Sensor Networks Funding (\$391,650 – DARPA, DSTO)
 - Multiple Target Tracking Funding (\$230,000, DSTO)
-

4 PLANS FOR 2007

APPROACH

Our approach for 2007 is to build on the success we have achieved in 2006 and prepare for further work in the following year. Initiatives are planned to further build on those already commenced; they are linked through our Strategies to our Strategic Themes.

THEME 1: NATIONAL COLLABORATION AND IDENTITY

The following are planned:

- The conduct of a workshop in Queensland (Great Barrier Reef) near the site of a large scale sensor deployment being undertaken by ISSNIP members, giving additional network members a good understanding of the associate issues and assisting them in designing superior algorithms.
- Further developments to the website will be undertaken particularly with respect to ease of usage as well as the reactivation of member links and profiles.
- Planning for several journal special issues and book volumes is underway to be produced around leading works first identified through the ISSNIP conference.
- Particular attention will be paid to promote the activities of ISSNIP groups. In addition to the profile already achieved in international academic circles through existing means, greater efforts will be made to raise the mainstream profile of Australian Sensor Networks research efforts.

THEME 2: INDUSTRY LINKAGE

Industry linkages will be improved by:

- Industry Linkage grants/DARPA grant applications in planned for 2006 are now planned for 2007 submissions.
- Talks are progressing with Iomniscient Pty Ltd for a Linkage Grant on Visual Sensor Networks.
- Building upon the work undertaken with these partners, plans for further collaborative efforts are expected to arise with new Network partners becoming involved.

THEME 3: INTERNATIONAL LINKAGES

International linkages will be strengthened by:

- The Third International Conference on ISSNIP will be held in Melbourne during November 2007.
-

- ISSNIP is sponsoring the Information, Decision and Control IDC 2007, to be held on the 12th-14th February 2007, at the Adelaide Hilton, Adelaide, Australia.
- The ISSNIP International Video Conference Seminar Series
- ISSNIP networking awards for Early Career Researchers and Post-Graduates.

THEME 4: EDUCATION

Education benefits will be improved through:

- Post-graduate and Early Career Researcher (ECR) Workshops
- Sensor Networks for secondary schools
- Development of Sensor Networks Lab
- Additional focussed workshops are being planned
- ISSNIP Undergraduate Project Awards

THEME 5: FUTURE FUNDING

Future funding is being pursued through:

- ARC LIEF grant proposal (from 2006)
- Discussions on a new proposal for European Framework are progressing.
- Proposal for a new Indo-Australian collaborative project on Sensor Networks for healthcare and rural sector is underway having been postponed from 2006.
- A number of joint funding proposals are expected from Hong Kong, USA, Italian and Australian funding sources.
- A joint proposal to National Science foundation was submitted in 2006 entitled "PIRE: US - Australia - Canada Partnership in Developing Middleware Technologies for Enabling Mobile Grid" with Prof. Buyya and A/Prof. Palani.
- Proposal planned for AOARD funding to support ISSNIP 2007.
- Proposal for research funding from Microsoft SensorMap request for research proposals to support web based sensor interface for the Great Barrier Reef project.

THEME 6: NEW INITIATIVES

ISSNIP Awards Program

The ARC Research Network on ISSNIP is proud to announce the ISSNIP Award Program. This program is intended to provide project funding for undergraduate, postgraduate and early career researcher projects for 2007.

The projects will focus on the applications of intelligent sensors and sensor networks.

- ISSNIP Early Career Researcher Networking Awards
 - 10 awards, up to \$10000 per person
 - Supporting early career researchers working through travel fellowships, access to infrastructure and appropriate project related costs and facilitating national and international collaboration for ECR's.
 - ISSNIP Post-Graduate Networking Awards
 - 10 awards, up to \$7500 per project
 - Travel fellowships supporting national and international collaborative exposure for post-graduate researchers and facilitating direct access to world leading expertise and infrastructure.
 - ISSNIP Undergraduate Project Awards
 - 10 awards, up to \$5000 per project
 - Supporting undergraduate intelligent sensors and sensor networks projects and the presentation of these at an event in late 2007 at which an award for best undergraduate project will be provided.
-

APPENDIX B: EXECUTIVE BOARD AND COMMITTEE MEETINGS

MEETINGS

A comprehensive range of meetings has been held over this period and are summarised in this Appendix

EXECUTIVE BOARD

The executive board meeting was held in January 2006. In reviewing draft annual report, particularly the network support of the development of several new grant applications involving the members and other active researchers and the success in securing new money for collaborative research by network members was well received by the committee.

The convener placed three programs under new collaboration awards – ISSNIP Undergraduate Project Awards, ISSNIP Postgraduate Networking Awards and ISSNIP Early Career Researcher Collaboration Awards. It was agreed that the awards carried performance indicators that will be evident in the final report from the awardees.

The committee agreed to hold approximately four meetings a year from 2007. The committee also agreed to appoint a network manager to support the development of focused programs in the strategic ISSNIP areas. The next meeting is scheduled in the 3rd week of March 2007.

RESEARCH AND INDUSTRY COMMITTEE

The ISSNIP Research-Industry committee, co-chaired by Professor Subhash Challa from UTS, Australia and M Palaniswami, is tasked with providing direction for the establishment and support of new collaborative projects.

Their extensive links with industry continue to aid the research network to form new collaborations and expand existing collaborations. These have included:

- A DEST-ISL grant in Distributed Sensor Networks which has provided a further platform to attract new international collaborators to the Network with expertise in environmental sensing.
 - A number of companies (Iomniscient Pty Ltd and Decisioneering Solutions) brought to the Network through this DEST-ISL project have now been exposed to additional Network participants enabling researchers explore new collaborative opportunities.
 - Work is also being undertaken with Intersystems through this program in Sensor and Enterprise Network Integration. The aim is the development of an intelligent gateway to bridge the gap between the data rich
-

'sensor/control' world and the event rich 'distributed objects' based network applications world.

- A new DEST-ISL project (The Utility Grid Project: Autonomic and Utility-Oriented Global Grids for Powering Emerging e-Research Applications) has been awarded to Network participants further demonstrating the success of the Research Network in providing expertise and support for such endeavours.
- ARC Linkage Grant on Design of Wireless Sensor Networks (LP0561200)
 - Thales Australia and University of Technology Sydney (funding - 360K). This project proposes to intelligently employ higher capabilities of mobile nodes and develop methods for rapid deployment, maintenance and routing that are aware of location, energy, and security.
- Remote Bridge Monitoring with Wireless Sensor Networks
 - Jointly funded project by NSW Road Traffic Authority (RTA), DEST, University of Melbourne and UTS (total funding 285K). The project uses a set of emerging wireless and network enabled sensors to capture essential information and contextually process information using UTS innovations (software/middleware and information fusion) in Sensor Network Access Points (SNAP) and remotely access/monitor to serve RTA applications.
- Aquaculture Yield Optimization using Wireless Sensor Networks
 - This project is a competitively funded UTS partnership grant with industry partner Rolachem. The collaborative project involved one of the leading scientists Prof. Vigneshwaran from Civil and Environmental engineering of UTS. The proposed system will provide real-time water quality monitoring as well as real-time water quality control to achieve optimised aquaculture production, using MEMS and wireless sensor technologies.
- Water Quality Monitoring using Distributed Wireless Sensor Networks
 - The collaborative project between Networked Sensor Technologies Lab (NeST) and Institute for water and resource management (IWERM) proposes a real-time, tools-based solution to sampling, monitoring and reporting data, using emerging low-cost wireless technology. The project has taken trans-disciplinary dimensions by engaging with selected, collaborating end-user groups including Sydney Catchment Authority, the Warringah Council and the Central-West CMA (STKHLD).
- Visual Sensor Networks.
 - SenSen is a start-up company founded by Prof Challa and led by Mr. Satish K Gupta, a graduate of MIT and Stanford and a successful entrepreneur from Silicon Valley, delivering intelligent video centric monitoring and surveillance software

Collaborative work has also been undertaken with the WSN group in UNSW, led by Prof. Sanjay Jha and A/Prof. Chun Tung on:

- ARC Linkage Infrastructure project: LE0775704 Australian wireless mobile, mesh and sensor research network (AusWiMMS)
- ARC Linkage project with RTA: LP0667900 Remote Bridge/Traffic Monitoring Using Intelligent Sensor Networks and Information Processing

The high point of this collaboration was the when our joint work was selected as one of the 10 best papers at the 3rd IEEE International Conference on Mobile Ad Hoc and Sensor Systems (MASS), Oct. 9-12, 2006, Vancouver, Canada.

Professor Challa was also an invited speaker at the Sensors Expo 2006 held in Chicago, USA, in June 2006 where he presented an overview of data and information fusion challenges for networked sensor systems. It was a major industry meeting with participation of representatives from over 500 industries working in the sensor systems space.

Industry involvement is continuously explored, with the profile of Network events and participant activities successfully attracting interest from potential partners, including commercial product developers (Procept).

INTERNATIONAL SCIENTIFIC ADVISORY COMMITTEE (ISSNIP-ISAC)

ISSNIP has established an International Scientific Advisory Committee consisting of the world's top researchers and research leaders in the area of sensor networks and its core disciplines.

The objective of the committee is to overview ISSNIP research activities and to advise research directions.

The main outcome of the meeting was to progress the implementation an Australian sensor network test bed, being implemented in collaboration with Australian Institute of Marine Science (AIMS), The University of Melbourne, Deakin, University of Queensland, James Cook University, UTS and the University of Twente.

The awarding of NCRIS funding for the establishment of an Integrated Marine Observing System has given a significant boost to this objective. A number of Research Network participants are members of this successful proposal, further enhancing the collaborative strengths of the group.

Following a review of Research Network activities and future events, an emphasis was placed on targeting the production of journal special issues or book volumes to be derived from the individual symposiums being conducted within the flagship ISSNIP conference in 2007.

EDUCATION COMMITTEE

The ISSNIP Education Committee, under the leadership of A/Professor Arcot Sowmya and A/Professor Dinesh Kant Kumar, promoted a number of developments in the area of education.

With the aim of coordinating the education outreach program for post ISSNIP graduate students and also grooming young researchers to take up active leadership roles, the committee oversaw the conduct of a number of very successful events including:

- An Early Career Researcher Workshop on Sensor Networks
 - The inaugural ISSNIP Summer School, a short course Introduction to Sensor Networks serving as a prelude to the Summer School
 - An ISSNIP seminar series and a Bio-signals Workshop
 - Importantly, these events were all coordinated by a collection of early career researchers.
-

APPENDIX C: ISSNIP ASSISTANCE TO OTHERS

FUNDED VISITORS

The following were funded researchers:

INTERNATIONAL VISITORS:

- Prof Havinga, UTwente, The Netherlands
- Prof Stuart Milner, University of Maryland, USA
- Prof Mohan Kumar, University of Texas, USA
- Prof Mihaela Ulieru, University of New Brunswick, Canada
- Professor H Weghorn, University of Stuttgart BA, Germany
- Associate Professor K T Ko, City University of Hong Kong, China
- Jim Bezdek, University of West Florida, USA
- Dr Takuya Ito, Tohoku University, Japan
- Prof Sushil Prasad, Georgia State University, USA
- Supriyo Chatterjea, University of Twente, The Netherlands
- Avinash Sridharan, University of Southern California, USA
- Dr Andrew Brooks, University of California, Santa Barbara, USA
- Pi-Jen Liu, National Chung Hsing University, Taiwan
- A/Prof Tung-Fung Fan, NMMBA, Taiwan
- Prof Ramesh, GM Labs, Bangalore, India
- A/Prof Chee Kheong Siew, Nanyang Technical University, Singapore
- Dr Sammy Chan, City University Of Hong Kong, China
- Dr Zvi Rosberg, Ben Gurion University, Haifa, Israel
- Prof Sharat Chandran, Indian Institute Of Technology, Mumbai, India
- Liansheng Tan, Central China Normal University, Wuhan, China

AUSTRALIAN EXCHANGE VISITS:

- Sridhar Poosapadi Arjunan, RMIT University, Australia
- Ganesh Naik, RMIT University, Australia

ISSNIP TRAVEL SUPPORT

A large number of researchers were provided with travel support by ISSNIP for a collection of events ranging from international collaborative visits to attendance

at Australian ISSNIP events and research visits. A selection of these is listed below. Further support was provided in the form of event sponsorship by ISSNIP, where event organisers utilised sponsorship funding to aid the travel expenses of invited speakers (Figures are indicative only).

INTERNATIONAL COLLABORATIVE TRAVEL SUPPORT:

- D. Musicki, (MSL – Sensor Fusion), \$ 8,102
- B. La Scala, (MSL – Sensor Fusion), \$ 5,526
- N. Okello, (MSL – Sensor Fusion), \$ 6,296
- M. Morelande, (MSL – Sensor Fusion), \$ 5,254
- X. Wang, (MSL – Sensor Fusion), \$ 5,830
- M. Rezaeian, (MSL – Sensor Fusion), \$ 9,060
- Mr Stuart Kininmonth, (AIMS – Environmental Sensing) \$2,190

STUDENT DOMESTIC TRAVEL SUPPORT:

- Sayeed Ahmed (University of Western Australia) \$1000
 - Babak Prazand (University of Western Australia) \$1000
 - Debora Martins De Freitas (James Cook University) \$1000
 - Fok Hing Chi Tivive (Steve) (University of Wollongong) \$1000
 - Giang Nguyen (Anne) (University of Wollongong) \$1000
 - Babak Pazand (University of Western Australia) \$1000
 - Dr Khalid Aboura (University of Technology, Sydney) \$1000
 - Rajib Chakravorthy (University of Technology, Sydney) \$1000
 - Mohammad Momani (University of Technology, Sydney) \$1000
 - Michael Liu (University of Technology, Sydney) \$1000
-

APPENDIX D: ISSNIP MEMBERSHIP

Research Network primary participants are shown in the following table:

	Title	First Name	Last Name
1	Associate Professor	Marimuthu	Palaniswami
2*	Associate Professor	Ian	Atkinson
3	Professor	Yianni	Attikiouzel
4	Professor	Adrian J	Baddeley
5	Professor	Peter	Bartlett
6*	Associate professor	Rezaul	Begg
7	Associate Professor	Natashia	Boland
8	Professor	Abdesselam	Bouzerdoum
9	Professor	Rajkumar	Buyya
10	Professor	Subhash	Challa
11	Professor	Ron	Chen
12	Dr	Vaughan	Clarkson
13	Professor	Stuart	Crozier
14	Associate Professor	Subhrakanti	Dey
15	Dr	Gamini	Dissanayake
16*	Dr	Matt	Duckham
17	Professor	Hugh F	Durrant-Whyte
18	Professor	Rob J	Evans
19	Professor	Muralidhar K	Ghantasala
20	Professor	Doug	Gray
21	Professor	Erol C	Harvey
22	Professor	Paul	Havinga
23	Professor	Cliff	Hooker
24	Professor	S. Sitharama	Iyengar
25	Dr / Professor	Lindsay	Kleeman
26	Professor	Rao	Kotagiri
27	Professor	Mohan	Krishnamoorthy
28	Professor	Vikram	Krishnamurthy
29	Associate Professor	Dinesh	Kumar
30	Professor	Steven	Low
31*	Associate professor	Priyan	Mandis
32*	Dr	Nallasamy	Mani
33	Professor	Iven	Mareels
34	Professor	Bill	Moran
35	Dr	David C	O'Carroll
36*	Professor	Bernard	Pailthorpe
37*	Dr	Pubudu	Pathirana
38	Professor	Ian	Petersen

39	Associate Professor	Himanshu Roy	Pota
40	Dr	Daniel	Ralph
41	Associate Professor	Predrag	Rapajic
42	Professor	Andrey	Savkin
43	Dr	Len J	Sciacca
44	Professor	Aruna	Seneviratne
45	Professor	Kate A	Smith
46	Professor	Arcot	Sowmya
47	Dr	Mandayam A	Srinivasan
48	Dr	Mandyam V	Srinivasan
49	Professor	David	Suter
50	Associate Professor	David	Tay
51	Professor	Svetha	Venkatesh
52	Associate Professor	Brijesh	Verma
53	Professor	Geoff	West
54	Professor	Lang	White
55	Professor	Abdelhak M	Zoubir
56	Professor	Moshe	Zukerman

* denotes affiliate investigators

APPENDIX E: NETWORK COLLABORATIONS

The table below presents a summary of the intra-network collaborative activities of ISSNIP Network researchers.

NR no.	ISSNIP Researcher	Collaborative Activities	Collaborative Partners
1	Palaniswami	<ul style="list-style-type: none"> New research grants Joint publications Joint conf./workshop org Industry partnerships Joint visitors Joint seminars Test bed collaboration Joint research grants Joint student supervision 	<ul style="list-style-type: none"> CI: 9, 26, 2, 56, 30, 11, 36, Kininmonth(AIMS) CI: 6, 32, 29, 50, 30, Cambridge. CI: 46, 51, 10, 9, 33 CI: 10, 51, 9 UNSW, UTS, RMIT, Adelaide U, UQ, DSTO RMIT, Monash, Deakin CI: 18, 26, 31, 56, 16 CI: 2, 10, 24, 36, 26, 33, 22 CI: 32
2	Atkinson	<ul style="list-style-type: none"> New research grants Joint research grants 	<ul style="list-style-type: none"> CI: 1, S. Kininmonth (AIMS) CI: 1, 10, 24, 36, 22
3	Attikiouzel	Moved to Murdoch University	
4	Baddeley		
5	Bartlett	Network support - expat. visit	CI 12, 54
6	Begg	<ul style="list-style-type: none"> Joint publications Research collaboration 2007 conference org 	<ul style="list-style-type: none"> CI: 29, 1 CI: 1, 29, 39
7	Boland	2007 event planning	CI: 1
8	Bouzerdoum	<ul style="list-style-type: none"> 2007 Conference org. Workshop support 	<ul style="list-style-type: none"> CI: 1, 10, 29, 6 CI: 1, 10, 32, R. Cardell-Oliver (UWA)
9	Buyya	<ul style="list-style-type: none"> New research grants Joint visitors Joint conference org. 	<ul style="list-style-type: none"> CI: 1, 26, Swinburne U, Adelaide U CI: 26 CI: 46, 51, 1
10	Challa	<ul style="list-style-type: none"> New research grants Joint publications Joint research grants Industry partnerships 	<ul style="list-style-type: none"> U Melbourne U Melbourne, UNSW CI: 24, 1, 2, 36, 22 CI: 1
11	Chen	New research grants	CI: 1, 30, 56
12	Clarkson	Conference org.	CI: 54, DSTO
13	Crozier		
14	Dey		
15	Dissanayake	Collaborative research	CI: 10
16	Duckham	<ul style="list-style-type: none"> Joint workshops 2007 event planning Test bed collaboration 	<ul style="list-style-type: none"> CI: 1, 29, 22 . CI: 26, 31, 56, 1, 18
17	Durrant-Whyte	2007 conference plans	
18	Evans	Test bed collaboration	CI: 26, 31, 56, 1, 16
19	Ghantasala	Conference planning	
20	Gray	Event support	
21	Harvey	2007 event planning	
22	Havinga	<ul style="list-style-type: none"> Joint visits Joint grants 	<ul style="list-style-type: none"> CI: 1 CI: 1, 2, 36, 10

		• Joint conference/workshop	• CI: 1, 2, 16
23	Hooker	•	•
24	Iyengar	• Joint research grants • Joint editorial work	• CI: 2, 10, 36, 1, 22 • CI: 1
25	Kleeman	•	•
26	Kotagiri	• Test bed collaboration • Joint visitors • Joint grant support – sens. lab	• CI: 18, 31, 56, 1, 16 • CI: 9 • CI: 1
27	Krishnamoorthy	•	•
28	Krishnamurthy	• Joint visit	• U Melbourne
29	Kumar	• Joint workshops • Joint visitors • Joint publications • New research grants • Joint supervision	• U Melbourne • UNSW, U Melbourne • CI: 6, 1 • CI: 39 • CI: 39
30	Low	• New research grants • Joint publications	• CI: 56, 1, 11 • CI: 1
31	Mandis	• 2007 joint event planning • Test bed collaboration	• CI: 1 • CI: 18, 26, 56, 1, 16
32	Mani	• Joint publication • Joint seminars • Joint student supervision	• CI: 1 • • CI: 1
33	Mareels	• Joint grants • Joint workshops	• CI: 1 • CI: 1
34	Moran	• Joint visitors • Joint workshops • Research Collaboration	• CI: 1, 12, U Adelaide • U Adelaide • DSTO
35	O'Carroll	• Workshop support • Research collaboration	• • U Melbourne
36	Pailthorpe	• New research grant • Joint research grant	• CI: 1, 2 • CI: 1, 2, 10, 24
37	Pathirana	• Joint seminars	• U Melbourne
38	Petersen	•	•
39	Pota	• New research grants • Joint supervision	• CI: 29 • CI: 29
40	Ralph	• Joint visitor • Research collaboration	• • CI: 32, 29
41	Rapajic	• Moved to University of Greenwich, UK	•
42	Savkin	•	•
43	Sciacca	• Collaborative research	• U Melbourne
44	Seneviratne	• Joint workshop	• UNSW, U Melbourne
45	Smith	• Moved to Deakin U • 2007 event plans	• •
46	Sowmya	• Workshop/Conference org • Joint visitors • 2007 event planning	• CI: 51, 1, 9 • CI: 49 •
47	Srinivasan	• Planning for 2007	•
48	Srinivasan	• Moved to Queensland	•
49	Suter	• Joint seminars • Joint visitors	• U Melbourne • CI: 46
50	Tay	• Joint publication • Collaborative research	• CI: 1, Cambridge • UNSW, U Melbourne
51	Venkatesh	• Joint visitors • Conference org. • Joint research grants	• U Melbourne • CI: 46, 1, 9 • CI: 53

52	Verma	<ul style="list-style-type: none">• 2007 Symposium planning	<ul style="list-style-type: none">•
53	West	<ul style="list-style-type: none">• Joint research grants	<ul style="list-style-type: none">• CI: 51
54	White	<ul style="list-style-type: none">• Joint visitors• Conference org.	<ul style="list-style-type: none">• CI: 12, 1
55	Zoubir	<ul style="list-style-type: none">•	<ul style="list-style-type: none">•
56	Zukerman	<ul style="list-style-type: none">• Joint visitors• Joint research grants• Test bed collaboration	<ul style="list-style-type: none">• CI: 1• CI: 30, 11, 1• CI: 18, 26, 31, 1, 16

Note: NR (ISSNIP Network Researcher) number includes CI's (Chief Investigators) and affiliate investigators

APPENDIX F: MEDIA COVERAGE AND PUBLICATIONS

MEDIA COVERAGE

ISSNIP researchers received significant media coverage raising the mainstream profile of such Sensor Networks related research activities in Australia and around the world. The following is some of our coverage:

- Hopefuls Pitch for Venture Cash, Australian IT, June 13, 2006
- Alchemi 1.0 .NET-Based Enterprise Grid Framework Released, Grid Today, Jan. 9, 2006, San Diego, USA.
- e-science 2005 Showcases Worldwide Progress, Grid Today, Jan. 16, 2006, San Diego, USA.
- Grid Brokers and Metaschedulers: Market Overview, Gridwise Tech, Feb. 2006, Kraków, Poland.
- Making the pace in a hot new year, The Age, Melbourne and Sydney Morning Herald, Australia, Jan 31, 2006.
- It's Study Time in Australia, Hindustan Times, April 12, 2006, Delhi, India.
- GRIDS Lab Releases Gridscape II, Grid Today, May 25, 2006, San Diego, USA.
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APPENDIX G: GLOSSARY

ADFA-UNSW	Australian Defence Force Academy UNSW
AIMS	Australian Institute of Marine Science
AMSI	Australian Mathematical Sciences Institute
ANU	Australian National University
ARC	Australian Research Council
CI	Chief Investigator
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSSIP	Cooperative Research Centre for Sensor Signal and Information Processing
DARPA	Defence Advanced Research Program Agency
DEST	Department of Education Science and Training
DEST-ISL	DEST International Science Linkages Programme
DSTO	Defence Science and Technology Organisation
EuroSSC	European Conference on Smart Sensing & Context
IEEE	Institute of Electrical and Electronics Engineers
IEEE EMBS	IEEE Engineering in Medicine and Biology Society
IMOS	Integrated Marine Observing System
ISSNIP	Intelligent Sensors, Sensor Networks and Information Processing
JCU	James Cook University
LIEF	Linkage—Infrastructure, Equipment and Facilities
NCRIS	National Collaborative Research Infrastructure Strategy
NICTA	National ICT Australia
NR	Network Researcher
QPSF	Queensland Parallel Supercomputer Facility
RN	Research Network
UNSW	University of New South Wales
UQ	University of Queensland
UTS	University of Technology, Sydney
UWA	University of Western Australia
VPAC	Victorian Partnership for Advanced Computing
