



Premier of Alberta

Office of the Premier, 307 Legislature Building, Edmonton, Alberta T5K 2B6 Canada



## **MESSAGE FROM HONOURABLE RACHEL NOTLEY, PREMIER OF ALBERTA**

On behalf of the Government of Alberta, it is my pleasure to welcome everyone to the Canadian Medical and Biological Engineering Society (CMBEC) 39 Conference.

Thank you for all the work you do to advance Alberta's medical community. As you take part in this forum, remember that improving communication and encouraging collaboration are the building blocks of the advancement of engineering, the life sciences and medical professions.

This conference offers delegates many opportunities to discover new ideas, develop working relationships and strengthen existing partnerships that will help your profession continue to move forward. At the end of this year's conference, I hope you feel energized, inspired and ready to put your new knowledge into practice.

A special thank you to the many organizers and volunteers who helped make this event a success. Best wishes to all for a memorable time in our beautiful province and a successful CMBEC39.

A handwritten signature in blue ink, appearing to read 'RN'.

**Rachel Notley**

*May 24, 2016*



## **MESSAGE FROM NAHEED K. NENSHI, MAYOR OF CALGARY**



On behalf of the citizens of Calgary and my City Council colleagues, I am pleased to welcome you to Calgary for CMBEC 39.

Over the coming days, researchers and practitioners in biomedical engineering and medical technology will have the chance to exchange valuable knowledge. Conferences such as this provide a wonderful opportunity for professionals to advance understanding and facilitate innovation, which is ultimately beneficial to Canadians accessing healthcare.

I would like to recognize the Canadian Medical and Biological Engineering Society for their hard work in putting together this conference for many years. The Society continues to show a tremendous dedication to the betterment of their field.

I hope that those of you visiting Calgary are able to explore everything our city has to offer, from the many parks, museums, restaurants and shopping districts. Wherever you go, you will encounter our special brand of western hospitality. Please enjoy your stay and I trust we will see you again soon.

Sincerely,

A handwritten signature in black ink, appearing to read "Naheed K. Nenshi", with a horizontal line underneath.

**Naheed K. Nenshi**  
MAYOR OF CALGARY

# Welcome / Bienvenue

## Message from CMBES President, Martin Poulin



On behalf of the Canadian Medical and Biological Engineering Society, I would like to welcome you to Calgary for our 39th national conference.

The committee organizers have worked hard to put forward a great program with 3 streams including the Academic, Clinical, and Biomedical Technology areas. We also have an impressive line-up of educational courses, which have been oversold.

I would like to extend my appreciation for the support of our Industry Partners who will be on hand Wednesday and Thursday to market their latest products and services. Please spend some time at the Exhibit Hall to show appreciation for their efforts to support our event. Note that there will be a prize drawn for those who visit all the booths.

Please enjoy the learning and sharing with colleagues over the next few days and don't forget to join us at the Banquet and Awards Night on Thursday. I also hope you have a little bit of spare time to enjoy some of the sights around Calgary.

Au nom de La Société Canadienne de Génie Biomédical, je vous souhaite à tous la bienvenue à Calgary pour notre 39<sup>ème</sup> conférence nationale.

Le comité organisationnel a travaillé très fort pour mettre sur pied un programme extraordinaire avec 3 volets qui comprennent la recherche académique, le volet clinique et les technologies biomédicales. Nous avons également une gamme impressionnante de cours de formation, qui ont été très demandés.

Je tiens également à exprimer mon appréciation auprès de nos partenaires de l'industrie qui appuient la conférence et qui exposeront leurs nouveaux produits et services sur place lors du congrès le mercredi et le jeudi. Prenez le temps de passer à la salle d'exposition pour aller les rencontrer et les remercier de supporter notre conférence. Noter qu'il y aura un tirage au sort pour ceux qui visitent le plus de kiosques.

Je vous souhaite de profiter de cette opportunité d'apprentissage et de partage avec les collègues au cours des prochains jours et n'oubliez surtout pas de nous rejoindre jeudi soir, pour le banquet et la Cérémonie de Remise des Prix. J'espère également que vous trouverez un peu de temps libre pour apprécier les attraits de la ville de Calgary et ses alentours.

I look forward to meeting many of you over the next few days.

Sincerely,

Martin Poulin, M.Eng., P.Eng.  
President, CMBES/SCGB

# Welcome from the CMBEC39 Organizing Committee

## Message from CMBEC39 Organizing Committee Chair, Kelly Kobe



On behalf of the 2016 CMBEC39 Organizing Committee, I'm excited to welcome you to Calgary, the home to the world renowned "Calgary Stampede – The Greatest Outdoor Show on Earth" and the gateway to the magnificent Canadian Rockies!

For the past year, the organizing committee have put in an incredible amount of time and effort into planning and bringing together an excellent program for which you are about to participate. I would like to take this opportunity to express my thanks to all members of the committee for their endless efforts, as well as Natalia Kaliberda and the Willow Group for all their hard work & support and ensuring we stayed on schedule.

With a full line up that covers the Clinical Engineering, Academic and Biomedical Technology streams including all the sold out Continuing Educational courses, it might be challenging deciding on which sessions to attend. We also wanted to ensure there is plenty of time for networking with colleagues from across Canada, so we have arranged a Meet & Greet Reception on the eve of the conference, an Opening Reception, Atrium Social, a Cocktail Hour event, and of course the Dinner Banquet, not to mention the time between sessions including lunch and touring through the vendor exhibit hall.

We also want to thank all of the vendors who are supporting the conference this year by participating with the exhibit hall and sponsorship opportunities, without their support this conference would not be possible.

With such a busy schedule we're still hopeful that you'll be able to find some time to see the sights and attractions that Calgary and surround area has to offer!

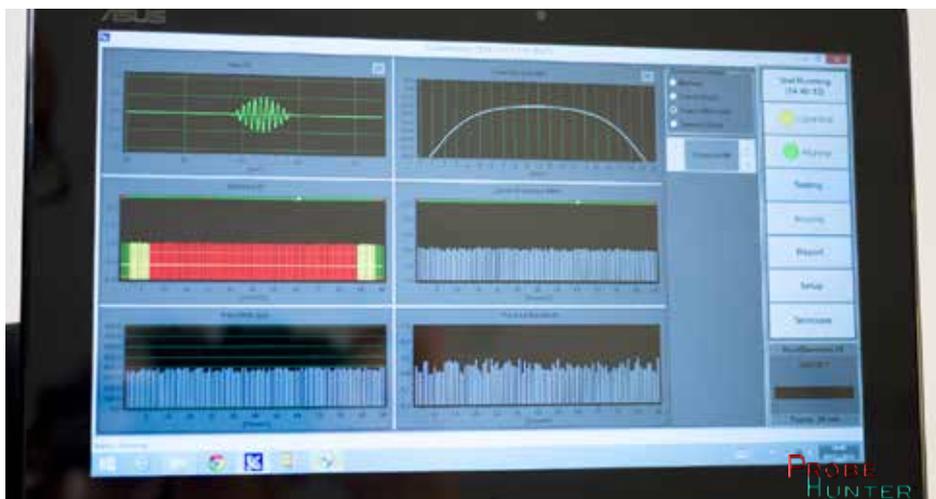
I look forward to seeing you all during the conference.

Sincerely,

A handwritten signature in black ink that reads "Kelly Kobe". The signature is written in a cursive, flowing style.

**Kelly Kobe, P.Tech(Eng.), CBET(c)**

CMBEC39, Organizing Committee Chair



## Quality Assurance of Ultrasound Probes

*ProbeHunter is a multi-brand testing device. The product is the result of Scandinavian innovation and a world-wide network of engineers and medical professionals.*

ProbeHunter is a multi-brand, real-time testing system for ultrasound probes, developed by a worldwide network of engineers and medical professionals. It's a pioneer device, enabling hospitals and ultrasound dealers to ensure the quality of the probes. Why is it important to test probes? Transducers are highly sensitive instruments, not only is the lens extremely vulnerable to rough handling, but probes' insides contain hundreds of crystals - each required to function perfectly in order to provide a correct medical diagnosis.

The most common reasons for faulty probes are rough handling (such as accidentally squeezing the cable or shocks during transport), using the wrong gel and/or cleaning detergent. A common misconception is that these damages are visible on the ultrasound screen, in reality, they

are not. "Many times doctors believe they can catch a faulty probe through the images, this is not the case," says Bjorn Segall, CEO of ProbeHunter Intl.

ProbeHunter provides dynamic testing without interrupting the regular work flow and everyday usage of probes, its adapters are designed to fit all major brands on the market - and given its living nature - ProbeHunter is able to test every new probe as soon as it's on the market. The team behind ProbeHunter has more than three decades of experience in ultrasound and has been testing probes in Scandinavian hospitals for the last 13 years.

**PROBE  
HUNTER®**  
www.probehunter.com



## 2016 CMBEC39 CONFERENCE ORGANIZING COMMITTEE

### **Conference Chair**

Kelly Kobe

*Alberta Health Services*

### **Academic Program**

Nigel Shrive (Chair)

*University of Calgary*

### **Clinical Engineering Program**

Amanda Saigeon (Co-Chair)

*Alberta Health Services*

Darrel Nilsson (Co-Chair)

*Alberta Health Services*

### **Biomedical Technology Program**

Wendy Stafford (Co-Chair)

*Alberta Health Services*

Jesse Esperame (Co-Chair)

*Alberta Health Services*

### **Continuing Education Program**

Roy Sharplin (Co-Chair)

*Northern Alberta Institute of Technology*

Nisha Madan (Co-Chair)

*Alberta Health Services*

### **Treasurer**

Kyle Eckhardt

*Winnipeg Regional Health Authority*

### **Exhibit/Sponsorship**

Martin Mass (Co-Chair)

*Alberta Health Services*

Bud Haycock (Co-Chair)

*Alberta Health Services*

### **Local Arrangements**

Carl Anderson (Co-Chair)

*Alberta Health Services*

Jamie Jaffray (Co-Chair)

*Alberta Health Services*

### **Website Support**

Michael Hamilton

*Winnipeg Health Sciences*

### **Conference Planning**

Natalia Kaliberda and

Shirley Trowbridge

*The Willow Group*

Murray Rice (Long Term Conference  
Chair – CMBES)

*University Health Network*

CMBES would like to thank this dedicated group of volunteers and professionals for their time and energy in coordinating this year's Conference.



## 2016 CMBEC 39 CONFERENCE - **KEYNOTE SPEAKERS**



### **Dr. Joseph Cafazzo**

**Wednesday, May 25, 8:00 am - 9:30am**

Dr. Joseph Cafazzo is Lead for the Centre for Global eHealth Innovation, a state-of-the-art research facility devoted to the evaluation and design of healthcare technology, hosting seventy researchers and staff. Dr. Cafazzo has been an active researcher of the use of technology to facilitate patient self-care of complex chronic conditions such as diabetes, end-stage renal disease, and congestive heart failure. He has advised and conducted research for public sector policy makers and private sector medical technology companies on the design and safety of technology in healthcare. He is Senior Director of UHN Healthcare Human Factors – the largest group of its kind devoted to the application of human factors engineering to problems of healthcare delivery and patient safety. He is Associate Professor in the Department of Health Policy, Management and Evaluation, and the Institute of Biomaterials and Biomedical Engineering, Faculty of Medicine, University of Toronto, where he teaches and conducts research in the areas of human factors, clinical engineering, and health informatics. In 2010 he was the recipient of the Career Scientist award by the Ontario Ministry of Health and Long Term Care.



### **Alan Mallory**

**Thursday, May 26, 8:00 am - 9:30 am**

**Reaching New Heights: Insights from the Summit of Mount Everest**

Climbing Mount Everest is considered one of mankind's greatest feats of human endurance. The two-month quest to reach the highest point on earth is a journey filled with unparalleled challenges and some of the roughest and most extreme conditions imaginable. In the spring of 2008, Alan Mallory embarked on the adventure of a lifetime after an incredible self-guided expedition on the mountain. The expedition challenged the mental, emotional and physical limits of their entire beings but to finally reach the end goal was an incredible feeling! Alan's presentation is an engaging visual and emotional journey that is supported by many of the stunning photos and short video clips captured along the gruelling quest to the top. It highlights the importance of many leadership qualities such as strategic planning, effective communication, teamwork and trust as well as the mentality and passion involved in conquering one's own Everest.



2016 CMBEC39 CONFERENCE

# Schedule-at-a-Glance

Tuesday, May 24, 2016

7:30 am – 8:00 am **Registration and Breakfast** ..... Grand Foyer 1/Bannerman

8:00 am – 11:30 am **Continuing Education Course**

**CE1**

**Location:  
Neilson 2**

**Lifepak 15 Service  
Training**

*Larry Hallett, Physio Control*

**CE2**

**Location:  
Neilson 1**

**Force Triad Service  
Training**

*Eric Levis, Medtronic*

9:30 am – 10:00 am **Refreshment Break** ..... Bannerman

11:30 am – 12:30 pm **Lunch** ..... Bannerman

12:00 pm – 4:00 pm **The shuttle pick-up location is at the Hyatt lobby entrance at 12:00 pm**

**South Health Campus**

*"Behind the Scenes" Tour*

12:30 pm – 4:00 pm **Continuing Education Course**

**CE1**

**Location:  
Neilson 2**

**Lifepak 15 Service  
Training**

*Larry Hallett, Physio Control*

**CE3**

**Location:  
Neilson 1**

**Force FX Service  
Training**

*Eric Levis, Medtronic*

2:00 pm – 2:30 pm **Refreshment Break** ..... Bannerman

7:00 pm – 9:00 pm **Atrium Social - Meet and Greet Reception** ..... Atrium

Access the schedule via your mobile device at [www.pheedloop.com/cmbec](http://www.pheedloop.com/cmbec)  
or [www.plp.io/cmbec](http://www.plp.io/cmbec) (No download is required)



# Wednesday, May 25, 2016

- 7:30 am – 8:00 am      **Registration and Breakfast** ..... Grand Foyer 1/3
- 8:00 am – 8:15 am      **Conference Opening and Welcome Remarks** .... Plenary Imperial Ballroom  
*Kelly Kobe, CMBEC39 Conference Chair*
- 8:15 am – 9:30 am      **Keynote Address:** ..... Plenary Imperial Ballroom  
**The Hospital at Home: The Evolution of Technology Design for Patient Self-Care**  
*Dr. Joseph Cafazzo*
- 9:30 am – 10:00 am      **Refreshment Break** ..... Grand Foyer 3
- 10:00 am – 11:30 am      **Concurrent Sessions**

<p style="text-align: center;"><b>A1</b></p> <p style="text-align: center;"><b>Location: Bannerman</b></p> <hr/> <p><b>Biosignal Acquisition and Processing</b></p>	<p style="text-align: center;"><b>B1</b></p> <p style="text-align: center;"><b>Location: Herald</b></p> <hr/> <p><b>Medical Battery Regulation</b></p> <p><i>Russell Gottschalk, Compliance and Enforcement Specialist, Health Canada</i></p>	<p style="text-align: center;"><b>C1</b></p> <p style="text-align: center;"><b>Location: Stephen</b></p> <hr/> <p><b>Medical Equipment &amp; IT Integration</b></p> <p><i>Penny Rae, Chief Information Officer, AHS</i></p>
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<p style="text-align: center;"><b>CE1</b></p> <p><b>Location: Neilson 2</b></p>	<p><b>Lifepak 15 Service Training (Cont'd)</b></p> <p><i>Larry Hallett, Physio Control</i></p>	<p style="text-align: center;"><b>CE4</b></p> <p><b>Location: Neilson 1</b></p>	<p><b>Medical Laser Safety Fundamentals</b></p> <p><i>Mathew Tracy, BET Instructor, NAIT</i></p>
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# Wednesday, May 25, 2016

11:30 am – 12:30 pm **Lunch** ..... Exhibit Hall  
12:30 pm – 2:00 pm **Concurrent Sessions**

<p style="text-align: center;"><b>A2</b> <b>Location: Bannerman</b></p> <p><b>Biomechanics with other themes</b></p>	<p style="text-align: center;"><b>B2</b> <b>Location: Herald</b></p> <p><b>ASET Certification: Competency based assessment</b> <i>Jennifer Bertrand, ASET Registrar</i> <i>Eric Morin, ASET Manager of Corporate Relations</i></p>	<p style="text-align: center;"><b>C2</b> <b>Location: Stephen</b></p> <p><b>CMDSNet - Improving Medical Device Safety</b> <i>Colleen Turpin, Problem Report Information Specialist, Health Canada;</i> <i>Barbara Harrison, Senior Corporate Regulatory Compliance &amp; Enforcement Advisor, Health Canada</i></p>
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<p style="text-align: center;"><b>CE1</b> <b>Location: Neilson 2</b></p>	<p><b>Lifepak 15 Service Training (Cont'd)</b> <i>Larry Hallett, Physio Control</i></p>	<p style="text-align: center;"><b>CE4</b> <b>Location: Neilson 1</b></p>	<p><b>Medical Laser Safety Fundamentals (Cont'd)</b> <i>Mathew Tracy, BET Instructor, NAIT</i></p>
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**PSAV**  
Technology Meets Inspiration

Welcome to the Hyatt Regency Calgary!

Your conference room High Speed Internet Access is being provided by PSAV.

**To connect, please follow these instructions:**

- Connect to network called:
  - PSAV\_Event\_Solutions**
- Open your internet browser and you should be directed to the PSAV Login Webpage. If you are not transferred, please type in google.com into the address bar and click go. This should transfer you to the PSAV Login Webpage.
- Please enter the access code **CMBES6416** then click on the connect button  
**\*\*Please note that all codes are CASE SENSITIVE\*\***

If you have any questions, please [dial 581 55](tel:58155) on the house phone.

Have a great day!

Presentation Services Audio Visual

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# Wednesday, May 25, 2016

2:00 pm – 2:30 pm      **Refreshment Break** ..... Exhibit Hall  
 2:30 pm – 4:00 pm      **Concurrent Sessions**

<b>A3</b> Location: Grand Foyer 3	<b>B3</b> Location: Herald	<b>C3</b> Location: Stephen
<b>Review of both Academic and Clinical Engineering Papers in Poster Format</b>	<b>Convergence of Biomedical and “Traditional” Information Security Concerns</b> <i>Robert Martin, Chief Information Security Officer, AHS</i>	<b>Safety Related Papers</b>

<b>CE5</b> Location: Neilson 1	<b>Quality Assurance of Ultrasound Transducers/Probes</b> <i>Bjorn Segall, BBS Medical AB</i>
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4:00 pm – 5:00 pm      **Networking on the Trade Show Floor** ..... Exhibit Hall  
 5:00 pm – 7:00 pm      **Opening Reception** ..... Exhibit Hall  
 7:00 pm – 10:00 pm      **Atrium Social** ..... Atrium

# Thursday, May 26, 2016

7:30 am – 8:00 am      **Registration and Breakfast** .....Grand Foyer 1/3

Sponsored by:



GE Healthcare

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# Thursday, May 26, 2016

8:00 am – 9:30 am **Keynote Address** ..... Plenary Imperial Ballroom  
**Reaching New Heights: Insights from the Summit of Mount Everest**  
*Alan Mallory*

8:00 am – 9:30 am **Continuing Education Course**

**CE6**

**Location:  
Neilson 1**

**Advances in Ultrasound Transducer Technology and the Role of Modern Quality Assurances Test Technology**

*Dave Dallaire, Acertara Acoustic Laboratories*

9:30 am – 10:00 am **Refreshment Break** ..... Exhibit Hall  
Sponsored by:



GE Healthcare

10:00 am – 11:30 am **Concurrent Sessions**

**A4**

**Location: Bannerman**

**Biomedical Image Processing**

**B4**

**Location: Herald**

**New Landscape of BMET Accreditation, Registration and Certification**

*Anthony Chan, Biomedical Engineering Program Head, BCIT*

**C4**

**Location: Stephen**

**Supportability of Medical Devices - Do we have a "Right to Repair"?**

*Mike Capuano, CMBES*

**CE6**

**Location:  
Neilson 1**

**Advances in Ultrasound Transducer Technology and the Role of Modern Quality Assurances Test Technology (Cont'd)**

*Dave Dallaire, Acertara Acoustic Laboratories*

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# Thursday, May 26, 2016

11:30 am – 12:30 pm **Lunch** ..... Exhibit Hall

12:30 pm – 2:00 pm **Concurrent Sessions**

<p style="text-align: center;"><b>A5</b> Location: Bannerman</p>	<p style="text-align: center;"><b>B5</b> Location: Herald</p>	<p style="text-align: center;"><b>C5</b> Location: Stephen</p>
<p><b>Biomedical Image Processing</b></p>	<p><b>Going Green - Emission Reduction, Capturing Scavenged Anesthetic Waste</b> <i>Dusanka Filipovic, President and Vice Chair, Blue-Zone Technologies Ltd</i> <i>Kim Greenwood, Director of Clinical Engineering, Children's Hospital of Eastern Ontario (CHEO)</i></p>	<p><b>Across Canada Review - Western Canada</b> <i>Amanda Saigeon, AHS</i></p>

**CE7**  
Location: Neilson 1

**Minimizing Ultrasound Transducer Failure Through Proper Care and Early Detection**  
*Kyle Grozelle, Manager of Global Education & Training, Summit Imaging*

2:00 pm – 2:30 pm **Refreshment Break** ..... Exhibit Hall

Sponsored by:



GE Healthcare

2:30 pm – 4:00 pm **Concurrent Sessions**

<p style="text-align: center;"><b>A6</b> Location: Bannerman</p>	<p style="text-align: center;"><b>B6</b> Location: Herald</p>	<p style="text-align: center;"><b>C6</b> Location: Stephen</p>
<p><b>Biomedical Technology</b></p>	<p><b>Northern and Southern Alberta Renal Program</b> <i>Ed Doppler, Shripal Parikh, Nim Herian, AHS</i></p>	<p><b>Across Canada Review - Eastern Canada</b> <i>Bud Haycock, Alberta Health Services</i></p>

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# Thursday, May 26, 2016

## CE8

**Location:**  
Neilson 1

### Innovations in Ultrasound Systems Diagnostics

*Kyle Grozelle, Manager of Global Education & Training, Summit Imaging*

4:00 pm – 5:00 pm

**Networking on the Trade Show Floor** ..... Exhibit Hall

6:00 pm – 7:00 pm

**Atrium Social: Cocktail Hour** ..... Atrium

Sponsored by:



7:00 pm – 10:00 pm

**Banquet and Awards Presentation** ..... Plenary Imperial Ballroom

Sponsored by:



# Friday, May 27, 2016

7:30 am – 8:00 am

**Registration and Breakfast** ..... Grand Foyer 1/Imperial 123

8:00 am – 9:30 am

**Concurrent Sessions**

## A7

**Location: Bannerman**

**Biomedical Technology**

## B7

**Location: Herald**

**RFID Implementation in Healthcare - University of San Antonio**

*Gene Winfrey, Director  
Information Services, San Antonio University Hospital*

## C7

**Location: Stephen**

**Case Study: Preventing Deaths - Dealing with design issues of Patient Equipment**

*Gord McNamee, Mac West Healthcare Technology Consulting*

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# Friday, May 27, 2016

8:00 am – 4:00 pm **Continuing Education Session**

<b>CE9</b> <b>Location:</b> <b>Neilson 1</b>	<b>CBET Certification Exam Material Review</b> <i>Rick Tidman, Biomed Professor</i>
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9:30 am – 10:00 am **Refreshment Break** .....Imperial 123

10:00 am – 11:30 am **Concurrent Sessions**

<b>A8</b> <b>Location: Bannerman</b>	<b>B8</b> <b>Location: Herald</b>	<b>C8</b> <b>Location: Stephen</b>
<b>Tissue and Cellular Engineering</b>	<b>CMMS Database Implementation</b> <i>Bud Haycock, AHS</i>	<b>Performance and Quality Assurance Related Papers</b>

11:30 am – 12:30 pm **Lunch** .....Imperial 123

11:30 am – 1:00 pm **CMBES Annual General Meeting** ..... Herald

12:30 pm – 2:00 pm **Concurrent Sessions**

<b>A9</b> <b>Location:</b> <b>Bannerman</b>	<b>Biomedical Technology</b>	<b>C9</b> <b>Location:</b> <b>Stephen</b>	<b>Clinical Engineering in ressource limited countries related papers</b>
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2:00 pm – 3:00 pm **Closing Remarks and Presentation of Paper Awards** .....Stephen  
Student Paper Competition Sponsor:

## MAQUET-DYNAMED

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Generation of  
Ultrasound Probe  
Tests*

*Real-time, dynamic and  
multi-brand transducer  
testing*

*FirstCall Compatible,  
tests new & old  
probes*

***ProbeHunter**  
is a multi-brand,  
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device with innovative  
technology designed to  
assure the quality of  
ultrasound  
probes.*

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Patient  
Safety**



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more about this innovative  
testing system.

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TUESDAY, MAY 24, 2016

## Continuing Education

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**7:30 am – 8:00 am**

Registration and Breakfast

*Grand Foyer 1/ Bannerman*

**8:00 am – 11:30 am**

Continuing Education Courses

**CE1**

**Meeting  
Room:**

**Neilson 2**



### **Service Training Course: Lifepak 15 Defibrillator**

*Larry Hallett, Field Service Technician, Physio-Control Inc.*

Physio-Control Lifepak 15 Service Seminar is aimed to be the “gold standard” in customer education. Biomedical Equipment Technologists and Clinical Engineers attending our comprehensive Biomedical Training Seminar will get hands-on instruction in instrument inspection, troubleshooting, maintenance, and calibration procedures.

**CE2**

**Meeting  
Room:**

**Neilson 1**



### **Service Training Course: Force Triad Electrosurgical Unit**

*Eric Levis, QA & Technical Product Support Specialist, Medtronic*

Medtronic’s Force Triad Service Seminar is designed to teach Biomedical Equipment Technologists and Clinical Engineers how to install, setup, operate, and calibrate our electrosurgical equipment.

**9:30 am – 10:00 am**

Refreshment Break

*Bannerman*

**11:30 am – 12:30 pm**

Lunch

*Bannerman*

**12:30 pm – 4:00 pm**

**South Health Campus “Behind the Scenes” Tour**

*South Health Campus*

The shuttle pick-up location is at the Hyatt lobby entrance at 12:00 pm

**12:30 pm – 4:00 pm**

Continuing Education Courses

**CE1**

**Meeting  
Room:**

**Neilson 2**



**Service Training Course: Lifepak 15 Defibrillator (Cont'd)**

*Larry Hallett, Field Service Technician, Physio-Control Inc.*

Physio-Control Lifepak 15 Service Seminar is aimed to be the “gold standard” in customer education. Biomedical Equipment Technologists and Clinical Engineers attending our comprehensive Biomedical Training Seminar will get hands-on instruction in instrument inspection, troubleshooting, maintenance, and calibration procedures.

**CE3**

**Meeting  
Room:**

**Neilson 1**



**Service Training Course: Force FX Electrosurgical Unit**

*Eric Levis, QA & Technical Product Support Specialist, Medtronic*

Medtronic’s Force Triad Service Seminar is designed to teach Biomedical Equipment Technologists and Clinical Engineers how to install, setup, operate, and calibrate our electrosurgical equipment.

**2:00 pm – 2:30 pm**

Refreshment Break

*Bannerman*

**7:00 pm – 9:00 pm**

Meet & Greet Reception

*Atrium*



WEDNESDAY, MAY 25, 2016

## Conference & Trade Show

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**7:30 am – 8:00 am**

Registration and Breakfast

*Grand Foyer 1/3*

**8:00 am – 8:15 am**

**Conference Opening and Welcoming Remarks**

*Kelly Kobe, Conference Chair*

*Plenary Imperial Ballroom*

**8:15 am – 9:30 am**

**Keynote Address**

*Plenary Imperial Ballroom*

### **The Hospital at Home: The Evolution of Technology Design for Patient Self-Care**

*Dr. Joe Cafazzo, Senior Director of UHN Healthcare Human Factors, Lead for the Centre for Global eHealth Innovation, Associate Professor, Faculty of Medicine, University of Toronto*

With the health system struggling to deliver services for a population mostly dealing with chronic illness, hospitals are in need of refining themselves. No longer can hospitals be viewed as solely dealing with acute care; rather, they must put forth greater efforts required to improve seamless continuity of care for their patients, who continue to bounce back through their emergency departments.

Although there have been numerous efforts in restructuring the system to this end, there are some fundamental technology issues that have been so slow to adapt. The medtech industry continues to design for the health system of today and not the system that we need to become. The transition of traditionally hospital-based technologies to the home has been slow and fraught with new issues of safety and support.

This year's keynote will present a new vision of the use of health technology, where the patient is more empowered to care for themselves, and can manage their condition where it would have been previously impossible. It requires that our profession reevaluate how health technology is conceived, designed and deployed. It will require new insights and skills, but will further expand the impact of our work on patient care.

**9:30 am – 10:00 am**

Refreshment Break

Grand Foyer 3

**10:00 am – 11:30 am**

Concurrent Sessions

**A1****Meeting  
Room:****Bannerman****Biosignal Acquisition and Processing****Wavelength-dependent properties of motion artifacts in action potentials acquired with dual wavelength cardiac optical mapping impact the performance of ratiometry.***Authors - M. Rodriguez, A. Nygren*

Cardiac optical mapping in whole heart preparations is a research tool that contributes to the understanding of normal and abnormal cardiac electrical activity. The value of the technique is challenged by the presence of motion artifacts in the action potentials retrieved. Motion artifacts appear as a distortion of the action potential and affect the evaluation of electrophysiological parameters of interest such as action potential duration. Dual wavelength optical mapping offers the possibility of correcting motion artifacts by taking advantage of the ratiometric properties of the potentiometric dye used to record the electrical activity. In dual wavelength optical mapping, action potentials are recorded at two wavelengths and a ratio signal is calculated between the signals, removing the artifacts common to both wavelengths. Ratiometry relies on the assumption that motion artifacts in the two channels are similar in direction and shape. However, in practice ratiometry does not completely remove motion artifacts, a fact that has not yet been explained. Differences in signal amplitude between channels have been reported by earlier studies; however, these differences can be dealt with by scaling the signals appropriately. Early data acquired for this study suggest more complex differences exist between motion artifacts acquired in both channels. These differences affect the performance of ratiometry and may explain the inability of the technique to completely remove motion artifacts. This paper presents early examples of how the differences in shape, direction and amplitude between motion artifacts in dual wavelength recordings affect the results of the calculated ratio signal.

**10:00 am – 11:30 am**  
Concurrent Sessions

**A1**

**Meeting  
Room:**

**Bannerman**



*Authors - E. Estupinan, A. Franco, J. Olarte*

### **Cardiac optical mapping using frequency-filtering techniques for low resolution cardiac images.**

The study of the cardiac signal is an area of special interest for various fields of human knowledge. Due to the complexity of the cardiac signal, making successful diagnosis on various pathologies associated with heart disease is very difficult. Cardiac optical mapping using voltage sensitive fluorescent dyes is a technique to estimate action potential duration and activation times. This could help to estimate the electrical waves propagation mechanism on the heart surface during normal cardiac rhythm. Cardiac optical mapping data is acquired in the form of fluorescence images from a vertical suspended freely beating perfused rat heart inside a chamber. The main objective is to develop a standalone application in Matlab that includes image-processing tools together with data analysis for cardiac optical mapping this tool is intended to be adaptable and user friendly. The vision system delivers a video that includes output signals between 0-5 volts or its digital equivalent with a bit resolution of 12 bits. This span includes a DC level, allowing recovering the zero value of the signal distinctively from a disconnection of the vision system. It is require a signal enhancing procedure that removes the DC level and rescales it to 8-bit representation. Thereafter the signal is processed using a spatial frequency filter to reduce noise artifacts and enhance borders. Afterwards a growing region technique is used to create a mask allowing extracting only heart signals. Finally, to estimate the activation times a region-based correlation is implemented.

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10:00 am – 11:30 am  
Concurrent Sessions

**A1**

Meeting  
Room:

Bannerman



Authors - Y. Athavale, M. Boulos, B. Murray, S. Krishnan

## Classification of periodic leg movement through actigraphy signal analysis.

Actigraphy can assist in the detection of periodic limb movements (PLMs) and other neuromuscular disorders in sleep. Although several actigraphs have been previously reported to accurately detect PLMs, most of them sample too infrequently to accurately detect PLMs. The Philips Respironics<sup>®</sup> Actical™ is a readily available actigraph that has the capability of sampling at relatively high frequencies. Through simultaneous recordings of EEG, EMG and actigraph signals, clinicians have been attempting to understand and diagnose neurological diseases. Although a clinician's expertise in diagnosing diseases is unquestionable, analyzing large amount of bio-signals for hidden information would require extensive informed aid from computer-based intelligent signal processing algorithms. These algorithms not only extract hidden information from the signal but also help in classifying between normal and abnormal test subjects based on their respective signal analysis. The objective of this research study is to develop novel tools for analyzing sleep actigraphy signals, captured using the Actical™, for estimating and classifying PLMs occurring during sleep. We simultaneously recorded polysomnography and bilateral ankle actigraphy in 108 consecutive patients presenting to our sleep laboratory. After pre-processing and conditioning, the bilateral ankle actigraphy signals were then analysed for 14 simple time, frequency and morphology-based features. Using a Naive-Bayes classifier we got a correct classification rate of 78.94%, with a sensitivity of 80.26% and a specificity of 73.68%. The algorithm developed in this study has the potential of facilitating identification of PLMs across a wide spectrum of patient populations via the use of bilateral ankle actigraphy.

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10:00 am – 11:30 am  
Concurrent Sessions

**A1**

Meeting  
Room:

Bannerman



*Authors - R. Booth, P.Goldsmith*

**A wrist worn muscle-computer interface using a piezo-electric sensor array.**

The average adult spends more hours per day interacting with a computer than sleeping. Computer interfaces that require low physical effort offer users a healthy and efficient interaction method. The lowest physical effort device is the brain-computer interface, which uses electric signals on the scalp. However, since electroencephalography signals are difficult to detect and process, we are investigating the use of alternative biosignals suitable for wearable computer interfaces. Sensors worn over or near muscles can detect electromyographic or mechanomyographic signals, where the latter refer to vibrations and pressure changes caused by muscle activation. Previously, mechanomyographic signals have been measured using accelerometers, microphones and other vibration sensing equipment, and some wearable computer interfaces based on muscle activation have been investigated. We are instead using piezo-electric sensors to measure vibration and pressure, as they are inexpensive, small and highly sensitive. Using piezo-electric sensors, we developed a wrist wearable sensor array that allowed unrestricted movement of the fingers and produced a recordable signal. The movement generated signals were recorded during experiments involving small individual finger movements. Each isolated movement was associated with a single recording which was analysed for a variety of signal features, correlation with the movement, and repeatability between sessions. The correlation and repeatability results support the use of piezo-electric sensors as a viable wearable computer interface sensor. Such a device could be used for prosthetic control, robot assisted surgery, and mobile computer interaction.

**B1**

Meeting  
Room:  
Herald



*Russell Gottschalk, Compliance and Enforcement Specialist,  
Health Canada*

**Medical Battery Regulation**

A presentation on the current status of the regulations surrounding the licensing and the department's policy on medical batteries. The purpose is to provide an explanation of how the licences are assessed, the rules found in the MDRs, the role of importers and distributors, what sites are inspected, numbers of MDEL holders and a survey of the devices holding licences in Canada. This presentation is directed at industry and hospital Biomedical Engineers who replace/refurbish or repair medical equipment containing batteries.

**10:00 am – 11:30 am**  
 Concurrent Sessions

**C1**

**Meeting Room:**  
**Stephen**



**Medical Equipment & IT Integration**

*Penny Rae, Chief Information Officer, Alberta Health Services*

Technology is converging. No longer does clinical equipment stand alone or work independently. In this session you will hear about where the trends in technology are taking us and the implications for your work, and health care more broadly. The session will touch on AHS's approach to the opportunities and challenges ahead of us and how that fits into our overall IMIT strategy.

**CE1**

**Meeting Room:**  
**Neilson 2**



**Service Training Course: Lifepak 15 Defibrillator (Cont'd)**

*Larry Hallett, Field Service Technician, Physio-Control Inc.*

Physio-Control Lifepak 15 Service Seminar is aimed to be the "gold standard" in customer education. Biomedical Equipment Technologists and Clinical Engineers attending our comprehensive Biomedical Training Seminar will get hands-on instruction in instrument inspection, troubleshooting, maintenance, and calibration procedures.

**CE4**

**Meeting Room:**  
**Neilson 1**



**Medical Laser Safety Fundamentals**

*Matthew Tracy, BET Instructor, Northern Alberta Institute of Technology*

This course is designed for anyone working with or around medical lasers. The course provides a brief overview of laser and laser light properties. A description of laser light tissue interactions and laser related injuries. Explanation of Laser Hazard Classifications, Safety Practices, and Control Measures.

**11:30 am – 12:30 pm**  
 Lunch in Trade Show Area

*Exhibit Hall*

12:30 pm – 2:00 pm  
Concurrent Sessions

**A2**

Meeting Room:  
Bannerman

**Academic Paper Session: Biomechanics with Other Themes**

**Physiological and Non-physiological effects on muscle conduction velocity estimation using high density EMG.**



*Authors - A. De, G. Johns, E. Morin*

Overall conduction velocity (CV) in a population of activated muscle fibres is related to the state of the muscle and can be estimated from the electromyogram (EMG). CV estimation is affected by the distance between electrodes of a bipolar pair (inter-electrode distance or IED), and the distance between two bipolar pairs used to detect conduction delay (inter-signal distance or ISD). Reported CV's are generally in the range of 3.5 – 5 m/s [Farina-MBEC-2001; Beck-JEK-2004]. The purpose of this study was to examine the effect on CV estimates of IED and ISD, contraction level, and muscle length. EMG data were recorded from the long and short heads of the biceps brachii (BBL and BBS), and brachioradialis (BR), of five subjects, using monopolar high-density EMG electrodes. Subjects performed elbow flexion contractions at three force levels (30, 40 and 50% maximum), and three elbow joint angles (60, 90 and 120 degrees). CV estimates were computed for different bipolar electrode configurations; estimates corresponding to published values were obtained for IED=15 mm and ISD=20 mm. ANOVA analysis of CV values revealed that contraction level had no significant effect ( $p$ -values: 0.336 to 0.774), and CV varied significantly with joint angle only for the highest contraction level in BBS ( $p=0.01$ ). Values for all contraction levels were then grouped; ANOVA analysis showed that CV varied significantly with muscle ( $p<0.00002$ ) for all joint angles. These results are analysed with regard to the nature of the EMG signal, and how the signal changes with contraction level and joint angle.

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12:30 pm – 2:00 pm  
Concurrent Sessions

**A2**

Meeting  
Room:  
Bannerman

**Academic Paper Session: Biomechanics with Other Themes**

**Alterations in the relative surface velocity of joint following anterior cruciate ligament injury in a sheep model.**



*Authors - M. Shekarforoush, K. Barton, M. Atarod, B. Heard, J. Sevick, D. Hart, N. Shrive*

Osteoarthritis is characterized as a potentially disabling chronic disease, which can decrease the quality of life of individuals. To date, many aspects of osteoarthritis remain unclear but epidemiologic studies have shown that people with a history of joint injury (especially in the knee joint) are at a high risk of developing OA. Recently, it has been suggested that changes in a knee joint relative surface velocity correlate more consistently with cartilage damage after joint injury. The reason can be explained by the fact that the directions of surface shear forces are related to the direction of surface relative velocity. Thus, an objective of this study was to determine the relative surface velocity of the knee joint before and after ligament injury and to correlate the change in the relative velocity with cartilage damage in a sheep model. We derived analytical formulas to define the linear and angular velocity of the tibiofemoral component of a knee joint. The results are compatible with the motion of the joint during a normal gait cycle. The results also show that there were changes in the timing of the phases of the gait cycle between the intact and follow-up time points after injuries in the subjects, evidence of changes in the direction of the relative velocity. This study provides new information about the role of joint surface relative velocity of the knee joint after ligament injury, which can be considered as a potential mechanical factor for cartilage damage.



GE Healthcare

12:30 pm – 2:00 pm  
Concurrent Sessions

**A2**

Meeting  
Room:  
Bannerman

**Academic Paper Session: Biomechanics with Other Themes**

**Determining in-vivo human tibiofemoral cartilage stiffness using dual-fluoroscopy and magnetic resonance imaging.**



*Authors - B. Ritchie, G. Kuntze, G. Sharma, J. Beveridge, J. Kupper, J. Ronsky*

Anterior cruciate ligament deficiency (ACLD) dramatically increases the risk of knee osteoarthritis (OA). Currently, there is no clinical diagnostic to predict joint degeneration in pre-radiographic OA. The purpose of this research is to develop methods to combine deformation and joint force estimates to determine changes in cartilage stiffness in pre-radiographic OA. Preliminary data were collected for ACLD (n=4, >5 year history) and healthy control (n=5, CON) subjects. 3D bone and cartilage models were created in Amira (FES, Germany) from magnetic resonance (MR) data obtained (GE 3T Discovery 750, USA). Dual-fluoroscopy (DF) images were collected in conjunction with ground reaction forces (GRF)(Bertec, USA) during standing weight bearing. Bone kinematics were determined in Autoscooper (Brown University, USA) and applied to cartilage models. Deformations were quantified as the change in median proximity of model faces (Matlab 2015b, MathWorks, USA). Cartilage deformation was higher in ACLD compared to the CON subject, indicating a reduced ability to resist compressive loading. These results provide proof of concept that cartilage stiffness changes in pre-radiographic OA and in-vivo DF/MR measure is sensitive to alterations in load deformation. Vertical GRF provided physiological loading rate data for analysis with the viscoelastic cartilage deformation response. This MSc will use inverse dynamics to estimate knee joint forces and load-deformation curve-fitting approaches to determine a model for cartilage stiffness mechanics. This research supports the development of novel clinical diagnostics for pre-radiographic OA. [1] Lohmander et al. 2007 Am. J. Sports Med. 35(10): 1756–1769. [2] Calvo et al. 2004 OA Cart. 12(11): 878–86.

12:30 pm – 2:00 pm  
Concurrent Sessions

**A2**

Meeting  
Room:  
Bannerman

**Academic Paper Session: Biomechanics with Other Themes**

**A novel computational approach for calculating sagittal plane urogenital kinematics from dynamic 2D ultrasound.**



*Authors - C. Czynnyi, M. Labrosse, L. Mclean*

Up to half of women experience stress urinary incontinence (SUI) during tasks that increase intra-abdominal pressure. The exact biomechanics underlying urine leakage remains unclear, but is likely associated with concurrent failures in urethral sphincter function, urethral support, and pelvic floor muscle (PFM) mechanics. The biomechanics of the continence system during functional tasks can be assessed by transperineal ultrasound imaging (USI). However, during imaging, neither the USI probe nor the imaging surface is fixed in 3D space. With the pubic symphysis as the only bony landmark partially visible on sequential images, the impact of probe motion is difficult to assess. In practice, clinical researchers often compare measurements at rest to those at peak dynamic displacement without compensating for probe motion, and omit directionality despite its likely relevance. One proposed method of compensation defines a co-ordinate system with the origin set as the infero-posterior pubic symphysis and one axis running parallel to the urethra. However, we have noted substantial urethral deformation during dynamic tasks performed by many women with SUI, which has led us to question the validity of this approach. Instead, we have developed a new computational method to compensate for in-plane rotation and translation, allowing for more accurate calculation of urogenital kinematics during dynamic tasks known to cause urine leakage. We will present our computational method applied to the study of urogenital kinematics during dynamic tasks including voluntary PFM contraction, cough, and Valsalva maneuvers. The proposed approach may be used to comprehensively study the pathomechanics associated with SUI in women.

**B2**

Meeting  
Room:  
Herald

**ASET Certification: Competency-Based Assessment**



*Jennifer Bertrand, ASET Registrar  
Eric Morin, ASET Manager of Corporate Relations*

The Association of Science and Engineering Technology Professionals of Alberta (ASET) has adopted competency-based assessment to create a modern, objective, and defensible process for evaluating the skills and knowledge of qualified technology professionals in Alberta. The presentation will review the ASET application process and how competency-based assessment is being used to assess the qualifications of international applicants and senior practitioners.

12:30 pm – 2:00 pm  
Concurrent Sessions

**C2**

Meeting  
Room:  
Stephen

**CMDSNet – Improving Medical Device Safety with Health Canada**



*Colleen Turpin, Problem Report Information Specialist, Health Canada*  
*Barbara Harrison, Senior Corporate Regulatory Compliance & Enforcement Advisor, Health Canada*

Health Canada will provide an overview of the CMDSNet program, what has been accomplished after six years, and future plans. Barbara will discuss the role of the Inspectorate with respect to the CMDSNet Program and describe what the Inspectorate does with the CMDSNet reports and why it is important that hospitals report medical device problems.

**CE1**

Meeting  
Room:  
Neilson 2

**Service Training Course: Lifepak 15 Defibrillator (Cont'd)**



*Larry Hallett, Field Service Technician, Physio-Control Inc.*

Physio-Control Lifepak 15 Service Seminar is aimed to be the “gold standard” in customer education. Biomedical Equipment Technologists and Clinical Engineers attending our comprehensive Biomedical Training Seminar will get hands-on instruction in instrument inspection, troubleshooting, maintenance, and calibration procedures.

**CE4**

Meeting  
Room:  
Neilson 1

**Medical Laser Safety Fundamentals (Cont'd)**



*Matthew Tracy, BET Instructor, Northern Alberta Institute of Technology*

This course is designed for anyone working with or around medical lasers. The course provides a brief overview of laser and laser light properties. A description of laser light tissue interactions and laser related injuries. Explanation of Laser Hazard Classifications, Safety Practices, and Control Measures.

**2:00 pm – 2:30 pm**

Refreshment Break

Exhibit Hall

**2:30 pm – 4:00 pm**

Concurrent Sessions

**A3**Meeting  
Room:

Grand Foyer 3

**Review papers in Poster Format****Analysis of big data in running biomechanics: Application of Multivariate Analysis and Machine Learning Methods.***Authors – A. Phinyomark, S. Osis, R. Ferber*

Much of the biomechanical research over the past 20 years has investigated the influence of potential injury risk factors in isolation. More likely, multiple biomechanical and clinical variables interact with one another and operate as combined risk factors to the point that traditional biomechanical analysis techniques (that is, using discrete variables, such as peak angles, together with a statistical hypothesis test, such as analysis of variance) cannot capture the complexity of these relationships. To identify these complex associations, advanced multivariate analysis and machine learning methods are necessary. However, to build accurate classification and prediction models, an adequate number of samples is needed, which grows exponentially with the number of variables used in the analysis. Therefore, to directly meet this need we have developed the infrastructure and established a worldwide and growing network of clinical and research partners all linked through the world's first automated 3-dimensional (3D) data collection and analysis system: 3D GAIT. Similarly, traditional data analytics may not be able to handle these large volumes of data. Hence, the appropriate multivariate analysis and machine learning methods must be developed. This paper begins with a brief introduction to our 3D data collection system, followed by a discussion of existing multivariate and machine learning methods that can be applied to big data analytics. Next, we provide a comprehensive overview of our proposed methods for 3D kinematic data during running from our database. Finally, important challenges and future research directions are presented.

2:30 pm – 4:00 pm  
Concurrent Sessions

**A3**

Meeting  
Room:  
Grand Foyer 3

### Review papers in Poster Format

#### **Design and manufacture of a custom ligament loading device for use with second harmonic generation microscopy.**

*Authors – J. Sevick, M. Xu, M. Courat, S. Andrews, N. Shrive*



Ligament insertions into bone (entheses) represent a natural adaptation to severe material mismatch. Load is transferred from relatively flexible connective tissue to relatively inflexible bone over typically not more than a millimeter. Adequate load transfer at an insertion site is necessary for normal joint function while preventing injury. A few models have been used to assess different aspects of insertional mechanics, but all suffer from limitations. Most importantly, there has been an inability to observe the behaviour of entheses under applied load. An accurate description of enthesis load transfer mechanics has thus been lacking. A relatively new and powerful microscopic technology, second-harmonic generation (SHG), for which the University of Calgary has recently acquired an advanced microscope, has been shown to image movement on a microscale and is a promising tool to overcome the first of these difficulties, microscopic observation. The remaining difficulty remains the precise loading of ligaments during SHG imaging, highlighting the need for a custom-built loading device. Ligament loading is not an unfamiliar procedure and commercially available equipment exists to do so, however, the infrastructure for simultaneously loading and microscopically imaging entheses does not exist. The purpose of this work is to detail the device design process, from concept to manufacture, emphasizing the solutions to the design's unique constraints and objectives and how they were determined. This includes the consolidation of a number of custom-machined components and commercially available hardware (for example: linear rail guides, strain gauges and precision motors).

**2:30 pm – 4:00 pm**  
Concurrent Sessions

**A3**

Meeting  
Room:

Grand Foyer 3

**Review papers in Poster Format**

**Multicomponent T2 analysis of glioblastoma in a mouse model.**



*Authors – S. Pandey, J. Dunn, T. Ali, S. Sarkar, V. Yong*

Glioblastoma Multiforme (GBM) is the most common and aggressive malignant primary brain tumour and average survival rates, even with aggressive treatment, is less than a year. A primary concern when imaging patients with tumors using MRI (Magnetic Resonance Imaging) is not being able to detect treatment response or tumor tissue characteristics adequately. MRI methods use the information obtained from the distribution of hydrogen protons from water-filled biological tissues. T2, the spin-spin relaxation time, is affected by the water environment and will increase with edema (excess water within tissues) and specific changes in cell type. Hence, unique T2 times reveal distinctive tissue characteristics. To date, T2 analysis of tumors has largely used monoexponential fitting. However, this method is not sensitive to the multicomponent nature of tissues within a defined volume (voxel). Using a mouse model implanted with tumor cells and multiexponential T2 analysis, superior differentiation between tissues can be detected within the mouse glioblastoma. We will use a novel visualization software to determine how the multicomponent T2 analysis can improve our sensitivity to specific tumor microenvironments. A study showing proof of principle has previously been published using mice implanted with patient-derived brain tumor initiating cells (BTICs). This project will use human derived glioblastoma cells in mice models to examine whether T2 can be used to detect treatment response. In addition MRI spectroscopy will be performed to detect the grade/type of tumor using the levels of metabolites present in and around the tumor volume.

**PHYSIO  
CONTROL**

2:30 pm – 4:00 pm  
Concurrent Sessions

**A3**

Meeting  
Room:

Grand Foyer 3

**Review papers in Poster Format**

**Fingerprinting of olive oil from spectral data.**



*Authors – N. Pinky, K. Ozanyan*

Olive oil is an extensively used product and extra virgin olive oil is much costlier than other edible oils. Hence, purity of olive oil is a very significant issue. Fluorescence spectroscopy is a largely acceptable, simple, reliable and quick technique for adulteration detection and fingerprinting of olive oil. In this project, principal component analysis has been performed on fluorescence spectral data of 100 samples including pure extra virgin olive oil and adulterated ones with sunflower oil. The analysis has been able to successfully map the samples in a clear pattern for adulteration detection. The maximum tolerance limit for detection of adulteration is  $\pm 4.71\%$  for the range of 0%-80% adulterated samples and  $\pm 5.67\%$  for the range of 80%-100% adulterated samples. Also, by using two third of the samples as training set, this system can detect the rest one third samples (test set) quite accurately with an average tolerance of only  $\pm 3.42\%$ . It has also been found that, short time exposure to laser, as a crude indication of possible long time exposure to sunlight, can definitely affect the fluorescence emission spectra. The two most significant wavelengths have been found (using variability) and validated (by principal component loading), that can replace the use of spectrometer with two color fiber optic probe. In this way, the computational complexity can be reduced to a great extent to make the adulteration detection system more affordable at retailer level.

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2:30 pm – 4:00 pm  
Concurrent Sessions

**A3**

Meeting  
Room:

Grand Foyer 3

**Review papers in Poster Format**

**Electrochemical sensor for the diagnosis of traumatic injuries of the central nervous system.**



*Authors – S. Khetani, R. Aburashed, M. Janmaleki, A. Sen, A. Sanati-Nezhad*

Injuries of the central nervous system (CNS) such as traumatic brain injuries (TBI) and traumatic spinal cord injury (tSCI) are widespread. Approximately, 170,000 individuals in Canada, suffers these injuries every year. Majority of the patients are left permanently disabled with limited restorative treatment and the cost of these CNS injuries is approximately \$15billion a year to the Canadian economy. One of the ways to accurately diagnose and manage these injuries for the effective outcome is by the detection of Biomarkers. Concentrations of biomarkers are found to be critical and provide vital information of health and healing of tissues. It is found that concentrations of several biomarkers associated with the injury of Neuron, Microglia, Astrocytes like SBDP, GFAP, S100 $\beta$ , etc. increases significantly post injury in blood and in CSF compared to uninjured state. Accurately measuring these biomarkers at the point of care can help in assessing the health and healing of the CNS during injury and while treating the injury. At present there is no point of care sensing device available for measuring these biomarkers for diagnosis and management of these injuries. We report a novel screen printed graphene based electrochemical biosensor for sensing S100 $\beta$  for the diagnosis and management of the CNS injury. Median concentration of S100 $\beta$  before injury is approximately 45pg/ml while post injury it increases five folds to 240pg/ml. We detected S100 $\beta$  in the dynamic range of 1pg/ml to 1ng/ml using this biosensor.

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2:30 pm – 4:00 pm  
Concurrent Sessions

**A3**

Meeting  
Room:

Grand Foyer 3

**Review papers in Poster Format**

**The relationship between the poroelastic wave and the electrokinetic effect for cancellous bone.**



*Author – Y. Yoon*

The poroelasticity theory has been used for elucidating the bone fluid flow in the cortical bone. However, not only the bone fluid flow is a primary mechanical stimulus to bone adaptation but also electrokinetic effect and piezoelectric effect. Therapeutic ultrasound is an emerging area in mechanobiology because the ultrasound is safe and it is believed to stimulate bone adaptation or bone mechanobiology. In this paper, we derive the poroelastic equation including the electrokinetic effect and numerically show the relationship between the poroelastic wave and the electrokinetic effect for cancellous bone. We analytically obtain the poroelastic wave in terms of the electrokinetic effect. It is believed that the derived relationship between the poroelastic wave and the electrokinetic effect is useful for further experiments and we can suggest what kind of ultrasound is the best for the therapeutic ultrasound stimulating for bone adaptation or mechanobiology.

**A3**

Meeting  
Room:

Grand Foyer 3

**Review papers in Poster Format**

**Maximizing the value of donated medical equipment in resource-limited countries: The role of donors and end-users**



*Authors – D. Williams, J. Kohler*

Medical technologies, such as medical devices, are essential to healthcare delivery yet, in some settings there is a pervasive shortage that severely limits the capacity of clinicians to assess, diagnose, treat, monitor, and prevent diseases. Transnational funders have taken on the responsibility of providing funds for almost 80% of medical equipment in countries with severe shortages, yet 70% of equipment goes unused and abandoned. This means that, in the best-case scenario, for every dollar spent on donations, at least 62.5 cents goes to waste. The question then arises about why funders continue to support such magnitudes of waste in settings where demand for improving healthcare is so high. This study aims to understand the roles of transnational donors and end-users in defining and implementing equipment donation and funding policies in Accra, Ghana. The study will explore how existing policies on equipment donation incorporate transparency and accountability. The study will also identify opportunities for optimizing the value of donations and minimizing waste for the end-users. We will develop a case study based on a review of policy and guideline documents, and on survey data and interviews of technicians, nurses, physicians, and staff of funding organizations. This study will contribute to the growing body of research at the intersection of health policy, transnational philanthropy, and development. Findings from this study will be useful to policymakers in improving utility (or value) of medical equipment, and subsequently enhancing health benefits.

**2:30 pm – 4:00 pm**  
Concurrent Sessions

**A3**

**Meeting  
Room:  
Grand Foyer 3**

**Review papers in Poster Format**

**Planning for replacement of contracted GI Endoscopy  
equipment in a regional setting.**



*Authors – M. Samiee, S. Wiebe, T.Gaamangwe*

The management of endoscopic equipment is commonly facilitated under a comprehensive equipment/consumable service contract. Contract can present challenges at renewal/termination time. Analysis of status and implications of different replacement options is necessary. This paper presents the results of our investigation into the status of endoscopy equipment in preparation for end of contract. The different options that were analyzed will be presented and provide a learning opportunity for other Clinical Engineering programs. An environmental scan of endoscopes and ancillary equipment within the Winnipeg Regional Health Authority facilities was conducted. The scan involved consultation with site equipment managers, manufacturers and third party repair companies. This information was reconciled with inventory in the hospital databases. The collected information was analyzed through various statistical parameters to delineate the various dimensions regarding distribution, status and impact of different replacement models/scenarios. The results of the scan provided an important insight into the current practice of endoscope management as well as the clinical, technical and economic impact of a possible vendor change. Inter-departmental equipment sharing was one of the aspects to consider. Technical implications included propriety equipment connections, which may necessitate complete replacement; approximately 70% worth of endoscopic equipment. The results provided invaluable input to inform an RFP preparation. An environmental scan is an important prerequisite for an evidence-informed replacement plan. This study considered some of the most relevant factors and provided invaluable information for stakeholders to prepare a comprehensive RFP. The study provides a learning opportunity for other CE programs in a similar situation.

2:30 pm – 4:00 pm  
Concurrent Sessions

**A3**

Meeting  
Room:  
Grand Foyer 3

**Review papers in Poster Format**

**Development and initial implementation of performance assurance work order prioritization system.**



*Authors – C. Bzovey, A. Krivoy, P. Kresta, M. Moore, T. Gaamangwe*

The implementation of an effective performance assurance (PA) system requires appropriate risk-based prioritization and optimization processes. Although a number of prioritization models have been developed, there are no generally accepted risk-based guidelines for prioritization of PA inspections. This paper presents a data and risk-based system for prioritizing PA inspection work orders. The developed system analyzes two parameters; the PA risk level of the device and the number of PA inspections missed, to determine the work order escalating factor and the priority level. To the best of our knowledge, incorporating the number of missed inspections in escalating inspections has not been extensively investigated. The system contributes to increasing inspection completion rates and optimizing resource utilization. The development and implementation of the system are presented, as well as opportunities for further development.

**B3**

Meeting  
Room:  
Herald

**Convergence of Biomedical and “Traditional” Information Security Concerns**



*Robert Martin, Chief Information Security Officer, Alberta Health Services*

The possibility of patient harm and data integrity issues, while comparing whether the risk vector of malicious attack is worse than the risk vector of insecure coding practices.

2:30 pm – 4:00 pm  
Concurrent Sessions

C3

Meeting  
Room:  
Stephen

## Clinical Engineering Paper Session

### Alarm Management Systems – Are you and your Hospital Ready?



*Authors - R. Yang, M. Maloney, M. Ramirez, H. Edwards,  
G. Morris, G. Nero*

Patient generated monitor alarms have been a concern for health care providers for years. Initiatives to ensure that clinicians hear an alarm or a warning signal when a patient's condition is deteriorating include: louder tones at the patients' bedside with concomitant warning lights outside of the patient room; centralized monitoring of the patient's conditions at the nursing station to name a few. Another initiative includes patient alarms generated at the bedside sent to dedicated pagers. Nursing personnel assigned to care for a monitored patient carry the pager and receive the alarms when their patient's condition is deteriorating (complementary alarm notification). The Joint Commission on Hospital Accreditation published a Prepublication Standards document establishing alarm management as a 2014 National Patient Safety Goal\*. The Safety goal was to be introduced in two phases culminating in the implementation of clinical alarm management policies and procedures by 2016. Manufacturers have developed systems that replace the older pager technology with smart phone technology, leveraging existing hospital's infrastructure such as WIFI to transmit the alarm conditions. The presentation will describe the process that the Hospital followed in implementing an Alarm Management System, including our experience with the complexity of such systems that involve alarm management servers, smart phone technology, patient monitoring practices and ultimately using the WIFI infrastructure. It is our intention to provide some lessons learned so that other institutions can avoid some of the challenges associated with implementing such technologies.

2:30 pm – 4:00 pm  
Concurrent Sessions

C3

Meeting  
Room:  
Stephen

### Clinical Engineering Paper Session

#### Wireless Smart Infusion Pumps - A proposed Continuous Quality Improvement Data Analysis Process



*Authors - J. Polisen, H. Hilfi, M. Bedard, A. Sedrakyan*

Errors associated with the use of infusion pumps can cause serious harm or death in hospitalized patients and increased costs to the health care system. Our study reviewed the continuous quality improvement (CQI) data collected from a wireless smart infusion pump device implemented at one of the largest Canadian teaching hospitals in a one year period. We reviewed the CQI summary data usage to assess Dose Error Reduction Software (DERS) compliance with the infusion pump's master drug library (MDL) and the frequency of drug alerts. Also, we proposed a CQI data analysis process to audit the DERS compliance and frequency of pump alerts. The CQI data indicated that DERS compliance with the infusion pump ranged from 72.14% to 100% depending on pre-defined clinical care areas (CCAs). The birthing unit, oncology, and critical care areas had the largest proportions of pumps alerts compared with the other CCAs. A CQI data analysis process was designed to monitor the performance of the wireless infusion pump system. The study findings provided information on patterns of use and risk reduction opportunities to inform the hospital's goal to enhance the delivery of quality care and patient safety. We presented a CQI data analysis process to monitor the performance of the wireless infusion pump system, and a plan to evaluate the effectiveness, acceptability and safe implementation of the process at the hospital.

2:30 pm – 4:00 pm  
Concurrent Sessions

C3

Meeting  
Room:  
Stephen

### Clinical Engineering Paper Session

#### **Adverse Incident Reporting and staff vigilance leads to early identification of medical equipment problems**



*Authors - M. Ramirez, E. Niles, N. Viridi, R. Yang, G. Patterson*

Adverse Incident reporting has become a standard of practice at SickKids. When staff experiences an adverse event they are encouraged to file an Incident Report. The Incident report system generates e-mails to people who need to be aware of the incident. When medical equipment is involved, Medical Engineering receives the Incident Report. Staff are asked to clearly identify the device that and send it to Medical Engineering. In August 2015, we received two incidents where a Syringe Module stopped working with a channel error message. The incidents happened in the Paediatric Intensive Care Unit (PICU). Testing of the Syringe module indicated that the module was working properly. A third incident occurred in the same unit. The QA leader for the PICU contacted Medical Engineering's Team leader to identify possible trends. Upon investigation, it was determined that the Channel Error was only being experienced in the PICU. We received a fourth incident with the same reported problem. Biomedical Engineering Technologists performed extended testing by simulating similar infusion as reported by nurse. This time the Technologists did duplicate the Channel Error. Upon opening the Syringe Module's casing, the technologists discovered some traces of oxidation/rust in the drive mechanism. This was suspected to be the cause of the Syringe Module failure. During the month of August we continued to receive Incidents with the same Syringe Module issue. The presentation will cover our findings of oxidation on the drive train, the company's response and the action plan to inspect and correct 800 Syringe modules.

**2:30 pm – 4:00 pm**  
Concurrent Sessions

**CE5**

**Meeting  
Room:  
Neilson 1**



*Bjorn Segall, BBS Medical AB*

**Quality Assurance of Ultrasound Probes**

Studies have shown that 35-40% of the ultrasound probes, all brands and types, at a non-tested hospital, have defects. Even after OEM's maintenance, service and scanners own test protocols. The presentation will describe that it is possible, through frequently testing and the introduction of a probe care program to take the faulty frequency down to 8-12%. Hard to get lower, since even some new probes have defects. Reasons for defective probes, common faults, the clinical impact, the impact of missing a few elements in the probe, testing methods and recommendations to Bio Med Engineers will be included in the presentation. The Presentation is referring to studies and conclusions performed during the last 14 years within the area of testing multi brand ultrasound probes in daily use at hospitals in the Nordic countries. It will describe the importance of frequently validating ultrasound probe performance for patient safety.

**4:00 pm – 5:00 pm**  
Networking on the Trade Show floor

*Exhibit Hall*

**5:00 pm – 7:00 pm**  
Opening Reception in Exhibit Hall

*Exhibit Hall*

**7:00 pm – 10:00 pm**  
Atrium Social

*Atrium*



THURSDAY, MAY 26, 2016

## Conference & Trade Show

**7:30 am – 8:00 am**

Registration and Breakfast

*Grand Foyer 1/3*

**8:00 am – 9:30 am**

Keynote Address

*Plenary Imperial Ballroom*

### Reaching New Heights: Insights from the Summit of Mount Everest

*Alan Mallory, International Speaker, Author and Professional Development Trainer*

Climbing Mount Everest is considered one of mankind's greatest feats of human endurance. The two-month quest to reach the highest point on earth is a journey filled with unparalleled challenges and some of the roughest and most extreme conditions imaginable. In the spring of 2008, Alan Mallory embarked on the adventure of a lifetime and set a world record along with four members of his family after an incredible self-guided expedition on the mountain. The expedition challenged the mental, emotional and physical limits of their entire beings but to finally reach the end goal was an incredible feeling! Alan's presentation is an engaging visual and emotional journey that is supported by many of the stunning photos and short video clips captured along the gruelling quest to the top. It highlights the importance of many leadership qualities such as strategic planning, effective communication, teamwork and trust as well as the mentality and passion involved in conquering one's own Everest.

**8:00 am – 9:30 am**

Continuing Education Course

**CE6**

**Meeting**

**Room:**

**Neilson 1**

### **Advances in Ultrasound Transducer Technology and the Role of Modern Quality Assurances Test Technology**



*Dave Dallaire, VP of Sales and Marketing, Acertara Laboratories*

This course will cover the history of ultrasound probe technology leading to a detailed discussion of the current advances in probe technology and QA Technology including:

- The physical construction of modern probes and crystal arrays,
- Modern strategies for the activation of crystal arrays,
- The trends in moving traditional system technology, including some image processing into the probe assembly,
- The move away from traditional Piezoelectric crystals and into other advanced materials,
- Associated advances in transducer test technology allowing QA to keep pace with modern probe technology.

**9:30 am – 10:00 am**

Refreshment Break

Exhibit Hall

Sponsored By:



GE Healthcare

**10:00 am – 11:30 am**

Concurrent Sessions

**A4**Meeting  
Room:

Neilson 1

**Academic Paper Session: Biomedical Image Processing****A saliency-based unsupervised method for angioectasia detection in capsule endoscopic images.***Authors - F. Deebea, S. Mohammed, F. Bui, K. Wahid*

Angioectasia is the most common origin of obscure gastrointestinal bleeding (OGIB), constituting 30-40% of the OGIB cases. It consists of dilated, ectatic, tortuous, thin-walled vessels of the mucosa or submucosa, involving small capillaries, veins, and arteries. Angioectasias lesions are mostly located in small bowel, and thus inaccessible to conventional wired endoscopy. Small bowel capsule endoscopy (SBCE), enabling the visualization of the entire small bowel, has become a particularly useful tool in the detection and management of angioectasia. To address the inadequate investigation in the field of automatic detection of angioectasia from capsule endoscopic images, we propose a two-staged saliency-based unsupervised detection algorithm. In the first stage, we construct a saliency map by combining a patch distinctness (PD) map and an Index of Hemoglobin (IHb) map obtained from original endoscopic images. The PD map is formed using a distance measure which computes the distinctness of image patches compared to an average image patch. The IHb map is formed using index of hemoglobin (IHb) to exploit the characterizing red hue of angioectasias. Finally, the PD map and the IHb map are combined to form the final saliency map. In the second stage, we perform a local maxima search from gradient image obtained from the saliency map to localize the ROIs (region-of-interests) containing angioectasias lesions. The proposed method yields 100% sensitivity and 90.1% accuracy in detecting angioectasia with low computational effort.

**10:00 am – 11:30 am**  
Concurrent Sessions

**A4**

**Meeting  
Room:  
Neilson 1**

**Academic Paper Session: Biomedical Image Processing**

**QCT reconstruction kernel has important quantitative effect on finite element estimated bone strength.**



*Authors - A. Michalski, B. Edwards, S. Boyd*

Quantitative computed tomography (QCT) is utilized in bone imaging for quantification of volumetric bone mineral density (vBMD), bone mineral content (BMC), and bone volume. QCT is emerging as an effective tool in combination with finite element (FE) analysis to predict bone failure strength and stiffness. Bone imaging by QCT often utilizes a sharpening reconstruction kernel to produce well-defined edges of the bone surface, whereas standard clinical visualization uses a medium smoothing reconstruction kernel. The effect of the reconstruction kernel on quantified measure of bone quality are unknown, but may have important effects on the final non-invasive assessment of bone strength. The purpose of this study was to determine the effects of QCT reconstruction kernel on the quantitative assessment of bone quality. We hypothesize that the QCT reconstruction kernel affects the outcome measures of vBMD, BMC, and FE predicted bone strength. Clinical QCT scans of the proximal femur were reconstructed using two representative kernels, a bone-sharpening kernel and standard smoothing kernel. QCT-FE analysis was performed using a standard sideways fall loading configuration. Output measures of vBMD, BMC, bone volume, and FE predicted bone strength and stiffness were compared for each reconstruction kernel. Significant differences were found in the measures of vBMD (% Difference: -17.73%,  $p < 0.001$ ), BMC (% Difference: 7.98%,  $p < 0.01$ ), and bone volume (% Difference: -9.78%,  $p < 0.001$ ) between the two reconstruction kernels. This work highlights the importance of reconstruction kernel for QCT-based FE models, and needs to be considered when predicting non-invasive osteoporotic bone strength and fracture risk.

10:00 am – 11:30 am  
Concurrent Sessions

**A4**

Meeting  
Room:  
Neilson 1

**Academic Paper Session: Biomedical Image Processing**

**Application of a fourier shift preprocessing stage to improve the resolution of resting state fMRI images.**



*Authors - E. Farahani, P. Adibpour, M. Smith*

Multiple sclerosis (MS) is a disease common in many northern-climate countries with Canada having 28% higher MS numbers on a population basis than second place Denmark. Optical Neuritis (ON) is known to affect the properties of the visual pathways in the brain, is often a precursor to MS, and has been suggested as a system model for MS pathology. We have investigated possible resting state functional magnetic resonance imaging (rs-fMRI) markers to track ON recovery or progression to MS. To obtain the necessary rs-fMRI temporal resolution requires discrete Fourier transform (DFT) reconstruction applied to 2D truncated (finite length) frequency domain MRI data sets followed by a 2D DFT-based correlation analysis across a time sequence of images to identify image regions that are connected through the brain's optical pathways. Another DFT-based transfer function determination identifies pathways impacted by ON; permitting differentiation between normal volunteers and ON patients. Windowing or low-pass filtering is required to remove ringing distortions from these five DFT application stages, but leads to lower fMRI spatial resolution and an undesirable loss in ON marker accuracy. Recently we have theoretically identified a Fourier shift manipulation (FSM) preprocessing stage that avoids the unnecessary loss of resolution that occurs with the use of global windowing during DFT application. We have previously demonstrated how applying FSM to data improves 1D DFT-based analysis under certain experimental MR-relevant situations. In this paper we extend the FSM approach to demonstrate an improvement in the 2D resolution of rs-fMRI images generated from truncated MRI k-space data.



10:00 am – 11:30 am  
Concurrent Sessions

**A4**

Meeting  
Room:  
Neilson 1

**Academic Paper Session: Biomedical Image Processing**  
**Fully automated fibroglandular tissue segmentation and bias correction in breast MR images using level set method.**



*Authors - M. Owjimehr, E. Fear*

In this paper an image processing method is proposed for bias correction and fibroglandular tissue segmentation from Magnetic Resonance Images (MRI) of human breast. The proposed method is based on level sets and includes three steps. In the pre-processing step, a chest wall line detection method is applied to separate the chest wall from the breast region in the MR images of breast. In the next step, a new level set algorithm is employed to estimate the bias field. The bias field estimation is used for intensity inhomogeneity correction, which leads to an efficient segmentation of the fibroglandular tissue. Finally, in the post-processing step, the skin layer is detected using morphological operations, and the fibroglandular tissue is extracted after skin layer subtraction. The proposed method has been validated on 2D images of an MR scan of the human breast. The implementation results show efficient performance of this method in tissue segmentation of MR images with the presence of intensity inhomogeneity.

**B4**

Meeting  
Room:  
Herald

**New Landscape of BMET Accreditation, Registration and Certification**



*Session Chair: Anthony Chan, Biomedical Engineering Program Head, BCIT*

Panel Members:

- Shripal Parikh – CBET(c) Certification
- Kim Greenwood - CBET(c) Certification
- Peter Portlock – TAC Technology Accreditation Canada
- Jennifer Bertrand – ASET Provincial Certification

The provincial technologists and technicians regulatory bodies of BC, AB, SK and ON withdrew their memberships from the Canadian Council of Technicians and Technologists (CCTT) in 2010 and established Technology Professionals Canada (TPC). Technology Accreditation Canada (TAC), working in partnership with TPC, is a new organization to accredit engineering technology programs in BC, AB, SK and ON. This session will briefly outline the history and roles of TPC and TAC, and explain the relationship between TPC, CCTT, and the provincial regulatory bodies (e.g. ASET, ASTTBC). The presentations will describe the standards and learning outcome indicators adopted by TAC, the process for review of those standards, and the accreditation of educational programs. It will also address the implications to practitioners on credential recognition, registration, mobility, etc. The impact and changes in BMETs' and dialysis technologists' certification will also be presented.

10:00 am – 11:30 am  
Concurrent Sessions

**C4**

Meeting  
Room:  
Stephen



### Supportability of Medical Devices – Do we have a “Right to Repair”?

*Session co-chairs:*

*Mike Capuano, CMBES VP and Manager, Biomedical Technology, Hamilton Health Sciences*

*Jean Ngoie, Regional Manager, Biomedical Engineering, Niagara Health System*

Panel Members:

Mario Ramirez, Director, Medical Engineering, The Hospital for Sick Children

Martin Poulin, Director, Biomedical Engineering, Vancouver Island Health Authority

Murray Rice, Manager, Medical Engineering, University Health Network (Toronto)

Kelly Kobe, Director, Clinical Engineering, Alberta Health Services (Calgary)

Things are heating up with respect to this important topic. The issue is being addressed by AAMI's Technology Management Committee's Task Force on Supportability. It was also a hot topic at the World Congress in Toronto last year. A white paper is now being worked on based on those discussions. This year's CMBES Conference is yet another opportunity to get these issues out into the open and see if there are ways to deal with this ongoing challenge of supportability. Do Biomed departments have to fight vendors (or even our own clients) to obtain the supports needed to effectively and efficiently provide the valuable in-house services hospitals need? Come to the session and have your say. Be part of the solution!

**CE6**

Meeting  
Room:  
Neilson 1



### Advances in Ultrasound Transducer Technology and the Role of Modern Quality Assurances Test Technology (Cont'd)

*Dave Dallaire, VP of Sales and Marketing, Acertara Laboratories*

This course will cover the history of ultrasound probe technology leading to a detailed discussion of the current advances in probe technology and QA Technology including:

- The physical construction of modern probes and crystal arrays,
- Modern strategies for the activation of crystal arrays,
- The trends in moving traditional system technology, including some image processing into the probe assembly,
- The move away from traditional Piezoelectric crystals and into other advanced materials,
- Associated advances in transducer test technology allowing QA to keep pace with modern probe technology.

**11:30 am – 12:30 pm**

Lunch in Trade Show Area

Exhibit Hall

**12:30 pm – 2:00 pm**

Concurrent Sessions

**A5****Meeting  
Room:****Bannerman****Academic Paper Session: Biomedical Image Processing****Evaluating the collagen network of articular cartilage using contrast-enhanced x-ray microscopy.**

*Authors - Y. Zhu, D. Bates, N. Sukhnandan, D. Ponjevic, J. Matyas,  
S. Boyd*

Osteoarthritis (OA) is a common chronic joint disease characterized by degenerative changes of joint cartilage, which is comprised of a composite of water-imbibing proteoglycans restrained by fibrillar collagen network. Early diagnosis of OA requires sensitive imaging, ideally at the cellular-molecular level, particularly the collagen network of injured articular cartilage. Whereas cartilage histopathology is destructive, time-consuming and limited to 2D views, contrast-enhanced x-ray microscopy (XRM) technology brings the possibility to non-destructively image the cartilage collagen network in 3D at high resolution. This study establishes a correlation between contrast-enhanced XRM and the gold-standard histology for the evaluation of the cartilage collagen network. Cartilage disks of 6 mm diameter from a healthy bovine knee were stained in phosphotungstic acid (PTA) for 0, 18, 36, 54, 72, 91 and 1151 hours to determine the optimal staining time for the contrast-enhanced XRM. 3x3 mm<sup>2</sup> cartilage cubes with subchondral bone were collected from both healthy and injured bovine knees. After PTA-staining for the optimal time, cartilage cubes were imaged using contrast-enhanced XRM and then histology evaluation. Images were analysed for the histology sections and compared with the matching XRM slices. Cartilage collagen network structures from the contrast-enhanced XRM had good correlation with those from histology for both healthy and injured bovine knee. Structural changes in cartilage collagen network between the healthy and injured knee were evaluated. We validated the contrast-enhanced XRM for the evaluation of the collagen network structure non-destructively, and the 3D cartilage volume provides rich information for OA pathology.

12:30 pm – 2:00 pm  
Concurrent Sessions

**A5**

Meeting  
Room:  
Bannerman

**Academic Paper Session: Biomedical Image Processing****A novel in vivo quantitative assessment of the knee using high resolution peripheral quantitative computed tomography.**

*Authors - A. Kroker, S. Manske, Y. Zhu, R. Barber, N. Mohtadi, S. Boyd*

Anterior cruciate ligament (ACL) tears are a common knee injury and increase the risk of developing osteoarthritis (OA). While the sequence of events leading to OA is poorly understood, evidence suggests rapid changes in subchondral bone mineral density (BMD) in the injured knee after the ACL tear may play a role. How these changes are reflected in the bone microarchitecture is not understood, largely because clinical imaging modalities lack the required resolution to visualize the microarchitecture. High resolution peripheral quantitative computer tomography (HR-pQCT), a novel human in vivo micro computed tomography system, is able to measure bone microarchitecture. Thirty-five participants were imaged with HR-pQCT at an isotropic resolution of 61  $\mu\text{m}$  after undergoing varying types of ACL reconstructions five-year prior. Approximately 6 cm of each knee was imaged. The medial and lateral weight bearing regions of both tibia and femur were analyzed. The subchondral bone in these regions was isolated and trabecular thickness, number, and BMD were measured at three depths (0-2.5mm, 2.5-5mm, 5-7.5mm) below the subchondral bone surface as well as cortical thickness and porosity. Scans took approximately 22 minutes per knee and provided rich 3D data showing bone morphology and microarchitecture. Bone microarchitectural parameters were successfully calculated for all regions and depths. We performed the first in vivo high resolution bone microarchitecture measurements of the human knee. Ongoing work includes establishing quantitative differences between lateral and medial bone compartments in the cohort, and characterizing differences between ACL deficient and healthy control knees.

12:30 pm – 2:00 pm  
Concurrent Sessions

**A5**

Meeting  
Room:  
Bannerman

**Academic Paper Session: Biomedical Image Processing**

**Factors affecting the level set segmentation of the heart ventricles in short axis cardiac perfusion MRI images.**



*Authors - D. Mousa, N. Zayed, I. Yassine*

This paper studies the effect of the registration and initialization of the level set segmentation on the performance of the extracting the heart ventricles for perfusion MRI images. Through the registration experiments, the translational transformation was studied based on both the spatial and frequency domain. The frequency domain based registration is mainly established on the phase correlation methodology. As for the segmentation experiments, the level set initialization, was done through extracting the ventricles' real shape from each slice, using threshold and a combination of morphological operations. Though, the final contour of any frame was used as the initial contour for the next frame. This proposed strategy differs from conventional ones in using the real shape of the ventricles as an initial contour than assuming it as circle or ellipse as in the literature. The second initialization strategy was based on defining the initial contour for each frame using the polar representation of the image. Two short axis view datasets of cardiac magnetic resonance (CMR) perfusion imaging were used in testing the proposed methods. Dice coefficient, sensitivity, specificity and Hausdorff distance have been used to evaluate and validate the segmentation results. The segmentation accuracy for left and right ventricles improved from 72% to 77% and from 70 % to 81% using the spatial domain based registration algorithm. The polar based initialization strategy improves the segmentation accuracy from 77 % to 81% and from 81% to 82% for the left and right ventricles respectively.

12:30 pm – 2:00 pm  
Concurrent Sessions

**A5**

Meeting  
Room:

Bannerman

### Academic Paper Session: Biomedical Image Processing

#### Porcine model to study mechanisms of left ventricular early filling.



*Authors - L. Burrowes, A. Satriano, N. Shrive, J. Tyberg*

During diastole the left ventricle (LV) fills with blood in two phases, late filling and early filling. Late filling, resulting in the mitral flow "A-wave", is a result of left atrial contraction. Early filling, manifest as the "E-wave", is thought to be substantially due to diastolic suction (DS), a phenomenon where the LV aspirates blood and fills itself, independent of atrial activity. Efficient filling of the ventricle is important for the heart to adjust to varying demands. Before studying a sick heart, we must first understand the mechanisms of filling in a healthy heart. To study DS, we invasively measured pressure in a porcine model and used cardiac MRI to evaluate LV cavitory volume and in-flow (velocity). Here, we demonstrate that DS does exist and can be quantified using two different methods. The volume of filling due to DS (VDS) was defined as the volume of filling from mitral valve opening (MVO) until minimum LV pressure (PLVmin) in the pressure-volume (PV) loop. There was a negative slope in the PV relationship between the time of MVO and PLVmin. The negative slope suggests the ventricle is relaxing faster than it is able to fill thus aspirating blood into itself (Katz, 1930). Using Wave Intensity Analysis (Parker & Jones, 1990), the intensity of the backwards decompression wave was determined and the total energy of the wave after MVO was calculated. This indicates the energy of the ventricle at the end of ejection which then assists in drawing blood into the ventricle.

**B5**

Meeting  
Room:

Herald

### Going Green – Emission Reduction Capturing Scavenged Anesthetic Waste



*Dusanka Filipovic, President and Vice Chair, Blue-Zone Technologies Ltd*  
*Kim Greenwood, Director of Clinical Engineering, Children's Hospital of Eastern Ontario (CHEO)*

During a typical surgery under general anesthesia, 95% of commonly used modern halogenated anesthetic drugs in an operation are scavenged and then vented from the operating room into the outside environment through specialized air ventilation systems. These anesthetics are very aggressive greenhouse gases with 20 year global warming impact up to 3,766 times greater than CO<sub>2</sub>. Blue-Zone has developed a unique greenhouse gas mitigation solution with health co-benefits for valuable halogenated anesthetic gases emissions. The globally proprietary Deltasorb or Centralsorb Anesthetic Collection Service provides hospitals with a simple and cost effective Cradle-to-Cradle solution to reduce carbon footprint, reduce public health risks and enable building valuable anesthetic production capacity.

**12:30 pm – 2:00 pm**  
Concurrent Sessions

**C5**

**Meeting Room:**  
**Stephen**

**Across Canada Review – Western Canada**



*Session Chair: Amanda Saigeon, Alberta Health Services*

British Columbia, Alberta, Saskatchewan, Manitoba

**CE7**

**Meeting Room:**  
**Neilson 1**

**Minimizing Ultrasound Transducer Failure Through Proper Care and Early Detection**



*Kyle Grozelle, Manager of Global Education & Training, Summit Imaging*

Preventing transducer failure is incredibly important as faulty probes can compromise patient safety by impacting image quality and potentially putting patients at risk for infection. The key to preventing transducer failure is implementing proper care methods and ensuring that everyone who handles the transducer is able to identify early warning signs. In this session, Kyle will break down a transducer so he can explain the function of each part and where failures typically occur. He will bring real-life examples of transducers in various conditions so participants can see what a damaged probe looks like, making it easier for them to identify problems on their own. He will then demonstrate techniques for detecting common problems, such as how to detect interior probe damage by examining the exterior.

**2:00 pm – 2:30 pm**  
Refreshment Break

*Exhibit Hall*

**2:30 pm – 4:00 pm**  
Concurrent Sessions

**A6**

**Meeting  
Room:  
Bannerman**

**Academic Paper Session: Biomedical Technology**

**Bone microarchitecture changes in peri and post menopausal women: Cortical porosity is a marker for accelerated change during menopause.**



*Authors - J. Bhatla, L. Burt, D. Hanley, S. Boyd*

During menopause, accelerated bone loss occurs, accompanied by bone microarchitecture changes. This has primarily been characterized with cross sectional dual x-ray absorptiometry (DXA). Our longitudinal study aims to compare rate of change (ROC) in bone microarchitectural parameters in peri- and post-menopausal women using high-resolution peripheral quantitative computed tomography (HR-pQCT). Participants were selected from the Calgary Canadian Multicentre Osteoporosis Study (CaMos) from menopause information provided by questionnaire (stage 1-5). The peri-menopause group (n=26) includes women beginning menopause transition to nearing the end (stage 2-4). The post-menopause group (n=65) had completed the midlife process (stage 5). HR-pQCT (Scanco Medical, Switzerland) non-dominant radius and left tibia scans provided baseline and follow-up (average=5.5yrs) assessments of bone mineral density, total area (Tt.Ar) and cortical porosity (Ct.Po). To compare repeat scans, automated 3D image registration was conducted (IPL software). T-tests compared differences between groups. Both groups lost radius and tibia bone density. ROC between groups was not different at the radius. In contrast, tibia Tt.Ar and Ct.Po ROC differed. Peri-menopausal women experienced accelerated Ct.Po change compared to post-menopausal women (9.0 and 6.3%/yr respectively,  $p=0.046$ ) and less Tt.Ar change (0.06 and 0.13%/yr,  $p=0.017$ ). Increased ROC in Ct.Po observed in peri-menopausal women is consistent with data showing increased bone remodeling during menopause, with inadequate repair. Similarly, Tt.Ar is known to increase with age, as observed in both groups, but appears to occur at a faster rate post-menopause. This is the first longitudinal study at high resolution to investigate longitudinal microarchitecture changes during and after menopause.

**2:30 pm – 4:00 pm**  
Concurrent Sessions

**A6**

**Meeting Room:  
Bannerman**

**Academic Paper Session: Biomedical Technology**

**Induced breast cancer cell apoptosis by synchrotron-based irradiation with monochromatic microbeams.**



*Authors - T. Wysokinski, T. Harkness, G. Belev, W. Dawicki, T. Arnason, J. Gordon, G. Davies, L. Lobanov, N. Zhu, A. Webb, D. Miller, D. Chapman, X. Liu*

Breast cancer is the most common female malignancy and has the second highest cancer related mortality in western women. Radiotherapy (RT) plays an important role in the modern breast cancer management of all stages. However, the efficiency of conventional RT continues to be limited because the treatment induces radio-toxicity in healthy tissues. In this work, we present the feasibility studies of the monochromatic micro-beam therapy (m-MRT) technique, a novel synchrotron based radiotherapy concept that uses high brilliance, monochromatic X-ray micro-beams smaller than 200 microns, applied to treat breast cancer tissue and cell samples. Two different energies were used for those tests: 50 keV and 100 keV. The tumor fragments and cells samples were irradiated ex-situ and then analyzed to assess the damages induced by m-MRT irradiation. Eight patient derived xenografted (PDX) tumor fragments were irradiated and implanted in live NOD Severe Combined Immuno-deficient (SCID) gamma (NSG) mice to assess the effect of irradiation on tumor growth comparing to the control. The pilot studies showed that the m-MRT treatment of cancerous tissue slowed down the tumor growth in (NSG) mice as compared to untreated controls. The biomolecule analysis demonstrated that the irradiation induced cancer cell apoptosis by triggering a stress response of the cells at radiation dose of 60 Gy or higher. Future studies will investigate how the cancer cells respond to the irradiation treatment in vivo in the live animals.

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**2:30 pm – 4:00 pm**  
Concurrent Sessions

**A6****Meeting  
Room:****Bannerman****Academic Paper Session: Biomedical Technology****A virtual training environment for prosthetic control.**

*Authors - I. Seagal, E. Morin*

One factor that impacts the operation and functionality of prosthetic devices is the lack of sensory feedback. Currently, there are no commercial prosthetics that offer feedback. To study the effects of feedback, a real-time system, based on the Matlab toolbox SynGrasp, is implemented in Simulink (The Mathworks, Inc.). SynGrasp supports the simulation of a variety of human and robotic hands. For the purposes of this study, a 20 degrees of freedom hand was selected as it accurately represents all hand movements associated with a circular grasp. The toolbox can simulate hand-object grasp interaction and calculate the contact forces. This functionality is ported into Simulink for real-time use. EMG control is achieved using two active bipolar SEMG electrodes on the ventral and dorsal surfaces of the forearm to control finger flexion and extension respectively. Sensory feedback is incorporated as a vibration at 235 Hz, via an 8 mm linear resonant actuator (Precision Microdrives Ltd.), secured over the lateral side of the upper arm. The mean contact force magnitude from the virtual environment is mapped to the vibration amplitude generated by the vibrotactile device. It has been shown that feedback in prosthesis control improved grasp precision and speed of grasping task completion. As well, it has been shown that a complex control scheme has a negative impact on subject performance. The goal of this study is to develop and test a relatively simple virtual tool for grasp training, with and without vibrotactile feedback.

2:30 pm – 4:00 pm  
Concurrent Sessions

**B6**

Meeting  
Room:  
Herald

**Northern and Southern Alberta Renal Program**



*Joe Reynolds, Biomedical Technologist, NARP*  
*Ed Doppler, Technical Manager, SARP*  
*Shripal Parikh, Dialysis Technician, SARP*

**NARP:** This presentation will cover an overview of the NARP program but focus on the Baldwin Home Hemodialysis Unit and the technologist’s role within the home hemodialysis program. It will present a brief history of Home Dialysis within NARP from inception to present day. From there the focus will be on the technologist’s role and how we are integrated into the Multidisciplinary Clinical Team. It will include a “day in the life” talk about a typical home hemodialysis technologist’s normal workday, including the stresses we face and the rewards we reap. It takes a special type of BMET to want to perform this type of work; find out if you are that person!

**SARP:** Water Treatment System for Hemodialysis: A Southern Alberta Renal Program Perspective: Purified water is an integral aspect of dialysis treatment. Water treatment systems play an important role in providing safe and effective treatment to dialysis patients. This presentation will highlight how the city water is purified to meet the standards set for dialysis grade water. Both, hospital based (in-center) and home based (portable) water purification systems will be discussed. SARP has set an extensive Quality Assurance program to meet and exceed existing CSA ISO standards for dialysis grade water. SARP has in-house technical services to help maintain water treatment systems and thus provides big cost savings to AHS. A valuable experience is gained by providing a complete technical solution and a new perspective is developed by SARP technical services through many challenges.



**2:30 pm – 4:00 pm**  
Concurrent Sessions

**C6**

**Meeting  
Room:  
Stephen**

**Across Canada Review – Eastern Canada  
Ontario, Nova Scotia, Quebec**



*Session Chair: Bud Haycock, Alberta Health Services*

Since April 1 2015, Quebec health network underwent a major reform as a result of the entry into action of the Law amending its organization and its governance by abolishing regional agencies (Bill 10). This law is primarily the combination of health and social services centers of each administrative region into one integrated center of health and social services (CISSS) or one integrated academic center of health and social services (CIUSSS). The old organizational structures are being revised including biomedical engineering departments (BIOMED). As a follow up of a study we made in November 2011 on the directorial affiliation of biomedical engineering departments in Quebec health network, we identified directorates to which are attached Biomedical Engineering Services in CISSS and CIUSSS. It shows that BIOMED is present in clinical, technological, medical and administrative directorates. Does this reflect a misunderstanding of the profession or is it the sign of the success of its transversal integration to a point that all the players in Quebec Health organization appropriate it? Unlike 2011, BIOMED is mainly attached in CISSS and CIUSSS to multidisciplinary services Directorate, thus favoring a counseling vision. In both cases BIOMED ended up in various directorates. Is this a sign that a clinical engineering directorate is to be considered in future organizational structures of Quebec health and social services?

**CE8**

**Meeting  
Room:  
Neilson 1**



**Innovations in Ultrasound Systems Diagnostics**

*Kyle Grozelle, Manager of Global Education & Training,  
Summit Imaging*

Learn about new and emerging tools and skills to troubleshoot and diagnose equipment in-house effectively, allowing a lower cost and reduced downtime. Using tools available in any biomed shop and the knowledge of technicians, we will examine common symptoms and errors along with the installation of common parts that sometimes require additional steps and configuration to restore a system to working order. At the end of the presentation, attendees will have the knowledge and skills to diagnose a wide variety of ultrasound equipment and the resources to repair a system to full functionality.

**6:00 pm – 7:00 pm**

Cocktail Hour

Sponsored By:



*Atrium*

**7:00 pm – 10:00 pm**

Banquet and Awards Presentation

Sponsored By:



*Plenary Imperial Ballroom*



FRIDAY, MAY 27, 2016

## Conference Sessions

**7:30 am – 8:00 am**

Registration and Breakfast

*Imperial 123*

**8:00 am – 9:30 am**

Concurrent Sessions

**A7**

**Meeting  
Room:**

**Bannerman**

### **Academic Paper Session: Biomedical Technology**

#### **How can personalized tourniquet systems accelerate rehabilitation of wounded warriors, professional athletes and orthopaedic patients?**



*Authors - J. McEwen, J. Jeyasurya, J. Owens*

Rehabilitation of wounded warriors, professional athletes and orthopaedic patients has profound health, economic, psychological, and social implications. This has motivated development and investigation of a new technique, Personalized Blood Flow Restriction Training (PBFRT), which may substantially reduce recovery time and improve rehabilitation. PBFRT involves exercising well below maximum intensity using an optimal personalized restrictive pressure (PRP) in a tourniquet cuff encircling a limb, for brief and repeated exercise periods according to a rehabilitation protocol. Although the exact mechanism is not fully understood, many studies have shown beneficial effects of blood flow restricted training on skeletal muscle strength and hypertrophy, and preliminary evidence suggests it may also promote bone formation. Advances in the development of modern tourniquet systems made within our group in Canada allow PBFRT to be performed with optimal safety and repeatability, establishing a PRP that automatically accounts for important variables including individual limb shape and size, muscle tone, blood pressure, gender, race, tourniquet cuff characteristics and application technique.

8:00 am – 9:30 am  
Concurrent Sessions

**A7****Meeting  
Room:****Bannerman****Academic Paper Session: Biomedical Technology****Can personalized tourniquet systems prevent chemotherapy-induced alopecia.**

*Authors - J. McEwen, J. Jeyasurya, M. Jameson, F. Howard, S. Abadi, C. Simmons*

Alopecia (hair loss) is a common consequence of cancer treatment known to have a profound impact on quality of life. Tourniquet technologies have been investigated from the mid-1960s to early 1980s as a strategy for preventing chemotherapy-induced alopecia (CIA) but their ambiguous results precluded incorporation into any standard of treatment. Our hypothesis is that fundamental advances inherent in personalized tourniquet systems developed within our group over 38 years enables the optimal, safe, comfortable and reliable stoppage of penetration of arterial blood into the scalp during infusion of chemotherapeutic agents, thereby preventing CIA and improving quality of life. This paper describes these advances, and presents options for integration into various treatment protocols involving modern chemotherapeutic agents having differing pharmacokinetics. Personalized tourniquet systems offer significant potential to safely prevent CIA, thereby improving quality of life with low treatment cost and low impact on treatment times and workflow.



**GE Healthcare**

8:00 am – 9:30 am

Concurrent Sessions

**B7**Meeting  
Room:

Herald

**RFID Implementation in Healthcare –  
University of San Antonio***Gene Winfrey, Director Information Services, San Antonio  
University Hospital*

Deploying RFID Technology in the real world. This session will focus on the paths a health system took in deploying RFID technology to track mobile medical equipment throughout the organization and describe how its mindset needed a paradigm shift in order to realize quantifiable success.

**C7**Meeting  
Room:

Stephen

**Case Study: Preventing Deaths – Dealing with design issues  
of Patient Equipment***Gord McNamee, President, Mac West Healthcare Technology  
Consulting*

Since the mid 1990's there has been a significant increase in the purchase and use of Patient Lifts in Canadian Health care facilities as a result of reported workplace caregiver injuries. This is also exacerbated by an increased number of obese and bariatric patients in Canadian Health care facilities. The intended use of Patient Lifts is to improve patient safety. A Patient Lift is a seemingly innocuous low risk medical device, however it has been quite the contrary. There are many documented patient /staff injuries and deaths as a result of manufacturer safety design flaws. In the Province of Manitoba there have been four reported patient deaths in a 2-year span using different manufacturers Patient Lifts. Gord will discuss strategies he initiated on behalf of Manitoba Healthcare facilities in addressing this on-going patient and staff safety issue. Patient Lifts are one of the least regulated medical devices that have been in direct causation of deaths and given the lowest safety classification by Health Canada a class 1 distinction. Patient Lifts are commonly overlooked by Healthcare facility Senior Management including Clinical/Biomedical Engineering departments as a low risk medical device. Patient Lifts are not given the importance they should and in many cases do not receive regular preventive maintenance inspections by qualified staff. This results in non-skilled staff performing corrective maintenance repairs incorrectly and not identifying potential safety issues. Caregivers also do not receive adequate on-going training addressing potential safety issues. At the conclusion of the presentation there will be time to discuss strategies to address improving Patient Lift safety and working with manufacturers in addressing design issues.

**8:00 am – 9:30 am**

Continuing Education Session

**CE9****Meeting  
Room:****Neilson 1****CBET Certification Exam Material Review***Rick Tidman, Biomed Professor, Durham College*

Biomedical Technicians and Technologists attending this course will review the information required for the successful completion of the CBET certification examination. The format of the exam will also be discussed, as well as general study tips and techniques that will aid in preparation for the exam.

**9:30 am – 10:00 am**

Refreshment Break

*Imperial 123***10:00 am – 11:30 am**

Concurrent Sessions

**A8****Meeting  
Room:****Bannerman****Academic Paper Session: Tissue and Cellular Engineering****Rheological study of novel viscosupplements.***Authors - M. Chernov, D. Grecov, T. Anastassiades, E. Kwok*

Osteoarthritis is a widespread joint disease that causes joint pain, stiffness, and loss of mobility. Over 10% of adults suffer from knee osteoarthritis alone. Despite the prevalence of the disease, there is a lack of effective treatments for osteoarthritis and consequently the disease progresses over time to the point of causing disability. As osteoarthritis progresses, synovial fluid loses inherent viscoelastic properties that make it an effective lubricant and shock absorber for weight bearing joints. The composition of synovial fluid constituents is observed to change as the disease progresses and is attributed as the primary reason for the change in fluid behaviour. In particular, hyaluronic acid concentration and molecular weight are observed to decrease. The principle behind viscosupplementation, a treatment for osteoarthritis, is to replace disease altered synovial fluid with a synthetic fluid comprised of high molecular weight and concentration hyaluronic acid via an intra-articular injection in order to restore natural shock absorbing and lubricating properties to the joint. The current work studies the shear and viscoelastic properties of a set of novel hyaluronic acid derivatives and aims to evaluate their suitability as a treatment for osteoarthritis based on rheological properties and comparison to existing viscosupplements. The compounds also possess anti-inflammatory properties which may further improve the diseased state of an affected joint. Parameters of interest include degree of shear thinning, zero shear viscosity, crossover frequency and time dependent behaviour. These parameters will be compared to existing viscosupplements as part of the treatment evaluation.

10:00 am – 11:30 am

Concurrent Sessions

**A8****Meeting  
Room:****Bannerman****Academic Paper Session: Tissue and Cellular Engineering****Microcarrier screening for skin-derived precursor schwann cell culture in stirred tank bioreactors.***Authors - K. Bowal, T. Walsh, R. Midha, M. Kallos*

Skin derived precursor Schwann cells (SKP-SCs) are currently being investigated for use in peripheral nerve repair. Current static culture methods are not adequate to produce the high number of cells needed for treatments. As a result, suspension bioreactors are an attractive option. To culture adherent cells, like the SKP-SCs, in suspension, it is common practise to use small spherical beads called microcarriers. Microcarriers typically have diameters of 100µm to 400µm can be manufactured out of many materials, but are typically made from materials that can withstand the forces seen in a bioreactor. When inoculated, the cells will attach to the microcarriers and proliferate. This attachment depends on many factors including chemical composition, surface topography, degree of porosity, and charge. Because there are many different commercially available microcarriers with varying properties, we needed to screen these for our specific cell type. We selected four microcarriers to test, Cytodex 3, Hillex II, ProNectin F, and Plastic Plus. We first compared attachment to the microcarriers in shaken well plates, then compared the growth kinetics of SKP-SCs in the shaken well plates. Finally we investigated the growth kinetics of SKP-SCs in bioreactors. We found that Cytodex 3 and Hillex II had the highest attachment rate after 18 hours. Over the growth period of 9 days, Cytodex 3 showed significantly higher growth compared to the other microcarriers. Lastly Cytodex 3 had the highest growth in suspension bioreactors. Based on these results we are confident in using Cytodex 3 to develop our process further.

10:00 am – 11:30 am

Concurrent Sessions

**A8**Meeting  
Room:

Bannerman

**Academic Paper Session: Tissue and Cellular Engineering****Effect of hydrodynamic shear on proteoglycan 4 secretion by bovine cartilage explants.***Authors - A. Morin, S. Regmi, T. Schmidt*

Proteoglycan 4 (PRG4) is a mucin-like glycoprotein present in synovial fluid and at the surface of articular cartilage. PRG4 exists as both monomeric and disulfide-bonded multimeric forms, which are secreted by chondrocytes in bovine cartilage explants. Dynamic shear stimulation of cartilage explant cultures has been shown to increase PRG4 mRNA expression levels, the quantity of high molecular weight PRG4 species and overall PRG4 secretion compared to unloaded controls. However, the effect of hydrodynamic shear on the secretion of PRG4 by chondrocytes in vitro remains to be determined. Therefore, the objective of this study was to compare the quantity and immunoreactive size distribution of PRG4 products secreted into medium by chondrocytes in bovine cartilage explants from stirred bioreactor (Shear+) versus T-flask (Shear-) cultures. Indirect enzyme-linked immunosorbent assay was used to quantitatively assess the amount of PRG4 in Shear+ and Shear- media compared to a standard of purified full-length recombinant human PRG4. The immunoreactive size distribution of PRG4 proteins in Shear+ and Shear- media was assessed using sodium dodecyl sulfate polyacrylamide gel electrophoresis followed by western blot detection using anti-PRG4 antibodies 4D6 and 9G3. The amount of PRG4 accumulated in Shear+ media was significantly greater than Shear- media ( $p < 0.001$ ), with no detectable difference in immunoreactive size distribution. These results demonstrate that the secretion of PRG4 by chondrocytes in vitro is regulated, in part, by hydrodynamic shear, and further contribute to the understanding of mechanical regulation of PRG4 expression.

10:00 am – 11:30 am

Concurrent Sessions

**A8**Meeting  
Room:

Bannerman

**Academic Paper Session: Tissue and Cellular Engineering****Fluid flow stimulation upregulates expression of S100 genes during breast cancer development and progression.**

Authors - K. Fuh, J. Withell, R. Shepherd, K. Rinker

S100 proteins are intracellular Ca<sup>2+</sup> sensors that participate in a range of biological processes including proliferation, invasion and differentiation. Overexpression of S100 genes has been observed in breast carcinomas. However, their roles during breast cancer initiation and progression have not been defined. The objective of this study was to analyze changes in gene expression profiles of S100 genes upon exposing human mammary epithelial cells (HMECs) to fluid flow. Relevant findings were correlated in gene profiles from clinical datasets. A bioreactor system consisting a parallel-plate flow chamber was used to expose HMECs to fluid shear stress, simulating exposure of cells to blood vessels during breast cancer initiation and progression. Total RNA from flow exposed cells and cells grown in static conditions was isolated. Differentially expressed genes were quantified using Affymetrix microarrays and RT-qPCR. Expression data showed more than 5 fold upregulation of S100P and S100A7 with flow stimulation. Consistent overexpression of S100 genes was also observed in ductal carcinoma in situ patient tissue compared to healthy breast, suggesting roles in breast cancer initiation. Kaplan – Meier curves of breast cancer patients (n=936), demonstrate that elevated expression of S100A7 and S100P correlate with reduced survival times. This study shows that exposing HMECs to fluid flow upregulates genes identified clinically to be overexpressed during breast cancer initiation and progression, including S100A7 and S100P. This suggests that our bioreactor platform is a useful tool for identifying how mammary epithelial cell exposure to blood flow affects breast cancer initiation and early stages of disease progression.



GE Healthcare

10:00 am – 11:30 am

Concurrent Sessions

**B8**Meeting  
Room:  
Herald**CMMS Database Implementation***Bud Haycock, Director of Clinical Engineering CoE, Alberta Health Services*

A discussion of the 4 year journey towards an integrated provincial CMMS system encompassing Clinical Engineering, Facilities Maintenance & Engineering, Project Management, Property Management, and Parking and Protective Services at Alberta Health Services. This CMMS covers about 2500 users, and serves about 100,000 AHS staff via the online Service Request Portal. Details will be shared on the original vision, the design and implementation, and the continuing refinement of the CMMS application. Group discussion and roundtable updates from other jurisdictions to follow.

**C8**Meeting  
Room:  
Stephen**Clinical Engineering Paper Session****Regional prioritization and replacement of surgical tables.***Authors - C.Bzovey, K. Eckhardt*

A surgical table audit conducted within the Winnipeg Regional Health Authority (WRHA) revealed one-third of the surgical tables were in need of replacement. Tables within the region requiring replacement were prioritized using a prioritization system developed in-house. A limited amount of capital was allocated to the initiative with the intention of targeting upwards of twenty-five surgical tables for replacement. The option of purchasing remanufactured tables was researched and analyzed to determine its viability compared to purchasing brand new. Research and analysis took the form of literature reviews, discussion with technicians from various hospital sites, along with a site-visit to a remanufacturing plant specializing in the remanufacturing process of surgical tables. The region concluded that the remanufacturing process was an acceptable and cost-effective option for replacement of the tables. Next, a regional RFP was developed. The RFP consisted of standard schedules, technical questions on the remanufacturing process along with a modified pricing schedule. The region was interested in obtaining proposals for three different options; (1) restoration of existing in-house tables, (2) purchase of remanufactured tables, and (3) purchase of new tables. The RFP was developed to allow for the region to select each table from option 1, 2 or 3.

Tables were selected according to site-specific needs with efforts focused on maintaining a standardized fleet at each site. A common requirement was the need for higher weight capacity. The strategy, cost effectiveness, and evaluation process used to successfully conduct the regional replacement of surgical tables will be discussed.

10:00 am – 11:30 am

Concurrent Sessions

C8

Meeting  
Room:  
Stephen**Is there a specific professional Act for Clinical Engineers?***Author - G. Zoabli*

In hospitals, biomedical engineer has several names: adviser in biomedical engineering, biomedical technology advisor, biomedical engineer, clinical biomedical engineer, clinical engineer or simply engineer. Biomedical engineering exists in Quebec hospitals for over forty years. The recent transformation of Quebec health network in integrated center of health and social services, and in integrated academic center of health and social services, revealed that the role of biomedical engineers in hospitals is misunderstood. Moreover, to date, there does not seem to exist a reserved professional act for clinical engineer while his counterpart medical physicist has a field of practice in radiation therapy, radiation protection and dosimetry. Given this state of facts, we suggest to share some reflections that may help to better understand some of the clinical engineer's roles that are similar to reserved tasks or exclusive professional acts.

C8

Meeting  
Room:  
Stephen**AIM CT accreditation program development for CT X-Ray systems.***Author - D. McTaggart*

The University Health Network maintains 22 CT X-ray systems at five hospital locations. The problem that was addressed was how to develop and implement a CT Accreditation Program at the University Health Network.

This program was developed to satisfy the needs for a standardized annual testing of CT dose and image quality parameters. Appropriate image quality test phantoms were selected and evaluated. This topic deals with the problem of how to develop and implement a CT Accreditation Program for the CT systems at the University Health Network. The project will deal with the selection of image quality and dose phantoms, establishing baseline data derived from the phantoms and storing the data for future reference. Another challenge of the project was to develop a quality assurance program that will satisfy the corporate vision of the University Health Network. This vision is concerned with achieving global impact. The work done in this report will be relevant to Canadian standards and incorporate global standards as well. A comprehensive CT Accreditation Program was then developed and implemented. The program was used to report on CT image quality and dose parameters. It is recommended that the AIM CT Accreditation Program be used at other hospitals to provide comprehensive image quality evaluation, dose monitoring and structured CT reporting.

**10:00 am – 11:30 am**

Continuing Education Session

**CE9**

**Meeting Room:**

**Neilson 1**

**CBET Certification Exam Material Review (Cont'd)**



*Rick Tidman, Biomed Professor, Durham College*

Biomedical Technicians and Technologists attending this course will review the information required for the successful completion of the CBET certification examination. The format of the exam will also be discussed, as well as general study tips and techniques that will aid in preparation for the exam.

**11:30 am – 12:30 pm**

Lunch

Imperial 123

**11:30 am – 1:00 pm**

CMBES Annual General Meeting

Herald

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12:30 pm – 2:00 pm

Concurrent Sessions

A9

Meeting  
Room:

Bannerman

**Biomedical Technology****Permutation entropy analysis of heart rate variability of the assessment of cardiovascular autonomic neuropathy.***Authors - L. Sanchez-Rodriguez, C. Carricarte, A. Machado, M. Brown, M. Estevez*

Heartbeat time series are clinically relevant biosignals as they hold substantial information regarding cardiovascular neuroregulatory mechanisms. Disorders of cardiovascular autonomic regulation occur during the pathogenesis of several diseases and are clinically important because of its life threatening consequences. Heart rate variability (HRV) analysis is widely used to characterize cardiovascular autonomic function (CAF), however its actual power relies on the selection of suitable features providing reliable information of the underlying neural modulation. Therefore, in this work we aim to explore the potential of permutation entropy (PE) analysis of HRV for evaluating neuropathological changes on CAF. For this purpose we quantified PE to assess the complexity of ordinal patterns from five minutes interbeat intervals series, in healthy subjects and patients with type 1 diabetes mellitus, including patients with cardiovascular autonomic neuropathy (CAN). We found that some PE indicators were significantly lower in the group of diabetic patients with CAN compared to those calculated for the control group, allowing differentiation between them. We hypothesize this happens due to a decrease of complexity in cardiac intervals series induced by physiological changes imposed by the disease. It was found that correlations of PE measures with standard HRV indicators depended only on the temporal scales considered to create the patterns, regardless their length. We concluded that PE analysis of HRV is an adequate and promising method for the assessment of CAN. Further research should be performed in order to unravel physiological meaning of this feature.

12:30 pm – 2:00 pm

Concurrent Sessions

**A9**Meeting  
Room:

Bannerman

**Biomedical Technology****Control of cardiac alternans in a realistic electromechanical model of cardiac tissue.***Authors - A. Hazim, Y. Belhamadia, S. Dubljevic*

Electrical alternans is a physiological phenomenon manifested as beat-to-beat oscillation (electric wave width alternation) of the cardiac action potential duration. Alternans has been shown to be a precursor to arrhythmias and sudden cardiac death, which is the most common cause of death in the industrialized world. The control of alternans has been explored in many studies in the literature. However, the majority of the existing control algorithms succeeded in suppressing alternans only in small pieces of cardiac muscle. To our knowledge, all the control algorithms are electric-based realization and have not considered mechanical properties of cardiac tissue, despite the fact that mechanical deformation is shown to influence the electrical activity of the heart tissue, and consequently the cardiac alternans. In a previous work, we presented a novel mechanical perturbation algorithm to control alternans. The proposed control algorithm succeeds to suppress the alternans in relevantly sized cardiac tissues. However, only a simplified mathematical model has been used for the numerical simulation and a more realistic model should be used to investigate the control of alternans which is the goal of this study. In this work, we will explore the feasibility of suppressing cardiac alternans in a realistic model by using the mechanical perturbation strategy. The electrical activity is represented by the Luo-Rudy model and the mechanical activity is represented by an active contractile tension model and the Mooney-Rivlin passive elasticity model. Numerical simulations are used to illustrate the feasibility and the effects of the proposed algorithms in suppressing cardiac alternans.

12:30 pm – 2:00 pm

Concurrent Sessions

C9

Meeting  
Room:  
Stephen**Biomedical Technology****A study of medical equipment donations: recipient experiences.**

*Authors - B. Bradley, C. Yoon, S. Zahedi, Y. Adusei-poku, B. Gentles*

Poorly executed medical equipment donations create major problems for developing countries. The International Outreach Committee of the Canadian Medical and Biological Engineering Society (CMBES), in partnership with the Ghana Biomedical Engineering Association, conducted a study to better understand the medical equipment donation practices of Canadian organizations, and to share best practices to help improve donation effectiveness. We surveyed and interviewed Canadian donor organizations as well as hospital administrators and health care workers in 29 Ghanaian hospitals that have received medical equipment donations. The overall results of our study will be presented, with a focus on the Canadian interviews and the perspectives of recipient hospitals in Ghana.



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**Have a great day!**

**Presentation Services Audio Visual**

12:30 pm – 2:00 pm

Concurrent Sessions

C9

Meeting  
Room:  
Stephen**Biomedical Technology****Medical device electronics development in resource limited settings: A Ugandan perspective.***Authors - P.N. Makobore, D. Kamugasha, P. Rolfe, R. Ssekitoleko*

The availability of vital medical equipment for the care of neonates and infants in developing countries remains scarce largely due to the prohibitively high cost. The majority of this equipment is imported and for the most part inappropriate for use in a low resource environment. Devices that are electrically operated are usually unable to withstand prevailing intermittent power supply which is a common occurrence in both urban and rural areas of Uganda. Early, accurate diagnosis and prompt treatment can significantly reduce preventable child deaths. The use of embedded technology in designing medical devices for diagnostics and therapeutic treatment offers a high level of efficiency, reliability and robustness. Design considerations include elimination of unnecessary features; ease of usability and meeting international safety standards. Our case study will focus on the design and verification of a low cost solar-powered electronically controlled gravity-feed infusion set for the safe delivery of intravenous fluid and/or drugs to neonates and infants. Its unique feature is the ability to dynamically control the flow rate based on feedback from a drop-monitoring module. Performance test results of the drop monitoring module pitted against a physical user count yields an accuracy of +/- 1count. Simple electronic medical devices designed under low resource setting constraints, can provide affordable, safe, accurate and efficient solutions to address this huge gap in the Ugandan healthcare sector. Once deployed in the field these devices have the potential to save many lives.

12:30 pm – 2:00 pm

Concurrent Sessions

C9

Meeting  
Room:

Bannerman

**Biomedical Technology****Control of cardiac alternans in a realistic electromechanical model of cardiac tissue.***Author - J. Ngoie*

In this talk we will discuss the issue of implementing a Biomedical Engineering Quality Management System (QMS). The aim is to ensure that the Biomedical Engineering Department performs their services at a consistent and adequate level across the organization. In the past, NHS Biomedical Technologists inconsistently created general checklists or carried out their Preventive Maintenance (PM) based on their own experience, guidance from technical training literature, or specifications from service manuals. We assigned a co-op student under the guidance of the regional manager of Biomedical engineering the task of creating a Biomedical Engineering Quality Manual that will include general procedures and specific medical device procedures with their respective checklists. The assignment also was to package all written procedures into a mobile application so that the members of the department can access them whenever needed. The reference standards used were: Canadian Medical and Biological Engineering Society (CMBES) standards of practice (CESOP), ISO 13485: Medical devices-Quality Management Systems as recommended by Health Canada and World Health Organization (WHO) guidelines on Health Technology Management. QMS is important to consider for any department of an organization that is committed to improve or maintain consistent Quality of services. The application have provided the Niagara Health System (NHS), Biomedical Engineering department with a quality system to follow. The long term goal is to share the application with other hospitals across the region and beyond.

12:30 pm – 4:00 pm

Concurrent Sessions

**CE9**

Meeting  
Room:

Neilson 1

**Biomedical Technology**

**CBET Certification Exam Material Review (Cont'd)**



*Rick Tidman, Biomed Professor, Durham College*

Biomedical Technicians and Technologists attending this course will review the information required for the successful completion of the CBET certification examination. The format of the exam will also be discussed, as well as general study tips and techniques that will aid in preparation for the exam.

2:00 pm – 3:00 pm

Closing Remarks and Presentation of Paper Awards

*Stephen*

*Student Paper Competition Sponsor:*

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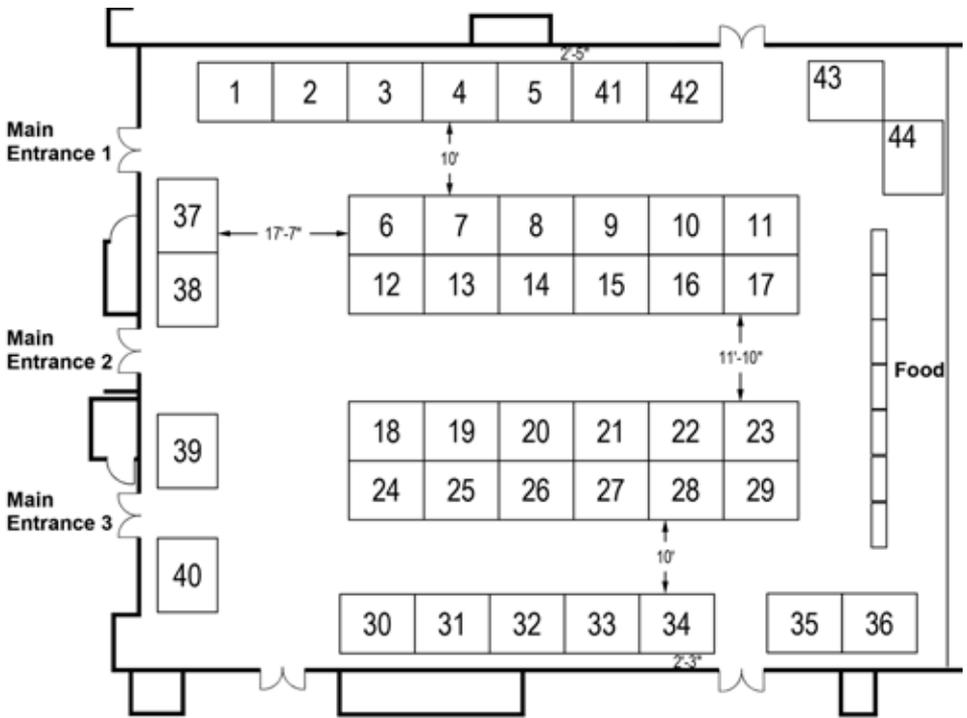
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## **TRADE SHOW LOCATION AND HOURS:**

**Wednesday, May 25, 2016**

**TRADE SHOW OPEN FROM 11:30 AM TO 7:00 PM**

11:30 am – 12:30 pm – Trade Show Networking: Lunch in Exhibit Hall

2:00 pm – 2:30 pm – Trade Show Networking: Refreshments in Exhibit Hall

4:00 pm – 5:00 pm – Trade Show Networking

5:00 pm – 7:00 pm – Opening Reception in Exhibit Hall

**Thursday, May 26, 2016**

**TRADE SHOW OPEN FROM 8:00 AM TO 5:00 PM**

9:30 am – 10:00 am – Trade Show Networking: Refreshments in Exhibit Hall

11:30 am – 12:30 pm – Trade Show Networking: Lunch in Exhibit Hall

2:00 pm – 2:30 pm – Trade Show Networking: Refreshments in Exhibit Hall

4:00 pm – 5:00 pm – Trade Show Networking

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 Prizes are provided by:

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# NOTES

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