

# Connaught Global Challenge Award -EHB Innovation Challenge Symposium 2022

## **Advanced Technology for Energy Harvesting in Biomedical (EHB) Device Applications**

With the rapid advances in wireless sensors, implantable electronics, and wearable devices, the demand for high-power-density and long-lifespan power sources is becoming increasingly stronger. Advanced multifunctional structures can capture energy from such sources as muscle contractions, body movement, and organ motion. Energy harvesting from such sources is thus emerging as an alternative energy solution to batteries, providing sustainable and clean energy for powering low-powered electronics, such as portable instruments and wearable devices.

Aiming to showcase and disseminate our advancements in the field of energy harvesting for biomedical applications, we would like to cordially invite you to join us at the CGCA-EHB Symposium 2022. The symposium shall shed light upon cutting edge technologies employed towards a smart and sustainable future in biomedical technologies.

Keynote lecture(s) will be delivered at the conference, emphasizing cutting-edge reforms and breakthroughs in the field of energy harvesting for biomedical devices. Finally, six grant winning projects will be presented, demonstrating cutting-edge solutions developed through the CGCA-EHB Innovation Challenge.

### **Topics**

This challenge's project topics range from, but are not limited to, the following technologies:

- Wearable / Implantable energy harvesters for biomedical applications. (Piezoelectric, etc.)
- Nano-generators.
- Nano-sensors.
- Other sustainable biomedical energy generation, storage solutions and methods.

**Date and Time:** May 10, 2022, from 9:30 AM to 3:00 PM

**Venue:** Virtual Symposium via Zoom

## CGCA-EHB Symposium (May 10, 2022)

### Inauguration

9:30 – 9:50

#### Welcome & Introduction

**Dr. Markus Bussmann**

Chair, Mechanical and Industrial Engineering

**Dr. Kamran Behdinan**

Professor, Mechanical Engineering

PI, CGCA – EHB

NSERC Chair in Multidisciplinary Engineering Design

Director, Advanced Research Laboratory for Multifunctional Lightweight Structures

**Dr. Cristina Amon**

Professor, Mechanical Engineering

Co-PI, CGCA - EHB

Dean Emerita, Faculty of Applied Science and Engineering (2006-2019)

Director, Advanced Thermal/fluid Optimization, Modelling and Simulation Lab

**Dr. Ridha Ben Mrad**

Professor, Mechanical Engineering

Co-PI, CGCA - EHB

Chair, Mitacs Research Council

Director, Mechatronics and Microsystem Design Lab

### Keynote Address

9:50 – 10:45

**Dr. Daniel J. Inman**

Harm Buning Collegiate Professor

Chair, Department of Aerospace Engineering

University of Michigan

**Topic: Advances in Biomedical Energy Harvesting for Biomedical Application**

10:45 – 11:40

**Dr. Sailu Nemana**

Vice President, R&D Sensor Technology

**Topic: Piezoelectrics and Their Applications for Energy Harvesting**

### Grant Challenge Presentations / Q&A

11:40 – 12:00

3D Printed Conductive Polymer Aerogel for Biomedical Thermoelectric Energy Generator

12:00 – 13:00

**Lunch Break**

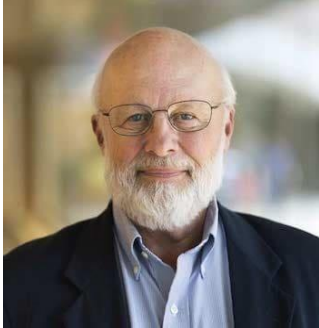


- 13:00 – 13:20** Binodal Ultra-stretchable Epidermal Self-Powered Sensor for Blood Oxygen and Pulse Rate Monitoring Using Triboelectric Nanogenerator
- 13:20 – 13:40** Use of a Novel Piezoelectric Energy Harvester as a Transcutaneous Electrical Nerve Stimulation Device
- 13:40 – 14:00** Energy Harvesting for Standard Compliant Wireless Medical Body Area Networks
- 14:40 – 14:20** Thin Film Piezoelectric Energy Harvester for Biomedical Applications
- 14:20 – 14:40** A Novel Biocompatible Piezoelectric Energy Harvester for the New Generation of Pacemakers

**Closing**

- 14:40 – 14:50** **Closing Remarks**

## Keynote Speakers



**Daniel J. Inman** received his Ph.D. from Michigan State University in Mechanical Engineering in 1980 and is the Harm Buning Collegiate Professor and former Chair of the Department of Aerospace Engineering at the University of Michigan. Since 1980, he has published eight books (on vibration, energy harvesting, control, statics, and dynamics), eight software manuals, 20 book chapters, over 410 journal papers and 674 proceedings papers, given 78 keynote or plenary lectures, graduated 68 Ph.D. students, and supervised more than 75 MS degrees. He works in the areas of applying smart materials and structures to solve aerospace engineering problems including energy harvesting, structural health monitoring, vibration suppression and morphing aircraft. He is a Fellow of the American Institute of Aeronautics and Astronautics, American Society of Mechanical Engineers, International Instituted for Acoustics and Vibrations, Society of Experimental Mechanics and American Academy of Mechanics. He won the ASME Adaptive Structures Award in April 2000, SPIE Smart Structures and Materials Lifetime Achievement Award in March of 2003, he received the ASME Den Hartog Award for lifetime achievement in teaching and research in vibration, the 2009 Lifetime Achievement award in Structural Health Monitoring, and the AIAA Structures, Structural Dynamics, and Materials Award, in 2014. He is currently Technical Editor of the *Journal of Intelligent Material Systems and Structures* (1999-present).

**Abstract:** Starting with the very basics of energy harvesting using the piezoelectric effect, a battery free pacemaker system is described. However, pacemakers can need reprogramming by a doctor from time to time based on the patient's record. The future here is to combine machine learning methods, neuromorphic computing and mechanics of composites to create a "smart pacemaker" by embedding a computing device into the pacemaker adding "brains" then patients with arrhythmia could receive immediate attention without even being aware of the changes or having to visit the surgeon. This talk will focus on what needs to be done to make this possible with the hopes of encouraging others to work in this area.



Currently Vice President at Sensor Technology, **Sailu Nemana** is responsible for the development of new piezo ceramic materials and production process refinements. He has been with Sensor Technology for 12 years after 8 years in the oil industry where he held roles in Technology R&D, operations engineering and refinery technical support. After approximately four years of industry experience, Sailu interrupted his career to complete his MS and PhD in chemical engineering at the University of California, Davis in 2006.

**Dr. Nemana** will present advancement of the technology in piezoelectric sensors design and characterizations, the research and technology development gaps, and their applications for energy harvesting.