EPSM-abec 2008 Conference notes

Engineering & Physical Sciences in Medicine and Australian Biomedical Engineering Conference

This is a summary by Anne-Louise Smith of interesting talks, workshops, speakers and posters that were presented in Christchurch 2008.

Plenary Sessions

T Peters A virtual reality environment to guide minimally-invasive intra-cardiac procedures

> *From Robarts Research, Canada www.robarts.ca*
>
> *CABG (coronary artery bypass grafts) use Da Vinci system to track the expected path of cardiac blood vessels under the rib cage so access port positions can be identified between the ribs and tools to reach the required portion of the blood vessel*
>
> *Mitral valve replacement through bagpipe-like dacron pouch, all 3 tools have access to pouch, airlock allows each tool access through the same opening without leaving it open.*
>
> *Transesophageal echo/US has lots of problems with the display – hard to understand. Use virtual reality effect by locking MRI to ultrasound image using a CT with a magnetic tracking system (MTS, Aurora)*
>
> *Brains & knees much easier to operate on than heart and lungs; there are no beating or breathing movements.*
>
> *Problems to overcome with virtual reality are: target location, tool collision, visual difficulties and tissue movement.*
>
> *Pre-op images different from op images due to tissue movement, hence tissue movement is an issue for cardiac models.*
>
> *AURORA: magnetic tracking system used in the designs*

P Hunter Computational Physiology - or putting Humpty Dumpty back together again
John Strong Memorial Lecture (public lecture)

> *Director, Bioengineering Inst, Uni Auckland, NZ*
> *http://www.bioeng.auckland.ac.nz/projects/index.php (lots of pictures)*
>
> *The Physiome Project (physiome = life as a whole) is a worldwide public domain effort to provide a computational framework for understanding human and other eukaryotic physiology. It aims to develop integrative models at all levels of biological organisation, from genes to the whole organism via gene regulatory networks, protein pathways, integrative cell function, and tissue and whole organ structure/function relations. Current projects include the development of:*
>
> *- ontologies to organise biological knowledge and access to databases*
>
> *- markup languages to encode models of biological structure and function in a standard format for sharing between different application programs and for re-use as components of more comprehensive models*

> *- databases of structure at the cell, tissue and organ levels*
>
> *- software to render computational models of cell function such as ion channel electrophysiology, cell signalling and metabolic pathways, transport, motility, the cell cycle, etc. in 2 & 3D graphical form*
>
> *- software for displaying and interacting with the organ models which will allow the user to move across all spatial scales*
>
> *Check out Figure 2 in this document that shows the spatial scale covered by this project (range 10^9): 2003: Hunter Peter J; Borg Thomas K Integration from proteins to organs: the Physiome Project. Nature reviews. Molecular cell biology 2003;4(3):237-43. http://www.bioeng.auckland.ac.nz/physiome/NatureReviewHunterBorg.pdf*
>
> *ONLINE MODEL RESOURCE*
>
> *Have started an online resource of models www.cellml.org*
>
> *Taken models from peer reviewed articles, you can download and run them from the web page, coded in CellML, can view the mathematics and can interact with the model. In future will be able to create your own composite model from the library of models with the mathematics behind it already.*

Clinical Engineering

Clinical Engineering-AS/NZS-3551 - Where Next?

Monday

R Wilkins & S Clifton Guidance on Management of medical equipment - How much to test? How often? How tied should the testing routine be to the manufacturers' specifications?

> *The current proposal is for a minimum set of tests similar to that required before an anaesthetist can use an anaesthetic machine: they are required to perform a leak test. That one test determines the functionality of the device to their requirement. They are also looking for a new term to replace Risk Management.*
>
> *Discussion documents are available for comment on the biomedical wiki pages: http://bme.asn.au These documents are due to be updated again real soon now, so if you think you have a lot to comment on, just check with Rob Wilkins as to when the latest document will be available.*
>
> *National Panel on Clinical Engineering developing guidelines with ACHS on Safety and Functional Testing of Medical Devices*
>
> *http://bme.asn.au/wiki/index.php/National_Panel_on_Clinical_Engineering_developing_guidelines_with_ACHS*
>
> *Setting the priorities for medical equipment testing - Draft 4*
>
> *http://www.bme.asn.au/wiki/images/docs/2008/Setting_priorities_080621.pdf*

M Flood Risk Management in the real world

> *Must document risk management process, including residual risk and if it is tolerable*

B Morrison Databases- Everyone has one. Why don't we standardise?

> *Bruce investigated their database of electrical safety tests to analyse 18 years of LifePak 9 (30 devices) use and 10 years of Baxter FloGards to find there was no change of electrical safety characteristics over time, they don't exceed AS3551:2004, and devices don't get worse with age. Use the power of the database to assess likelihood of events occurring, document then change test patterns accordingly.*

GE sponsored session: M Armstrong Asset Management - Case study

A Richards Peer review and benchmarking

Clinical Engineering Practice
Tuesday am

J Davie Performance and safety testing of medical equipment

K Wilson Using risk management to manage planned maintenance of biomedical technology

J Neville Unified biomedical asset management system

S Scahill Modular servicing, a wolf in sheeps clothing.

M Lovett The forgotten side of mechanical support; technical support; optimising outcomes in a remote mechanical support program

Clinical Engineering Technology & Development
Tuesday pm

Keynote Address T Cooper (2x15min) 80001: Network Classification & Wireless Network Management and IHE PCD: What is REAL vs. what is a DREAM

T Cowan Creating a partnership with your information and communications technology department

J Coles Wireless networking for infusion pump management

G O'Grady A novel instrument for the laparoscopic measurement of gastric electrical activity and invivo validation in a porcine model

M Oldakowski Design of a polymeric two-part intramedullary nail

Biomedical Engineering Services
B Morrison New frontiers - new areas of IT, imaging, clinical networks, clinical information systems and their interactions with conventional medical devices and networks

GE Sponsored sessions

Monday: D Venning Anaesthesia Technology – Current and future trends in electronic workstations

Thursday: A Barnhill Healthcare IT Education "Securing the Healthcare Environment" and "DICOM"

Clinical Engineering Respiratory Workshop

Part 1
Wednesday 9.00

W Morriss The Oxygen Cascade – How oxygen gets from the atmosphere in our cells

Part 2
Wednesday 10.30

P Kelly Clinical aspects of a respiratory lab – What we measure and what it means

S MacDonald Imaging the respiratory system

M Hlavac Common respiratory ailments and` treatment

Part 3
Wednesday 13.30

G Shaw Lung recruitment and ventilator weaning

D Bowie Differences between spinal injuries ventilation and anaesthetic/ICU ventilation

G Shaw Research frontiers in Respiratory Medicine

Part 4
Wednesday 15.30

J Jones Sleep unit introduction – testing and treatment of sleep disorders

G Robinson Flight retrieval and hypobaric medicine

S Inglis Hyperbaric medicine

Posters

33 C Fox Development of a new instrument for assessment of patient motion

40 J Jor A structurally-based model of skin mechanics

41 J Yoo Cheap and simple multichannel optic module for urinalysis

43 P Atkin RCD area testing using attribute sampling systems

45 P Du Computational simulations of gastric electrical activity

48 J Khoo Power characterisation of digital signal processing schemes in a wireless on-body-network, long-term monitoring system

51 G Poudel A 2-D pursuit tracking task for behavioural detection of lapses

55 V Chin Magnetic safety test for equipment in intra-operative MRI

> *MRI use inside OT allows new opportunities for unexpected interactions with magnetic materials. The poster from RPA describes how devices were tested for compatibility by tethering the devices, moving them into the field and measuring the movement force.*
>
> *ALS: Any chance of permanent installation of this test?*

Clinical Research

Clinical Modelling
Monday13.30

N Abdul Razak Clinical data validation of a new, physiologically relevant critical care glycaemic control model

P Docherty Clinical model-based assessment of insulin sensitivity – fewer measurements and high resolution

J Parente Model based insulin sensitivity as a metabolic marker for sepsis in the ICU

A Le Compte Blood Glucose Modelling and Control for Pre-term Infants

J Boyle Forecasting emergency department daily admissions

N Chepa Predicting the spread of cancer using neural networks approach

Biomedical Instrumentation
Monday 16.00

H Round Breathing stabilization with a solenoid array

D McCormick Small animal implantable telemetry system

> *Internally measures BP (tube filled with thixotropic gel, with ambient pressure at receiver) and sympathetic nerve activity.*
>
> *Spin-off company made to commercialise: Telemetry Research Inc.*
> *www.telemetryresearch.com* *www.bioeng.auckland.ac.nz/commercial/telemetry*

O Pallotta Testing lymphoedema viscoeleastic tonometer

L Burrow Abdominal palpation simulator: forces applied

Applied Biomechanics
Wednesday 10.30

O Pallotta Instrumented implants - a review

C Marincek Functional Electrical Stimulation

M Crichton Micro-nanoprojection array patches for targeted vaccine delivery to skin: investigation of mechanical penetration interactions

V Rajagopal Breast Biomechanics for Multi-Modal Image Analysis

M Javadi A 3D parametric model of lower cervival spine (C3-C7)

C Field Biomechanical response in mandibular bone due to mastication loading of 3-unit Fixed Partial Dentures (FPD)

Physiology/Signal Processing
Thursday 10.30

G Poudel Increased multisensory activity during cued slow-eye-closure while performing a visuomotor tracking task: an fMRI study

J Egbuji In-vivo mapping of gastric electrical activity

A Ghoreyshi Identification of oculomotor subsystems: multiple input/single output systems

E Tkacz ICA and spectral analysis of electrogastrogram signal

T Perera Working towards a non-invasivecontinuous blood-glucose monitor

S Yasini Blood glucose regulation in type I diabetic patients using robust Hinfinity control

Workshop: Innovation in Medical Technologies

Part 1

Tuesday 10.30

D Hortle (Cochlear, Australia) Market research

> *Biomeds are innovators and early adopters that like new features; they tend to sell products as if the market were also early adopters. The largest part of the market is mainstream: early herd and late conservatives, who shy away from anything with new features/miracles that looks risky. They need to know that it is an everyday device, and rely on word of mouth to be assured that everyone else is using it. Development of a well-known brand relies on marketing an experience for an emotional response, not technology & features for a rational response.*
>
> *Cochlear experience: Change from marketing to innovators and leading edge surgeons: miracle of hearing and whiz-bang technology, to marketing to mainstream adults: 'everyday hearing for everyday life' and 'you are entitled to hear; it is a disgrace not to hear' (give people sense of anger and indignation to demand hearing from their doctor).*
>
> *Culture of the people is very important when trying to sell the products – technology transfer.*
>
> *Need to feed into the clinical loop and understand how people are recommended to use hearing aids and find out way they fall through the gaps.*
>
> *A brand can help protect your product from rival products. A brand is a result of an emotional response. People have a feeling about the brand rather than compare the specs to make a decision. E.g. Colgate toothpaste, people buy it even though it has same ingredients as other toothpastes.*

S McKenzie (Endeavour Capital, NZ) Early stage funding

> *What they look for 1) Overwhelming customer need with responses like: finally, thank goodness, at last, no-brainer purchase decision, 2) Market size large enough to support $50 million in 5 years, 3) Competition – lack of highly motivated, well-resourced competitors*
>
> *Next they look at the people and IP: Have the people met similar challenges before – commercial, technical & regulatory? Is the IP in a robust position especially for a medical device, and is there freedom to operate?*

> *For early stage evaluations, don't use discounted cash flow as there is too many unknowns and it should only be applied to stable business models. Flexibility in the business plan is essential. An analysis of Havard spinoffs showed that 200 failed and 200 succeeded. Of those that succeeded, 91% used an entirely different business strategy than that presented initially. Most that failed stuck with the same business plan they started with.*
>
> *Serial entrepreneurs should aim to own 20-25% when they exit. If it is any less than this, they tend to stop working so hard because the returns are too small.*
>
> *To see how hard it is to pick good ideas to back, look at Bessamer Venture Partners, one of US oldest and most successful venture capital firms that still get things wrong. They have an AntiPortfolio of opportunities that didn't think would work: eBay, Federal Express (FedEx), Google… www.bvp.com/Portfolio/AntiPortfolio.aspx*

A Smith (Davies Collison Cave, Australia) Intellectual property and medical devices

> *Definition of novel and inventive: not apparent to the well-read idiot who is not an insightful person.*

M Flood (Therapeutic Goods Agency, Australia) Regulation in innovation – an embuggerance or a necessity!

> *ALS Prize for best presentation title*

Part 2

Tuesday 13.30

J Stonier (Davies Collison Cave, Australia) Key licensing issues

> *You don't get the deal you deserve; you get the deal you negotiate.*
>
> *Subject matter: patent, know-how, with technical assistance, manufacturing, distribution rights*
>
> *Extent of rights: make, use, sell; geographical; exclusive, sole, non-exclusive, sub-licence*
>
> *Financial and commercial considerations: lump sum, milestone payments, royalties*
>
> *Valuation of intangible assets – here are 3 options*
>
> *1) Licensors investment in technology OR cost of best alternative for licensee to replicate*
>
> *2) Licensees potential profit increase or cost savings: starting rule of thumb ¼ to 1/3 of benefit to licensor. Impact of risk also a factor: state of technology, maturity of industry, capital infrastructure needed. Eg: sales price $1500, costs $750, thus profit $750, ¼ = $187.50 which is roughly 12.5% of sales price.*
>
> *3) Comparable market transactions, industry or product norms: vaccine royalties 5-10% net sales, varies with exclusivity, maturity, stage of trials.*

K Reynolds (Flinders Medical Devices & Technologies, Aust.) The medical device partnering program in SA

L Kotan (Dynamic Controls, NZ) Manufacturing: from prototype to production

> *DFM, Design for manufacture – Material: about 80% of manufacture cost, must have accurate parts list (manufacturer, part number, values, range allowed), designer & manufacturer need to work form same component library*
>
> *DFM-Process: pre-build recommendations, FMEA/PFMEA*

DFT, Design for test: not just functionality at end, also programming, data storage, logistical functions, input from designer – how can product be tested, input from manufacturer – how should product be tested.

Part 3
Tuesday 15.30

R Fright (ARANZ Medical, NZ)

They are the group that make the FastSCAN that Neil Piller uses

Start up company with a scanner product but not sure of the market. Sold it via the web to lots of different groups with different needs and uses for the product. This created a range of needs for the software that came with the scanner. The group decided to focus on one market area and write the software for that one area – Prosthetics

Later released software that was used for mining applications – Leapfrog

Silhouette

scans ulcers and wounds

exports to hospital system

wound measurement – depth, area, colour

pressure sore tracking method

resistance to the technology due to the market group – 45 years – don't perceive that technology is the answer

S O'Neill (Enztech, NZ)

Company that makes tools to assist putting in implants. Knees, spinal, hip maxi facial

Make tools for the much larger implant companies – Zimmer, Johnson and Johnson

Have developed a brand

LISTENING AND WATCHING THE CUSTOMER IS VERY IMPORTANT -> GOOD PRODUCTS

PROTOPYE EARLY, PROTOTYPE OFTEN AND QUCIKLY

S Gowland (Mobile Medical Services, NZ)

Sharing equipment, sharing knowledge to rural areas

Mobile hospital facilities – PET, medical robotics, day surgery van

Mobile knowledge – data transmission rate too low – delay, need 3 -5Mb/sec.

Telepresence gives assistance or learning environment

Augmented reality – put images onto anatomy

Virtually taking the GP to surgery location

Ship – medical treatment, circles the islands loops every 6 weeks. Has cardiac surgery facilities, educational resources and entertainment.

Rehabilitation

Rehabilitation Therapy
Tuesday 15.30

C Pretty Glucose control and drug therapy

A Sundaresan Minimal model of lung mechanics for optimising ventilator treatment of ARDS

> *Working with data from Flinders ICU*

A-L Smith Predicting fentanyl-induced loss of airway tone

C Innes Predicting driving ability with and without dementia

L Le-Ngoc Validation of a new hand-held dynamometer with simultaneous force and angle measurement

E Passmore Trans-oesophageal pulse oximeter

Rehabilitation
Thursday 10.30

K Kiguchi Adjustment of assisting walking patterns of a lower limb powerassist exoskeleton according to walking velocity

J Nicholls Clinical experiences of a prototype exercise system that combines bilateral upper limb exercises and augmented reality.

J Khoo Wireless on-body- network breathing rate and depth measurement during activity

M Heitger A novel biomarker of post-concussion syndrome

S Lin Sensory control of leg muscle activation during locomotion in stroke patients in relation to knee joint position sense

D Budgett Closed loop frequency based power regulation for transcutaneous energy transfer systems

Virtual/Augmented Reality

Monday 1030

A Duenser Cybertherapy - The use of VR and AR in clinical assessment, treatment and rehabilitation

> *Virtual classroom – AHDA assessment – head movement.*
> *Good to show the parents and also monitor the effects of the conditions*
> *Rearrangement of 3D objects – spatial resolution, manipulation*
> *Rehabilitation – retrain spatial abilities*

> - *strokes*

- *simulate an environment e.g. supermarket, kitchen, fake knives*
- *can provide hints and tips*
- *motor rehabilitation*
- *more interesting and therefore more likely to do exercises compared to traditional rehabilitation*
- *game like features used e.g. sports – soccer*
- *see themselves achieving something and increases motivation*

Low cost environment possible

Stick with two balls and have image recognition software to track the movement

Haptic device – Falcon $200 and have two systems to allow simulation of pinching action.

The systems have to be different from games – games have no control of feedback, no over stimulus. The simulations have more control over the range and what you want to control

Pain distraction technique: during wound care, dental care. Studies have shown a decrease in pain during the use of VR

Disorder treatments: phobias- social, public speaking-vary the audience

Flight phobias, claustrophobia, animals, post traumatic stress disorder

Therapist training: -VR patient

Monday 1330

N Navab Action and workflow driven augmented reality (VIA video conference)

INTEGRATION OF IMAGING DATA TO CLINIAN IN A USEFUL WAY

X-rays, ultrasound, CT, PET etc all provide ample data and we need to be able to integrate the info into a usable form via a user interface.

Haptics/feeling is very important

Depth perception is difficult

Ghost viewing

project an image of the bone, muscle (info under skin) when you look at a region during surgery. – like superman's x-ray glasses

Virtual mirror

Allows you to see regions not exposed during surgery. E.g. spinal surgery, can see the exposed spine but not behind the spine. Mirror uses the image data taken pre op to project an image for the user as to the information not visible during surgery. Allows alignment of drills, etc during surgery.

Virtual reality Drill

Screw into spine at the right angle from image data projected onto the body during surgery. Provides visual feedback as to the angle of the drill.

Culture of the clinician

> *Need to change the culture of clinicians to accept the technology. This will become easier as medical simulation will adjust the cultural change.*

Monday 1400

R Eagleson Perceptual capacities and constraints in augmented reality biomedical displays

> *Cognitive science perspective of VR*
>
> *THE WAY OUR MINDS CAN TRICK US WITH VISCUAL INFORMATION IS IMPORTANT IN VR AND AR DESIGNS*
>
> *Projection of image is very important – shadows, reflections, translucence, gradients, global luminance*
>
> *Volumetric images are difficult to create*
>
> *Graphical user cards can deal with some of these things, but not real time*
>
> *Context is required for recognition*

Biomedical Instrumentation

Monday 1530

H Round Breathing stabilization with a solenoid array

> *Solenoids were placed on the chest to force the person to breath at a set pattern for gated radiotherapy*
>
> *System is better than the air bag system but still needs further work*

Monday 1545

D McCormick An implantable telemeter for chronic recording of blood pressure and sympathetic nerve activity in small animals

> *Spin of company from a NZ university working on a telemetry unit for rats*