# 2005 International Conference on Intelligent Sensors, Sensor Networks and Information Processing.
# ISSNIP 2005

5 - 8 December 2005
Melbourne, Australia

## Conference Program

## Organised by


## Sponsored by

Australian Government
Australian Research Council

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

www.sensornetworks.net.au



## Technical Co-Sponsorship:


IEEE Sensors Council

# Welcome Message

On behalf of the organising and Program Committee of the 2nd International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP 2005), it is with great pleasure that I welcome you to Melbourne to participate in this exciting technical program. This event has been made possible by the Australian Research Council's (ARC's) Research Network on Intelligent Sensors, Sensor Networks and Information Processing (www.sensornetworks.net.au). The first conference (ISSNIP-04) was successfully held in Melbourne and drew more than 200 participants. So it is with this success that we present the second international conference as a part of the series of events organised by the ARCRN on Sensor Networks. We hope that you will find the technical program, tutorials and the plenary talks enjoyable and most beneficial.

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 recognized 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. The scientific challenges which must be overcome in order to realize the enormous potential of sensor networks are substantial and multidisciplinary in nature.

Therefore, this conference appropriately focuses on the tools and techniques for the development of smart sensor systems and sensor networks. The emphasis is on creating an exciting environment for effective collaboration amongst a multi-disciplinary team for the successful development and exploitation of sensor networks. These disciplines include bio and nano sensor science, large scale system optimization, data and information processing, wireless networks and computer communications, electronics and mechatronics.

We are fortunate to have some of the world's leading researchers as plenary and invited speakers in the theme areas of the conference. This gives participants an opportunity to interact with the best minds for inspiration and guidance to address some of the challenging interdisciplinary problems. We have received research papers from countries around the globe. The submitted full papers were peer reviewed and selected papers were recommended by the track chairs based on the recommendation

of the international program committee. The topics covered included Sensor Networks, Smart Sensors and Intelligent Information Processing techniques. We sincerely hope that this conference provides the delegates with an opportunity for fruitful interaction and cross-fertilisation of ideas.

We acknowledge the support from the sponsors. The ARC's vision in fostering this inter-disciplinary theme with support for a research network is gratefully acknowledged. We also express our gratitude to all the technical program committee members and the reviewers who gave their valuable time in providing critical reviews. The conference would not have been possible without the help of the local organising committee and the volunteers and we thank them most sincerely.

**M Palaniswami**
**General Chair**
**ISSNIP 2005**

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*Department of Electrical Engineering,University of Melbourne, Australia.*

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# ISSNIP 2005 : Conference Program at a Glance

Langham Hotel, Southbank, Melbourne, Australia

5-8th December 2005

| December 5th, 2005 - Monday | | | |
|---|---|---|---|
| 8:30 AM | Registration | | |
| 9:00 am to 10:30 am | Sensor Networks<br>**Clarendon B** | Sensor Fusion<br>**Yarra I** | Intelligent Information Processing<br>**Flinders** |
| | Tutorial I-A<br><br>Ultra Low Power Sensor Networks<br><br>Prof. Jan Rabaey, University of California at Berkeley, USA | Tutorial II-A<br><br>Pervasive Computing and Communications<br><br>Prof. Mohan Kumar, University of Texas at Arlington, USA | Industrial Showcase in the Field of Sensors and Sensor Networks<br><br>(Setup in Ballroom Foyer) |
| 10:30 am to 11:00 am | Delegate Tea Break | | |
| 11:00 am to 12:30 pm | **Tutorial I-A (continued)** | Tutorial II-A (continued) | Industrial Showcase in the Field of Sensors and Sensor Networks (Presentations) |
| 12:30 pm to 1:30 pm | Delegate Lunch | | |

| | | | |
|---|---|---|---|
| 1:30 pm to 3:00 pm | Tutorial I-B<br><br>Swarm Intelligence and Applications<br><br>Prof. Ganesh Kumar Venayagamoorthy, The University of Missouri-Rolla (UMR), USA | Tutorial II-B<br><br>Information Fusion in Next Generation Networked Sensing Systems<br><br>Professor Subhash Challa, University of Technology, Sydney, Australia | e-Science Workshop |
| 3:00 pm to 3:30 pm | Delegate Afternoon Tea Break | | |
| 3:30 pm to 5:30 pm | Tutorial I-B (continued) | Tutorial II-B (continued) | Special Session<br><br>Information Processing in Neuroimaging Research<br><br>chaired by Prof. Gary Egan |
| | Alto Room: Top Level | | |
| 6:30 PM | Conference Inauguration<br><br>Cocktail Party | | |

| December 6th, 2005 - Tuesday | | | |
|---|---|---|---|
| 8:30 AM | Registration | | |
| | Clarendon Ballroom | | |
| 9:00 am to 9:30 am | Opening Remarks<br>Dr. Nandagopal, DSTO | | |
| 9:30 am to 10:30 am | Plenary Talk IA: Prof. Ian Foster (e-Science)<br>*Argonne National Laboratory & University of Chicago, USA*<br>**Service-Oriented Science: Scaling the Application and Impact of eResearch** | | |
| 10:30 am to 11:00 am | Delegate Tea Break | | |
| 11:00 am to 12:30 pm | Sensor Networks<br>**Clarendon B** | Sensor Fusion<br>**Yarra I** | Intelligent Information Processing<br>**Flinders** |
| | Session I-A: Wireless Sensor Networking Issues<br>chair: *Dr Thomas Hanselmann*<br>64,68,76,75,116 | Session I-B: Sensor Fusion Applications<br>chair: *Dr Rezaul Begg*<br>71,45,90,73,128 | Session I-C:Sensor Network Applications I<br>chair: *Dr. Xiuping Jia.*<br>Invited talk: Sensing by the ear and for the ear, *Dr. David Grayden*<br>**115,111,13** |
| 12:30 pm to 2:00 pm | Delegate Lunch | | |

| | Clarendon Ballroom | |
|---|---|---|
| 2:00 pm to 3:00 pm | Plenary Talk IB : Prof. Jan Rabaey<br>*Donald O. Pederson Distinguished Professor, University of California at Berkeley, USA*<br>Ambient Intelligent - Where Multimedia and Sensor Networks Meet | |
| 3:00 pm to 3:30 pm | Delegate Afternoon Tea Break | |
| | Clarendon B | Yarra I |
| 3:30 pm to 4:15 pm | ISSNIP Keynote Talk I: Prof. Vittal Rao<br>*Rutledge-Emerson Distinguished Professor of Electrical and Computer Engineering, University of Missouri-Rolla, USA.*<br>The Role of Sensor Networks in Cyber Infrastructural Systems | Session II-A: Sensor Network Architectures and Fusion<br>chair: *Prof. Subhash Challa*<br>Invited talk: Cramer-Rao bounds for estimation and tracking, *Dr. Branko Ristic* |
| 4:15 pm to 5:15 pm | Panel : Sensor Networks and Cyberengineering Systems<br>chair: Prof. Vittal Rao | **117,131,35** |
| 5:30 pm | Conference Tour | |

| December 7th, 2005 - Wednesday | | | |
|---|---|---|---|
| | Sensor Networks<br>**Clarendon B** | Sensor Fusion<br>**Yarra One** | Intelligent Information Processing<br>**Flinders** |
| 8:15 am to 9:15 am | Session III-A: Deploying in Sensor Networks<br>chair: *Dr. Kennie Jones*<br>47,92,113 | Session III-B: Target Tracking and Defense<br>chair: *Dr Rezaul Begg*<br>30,65,38 | Session II-C: Machine Learning Applications<br>chair: *Dr Pubudu N. Pathirana*<br>85,108,48 |
| | Clarendon Ballroom | | |
| 9:30 am to 10:30 am | Plenary Talk 2A: Prof. John Parmentola<br>*Director for Research and Laboratory Management, US Army.*<br>The Network – A Revolutionary Capability for the Warfighter | | |
| 10:30 am to 11:00 am | Delegate Tea Break | | |

| | Clarendon B | Yarra I | Yarra II |
|---|---|---|---|
| 11:00 am to 12:40 pm | Session IV-A: Energy Efficiency and Resource Balancing in Sensor Networks<br>chair: *A. Prof. Sabu Emmanuel*<br>Invited talk: Farm Applications of Wireless Adhoc Sensor and Actuator Networks, *Dr. Pavan Sikka*<br>23,91,37,101 | Session IV-B: Localization in Sensor Networks<br>chair: *Dr. Rachel Cardell-Oliver*<br>Invited talk: Distributed Real-Time Applications on SensorGrids, *A. Prof. Chen-Khong Tham*<br>80,97,106 | Session III-C: Pattern Recognition I<br>chair: *Dr. Anthony Finn.*<br>Invited talk: Enabling Civil Applications of Unmanned Airborne Vehicles, *A. Prof. Rodney Walker*<br>49,60 |
| | | | **Flinders** |
| | | | Session IV-C: Pattern Recognition II<br>chair: *Dr. David Grayden*<br>**82,2,28,43** |
| 12:40 pm to 2:00 pm | Delegate Lunch | | |
| Clarendon Ballroom | | | |
| 2:00 pm to 3:00 pm | Plenary Talk 2B: Prof. Hideo Matsuda (e-Science)<br>*Department of Bioinformatic Engineering, Osaka University, Japan*<br>A Grid Environment for Data Integration of Scientific Databases | | |

| | | |
|---|---|---|
| 3:00 pm to 3:30 pm | Delegate Afternoon Tea Break | |
| | Yarra I | Clarendon B and C |
| 3:30 pm to 5:00 pm | ISSNIP Keynote Talk II: Prof. Stuart Milner<br><br>*Research Professor and Director, Center for Networking of Infrastructure Sensors, A. J. Clark School of Engineering, University of Maryland at College Park, USA.*<br><br>**Challenges in Directional Wireless Sensor Networks** | Poster Session<br><br>**20,24,26,27,114,81,46,119,34,57,103,95,66,132,51,12,98** |
| 7:00 PM | **Conference Dinner at Melbourne Aquarium** | |

| December 8th, 2005 - Thursday | | | |
|---|---|---|---|
| | Sensor Networks | Sensor Fusion | Intelligent Information Processing |
| | **Clarendon C** | **Yarra I** | **Flinders** |
| 8:15 am to 9:15 am | Session V-A: Processing and Services in Sensor Networks<br>chair: *Dr. Pavan Sikka*<br>69,74,40 | Workshop on UAV<br>chair: *Dr. Anthony Finn (DSTO)* | Workshop on Machine Learning and applications to Sensor Networks<br>chair: *Dr. Danil Prokhorov and Prof. Erkki Oja.* |
| 9:30 am to 10:30 am | Plenary Talk 3A: Prof. M Srinivasan<br>*Centre for Excellence in Vision Science, Research School of Biological Sciences, Australian National University.*<br>Insect-inspired sensors for autonomous visual guidance | | |
| 10:30 am to 11:00 am | Delegate Tea Break | | |
| 11:00 am to 12:30 pm | Session VI-A: Sensor Applications<br>chair: *Prof. Paul Havinga*<br>59,99,96,110,72 | Workshop on UAV (continued) | Workshop on Machine Learning and applications to Sensor Networks |
| 12:30 pm to 2:00 pm | Delegate Lunch | | |

| | | | |
|---|---|---|---|
| 2:00 pm to 3:00 pm | Plenary Talk 3B: Professor Carole Goble (e-Science)<br>*The e-Science North West Centre, The University of Manchester, UK*<br>Putting Semantics into e-Science and Grids | | |
| 3:00 pm to 3:30 pm | Delegate Afternoon Tea Break | | |
| | Clarendon C | Yarra I | Flinders |
| 3:30 pm to 4:30 pm | ISSNIP Keynote Talk III: Prof. Robin J. Evans<br>*Professor and Chair of Telecommunications, University of Melbourne, Australia.*<br>Wireless Sensor Networks- SCADA Systems without wires or Something More | Workshop on UAV (continued) | Workshop on Machine Learning and applications to Sensor Networks |
| 4:30 pm to 5:10 pm | Session VII-A: Security and Intrusion Detection in Sensor Networks<br>chair: *Dr. N. Mani*<br>130,77 | | |
| 5:15pm | Conference Closing Speech | | |

# ISSNIP 2005 Technical Sessions Program

## Tutorials

### Date: 5th December 2005, Monday
**Venue: Clarendon B**

*(9.00am-10.30am, 11.00am-12.30pm)* **Ultra Low Power Sensor Networks,** Prof. Jan Rabaey, University of California at Berkeley, USA.

*(1.30pm-3.00pm, 3.30pm-5.00pm)* **Swarm Intelligence and Applications,** Prof. Ganesh Kumar Venayagamoorthy, The University of Missouri-Rolla (UMR), USA.

**Venue: Yarra I**

*(9.00am-10.30am, 11.00am-12.30pm)* **Pervasive Computing and Communications,** Prof. Mohan Kumar, University of Texas at Arlington, USA.

*(1.30pm-3.00pm, 3.30pm-5.00pm)* **Information Fusion in Next Generation Networked Sensing Systems,** Prof. Subhash Challa, University of Technology, Sydney, Australia.

## 1st Industrial Showcase in the Field of Sensors and Sensor Networks (Presentations)

### Date: 5th December 2005, Monday
**Venue: Flinders Room**

*(11.00am - 11.30am)* **IDM Instruments Pty Ltd**, **Australia, "**Position & Rotational Transducers (product range)", *Paul Cibotto.*

*(11.30am - 12.00pm)* **The Boeing Company**, **USA, "**Mission Requirements: A Look at Sensor Systems Integrated Into Larger Systems", *Dr. Stubberud Stephen C.*

*(12.00pm - 12.30pm)* **Ambient Systems, Netherlands, "**Ambient Systems Sensing Technology", *Stefan Dulman.*

## Technical Sessions / Oral Presentations

## 6th December 2005, Tuesday

**Opening Remarks** *(9.00am-9.30am)*

**Plenary Talk 1A** *(9.30am-10.30am)*
**Venue: Clarendon Ballroom**
**Speaker: Prof. Ian Foster,** *Argonne National Laboratory & University of Chicago, USA*

**Title:** Service-Oriented Science: Scaling the Application and Impact of eResearch

**Morning Tea Break** *(10.30am-11.00am)*

## Session I-A: Wireless Sensor Networking Issues

**Venue: Clarendon B**
**Chair: Dr. Thomas Hanselmann**

*(11.00am - 11.20am)* **#64** Collision-free Time Slot Reuse in Multi-hop Wireless Sensor Networks, *Lodewijk Van Hoesel and Paul Havinga.*

*(11.20am - 11.40am)* **#68** Experiments with Reliable Data Delivery in Wireless Sensor Networks, *Mihai Marin-Perianu and Paul Havinga*.

*(11.40am - 12.00pm)* **#76** An Analysis of Cross-Layer Interactions in Sensor Network Applications, *Andreas Lachenmann, Pedro Jose Marron, Daniel Minder and Kurt Rothermel.*

*(12.00pm - 12.20pm)* **#75** Performance of MIMO-based wireless sensor networks with cochannel interference, *Amin Abbosh and David Thiel.*

*(12.20pm - 12.40pm)* **#116** Data loss regulation to ensure information quality in sensor networks*, Andrei Tolstikov, Chen-Khong Tham and Jit Biswas.*

## Session I-B: Sensor Fusion Applications

**Venue: Yarra I**
**Chair: Dr. Rezaul Begg**

*(11.00am - 11.20am)* **#71** Incorporation of Uncertainty into Level 2 Fusion Association Metrics, *Stephen Stubberud and Kathleen Kramer*.

*(11.20am - 11.40am)* **#45** On Accessing GSM-enabled Mobile Sensors, *Zissis Plitsis Ioannis Fudos Evaggelia Pitoura and Apostolos Zarras.*

*(11.40am - 12.00pm)* **#90** Context awareness in I-centric systems, *Olaf Droegehorn, Sandra Haseloff ,Tino Loeffler and Klaus David.*

*(12.00pm - 12.20pm)* **#73** Geometric Optimisation of SU-8 Piezoresistive Cantilever Sensors for Biochemical Applications, *Siripon Sukuabol, Dinesh K. Sood and Gary Rosengarten.*

*(12.20pm - 12.40pm)* **#128** Development of Portable Internet Access Module for Sensor Data Collection, *Haifeng Chen and Jungtae Lee.*

## Session I-C: Sensor Network Applications I

**Venue: Flinders Room**
**Chair: Prof. Arcot Sowmya**

*(11.00am - 11.40am)* **#Invited Session Talk**, Sensing by the ear and for the ear, *Dr. David Grayden, The Bionic Ear Institute, Australia.*

*(11.40am - 12.00pm)* **#115** Vision-based SLAM using natural features in indoor environments, *Jaime Valls Miro, Gamini Dissanayake and Weizhen Zhou.*

*(12.00pm - 12.20pm)* **#111** Automatic Ground Control Points Refinement For Remote Sensing Imagery Registration, *Xiuping Jia*.

*(12.20pm - 12.40pm)* **#13** An Automotive three-microphone Voice Activity Detector and noise canceller*, Ziming Qi and Tom Moir.*

## Lunch Break *(12.40pm-2.00pm)*

**Venue:** Ballroom Foyer or Sante (student delegates only) in Crown

**Plenary Talk 1B** *(2.00pm-3.00pm)*
**Venue: Clarendon Ballroom**
**Speaker: Prof. Jan Rabaey,** *Donald O. Pederson Distinguished Professor University of California at Berkeley, USA.*
**Title:** Ambient Intelligence - Where Multimedia and Sensor Networks Meet.

## Afternoon Tea Break *(3.00pm-3.30pm)*

**Venue:** Ballroom Foyer

**ISSNIP Keynote Talk I** *(3.30pm-4.15pm)*
**Venue: Clarendon B**
**Speaker: Prof. Vittal Rao,** *Rutledge-Emerson Distinguished Professor of Electrical and Computer Engineering, University of Missouri-Rolla, USA.*
**Title:** The Role of Sensor Networks in Cyber Infrastructural Systems

## Panel Session: Sensor Networks and Cyberengineering Systems

*(4.15pm-5.15pm)*
**Venue: Clarendon B**
**Chair: Prof. Vittal Rao**

## Session II-A: Sensor Network Architectures and Sensor Fusion

**Venue: Yarra I**
**Chair: Prof. Subhash Challa**

*(3.30pm-4.10pm)* **#Invited Session Talk,** Distributed Real-Time Applications on SensorGrids, *Chen-Khong Tham, NUS Singapore. (withdrawn)*

*(4.10pm-4.30pm)* **#131 Invited Paper** Architectures for wireless sensor networks, *S.O. Dulman.*

*(4.30pm-4.45pm)* **#35** An Ecosystem Model for Massively-Deployed Sensor Networks, *Kennie Jones, Kenneth Lodding, Stephen Olariu and et. al.*

*(4.45pm-5.00pm)* **#117** Simultaneous Localization and Mapping in Wireless Sensor Networks, *Subhash Challa, Frank Leipold, Suhrud K Deshpande and Michael Lieu.*

## Conference Tour

*(5.30pm-10.00pm)*
*Bus departs from the main entrance of Langham Hotel.*

# 7th December 2005, Wednesday

## Session III-A: Deployment of Sensor Networks
**Venue: Clarendon B**
**Chair: Dr. Kennie Jones**

*(8.15am-8.35am)* **#47** The Effects of Deployment Irregularity on Coverage in Wireless Sensor Networks, *David Marsh, Richard Tynan, Gregory O'Hare and Antonio Ruzzelli.*

*(8.35am-8.55am)* **#92** FPGA Implementation of Cluster Formation Algorithms in Mobile Ad-hoc Networks, *Gayathri Venkataraman.*

*(8.55am-9.15am)* **#113** A New Energy-efficient Clustering Protocol for Wireless Sensor network, *M. P. Singh and M. M. Gore.*

## Session III-B: Target Tracking and Defense
**Venue: Yarra I**
**Chair: Dr. Xiuping Jia**

*(8.15am-8.35am)* **#30** Multiple Target Tracking for Surveillance: A Particle Filter Approach, *Punarjay Chakravarty and Ray Jarvis.*

*(8.35am-8.55am)* **#65** Test Bed for a Smart Millimetre Wave Radar Sensor, *Graham Brooker and Nick McCouat.*

*(8.55am-9.15am)* **#38** A Comparison of Probabilistic Representations for Decentralised Data Fusion*, Lee Ling Ong, Matthew Ridley, Ben Upcroft and et. al*.

## Session II-C: Machine Learning Applications
**Venue: Flinders Room**
**Chair: Dr Pubudu N. Pathirana**

*(8.15am-8.35am)* **#85** Path planning for sensor data collecting mobile robot, *Pubudu Nishantha Pathirana, Timothy Black and Saeid Nahavandi.*

*(8.35am-8.55am)* **#108** Particle Swarm Optimisers for Cluster formation in Wireless Sensor Networks, *Siddeswara Mayura Guru, Saman Halgamuge and Saman Fernando.*

*(8.55am-9.15am)* **#48** Emergent Intertransaction Association Rules for Abnormality Detection in Intelligent Environments*, Sebastian L , Svetha Venkatesh and Geoff West*.

**Plenary Talk 2A** *(9.30am-10.30am)*
**Venue: Clarendon Ballroom**
**Speaker: Dr. John Parmentola,** *Director for Research and Laboratory Management, US Army.*
**Title:** The Network – A Revolutionary Capability for the Warfighter.

## Morning Break *(10.30am-11.00am)*

**Venue:** Ballroom Foyer

## Session IV-A: Energy Efficiency and Resource Balancing in Sensor Networks

**Venue: Clarendon B**
**Chair: A. Prof. Sabu Emmanuel**

*(11.00am-11.40am)* **#Invited Session Talk**, Farm Applications of Wireless Adhoc Sensor and Actuator Networks, *Dr. Pavan Sikka, CSIRO , Australia.*

*(11.40am-11.55am)* **#23** Energy Balancing in the Self-configuring Sensor Networks, *Kazi Sakib, Zahir Tari and Ibrahim Khalil.*

*(11.55am-12.10am)* **#91** An Energy-Time Based Load Balancing Technique for Wireless Sensor Networks*, Mudasser Iqbal, Iqbal Gondal and Laurence Dooley.*

*(12.10am-12.25pm)* **#37** A Distributed Architecture for a Ubiquitous RFID Sensing Network, *Damith Chinthana Ranasinghe, Kin Seon Leong, Mun Leng Ng and et. al.*

*(12.25pm -12.40pm)* **#101** Impact of Distributed Resource Allocation in Sensor Networks, *Mao Ching Foo and Hock Lim*.

## Session IV-B: Localization in Sensor Networks

**Venue: Yarra I**
**Chair: Dr. Rachel Cardell-Oliver**

*(11.00am-11.40am)* **#Invited Session Talk,** Cramer-Rao bounds for estimation and tracking, *Dr. Branko Ristic, DSTO Australia.*

*(11.40am-12.00pm)* **#97** Instrumental Variable Estimator for 3D Bearings-Only Emitter Localization, *Kutluyil Dogancay and Gokhan Ibal.*

*(12.00pm -12.20pm)* **#80** Bias Compensation for Least-Squares Multi-Pulse TDOA Localization Algorithms, *Kutluyil Dogancay and Doug Gray.*

*(12.20pm -12.40pm)* **#106** Combination of RFID and Vision for Mobile Robot Localization, *Heesung Chae and Kyuseo Han.*

## Session III-C: Pattern Recognition II

**Venue: Yarra II**
**Chair: Dr. Anthony Finn.**

*(11.00am-11.40am)* **#Invited Session Talk,** Enabling Civil Applications of Unmanned Airborne Vehicles, *A. Prof. Rodney Walker, Australian Research Centre for Aerospace Automation, Queensland University of Technology, Australia.*

*(11.40am-12.00pm)* **#49** Spatial Activity Recognition in a Smart Home Environment using a Chemotactic Model**,** *Daniel Riedel, Svetha Venkatesh and Wanquan Liu*.

*(12.00pm-12.20pm)* **#60** Face Recognition based on Ordinal Correlation, *Ronny Tjahyadi, Wanquan Liu, Senjian An and Svetha Venkatesh.*

## Session IV-C: Pattern Recognition I
**Venue: Flinders Room**
**Chair: Dr. David Grayden**

*(11.00am-11.20am)* **#82** Learning to Recognise Roads from High Resolution Remotely Sensed Images*, Xiongcai Cai, Arcot Sowmya and John Trinder.*

*(11.20am-11.40am)* **#2** Model-based approaches for predicting gait changes over time, *Galina Veres, Mark Nixon and John Carter.*

*(11.40am-12.00pm)* **#28** Factored State-Abstract Hidden Markov Models for Activity Recognition Using Pervasive Multi-modal Sensors, *Dung Tran, Dinh Phung, Hung Bui and Svetha Venkatesh.*

*(12.00pm-12.20pm)* **#43** Data Association for the PHD Filter, *Daniel Clark and Judith Bell.*

## Lunch Break *(12.30pm-2.00pm)*
**Venue:** Ballroom Foyer or Sante (student delegates only) in Crown

**Plenary Talk 2B** *(2.00pm-3.00pm)*
**Venue: Clarendon Ballroom**
**Speaker: Prof. Hideo Matsuda,** *Department of Bioinformatic Engineering, Osaka University, Japan.*
**Title:** A Grid Environment for Data Integration of Scientific Databases

## Afternoon Tea Break *(3.00pm-3.30pm)*
**Venue:** Ballroom Foyer

**ISSNIP Keynote Talk II** *(3.30pm-4.30pm)*
**Venue: Yarra I**
**Speaker: Prof. Stuart Milner,** *Research Professor and Director, Center for Networking of Infrastructure Sensors, A. J. Clark School of Engineering, University of Maryland at College Park, USA.*
**Title:** Challenges in Directional Wireless Sensor Networks.

## Poster Session *(3.30pm-5.00pm)*
**Venue: Clarendon Ballroom**

## Conference Dinner *(7.00pm)*
**Venue: Melbourne Aquarium**
*Delegates who do not know the way can assemble at the reception area of Langham by 6.45pm. Conference volunteers will be there to show the way. Estimated walking time is 15 minutes.*

## 8th December 2005, Thursday

### Session V-A: Processing and Services in Sensor Networks
**Venue: Clarendon C**
**Chair: Dr. Pavan Sikka**

*(8.15am-8.35am)* **#69** CODE: Description Language for Wireless Collaborating Objects, *Raluca Marin-Perianu, Hans Scholten and Paul Havinga.*

*(8.35am-8.55am)* **#74** Service Discovery in Wireless ad-hoc Control Networks, *Shengrong Bu.*

*(8.55am-9.15am)* **#40** Collaborative Processing in Sensor/Actuator Networks for Environment Control, *Masayuki Nakamura, Atsushi Sakurai, Shizuo Furubo and Hiroshi Ban.*

**Plenary Talk 3A** *(9.30am-10.30am)*
**Venue: Clarendon Ballroom**
**Speaker: Prof. M Srinivasan,** *Centre for Excellence in Vision Science, Research School of Biological Sciences, Australian National University.*
**Title:** Insect-inspired sensors for autonomous visual guidance.

### Morning Break *(10.30am-11.00am)*
**Venue:** Ballroom Foyer

### Session VI-A: Sensor Applications
**Venue: Clarendon C**
**Chair: Prof. Paul Havinga**

*(11.00am-11.20am)* **#59** Determining the percentage of toe-walking steps in toe-walking gait using miniature dual axis accelerometer in Idiopathic Toe-Walking Children, *Gita Pendharkar, David Morgan and Paul Percival.*

*(11.20am-11.40am)* **#99** Trade-offs in the Distribution of Neural Networks in a Wireless Sensor Network**,** *Mike Holenderski Johan Lukkien and Chen Khong Tham*.

*(11.40am-12.00pm)* **#96** Round Robin Cycle for Predictions in Wireless Sensor Networks, *Yann-Ael Le Borgne and Gianluca Bontempi..*

*(12.00pam-12.20pm)* **#110** Medical Informatics System with Wireless Sensor Network-enabled for Hospitals, *Kok Keong Peter Loh and Allan Lee.*

*(12.20pm-12.40pm)* **#72** On the Performance of Asynchronous Sensor Networks for Detection, *Sriram Narayanan and Douglas Jones*.

### Lunch Break *(12.40pm-2.00pm)*
**Venue:** Ballroom Foyer or Sante (student delegates only) in Crown.

**Plenary Talk 3B** *(2.00pm-3.00pm)*
**Venue: Clarendon Ballroom**
**Speaker: Prof. Carole Goble,** *The e-Science North West Centre, The University of Manchester, UK.*
**Title:** Putting Semantics into e-Science and Grids.

## Afternoon Tea Break *(3.00pm-3.30pm)*
**Venue:** Ballroom Foyer

**ISSNIP Keynote Talk III** *(3.30pm-4.30pm)*
**Venue: Clarendon C**
**Speaker: Prof. Robin J. Evans**
**Title:** Wireless Sensor Networks- SCADA Systems without wires or Something More.

## Session VII-A: Security and Intrusion Detection in Sensor Networks
**Venue: Clarendon C**
**Chair: Dr. N. Mani**

*(4.30pm-4.50pm)* **#130 Invited Paper,** An Overview of Wireless Sensor Network Security: Energy-Efficient Attack and Defense, *Y.W. Law.*

*(4.50pm-5.10pm)* **#77** A Cost-Efficient Counter-Intrusion Scheme for One-Time Sensor Networks, *Chandana Gamage, Jussipekka Leiwo, Kemal Bicakci and et. al.*

## Closing Remarks *(5.15pm)*

## Workshop on Unmanned Aerial Vehicles (UAV)

### Date: 8th December 2005, Thursday
**Venue: Yarra I , Workshop Chair: Dr. Anthony Finn**

*(8:30am – 9:30am)* **Keynote Talk**: Cooperative UAVs as a Complex System of Networked Sensors, *Salah Sukkarieh.*

**Plenary Talk 3A** *(9.30am-10.30am)*
**Venue: Clarendon Ballroom**
**Speaker: Prof. M Srinivasan,** *Centre for Excellence in Vision Science, Research School of Biological Sciences, Australian National University.*
**Title:** Insect-inspired sensors for autonomous visual guidance.

**Morning Break** *(10.30am-11.00am)*
**Venue:** Ballroom Foyer

*(11.00am-11.20am)* 3-D Reconstruction of Terrain Maps from UAV Imagery, *Anton van den Hengel.*

*(11.20am-11.40am)* Acoustic Sensors for UAV's*, *Brian Ferguson, Neil Travis.*

*(11.40am-12.00pm)* #***18*** Persistence Acquisition and Maintenance for Autonomous Formations, *Changbin Yu, Barıs Fidan, Brian Anderson.*

*(12.00pm -12.40pm)* DSTO Grand Challenge*, *Bevan Bates.*

**Lunch Break** *(12.30pm-2.00pm)*
**Venue:** Ballroom Foyer or Sante (student delegates only) in Crown.

**Plenary Talk 3B** *(2.00pm-3.00pm)*
**Venue: Clarendon Ballroom**
**Speaker: Prof. Carole Goble,** *The e-Science North West Centre, The University of Manchester,UK.*
**Title:** Putting Semantics into e-Science and Grids.

*(3.30pm-3.50pm)* #***104*** Vision Based Forced Landing Site Selection System for Autonomous UAV, *Daniel Fitzgerald, Rodney Walker, Duncan Campbell.*

*(3.50pm-4.10pm)* #***118*** Autonomous Control of Multiple UAVs for the Passive, *Sam Drake, Kim Brown, Jeremy Fazackerley, Anthony Finn.*

*(4.10pm-4.30pm)* On UAV team formation for Emitter Geolocation*, *Luke Marsh, Sam Drake, Greg Calbert, Don Gossink.*

*(4.30pm-4.50pm)* #***31*** Agent-based Controller for Satellite Formation Flying, *K.K.T. Thanapalan, S.M. Veres.*

*(4.50pm-5.10pm)* #***58*** A simulator for exploring autonomous control of multiple UAVs at non-radar controlled airstrips, *Remus Chang, Peter Lindsay.*

## Workshop on Applications of Machine Learning to Sensors and Sensor Networks

### Date: 8th December 2005, Thursday

**Venue: Flinders Room**
**Workshop Chairs: Dr. Danil Prokhorov and Prof. Erkki Oja.**

*(08:30am – 09:30am)* **Keynote Talk, *#123*** Virtual Sensors and Their Automotive Applications, *Danil Prokhorov*.

**Plenary Talk 3A** *(9.30am-10.30am)*
**Venue: Clarendon Ballroom**
**Speaker: Prof. M Srinivasan,** *Centre for Excellence in Vision Science, Research School of Biological Sciences, Australian National University.*
**Title:** Insect-inspired sensors for autonomous visual guidance.

**Morning Break** *(10.30am-11.00am)*
**Venue:** Ballroom Foyer

*(11:00am – 11:30am)* **Invited Talk** Stochastic Meta-Descent: Rapid, Scalable Adaptation to Sensory Signals, *Alex Smola*.

*(11:30am – 12:30pm)* **Keynote Talk,** Independent Component Analysis for large-scale sensor array data, *Erkki Oja*.

**Lunch Break** *(12.30pm-2.00pm)*
**Venue:** Ballroom Foyer or Sante (student delegates only) in Crown.

**Plenary Talk 3B** *(2.00pm-3.00pm)*
**Venue: Clarendon Ballroom**
**Speaker: Prof. Carole Goble,** *The e-Science North West Centre, The University of Manchester, UK.*
**Title:** Putting Semantics into e-Science and Grids

*(3.30pm – 4.00pm)* **Invited Paper *#70*** Mobile Sensor Systems*, William Smuda.*

*(4.00pm –4.30pm)* **Invited Paper *#129*** Multi-Agent Systems on Sensor Networks: A Distributed Reinforcement Learning Approach, *Chen Khong Tham and Jean-Christophe Renaud.*

*(4.30pm –5.00pm)* ***#107*** Information Discovery in Ecological Systems by Artificial Neural Networks: Algal Blooms at Gippsland Lakes, *Neha Khanna, John Smith and Margaret Lech.*

## Special Session Information Processing in Neuroimaging Research

**Special Session Chair: Prof. Gary Egan**

**Date: 5th December 2005, Monday**
**Venue: Flinders Room**

*(3:00pm – 3:40pm)* **Keynote Talk**, *Prof. Gary Egan, Head of the Neuroinformatics Laboratory National Neuroscience Facility, Melbourne.*

*(3:40pm – 4:00pm*) Modeling brain functions: Application of non-linear filtering methods to fMR data, *Leigh Johnston.*

*(4:00pm – 4:20pm)* Analysing brain micro-structure: cortical parcellation methods, *Chris Adamson.*

*(4:20pm – 4:40pm*) Investigating brain function: fMR time series analysis methods, *Eugene Duff.*

*(4:40pm – 5:00pm)* Analysing large datasets: Grid analyses of neuroimaging data, *Scott Kolbe.*

## Poster Session

**Date: 7th December 2005, Wednesday**
**Venue: Clarendon Ballroom**
**Time: 3.30pm – 5.00 pm**

**P01: #20** Efficient Coxian Duration Modelling for Activity Recognition in Smart Environment with the Hidden semi-Markov Model**,** *Thi Duong, Dinh Phung, Hung Bui and Svetha Venkatesh.*

**P02: #24** Online Context Recognition in Multisensor Systems using Dynamic Time Warping, *Ming Hsiao Ko, Geoff West, Svetha Venkatesh and Mohan Kumar.*

**P03: #26** Boosted Markov Networks for Activity Recognition, *The Truyen Tran, Hung Hai Bui and Svetha Venkatesh.*

**P04: #27** A Neural Network Aided Target Tracking Algorithm Using Anglular Measurements**,** *Nasser Sadati and Damoun Langary.*

**P05: #114** Information Fusing Control of the DNA Microinjection Volume Based on Stochastic Fuzzy Neural Network**,** *Ling Zhang.*

**P06: #81** Multi-sensor approach for people detection, *Zhengzhi Zhang and K. R. S. Kodagoda*.

**P07: #46** Cramer-Rao Lower Bounds for Mobile Robot Navigation, *Zhimin Jiang, Sen Zhang and Lihua Xie.*

**P08: #119** Incorporating Contextual Audio For An Actively Anxious Smart Home, *Simon Moncrieff, Svetha Venkatesh, Geoff West and Stewart Greenhill.*

**P09: #34** Optimal Placement for Opportunistic Cameras Using Genetic Algorithm, *Rami Al-Hmouz and Subhash Challa*.

**P10: #57** A Simple Model for Evaluating the Scalability in Wireless Sensor Networks, *Venkat R.*

**P11: #103** Using a Diversity Scheme to Reduce Energy Consumption in Wireless Sensor Networks, *Vahid Shah-Mansouri, Mohammad Mohammadnia-Avval and Yashar Ghiassi-Farrokhfal.*

**P12: #95** Bloom filters for data aggregation and discovery: a hierarchical clustering approach, *Peter Hebden and Adrian Pearce.*

**P13: #66** Impact Time and Point Predicted Using a Neural Extended Kalman Filter, *Kathleen Kramer and Stephen Stubberud.*

**P14: #132** Sensor for evaluation of Dental pulp vitality test using Pulse Oximetry technique, *Koruthu P Varughese and Prasanth Balan*.

**P15: #51** Analysis and Optimization Of Routing Protocols in WPANs, *Debarshi Kumar Sanyal, Sudeepta Ray and Uttam Kumar Roy.*

**P16: #12** Vehicle Flow Detection Statistic Algorithm Based on Computer Vision, *Chen Zhenxue and Wang Guoyou*.

**P17: #98** A Memory Efficient Architecture for Deblocking Filter in H.264 Using Vertical Processing Order**,** *Chung-Ming Chen and Chung-Ho Chen.*

**P18: #133** Ambient Systems Sensing Technology, *Stefan Dulman.*

# Abstract List

## #2 Model-based approaches for predicting gait changes over time

*Galina Veres, Mark Nixon and John Carter*

Interest in automated biometrics continues to increase, but has little consideration of time which are especially important in surveillance and scan control. This paper deals with a problem of recognition by gait when time-dependent covariates are added, i.e. when 6 or 12 months have passed between recording of the gallery and the probe sets, and in some cases some extra covariates present as well. We have shown previously how recognition rates fall significantly when data is captured between lengthy time intervals. Under the assumption that it is possible to have some subjects from the probe for training and that similar subjects have similar changes in gait over time, we suggest predictive models of changes in gait due both to time and now to time-invariant covariates. Our extended time-dependent predictive model derives high recognition rates when time-dependent or subject-dependent covariates are added. However it is not able to cope with time invariant covariates, therefore a new time-invariant predictive model is suggested to accommodate extra covariates. These are combined to achieve a predictive model which takes into consideration all types of covariates. A considerable improvement in recognition capability is demonstrated, showing that changes can be modelled successfully by the new approach.

## #13 An Automotive three-microphone Voice Activity Detector and noise canceller

*Ziming Qi and Tom Moir.*

This paper addresses issues in improving hands-free speech recognition performance in car environments. A threemicrophone array has been used to form a beamformer with normalised least-mean squares (NLMS) to improve Signal to Noise Ratio (SNR). The array has been implemented with a Voice Activity Detector (VAD) which uses time-delay estimation together with magnitude-squared coherence (MSC). An experiment clearly shows the ability of the composite system to reduce noise outside of a defined active zone.

## #18 Persistence Acquisition and Maintenance for Autonomous Formations

*Changbin Yu, Barıs Fidan, Brian Anderson.*

Built upon a recently developed theoretical framework, we consider some practical issues raised in autonomous multiagent formation control. We use the notions of rigidity and persistence to analyze the cohesiveness of the formation structure and maintenance of the constraints on each individual agent. We present basic properties of persistent formations and give an operational criterion to determine if a formation is persistent. Using the framework we develop, we seek to provide systematic ways of acquiring persistence for classes of formations often found in real world applications. Decentralized automatic acquisition of persistence for rigid formations is an open problem and answers found for these specific examples may serve as hints for seeking a general solution. Another focus of this paper is on how to transfer autonomy (abstracted as degrees of freedom) among agents, when the formation changes with new agent(s) added, to preserve persistence.

## #20 Efficient Coxian Duration Modelling for Activity Recognition in Smart Environment with the Hidden semi-Markov Model

*Thi Duong, Dinh Phung, Hung Bui and Svetha Venkatesh.*

In this paper, we exploit the discrete Coxian distribution and propose a novel form of stochastic model, termed as the Coxian hidden semi-Makov model (Cox-HSMM), and apply it to the task of recognising activities of daily living (ADLs) in a smart house environment. The use of the Coxian has several advantages over traditional parameterization (e.g. multinomial or continuous distributions) including the low number of free parameters needed, its computational efficiency, and the existing of closed-form solution. To further enrich the model in real-world applications, we also address the problem of handling missing observation for the proposed Cox-HSMM. In the domain of ADLs, we emphasize the importance of the duration information and model it via the Cox-HSMM. Our experimental results have shown the superiority of the Cox-HSMM in all cases when compared with the standard HMM.

Our results have further shown that outstanding recognition accuracy can be achieved with relatively low number of phases required in the Coxian, thus making the Cox-HSMM particularly suitable in recognizing ADLs whose movement trajectories are typically very long in nature.

## #23 Energy Balancing in the Self-configuring Sensor Networks

*Kazi Sakib, Zahir Tari and Ibrahim Khalil.*

Like other distributed systems, unattended sensor networks need to be balanced not only by load but also in terms of energy. Sensor networks are expected to live long. Lifetime can be maximized if and only if a balanced network can be formed. In this research work we first identify the tasks, that

a sensor node accomplishes in its life time. Based on those, we define the sensor node life-cycle. Then we characterize the nodes based on their residual energy levels as, SEN – nodes having sufficient energy to perform additional responsibilities other than its own sensing task, or NEN - nodes having only necessary energy to perform its own task. Every node starts as SEN, and at some point it becomes NEN based on a predefined threshold value. Thus the nodes are protected from the early exhaustion. Finally, we developed a virtual clustering technique which is self-configurable and scalable. We apply our approach to a simulation environment and the simulation results justify our assertion.

## #24 Online Context Recognition in Multisensor Systems using Dynamic Time Warping

*Ming Hsiao Ko, Geoff West, Svetha Venkatesh and Mohan Kumar.*

In this paper, we present our system for online context recognition of multimodal sequences acquired from multiple sensors. The system uses Dynamic Time Warping (DTW) to recognize multimodal sequences of different lengths, embedded in continuous data streams. We evaluate the performance of our system on two real world datasets: 1) accelerometer data acquired from performing two hand gestures and 2) NOKIA's benchmark dataset for context recognition. The results from both datasets demonstrate that the system can perform online context recognition efficiently and achieve high recognition accuracy.

## #26 Boosted Markov Networks for Activity Recognition

*The Truyen Tran, Hung Hai Bui and Svetha Venkatesh.*

We explore a framework called boosted Markov networks to combine the learning capacity of boosting and the rich modeling semantics of Markov networks and applying the framework for video-based activity recognition. Importantly, we extend the framework to incorporate hidden variables. We show how the framework can be applied for both model learning and feature selection. We demonstrate that boosted Markov networks with hidden variables perform comparably with the standard maximum likelihood estimation. However, our framework is able to learn sparse models, and therefore can provide computational savings when the learned models are used for classification.

## #27 A Neural Network Aided Target Tracking Algorithm Using Anglular Measurements

*Nasser Sadati and Damoun Langary.*

This paper investigates the problem of maneuvering target tracking by using hybrid (intelligent/classical) methods. The adaptive capability of filters is known to be increased by incorporating a neural network into the filtering procedure. The proposed algorithm is implemented with two secondorder Gaussian filters based on the current statistical model and a multilayer feedforward neural network. The two filters, which use the noise corrupted measurements of the target line of sight (LOS) angle, track the same maneuvering target in parallel. The neural network automatically considers all the state information of the two filters and adaptively adjusts the process variance of one of them to achieve better performance in different target maneuver tracking. Simulations results clearly show that the proposed adaptive algorithm tracks maneuvering targets very well with higher precision over a wide range of maneuvers.

## #28 Factored State-Abstract Hidden Markov Models for Activity Recognition Using Pervasive Multi-modal Sensors

*Dung Tran, Dinh Phung, Hung Bui and Svetha Venkatesh.*

Current probabilistic models for activity recognition do not incorporate much sensory input data due to the problem of state space explosion. In this paper, we propose a model for activity recognition, called the Factored State-Abtract Hidden Markov Model (FS-AHMM) to allow us to integrate many sensors for improving recognition performance. The proposed FSAHMM is an extension of the Abstract Hidden Markov Model which applies the concept of factored state representations to compactly represent the state transitions. The parameters of the FS-AHMM are estimated using the EM algorithm from the data acquired through multiple multi-modal sensors and cameras. The model is evaluated and compared with other exisiting models on real-world data. The results show that the proposed model outperforms other models and that the integrated sensor information helps in recognizing activity more accurately.

## #30 Multiple Target Tracking for Surveillance: A Particle Filter Approach

*Punarjay Chakravarty and Ray Jarvis.*

This paper describes a system that uses multiple particle filters to track an unknown number of targets from range data. The tracked targets do not move with constant velocity or acceleration, which fits the requirements of a system that tracks the movement of people. Results from simulations involving tracking of 10 manoeuvring targets in clutter are presented.

## #31 Agent-based Controller for Satellite Formation Flying

*K.K.T. Thanapalan, S.M. Veres.*

In this paper an agent based control scheme for satellite formation flying is discussed. The underlying idea of our design is to use a multi-agent architecture for satellite formation flying control. The architecture is designed to enable autonomous formation flying activities. The performance requirements and algorithms are described.

## #34 Optimal Placement for Opportunistic Cameras Using Genetic Algorithm

*Rami Al-Hmouz and Subhash Challa*.

Oppurtunistic Information Fusion (OIF) is introduced to enable the same sensors to provide data for multiple applications. Sensor location plays a crucial rule to get the maximum amount of useful information. This paper examines the optimal placement of cameras for a Networked Sensing Systems (NSS) that are designed to monitor a pre defined region to have as much coverage as possible with the purpose of serving multiple applications. This can be rephrased as a camera location optimization problem with multiple objective functions. Multi-Objective Genetic Algorithms (MOGA) is used with camera coverage as the two objective functions to be maximized.

## #35 An Ecosystem Model for Massively-Deployed Sensor Networks

*Kennie Jones, Kenneth Lodding, Stephen Olariu, L. Wilson, C. Xin*

Research in wireless sensor network technology has accelerated rapidly in the last decade. Promises of ubiquitous control of the physical environment by these networks open avenues for new applications that will redefine the way we live and work. Due to the small size and low cost of sensor devices, visionaries promise systems enabled by deployment of massive numbers of sensors working in concert. Recent sensor network research has concentrated on developing techniques for performing relatively simple tasks with minimal energy expense, assuming some form of centralized control. Unfortunately, centralized control does not scale to massive size networks and execution of simple tasks in sparse networks will not lead to the sophisticated applications predicted. The contribution of this work is to continue our work in looking at massively-deployed sensor networks, motivated by lessons learned from the way biological ecosystems are organized. We demonstrate that in such a model, fully

distributed synchronization can be performed in a scalable fashion in massively deployed sensor networks, where individual motes operate based on local information, making local decisions that are aggregated across the network to achieve a globally-meaningful effect.

## #37 A Distributed Architecture for a Ubiquitous RFID Sensing Network

*Damith Chinthana Ranasinghe, Kin Seon Leong, Mun Leng Ng, D.W.Engels, P.H. Cole.*

The concept of a "Networked Physical World" originated from the Auto-ID Center, now called the Auto-ID Labs. Such a system can be realized with a combination of automatic identification technology and a ubiquitous computer network that will glue the physical world together. The ability to form a ubiquitous network of physical objects has a wide range of applications including manufacturing automation, supply chain management and collection of sensor derived data. We describe the building block system components of a distributed ubiquitous RFID network aimed at enabling ubiquitous sensing with RFID and explore the data flows within the system.

## #38 A Comparison of Probabilistic Representations for Decentralised Data Fusion

*Lee Ling Ong, Matthew Ridley, Ben Upcroft, Suresh Kumar, Tim Bailey, Salah Sukkarieh, Hugh Durrant-Whyte.*

This paper compares and constrasts three different probabilistic models - Particle representations, Parzen density estimates, and Gaussian mixture models - for non-Gaussian, non-linear feature tracking, when applied to multiple autonomous vehicles using the Decentralised Data Fusion (DDF) paradigm. These probabilistic models were chosen as they are all capable of approximating the probability distributions of an ideal Bayesian _lter and have different properties with regard to computational ef_ciency and quality of the approximation. In order to show that each model satisfy the DDF requirements of modularity, scalability and robustness, the performance of each representation is taken from a simulation for multi-sensor bearing-only tracking. Performance is evaluated in three areas: (a) mathematical accuracy and optimality of fusion for correlated information between nodes, (b) computational ef_ciency and accuracy of various operations in the DDF framework and © bandwidth requirements for communicating the representations over a wireless network.

## #40 Collaborative Processing in Sensor/Actuator Networks for Environment Control

*Masayuki Nakamura, Atsushi Sakurai, Shizuo Furubo and Hiroshi Ban*

This paper describes collaborative sensing and actuation algorithms for environment control in the framework of optimization. The sensor network topology is self-configured according to the sensing information to optimize sensing utility. Experimental results show that the algorithms provide the sensor network topology for optimal sensing. The server can gather the sensing data from all sensor nodes robustly using the collaborative sensing algorithm and calculate the control signals for actuators to balance energy savings against the quality of the control signals. In addition to a centralized algorithm, a distributed algorithm is also proposed to calculate the control signals. Simulations reveal that the distributed algorithm, which is more scalable than the centralized one, can provide the same performance as the centralized one.

## #43 Data Association for the PHD Filter

*Daniel Clark and Judith Bell.*

The Probability Hypothesis Density (PHD) _lter was developed as a suboptimal method for tracking a time varying number of targets. The _rst order statistical moment of the multiple target posterior distribution, called the Probability Hypothesis Density, gives the expected locations of the targets. This property is used instead of the full multi-target posterior distribution as it requires signi_cantly less computation. Particle _lter implementations have demonstrated the potential of the algorithm for real-time tracking applications. One of the main criticisms of the PHD _lter is that there is no means of associating the same target between frames.Whilst this may be of advantage if the main concern is where the targets are, it is a major drawback if it is necessary to identify the trajectories of the different

targets. Novel techniques for solving the problem of track continuity are presented here and demonstrated on simulated data

## #45 On Accessing GSM-enabled Mobile Sensors

*Zissis Plitsis Ioannis Fudos Evaggelia Pitoura and Apostolos Zarras.*

In this paper, we propose a middleware framework that unifies access to GSM-enabled sensor devices in a global computing environment. Typically, communication with mobile sensors relies on proprietary protocols, involving the exchange of SMS and MMS messages. In the proposed framework, we use XML-based control descriptions that abstractly specify these protocols to generate proxies and corresponding WEBbased (HTML, WAP and WEB services) interfaces that realize them. Thus, we provide access transparency over different kinds of mobile sensors. Besides the overall architecture of the proposed framework, we discuss a particular instance where a GSM-enabled camera with temperature, and motion detection sensors is incorporated into our global computing environment. Finally, we assess the performance of the proposed framework by presenting experimental results.

## #46 Cramer-Rao Lower Bounds for Mobile Robot Navigation

*Zhimin Jiang, Sen Zhang and Lihua Xie.*

This paper studies the Cramer-Rao Lower Bound (CRLB) of the simultaneous localization and map building (SLAM) problem for mobile robot navigation. Performance evaluation of SLAM is carried out and the Extended Kalman filtering (EKF) technique is verified to be effective for the SLAM problem through the CRLB analysis. Detailed simulation and experimental results show that the process noise, measurement noise and feature number has influences on the CRLB of the SLAM.

## #47 The Effects of Deployment Irregularity on Coverage in Wireless Sensor Networks

*David Marsh, Richard Tynan, Gregory O'Hare and Antonio Ruzzelli.*

One commonly employed method to calculate whether a wireless sensor network can adequately sense the entirety of a region of interest is to define the area that a sensor can monitor and ensure that the union of all these areas leaves no part of the region uncovered. This paper shows the results of a series of experiments in simulation designed to show how various degrees of deviation from intended node placement locations in a wireless sensor network affect the achievable coverage using this model. The main result is that irregular deployments are only slightly less efficient than highly regular ones but that since they have less redundancy they fail before regular cases. This is manifested by the regular patterns maintaining coverage by increasing the number of active nodes while the irregular ones fail to achieve coverage despite having activated a low proportion of the available nodes due to the remaining nodes being situated at ineffective locations.

## #48 Emergent Intertransaction Association Rules for Abnormality Detection in Intelligent Environments

*Sebastian L , Svetha Venkatesh and Geoff West*.

This paper is concerned with identifying anomalous behaviour of people in smart environments. We propose the use of emergent transaction mining and the use of the extended frequent pattern tree as a basis. Our experiments on two data sets demonstrate that emergent intertransaction associations are able to detect abnormality present in real world data and that both short and long term behavioural changes can be discovered. The use of intertransaction associations is shown to be advantageous in the detection of temporal association anomalies otherwise not readily detectable by traditional “market basket” intratransaction mining.

## #49 Spatial Activity Recognition in a Smart Home Environment using a Chemotactic Model

*Daniel Riedel, Svetha Venkatesh and Wanquan Liu*.

Spatial activity recognition is challenging due to the amount of noise incorporated during video tracking in everyday environments. We address the spatial recognition problem with a biologically-inspired chemotactic model that is capable of handling noisy data. The model is based on bacterial chemotaxis, a process that allows bacteria to change motile behaviour in relation to environmental gradients. Through adoption of chemotactic principles, we propose the chemotactic model and evaluate its performance in a smart house environment. The model exhibits greater than 99% recognition performance with a diverse six class dataset and outperforms the Hidden Markov Model (HMM). The approach also maintains high accuracy (90-99%) with small training sets of one to five sequences. Importantly, unlike other low-level spatial activity recognition models, we show that the chemotactic model is capable of recognising simple interwoven activities.

## #57 A Simple Model for Evaluating the Scalability in Wireless Sensor Networks

*Venkat R.*

Recent advances in wireless technology have enabled the rapid development of wireless sensor networks. Such networks, consisting of ten to thousands of randomly deployed nodes collaborating to achieve a goal, are used in a variety of applications. We have developed a new framework called TinyMaCLaS(tiny middleware and compositional language for sensor networks) for sensor networks that simpli_es the process of developing applications. As a part of this framework, we have developed a COMiS(component oriented middleware for sensor networks). Most of the protocols and middleware argue scalability through simulations. Unfortunately, theoretical analysis does not exist for scalability. We have done theoretical analysis, in order to prove the scalability of our middleware. The paper presents the theoretical analysis, and it can be used for any middleware or protocol.

## #58 A simulator for exploring autonomous control of multiple UAVs at non-radar controlled airstrips

*Remus Chang, Peter Lindsay.*

The paper discusses the use of modeling and simulation to explore concepts of autonomous control for UAVs operating in the vicinity of an airstrip. A state-based algorithm is developed for autonomous collision detection and avoidance, and for developing flight plans that respect the NASA SATS (Small Aircraft Transportation System) concept. The resulting model takes as inputs an initial configuration of UAVs waiting to land at an airport and departing UAVs waiting to take off, as well as the performance characteristics of the UAVs involved. The simulator enables us to explore how well safe separation standards are maintained under different values of SATS parameters. This in turn gives a method for calibrating SATS for particular airstrips and UAV types.

## #59 Determining the percentage of toe-walking steps in toe-walking gait using miniature dual axis accelerometer in Idiopathic Toe-Walking Children

*Gita Pendharkar, David Morgan and Paul Percival*

Idiopathic toe-walking (ITW) is a relatively common condition worldwide in children. ITW children are diagnosed by excluding all known causes of toe-walking, including neuromuscular or orthopaedic disorders and physical injuries. As a consequence of toe-walking, ITW children tend to develop shortened calf muscles which may lead to a number of problems such as improper balance of the body caused by a slightly shifted centre of gravity. Currently, the severity of toe-walking in ITW children is evaluated from the measurement of the ankle range of passive movement (ROM) and parental observations. However, long term monitoring of treatment for ITW children is missing. Accelerometers have proved to be efficient and reliable compared to other devices and techniques, for analyzing the gait pattern and detection of the stance phase and can be small and unobtrusive. Gait monitoring boots fitted with dual axis accelerometer in the heel have been developed, which would serve as long term gait monitoring device for ITW children. The aim of this paper is to detect the stance phase from the

acceleration signals obtained from the dual axis accelerometer for both normal and toe-walking gait and then distinguish the toe-walking steps from normal steps in the gait of ITW children.

## #60 Face Recognition based on Ordinal Correlation

*Ronny Tjahyadi, Wanquan Liu, Senjian An and Svetha Venkatesh.*

In this paper, we propose a new face recognition system based on the ordinal correlation principle. First, we will explain the ordinal similarity measure for any two images and then propose a systematic approach for face recognition based on this ordinal measure. In addition, we will design an algorithm for selecting a suitable classification threshold via using the information obtained from the training database. Finally, experimentation is conducted on the Yale datasets and the results show that the proposed face recognition approach outperforms the Eigenface and 2DPCA approaches significantly and also the threshold selection algorithm works effectively.

## #64 Collision-free Time Slot Reuse in Multi-hop Wireless Sensor Networks

*Lodewijk Van Hoesel and Paul Havinga.*

To ensure a long-lived network of wireless communicating sensors, we are in need of a medium access control protocol that is able to prevent energy-wasting effects like idle listening, hidden terminal problem or collision of packets. Schedulebased medium access protocols are in general robust against these effects, but require a mechanism to establish a nonconflicting schedule. In this paper, we present such a mechanism which allows wireless sensors to choose a time interval for transmission, which is not interfering or causing collisions with other transmissions. In our solution, we do not assume any hierarchical organization in the network and all operation is localized.We empirically show that our localized algorithm is successful within a factor 2 of the minimum necessary time slots in random networks; well in range of the expected (worst case) factor 3-approximation of known first-fit algorithms. Our algorithm assures similar minimum distance between simultaneous transmissions as CSMA(/CD)-based approaches.

## #65 Test Bed for a Smart Millimetre Wave Radar Sensor

*Graham Brooker and Nick McCouat.*

With the introduction of millimetre wave radar systems in various commercial applications, including collision avoidance, cruise control, autonomous navigation and imaging, it is now clear that a “one size fits all” approach to radar system development is not effective. This paper describes the implementation of a test bed millimetre wave system comprising a coherent 94GHz front end, a fast arbitrary waveform generator based modulator and a fast digitiser which, with their associated software, will allow for the development and evaluation of modulation and signal processing techniques which can be adapted to various radar based tracking and imaging requirements. This research is aimed primarily at the development of a single, intelligent, adaptive radar system that is capable of performing many of the short and medium range sensing roles required by the airborne and ground based autonomous systems under development at the ACFR.

## #66 Impact Time and Point Predicted Using a Neural Extended Kalman Filter

*Kathleen Kramer and Stephen Stubberud.*

Predictive target tracking is becoming increasingly important for a wide variety of applications, including for the prediction of when and where a ballistic projectile may hit the ground. Not only is such predictive tracking useful for providing a determination of whether the target will strike a valuable asset, it can also provide information about the order in which targets may be struck, and provide for the most effective use of resources in responding to threats. One such problem is the tracking of a ballistic trajectory using information from a ground-based sensor to direct high-cost precision strike munitions. A neural Kalman filter approach to target tracking is presented as a technique to improve the motion model of the target while it is being tracked in flight. A linearized version of that model is then used to provide an improved estimate of the predicted location of the target. Results are presented from use of a neural extended Kalman filter for predictive target tracking of a ballistic trajectory. The

tracker is able to fuse information over the course of the trajectory and, as a result, estimate the time and location that the ballistic target will strike. To respond to manoeuvres by the target, the motion model becomes a composite of the a priori motion model of a ballistic trajectory and a neural network. Prediction to ground impact is calculated and updated throughout the trajectory after each sensor measurement.

## #68 Experiments with Reliable Data Delivery in Wireless Sensor Networks

*Mihai Marin-Perianu and Paul Havinga*.

The increasing complexity of Wireless Sensor Networks (WSN) applications require simple, yet reliable, underlying networking mechanisms. In this paper, we describe the experiments performed to establish the real challenges and sources of errors for the reliable data delivery problem. We also discuss several implementation solutions and try to establish the issues that should be taken into account in the design phase. The results are obtained by field measurements, therefore we consider them relevant and useful. Our work relies on tight interaction among transport, routing and medium access layers, with the overall goal of achieving energy efficiency through cross-layer optimizations.

## #69 CODE: Description Language for Wireless Collaborating Objects

*Raluca Marin-Perianu, Hans Scholten and Paul Havinga.*

This paper introduces CODE, a Description Language for Wireless Collaborating Objects (WCOs), with the specific aim of enabling service management in smart environments. WCOs extend the traditional model of wireless sensor networks by transferring additional intelligence and responsibility from the gateway level to the network. WCO are able to offer complex services based on cooperation among sensor nodes. CODE provides the vocabulary for describing the complex services offered by WCO. It enables description of services offered by groups, on-demand services, service interface and sub-services. The proposed methodology is based on XML, which is widely used for structured information exchange and collaboration. CODE can be directly implemented on the network gateway, while a lightweight binary version is stored and exchanged among sensor nodes. Experimental results show the feasibility and flexibility of using CODE as a basis for service management in WCO.

## #70 Mobile Sensor Systems

*William Smuda.*

Mobile robots must adapt to react safely with other robots, the environment and their mission. Adaptive behaviors for multiple mission scenarios require multi-level controls and the ability to modify controls at many levels. In many sensing and operational scenarios, deterministic solutions are not practical. Due to the inherent complexity of real world operations changes within even a single mission scenario, can cause major software revisions. Soft Computing techniques, expert systems, neural networks and other adaptive learning techniques are a potential solution to reduce cost and risk.

## #71 Incorporation of Uncertainty into Level 2 Fusion Association Metrics

*Stephen Stubberud and Kathleen Kramer*.

Level 2 data fusion, also referred to as Situational Assessment, can be considered the determination and interpretation of relationships between objects. In a battlespace environment, these related objects can be considered Level 1 target tracks or existing Level 2 objects or groups. The Level 2 state used is comprised of group kinematics, group composition, formation, and region of influence. To develop an automated Level 2 fusion approach, association metrics were defined with mathematical rigor. These association metrics included a group distance measure, a cardinality distance measure and gap metric angle measure for composition, and an area metric that can be used for region of influence. The initial development of these metrics did not include the ability to process target uncertainty information. In this work, the target uncertainty information is incorporated successfully into the aforementioned metrics.The defined uncertainty models are based on the Gaussian covariance for the target kinematics and the use of a Bayesian taxonomy for reporting classification information.

## #72 On the Performance of Asynchronous Sensor Networks for Detection

*Sriram Narayanan and Douglas Jones*.

Energy efficiency is of principal concern when designing sensor networks for distributed measurement applications. Wireless sensor networks comprising many energy-efficient nodes with asynchronous sleep/awake cycles offer a low power, cost effective and simple alternative to planned and synchronized networks. Detecting the presence of a target is a common problem in many sensor network applications. We develop a mathematical model to represent an asynchronous sensor network and provide a comparison of this type of a network against a benchmark scheduled network for a detection application. This comparison is drawn first assuming that the probability of detection is one if the target is present within a sensing radius of a sensor node. A more realistic comparison of the networks is then made by relaxing this assumption. We show that for applications where a moderate detection coverage is sufficient, the asynchronous sensor network compares well with a scheduled network and is thus a promising alternative to traditional sensor network architectures.

## #73 Geometric Optimisation of SU-8 Piezoresistive Cantilever Sensors for Biochemical Applications

*Siripon Sukuabol, Dinesh K. Sood and Gary Rosengarten.*

We demonstrate the design and optimisation of polymerbased piezoresistive cantilevers used for detecting changes in surface stresses due to binding and hybridization of biomolecules on the surface of the cantilever. Various cantilever shapes (namely rectangular, T shape, inverse T shape, V shape and long- and short-based U shape) were simulated via finite element analysis using ANSYS software. Simulations were also conducted on stress concentration regions (SCRs) created by removal of segments from under the base of the cantilever. Performance was measured on the basis of both displacement sensitivity and surface stress sensitivity. It was found that the optimum shaped cantilevers were the inverse T shape and the long-based U shape. Cantilevers with stress concentration regions showed improved sensitivity. Removal of sections from under the base to leave two short legs (dual-leg design) provided superior results to removal of a single channel under the base. Overall the cantilever design that produced optimum sensitivity for use in biochemical applications was the inverse T shaped cantilever with the dual-leg SCR design. This device had very high surface stress sensitivity within an acceptable range of values for resonant frequency.

## #74 Service Discovery in Wireless ad-hoc Control Networks

*Shengrong Bu.*

A new concept in distributed control systems called Wireless Ad-hoc Control Networks (WACNets) is developed. WACNets is formed by a collection of nodes with the ability to sense, actuate and control. The network does not have a fixed structure, but evolves and self organises itself according to the control requirements of the system. The service discovery developed for WACNets is reported. A review of the existing Service Discovery Protocol (SDPs) including Jini, Salutation, Universal Plug and Play (UPnP), and Bluetooth technology is carried out. An overview of WACNets is provided. The service discovery protocol developed for WACNets is introduced and its characteristics are described. Some results are provided.

## #75 Performance of MIMO-based wireless sensor networks with cochannel interference

*Amin Abbosh and David Thiel.*

Energy requirements of MIMO-based limited-energy wireless sensor networks are analyzed and simulated in the presence of the worst case cochannel interference and under different propagation conditions. The analysis and simulations were compared between three different types of systems, SISO, MIMO and MIMO with CSI. Results demonstrate the robustness of MIMO based wireless sensor networks in spite of the strong cochannel interference that may exist.

## #76 An Analysis of Cross-Layer Interactions in Sensor Network Applications

*Andreas Lachenmann, Pedro Jose Marron, Daniel Minder and Kurt Rothermel.*

In the field of sensor networks cross-layer interactions are favored over strict layering of components and regarded as a way to provide the optimization capabilities required by sensor network applications. Despite their importance, developers tend to devise specific solutions for the application at hand, instead of designing more general primitives that can be used across applications. The contribution of this paper is twofold:We analyze several typical sensor network applications and provide a classification of the types of cross-layer interactions found in their code. Based on this classification, we propose TinyXXL, an extension to the nesC language that defines primitives for seamless cross-layer data exchange.

## #77 A Cost-Efficient Counter-Intrusion Scheme for One-Time Sensor Networks

*Chandana Gamage, Jussipekka Leiwo, Kemal Bicakci, Bruno Crispo, Andrew S. Tanenbaum. .*

We propose a secure one-time sensor scheme that is highly resistant to forged messages and replay message attacks. A sensor in a one-time sensor network transmits only a single message in its life time but retransmits messages from other sensors to provide message routing. The only security-specific computational capability required from a one-time sensor in our scheme is a hash function. The bulk of security related data in our scheme is static and therefore can be stored in non-volatile memory. This is an important design criteria as energy is the most critical resource in commonly used lowcost battery-powered wireless sensors. We further improve the storage efficiency of the proposed solution using Bloom filters.

## #80 Bias Compensation for Least-Squares Multi-Pulse TDOA Localization Algorithms

*Kutluyil Dogancay and Doug Gray.*

A weighted least squares (WLS) estimator is presented for time difference of arrival (TDOA) localization of an emitter using multiple TDOA measurements collected by moving receivers. A comprehensive bias analysis for this estimate is provided. Based on the outcomes of the bias analysis, a bias compensation algorithm is developed to reduce the severe WLS estimation bias. The proposed algorithm utilizes an estimate of the instantaneous bias derived from the WLS estimate itself. The significant bias reduction capability of the proposed bias compensation algorithm is illustrated with simulation examples involving geolocation of a pulse radar by unmanned aerial vehicles (UAVs).

## #81 Multi-sensor approach for people detection

*Zhengzhi Zhang and K. R. S. Kodagoda*.

Human detection is an important research topic for many researchers who are working with surveillance, safe driving, military and security applications. It is now becoming more and more appropriate with the global increase in the terrorism related activities. This paper presents an algorithm for people detection using information gathered from a composite moving sensor incorporating a camera and a laser range finder. Laser range finder is used to identify a region of interest (ROI) where a moving object is likely to be present. Corresponding ROI in the visual image is then analyzed and a hierarchical template matching strategy is used to confirm the presence of a moving human. This approach improves the robustness of the template matching and the computational efficiency as the matching is only done in the resized ROI. The proposed strategy is evaluated through experimentation.

## #82 Learning to Recognise Roads from High Resolution Remotely Sensed Images

*Xiongcai Cai, Arcot Sowmya and John Trinder.*

Automatic Road Extraction from remotely sensed images is a fundamental step in the acquisition and maintenance of geographical databases. This paper proposes an automatic road recognition algorithm based on fusion of junction and segment information. Road segments and junctions in an image are independently acquired as features of edge pairs. Then, the classification decisions of the segment and

junction classifiers are fused to learn initial seeds for the extended fast marching level set method. The decisions of segment classifiers and fast marching level set method are then combined to improve road extraction. The primary contribution of our approach is its ability to learn the seed points and the stopping criterion for fast marching level set methods. Experimental results on remotely sensed image datasets demonstrate the validity of the proposed algorithm.

## #85 Path planning for sensor data collecting mobile robot

*Pubudu Nishantha Pathirana, Timothy Black and Saeid Nahavandi.*

A mobile robot employed for data collection is faced with the problem of travelling from an initial location to a final location while maintaining as close a distance as possible to all the sensors at a given time in the journey. Here we employ optimal control ideas in forming the necessary control commands for such a robot resulting not only the necessary acceleration commands for the underlying robot, but also the resulting trajectory. This approach can also be easily extended for the case of producing the optimal trajectory for an ariel vehicle used for data collection from indiscriminately scattered ad-hoc sensors located on the ground. We demonstrate the implementation of our algorithm using a Pioneer 3-AT robot.

## #90 Context awareness in I-centric systems

*Olaf Droegehorn, Sandra Haseloff ,Tino Loeffler and Klaus David.*

Capturing contextual information, especially higherlevel contexts, enables systems to understand and predict the behaviour of a mobile user. This kind of information is mostly implicit, abstracting a complex state of a situation, and can only partly be captured by sensors. Higher-level context has the potential to make user applications simpler and more intuitive. However, composing higher-level contexts from explicit, atomic contexts requires complex procedures to be used and uncertainty due to inconsistent sensor readings and incomplete information to be reduced. In this paper, we introduce a new approach that assists application developers to take higher-level contexts into account without the need to know the details of atomic contexts. To demonstrate our approach, we will introduce the Context-Aware E-Pad (CAEP) we have designed and implemented.

## #91 An Energy-Time Based Load Balancing Technique for Wireless Sensor Networks

*Mudasser Iqbal, Iqbal Gondal and Laurence Dooley.*

The load profiles of Parent Nodes (PNs) in a network can be used to define their current state as well as to predict potential failures caused by energy loss due to high loads on particular PNs. This paper presents a novel load balancing model that maintains PNs in a state whereby the time-to-live requirement is met. Our model is distributed and utilises historical load profile information about each PN to improve the estimate accuracy of its remaining lifetime before failure. Results prove that the proposed methodology achieves effective reconfiguration performance as well as maintains QoS, especially in high density ad hoc networks.

## #92 FPGA Implementation of Cluster Formation Algorithms in Mobile Ad-hoc Networks

*Gayathri Venkataraman.*

Scalability has been an important issue in mobile ad-hoc network (MANET). Clustering is one of the mechanisms that are used in handling the scalability issue. Many cluster formation and cluster maintenance algorithms have been proposed for MANET. This paper presents the hardware implementation and study of some of the proposed cluster formation algorithms such as lowest ID, highest degree, Kclustering, and weighted clustering algorithm (WCA). The FPGA implementation shows that for all four clustering algorithms implemented, the CLB slices used is between 123 slices and 559 slices with operating frequency between 137.95 MHz and 325.5 MHz. For the same algorithms implemented, the total power consumption is between 667.5 mW and 795.4 mW while the total current consumption is between 329.2 mA and 401.3 mA.

## #95 Bloom filters for data aggregation and discovery: a hierarchical clustering approach

*Peter Hebden and Adrian Pearce.*

This work addresses the data aggregation problem by tightly integrating the processes of building and maintaining distributed data structures while optimally serving queries over the network. Importantly, the approach goes beyond existing clustering techniques by addressing the incremental problem at the same time as the query problem.

## #96 Round Robin Cycle for Predictions in Wireless Sensor Networks

*Yann-Ael Le Borgne and Gianluca Bontempi.*

Use of prediction models in sensor networks proves to be efficient with respect to energy savings, as it allows sensors whose readings are predicted to remain in their idle mode, thereby consuming orders of magnitude less energy that in the active mode. In the context of continuous monitoring, where a set of sensors is typically required to regularly send their readings to a central server, an interesting approach consists in splitting the set of sensors in two subsets, such that readings of one subset are used to predict readings of the second subset. In this paper, we propose to identify several sensor subsets for predictions, that are used in turn in a round robin fashion. Identification of different sensor subsets allows to detect erroneous models or sensor failure, and to better distribute energy consumption. Efficiency of the proposed procedure is demonstrated on a set of experiments using real world sensor data.

## #97 Instrumental Variable Estimator for 3D Bearings-Only Emitter Localization

*Kutluyil Dogancay and Gokhan Ibal.*

This paper develops a closed-form three-dimensional passive bearings-only localization algorithm based on the method of instrumental variables. The proposed localization algorithm is shown to attain a significant reduction in bias and root-meansquare error vis-‘a-vis orthogonal vector and pseudolinear estimators. It also has less computational requirements than a maximum likelihood estimator thanks to involving no iterative computations that are prone to instability problems. Further complexity reduction is shown to be achievable by averaging bearing measurements over finite-length non-overlapping windows. Simulation studies are provided to illustrate the effectiveness of the proposed instrumental variable estimation algorithm in a radar localization application.

## #98 A Memory Efficient Architecture for Deblocking Filter in H.264 Using Vertical Processing Order

*Chung-Ming Chen and Chung-Ho Chen.*

In this paper, we study and analyze the memory reference of deblocking filter in H.264/AVC baseline decoder based on SimpleScalar/ARM simulator. The simulation result shows that the memory reference is known to be very time consuming in this new video coding standard . In order to reduce the memory reference and thus improve overall system performance, we propose a vertical processing order with efficient VLSI architecture which simultaneously processes the horizontal filtering of vertical edge and vertical filtering of horizontal edge. As a result, the memory performance of the proposed architecture is improved by 4.4 times when compared to software implementation. Moreover, the system performance of our proposal is 129% faster than the advanced architecture of previous proposal.

## #99 Trade-offs in the Distribution of Neural Networks in a Wireless Sensor Network

*Mike Holenderski Johan Lukkien and Chen Khong Tham*.

This article investigates the tradeoff between communication and memory usage in different methods of distributing neural networks in a Wireless Sensor Network. A structural approach is presented, categorized in two dimensions: horizontal and vertical decomposition. Horizontal decomposition turns

out to be more attractive, due to high reuse of data present at the processor node. General properties of an alternative sematic approach are suggested theoretically allowing to dramatically increase efficiency.

## #101 Impact of Distributed Resource Allocation in Sensor Networks

*Mao Ching Foo and Hock Lim*.

Sensor networks have generated much interest in the research community because they have a wide range of potentially impactful applications. In this field, one of the major research challenges is the distributed resource allocation problem. This problem concerns how one should allocate or schedule the limited resources in a sensor network to minimize costs and maximize capability. Although various distributed resource allocation techniques have been proposed, the impact of such techniques on real application scenarios of sensor networks is not well understood. In this paper, we study the impact of distributed resource allocation in two realistic application scenarios; namely, the tasking of look-sectors for cameras to monitor vehicle movement, and the sensor mode management in an acoustic sensor network to track vehicle movement. Our simulation results for these two scenarios indicate that with distributed resource allocation, a sensor network can provide a good tradeoff between performance objectives such as target tracking accuracy, coverage area, and network lifetime.

## #103 Using a Diversity Scheme to Reduce Energy Consumption in Wireless Sensor Networks

*Vahid Shah-Mansouri, Mohammad Mohammadnia-Avval and Yashar Ghiassi-Farrokhfal.*

In this paper, a new transport layer method is proposed utilizing a diversity scheme to make an end to end communication reliable and consequently reduce power consumption in large scale sensor networks. Sensor networks are composed of large number of battery powered nodes. Energy consumption is the most important design objective in sensor networks while delay and throughput are taken less into account. Wireless transmission is the other important characteristic of these networks. Small-scale fading decreases wireless communication performance. In a fading channel higher SNRs is needed and consequently more energy is consumed. In addition to error occurred because of poor communication node-to-node links are unreliable because of the insatiability of nodes and therefore the corresponding endto-end links are unreliable.In order to overcome the first issue which is poor communication, transport layer methods proposed. For the second problem sensor network routing protocols propose path redundancy in order to guarantee a reliable packet delivery. Path redundancy makes some copies of a packet to receive to destination. This is a type of diversity. We combine these two methods and propose Simple Transport Protocol for Wireless sensor network (STPW) which is a transport layer method to make the end to end communication reliable.

## #104 Vision Based Forced Landing Site Selection System for Autonomous UAV

*Daniel Fitzgerald, Rodney Walker, Duncan Campbell.*

This paper presents a system overview of the UAV forced landing site selection system and the results to date. The forced landing problem is a new field of research for UAVs and this paper will show the machine vision approach taken to address this problem. The results are based on aerial imagery collected from a series of flight trials in a Cessna 172.The aim of this research is to locate candidate landing sites for UAV forced landings, from aerial imagery. Output image frames highlight the algorithm's selected safe landing locations. The algorithms for the problem use image processing techniques and neural networks for the classification problem.The system is capable of locating areas that are large enough to land in and that are free of obstacles 92.3% ± 2% (95% confidence) of the time. These areas identified are then further classified as to their surface type to a classification accuracy of 90% ± 3% (98% confidence). It should be noted that although the system is being designed primarily for the forced landing problem for UAVs, the research can also be applied to forced landings or glider applications for piloted aircraft.

## #106 Combination of RFID and Vision for Mobile Robot Localization

*Heesung Chae and Kyuseo Han.*

This paper illustrates an efficient method for global localization incorporating signal detection from artificial landmark consisted of RFID tags, and for fine localization incorporating feature descriptor derived from a view of scene. The system incorporates a RFID reader on a mobile robot checking the signal from RFID tags to localize the robot with respect to global position. After determining the global position of the robot, the feature matching can be used to checking the local position of it in a predetermined global position. And we propose a successive global-to-fine localization algorithm using RFID tags and feature matching respectively. The experimental results showed the proposed algorithm has improved the localization performance on indoor environments with a mobile robot.

## #107 Information Discovery in Ecological Systems by Artificial Neural Networks: Algal Blooms at Gippsland Lakes

*Neha Khanna, John Smith and Margaret Lech.*

This paper aims to discuss two aspects of working with large ecological data sets; analysis and modelling of ecological data sets, and subdivision of data into smaller subsets for the purpose of analysis and modelling. Different approaches to the information discovery in ecological systems based on Artificial Neural Networks (ANNs) are considered. ANNs are powerful modelling tools. Their strength is derived from their ability to model complex, non-linear relationships. However, a drawback of ANNs is that they cannot distinguish between noise and actual data in a system. Ecological systems are prone to greater noise than many other systems. The solution therefore lies in applying ANNs to ecological problems more creatively. In algal blooms and similar ecological problems the use of ANNs has been primarily limited to the predictive modelling and sensitivity analysis. This paper proposes a multi-stage analysis comprising of predictive function modelling, sensitivity analysis, principal component analysis (PCA) and non-linear principal component analysis (NLPCA). The most common method of data subdivision for training, validating and testing is a method of random or redundant subsets. This method of data subdivision is not always appropriate because ecological systems represent open sets with complex relationships. Ecological data are often incomplete and contaminated by noise. This paper proposes a systematic approach to subdivision of data into training, validating and testing datasets.

## #108 Particle Swarm Optimisers for Cluster formation in Wireless Sensor Networks

*Siddeswara Mayura Guru, Saman Halgamuge and Saman Fernando.*

We describe the results of a performance evaluation of four extensions of Particle Swarm Optimisation (PSO) to reduce energy consumption in wireless sensor networks. Communication distances are an important factor to be reduced in sensor networks. By using clustering in a sensor network we can reduce the total communication distance, thus increasing the life of a network. We adopt a distance based clustering criterion for sensor network optimisation. From PSO perspective, we study the suitability of four different PSO algorithms for our application and propose modifications. An important modification proposed is to use a boundary checking routine for re-initialisation of a particle which moves outside the set boundary.

## #110 Medical Informatics System with Wireless Sensor Network-enabled for Hospitals

*Kok Keong Peter Loh and Allan Lee.*

The inventions and feature-improvements of smaller, more robust wireless, wearable vital sign sensors have made possible the deployment of such devices in a hospital environment setup to assist in managing patients' information. Emergency medical care, triage, and intensive care can all benefit from continuous vital sign monitoring, especially immediate notification of patient deterioration. Sensor data can be integrated into electronic patient care records and retrieved for later analysis. This paper describes the design of a medical informatics system that utilises the benefits of wireless sensor networks. Oracle® Healthcare Transaction Base (HTB) serves as the platform for integration, development and operation in a typical hospital medical informatics system. A workflow engine is proposed to interface between the wireless sensor networks and the HTB. This system will provide the flexibility and expandability to integrate sensor-nodes of different purposes, which are used to collect

patient's vital data; such as heart rate, blood oxygen saturation, electrocardiograph (ECG), motion, and patient location.

## #111 Automatic Ground Control Points Refinement For Remote Sensing Imagery Registration

*Xiuping Jia*.

Several sources of geometric distortion are contained in optical remote sensing images including earth rotation, platform movement, scanning nonlinearity. They result in geometric errors on scene level, image level and pixel level. It is critical to rectify the errors before a thematic map is generated, especially when the remote sensing data need to be integrated together with other GIS data. In this paper, image registration techniques are addressed and an automatic procedure is developed for refining manually selected ground control points. Both feature matching and intensity matching have been taken into account by generating three mapping functions to model the location relationships in two spatial directions and the brightness relationship between the master image and the image to be registered. The new method reduces the dependency on the accuracy of initial manually selected ground control points and improves the spatial correlation of the image. The registration quality is significantly improved. The developed procedure is demonstrated step-by-step using a Landsat ETM+ data set. The experiments showed that the proposed method is effective and easy to implement.

## #113 A New Energy-efficient Clustering Protocol for Wireless Sensor network

*M. P. Singh and M. M. Gore.*

In this paper, we propose an energy-efficient clustering protocol for wireless sensor networks. The wireless sensor network can be represented by virtual groups known as clusters. In comparison with tree-based wireless sensor networks, clustering is an effective technique for prolonging sensor network life, and for load balancing. The proposed protocol runs in a distributed environment. There are two important parameters, namely hold back (t), and number of hops (h) in the proposed algorithm. The proposed protocol forms clusters at a distance of at most h hops from the clusterhead. Every node initializes its hold back value with a randomly generated value. The size of the cluster depends on the value of h. In comparison to Adaptive clustering protocol, the new protocol avoids broadcasting cluster messages unnecessarily. The sensor node with t = 0, becomes the clusterhead and broadcasts a cluster message to form a cluster. In the proposed algorithm, every node does not start broadcasting. The proposed algorithm reelects clusterheads during maintenance phase. Hence, this algorithm adapts to the dynamic nature of the wireless sensor networks. The simulation results demonstrate that the proposed protocol reduces energy consumption.

## #114 Information Fusing Control of the DNA Microinjection Volume Based on Stochastic Fuzzy Neural Network

*Ling Zhang.*

The single-factor controlling accuracy of the DNA microinjection volume by a gaseous-electrical controller is not satisfying by now. A method based on SFNN to fuse controlling factors' information, including injection pressure, time and pipette's size, etc. is presented in this paper, by which the controlling of DNA microinjection volume is improved. The experimental results show that, compared with the single-factor control, the new method is more effective, and less sensitive to the noise in the input parameters' measurement.

## #115 Vision-based SLAM using natural features in indoor environments

*Jaime Valls Miro, Gamini Dissanayake and Weizhen Zhou.*

This paper presents a practical approach to solve the simultaneous localization and mapping (SLAM) problem for autonomous mobile platforms by using natural visual landmarks obtained from an stereoscopic camera. It is an attempt to depart from traditional sensors such as laser rangefinders in order to gain the many benefits of nature-inspired information rich 3D vision sensors. Whilst this makes the system fully observable in that the sensor provide enough information (range and bearing) to compute the full 2D estate of the observed landmarks from a single position, it is also true that depth

information is difficult to rely on, particularly on measurements beyond a few meters (in fact the full 3D estate is observable, but here robot motion is constrained to 2D and only the 2D problem is considered). The work presented here is an attempt to overcome such a drawback by tackling the problem from a partially measurable SLAM perspective in that only landmark bearing from one of the cameras is employed in the fusion estimation. Range information estimates from the stereo pair is only used during map building in the landmark initialization phase in order to provide a reasonably accurate initial estimate. An additional benefit of the approach presented here lies in the data association aspect of SLAM. The availability of powerful feature extraction algorithms from the vision community, such as SIFT, permits a more flexible SLAM implementation separated from feature representation, extraction and matching, essentially carrying out matching with minimal recourse to geometry. Simulation results on real data illustrate the validity of the approach.

## #116 Data loss regulation to ensure information quality in sensor networks

*Andrei Tolstikov, Chen-Khong Tham and Jit Biswas.*

In this paper, we consider a simple model for information loss as data propagates through a sensor network in response to continuous queries. We present an admission control scheme based on bounds placed on data loss probability, for sensors that contribute to aggregate query results. We expect that it will be possible to regulate this probability and thus guarantee the completeness of information obtained from the sensors. Our scheme uses the stochastic model of wireless data channel based on Pareto distribution of total waiting and service time. The parameters of distribution are obtained by measurement. Analyzed the loss of data units due to three reasons: overflow of network buffer, aggregation buffer and due to delay beyond timeout after which intermediate node assumes that the data was lost. Although the admission scheme adds some additional overhead to the sensor network operation, it is still limited to the cases when a new query is disseminated or a query mapping to resources is changing.

## #117 Simultaneous Localization and Mapping in Wireless Sensor Networks

*Subhash Challa, Frank Leipold, Suhrud K Deshpande and Michael Lieu.*

Wireless sensors became smaller and cheaper in the recent years. Applications with thousands of nodes for tracking and monitoring are now feasible. Many of them require the knowledge about the locations of the sensors. The process of localization depends on estimating the position of the features within the environment. This paper proposes a novel algorithm to localize the sensors in any environment. Unlike any other technique like conventional SLAM, this new method does not require any architecture involving non-active beacons or mobile agents, such as robot. The new algorithm is presented that uses the sensors which act as active beacons themselves. The localization uses a least squares estimation (LSE), which processes the measured distances between the sensors. The distance measured was calculated based on received signal strength indicators (RSSI). Experiments were carried out in Mica2 Motes sensor networks. The estimated locations in the experiments were less then one meter away from the true locations which is an error of less than 10% of the transmission range from the sensors.

## #118 Autonomous Control of Multiple UAVs for the Passive

*Sam Drake, Kim Brown, Jeremy Fazackerley, Anthony Finn*

This paper describes an algorithm that has been used for the autonomous control of multiple UAVs tasked with the high level objective of locating a radar subject to a number of real world constraints. The distributed, fully autonomous, cooperative control of the multiple UAV system was executed using sensor input from a heterogenous network of miniaturised Electronic Surveillance (ES) payloads. An ES sensor onboard one UAV detected a radar target and cross-cued ES receivers onboard two other UAVs. Based on the information shared between these UAVs the target radar was approximately located by each UAV. Once the UAVs had coarsely located the target they autonomously, dynamically, and continuously adapted their flight trajectories to progressively improve the accuracy with which they were able to co-operatively locate the radar target. The UAVs were able to accurately locate the radar while simultaneously avoiding no-fly zones, one another and remaining within communication range.

## #119 Incorporating Contextual Audio For An Actively Anxious Smart Home

*Simon Moncrieff, Svetha Venkatesh, Geoff West and Stewart Greenhill*

In this paper we explore an emotive, multi-modal smart house. The smart house is an instance of a monitoring application, inspired by the need to provide semi-autonomous assisted living for elderly and infirm people. A particular aspect of smart environments relevant to the care of the elderly is the detection of potential hazards. A hazardous situation represents an abnormal activity or event. Consequently, to detect abnormality we model normality, that is, the normal activities associated with a user's interaction with the environment. We use the concept of anxiety as a measure of normality modelled with a probabilistic approach. The anxiety is associated with a hazardous device using a fusion of multi-model data. The data is gathered from simple sensors, and from information derived from the audio domain indicating the presence of an activity within the environment. We present the results for the anxiety for a number of activity sequences, both normal and abnormal. The pervasive nature of the audio data enabled the detection of activity when interactions between a user and device didn't occur, successfully preventing false hazardous situations from being detected.

## #123 Virtual Sensors and Their Automotive Applications

*Danil Prokhorov***.**

We1 highlight potential of advanced signal processing algorithms for automotive problems of sensing various hard-to measure quantities. We illustrate virtual sensor capabilities with three examples (misfire detection, torque monitor and sensorless detection of changes in tire pressure).

## #128 Development of Portable Internet Access Module for Sensor Data Collection

*Haifeng Chen and Jungtae Lee.*

Recently, many researches and development activities on sensor node hardware have been done for the sensor networks. Although well designed for general sensor networks, they are often too heavy and complex for simple applications to be used to access distributed sensor nodes separately and directly over internet. This paper aims to address this issue with a novel approach; by developing a simpler internet access module which collects sensor data for simple applications without platforms support. In this scheme, each sensor node can be easily accessed over internet (wired or wireless) by user. This module is very cheap and easy to be built, and a high performance can be achieved by using a hardware TCP/IP chip.

## #129 Multi-Agent Systems on Sensor Networks: A Distributed Reinforcement Learning Approach

*Chen Khong Tham and Jean-Christophe Renaud.*

Implementing a multi-agent system (MAS) on a wireless sensor network comprising sensor-actuator nodes with processing capability enables these nodes to perform tasks in a coordinated manner to achieve some desired system-wide objective. In this paper, several distributed reinforcement learning (DRL) algorithms used in MAS are described. Next, we present our experience and results from the implementation of these DRL algorithms on actual Berkeley motes in terms of communication, computation and energy costs, and speed of convergence to optimal policies. We investigate whether globally optimal or merely locally optimal policies are achieved. Finally, we discuss the trade-offs that are necessary when employing DRL algorithms for coordinated decision-making tasks in resourceconstrained wireless sensor networks.

## #130 An Overview of Wireless Sensor Network Security: Energy-Efficient Attack and Defense

*Y.W. Law.*

The security of wireless sensor networks (WSNs) is a complex issue. While security research of WSNs is progressing at a tremendous pace, and many security techniques have been proposed, no

comprehensive framework has so far emerged that attempts to tie the bits and pieces together to ease the implementors' adoption of the technologies. We answer the challenge by proposing a guidelines according to which WSN security can be implemented in practice.

## #131 Architectures for wireless sensor networks

*S.O. Dulman.*

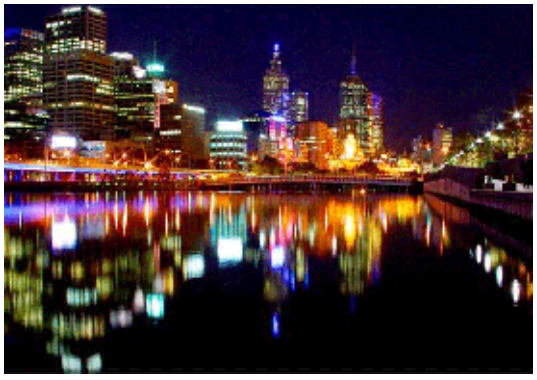
Various architectures have been developed for wireless sensor networks. Many of them leave to the programmer important concepts as the way in which the inter-task communication and dynamic reconfigurations are addressed. In this paper we describe the characteristics of a new architecture we proposed - the data-centric architecture. This architecture offers an easy way of structuring the applications designed for wireless sensor nodes that confers them superior performances.

# ISSNIP 2005 Conference Events

**Conference Inauguration**: The inauguration event will consist of a cocktail party which will be held in the Alto Room on the top most floor of the Langham Hotel. The room sports a magnificent view of Melbourne CBD across the Yarra River. The event will begin at 6.30pm.

**Conference Dinner**: The conference dinner will be held at 7pm on Wednesday, 7th December 2005 at the Melbourne Aquarium. Delegates who are interested in finding their way to the dinner are welcomed to do so. Those who are less adventurous are invited to assemble at the Langham Hotel reception area at precisely 6.45pm. Volunteers will be there to lead you to the dinner where along the way you will enjoy the sights of the Yarra River and walk past the world famous Crown Casino Hotel.

**Conference Closing Ceremony**: The closing ceremony will commence at 5.15pm in the Clarendon Ballroom on Thursday 8th December 2005.



# *Conference Tour*

***Tuesday, December 6th 2005***

Come and see the great sights Melbourne has to offer in a 4.5 hr evening tour of our great city. We will be visiting the following locations

***St Kilda*** – a lively and cosmopolitan area located east of the city of Melbourne bordering on the ocean. Features include the historic sea baths, Luna Park and the Esplanade hotel, commonly known as 'the Espy'. This is where all the top Victorian and interstate music acts play to crowds most nights of the week.

***Lygon St*** – Italian restaurant capital of Australia, good ambience for outdoor dining, and nightly entertainment.

***Southbank*** – a stylish entertainment area which is situated alongside the Yarra River and the spectacular Flinders Street Station. Features many restaurants and bars and thrives on street performers.

***The Shrine*** – Victoria's largest and most visited war memorial, Melbourne's most recognised landmark. Permanent memorial to the Anzacs.

***The CBD*** – features Swanston St walk, Bourke St Mall (biggest MYER in Melbourne), Chinatown (Yum Cha), QV (shopping), Federation Square, IMAX theatre, Royal Botanical Gardens, Rialto.

***South Yarra –*** a trendy and stylish shopping area; famous for its explosive weekend nightlife.

***Toorak –*** features the hottest real estate properties of the city. Come see how the rich & famous live in Melbourne

All this for **$10 AUD**. **50** positions currently available. Bus departs from front of Langham Hotel at **5.30pm**. Dinner of a souvlaki and soft drink will be served during the tour. Note that the tour is open to all ISSNIP and e-Science delegates and hence early registration is a must to ensure a place on the tour. Payments for the tour can be made prior to boarding the bus.

Conference lunches for **student delegates** will be held at Sante Restaurant at Crown Casino between 12:30pm and 2:00pm on Tuesday, Wednesday and Thursday.



Overlooking the Yarra River, Sante is a buffet-style international restaurant featuring Carvery, Mediterranean, Asian and salads selection plus an array of tempting desserts.

Conference delegates will feast on International Food Market Menu. Soft drinks included.

**Western Buffet**
Pasta of the day
Kangaroo Chasseur
Vegetarian Pizza
Poached Mussels in Tomato and Tarragon Salsa
Crumbed Hoki Fish Fillets
Chicken Roast with a variety of sauces
Full range of Western condiments
*1/3 of the Western Buffet changes daily

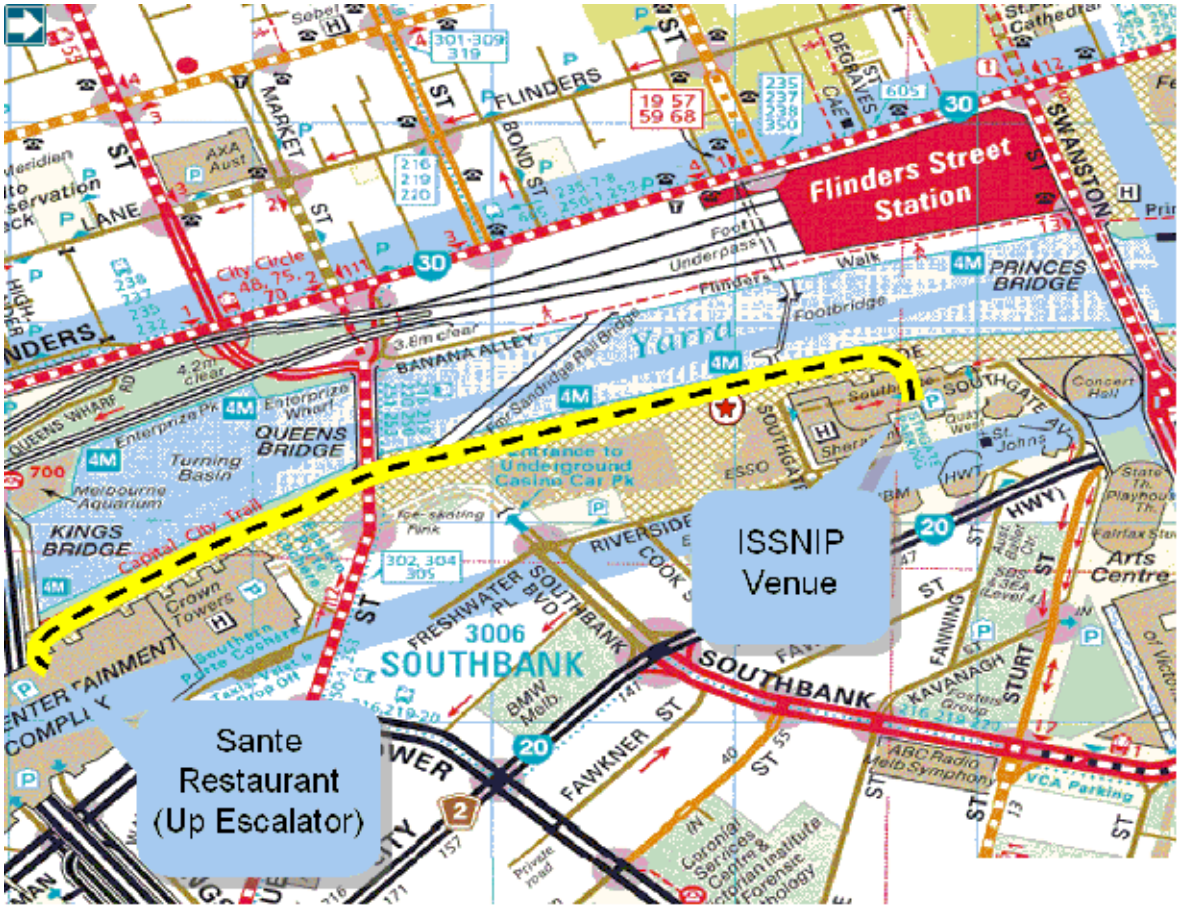
**Asian Buffet**
Spring Rolls
Stir Fried Vegetables
Hokkian Noodles
Steamed Rice
Malaysian Beef Curry
Honey and Sesame Chicken Wings
Choy Sum
Full range of Asian Condiments
*1/3 of the Asian Buffet changes daily

**Salad Buffet**
Coleslaw
Herbed Potato
Mixed Bean Salad
Roma Tomatoes
Cucumber
Mixed Lettuce Salad
Cos Lettuce
Assorted dressing

**Carvery**
Roast Beef
Roast Leg of Pork
Rosemary and Red wine Jus
Roast Potatoes
Fresh Streamed Vegetables
Full Selection of Condiments

**Dessert Buffet**
Pavlova
Chocolate Mousse
Bread and Butter Pudding
Mud Cake
Almondberry Cake
Lemon Meringue Pie
Black Forest
Chocolate Truffle
Pecan Tart
Tiramisu
Carrot Cake
Selections of Fresh Fruit

Location: Level 1, access from retail promenade, escalators or lift access.
Follow the dashed lines from the conference venue to the restaurant. Please remember to present your lunch ticket to be admitted to the buffet. Volunteers will be present to guide you to the restaurant.



# *Student Night*

**Wednesday 7th December 2005**

The organizers of the ISSNIP Melbourne conference encourage all students delegates to participate in the student night events. This night is the perfect way to kick back and cool down after an intensive conference and more importantly an excellent opportunity to connect with other students and researchers in a more laid back setting. The night will be advance as follows

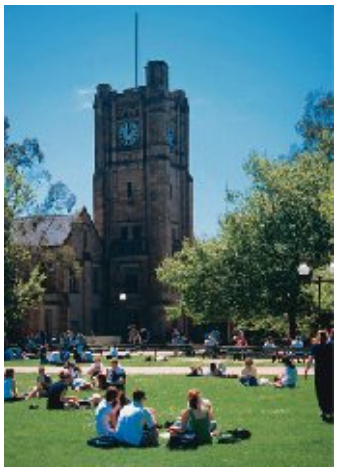
**6:00 – 7:30pm:** Meet us on Melbourne University South Lawn 6:30-7pm for a BBQ the Australian way. Time to converse, eat and enjoy a summer evening on our picturesque campus lawns

**8:00 – 10:00pm:** Follow us by foot to Melbourne Central Hoyts Cinema Complex where we will enjoy the next movie in the Harry Potter series.

Movie Overview : Harry (Daniel Radcliffe) being selected to compete in the prestigious Triwizard Tournament, which pits him against older and more experienced students from Hogwarts and two rival European wizarding schools. Meanwhile, supporters of Harry's nemesis, the evil Lord Voldemort (Ralph Fiennes), send a shockwave of fear throughout the wizard community when their Dark Mark scorches the sky at the Quidditch World Cup, signalling Voldemort's return to power. But for Harry, this is not the only harrowing news causing him anxiety -- he still has yet to find a date for Hogwarts' Yule Ball dance.

**10:00pm and after:** Join us on what the locals call a "pub crawl". Come see some of Melbourne's oldest pubs, listen to some great new rock talent and enjoy fine Australian Beer.

Pubs on the list: Bridie O'Reillys, The Oxford Scholar, Elephant and Wheelbarrow, Naughtons, The Clyde, Pa's and Jimmy Watsons Wine Bar.




Please send all reservations or further queries to Sophia at sophia.kaplantzis@eng.monash.edu.au.

# Third International Conference on Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP 2007)

**July 2-5, 2007**
**Cairns, Australia**

**General Chair**
M Palaniswami, Australia

**Program Committee**
Paul Havinga
Erol Harvey
Arcot Sowmya
Rezaul Begg
Nallasamy Mani
David O'Carroll
David Grayden
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Brijesh Verma
Rezaul Begg
Robert Slaviero
Ravi Kothari
Svetha Venkatesh
Rob Evans

THE UNIVERSITY OF MELBOURNE

The 3rd International Conference on Intelligent Sensors, Sensor Networks and Information Processing – 2007 (**ISSNIP 2007**) will be held in Cairns, Australia during the period of July 2-5, 2007. This conference will be a continuing conference in the series of international Sensor Network conferences in Australia. The conference will focus on both theory and applications of intelligent sensors and smart systems.

Sensor Networks: Topics of interest in this area include modeling of specific sensor networks and sensor arrays, methods for ad hoc deployment, algorithms for sensor localization and tracking of mobile users, energy issues, in-situ calibration methods and so on.

Sensor Fusion and Tracking: Areas of general interest include but are not limited to Multi-sensor fusion, Target detection and tracking, Target recognition, Data association, Sensor registration, Situation assessment, Image or sensor data fusion, Distributed inference and fusion, Sensor tasking and control, Sensor scheduling and optimization.

Intelligent Information Processing: Machine Intelligence methods such as Adaptive Learning and Neural Networks, Support Vector Machines, Genetic algorithms, Hybrid intelligent systems, Multi-agent systems such as reinforcement learning, Intelligent control with possible applications to sensor technology. Other topics of interest include hardware implementations, new coding and compression techniques, new online monitoring and data collection methods.

Paper submission: Prospective authors are invited to submit full papers, up to 6 pages in length, using electronic submission via the conference web site. Papers will be fully refereed and accepted papers will be published in the conference proceedings.

Tutorials/Workshops/Special Sessions: Those who are interested to organize a tutorial, workshop or a special session are invited to send an abstract and title of their proposed session to swami@ee.unimelb.edu.au