

Faculty of Computing Health and Science

Research Unit Annual Report

RESEARCH UNIT NAME: Artificial Intelligence and Optimisation Research Group

RESEARCH UNIT LEVEL (tick):

- | | |
|--|---|
| <input checked="" type="checkbox"/> Level I Research Group | <input type="checkbox"/> Level II Research Centre |
| <input type="checkbox"/> Level III Research Institute | <input type="checkbox"/> Centre of Excellence |

YEAR: 2010

BRIEF OVERVIEW (1-2 paragraphs outlining major activities conducted in past year)

The Artificial Intelligence and Optimisation Research Group (AIORC) brings together researchers with specific interest in the development of applied and basic research involving interdisciplinary concepts from artificial intelligence, optimization and simulation, games and mobile technology, image and signal processing, for creating intelligent solutions in various domains such as computer games, health information technology, resource mining, software engineering, security and biometrics. Together with their collaborators, the members of the group was successful in being awarded 3 new grants, published 3 book chapters, 4 refereed journal papers and 24 refereed conference papers. There were 2 completions, 1 Doctor of Information Technology and 1 Honours. Members of AIORC also have a high level of engagements with their communities, both local and international. Examples include: WAMBOT, with collaborators from University of WA, Flinders University and primary sponsor Thales Australia; BotPrize Competition, Fetal Monitoring via Mobile and AE2 Commander, a project funded by the National Archives of Australia under the Ian Maclean Award and it explores the use of archival documents in an interactive goal-driven 3D computer game.

MEMBERSHIP (Full Title of Researchers, including staff, research students, adjuncts in the past year)

Group Leaders

Associate Professor C. Peng Lam and Associate Professor Philip Hingston

Group Members

Dr Jitian Xiao, Dr Michael Johnstone, Dr Martin Masek, Dr Chang Su Lee, Dr JinSong Leng, Dr Minh Tran

Adjunct Appointments

Dr. Geoff Roy, Mr Robert Whitney, Dr Adrian Boeing, Prof. HuaiZhong Li

PhD

Viv Campbell -- M. Johnstone & G. Roy & C. P. Lam
The processes used by novice programmers

Warren Creemers – P. Hingston & M. Masek

Affective computing

Vinh Dang -- C. P. Lam & C. Lee & S. Law & R. Martins
Feature selection techniques for selecting relevant feature subsets in biological data

Usman Farooq -- C. P. Lam & H. L. Li
Application of Metaheuristic Techniques for Software Testing

Savo Kordic -- C. P. Lam & J. Xiao & H. L. Li
Alarm Management – Silence is Golden

Valerie Maxville -- C. P. Lam & J. Armarego
Strategies for the Intelligent Selection of Components

Dmitry Zatselyapin -- C. P. Lam & M. Masek
Automatic generation of Test Oracles for Web Services

DIT

Jeff Sinclair – P. Hingston & M. Masek
A feedback control system for exergames

Suchira Chaigusin – C. P. Lam & P. Hingston & J. Clayden
An Intelligent Approach for the Prediction of SET50 Index of the Stock Exchange of Thailand (SET)

Tirtha Ranjeet - C. P. Lam & P. Hingston & M. Martin
Investigation and Development of the Optimization Strategies for Automated Red Teaming

Master

Harvey Martin – J. Xiao

Honours

Nicolas Garel – M. Masek & A. Boeing.
Object Identification for Autonomous Mobile Robots

Rohan Anchan – M. Masek & C.P. Lam
Estimating Pulse Wave Velocity based on Audio and Video Data acquired using Mobile Phone Sensors.

David Craggs – M. Johnstone.
An Analysis and Comparison of Predominant Word Sense Disambiguation Algorithms

Robert Thompson – M. Johnstone.
Military Semi-autonomous Course of Action Technology Simulation and Modelling

NEW GRANTS (Identify Funding Body, Value of grant, Years funded, Chief Investigator, collaborators, title)

1. **Lam C. P., Masek M.**, Remote Blood Pressure Monitoring for Preeclampsia – Funding Body: Nortel Networks, Amount: \$25000, 2011

2. Martins, R., Laws, S., Wenk, M., Gupta, V. B., Rodrigues, J., **Lam, C.P.** Discovery and validation of Alzheimer's disease biomarkers in human plasma Funding bodies: NHMRC - \$352524, 2011-2013
3. Dooley, J., **Masek M.**, Cross, D., **Hingston, P.**, Brown, D. Promoting youth mental health using gaming technology: A RTC Study – Funding Body: Healthway, Amount: \$30000, 2010-2011

PUBLICATIONS, REFERRED BOOKS, CHAPTERS, JOURNAL ARTICLES, CONFERENCE PAPERS, REPORTS

Note that publications shown below with a different colour text and * by the authors' names indicate that these publications have also been included in reports from either the e-Health or the e-Agriculture research group.

Refereed Journal Articles

***Leng J.**, Hong T.P. (2010). Mining outliers in correlated subspaces for high dimensional data sets. *Fundament Informaticae*, 99:71–86.

***Leng J.**, Huang Z. (2010). Outliers detection with correlated subspaces for high dimensional datasets. *International Journal of Wavelets, Multiresolution and InformationProcessing*, 9:227–236.

***Leng J.**, Peng C.P. (2010). Reinforcement learning of competitive and cooperative skills in soccer agents. *Applied Soft Computing*, 11:1353–1362.

Cho,C., Park,J., Boeing,A., Hingston,P.F. (2010). "An implementation of a garment-fitting simulation system using laser scanned 3D body data". *Computers in Industry*. 61 (6): 550-558.

Book Chapters

Lam, C. P. (2010). Computational Intelligence for Functional Testing , in *Artificial Intelligence Applications for Improved Software Engineering Development: New Prospects*", Editor (F.Meziane and S. Vadera), pp. 233- 258, IGI Global, Hershey, New York, USA.

Kordic, S., Lam, C. P. , Xiao, J., Li, H., (2010) Patterns Relevant to the Temporal Data-Context of an Alarm of Interest , in *Dynamic and Advanced Data Mining for Progressing Technological Development: Innovations and Systemic Approaches*, Editor (ABM Ali and Yang Xiang), pp. 18-39, IGI Global, Hershey, New York, USA.

Subsorn, P., **Xiao, J.**, Clayden, J. (2010) Forecasting Rubber Production using Intelligent Time Series Analysis to Support Decision Makers, *Decision Support Systems, Advances In*, editor: Ger Devlin, ISBN No.: 978-953-307-069-8, pp43–56, Intech, Rijeka, Croatia.

Refereed Conference Papers

***Sinclair, J., Hingston,P.F., Masek,M.,** Nosaka,K. (2010). Testing an Exergame for Effectiveness and Attractiveness. *International IEEE Consumer Electronics Society's Games Innovation Conference*. Hong Kong. IEEE. 1-8.

- *Huang, Z., **Leng J.** (2010). Analysis of Hu's moment invariants on image scaling and rotation. In Proceedings of the 2nd International Conference on Computer Engineering and Technology, pages 476–480.
- *Huang, Z., **Leng J.** (2010). A novel binarization algorithm for ballistics imaging systems. In Proceedings of the 3rd International Congress on Image and Signal Processing, pages 1287–1291.
- *Huang, Z., **Leng J.** (2010). An online ballistics imaging system for firearm identification. In Proceedings of the 2nd International Conference on Signal Processing Systems, pages 68–72.
- ***Leng, J.** (2010). A novel subspace outlier detection approach in high dimensional data sets. In Proceedings of the 3rd International Conference on Computer and Electrical Engineering, pages 162–165. IEEE Press.
- ***Leng J.**, Huang Z., Li. D. (2010). Analyzing features of cartridge cases for ballistics recognition. In Proceedings of the 14th International Conference on Image Processing, Computer Vision, and Pattern Recognition, pages 720 –725.
- ***Leng J.**, Huang Z., Li. D. (2010). Features extraction and classification of cartridge images for ballistics identification. In Proceedings of the 23rd international conference on Industrial engineering and other applications of applied intelligent systems, IEA/AIE'10, pages 331–340, Berlin, Heidelberg, 2010. Springer-Verlag.
- ***Leng J.**, Huang Z., Li. D. (2010). A novel approach for identifying firearms with ballistic projectile images. In Proceedings of the 14th International Conference on Image Processing, Computer Vision, and Pattern Recognition, pages 774 – 748.
- ***Leng J.**, Lim C.P., Li, J., Li. D., Jain, L.C. (2010). A role-based cognitive architecture for multiagent teaming. In Agent and Multi-agent Technology for Internet and Enterprise Systems, number 289 in Studies in Computational Intelligence, pages 229–255. Springer, Heidelberg.
- ***Leng, J.**, Valli, C., Armstrong, L. (2010) A wrapper-based feature selection for analysis of large data set. In Proceedings of the 3rd International Conference on Computer and Electrical Engineering, pages 166 – 170. IEEE Press.
- Hingston,P.F.**, Preuss,M., Spierling, D. (2010). RedTNet: A Network Model for Strategy Games. IEEE Congress on Evolutionary Computation. Gary Fogel. Barcelona International Convention Centre, Barcelona, Spain. IEEE. 1-9.
- Hingston,P.F.** (2010). A New Design for a Turing Test for Bots. IEEE Symposium on Computational Intelligence and Games. Copenhagen. IEEE. 345-350.
- Creemers,W.**, **Hingston,P.F.** (2010). Hardware Implementation of the Self Assessment Manikin. 7th International Conference on Design & Emotion. Chicago. IIT Institute of Design. 1-10.
- Hingston,P.F.** (2010). Evolving Group Strategies for IPD. IEEE Congress on Evolutionary Computation. Gary Fogel. Barcelona International Convention Centre, Barcelona, Spain. IEEE. 1-7.
- Zeng,F., Decraene,J., Low,M., **Hingston,P.F.**, Wentong,C., Suiping,Z., Chandromahan,M. (2010) Autonomous Bee Colony Optimization for Multi-objective Function. IEEE Congress on Evolutionary Computation. Gary Fogel. Barcelona International Convention Centre, Barcelona, Spain. IEEE. 1-8

Johnstone M.N. (2010). Threat Modelling with Stride and UML. Proceedings of the 8th Australian Information Security Management Conference, Edith Cowan University, Perth Western Australia, 30th November-2nd December 2010.

Campbell, V., Johnstone M.N. (2010). The Significance of Learning Style with respect to Achievement in First Year Programming Students. Proceedings of the 21st Australian Software Engineering Conference (ASWEC 2010), Auckland, New Zealand, 6-9 April 2010.

Laws, S.M., Mondal, A., **Lam, C.P.**, Ames, D., Bush, A.I., Ellis, K. A., Doecke, J., Faux, N.G., Gupta, V., Lui, J. K., Masters, C. L., Rowe, C. C., Szoeka, C., Taddei, K., Villemagne, V. L., Martins, R.N., Analysis of peripheral blood biomarkers: towards the early diagnosis Alzheimer's disease, Alzheimer's Association International Conference for Alzheimer's Disease (ICAD 2010), Honolulu, Hawaii, July 2010.

Masek, M., Boeing, A., Bailey, W. (2010). Critical Infrastructure Protection Risk Modeling with Games Technology. World Computer Congress, Brisbane, Queensland, 20-23 September 2010.

Lee, C. S. (2010). Adaptive T-S type Rough-Fuzzy Inference Systems (ARFIS) for Mobile Robot Navigation," International Conference on Control, Automation and Systems (ICCAS), pp. 403-408, Gyeonggi-do, Korea, Oct 2010.

Xiao, J. (2010). Construction of Similarity Profile of Dynamic Web Documents for Similarity-aware Web Content Management. In the Proceedings of *The IET 3rd International Conference on Wireless, Mobile & Multimedia Networks* (ICWMMN2010), Sept. 26-29, Beijing, China, Page 335-338.

Xiao J., Lu, J., Chin, K. L., Xu J. Yao, J. (2010). Cross-Cultural Learning Challenges And Teaching Strategies For First-Year Asian Students In Australian Universities, Proceedings of the 2nd International Conference on Computer Supported Education (CSEDU2010), Vol. 2, Valencia, Spain, April 7-10, 2010, ISBN: 978-989-674-024-5, pp297-308.

Lu, J., Chin, K. L., Yao, J., Xu J., and **Xiao J.** (2010). Cross-Cultural Education: Learning Methodology and Behaviour Analysis for Asian Students in IT Field of Australian Universities, In the Proceedings of 12th Australasian Computing Education Conference (ACE 2010), Brisbane, Australia, January 2010, Page 117-126.

Egea, K., Lu, J., **Xiao J.**, and Clear T. (2010). ACE2010 Panel: Internationalisation and Cross Cultural Issues in Computing Education, *Proceedings of 12th Australasian Computing Education Conference (ACE 2010)*, Brisbane, Australia, January 2010, Page 25-31.

HIGHER DEGREE BY RESEARCH LOAD (list name of candidate and degree type)

PhD

Viv Campbell, Warren Creemers, Vinh Dang, Usman Farooq, Savo Kordic, Valerie Maxville, Dmitry Zatselyapin

DIT

Jeff Sinclair, Suchira Chaigusin, Tirtha Ranjeet

Master

Harvey Martin

Honours

Nicolas Garel, Rohan Anchan, David Craggs, Robert Thompson

HIGHER DEGREE BY RESEARCH COMPLETIONS (List name, degree, title of thesis)

Panida Subson – Doctor of Information Technology
An Investigation into a Sales and Production Web-Based Forecasting Decision Support System for the Public Agricultural Rubber Industry in Thailand

Nicolas Garel – Bachelor of Computer Science (Honours)
Object Identification for Autonomous Mobile Robots

VISITORS AND COLLABORATIONS (List the organisation's name and short summary of the nature of the collaboration. Separate into local, national and international)

International

TU Dortmund University, Germany – A/Professor Hingston visited TU Dortmund in July, and Mr Daniel Spierling visited ECU from late 2009 to September 2010. Mr Spierling worked on a Red Teaming project funded by DSTO, collaborated with A/Professor Hingston and Dr Mike Preuss (TU Dortmund), and completed a research thesis. A number of publications were planned and the first of these completed, and discussions were held regarding possible joint research proposals.

Nanyang Technological University, Singapore - A/Professor Hingston visited in August, and continues to collaborate on Red Teaming studies.

Prof. H. L. Li, Wenzhou University, China – Worked on Joint grant application (China) in the area of software testing. Prof. Li is also the associate supervisor for two PhD project and have worked with C.P. Lam and J. Xiao in a book chapter published in 2010. Prof Li visited ECU twice in 2010.

COMMUNITY ENGAGEMENT ACTIVITIES AND LINKAGES (Provide a brief overview of any significant activity)

WAMBOT – Fourth place in Multi-Autonomous Ground-robotic International Challenge

Researchers from ECU, in collaboration with the University of WA, Flinders University and primary sponsor Thales Australia, have won fourth place in the Multi-Autonomous Ground-robotic International Challenge, a multi-million dollar competition run by the Australian Defence Science and Technology Organisation (DSTO) and the US Department of Defence. The aim of this international competition is to attract the most innovative solutions from around the world to address a technology gap faced by coalition forces operating in urban combat zones. The *Western Australian MAGIC 2010 Robotics Team* or WAMBOT was the only Australian team shortlisted for the finals. The ECU team members are Dr Adrian Boeing, Dr. Martin Masek, Dr ChangSu Lee and Nicolas Garel (Honours Student).

BotPrize Competition - The BotPrize contest challenges programmers to create a software "bot" to control a game character that can pass for human, as judged by a panel of experts. The contest has run in Copenhagen (2010), attracting 10-20 international teams and a great deal of interest in the games programming community world-wide.

Fetal Monitoring via Mobile Phone - This project is funded by Microsoft Research. Our project partner is Mercy Hospital Mount Lawley and portable monitoring equipment has been generously provided by Arjo-Huntleigh Healthcare. The developed prototype incorporates elements from mobile technologies, signal processing and software development for the management of pregnancies at risk

that requires regular monitoring of the fetal heart rate. Completion of hospital trials to demonstrate that fetal heart rate can be obtained successfully by mothers using the developed prototype was carried out with the help of our partners in Mercy Hospital Mount Lawley.

AE2 Commander – Funded by the National Archives of Australia under the Ian Maclean Award, this project explores the use of archival documents in an interactive goal-driven 3D experience (also known as a computer game). The topic for this project was chosen as the mission of the Australian WW1 submarine AE2 to penetrate the Dardanelles strait. Development on the game and website spanned 2010, with data collection and release of the game on the 17th April 2011. Engagement with the community included:

- Public lecture on the project, 12th May 2010 at the ECU Library, Mount Lawley.
- Invited lecture, 23rd June 2010, R U Game?: Games and Public Libraries, State Library of New South Wales.

FUTURE PLANS AND DIRECTION (Provide an overview)

The goals for this group in the next 3 years will be:

- Explore opportunities with various research groups within the School, Faculty and University, especially in the areas identified to have an emerging synergy. Examples include the health and security areas with AIORC, with some members starting to work in projects related to these domains.
- Remain focused on building on our existing core research capabilities in artificial intelligence, optimization, simulation, and/or software development.
- Develop research partnerships with Government agencies and ICT industry. These include agencies like DSTO, CSIRO and companies like Thales Australia and Raytheon.
- Build the number of Postgraduate research students.
- Build capacity and momentum by expanding the group's national and international linkages via identified projects of mutual interest. In the case of Computer-based Red Teaming, the group will:
 - o Grow existing national and international collaboration with research teams in Singapore (DSO and Nanyang University) and Germany (TU Dortmund)
 - o recruiting and training research students (presently one DIT student is in progress, 2 Honours student and a new PhD student to commence in Semester 2, 2011)
 - o seeking collaboration and funding with DSTO, following an initial project that was completed in April 2010.
- Explore Grant opportunities and build capabilities (and track record) to support submissions of Category 1 grant applications.

DATE OF NEXT FORMAL REVIEW