



# Postgraduate Alumni Intersections – Program

*celebrating 50 years of postgraduate studies at the School of Surveying and Spatial Information Systems, UNSW*

**12-14 February 2007**

**Monday 12 February**

**12:30-1:30 Registration**

**1:30-1:40 Welcome**

## **Session I**

1:40-2:05 David Lemon

2:05-2:30 David Lin

2:30-2:55 Linlin Ge

## **Information Science (Chair: Craig Roberts)**

[Sharing Water Information through a Water Resources Observation Network](#)

[Application of a Back-Propagation Artificial Neural Network to Regional Grid-Based Geoid Model Generation Using GPS and Leveling Data](#)

[Interferometric Synthetic Aperture Radar Studies in UNSW](#)

## **Afternoon Tea**

## **Session II**

3:30-3:55 Kim Mobbs

3:55-4:20 Volker Janssen

4:20-4:45 Gary Jeffress

## **Journeys (Chair: Jinling Wang)**

[Myths About Geostationary Spacecraft Operations](#)

[Volcano – Motorway – Ice Shelf: A Journey with GPS](#)

[Surveying Education and Research in Texas](#)

**4:50-5:30 School Tour**

**5:30-7:30 Travel to Thai Restaurant**

**7:30- Thai Dinner**



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## Tuesday 13 February

### Session III

9:00-9:25 A. H. William Kearsley  
9:25-9:50 Bruce Forster  
9:50-10:15 Jean M. Rueger  
10:15-10:40 Fritz Brunner

### Geomatics in UNSW (Chair: Bruce Harvey)

[Twenty Five Years of Geoid Studies at UNSW](#)  
[Trends And Problems in Remote Sensing of Human Settlements](#)  
[Some Aspects of Electronic Distance Measurement](#)  
[UNSW versus TUG](#)

### Morning Tea

### Session IV

11:10-11:35 Greg Dickson  
11:35-12:00 Hung-Kyu Lee  
  
12:00-12:25 Bensun Hung  
12:25-12:50 Roger Merritt

### Datums (Chair: Bruce Harvey)

[Survey Adjustments and GPS VCV Matrices Modelled for GEOLAB](#)  
[The Second Order GPS Network Adjustment in Korea](#)  
[How to Revise Topographic Map with Metre-Level Earthquake Deformation Using GPS Control Points in Taiwan](#)  
[Cadastral Upgrades with the Parametric Least Squares Adjustment Technique](#)

### 12:50-1:50 Lunch

### Session V

1:50-2:15 Peter Teunissen  
2:15-2:40 Don Grant  
2:40-3:05 Bill Ely  
3:05-3:30 Toshi Tsujii

### GeoPositioning (Chair: Linlin Ge)

On the Prospects of GPS+Galileo Ambiguity Resolution  
[A Changing Approach to Geodetic Networks and Standards](#)  
[Aircraft Navigation - from Sextants to Satellites](#)  
[Development of a BOC/CA Pseudo QZS and Multipath Analysis Using an Airborne platform](#)

### Afternoon Tea

### Session VI

4:00-4:20 Rod Eckels  
4:20-4:40 Rod MacLeod  
4:40-5:00 Doug Kinlyside  
5:00-5:30 Martin Nix

### GNSS (Chair: Linlin Ge)

[20 years of GPS Development at Leica Geosystems](#)  
[The Advantages of Multi-frequency, Multi-constellation GNSS for Precision Navigation and Guidance](#)  
TBA  
[GNSS Related Systems for Mining and Agriculture](#)

**5:30-6:30 Travel to Coogee Beach**

**6:30-8:30 Beachside BBQ**



# Postgraduate Alumni Intersections – Program

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## Wednesday 14 Feb.

### Session VII

9:00-9:30 Kurt Lambeck  
9:30-9:55 Paul Tregoning  
9:55-10:20 Richard Coleman  
10:20-10:45 Bill Hirst

### Geodesy (Chair: Kurt Lambeck)

Geodesy in Australia

Geophysics from Geodesy: What have we Learned?

[New Insights into Ice Shelf Rifting from Seismic, Remote Sensing and Geodetic Monitoring](#)

[The role of Surveying and Geodesy in Delineating and Delimiting Marine Zones](#)

### Morning Tea

### Session VIII

11:15-11:45 Will Featherstone  
11:45-12:10 Fritz Brunner  
12:10-12:30 Yuzo Ishikawa  
12:30-12:55 Horng-Yue Chen

### Geodesy (Chair: Chris Rizos)

[The Dangers of Fitting Gravimetric Quasigeoid Models to GPS-Levelling in Australia](#)

[Continuous Landslide Monitoring: GPS and FOS](#)

[Active Period Along the Indian Plate Boundary](#)

[Coseismic Displacements and Slip Distribution Inferred from GPS Geodetic Observations for the 1 April 2006 Peinan, Southeastern Taiwan, Earthquake](#)

### 12:55-2:00 Lunch

### Session IX

2:00-2:35 Gary Johnston  
2:35-3:00 Ramesh Govind  
3:00-3:25 Peter Morgan  
3:25-3:45 Harvey Mitchell

### Geodesy (Chair: Samsung Lim)

[Geodesy in Australia: A Historical Review and Extrapolation into the Future](#)

[Orbit Determination and Analysis of GIOVE-A Using SLR Data](#)

[Using Gravity Data Spread Over 50 Years to Interpret Ice Models at the Last Glacial Maximum at Casey, Wilkes Land, East Antarctica](#)

[Sea-Surface Topography - Over Three Decades](#)

# **Aerosol Retrievals in Australia: Need for a Bright Target Object Approach!**

**Sunil Bhaskaran**

**Geospatial and Earth Monitoring Division, ACRES, Geoscience Australia, Canberra, Australia**

**Tel: +61-2-62499163. Email: Sunil.Bhaskaran@ga.gov.au**

## **Abstract**

This presentation outlines a) a methodology to develop a bright-target object approach for retrieving aerosols from satellite images over bright surfaces in Australia and b) discusses the significance of developing this approach for generating accurate reflectance products. Estimating aerosol properties is one of the first steps in generating high-level land surface products from satellite observations. Due to the complex nature and short life cycle of aerosols satellites such as the Moderate Resolution Imaging Spectroradiometer (MODIS), Total Ozone Mapping Spectrometer (TOMS), and Geostationary Operational Environmental Satellite (GOES) have been used for retrieving and studying aerosol distribution and characteristics. The underlying algorithm to retrieve aerosols from MODIS relies broadly on two criteria **a)** existence of a stable empirical relationship between the mid-IR band (2.1 $\mu\text{m}$  - MODIS band 7) and the blue (0.49 $\mu\text{m}$  - MODIS band 3) band and the mid-IR (2.1 $\mu\text{m}$ ) and red band (0.66 $\mu\text{m}$  - MODIS band 1) and **b)** assumption that the surface area is covered by dense vegetation canopies only. This means that the algorithm will only retrieve aerosol in the 0.49 $\mu\text{m}$  and 0.66 $\mu\text{m}$  (visible bands) if the land surface was covered by dense vegetation canopies. The algorithm also assumes the absence of any absorption by aerosols in the mid-IR (2.1 $\mu\text{m}$ ). These assumptions warrant further investigation since moist soil and other water bodies may be confused as dense vegetation and the presence of mineral or dust aerosols which absorb solar energy in the mid-IR (2.1 $\mu\text{m}$ ) may contradict the assumption that there is no absorption by aerosols in the mid-IR (2.1 $\mu\text{m}$ ) regions. Land surfaces in Australia however resemble arid and semi arid surfaces where the dark-target object approach/algorithm may not lead to aerosol retrievals at all! This may influence the accuracy of the reflectance and thereafter the final downstream thematic products. From a remote sensing point of view retrieval of aerosols from all surfaces is vital for atmospheric correction and generation of accurate surface reflectance products. Whilst there are some densely vegetated regions in Australia, the majority surfaces are bright targets which demand the development of a bright-target object approach for aerosol retrievals. Developing a complimentary bright-target object approach is vital for better aerosol retrievals in Australia. However this is a challenging area of research since the surface reflectance from terrestrial features in the VIS regions (0.49-0.66 $\mu\text{m}$ ) is a combination of solar reflectance and the predominating Rayleigh aerosol backscatter. The methodology presented here may provide some solutions/options to estimate aerosols over bright areas.

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## **UNSW versus TUG**

**Fritz K. Brunner**

**Engineering Geodesy and Measurement Systems**

**Graz University of Technology**

**Steyrergasse 30**

**A-8010 Graz**

**fritz.brunner@tugraz.at**

## **Abstract**

I would like to reflect on my time at UNSW, as staff member, and as Head of the School of Surveying. During the past 13 years I have been leading the Institute of Engineering Geodesy and Measurement Systems of the Graz University of Technology. The major achievements will be presented. Finally, I would like to share my personal opinion and experiences about the differences between the two universities, the people living there and in particular talk about their attitudes.

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## **Continuous Landslide Monitoring: GPS and FOS**

**Fritz K. Brunner**  
**Engineering Geodesy and Measurement Systems**  
**Graz University of Technology**  
**Steyrergasse 30**  
**A-8010 Graz**  
**fritz.brunner@tugraz.at**

### **Abstract**

A continuous and autonomous GPS monitoring system has been developed for the investigation and monitoring of landslides. Several processing algorithms have been developed to improve the accuracy of the measured motions. To demonstrate the applicability of this system, results of the monitoring of the deep-seated mass movement Gradenbach, Austria, are presented. They were obtained from several sporadic and continuous measurement campaigns during the last seven years. The motions can be determined with a precision of 4 mm in horizontal direction and 7 mm in vertical direction.

The accurate GPS results suggest that the velocity of the deep-seated mass movement at Gradenbach is not uniform but rather intermittent, i.e., accelerated motions are followed by quiescent periods. However, GPS surveys are not sufficiently precise to investigate the mechanics of this phenomenon. Therefore, we are developing a strain-rosette for in-situ measurements of distance changes. It consists of three embedded extensometers featuring a separation in orientation of 120°. The sensors are long gauge (5m) fibre optical interferometers of SOFO type yielding a precision of 2 µm for absolute length changes. However, using a different measurement technique relative length changes can be determined with a precision of 0.01 µm at 1 kHz. The concept, design and first test results will be presented.

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## **Coseismic Displacements and Slip Distribution Inferred from GPS Geodetic Observations for the 1 April 2006 Peinan, Southeastern Taiwan, Earthquake**

**Horng-Yue Chen, Ya-Lu Hsu, Long-Chen Kuo, Chi-Ching Liu, Jen-Cheng Lee and Shui-Beih Yu**  
**Institute of Earth Sciences, Academia Sinica, Taiwan**

### **Abstract**

We have set up 52 campaign-mode stations combined with 6 continuously recording GPS stations (CORS) in an area of 15x15 km<sup>2</sup> which located in southeastern Taiwan since 2001, complemented with the precise leveling to detect the near fault deformations. On the 1<sup>st</sup> April 2006 occurred a moderate ( $M_L$  6.35) shallow earthquake, near Peinan township, Taitung, and the epicenter is located at 22.88°N 121.08°E (CWB earthquake report, 2006). This

event provides a good opportunity to study the detail geological structures of the Longitudinal Valley Fault (LVF) near the Taitung area. According to the GPS and precise leveling results, the displacements show three different deformation types, which are with about 35 mm westward and 30 mm subsidence in the southernmost part of the Coastal Range, with about 45 mm southward and 20 mm uplift in the east margin of the Central Range, and about 10 mm northward and 15 mm uplift near the Luyeh area on the west side of the Coastal Range. This unique coseismic deformation pattern can be used to realize the collision characteristics of the suture zone between the Philippine Sea plate and Eurasian plate at the southernmost Longitudinal Valley.

Key words: CORS, Coseismic deformation, Dislocation model.

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## **New Insights into Ice Shelf Rifting from Seismic, Remote Sensing and Geodetic Monitoring**

**Prof Richard Coleman, Centre for Marine Science, University of Tasmania  
Jeremy Bassis, Dr Helen Fricker, Prof Bernard Minster - Scripps Institution of Oceanography,  
USA**

### **Abstract**

Most of the mass loss from the Antarctic ice sheet takes place at the fronts of ice shelves and glacier tongues, via iceberg calving, or by basal melting from below the ice shelf. Icebergs separate from the parent ice along large rifts, or fractures through the total thickness of ice, that progressively form with the deformation and flow of the ice. Ice shelf rifting is an important glaciological process about which we know very little.

Calving of ice shelves happens when large sections of the floating ice shelf break off. The nature and frequency of such calving events is of interest, especially to understand if any links exist with global climate change - i.e., whether the oceans are warming and causing increased calving and melting of the ice shelves. Our region of study is the Amery ice Shelf, which is the largest ice shelf in East Antarctica. This ice shelf drains the grounded portion of the Lambert Glacier Basin-Amery Ice Shelf System, which accounts for  $1.6 \times 10^6$  km<sup>2</sup> of the grounded East Antarctic ice sheet (16% of its total area). The last major calving event on the Amery occurred in 1963-64 and we have been studying a section at the front of the ice shelf since the austral summer season of 2002-03. using a combination of remote sensing (satellite imagery, satellite altimetry), GPS and seismic measurements. We affectionately call this area of the Amery the "Loose Tooth" (LT). The LT region is some 30 by 30 km in area with ice thicknesses of about 300 m - the equivalent volume of some 667 trillion stubbies!

We have learnt that propagation of one of the LT rifts behaves episodically, with recurrence intervals of 10-30 days, and the rift displays a seasonal character in its lengthening that is still to be explained. We see patterns of seismicity that scatter around the moving rift tip but also along bands of crevasses in the ice shelf flow direction. The dynamics of fracture have analogies with earthquake physics but we need additional measurements over of full year to unravel some of the remaining mysteries. Our project will form part of an Australian contribution to the International Polar Year program.

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## **Survey Adjustments and GPS VCV Matrices Modelled for GEOLAB**

**Greg Dickson**

**Abstract**

Observation variance models for conventional terrestrial observations, directions, EDM, etc have long been recognized and are based on accepted techniques and premises. Although differential baseline GPS has been around for 20 years accepted variance models have not become established. Compounding this situation is the unfamiliar (in visualisation) Conventional Terrestrial coordinate system that 3D adjustments work in.

Aspects of GPS VCV matrixes are looked at. A methodology and some rules are suggested, in how to approach the Least Squares Adjustment of GPS baselines, and ratify the analysis of results with particular focus on GEOLAB

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**Aircraft Navigation – from Sextants to Satellites**

**W.S. Ely**

**Abstract**

Aircraft navigation has evolved from nautical navigation techniques as the demands for precision and reliability have increased over the past 80 years. The International Civil Aviation Organisation (ICAO) has developed a new approach to defining these requirements, which does not specifically address the technology involved, but rather specifies a Required Navigation Performance (RNP), allowing navigation technologies to evolve to meet the requirements. The impact of the RNP approach has been profound, presenting many challenges to navigation system providers and certification authorities, specifically with how the demanding requirements can be proven.

The presentation will cover a brief history of aircraft navigation techniques and systems, culminating in the development of the RNP standards, and describing how Global Navigation Satellite Systems (GNSS) are currently evolving within the RNP architecture.

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**20 years of GPS Development at Leica Geosystems**

**Rod Eckels**

**Abstract**

The presenter will discuss his experience of 20 years of GPS development at Leica GeoSystems. The presentation will cover some of the important GPS technological “breakthroughs” that have occurred since the first constellation was launched and the subsequent impact on the Surveying market at the time. Some thoughts on recent developments and current trends in the GPS market will be discussed.

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**The Dangers of Fitting Gravimetric Quasigeoid Models to GPS-Levelling in Australia**

**Will Featherstone**

**Abstract**

Since the AHD is to be retained for the 'foreseeable future' by government geodetic agencies, we will be forced to distort a perfectly good gravimetric quasigeoid model to fit a distorted local vertical datum. This strategy, while providing an interim pragmatic solution for GNSS users, will leave Australia with a vertical datum that cannot fully profit from modern geodetic techniques, notably dedicated satellite gravimetry. As such, the definition and realisation of the AHD must be revisited if it is to keep pace with developments to the horizontal geodetic datum, including the modelling of temporal variations of gravity and height.

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**Trends and Problems in Remote Sensing of Human Settlements**

**Bruce Forster**

**Abstract**

Advances in both airborne and spaceborne remote sensing systems have provided a range of tools for monitoring and managing human settlements. In particular the availability of very high spatial resolution satellite systems has dramatically increased access to high quality two-dimensional spatial information, while laser profilers and interferometric synthetic aperture radar have allowed for rapid acquisition of digital surface models. In this paper an historical overview of urban remote sensing, including problems and applications, is followed by a discussion of the properties of systems and their acquired data. The paper concludes with an overview of future developments.

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**Interferometric Synthetic Aperture Radar Studies in UNSW**

**Dr. Linlin Ge**  
**Senior Lecturer & Project Leader**  
**Cooperative Research Centre for Spatial Information (CRCSI)**  
**School of Surveying & Spatial Information Systems**  
**The University of New South Wales**  
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**Abstract**

Interferometric Synthetic Aperture Radar (InSAR) Studies in UNSW have been funded by the Australian Research Council, the Australian Coal Association Research Program, the Cooperative Research Centre for Spatial Information, and so on. The UNSW InSAR research has three major components: InSAR for digital elevation model (DEM) generation, ground surface displacement measurement using Differential InSAR (DInSAR) and long term ground deformation monitoring with Permanent Scatterer InSAR (PSInSAR).

InSAR DEMs generated from SAR data acquired by the space shuttle and satellites have been compared to DEMs produced with photogrammetry, airborne laser scanning (ALS),

and ground survey. It has been found that InSAR DEMs are of the same quality as photogrammetric DEMs but are much more cost effective.

Differential InSAR (DInSAR) has been extensively tested in the region between Sydney and Wollongong with 7 active mine collieries. Repeat-pass acquisitions by the ERS-1, ERS-2, JERS-1, Radarsat-1 and Envisat satellites were used to monitor mine subsidence. Sub-centimetre accuracy has been demonstrated by comparing the DInSAR results against ground survey profiles. The ERS tandem DInSAR results, on the other hand, revealed mm-level resolution. The UNSW InSAR Team is also monitoring ground displacement in the Hunter Valley coalfields and a few sites outside Australia.

Permanent scatterer radar interferometry (PSInSAR) is the latest InSAR technology to measure ground deformation at mm/year accuracy. Unlike the differential InSAR which uses a pair of radar images, PSInSAR has to work with a stack of radar images. The UNSW InSAR Team recently has some breakthrough in the applications and software development of PSInSAR. As a result, we have produced PSInSAR results for Canberra, Sydney, Newcastle, Perth, Brisbane, Tahmoor and Handan.

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## **Orbit Determination and Analysis of GIOVE-A Using SLR Data**

**Ramesh Govind  
Geoscience Australia  
Canberra, Australia**

### **Abstract**

Using the early available SLR data since its launch, precise orbit determination of the first Galileo test satellite, GIOVE-A, was undertaken in weekly arcs. A description of the contributing data set, the computation process and the initial results of the orbit quality are presented. From these solutions, the inferred data quality from the individual stations is summarised. Using one estimate of the state vector from these solutions, the results of the spectral analysis of the orbit perturbations due to the Earth's gravity field is presented. The GIOVE-A spectral analysis is compared with those of the current GNSS constellations. A general summary of products and results from the long term analysis of SLR observations to the standard geodetic satellites is also presented.

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## **A changing approach to geodetic networks and standards**

**Don Grant**

### **Abstract**

Historically, geodetic networks in New Zealand, as in most countries, were defined principally in accordance with how they were observed with the technology of the day. As the accuracy of technology improved dramatically, particularly with GPS, this created anomalies with "lower order" but more accurate GPS networks being distorted to fit "high order" theodolite observed networks.

The focus now is on what the geodetic system is trying to achieve, the accuracy and other characteristics needed to achieve those things, and less on the changing "how-to" of

geodetic survey technology. Another change has been the maturing of the geodetic "industry" which undertakes the geodetic surveys on contract. There is a decreasing need to provide highly prescriptive specifications that tell the contractors how to do their jobs.

This presentation will briefly describe the changes over time and outline how new network design philosophy will affect the New Zealand geodetic system.

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## **The role of Surveying and Geodesy in Delineating and Delimiting Marine Zones**

**Bill Hirst,  
Project Leader  
Marine Spatial Information and Boundary Advice  
Geoscience Australia**

### **Abstract**

Unlike land boundaries, the world's maritime boundaries are generally defined in terms of geographic coordinates. Determining and describing these boundaries has frequently been done within the legal profession and without consultation with spatially trained experts. The results can be ambiguous and problematic.

Surveillance and enforcement also requires an understanding of basic surveying and geodetic principles. This presentation examines the role of surveying and geodesy in marine boundary formulation and some operational issues.

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## **How to revise topographic map with metre-level earthquake deformation using GPS control points in Taiwan**

**Dr. Pen-Shan Hung  
Head of Department of Land Management,  
Feng-Chia University, Taichung, Taiwan,  
e-mail: pshung@fcu.edu.tw**

### **Abstract**

The 1999 Chi-Chi earthquake ( $M_w$  7.6), ruptured a major thrust fault along the central Taiwan. The co-seismic horizontal displacements at left-side points of Chelungpu fault in Taichung is about 0.4 to 1.6 meters toward  $110^\circ$  to  $125^\circ$  and decrease gradually away from the fault. However, the more complicated displacement is at the eastern section which is about 5 to 7.5 meters at  $326^\circ$  to  $330^\circ$ .

Taichung topographic maps with GIS attributes started surveying in 1997 and just finished before the earthquake. The maps should be resurveyed or revised to be concurrent with reality. The coordinates of GPS control points measured before and after earthquake. A least-squares regression is used to establish functions of the displacement of GPS points, and it is used to revise the maps, not resurvey. It was shown that the maximum residual determined from this model was less than 4 cm at western section of the Chelungpu fault. Therefore, the topographic maps in the western part of the Chelungpu fault in Taichung is not resurveyed, but successfully revised by the approach.

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## **Active Period along the Indian Plate Boundary**

**Yuzo Ishikawa**

**Matsushiro Seismological Observatory, Japan Meteorological Agency**

### **Abstract**

The temporal change of the seismic activity along the plate boundary between the India-Australian plate and the Eurasian plate was analyzed using PDE monthly, weekly and QED catalogues (USGS) and the Utsu catalogue (released June 2002) for the historical events. Mogi (1974) showed that the active and quiet periods of the seismicity had been repeated along this plate boundary and the last active period was from 1931 to 1951. Using the new catalogue, the recent new active period was identified. This active period started in 1997 in Tibet and the epicenters spread to Turkey and Sumatra. The 2004 Sumatra M9.0, the 2005 Sumatra M8.6 and the 2005 Pakistan M7.6 earthquakes are included. In the former active period from 1931 to 1951 identified by Mogi, the seismicity was very high especially in the eastern part of the border area between China and India, including three M8 events (1934 M8.3, 1950 M8.6, 1951 M8.0). The earthquakes in the last but one active period from 1889 to 1918 located along the Sumatra and in the western part of Tibet. Some hypocenters in this active period located near the recent ones, for example, the 2005 Pakistan M7.7- the 1905 M8.6, The 2000 Turkmenistan M7.5 - the 1895 M7.7, the 2005 Tanzania M7.2 - the 1910 M7.7. As two past active periods continued for about 20 years, this active period will continue 10 more years.

The seismic gap was identified in the region west off the middle part of Sumatra island. The low seismicity areas were found along the plate boundary and they coincided with the source regions of the 1833 (M8.7) and the 1861 (M8.4) events. In case of the 1861 (M8.4) event, the M8.7 earthquake occurred in the low seismic region in March after our founding. In case of the 1833 event, it coincides very well with the low seismicity area and the estimated source region defined after Natawjdaja et al.(2004). A second kind of seismic gap was also found in this region and the relation between period of the second kind of the seismic gap to magnitude of the future event showed that the next mega thrust in this seismic gap would occur in the next several years.

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## **Volcano – Motorway – Ice Shelf: A Journey with GPS**

**Volker Janssen**

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[Volker.Janssen@utas.edu.au](mailto:Volker.Janssen@utas.edu.au)

### **Abstract**

This presentation traces a journey that begins as a PhD student at UNSW working on a mixed-mode GPS-based volcano deformation monitoring system and continues as “Dr GPS” along a Sydney motorway before heading “down down under” as a lecturer at the University of Tasmania. The journey ventures even further south in order to carry out GPS fieldwork in Antarctica and to investigate strain in the vicinity of an active rift system on the Amery Ice

Shelf using GPS observations. A few side trips to Hong Kong and the Philippines are also undertaken in order to enable navigating as a pair.

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## **Surveying Education and Research in Texas**

**Dr. Gary Jeffress, RPLS**  
**Professor of Geographic Information Science**  
**Department of Computing and Mathematical Sciences**  
**Director, Conrad Blucher Institute for Surveying and Science**  
**Texas A&M University-Corpus Christi**  
**6300 Ocean Drive, Corpus Christi, Texas 78412**  
**Email: Gary.Jeffress@tamucc.edu**

### **Abstract**

In 1987 the Conrad Blucher Institute for Surveying and Science (CBI) was established and dedicated at Texas A&M University-Corpus Christi with the mission to develop a surveying education program and to undertake research in surveying related sciences. In 1995 Texas A&M University-Corpus Christi introduced a surveying education program with the title Bachelor of Science in Geographic Information Science. This program is ABET accredited under the Applied Science Commission since 2000. The program has two emphases; 1) Geomatics, which focuses on cadastral surveying and leads to Registered Professional Land Surveyor licensure in Texas, and 2) Geographic Information Systems, which focuses on the design, installation, and use of GIS software. CBI was seeded by a generous endowment by Conrad and Zula Blucher. Conrad Blucher was a former County Surveyor who was the last of three generations of Blucher surveyors in South Texas going back to 1849.

Research into Texas littoral boundary definition commenced in 1989 with the establishment of the Texas Coastal Ocean Observation Network. Coastal geoid determination research commenced in 1997. Large water level and meteorological data sets led to research using Artificial Neural Networks to better predict water level and coastal flooding. These data collection and modeling research efforts led to cooperative agreements with the US National Ocean Service and National Geodetic Survey have since led to the implementation of the Texas Height Modernization program in 2005.

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## **Geodesy in Australia: A historical Review and extrapolation into the future**

**Gary Johnston, John Manning, Jim Steed**  
**Geoscience Australia**

### **Abstract**

The evolution of national Geodesy in Australia over the last 50 years has been influenced by two key factors. The first and most obvious was the introduction of new technology that allowed faster and more accurate surveys over larger areas. The second was the implementation of research which often provided incremental but critical stimulation.

This presentation chronicles the evolution of national geodesy in Australia over the fifty years in line with UNSW's jubilee celebrations, and then extends that evolution into the next

decade based on recent decisions about the enhancement of Australia's Geodetic Infrastructure.

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## **Twenty Five Years of Geoid Studies at UNSW**

**A. H. W. Kearsley**

### **Abstract**

In this presentation I will review

- a) my most significant contributions to precise relative geoid determinations,
- b) the current limitations to geoid evaluation in Australia, and
- c) the impact that redefining the global Geoid in terms of  $W_0$  (as defined by analysis of world-wide altimetry), instead of  $U_0$  will have upon our understanding of distortions in the AHD.

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## **The Second Order GPS Network Adjustment in Korea**

**Hung-Kyu Lee**

**Department of Civil Engineering  
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Tel: +82-55-279 7597, Fax: +82-55-285 9491, E-mail: [hkyulee@changwon.ac.kr](mailto:hkyulee@changwon.ac.kr)**

### **Abstract**

New geocentric geodetic datum has recently been adopted in Korea; Korean Geodetic Datum 2002 - KGD2002, to replace the existing Tokyo datum, which had been used in this country since early 20th century. For the datum realization, very long baseline interferometry (VLBI) observations were initially carried out in 1996 to determine the coordinates of the origin of KGD2002 based on the International Terrestrial Reference Frame (ITRF). Continuous GPS observations were collected from 14 reference stations across Korea to compute the coordinates of the first order geodetic control points. During the campaign, GPS observations were also collected at about 10,000 existing geodetic control points. Network adjustment with all the observations has been performed since October 2005. In this presentation, the KGD 2002 and GPS observation is overviewed and results of the second order GPS network adjustment is summarised.

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## **Sharing Water Information through a Water Resources Observation Network**

**David Lemon**

### **Abstract**

The Water Resources Observation Network Reference Model (WRON-RM) describes a framework for:

- linking Australia's many water and water related data assets;

- harnessing new data streams from satellites and on-ground sensor networks; and
- processing and utilising water information.

This framework will enable the coupling of data and processing services to a new generation of forecasting and reporting technologies which will greatly improve the visibility, currency and usability of information on our water resources. This Water Resources Observation Network (WRON) will allow for improved environmental, social and economic outcomes with respect to water.

This talk will describe the work being undertaken by CSIRO to develop the WRON and in particular the WRON Reference Model which will underpin the WRON.

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## **Application of a Back-Propagation Artificial Neural Network to Regional Grid-Based Geoid Model Generation Using GPS and Leveling Data**

**Lao-Sheng Lin**

**Associate Professor, Department of Land Economics, National Chengchi University, 64,  
Section 2, Chihnan Road, Taipei 116, Taiwan.**

### **Abstract**

The height difference between the ellipsoidal height  $h$  and the orthometric height  $H$  is called undulation  $N$ . The key issue in transforming the GPS-derived ellipsoidal height to the orthometric height is to determine the undulation value accurately. If the undulation  $N$  for a point whose position is determined by a GPS receiver can be estimated in the field, then the GPS-derived 3-D geocentric coordinate in WGS-84 can be transformed into a local coordinate system and the orthometric height in real-time. In this paper, algorithms of applying a back-propagation artificial neural network (BP ANN) to develop a regional grid-based geoid model using GPS data (e.g., ellipsoidal height) and geodetic leveling data (e.g., orthometric height) are proposed. In brief, the proposed algorithms include the following steps: (1) establish the functional relationship between the point's plane coordinates and its undulation using the BP ANN according to the measured GPS data and leveling data; (2) develop a regional grid-based geoid model using the imaginary grid plane coordinates with a fixed grid interval and the trained BP ANN; (3) develop an undulation interpolation algorithm to estimate a specific point's undulation using the generated grid-based geoid model; and (4) estimate the point's undulation in the field and transform the GPS ellipsoidal height into the orthometric height in real-time. Three data sets from the Taiwan region are used to test the proposed algorithms. The test results show that the undulation interpolation estimation accuracy using the generated grid-based geoid is in the order of 2-4 cm. The proposed algorithms and the detailed test results are presented in this paper.

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## **The Advantages of Multi-frequency, Multi-constellation GNSS for Precision Navigation and Guidance**

**Rod MacLeod**

**Regional Manager – SE Asia and Australia**

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### **Abstract**

The next five years promise to be some of the most exciting since the advent of the first GPS (Global Positioning System) satellites in the 1980's. By 2012, some 78 GNSS (Global Navigation Satellite System) satellites should be orbiting the earth, including at least 24 satellites of the US GPS system, up to 24 satellites of the revitalised Russian GLONASS system, and up to 30 satellites of the new multi-billion Euro, European Galileo system. The US government has announced its GPS Modernization initiative to add civilian signals to the L2 signal (known as L2C), and a third L5 signal with the launch of new satellites.

NovAtel is focused on the high precision GNSS market, where accuracy and reliability are paramount. NovAtel is a recognized world leader in high-precision positioning technologies and already provides "GPS +" integrated positioning solutions into various markets. These additional measurements include SBAS and GLONASS satellite signals and terrestrial IMU input. We are also working through the Canadian Space Agency on developing a GPS+GALILEO receiver.

This presentation will show how the options available to users of precision navigation technology while significant now, will expand greatly by 2012, and what type of receiver may be available to utilise these multiple satellite constellations and multiple broadcast frequencies resulting in virtually instantaneous resolution of one's position on earth to centimetres for diverse commercial applications.

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## **Cadastral Upgrades with the Parametric Least Squares Adjustment Technique.**

**Roger Merritt**

### **Abstract**

The paper explains some of the legacy accuracy issues in the digital cadastre, and discusses how the digital cadastre can be upgraded using Deposited Plans, GPS, and a Parametric Least Squares Adjustment package.

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## **Sea-Surface Topography - over three decades**

**Harvey Mitchell**  
**University of Newcastle**

### **Abstract**

In the early 1970s the discrepancy in results between the Australian continent-wide levelling survey and mean sea-level focussed interest on errors in the definition of the geoid by levelling, and, more importantly, on the existence of sea-surface topography. However, despite the widespread use of satellite altimetry and higher resolution geoids, the question of how closely levelling surveys and MSL should agree is not resolved after 30 years. It is still not clear whether there is a fault in the Australian levelling, nor has the nature of sea-surface topography around this continent been fully quantified. The seminar is a reflection of events of the past three decades, considers the best explanation of the problem, and reflects on its relevance and importance, along with some other geodetic issues of the 1970s which remain largely un-resolved.

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## **Myths about Geostationary Spacecraft Operations**

**Kim Mobbs**

### **Abstract**

Once a satellite is launched into geostationary orbit, it just stays there. If a satellite breaks, astronauts can go up in the shuttle and fix it. At the end of a satellite's life, you shoot it into the sun to burn up. The realities of operating a geostationary satellite are very different. This presentation will dispel these myths and give you an insight into what is really involved.

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## **Using gravity data spread over 50 years to interpret ice models at the last glacial maximum at Casey, Wilkes Land, East Antarctica.**

**Peter Morgan, University of Canberra, [petermorgan@grapevine.net.au](mailto:petermorgan@grapevine.net.au)**

**Brad Bailey, Macquarie University, [bbailey@els.mq.edu.au](mailto:bbailey@els.mq.edu.au)**

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**Hugo Schotman, Delft University of Technology, [hugo@deos.tudelft.nl](mailto:hugo@deos.tudelft.nl)**

**Richard Coleman, University of Tasmania, [Richard.Coleman@utas.edu.au](mailto:Richard.Coleman@utas.edu.au)**

### **Abstract**

Gravity observations in Antarctica date from the mid 1950's when Antarctic bases were established at Dumont D'Urville by the French and Mawson by the Australians. However it was not until the IGY and the establishment of McMurdo by the Americans that gravity observations reached a reliable level. There were two major reasons for this. The first was the shorter transport times that the air link between Christchurch and McMurdo provided. The second was the use of the first global ranging Lacoste and Romberg instruments. These early gravity observations were primarily driven by a geophysical need. The need to interpolate the ice/rock interface as determined by seismic methods. However in 1964 it was recognised that changes in gravity could provide a "better" method of determining ice volume/thickness changes in Antarctica than conventional levelling. The Australian gravity program thus became a glaciological rather than a geophysical program.

During the period 1970 to 1985 there are several good ties between Australia and Casey (Wilkes) and Mawson all with Lacoste and Romberg gravity meters. In several instances these meters were also run over the Christchurch-McMurdo leg of the Western Pacific Calibration Range. More recently two of the meters that participated in these surveys again occupied the fundamental marks in the Casey (Wilkes) area. Calibration was effected via the Australian Calibration line which now has absolute values on its major stations.

An analysis of the data shows, statistically, that the gravity change at Casey is zero over the period 1957 to 2004. This is in agreement with GPS observations at Casey. We are able to interpret this zero change in terms of ice loading models as developed by Budd and latter by Goodwin et al. We show that Goodwin's model B of ice extent at the last glacial maximum is to be preferred over both of the more extensive Budd and Goodwin A models. This result suggests that the Antarctic ice mass along this sector of Wilkes Land was less than previously thought.

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## **GNSS related systems for mining and agriculture**

**Martin Nix**

### **Abstract**

Leica Geosystems established a center for product development in Brisbane in 2003. The center is focused on guidance and control systems for off-road vehicles and as such, GNSS lies at the core of the positioning of the machinery. The contribution of GNSS to mining and agriculture operations throughout the world is significant and the Australian designed and developed products will be presented as examples of the contribution. New R&D initiatives in GPS augmentation as well as "location aware" site monitoring systems for mining and agriculture will further enhance safety and productivity on site. The potential impact for the site, the design of machinery and thus agriculture and mining industries will be considered in the presentation.

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## **Some Aspects of Electronic Distance Measurement**

**Jean M. Rüeger**

### **Abstract**

During his time at UNSW, the speaker has worked on many facets of electronic distance measurement (EDM). On this occasion, he will summarise some of the many areas of work: EDM instrument calibration, use of cheap reflectors, atmospheric models in EDM (local scale parameter method), refractive indices of light and radio waves, reciprocal and leap-frog EDM height traversing.

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## **Development of a BOC/CA Pseudo QZS and Multipath Analysis Using an Airborne platform**

**Toshiaki Tsujii, Hiroshi Tomita, Yoshinori Okuno, Satoshi Kogure, Motohisa Kishimoto**  
**Japan Aerospace Exploration Agency**

**Kazuki Okano, Dinesh Manandhar, Ivan Petrovski, and Masahiro Asako**  
**Institute of Advanced Satellite Positioning Technology, GNSS Technologies Inc.**

### **Abstract**

Japan has been investigating a new satellite based positioning system called Quasi-Zenith Satellite System (QZSS). The service area is limited to Japan and nearby countries since the QZSS consists of Quasi-Zenith satellites and geostationary satellites. The orbit of QZS is designed so that the users in Japan can observe the satellite at nearly zenith angle. Therefore, the QZSS is expected to enhance the availability of positioning in urban/mountainous area. A binary offset carrier (BOC) modulation is supposed to be used for one of QZS signals.

The aviation group of JAXA and GNSS Technologies Inc. have developed a pseudolite, which transmits BOC(1,1) as well as C/A., and conducted flight tests. The pseudolite was installed on a helicopter and was considered as a pseudo QZS. Several tests to measure the multipath effect on BOC and C/A signals were conducted and the results will be shown in the meeting.

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