ISSNIP

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

2007 ANNUAL REPORT

THE UNIVERSITY OF
MELBOURNE

ARC Research Network on Intelligent Sensors, Sensor Networks and Information Processing

CONVENOR: Associate Professor M. Palaniswami
Department of Electrical and Electronic Engineering
The University of Melbourne Parkville, Victoria, 3010 Australia
Tel: +61 - 3 - 8344 6710   Fax: +61 - 3 - 9347 1094
Email: swami@ee.unimelb.edu.au   http://www.sensornetworks.net.au

CONTENTS

CHAIRMAN'S MESSAGE

It is pleasing to note that the ISSNIP ARC Research Network has achieved significant outcomes against each of its six Strategic Themes during 2007.

There has been considerable progress in advancing the Sensor and Sensor Network science through a large number of research publications in books, book chapters, journals and conferences.

ISSNIP has established new research linkages with the European Union science community.

This Research Network has made an impressive contribution to building Australia's national capability and knowledge base in Sensor & Sensor Network technology.

This has been accomplished through industry interactions and some 26 high profile conferences, workshops, seminars and related activities. It also supported 39 international visits, bringing high calibre researchers from around the world deeper into the Network.

ISSNIP's activities in 2007 have made good contribution towards a better understanding of our environment through sensing and networking.

This has been particularly so in the Great Barrier Reef area, thus paving way for better management of some of our environmental issues in that region.

I am highly impressed with the leadership demonstrated by ISSNIP participants, associates and particularly the Convenor through his leadership of a multitude of successful activities throughout last year.

I am delighted with the outcomes of ISSNIP for 2007 and highly commend you to this Annual Report.

Dr D. (Nanda) Nandagopal

Chairman, Executive Board

ARC Research Network
Intelligent Sensors, Sensor Networks and Information Processing
March 2008

CONVENOR'S INTRODUCTION

The ARC Research Network on ISSNIP has had a very successful year, producing many significant achievements throughout 2007, effectively building on the foundations of the previous year. Taking on the recommendations and feedback from Network members and its various committees, 2007 saw the implementation of a number of new initiatives and growth in a number of areas. In particular, the ISSNIP awards program, as part of the education initiative, delivered support to PhD students and Early Career Researchers. These awards quickly produced effective outcomes in the creation of new collaborative links across and beyond the Network, as well as subsequent research outcomes.

The Third International Conference on ISSNIP, held in December 2007, was a great success, raising the standard, profile and reputation of the flagship conference series.

Many new collaborative links were formed amongst ISSNIP members and conference participants utilising the opportunity presented by a large number of high quality local and international keynote speakers.

In 2007, the ISSNIP Chief Investigators meeting was held, giving an opportunity to showcase the programs being undertaken across the Network. The highly successful meeting was attended by both local and international network members and research students.

Once again, ISSNIP supported a large number of conferences and workshops, further increasing the Network's profile among the academic and industry communities.

Network members continued to successfully attract new research funding and form valuable new links, including numerous international links to EU 6th and 7th FP projects and new international academic and industry links.

Much has been achieved through the efforts of members of the Research Network throughout 2007. Importantly, the many outcomes achieved, such as new project funding, joint publications and the creation of new collaborative links, would not have been achieved without the support of the ARC Research Network and opportunity for its members to leverage the collective resources of the Network. Thus, I present this annual report, approved by the Executive Board and thank all of those who have contributed to its success.

Associate Professor M. Palaniswami

Convenor
March 2008

Department of Electrical and Electronic Engineering
The University of Melbourne
Parkville, Victoria 3010; Australia
Ph: +61-3-83446710
Fax: +61-3-93471094
email: swami@ee.unimelb.edu.au

1. EXECUTIVE SUMMARY

The year 2007 has been very busy for the ARC Research Network on ISSNIP and the provision of time and expertise by members of the Network have been very much appreciated. The number and quality of items reported on herein is testimony to the value of the Network to those researchers.

In 2006, the Network adopted the approach of using structured Strategic Themes to achieve its vision (summarised in Figure 1 on page 12). This has been of significant benefit in helping the Network achieve focus in a research area as broad and diverse as ISSNIP. In particular, we have found the linkage of R&D activity with conferences, outreach programs and education, and an excellent flow of visiting international experts, to be quite powerful in generating valuable increases in knowledge. The Network intends to continue this practice.

A summary of 2007 outcomes against those planned from 2006 is shown in Section 4. More detail on those outcomes, and more, can be found in Section 5.

Forward plans have again been developed and intended outcomes for 2008 are provided at Section 6.

Considerable interaction with industry has been taking place and an Industry Affiliates Program has been developed for launch in 2008. The number of participants in this initiative is reflective of the importance our industry partners place on research undertaken by the Network. More detail on the broader ISSNIP industry program and the Industry Affiliates Program can be found in the industry linkage section.

The ISSNIP Annual Conference continues to provide excellent opportunities for the entire network to meet and grow from the presence of many world class researchers and users of complex sensing technology. The Conference in 2007 also hosted the first international symposium on RFID technology, which served to highlight how valuable this technology will be in the future.

World attention has been growing on environmental matters, and intelligent sensors and networks have great potential to accurately measure and monitor environmental phenomena. Several members of the Network are expert in this field and they have made a significant contribution to our improved understanding of environmental issues. Reports of their work are incorporated in multiple places in this document.

This 2007 Report contains a comprehensive synthesis of ARC Research Network on ISSNIP.

2. ISSNIP VISION AND STRATEGIC APPROACH

NATIONAL BENEFIT

The development 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 placing Australian researchers at the forefront of this development. Sensor Networks offer the ability to accurately and reliably gather vast amounts of information at low cost across a variety of environments. The development of this technology is offering new opportunities in the areas of environment, security and health.

The Research Network provides the framework for the critical interdisciplinary collaborations necessary to address the technical challenges in this area. ISSNIP thus plays a valuable role in advancing Frontier Technologies for great national benefit, in terms of the application of the technology being developed as well as the potential commercial gains for related Australian industry partners.

ISSNIP is aiding the 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.

Network members have leveraged the resources of ISSNIP through its many national and international collaborative research projects such as the DEST-ISL project on Distributed Sensor Networks to gain access to European Union 6th Framework Programme (EU 6th FP) projects such as E-Sense

in order develop new international links. Aided by joint workshops, such events have generated positive outcomes in the form of new project proposals and links to EU 7th FP projects. Network links to Great Barrier Reef environmental sensing projects, through the DEST-ISL project and the NCRIS-Integrated Marine Observing System (IMOS) project have given members the opportunity to be part of new related proposals that add another dimension to already successful collaborative partnerships, linking up with new Australian research partners as well as international academic and industry partners. These outcomes have been aided by ISSNIP support of joint workshops and meetings, building on the strong foundation of interdisciplinary collaborative links of the Network. In undertaking these new projects, ISSNIP researchers continue to successfully advance national interests in the development of Frontier Technologies.

Research collaborations with DSTO on defence related applications, including geo-location, sensor fusion and unmanned aerial vehicle development serve to enhance the national security and defence capabilities with respect to the challenge of monitoring Australia's vast border regions. These links are reinforced by the access to international expertise in this area provided through ISSNIP support of world leading keynote speakers undertaking related works in Europe and the USA.

International involvement in the ISSNIP Research Network continues to grow with an ever increasing profile generated

through the 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 numerous awards, roles on Journal editorial boards and international societies, together with continued invitations for plenary/keynote talks. Australia's position at the forefront of sensor network technology development is made possible 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 national 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.
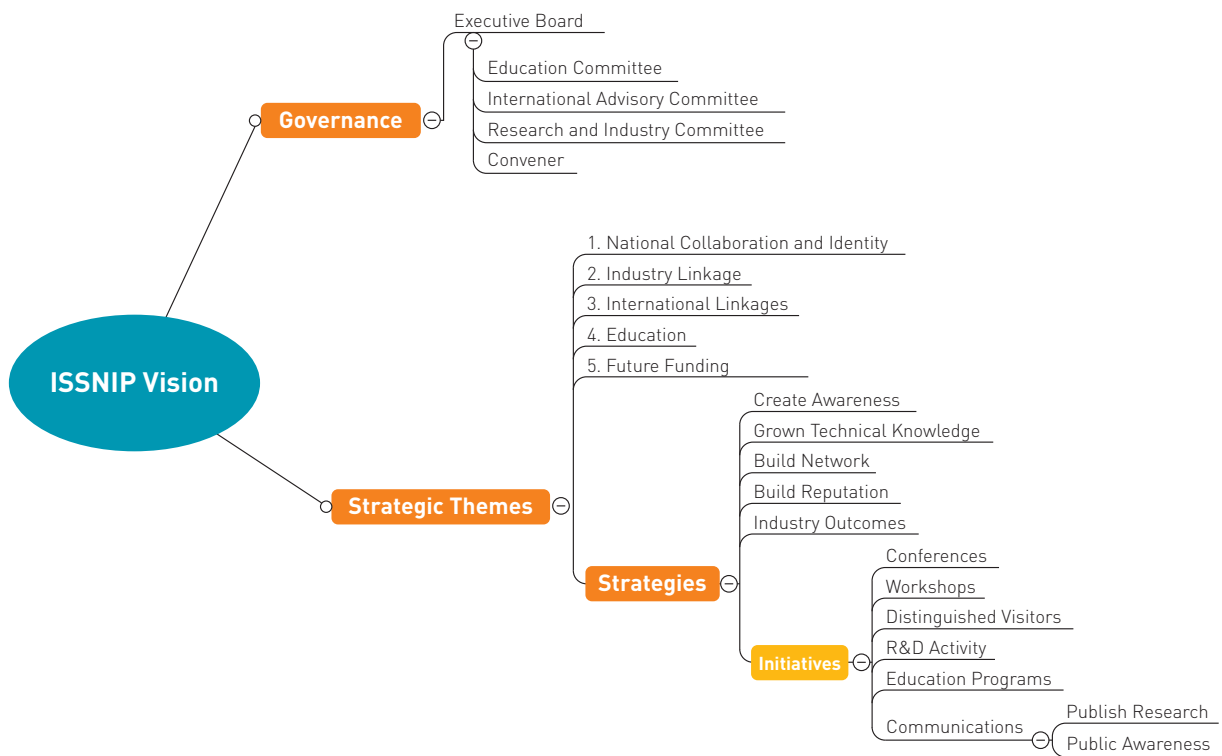
Figure 1: Achieving the ISSNIP Vision

3. 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.
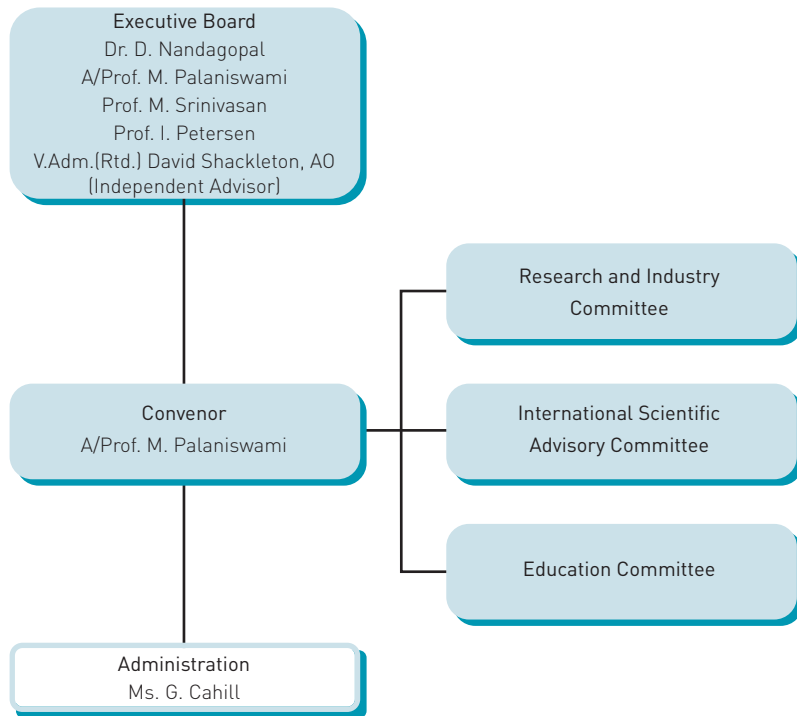
Figure 2: ISSNIP Senior Governance

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 (Policy and Programs) 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). The Executive Board included Vice Admiral (Retired) David Shackleton, AO, as an independent advisor.

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 A.

4. SUMMARY OF 2007 ACHIEVEMENTS

PLANNING FOR 2007

In 2006 the Network reported that it had adopted a series of Strategic Themes (see Figure 1) that formed the basis of planning and supporting activities to drive the direction of the network. This has proved to be very successful.

More detail of the Network's outcomes is provided in Section 5, and planned outcomes for 2008 are shown in Section 6.

The following table summarises achievements of the Network for 2007 against its objectives developed in the 2006 Report.

THEME 1: NATIONAL COLLABORATION AND IDENTITY

The conduct of a workshop in Queensland (Great Barrier Reef)	Replaced with Melbourne workshop. Queensland event to be held in 2008
Further developments to the website	Improved usage and layout. New layout to be launched in 2008.
Planning for several journal special issues and book.	Continuing through 2008.
Promote the activities of ISSNIP groups.	Undertaken through Linkage report publication.

THEME 2: INDUSTRY LINKAGE

Industry Linkage grants/DARPA grant applications.	New grants obtained. See grant applications.
Talks with iOmniscient Pty Ltd for a Linkage Grant on Visual Sensor Networks.	Application being submitted in 2008 round.
Building upon the work undertaken with these partners, plans for further collaborative efforts are expected to arise with new Network partners becoming involved.	Achieved through multiple new grant proposals being submitted in 2008.

THEME 3: INTERNATIONAL LINKAGES

The Third International Conference on ISSNIP will be held in Melbourne during November 2007.	Very successfully completed. See conference report.
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.	Successfully completed. See conference report.
The ISSNIP International Video Conference Seminar Series	Video conferencing utilised for selected presentations in the ISSNIP seminar series.
ISSNIP networking awards for Early Career Researchers and Post-Graduates.	Successfully implemented. See ISSNIP awards program.

THEME 4: EDUCATION

Post-graduate and Early Career Researcher (ECR) Workshops	Successfully completed.
Sensor Networks for secondary schools	Ongoing development. Under review.
Development of Sensor Networks Lab facility.	Ongoing development. See Rowden-White
Additional focussed workshops are being planned.	High number of workshops conducted. See workshop report.
ISSNIP Undergraduate Project Awards	Successfully implemented. See ISSNIP awards program.

THEME 5: FUTURE FUNDING

ARC LIEF grant proposal (from 2006)	Made reserve list. Will be resubmitted in 2008.
Discussions on a new proposal for European Framework are progressing.	Links established with EU 7th FP project SENSEI.
Proposal for a new Indo-Australian collaborative project on Sensor Networks for healthcare and rural sector is underway having been postponed from 2006.	Postponed. Under review.
A number of joint funding proposals are expected from Hong Kong, USA, Italian and Australian funding sources.	See Funding section. Additional proposals occurring through 2008.
A joint proposal to NSF 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.	Not Awarded
Proposal planned for AOARD funding to support ISSNIP 2007.	AOARD sponsor for 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.	Grant awarded. Project underway.

THEME 6: NEW INITIATIVES

ISSNIP Awards Program	Successfully implemented. See Education section.

ISSNIP

5. ACHIEVEMENTS FOR 2007

OVERVIEW

The ARC Research Network on ISSNIP has once again made significant progress in advancing the interests of Australian research in sensor networks and related areas. The progress achieved under each of the strategic themes demonstrates the effectiveness of the ISSNIP framework. Some of those achievements are described here.

Significant progress has been made in each of the five strategic priority areas:

- The international profile of the Research Network continues to grow, evidenced by the success of the third international conference in the ISSNIP series and the number and quality of the international keynote speakers. The number of ISSNIP supported workshops and conferences increased. The involvement of ISSNIP members in a number of successful funding proposals is also testimony to effective collaboration being fostered by the Network and profile now established by ISSNIP. The ISSNIP CI's meeting also successfully met the objectives of this theme in facilitating new national and international collaborative links (Strategic Priority 1).

- ISSNIP has continued to create new industry linkages through various projects that are being established, notably through ISSNIP's participation in various Great Barrier Reef projects with partners including (Milan Polytechnic University, Torino Wireless Foundation, James Cook University, the Danish Hydraulics Group and the Queensland Cyber Infrastructure Foundation). Interest is already being expressed in the soon to be launched ISSNIP Industry Affiliates program. (Strategic Priority 2).

- ISSNIP has established a successful network of international collaborators. This program has continued to grow with new linkages being formed including new links to EU 7th FP project partners, with a joint workshop to be held in mid-2008, as well as new US links with a joint ISSNIP-US workshop also proposed. Additional international project links have been formed through GBR work mentioned above. The number of international visitors and joint publications also demonstrate progress in the area. (Strategic Priority 3).

- ISSNIP has continued to run successful post-graduate and early career researcher workshops and related events. The ISSNIP Awards program was successfully been established, with 12 awards distributed and significant outcomes achieved by the recipients as result of this support, with presentations by recipients given at the ISSNIP CI's meeting. (Strategic Priority 4).

- ISSNIP has successfully utilised the collaborative framework of the Research Network to attract new research funding, leveraging the expertise and profile of the Research Network and its members. This is evident in growing number of nationally and internationally funded research projects. (Strategic Priority 5).

Our achievements against our five strategic themes and strategies are aggregated and shown in the following summary of activities.

INITIATIVE	NUMBER
Active participants	175
- ECRs and Post-grads funded (includes 27 ISSNIP 2007 poster-abstract session participants)	54
Events conducted/supported	
- Conferences	7
- Workshops	9
- Education Programs (includes ISSNIP Seminar Series as single program)	5
- Collaborative Meetings	5
International Visits	62
Significant Publications	
- Books/Book Chapters	8
- Journal articles	10
- Conference Papers	39
Targeted activities (including education programs)	32
Media Reports	6
New Grants	11
Universities Receiving Funding	12

Table 1: Summary of Initiatives for 2007

More details of ISSNIP support provided for researcher travel funding is provided in Appendix B. A detailed listing of publications and other media exposure is given in Appendix E.

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.

IDC2007 - INFORMATION, DECISION AND CONTROL

Australia 11-14th February 2007, Adelaide Hilton, Adelaide, Australia

Keynote and Plenary Speakers were:

Number of Attendees: 153 (34 students, ~30 ECR)

The aim of IDC 2007 was to bring together scientists, engineers and mathematicians working across the disciplines of signal processing and communications, decision and control, and data and information fusion. Progress in these disciplines is critical to the successful implementation of large interconnected and distributed systems such as military C4I systems, communication networks, distributed sensor networks, large scale distributed control systems, and multi-platform autonomous vehicle applications. IDC 2007 was structured along the lines of similar multi-conferences held

ISSNIP

over recent years around the world. It provided technically strong symposia for each of the core disciplines with significant overlap and interaction between the various groups. The conference theme in 2007 was "The Challenge of Distributed Systems" with three supporting theme streams in: Distributed Test, Training and Experimentation; Distributed Radar Systems; and Uninhabited Airborne Systems: Toward True Autonomy.

12th INTERNATIONAL COMS CONFERENCE COMS2007

September 2-6 in Melbourne

Plenary speakers (among others):

- Professor Yoshinobu Baba - Department of Applied Chemistry, Graduate School of Engineering, Nagoya University
- Clive Davenport - President MANCEF, CEO Small Technologies Cluster, Managing Director MNT Innovations, Melbourne, Australia
- Dr Kees Eijkel - CEO Kennispark, Twente, Enschede, Netherlands, an organisation that is responsible for commercialisation and related area development
- Professor Masayoshi Esashi - Director of Micro/Nanomachining Research and Education Center in Tohoku University, Japan
- Dr Erol Harvey - CEO, miniFAB (Australia) and Professor of Microtechnology at Swinburne University of Technology in Melbourne, Australia (ISSNIP CI)
- Dr Abid Khan - Director, Monash Institute for Nanosciences, Monash University, Melbourne, Australia

COMS is the leading international conference on the commercialisation of micro and nano technologies. The conference addresses the issues of opportunity realisation - from research, technology transfer, manufacturing processes, facilities, infrastructure, investment, applications and markets, to unique issues such as regulatory, social implications, education and workforce development.

COMS2007 brought together leaders from all over the world and every sector of the supply chain - from high tech companies, national labs, regional development and government agencies, investment and consulting groups, market researchers, educationalists and students - all sharing, learning and creating partnerships in an open interactive environment.

There were 3 categories of participants due to the structure of the conference.

- Registered conference delegates – 363
- Teachers, students and general public at "Education Day" – 80
- Engineers Australia Breakfast – 80
- Including at least 15 fully identified post and under-grad students, over 25 secondary school students

Outcomes: Greater appreciation of issues involved in commercialising small technology products diffused into the Australian research and business community; as well as greater understanding of the ethical, societal and health risks and impacts. Collaborative projects and closer interactions are being developed with international groups such as Orange County Science Centre (California), AIST (Japan) Sandia National Laboratories (USA),

the Micromachine Centre (Japan), IMEC (Belgium) and the MESA+ Nano Institute (Netherlands) as a result of the conference, site visits and meetings held post the conference - but organised as an integral part of the conference. A collaboration has been established between Victoria's Department of Primary Industries and Grape Networks (USA). NanoVic's "NanoBits" education kit is being evaluated as an educational tool in the USA. A collaboration has developed between Mexico and Australia with respect to the Cooperative Research Centres Program.

The conference delivered an enhanced global reputation as seen from the large amount of feedback regarding the impressive amount and quality of Australian scientific achievements and endeavours in nano-micro-bio technologies.

THE 5th ACM CONFERENCE ON EMBEDDED NETWORKED SENSOR SYSTEMS (SENSYS)

6-9 November, Swissotel, Sydney, Australia

General Chair: Sanjay Jha, University of New South Wales

The 5th ACM Conference on Embedded Networked Sensor Systems (SenSys) is a highly selective, single-track forum for the presentation of research results on systems issues in the area of embedded, networked sensors. The hosting of a leading international conference in Sensor Systems offered valuable exposure to ISSNIP as the focal point of Sensor Network research in this region. As part of the conference program an ISSNIP sponsored PhD colloquium was also conducted.

19th NATIONAL CONFERENCE OF THE AUSTRALIAN SOCIETY FOR OPERATIONS RESEARCH

3-5 December, 2007, RMIT University, Melbourne, Australia

"Theme: Operations Research for Today and Tomorrow"

Keynote Speakers
- Assoc. Prof. Natashia Boland, University of Melbourne. Director: Melbourne Operations Research (ISSNIP CI)
- Professor Reuven Rubinstein, Technion - Israel Institute of Technology, William Davidson Faculty of Industrial Engineering and Management
- Professor Michael Trick, Carnegie Mellon University, Professor of Operations Research, Tepper School of Business and Vice President IFORS, North America

Invited Speakers
- Dr. Barbara M. Smith, Reader, School of Computing, University of Leeds
- Assoc. Prof. Moshe Sniedovich, University of Melbourne, Department of Mathematics and Statistics

ISSNIP Talk: Dr. A. Shilton, University of Melbourne.

The 19th National Conference of the Australian Society for Operations research featured a number of invited sessions and contributed papers on all aspects of operations research in the modern world, including (but not restricted to) critical international issues such as environmental problems, major industrial concerns like supply chain management and modern methods of communication which can be used in the shared teaching of operations research.

The ASOR National Conference had 106 participants of which 26 were early researchers, 15 of whom were support by ISSNIP to attend. ISSNIP support was also utilised for invited visitors: Prof. Barbara Smith (UK) giving a plenary talk on Constraint Programming; along with some of the other senior researchers in this area such as Joachim Schimpf (Europe). ISSNIP support also enabled an embedded program on Constraint Programming/Hybrid OR Methods and their Applications at the ASOR conference.

3rd INTERNATIONAL CONFERENCE ON INTELLIGENT SENSORS, SENSOR NETWORKS AND INFORMATION PROCESSING

3-6 December 2007, Langham Hotel, Melbourne, Australia

Chair: A/Prof. M. Palaniswami

Keynote speakers:
- Prof. Rob Evans (NICTA/University of Melbourne)
- Prof. Nitish Thakor (Johns Hopkins University, USA)
- Prof S. Jagannathan (University of Missouri-Rolla, USA)
- Prof. Vijay Varadan (Pennsylvania State University, USA)
- Dr. Ronald Mahler (Lockheed Martin Tactical Systems, USA)
- Prof. Mohan Trivedi (University of California, San Diego, USA)
- Prof. Hugh F. Durrant-Whyte (University of Sydney)
- Prof. Alex Zelinsky (CSIRO)
- Prof. Sally Holbrook (University of California, Santa Barbara, USA)
- Prof. Ian Marshall (Lancaster University, UK)
- Prof. Anibal Ollero (University of Seville, Spain)
- Prof. Stuart Milner (University of Maryland, USA)
- Prof. Mohan Kumar (The University of Texas, Arlington, USA)
- Dr. Andy Coon (BBN Technologies, USA)

Tutorials:
- Dr. Christopher R. Wren (Mitsubishi Electric Research Laboratories, USA)
- Dr. Ganesh Kumar Venayagamoorthy, and Raghavendra Kulkarni (University of Missouri-Rolla, USA)

ISSNIP 2007, the Third conference in the ISSNIP series and flagship event of the Research Network was once again a great success attracting a large number of high profile international speakers and quality papers from around the world. It was organised as a collection of Symposiums encompassing the priority research themes of ISSNIP together with tutorials and a selection of workshops, with the main technical program split into oral and poster presentations. Included in the social program was welcome cocktail function at the Langham's Alto room overlooking the city and the Yarra precinct below in addition to a well received banquet dinner at Docklands. Receiving 203 valid submissions, the technical program committee accepted 128 papers for publication, following the peer review process. Of the accepted papers 63 had a student as first author. The total attendance was 275 (237 ISSNIP, 38 RFID) in addition to those attending the ICIAfS and IVRI co-conferences. The conference also awarded a best paper and best student paper, based on nominations from the Symposium Chairs and further

ISSNIP

review by the selection committee (including a number of international keynote speakers).

Positive feedback was received and a significant number of new collaborative links have been established. Other direct outcomes include the planning for new events (workshops/meetings) in 2008, as well as new research proposals and corresponding funding applications, details of which appear throughout this report. The efforts of the Organising Committee, Symposium Chairs and Technical Program Committees have set high standard for the conference, which is aiming to be surpassed at the ISSNIP 2008 conference hosted in Sydney.

ISSNIP Co-Conferences:

THIRD INTERNATIONAL CONFERENCE ON INFORMATION AND AUTOMATION FOR SUSTAINABILITY: ICIAFS2007

4-6 December 2007, Langham Hotel, Melbourne, Australia

SECOND INTELLIGENT VEHICLES AND ROAD INFRASTRUCTURE CONFERENCE: IVRI'07

6 December 2007, Langham Hotel, Melbourne, Australia

Chairs: Professor Harry C. Watson, Department of Mechanical and Manufacturing Engineering, University of Melbourne, Australia; A/Prof S. Halgamuge, Department of Mechanical and Manufacturing Engineering, University of Melbourne, Australia

Held alongside ISSNIP 2007, the ICIAfS and IVRI conferences offered joint access to the respective conferences, shared keynote talks and breaks. This enabled a greater multi-disciplinary interaction across the three events. The plenary speaker for ICIAfS was Clarence W. de Silva, P.Eng., Fellow ASME, Fellow IEEE, and Fellow Canadian Academy of Engineering, and Professor of Mechanical Engineering at the University of British Columbia, Vancouver, Canada. Sponsored by the IEEE Systems, Man and Cybernetics Society, IEEE Computational Intelligence Society and SAE, the conferences featured 29 presentations across three days including sessions on: Adaptive Control; Monitoring for fault tolerant control; Applications of AI; AI and Cognition in Automation; Swarms and Networks; Intelligent Signal Processing; and Automated Vehicles.

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.

ISSNIP/ISPRS JOINT INTERNATIONAL WORKSHOP ON DISTRIBUTED GEOINFORMATICS AND SENSING, UBIQUITY, AND MOBILITY

19 September 2007, co-located with COSIT'07, at Mount Eliza, Melbourne, Australia.

Distributed Geoinformatics '07, chaired by Matt Duckham (ISSNIP AI), Arie Croitoru, and Peggy Agouris, and Sensing, Ubiquity, and Mobility '07, chaired by Lars Kulik (ISSNIP AI) and Egemen Tanin (ISSNIP AI)) with Patrick Laube (ISSNIP AI) as the local organiser.

Workshop Keynote Speaker:

- Dr Pavan Sikka (CSIRO ICT Centre, Queensland Centre for Advanced Technologies (QCAT), Pullenvale, QLD, Australia)

Invited speakers:

- Antoine Desmet (University of Wollongong, Australia)
- Daniel T. H. Lai (The University of Melbourne, Australia)
- Ickjai Lee (James Cook University, Australia)
- Antoni Moore (University of Otago, New Zealand)
- Femke Reitsma (University of Edinburgh, United Kingdom) and Matt Duckham (The University of Melbourne, Australia)
- Muhammad Jafar Sadeq (The University of Melbourne, Australia)

This one-day workshop was concerned with new advances in both the theory and applications of distributed spatiotemporal information processing and analysis. Specifically, the workshop aimed to bring together researchers with interests in spatial information theory and researchers with interests in specific spatial application domains, such as ecology, natural resource management, and marine science; transportation and human navigation; and emergency management and logistics. The workshop included papers from around Australia, the UK, France, Korea, USA, and New Zealand.

The timing of the workshop, scheduled as a pre-COSIT workshop, provided the opportunity to take advantage of additional high-profile attendees from the international spatial information theory community. dg/sum'07 hosted 19 subscribed attendees. ISSNIP co-sponsorship enabled the provision of travel support scholarships and subscription packages for students.

Following a successful workshop, the organisers are producing a special issue of the Elsevier journal Computers, Environment, and Urban Systems - Special Issue on Distributed and Mobile Spatial Computing

EMBEDDED NETWORKING WORKSHOP

6th September 2007, NICTA ATP Laboratory

- Prof. Jim Kurose (University of Massachusetts)
- Prof. Jennifer Rexford (Princeton University)
- Prof. Nick McKeown (Stanford University)
- Prof. Serge Fdida (University Pierre and Marie Curie)

- Dr. Renata Teixeira (LIP6 (Laboratoire d'Informatique de Paris 6))
- Dr. Christophe Diot (Thomson Technology)

Featuring keynote talks by international experts, topics included: Collaborative Adaptive Sensing of the Atmosphere; Virtual Network Infrastructure; among others. Additionally, the workshop included a tour of the NICTA ATP Laboratory.

THE 51st ANNUAL MEETING OF THE AUSTRALIAN MATHEMATICAL SOCIETY

25-28 September, 2007, La Trobe University, Melbourne, Australia

The plenary and keynote talks included:

- Steve Wright, University of Wisconsin-Madison, USA (Plenary)
- Andy Philpott, University of Auckland, NZ (Keynote)
- Jerzy Filar, University of South Australia (Keynote)
- Danny Ralph, University of Cambridge, UK (Keynote) (ISSNIP CI)

Special Session on Optimisation and Operations Research organised by Phil Howlett (University of South Australia) and Natasha Boland (University of Melbourne) (ISSNIP CI)

ISSNIP support for this event included funding for plenary and keynote speakers, Steve Wright and ISSNIP CI Danny Ralph, which then provided a platform for further collaborative meetings. Attended by 198 researchers, the link to ISSNIP represents the diverse interdisciplinary coverage of the Research Network required to address its research challenges.

SENSORS FOR THE GREAT BARRIER REEF - WORKSHOP.

In conjunction with ISSNIP 2007

Monday, December 3, 2007, Langham Hotel, Melbourne

Speakers:

- Ron Johnstone (University of Queensland)
- Ian Atkinson (James Cook University)
- Scott Bainbridge (Australian Institute of Marine Science)
- Stuart Kininmonth (Australian Institute of Marine Science)
- Yee Wei Law (The University of Melbourne)
- Sutharshan Rajasegarar (The University of Melbourne)
- Johan Kuperus (The University of Twente, The Netherlands)

The Sensors for the Great Barrier Reef - Workshop was a working group meeting with the aim of identifying the ongoing research and implementation challenges faced by sensor network deployments in the Great Barrier Reef. In addition, it served to illustrate the opportunities for researchers interested in this area to be able to evaluate the sensor networks developments in the corresponding deployments. It was attended by researchers, from the research network as well as attendees of the conference.

WORKSHOP ON OPTIMISATION IN SENSOR NETWORKS

Monday, December 3, 2007, Langham Hotel, Melbourne

Co-Chairs: Adil Bagirov (Ballarat University) and Daniel T.H. Lai (The University of Melbourne) – (ISSNIP AI's)

The workshop on Optimisation in Sensor Networks was held on the 3rd of December, 2007 in conjunction with the 3rd International ISSNIP conference. The workshop objective was to bring together Australian and international researchers to discuss recent Optimisation problems in sensor networks that required further attention and scrutiny. Optimisation issues covered in this area included localisation in sensor networks, energy efficiency schemes, optimal sensor placement for tracking and scheduling for optimal sensor coverage. There were 6 presentations in the workshop on topics ranging from optimal node placement to non-smooth Optimisation techniques for localisation. The presentations were followed by a discussion session. The workshop was attended by over 30 participants with almost 10 students. Several interesting topics concerning practical implementations of Optimisation algorithms in sensor networks were brought up during the discussion session. This session was actively attended by postgraduate students who were keen on discussing possible solutions to their research problems. The workshop resulted in active student participants and new partnerships. For example, collaboration between Melbourne University and Ballarat University in the area of 3D sensor network localisation were enhanced with new interest from participating researchers. It is expected that this collaboration would lead to future publications and grant opportunities.

THE FIRST INTERNATIONAL SYMPOSIUM ON RFID TECHNOLOGY - RESEARCH CHALLENGES AND INDUSTRY PERSPECTIVES

In conjunction with ISSNIP 2007

December 5th, 2007, Langham Hotel, Melbourne, Australia.

Chair: Kate Smith-Miles (Deakin University, Australia) (ISSNIP CI), Robin Doss (Deakin University, Australia)

- Gordon Buchan, IBM Sensors and Actuators Solutions group, Sales Lead - Australia/New Zealand
- Ken Evers, Victorian Department of Primary Industries, Biosecurity Division, Animal Standards Branch
- Ken Laing PNIA, ACIS, VP Sales and Business Development, Magellan Technology
- Kevin Larnach, Principal, Convergent Solutions, Telstra Enterprise & Government
- Steven D Perera, President & CEO, Regni Group of Companies
- Kelvin Slade, Systems Solutions Division, NEC
- Chester Wang, APAC RFID & Embedded Solution Manager, Oracle APAC, Emerging Technology

In bringing together RFID researchers and practitioners from academia, industry and government to discuss recent developments in RFID systems and technology, this event served to identify key research challenges in the design, operation, analysis, practical application and Optimisation of RFID systems that are relevant from an industry-oriented perspective. The symposium featured invited speakers from industry and government who provided valuable insight into

RFID research going forward. Topics covered included RFID technologies, standards, security and privacy, strategic issues, applications and information management. Held in conjunction with ISSNIP 2007, the RFID symposium had 38 delegates from academia and industry with 7 higher degree research students and 8 early career researchers. Further information are supplied in the Industry Linkages section.

INVITED WORKSHOP SELF-ORGANISING NETWORKS

Thursday, December 6th 2007, Langham Hotel, Melbourne, Australia

Chairs: Stuart Milner, University of Maryland (USA) and Sylvie Perreau University of South Australia.

This invited workshop, a joint ISSNIP-ACORN event took place during the final day of the ISSNIP conference in conjunction with the Symposium on Autonomous Configurability. Drawing together a high calibre audience to identify the collaborative research potential, the success of the event is easily measure in the outcomes of an NSF proposal for a joint ISSNIP-US workshop in 2008 and also plans for future a project proposal in the area.

MT LOFTY 2007

December 7th to 9th, Mt Lofty House, Adelaide Hills

Mt Lofty 2007 incorporated two events: The 2nd Neural Stem Cells & Frontier Technologies for Brain Repair Workshop and The 2nd Australian Workshop on Computational Neuroscience. It was hosted by the University of Adelaide's Computational Neuroscience Research Cluster (CNRC).

Convenors: Dr Simon Koblar and Assoc. Prof. David O'Carroll (ISSNIP CI)

Workshop coordinators: Christine Barry and Alison Wigg.

The workshop addressed four major themes:

- Computational neuroscience
- Neural stem cell biology
- Frontier technologies for brain repair
- Translation into clinical practice

Key Australian and international researchers participated, from fields including Computational Neuroscience, Bionics, Electrical and Electronic Engineering, Genetics, Medicine, Nanotechnology, Neurology, Neurosurgery, Pathology, Psychology. Fifty-six researchers attended, including 22 who are early career researchers or PhD students.

There were many positive outcomes of this year's event. The workshop consolidated and extended cross-institutional and cross-disciplinary research collaborations and facilitated the development of new collaborations. Participation by a number of ARC and NH&MRC review panel members provided a valuable opportunity for participants to discuss the strengths and weaknesses of potential new projects. Early career researchers benefited through the dissemination of current work and the opportunity to build important research relationships. Tangible outcomes include cross-institutional laboratory visits (both interstate and international) and several new joint funding submissions from new research collaborations developed during this workshop. New joint applications include at least one Human Science Frontiers Program grant application and a number of NHMRC applications in the current round. A 2008 Mt Lofty workshop is currently being planned

INTERNATIONAL WORKSHOP ON MOBILE COMPUTING TECHNOLOGIES FOR PERVASIVE HEALTHCARE 2007

10th and 11th of December, 2007 Phillip Island, Melbourne, Australia

Workshop Chair: Dr. John Q. Fang, RMIT University; Workshop Co-Chair: A/Prof. Dinesh Kant Kumar, RMIT University (ISSNIP CI), Dr. Horace King, IEEE Victoria Section; Honorary Chair: Prof. Irena Cosic, RMIT University; Honorary Co-Chair: A. Prof. M. Palaniswami, University of Melbourne

Keynote Speakers:

- Prof. Metin Akay
- Prof. Emil Jovanov
- Prof. N Thakor
- Prof. Jayadeva
- Dr. A Coon

The pervasive healthcare and its delivery largely rely on the mobile computing, embedded and wearable technologies, wireless networks, sensor technologies, medical information system and other advanced technologies. This workshop, attended by 28 researchers, discussed a set of related technologies that can be effectively utilised to design and implement new emerging pervasive healthcare delivery systems. It also provided a forum for interaction between Australian researchers and world leading researchers in this area as well as industry participants.

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 PHD STUDENTS IN SIGNALS & SYSTEMS WORKSHOP

April 12-13, University of Melbourne, Australia. Coordinator: Prof. D. Nesic

The ISSNIP PHD workshop in signals and systems gave postgraduate students an opportunity to present their work to an audience consisting of academics and their fellow students. The two day program included 25 presentations across a range of topics including:

- Bio-medical applications
- Networked control systems
- Estimation and control
- Nonlinear control
- Signal processing and telecommunications
- Optimisation and numerical methods

With a total attendance of 50 people, the presenters were drawn from around the country, with students and academics attending from the University of Melbourne, University of Newcastle, ANU, DSTO and ADFA-UNSW.

While only students were presenting talks, many academics attended all sessions and provided feedback to students on their work and facilitated the discussions after each talk. There were 6 sessions with a range of topics ranging from biomedical applications to control over networks and telecommunications.

As control and signal processing are enabling technologies, they are relevant to a range of various engineering applications including sensor networks that

ISSNIP

is the focus of ISSNIP activities. One whole session of the workshop was dedicated to control of systems over networks. The workshop allowed students to present their work in front of a very high quality audience and this atmosphere facilitated the discussions that provided invaluable feedback to students on their work. Very positive feedback was obtained regarding the organisation and quality of the talks from students and academics alike.

SENSYS 2007 DOCTORAL COLLOQUIUM

Tuesday, 6 November 2007, University of Sydney, Australia

The SenSys 2007 Doctoral Colloquium supported by ISSNIP, saw twelve student presentations of an overview of their topic, followed by dedicated discussion time with a panel of experts. The Panelists and Advisory Committee included:

- Jan Beutel (ETH)
- Nirupama Bulusu (Portland State)
- John Heidemann (University of Southern California)
- Phil Levis (Stanford)
- Lama Nachman (Intel Research)
- Mani Srivastava (University of California, Los Angeles)
- Kamin Whitehouse (University of Virginia)

Chairs:

- Mike Hazas (Lancaster University)
- Athanassios Boulis (National ICT Australia)
- Lewis Girod (Massachusetts Institute of Technology)

ISSNIP SEMINAR SERIES

Location: The University of Melbourne. Coordinator: Dr Yee Wei Law.

The introduction of the ISSNIP Seminar Series in 2007 presented a regular forum for local and visiting Australian and international researchers to present current research. This year's seminar series introduced video conferencing for simultaneous presentations to the Melbourne audience and the local audience of the visiting researcher. Discounting time-zone challenges, the trial successfully enabled discussions between the two audiences following the presentation.

Once again, the seminars given by distinguished visitors were interspersed with those delivered by local researchers proving to be a useful medium in which to obtain feedback on research work. The series was 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 continues to 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.

ISSNIP AWARDS PROGRAM

The ISSNIP Awards program was a new initiative established to support emerging researchers through the facilitation of collaborative activities.

Three types of awards are given out, including:

- ISSNIP Undergraduate Project Awards
- ISSNIP Postgraduate Networking Awards
- ISSNIP Early Career Researcher (ECR) Networking Awards

This year 4 ECRs and 6 post graduate students received awards. Also, 2 groups of under graduate students who are supervised by ISSNIP CI's and affiliates received awards. Awardees were given the opportunity to make a presentation of their progress during a poster session at the ISSNIP CI's meeting, while also forming new links though attendance at ISSNIP 2007. Significant progress has been made by award recipients in terms of international peer reviewed publications enabled through the support provided by the awards to obtain access to external researchers and undertake collaborative work. A number of recipients have reported the formation of new collaborative links both within and beyond ISSNIP as a direct result of support provided by this Research Network program, with invitations to visit laboratories in the USA one such example. The Awards program has successfully enabled recipients to forge strong collaborative links across the country, resulting in important research advances.

Following are the list of successful recipients of the 2007 ISSNIP scholarship awards.

Name/Type of Award	Levin Kuhlmann, ECR
Supervisors / ISSNIP Collaborators	Prof. Iven Mareels
Title	Develop bio- and MR-compatible polymer-based electrodes for EEG recording and electrical brain implants, through collaboration with Australian polymer groups
Affiliation	The University of Melbourne
Name/Type of Award	Rinku Panchal, ECR
Supervisors / ISSNIP Collaborators	A/Prof. Brijesh Verma
Title	A Novel Pattern Classification Technique for the Diagnosis of Breast Cancer
Affiliation	Central Queensland University
Name/Type of Award	Russell Brinkworth, ECR
Supervisors / ISSNIP Collaborators	A/Prof. David O'Carroll
Title	Testing Bio-inspired Motion Detection Models
Affiliation	University of Adelaide
Name/Type of Award	Stuart Kininmonth, ECR
Supervisors / ISSNIP Collaborators	A/Prof. Ian Atkinson
Title	Travel for Sensor Networks in the Great Barrier Reef project
Affiliation	Australian Institute of Marine Sciences
Name/Type of Award	Freestone & Peterson, Postgraduate Student
Supervisors / ISSNIP Collaborators	Prof. Iven Mareels A/Prof. M. Palaniswami
Title	Workshop in Neuroengineering, 2008
Affiliation	The University of Melbourne
Name/Type of Award	Ganesh Naik, Postgraduate Student
Supervisors / ISSNIP Collaborators	Prof. Dinesh K Kumar
Title	Source localisation using Under complete Independent Component Analysis (ICA)
Affiliation	RMIT
Name/Type of Award	Olga Bondarenko, Postgraduate Student
Supervisors / ISSNIP Collaborators	Prof. Michael Kingsford
Title	Applying Electronic Sensor Network in Marine Environment
Affiliation	James Cook University
Name/Type of Award	Shivali Goel, Postgraduate Student
Supervisors / ISSNIP Collaborators	Dr Jemal Abbawajy
Title	Energy-Efficient Communication Protocol for Underwater Acoustic Sensor Networks
Affiliation	Deakin University
Name/Type of Award	Steven Wiederman, Postgraduate Student
Supervisors / ISSNIP Collaborators	A/Prof. David O'Carroll
Title	Cross-compatibility between Bio-inspired Elementary Small Target Motion Detection (eSTMD) and Traditionally Engineered Solutions for Target Detection and Tracking
Affiliation	University of Adelaide
Name/Type of Award	Syed Z Hassan, Postgraduate Student
Supervisors / ISSNIP Collaborators	A/Prof. Brijesh Verma
Title	A Hybrid Data Mining Approach for Knowledge Extraction and Classification in Medical Databases
Affiliation	Central Queensland University
Name/Type of Award	Chong, Chen & Chan, Undergraduate Student
Supervisors / ISSNIP Collaborators	Dr. Daniel Lai
Title	GAIT shoe: A smart wireless sensor device for monitoring and tracking gait patterns
Affiliation	The University of Melbourne
Name/Type of Award	Nandika Thapar, Undergraduate Student
Supervisors / ISSNIP Collaborators	Prof. Erky Dutkiewicz
Title	Design, Implementation and Optimisation of ZigBee Wireless Sensor Network Routing and Channel Access Algorithms for Industrial Control Applications
Affiliation	Wollongong University

ISSNIP

COURSE AND LABORATORY DEVELOPMENT

The successful efforts of ISSNIP researchers in developing related educational infrastructure for undergraduate and postgraduate programs has been reported in the literature, as indicated below.

SUM (sensing, ubiquity, mobility) lab

Lars Kulik, "Mobile Computing Systems Programming: A Graduate Distributed Computing Course", IEEE Distributed Systems Online, vol. 8, no. 5, 2007, art. no. 0705-o5004.

Egemen Tanin, "Teaching Wireless Sensor Networks at the University of Melbourne," IEEE Distributed Systems Online, vol. 8, no. 6, 2007, art. no. 0706-o6002.

Rajkumar Buyya and Kotagiri Ramamohanarao, "An Innovative Master's Program in Distributed Computing," IEEE Distributed Systems Online, vol. 8, no. 1, 2007, art. no. 0701-o1002.

EDUCATION OUTREACH

The ISSNIP education group has made progress in attracting international experts to Australia, and its key members have been invited overseas by highly recognised international grants. These visitors have included: Professor Hans Weghorn (University of Stuttgart); Professor Tzyy Jung (University of California, San Diego); Professor Mihaela Ulieru (University of Brunswick, Canada); Professor Nitish Thakor (Johns Hopkins University); Dr Andy Coon (BBN Tech Inc) and Professor Jayadeva (Indian Institute of Technology). This has developed the improved use of resources and expertise and ISSNIP have been able to tap into the best known international experts

while making their presence felt in the international arena.

In keeping with the commitments for education and networking, A/Prof. Dinesh Kumar (RMIT) was invited to Germany to give a series of talks to graduate students.

Four young graduate students from Stuttgart, Germany, visited RMIT University, Melbourne and undertook a joint project between RMIT, University of Stuttgart BA and University of Melbourne to develop mobile devices based sensor networks using commonly available Bluetooth technology. The project was successfully completed, and since then has helped RMIT develop a new sensor network laboratory.

Professor T. Dallessio, and Dr Silvia, University of de Roma tri, Italy hosted Associate Professor Dinesh K. Kumar to discuss issues related to sensor fusion of biosignal and vision data for human movement sensing for disease and sports applications. Mr Singh from RMIT was awarded a scholarship by Prof. Dallessio to spend six months in Roma at the end of 2007.

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

PROF. HUGH DURRANT-WHYTE – UNIVERSITY OF SYDNEY

Prof. Durrant-Whyte's keynote talk at ISSNIP 2007 highlighted the importance of information state filtering and use of mutual information in autonomous mobile sensor networks. He showed that these concepts lead to robust algorithms that can solve highly complex but very practical tasks like the control of autonomous unmanned aerial as well as ground vehicles in mining. The talk related to direct work done at the University of Melbourne where numerous people are involved in scheduling and trajectory planning tasks for UAVs.

PROF. LYLE NOAKES - THE UNIVERSITY OF WESTERN AUSTRALIA

Prof. Noakes is a leading expert in engineering applications of differential geometry. Many problems of constraint nature live on manifolds and not vector spaces. During his visit to Melbourne, Prof. Noakes engaged in discussions with ISSNIP members and visitors to show new mathematical methods to solve engineering problems that emerge more and more in the field of sensor networks, tracking, data estimation and machine learning. These discussions have led to some initial research on pose estimation from radar signals which are very promising.

DR. RONALD MAHLER – LOCKHEED MARTIN TACTICAL SYSTEMS, USA

Dr Mahler gave an ISSNIP 2007 keynote talk about the state of the art in random set information fusion. His talk included not only tracking but showed also how to do a unified information fusion across many different methods like Dempster-Shafer Theory, Fuzzy

Logic or report based statements. He is the inventor of this framework and research in this area is now pursued around the globe and has started to become a hot topic with many applications. Dr Mahler visited with researchers at the University of Melbourne for an additional week using the time to discuss some ideas related to the efficient and accurate tracking of many targets, an inherently difficult task. No doubt that his visit has initiated new research at the University of Melbourne.

PROF. MOHAN TRIVEDI – UNIVERSITY OF CALIFORNIA, SAN DIEGO, USA

Prof. Trivedi's keynote talk at ISSNIP 2007 entitled 'Holistic Perception and Dynamic Displays for Active Safety' highlighted the current state of the art of driver assisted technologies. An important aspect of Prof. Trivedi's work is how to interpret contextual information and make use of relevant information in real-time. Prof. Trivedi's research gets a lot of support from large car manufacturers and shows how important holistic approaches and multi-disciplinary research is to solve complex problems in engineering and society and also visited the University of Tasmania. Exploratory discussions were also held with University of Melbourne researchers regarding potential for collaboration in bushfire detection and management related projects. He also lent his expertise on the conference best paper selection committee and the ISSNIP International Science Advisory Committee.

PROF. ALEX ZELINSKY - CSIRO

Prof. Zelinsky gave an ISSNIP 2007 keynote talk that stressed the inter- and multi-disciplinary approaches to many current problems of global environmental dimensions that can be better understood with data processing from sensor networks. He also showed very innovative research being conducted at CSIRO with applications of large scale sensor networks in the agricultural sector, which is an important sector to the Australian economy.

PROF. S. JAGANNATHAN - UNIVERSITY OF MISSOURI-ROLLA, USA

Prof. Jagannathan visited Melbourne as a keynote speaker for ISSNIP 2007, giving a talk entitled: Energy Efficient Protocols for Wireless Ad hoc and Sensor Networks: A Computational Intelligence Perspective. In addition, he also lent his expertise to the ISSNIP ISAC meeting.

PROF. NITISH THAKOR - JOHNS HOPKINS UNIVERSITY, USA

Professor Nitish Thakor, Chief Editor of IEEE Biosignals, is a world leader in the field of Biomedical Engineering and Professor at Johns Hopkins University, USA. He visited

Melbourne and gave presentations at RMIT, University of Melbourne, and UNSW - ADFA. He is currently in discussion with various biomedical groups from ISSNIP and developing a Human Computer Interface project for disabled. Prof. Thakor was also a keynote speaker for ISSNIP 2007, and keynote speaker at the ISSNIP supported International Workshop on Mobile Computing Technologies for Pervasive Healthcare 2007 while undertaking collaborative work with Prof. D.K. Kumar (RMIT). Prof. Thakor also lent his expertise to the ISSNIP International Science Advisory Committee during his visit.

DR. ANDY COON – BBN TECHNOLOGIES, USA

Andy Coon was a keynote speaker at ISSNIP 2007 and also at the ISSNIP supported International Workshop on Mobile Computing Technologies for Pervasive Healthcare 2007, while undertaking collaborative work with Prof. D. K. Kumar (RMIT).

PROF. VIJAY VARADAN - PENNSYLVANIA STATE UNIVERSITY

Prof Varadan was a keynote speaker at ISSNIP 2007 in conjunction with his visit to Canberra as symposium chair and plenary speaker at the SPIE Microelectronics, MEMS and Nanotechnology Conference during December.

PROF. SALLY HOLBROOK – UCSD, USA

Prof. Holbrook delivered an ISSNIP 2007 keynote talk entitled: Environmental Sensor Networks on Coral Reefs: Scientific Needs and Technological Challenges. In addition she also participated in the ISSNIP ISAC meeting as well as the CREON-GLEON meeting. The outcomes of this visit included plans for joint project proposals with existing and new ISSNIP collaborators.

PROF. IAN MARSHALL - LANCASTER UNIVERSITY, UK

Prof. Marshall (ISSNIP AI) delivered an ISSNIP 2007 keynote talk entitled: Design and implementation of a heterogeneous distributed sensing system to characterise dynamic processes in upland peat. In addition, he also lent his expertise serving on the best paper selection committee, the ISSNIP ISAC meeting and also made a presentation at the ISSNIP CI's meeting. The visit also allowed for collaborative research meetings to be undertaken with DEST-ISL project partners.

PROF. ANIBAL OLLERO - UNIVERSITY OF SEVILLE, SPAIN

Prof. Ollero delivered an ISSNIP 2007 keynote talk entitled: Integration of UAVs and Wireless Sensor Networks - The European AWARE project. He also participated in the ISSNIP ISAC meeting. His expertise proved valuable to local researchers undertaking UAV related research. Prof. Ollero's

visit also encompassed collaborative research meetings with Queensland researchers.

PROF. STUART MILNER - UNIVERSITY OF MARYLAND, USA

Prof. Milner (ISSNIP AI) visited both the University of Adelaide and the University of Melbourne on a research exchange that included his participation in ISSNIP 2007 as Symposium Chair, keynote speaker and member of the best paper selection committee.
In addition, he also participated in the ISSNIP ISAC meeting and made a presentation at the ISSNIP CI's meeting. He also gave a joint seminar between the University of Melbourne and the University of Maryland via video conference for the ISSNIP seminar series early in the year. Prof. Milner also conducted an invited workshop on Self-Organising Networks. Outcomes of this visit include a proposal for a joint ISSNIP-US workshop and research project.

DR. HARRY SCHMITT – RAYTHEON, USA

Dr. Schmitt (ISSNIP AI) undertook a collaborative research visit to the University of Melbourne that took in the ISSNIP 2007 conference. He also participated in the ISSNIP ISAC meeting reporting on collaborative research experience and opportunities.

PROF. MOHAN KUMAR - THE UNIVERSITY OF TEXAS, ARLINGTON, USA

Prof. Kumar (ISSNIP AI) was a visitor to Melbourne for ISSNIP 2007 where he served as

Symposium Chair, delivered and keynote talk entitled: Seamless Middleware Services for Pervasive Computing Environments. Prof. Kumar also contributed to the ISSNIP ISAC meeting as well as the ISSNIP CI's meeting in addition to collaborative research meetings with ISSNIP members.

DR. GANESH KUMAR VENAYAGAMOORTHY - UNIVERSITY OF MISSOURI-ROLLA, USA

Dr. Venayagamoorthy (ISSNIP AI) visited Australia as the Chair for the Symposium on Computational Intelligence for Sensor Networks at ISSNIP 2007 also delivering a conference tutorial with Raghavendra Kulkarni, in addition to providing assistance on the Best Paper selection committee. He also lent his expertise to the ISSNIP ISAC meeting and gave a presentation at the ISSNIP CI's meeting.

DR. PAUL HAVINGA – UNIVERSITY OF TWENTE, THE NETHERLANDS

Dr Havinga, Professor at the University of Twente and ISSNIP CI, visited Australia as a Symposium Chair for ISSNIP 2007. His visit also included collaborative research meetings with project partners from the University of Melbourne, AIMS and JCU. The visit also took in the ISSNIP CI's meeting, as well as the ISSNIP - E-Sense meeting between ISSNIP researchers and EU 6th FP project members accompanying Dr. Havinga.

PROF. JAYADEVA - INDIAN INSTITUTE OF TECHNOLOGY DELHI, INDIA

Prof. Jayadeva was a keynote speaker at the International Workshop on Mobile Computing Technologies for Pervasive Healthcare 2007. During this visit, collaborating with RMIT researchers, he also delivered an ISSNIP seminar at the University of Melbourne on Pervasive Intelligence, also discussing Twin Support Vector Machines and implementation of SVM's on a chip. He met with a number of researchers from across the universities of Melbourne and has now started working with them on a joint project.

DR. CHRISTOPHER WREN - MITSUBISHI ELECTRIC RESEARCH LABORATORIES, USA

Dr. Christopher R. Wren, a Research Scientist at the Mitsubishi Electric Research Laboratories in Cambridge, MA, USA, visited Australia as part of ISSNIP 2007 to deliver a tutorial entitled: Ambient Intelligence for Better Buildings. His work on perception is targeted at improving human-system interactions. The tutorial covered lessons learned from a long-term study of the uses of sensor networks in buildings.

PROF. BHASKAR KRISHNAMACHARI – UNIVERSITY OF SOUTHERN CALIFORNIA, USA

Prof. Krishnamachari (ISSNIP AI) visited the University of Melbourne and the University of New South Wales in December in lieu of not being able to attend ISSNIP 2007 (as a proposed keynote speaker). In addition to undertaking collaborative research discussions with Palaniswami (University of Melbourne) and

Kininmonth (on a research visit from AIMS), Prof Krishnamachari also delivered a seminar as part of ISSNIP seminar series entitled: Modelling communication in wireless sensor networks.

PROF. HANS WEGHORN - THE UNIVERSITY OF STUTTGART, GERMANY

Prof Weghorn undertook a research visit to RMIT early in the year continuing a successful research collaboration with Prof D. K. Kumar. During his visit he also conducted a seminar as part of the ISSNIP seminar series at the University of Melbourne, entitled: Efficient Information Access from Constraint Wireless Terminals - Exploiting Personalisation And Location-Based Services.

DR MARCELO ESPINOZA - KATHOLIEKE UNIVERSITEIT LEUVEN, BELGIUM

Dr Marcelo Espinoza visited the University of Melbourne conducting collaborative research applying the technique of LS-SVM on the analysis of financial data, and the prediction of link-layer traffic as used in energy-efficient link-layer jamming attacks. During this visit he delivered, for the ISSNIP seminar series, a talk entitled: Structured Kernel Based Modelling for Nonlinear System Identification.

PROF. ANDRE DE CARVALHO - THE UNIVERSITY OF SAO PAULO, BRAZIL

Dr Andre de Carvalho visited Central Queensland University. He is currently working on applications of Computational Intelligence in Sensor Fusion for an Artificial Tongue, Gene Recognition and Analysis of Gene Expression. During his visit, Prof. Carvalho presented a seminar entitled "Applying Case

Based Reasoning to Sensor Fusion" at CQU via AccessGrid at University of Queensland, Queensland University of Technology and Griffith University and presented a paper at ISSNIP 2007.

PROF. TZYY-PING JUNG - ASSOCIATE DIRECTOR OF SCHWATZ INSTITUTE, UNIVERSITY OF CALIFORNIA, SAN DIEGO, USA

Professor Jung lecture at RMIT

Prof Jung lecture at Melbourne University

Prof Tzyy-ping Jung is a specialist in bio-signals. He visited Melbourne in April spending two weeks interacting with ISSNIP residents on topics related to emotive machines. He gave very well attended seminars at the University of Melbourne and RMIT entitled: Identifying drowsiness for automobile drivers using wireless EEG, covering topics ranging from signal classification and biomedical engineering, to MEMS and VLSI technology. He also introduced the state-of-the-art EEG wireless electrode system that is being developed at the in-wafer micro-fabrication foundry at National Chiao Tung University, Taiwan, where he is also affiliated. The tiny wireless sensors could potentially revolutionise the application of

wireless sensor networks to the measurements of bio-signals. He had various meetings with other researchers resulting in a collaborative project with Sridhar Arjan and Waichee Yau (RMIT). This has resulted in collaborative work and two papers related to identifying emotions and alertness during driving from EEG currently being finalised. Professor Jung is expected to return next year.

DR. ERIC WING MING WONG - CITY UNIVERSITY OF HONG KONG

The visit of Eric Wing Ming Wong, Associate Professor at the City University of Hong Kong, focussed on a project aiming to evaluate how large buffers need to be as bit-rate increases in Dense Wavelength Division Multiplexing (DWDM) networks. This is an important question because buffering in the optical domain is very difficult and costly.

In an extensive collaboration that include Eric Wing Ming Wong, Lachlan L. H. Andrew (from Caltech), Tony Cui (PhD student, University of Melbourne), and three University of Melbourne, Dept. of EEE professors: Bill Moran (ISSNIP CI), Rodney S. Tucker and Moshe Zukerman (ISSNIP CI), a model was developed that evaluates packet blocking probability for a DWDM network and we have demonstrated that very small buffers are required.

A paper entitled "Towards a Bufferless Optical Internet" co-authored by all the collaborators has been completed and submitted to OSA/IEEE Journal of Lightwave Technology.

The ISSNIP researchers plan to extend their collaboration with Eric W. M. Wong and L. L. H. Andrew to study how best to design and dimension DWDM networks to meet required quality of service requirements at minimal cost.

PROF. STEVE WRIGHT - UNIVERSITY OF WISCONSIN-MADISON, USA

Steve Wright was Plenary Speaker at the 51st Australian Mathematical Society Conference. The September 2007 visit was supported by ISSNIP. Dr Wright delivered a plenary lecture on "Optimisation: Foundations and Applications" and an address on "Optimisation and Cancer Treatment" to an audience of teachers. The meeting also provided an opportunity for discussion with ISSNIP-affiliated colleagues Natashia Boland, Andrew Eberhard, and Danny Ralph on research topics, including optimisation-based algorithms for machine learning and support vector machines. These are extremely active areas within ISSNIP and many opportunities for future collaborations between optimisation specialists, computer scientists, and electrical engineers were identified. Such links included: compressed sensing applications, in which sparse signals can be reconstructed, using optimisation techniques, from noisy observations. Compressed sensing has been the subject of intense study during the past 4-5 years from numerous viewpoints - theoretical, algorithmic, and application-related.

DR. DANIEL RALPH - UNIVERSITY OF CAMBRIDGE, UK

Daniel Ralph (ISSNIP CI) was a keynote speaker at the Australian Mathematical Society meeting at La Trobe University in September 2007. In addition collaborations were undertaken with Prof Andrew Eberhard and Dr Sergei Schreider at RMIT. The AMS talk, entitled

"Nonlinear programming developments in solving Mathematical Programs with Complementarity Constraints (MPCCs)", is on a topic that provides input to utility estimation in a general economic context. It is a joint project with Eberhard and Schreider in addition to other researchers and PhD students. Additional meetings occurred during October including A/Prof. Palaniswami, and led to two initiatives that link the project to applied work that is ongoing under the umbrella of the ISSNIP, in particular on the Great Barrier Reef project.

Informal discussions were also held with ISSNIP associates A.-Prof Natashia Boland (U Melbourne) and Prof Phil Howlett (U South Australia).

PROF. JAMES BEZDEK - UNIVERSITY OF WEST FLORIDA, USA

Prof. James Bezdek visited the University of Melbourne from February to May 2007. During that period he worked closely with A/Prof. Leckie (ISSNIP AI) and A/Prof. Palaniswami on techniques for anomaly detection in wireless sensor networks.

This work has resulted in a new formalism for characterising different types of anomalies in sensor networks, based on a general form of hyper-ellipsoidal model. Prof. Bezdek collaborated closely with the supervision of one our PhD students, Mr Sutharshan Rajasegarar, on this topic.

Prof. Bezdek also worked closely with A/Prof. Leckie and Dr Wang on scalable methods for finding clusters in large data sets.

This collaboration has resulted in several journal and international conference papers being published in 2007.

CONTRIBUTION TO KNOWLEDGE

The Network has built upon the foundations of existing international collaborations, via the DEST-ISL project on Distributed Sensor Networks and the NCRIS-IMOS project to become part of a new project adding another dimension to the important work being undertaken in monitoring and studying the Great Barrier Reef.

As a co-investor in the IMOS project, ISSNIP members are also providing sensing expertise to the work being undertaken within the Great Barrier Reef Ocean Observing System (GBROOS) node of IMOS.

The Smart State Project: Smart Environment Monitoring and Analysis Technology (SEMAT) will develop improved infrastructure products, processes and systems for monitoring a broad range of marine environments. These developments will successfully advance national interests in the development of Frontier Technologies.

The defence related work of ISSNIP in collaboration with DSTO has made advances in localisation technology applicable to UAVs and other mobile sensor platforms.

A number of healthcare projects being conducted under the ISSNIP framework are also making advances in the area of gait analysis for fall prevention in the elderly, sleep apnoea detection, cancer detection and protein modelling.

Sensor Networks developments have been significant in the areas of anomaly detection, intrusion detection, security, mobile geosensor networks and bushfire detection using visual sensor networks. The outcomes of these various developments are evident in the large number of related publications. A number of industry-linked projects will see outcomes from these technological findings in the development commercial products.

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

INTERNATIONAL OUTREACH

Many international visits were made as the result of and with the assistance of the Research Network, in addition the utilisation of opportunities presented by the visits of international researchers to Australia in forming new international collaborative links.

CREON

In conjunction with ISSNIP 2007, the Workshop on Sensors for the Great Barrier Reef was held on December 3. Leveraging the presence of a number of key international experts from the USA and Asia, this workshop was held to further discuss the challenges facing environmental monitoring of the Great Barrier Reef. Additionally, a Coral Reef Environmental Observatory Network (CREON) & Global Lake Ecological Observatory Network (GLEON) Meeting was held the following day, drawing together a contingent of international researchers to facilitate the deployment and development of sensor networks in lakes and the marine environment. The outcomes of such events built on existing collaborative foundations to form new international links and future project proposals.

SEMAT MEETING

A meeting for the Smart Environment Monitoring and Analysis Technology (SEMAT) project was held delivering a Queensland Government Smart State proposal drawing together research teams from around Australia and importantly, partnerships with Italian academia and industry for the development of new sensing technology hardware.

ISSNIP – E-SENSE MEETING

The ISSNIP 2007 conference again proved to be an effective platform for generating new international links, with the attendance of members of an EU 6th FP project "E-Sense". A joint meeting between ISSNIP and E-Sense researchers following the conference has resulted in plans to run a joint EU-ISSNIP workshop in Stockholm in mid-2008, creating a new link with ISSNIP and EU 7th FP project SENSEI.

THE UTILITY GRID PROJECT

Through the activities of the DEST-ISL Utility Grid Project, ISSNIP CI, A/Prof. Rajkumar Buyya has undertaken significant international outreach activities. This has included a one day "Australian and European Grid Collaboration Workshop" hosted at the University of Melbourne on Jan 29, 2007. The events focused on presentations from both European and Australian researchers and focused on established collaboration between ProActive/GridComp Project led by Dr. Denis Caromel, INRIA - I3S CNRS - Univ. Nice, France. Integration of ProActive component programming model with the Gridbus Scheduler was performed with results presented by project member Mr. Xingchen Chu, at the "GridCOMP Workshop and Tutorial - 30 Oct - 1 Nov 2007 - Beijing, China" sponsored by the European Union.

A/Prof Buyya visited European CoreGrid partners, during June 21-30, 2007. He visited UPC and Barcelona Supercomputing Center, Barcelona, Spain and

developed cooperation on implementation of Gridscalar programming model under the Gridbus Broker environment. He also visited the the University of Calabria, Rene/Cosenza, Italy. In both locations, the A/Prof Buyya presented a seminar on Gridbus and Market-Oriented Computing. In addition, he also presented an invited keynote talk at the "International Grid Scheduling" workshop organised by the University of Calabria at Cetraro in Italy.

As part of this ISL Project, during Sept. 16-30, 2007, he visited: Texas A&M University; Rutgers: The State University of New Jersey; Princeton University; and the University of California at Irvine. These visits helped in building and strengthening collaborative efforts with Princeton University for new projects such as a recently announced ARC Discovery Project (InterGrid: Peering Architecture and Policies for Internetworking Disparate Grids). Dr. Buyya presented seminars on his research at Texas A&M (part of a seminar-based Advanced Graduate Course in Computing), Rutgers (Centre for Advanced Information Processing), and California Institute for Telecommunications and Information Technology (UCI Division).

Lastly, grid technologies developed as part of this project were exhibited at the e-Science 2007 conference

AUSTRALIAN INTERNATIONAL OUTREACH

Exploratory visits by Australian ISSNIP researchers to different groups around the world also served the international outreach objective. Of note was the visit of Prof. Rezaul Begg (Victoria University) to India. Meeting with researchers during the International Conference on Computer and Information Technology (ICCIT) and also visiting the Bangladesh University of Engineering & Technology (BUET), Electrical and Electronic Engineering department to meet with staff engaged in biomedical engineering research. In particular, Dr Aynal Haque (academic and researcher in biomedical engineering at BUET), the potential for joint collaboration in biomedical engineering was explored in addition to the hosting of a related workshop in association with the recently established a Centre for Biomedical Engineering.

Professor M. Srinivasan, Member of ISSNIP Executive Board participated in the 1st US-Asian Demonstration and Assessment of Micro Aerial Vehicle (MAV) and Unmanned Ground Vehicle (UGV) technology and gave a keynote lecture on vision based navigation and control. The MAV/UGV competition demonstrated many sensor and sensor network technologies.

Also Dr D. Nandagopal, the ISSNIP Executive Board Chairperson, participated in the above International event as a member of the judging panel and networked extensively with international researchers in this advanced technology area. He also invited the US Army organisers of the event to consider hosting the next event in Australia.

Professor T Dallessio, and Dr Silvia, University de Roma tri, Italy hosted Associate Professor Dinesh K Kumar (RMIT) to discuss issues related to sensor fusion of biosignal and vision data for human movement sensing for disease and sports applications. As mentioned earlier, A/Prof. Dinesh Kumar (RMIT) was also invited to Germany to give a series of talks to graduate students.

Described in the Research Network Collaboration section are a number of international outreach activities undertaken by members of the Melbourne Systems Laboratory (and joint ISSNIP members) in conducting business development meetings and international research collaborations.

ECR AND STUDENT VISITS

Research Network ECR's and research students were also very active in fulfilling ISSNIP's international outreach objectives. A visit to ISSNIP CI Prof Zoubir (Darmstadt University of Technology) was undertaken by Dr S. Marusic (University of Melbourne) to discuss collaboration opportunities and ISSNIP support for future researcher exchanges. This was in addition to collaborative research undertaken with French research partners for medical diagnostic research and planning for future proposals.

Support provided through the ISSNIP awards program enabled a number of collaborative visits by S. Kininmonth (AIMS) to European agencies that have been collaborating with AIMS, originally instigated by the Danish government to deliver a key note address at a Nordic Council conference on marine reserve design and in doing so enhance the existing relationships. This outreach also incorporated a visit to ISSNIP collaborators in Enschede at the University of Twente and Ambient Systems, where a seminar was also delivered. A meeting with Alessandro Gandali from Milan Polytechnic University enabled through the collaborative links of ISSNIP AI - Ron Johnstone (UQ) provided an opportunity to initiate a wider collaboration. US meetings included: American Museum of Natural History researcher Peter Ersts; Martin Bean, Microsoft director of education whose portfolio includes distributed computing research; and ISSNIP AI Dr Bhaskar Krishnamachari

(University of Southern California) and his team, where another seminar was delivered. Additionally, the ISSNIP award provided assistance to conduct the duties of chair for the environmental sensor network symposium at ISSNIP2007, which brought all the above mentioned researchers to Melbourne where the difficulties and successes of developing this technology were discussed.

Dr. Jayavardhana Gubbi (University of Melbourne) visited Medical Intelligence and Language Technology laboratory, Indian Institute of Science, Bangalore (supervised by A/Prof. A. G. Ramakrishnan) and delivered a talk about the establishment and achievements of ISSNIP. He visited Prof. N. Srinivasan from Molecular Biophysics lab and held discussion regarding a possible DEST joint India-Australia project on Computational Biology starting 2008. He also met A/Prof. Sowdhamini from Tata Institute of Fundamental Research (TIFR), Bangalore regarding the same project. He met Dr. Keshava Prasad from Institute of Bioinformatics, Bangalore with regards to establishment of new collaboration with ISSNIP in healthcare research.

Ms Waichee Yau (RMIT) was awarded a scholarship under the Baden Wurdenburgh, Germany grant (worth approx Euro 5000). With A/Prof Dinesh Kumar (RMIT) and Prof H. Weghorn (University of Stuttgart), Waichee worked for 6 months in Stuttgart where studied the differences between styles of speaking among different demographics. Her work has resulted in joint publications.

Ganesh Naik (RMIT) conducted a research visit to Stuttgart, Germany, with the support and funding from Landesstiftung Baden-Wurttemberg GmbH and Baden-Württemberg Stipendium. The duration of the stay was from December-2006

to April-2007 at BA-Stuttgart. This exchange program enabled him to conduct research in a new direction with the valuable help and advice of Prof. Dr. Hans Weghorn from BA-Stuttgart. The main outcomes of the visit were the development of a hand gesture identification system and testing of the reliability of the use of Hand EMG and Facial EMG signals. A new analysis on limitation and applications of Facial EMG and Hand EMG for the hand gesture and speaker identification system was designed. The results from this analysis were submitted as three technical papers. The outcomes of the research conducted in BA Stuttgart will also be submitted in International Journals in near future.

Ganesh Naik and Professor Weghorn at the research laboratory in Stuttgart

Sutharshan Rajasegarar (University of Melbourne) visited Prof. Ian W Marshall and his research team at Lancaster Environment Centre, Lancaster University, UK in July. Discussions were held with group members of various research projects, including: moisture monitoring along the river banks using wireless sensor networks; a self-organising grid-based flood monitoring and warning system capable of performing on-site flood modelling; a vibration monitoring system using mobile sensor nodes for recording workers' usage of tagged vibrating tools such as drills; and a firemen tracking system using wireless sensor networks.

A number of additional ISSNIP supported collaborative research visits were also undertaken to the Netherlands,

the USA and the UK in association with existing Network partners, but also to explore new collaborative links. Keynote talks were also given by a number of ISSNIP members at numerous conferences and workshops. In being awarded a research grant by Microsoft Research for the SensorMap on the Great Barrier Reef project, affiliated researchers visited MIT providing a unique opportunity to increase the international profile of ISSNIP and its programmes amongst the worldwide Sensor Network community.

The ability to leverage the expertise and resources gathered with the ISSNIP framework continues to be an invaluable tool in creating new opportunities by facilitating the interactions between different research groups.

INDUSTRY LINKAGES

Industry linkages continue to be a high priority for the Research Network. In building upon the already strong record of industry participation, ISSNIP members have been successful in growing this aspect of the Network. Many new links have been established and new projects commenced with existing partners. Some of these include the Bio-inspired target detection project of ISSNIP CI's S. Challa and D. O'Carroll with industry partner Tanner Research. This work, being undertaken by ISSNIP awardee S. Wiederman, utilises a strong collaborative link with the US industry partner (Tanner Research Inc., Monrovia, USA) via research contracts and an ARC linkage project (LP0667744), which implements hardware versions of the reseachers' biomimetic models in analog VLSI circuitry.

Additionally, through a DEST-ISL project link, University of Melbourne researchers have

ISSNIP

developed technology for the detection of forest fires using visual sensor networks together with industry partner iOmniscient. Work with the NSW Road Traffic Authority by researchers from UTS has continued through this same program, developing technology of heavy vehicle monitoring for management of RTA bridge assets. The Networked Sensor Technologies (NeST) Lab at UTS has taken up a significant facilitating role to bring together industry partners like ADI (Thales) RTA, Rolachem, Intersystems, iOmniscient, Cradle Technologies and others. The number of industry linked projects within ISSNIP thus continues to grow, through newly announced linkage projects and future proposals for DEST-ISL and ARC linkage projects.

Two individuals, Drs. Craig Savage and Harry Schmitt, from Raytheon in the United States have been active collaborators and participants in ISSNIP. In particular, Dr. Savage has been in Australia for the past three years, working with individuals from the University of Melbourne and National ICT Australia (NICTA). The ISSNIP conference has proven to be an effective conduit for information exchange and collaboration between Raytheon and a number of personnel in Australia. Through ISSNIP, Raytheon has identified a potential synergy with the Defence Science Technology Organisation (DSTO), and is submitting a proposal for a demonstration. Furthermore, the ISSNIP conference has increased linkages between Raytheon personnel with other people in the United States.

START UP COMPANY - SENSEN NETWORKS PTY LTD

The network facilitated a start up, SenSen Networks Pty Ltd (SenSen), founded in August 2006 as a spin off from NeST

Lab, University of Technology, Sydney. SenSen's focus is to develop products based on Video-centric Monitoring, Surveillance, Security and Operations. It successfully raised venture funding in early 2007.

THE UTILITY GRID PROJECT

Through the second DEST-ISL project of ISSNIP CI, A/Prof Rajkumar Buyya, industry links have been expanded to include new organisations. These include:

- French National Institute for Research in Computer Science and Control (INRIA), France
- Centre for Development of Advanced Computing (C-DAC), India
- Satyam Computer Services Ltd.
- Intrepid Gepphysics, Melbourne
- Tjurunga Research Pty Ltd, Melbourne
- Victorian Partnership for Advanced Computing (VPAC), Melbourne

Academic partners in this project include:

- Belfast e-Science Centre, The Queen's University of Belfast, UK
- Universität Bayreuth, Germany
- Universitat Politècnica de Catalunya, Spain
- Welsh e-Science Centre, Cardiff University, UK
- Huazhong University of Science and Technology (HUST), China
- Rutgers, The State University of New Jersey, USA
- The University of Adelaide, Adelaide
- Deakin University, Geelong
- Royal Melbourne Institute of Technology (RMIT) University, Melbourne
- Swinburne University of Technology, Melbourne

SEMAT MEETING

New links have been established through the proposed SEMAT project (mentioned earlier), which draws together researchers from James Cook University, the University of Melbourne, international partners Torino Politechnic and Milan Politechnic, along with industry partners, Petalogix, Torino Wireless Foundation, WBM Oceanics Australia. It also developed a direct industry partnership with the Port of Brisbane Corporation who are currently formulating an agreement to apply and further develop parts of the sensor network system. A meeting was held for which the total attendance at the demonstration was 43 people (of which 18 were international, 8 were from UQ, and the remainder came for other Universities, Qld State Development, the Qld EPA, AIMS, the SEQ Waterways Partnership and other potential end-users of the SEMAT system). In addition to the specific agreements to work more closely with organisations such as GBRMPA, the demonstration meeting secured collaborations with AIMS and the SEQ Waterways Partnership. Both of these entities are assured end-users of the SEMAT system and/or the information it will generate. In addition, the meeting expanded the basis of the collaboration between Milan and UQ so that formal meetings are now proposed for 2008 to expand the University level relationship.

RFID SYMPOSIUM

The First International Symposium on RFID technology was held during ISSNIP 2007. The main purpose of this symposium was to serve as a forum that brought together RFID researchers and practitioners from academia, industry and government to discuss recent developments in

RFID systems and technology. The symposium featured invited speakers from industry and government who provided valuable insight into RFID research going forward. A brainstorming session moderated by Cal Anderson, Vice-President of the RFID association of Australia (RFIDAA) identified significant research challenges that lie ahead of RFID researchers and are of critical importance to the success of the RFID industry globally. This highly successful event proved to be a valuable tool in linking industry needs with academic research expertise. The symposium presented a unique opportunity for academic researchers to discuss their research ideas with industry experts. With much positive feedback received, the pursuit of new collaborations is expected as a direct result of the symposium leading to industry-funded university research and ARC Linkage grant applications.

INDUSTRY AFFILIATES PROGRAM

Developed through 2007, the Industry Affiliates Program will be launched in 2008 together with the updated website. The program aims to consolidate the extensive industry contacts that exist throughout the Network and provide an interface between these companies and ISSNIP members, enabling new collaborations to be formed. In addition, this should develop into a focal point for the wider community of sensors related researchers and related companies as a medium to readily identify required expertise. The program will grow ISSNIP large industry participation, some of which currently includes organisations such as:

- Compumedics
- iOmniscient
- RTA-NSW
- Queensland Parallel Supercomputer Facility (QPSF)
- AIMS
- Intersystems
- Raytheon
- Decisioneering
- Tenix
- Royal Children's Hospital
- Microsoft
- Tanner Research
- Ambient Systems
- ADI (Thales)
- Rolachem
- Cradle Technologies

RESEARCH NETWORK COLLABORATION

The Research Network continues to support collaborative research endeavours as one of its key objectives. A number of such collaborations were undertaken nationally and internationally, giving Australian researchers access to world leading expertise while also giving exposure to the Network as a world leading research group of its own accord.

The bulk of this activity was undertaken through the ISSNIP support of international visitors and keynote speakers in the many conferences and workshops listed earlier. On the back of these events, distinguished visitors also conducted additional meetings and seminars with ISSNIP researchers and their Australian research colleagues.

Additionally ISSNIP supported research exchanges of Australian researchers to Europe, the USA and Asia. New collaborations are always being sought. Accordingly, progress has been made in strengthening ties between ISSNIP and the CSIRO.

A conceptual view of the collaboration within the ISSNIP is given in the following figure. The fundamental theory being addressed forms the kernel of the research structure which is used by the application layer.

The applications developed are of great value to Australian industry and governmental funding organisations and academic institutions forms the final outer layer which financially supports the complete structure. A detailed summary of the intra-network collaborations undertaken appear in the collaboration matrix of Appendix D.
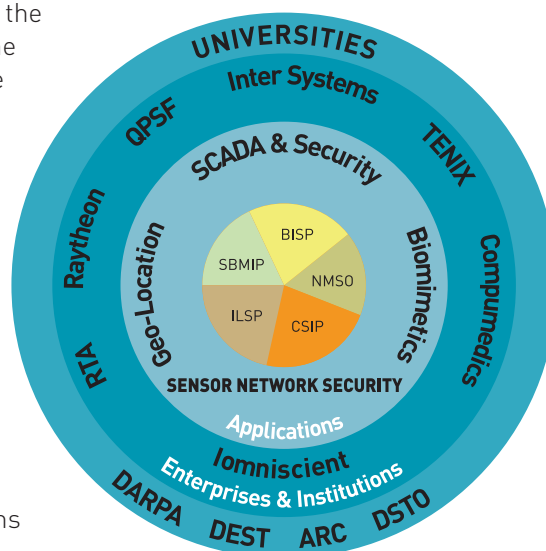
BISP: Bio Inspired Signal Processing
NMSO: Non-linear Methods and Stochastic Optimisation
CSIP: Collaborative Signal and Information Processing
ILSP: Inference and Learning by Signal Processing
SBMIP: Scale Based and Multi-dimensional Information Processing

MEMBERSHIP

The following chart gives an indication of participation of Australian, International, Affiliates, Early Career Researchers (ECRs) and Students in ISSNIP, while a detailed listing of ISSNIP members and member organisations is given in Appendix C.
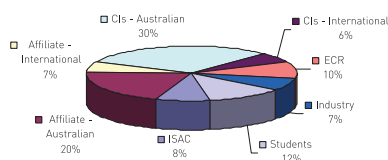
INTER-NETWORK EVENTS

A workshop was jointly organised by ISSNIP and ACORN members in December 2007. The invitational workshop co-hosted by Prof Stuart Milner (University of Maryland) and Dr Sylvie Perreau (University of South Australia) was conducted during the final day of ISSNIP2007, drawing on high level expertise from around the country together with a number of high level international visitors.

ISSNIP CHIEF INVESTIGATORS' MEETING

In December 2007, the Research Network hosted the ISSNIP CI's meeting. Held at the Langham Hotel on the day following the conclusion of the ISSNIP 2007 conference, all ISSNIP CI's were invited to participate in an event which sought to showcase the diverse and multi-disciplinary projects being undertaken within the Network. Attended by a large number of ISSNIP members and international visitors, the meeting offered a unique opportunity for researchers to not only review progress of current projects but also identify future needs. Many presentations thus served as an open call for future collaboration and new links to be established.

The speakers included:
- M. Palaniswami (University of Melbourne)
- Raj Buyya (University of Melbourne)
- Gamini Dissanayake (University of Technology, Sydney)
- Pubudu Pathirana (Deakin University)
- Ian Atkinson (James Cook University)
- Scott Bainbridge (Australian Institute of Marine Science)
- Ron Johnstone (University of Queensland)
- Stuart Kininmonth (Australian Institute of Marine Science)
- Rezaul Begg (Victoria University)
- Doug Gray (University of Adelaide)
- Arcot Sowmya (University of New South Wales)
- Dinesh Kant Kumar (RMIT University)
- Bijan Samali (University of Technology, Sydney)
- M. Srinivasan (University of Queensland)
- Paul Havinga (University of Twente)
- Ian Marshall (University of Lancaster)
- Mohan Kumar (University of Texas, Arlington)
- Ganesh Kumar Venayagamorthy (University of Missouri-Rolla)
- Chris Leckie (University of Melbourne)
- Adil Bagirov (University of Ballarat)
- Stuart Milner (University of Maryland)
- Salim Bouzerdoum (University of Wollongong)

The program also included a poster session where approximately 50 poster presentations were made by various groups within ISSNIP as well as by the recipients of ISSNIP awards. This was well received and provided a valuable opportunity for in-depth discussions as well as the formation of new links by students and early career researchers alike.

The meeting closed, will the announcement of the location for the ISSNIP 2008 conference and a call for contributions at all committee levels. The meeting was successful in its objective, with plans underway for future events.

ISSNIP COLLABORATIONS: RESEARCH LINKAGE REPORT – 2007

Launched at the ISSNIP CI's meeting the "ISSNIP Collaborations: Research Linkage Report – 2007" and also available on the Research Network website, this 60 page booklet was prepared to serve as a guidebook for ISSNIP researchers and other interested parties both academic and industry based, in describing the ISSNIP framework and the current collaborative projects being undertaken. Other features included a full listing of ISSNIP chief investigators, affiliate investigators and student members with email contact details, as well as a listing of sensor networks resources. It will become a useful resource tool in presenting an overview of the diverse capabilities encompassed by the Network as well as access to relevant areas of expertise.

MSL – RESEARCH COLLABORATIONS AND BUSINESS DEVELOPMENT

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, among others. Together with ISSNIP support, this program has generated significant collaborative research as well as substantial efforts in engaging industry, as detailed by the business development meetings listed below.

MSL hosted a number of research visitors during 2007, including: Prof Robert Calderbank, Princeton University, USA (2 weeks); Dr Lyle Noakes, University of Western Australia (1 week); Mr Peter Sarunic, EWRD, DSTO (1 week); and Jinzhi Wang, Peking University, China.

The following Business Development Meetings and Research Collaboration were also undertaken by MSL researchers (also ISSNIP CI's):

- Business development meetings with DSTO personnel in Adelaide (Bill Moran, Gavin Thoms, Barbara La Scala)
- Business development meetings regarding concept technology demonstrators with Australian DoD and Raytheon Australia in Canberra (Bill Moran, Gavin Thoms)
- Business development meetings with Wavelet Technologies and Cradle Technology, USA (Subhash Challa)
- Business development meetings with Vision and Image Processing Lab at the Indian Institute of Information Technology (Subhash Challa, Bill Moran)

- Business development meetings with DARPA program managers, USA (Bill Moran)
- Research collaboration with Louis Scharf and Edwin Chong, Colorado, USA (Bill Moran)
- Research collaboration with E. Wong and M. Zukerman on Teletraffic at the City University of Hong Kong (Bill Moran)
- Research collaboration with Robert Calderbank at Princeton, USA (Bill Moran)
- Research collaboration with Doug Cochran at Arizona State University (Bill Moran)

MSL researchers also represented the group at numerous international and domestic conferences and workshops, further raising the international profile of Australian research. These included:

- International Conference on Pervasive Computing and Communications (PERCOM'07) in New York City, USA (Mohammad Jafar Rezaeian)
- ICASSP'07 Conference in Honolulu, USA (Mark Morelande)
- International Conference on Hybrid Systems: Computation and Control (HSCC'07), Pisa, Italy (Jen Davoren)
- 10th International Conference on Information Fusion, Quebec, Canada (Thomas Hanselmann, Mark Morelande, Darko Musicki, Nickens Okello, Xuezhi Wang)
- World Congress on Engineering (WCE'07) London, UK (Marcus Brazil)
- Asilomar'07 Conference in Big Sky, MT, USA (Bill Moran, Stephen Howard)
- International Fire and Security Conference in Delhi, India (Subhash Challa, Bill Moran)
- Logical Foundations of Computer Science (LFCS) Symposium in New York City, USA (Jen Davoren)

Also,

- Ba-Ngu Vo guest speaker at NICTA short course on Tracking and Data Fusion in Adelaide
- Information, Decision and Control (IDC 2007) Conference in Adelaide (Barbara La Scala, Darko Musicki, Nickens Okello, Xuezhi Wang)
- Phased Array Radar workshop in Sydney (Xuezhi Wang)
- Joint Strike Fighter Advanced Technology and Innovation Conference in Melbourne (Gavin Thoms)
- International Conference on Networks (ICON'07) conference in Adelaide (Xuezhi Wang)
- Progress in Radar Research workshop in Adelaide (Barbara La Scala)
- Attendance at the ISSNIP conference in Melbourne (Thomas Hanselmann, Barbara La Scala, Stephen Searle, Xuezhi Wang)

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 exposure given to ISSNIP events as well as important publications of research emanating from the Network. The introduction of new mechanisms such as the

ISSNIP

ISSNIP Newsletter also serves this purpose. Additionally, the recognition of ISSNIP CI's for their research endeavours also raises the collective profile of ISSNIP expertise.

In the coming year additional profile for the Network will be obtained through the online real-time publication of GBR sensor data through the Microsoft funded SensorMap RFP project.

Further details of media coverage and publications related to ISSNIP are shown at Appendix E.

ISSNIP NEWSLETTER

The ISSNIP Newsletter was also launched in 2007, with four editions produced. These were distributed though the vast email contacts of the Research Network and also made available on the website. These served as useful tool to regularly update Network members on upcoming events, project outcomes, employment opportunities within the Network and other relevant issues. The editorial Board consisted: Dr. Yee Wei Law, Dr. Slaven Marusic, Prof. Paul Hainga and A/Prof. Palaniswami.

AWARDS

Knowledge Transfer Award Winners

The inaugural University of Melbourne Vice-Chancellor's Knowledge Transfer Awards were presented at an awards presentation and symposium. The awards included overall excellence winners, project grants for knowledge transfer initiatives and grants to host visiting scholars to further the scholarship and understanding of knowledge transfer. A number of ISSNIP CI's were independently recognised.

Excellence Award:

- Professor Iven Mareels, for a team project: Modelling and controlling of irrigation channel systems to assist in solving Melbourne's water shortage crisis, working with industry partner Rubicon Systems Australia to produce substantial water savings and greater water efficiency through the automation of irrigation systems.

Excellence Awards – commendations:

- Associate Professor Rajkumar Buyya (Computer Science and Software Engineering) – The Gridbus Project
- Associate Professor Marimuthu Palaniswami (Electrical and Electronic Engineering) – Distributed sensor networks with industry applications to healthcare, defence and environment.

Other

Associate Professor Rajkumar Buyya (Computer Science and Software Engineering, University of Melbourne)

- The Journal of Information and Software Technology in Jan 2007 issue, based on an analysis of ISI citations, ranked Dr. Buyya's work (published in Software: Practice and Experience Journal in 2002) as one among the "Top 20 cited Software Engineering Articles in 1986-2005".
- The Chris Wallace Award for Outstanding Research Contribution 2008 from the Computing Research and Education Association of Australasia, CORE, which is an association of university departments of computer science in Australia and New Zealand.

- Associate Professor Rajkumar Buyya and Hui Li received the Best Paper Award at the 3rd IEEE International Conference on e-Science and Grid Computing for their work on model-driven simulation of grid scheduling strategies. The paper was co-authored by a visiting research student from Leiden University, The Netherlands.
- Best Research Demo Award: Dr. Buyya and his team members (Jia Yu and Mustafizur Rahman) won the Best Research Demo Award at the 3rd IEEE International Conference on e-Science and Grid Computing for their software technology "Gridbus Workflow Engine". This award was presented for live and innovative demonstration of their Gridbus technology and its application to fMRI (functional Magnetic Resonance Imaging) problems by utilising world-wide Grid resources from Australia, Japan, and USA.

Professor Ramamohanarao (Rao) Kotagiri (Computer Science and Software Engineering, University of Melbourne)

- Prof. Kotagiri received the PAKDD 2007 Distinguished Contribution Award. PAKDD (Pacific-Asia Conference on Knowledge Discovery and Data Mining) is a leading international conference in the areas of data mining and knowledge discovery. The steering committee of PAKDD decided to confer the award on Rao based on his "persistent outstanding contributions to PAKDD and eminent academic record".

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 has been through another stage of re-development addressing issues associated with: appearance, functionality and focus, in order to reflect high level of activity being undertaken within the Network. The updated website is due to be launched in April/May 2008.

Also proposed to be added to the website functionality is an interface for ISSNIP members to be able to submit funding proposals for ISSNIP events/activities online and also similarly supply reports for supported proposals with relevant information readily accessible. This will improve the efficiency of proposal submission and record keeping.

GRANT APPLICATIONS

Significant progress continues to be made in keeping with the Research Network objective of attracting further research funding for Australian researchers. ISSNIP has successfully utilised the collaborative framework of the Research Network to attract new research funding. A number of applications for funding by ISSNIP researchers have been successful. A number of future applications are in preparation resulting directly from ISSNIP collaborative activities. Described here are some of the more significant funding programs involving ISSNIP members.

SENSORMAP FOR THE GREAT BARRIER REEF

As part of Microsoft Research request for proposals (RFP) entitled 'SensorMap: Browsing the Physical World in Real-Time', A/Prof M. Palaniswami (ISSNIP CI), A/Prof I. Atkinson (ISSNIP AI), S. Kininmonth (ISSNIP AI) and Dr. S. Marusic (ISSNIP AI) were successful in obtaining a grant for the project entitled "SensorMap for The Great Barrier Reef". Utilising the core infrastructure associated with a sensor network deployment currently in progress on the Great Barrier Reef, this project will aid in the collection and dissemination of a diverse range of unique sensor data.

ROWDEN WHITE SENSOR NETWORKING LABORATORY

The Rowden White Sensor Networking Laboratory has been set up at the University of Melbourne using an E. Rowden White Foundation Grant of $100,000, by J. Ellershaw, M. Duckham (ISSNIP AI), A. Kealy, S. Winter, R. Tucker, J. Papandriopoulos, A. Overmars, R. Kotagiri (ISSNIP CI), R. Buyya (ISSNIP CI), Lars Kulik (ISSNIP AI), E. Tanin (ISSNIP AI), P. Mendis (ISSNIP AI), H. Malano, D. Smith. The lab will be used for teaching as well as research purposes. The main equipment so far in the lab consist of 100 Imote2 nodes from Crossbow.

Figure 2. Rowden White Sensor Networking Laboratory is to be equipped with 100 Imote2 nodes from Crossbow

ARC DISCOVERY PROJECTS

- A/Prof Rajkumar Buyya (ISSNIP CI) and Dr J Abawajy *InterGrid: Peering Architecture and Policies for Internetworking Disparate Grids* (3 year project of $216,000 total funding from the ARC)

- Professor Rao Kotagiri (ISSNIP CI), Dr L Kulik (ISSNIP AI), Dr E Tanin (ISSNIP AI), Dr R Zhang, Professor H Samet and Professor H Jagadish *EPOS: Efficient Processing of Moving Object Streams in Data Management Systems* (4 year project of $590,000 total funding from the ARC)

- Professor Bill Moran (ISSNIP CI), Dr B La Scala, Dr I Clarkson, Professor B Quinn, Dr S Howard and Professor A Calderbank *Information Geometry and Compressive Sensing for Radar and Communications* (4 year project of $763,000 total funding from the ARC)

- A/Prof B Vo (ISSNIP AI), Professor A Baddeley (ISSNIP CI) and A/Prof A Doucet *Performance evaluation and characterisation for filtering in multi-object system* (3 year project of $270,000 total funding from the ARC)

ISSNIP

- A/Prof B Vo (ISSNIP AI) and Professor D Suter (ISSNIP CI) *Visual tracking of multiple objects: A stochastic geometrical approach* (3 year project of $235,000 total funding from the ARC)

- Dr S Winter (ISSNIP AI) *Intelligent Self-Organising Transport* (3 year project of $165,000 total funding from ARC)

- Dr R Zhang, Dr J Bailey and Professor Rao Kotagiri *SeqSeeker: A searc engine for large numbers of very long sequences* (3 year project of $234,000 total funding from ARC)

ARC LINKAGE PROJECT

- A/Prof S Dey (ISSNIP CI); Dr B La Scala; Prof IM Mareels (ISSNIP CI); Dr LS Irlicht; Mr L de Bever; Mr S Bone and Mr A Randall with Victorian Funds Management Corporation as Industry Partner- *Robust Optimal Asset Liability Management via*

Stochastic Control Theory (3 year project of $153,762 total funding from the ARC plus one Australian Postgraduate Award (Industry) (APAI)).

- R. Buyya (ISSNIP CI), A Novel Software System for .NET-based Enterprise Grid Computing, Linkage Project, Australian Research Council (ARC) and Microsoft Corporation, Australia, 2007-2010. Amount: $395,000 (ARC: $265,000 and Microsoft: $130,000).

ARC LINKAGE INFRASTRUCTURE & EQUIPMENT FUNDING (LIEF)

- A/Prof JP Walker; Prof W Moran; A/Prof JM Hacker; Prof CT Simmons; Prof DA Gray (ISSNIP CI); A/Prof MJ Lynch and Dr L Ge with The Flinders University of South Australia, University of Adelaide, UNSW and Curtin University of Technology - *High resolution airborne*

radar for environmental research: soil moisture, vegetation, salinity and terrain mapping ($400,000 total funding from the ARC)

INTERNATIONAL GRANTS AND PROJECTS

- A/Prof. Dinesh Kumar (RMIT University) was awarded the Erasmus Mondu Grant (European Union) for visiting Professors worth Euros 14500.

- Joint Research Center (JRC), the peak research body of European Union entered into an agreement with the University of Melbourne and RMIT University to use sensor networks to study impact of noise pollution. This project funded by JRC is worth approx Euro 100,000.

- Federal Government of Brazil invited key members of ISSNIP to help develop Biosignal research in Brazil under a grant worth R$ 29,500.

Project: Olga Bondarenko - Applying Electronic Sensor Network in Marine Environment.

Picture of surface buoy with RF module and antennae.

Project: Olga Bondarenko - Applying Electronic Sensor Network in Marine Environment.

Underwater picture of mooring with temperature.

6. PLANS FOR 2008

APPROACH

Our approach for 2008 is to build on the success we have achieved in 2007 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 (replaced the proposed 2007 event with a Melbourne meeting during ISSNIP 2007), giving additional network members a good understanding of the associated issues and assisting them in designing superior algorithms.

- The new website will be launched in early 2008 reflecting feedback associated with ease of usage as well as the reactivation of member links and profiles. Added to this will be an online forum as well as post-event reporting mechanisms.

- Journal special issues and book volumes will be emphasised as desired outcomes of ISSNIP 2008.

- Promotion of the activities of ISSNIP groups will be undertaken with greater efforts to raise the mainstream profile of Australian Sensor Networks research efforts.

- ISSNIP Neuroengineering Workshop (organised by ISSNIP awardees) will be held in conjunction with the 3rd Australian Workshop in Computational Neuroscience from November 20th until the 22nd, immediately following end of the 1st International Medical Bionics Conference.

- Proposed Workshop on Research and Applications of Sensor Networks in Transportation (late 2008/early 2009).

THEME 2: INDUSTRY LINKAGE

Industry linkages will be improved by:

- Industry Affiliates Program

- Linkage Grant on Visual Sensor Networks proposed for 2008 with iOmniscient Pty Ltd.

- Industry linkage exploration in the area of composite materials and sensor networks.

- On the success of RFID2007, the 2nd International Symposium on RFID Technology is planned to be held in 2008 or 2009.

THEME 3: INTERNATIONAL LINKAGES

International linkages will be strengthened by:

- The Fourth International Conference on ISSNIP will be held in Sydney during December 2008.

- New DIISR-ISL funding proposal.

- ISSNIP-EU proposed workshop to be held in Europe linking ISSNIP researchers with EU FP7 project researchers.

- ISSNIP-US proposed workshop on auto-configurable systems with proposal for NSF support.

- COMS outcomes:
  - Australia is participating in Nanotech 2008, Tokyo, Japan in February, 2008, with a planned delegation of 30+ including 10 students from La Trobe University.
  - ICONN 2008 to be held in Melbourne February 2008 will be Australia's nanotechnology event of the year.
  - COMS 2008, will be held in Puerto Vallarta, Mexico in August 2008 and attended by an Australian Delegation.
  - 2nd Integration and Commercialisation of Micro and Nanosystems International Conference & Exhibition will be held in Hong Kong in June 2008 and attended by an Australian Delegation.

THEME 4: EDUCATION

Education benefits will be improved through:

- Post-graduate and Early Career Researcher (ECR) Workshops
- Additional Development of Sensor Networks Lab
- Development of the GBR Sensor Network Testbed and SensorMap interface
- Additional focussed workshops are being planned.
- Efforts will continue in the establishment of a large scale world class sensor network testbed to aid the education and research efforts of ISSNIP researchers and students.

THEME 5: FUTURE FUNDING

Future funding is being pursued through:

- Queensland Government Smart State Program - SEMAT
- DIISR-ISL project on sensor networks for measuring effects of climate change
- ARC Linkage Project – multi-sensor scene analysis
- ARC Linkage Project – body area sensor networks
- ARC Linkage Project - Researchers from Deakin University will be submitting an ARC Linkage application on "Collision Avoidance in RFID Deployments".
- AOARD proposal for sensing project support
- NSF funding for joint ISSNIP-US workshop on autoconfigurable sensor networks
- Australian Academy of Technological Sciences and Engineering (ATSE) funding for joint ISSNIP-EU (FP7 project) workshop
- ARC LIEF grant proposal for the establishment of sensor network testbed.
- A joint application with Prof. N. Thakor (Johns Hopkins University) and ISSNIP biosensors group members along with video sensor experts of ISSNIP was invited by the Victorian Neurotrauma Centre and is currently under review. The total value of this grant is $5 million.

THEME 6: NEW INITIATIVES

The role of The ARC Research Network on ISSNIP is to promote collaborative research, raise the profile of Australian researchers locally and internationally and provide access by Australian researchers to outside technological expertise and facilities. In helping to achieve these objectives ISSNIP gives funding to support travel, collaborative visits. The introduction of a simplified structure for accessing network funds by members is detailed below.

ISSNIP TRAVEL GRANTS ($1000)

A number of grants of $1000 are being made available to ISSNIP Research Network members (and affiliates) to support travel to conferences and workshops, as well as research visits to undertake collaborative work encompassed by the ISSNIP research themes. These grants are intended to assist with related expenses including travel costs and registrations. A limited number of grants are also available to non-members for collaboration with ISSNIP members.

ISSNIP SUPPORT OF CONFERENCES, WORKSHOPS AND DISTINGUISHED VISITORS

Building upon the success of events run by ISSNIP members, support of Conferences, Workshops, Distinguished Visitors Seminars and related events is once again available upon request. Expenditure of ISSNIP support is primarily to offset the costs of participation by ISSNIP members as well as support travel related expenses of invited speakers (in accordance with ARC funding guidelines). Supported events should be focussed on the key thematic areas of ISSNIP and endeavour to meet the broad objectives of the Research Network. Inquiries should be made directly to the ISSNIP Network Convenor.

ISSNIP SEMINAR SERIES EXPANSION

As part of the ISSNIP education program, an expansion of the ISSNIP Seminar Series is planned. This will entail seminars for researchers and PhD candidates on classifiers, intelligent systems and sensor networks, to be organised by local experts in Canberra, Brisbane and Sydney. Additionally, it is also planned to extend this program to rural and regional Victoria (University of Melbourne, Gippsland campus).

ISSNIP

APPENDIX A: 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 conducted a meeting via telephone conference on March 28 to approve the annual report. The report was approved subject to minor corrections. The successful outcomes of 2007 for the Network were noted and the progress made, well received by the board. Recommendations for increased international profile and increased industry interaction were also noted. A further meeting is to be conducted in April to further discuss Network initiatives and also the prospects for ongoing Network operation beyond 2009.

RESEARCH AND INDUSTRY COMMITTEE

The ISSNIP Research-Industry committee, co-chaired by Professor Subhash Challa from NICTA, Australia and M Palaniswami, is tasked with providing direction for the establishment and support of new collaborative projects. This year saw the establishment of the ISSNIP Industry affiliates program to provide a clear pathway for ISSNIP researchers to linked industry members. Developed throughout the year, the program will be officially launched in 2008.

The level of industry involvement in ISSNIP also increased with a number of new linkages formed, with a commitment to explore formal research links through 2008 in the form of new International Science Linkages as well as a number of ARC Linkage project proposals. These are detailed throughout the report.

Direct outcomes of the committee have also included the following:

- Networked Sensor Technologies (NeST) Lab at UTS has taken up a significant facilitating role to bring together Industry partners like ADI (Thales), RTA, Rolachem, Intersystems, iOmniscient, Cradle Technologies and others.

- Six collaborative meetings and workshops were held between several industry partners, UTS, University of Melbourne, UNSW and University of Sydney.

- The network facilitated a start up, SenSen Networks Pty Ltd (SenSen), to be founded in Aug 2006 as a spin off from NeST Lab, University of Technology, Sydney. SenSen's focus is to develop products based on Video-centric Monitoring, Surveillance, Security and Operations. It successfully raised venture funding in early 2007.

- Industry linkages with US Company Cradle Technologies were established leading to several visits by Cradle Scientists to visit Australia to conduct collaborative research.

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 committee met on December 4, 2007. In addition to A/Prof. Palaniswami (ISSNIP Convenor), international representatives included:

- A/Prof. Palaniswami (ISSNIP Convenor)

- Dr. Harry A Schmitt, (Raytheon, USA)

- Prof. S. Jagannathan (University of Missouri-Rolla)

- Prof. Sally Holbrook (UCSD)

- Prof. Ian Marshall (Lancaster University, UK)

- Prof. Anibal Ollero (University of Seville, Spain)

- Prof. Stuart Milner (University of Maryland, USA)

- Prof. Mohan Kumar (The University of Texas, Arlington, USA)

- Dr. G. K. Venayagamoorthy (University of Missouri-Rolla, USA)

- Prof. Nitish Thakor (Johns Hopkins University)
- Prof. Mohan Trivedi (UCSD)

The main outcome of the meeting was the review and identification of new funding opportunities for international collaboration, through programmes identified at various funding agencies including DEST, NSF, EU Framework Programme, DARPA. As well as potential areas of interest for such work, a recommendation to disseminate relevant information from respective groups to facilitate new link was also made. Positive feedback was given for the organisational framework of the conference.

EDUCATION COMMITTEE

The ISSNIP Education Committee, under the leadership of A/Professor Dinesh Kant Kumar and A/Professor Arcot Sowmya, again promoted a number of developments in the area of education. Of particular note was the ISSNIP Awards Program. The committee effectively reviewed submissions and allocated the awards. Additional programs included Post-Graduate workshops and a number of post-graduate seminars. Dr Fang and Kumar (RMIT) also organised the Workshop of Mobile Computing for Pervasive Healthcare at Philip Island. The 2007 year also saw the development of course work related to ISSNIP research themes as well as the establishment of sensor networks labs for use by students and researchers alike.

ISSNIP education group has made progress in attracting international experts to Australia, and its key members have been invited overseas by highly recognised international grants. This has developed the improved use of resources and expertise and ISSNIP have been able to tap into the best known international experts while making their presence felt in the international arena. Importantly, a number of key members of ISSNIP and some of the invited guests began conducting joint research, as a consequence of these networking opportunities, resulting in the production of a number of joint publications. These opportunities have expanded the profile of Australian educators internationally, as Professor T Dallessio and Dr Silvia, University de Roma tri, Italy, hosted Associate Professor Dinesh K Kumar, during which time a number of seminars were delivered.

Some of the other outcomes are listed below:

- Visit to RMIT University by four young graduate students from Stuttgart, Germany, undertaking a joint project between RMIT, University of Stuttgart BA and University of Melbourne, and resulting in the development of sensor network lab.

- Visits and seminars by Professor Hans Weghorn, Professor Tzyy Jung, Professor Nitish Thakor, Dr Andy Coon and Professor Jayadeva (detailed in the distinguished visitors section). Also, Prof Mihaela Ulieru (Chair of Computer Science, University of New Brunswick, Canada), visited Melbourne in January 2007 (noted in the last annual report) and gave very well attended seminars on the future growth of networks at RMIT, University of Melbourne and in UNSW. She has begun active collaborations with UNSW.

Scholarships and awards:

- Mr Singh from RMIT has been awarded a scholarship by Prof Dallessio (University de Roma tri, Italy) to spend 6 months in Roma at the end of 2007.

- Ms Waichee Yau was awarded a scholarship under the Baden Wurdenburgh, Germany grant (worth approx Euro 5000).

Significant Outcomes:

- A joint application with Prof Thakor and ISSNIP biosensors group members along with Video sensor experts of ISSNIP were invited by the Victorian Neurotrauma Center and is currently under review. The total value of this grant is 5 million.

- Joint Research Center (JRC), the peak research body of European Union got into an agreement with Melbourne University and RMIT to use sensor networks to study impact of noise pollution. This project funded by JRC is worth approx Euro 100,000.

- Federal Government of Brazil invited key members of ISSNIP to help develop Biosignal research in Brazil under a grant worth R$ 29,500.

- A/Prof. Kumar was awarded the Erasmus Mondu Grant (European Union) for visiting Professors worth Euros 14500.

- Dr Andy Coon, now a director at DARPA, has invited ISSNIP to participate in a DARPA program.

ISSNIP

APPENDIX B: ISSNIP ASSISTANCE TO OTHERS

FUNDED VISITORS

The following were funded researchers:

INTERNATIONAL VISITORS:

- Dr. Jussi Pakkanen - Helsinki University of Technology, Finland
- Mr. Johan Kuperus - The University of Twente, The Netherlands
- Dr. Ronald Mahler – Lockheed Martin Tactical Systems, USA
- Prof. Mohan Trivedi – UCSD, USA
- Prof. S. Jagannathan - University of Missouri-Rolla, USA
- Prof. Nitish Thakor - Johns Hopkins University, USA
- Dr. Andy Coon – BBN Technologies, USA
- Prof. Vijay Varadan - Pennsylvania State University, USA
- Prof. Sally Holbrook – UCSD, USA
- Prof. Ian Marshall - Lancaster University, UK
- Prof. Anibal Ollero - University of Seville, Spain
- Prof. Stuart Milner - University of Maryland, USA
- Dr. Harry Schmitt – Raytheon, USA
- Prof. Mohan Kumar - The University of Texas, Arlington, USA
- Prof. R. Jain – Singapore
- Dr. Christopher R. Wren - Mitsubishi Electric Research Laboratories, USA

- Dr. Ganesh Kumar Venayagamoorthy - University of Missouri-Rolla, USA
- Dr. Paul Havinga – University of Twente, The Netherlands
- Prof. Bhaskar Krishnamachari - USC, USA
- Prof. Hans Weghorn - The University of Stuttgart, Germany (RMIT visitor support)
- Dr. Marcelo Espinoza - Katholieke Universiteit Leuven, Belgium
- Dr. Andre De Carvalho - The University of Sao Paulo, Brazil
- Dr. Eric Wing Ming Wong, City University of Hong Kong
- Prof. Steve Wright, University of Wisconsin-Madison, USA
- Prof T Selvi, Anna University, India
- Dr Kris Bubendorfer, Victoria University of Wellington, NZ
- Prof Jim Bezdek, University of West Florida, USA
- Prof Robert Calderbank, Princeton University, USA
- Jinzhi Wang, Peking University, China
- S Zieger, Dresden University of Technology, Germany
- Prof Martin Adams, Nanyang Technological University, Singapore
- Mr John Mullane, Nanyang Technological University, Singapore

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 provide 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:

- S. Kininmonth, Australian Institute of Marine Science ($5000) ISSNIP Award
- R. Begg, Victoria University
- G. R. Naik, RMIT University
- J. Jin, The University of Melbourn
- S. Rajasegarar, The University of Melbourne
- S. Marusic, The University of Melbourne
- J. Gubbi, The University of Melbourne
- A. Khandoker, The University of Melbourne
- D. Lai, The University of Melbourne
- J. S. Sun, The University of Melbourne
- S. Challa, The University of Melbourne
- B. Moran, The University of Melbourne

- M. Jafar Rezaeian, The University of Melbourne
- M. Morelande, The University of Melbourne
- J. Davoren, The University of Melbourne
- T. Hanselmann, The University of Melbourne
- D. Musicki The University of Melbourne
- N. Okello, The University of Melbourne
- X. Wang, The University of Melbourne
- M. Brazil, The University of Melbourne
- St. Howard, The University of Melbourne
- A Shilton, The University of Melbourne
- O. Bondarenko, James Cook University
- K Smith Miles, Deakin University

DOMESTIC TRAVEL SUPPORT:

- A. Sowmya, The University of New South Wales
- D. Gray, University of Adelaide
- G. Dissanayake, University of Technology, Sydney
- A. Bouzerdoum, University of Wollongong
- I. Atkinson, James Cook University
- R. Johnstone, University of Queensland
- S. Bainbridge, Australian Institute of Marine Science
- O. Bondarenko, James Cook University
- R. Panchal, Central Queensland University
- S. Z Hassan, Central Queensland University
- L. Noakes - The University of Western Australia
- H. Durrant-Whyte, University of Sydney

- S. Kininmonth, Australian Institute of Marine Science
- A. Zelinsky, CSIRO
- R. Addie, University of Southern Queensland
- R. S. A. Brinkworth, University of Adelaide
- S. Wiederman, University of Adelaide
- B. La Scala, The University of Melbourne
- D. Musicki, The University of Melbourne
- N. Okello The University of Melbourne
- X. Wang, The University of Melbourne
- B. Moran, The University of Melbourne
- G. Thoms, The University of Melbourne
- P. Sarunic, EWRD, DSTO
- B Verma, Central Queensland University
- M Srinivasan, University of Queensland
- S. Goel, DeakinISSNIP Award

ISSNIP

APPENDIX C: ISSNIP MEMBERSHIP

AUSTRALIAN PARTNER ORGANISATIONS

The following organisations have signed the contract with ISSNIP pledging their support. They form the core group of network members.

THE UNIVERSITY OF MELBOURNE – LEAD UNIVERSITY

- Australian Institute of Marine Science (AIMS)
- Curtin University
- Deakin University
- Defence Science and Technology Organisation (DSTO)
- James Cook University
- La Trobe University
- MINIFaB
- Monash University
- National ICT Australia Pty Ltd. (NICTA)
- The University of Adelaide
- The University of New South Wales
- University of Ballarat
- University of Technology, Sydney
- University of Wollongong (in place of Edith Cowan University)
- Victoria University

INTERNATIONAL PARTNER ORGANISATIONS

Researchers from the following overseas universities have agreed to be a part of ISSNIP network. Several of them have made visits to Australia in the past three years.

- California Institute of Technology (Caltech), USA
- Cambridge University, UK

- City University, Hong-Kong
- Darmstadt University of Technology, Germany
- Louisiana State University, USA
- Massachusetts Institute of Technology, USA
- University of British Columbia, Canada
- University of Twente, The Netherlands
- Western Michigan University, USA

RESEARCH NETWORK MEMBERS

CHIEF INVESTIGATORS

1. **Assoc/Prof. M. Palaniswami,** The University of Melbourne
2. **Prof. Yianni Attikiouzel,** Murdoch University
3. **Prof. Adrian J Baddeley,** The University of Western Australia
4. **Prof. Peter Bartlett,** University of California Berkeley
5. **Prof. Natashia Boland,** The University of Melbourne
6. **Prof. Abdesselam Bouzerdoum,** University of Wollongong
7. **Assoc/Prof. Rajkumar Buyya,** The University of Melbourne
8. **Prof. Subhash Challa,** NICTA-VRL
9. **Prof. Ron Chen,** City University of Hong Kong

10. **Dr. Vaughan Clarkson,** The University of Queensland
11. **Prof. Stuart Crozier,** The University of Queensland
12. **Prof. Subhrakanti Dey,** The University of Melbourne
13. **Prof. G. Dissanayake,** University of Technology, Sydney
14. **Prof. Hugh F Durrant-Whyte,** The University of Sydney
15. **Prof. Rob J Evans,** The University of Melbourne
16. **Dr. Muralidhar K Ghantasala,** Western Michigan University
17. **Prof. Doug Gray,** University of Adelaide
18. **Prof. Paul Havinga,** University of Twente
19. **Prof. Erol C. Harvey,** Swinburne University of Technology
20. **Prof. Cliff Hooker,** University of Newcastle
21. **Prof. S. Sitharama Iyengar,** Louisiana State University
22. **Assoc/Prof. Lindsay Kleeman,** Monash University
23. **Prof. Rao Kotagiri,** The University of Melbourne
24. **Dr. Mohan Krishnamoorthy,** CSIRO
25. **Prof. Vikram Krishnamurthy,** University of British Columbia

26. **Assoc/Prof. Dinesh Kumar,**
RMIT University

27. **Prof. Steven Low,**
Caltech

28. **Prof. Iven Mareels,**
University of Melbourne

29. **Prof. Bill Moran,**
The University of Melbourne

30. **Assoc/Prof. David C O'Carroll,**
The University of Adelaide

31. **Prof. Ian Petersen,**
Australian Defence Force Academy

32. **Assoc/Prof. Himanshu Pota,**
The University of New South Wales

33. **Prof. Daniel Ralph,**
University of Cambridge

34. **Prof. Andrey Savkin,**
The University of New South Wales

35. **Dr. Len J Sciacca,**
DSTO

36. **Prof. Aruna Seneviratne,**
The University of New South Wales

37. **Prof. Kate A Smith-Miles,**
Deakin University

38. **Prof. Arcot Sowmya,**
The University of New South Wales

39. **Dr. Mandayam A Srinivasan,**
Massachusetts Institute of Technology

40. **Prof. Mandyam V Srinivasan,**
Australian National University

41. **Prof. David Suter,**
Monash University

42. **Assoc/Prof. David Tay,**
La Trobe University

43. **Prof. Svetha Venkatesh,**
Curtin University of Technology

44. **Assoc/Prof. Brijesh Verma,**
Central Queensland University

45. **Prof. Geoff West,**
Curtin University of Technology

46. **Prof. Lang White,**
University of Adelaide

47. **Prof. Abdelhak M Zoubir,**
Darmstadt University of Technology

48. **Prof. Moshe Zukerman,**
University of Melbourne

AFFILIATE RESEARCHERS

1. **Assoc/Prof. Rezaul Begg,**
Victoria University

2. **Dr. Nallasamy Mani,**
Monash University

3. **Assoc/Prof. Ian Atkinson,**
James Cook University

4. **Prof. Bernard Pailthorpe,**
The University of Queensland

5. **Dr. Pubudu Pathirana,**
Deakin University

7. **Dr. Chris Manzie,**
The University of Melbourne

9. **Assoc/Prof. Ba-Ngu Vo,**
University of Melbourne

10. **Dr. Surya Singh,**
University of Western Australia

11. **Assoc/Prof. Saman Halgamuge,**
University of Melbourne

12. **Dr. Peter Corke,**
CSIRO

13. **Dr. Tim Wark,**
CSIRO

14. **Assoc/Prof. Ron Johnstone,**
University of Queensland

15. **Dr. Graham Stanley Woods,**
James Cook University

16. **Dr. Christopher Leckie,**
University of Melbourne

17. **Mr. Stuart Kininmonth,**
Australian Institute of Marine Science

18. **Prof. Scott Bainbridge,**
Australian Institute of Marine Science

19. **Dr. Bernard Rolfe,**
Deakin University

20. **Dr. Jemal H. Abawajy,**
Deakin University

21. **Dr. Lars Kulik,**
The University of Melbourne

22. **Dr. Egemen Tanin**
The University of Melbourne

23. **Dr. Adil Bagirov,**
University of Ballarat

24. **Dr. Siddhi Kulkarni,**
University of Ballarat

25. **Prof. K. B. Letaief,**
Hong Kong University of Science and Technology

26. **Prof. Deborah Estrin,**
UCLA

27. **Prof. Bhaskar Krishnamachari,**
University of Southern California

28. **Prof. Lawrence Carin,**
Duke University

29. **Prof. Ian Akyildiz,**
Georgia Institute of Technology

30. **Dr. Srikanta P Kumar,**
BAE Systems

31. **Assis/Prof. T Kirubarajan,**
McMaster University

32. **Dr. Mahendra Malick,**
Lockheed-Martin Orincon

33. **Prof. David Fogel,**
Natural Selection

35. **Dr M Jones,**
Tenix

ISSNIP

36. **Prof. Stuart Milner,** University of Maryland

37. **Dr. Guang Deng,** La Trobe University

38. **Dr. Nanda Nandagopal,** DSTO

39. **Assoc/Prof. Nick Kingsbury,** Cambridge University

40. **Prof. Mohan Kumar,** The University of Texas at Arlington

41. **Dr. Peter Dower,** University of Melbourne

42. **Dr. Vishy Karri,** University of Tasmania

43. **Assoc/Prof. G. K. Venayagamoorthy,** University of Missouri - Rolla

44. **Mr. Matthew Garratt,** Australian Defence Force Academy

45. **Dr. Duncan McFarlane,** Cambridge University

46. **Dr. Stephen Winter,** The University of Melbourne

47. **Prof. Eryk Dutkiewicz,** University of Wollongong

48. **Prof. Jim Bezdek**, University of West Florida

EARLY CAREER RESEARCHER

1. **Dr. Ahsan Khandoker,** The University of Melbourne

2. **Dr. Alistair Shilton,** The University of Melbourne

3. **Dr. Daniel Lai,** The University of Melbourne

4. **Dr. Jayavardhana Gubbi,** The University of Melbourne

5. **Dr. Jin Sheng Sun,** The University of Melbourne

6. **Dr. Levin Kuhlmann,** The University of Melbourne

7. **Dr. Mithun Prasad,** UCLA

8. **Dr. Russell Brinkworth,** University of Adelaide

9. **Dr. Slaven Marusic,** The University of Melbourne

10. **Dr. Thomas Hanselmann,** The University of Melbourne

11. **Dr. Valeri Ougrinovski,** University of New South Wales

12. **Dr. Wei Hua Wang,** The University of Melbourne

13. **Dr. Yee Wei Law,** The University of Melbourne

14. **Dr. Jussi Pakkanen,** Helsinki University of Technology, Finland

15. **Dr. Pazit Levinger,** La Trobe University

16. **Dr. Alex Leong**, The University of Melbourne

17. **Dr. Patrick Laube**, The University of Melbourne

18. **Dr. Chinnu Subramaniam,** Deakin University

19. **Dr. Craig Savage**, The University of Melbourne

20. **Dr. Srikumar Venugopal**, The University of Melbourne

21. **Dr. Chao Jin**, The University of Melbourne

22. **Dr. James Andrew Broberg**, The University of Melbourne

23. **Dr. Xingchen Chu**, The University of Melbourne

24. **Dr. SungJin Choi**, The University of Melbourne

STUDENTS

1. **Mr. Andre Peterson,** The University of Melbourne

2. **Mr. Bharat Sundaram,** The University of Melbourne

3. **Mr. Chandan Kumar Karmakar,** The University of Melbourne

4. **Mr. Dean Freestone,** The University of Melbourne

5. **Mr. Ganesh Naik,** RMIT University

6. **Mr. Jason Jiong Jin,** The University of Melbourne

7. **Mr. Shivali Goel,** Deakin University

8. **Mr. Steven Wiederman,** University of Adelaide

9. **Mr. Sutharshan Rajasegarar,** The University of Melbourne

10. **Mr. Syed Z Hassan,** Central Queensland University

11. **Ms. Olga Bondarenko,** James Cook University

12. **Ms. Rinku Panchal,** Central Queensland University

13. **Mr. Samitha Wathsala Ekanayake,** Deakin University

14. **Ms. Sophie Kaplantzis,** Monash University

15. **Ms Waichee Yau,** RMIT University

16. **Mr. Vijay Pal Singh**, RMIT University

17. **Mr. Kris Nilsen,** The University of Melbourne

18. **Mr. Edgar Charri,** The University of Melbourne

19. **Mr. Stefan Zieger,** Dresden University of Technology, Germany

20. **Mr. Johan Kuperus,**
University of Twente,
The Netherlands

21. **Maen Takruri,**
University of
Technology, Sydney

22. **Nandika Thapar,**
University of
Wollongong

23. **Mr. Sai Kwong Chong,**
University of
Melbourne

24. **Ms. Xiao Rong Chen,**
University of
Melbourne

25. **Ms. To Yan Chan,**
University of
Melbourne

26. **Ms. Pranita Praveen,**
University of
Melbourne

27. **Mr. Xiongcai Cai,**
University of New
South Wales

28. **Mr. Anuraag Sridhar,**
University of New
South Wales

29. **Mr. Peter McLeod,**
Central Queensland
University

30. **Mr. Hong Lee,**
Central Queensland
University

31. **Xilin Yang,**
University of New
South Wales,
Canberra

32. **Juntao Xi,**
Monash University

33. **Mr. Joseph Violi,**
Monash University

34. **Mr. Kamleshkumar
Suthar,**
Western Michigan
University, USA

35. **Ms. Laura Stojkov,**
RMIT University

36. **Mr. Muhammad Jafar
Sadeq**,
University of
Melbourne

37. **Mr. Mohammed Ziaur
Rahman,**
Monash University

38. **Mr. Matthew
Fernandes,**
RMIT University

39. **Ms. Lisa Grant,**
University of Missouri-
Rolla, USA

40. **Mr. Curtis Parrott,**
University of Missouri-
Rolla, USA

41. **Mr. Stephen Glass,**
Griffith
University/NICTA

42. **Mr. Bilal Ahmed,**
University of New
South Wales,
Canberra

43. **Mr. Darius Ted Dela
Cruz,**
University of
Melbourne

44. **Mr. Robert Marshall,**
University of
Melbourne

45. **Mr. Sridhar Poosapadi
Arjunan,**
RMIT University

46. **Mr. Simon Taylor,**
Victoria University

47. **Ms. Kate Lynch,**
Victoria University

48. **Mr. Van Nguyen**,
La Trobe University

49. **Jia Yu**,
University of
Melbourne

50. **Anthony Sulistio**,
University of
Melbourne

51. **Chee Shin Yeo**,
University of
Melbourne

52. **Rajiv Ranjan**,
University of
Melbourne

53. **Marcos Assunção**,
University of
Melbourne

54. **Marco A. S. Netto**,
University of
Melbourne

55. **Al-Mukaddim Khan
Pathan**,
University of
Melbourne

56. **Saurabh Garg**,
University of
Melbourne

57. **Md Mustafizur
Rahman**,
University of
Melbourne

58. **Khaled Ahsan
Talukder**,
University of
Melbourne

59. **Suraj Pandey**,
University of
Melbourne

60. **Mr. Alex Wai Poon**,
RMIT University

61. **Mr. Melaku Alemu**,
RMIT University

62. **Mr. Conor McCoeey**,
RMIT University

63. **Mr. Michael
Mestrovic**,
RMIT University

64. **Shern Yau**,
RMIT University

65. **Ms Yajun Lin**,
RMIT University

66. **Ms Bei Bei Zhou**,
RMIT University

67. **Qing Ming Li**,
RMIT University

68. **Arunava Banerjee**,
RMIT University

ISSNIP RESEARCH COLLABORATION MATRIX

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

CI no.	ISSNIP Researcher	Collaborative Activities	Collaborative Partners
1	Palaniswami	• New research grants • Joint publications • Joint conf./workshop org • Industry partnerships • Joint visitors • Joint research grants • Joint student supervision	• AI: 17, 3 • CI: 26, 48, AI: 1, 16, 23 • CI: 5, 6, 13, 14, 15, 16, 18, 26, 36, 37, 38, 44, AI: 1, 3, 5, 8, 9, 11, 12, 13, 14, 17, 22, 23, 26, 33, 35, 36, 37, 39, 42 • UQ, JCU • RMIT • CI: 7, 8, 18, 23, 27, 28, 29, 48, AI: 3, 16, 17 • AI: 2, 16,
2	Attikiouzel	•	•
3	Baddeley	• New research grant	• AI: 9
4	Bartlett	•	•
5	Boland	• Conference & workshop org	• CI: 1
6	Bouzerdoum	• Conference org • Joint research projects	• CI: 1, 6, 38 • CI: 11, 38, 43, 44
7	Buyya	• New testbed grants • Joint research grants • Joint visitors • Joint research project	• CI: 23, AI: 6, 8, 21, 22 • CI: 1, 23 • CI: 24 • CI: 1, 23
8	Challa	• Joint research grants • Industry partnerships • Joint research project • Joint student supervision	• CI: 1, 23, 28, 29, AI: 16, 17 CI: 1, 8 • CI: 1 • CI: 30 • CI: 30
9	Chen	• Joint publications	• CI: 1, 48, 27
10	Clarkson	•	•
11	Crozier	• Joint research projects	• CI: 6, 38, 43, 44
12	Dey	• New research grant	• CI: 28
13	Dissanayake	• Collaborative research • Conference org.	• CI: 8 • CI: 1, 6, 38
14	Durrant-Whyte	• 2007 conference keynote	•
15	Evans	• 2007 conference keynote	•
16	Ghantasala	• Conference org	• CI: 1
17	Gray	• New research grant	• CI: 29
18	Harvey	• Conference org.	• CI: 1
19	Havinga	• Joint visits • Joint grants • Joint conference/syposium	• CI: 1 • CI: 1, 8 ,AI: 3, 4, 16 • CI: 1, AI: 13
20	Hooker	•	•
21	Iyengar	• Joint research grants	• CI: 2, 8, 36, 1, 20
22	Kleeman	•	•
23	Kotagiri	• New testbed grant • New research grant	• CI: 7, AI: 6, 8, 21, 22 • AI: 21, 22
24	Krishnamoorthy	•	•
25	Krishnamurthy	• Joint visit	• U Melbourne
26	Kumar	• Joint conference/symposium • Joint visitors • Joint research grants • Joint supervision	• CI: 1, AI: 1 • U Melbourne • CI: 32 • CI: 32
27	Low	• Joint research grants • Joint publications	• CI: 48, 1, 9 • CI: 1
28	Mareels	• Joint grants • New research grant	• CI: 1, 8, 23, 29, AI: 16, 17 • CI: 12
29	Moran	• New research grant • Joint visitors • Joint workshops • Research Collaboration • Joint research grant	• CI: 17 • CI: 1, 11, U Adelaide • U Adelaide • DSTO • CI: 1, 8, 23, 28, AI: 16, 17
30	O'Carroll	• Joint Research Project • Joint student supervision	• CI: 8, 40 • CI: 8
31	Petersen	•	•
32	Pota	• Joint research grants • Joint supervision	• CI: 26 • CI: 26

33	Ralph	• Joint visitor • Research collaboration	• . • CI: 26, AI: 2
34	Savkin	•	•
35	Sciacca	• Collaborative research	• U Melbourne
36	Seneviratne	• Workshop org.	•
37	Smith-Miles	• Symposium org.Planning for 2008	• U Melbourne
38	Sowmya	• Workshop/Conference org • Joint visitors • 2007 event planning • Joint research projects	• CI: 46, 1, 7 • CI: 44 • • CI: 6, 11, 43, 44
39	Srinivasan	• Planning for 2007	•
40	Srinivasan	• Joint research project	• CI: 30
41	Suter	• New research grant	• AI: 9
42	Tay	• Joint research project • Collaborative research	• AI: 39 • UNSW, U Melbourne
43	Venkatesh	• Conference org. • Joint research grants • Joint research projects	• CI: 1 • CI: 46 • CI: 6, 11, 38, 44
44	Verma	• Conf/Symposium org. • Joint research projects	• CI: 1, AI: 24 • CI: 6, 11, 38, 44
45	West	• Joint research grants	• CI: 43
46	White	• Joint visitors • Conference org.	• CI: 11, 1
47	Zoubir	• Event planning	• CI: 1
48	Zukerman	• Joint visitors • Joint research grants • Test bed collaboration	• CI: 1 • CI: 27, 9, 1 • CI: 16, 24, 31, 1, 16

Note: CI: Chief Investigators. AI: affiliate investigators

ISSNIP

APPENDIX E: MEDIA COVERAGE AND PUBLICATIONS

MEDIA COVERAGE

ISSNIP researchers have continued to receive media coverage raising the mainstream profile of their Sensor Networks related research activities in Australia and around the world. The following is some of our coverage:

"RFID symposium, Melbourne," FEN - Australia's premier manufacturing news website (www.myfen.com.au), 5-Oct-2007

"University Conferences Explore Technology Niches," Media Release: State Government of Victoria, The Minister For Information And Communication Technology, Date: Wednesday, December 5, 2007

"New technology could tighten border security," Media Release , Deakin University, 30 November 2007, Issued by: Mandi O'Garretty, Senior Media Officer

"Microsoft Takes An Interest In Gridbus," November 20, 2007, By Paul Shread, gridcomputingplanet.com

Rajkumar Buyya (University of Melbourne) has discussed his work on the development of Grid Simulation (GridSim) Technology. International Science Grid This Week, 17 October.

"Gastro cameras make waves for reef research", UQ News, 3 December, 2007, Ron Johnstone (UQ)

PUBLICATIONS

During 2007, there were several publications in Books, Journals and Conferences demonstrating collaboration between network members. Listed below are only some of the significant publications directly aided by ARC Research Network activity and support, either in forging collaborations; leveraging network support for new projects; or facilitating collaborative research as part of the Research Network objectives. In particular, this includes joint works: between ISSNIP CI's and AI's; across institutions; between ISSNIP CI's and research visitors.

BOOKS

1. Begg RK, Lai DTH and Palaniswami M (2007). Computational Intelligence in Biomedical Engineering, Taylor & Francis Books Inc (CRC Press), Boca Raton, Florida, USA (392 pages), ISBN: 9780849340802.

2. Proceedings of the 3rd International Conference on Intelligent Sensors, Sensor Networks and Information Processing, 2007. Eds: M.Palaniswami, S. Marusic, Y. W. Law.

BOOK CHAPTERS

1. Jayavardhana Gubbi, Palaniswami M., Michael Parker, Kernel Methods for Protein Structure prediction, Accepted as book chapter: Kernel Methods for Protein Structure Prediction, Wiley Book Series on Bioinformatics: Computational Techniques and Engineering. March 2007.

2. S. Z. Hassan Zaidi & Brijesh Verma, "Hybrid Data Mining For Medical Applications". In the Handbook of Research on Modern Systems Analysis and Design Technologies and Applications, published by Idea Group Reference - IGR (www.idea-groupref.com) (2007-2008 Academic Year).

3. Jinsheng Sun and Moshe Zukerman, An Adaptive Neuron AQM for a Stable Internet, Lecture Notes in Computer Science Vol.4479, Proc. IFIP Networking 2007, pp. 844-854, Atlanta, May 2007.

4. Jinsheng Sun and Moshe Zukerman, Improving RED by a Neuron Controller, Lecture Notes in Computer Science Vol.4516, Proceedings of ITC20 , pp. 434–445, 2007.

5. Khandoker, A. H. and Begg R. K. " Machine learning for designing an automated medical diagnostic system". In: 'Encyclopaedia of Systems Analysis and Design'. Eds Mahbubur Syed, Department of Computer Information Sciences Sharifun Nessa, Department of Management Minnesota State University, Mankato. In press.

6. Jayavardhana Gubbi, Alistair Shilton, Marimuthu Palaniswami, Kernel Methods for Protein Structure prediction, In Y. Zhang and J. Rajapakse, editors, Machine Learning in Bioinformatics, Wiley, In Press, 2007.

JOURNAL ARTICLES

1. Jinsheng Sun, Sammy Chan, King-Tim Ko, Guanrong Chen and Moshe Zukerman. Instability effects of two-way traffic in a TCP/AQM system. Computer Communications, v 30, n 10, July, 2007, p 2172

2. Khandoker, A. H., Palaniswami M. and Begg. R. K. "A comparative study on approximate entropy measure and poincaré plot indexes of minimum foot clearance variability in the elderly during walking'. Journal of Neuroengineering and Rehabilitation (JNER), in press.

3. Sutharshan Rajasegarar, Christopher Leckie and Marimuthu Palaniswami "Anomaly Detection in Wireless Sensor Networks", in IEEE Wireless Communications Magazine (To appear), 2008. ISSN 1536-1284.

4. Jayavardhana Gubbi, Daniel Lai, Michael Parker, Marimuthu Palaniswami - Protein Secondary Structure Prediction using Support Vector Machines and a New Feature Representation, 551-567, International Journal of Computational Intelligence and Applications, 2007.

5. Jinsheng Sun and Moshe Zukerman, RaQ: A Robust Active Queue Management Scheme Based on Rate and Queue Length, Computer Communications, v 30, n 8, June 2007, p 1731-1741.

6. Khandoker AH, Lai D, Begg RK and Palaniswami M. Wavelet-based feature extraction for automated screening of balance impairments in the elderly. IEEE Transactions on Neural Systems and Rehabilitation Engineering, in press.

7. Ganesh R Naik, Dinesh K. Kumar, and Hans Weghorn, 2007. "Limitations and applications of ICA for Surface Electromyogram-validation for identifying hand gestures", Special issue of International journal of Computational Intelligence and Applications (IJCIA).

8. Wang, L, Bezdek, J. C., Leckie, C. and Kotagiri, R. (2008). Selective sampling for Approximate clustering in very large data, in press, Int. J. Intell. Systems.

9. Wang, L., Leckie, C., Kotagiri, R. and Bezdek, J. C. (2008). Approximate spectral clustering using selective sampling and extension, in preparation, IEEE Trans. Pattern Analysis and Machine Intelligence.

10. Y.W. Law and L. van Hoesel and J. Doumen and P. Hartel and P. Havinga and M. Palaniswami, "Energy-Efficient Link-Layer Jamming Attacks against Wireless Sensor Network MAC Protocols," ACM Transactions on Sensor Networks, 2008 (to appear).

REFEREED CONFERENCE PAPERS

1. Shilton, A. and Lai, D. - Iterative Fuzzy Support Vector Machine Classification, in Proc. of the IEEE conference on Fuzzy Systems, London, England, July 23-26, 2007.

2. Shilton, A. and Lai, D. - Quaternionic and complex-valued Support Vector Regression for Equalisation and Function Approximation, in Proc. of the International Joint conference on Neural Networks, Orlando, Florida, USA, August 12-17, 2007.

3. Shivali Goel, Jemal Abbawajy - Performance of Smart Antennas with Receive Diversity in Wireless Sensor Networks (accepted in IEEE International Conference on Signal Processing, Communications and Networking (ICSCN 2008), Jan 4-6, 2008).

4. Sutharshan Rajasegarar, Christopher Leckie, Marimuthu Palaniswami, and James C Bezdek, "Quarter Sphere Based Distributed Anomaly Detection in Wireless Sensor Networks,"in Proc. of IEEE International Conference on Communications (IEEE ICC 2007), pp.3864-3869, (Glasgow, Scotland), June 2007.

5. Sutharshan Rajasegarar, James C Bezdek, Christopher Leckie and Marimuthu Palaniswami "Analysis of Anomalies in IBRL Data from a Wireless Sensor Network Deployment", in Proc. of International Conference on Sensor Technologies and Applications (SENSORCOMM 2007), pp 158-163, (Valencia, Spain), Oct 2007.

6. Y.W.Law, L.-H. Yen, R. Di Pietro, and M. Palaniswami. Secure k-Connectivity Properties of Wireless Sensor Networks. 3rd IEEE International Workshop on Wireless and Sensor

ISSNIP

Networks Security (WSNS 2007), in conjunction with the 4th IEEE International Mobile and Ad-hoc and Sensor Systems (MASS 2007).

7. Karmakar C.K., Khandoker A. H., Palaniswami M. "Power spectrum analysis of ECG signals during obstructive sleep apnoea/hyponea epochs", 3rd International conference on Intelligent sensors, sensor networks and information processing (ISSNIP), December 3-6, 2007 in Melbourne, Australia.

8. Karmakar C.K., Khandoker A. H., Palaniswami M. and Begg R. K., Taylor S., "Understanding Ageing Effects by Approximate Entropy Analysis of gait variability". 29th IEEE EMBS Annual International Conference pp 1965-1968, August 23-26, 2007 in Lyon, France.

9. Khandoker A. H., and Palaniswami M. "Automated recognition of obstructive sleep apnoea syndrome from electrocardiogram recordings". 10th International Sleep and Breathing Meeting, 31 August - 1 September 2007 in Palm Cove, Australia.

10. Khandoker A. H., Karmakar C.K., Palaniswami M. "Screening Obstructive Sleep Apnoea Syndrome from Electrocardiogram Recordings Using Support Vector Machines". 34th Annual Computers in Cardiology, October 1-3, 2007 in Durham, USA.

11. Khandoker A. H., Karmakar C.K., Palaniswami M. and Begg R. K. "Wavelet-Based Multiscale Analysis of Minimum Toe Clearance Variability in the Young and Elderly during Walking". 29th IEEE EMBS Annual International Conference, pp 1558-1561, August 23-26, 2007 in Lyon, France.

12. Khandoker A. H., Kimura Y., Palaniswami M. "Non-Invasive Determination of Electromechanical Time Intervals of Cardiac Cycle Using Abdominal ECG and Doppler Ultrasound Signals from Fetal Hearts". 34th Annual Computers in Cardiology, October 1-3, 2007 in Durham, USA.

13. Khandoker A. H., Lynch K., Karmakar C.K., Palaniswami M. and Begg R. K. "Regulation of Minimum Toe Clearance Variability in the Young and Elderly during Walking on Sloped Surfaces". 29th IEEE EMBS Annual International Conference, pp 4887-4890,August 23-26, 2007 in Lyon, France.

14. Lai, D., Khandoker A. H., Palaniswami M. and Begg R. K. "A hybrid Support Vector Machine and autoregressive model for detecting gait disorders in the elderly'. 2007 International Joint Conference on Neural Networks (IJCNN), August 12-17, 2007.

15. Olga Bondarenko, Stuart Kininmonth , Michael Kingsford 2007 "Coral Reef Sensor Network Deployment for Collecting Real Time 3-D Temperature Data with Correlation to Plankton Assemblages". In Proceedings for SENSORCOMM 2007, Valencia, Spain

16. Olga Bondarenko, Stuart Kininmonth , Michael Kingsford 2007 "Underwater Sensor Networks, Oceanography and Plankton Assemblages", 2007, In Proceedings for ISSNIP 2007, Melbourne, Australia

17. S. Kaplantzis, A. Shilton, N. Mani and Y.A. Sekercioglu, "Detecting Selective Forwarding Attacks in Wireless Sensor Networks using Support Vector Machines", In Proceedings of The third International Conference on Intelligent Sensors, Sensor Networks and Information Processing - 2007

18. S. Z. Hassan Zaidi & Brijesh Verma, "A Hybrid Data Mining Approach for Knowledge Extraction and Classification in Medical Databases". In 7th International Conference on Intelligent Systems Design and Applications (ISDA'07), published by IEEE Computer Society, October 22-24, 2007, Rio de Janeiro, BRAZIL

19. S. Z. Hassan Zaidi & Brijesh Verma, "Decisions Fusion Strategy: Towards Hybrid Cluster Ensemble. In Symposium on Machine Learning and Applications". The Third International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP 2007), December 3-6, Melbourne, Australia.

20. Jinsheng Sun, Moshe Zukerman and M. Palaniswami, Stabilising RED using a fuzzy controller. proc. ICC 2007, Glasgow, Jun. 2007.

21. Jinsheng Sun, Moshe Zukerman and Marimuthu Palaniswami. A Stable Adaptive PI

Controller for AQM. 2007 International Symposium on Communications and Information Technologies (ISCIT 2007), pp.707-712, Sydney, October 2007.

22. Adil Bagirov , D. Lai and M. Palaniswami, "A nonsmooth optimisation approach to sensor network localisation", accepted in the 3rd International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP), Dec 3-6, 2007.

23. Bondarenko O. Kininmonth, S. and Kingsford, M. 2007. Wireless Sensor Network Deployment for Collecting Real Time 3-D Temperature Data with Correlation to Plankton Assemblages in Nelly Bay, Magnetic Island Australia

24. Cameron Huddlestone-Holmes, Gilles Gigan, Graham Woods, Adam Ruxton, Ian Atkinson, and Stuart Kininmonth 2007. Infrastructure for a Sensor Network on Davies Reef, Great Barrier Reef

25. Ganesh R Naik, and Dinesh K. Kumar. "Limitations and applications of ICA in Facial sEMG and Hand gesture sEMG in Human Computer Interaction", HCSNet Workshop on the Use of Vision in HCI - VisHCI 2007. In conjunction with DICTA, Adelaide, 2nd December 2007

26. Ganesh R Naik, Dinesh K. Kumar, and Hans Weghorn. "ICA based identification of sources in sEMG", 3rd International conference on Intelligent Sensors Sensor networks and Information, Melbourne, Australia, 3-6 December 2007

27. Ganesh R Naik, Dinesh K. Kumar, and Hans Weghorn. "Identification of number of independent sources in surface EMG recording using overcomplete ICA", The 1st International Conference on Signal Processing and Communication Systems, ICSPCS 2007, Gold Coast, Australia, 17-19 December 2007

28. Ganesh R Naik, Dinesh K. Kumar, and Hans Weghorn. "Performance comparison of ICA algorithms for Isometric Hand gesture identification using surface EMG", 3rd International conference on Intelligent Sensors Sensor networks and Information, Melbourne, Australia, 3-6 December 2007

29. Ganesh R Naik, Dinesh K. Kumar, and Hans Weghorn. "Subtle Hand Gesture Identification for HCI using Temporal Decorrelation Source Separation BSS of surface EMG", HCSNet Workshop on the Use of Vision in HCI - VisHCI 2007. In conjunction with DICTA, Adelaide, 2nd December 2007

30. Ganesh R Naik, Dinesh K. Kumar, Hans Weghorn, Vijay Singh and Marimuthu Palaniswami. "Improving Isometric Hand Gesture Identification for HCI based on Independent Component Analysis in Bio-Signal Processing", In Proceedings of PRIS International workshop, 2007, Funchal, Madeira - Portugal, 12-16, June 2007.

31. Ganesh R Naik, Dinesh K. Kumar, Hans Weghorn, Vijay Singh and Marimuthu Palaniswami.

"Real-time Hand gesture identification for HCI based on ICA of surface Electromyogram", IADIS International Conference Interfaces and Human Computer Interaction, Lisbon, Portugal 6-8 July 2007

32. J. Jin, W. H. Wang and M. Palaniswami, "Application-oriented flow control for wireless sensor networks," Proc. of the third International Conference on Networking and Services (ICNS), Athens, Greece, June 2007.

33. J. Jin, W. H. Wang and M. Palaniswami, "Utility max-min fair flow control for heterogeneous sensor networks," to appear in Proc. of ISSNIP 2007.

34. J. Jin, W. H. Wang and M. Palaniswami, "Utility max-min fair flow control for multipath communication networks," to appear in Proc. of ICSPCS 2007.

35. J. Pakkanen and D. Lai, "A study of transmission overheads for sensor network localisation schemes", accepted in the 3rd International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP), Dec 3-6, 2007.

36. J. Pakkanen, D. Lai and M. Palaniswami, " A study on multidimensional scaling (MDS) algorithms for 3D sensor network localisation ", ISSNIP/ISPRS Joint International Workshop on Distributed Geoinformatics and Sensing, Ubiquity and Mobility, (13 pages), 2007.

37. Wahab Y, Zayegh A, Begg RK, Veljanovski1 R (2007) "Analysis of foot-to-ground clearance

measurement techniques for MEMS realisation." In Proceedings of the 10th International Conference on Computer and Information Technology, December 27-29, Dhaka, Bangladesh. CD.

38. Tom Kobialka, Rajkumar Buyya, Christopher Leckie, and Rao Kotagiri, "A SensorWeb Middleware with Stateful Services for Heterogeneous Sensor Networks," Proceedings of the 3rd International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP 2007, IEEE Press, Piscataway, New Jersey, USA), Dec. 3-6, 2007, Melbourne, Australia.

39. Wang, L., Leckie, C., Wang, X., Bezdek, J. C. and Kotagiri, R. (2007). Tensor Space Learning for Analysing Activity Patterns from Video Sequences, Proc. IEEE ICDM'07 Workshop on Knowledge Discovery and Data Mining from Multimedia Data and Multimedia Applications (KDM), 63-68.

APPENDIX F: GLOSSARY

ADFA-UNSW	Australian Defence Force Academy UNSW
AI	Affiliate Investigator
AIMS	Australian Institute of Marine Science
AMSI	Australian Mathematical Sciences Institute
ANU	Australian National University
AOARD	Asian Office of Aerospace Research and Development
ARC	Australian Research Council
CI	Chief Investigator
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DARPA	Defence Advanced Research Program Agency
DEST	Department of Education Science and Training
DIISR	Department of Innovation, Industry, Science and Research
IMOS	Integrated Marine Observing System
ISL	International Science Linkages Programme
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
NSF	National Science Foundation
RFID	Radio Frequency Identification
RN	Research Network
UAV	Unmanned Aerial Vehicle
UNSW	University of New South Wales
UQ	University of Queensland
UTS	University of Technology, Sydney

APPENDIX G: LINKAGE REPORT EXTRACTS

PROJECT DESCRIPTIONS

This appendix includes a description of the projects being undertaken by ISSNIP researchers, as they appeared in the ISSNIP Collaborations – Research Linkage Report - 2007. The linkage report was released at the ISSNIP CI's meeting and is intended as guide to the various projects and collaborations being undertaken within ISSNIP. It thus serves as guide for ISSNIP researchers and potential new external collaborators as a comprehensive overview of ISSNIP expertise and current research activities.

A brief overview of research activities supported across the ISSNIP network is presented. The primary objective of the ARC to enhance the scale and focus of research and to encourage interdisciplinary activities is realised with these projects. The project abstract, chief investigator, post doctoral researchers, post graduate students and overseas collaborators for each project is given for the year 2007.

DEST-ISL Project on Distributed Sensor Networks

Distributed Sensor Networks, consisting of a potentially very large number of diverse sensors interconnected via a low data-rate communication network, have the potential to make an unimaginable impact on many areas of human activity. The area of sensing technologies and sensor networks is now recognised by international funding agencies such as the European Commission, DARPA and NSF to be among the top five emerging technologies that will shape the future of human kind and have a major impact on the quality of life over the next 20 years.

This project will provide an urgently needed national focus and identity for Australian research in the rapidly emerging and highly significant area of sensor networks. It will build a national collaborative framework to grow and support the essential industry/research co-operation needed to fully exploit advances in sensor network science and technology to address major national social challenges in the areas of environment and security. It will provide Australian researchers with strong linkages and exchange opportunities with the major international sensor networks research efforts in the USA and Europe.

In the National Research Priority areas of Defence, Environment, Security and Frontier Technologies, this project addresses three focussed themes of applications: Security in Sensor Networks, Environmental Monitoring and Surveillance & Geo-Location.

In the area of environment, the project develops algorithms for modelling the effects of pollution in the Great Barrier Reef to protect this national asset. In the area of defence, it will concentrate on advanced algorithms for deployment in Unmanned aerial Vehicles to safeguard border security. In the area of critical infrastructure security, we plan to develop robust intrusion detection algorithm that are integrated in the SCADA systems for controlling energy and water supply networks.

Principal Investigator:
M. Palaniswami
Chris Leckie
Stuart Kininmonth
Subhash Challa
Rao Kotagiri
Iven Mareels
Bill Moran

Collaborations:
Anthony Finn, DSTO
Bijan Samali, University of Technology - Sydney
Pramod Varshney, Syracuse University
SS Iyengar, Louisiana State University
Paul Havinga, University of Twente
Ian Marshall, University of Kent
Erkki Oja, Helsinki University
Bhaskar Krishnamachari, USC

Industry Collaborations:
Bernard Pailthorpe, QPSF Ltd
Harry Schmitt, Raytheon
Rustom Kanga, iOmniscient Ltd
Stella Wei Wang, Decisioneering Pty Ltd
Road Traffic Authority, Sydney

Post Doctoral Research Fellows:
Alistair Shilton
Yee Wei Law
Slaven Marusic
Jayavardhana Gubbi

Students:
Bharat Sundaram
Sutharshan Rajasegarar

ISSNIP

Principal Investigator:
Matt Duckham

Post Doctoral Research Fellows:
Patrick Laube

Spatial computing for mobile geosensor networks

Geosensor networks are revolutionizing not just the capture but also the processing of spatial information. Whereas conventional spatial computing relies on powerful centralized databases and information systems, geosensor networks require new distributed solutions for in-network geodata processing and knowledge discovery. This project is developing new data structures and algorithms for distributed geoinformation processing in mobile, ad-hoc geosensor networks. Such distributed and mobile geospatial technologies have important application to many domains, including transportation, tracking, navigation, sustainable management of natural environments, and emergency preparedness and response.

Principal Investigator:
Subhra Dey

Post Doctoral Research Fellows:
Alex Leong

Power Efficient State Estimation using Multiple Sensors

We consider state estimation of scalar linear systems using analog forwarding with multiple sensors, for both multiple access and orthogonal access schemes. Optimal state estimation can be achieved at the fusion centre using a time varying Kalman filter. In many situations, it is shown that the error covariance decays at a rate of $1/M$ when the number of sensors M is large. Optimal allocation of transmission powers subject to constraints on the error covariance or sum power is considered, and compared with simpler schemes such as equal power allocation.

Principal Investigator:
Raj Buyya

Collaborations:
M. Palaniswami
UniMelb
Rao Kaotagiri
UniMelb

Post Doctoral Research Fellows:
Srikumar Venugopoal
Chao Jin
James Andrew Broberg
Xingchen Chu
SungJin Choi

Students:
Jia Yu
Anthony Sulistio
Chee Shin Yeo
Rajiv Ranjan
Marcos Assunção
Al-Mukaddim Khan Pathan
Saurabh Garg
Md Mustafizur Raham
Khaled Ahsan Talukder
Suraj Pandey

International Science Linkage Project on Grid Computing

Grid computing is emerging as an enabler for the creation of global Cyberinfrastructure for e-Research applications and is recognised as one of the top five emerging technologies that will have a major impact on the quality of science and society over the next 20 years.

This International Science Linkage (ISL) Project, funded by the Australian Department of Education, Science and Training (DEST) from Nov. 2006-Dec. 2009, links Australian researchers with international researchers primarily through (1) two EU FP6 projects: CoreGrid and CatNets, (2) Chinese Grid project (ChinaGrid), (3) Indian Grid project (Garuda), and (4) American AutoMate. The project is aimed at enhancing the scope and depth of Australian R&D in Grid computing and e-Research; establishing linkages to enable the leveraging of the capabilities and resources of both Australian and international partners; and developing grid technologies that improve agility and utility of national and international Cyberinfrastructure powering e-Research applications.

This project aims to produce basic scientific discoveries and turn them into commercial outcomes through the development of:

1. an advanced grid application development environment that
2. supports the linking of distributed scientific models and resources;
3. an economic-based and self-organising autonomic layer that
4. overlays network architectures and systems for Internet-based enterprise
5. and global Grids;
6. economic-based grid protocols for service negotiation and
7. resource allocation;
8. algorithms for decentralised resource management and application scheduling on global grid environment;
9. grid middleware for composing and deploying e-Research applications on utility-driven enterprise and global grid computing environments; and
10. applications on utility-driven enterprise and global grid computing environments; and
11. e-Research application demonstrators in Geophysics and life sciences areas.

BigNet Sensor Network Testbed

Wireless Sensor Networks (WSNs) have taken only a decade from being postulated to being driven by industry standards (the ZigBee Alliance has over 200 members). Many large scale implementations are under construction around the world.

ISSNIP is collaborating with CUBIN and NICTA to develop a Wireless Sensor Network Testbed, "BigNet". BigNet will be constructed in stages throughout 2008 and beyond. It will enable a partnership of academic groups and industry to conduct research, teaching and application development. It will create a focus and a testbed for sensors networks in Australia and will become an important element of national infrastructure. A student laboratory for sensor network testbed has also been funded by the A. E. Rowden White Foundation. Student projects will be supervised by staff from Geomatic Engineering, Civil & Environmental Engineering, Computer Science & Software Engineering and Electrical & Electronic Engineering. Students will be on working in groups that span departments to maximise the learning potential and exposure to a range of disciplines during their final year of undergraduate study. Currently ISSNIP students and postdocs are implementing a small testbed with 25 sensors to demonstrate the developed anamoly detection algorithms.
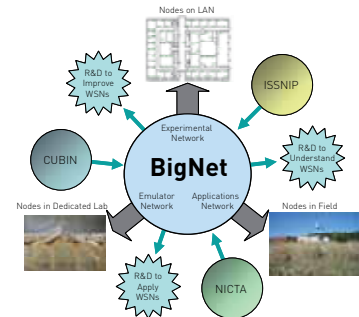
Applications of support vector regression to sensor network localisation and network intrusion detection

The primary focus of our research is the extension of support vector machine methods for non-real target regression and directly multi-class classification. Our recent work has included the extension of the standard SVR model to division algebraic targets. Applications of this work include equalisation in non-linear communications channels and geometric regression problems in 2 and 3 dimensions. In addition to this we have been studying other extensions of SVM methods including iterative fuzzy approaches that allow one to implement arbitrary empirical risk functions; as well as applications of support vector regression and density estimation to sensor network localisation, anomaly detection and network intrusion detection.

Principal Investigator:
Marimuthu Palaniswami

Post Doctoral Research Fellows:
Alistair Shilton
Daniel T.H. Lai

Students:
Bharat Sundaram
Sophia Kaplantzis

Secure k-connectivity properties of wireless sensor networks

A k-connected wireless sensor network (WSN) allows messages to be routed via one (or more) of at least k node-disjoint paths, so that even if some nodes along one of the paths fail, or are compromised, the other paths can still be used. This is a much desired feature in fault tolerance and security. k-connectivity in this context is largely a well-studied subject. When we apply the random key pre-distribution scheme to secure a WSN however, and only consider the paths consisting entirely of secure (encrypted and/or authenticated) links, we are concerned with the secure k-connectivity of the WSN. This notion of secure k-connectivity is relatively new and no results are yet available. The random key pre-distribution scheme has two important parameters: the key ring size and the key pool size. While it has been determined before the relation between these parameters and 1-connectivity, our work in k-connectivity is new. Using a recently introduced random graph model called kryptograph, we derive mathematical formulae to estimate the asymptotic probability of a WSN being securely k-connected, and the expected secure k-connectivity, as a function of the key ring size and the key pool size. Finally, our theoretical findings are supported by simulation results.

Principal Investigator:
Marimuthu Palaniswami

Collaborations:
Li-Hsing Yen, National University of Kaohsiung, Taiwan
Roberto Di Pietro, Universita di Roma Tre, Italy

Post Doctoral Research Fellows:
Yee Wai Law

ISSNIP

Principal Investigator:

Chris Leckie

M. Palaniswami

Collaborations:

Jim Bezdek

Students:

Sutharshan Rajasegarar

Detecting Anomalies in Wireless Sensor Networks

Wireless sensor networks consist of large number of sensors, which are capable of communicating via a wireless medium. They are resource constrained in terms of energy, which affects their communication capabilities. Sensor networks are vulnerable to malicious attacks and faults. This would introduce misbehavior in the measurements it collects as well as traffic in the network. A key challenge in sensor networks is to identify these misbehaviors or anomalies in the network with high accuracy while consuming minimum energy in the network so as to prolong the lifetime of the network. We present our distributed approaches, which perform more in-network processing in the network with minimum communication overhead, for detecting these anomalies in wireless sensor networks.

Principal Investigator:

Nallasamy Mani

Collaborations:

Ahmet Sekercioglu, Monash University

Post Doctoral Research Fellows:

Alistair Shilton

Students:

Sophia Kaplantzis

Intrusion Detection in Wireless Sensor Networks

The aim of our project is developing a theoretical model to detect DoS routing threats in WSNs in an accurate and energy efficient manner, using smart classification techniques. In particular we are investigating the robustness of state-of-the-art routing protocols against a spectrum of attacks including Black hole attacks, selective forwarding attacks and packet spoofing attacks. We then adopt computational intelligence techniques such as ANNs, SVM, game theory in an attempt to build an accurate and optimized intrusion detection system for WSNs that works in conjunction with such protocols. A simulation tool based on OMNeT++ has been developed to further investigate the credibility of our theories. Furthermore, the applicability of techniques such as LISYS and Honeypots for WSNs are to be investigated.

Principal Investigator:

Adil Bagirov

Collaborations:

Jussi Pakkanen, Helsinki University of Technology, Finland

Post Doctoral Research Fellow:

Daniel T.H. Lai

Localization in Wireless Sensor Networks

The problem in self-localization for wireless sensor networks has experienced a recent explosion in interest. Two dominant methods are currently in use, namely Multi Dimensional Scaling (MDS) and Semi-definite Programming (SDP), however many limitations still remain when applying these techniques. Furthermore, previous work has concentrated mostly on 2D localization problems while real world applications exist in 3D. This project attempts to investigate the limitations of current methods in greater detail from a theoretical view point. We are interested in mathematical modelling of the optimization problem and applying it to solving 3 dimensional localization problems.

Techniques for constructing complex analytic wavelets

Wavelet analysis is one of the success stories in mathematics that has found many real world applications and some have been adopted by industry, eg. JPEG2000, digital cinema. Wavelet basis functions are excellent tools for analysing function space (eg. Sobolev) and signals (eg. image). Traditional wavelets (eg. Daubechies family) are real valued. This project will develop techniques for constructing new wavelets that are complex valued. Complex wavelets can perform better in signal analysis as they provide angle or phase information not available from real wavelets. These novel complex wavelets are applicable in many areas involving numerical data (eg. biomedical, financial) for extracting useful information in decision making.

Principal .Investigator:

David Tay

Collaborations:

N.G. Kingsbury, University of Cambridge, UK

Students:

Van Nguyen

Marine sensor networks on the Great Barrier Reef: opportunities and collaborations

This ISSNIP project aims to enhance collaborations for the development of sensor networks on the Great Barrier Reef. The implementation of sensor networks in the marine environment has many challenges with corresponding rewards in data collection. To create a hardware and software architecture that will facilitate the routine use of this emerging technology requires close collaborations from around the world. The first stage of this project was to engage with the development teams at Ambient Systems and the University of Twente.
Understanding their approach to hardware and software issues has been critical for ongoing work since the AmbientRT
platform forms the basis of the GBR sensor
network. The next week involved the participation in a Nordic workshop on marine protection and networks. Meetings in Italy with the Milan Polytechnic highlighted the underwater network development progress. The National Museum of Natural History in New York highlighted the capacity to use sensor networks for conservation while the two days with Microsoft Education director Martin Bean provided clear indications of the tremendous potential in this technology. Several days at the University of Southern California demonstrated the capacity for the development community to remain leaders in the sensor network research. All of these collaborations greatly assist the development of the Marine Sensor network at Magnetic Island. In particular a close working partnership with the University of Melbourne and AIMS has accelerated our capacity to produce a fully operational sensor network. Concluding this project will be the ISSNIP conference where I will chair the environmental sensor network sessions.

Principal Investigator:

Stuart Kininmonth

Collaborations:

Ian Atkinson, James Cook University

Bernard Pailthorpe, University of Queensland

Ron Johnstone, University of Queensland

M. Palaniswami, University of Melbourne

ISSNIP

Principal Investigator:

Stuart Kininmonth

Collaborations:

Michael Kingsford,
James Cook University

Students:

Olga Bondarenko

Applying Electronic Sensor Network in Marine Environment

The Great Barrier Reef Australia (GBR) is affected by cold water intrusions originating in the Coral Sea and upwelled on the reef. Therefore biological interest in GBR upwellings has been driven by the view that upwelled waters rich in nutrients boost plankton production and overall productivity of the GBR system. We propose to employ a Wireless Sensor Network (WSN) for in situ monitoring of upwellings. Temperature is a good proxy for upwelling however 3D dense spatial data is required to describe upwelling and their impact on plankton abundance. The array of underwater sensors was deployed at various depths on the coral reef in Nelly Bay, Magnetic Island, GBR. We propose that the temperature data is communicated real time using RF signal to the on-shore base station. WSN has capability to communicate temperature data in real time thus offering the opportunity for rapid response times to measure the biological impact of upwelling on reef assemblages. This permits us to collect the plankton data in real-time synchronized to the temperature changes. This paper outlines the methods of the deployment of WSN for ecological research. It also describes preliminary results.

Study site at Nelly Bay, Magnetic Island, Australia. The sensor network consists of 4 moorings (1-2, 3-4, 5-6, and 7-8). Each mooring has 7 sensors deployed on vertical scale 2 metres apart and 2 data loggers (Figure 3). Each data logger has a number on the map 1-8. The temperature surfaces were extrapolated from the data loggers point data recorded on 17/09/07 for illustration purposes only.
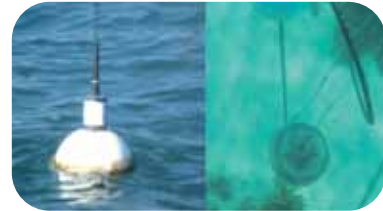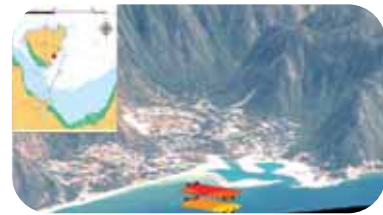
Photo image of the WSN buoy from above the water (left) and an under water image of sensor string.

Principal Investigator:

Arcot Sowmya

Students:

Anuraag Sridhar

Multi-Camera Multi-Person Pointing Gesture Recognition for Interaction in Immersive Environments

A field of research that has greatly benefited from recent advances in hardware and software technologies is that of immersive environments. Immersive environments have proven to be quite useful in fields ranging from entertainment to education.

As such environments improve, there is also a constant need to improve the interaction paradigm within the immersive application. This problem has been tackled in many different ways from virtual reality gear through to computer vision based interaction. Vision-based interaction provides the least encumbered mechanism for interaction as it removes the reliance on wires, markers
and wearable outfits.

In this research we demonstrate a system which uses multiple cameras to allow multiple people to interact with a large-scale immersive display, via a pointing gesture. The cameras are separated into two basic subsets - overhead cameras and side cameras. Overhead cameras are used to perform multi-person tracking, and side cameras are used to perform posture recognition.

The research will combine methods from past research in a unique manner to provide tracking. We will provide a demo of our work so far, including a preliminary interaction system which provides the reconstruction of a pointing gesture in 3D.

Automated Detection of Gait Disorders

There are several projects currently in progress in this area. The major aim here is to develop intelligent automated diagnostic systems that are capable of detecting gait pattern changes caused by diseases or post-operative and other interventions which can affect the locomotor system.

We are investigating various gait pathologies such as elderly with balance impairments leading to falls, post-operative recovery in knee osteoarthritis and patellofemoral pain syndrome, and multi-classification of hemiplegics in cerebral palsy patients.

In this endeavour, various computational intelligence techniques such as support vector machines and artificial neural networks are being employed to learn relationships between gait types (e.g., falling behaviour) and the related gait parameters (e.g., temporal-spatial, lower limb motion, and foot-ground reaction force-time data). Potential application areas include: screening fallers for minimizing falls incidence, diagnosis of gait pathology, evaluation of treatments and therapies, and rehabilitation monitoring.

Principal Investigator:
Rezaul Begg

Collaborations:
Cathy Said, Austin Health
Keith Hill, NARI
Richard Baker, Royal Children's Hospital
Adam Miller, Marybed Hospital, USA

Post Doctoral Research Fellows:
Daniel T.H. Lai
Ahsan Khandoker
Pazit Levinger

Students:
Simon Taylor
Kate Lynch
Chandan Karmakar

Smart Shoe Sensors

The major objective for this project is to develop wireless sensor systems that would allow analysis of human movement and gait functions to be carried out in the natural movement environment rather than in the lab i.e., while performing various activities of daily living. Initial work in this area has allowed us to develop a prototype shoe sensor system to monitor foot motion over the ground. Further developments are underway including inclusion of additional sensors and on-board intelligent signal processing for real-time decision-making and feedback. Major application areas involve: detecting tripping risks in fall-prone older adults and amputees, development of biofeedback system for helping people in rehabilitation, and analysing performance during sporting activities.

Principal Investigator:
Rezaul Begg

Collaborations:
Robert Stokes, Victoria University

Post Doctoral Research Fellows:
Daniel T.H. Lai

Students:
Sai Kwong Chong
To Yan Chan
Xiaorong Chen

ISSNIP

Principal Investigator:

M. Palaniswami

Collaborations:

Eugene Zilberg,
Compumedics Ltd

David Burton,
Compumedics Ltd

Post Doctoral Research Fellow:

Ahsan Khandoker

Jayavardhana Gubbi

Students:

Chandan Karmaker

Kris Nilsen

Screening Sleep Disordered Breathing using ECG signals

Sleep apnoea hypopnea syndrome (SAHS) is a common sleep related breathing disorder that is usually diagnosed through expensive studies in sleep laboratories. Undiagnosed SAHS is associated with cardiovascular morbidity as well as excessive daytime sleepiness and poor quality of life. If SAHS could be diagnosed using only ECG recordings, it could be possible to diagnose SAHS inexpensively from ECG recordings acquired in the patient's home. In this collaborative research project, we are working on developing algorithms to detect sleep disordered breathing based on ECGs and nonlinear modelling of heart rate variability. We investigated into different machine learning techniques [support vector machines (SVM), Neural Network (NN), Quadratic discriminant (QD) model]

with an aim to find an appropriate model for the automatic detection of SAHS types from their respective overnight ECG recordings and estimation of relative degree of sleep disordered breathing. This investigation may provide essential information for introducing a novel screening device that can aid sleep specialist or other physicians in the initial assessment of patients with suspected SAHS and estimate the relative risk of sleep related breathing disorder, thereby indicating need for referral for overnight sleep studies [i.e. polysomnogram (PSG) recording]. This in turn may help prioritize patients, so that those in greatest need of treatment will undergo full PSG recordings in a timely manner, while those without apnoea will be able to avoid this tedious procedure.

Principal Investigator:

M. Palaniswami

Collaborations:

Rezaul Begg, Victoria University

Post Doctoral Research Fellows:

Ahsan Khandoker

Daniel T.H. Lai

Slaven Marusic

Students:

Chandan Karmaker

Human gait pattern analysis and modelling

Understanding the underlying mechanisms and associated deficits in movement dynamics across the lifespan and the effects of pathological conditions, such as falls, will lead to many applications in the design and evaluation of diagnostic and assessment methods for human movement. For example, the methods may be used to assess age-related decline in gait control, the associated risk of sustaining a fall, and determining the effects of exercise interventions and treatments. Falls and injuries during walking in older adults are a major public health issue and cost Australia $498million pa; these costs are projected to triple by 2051 if falls rates remain unchanged (Moller, 2003). But they may be preventable if risk factors can be identified. This project addresses specific research questions

RQ1: What are the key features and variability indices (statistical and nonlinear, e.g., Poincare plots, Approximate entropy, Detrended Fluctuation Analysis, wavelet based fractal correlations etc) that characterise dynamic steady-state control during locomotion?

RQ2: How are these features and indices influenced by more challenging gait tasks, such as walking on inclined surfaces?

RQ3: How do gait variability and control mechanisms change due to ageing and pathology, for example falling behaviour?

Diagnosis of fetal heart defects using ECG and Doppler ultrasound

Principal Investigator:
M. Palaniswami

Collaborations:
Yoshitaka Kimura, Tohoku University, Japan

Post Doctoral Research Fellow:
Ahsan Khandoker

Human health in the developing foetus is critical to the future well being of the adult. At least 8 of every 1,000 infants born each year have heart defect and 1.9% of Australians with cardiovascular defects are alive today (National Health Survey, 2001). This project proposes a novel non-invasive system to recognize the timings of foetal cardiac events on the basis of analysis of electrical (foetal ECG) and mechanical (Doppler ultrasound signals) heart activity together to enable obstetricians to detect an early stage of prenatal cardiac dysfunction. The outcome of this project will improve the prenatal cardiovascular risk assessment tools in Australia.

Develop bio- and MR-compatible polymer-based electrodes for electroencephalography (EEG) recording and electrical brain implants

Principal Investigator:
Ivan Mareels

Post Doctoral Research Fellow:
Levin Kuhlmann

Develop bio- and MR-compatible polymer-based electrodes for electroencephalography (EEG) recording and electrical brain implants, through collaboration with Intelligent Polymer Research Institute (Wollongong) and St. Vincent's Hospital (Melbourne). EEG is the art of recording electrical potentials from the brain. These potentials can be recorded from the scalp or intracranially. EEG is useful for studying how the brain works, diagnosing patients, or detecting neural events, like seizures. Most current EEG electrodes are made of metal (stainless steel, titanium, platinum, silver, gold). Metal electrodes are not the most biocompatible materials, in that they do not interface well with brain tissue and have relatively high impedances. In addition, metal electrodes are not very compatible with magnetic resonance imaging (MRI). Even if the metals have weak magnetic properties they can still (1) distort the MR image, and (2) heat tissue through RF based effects. Moreover, the stronger the magnetic field strength in the MR scanner, the more significant these problems become. This project will facilitate the development of polymer-based electrodes that are more bio- and MRI-compatible.

ISSNIP

Principal Investigator:

Raj Buyya

M. Palaniswami

Collaborations:

Michael Parker, SVIMR, Australia

Post Doctoral Research Fellow:

Jayavardhana Gubbi

Chao Jin

Enterprise Grid enabled Web Portal for Protein Structure Prediction

The structure of protein plays a key role for structure-based design of drugs and treating new and existing diseases. However it is still a challenge to find out protein structure based on its sequence, and the dependence on experimental methods may not yield protein structures fast enough to keep up with the requirement of today's industry. Fortunately, the energy landscape theory enables a framework for the development of computationally-based algorithms to predict the structure of unknown proteins based on their sequence alone, which is known as protein structure prediction. From the perspective of computer science, protein structure prediction is a computing intensive task.

A large number of algorithms have been presented for protein structure prediction. To help the collaboration between protein scientists across the world, it is a necessity for researchers to share their algorithms and results to colleagues at different geographical locations. Furthermore, to speed up the process of finding out new protein structures, we definitely need a proper platform which can reduce the time consumed by prediction algorithms and at the same time make the discovery of new prediction algorithms to be easy. Currently, machine learning methods are popular used for secondary structure prediction. For example, SVM (Support Vector Machine) based prediction has many advantages compared with other methods and definitely requires parallel processing for efficiency improvement.

To achieve above two targets, Grid computing makes an important promise. Grid computing can provide faster computation facilities as a means for researchers to do existing research faster, and it also promises them a number of other facilities such as working in a collaborative environment, reducing costs, and gaining access to an increased number of resources and instruments, allowing for more advanced research to be carried out by a wider community of users.

This project deals with the design, development and deployment of an interactive web-based portal for quick discovering and sharing algorithms of protein secondary structure prediction. Specially, this platform aims to support following features:

1) Public users are easy to access prediction algorithms released in our web-portal and manage the prediction history results in an on-line manner.

2) A collaborative environment to encourage and assist the entry of new workers into deployment of new prediction algorithms in a parallel way, particularly those with less well developed skills and expertise on parallel programming.

The infrastructure, named "Jeeva", includes an interactive web interface for users to submit its requests to various kinds of structure prediction, collection results and manage history data, and a grid middle to make prediction algorithm researchers easily deploy their staff in a distributed environment, mange and monitor the distributed environment. To achieve the target of the grid middle, We get assistance from Aneka, which is a .NET based Grid software platform to simply the creation of enterprise Grid environment.

Learning Level Set Methods for Image Segmentation and Object Extraction

Principal Investigator:
Arcot Sowmya

Students:
Xiongcai Cai

During the past decades, a wide variety of mathematical and computational frameworks have been proposed to deal with Computer Vision problems. In general, most of those problems can be formulated as data partitioning problems, particularly frame partitioning problems in Computer Vision such as image and video segmentation, visual object recognition and tracking.

Traditional methods in visual processing are based on spectral transforms or stochastic/statistical models. These methodologies have been highly successful. Recently, there has been increased interest in novel ways of analysing, formulating and representing the data partitioning problems via variational approaches. Notable examples of such techniques are total variation regularised image restoration methods and variational level set methods for image segmentation. More recently, many researchers in computer vision and applied mathematics started applying this new approach to other problems. One of them is to combine level set based active contour models with non-linear regression models for motion tracking. Others attempt to consider the potential for solving the general data partitioning problem using variational methods, which poses new challenges in extending and applying level set based active contour models to machine learning problems.

This approach offers a systematic treatment of geometric features of visual information, such as shapes, contours and curvatures, as well as temporal features such as shape and pixel changes. In the level set framework, this requires those features to be weighted and combined in the energy function. Therefore, information fusion and parameter tuning become vital for the successful application of level set methods.

We have developed a learnable framework for automatic parameter tuning and information fusion of level set methods. This framework utilises a search and learn strategy to parameter tuning, based on the wrapper approach for feature selection. Firstly, a searching method is employed to generate a set of training instances which contains a feature vector describing the configuration of the current processing and an optimal parameter vector for that configuration. This is done by testing a set of parameter value candidates, evaluating their performance and selecting the one with best performance using techniques such as Sequential Search or Genetic Search. Then the set of instances are fed into a machine learning procedure to learn how to choose optimal parameter values for a new dataset. Learning techniques such as SVM-Regression and Neural Networks can be utilised for this task.

The information fusion problem can be solved in the same tuning framework. Firstly, based on the nature of the level set method, a variety of features can be fused using a linear combination approach, where each feature is multiplied by a weighting parameter value and then combined to create the energy function of the level set method. By this approach, the information fusion problem becomes the parameter tuning problem: how to tune the weighted parameter to force the evolving contour to stop at the true boundaries of the objects. This can then be solved using the automatic parameter tuning framework described above.

The developed automatic parameter tuning and information fusion method embedded in the level set method framework has been employed for providing original solutions to image segmentation and object extraction in computer vision. Several experimental results for each of the above tasks are supplied, demonstrating the effectiveness of the proposed solutions and indicating the potential of the dynamic tuning and fusion model.

ISSNIP

During the past decades, a wide variety of mathematical and computational frameworks have been proposed to deal with Computer Vision problems. In general, most of those problems can be formulated as data partitioning problems, particularly frame partitioning problems in Computer Vision such as image and video segmentation, visual object recognition and tracking.

Traditional methods in visual processing are based on spectral transforms or stochastic/statistical models. These methodologies have been highly successful. Recently, there has been increased interest in novel ways of analysing, formulating and representing the data partitioning problems via variational approaches. Notable examples of such techniques are total variation regularised image restoration methods and variational level set methods for image segmentation. More recently, many researchers in computer vision and applied mathematics started applying this new approach to other problems. One of them is to combine level set based active contour models with non-linear regression models for motion tracking. Others attempt to consider the potential for solving the general data partitioning problem using variational methods, which poses new challenges in extending and applying level set based active contour models to machine learning problems.

This approach offers a systematic treatment of geometric features of visual information, such as shapes, contours and curvatures, as well as temporal features such as shape and pixel changes. In the level set framework, this requires those features to be weighted and combined in the energy function. Therefore, information fusion and parameter tuning become vital for the successful application of level set methods.

We have developed a learnable framework for automatic parameter tuning and information fusion of level set methods. This framework utilises a search and learn strategy to parameter tuning, based on the wrapper approach for feature selection. Firstly, a searching method is employed to generate a set of training instances which contains a feature vector describing the configuration of the current processing and an optimal parameter vector for that configuration. This is done by testing a set of parameter value candidates, evaluating their performance and selecting the one with best performance using techniques such as Sequential Search or Genetic Search. Then the set of instances are fed into a machine learning procedure to learn how to choose optimal parameter values for a new dataset. Learning techniques such as SVM-Regression and Neural Networks can be utilised for this task.

The information fusion problem can be solved in the same tuning framework. Firstly, based on the nature of the level set method, a variety of features can be fused using a linear combination approach, where each feature is multiplied by a weighting parameter value and then combined to create the energy function of the level set method. By this approach, the information fusion problem becomes the parameter tuning problem: how to tune the weighted parameter to force the evolving contour to stop at the true boundaries of the objects. This can then be solved using the automatic parameter tuning framework described above.

The developed automatic parameter tuning and information fusion method embedded in the level set method framework has been employed for providing original solutions to image segmentation and object extraction in computer vision. Several experimental results for each of the above tasks are supplied, demonstrating the effectiveness of the proposed solutions and indicating the potential of the dynamic tuning and fusion model.

Testing Bio-inspired Motion Detection Models

Principal Investigator:
David C. O'Carroll
Mandyam V. Srinivasan

Students:
Russell S.A. Brinkworth

This project will test bio-inspired models of the insect visual system under realistic conditions. It will take a recently developed model of rotational motion processing by the fly and apply it to conditions involving both translation and rotation in order to produce a full motion detection model based solely on passive optical inputs. As a consequence of this project a number of high resolution, high dynamic range (HDR), full panorama movies will be recorded. This, together with the motion trajectory of the recording platform, will be a useful base set for researchers looking to develop and test other models of motion detection. The successful demonstration of these algorithms will have applications in the development of miniature autonomous systems in defence and civilian roles, including robotics, miniature unmanned aerial vehicles, intruder detection and collision avoidance sensors.

A Stable Adaptive PI Controller for AQM

Active Queue Management (AQM) is an effective method to provide an early notification of network congestion by pro-actively dropping or marking packets. In this project, we introduce some new AQM schemes to improve the performance of TCP/AQM system. We analyse the stability and use simulation results to demonstrate that the performance of proposed AQM schemes is superior to some well-known AQM such as ARED, PI and REM.

Principal Investigator:

Moshe Zukerman
M. Palaniswami

Collaborations:

Sammy Chan, University of Hong Kong

King-Tim Ko, University of Hong Kong

Guanrong Chen, City University of Hong Kong

Post Doctoral Research Fellows:

Jinsheng Sun

Optimal Flow Control for Multi-Service Networks

This project aims to develop a manageable and scalable framework for QoS provision of multi-service networks. It involves an optimal flow control scheme and efficient resource/bandwidth allocation architecture, consisting of both source algorithm and congestion control feedback, for future communication networks including pervasive Internet, ad-hoc wireless networks and sensor networks. Special emphasis will be on supporting real-time applications, which possess non-concave utility functions.

We are developing novel distributed application-oriented flow control framework for single-path and multi-path networks, achieving utility proportional/max-min fairness to provide QoS guarantees. Meanwhile, wireless sensor network nowadays attracts more and more research attention due to its wide range of current and potential applications from environmental monitoring and conservation, to home automation and health-care services, to business inventory control and manufacturing. In order to address this serious need, we will develop optimal flow control strategies based on control theory and optimization to support real-time sensor network applications with physical sensor node power constraint.

In summary, the project has the potential to significantly enhance the future information networks to meet specified QoS requirements especially for demanding real-time services.

Principal Investigator:

M. Palaniswami

Collaborations:

Moshe Zukerman, UniMelb

Steven H. Low, Caltech, USA

Post Doctoral Research Fellows:

Weihua Wang

Students:

Jason Jiong Jin

ISSNIP

Principal Investigator:

Brijesh Verma

Students:

Syed Zahid Hassan

Decisions Fusion Strategy: Towards Hybrid Cluster Ensemble

Clustering ensembles have renowned as a powerful method for improving both the performance and constancy of unsupervised classification solutions. However, finding a consensus clustering from multiple algorithms is a difficult problem that can be approached from combinatorial or statistical perspectives. We offer a new clustering strategy which is formulated to cluster extracted mammography features into soft clusters using unsupervised learning strategies and 'fuse' the decisions using majority voting and parallel fusion in conjunction with a neural classifier. The idea is to observe associations in the features and fuse the decisions (made by learning algorithms) to find the strong clusters which can make impact on overall classification accuracy. Two novel techniques are proposed for fusion, majority-voting based data fusion, and neural-based fusion. The proposed approaches are tested and evaluated on the benchmark database— digital database for screening mammograms (DDSM). This study compares the performance of the proposed ensemble approach with other fusion approaches for clustering ensembles. Experimental results demonstrate the effectiveness of the proposed method on benchmark dataset.

Principal Investigator:

M. Palaniswami

Collaborations:

Eugene Zilberg, Compumedics Ltd

David Burton, Compumedics Ltd

Post Doctoral Research Fellows:

Ahsan Khandoker

Students:

Kris Nilsen

Combining ECG morphology and heart rate parameters for the detection of sleep disorder breathing events

Sleep apnoea is usually diagnosed in sleep laboratories through sleep studies. These procedures are typically expensive and require the patient to sleep the night in the laboratory. If sleep apnoea could be diagnosed by examining the ECG signal, the diagnostic recording could be made in the patient's home using standard ECG monitoring technology particularly taking into account large obstructive sleep apnoea prevalence among cardiac patients.

It is hypothesised that analysis of the morphology of the ECG and the combination of other analytic techniques such as heart rate analysis could lead to the detection of actual start and end of apnoea/hypopnoea events and therefore the calculation of the apnoea-hypopnoea index. Regression modelling techniques were used to investigate the relevance of ECG waveform morphology and heart rate parameters that were identified visually. Statistical analysis showed that all the physiological predictors were significant. The multivariate analysis demonstrated that the combination of parameters outperforms any single parameter model and the models based on only heart rate parameters or only the ECG waveform morphology parameters. The multivariate analysis also showed encouraging results indicating that an algorithm using a combination of heart rate parameters and ECG morphology parameters could be constructed that would enable the detection of actual events and could be used to generate an apnoea-hypopnoea index.

Design, Implementation and Optimisation of a ZigBee Wireless Sensor

Principal Investigator:
Eryk Dutkiewicz

Students:
Nandika Thapar

ZigBee is a promising new international standard being promoted by the ZigBee Alliance. It is designed for home automation and industrial control networks, among other applications. This evolving standard is aimed to be a low power, low cost wireless solution that can support many different applications that consist of unsupervised devices, in an interoperable and scalable way. This thesis project aims to investigate these claims with a focus on ZigBees' application in industrial control. For Wireless Sensor Networks (WSN), energy conservation, self con_guration and reliability are the primary considerations while designing a protocol. In this project, channel access and routing protocols are investigated to identify the design challenges and optimisation parameters for ZigBee WSN. The target application for the ZigBee network is temperature sensing in the steel manufacturing process at the BlueScope Steel plant at Port Kembla, NSW, Australia. The requirements of this application, with a focus on the BlueScope environment, have been investigated. This thesis is also a testbed of Freescale Semiconductors ZigBee development kits. Initial assessment of Freescale's development kit capabilities has been made by implementing and evaluating a test ZigBee network. A prevailing mathematical model was corrected and then modified to achieve an optimal network configuration that is power efficient, while guaranteeing reliable sensor data delivery to the control centre. This optimisation was realised within the constraints of the ZigBee Specifications and the BlueScope Steel environment and requirements. Comparisons have been drawn between the Freescale and Chipcon proprietary hardware to establish which device gives more efficient performance in terms of power consumption under similar network conditions. The battery lifetime of Freescale devices has also been estimated using the modified mathematical model. This has been compared with the battery life estimate drawn from the data sheet values and also through practical measurements. This thesis lays grounds for future development and testing of ZigBee WSN with the latest version of Freescale's Beekit GUI.

ISSNIP

Principal Investigator:

Dinesh Kant Kumar

Collaborations:

Hans Weghorn, University of BA. Stuttgart, Germany

Students:

Ganesh Naik

Improving Isometric Hand Gesture Identification for HCI based on Independent Component Analysis in Bio-signal Processing

(HCI) applications. There is an urgent need for establishing a simple yet robust system that can be used to identify subtle complex hand actions and gestures for control of prosthesis and other computer assisted devices. Here, an approach is explained to demonstrate how hand gestures can be identified from isometric muscular activity, where signal level is low and changes are very subtle. Obvious difficulties arise from a very poor signal to noise ratio in the recorded electromyograms (EMG). Independent component analysis (ICA) is applied to separate these low-level muscle activities. The order and magnitude ambiguity of ICA have been overcome by using a priori knowledge of the hand muscle anatomy and a fixed un-mixing matrix. The classification is achieved using a back-propagation neural network. Experimental results are shown, where the system was able to reliably recognize motionless gestures. The system was tested across users to investigate the impact of inter-subject variation. The experimental results demonstrate an overall accuracy of 96%, and the system was shown being insensitive against electrode positions, since these successful experiments were repeated on different days. The advantage of such a system is, that it is easy to train by a lay user, and that it can easily be implemented as real-time processing after an initial training. Hence, EMG-based input devices can provide an effective solution for designing mobile interfaces that are subtle and intimate, and there exist a range of applications for communication, emotive machines and human computer interface.

Principal Investigator:

Eryk Dutkiewicz

Students:

Nandika Thapar

Real-time hand gesture identification for human computer interaction based on ica of surface electromyogram

Today, there exists a variety of interfaces that allow human users to interact with computerized systems. Many of these input and output devices force the user to adapt to the requirements of the machine construction, like e.g. numeric keyboards on tiny devices often have to be used also for letter input. In contradiction to such technically-driven concepts, the aim of the investigation presented here is to provide a reliable input mode, which enables machine control for rehabilitation and human-computer interaction applications in a quite natural way. The processing in this new input system consists of three major stages: At first, hand gestures are sensed from non-invasive surface electromyograms, and in the second step the activities of the involved individual muscles are decomposed by semi-blind independent component analysis (ICA). In the last step, the particular hand action is identified with an artificial neural network (ANN). In this model-based approach, the order and magnitude ambiguity of ICA have been overcome by using a priori knowledge of the hand muscle anatomy and a fixed un-mixing matrix for the signal decomposition. In 360 single-shot experiments, this system was able to classify all tested hand gestures fully correct. These experimental results demonstrate that the proposed approach yields a high recognition rate with various gestures, and the system was verified being insensitive against electrode positions. A comparative evaluation of applying the same recognition mechanism in identifying facial movement yields new findings about the properties of the derived ICA mixing matrix, which can be exploited as indicator for the reliability and efficiency of the pattern classification mechanism in a distinct application.

Energy-Efficient Communication Protocol for Underwater Acoustic Sensor Networks

Principal Investigator:
Jemal Abbawajy

Students:
Shivali Goel

The availability of tiny sensors and low-power wireless communications will enable the deployment of distributed sensor/actuator networks for a wide range of applications. However, wireless sensor networks pose diverse set of challenges that need to be tackled for efficient deployment of the wireless sensor networks in various environments including underwater. In this research, we focus on fundamental wireless networking challenges that underpins wireless sensor network systems. Specifically, a wireless communication system suffers from multipath, Doppler spread and high propagation delays. These effects are more pronounced in a microcell environment due to different types of buildings and irregular distribution of scatterers present in the environment, giving rise to multipath. These multipath signals arrive at the receiver from different directions at different times. All of these multi-paths taken by the wireless signal possess different properties, and hence, each multipath signal has its own distinctive carrier phase shift, amplitude, angle of arrival, and time delay. High propagation delays can further give rise to inter-symbol interference.

A possible approach to address these issues is through the geometrical definition of the scattering region to calculate the above parameters. The geometry of the multipath propagation plays a vital role for communication systems to suppress multipath. In the proposed network, the sensors are deployed on the area which has to be effectively covered and an ad-hoc network is established between the sensors to communicate with each other. The system model assumes a cluster based wireless sensor network (WSN) which collects information from these sensors, filters and modulates the data and transmit it through a wireless channel to be collected at the receiver. Using this model, wireless sensor networks can be put into a number of applications like pollution detection systems by monitoring the level of polluting substances and identifying the source in the deployed area, by deploying on buildings and structures these networks can be used to ensure reliability and safety by continuous monitoring, can also be used to detect and locate damages on the deployment area, can be used for home/office automation, motion tracking, intrusion detection and many more. We propose a Geometrically Based Single Bounce Elliptical Model (GBSBEM) for multipath components involving randomly placed scatterers in the scattering region with sensors deployed on a field. We first develop a GBSBE model and based on this model we develop our channel model. We add reliability and robustness to this cluster based WSN by using smart antennas at the receiver. Use of Smart antenna system at the receiver end, which exploits various receive diversity combining techniques like Maximal Ratio Combining (MRC), Equal Gain Combining (EGC), and Selection Combining (SC), adds novelty to this system. The focus of the model is to consider the scenario of local scattering giving rise to multipaths. This multipaths and the resulting fading are modelled as stochastic processes and channel characteristics like time-variation, amplitude, and angular spread are modelled using GBSBEM. Another important issue with the sensor networks is efficient power usage. The model in itself proves that the performance of the system increases if the transmission power increases. Since the cluster head is located very near to the sensor nodes, the sensor nodes do not require high transmission powers so they do not face the reach-back problem. The model justifies the use of receive diversity at the receiver for reliable communication between the cluster head and the receiving arrays when applying receive diversity. We also quantify the fact that with the increase in the number of antenna elements, we are able to increase the reliability and robustness of the system. Initially the model parameters and the overall efficiency of the system is solved with lesser number of antenna elements in the receiving array; however, they can be extended to N numbers for a large receiving array.

ISSNIP

Principal Investigator:

David O'Carroll

Subhash Challa

Collaborations:

Patrick Shoemaker,
Tanner Research, USA

Students:

Steven Wiederman

Cross-compatibility between Bio-inspired Elementary Small Target Motion Detection (eSTMD) and Traditionally Engineered Solutions for Target Detection and Tracking

We have previously developed a bio-inspired model, based on neural processing within the insect visual system, which allows for the detection of small moving targets against cluttered moving backgrounds. This research involves a multidisciplinary approach, combining an investigation of cellular neurophysiology, via electrophysiological techniques, with the development of mathematical models that mimic this complex biological behaviour. We presently have a collaborative link with a US industry partner that implements hardware versions of our biomimetic models in analog VLSI circuitry. The ISSNIP component of our project is presently investigating regions of cross-compatibility between our biological modelling with more traditionally engineered solutions of target detection and tracking. The aim of our project is to develop a close collaborative environment between the two disciplines ensuring knowledge of the different computational approaches are shared and that solutions to problems associated with target detection are derived.

Principal Investigator:

Brijesh Verma

Collaborations:

Abdesselam Bouzerdoum

Arcot Sowmya

Stuart Crozier

Svetha Venkatesh

Post Doctoral Research Fellows:

Rinku Panchal

Students:

Peter McLeod

Syed Zahid Hassan

Hong Lee

A Novel Pattern Classification Technique for the Diagnosis of Breast Cancer

This project aims to study suspicious areas and their classification in digital mammograms for the development of a fast and reliable computer aided diagnostic system for breast cancer screening. The system will be capable of recalling previously seen patterns and classifying new patterns with high accuracy. The main aims of this project are as follows.

1. Investigate a new feature extraction technique based on soft-clustering and 3D information from suspicious areas in digital mammograms.

2. Investigate a novel algorithm based on accuracy and genetic algorithms to find the significant of features extracted from suspicious areas in digital mammograms. The aim is to find a feature or features with consistent classification accuracy.

3. Investigate a novel learning algorithm for the classification of features into benign and malignant classes. The aim is to achieve 100% accuracy rate on seen/training mammograms (memorisation/association ability), high accuracy rate (95-100%) on unseen/test mammograms (generalisation ability) and fast training of the network.

A Hybrid Data Mining Approach for Knowledge Extraction and Classification in Medical Databases

This project aims to study a novel hybrid data mining approach which is an effective combination of statistical and intelligent techniques in conjunction with a neural fusion, in order to utilize the strengths of each individual technique and compensate for each other's weaknesses. More specifically, this project presents a novel hybrid data mining approach for knowledge extraction and classification in medical databases. The approach combines various clustering techniques such as self organizing map, k-means, etc. with a neural network based data fusion. The idea is to cluster all data in soft clusters using neural and statistical clustering and fuse them using serial and parallel fusion in conjunction with a neural classifier.

Principal Investigator:
Brijesh Verma

Collaborations:
Abdesselam Bouzerdoum
Arcot Sowmya
Stuart Crozier
Svetha Venkatesh

Post Doctoral Research Fellows:
Rinku Panchal

Students:
Peter McLeod
Syed Zahid Hassan
Hong Lee

Knowledge-based Advanced Segmentation Technique for Off-Line Cursive Handwritten Text Recognition

This project aims to study a novel knowledge-based advanced segmentation technique to increase the performance of intelligent handwriting recognition systems. An over-segmentation algorithm is introduced to dissect the text words based on the vertical pixel density between upper and lower baselines. Each segment from the over-segmentation is passed to the multiple expert based validation process. First expert compares the total pixel of the segment to a threshold value. The threshold is set and calculated before the segmentation by scanning the stroke components in the word. Second expert checks for holes. Third expert validates segmentation points using a neural voting approach which is trained on segmented characters before validation process starts. Final expert is based on oversized segment analysis to detect possible missed segmentation points.

Target Localization using Complex Support Vector Machines

Developing localization algorithms for Distributed Sensor Networks is an open research problem. The localization problem for Sensor Networks can be defined as finding the physical location of an 'entity of interest' (to the network) using data being collected during runtime of the network. The 'entity of interest' could be a sensor node in the network or it could be a target that the network is aiming to localize. The algorithms being developed for Sensor Network localization can be broadly classified under Graph theoretic approaches. The features used for localization usually include Signal Strength, Time of Arrival, Time Difference of Arrival, Angle of Arrival and Node Transmission Radius. In this project, a sensor node is an abstraction used to describe any entity capable of sensing the environment, collecting data and communicating over the network. Thus the sensor node could represent an inexpensive mote with attached sensors, a gateway node acting as a hop point, an underwater node capable of sensing and communicating under water or even an Unmanned Aerial Vehicle. The fundamental aim of the project is to model the localization problem as a function estimation problem. Thus the research task is to find features in the sensor node data that can be used to perform the required localization. Given the set of suitable features and training data set of locations of the 'entity of interest', we propose to use Support Vector Regression (SVR) to estimate the function relating the two. As a first step, we implemented this technique to localize hostile RADAR using a formation of 3 UAVs. This work has now been modified for better performance using Complex Support Vector Regression (CSVR). The poster will present our current approach and the ramifications for terrestrial Wireless Sensor networks.

Principal Investigator:
M. Palaniswami

Post Doctoral Research Fellows:
Alistair Shilton

Students:
Bharat Sundaram

ISSNIP

Principal
Investigator:
Stuart Milner

Post Doctoral
Research Fellows:
Alistair Shilton

Collaborations:
M. Palaniswami,
UniMelb

Sylvie Perreau,
University of South
Australia

Peter Soubridge, DSTO

Robert Bonneau,
US Air Force Office of
Scientific Research

LtCol William Nace, US
Air Force Office of
Scientific Research

Jonathan Manton, ARC

Robert Herklotz,
US Air Force Office of
Scientific Research

Lars Rasmussen,
ACORN

Autonomous Configurability and Control in Dynamic Wireless Networks

Networks that are self-organizing or autonomously reconfigurable can automatically change their fundamental structure or network topology in response to degradation and/or the absence or loss of system function/connectivity. They allow real-time and ad hoc insertion and deletion of physical links and communications nodes— comprising a mobile network topology. In addition, such systems are capable of intelligent and automatic control of platforms or base stations.

Such networks are currently of great interest in defence applications, especially tactical, network centric operations as well as civil applications such as emergency response. While the benefits of deploying totally decentralised ad hoc networks in these kinds of uncertain and dynamic environments have been demonstrated, the topology of such decentralised networks may not always be appropriate for hierarchy based control commands and decision making strategies characteristic of these military and civilian applications.   In other words, the network topology should enable and facilitate the chain of events driving decision making and planning strategies, while taking advantage of the flexibility offered by a mobile ad hoc network. This flexibility of course, comes with the cost of signalling and latency associated with the complicated task of routing and reconfiguration in such volatile and uncertain environments.

A workshop is being organised alongside 2007 ISSNIP conference which will bring together program managers and researchers from the defence industry, government research organizations and academia in order to explore new research directions addressing self organizing and autonomously reconfigurable networks and to establish a fundamental understanding of methods of investigation and techniques for the design of autonomously reconfigurable engineered systems. The questions of how to optimise the network topology, routing and resource allocations under constraints will be addressed in the contexts of defence and civilian applications.

Principal
Investigator:

M. Palaniswami
Ian Atkinson
Stuart Kininmonth
Slaven Marusic

Post Doctoral
Research Fellows:
Jayavardhana Gubbi

Students:
Suthershan
Rajasegarar

SensorMap for The Great Barrier Reef

Recent developments in technology together with widely observed climate change phenomena have revealed coral reef ecosystems as critical areas greatly susceptible to impact of global climate variations as well as other man-made influences, but also as early indicators of such events. The need to understand and protect such delicate ecosystems has created an urgent demand for the sensor networks technologies to be deployed in order to perform essential environmental monitoring and information collection. This data can then be analysed by higher level systems such as a semantic web to eventually provide predictive information on destructive events such as coral bleaching. The proposed SensorMap project on The Great Barrier Reef will provide a valuable interface between the sensors and higher level objectives of multidisciplinary research teams around the world, from sensor networks researchers to marine biologists. Utilising the core infrastructure associated with a sensor network deployment currently in progress on the Great Barrier Reef, this project will aid in the collection and dissemination of a diverse range of unique sensor data.

Smoke Detection from Video Images

Visual sensor network is becoming a reality with increased computational capabilities. This includes an array of cameras positioned strategically to monitor sensitive areas. Of late, there has been an increased interest in detection of fire in critical infrastructures including tunnels, hangers and also in detection of bush fires. Due to the deployment of visual sensor networks for surveillance purposes, there is a possibility of using this existing infrastructure in designing early warning system. This can be accomplished by the detection of smoke. When continuous video is being analysed, if there is a fire, smoke will cause the scene to appear semi-transparent. This will reduce clarity and hence there is a reduction in high frequency component. This project proposes to make use of the above feature in designing an early warning system.

Multi camera Intelligent Surveillance systems are one of the key offerings of iOmniscient. iOmniscient seek low-cost and high-speed algorithms that can run in the distributed video surveillance network to offer smarter video surveillance solutions. Their Non-Moving Object Detector won us accolades all over the world and we are keen to extend it to other smart features like detection of slip and fall, tracking objects across multiple camera systems and also explore the application of multiple, heterogeneous sensors to aid the video surveillance solutions. This collaborative project under the purview of DEST-International Science Linkage grant on Distributed Sensor Networks intends to develop new algorithms for smoke detection. This falls under the category of surveillance in visual sensor networks of DEST-ISL project.

Principal Investigator:

M. Palaniswami

Collaborations:

Rustom Kanga, iOmniscient Ltd

Post Doctoral Research Fellows:

Jayavardhana Gubbi

Slaven Marusic

ISSNIP