

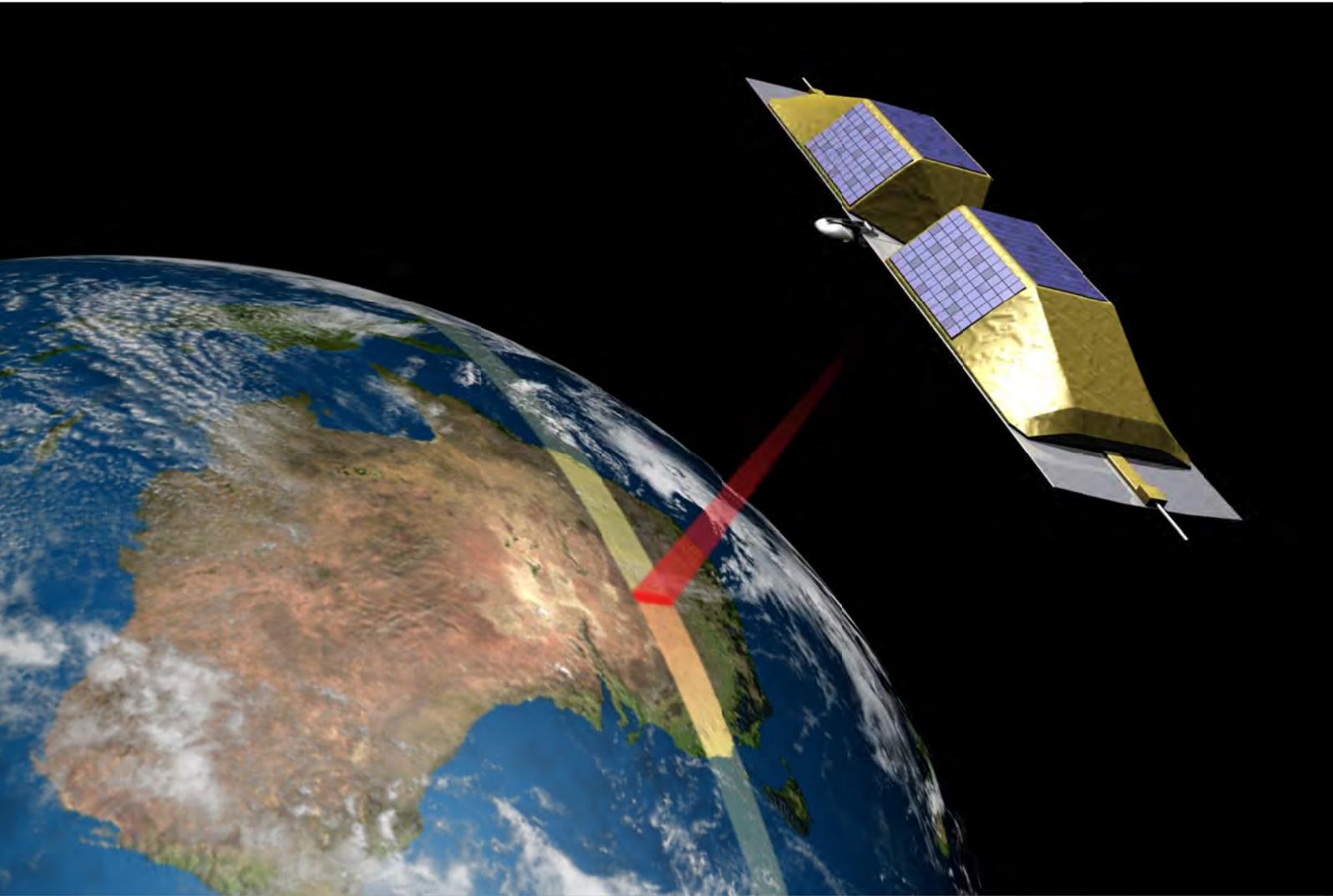


Australian Centre for Space Engineering Research (ACSER) ANNUAL REPORT 2013

Never Stand Still

Faculty of Engineering

School of Electrical Engineering & Telecommunications





Cover picture: Artist's impression of a single Garada SAR Formation Flying Satellite tracing its reflectometry path across the Australian continent.

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AUSTRALIA

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1. Director's Report

This is the third Australian Centre for Space Engineering Research (ACSER) annual report, covering our third full calendar year of operation, 2013.

The year promised to be one of highs and lows, and so it was. The lows were expected and somewhat unavoidable, but the highs proved in some cases to be spectacular.

ACSER's main achievements in 2013 were the successful completion of the Garada "SAR Formation Flying" and the Warrawal "Comprehensive Tertiary Education Program in Satellite Systems Engineering" projects funded by the Australian Space Research Program (ASRP). The final deliverables for Garada were a 1300 page technical report describing phase 0 of an L-band Synthetic Aperture Radar (SAR) satellite mission to deliver a 10m resolution soil moisture map of Australia every three days, and an implementation report that showed how easy it would be for such a system to pay for itself. The Warrawal project delivered the new Masters program in Satellite Systems Engineering and completed the BLUEsat craft for stratospheric balloon launch.

With the end of these large projects, it was inevitable that the centre would contract, and the staff who left the centre as a result were; Steven Tsitas, Jinghui Wu, Gordon Roesler, Mauro Grassi, James Carrapetta, and Stanija Buvac. Mazher Choudhury and Kegen Yu moved to Civil Engineering. Recruits did not balance these losses. From Civil Engineering, Eamonn Glennon formally joined the centre and a new administrator was appointed, Cheryl Brown. Lily Qiao, Joon Wayn Cheong, Ediz Cetin and Barnaby Osborne remained with the centre, as did Nagaraj Shivaramaiah, at least until January 2014.

Four GPS receivers were delivered to BAE Systems, thence to DSTO and onward to the US Air Force Research Laboratory under the Biarri project. The receivers will fly on a constellation of CubeSats used to support space situational awareness research.

The QB50 satellite passed its Preliminary Design Review and entered the Critical Design Review at year's end. All of the experimental payloads made good progress.

The SMiLE experiment will fly on the International Space Station and examine droplet formation in microgravity. It is also approaching Critical Design Review.

The highest profile activity of 2013 was undoubtedly the Off-Earth Mining Forum, the first event of its type in the world. It created a media storm, including live interviews on BBC radio, slots on syndicated radio across the US, items in the Times of India, coverage by all local television stations. It created significant momentum for ACSER to lead in this exciting new research area which engages multiple Engineering Schools and multiple Faculties. An ARC Centre of Excellence bid was led by ACSER with off-earth mining at its core, and several internal and international collaborations



Prof. Andrew Dempster, ACSER Director, at the 2013 Space Industry Forum hosted by ACSER at UNSW Kensington, 14/11/2013.

were initiated. The highlight of the Forum was a public lecture on the Curiosity rover on Mars that oversubscribed the 1000 seat Clancy Theatre by Deputy Director of NASA Jet Propulsion Laboratory (JPL), Rene Fradet.

Physical space remains a challenge for the centre. To make shunt space for the School of Mechanical & Manufacturing Engineering whilst their building is undergoing renovation, we moved from the fourth floor to the first floor of G17, with the associated re-cabling from rooftop antennas. Two further moves are envisaged before the centre can settle: out of G17 to be renovated, then back into the renovated premises by 2016.

2014 presents new challenges: to stabilise the size of the team, to deliver QB50, to see Biarri and BLUEsat launched, and to re-launch the world-renowned Satellite Navigation and Positioning (SNAP) Laboratory as a collaboration with the School of Civil and Environmental Engineering.



Professor Andrew Dempster

Director

Australian Centre for Space Engineering Research



Left-Right: Dr Bamaby Osborne (ACSER), Ali Göktoğan (USyd), Laurent Sibille (NASA) A/Prof Serkan Saydam (ACSER), Dr Gordon Roesler (ACSER), Rene Fradet (NASA), A/Prof Leonhard Bernold (UNSW), Dr Behrokh Khoshnevis (USC), Prof. Andrew Dempster (ACSER), Dr Kris Zacny (Honeybee Robotics) at the 2013 "Curiosity On Mars" talk by René Fradet in Clancy Auditorium, hosted by ACSER at UNSW Kensington, 21/02/2013.

2. About ACSER

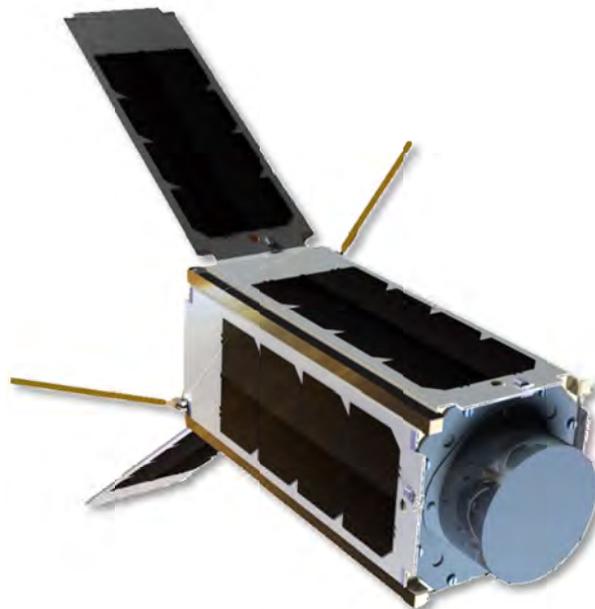
The Australian Centre for Space Engineering Research (ACSER) was launched at the University of New South Wales on the 22 November 2010 by former astronaut Dr. Jan Davis. The centre aims to establish UNSW as a significant player in increasing Australia's capabilities in space.

The centre draws on the huge expertise of Australia's largest Engineering faculty. ACSER resides in the School of Electrical and Telecommunications Engineering in the Faculty of Engineering at UNSW and interacts with most of the Schools in that Faculty: Mining Engineering, Mechanical and Manufacturing Engineering, Computer Science and Engineering, Civil and Environmental Engineering, as well as the Engineering and Information Technology School of UNSW Canberra. Collaborations have been developed with the Faculties of Science, Business, Law, and Arts and Social Sciences. Future opportunities are being examined with Photovoltaic and Renewable Energy Engineering and Chemical Engineering.

Current projects include the QB50 CubeSat program, where 50 CubeSats are being developed around the world for ionospheric monitoring and also to carry payloads for the individual satellite developers. The Biarri project will carry ACSER GPS receivers on its cubesat constellation led by the US Air Force Research Laboratory. The new Masters in Satellite Systems Engineering has begun enrolling students.

ACSER regularly organises workshops and seminars on a range of space-related topics of interest to the wider space community. In 2013, ACSER hosted the world's first Off-Earth Mining Forum, co-hosted the Australian Space Science Conference, hosted three external workshops, as well as several internal to UNSW.

The year ahead offers many opportunities and challenges, including delivery of outcomes in several projects, the relaunch of the SNAP Lab, and new research funding initiatives.



*Artist's
impression of
the UNSW QB50
ECO CubeSat
satellite.*

3. ACSER Objectives

Vision

To provide national leadership for Australian space engineering research.

Purpose

To develop space capabilities relevant to Australia's needs through research, innovation and education.



René Fradet presents "Curiosity On Mars" talk in a booked-out Clancy Auditorium, hosted by ACSER at UNSW Kensington, 21/02/2013.

4. ACSER Strategy

ACSER Strategy

Our Vision

To provide national leadership for Australian space engineering research.

To foster collaborations between researchers, industry and government and to nurture links between our national and international partners to achieve Australia's space ambitions.

In pursuing the vision, ACSER upholds the principles underpinning its foundation.

- Advance Australia's space aspirations
- Enhance the reputation of UNSW
- Promote collaboration between the schools, faculties and campuses of UNSW

Our Purpose

To develop space capabilities relevant to Australia's needs through research, innovation and education.

Engage the Community

Promote collaborations between ACSER, groups with space capabilities and the Australian market for space services, technologies and expertise.

Ensure Market Suitability

Pursue programs and activities that fit the needs, expectations and constraints of the domestic and international space markets.

Pursue Excellence & Innovation

Create and transfer new knowledge in space capabilities, technologies and applications

Educate

Raise Australian awareness of issues and developments in space, and educate a new generation of space professionals.

Capabilities

- Enable access to facilities for ACSER collaborators.
- Strengthen the ACSER expertise base through strategic recruitment and post-graduate education.

Resources

Develop a funding and operational model that guarantees ACSER's long-term viability.

5. ACSER Committees

Management Committee

Responsible for ensuring the objectives of the Centre are pursued and implemented.

This Committee is comprised of internal UNSW executive as listed below. Due to the dissolution of the School of Surveying & Geospatial Engineering (SAGE) at the end of 2012 and the transition of ACSER to the School of Electrical Engineering & Telecommunications (EET) in 2013, both the former Head of School of SAGE and the Head of School of EET sat on the Management Committee in 2013.



Professor Andrew Dempster is Director of the Australian Centre for Space Engineering Research (ACSER) at the University of New South Wales (UNSW). He is also Director of Research in the School of Surveying and Spatial Information Systems and Director of Postgraduate Research in the Faculty of Engineering. He has a BE and MEngSc from UNSW and a PhD from University of Cambridge in efficient circuits for signal processing arithmetic.

Andrew was system engineer and project manager for the first GPS receiver developed in Australia in the late 80s and has been involved in satellite navigation ever since. He is leading the development of space engineering research at ACSER.



Professor Graham Davies is the Dean of Engineering at the University of New South Wales. Until April 2008 he was the Sir James Timmins Chance Professor of Engineering at the University of Birmingham and executive head of the School of Engineering. He trained as a chemical physicist at the University of Wales, where he completed his doctoral studies.

He is a Fellow of the Royal Academy of Engineering, The Institution of Engineers Australia (FIEAust), the Institution of Electrical Engineers, the Institute of Physics and IoM3. In 2008 and in 2009 he was named as one of the top 100 most influential scientists and engineers in Australia.



Professor Merlin Crossley is the Dean of Science at the University of New South Wales. He completed his BSc degree at the University of Melbourne, majoring in genetics and microbiology. He moved to Oxford University supported by a Rhodes Scholarship to pursue his doctorate, and then did post-doctoral research at Oxford and at Harvard Medical School. He returned to Australia in 1995 and held various positions at the University of Sydney, including Professor of Molecular Genetics 2005-9, Acting Dean of Science 2004, Director of Research for the College of Sciences and Technology 2005, and was Acting Deputy Vice-Chancellor Research 2006-8. At the end of 2009 he moved to UNSW to take up the position of Dean of Science.



Professor Michael Frater is the Rector of the University College of the University of New South Wales at the Australian Defence Force Academy. Previous leadership roles include Head of the School of Engineering & Information Technology (2009-2010), Head of the School of Information Technology and Electrical Engineering (2007-9), and Presiding Member of the University College Academic Board (2006-7).

Michael Frater holds bachelor degrees in electrical engineering and science from the University of Sydney, a Masters in Higher Education from the University of New South Wales and a Doctor of Philosophy in systems engineering from the Australian National University.



Professor Chris Rizos is currently Head of the School of Surveying & Spatial Information Systems at the University of New South Wales, Sydney, Australia. Chris has been researching the technology and applications of GPS since 1985, and established over a decade ago the Satellite Navigation and Positioning group at UNSW, today the largest academic GPS/GNSS and wireless location technology research laboratory in Australia.

Chris is the President of the International Association of Geodesy (IAG), and a member of the Executive and Governing Board of the International GNSS Service (IGS). Chris is currently Chair of the working group developing the strategic plan for GNSS for Australia.



Professor Eliathamby Ambikairajah is Head of School of Electrical Engineering and Telecommunications, University of New South Wales (UNSW), Australia. Professor Ambikairajah's research interests include speech enhancement, speaker recognition, language recognition, emotion detection and biomedical signal processing. He has authored and co-authored more than 250 conference and journal papers, and is also a regular reviewer for several IEEE, IET and other journals and conferences. He was the Technical Program Co-Chair for the inaugural APSIPA Summit and Conference in 2010. For his contributions to speaker recognition research, he was invited as a Visiting Scientist to the Institute of Infocomms Research (A*STAR), Singapore in 2009, where he is currently a Faculty Associate.

He received his BSc(Eng) degree from the University of Sri Lanka and received his PhD degree in Signal Processing from Keele University, UK. He was appointed as Head of Electronic Engineering and later Dean of Engineering at the Athlone Institute of Technology in the Republic of Ireland from 1982 to 1999. His key publications led to his repeated appointment as a short-term Invited Research Fellow with the British Telecom Laboratories, U.K., for ten years from 1989 to 1999.

Professor Ambikairajah received the Vice-Chancellor's Award for Teaching Excellence in 2004 for his innovative use of educational technology, the School Awards for Teaching Excellence in 2003, and Academic Management in 2001. He is a currently an APSIPA Distinguished Lecturer for the 2013-14 term. He is a Fellow and a Chartered Engineer of the IET UK and Engineers Australia and is a Member of the IEEE and APSIPA.

Two Management Committee Meetings were held in 2013. Following are the dates and attendees:

5th Management Committee Meeting

12th March 2013

Present:

Prof Merlin Crossley (Chair)
Prof Andrew Dempster (Director)
Prof Graham Davies
Prof Michael Frater
Prof Chris Rizos
Prof Eliathamby Ambikairajah

6th Management Committee Meeting

26th November 2013

Present:

Prof Andrew Dempster (Director)
Prof Graham Davies (acting chair)
Prof Michael Frater
Prof Eliathamby Ambikairajah

Advisory Committee

Responsible for providing feedback on the strategy and direction of the Centre.

This Committee is comprised of the following internal UNSW executive and external industry members:



Brett Biddington operates a consultancy business which focuses on space matters. Previously he was employed by Cisco Systems, where he worked in a small team which had been formed to transform global space communications by placing internetworking technologies in space. He is actively involved in the Australian space community including the national security, space science, astronomy and education sectors.

Before joining Cisco, he served for 23 years in the Royal Australian Air Force occupying a range of intelligence, security and capability development appointments. Brett is Chair of the Space Industry Association of Australia and a member of the Australian Government's Space Industry Innovation Council. He has written two reports (second with Roy Sach) for the Kokoda Foundation about Australian space policy.



Dr Anthony Lindsay joined the Australian Defence Science and Technology Organisation in 1988. His research was in the areas of communications and non-communications electronic warfare (EW). He has led international collaboration with the UK and has led major collaborative efforts with the US on the NULKA anti-ship missile decoy program and Project Arrangement 10 – Aircraft Survivability (the latter being the largest-ever PA undertaken between the two Nations).

From 2000 to 2005 he was Research Leader, Air Electronic Warfare, in Electronic Warfare and Radar Division, DSTO. In this position he was responsible for managing and coordinating all DSTO R&D and operational support in airborne non-communications EW for the Royal Australian Air Force.

From December 2005 until February 2008 he held the diplomatic post of Counsellor, Defence Science at the Australian Embassy in Washington, after which he returned to Australia on promotion to his current position as Chief of the Intelligence, Surveillance and Reconnaissance Division of DSTO.



Donna Lawler is a commercial satellite lawyer for Optus and a member of the International Institute of Space Lawyers. After completing an Arts/Law degree at UNSW she worked at a number of major law firms in Australia and overseas, specialising in Technology and Communications Law. She has provided legal advice on all aspects of the Optus Satellite business since joining Optus in 1999, and has had key involvement in the build and launch programmes for six satellites, including the negotiation of satellite purchase and launch contracts on behalf of Optus and its parent company SingTel.

During more than a decade in the satellite industry, Donna has secured the use of orbital slots, advised on risk, liability and insurance issues for space-related projects and negotiated satellite capacity contracts with Australian broadcasters, international satellite operators and government entities, including the NBN. She has published papers on Space Law topics and is a regular guest lecturer in Space Law at a number of Universities in Australia and overseas.



Mark Gauci is Director, Business Development at the Faculty of Engineering, UNSW. Mark is responsible for implementing the faculty Community Engagement Strategy, with a specific goal of improving links with business.

Prior to joining UNSW Mark was CEO of BTF-bioMérieux, an Australian biologicals manufacturing company that is part of the global microbiology diagnostics group bioMérieux S.A. group (based in Lyon, France). Mark was the founding CEO of BTF-bioMérieux and led its development from Macquarie University spin-out, through to operating as a wholly owned subsidiary of bioMérieux over approximately 10 years.

Prior to forming BTF Mark worked as researcher at Macquarie University in the application of lasers in biological sciences for 6 years.



Stephen Ward has worked in the area of international coordination of space programmes, global environment and climate change since 1990. He first worked in Europe for the consultancy 'Smith System Engineering' in support of study assignments for a broad range of clients world-wide. These include; British National Space Centre, European Commission, European Space Agency, European Environment Agency, Mitsubishi Corporation, and the National Space Development Agency of Japan. Through this work he developed a broad understanding of a range of sectors related to Earth observation and climate – including the co-operation processes behind the planning of future programmes (through bodies such as CEOS – The Committee on Earth Observation Satellites, UNFCCC, IGOS, WMO, UNEP and others).

He is extremely well connected with the relevant major actors in government internationally having worked at senior-levels as trusted consultant to agencies in UK, Europe, USA, China, Japan, South Africa, and Thailand, with a 'can-do' reputation amongst these communities for mobilising people, meetings and documents into processes and outcomes that fulfil government policies and programmes.

In 2000, he founded his own consulting companies – Symbios Spazio and Symbios Communications - and has since been based in Sydney, Australia. From there he continues to support a range of clients world-wide in space policy studies and space-related projects, including: British National Space Centre, Council for Scientific and Industrial Research, South Africa, European Space Agency, Itochu Corporation, Japan Aerospace Exploration Agency, Ministry of Science and Technology of China and United States Geological Survey, USA. He is the author of *The Earth Observation Handbook* published by the European Space Agency.



Before **Dr Laurent Rivory** was appointed as Director, Research Strategy Office at UNSW, he held the position of Senior Director of Research and Development for six years at Johnson & Johnson Research. In this capacity, he led a number of drug-development and drug-discovery projects, in the fields of virology, cancer, diagnostics, RNA therapeutics and ophthalmology. From 2005 to 2006, Laurent was a member of the Johnson & Johnson DC Ophthalmology Task Force.

Prior to his involvement in the pharmaceutical industry, Laurent was a successful research leader in the field of cancer pharmacology. From 1997 to 2005, he served as Head of the Cancer Pharmacology Laboratory of the Sydney Cancer Centre, at the Royal Prince Alfred Hospital.

Laurent is a graduate of the Australian Institute of Company Directors (AICD) and carried out his post-doctoral studies as an INSERM-NHMRC Fellow in Bordeaux, on aspects of the pharmacology of the cancer drug irinotecan, which is now known as Camptosar®. He has consulted for pharmaceutical companies and government regulatory bodies, including the Therapeutic Goods Administration (TGA) and is a past member of the TGA's Pharmaceutical Sub-Committee.

In 2013 two Advisory Committee Meetings were held. Following are the dates and attendees:

5th Advisory Committee Meeting

27th February 2013

Present:

Mr Brett Biddington (Chair)
Prof Andrew Dempster (Director)
Dr Tim Payne (on behalf of Tony Lindsay)
Dr Laurent Rivory
Mr Stephen Ward
Ms Donna Lawler

6th Advisory Committee Meeting

27th August 2013

Present:

Mr Brett Biddington (Chair)
Prof Andrew Dempster (Director)
Dr Anthony Lindsay
Dr Laurent Rivory
Mr Stephen Ward
Prof Chris Rizos
Mr Mark Gauci
Prof Michael Frater

6. YEAR IN REVIEW: Projects

Garada – SAR Formation Flying Project

Garada “SAR Formation Flying” was a 2½ year project funded by the Australian Space Research Program evaluating synthetic aperture radar (SAR) spacecraft to address Australian Earth observation needs, and to advance the use of Global Navigation Satellite Systems (GNSS) for space applications. UNSW led the project, which was the catalyst for the formation of ACSER, which managed it. Partners were Curtin University of Technology, BAE Systems Australia, EADS Astrium (UK), TU Delft (Netherlands) and General Dynamics (NZ).

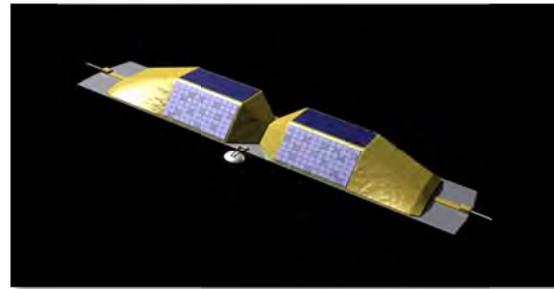
SAR was found to be highly feasible for measuring critical Australian environmental parameters. The satellite and sensor design are highly suitable for measuring soil moisture, flooding, and forest change. Other measurements, such as interferometry, coherent change detection, medium resolution radar imaging, and maritime surveillance would be available.

Three space-ready GNSS receivers were developed. One passed extensive functional and environmental tests and was sent to the US Air Force for integration into its Biarri satellites. Partners were BAE Systems and the Defence Science and Technology Organisation (DSTO).

Extensive interviews led to the soil moisture application, which provided sufficient specificity of requirements to allow design to progress, and also meant most other applications were also feasible. A User Advisory Group, consisting of experts in soil moisture measurement, SAR operation and calibration provided detailed user requirements. Using best aerospace engineering practices, over 1,000 requirements were identified,



Garada Project, Potential Formation for Flood Monitoring



Artist's impression of the Garada satellite.

translating user requirements into system, space segment and ground segment functional performance.

The required sensor characteristics, number of spacecraft, and orbital geometry followed from those requirements. The mission baseline has two spacecraft in the same orbit, one-half orbit apart, each carrying a large SAR. A unique structure enables safe launch of the very large radar, precise planarity, and adequate volume for subsystems. Computer simulation of the structure at launch showed stresses and deflections within required limits. Special antenna elements were designed to enable precise control of the radar signal polarisation. The spacecraft's mission would not be severely limited by thermal considerations.

Sensing the Earth's surface using reflected GNSS signals was also investigated, using receivers on the UNSW aircraft. The orbit configuration provides a complete soil moisture map of all of Australia every three days, a much higher update rate than for any current or future soil moisture satellite. A wide range of users would be able to access timely soil moisture data.

It was found that over 200 Australian companies had the potential to contribute to such a program in hardware, software, management or support roles. A plan was developed to leverage a satellite procurement program to enhance Australian skills and capabilities.

The program produced a complete functional specification, system architecture, and implementation study for the system ground segment. Various locations on the Australian continent were examined, as well as a hypothetical Antarctic station.

QB50

QB50 is a network 50 CubeSats that will be launched together in the first half of 2015 into a 'string-of-pearls' configuration in a circular orbit in LEO (320-380 km), at a high inclination (79 degrees). These CubeSats will comprise a mix of atmospheric double CubeSats and double or triple CubeSats for science and technology demonstration. UNSW has successfully applied to design, build and supply one of the atmospheric double CubeSats, UNSW EC0. In addition to the customer supplied atmospheric science payload, the UNSW design will incorporate three additional payload boards and a novel rapid manufactured satellite structure. The payloads are a new space GPS board developed at UNSW, a systems computer board running sel4, a microkernel operating system developed by NICTA and a FPGA based systems computer board. These payloads will allow the investigation of two GPS based remote sensing techniques, radio occultation and GPS reflectometry, as well as demonstration of a variety of error correcting and fault tolerant algorithms on the systems computer boards.



Dr Barnaby Osborne presenting the 3D-printed QB50 rapid prototype at the QB50 Workshop, UNSW Kensington, 29/11/2013

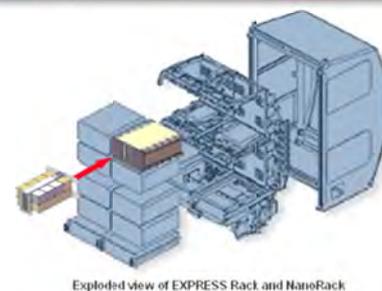
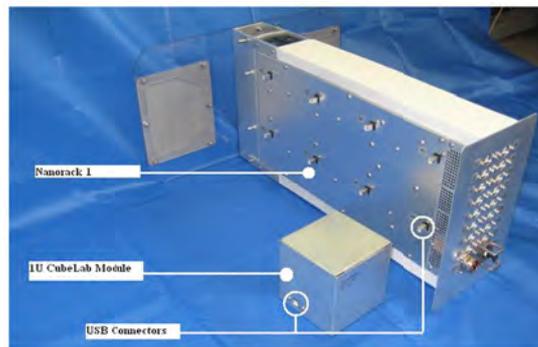
During 2013 the UNSW QB50 project completed the Preliminary Design Review milestone and the Critical Design Review was submitted. The CubeSat design reached a detailed level of definition, and procurement of long lead-time items and new technologies got underway. The team is now well established in their roles, and there is a good coverage of required skills. All up there are 28 UNSW and NICTA personnel working on the project. There has been \$252,000 of cash committed to the project, and this has leveraged a further \$464,000 of in-kind contribution through labour and technology development.



Artist's impression of the QB50: This image, by PhD student Jendi Kepple, has been used by UNSW in advertising and by the QB50 consortium on its home page.

SMILE

This project aims to carry out an experimental investigation into the dynamics of droplet production in a reduced gravity environment onboard the International Space Station (ISS). The experiment has been designed to interface with and occupy a 1U (11cm x 10cm x 10cm) slot in the nano labs rack provided by NanoRacks. The investigation will focus on clearly identifying the dynamics of a newly identified drop formation process present in reduced gravity environments (akin to a dripping tap in reduced gravity). The experiment comprises a flow chamber (where the drops are formed and observed), a syringe pump to provide the flow, two control valves, two USB cameras and a microcontroller. The assembly is housed in a rotating drum, allowing the system to be spun and introducing a centrifugal force to separate the fluid from the air in the flow chamber. Flow rate control allows adjustment of fluidic parameters such as Reynolds and Weber number. Cameras monitor the fluid flow into the chamber and provide the principle data output. Outcomes from this investigation will be the experimental identification of the measure of the chaos present in this system and a refinement of the understanding of the transitions into and out of this flow regime. Applications of this work are relevant to industries that rely on drop on demand processes such as ink-jet, PCB, flexible electronics and genome printing.



Exploded view of EXPRESS Rack and NanoRack

There are two partner organisations key to this project; 1. The International Space University (ISU) in France and 2. NanoRacks in the US. From these institutions this project has a current team of four academics, one researcher and two undergraduates. However, this project has been running for the past 5 years and has had the prior contribution of three other academics, 2 researchers and 17 undergraduates over this time. Throughout the duration, the project has attracted \$110,000 in real terms leveraging approximately a further \$255,000 in in-kind contributions.

In 2013 the experiment reached an advanced level of maturity and the team began preparing for critical design review.

In 2014 the novel aspects of the experiment will be prototyped in the lab and a functional engineering model assembled. The launch contract is being reviewed by Nanoracks and ISU with the next step being the inclusion of the experiment on the register of supported experiments on the launch manifest. The project is aiming for a Q1 2015 handover of flight hardware for an expected Q2/Q3 2015 launch and operations.

Right:
Location of NanoRacks nano labs rack on the International Space Station (ISS)
Inset: NASA astronaut Shannon Walker, extracting lab racks on the ISS



Warrawal

The Warrawal project was led by Dr Elias Aboutanios and comprised a consortium consisting of UNSW, Thales-Alenia Space, Optus, and ISAE. The project established Australia's first comprehensive Masters' Program in Satellite Systems Engineering and completed the BLUEsat satellite and prepared it for a stratospheric balloon launch. These major work-packages were completed in June 2013.

The program was put to the Engineering Faculty Education Committee as a stream of the Masters of Engineering Science Extension (8539) program. This required a change of the structure from the original ASRP proposal. It was approved and launched in April 2013 and opened for admission applications for semester 1, 2014. In addition to the stream, a number of new courses were developed and other courses were developed or reformatted to fit the masters. These were also put through the approval process. An advertising budget for the program has been approved to promote it and achieve the target number of enrolments for sustainability.

The BLUEsat work-package was also completed on time and the satellite demonstrated at the closing Warrawal project meeting. The satellite has been developed for a balloon launch mission to an altitude of 35 to 40km. The balloon launch eliminates the need for certain components like solar panels. The mission will last for approximately 12 hours, during which a number of experiments will be carried out. The satellite will then be recovered and the effects of the launch and near space environments studied.

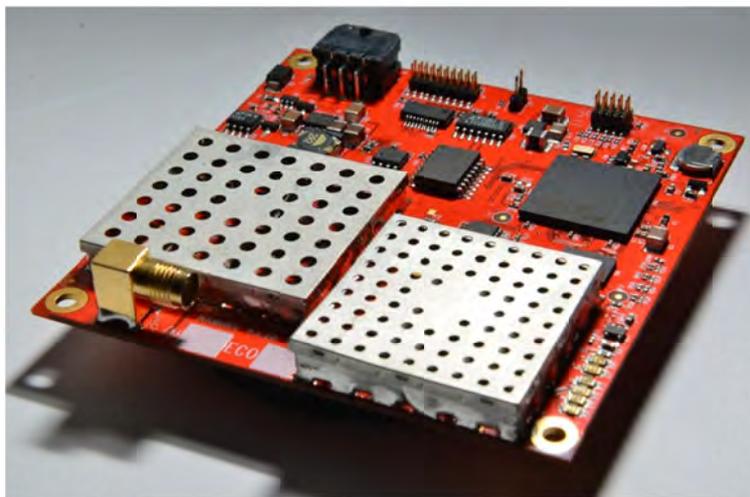


At the launch of the Australian Satellite Utilisation Policy, Dr Elias Aboutanios shows Assistant Innovation Minister, Kate Lundy, a CubeSat development workstation. Several of these are now installed in Room 217 of the Electrical Engineering Building

Biarri

The Biarri program represents the first serious application of GPS technology that has been under development at UNSW and its partners for over a decade. The project required the delivery of four Global Positioning System receivers to Defence Science and Technology Organisation's (DSTO) Intelligence, Surveillance and Reconnaissance Division (ISRD) for integration into three Boeing Colony-2 3U (shoebox sized) CubeSat spacecraft at the US

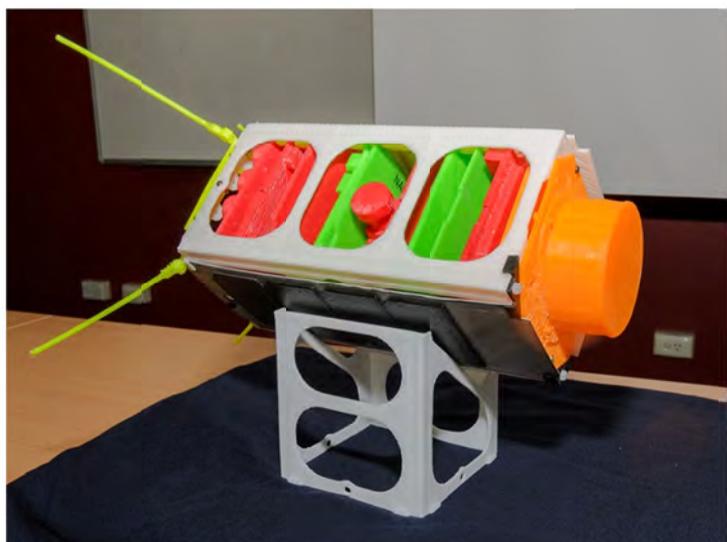
Air Force Research Laboratory in Albuquerque, New Mexico. UNSW has also provided full receiver and software documentation, as well as providing advice regarding operation of the receiver.



*Namuru
V3.2 GPS
Receiver
Board*

The design of the bespoke Namuru V3.2 GPS receiver has ensured that the demanding requirements of reliably navigating in low-earth-orbit, providing centimetre level relative positioning between the three spacecraft and 20ns accuracy timing signals have been achieved. The receiver offers in-field upgrades of both firmware and field-programmable-gate-array designs, thereby minimizing operational risk and improving receiver flexibility to perform other GPS related experiments.

The flight models were delivered to DSTO in February 2014 following functional testing at UNSW in December 2013 using ACSER's GPS simulator. Vibration, thermal and emissions tests were also performed in Adelaide by BAE Systems prior to delivery. The satellites are expected to be launched in 2015 and will be used to perform experiments relating to Space Situational Awareness.



*3D-printed
rapid-prototype
of the UNSW
QB50 ECO
satellite*

DSTO also intend to use the receiver on the Buccaneer 3U CubeSat, which is an Australian follow-on CubeSat, while UNSW intend to fly the receiver on its QB50 ECO satellite.

7. YEAR IN REVIEW: Workshops & Events

Off Earth Mining Forum

19th - 21st February 2013

The Off Earth Mining Forum was a three day event at UNSW hosted by the Australian Centre for Space Engineering Research. The forum focused on identifying the challenges that face the race to mine the moon and nearby celestial bodies and explored some of the possible pathways and technologies that might offer a solution.

The conference provided a forum for communication among current and future industry leaders and also provided an opportunity for scientists and engineers to discuss how current technology and research may be used to establish a viable off earth mining program.

The event attracted over 100 attendees and gained significant media attention on both a local and international scale for ACSER and UNSW. An overview of the media coverage can be found on the ACSER website at this address:

<http://www.acser.unsw.edu.au/oemf/Media.html>

Day 01 - Wednesday 20 th February 2013		
Forum Welcome and Introduction	Andrew Dempster	UNSW
OEMF Working Group Introduction	Andrew Dempster	UNSW
Wednesday - Morning Session 1 - An Innovative Approach to Space		
System Engineering for an Off Earth Mining Capability	Gordon Roesler	UNSW
The Moon - a Lawless Outpost?	Donna Lawler	Optus Satellite
Wednesday - Morning Session 2 - Enabling Technologies		
Locata: a Technology Component of Mine Automation	Chris Rizos	UNSW, on behalf of Locata & Leica Geosystems
Microgravity Geology: A New Challenge for Human and Robotic Space Exploration	Hajime Yano	ISAS, Japan Aerospace Exploration Agency (JAXA)
Virtual Mine (ViMINE) - An innovative Simulation Technique for Novel Mining Systems	Serkan Saydam	UNSW
Wednesday - Afternoon Session 1 - Automation		
Mining Machine Automation	Pieter Prinsloo	Sandvik Mining and Construction
Lunar and Martian Robotic Construction using In-Situ Resource Utilization	Behrokh Khoshnevis	University of Southern California
Remotely Operated Robotic Rock Breaker	Adrian Boeing	Transmin Pty Ltd
Offworld Robotic Excavation for Large-Scale Resource Extraction and Habitat Construction	Matthew Dunbabin	Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Representing Australia at NASA's Lunabotics Lunar Mining Competition	Daniel Linton	Sydney Lunabotics
Wednesday - Afternoon Session 2 - Keynote		
Mars Curiosity, her successes and challenges	René Fradet	Jet Propulsion Laboratory, NASA

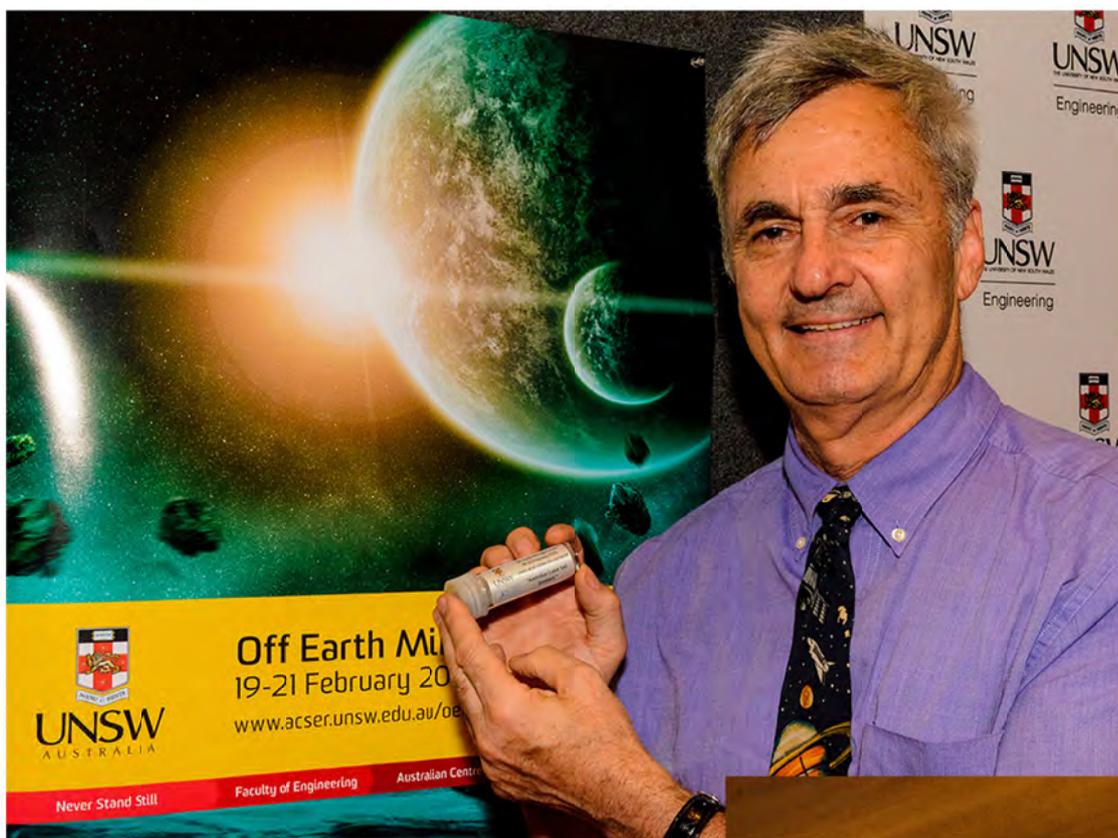
Day 02 - Thursday 21 st February 2013		
Thursday - Morning Session 1 - Resource Utilization		
The Coming Revolution of Industry in Space	Philip Metzger (By Video)	NASA, KSC
Behavior of Lunar Simulants in Reduced Gravity Flights	Robert Mueller (By Video)	NASA, KSC
Water Extraction System for Moon, Mars, and Asteroids	Kris Zacny	HoneyBee Robotics
Thursday - Morning Session 2 - Research with Soil Simulants & Analogues		
Taxonomy for Lunar Simulants	Laurent Sibille	NASA
PISCES Lunar Concrete Pilot Project	Christian Andersen	Pacific International Space Center for Exploration Systems (PISCES)
An Australian Soil Simulant to Study Lunar Mining and Construction	Leonhard Bernold	University of New South Wales
What can the Australian Experience Teach us about Exploring and Mining the Moon?	Jonathan Clarke	Australian Centre for Astrobiology
Thursday - Afternoon Session 1 - Analytical Frameworks		
Reducing Costs of Space Operations Using Predictive Modelling	Jason Held	Saber Astronautics
Project Concepts for Near-Term Commercial Asteroid Mining	Mark Sonter	Asteroid Enterprises Pty Ltd
Thursday - Afternoon Session 2 - Off-Earth Mining In a Larger Context		
Fundamentals of Space Security	Roy Sach	UNSW
Managing Heritage Values in Lunar and Asteroid Mining: What Are the Issues	Alice Gorman	Australian Cultural Heritage Management Pty Ltd

Simulants and Analogues for Space Mining Research Workshop

19th February 2013

Held to coincide with the Off-Earth Mining Forum, this workshop aimed to address the issues of designing and testing technologies to be used for mining and construction in space, as well as the challenge of developing the requisite engineering expertise and knowledge that took thousands of years to develop on Earth. Since the Apollo missions, sophisticated facilities have been built to simulate extraterrestrial sites in order to train and test astronauts, out-of-this-world tools, equipment, and vehicles. At the same time, the educational contributions of those centres have been invaluable.

At this workshop, six international experts addressed the problems related to establishing facilities that simulate environments that have so far never been visited by men. Presenters discussed the creation of soil simulants, subsurface geology and surface analogues that would provide adequate fidelity for chemical composition, mineralogy, density, strength, etc. and other challenges such as the consequences of vacuum and (micro) gravity.



A/Prof Leonhard Bernhold at the Simulants and Analogues for Space Mining Research Workshop, UNSW Kensington, 19 -21/02/2013.

"Australian Lunar Soil Simulant" sample given to attendees of the Off Earth Mining Forum and Space Mining Research Workshop, UNSW Kensington, 19 -21/02/2013.



Curiosity on Mars - ACSER Distinguished Guest Lecture

21st February 2013

René Fradet, Deputy Director of the Engineering and Science Directorate at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, visited UNSW to present the both the keynote address at the Off Earth Mining Forum and to provide an ACSER Distinguished Guest Lecture on the topic of the continuing NASA Curiosity Rover mission that landed on Mars in 2012. The lecture discussed the tremendous successes of Curiosity to date, from landing on Mars to photographing, sampling and inspecting her surface. There was an overwhelmingly positive response from the campus community to the lecture which succeeded in filling Clancy Auditorium.



René Fradet presenting the Curiosity on Mars Lecture, Clancy Auditorium, UNSW Kensington, 21/02/2013.

Roadmap to an Australian Civilian Satellite SAR Capability - Workshop

8th October 2013

In 2013 ACSER delivered three reports to the government on Australia's Synthetic Aperture Radar (SAR) requirements. This workshop brought together Australian leaders in the SAR industry to discuss how to proceed from these submissions towards a satellite SAR capability for Australia. ACSER staff presented their findings based on research arising from the Garada project (primary focus on soil moisture detection), with further presentations made by industry representatives on other SAR applications, SAR delivery and other aspects of earth observation



Prof Dempster presenting at the SAR Capability Workshop, UNSW Kensington, 8/12/2013.

Australian Space Industry Forum

14th November 2013

In cooperation with the Space Industry Association of Australia (SIAA), ACSER hosted a panel entitled: "The Australian Space Industry - Where to from here?".

Having reached a cross roads after the conclusion of the highly successful Australian Space Research Program, followed by the release of a national Satellite Utilisation Policy by the Federal Government, local industry is once again facing uncertainty about future directions for space activity in Australia. The forum heard from a broad range of Australia's present and future space industry leaders who shared their views on new possibilities for the space industry in Australia.

Panelists:

- David Ball, NewSat
- Brett Biddington, Biddington Research
- Professor Andrew Dempster, ACSER UNSW
- Eren Gorur, Australian Youth Aerospace Association
- Stephen Ward, Symbios Communications
- Moderator: Michael Davis, Chair, SIAA



Panelists at the Australian Space Industry Forum, UNSW Kensington, 14/11/2013.

QB50 Workshop

29th November 2013

QB50 is a network of 50 CubeSats created by university teams from around the world that will be launched together in the first half of 2015 into a 'string-of-pearls' configuration in a circular orbit at 320 km altitude, inclination 79 degrees. These CubeSats will comprise a mix of atmospheric double CubeSats and double or triple CubeSats for science and technology demonstration, bearing a designated payload of atmospheric measuring equipment with the remainder of the payload space available for our own research purposes.

This workshop brought together all the QB50 team participants who had worked over the prior 18 months and was crucially timed before entering the final stages of preparing documentation for the Critical Design Review (CDR). Discussions throughout the workshop covered the QB50 experiment goals and requirements, the CubeSat system design, the UNSW/NICTA payloads and experiments and the current progress/needs of the project.



Artist's impression of the QB50: This image, by PhD student Jendi Kepple, has been used by UNSW in advertising and by the QB50 consortium on its home page.



QB50 Workshop attendees and team members, UNSW Kensington, 29/11/2013.

GNSS Vulnerability Workshop

4th December 2013

ACSER has established Global Navigation Satellite Systems (GNSS) workshops as a regular feature of our yearly event calendar. This one day workshop was the third such themed hosted at UNSW. It was sponsored by the Institution of Engineering & Technology (IET) Radar, Sonar and Navigation Network and brought together speakers from government organisations, companies and universities working in the field and day-to-day GNSS users. Discussions covered the reliance of critical infrastructure on GNSS, the extent of potential damage and vulnerability, and possible solutions to alleviate these vulnerabilities.



ACSER staff member and IET Radar Sonar and Navigation Network representative Dr Ediz Cetin (left) with IET NSW local network representatives Dr Paul Axon (middle) and Graham Lee (right) at the GNSS Vulnerability Workshop UNSW Kensington, 4/12/2013.



GNSS Vulnerability Workshop attendees, UNSW Kensington, 4/12/2013.

ACSER Seminar Series

ACSER's seminar series plays an important role in achieving several of its aims: outreach, engagement within and without the faculty and university, mentoring of staff, and research training for postgraduate students. The seminar series was launched when ACSER transferred from the School of Surveying & Geospatial Engineering to the School of Electrical Engineering & Telecommunications.

<i>Seminar Title</i>	<i>Presenter</i>	<i>Date</i>
"The Garada Project"	Andrew Dempster	02-May-13
"A Radar Imaging Satellite for Australia"	Gordon Roesler	09-May-13
"Garada's SAR Solution"	Mauro Grassi	09-May-13
"Garada SAR Formation Flying, Applications and Mission Concept"	Steven Tsitas	16-May-13
"Satellite Orbit Model for Garada Project"	Li (Lily) Qiao	16-May-13
"Developing an Australian GPS Receiver for Operation in Space"	Garada Receiver Team	06-Jun-13
"GNSS Bistatic Airborne Experiments for Remote Sensing"	Kegen Yu	20-Jun-13
"UNSW QB50 CubeSat Project"	Barnaby Osborne	20-Jun-13
"Warawal - Australia's First Masters in Satellite Systems Engineering"	Elias Aboutanios	27-Jun-13
"Analysis of Performance Degradation Due to RF Impairments in Quadrature Bandpass Sampling GNSS Receivers"	Vaidhya Mookiah	04-Jul-13
"Timing Performance of V2R3 Namuru Operating in Position-Hold Mode"	Joseph Gauthier	04-Jul-13
"Low Cost Adaptive Array Signal Processing by Subarray Selection"	Xiangrong Wang	04-Jul-13
"Analysis of Receiver Observables to Spoofing Attacks Using Software Receivers"	Ryan Thompson	11-Jul-13
"Ionospheric path delay modelling for spacecraft formation flying"	Yang Yang	11-Jul-13
"A Comparison of Algorithms Adopted in Fingerprint-based Indoor Positioning Systems"	Kai Zhao	11-Jul-13
"Vectored Thrust Aerial Vehicles: Design and Control"	Jay Katupitiya	01-Aug-13
"Composites in Space Applications"	Garth Pearce	08-Aug-13
"Examples of Perception Applied to Autonomous Systems"	Jose Guivant	15-Aug-13
"Behaviour-based Control Law for Spacecraft Swarm Operations"	Nathan Kinkaid	15-Aug-13
"Plasma nozzles, thruster testing and space simulation at the ANU"	Rod Boswell	22-Aug-13
"Telemetry, Command and Ranging Subsystem for LEO Satellite"	Kiho Kwon	26-Aug-13
"Biomimetic Structures - Nature as Inspiration for Engineering Design"	Naomi Tsafnat	30-Aug-13
"Research on Technologies for Space Mining and Construction Spawns Dual-Use Applications"	Leonhard Bernold	05-Sep-13
"GNSS Reflectometry - An Overview"	Scott O'Brien	10-Oct-13
"A custom multicore architecture for GNSS baseband receiver"	Vinh Tran Tuan	10-Oct-13
"NASA Ames Academy Experience"	Thomas Cooney	21-Nov-13
"Design and Performance of the Fingerprinting Technique for Indoor Location"	Vahideh Moghtadaiee	21-Nov-13
"The Feasibility of a Dedicated Satellite End-Of-Life Disposal Mission in Geostationary Earth Orbit "	Joseph Duong	25-Nov-13
"Thermal Vacuum Outgassing Testing of Rapid Prototyped Material used in QB50"	Henry Kuo	25-Nov-13
"LEO Precise Orbit Determination &Spacecraft Relative Navigation using GPS Observations-Final Review"	Yang Yang	12-Dec-13
"QB50: Rapid Manufactured Satellite Structure"	Jendi Keple	12-Dec-13

8. Higher Degree Research

Upwards of 133 enquiries were made during 2013 regarding PhD topics listed on the ACSER PhD website, located here:
<http://www.acser.unsw.edu.au/phd.html>

Postgraduate Research Students supervised by ACSER staff

Student	Program Type	School	Commencement Year	Completion Year	ACSER Funded Scholarship/Stipend
Joseph Gauthier	Masters by Research	EET	2011	2013	
Joshua Brandt	PhD	MECH	2013		
Kai Zhao	Masters by Research	EET	2012		
Sanat Biswas	PhD	EET	2013		\$25,000 / year for 3 years
Scott O'Brien	PhD	EET	2013		
Vahideh Moghtadaiee	PhD	EET	2009	2013	
Vaidhya Mookiah	PhD	EET	2012		\$25,000 / year for 3 years
Vinh Tran	PhD	EET		2013	
Alexandre Lefort	Masters Practicum (ENSTA ParisTech, France)	N/A	2013	2013	\$450 / week for 12 weeks
Giulio Gabelli	Visiting PhD Student (University of Bologna, Italy)	N/A	2013	2013	
Yang Yang	PhD Practicum (China)	N/A	2013	2013	

Undergraduate 4th Year Thesis Students supervised by ACSER affiliated staff

Student	School	Supervisors (*ACSER-employed staff)
Thomas Fisk	EET	Ediz Cetin* , Oliver Diessel (CSE)
Thien Nguyen	MECH	Ediz Cetin* , Barnaby Osborne* , Naomi Tsafnat (MECH)
Joseph Duong	MECH	Naomi Tsafnat (MECH), Nathan Kinkaid (MECH)
Henry Kuo	MECH	Barnaby Osborne* , Naomi Tsafnat (MECH), Nathan Kinkaid (MECH)
Georgia Craig	MINING	Serkan Saydam (MINE)
Mark Lucas	MINING	Serkan Saydam (MINE)
Timothy Pelech	MINING	Serkan Saydam (MINE)

9. Centre Grant Funding

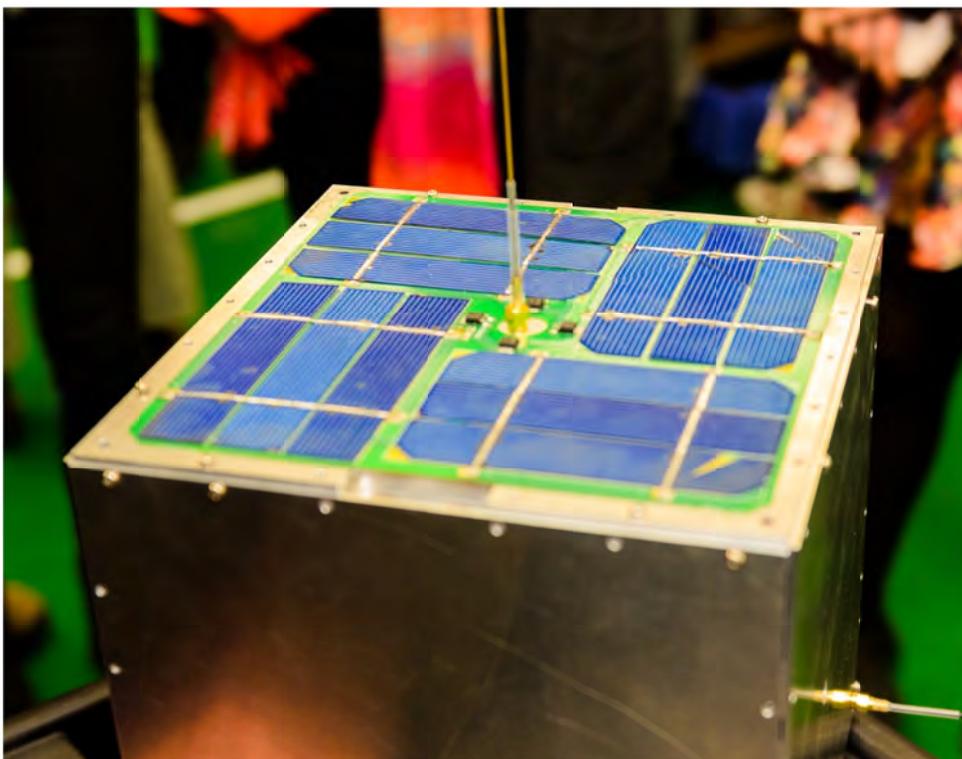
The following grants cover funding received by ACSER during 2013. In addition to below, there were a number of carried over funds from grants relating to existing projects.

Grant	Project Period	Research Topic	Partners	Granting Organisation	Awarded Amount	ACSER's Portion
Garada	Nov-2010 to Jun-2013	Formation Flying of SAR Satellites	UNSW, Astrium Limited, Curtin University of Technology, Delft University of Technology, General Dynamics and BAE Systems	Australian Space Research Program (ASRP)	\$4,664,583	\$2,774,474
WARRAWAL	Jun-2011 to Jun-2013	A Comprehensive Tertiary Education Program in Satellite Systems Engineering	UNSW, Thales Alenia Space, Optus, Institut Supérieur de l'Aéronautique et de l'Espace	Australian Space Research Program (ASRP), UNSW	\$675,173	\$634,980
QB50	2013-2015	An International Network of 50 CubeSats	UNSW	UNSW	\$75,000	\$75,000
Faculty Research Grant	Jan 2013 to Dec-2013	Satellite Based Space Debris Monitoring <i>Investigator: Dr Ediz Cetin</i>	UNSW	UNSW Faculty of Engineering	\$25,000	\$25,000
Faculty Research Grant	Jan 2013 to Dec-2013	GPS Reflectometry Experiment for QB50 Cubesat Mission <i>Investigator: Dr Eamonn Glennon</i>	UNSW	UNSW Faculty of Engineering	\$30,000	\$30,000
MREII	Jan 2013 to Dec-2013	Satellite Navigation and Positioning (SNAP) Lab Infrastructural Support	UNSW	UNSW	\$100,000	\$100,000
Goldstar	Jan 2013 to Dec-2013	Real-time On-board Configurable Synthetic Aperture Radar Processing	UNSW	UNSW	\$40,000	\$40,000
ACSER Centre Support Funds	2011 - 2014		UNSW	UNSW	\$600,000	\$200,000 (for 2013)

10. Financial Report

Statement of Financial Performance for the Period 1st-Jan-2013 to 31st-Dec-2013

	Total
Income	
External Funds	\$ 1,043,684
UNSW Contribution	\$ 674,500
Total Income	\$ 1,718,184
Expenses	
External Payments (Consortium Members)	\$ 453,546
Payroll	\$ 1,196,143
Equipment	\$ 55,126
Materials and Maintenance	\$ 158,565
Infrastructure (Levies)	\$ 195,139
Travel	\$ 117,789
Total Expenses	\$ 2,176,308
Operating result for the period	-\$ 458,124
Surplus (Deficit) Bfwd from Prior Period	\$ 1,101,161
Retained Funds Surplus (Deficit)	\$ 643,037



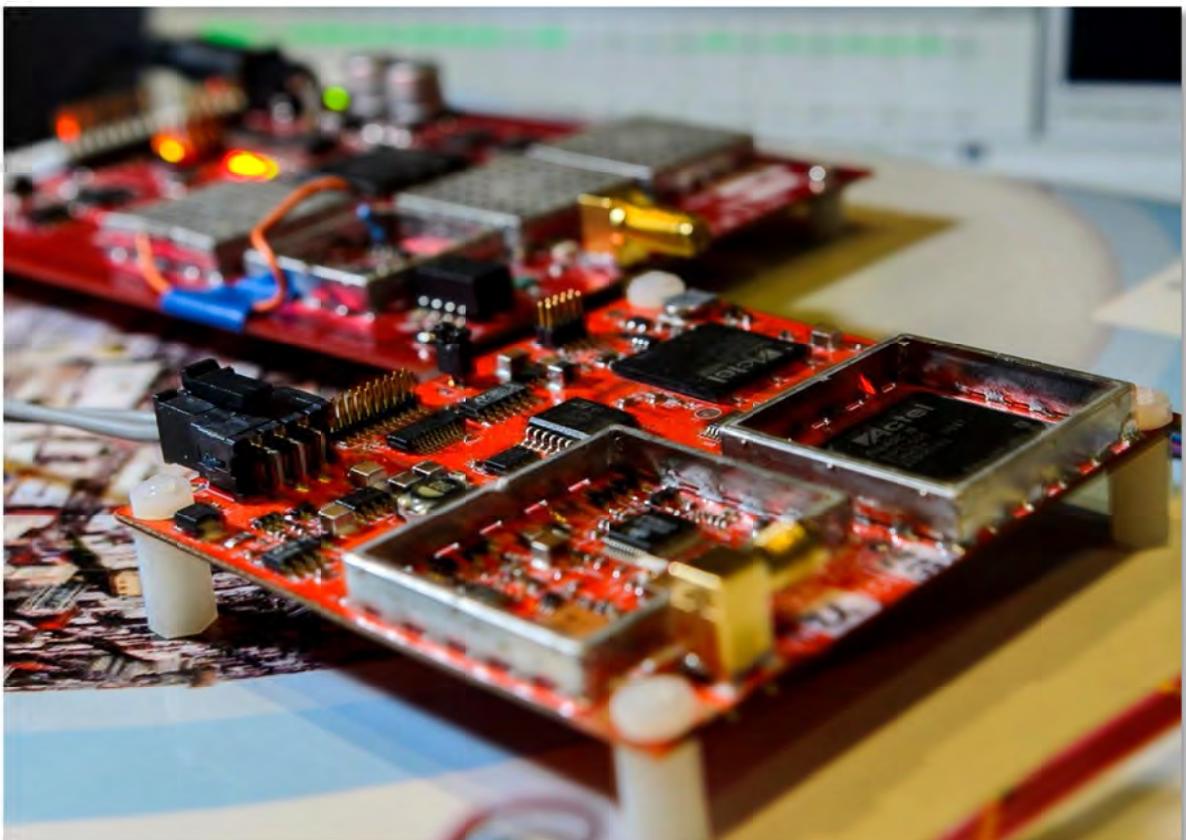
*The
BLUESat
student
project
satellite.*

11. Government Submissions

On 13th June 2013 Prof Andrew Dempster participated in a roundtable discussion providing advice to the Federal Government on the development and implementation of a Space Community of Interest to advise the Trusted Information Sharing Network (TISN) for Critical Infrastructure Resilience. The TISN provides an environment where business and government can share vital information on security issues relevant to the protection of our critical infrastructure and the continuity of essential services in the face of all hazards.



*Dr Mazher
Choudhury
working on
Namuru
Board
development.*



*Namuru
boards
going
through
simulation
testing*

12. Media & Publicity

ACSER had a highly effective year in achieving its outreach objectives and raising the Centre's profile and of Space Engineering Research activities within Australia and at UNSW.

Highlights of ACSER media coverage in 2013:

- Off- Earth Mining Forum coverage was extensive, appearing in at least 30 Australian news sources and 18 International ones. For full list see <http://www.acser.unsw.edu.au/oemf/Media.html>
- The landing of Curiosity Rover benefitted ACSER as media agencies turned to ACSER for local expert opinion on the project.
- Prof Andrew Dempster was featured advocating for an Australian Space Agency in several news and opinion pieces, covering both written sources and radio.
- ACSER-supervised 4th year Engineering student Thomas Cooney appeared in several technology orientated online and print news sources after winning a scholarship to the NASA Academy for his circuit board designed to process radar signals as part of the Garada project to monitor water resources .
- The launch of the MEngSci specialisation in Satellite Systems Engineering made headlines on the UNSW website with a focus on the \$650,000 worth of funding provided by the Federal Governments Australian Space Research Program and the program's pre-existing industry links.
- BLUEsat was featured in local print/online media regarding its scheduled launch in 2014 from Wagga Wagga.

Exclusive of the Off-Earth Mining Forum coverage, ACSER was featured in at least 29 other media stories. For a full list refer to: <http://www.acser.unsw.edu.au/media.html>



Thomas Cooney's circuit board, for which he was awarded a NASA Academy Scholarship.

13. Our People

Centre Staff

Academic

Prof Andrew Dempster, Director of ACSER
 Prof Chris Rizos, Professor, Geodesy & Navigation
 Dr Elias Aboutanios, Senior Lecturer
 Dr Barnaby Osborne, Senior Lecturer

General

Ms Stanija Buvac, Administrator
 Mr James Carrapetta, Project Administrator

Research

Dr Ediz Cetin, Senior Research Associate
 Dr Eamonn Glennon, Senior Research Associate
 Dr Yong Li, Senior Research Associate
 Dr Nagaraj C Shivaramaiah, Senior Research Associate
 Dr Kegen Yu, Senior Research Associate
 Dr Mazher Choudhury, Research Associate
 Dr Li (Lily) Qiao, Research Associate
 Dr Joon Wayn Cheong, Research Associate
 Joseph Gauthier, PhD Student
 Yang Yang, PhD Student
 Sanat Biswas, PhD Student
 Scott O'Brien, PhD Student
 Vinh Tran, PhD Student
 Vahideh Moghtadaiee, PhD Student
 Kai Zhao, PhD Student
 Vaidhya Mookiah, PhD Student
 Vahideh Moghtadaiee, PhD Student
 Dr Kiho Kwon, Visiting Fellow

ACSER affiliates across UNSW

Global Navigation Satellite Systems

Prof Andrew Dempster
 Prof Chris Rizos
 A/Prof Samsung Lim
 Dr Eamonn Glennon
 Dr Craig Roberts
 A/Prof Jinling Wang
 Dr Yong Li
 Dr Binghao Li
 Dr Ediz Cetin
 Mr Thomas Gallagher
 Dr Joon Wayn Cheong

SAR / Formation Flying

Prof Andrew Dempster
 Prof Chris Rizos
 Dr Yong Li
 Dr Steven Tsitas
 Dr Eamonn Glennon
 Dr Kegen Yu
 Dr Nagaraj C Shivaramaiah
 Dr Jinghui Wu
 Dr Li (Lily) Qiao
 Dr Joon Wayn Cheong
 Mr James Carrapetta
 Joseph Gauthier, PhD Student
 Yang Yang, PhD Student
 Sanat Biswas, PhD Student
 Scott O'Brien, PhD Student
 Vinh Tran, PhD Student
 Vahideh Moghtadaiee, PhD Student
 Kai Zhao, PhD Student
 Vaidhya Mookiah, PhD Student
 Vahideh Moghtadaiee, PhD Student

Earth Observation

A/Prof Linlin Ge
Prof John Trinder
Prof Arcot Sowmya
A/Prof Jeremy Bailey

Hypersonics

Dr Sean O'Byrne
Dr Neil Mudford
A/Prof Andrew Neely
Prof Ian Petersen
Dr Tapabrata Ray
A/Prof Harald Kleine
Dr Joseph J. Kurtz
Dr Carlos G. Rodriguez

Space Simulation and Design

Dr Garth Pearce
Dr John Olsen
Dr John Page
Dr Naomi Tsafnat
Dr Robert Taylor
Dr Zoran Vulovic

Space Situational Awareness

Dr Andrew Lambert
Dr Murat Tahtali
A/Prof Mark Pickering
A/Prof Don Fraser

Spacecraft Attitude Dynamics, Control and Orbit Correction

Dr Sreenatha Anavatti
Dr Matt Garratt
A/Prof Valeri Ougrinovski
Dr Tapabrata Ray
Mr Himanshu Pota

Spaceborne Imaging and Remote Sensing

Dr Xiuping Jia
Dr Andrew Lambert
A/Prof Mark Pickering
Dr Mike Ryan
A/Prof Don Fraser
A/Prof Charles Harb
A/Prof Jeremy Bailey

High Temperature Materials

Dr Krishna Shankar
Mr Alan Fien
Prof Michael Ferry
A/Prof Sammy Chan
Dr Kevin Laws

Robotics

Prof Claude Sammut

Reconfigurable Computing

Dr Oliver Diessel

Signal Processing

Dr Elias Aboutanios
Prof Victor Solo
Prof David Taubman
Prof Andrey Savkin
A/Prof Don Fraser

Space Experiments

Dr Barnaby Osborne
Dr Victoria Timchenko
A/Prof Tracie Barber

Communications

Dr Jinhong Yuan

Satellite Power Systems

A/Prof John Fletcher

Space Educational Programs

Dr Elias Aboutanios
Dr Alex von Brasch
Dr John Page
Dr David Clements
Prof Michael Frater
A/Prof Ravi Sood
Prof Eliathamby Ambikairajah
Dr Barnaby Osborne

14. Publications

 - Denotes publications by core ACSER team members.

Book Chapters

-  AL-KHUDAIRI O., HADAVINIA, H., LEWIS E., OSBORNE, B. P. and BRYARS, L.S., "ADVANCED COMPOSITE MATERIALS FOR AUTOMOTIVE APPLICATIONS: Chapter 12 Building Delamination Fracture Envelope under Mode I/Mode II Loading for FRP Composite Materials", Publication Date: 6 Dec 2013 | ISBN-10: 1118423860

Refereed Journal Articles

-  ALAM, N., BALAEI, A. T. and DEMPSTER, A. G., "Relative Positioning Enhancement in VANETs: A Tight Integration Approach", *IEEE Trans Intelligent Transport Systems*, vol 14, no1, Mar 2013, pp47-55, 10.1109/TITS.2012.2205381
-  ALAM, N., KEALY A. and DEMPSTER, A. G., "An INS-aided tight integration approach for relative positioning enhancement in VANETs", *IEEE Transactions on Intelligent Transportation Systems*, vol 14 no 4, Dec 2013, pp1992-1996
-  ALAM, N., KEALY A. and DEMPSTER, A. G., "Cooperative Inertial Navigation for GNSS_Challenge Vehicular Environments", *IEEE Trans Intelligent Transport Systems*, vol 14, no 3, Sep 2013, pp1370-1379
-  ALAM, N. and DEMPSTER, A. G., "Cooperative positioning for vehicular networks: Facts and future", *IEEE Transactions on Intelligent Transportation Systems*, vol 14 no 4, Dec 2013, pp1708-1717
-  AL-SHAERY, A., ZHANG, S. and RIZOS, C., An enhanced calibration method of GLONASS inter-channel bias for GNSS RTK. *GPS Solutions*, 17(2) 2013, 165-173.
-  CHEN, L., LI, B., ZHAO, K., RIZOS, C. and ZHENG, Z., "An Improved Algorithm to Generate a Wi-Fi Fingerprint Database for Indoor Positioning", *Sensors* 2013, 13, 11085-11096; doi:10.3390/s130811085
-  COLE, A., WANG, J., DEMPSTER, A. G. and RIZOS C., "VirtualLites: Aided single epoch GPS integer ambiguity resolution for agricultural land vehicle applications", *Journal of Applied Geodesy*, vol 7 no 4, 2013, pp247-256
-  FENG, Y., GU, S., SHI, C. and RIZOS, C., "A reference station-based GNSS computing mode to support precise positioning services and network-based GNSS data analysis". *Journal of Geodesy*, 87(10-12) 2013, 945-960.
-  FERRY, M., LAWS, K.J., WHITE, C., MISKOVIC, D.M., SHAMLAYE, K.F., XU, W. and BILETSKA, O., "Recent developments in bulk metallic glass composites". Invited prospective article. *MRS Communications*, vol.3, 2013, pp. 1-12.
-  GALLAGHER, T., WISE, E., YAM, H. C., LI, B., RAMSEY-STEWART, E., DEMPSTER, A. G. and RIZOS, C., "Indoor navigation for people who are Blind and Vision Impaired: where are we and where are we going?", submitted to *Journal of Location Based Services* 2013
-  JIANG, W., LI, Y., RIZOS, C. and BARNES, J., Flight evaluation of a Locata-augmented multisensor navigation system. *Journal of Applied Geodesy*, 7(4) 2013, 281-290.
-  JIANG, W., LI, Y. & RIZOS, C., On-the-fly Locata/inertial navigation system integration for precise maritime application. *Measurement Science & Technology*, 24(10) 2013, 105104.
-  LI, L., CHEONG, J. W., WU, J. and DEMPSTER, A. G., "Improvement to Multi-resolution Collective Detection in GNSS Receiver", *The Journal of Navigation*, 2013, doi:10.1017/S0373463313000635, 2013, http://journals.cambridge.org/repo_A90fcHz1
-  LI, B., GALLAGHER, T., RIZOS, C. and DEMPSTER, A. G., "Using geomagnetic field for indoor positioning", *Journal of Applied Geodesy*, vol 7 no 4, 2013, pp299-308
-  LU, L., LI, Y., & RIZOS, C., "Virtual baseline method for BeiDou attitude determination: An improved long-short baseline ambiguity resolution method". *Advances in Space Research*, 51(6) 2013, 1029-1034.
-  MOGHTADAIEE, V. and DEMPSTER, A. G., "Determining the Best Vector Distance Measure for Use in Location Fingerprinting", *IEEE Trans. On Mobile Computing*, 2013 (Submitted).

- MOGHTADAIEE, V. and DEMPSTER, A. G., "Indoor Location Fingerprinting Using FM Radio Signals," *IEEE Trans. On Broadcasting*, 2013 (Submitted).
- MOGHTADAIEE, V. and DEMPSTER, A. G., "Design Protocol and Performance Analysis of Indoor Fingerprinting Positioning Systems," *Elsevier Physical Communication, Special issue on Navigation & Tracking*, 2013 (Submitted)
- REHMAN, O., FIDAN, B. and PETERSEN, I. R., "Feedback linearization-based robust nonlinear control design for hypersonic flight vehicles", Proceedings of the Institution of Mechanical Engineers, Part I: Journal of Systems and Control Engineering, Vol. 227, No. 1 (3-11), 2013.
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- CHOY, S., HARIMA, K., LI, Y., WAKABAYASHI, Y., TATESHITA, H., KOGURE, S. and RIZOS, C., "Precise Point Positioning Utilising the Japanese Quasi-Zenith Satellite System (QZSS) LEX Corrections". GNSS Precise Positioning Workshop: Reaching Full Potential, Ottawa, Canada, 12-14 June 2013.
- DEMPSTER, A. G., "Current & Future Activities at ACSER", Aerospace Futures, Adelaide, 10 July 2013
- DEMPSTER, A. G., "Current & Future Activities at ACSER", Australian Space Development Conference, Adelaide, 9 July 2013
- DEMPSTER, A. G., "Current & Future Activities at ACSER", Australian Space Science Conference, UNSW, 30 September 2013
- DEMPSTER, A. G., "GNSS Interference: Sources, Effects and Mitigation", Korean GNSS Conference, Jeju, Korea, 7 November 2013
- DEMPSTER, A. G., "Technological Limits to Positioning Accuracy for C-ITS", IGNSS Conference, Gold Coast, 17 July 2013
- DEMPSTER, A. G., "Technological Limits to Positioning Accuracy for C-ITS", IS-GNSS Conference, Istanbul, Turkey, 23 October 2013
- DEMPSTER, A. G., "Technological Limits to Positioning Accuracy for C-ITS", visiting professorial lecture, University of Westminster, London, 28 October 2013
- DEMPSTER, A. G., "The Garada SAR Formation Flying Project", Australian Space Science Conference, UNSW, 1 October 2013
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15. Collaborators



UNSW
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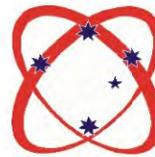


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CORPORATION LIMITED



Curtin University



ISAE

Institut Supérieur de l'Aéronautique et de l'Espace



TU Delft

Delft University of Technology



Optus Satellite

16. 2013 Team Photo



From left to right:

First Row:

James Carrapetta, Dr Mauro Grassi, Dr Mazher Choudhury, Prof. Andrew Dempster, Dr Eamonn Glennon, Stanija Buvac, Dr Jinghui Wu, Dr Li (Lily) Qiao.

Second Row:

Dr Kegen Yu, Dr Ediz Cetin, Scott O'Brien, Vaidhya Mookiah, Dr Tao Wang, Vinh Tran, Yang Yang, Dr Joon Wayne Cheong.

Third Row:

Mitch Wenke, Henry Kuo, Joseph Gauthier, Dr Naomi Tsafnat, Dr Barnaby Osborne, Thomas Fisk, Thien Nguyen, John Aiden Rohde, Dr Gordon Roesler.



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