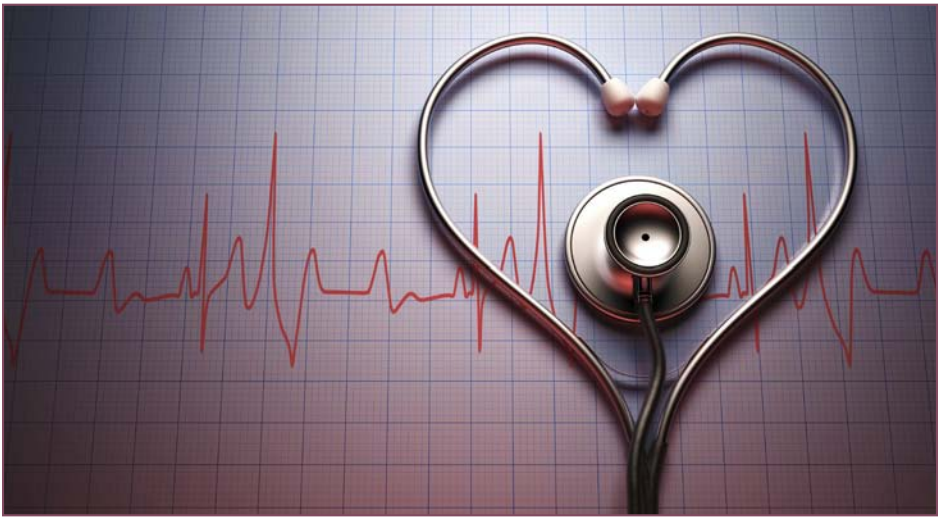
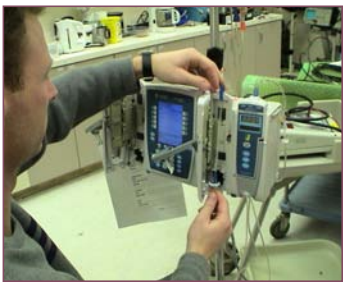
# 2014 CMBEC 37 CCGB Conference

May 20 - 23, 2014

Marriot Renaissance Harbourside Hotel in Vancouver, BC

**PROGRAM**





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BRITISH COLUMBIA

# A Message from the Premier

As Premier of the Province of British Columbia, it is my pleasure to extend greetings to the delegates of the 37th National Conference of the Canadian Medical and Biological Engineering Society, here at the Marriot Renaissance Harbourside Hotel.

This annual event brings together the Canadian Biomedical and Clinical Engineering communities, allowing for networking and sharing of important knowledge and current work. Delegates will have the opportunity to discuss issues ranging from scientific research to the pressing matters facing those working in the Technology Health Care field. With the great amount of knowledge and expertise to be shared, I have no doubt this will be an informative and productive event.

I would like to commend the organizing committee for their great efforts in bringing this Conference to fruition. Your work is a wonderful contribution to your profession, along with the local and global communities benefiting from the ideas generated over the course of these four days.

To all those visiting from outside British Columbia, welcome. I hope you will enjoy your stay and have an opportunity to explore some of the beauty and charm that this corner of the province has to offer.

Best wishes for a productive and successful National Conference.

Sincerely,

Christy Clark
Premier

# A Message from the Mayor

On behalf of the citizens of Vancouver, and my colleagues on City Council, I want to extend my warmest greetings to all those attending the 37th National Conference of the Canadian Medical and Biological Engineering Society in Vancouver.

The City of Vancouver is committed to building to a sustainable and thriving health care system. The leading edge work of our region's Health and Medical Device sectors and Educational Institutions positively impacts the lives of many around the world. By working to foster dialogue and the exchange of ideas between different areas of the Canadian Biomedical and Clinical Engineering communities we will ensure all Canadians and those beyond our borders receive the very best health care has to offer.

We are also very proud of the reputation Vancouver enjoys as one of the world's most beautiful and unique meeting destinations. I hope that in addition to attending the congress you are able to experience the many cultural and recreational activities the City has to offer. I know everyone involved in organizing the congress will ensure your time with us is special.

Once again, welcome to Vancouver, and I hope you enjoy your visit.

Yours truly,

Gregor Robertson MAYOR

# To all CMBEC 37 CCGB participants

On behalf of the CMBES Executive Committee, I would like to welcome all delegates to the 37th Canadian Medical and Biological Engineering Conference.

For the past three years, we have been strategically focusing on collaborating with provincial societies and organizing joint conferences. They were all very successful events and helped us to expand CMBES network. However I have to admit that I am excited to have our own standalone conference this year. I missed it! Historically our Vancouver conferences have always been outstanding with amazing local and national participation, and expect no less this year!

The conference organizing committee, led by Martin Poulin, has done an outstanding job of putting together an excellent program. I would like to express my thanks to all members of the committee for their efforts. In addition, special thanks to Anne Stacey and every one in Willow Group for all their work in support of the conference.

As usual, we have an excellent continuing education program, but with a new touch this year; all the courses are now included in the overall conference registration fees. I am quite excited and supportive of this new model. Our annual conferences have been a source of education as well as an opportunity for networking. So I think it is a natural evolution to combine both within one registration fee. And it's great to know that registrants of our Continuing Education sessions will receive Certificates of Completion and EIC Continuing Education Units.

CMBES is approaching a monumental mile stone: next year we will be celebrating our 50th anniversary. We have an amazing and rich history made by leaders, innovators, scientists, biomedical and clinical engineers, technologists, who uniquely served patients, the medical community, and Canadian Healthcare. And there is no doubt, Canadian Medical and Biological Engineering Society will keep going with the selfless efforts and time pledged by our volunteers, who work in all our committees. I would like to sincerely thank each and every volunteer, who contributed to CMBES.

Next year, we will jointly host the 2015 World Congress on Medical Physics and Biomedical Engineering in Toronto. I have no doubt it will be an amazing opportunity to celebrate our 50th anniversary during the largest event in our history. Don't miss this historical occasion, check CMBES website and forum for details.

Sincerely,

Murat Firat M.Sc., P.Eng., CCE
President,
The Canadian Medical and Biological Engineering Society
La Societe Canadiénné de Génie Biomédical

# Welcome / Bienvenue

On behalf of the Canadian Medical and Biological Engineering Society, I would like to welcome each and every one of you to Vancouver and the West Coast.

The committee organizers have worked hard to put forth a great program with 3 streams including the Academic, Clinical and Medical Device 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 the Exhibitors who will be on hand Wednesday and Thursday to market their latest products and services. Please spend some time at the Exhibit Hall and note there is a prize draw for those that visit the most booths.

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

Au nom de La Société Canadienne du Génie Biomédical, je vous souhaite tous la bienvenue à Vancouver et la Côte Ouest.

Le comité organisationnel a travaillé très fort pour mettre sur pieds un programme extraordinaire avec 3 volets qui comprennent la recherche académique, les équipements cliniques et médicaux. Nous avons également une gamme impressionnante de cours de formation, qui ont été survendues.

Je tiens à exprimer mon appréciation auprès des compagnies qui nous appuient avec des expositions sur la commercialisation de leurs nouveaux produits et services sur place lors du congrès mercredi et jeudi. S'il vous plaît passer un peu de temps à la salle d'exposition et noter qu'il y aura un tirage au sort pour ceux qui visitent le plus de kiosques.

S'il vous plaît profiter de l'apprentissage et du partage avec des collègues au cours des prochains jours et n'oubliez surtout pas de nous rejoindre à l'Aquarium de Vancouver, jeudi soir, pour le banquet et la Cérémonie de Remise des Prix (aussi survendues).

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

Sincerely,

Martin Poulin, M.Eng., P.Eng.
Chair, CMBEC 37 CCGB

# 2014 CMBEC37 Conference Organizing Committee

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Martin Poulin
*Vancouver Island Health Authority*

**Treasurer**
Kyle Eckhardt
*Winnipeg Regional Health Authority*

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**Continuing Education Program**
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Jochen Boehm (Co-Chair)
*British Columbia Institute of Technology*

**Exhibit/Sponsorship**
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*Northern Health*
Stephane Lajeunesse (Co-Chair)
*Canadian Forces Health Services Centre (Pacific) | National Defence*

**Local Arrangements**
Cai Long
*Providence Health Care*
Graham Wickham
*Vancouver Coastal Health Authority*
Maria Fredrikssen
*Fraser Health*

**Website Support**
Michael Hamilton
*Winnipeg Health Sciences*

**Conference Planning**
Anne Stacey, The Willow Group

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

# 2014 CMBEC37 CONFERENCE

## Tuesday, May 20, 2014

8:00 am – 8:30 am **Registration and Continental Breakfast** ..... *Meeting Room SALON C*

8:30am – 12:00pm **Continuing Education Course**

**CE1 – Cybersecurity in Healthcare**
*Meeting Room SALON E*

*Anthony J. Coronado, Biomedical Engineering Manager, Methodist Hospital of Southern California*

**CE2 – Service Course: Force Triad ESU**
*Meeting Room Port of VANCOUVER*

*Chris Frost, Field Service Manager, Technical Service, Covidien*

10:15 am – 10:30 am **Refreshment Break** ..... *Meeting Room SALON C*

12:00 pm – 1:00 pm **Lunch** ..... *Meeting Room SALON C*

3:15 pm – 3:30 pm **Refreshment Break** ..... *Meeting Room SALON C*

1:00pm – 4:30pm **Continuing Education Course**

**CE1 – Cybersecurity in Healthcare**
*Meeting Room SALON E*

*Anthony J. Coronado, Biomedical Engineering Manager, Methodist Hospital of Southern California*

**CE2 – Service Course: Force Triad ESU**
*Meeting Room Port of VANCOUVER*

*Chris Frost, Field Service Manager, Technical Service, Covidien*

6:00 pm – 8:00 pm **CMBES Executive Meeting (Private)**..... *Meeting Room SALON E*

# Wednesday, May 21, 2014

7:30 am – 8:15 am **Registration and Continental Breakfast** ..... *Grand Foyer*

8:15 am – 8:30 am **Conference Opening and Welcoming Remarks** ..... *Plenary SALON A*
*Martin Poulin, Conference Chair*

8:30 am – 10:00 am **Keynote Address:**
**LEARNING FROM CHALLENGES MEDICAL DEVICE COMPANIES ARE FACING TODAY TO BETTER PREPARE FOR THE FUTURE.**
*Jennifer Arntorp, Director of Operations / General Manager at Sorin Group Canada Inc.*

10:00 am – 10:30 am **Refreshment Break** ..... *Grand Foyer*

10:30 am – 12:00 pm **Concurrent Sessions**

A1 – A1: Biomechanics
*Meeting Room SALON B*

CS1: Consolidation Of Biomedical Engineering: Status Report
*Meeting Room SALON D*

MD1 – Product Development & Innovation I
*Meeting Room SALON F*

**CE3 – Future Trends In Health Technology Management**
*Meeting Room SALON E*

*James P. Keller, Jr., VP, Health Technology Evaluation and Safety, ECRI*

**CE4 – Effective Battery Management Practices**
*Meeting Room PORT OF VANCOUVER*

*Mr. Isidor Buchmann, CEO & Founder Cadex Electronics*
*Mr. Bruce Adams, VP Sales Cadex Electronics*

12:00 pm – 1:30 pm **Lunch in Trade Show Area** ..... *Harbourside Ballroom*

1:30 pm – 3:00 pm **Trade Show open for invited healthcare workers**

1:30 pm - 3:00 pm **Concurrent Sessions**

A2 – Biomedical Image Processing I
*Meeting Room SALON B*

CS2 – Cross Country Check-up: Around the Table: What Issues Are Filling Your Days?
*Meeting Room SALON D*

MD2 – Product Development & Innovation II
*Meeting Room SALON F*

**CE3 – Future Trends In Health Technology Management (Cont'd)**
*Meeting Room SALON E*

*James P. Keller, Jr., VP, Health Technology Evaluation and Safety, ECRI*

**CE4 – Effective Battery Management Practices (Cont'd)**
*Meeting Room PORT OF VANCOUVER*

*Mr. Isidor Buchmann, CEO & Founder Cadex Electronics*
*Mr. Bruce Adams, VP Sales Cadex Electronics*

3:00 pm – 3:30 pm **Refreshment Break in Trade Show Area** ..... *Harbourside Ballroom*

3:30 pm – 5:00 pm **Concurrent Sessions**

A3 – Biomedical Image Processing II
*Meeting Room SALON B*

CS3 – Clinical Engineering Paper Session
*Meeting Room SALON D*

MD3 – Imaging and Spectroscopy
*Meeting Room SALON F*

5:00 pm – 7:00 pm **Opening Reception in Trade Show** ..... *Harbourside Ballroom*
*Presented by Dunlee*

DUNLEE

# Thursday, May 22, 2014

7:30 am – 8:15 am **Registration and Continental Breakfast** ..... *Grand Foyer*

7:50 am – 8:15 am **Morning Address**..... *Plenary SALON A*
*Jason Chen, Executive Editor-in-Chief, Journal of Medical and Biological Engineering*

8:15 am – 8:30 am **Conference Opening and Welcoming Remarks** .....*Plenary SALON A*
Martin Poulin, Conference Chair

8:30 am – 9:30 am **Keynote Presentation :**
**HEALTH, CARE, AND CONNECTION: ENHANCING PERSON-CENTERED CARE THROUGH BIOMEDICAL DEVICE INTEGRATION**
Dr. Christina Vuksic, Physician, EHR Consultant

9:30 am – 10:30 am **Refreshment Break in Trade Show Area** ..... *Harbourside Ballroom*



10:30 am – 12:00 pm **Concurrent Sessions**

A4 – Medical and Assistive Devices Engineering
*Meeting Room SALON B*

CS4 – CMMS: The BC Experience And Plans For The Province.
*Meeting Room SALON D*

MD4 – Tourniquet Technology
*Meeting Room SALON F*

**CE5 – Introduction To Networks In Healthcare – An IT Perspective**
*Meeting Room SALON E*

*Dubravko Pajalic, Leader, Research Information Systems (RIS) BC Cancer Agency Cancer Research Centre*

**CE6 – Routine Testing Of Medical Devices In The Modern World: Updating Clinical Engineering Practice**
*Meeting Room PORT OF VANCOUVER*

*Ron Evans, President & VP New Product Development, Datrend Systems Inc.*

12:00 pm – 1:30 pm **Lunch in the Exhibit Hall** ..... *Harbourside Ballroom*

1:30 pm – 3:00 pm **Trade Show open for invited healthcare workers**

1:30 pm – 3:00 pm **Concurrent Sessions**

| | | |
|---|---|---|
| A5 – Biosignal Acquisition and Processing I<br>*Meeting Room SALON B* | CS5 – Clinical Engineering Paper Session<br>*Meeting Room SALON D* | MD5 – Rehabilitation Engineering<br>*Meeting Room SALON F* |

**CE5 – Introduction To Networks In Healthcare – An IT Perspective (Cont'd)**
*Meeting Room SALON E*

*Dubravko Pajalic, Leader, Research Information Systems (RIS) BC Cancer Agency Cancer Research Centre*

**CE6 – Routine Testing Of Medical Devices In The Modern World: Updating Clinical Engineering Practice (Cont'd)**
*Meeting Room PORT OF VANCOUVER*

*Ron Evans, President & VP New Product Development, Datrend Systems Inc.*

3:00 pm – 3:30 pm **Refreshment Break in Trade Show Area** ..... *Harbourside Ballroom*

3:30 pm – 5:00 pm **Concurrent Sessions**

| | | |
|---|---|---|
| A6 – Biosignal Acquisition and Processing II<br>*Meeting Room SALON B* | CS6a – Educational Paper Session<br><br>CS6b - CESOP Review<br>*Meeting Room SALON D* | MD6 – Robotic Engineering<br>*Meeting Room SALON F* |

7:00pm – 10:00pm **CMBEC37 Banquet and Awards Presentation**..... *Vancouver Aquarium*

# Friday May 23, 2014

8:00 am – 8:30 am **Registration and Continental Breakfast** ..... *Grand Foyer*

8:30 am – 10:00 am **Concurrent Sessions**

A7 – Sensors and Instrumentation
*Meeting Room SALON B*

CS7 – Medical IT-Networks: Future Planning for Biomedical Device Integration
*Meeting Room SALON D*

**CE7 – Wireless Technology In Healthcare**
*Meeting Room SALON E*

*James P. Keller, Jr., VP, Health Technology Evaluation and Safety, ECRI*

**CE8 – Display Technology For Healthcare Applications**
*Meeting Room PORT OF VANCOUVER*

*Roger Milford, Director & CEO, Shinda Medical Inc.*

10:00 am – 10:30 am **Refreshment Break** ..... *Grand Foyer*

10:30 am – 12:00 pm **Concurrent Sessions**

A8 – Clinical, Cellular, and Neuro Engineering
*Meeting Room SALON B*

CS8 – TeleHealth: Using Technology to Deliver Patient Care... Is Your Clinical Engineering Department in the Picture?
*Meeting Room SALON D*

**CE7 – Wireless Technology In Healthcare (Cont'd)**
*Meeting Room SALON E*

*James P. Keller, Jr., VP, Health Technology Evaluation and Safety, ECRI*

**CE8 – Display Technology For Healthcare Applications (Cont'd)**
*Meeting Room PORT OF VANCOUVER*

*Roger Milford, Director & CEO, Shinda Medical Inc.*

12:00 pm – 1:30 pm **Lunch** ..... *Grand Foyer*

**CMBES Annual General Meeting** ..... *Meeting Room SALON D*

1:30 pm – 3:00 pm **Concurrent Sessions**

| | |
|---|---|
| A9 – Physiological Systems / Modeling<br>*Meeting Room SALON B* | CS9 – Improving the Effectiveness of Medical Device Donations<br>*Meeting Room SALON D* |

3:00 pm – 4:00 pm
**Closing Remarks**
**Presentation of Paper Awards** ..... *Meeting Room SALON D*

TUESDAY, MAY 20, 2014

# Continuing Education

**8:00 am - 8:30 am**
Registration and Continental Breakfast *Meeting Room SALON C*

**8:30am - 12:00pm**
Continuing Education Courses

**CE1 - Cybersecurity in Healthcare** *Meeting Room SALON E*

- Anthony J. Coronado, Biomedical Engineering Manager, Methodist Hospital of Southern California

This course will examine the changes presented from new medical equipment technology in regards to PC based/networked equipment and new vulnerabilities associated. A detailed explanation of the risk assessment needed to determine all cyber vulnerabilities, which includes electronic patient information protection and patient safety will be given. This course will also provide a sampling of a mitigation plan and the establishment of a Secure Medical Device Network (SMDN) at a healthcare facility. Detailed instructions on incorporating IT functions to daily Biomedical Engineering functions will be included. Developing a program that incorporates Asset Management, Project Management, Risk Management, and Configuration Management will be explained in detail.

**CE2 - Service Course: Force Triad ESU** *Meeting Room PORT OF VANCOUVER*

- Chris Frost, Field Service Manager, Technical Service, Covidien

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

**10:15 am - 10:30 am**
Refreshment Break *Meeting Room SALON C*

**12:00 pm – 1:00 pm**
Lunch *Meeting Room SALON C*

**3:15 pm – 3:30 pm**
Refreshment Break *Meeting Room SALON C*

**1:00pm - 4:30pm**
Continuing Education Courses

**CE1 - Cybersecurity in Healthcare *(repeat of morning session)*** *Meeting Room SALON E*

- Anthony J. Coronado, Biomedical Engineering Manager, Methodist Hospital of Southern California

This course will examine the changes presented from new medical equipment technology in regards to PC based/networked equipment and new vulnerabilities associated. A detailed explanation of the risk assessment needed to determine all cyber vulnerabilities, which includes electronic patient information protection and patient safety will be given. This course will also provide a sampling of a mitigation plan and the establishment of a Secure Medical Device Network (SMDN) at a healthcare facility. Detailed instructions on incorporating IT functions to daily Biomedical Engineering functions will be included. Developing a program that incorporates Asset Management, Project Management, Risk Management, and Configuration Management will be explained in detail.

**CE2 - Service Course: Force Triad ESU**
***(repeat of morning session)*** *Meeting Room PORT OF VANCOUVER*

- Chris Frost, Field Service Manager, Technical Service, Covidien

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

**6:00pm – 8:00pm**
CMBES Executive Meeting (Private) *Meeting Room SALON E*

WEDNESDAY, MAY 21, 2014

# Conference & Trade Show

**7:30 am - 8:15 am**
Registration and Continental Breakfast *Grand Foyer*

**8:15 am - 8:30 am**
Conference Opening and Welcoming Remarks *Plenary SALON A*

- Martin Poulin, Conference Chair

**8:30 am – 10:00 am**
Keynote Address: Learning From Challenges Medical Device Companies Are Facing Today To Better Prepare For The Future. *Plenary SALON A*

- Jennifer Arntorp, Director of Operations / General Manager at Sorin Group Canada Inc.

**10:00 am - 10:30 am**
Refreshment Break *Grand Foyer*

**10:30 am - 12:00 pm**
Concurrent Sessions

**A1 – Biomechanics** *Meeting Room SALON B*

Co-Activation Of Leg Muscles Differs While Ascending And Descending Stairs

- Kazushige Kimura, Zahra Moussavi

Co-activation of the agonist-antagonist leg muscles has been studied during walking on flat, uphill, and downhill surfaces. This study aimed to examine any plausible difference between the amount of co-activation of the leg muscles while ascending and descending stairs. Twelve healthy individuals went up 12 stairs one at a time, and then down one at a time. Surface electrodes were placed on subjects' left leg, and electromyography (EMG) signals recorded. The signals were segmented to each step's data; the root-mean-square (RMS) values were calculated over 100 ms windows with 50% overlap between successive windows. Co-activation, defined as the overlapped area between RMS value of the EMG signals of the agonist and antagonist muscles, was calculated for every ascending and descending step and averaged for all ascending (and descending) steps for each subject. Results showed co-activation during ascending stairs was significantly ($p<0.01$) larger than that of during descending.

### The Influence Of Submaximal Concentric Exercise On Chondrocyte Death And Synovial Fluid Proteins In Articular Cartilage Of The Rabbit Knee


- Nada Abughazaleh, Ziad Abusara, Roman Krawetz, and Walter Herzog



*Background:* Articular cartilage is a highly specialized connective tissue that covers the ends of bones in joints. Excessive joint loading has been associated with changes in synovial fluid (SF) proteins and percentage of chondrocyte death in the superficial zone of cartilage.
*Objective:* The aim of this study was to apply moderate exercise and evaluate the effect of muscle force induced concentric submaximal joint loading on chondrocyte death, and SF content.
*Method:* Cyclic loading using submaximal concentric contractions were applied for 30 minutes at an activation level corresponding to 15% of the maximum isometric knee extensor force.
*Result:* There were no significant differences in percentage cell death between mechanically loaded and unloaded control joints, and no significant change in the number of proteins found in SF of experimentally loaded and unloaded control joints.
*Conclusions:* moderate exercise does not appear to cause chondrocyte death which is consistent with the idea that normal walking is not associated with cartilage damage, and joint articular cartilage can handle this type of loading without altering the composition of SF.


### Effects Of Bracing On Pointing Task Accuracy


- Tarek Mohammad, Yen Po Liu, Antony Hodgson



Bracing is a relatively understudied technique for reducing the variability of tool endpoint movements during mechanical interactions involving users, tools, and workpieces. This study examined the effect of bracing on pointing task performance as a precursor to future studies related to potential applications of bracing in surgery. Three adult subjects were asked to perform three separate tasks using a laser pointer while supported by three levels of bracing. The three tasks are to steadily focus the laser pointer to a point target for 10 seconds, to move the laser pointer between two point targets at 20cm, and to complete one revolution about a circle of 25 cm diameter. In the latter two tasks, each subject executed the task in two different modes: emphasizing accuracy and emphasizing speed. The subjects' performance was evaluated based on the variance of the radial deviation of their positions from the target. The study suggested that while bracing could have a significant effect on variability, the results were still highly variable and occasionally opposite to the desired effect. This in turn suggests a strong need for a design tool to accurately predict the impact of a brace that will effectively and consistently enhance task performance.


### Evaluating In Vivo Bone Motion Of Hip Joints Under Weight-Bearing Condition Using Open MRI


- Xiumei Kang, David R. Wilson, Antony J. Hodgson



Femoroacetabular impingement (FAI) is a mechanical hip disorder leading to pain and reduced hip range of motion. Evaluating in vivo hip motions in daily activities (e.g. sitting, squatting) are important in FAI assessment. This study estimated the repeatability of in vivo bone motions in sitting postures based on MRI images. Three healthy subjects were scanned in 2 repeated supine positions and 4 repeated sitting cycles to obtain high and

low resolution MRI images. The images were segmented and registered to calculate the hip angles at sitting postures. We found that the intra-subject repeatability of in vivo bone motions during repeated sitting was good to excellent (SD 1.9°). The intra-subject repeatability of bone motions during repeated lying postures was excellent (SD 0.8°). The results indicated that it may be challenging for subjects to reproduce the sitting than supine posture, and there were larger variation in pelvis than femur in sitting repositioning.

### A Biomechanical Study Of Cyclic Loading Of Distal Volar Radius Plates For The Treatment Of Distal Radius Osteotomies

- Lisa M. Burke, Amy C. Hsiao, Alexandra C. R. Stratton, Chris B. Hamilton, Caroline Forsythe, Craig N. Stone, Andrew J. Furey

A distal radius (Colles') fracture is a common injury resulting from a fall on the outstretched hand. The fracture consists of a compressive fracture of the dorsal side of the bone and tensile fracture of volar side. The purpose of this study is to simulate clinical conditions of cyclic loading at forces needed for basic activities for daily living (ADLs). Osteotomies were conducted on distal radius sawbones with volar plate fixation, using five volar and distal plate designs of stainless steel and titanium for comparison. All applicable samples failed within 8 cycles of an axial load to 350 N, thus the results suggest that a patient with a distal radius fracture cannot undergo ADLs in early stages of treatment. The results of this study can be used to help design a plan of postoperative motions to prevent malunion and avoid complication in the healing of the fracture.

### Biomechanical Optimization Of The Angle And Position For Surgical Implantation Of The Depuy Silent Hip Implant

- Gillian E. Cook, Saeid Samiezadeh, Zachary Morison, Mina S.R. Aziz, Habiba Bougherara, Radovan Zdero, Emil H. Schemitsch

Total hip replacements are becoming increasingly popular in the younger population. Conservative implants were developed to preserve bone stock and improve the physiologic loading of the hip joint. The Silent Hip is a conservative implant with no prior biomechanical research. This study endeavoured to determine the 3D orientation of the Silent Hip within the proximal femur that would yield a stress distribution most similar to an intact femur. Synthetic femurs were instrumented with strain gages and implanted with the Silent Hip in 7 orientations. Subclinical loads were applied to the femurs using an Instron tester. Resulting strains were used to validate corresponding finite element models of the implanted femur in each orientation. Stresses between orientations were compared to an intact femur model and the percent difference was calculated. Preliminary results indicate a valgus and posterior orientation is optimal, which has implications for the best surgical placement of the Silent Hip.

**CS1 – Consolidation Of Biomedical Engineering: Status Report** *Meeting Room SALON D*
*Session Chair: Gordon Jasechko, M.Eng., P.Eng., Biomedical Engineer, Island Health, Victoria, BC*

- Eldon Berezanski, P.Eng, Director of Clinical Engineering, Edmonton Zone, Edmonton, AB
- Chris Buck, P.Eng, Executive Director Lower Mainland Biomedical Engineering, Vancouver, BC

In today's world of cost saving measures consolidation of healthcare services is inevitable. In hospital Biomedical Engineering departments are one common services that is looked upon to find efficiencies, cost savings and eliminate redundancies. Programs across Canada are all at various stages of consolidation. This session will have speakers from British Columbia and Alberta and will frame their situations, share experiences and allow for audience questions.

**MD1 – Product Development & Innovation I** *Meeting Room SALON F*

*Session Chair: Nancy Paris, MASc, PEng, FEC, Director, Product and Process Applied Research Team, BCIT Technology Centre*

Portable Blood Pressure Monitoring Using Pulse Transit Time

- Tyler Worthing, Wilhelm Wenngren, Ryunosuke Nakamatsu, Thomas Johnson

This paper explores the possibility of using a head worn photoplethysmograph (PPG) in conjunction with an electrocardiogram (ECG) to provide a mobile and robust method of estimating blood pressure. Signals from the PPG and ECG sensors are used to measure pulse transit time (PTT) which is then combined with a method of calibration to estimate blood pressure. Two values of blood pressure are collected for calibration: one while the subject is at rest and another after a brief period of physical activity. The result of this calibration is a model that directly equates changes in PTT to changes in blood pressure. The goal of this work is to design a system that can provide mobile health monitoring of both heart activity and blood pressure. The sensor design and digital signal processing methods used to combine the PPG and ECG signals with adjunct calibration data are described.

A Novel Multielectrode Catheter System For Global Mapping And Ablation Of The Left Atrium For The Treatment Of Atrial Fibrillation

- Hans Kottkamp MD, Dan Reinders, Ashkan Sardari, Saar Moisa, Daniel Weinkam, Jeff Brewster, Kevin Chaplin

A novel multi-electrode catheter system, The Globe™ Mapping and Ablation system, was developed for global treatment of atrial fibrillation (AF). The Globe system uses a high density array of up to 275 electrodes to provide detailed electrophysiological mapping of the left atrium. The Globe system also provides radiofrequency (RF) ablation from the same electrodes to create lesions within the atrium, with the position of these lesions being used to treat the AF

Integrating Human Factors And Usability Testing Into Medical Device Risk Management

- Florin Gheorghe, H.F. Machiel Van der Loos

The application of human factors in medical device development is a required component of pre-market submission by regulatory bodies. While manufacturers currently manage product development using well known risk management approaches (e.g. ISO 14971), the adoption of human factors and usability may not be as familiar and effectively integrated. However, the human factors process must communicate directly with the risk management steps that companies already have in place. This talk provides an introduction to human

factors and usability testing for medical devices as an integrated component of risk management. Qualitative user research methods are presented that are useful in conducting this work, and are based on the authors' research on participatory design methods for medical devices in Uganda.

Human Factors Engineering in Healthcare: A Procurement Process for Devices and Equipment

- Allison Muniak, M.A.Sc., Human Factors Specialist, Quality & Patient Safety, Vancouver Coastal Health

**CE3 – Future Trends In Health Technology Management** *Meeting Room SALON E*

- James P. Keller, Jr., VP, Health Technology Evaluation and Safety, ECRI

This course will review where the health technology management profession is headed over the next five to ten years. It will discuss the healthcare and technology factors influencing these new directions. Practical perspectives will be provided on how today's health technology managers should be preparing for the future from personal growth, department and business management, and strategic direction points-of-views. Examples of topics to be covered include integration with HIT, new venues for providing technology services (like in patient homes), and new technologies that are expected to most influence changes in the health technology management profession.

**CE4 – Effective Battery Management Practices** *Meeting Room PORT OF VANCOUVER*

- Mr. Isidor Buchmann, CEO & Founder Cadex Electronics
- Mr. Bruce Adams, VP Sales Cadex Electronics

Batteries play a vital role in delivering patient care. Over time, rechargeable batteries lose capacity and smart fuel gauge systems can lose accuracy. Battery management is one of the Top 10 problems faced by today's Biomedical Engineers. This session will identify tips and practices for effective Battery Management to improve patient care, reduce safety risks and reduce capital costs by rightsizing battery inventories. Audience participants will -

- Recognize the importance of routine battery management to avoid risk of battery failure
- Learn techniques for management & calibration of medical device batteries, including smart batteries
- Learn tips to set-up replacement or reconditioning cycles for battery-powered medical devices and measure and track battery state-of-health

**12:00 pm – 1:30 pm**
Lunch in Trade Show Area *Harbourside Ballroom*

**1:30 pm - 3:00 pm**
Concurrent Sessions

**A2 – Biomedical Image Processing I** *Meeting Room SALON B*

### A Low-Cost Image Compression Algorithm For Wireless Endoscopy Using A Novel Yef Color-Space

- Atahar Mostafa, Tareq Khan, and Khan Wahid

Wireless capsule endoscopy (WCE) is a non-invasive technique to receive images of intestine for medical diagnostics. Here, a patient ingests a specially designed electronic capsule which has imaging and wireless circuitry embedded inside. While the capsule travels through the gastrointestinal tract, it captures images and sends them wirelessly to outside world where the images are displayed for diagnosis. The main design challenges of endoscopy capsule are accruing and transmitting acceptable quality images by utilizing as less hardware and battery power as possible. In order to save wireless transmission power and bandwidth, an efficient image compression algorithm needs to be implemented inside the endoscopy electronic capsule. In this paper, an integer discrete-cosine-transform (DCT) based image compression algorithm is presented that works on a low-complexity color-space, referred as YEF, designed earlier by our group. A low-cost quantization scheme with chroma sub-sampling options is also implemented to achieve higher compression.

### Non-Invasive Flow Contrast Imaging Of Blood Vessels In Human Retina

- Jing Xu, Kevin Wong, Sherry Han, Michelle Cua, Yifan Jian, Marinko V. Sarunic

The purpose of this study was to investigate non-invasive and label-free optical imaging techniques to visualize blood flow in the retina. This is important for clinical ophthalmology to monitor changes in the microcirculation of the retina that occur in diseases causing blindness such as diabetic retinopathy. Imaging was performed with a custom built Fourier Domain Optical Coherence Tomography (FD OCT) system. Flow contrast was obtained using a technique called speckle variance (sv) OCT. Real time processing and visualization was implemented on a Graphics Processing Unit (GPU). The display window included structural OCT data, en face projections of the intensity data, and the svOCT en face projections of retinal microvasculature. Blood vessels and microvasculature from different retinal depth layers can be visualized in real-time during data acquisition, and the results suggest that GPU accelerated svOCT has potential to be a suitable technique for longitudinal monitoring of pathological changes in the retina.

### X-Ray In-Line Phase Contrast Imaging For In Vivo Visualization Of Tissue Repair Scaffolds For Nerve Tissue Engineering

- Ning Zhu, Ajay Rajaram, Huishu Hou, David Schreyer, and Daniel X.B. Chen, George Belev, and Tomasz W. Wysokinski

Conventional radiography is limited for the in vivo applications of soft tissue imaging, such as nerve and scaffolds imaging in nerve tissue engineering. It cannot produce enough image contrast for in vivo visualization. A synchrotron radiation based x-ray phase contrast imaging (PCI) technique can provide additional phase contrast to enhance the image contrast of sample structure in situ. In the present study, PCI combined with computed tomography was used for the study of nerve tissue scaffolds in situ. The scaffold was implanted at the site of transection of a sciatic nerve in a rat. The scaffold-implanted

hindlimb was imaged by using PCI-CT. After three dimensional reconstruction, the images successfully show the structure of the alginate scaffolds and the profile of the nerve conduit. The PCI-CT technique shows great potential to monitor nerve tissue regrowth and scaffold degradation over a longer survival period in live animals.

Toward Feature-Based Endoscopic Region Alignment With Augmented Reality

- Jiawei Zhou and Shahram Payandeh

To provide intra-operative guidance in Minimally Invasive Surgery (MIS), an interactive human computer interface is designed in our previous work which allows surgeon to manually register and overlaid patient's pre-operative images on surgical scene. However, if the endoscopic view changes due to the movements of the endoscope, the registered image is lost and needs to be manually realigned. To maintain a robust region alignment between different camera views, a feature-based approach is presented in this paper. In the preliminary in-vitro Augmented Reality (AR) study, a simple marker-based AR system is developed on a mobile platform. To explore the notion of AR application to real MIS scene, some specific regions in the surgical cavity can be considered as the 'natural marker' in order to register the overlaid virtual object. In order to realize such local region alignment between various camera views, an image matching algorithm based on SIFT is applied and evaluated in in-vivo surgical scenes.

**CS2 – Cross Country Check-up: Around the Table: What Issues Are Filling Your Days?** *Meeting Room SALON D*

*Session Chair: Andrew Ibey, M.Eng, P.Eng., CCE, LM Biomedical Engineer, Fraser Health, Providence Health Care, Provincial Health Services Authority, Vancouver Coastal Health*

- Jean Ngoie, C.Eng., Regional Mgr. Biomedical Engineering, Niagara Health System
- Ted MacLaggan, MScE. P.Eng., Manager of Biomedical Engineering, IWK Health Centre
- Kyle Eckhardt, MEng, EIT, Regional Clinical Engineer, Winnipeg Regional Health Authority
- Gnahoua Zoabli, ing., M.ing., Ph.D., Chef du service du genie biomedical, CSSS Lac-des-Deux-Montagnes
- Marie-Ange Janvier, Clinical Engineer, Clinical Engineering, CHEO
- Kelly Kobe, P.Tech.(Eng.), CBET(C), Director, Calgary Zone, Clinical Engineering, Alberta Health Services, Foothills Medical Centre

Cross country checkup provides a snapshot of "hot topics" in Biomedical Engineering departments across Canada. Although our core service remains the same, how we apply it and some of the peripheral work may be unique across the country. This session will have speakers from Nova Scotia, Ontario, Alberta and Quebec to give the CMBES community an update on current provincial topics.

**MD2 – Product Development & Innovation II** *Meeting Room SALON F*

*Session Chair: Judy Findlay, M.A.Sc., P.Eng., Principal Consultant, Advance Biomedical Inc.*

3D Cell Culture With Integrated Oxygen Control And Measurement

- Samantha M. Grist, Selim Gawad, Carmen Bayly, Linfen Yu, Lukas Chrostowski, and Karen C. Cheung

We present the development of a novel cell culture environment for applications in cell-based drug screening, integrating three-dimensional (3D) cell culture with in situ generation and measurement of hypoxic conditions and oxygen gradients. This platform permits the manipulation of oxygen levels around the cells during the drug screening process. Oxygen control and measurement capabilities are integrated into a microfluidic 3D culture environment in which tumour spheroids are encapsulated and wholly contained within microfluidically-generated alginate beads. This system is integrated with a patterned phosphorescent optical oxygen sensor film to measure the oxygen levels inside the device. Finally, a system has been developed to provide time-varying gaseous oxygen levels to the microfluidic devices in addition to spatial gradients, which will further expand the ability of the microfluidic system to model the in vivo conditions experienced by tumour cells and offer greater potential for improving the drug screening process.

### On-Board Array For Multiplexed Semi-Active Cooling Rate Controlled Cryopreservation Of Living Cell

- Hsiu-Yang Tseng, Scott Malfesi, Nadia Tehranchi, Bonnie Gray

An optimal cooling rate is a critical factor affecting the survival of biological cells during cryopreservation. On-board cooling rate controlled cryopreservation under low-temperature environments has been successfully developed with disposable, biocompatible storage chambers on top of localized heaters on the printed circuit board. The assembly allows simple manipulation, sample loading and extracellular ice formation. Thin-film heater was deposited on the board by electroless plating and photolithography. A feedback control program was embedded in a microcontroller, along with the heater functioning simultaneously as the resistive heating elements and temperature sensors, to semi-actively control the transient temperature profiles during the freezing process for multiplexed requirements. Our device was able to maintain a stable cooling rate below 1 per minute. The research indicates that this device can be a low-cost, reliable and convenient tool for laboratory use in cryopreservation.

### An Intelligent Energy-Efficient Implantable CMOS Neural Prosthetic To Promote Personalized Therapy For Neurological Disorders

- Mohammad Poustinchi, Sam Musallam

Many neurological and psychiatric conditions are the result of abnormal neurotransmitter concentrations in the brain. Our ultimate goal is to develop a neural prosthetic device that can maintain therapeutic levels of chemical concentrations in the brain in real time. The negative consequences of systemic drug delivery and aberrant neurotransmitter concentrations will be eliminated by personalizing neurotherapy and delivering drugs at the exact location they are needed. We have developed a low power implantable closed-loop CMOS neurotrophic factor delivery microsystem which by protecting the healthy neurons and restoring damaged ones can maintain therapeutic levels of chemical concentrations in the brain. The hybrid microsystem is composed of novel biosensor that can sense micromolar concentration of neurotransmitters (dopamine) and embedded negative feedback circuits that control the flow of pharmacological agents in micro fluidic channels. Additionally MEMS (Micro Electro Mechanical System) pumps connected to the probes to inject micromolar concentration of neurotrophic factors such as GDNF into the brain in order to protect and restore Dopaminergic neurons in the nigrostraital pathway.

Rapid Prototyping Of Meso-Scale Fluidic Devices And Masters For PDMS Molding

- Nadia Tehranchi, Bonnie L. Gray

We describe a new and simple fabrication method that enables inexpensive and rapid prototyping of meso-scale fluidic systems and interconnect structures between micro- and meso- scale fluidic devices. Devices and systems are designed using simple CAD software and printed in a few minutes using an inexpensive MakerBot 3D printer. Printed structures are used directly or as a master for molding of polydimethylsiloxane (PDMS) structures via soft lithography. Using this method, input and output ports, and interfaces to a meso-scale fluidic board or between meso-scale fluidic components, can be placed with high geometric versatility. Our method offers a cost-effective alternative to prototyping of meso-fluidic systems using conventional microfabrication, or using injection-molding/ conventional machining of polymers.
This paper introduces the MakerBot 3D printer for prototyping of meso-scale fluidic structures and shows a demonstration of interconnect between MakerBot-printed and PDMS structures. Initial results show that the cylinder and hole interconnect structures result in a reversible mechanical and fluidic bond.

**CE3 – Future Trends In Health Technology Management *(Cont'd)*** *Meeting Room SALON E*

- James P. Keller, Jr., VP, Health Technology Evaluation and Safety, ECRI

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**3:00 pm - 3:30 pm**
Refreshment Break in Trade Show Area *Harbourside Ballroom*

**3:30 pm - 5:00 pm**
Concurrent Sessions

**A3 – Biomedical Image Processing II** *Meeting Room SALON B*

### A Labview Based Graphic User Interface For Multimodality Confocal And Multi-Photon Microscopy Imaging And Spectroscopy Measurement

- Wenbo Wang, Yunxian Tian, Jianhua Zhao, Harvey Lui, Haishan Zeng

Confocal laser scanning microscopy (CLSM) and multiphoton microscopy (MPM) are becoming increasingly popular for non-invasive diagnostics of human tissues and biological samples. We developed a customized software platform that offered highly flexible CLSM and MPM imaging capacity. The software used Labview graphic programming language and national instrument's DAQmx software. Multiple advanced design patterns, e.g., queued and event-driven state machines for simultaneous tasks during run time. The software architecture fully utilized the multi-threading capability of windows. Practical features include responsive user interface interaction, on-the-fly image display, and synchronized signal generation and data acquisition. Run-time communication with peripheral devices was realized via serial ports and digital pulses. The galvometric mirror scanning pattern and image reconstruction function modules are described. Test results on raster scanning, imaging reconstruction, and calibration procedures are reported. Confocal images, multiphoton microscopy images, and two-photon fluorescence spectra of collagen and skin tissue samples are demonstrated.

### Recent Advances On Magnetic Multilayer-Based Magnetoplasmonic Sensors For Biomedical Applications

- Conrad Rizal, Belaid Moa, and Alexandre G. Brolo

The Surface Plasmon Resonance (SPR) is the basis for many sensitive sensors. When they are excited by an incident light, the surface plasmon (SP) oscillations propagate at the interface of a metal and a dielectric medium, and generate very confined electromagnetic waves at this interface. The excitation condition of SPs depends on the electromagnetic properties of the interface, especially the refractive index of a bio-sample. This mechanism of detection, however, is not effective for all bio-samples, especially the ones with low concentrations. To address this, magnetic and optical properties of multilayers, and SPs are combined to enhance the sensitivity of biosensors and improve their signal-to-noise ratio. The magneto-optic (MO) Kerr effect in these multilayers is intensified when SPs are excited. Instead of measuring the linear variation in the angle of the minimum reflectivity, the magnetoplasmonic sensors measure the intensity variation in the MO effect and, therefore, outperform SPR biosensors.

### Investigation Of Fluorescence Coherence Tomography For Optofluidic Applications

- Lukas-Karim Merhi, Bhuvaneshwari Karunakaran, Sae-Won Lee, Ash M. Parameswaran, Soumyo Mukherji, Debjani Paul, Mirza Faisal Beg, Marinko V. Sarunic

Conventional Flow Cytometers (FC) and Fluorescence-Activated-Cell-Sorters (FACS) are mechanically complex, bulky, and require human operators, large sample volumes and preparation procedures for proper diagnosis of diseases such as leukemia and malaria. For this reason, there has been an increasing demand for miniaturization, cost reduction, and portability of such devices. Lab-on-a-chip devices, which integrate microfluidics with other technologies, have been emerging as a potential solution to miniaturization of FC/FACS technology.
In this report, the integration of a novel optical imaging technique called Fluorescence Coherence Tomography (FCT) with microfluidics is presented. The FCT was used to measure the position of flowing fluorescent particles in the cross-section of the microchannel (perpendicular to the direction of flow). This type of measurement was motivated by recent reports in the literature demonstrating that a cell's position in a microchannel is highly sensitive to its size and stiffness, which in turn are important biomarkers for cell classification.

### Imaging Fluorescence Labeled Cells In Mice Retina Using Fluorescence Scanning Laser Ophthalmoscopy

- Sujin Lee, Yifan Jian, Marinko V. Sarunic

Small animal models of diseases serve as a vital component in vision research, where they facilitate the understanding of the underlying biological processes, identification of potential causative genes for human disorders, and development of therapies against vision-robbing diseases. Mice and rats are common candidates for preclinical vision research due to the similarity of their eyes with human eyes, and availability of transgenic strains that represent human diseases.
Scanning Laser Ophthalmoscopy (SLO) is a non-invasive retinal imaging modality used to obtain high resolution en face images of the retina in vivo. We have demonstrated dual channel fluorescence/confocal SLO system custom designed for mouse retinal imaging that is capable of both structural and functional imaging.
Mice that express enhanced green fluorescent protein (EGFP) in retinal ganglion cells (RGC) and microglia cells respectively were imaged in this study. The results demonstrate a system that could assist researchers investigate new therapies and understand dynamic behavior of the retinal cells.

## CS3 – Clinical Engineering Paper Session

*Meeting Room SALON D*

*Session Chair: Dale Morgan, Dale Morgan P.Eng, BET©, Operations Manager, Medical Safety & Technology, CSA Group*

### Self-Assessment Of Insulin Sensitivity

- M. Barazandegan, F. Ekram, K.E. Kwok, and R. B. Gopaluni

Several methods have been proposed to evaluate a person's insulin sensitivity from an oral glucose tolerance test and the euglycemic insulin clamp technique. However, all are neither easy nor inexpensive to implement since the plasma insulin concentration as a key variable for assessing the insulin sensitivity index (ISI) is required to be clinically measured at specific times. Therefore, it is desirable to develop a new ISI that can be easily and accurately obtained by patients themselves without costly, time consuming and inconvenient testing methods. In the current work, we proposed a novel but simple self-administered testing method, which can be used to estimate the insulin sensitivity index. The test was evaluated

by using the diabetic-patient dynamic model developed previously. Later, it was shown that the proposed new ISI is comparable to the M-value obtained from the accurate clinical glucose clamp method to obtain insulin sensitivity.

### Facilitating Independent Living Of Individuals With Neurological Disorders

- Mojgan Tavakolan, Carlo Menon

A compelling goal for our society is to facilitate independent living of individuals with upper extremity (UE) impairment. The degree of impairment could be greatly reduced by using Electroencephalography (EEG) controlled assistive devices. The successful implementation of EEG controlled devices relies on the capability of determining individuals' actions. A preliminary study was conducted to evaluate the performance of a classification scheme. Multi-class support vector machine (SVM) was used as a classifier and an acceptable classification error rate (less than 14%) on average was obtained. It was observed that the classification of three right-arm movements, namely rest, grasp and elbow flexion, was feasible.

### Intravenous Therapy - Towards An Integrated Approach For The Selection Of Infusion Devices At Csss Du Lac-Des-Deux-Montagnes

- Gnahoua Zoabli, Sylvain Marcil, Liane Rouiller, Nathalie Bigras, Chantale Séguin, Nancy Chabot, France Granger, Arielle Katia M. Bada and Lucie Dugré

CSSS du Lac-des-Deux-Montagnes is facing an end of supply of volumetric pumps for about two years to come. This affects the replacement of defective or obsolete volumetric pumps, and the need to add new ones to meet the growth of our clinical services. To simplify the secure choice of alternative infusion methods to volumetric pumps, a working group composed of various medical and clinical managers has developed a simplified decision process of available IV technologies.
This study helped identify care units that will experience less volumetric pumps during the two-year period. These units are paired with those with whom they have a clinical functional link and for whom a surplus of volumetric pumps is identified. This has created functional exchange links and has made easy the selection of alternative IV technologies to significantly reduce the use of volumetric pumps as recommended in the revised medication administration guide.

## MD3 – Imaging and Spectroscopy

*Meeting Room SALON F*

*Session Chair: David Morgan, PhD, Chief Technology Officer, LED Dental Inc.*

### Combining Two Breast Cancer Diagnosis Technologies- Diffuse Optical Tomography With EIS

- Majid Shokoufi, Parvind Grewal, and Farid Golnaraghi

Both Frequency-Domain Diffuse Optical Tomography (FD-DOT) and Electrical Impedance Spectroscopy (EIS) are mature and developed technologies that have been used separately for breast cancer detection. In this paper, we have developed and present a handheld diffuse optical tomography probe combined with EIS to monitor, non-invasively, real time biological tissue activity in vivo. The proposed probe has two near-infrared

wavelengths LEDS (capsulated in one package) and one photodiode, and two Ag/AgCl electrodes. Using FD-DOT with multispectral evaluation algorithm, we can measure optical absorption and scattering properties in normal and cancerous breast tissue. The EIS provides information regarding electrical properties of tissue specifically increased cellular water, sodium content, altered membrane permeability, and changed packing density and orientation of cells. The combined FDOT-EIS system is used to provide simultaneous electrical as well as optical characteristics of in-vivo tissue.

### Multimode Imaging Applied Toward Diagnosis Of Skin Cancer

- Fartash Vasefi, Nicholas MacKinnon, Daniel L. Farkas

We introduce a clinical prototype of SkinSpect – a multimode dermoscope combining fluorescence, polarization and hyperspectral imaging. SkinSpect determines relative melanin and hemoglobin concentrations and oxygen saturation while effectively correcting for the melanin-hemoglobin crosstalk seen in other spectral dermoscopy approaches. Optical specifications and performance of clinical and previous research prototypes are compared. Light source programming and image polarization selection using a LCVR are optimized to improve accuracy of skin chromophore quantitation. The multimode dermoscope combines polarization/hyperspectral imaging with a computationally rapid analytical model. We employ specific spectral ranges in visible and NIR wavelengths for mapping the distribution of skin bio-molecules. This corrects the melanin-hemoglobin misestimation common to other systems, without resorting to complex and computationally intensive tissue models prone to inaccuracies due to over-modeling. Human skin measurements including melanocytic nevus, vitiligo, and venous/arterial occlusion were investigated. The end goal is earlier, more reliable diagnosis of major disease such as cutaneous melanoma.

### Development Of A Mobile Medical Application For Imaging And Analysis Of Arthritis Of The Hand

- Nicholas MacKinnon, Shanil Gunasekara, Fartash Vasefi

This project introduces a new smartphone and tablet deployable mobile medical application that utilizes device sensors, internet connectivity and cloud-based image processing to document and analyze physiological characteristics of hand arthritis. The application facilitates image capture and performs image processing that identifies hand fiduciary features and feature metrics to report and quantify the progress of arthritic disease. In addition to describing this process, we discuss the technical issues and regulatory challenges related to development and deployment of mobile medical applications with reference to the 2013 FDA Final Guidance on Mobile Medical applications, HIPA requirements, and compliance with the ISO/IEEE 11073-10201 Domain Information Model (DIM) standard for integration with personal or institutional health records.

### Electrical Impedance Spectroscopy To Monitor Salivary Function

- Parvind K Grewal, Steven Thomas, Anand Karvat, Farid Golnaraghi, Jeff Liu, Krishnan Kalpagam and Kirpal S Kohli

Xerostomia is a known side effect of radiation therapy (RT). Measurement of salivary output is one of the popular non invasive, cost effective methods used to observe RT side effect

over the glands, but is unreliable and cumbersome. This paper introduces Electrical Impedance Spectroscopy (EIS), using superficially placed electrodes for monitoring salivary output non-invasively. The reference electrode is positioned below the ear-lobe and the measuring electrode is positioned over the temporomandibular joint at a distance of 2 cm. Lemon juice has been used as an activator, and in vivo readings from both left and right contralateral parotid glands are reported. Considered frequency range is from 1 Hz to 7 MHz and 100KHZ to 1 MHz. Observed variation in impedance during active and rest stage of the glands suggest the usability of EIS in non-invasively measuring saliva using superficially placed electrodes. This may further lead to advances in overcoming xerostomia caused as a radiation side effect.

Optical Glucose Monitoring Sensor

- Sahba Talebi Fard, Ezra Kwok, Lukas Chrostowski

Diabetes Mellitus is a common chronic disease, for which Continuous Glucose Monitoring (CGM) improves patients' health and their quality of life. Our goal is to investigate a novel optical system for accurate glucose predictions to establish a reliable CGM system. We have investigated absorption spectroscopy using both broadband white light and Vertical Cavity Surface Emitting Lasers (VCSELs). Using only two VCSELs that have tunable wavelength around 7nm, along with multivariate methods for preprocessing and model calibrations, we were able to predict concentrations of glucose in buffer solutions, and blood serum with RMSEP of about 1mM and 2mM respectively. We are currently investigating Evanescent Field (EF) sensors, silicon-on-insulator based resonator sensors. These sensors, fabricated in well-developed foundry services, can be integrated with CMOS circuitry for the integration of systems on chips. In this paper, both the Absorption Spectroscopy and EF sensing optical methods, and their suitability for CGM will be presented.

**5:00 pm – 7:00 pm**
Opening Reception in Trade Show *Harbourside Ballroom*

Presented by:

DUNLEE

THURSDAY, MAY 22, 2014

# Conference & Trade Show

**7:30 am - 8:15 am**
Registration and Continental Breakfast *Grand Foyer*

**7:50 am - 8:15 am**
Morning Address *Plenary SALON A*
Jason Chan, Executive Editor-in-Chief, Journal of Medical and Biological Engineering

**8:15 am - 8:30 am**
Conference Opening and Welcoming Remarks *Plenary SALON A*
- Martin Poulin, Conference Chair

**8:30 am – 9:30 am**
Keynote Address: Health, Care, and Connection: Enhancing Person-Centered Care Through Biomedical Device Integration

- Dr. Christina Vuksic, Physician, EHR Consultant

**9:30 am - 10:30 am**
Refreshment Break in Trade Show Area *Harbourside Ballroom*



**10:30 am - 12:00 pm**
Concurrent Sessions

**A4 – Medical and Assistive Devices Engineering** *Meeting Room SALON B*
*Session Chair: Poman So, Ph.D., P.Eng, Associate Professor, University of Victoria*

Virtual-Reality Simulator For Training In Myringotomy With Tube Placement
- Caiwen Huang, Sumit K. Agrawal, Hanif M. Ladak

Myringotomy with tube insertion is a very common surgical procedure in which a tiny incision is made in the eardrum and a ventilation tube is inserted to treat middle-ear infections. The objective of this work is to develop a virtual-reality simulator for training

in myringotomy with tube insertion. In the implementation, a geometrically accurate digital model of the ear was created from micro-computed tomography images. Eardrum dynamics were represented using a mass-spring system. Subdivision cutting was implemented to permit interactive cutting of the virtual eardrum. A haptic arm was employed for 3D positioning of virtual surgical tools such as a speculum, microscope, blade and forceps and for providing force feedback. Qualitative feedback from instructing ear surgeons indicates that speculum placement, microscope positioning, eardrum cutting and tube insertion were simulated with sufficient realism for training purposes.

### The Effects Of Arterial Wall Motion On Artificial Heart Valves Using Fluid-Structure Interaction

- Han Hung Yeh, Dana Grecov, and Satya Karri

In this paper, the hemodynamics of artificial heart valve was investigated using computational model with experimental data validation. The use of fully-coupled fluid-structure interaction (FSI) in COMSOL Multiphysics simulated both the fluid dynamics and the valve leaflet behavior. The analysis of particle image velocimetry (PIV) experimental data, conducted using the ViVitro Flow Loop, was followed for the model with a normal rigid wall assumption. Furthermore, a separate computational model was built in order to investigate the impact of the addition of expendable aortic wall. It was found that, the overall leaflet dynamics had minor difference in between; however, the rigid wall model had a slightly higher overall flow velocity and a peak of maximum leaflet stress during valve closure. With several assumptions made for current models, improvements, such as non-Newtonian blood, are expected in the future for a more accurate prediction.

### A Characterization Of Weight Distribution During Assisted Sit-To-Stand In Stroke Subjects

- Jennifer L. Sullivan, Elizabeth Croft, Antony Hodgson, H.F. Machiel Van der Loos

When performing a bilateral force-production task, studies show that we seem to rely on an internal sense of effort (SOE) to match forces between sides: that is, instead of comparing the actual force magnitudes, we compare how hard each limb is working relative to its maximum strength. For stroke survivors suffering from hemiparesis, matching effort results in a discrepancy between perceived force production and actual force production, leaving them unable to match bilateral forces correctly. To see if this same effort-matching strategy is evident in a functional task, a robotic assist was used to assess weight distribution during sit-to-stand in both stroke and control participants. Results imply that the extent to which weight distribution is influenced by SOE versus other sensory signals may vary among individuals. Furthermore, SOE seems to be utilized less by people with more asymmetric weight distributions than by people who are more symmetric.

### Development Of 3D Virtual Reality For Training And Assessing Movement Kinematics Of Subject With Parkinson's Disease

- Hsiao-Yu Lee, Zong-Syuan Huang, Chien-An Chen, Chao-Chen Lo, Jia-Jin J. Chen, Yu-Lin Wang, Kao-Chang Lin

Ball catching movements are characterized by eye-hand-foot coordination, which are suitable balance training programs for Parkinson's disease (PD) patients. Main purpose of

this study was to investigate the effects of optical flow manipulation in virtual reality (VR) environment on catching virtual balls during standing and one-step forward movements for subjects with PD. Important parameters, including arm-trunk movement and trunk movement, were utilized as the assessment indices of balance and postural control. The derived parameters were compared between baseline data without optical flow and those with optical flow. Our results demonstrated improvement on arm-trunk coordination and postural stability index during standing task. Also, PD subjects showed better postural adjustments prior to gait initiation and achieved greater inclination angle on one-step forward task. This study indicated that inertial motion sensors with optical flow of VR could improve both arm-trunk control and balance on ball catching performance as potential PD balance training system.

**CS4 – CMMS: The BC Experience And Plans For The Province** *Meeting Room SALON D*
*Session Chair: Dave Gretzinger, MHSc PEng CCE, Director Medical Engineering, University Health Network & Mount Sinai Hospital*

### Computerized Maintenance Management System For A Consolidated Program

- Andrew Ibey MEng, PEng, CCE, Doug King MEng, PEng, Tony Hsieh BMET, PEng, Tim Hutnan BMET, John Dixon BMET, Richard Soet BMET

Clinical Engineering (CE) departments require a documentation system, whether its paper, computerized or cloud based. The Computerized Maintenance Management System (CMMS) database has been described as early as 1985. Others have documented the functionality of the CMMS as a repository for: service history data, preventive maintenance schedules, warranty periods, and alerts & hazard. Nowadays, the CMMS plays an even greater role in the coordination of CE services as departments face an increasing demand of fleet size, net new technologies, lifecycle analysis and alerts tracking and updating clinical staff on medical equipment. Venturing into a consolidated operation, the CMMS provides a focus point for conversations about business processes, operational requirements, technology management, and support of clinical services. This paper will focus on the principles of planning and implementation of a CMMS and highlight some of the practical challenges associated with combining operations and data from disparate CMMS systems into one database.

### What Constitutes An Asset?

- Doug King M.Eng., P.Eng, Andrew Ibey M.Eng., P.Eng., CCE, Tony Hsieh BMET, P. Eng., Tim Hutnan BMET, John Dixon BMET, Richard Soet BMET

Most Clinical Engineering (CE) departments have difficulty determining their equipment responsibility and the responsibility of other service departments in the hospital. The Computerized Maintenance Management System (CMMS) is the center for all clinical engineering equipment and its management. What should be entered into the CMMS to maintain a service history and what should not? Where is the balance between operational need and maintaining a high degree of data quality in the CMMS? The lower mainland biomedical engineering (LMBME) department in Vancouver proposes a guideline to determine what is included and excluded from the CMMS. The authors believe this a novel concept and are the first to introduce this topic for CE assets. This can help CE departments

better manage and maintain data integrity of their assets, and help initiate a dialogue with overlapping service departments, and clarify equipment responsibility for clinical staff.

**MD4 – Tourniquet Technology** *Meeting Room SALON F*

*Session Chair: Mike Jameson, President, Delfi Medical Innovations Inc.*

### Development Of An Ultrasonic Tourniquet System For Surgical Applications

- Alida Verster, Nathanael Tung, Wee Kee Ong, Brian Sieu, Jeswin Jeyasurya MASc, Kwun-Keat Chan BASc, Michael Jameson DipIT, James McEwen OC, PhD, DSc, PEng.

An ultrasonic tourniquet system for surgical application is developed to dynamically adjust tourniquet cuff pressure throughout the duration of a surgery to maintain a bloodless surgical field. User intervention is not required during operation. Current limb occlusion methods are not ideal due to the risk of nerve damage to the patient by applying excessive pressure and being unable to anticipate the loss of limb occlusion due to fluctuations in blood pressure. The system relies on ultrasound measurements to determine the tourniquet pressure at which blood flow stops in the limb's main artery. A control algorithm determines if there is blood flow underneath a transducer, and increases or decreases the tourniquet pressure so that limb occlusion pressure is achieved. The control algorithm continuously monitors the blood flow in the limb artery to account for blood pressure variations. The current system is able to achieve limb occlusion within two to three minutes.

### Current Concepts In Tourniquets

- Jeswin Jeyasurya MASc, Michael Jameson DipIT, Ken Glinz DipIT, Hooman Sadr MD, Brian Day MD FRCSC, Bassam Masri MD FRCSC and James McEwen OC, PhD, PEng.

Within the last thirty years, there have been important improvements in the technology of tourniquet instruments and tourniquet cuffs. This paper provides an overview of current concepts in tourniquets in the following six areas: 1) Safety features integrated into modern tourniquet systems; 2) The use of Limb Occlusion Pressure (LOP) to enable individualized, optimal tourniquet pressure settings to be achieved; 3) Personalization of tourniquet cuffs through the use of variable contour design and availability of cuffs to fit pediatric and bariatric patient populations; 4) Reduction of soft tissue injuries through the use of limb protection sleeves matched to the limb size and cuff size; 5) Non-pneumatic tourniquets, developed for stopping arterial blood flow simply and rapidly in pre-hospital military and emergency settings, but with less safety and less accuracy than surgical tourniquet systems; and 6) Ongoing innovations to automatically maintain tourniquet pressures near ongoing optimal limb occlusion pressure for individual patients throughout a surgical procedure.

### Junctional Tourniquet Effector Head- Minimal Forces And Pressures Producing Occlusion

- Eoghan O'Muiris, Vincent Casey

Junctional tourniquets capable of controlling haemorrhage from distal sites are being actively developed for pre-hospital and emergency settings. One category of device uses a mechanical effector head to occlude a target artery. It is important to minimise the forces and pressures used in order to avoid tissue and organ damage and to ensure subject comfort. Here, biomedical interface pressure transducers (BIPTs) are used to measure the actual pressures arising at the interface between tourniquet effector heads and tissue at

the onset of artery occlusion. A dynamometer is used to simultaneously measure the force applied to the actuator handle of prototype effector heads. Forces in the range 100-150 N and average interface pressures in the range 200-300 mmHg were found to produce iliac and femoral artery occlusion. Audio feedback from an integrated Doppler probe facilitates optimum pressure point location with prospects for significant reductions in the forces required to affect occlusion.

**CE5 – Introduction To Networks In Healthcare – An IT Perspective** *Meeting Room SALON E*

- Dubravko Pajalic, Leader, Research Information Systems (RIS) BC Cancer Agency Cancer Research Centre

Based on real-life examples, the course will allow participants to practice various stages of completing a network project involving information technology (storage planning, network design, risk assessment, compliance etc.). Following good practices in project management, participants will review, update, create and test their own custom project templates, risk assessment procedures and bring back to their work environment a number of useful skills and tools.

**CE6 – Routine Testing Of Medical Devices In The Modern World: Updating Clinical Engineering Practice** *Meeting Room PORT OF VANCOUVER*

- Ron Evans, President & VP New Product Development, Datrend Systems Inc.

The applicable standard for basic safety of electromedical equipment was revised a few years ago. As manufacturers adapt to the changes, how does this impact the way routine tests should be carried out throughout the life of a medical device?
Routine testing of medical devices consume a significant portion of a Biomedical Engineering department's human resources. This workshop introduces new ways to measure and improve safety and to streamline operations that help save time and cut costs in the long run.
This workshop:

- Reviews applicable standards, regulations and relevant clauses to help you determine what is actually required for routine safety and performance testing of medical devices and for the documentation of such tests
- Demonstrates new options for streamlining routine testing of medical devices: networking, automation, report generation and other new features

**12:00 pm – 1:30 pm**
Lunch in the Exhibit Hall *Harbourside Ballroom*

**1:30 pm - 3:00 pm**
Concurrent Sessions

**A5 – Biosignal Acquisition and Processing I** *Meeting Room SALON B*
*Session Chair: : Poman So, Ph.D., P.Eng, Associate Professor, University of Victoria*

Normalization Of Erector Spinae EMG For Isokinetic Cycling Trials

- Chad Atton, Evelyn Morin Ph.D.

In designing a research study to understand how the lower back muscles function while cycling, a method to normalize EMG signals is required. Static isometric maximum voluntary contractions (MVCs) are normally used for this purpose but typically provide poor results for dynamic exercise. A sprint protocol was developed to obtain EMG data for normalization on the bicycle. The dynamic nature of the EMG signal required analysis to determine a best method for finding a single normalization factor. The best method was determined by examining the reliability and repeatability (typically represented by Coefficient of Variation (CV) and Intra-Class Correlation (ICC)) of the normalized results, and the minimized difference between the normalized EMG signals of the left and right erector spinae muscles. Results indicate that selecting the overall maximum value of the rectified EMG signals recorded during the sprint trials gives the best normalization value.

### An Energy Dispersive Bent Laue Monochromator For K-Edge Subtraction Imaging


- Nazanin Samadi, Honglin Zhang, Mercedes Martinson, Bassey Bassey, George Belev, Dean Chapman


K-Edge Subtraction (KES) is a quantifiable synchrotron imaging method delivering a contrast element (i.e. iodine) and matrix material (usually water) image in both projection imaging and computed tomography. With living systems imaging beams are prepared above and below the contrast element K-edge by utilizing a splitter that blocks approximately 1/3 of the beam to prevent "edge crossing" energies beyond a bent Laue monochromator.

A new bent Laue monochromator has been developed that has very good focal and energy dispersive properties with approximately 4% of the vertical beam profile at "edge crossing" energies, thus no splitter is employed. The beam can be narrowed vertically allowing a smaller crossover angle than a splitter based system which minimizes artifacts.

The focal and energy dispersive properties and details of artifacts caused by the beam focusing at the sample location will be discussed along with examples of the beam and object images.

### Neuronal Differentiation Of Human Induced Pluripotent Stem Cells Seeded On Melt Electrospun Microfibers


- Nima Khadem Mohtaram, Junghyuk Ko, Craig King, Amy Montgomery, Lin Sun, Rishi Vasandani, Martin Byung-Guk Jun and Stephanie M. Willerth


Neural tissue engineering strategies include using biomaterial scaffolds that mimic the microenvironment present in healthy tissue to direct stem cell differentiation into neural phenotypes. We hypothesized that a tissue-engineered scaffold made of the biocompatible and biodegradable polymer poly (ε-caprolactone) (PCL) could promote neuronal differentiation of human induced pluripotent stem cells (hiPSCs) through the presentation of physical cues. The topography of the microfibers plays an important role in regulating the differentiation of hiPSCs into neural phenotypes seeded electrospun PCL scaffolds. Using the technique of melt electrospinning, we fabricated 3D scaffolds with different physical topographies. Then we demonstrated that hiPSC-derived neural progenitors differentiated into neurons when seeded onto these fibrous melt electrospun scaffolds. In particular, the physical cues of electrospun microfiber scaffolds have an effect on the viability and neuronal differentiation of human iPSCs. This novel combination of the microfibers with hiPSCs is a promising approach for neural tissue engineering applications.

### EEG Signal Analysis For Epileptic Seizure Prediction- A Review Study

- Tahereh Rashnavadi

One of the main applications of electroencephalography (EEG) is to record and monitor the brain signals of epileptic patients. Due to apparently unpredictable nature of epileptic seizures, the onset of seizure can cause epileptic patients to hurt themselves. Thus, in order to acquire novel diagnostic and therapeutic techniques to improve the treatment of these patients, a reliable detective system is required to warn the patient minutes before the seizure occurrence. Epileptic seizures are preceded by detectable changes in the EEG signal. These changes can act as the trigger signs of the upcoming seizure. Hence, several methods have been proposed to predict/detect the epileptic seizures through the EEG analysis. These methods are developed based on signal processing and machine learning techniques. This paper provides a review on EEG signal processing for epileptic seizure prediction with emphasize on support vector machine (SVM) as one of the most effective classifiers for EEG signal.

## CS5 – Clinical Engineering Paper Session

*Meeting Room SALON D*

*Session Chair: Anthony Chan, PhD, PEng, CEng, CCE, Program Head, Biomedical Engineering, School of Health Sciences, British Columbia Institute of Technology*

### A Provincial Neonatal Transport Incubator For Ontario

- Mario Ramirez, M.A.Sc., P.Eng, CCE, Navtej Virdi, CBET, Kim Greenwood MASc., P.Eng., Rachel Zhang, MHSc.

Access to critical neonatal care in a regionalized system requires timely stabilization and transport from one facility to another supported by expert transport clinicians and life sustaining equipment. When a neonate requires critical care in Ontario, the patient needs to be transported to one of the four designated Neonatal Centers; McMaster Children's Hospital (MCH) Hamilton Health Science Centre, The Children's Hospital of Eastern Ontario (CHEO), London Health Sciences Centre or The Hospital for Sick Children in Toronto (SickKids). When a transport is required to either of the mentioned hospitals, their transport team would get their transport incubator ready and have the ambulance and the air transport take them to the required hospital for transporting the neonate back to their Neonatal Intensive Care Unit. While the main Transport incubator system at each centre has the basic equipment, main incubator, physiological monitor, infusion pumps, ventilator, portable suction, each Transport team has some differences in configuration that makes it challenging for the transport team, the ground ambulance and the air ambulance team to transport the patients in a safe and efficient manner. The need to have a standard Neonatal Transport Incubator was identified by the four Neonatal teams and was supported by the Provincial Council for Maternal and Child Health (PCMCH). To this end, the PCMCH established a Task Force to develop a standard configuration for the Transport System that will be used by the four Transport teams. A Standardized Neonatal Transport Deck Work Group (SNTDWG) was established consisting of a multi-disciplinary team from all four hospitals including neonatologists, transport nurses, respiratory therapists, medical engineering, emergency medical services workers and the air/land transport representatives. This paper describes the process that was followed to arrive to a Standard Transport Incubator that will be used by all the Transport Teams in the four designated Hospitals. This is the first provincial Neonatal Transport System

in Ontario that will ensure the safe transport of neonates while at the same time ensuring the safety of the transport team.

### Staff Engagement As A Means Of CE Service Excellence

- Mario Ramirez, M.A.Sc., P.Eng, CE, Rocky Yang, , Navtej Virdi, CBET, Greg Patterson, CBET, Eric Niles, Bsc.

Staff engagement has been identified as a good indicator of Departmental performance. An engaged work force represents the commitment of the employee to the organization and the department. Job engagement represents the satisfaction that the employee feels about the job they do, their ability to get immersed in their work and produce satisfactory results that could result in Service Excellence. Engaged employees are less prone to take time off sick and are more productive overall. The Hospital for Sick Children in Toronto, Ontario has been conducting Staff Engagement surveys for the past ten years. The Medical Engineering Department has used the Engagement survey results to improve staff engagement and improve service delivery to our customers. Through annual departmental planning days and follow up on actions the departmental engagement has improved over the past years to the recent results where only one of the 28 drivers of engagement fell below the Hospital's average. This has resulted in improved Service Excellence to customers as demonstrated by the quarterly Service Excellence conducted by the Corporate Service Portfolio. The presentation will illustrate the engagement results in the past year, and the steps taken to improve staff engagement. In addition, examples will be presented of how the department has demonstrated service excellence and commitment.

### The Development Of A Text On Human Factors For Clinical Engineering

- Anthony Easty, PhD, PEng, CCE; Patricia Trbovich PhD; Ying Ling Lin MSc; Andrea Cassano-Piché, MSc, PEng

This paper describes the development of a text on applying human factors methods to clinical engineering situations, targeted at engineers and technologists working in health care settings. The development of this text was undertaken at the request of the Clinical Engineering Division (CED) of the International Federation of Medical and Biological Engineering (IFMBE).
The text provides a basic introduction to human factors methods that can be easily and usefully applied to clinical engineering tasks, to improve the likelihood that medical technology will be used safely and effectively. Topics such as observational analysis, heuristic analysis and usability testing are presented with examples of their application. Clinical engineering scenarios such product selection and incident investigation are presented, and the relevant human factors techniques are described. Tools such as failure mode and effect analysis and root cause analysis are also presented.

### The Value Of Interactive Training Tools For Knowledge Development In The Use Of Health Care Technologies

- Anthony Easty PhD, PEng, CCE; Christopher Colvin, MHSc; PatriciaTrbovich, PhD

This paper describes the development of a group of interactive training tools designed to support typical clinical users in the safe and effective use of health care technologies. These tools have a high graphical content which mimics the look and feel of actual interaction

with a physical device. They allow users to learn at their own pace, and in an environment of their own choosing.
The development of these tools is a response to the fact that the traditional in-service session in a busy clinical environment is often not an effective learning experience for those who participate, and as health care technologies become more complex and more numerous, there is a need for clinical users to be as comfortable as possible with the safe and effective operation of health care technologies.

**MD5 – Rehabilitation Engineering** *Meeting Room SALON F*

*Session Chair: Dr. Mike Van der Loos, Ph.D., P.Eng., Associate Professor, Dept. of Mechanical Engineering, University of British Columbia*

### Towards The Design Of A Pronation/Supination Orthosis For Essential Tremor Assessment And Suppression

- S. Sheikholeslami, A. M. Elnady, G. Herrnstadt C. Menon

Essential tremor is a neurological disorder that causes involuntary, approximately rhythmic, oscillatory movement of a body part. The severity of these uncontrolled oscillations is visible in the upper limp movements especially in the hand and wrist. In this paper our aim is to develop an innovative technology, consisting of a lightweight and wearable exoskeleton to assess and suppress wrist tremor in supination and pronation movements. Our innovative design includes the utilization of a new mechanism to suppress the tremor, which is composed of a micro magnetic particle brake and a series of light pulleys connected with a synchromesh cable.
This device was tested on three healthy volunteers. The results show that our device is able to detect tremor frequencies and amplitudes.

### A Portable 3D Printed 2D of Arm Exoskeleton For Rehabilitation

- Jake Webb, Gil Herrnstadt, Zhen Gang Xiao, Carlo Menon

Rehabilitation robotics is an evolving field with the potential to create new therapeutic methods and to enhance their effectiveness. A lightweight robotic arm orthosis for the elbow flexion/extension and forearm pronation/supination has been developed. The exoskeleton is 3D printed using an ABS variant and can be battery operated. Several tests are conducted to evaluate the mechanical properties and performance of the device. Finally a discussion is presented considering treatment alternatives as well as future orthoses advancements.

### Re-Usable Post Operative Lower Leg Supports

- Andrew Brule, MASc, MBA, PEng

For decades Sunny Hill Health Centre's (SHHC) Positioning and Mobility Team (PMT) have been called to BC's Children's Hospital for emergency post-operative positioning for children confined to wheelchairs having just had lower leg surgeries. Post operatively, physicians usually require the client's legs, often in casts, to be abducted and elevated in specific positions for them to leave bed and become mobile as soon as possible. This required expensive, labour intensive custom solutions for each client. SHHC's PMT developed a low cost ($150), adjustable, reusable lower leg trough that can be mounted on

the client's own wheelchair. These leg troughs reduce the knowledge, skill, labour and costs required to implement a solution and allows the client to be transferred to the community as soon as medically stable. When the client has recuperated, the community team can remove the system and return it to the hospital for sterilization and re-use.

**CE5 – Introduction To Networks In Healthcare – An IT Perspective**
***(Cont'd)*** *Meeting Room SALON E*

- Dubravko Pajalic, Leader, Research Information Systems (RIS) BC Cancer Agency Cancer Research Centre

Based on real-life examples, the course will allow participants to practice various stages of completing a network project involving information technology (storage planning, network design, risk assessment, compliance etc.). Following good practices in project management, participants will review, update, create and test their own custom project templates, risk assessment procedures and bring back to their work environment a number of useful skills and tools.

**CE6 – Routine Testing Of Medical Devices In The Modern World: Updating Clinical Engineering Practice *(Cont'd)*** *Meeting Room PORT OF VANCOUVER*

- Ron Evans, President & VP New Product Development, Datrend Systems Inc.

The applicable standard for basic safety of electromedical equipment was revised a few years ago. As manufacturers adapt to the changes, how does this impact the way routine tests should be carried out throughout the life of a medical device?
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**3:00 pm - 3:30 pm**
Refreshment Break in Trade Show Area *Harbourside Ballroom*

**3:30 pm - 5:00 pm**
Concurrent Sessions

**A6 – Biosignal Acquisition and Processing II** *Meeting Room SALON B*
*Session Chair: : Poman So, Ph.D., P.Eng, Associate Professor, University of Victoria*

Automatic Segmentation Of Vascular Patterns In Dermoscopy Images

- Pegah Kharazmi, Tim. K. Lee

Melanoma is the most fatal skin cancer with an increasing incidence in Canada. Dermoscopy is a non-invasive diagnostic technique for in-vivo observation of skin, allowing better visualization of cutaneous structures. Various features may be found in dermoscopic images; each correlates with a histopathologic structure, suggesting a skin disorder. Among these features, blood vessel morphology is very important. The presence, shape and irregularity of vessels in skin lesions are suggestive clues for abnormalities and malignancies. In this paper, we present a machine learning framework for automated detection and segmentation of vascular patterns in two-dimensional dermoscopy images. Our method consists of preprocessing, feature extraction, pixel selection, classification using decision-tree and post processing. As a result, a mask image is produced segmenting vascular structures. An accuracy of 92% and 78% has been achieved on training and testing dataset respectively. Our method can be used in computer analysis of dermoscopic images, to provide better diagnostic power.

### Contrast-Enhanced Micro-Computed Tomography Of The Human Middle Ear

- Rohani, S. Alireza; Liu, Jian; Umoh, Joseph U.; Holdsworth, David W.; Agrawal, Sumit K.; Ladak, Hanif M.

High-resolution imaging of middle-ear geometry is essential for finite-element modeling. It is difficult to visualize middle-ear soft tissues in micro-computed tomography (micro-CT) images because of lack of contrast. The objective of this research is to evaluate the efficacy of IKI (iodine potassium iodide) solution as a contrast agent. Two human temporal bones were used in this experiment. Following fixation using formaldehyde, one bone was stained in IKI solution, whereas the other was not stained. Samples were scanned using a micro-CT system at a resolution of 20 µm. Contrast-to-noise ratios (CNRs) of the tympanic membrane, tensor tympani and stapedius muscle were calculated for each dataset. After staining, the CNRs of the tympanic membrane and tensor tympani were increased while no change in CNR was measured for the stapedius muscle. Staining with IKI solution improves the contrast of the soft tissues when imaging using micro-CT.

### Electrochemical Detection Of Hydrolyzed Fluorescein Diacetate For Cell Viability Tests

- Shruti Menon, Nandimalla Vishnu, Shanker Shyam Sundhar Panchapakesan, Annamalai Senthil Kumar, Krishnan Sankaran, Peter Unrau & M. Ash Parameswaran

Fluorescein diacetate hydrolysis is a popular fluorimetric assay in cell viability tests, however the methodology is expensive and not portable. We report an economical method of determining bacterial cell viability by detecting the electrochemical oxidation peak signature of fluorescein, the hydrolyzed product of fluorescein diacetate. In the future, this would enable the development of portable electronic systems that can perform bacterial cell viability and point-of-care antibiogram tests in remote locations.

### Real-Time Algorithm Based On Empirical Wavelet Transforms To Remove Baseline Drift In Biomedical Signals

- Tam H.M. Nguyen, Anh V. Dinh, Francis M. Bui, Toi V. Vo

Baseline drift is inevitable in many biomedical applications, and its removal remains an ongoing research topic. In most cases, baseline drift is due to respiration, muscle contraction, and electrode impedance changes due to perspiration or movement of the

body. Without baseline drift removal, clinical misdiagnoses may occur due to distortions and interferences in the acquired signals, which prevent proper visual representation of the signal. In this paper, a low-complexity algorithm is proposed based on the empirical wavelet transform, to realize a strategically designed high-pass filter for removing the baseline drift. The proposed method uses the local maxima in the signal spectrum to determine the cut-off frequency of the high-pass filter. Experiment results show a low complexity with better results compared to other methods. The technique can be used in real-time applications on portable devices.

**CS6a – Educational Paper Session** *Meeting Room SALON D*

*Session Chair: Sarah Kelso, M.Sc., EIT, Regional Clinical Engineer, Clinical Engineering Program, c/o Health Sciences Centre*

Design Of An Ergonomic Electrocautery Smoke Evacuator- A Case Study For Medtech Design

- Navid Shirzad, Jacqueline Soicher, Quan Gau, Chao Jin, Machiel Van der Loos

The adoption of a new medical device relies heavily on its ability to fit into the multifaceted medical environment and satisfy the users' needs. These needs are often overlooked in the traditional design process, which focuses on the functional requirements of the device and user input is often sought only in later stages of the design. This paper outlines the user centred design approach that is gaining popularity among the innovators in the medical technology field. This design approach relies heavily on immersion of the design team in the medical environment during the entire design process. The approach being proposed here will be demonstrated through the design and evaluation of the first generation prototype of an ergonomic tube-less electrosurgery smoke evacuation device.

Complexities Faced By Pediatric Hospitals With Healthcare Technologies

- Y. Rachel Zhang B.A.Sc., Abiola Ogungbemile B.A.Sc., M.A.Sc., Marie-Ange Janvier ing., Ph.D., and Kim Greenwood P.Eng., M.A.Sc

As healthcare technologies advance, paediatric hospitals face unique challenges to accommodate a diverse range of patients – from neonates weighing 0.5kg to young adults over 200kg. Based on the experiences of Children's Hospital of Eastern Ontario, we present case studies to highlight the deficiencies in medical device design and the complexities faced by the Clinical Engineering Department in supporting the clinical departments in terms of equipment procurement, safety, usage, maintenance and sourcing consumables. We hope to engage the healthcare community and medical device manufacturers to inspire more paediatric-focused designs.

**CS6b – CESOP Review with Bill Gentles**

- Bill Gentles, PhD. P.Eng, CCE, (Chair), Chair, CMBES CESOP2013 Working Group, Vice President, BT Medical Technology Consulting
- Anthony Chan, PhD, PEng, CCE, Program Head, Biomedical Engineering, School of Health Sciences British Columbia Institute of Technology
- Kelly Kobe, CBET(C), CET, Director, Cinical Engineering, Alberta Health Services, Calgary Zone

- Mario R. Ramirez, Director, Medical Engineering, Sick Kids Hospital
- Tim Rode, Director, DI Strategic Planning and Biomedical Engineering Services, Interior Health Diagnostic Imaging Services
- Gnahoua Zoabli, ing., M.ing., Ph.D., Chef du service du génie biomedical, CSSS Lac-des-Deux-Montagnes, Saint-Eustache

The original Clinical Engineering Standards of Practice for Canada was published by CMBES in 1998. It was recognized that for this Standards of Practice document to remain relevant to Canadian Clinical Engineers, it must undergo periodic reviews and updating. The second edition was published in 2007. A CMBES working group, with representation from across the country, has been working on the newly revised edition for over a year. A final draft was presented to the CMBES members for comment in the fall of 2013, and many of the comments received from members have been incorporated. The standard is now ready for publication.
There have been many changes in the 2014 edition, both in format and content. This session will provide an overview of the most important changes in the new document, with an opportunity for Q&A.
After the conference, CMBES members will be asked to vote by electronic ballot whether or not they approve of the new standard. If approved by the membership, the 2014 edition of the Clinical Engineering Standards of Practice for Canada will be published in September 2014. It will be available at no charge to CMBES members.

**MD6 – Robotic Engineering** *Meeting Room SALON F*

*Session Chair: Dr. Mike Van der Loos, Ph.D., P.Eng., Associate Professor, Dept. of Mechanical Engineering, University of British Columbia*

### Recent Trends In Lower-Limb Robotic Rehabilitation Orthosis - Pneumatic Muscle Actuated Gait Trainer Systems

- Mohd Azuwan Mat Dzahir and Shin-ichiroh Yamamoto

A review study was conducted on existing lower-limb orthosis systems for rehabilitation which implemented pneumatic muscle type of actuators with the aim to clarify the current and ongoing research in this field. It is a general assumption that pneumatic muscles will play an important role in the development of assistive rehabilitation robotics system. In the last decade, the development of this orthosis system was relatively slow compared to the motorized orthosis system. However, in recent years, the interest in this field had grown exponentially mainly due to the demand on a much compliant human-robotics system and advantageous attributes of the pneumatic muscles. Based on the review study, it could be understood that suitable control schemes and strategies have yet to be found. In this research, a co-contraction controls scheme is proposed. Results demonstrated the co-contraction controls ability to manoeuvre and improvise the joint's stiffness and stability of the leg orthosis.

### A Study Of Multi-Modal Interface In Robotic Assistive Systems

- Carlos Diaz and Shahram Payandeh

Several medical conditions can limit the ability of visually impaired people to obtain information about the environment. Remote sensing of objects could allow users to detect and avoid obstacles and to enrich their perception.

For this project a multimodal interface was designed using a 3D Kinect sensor to gather information from the scene, a haptic globe and a gesture recognition system to map the location, dimensions and shape of sample objects into the user hands. The system provides a way to "extend" the reach of the hands as a remote sensing tool allowing the user to scan the environment from a "safe distance".
Sample objects are analyzed and spatially represented. The depth information is used to build a vibrotactile map on a haptic glove enhanced with vibration motors. The user can perceive the shape, location and dimensions of the remote objects by moving the glove inside a scanning region.

Restoring Walking After Spinal Cord Injury

- Bradley Holinski, Alex Paquet, Patrice Topart, Dirk G. Everaert, Richard B. Stein, Vivian K. Mushahwar

A spinal cord injury may cause paralysis and altered motor function. Intraspinal microstimulation can be used to activate latent motor networks in the ventral horn of the spinal cord that remain intact below the lesion level after a traumatic spinal cord injury. Previous work in cats has shown that ISMS activates networks of neurons in the lumbosacral region of the spinal cord and produces co-ordinated multi-joint movements, which tend to be fatigue-resistant. In this work, we demonstrate that ISMS produces over ground walking in adult cats for distances nearing 1 km. One of the main challenges in producing functional walking is the spatial targeting of motor networks within the spinal cord. An electrode is under development that contains multiple independent stimulation sites along the length of the electrode to improve the probability of stimulating the target region. These developments might eventually help to restore functional walking after spinal cord injury.

INO: From Concept to Reality

- Brad Holinski, PhD, EIT

INO is a private not-for-profit corporation and consists of the largest pool of industrial-focused optics and photonics expertise in Canada with over 200 employees. Established in 1988, INO has since executed over 5,000 contracts for industry, transferred over 50 unique technologies and spun off 29 companies (all of which are still in business).
The overall goal of INO is to partner with companies and researchers to improve their competitive edge and develop their business through the development of novel light-based solutions. INO specializes in creating solutions that are not available off the shelf and taking them to market with an industry partner. INO also possesses a variety of technologies and innovative processes based on a strong intellectual property (IP) portfolio. These assets could represent unique business opportunities for companies wishing to commercialize them. This talk will highlight INO's capabilities and foster ideas for collaboration within the medical device industry.

**7:00 pm – 10:00 pm**
CMBEC37 Banquet and Awards Presentation *Vancouver Aquarium*

FRIDAY, MAY 23, 2014

# Conference Sessions

**8:00 am - 8:30 am**
Registration and Continental Breakfast *Grand Foyer*

**8:30 am - 10:00 am**
Concurrent Sessions

**A7 – Sensors and Instrumentation** *Meeting Room SALON B*
*Session Chair: Andrew H. Rawicz, PhD, PEng, Professor, Simon Fraser University*

A Wi-Fi Based Personal Wireless Hub For Medical Data Acquisition Application

- Ravi Shrestha, Khan Wahid

The paper presents a design of a Wi-Fi based Personal Wireless Hub (PWH) for medical application. Using the PWH, data from wired and wireless biosensors are collected and sent to data acquisition unit for further processing. The proposed PWH is a light weight, power efficient and multipurpose device which is used with different biosensors, especially to collect physiological data from human body. An android based mobile application is developed that will store, analyze and display the medical data collected from the Wi-Fi based PWH. The collected data can be sent to remote server using an android based smart device and/or stored in local storage. This enables remote and local access of medical data for diagnosis purpose. The Wi-Fi based personal wireless hub is prototyped in laboratory and tested with android application and computer software.

Fabrication And Fluidic Testing Of Versatile Microfluidic Devices For The Measurement Of Nitric Oxide (No) Release By Endothelial Cells Under Flow In Microfluidic Channels

- Shaghayegh Hosseinpour, Bonnie L. Gray

Endothelial cells (ECs) form a monolayer of cells (endothelium) lining the inner surface of blood vessels. Vascular function can be monitored in part through the endothelium's release of nitric oxide (NO), which has been proposed as the major mechanism of EC dysfunction. Furthermore, the shape of ECs can be altered, e.g., via microchannels or other microstructures, which also has an effect of EC function. However, shape and NO release are often not studied simultaneously. Thus there is need to develop versatile instrumentation in order to understand the relation between EC shape, function and NO release in order to provide invaluable insights into arterial disease mechanisms. We have previously designed,

fabricated, and tested a microfluidic system that successfully measured the small NO concentrations produced from ECs cultured in microfluidic channels of different widths under no flow conditions. Although the system provided the capability for a range of morphological and functional studies, we now propose microfluidic devices for a flow through system with thinner microfluidic channels that are closer to the cell size, which will enable the control of the cell shape with flow or without flow. The design, fabrication, and fluidic testing (not including cell culture or NO detection) of this system are presented in this paper.

### Novel Use Of Cortical Electrical Stimulation For Modulating Brain Plasticity In Parkinson's Disease Rats

- Jia-Jin Jason Chen, Wan-Shan Chang Chien, Tsung-Hsun Hsieh, Chih-Wei Peng

Motor cortex theta burst stimulation (TBS) protocols delivered by repetitive magnetic stimulation (rTMS) are capable of modulating motor cortical excitability through plasticity-like mechanisms for therapeutic potential of Parkinson's disease (PD). A 6-hydroxydopamine-lesioned PD animal model under TBS treatment was used. To better understand the neural mechanism underlying the TBS effects and to enable translational research in rodent disease models, we developed methods for cortical electrical stimulation (CES) to motor cortex in anesthetized rats and examined whether TBS protocols lead to the changes in motor cortical excitability in advanced PD rats. In parallel with human results, continuous TBS successfully suppressed motor evoked potentials (MEPs), while MEPs increased after intermittent TBS in healthy rats. In the effects of TBS in PD rats, CES-TBS induced motor plasticity was absent in advanced PD rats. This animal model could be used for developing novel translational research and therapeutic strategies of CES for PD subjects.

## CS7 – Medical IT-Networks: Future Planning for Biomedical Device Integration

*Meeting Room SALON D*

*Session Chair: Gordon Jasechko, Biomedical Engineering, Vancouver Island Health Authority*

- Rob Hollis, Project Manager, Infrastructure, Devices and Biomedical Device Integration, Island Health
- Bill Kempthorne, Manager, Network Services, Island Health
- Kyle Eckhardt, MEng, EIT, Regional Clinical Engineer, Winnipeg Regional Health Authority

This session consists of panel members describing their work designing the infrastructure to support the integration of biomedical devices communicating to an enterprise information system (electronic health record). They will speak to the challenges faced with designing wired and wireless systems to be secure and reliable to meet the workflow needs of a networked biomedical devices, planning and implementing the connection of biomedical devices to the network and planning the management of medical devices on the network using the structure defined by IEC 80001.

## CE7 – Wireless Technology In Healthcare

*Meeting Room SALON E*

- James P. Keller, Jr., VP, Health Technology Evaluation and Safety, ECRI

Wireless technologies in healthcare are growing at a tremendously fast pace. The clinical engineering and health technology management professions are integral players in

helping to plan for and manage wireless technologies. This course will review the wireless technologies being used in the healthcare setting, discuss clinical engineering/health technology management's roles in managing wireless technologies, and discuss likely future directions of wireless technologies in healthcare. Technology topics like real time location systems, wireless telemetry, wireless applications for clinical alarm management, and telemedicine will be discussed. This course will also review policies and procedures for managing wireless technologies, relevant risk management standards, regulatory matters, and core competencies required for clinical engineering/health technology management professionals working in the wireless realm.

**CE8 – Display Technology For Healthcare Applications** *Meeting Room PORT OF VANCOUVER*

*Session Chair: Andrew Ibey, M.Eng, P.Eng., CCE, LM Biomedical Engineer, Fraser Health, Providence Health Care, Provincial Health Services Authority, Vancouver Coastal Health*

- Roger J. Milford, CEO, Shinda Medical Inc.

This course looks at the difference between medical displays and an ordinary off-the-shelf display. We'll also look at the differences within medical displays, such as diagnostic vs. clinical displays. We'll examine which displays should be used to view Mammo, DR, CR, CT, MRI and PET images. We'll discuss the DICOM curve, and the reason for calibrating displays, as well as the types of calibration available. Lastly we'll cover the ergonomics and room lighting requirements, as well as the setting up of displays, cables and connections.

**10:00 am – 10:30 am**
Refreshment Break *Grand Foyer*

**10:30 am - 12:00 pm**
Concurrent Sessions

**A8 – Clinical, Cellular, and Neuro Engineering** *Meeting Room SALON B*

*Session Chair: Andrew H. Rawicz, PhD, PEng, Professor, Simon Fraser University*

Imaging Method Developed For The Tracking Of Single Cell Behaviours In Inkjet Cell Printing Systems

- Eric Cheng, Ali Ahmadi, Karen C. Cheung

The ability to reliably achieve drop-on-demand dispensing of cells with an inkjet nozzle has numerous potential applications in tissue engineering, cell assays and therapeutics. Previous work has demonstrated that the number of cells dispensed per droplet does not follow the expected statistical distributions, and is inhomogeneous. To investigate this phenomenon, the flow-induced cell behaviour within an inkjet nozzle is characterised by implementing a cell tracking algorithm to better understand the mechanisms behind unreliable cell printing. In the present work, visualization of each cell within the nozzle during droplet ejection has been achieved by high-speed imaging through an objective lens with a low depth of field. The videos captured are analysed using a cell segmentation algorithm to identify the cell's path traveled during the droplet ejection process. Overall, the presented method allows for the study of cell behaviours during printing for increasing the reliability of current inkjet cell printing systems.

### Visual Tracking In Laparoscopic Surgery Using Adaptive Gaussian Mixture Model And Stochastic Filter


- Jiawei Zhou, Shahram Payandeh


In order to assist surgeons during Minimally Invasive Surgery (MIS), a surgeon computer interactive system is designed to provide visual tracking of surgical instrument under mono-endoscopic camera. In our previous work, a real-time visual tracking algorithm which combines 2D feature recognition with stochastic approach (Kalman Filter and its extension) was presented. By tracking the edges and tip of the surgical instrument, this method works well in ideal and emulated environment but has limitation tackling real laparoscopic scene because of the complexity of image background. To eliminate noise from the interfering factors such as smoke, blood and vessel, we introduce a background subtraction method where an adaptive Gaussian mixture model (AGMM) is applied to detect moving foreground object by setting a background model based on pixel color information. To compare AGMM approach with stochastic methods, the experiments are conducted under both in-vitro training environment and in-vivo environment.

### Test-Retest Reliability Of Center Of Pressure And Electromyography Measures In Bipedal Quiet Standing In Healthy Adults


- Niyousha Mortaza, Zahra Moussavi, Cheryl M. Glazebrook


Center of pressure (COP) and electromyography (EMG) measurements during quiet standing in different visual (open-eyes vs. closed-eyes) and support surface (foam vs. firm surfaces) conditions are extensively used in assessing postural balance. Hence, it is important to ensure the reliability and reproducibility of these measures. The aim of this study was to assess the test-retest reliability of bipedal quiet standing in different visual and support surface conditions. The results showed good to fair level of reliability for the mean velocity and root mean square (RMS) values of COP excursion and low level of reliability for the leg muscles' EMG activity. The results implications and limitations are discussed.

### Magnetization In Microsurgery- Causes & Potential Solutions


- P Edgcumbe, A Santoso, M Semple, K Talebian, X Qin, N Van Laeken, A Hodgson


Microsurgery is a surgical technique to connect blood vessels and nerves of approximately 1mm in diameter. The needles are microscopic (0.1-1mm diameter) and a small amount of magnetization of the needle or surgical instrument can create a magnetic force between the needle and instrument that interferes with the surgery. Our survey of the Canadian Society of Plastic Surgeons showed that magnetization occurs in 38% of microsurgeries. The consequences of magnetization may include damage to the patient's blood vessels and/or nerves, sub-optimal post-operative recovery, and increased operating room time. We identify the magnetic surgical mats and magnetic needle counters as sources of magnetization. Additionally, we propose and demonstrate two possible solutions to magnetization during microsurgery:

1. Thermal annealing treatment of the surgical instruments or needles,
2. The use of a medical grade handheld demagnetizer in the operating room.The medical grade demagnetizer, used in the operating room, is the recommended solution.

**CS8 – TeleHealth: Using Technology to Deliver Patient Care... Is Your Clinical Engineering Department in the Picture?** *Meeting Room SALON D*

*Session Chair: Andrew Ibey, M.Eng, P.Eng., CCE, LM Biomedical Engineer, Fraser Health, Providence Health Care, Provincial Health Services Authority, Vancouver Coastal Health*

- Margarita Loyola, P.Eng. MBA, CCE, CPHIMS-CA, Manager Telehealth at Island Health
- Dean Driver, Manager, eHealth, Inter Tribal Health Authority
- Sarah Robertson , Manager, Telehealth Core Services, IMITS
- Dr. John Pawlovich, FCFP, REAP (Rural Education Action Plan, BC) Program Coordinator, Clinical Associate Professor, Dept. of Family Practice, UBC
- Trent Horwood, Telus (former VIHA Telehealth nurse), TeleHome Monitoring

Project Managers and clinical champions from the province of BC will speak about their experiences implementing telehealth projects including teleoncology, teleophalmology and telecardiology. The discussion will include tips on implementing these types of services and how telehome equipment is being serviced now and in the future.

**CE7 – Wireless Technology In Healthcare *(Cont'd)*** *Meeting Room SALON E*

- James P. Keller, Jr., VP, Health Technology Evaluation and Safety, ECRI

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**CE8 – Display Technology For Healthcare Applications (Cont'd)** *Meeting Room PORT OF VANCOUVER*

- Roger Milford, Director & CEO, Shinda Medical Inc.

This course looks at the difference between medical displays and an ordinary off-the-shelf display. We'll also look at the differences within medical displays, such as diagnostic vs. clinical displays. We'll examine which displays should be used to view Mammo, DR, CR, CT, MRI and PET images. We'll discuss the DICOM curve, and the reason for calibrating displays, as well as the types of calibration available. Lastly we'll cover the ergonomics and room lighting requirements, as well as the setting up of displays, cables and connections.

**12:00 pm – 1:30 pm**
Lunch *Grand Foyer*

CMBES Annual General Meeting *Meeting Room SALON D*

**1:30 pm – 3:00 pm**
Concurrent Sessions

**A9 – Physiological Systems / Modeling** *Meeting Room SALON B*
*Session Chair: Andrew H. Rawicz, PhD, PEng, Professor, Simon Fraser University*

### Control Of Cardiac Alternans Using Electrical Boundary Pacing And Spatially Distributed Perturbation Control

- Azzam Hazim, Youssef Belhamadia, and Stevan Dubljevic

Electrical alternans is a physiological phenomenon that is a beat-to-beat oscillation (alternation) of the cardiac Action Potential Duration (APD). Alternans have been shown to be a precursor to arrhythmias and sudden cardiac death (SCD). The presence of electrical alternans induces, through the mechanism of the excitation-contraction coupling (ECC), an alternation in the heart muscle contractile activity, while contraction of cardiac tissue affects electrophysiological properties via mechanoelectrical feedback (MEF). Mathematically, Nash-Panfilov (NP) model is mostly used for the electromechanical coupling and it takes into account the electrical and mechanical properties of cardiac tissue to link the excitation with contraction. In this work, we develop a control algorithm, using NP model in the limit of small deformations, that combines electrical boundary pacing and error based feedback control to annihilate alternans. The results show that we can successfully control alternans when mechanical and electrical effects of heart are considered.

### A Three-Dimensional Regional Myocardial Strain Computation Method With Displacement Encoding With Stimulated Echoes In Healthy Subjects And Dilated Cardiomyopathy Patients Validated In Reference To Tagged-Mri

- Julia Kar, Andrew K. Knutsen, Brian P. Cupps, Michael K. Pasque

Cine Displacement ENcoding with Stimulated Echoes (DENSE) is an MRI technique that facilitates rapid high resolution quantification of myocardial function. We investigated the accuracy of 3D left ventricular (LV) regional strains computed with DENSE in healthy subjects and in nonischemic, nonvalvular, dilated cardiomyopathy (DCM) patients. A meshfree multiquadrics Radial Point Interpolation Method (RPIM) was used for computing Lagrange strains in sixteen LV regions per subject. Strains computed with DENSE were validated in reference to standard tagged-MRI and with DENSE repeatability studies. Regional strain agreements between modalities and repeatability studies were observed with Bland-Altman analyses. Differences between normal and DCM regional strains computed with DENSE were estimated with Welch-Satterthwaite t-tests. Good regional strain agreements with tagged-MRI and in repeatability studies validated DENSE as a reliable high resolution modality. Differences between DCM and normal strains demonstrate the ability to quantify myocardium dysfunction with the DENSE-RPIM framework.

### Modeling Of Bioelectromagnetic Effects Using The Transmission Line Matrix Method

- Poman P.M. So

The electrical properties of human tissues affect the interaction of electromagnetic (EM) fields with the human body. The effects depend on the tissue properties as well

as on the strength and frequency of the EM signals. These effects can be modeled using numerical methods. This paper describes the essence of a graphic processing unit accelerated Transmission Line Matrix (TLM) method with emphasis on applying TLM to bioelectromagnetic modeling.

### Effect Of Compression Over Electrical Admittance Of Chicken Breast And Rat Breast

- Sepideh M. Moqadam, Parvind Grewal, Farid Golnaraghi

Bio-impedance of tissue varies with the amount of applied compression. This paper presents the observed changes in vitro in bioimpedance of chicken and rat breast under various levels of compression. Soft tissue admittance at various pressure levels, is measured using bi-polar bio-impedance measurement set up and finger wearable force sensors over Ag/AgCl electrodes. Thus by changing the frequency of driving signal, multi frequency measurements at various pressure levels are obtained. Fitting the Cole-Cole model to the multi-frequency admittance measurements at various pressure levels, provides the mappings of parameters showing the relationship between the applied pressure and the admittance of soft tissue. The effect of pressure on bio-impedance parameters in the Cole-Cole model is deduced by means of the least square method and Cole-Cole circuit theory. Studying the bio-impedance of twenty chicken breasts and two rat breasts under compression illustrates the changes in bio-impedance of tissue resulting from the loss of fluid in the tissue.

## CS9 – Improving the Effectiveness of Medical Device Donations

*Meeting Room SALON D*
*Session Chair: Kyle Eckhardt, MEng, EIT, Regional Clinical Engineer, Winnipeg Regional Health Authority*

### Improving The Effectiveness Of Medical Equipment Donations From Canada To Developing Countries- A Survey

- Bill Gentles, PhD. P.Eng, CCE, (Chair), Chair, CMBES CESOP2013 Working Group, Vice President, BT Medical Technology Consulting
- Shahrzad Mirzazadeh, Research Assistant, CMBES and Centre for Global Engineering, University of Toronto
- John Zienaa, Clinical Engineering Manager, Ghana Health Service, Accra, Ghana
- Yolanda Adusei Poku, Clinical Engineer, Ghana Health Service, Accra, Ghana

A paper presentation entitled: "Improving The Effectiveness Of Medical Equipment Donations From Canada To Developing Countries: A Survey" will be presented by Sharzad Mirzazadeh.
While many organizations across Canada donate medical equipment and supplies, no previous study has evaluated the donation practices of these organizations. This study aims to determine the effectiveness of Canadian medical equipment and supplies donations to low-income countries, with a primary focus on donations to Ghana. This study was initiated by the International Outreach Committee (IOC) of the Canadian Medical and Biological Engineering Society (CMBES), which has had a long-standing relationship with the Ghana Biomedical Association.
John Zienaa will give a brief presentation on issues with donated equipment as experienced by Ghana, a recipient of medical equipment donations.
A roundtable discussion will follow the presentations, with a discussion of the Health Canada position on medical device donations, as well as other issues related to the topic.

Improving The Effectiveness Of Medical Equipment Donations From Canada To Developing Countries- A Survey

- Shahrzad Mirzazadeh, Beverly Bradley, Bill Gentles, Shauna Mullally

Previous studies conducted in the United States and Europe have shown that as much as 70% of medical equipment that is donated to developing countries is never put into use, leaving equipment deficiencies in these countries unresolved. There have been no studies to assess the scope and effectiveness of donation practices from Canadian organizations to developing countries – a gap that this study aims to fill. Our preliminary research has uncovered over 50 Canadian organizations engaged in the donation of medical equipment and supplies. We are currently surveying and interviewing these organizations to better understand different organizational models and processes for donation initiation, planning and implementation. This research project will culminate with the dissemination of best practices for Canadian organizations, with the aim of improving donation effectiveness. In this presentation, we will report on the preliminary findings of our research, and encourage attendees who are engaged in donations to share their experience with us.

**3:00 pm – 4:00 pm**
**Closing Remarks**
**Presentation of Paper Awards** *Meeting Room Salon D*