

Wireless Health 2010

Academic and Research Conference

Pre-Conference Workshop:
October 4, 2010

Conference Sessions:
October 5–7, 2010

Hilton La Jolla Torrey Pines
10950 North Torrey Pines Road
La Jolla, CA 92037



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Wireless-Life Sciences
Alliance

Wireless Health 2010
Academic and Research Conference

Pre-Conference Workshop:
October 4, 2010

Johnson & Johnson
3210 Merryfield Row
San Diego, CA 92121

Conference Sessions:
October 5-7, 2010

Hilton La Jolla Torrey Pines
10950 North Torrey Pines Road
La Jolla, CA 92037



Dear Partners, Academicians, Researchers and Attendees:

It is my pleasure to welcome you to San Diego, California and the Hilton La Jolla Torrey Pines for Wireless Health 2010, the first in an annual series of academic and research conferences on wireless health, presented by the Wireless-Life Sciences Alliance (WLSA).

Since 2005, it has been our mission to accelerate innovation in wireless health. The WLSA Convergence Summit brings together global business leaders, innovators and thought leaders in May each year. With Wireless Health 2010 and the annual meetings to follow, we are convening the engineering community with the clinical, governmental and business leaders who are applying wireless health innovations in real world settings.

To commemorate this first year, we are fortunate to have the support and participation of the true pioneers in wireless health, who are also our Conference co-chairs: Dr. Irwin Jacobs, Dr. Eric Topol, Dr. Patrick Soon-Shiong, and Dr. Chris Toumazou. Each of these gentlemen has established a lifetime of credibility in research and in the application of the fruits of research.

The Wireless Health 2010 Steering Committee and Technical Program Committee members, who represent internationally renowned universities and research institutes, have worked tirelessly to create this conference. Due to their work, you will have the opportunity to learn about the most innovative research in the field. Overall, the conference offers a unique opportunity for learning and discussion among members of the various communities who share the goal of improving health globally through the convergence of wireless communications and life sciences technologies.

Finally, I want to acknowledge our event sponsors at Qualcomm, the Institute of Engineering in Medicine, West Wireless Health Institute, AT&T and Johnson & Johnson, and TATRC who have helped defray our costs and without whom this conference would not be possible.

The funding from TATRC was awarded and administered by the U.S. Army Medical Research & Materiel Command (USAMRMC) and the Telemedicine & Advanced Technology Research Center (TATRC), at Fort Detrick, MD under Contract Number: W81XWH0420025.

Sincerely,

Robert B. McCray, President & CEO
Wireless-Life Sciences Alliance

Wireless-Life Sciences Board of Directors

Don Jones, Founding Director and Chairman,
Wireless-Life Sciences Alliance
Vice President, Health & Life Sciences,
Qualcomm

Robert B. McCray,
President & CEO, Wireless-Life Sciences Alliance

Jeffrey Belk, Director and VP, Wireless Convergence
Wireless-Life Sciences Alliance

Sharon Henry
Director, Wireless-Life Sciences Alliance
Director, American Medical Response

M. Wainright Fishburn, Jr.,
Director, Wireless-Life Sciences Alliance
Partner, Cooley LLP

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Computer Engineering, University of Virginia

Jalal Mapar, Department of Homeland Security

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Noam Ziv, Vice President of Engineering,
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San Diego is the premier location in the U.S. for convergence of wireless and life sciences.

The Wireless-Life Sciences Alliance (WLSA) is a special purpose, non-profit trade organization for innovators, globally relevant companies, scientists, physicians, and policy makers.

The WLSA is dedicated to creating value and improving health, globally, through the convergence of communications technologies, consumers, caregivers and all sectors of the life sciences and technology environment. WLSA partners and companies all over the world are using wireless health innovations to better manage chronic conditions, preempt disease and improve the lives of the elderly and under-served populations around the world.

The principal activities of the WLSA involve the creation of invitational group and private meetings in quality settings during which proprietary information is shared and in which partners meet the most dynamic and innovative organizations and individuals shaping the future of wireless health.

WLSA founders recognized the wireless health opportunity in 1999. In forming the organization, with the critical support of Qualcomm and Johnson & Johnson in 2005, the WLSA established from the start an operating principal that its meetings would be invitational rather than “pay-to-play,” and that invitations would be based on the quality of the invitee’s achievement or innovation and capability to create valuable wireless health innovations.

For more information on partnership in the Wireless-Life Sciences Alliance, please visit www.wirelesslifesciences.org.



DONALD JONES

Vice President, Health & Life Sciences, QUALCOMM

Donald Jones serves as Vice President of Business Development for Health & Life Sciences at Qualcomm, where he is responsible for Qualcomm’s enablement of wireless technologies in the health and life sciences markets. Don co-founded the Wireless-Life Sciences Alliance in 2005. He serves on the boards of the Alliance Healthcare Foundation and the American Telemedicine Association, and was a founding board member of the West Wireless Health Institute.

Prior to joining Qualcomm, Jones spent 22 years developing and growing health-care enterprises. He served as chief operating officer of MedTrans (now American Medical Response - AMR), the world’s largest emergency medical services provider. Don was founder and chairman of EMME, Mexico’s largest member-based, subscription health service. He was senior vice president of marketing for HealthCap, a venture capital backed startup, which rapidly grew to become the second largest provider of women’s healthcare in the United States. Don has extensive experience in mergers and acquisitions, having been involved in more than 130 acquisitions. In 2000, the Journal of Emergency Medical Services (JEMS) named Jones One of the 20 Most Influential People in EMS.



ROBERT B. McCRAY

President & CEO, Wireless-Life Sciences Alliance

Robert B. McCray is the President & CEO of the Wireless-Life Sciences Alliance, Chairman of Alliance Healthcare Foundation, Special Advisor to TripleTree LLC, Member of Midmark Corporation Board of Directors, Member of Board of Directors of CONNECT and an active advisor to several companies. Rob leverages over 25 years of experience as a business owner, senior operating executive, and legal and transactional advisor to private and public companies.

Rob has served as President, COO and an early investor in Digital On-Demand, Inc., a retail services technology company, and as Chairman, President and CEO of HealthCap, Inc., a venture capital-backed physician practice management company that returned 90% CAGR to its investors. Rob also served as Managing Director of Caremark Physician Resources, directing its formation during its initial high-growth years prior to its sale to MedPartners, Inc. He also co-founded OnCall Medicine, Inc., a medical house calls company. Prior to his success as a business operator, he was a Managing Partner in his law firm and a partner in a predecessor and transactional legal and consulting services to the healthcare industry for over 20 years.



JEFFREY K. BELK

Vice President, Wireless Convergence, Wire-Life Sciences Alliance

In addition to his Vice President position with the WLSA, Jeff Belk is Managing Director of ICT168 Capital, LLC, focused on developing and guiding global growth opportunities in the Information and Communication Technology space. Formerly, Jeff spent almost 14 years at Qualcomm, where prior to his departure in early 2008, he was Qualcomm's Senior Vice President of Strategy and Market Development, focused on examining changes in the wireless ecosystem and formulating approaches to help accelerate mobile broadband adoption and growth. Prior to Qualcomm, Jeff spent ten years in the early growth years of the PC industry, primarily with Proxima Corporation. He joined the company in 1983, when the company was less than 25 employees, and was with the company through its IPO in the early 90's in several key distribution, product management, and international roles. Jeff serves on the Board of Directors of Peregrine Semiconductors and InterDigital Corporation.



SHARON HENRY

Director, American Medical Response

Sharon Henry currently directs wireless initiatives for Emergency Medical Services Corporation (EMSC), the nation's leading provider of ambulance and outsourced physician services which provides services each year to more than 10 million patients in more than 2,000 communities nationwide.

Sharon has been in the ambulance service business for thirty years, ten of which were in mergers and acquisitions during the roll-up of ambulance companies to large providers in the late 1990s. She co-founded MedicWest Ambulance in Las Vegas, Nevada which was sold to EMSC in 2007, and is now the sole provider of service in the Las Vegas market. Sharon has managed large national performance based ambulance contracts and 911 emergency call centers.



M. WAINWRIGHT FISHBURN, JR.

Partner, Cooley LLP

Wain Fishburn is a founding partner of Cooley LLP's San Diego office and represents high growth technology and life sciences corporations ranging from start-up to public. Wain is an active community leader and has shaped many industry organizations. He is a founding board member of the Corporate Directors Forum, as well as BIOCOM, where he currently serves as Vice Chair of the BIOCOM Board of Directors. He is a member of the Board of Trustees and the Executive Committee of the Sanford-Burnham Institute for Medical Research. He serves on the Board of Directors for the Critical Path Institute, an independent institute created in part by the FDA, dedicated to improving the regulatory path for innovative medical therapies. Wain is a founder of two public companies and prior to law school, worked in the corporate environment assisting with the divestiture of a group of 12 operating companies.

ABOUT WIRELESS HEALTH 2010

Wireless Health 2010 was established to provide the highest profile academic and industrial research forum for the emerging field of Wireless Health. The mission of the Wireless Health 2010 organization is to include and promote an international community that will accelerate the development and adoption of this new vision for healthcare. At the same time, it is intended to create the academic research forum that enables students and faculty with the highest profile and greatest impact opportunities for publications and promotion of progress.

Wireless Health 2010 provides a critical networking opportunity that links each of the Wireless Health communities and organizations – ranging from the academic, engineering, medical and industry communities to the federal, regulatory and standards communities – together for the first time in one forum. It also provides a valuable and timely education event that informs each of the communities about opportunities that occur in this new field combining healthcare, wireless technology, information technology, and a broad set of new products and services.

The academic, engineering, medical and industry research community that are advancing Wireless Health contributed papers at Wireless Health 2010. A distinguished Technical Program Committee has been formed including leaders in this new field and leaders in its constituent areas. Together, this positions Wireless Health 2010 as providing the elite forum for fundamental research.

For post conference updates and information on future conferences, please visit www.wirelesshealth2010.org

General Chairs of Wireless Health 2010:

Irwin Mark Jacobs, Ph.D.

Patrick Soon-Shiong, M.D.

Eric Topol, M.D.

Chris Toumazou, Ph.D.

Executive Chair: Robert B. McCray

Federal Programs Chair: Jalal Mappar

Industry Chair: Harinath Garudadri, Ph.D.

Publicity Chair: John Lach, Ph.D.

Publications Chair: Roozbeh Jafari, Ph.D.

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Harinath Garudadri, Senior Staff, Qualcomm
Roozbeh Jafari, Department of Electrical Engineering, University of Texas at Dallas
***William Kaiser**, Electrical Engineering Department, University of California, Los Angeles
John Lach, Department of Electrical and Computer Engineering, University of Virginia
Jalal Mapar, Department of Homeland Security
Robert McCray, CEO, Wireless-Life Sciences Alliance
Mehran Mehregany, West Wireless Health Institute
Balakrishnan Prabhakaran, Department of Computer Science, University of Texas at Dallas
Majid Sarrafzadeh, Computer Science Department, University of California, Los Angeles
Noam Ziv, Vice President of Engineering, Qualcomm

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Paolo Bonato, Harvard
Alex Bui, University of California, Los Angeles
Gert Cauwenberghs, University of California, San Diego
***Shu Chien**, University of California, San Diego
Paul Crawford, Intel
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Hari Garudadri, Qualcomm
Geri Gay, Cornell
Sandeep Gupta, Arizona State University
Roozbeh Jafari, University of Texas, Dallas
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Garudadri C. Sekhar, LV Prasad Eye Institute, Hyderabad
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Mani Srivastava, University of California, Los Angeles
***Jack Stankovic**, University of Virginia
Kristin Tolle, Microsoft
Chris Toumazou, Imperial College London
Alfred Weaver, University of Virginia
Matt Welsh, Harvard
Paul Wright, University California, Berkeley
Guang-Zhong Yang, Imperial College, London
Mark Yarvis, Intel
Eric Yeatman, Imperial College London
Yuan-Ting Zhang, Chinese University of Hong Kong
Lin Zhong, Rice University
Noam Ziv, Qualcomm

*Technical Program Committee Co-Chairs



Monday, October 4 :: Pre-Session Workshops

Time: 9:00am – 6:00pm

Location: Offices of Johnson & Johnson

9:00 AM

Registration Opens

10:00 AM – 1:00 PM

Wireless Health Informatics Workshop

Co-Chairs: **John Lach, Ph.D.**, University of Virginia & **Roozbeh Jafari, Ph.D.**, University of Texas at Dallas

10:00 AM

Wireless Health Informatics: Challenges and Opportunities

John Lach, Ph.D., University of Virginia

10:15 AM

Case Studies on Wireless Health Applications and Data Management Techniques

Roozbeh Jafari, Ph.D., University of Texas at Dallas

10:45 AM

WARD 2.0: Building a Comprehensive Human Activity Database for Muscular Dystrophy Patients via Body Sensors and Mobile Cameras

Allen Yang, Ph.D., University of California, Berkeley

11:15 AM

Head IT: A Human Electrophysiology, Associated Anatomic Data and Integrated Tool Resource

Scott Makeig, Ph.D., University of California, San Diego

11:45 AM

Breakout Sessions

12:35 PM

Breakout Reports

1:00 PM

Workshop concludes

1:00 – 2:00 PM

Lunch (Johnson & Johnson Courtyard)

2:00 PM – 5:00 PM

Human Motion Monitoring and Classification Workshop

Chair: **Maxim Batalin, Ph.D.**, Wireless Health Institute,
University of California Los Angeles

Topic 1: Medical foundations and applications of human motion

Bruce Dobkin, M.D., University of California Los Angeles, Neurology

Topic 2: Human motion analysis from the perspective or practical applications of Motor Control

Robert Wagenaar, Ph.D., Boston University

Topic 3: Wireless health infrastructure and instrumentation for human motion analysis

John Lach, Ph.D., University of Virginia

Topic 4: Machine learning techniques for automated classification of human motion

Maxim Batalin, Ph.D., Wireless Health Institute, University of California Los Angeles

Tutorial/Demo: An end-to-end human motion analysis tutorial: from capturing sensor data to processing at the server

Moderator: **Maxim Batalin, Ph.D.**, Wireless Health Institute,
University of California Los Angeles

5:00 – 6:00 PM

Networking Reception in Johnson & Johnson Courtyard



Tuesday, October 5 :: Conference Sessions

Time: 8:00am – 6:45pm

Location: Hilton La Jolla Torrey Pines, Fairway Pavilion

7:00 AM

Registration Opens (Continental Breakfast Available)

8:00 AMOpening Remarks: **Robert B. McCray**, President & CEO, Wireless-Life Sciences Alliance**8:15 AM****Keynote: Chris Toumazou, Ph.D.**, Director, Institute of Biomedical Engineering at Imperial College London; CEO, Toumaz Technology LTD; General Chair of Wireless Health 2010 Conference*Towards Disposable Healthcare: A Paradigm Shift*Introduction by **Don Jones**, Vice President, Health & Life Sciences, Qualcomm; Chairman, Wireless-Life Sciences Alliance**9:00 AM****Paper Session #1: Body Sensor Networks****1.1 A Mining Technique Using N-grams and Motion Transcripts for Body Sensor Network Data Repository****Vitali Loseu** (*University of Texas at Dallas, US*); **Hassan Ghasemzadeh, Ph.D.** (*University of Texas at Dallas, US*) **Latifur Khan, Ph.D.** (*University of Texas, US*); **Roozbeh Jafari, Ph.D.** (*University of Texas at Dallas, US*)**1.2 Dandelion: A Framework for Transparently Programming Phone-Centered Wireless Body Sensor Applications for Health****Felix Xiaozhu Lin** (*Rice University, US*); **Ahmad Rahmati** (*Rice University, US*); **Lin Zhong, Ph.D.** (*Rice University, US*)**10:00 AM**

Break

10:15 AM

Paper Session #2: Mobile Gait Analysis

2.1 Comparative Study of Segmentation of Periodic Motion Data for Mobile Gait Analysis

Aris Valtzanos (University of Edinburgh, UK), D.K. Arvind (University of Edinburgh, UK), Subramanian Ramamoorthy (University of Edinburgh, UK)

2.2 Towards Power Optimized Kalman Filter for Gait Assessment using Wearable Sensors

Prem Santosh Udaya Shankar (University of Texas at Dallas, US); Nikhil Raveendranathan (University of Texas at Dallas, US); Nicholas Gans (University of Texas at Dallas, US); Roozbeh Jafari, Ph.D. (University of Texas at Dallas, US)

11:15 AM

Paper Session #3: Energy Efficient Sensing

3.1 Just-in-time Sampling and Pre-filtering for Wearable Physiological Sensors: Going from Days to Weeks of Operation on a Single Charge

Nan Hua (Georgia Tech, US); Ashwin Lall (Georgia Tech, US); Justin K Romberg (Georgia Tech, US); Jun Xu (Georgia Tech, US); Mustafa al'Absi, Ph.D. (University of Minnesota Medical School, US); Emre Ertin (Ohio State University, US); Santosh Kumar (University of Memphis, US); Shikhar Suri (Georgia Tech, US)

11:45 AM

Paper Session #3: Energy Efficient Sensing

3.2 Blood Oxygen Estimation from Compressively Sensed Photoplethysmograph

Pawan Baheti (Qualcomm, US); Harinath Garudadri, Ph.D. (Qualcomm, US); Somdeb Majumdar (Qualcomm Inc., US)

12:15 PM – 1:40 PM

Lunch & Networking Session (Fairway Pavilion, Terrace & Gardens)

Technical Demonstrations & Industry Demonstrations will be open during the extended lunch period.

Technical Demonstrations sponsored by West Wireless Health Institute.

1:40 PM

Paper Session #4: Energy Efficient Networking

4.1 Evaluation of Body Sensor Network Platforms: A Design Space and Benchmarking Analysis

Sidharth Nabar (*University of Washington, US*); **Ayan Banerjee** (*Arizona State University, US*); **Sandeep Gupta, Ph.D.** (*Arizona State University, US*); **Radha Poovendran, Ph.D.** (*University of Washington, US*)

4.2 Energy Optimization in Wireless Medical Systems Using Physiological Behavior

Hyduke Noshadi (*University of California at Los Angeles, US*); **Foad Dabiri, Ph.D.** (*University of California at Los Angeles, US*); **Saro Meguerdichian** (*University of California at Los Angeles, US*); **Miodrag Potkonjak, Ph.D.** (*University of California at Los Angeles, US*); **Majid Sarrafzadeh, Ph.D.** (*University of California at Los Angeles, US*)

2:40 PM

Paper Session #5: Emergency Care

5.1 A Context-Management Framework for Telemedicine: An Emergency Medicine Case Study

Rita H. Wouhaybi, Ph.D.¹; **Mark D Yarvis, Ph.D.**¹; **Philip Muse**¹; **Chieh-Yih Wan, Ph.D.**¹; **Sangita Sharma**¹; **Sai Prasad**¹; **Lenitra Durham, Ph.D.**¹; **Ritu Sahni, M.D.**²; **Robert Norton, M.D.**²; **Merlin Curry, M.D.**²; **Holly B. Jimison, Ph.D.**²; **Richard Harper, M.D.**²; **Robert A Lowe, M.D.**²

¹ *Intel Corporation, US*

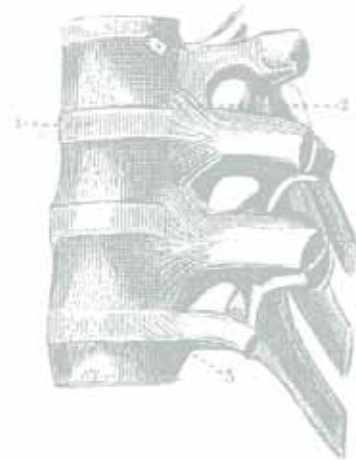
² *Oregon Health & Science University, US*

5.2 Remote Physiological Monitoring of First Responders with Intermittent Network Connectivity

Jingyuan Li (*University of Virginia, US*); **Tejaswi Tamminedi** (*UtopiaCompression Corporation, US*); **Guy Yosiphon, Ph.D.** (*UtopiaCompression Corporation, US*); **Anurag Ganguli, Ph.D.** (*UtopiaCompression Corporation, US*); **Lei Zhang** (*UtopiaCompression Corp., US*); **John Stankovic, Ph.D.** (*University of Virginia, US*); **Jacob Yadegar, Ph.D.** (*UtopiaCompression Corporation, US*)

3:40 PM – 4:00 PM

Break (Light refreshments served)



4:00 PM

Workshop: Wireless Health Research Challenges and Opportunities

Challenges & Opportunities in Signal Processing:

- **Emil Jovanov, Ph.D.**, University of Alabama, Huntsville
- **Julien Penders**, IMEC
- **Steve Baker, Ph.D.**, Welch-Allyn
- **Harinath Garudadri, Ph.D.**, Qualcomm

Challenges & Opportunities in Computer Science:

- **Majid Sarrafzadeh, Ph.D.**, University of California, Los Angeles
- **John A Stankovic, Ph.D.**, University of Virginia
- **Tajana Šimunić Rosing, Ph.D.**, University of California, San Diego

Challenges & Opportunities in Medical Informatics:

- **John Lach, Ph.D.**, University of Virginia
- **Roozbeh Jafari, Ph.D.**, University of Texas at Dallas

Funding Opportunities in Wireless Health:

- **Wendy Nilsen, Ph.D.**, National Institutes of Health
- **Audie Atienza, Ph.D.**, National Institutes of Health

5:45 PM

Break

6:00 PM

Keynote: **Dean Kamen**, Prolific Inventor & Founder, DEKA

Introduction by **Roberto Padovani, Ph.D.**, Executive Vice President and Chief Technology Officer, Qualcomm

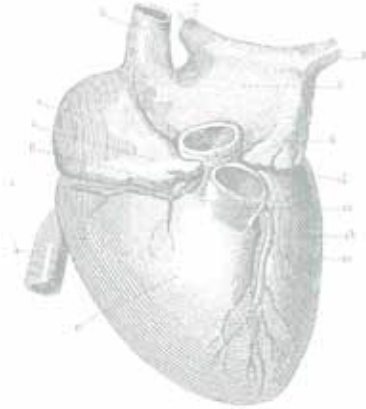
6:45 PM

Close of Session

Wednesday, October 6 :: Conference Sessions

Time: 8:00am – 7:00pm

Location: Hilton La Jolla Torrey Pines, Fairway Pavilion

**7:00 AM**

Registration Opens (Continental Breakfast Available)

8:00 AMOpening Remarks: **Robert B. McCray**, President & CEO, Wireless-Life Sciences Alliance**8:15 AM**

Keynote: Eric Topol, M.D., Vice-Chairman of the Board and Chief Innovation Officer, West Wireless Health Institute; The Gary and Mary West Endowed Chair of Innovative Medicine; Director, Scripps Translational Science Institute; Chief Academic Officer, Scripps Health; General Chair of Wireless Health 2010 Conference

Rebooting Medicine: How Wireless Empowers Consumers to Take Over Their Healthcare

9:00 AM**Paper Session #6: Health Awareness****6.1 Social Sensing: Obesity, Unhealthy Eating and Exercise in Face-to-Face Networks**

Anmol Madan (*Massachusetts Institute of Technology, US*); **Sai Moturu, Ph.D.** (*Massachusetts Institute of Technology, Media Lab, US*); **Alex Pentland** (*Massachusetts Institute of Technology, US*)

6.2 A Networked System for Self-management of Drug Therapy and Wellness

Kit Yee Au-Yeung (*Proteus Biomedical, Inc, US*); **Timothy Robertson, Ph.D.** (*Proteus Biomedical, Inc, US*); **Hooman Hafezi** (*Proteus Biomedical, Inc, US*); **Gregory Moon, M.D.** (*Proteus Biomedical, Inc, US*); **Lorenzo DiCarlo, M.D.** (*Proteus Biomedical, Inc, US*); **Mark Zdeblick, Ph.D.** (*Proteus Biomedical, Inc, US*); **George Savage, M.D.** (*Proteus Biomedical, Inc, US*)

10:00 AM

Break

10:15 AM**Paper Session #7: Clinical Risk Assessment****7.1 Trapezius Muscle EMG as Predictor of Mental Stress**

Jacqueline Wijsman (*University of Twente, NL*); **Bernard Grundlehner** (*Holst Centre/IMEC-NL, NL*); **Julien Penders** (*Imec-NL, NL*); **Hermie Hermens, Ph.D.** (*University of Twente, NL*)

7.2 Portable, Non-Invasive Fall Risk Assessment in End Stage Renal Disease Patients on Hemodialysis. **Thurmon Lockhart, Ph.D.** (*Virginia Tech, US*); **Adam Barth** (*University of Virginia, US*); **Xiaoyue Zhang** (*Virginia Tech, US*); **Rahul Songra** (*Virginia Tech, US*); **Emaad Abdel-Rahman, M.D.** (*University of Virginia, US*); **John Lach, Ph.D.** (*University of Virginia, US*)

11:15 AM

Keynote: Irwin Jacobs, Ph.D., Co-Founder, Qualcomm Incorporated; Chairman, Salk Institute Board of Trustees; General Chair of Wireless Health 2010 Conference

Violating the Laws of Physics and Other Cool Things I Have Learned

Introduction by **Stephen Burger**, Area Vice President Business Development, AT&T Emerging Devices

12:00 PM

Lunch (Pavilion Gardens)

12:45 PM

Luncheon Keynote: Patrick Soon-Shiong, M.D., CEO of Abraxis Health; Executive Director, UCLA Wireless Health Institute; Professor of Microbiology, Immunology, and Molecular Genetics Professor of Bioengineering at UCLA; General Chair of Wireless Health 2010 Conference

1:30 PM

Break

1:45 PM

Paper Session #8: Cardiac and Brain Monitoring

8.1 Miniaturized Wireless ECG-monitor for Real-time Detection of Epileptic Seizures

Fabien Massé (*Holst Centre/Imec, NL*); **Aline Serteyn** (*Holst Centre/Imec, NL*); **Martien van Bussel** (*Kempenhaeghe/Hobo Heeze, NL*); **Johan Arends** (*Kempenhaeghe/Hobo, NL*); **Julien Penders** (*Imec-NL, NL*)

8.2 Wireless Non-contact Cardiac and Neural Monitoring

Yu M. Chi (*University of California, San Diego, US*); **Patrick Ng** (*University of California, San Diego, US*); **Eric Kang** (*University of California, San Diego, US*); **Joseph Kang** (*University of California, San Diego, US*); **Jennifer Fang** (*University of California, San Diego, US*); **Gert Cauwenberghs, Ph.D.** (*University of California, San Diego, US*)



2:40 PM

Panel Discussion #1: Wireless Health in Developing Regions

Moderator: Harinath Garudadri, Ph.D., Qualcomm

Panelists:

- GC Sekhar, M.D., Director, LV Prasad Eye Institute
- Joel Robertson, M.D., CEO & President, Robertson Technologies
- Richard Garfein, Ph.D., UCSD Global Public Health
- Nicolas Cuttriss, M.D., Co-Founder & Chariman of the Board, American Youth Understanding Diabetes Abroad Inc (AYUDA)

3:25 PM

Break

3:40 PM

Panel Discussion #2: Clinical Applications of Wireless Health

Moderator: Ashok Kaul, VP – Healthcare Convergence,

Wireless-Life Sciences Alliance

Panelists:

- Leslie Saxon, M.D., Chief – Division of Cardiovascular Medicine, USC Keck School of Medicine; Professor of Clinical Medicine, USC
- Ravi Mehta, M.D., Professor of Medicine in the Division of Nephrology; Director of Clinical Nephrology and Dialysis Programs UCSD Medical Center; Associate Director of the GCRC
- Mark Carlson, M.D., Chief Medical Officer and Senior Vice President, Research and Clinical Affairs, Cardiac Rhythm Management Division, St. Jude Medical
- David Price, M.D., Executive Director, Clinical Research at DexCom

4:25 PM

Paper Session #9: Activity Monitoring

9.1 Monitoring Body Positions and Movements During Sleep using WISPs

Enamul Hoque (*University of Virginia, US*); Robert F Dickerson (*University of Virginia, US*); John Stankovic, Ph.D., (*University of Virginia, US*)

9.2 AndWellness: An Open Mobile System for Activity and Experience Sampling

John Hicks (*University of California Los Angeles, US*); Nithya Ramanathan, Ph.D. (*University of California Los Angeles, US*); Deborah Estrin, Ph.D. (*University of California Los Angeles, US*)

5:20 PM

Reception Welcome Remarks: **Stephen Burger**, Area Vice President, Business Development, Emerging Devices, AT&T

Reception (Fairway Pavilion, Terrace & Gardens)

7:00 PM

Close of Session



Thursday, October 7 :: Conference Sessions

Time: 8:00am – 2:00pm

Location: Hilton La Jolla Torrey Pines, Fairway Pavilion

7:00 AM

Registration Opens (Continental Breakfast Available)

8:00 AM

Opening Remarks

Robert B. McCray, President & CEO, Wireless-Life Sciences Alliance

8:05 AM

Keynote: Rod Pettigrew, Ph.D., M.D., Director, National Institute of Biomedical Imaging and Bioengineering at the National Institutes of Health

8:50 AM

Panel Discussion #3: Protecting the Protectors: Ensuring Health and Safety of First Responders Through Wireless Localization and Physiological Monitoring

Organizer: Jalal Mapar, Department of Homeland Security, Science and Technology

Directorate: National Program

Panelists:

- **Jalal Mapar,** Department of Homeland Security, Science and Technology
- **John Orr, Ph.D.,** Electrical & Computer Engineering, Worcester Polytechnic Institute
- **Denise Smith, Ph.D.,** Exercise Science Department, Skidmore College
- **John Ames,** Technology Group Senior Staff, QinetiQ North America
- **Maxim Batalin, Ph.D.,** Wireless Health Institute, University of California Los Angeles

9:35 AM

Panel Discussion #4: The Telemedicine & Advanced Technology Research Center (TATRC): Mobile Healthcare in the U.S. Army

Organizer: Shu Chien, M.D., Ph.D., Director, Institute for Engineering in Medicine at University of California, San Diego

Panelists: Members of TATRC, including:

- **COL Ron Poropatich, M.D.**
- **Holly Pavliscsak**
- **Jeanette Rasche**
- **Cynthia Barrigan**
- **COL Robert Vigersky, M.D.**

10:30 AM

Break (Light Refreshments Served)

10:45 AM

Keynote: D. Helen Gill, Ph.D., Program Manager, Cyber-Physical Systems at the National Sciences Foundation, Directorate for Computer & Information Science & Engineering

11:30 AM

Paper Session #10: Embedded Intelligence

10.1 Hierarchical Multiple Sensor Fusion using Structurally Learned Bayesian Network

Lei Zhang (*UtopiaCompression Corp., US*); **Tejaswi Tamminedi** (*UtopiaCompression Corporation, US*); **Anurag Ganguli, Ph.D.** (*Utopia-Compression Corporation, US*); **Guy Yosiphon, Ph.D.** (*UtopiaCompression Corporation, US*); **Jacob Yadegar** (*UtopiaCompression Corporation, US*)

10.2 An intelligent and portable ambulatory medical toolkit for automatic detection and assessment of traumatic brain injuries

Priya Ganapathy, Ph.D. (*UtopiaCompression Corporation, US*); **Shantanu Joshi** (*UtopiaCompression Corporation, US*); **Jacob Yadegar, Ph.D.** (*UtopiaCompression Corporation, US*); **Niranjan Kamat** (*UtopiaCompression Corporation, US*); **Calin Caluser** (*Metritrack LLC, US*)

12:25 PM

Keynote: Jonathan Sackner Bernstein, M.D., Associate Director, Center for Devices & Radiological Health at the Food and Drug Administration (FDA)

1:10 PM

Presentation of Awards

- Best Paper
- Best Student Paper
- Best Demo

Closing Remarks by Members of the Steering Committee

1:30 PM

Adjourn

Paper Session #1: Wireless Health in Developing Regions

1.1 A Mining Technique Using N-grams and Motion Transcripts for Body Sensor Network Data Repository

Hassan Ghasemzadeh, Ph.D. (*University of Texas at Dallas, US*)

Roosbeh Jafari, Ph.D. (*University of Texas at Dallas, US*)

Latifur Khan, Ph.D. (*University of Texas, US*)

Vitali Loseu (*University of Texas at Dallas, US*)

Recent years have seen a large influx of applications in the field of Body Sensor Networks (BSN). BSN, and in general wearable computers with sensors, can give researchers, users or clinicians access to tremendously valuable information extracted from data that were collected in users' natural environment. With this information, one can monitor the progression of a disease, identify its early onset or simply assess user's wellness. One major obstacle is managing repositories that store large amounts of BSN data. To address this issue, we propose a data mining approach for large BSN data repositories. We represent sensor readings with motion transcripts that maintain structural properties of the signal. To further take advantage of the signal's structure, we define a data mining technique using n-grams. We reduce overwhelmingly large number of n-grams via information gain (IG) feature selection. We report the effectiveness of our approach in terms of the speed of mining while maintaining an acceptable accuracy in terms of precision and recall. We demonstrate that the system can achieve average 99% precision with an average 100% recall on our pilot data with the help of only one transition for each movement.

1.2 Dandelion: A Framework for Transparently Programming Phone-Centered Wireless Body Sensor Applications for Health

Felix Lin (*Rice University, US*)

Ahmad Rahmati (*Rice University, US*)

Lin Zhong, Ph.D. (*Rice University, US*)

Many innovative mobile health applications can be enabled by augmenting wireless body sensors to mobile phones, e.g. monitoring personal fitness with on-body accelerometer and EKG sensors. However, it is difficult for the majority of smartphone developers to program wireless body sensors directly; current sensor nodes require developers to master node-level programming, implement the communication between the smartphone and sensors, and even learn new languages. The large gap between existing programming styles for smartphones and sensors prevents body sensors from being widely adopted by smartphone applications, despite the burgeoning Apple App Store and Android Market. To bridge this programming gap, we present Dandelion, a novel framework for developing wireless body sensor applications on smartphones. Dandelion provides three major benefits: 1) platform-agnostic programming abstraction for in-sensor data processing, called senselet, 2) transparent integration of senselets and the smartphone code, and 3) platform-independent development and distribution of senselets. We provide an implementation of Dandelion on the Maemo Linux smartphone platform and the Rice Orbit body sensor platform. We evaluate Dandelion by implementing real-world applications, and show that Dandelion effectively eliminates the programming gap and significantly reduces the development efforts. We further show that Dandelion incurs a very small overhead; in total less than 5% of the memory capacity and less than 3% of the processor time of a typical ultra low power sensor.

Paper Session #2: Mobile Gait Analysis

2.1 Comparative Study of Segmentation of Periodic Motion Data for Mobile Gait Analysis

Aris Valtazanos (*University of Edinburgh, UK*)

D.K. Arvind (*University of Edinburgh, UK*)

Subramanian Ramamoorthy (*University of Edinburgh, UK*)

Two approaches are presented and compared for segmenting motion data from on-body Orient wireless motion capture system for mobile gait analysis. The first is a basic, model-based algorithm which operates directly on the joint angles computed by the Orient sensor devices. The second is a model-free, Latent Space algorithm, which first aggregates all the sensor data, and then embeds them in a low-dimensional manifold to perform segmentation. The two approaches are compared for segmenting four different styles of walking, and then applied in a hospital-based clinical study for analysing the motion of elderly patients recovering from a fall.

2.2 Towards Power Optimized Kalman Filter for Gait Assessment using Wearable Sensors

Prem Santosh Udaya Shankar (*University of Texas at Dallas, US*)

Nikhil Raveendranathan (*University of Texas at Dallas, US*)

Nicholas Gans (*University of Texas at Dallas, US*)

Roosbeh Jafari, Ph.D. (*University of Texas at Dallas, US*)

Systems with wearable and wireless motion sensors have been receiving significant attention in the past few years specifically for the applications of human movement monitoring. One important concern in design of wearable and wireless motion sensors, also referred to as Body Sensor Networks (BSNs), is the form factor. The smaller form factor makes the device easily portable and wearable, hence improving users' acceptability. Battery often dominates the form factor. Kalman filters have been widely used for estimating the displacement of body joints using several inertial sensors mounted on body. In order for the Kalman filters to work effectively, accelerometer and gyroscope sensors readings have collectively been utilized. Furthermore, some researchers have integrated magnetometer sensor readings in the Kalman filter operation. Some inertial sensors, for example, gyroscopes are more power consuming compared to others. A typical gyroscope that we use in our study consumes approximately 30 mW while accelerometer takes 2.7 mW, which is roughly one order of magnitude less. In this paper, we introduce power optimized Kalman filters. The sensors are activated and deactivated timely reducing the power consumption and also keeping the change in accuracy acceptable. Our results show that with this approach, there is a reasonable reduction in the consumption of power.

Paper Session #3: Energy Efficient Sensing

3.1 Just-in-time Sampling and Pre-filtering for Wearable Physiological Sensors: Going from Days to Weeks of Operation on a Single Charge

Nan Hua (*Georgia Tech, US*)

Ashwin Lall (*Georgia Tech, US*)

Justin Romberg (*Georgia Tech, US*)

Jun Xu (*Georgia Tech, US*)

Mustafa al'Absi, Ph.D. (*University of Minnesota Medical School, US*)

Emre Ertin (*The Ohio State University, US*)

Santosh Kumar (*University of Memphis, US*)

Shikhar Suri (*Georgia Institute of Technology, US*)

Continuous monitoring of human physiology and behavior in natural environments via unobtrusively wearable wireless sensors is witnessing rapid adoption in both consumer health-care and in scientific research studies, since those portable and long-running devices can provide critical information for diagnosis and early prevention of disease, as well as invaluable data for scientific studies. Due to the requirement of continuous monitoring, these sensors, all operating on small wearable batteries, require frequent recharging. Lowering this recharging burden is essential for their widespread adoption.

In this paper we explore mechanisms for significantly enhancing the lifetime of these wearable sensors at the cost of a small loss in their sensing accuracy. We propose two ideas that build upon our observation that collecting bursts of samples over short periods of time is sufficient to capture the most interesting and informative part of the signal. In the first part of this paper, we propose a general methodology for reconstructing bandlimited signals accurately from such short bursts of samples. While this reconstruction task is in nature an ill-conditioned problem, we show that the insertion of an analog "modulated pre-filter" hardware module before the ADC can almost surely alleviate this conditioning problem. In the second part of this paper, we describe just-in-time sampling, which by sampling in short bursts at the "right" times, can accurately track R-wave peaks in ECG signals. Using simulations on publicly available traces as well as self-collected data, we show the efficacy of this technique.

3.2 Blood Oxygen Estimation from Compressively Sensed Photoplethysmograph

Pawan Baheti (*Qualcomm, US*)

Harinath Garudadri, Ph.D. (*Qualcomm, US*)

Somdeb Majumdar (*Qualcomm Inc., US*)

In this work, we consider low power, wearable pulse oximeter sensors for ambulatory, remote vital signs monitoring applications. It is extremely important for such sensors to maintain clinical accuracy and yet provide power savings to enable non-intrusive, long lasting sensors. Our contributions in this work include sub-Nyquist, random sampling of evanescent red and infra red (IR) photoplethysmograph (PPG) signals in real time under the Compressed Sensing (CS) paradigm. We describe the real time platform and demonstrate that the SpO₂ accuracy is not compromised due to aliasing of ambient light artifacts, even when average number of measurements is much below that of Nyquist rate. We briefly discuss the various modules contributing to overall power consumption of a wireless pulse oximeter sensor and show that 10x reductions in LED power and radio power are possible, without sacrificing the SpO₂ accuracy.

Paper Session #4: Energy Efficient Networking

4.1 Evaluation of Body Sensor Network Platforms: A Design Space and Benchmarking Analysis

Sidharth Nabar (*University of Washington, US*)

Ayan Banerjee (*Arizona State University, US*)

Sandeep Gupta, Ph.D. (*Arizona State University, US*)

Radha Poovendran, Ph.D. (*University of Washington, US*)

Body Sensor Networks (BSNs) consist of sensor nodes deployed on the human body for health monitoring. Each sensor node is implemented by interfacing a physiological sensor with a sensor platform consisting of components such as microcontroller, radio and memory. Diverse needs of BSN applications require customized platform development for optimizing performance. In this paper, we propose a two-phase framework to evaluate the performance of sensor platforms to match a BSN's computation, communication and sensing requirements: 1) **Design Space Determination**, wherein we investigate salient features of BSN platforms and quantify them as design coordinates through evaluation metrics such as SPSW (Samples Processed per Second per Watt) and EPC (Expected Power Consumption). To measure these metrics for a platform under typical BSN application workloads, we propose BSNBench, a benchmarking suite composed of basic tasks that occur in diverse BSN applications. BSNBench enables an accurate profiling of platforms based on the design coordinates ; 2) **Design Space Exploration**, wherein we explore the design space to find the most suitable platform for a given application. We demonstrate the usage of our framework through a case study, where we consider two practical BSN applications and choose suitable platforms for them.

4.2 Energy Optimization in Wireless Medical Systems Using Physiological Behavior

Hyduke Noshadi (*University of California at Los Angeles, US*)

Foad Dabiri, Ph.D. (*University of California at Los Angeles, US*)

Saro Meguerdichian (*University of California at Los Angeles, US*)

Miodrag Potkonjak, Ph.D. (*University of California at Los Angeles, US*)

Majid Sarrafzadeh, Ph.D. (*University of California at Los Angeles, US*)

Wearable sensing systems are becoming widely used for a variety of applications, including sports, entertainment, and military. These systems have recently enabled a variety of medical monitoring and diagnostic applications in Wireless Health. The need for multiple sensors and constant monitoring lead these systems to be power hungry and expensive, with short operating lifetimes. In this paper, we introduce a novel methodology that takes advantage of the influence of human behavior on signal properties and reduces those three metrics from the data size point of view. This, in turn, directly influences the wireless communication and local processing power consumption. We exploit intrinsic space and temporal correlations between sensor data while considering both user and system behavior. Our goal is to select a small subset of sensors to accurately capture and/or predict all possible signals of a fully instrumented wearable sensing system. Our approach leverages novel modeling, partitioning, and behavioral optimization, which consists of signal characterization, segmentation and time shifting, mutual signal prediction, and subset sensor selection. We demonstrate the effectiveness of the technique on an insole instrumented with 99 pressure sensors placed in each shoe, which cover the bottom of the entire foot, resulting in energy reduction of 56% to 96% for error rates of 5% to 17.5%.

Paper Session #5: Emergency Care

5.1 A Context-Management Framework for Telemedicine: An Emergency Medicine Case Study

Rita Wouhaybi, Ph.D. (*Intel Corporation, US*)
 Mark Yarvis, Ph.D. (*Intel Corporation, US*)
 Philip Muse (*Intel Corporation, US*)
 Chieh-Yih Wan, Ph.D. (*Intel Corporation, US*)
 Sangita Sharma (*Intel Corporation, US*)
 Sai Prasad (*Intel Corporation, US*)
 Lenitra Durham, Ph.D. (*Intel Corporation, US*)
 Ritu Sahni, M.D. (*Oregon Health & Science University, US*)
 Robert Norton, M.D. (*Oregon Health & Science University, US*)
 Merlin Curry, M.D. (*Oregon Health & Science University, US*)
 Holly Jimison, Ph.D. (*Oregon Health & Science University, US*)
 Richard Harper, M.D. (*Oregon Health & Science University, US*)
 Robert Lowe, M.D. (*Oregon Health & Science University, US*)

Patient care can be intense and stressful, especially in emergency care situations. Emergency care has two parts, field care by a paramedic and in-hospital care. Paramedics often consult with physicians before the patient reaches the hospital. To do this effectively, they must convey the patient's condition rapidly and effectively. Upon hospital arrival they must also transfer as much patient data as possible to ensure continuation of care. In this paper, we present a context-management framework for telemedicine that is designed to capture sensor data for transfer to a remote location. We further describe an application developed on top of the framework for emergency medicine. We examine design considerations for the application based on collaboration with medical personnel. Finally, we present technical results obtained from use of the technology in simulated emergency scenarios.

5.2 Remote Physiological Monitoring of First Responders with Intermittent Network Connectivity

Jingyuan Li (*University of Virginia, US*)
 Tejaswi Tamminedi (*UtopiaCompression Corporation, US*)
 Guy Yosiphon, Ph.D. (*UtopiaCompression Corporation, US*)
 Anurag Ganguli, Ph.D. (*UtopiaCompression Corporation, US*)
 Lei Zhang (*UtopiaCompression Corp., US*)
 John Stankovic, Ph.D. (*University of Virginia, US*)
 Jacob Yadegar (*UtopiaCompression Corporation, US*)

First responders have been observed to be at increased risk of cardio-vascular diseases compared to the general population. A high percentage of cardiac events have been found to occur during missions. Continuous physiological monitoring during missions can be effective in reducing the number of fatalities. Real-time physiological data such as ECG can be collected using body-worn sensors. This sensor data can be processed on the body itself or can be communicated over an ad hoc wireless network to the incident command center located nearby. First responder missions often take place inside building structures where network connectivity is intermittent. Intermittent connectivity can lead to loss of critical physiological data or delay in that information reaching the base station. Hence, some amount of local processing is needed in order to limit the amount of data that is communicated. In this paper, we introduce a novel Hidden Markov Model based classifier for myocardial infarction detection. The classifier fidelity can be adapted based on the processing power available. We present a peer-to-peer networking protocol for communication over disrupted networks. A low fidelity classifier is used to perform local processing and assign priorities to the data based on its criticality. It is complemented by a disruption-aware epidemic forwarding protocol for transferring first responder's physiological data to the base station. We show that with prioritized epidemic forwarding and buffer eviction policy, packet delivery ratio for abnormal data increases and the latency associated with abnormal packets reaching the destination decreases.

Paper Session #6: Health Awareness

6.1 Social Sensing: Obesity, Unhealthy Eating and Exercise in Face-to-Face Networks

Anmol Madan (*MIT, US*)

Sai Moturu, Ph.D. (*MIT Media Lab, US*)

Alex Pentland (*MIT, US*)

What is the role of face-to-face interactions in the diffusion of health-related behaviors- diet choices, exercise habits, and long-term weight changes? We use co-location and communication sensors in mass-market mobile phones to model the diffusion of health-related behaviors via face-to-face interactions amongst the residents of an undergraduate residence hall during the academic year of 2008-09. The dataset used in this analysis includes bluetooth proximity scans, 802.11 WLAN AP scans, calling and SMS networks and self-reported diet, exercise and weight-related information collected periodically over a nine month period.

We find that the health behaviors of participants are correlated with the behaviors of peers that they are exposed to over long durations. Such exposure can be estimated using automatically captured social interactions between individuals. To better understand this adoption mechanism, we contrast the role of exposure to different sub-behaviors, i.e., exposure to peers that are obese, are inactive, have unhealthy dietary habits and those that display similar weight changes in the observation period. These results suggest that it is possible to design self-feedback tools and real-time interventions in the future. In stark contrast to previous work, we find that self-reported friends and social acquaintances do not show similar predictive ability for these social health behaviors.

6.2 A Networked System for Self-Management of Drug Therapy and Wellness

Kit Yee Au-Yeung (*Proteus Biomedical, Inc, US*)

Timothy Robertson, Ph.D. (*Proteus Biomedical, Inc, US*)

Hooman Hafezi (*Proteus Biomedical, Inc, US*)

Gregory Moon, M.D. (*Proteus Biomedical, Inc, US*)

Lorenzo DiCarlo, M.D. (*Proteus Biomedical, Inc, US*)

Mark Zdeblick, Ph.D. (*Proteus Biomedical, Inc, US*)

George Savage, M.D. (*Proteus Biomedical, Inc, US*)

Background: A networked wellness system is under development to document actual ingestions of oral medications, to differentiate types/doses of drugs taken simultaneously, and to provide these data along with other metrics to patients and providers for individually tailored care.

Methods: After ingestion, an edible sensor (embedded in drug) is activated by stomach fluid and communicates to a wearable monitor that identifies the sensor as unique and records ingestion time/date. The monitor also collects physiologic data and communicates via mobile phone to a secure server that integrates the data with other wireless devices (e.g. blood pressure, weight). Summary reports are generated periodically for patient and physician review.

Results: No adverse effects were observed in animals using repeated, exaggerated doses of sensors. Two drug-sensor form factors have been tested in 3392 human ingestions with no major and very few minor adverse effects. Sensitivity was 97.0% and specificity was 97.7% when compared to directly observed ingestion. The system identified and differentiated up to 4 simultaneously ingested sensors with an identification accuracy of 100%. Data integration with multiple devices and report generation have been piloted successfully.

Conclusions: Pre-clinical and early clinical system safety appear satisfactory; data integration and communication appear to be feasible. By providing context-rich information and fostering communication, this system may enhance patient-provider relationship and care coordination.

Paper Session #7: Clinical Risk Assessment

7.1 Trapezius Muscle EMG as Predictor of Mental Stress

Jacqueline Wijsman (*University of Twente, NL*)
 Bernard Grundlehner (*Holst Centre/IMEC-NL, NL*)
 Julien Penders (*Imec-NL, NL*)
 Hermie Hermens, Ph.D. (*University of Twente, NL*)

Stress is a growing problem in society and can, amongst others, induce musculoskeletal complaints, related to sustained muscle tension. The ability to measure stress with a wireless system would be useful in the prevention of stress-related health problems. The aim of this experiment was to derive stress levels of subjects from electromyography (EMG) signals of the upper trapezius muscle. Two new stress tests were designed for this study, which aimed at creating circumstances that are similar to work stress. An experiment is described in which EMG signals of the upper trapezius muscle were measured during three different stressful situations. Stress tests included a calculation task (the Norinder test), a logical puzzle task and a memory task, of which the last two were newly designed.

The results show significantly higher amplitudes of the EMG signals during stress compared to rest and fewer gaps (periods of relaxation) during stress. Also, mean and median frequencies were significantly lower during stress than during rest. The differences in EMG features between rest and stress conditions indicate that EMG is a useful parameter to detect stress. These results show opportunities for the inclusion of EMG sensors in a wireless system for ambulatory monitoring of stress levels.

7.2 Portable, Non-Invasive Fall Risk Assessment in End Stage Renal Disease Patients on Hemodialysis

Thurmon Lockhart, Ph.D. (*Virginia Tech, US*)
 Adam Barth (*University of Virginia, US*)
 Xiaoyue Zhang (*Virginia Tech, US*)
 Rahul Songra (*Virginia Tech, US*)
 Emaad Abdel-Rahman, M.D. (*University of Virginia, US*)
 John Lach, Ph.D. (*University of Virginia, US*)

Patients with end stage renal diseases (ESRD) on hemodialysis (HD) have high morbidity and mortality due to multiple causes, one of which is dramatically higher fall rates than the general population. The mobility mechanisms that contribute to falls in this population must be understood if adequate interventions for fall prevention are to be achieved. This study utilizes emerging non-invasive, portable gait, posture, strength, and stability assessment technologies to extract various mobility parameters that research has shown to be predictive of fall risk in the general population. As part of an ongoing human subjects study, mobility measures such as postural and locomotion profiles were obtained from five (5) ESRD patients undergoing HD treatments. To assess the effects of post-HD-fatigue on fall risk, both the pre- and post-HD measurements were obtained. Additionally, the effects of inter-HD periods (two days vs. three days) were investigated using the non-invasive, body-worn motion capture technology and novel signal processing algorithms. The results indicated that HD treatment influenced strength and mobility (i.e., weaker and slower after the dialysis, increasing the susceptibility to falls while returning home) and inter-dialysis period influenced pre-HD profiles (increasing the susceptibility to falls before they come in for a HD treatment). Methodology for early detection of increased fall risk - before a fall event occurs - using the portable mobility assessment technology for out-patient monitoring is further explored, including targeting interventions to identified individuals for fall prevention.

Paper Session #8: Cardiac and Brain Monitoring

8.1 Miniaturized Wireless ECG-Monitor for Real-Time Detection of Epileptic Seizures

Fabien Massé (*Holst Centre / imec, NL*)
 Aline Serteyn (*Holst Centre / imec, NL*)
 Martien van Bussel (*Kempenhaeghe / Hobo Heeze, NL*)
 Johan Arends (*Kempenhaeghe / Hobo, NL*)
 Julien Penders (*Imec-NL, NL*)

Recent advances in miniaturization of ultra-low power components allow for more intelligent wearable health monitors. Such systems may be used in a wide range of application areas. Here, the development and evaluation of a wireless wearable electrocardiogram (ECG) monitor to detect epileptic seizures from changes in the cardiac rhythm is described. The ECG is measured using an ultra-low-power circuit for bio-potential acquisition. The ECG data is continuously analyzed by embedded algorithms: a robust beat-detection algorithm combined with a real-time heart beat-based epileptic seizure detector. Each detected seizure candidate triggers its transmission to a receiving radio-station. At the same time, the detected events and the raw ECG data are stored on an embedded memory card from which they can be wirelessly downloaded for off-line analysis. The performance of the system in terms of power-consumption, robustness of the radio-link and comfort of use is reported. In its current implementation, the proposed ECG-monitor prototype has a size of 52x36x15mm³, and an autonomy of one day. Wireless, miniaturized and comfortable, this prototype opens new perspectives for continuous and ambulatory health monitoring.

8.2 Wireless Non-contact Cardiac and Neural Monitoring

Yu Chi (*University of California, San Diego, US*)
 Patrick Ng (*University of California, San Diego, US*)
 Eric Kang (*University of California, San Diego, US*)
 Joseph Kang (*University of California, San Diego, US*)
 Jennifer Fang (*University of California, San Diego, US*)
 Gert Cauwenberghs, Ph.D. (*University of California, San Diego, US*)

Ubiquitous physiological monitoring will be a key driving force in the upcoming wireless health revolution. Cardiac and brain signals in the form of ECG and EEG are two critical health indicators that directly benefit from long-term monitoring. Despite advancements in wireless technology and electronics miniaturization, however, the use of wireless home ECG/EEG monitoring is still limited by the inconvenience and discomfort of wet, adhesive electrodes.

We have developed a wireless biopotential instrumentation system using non-contact capacitive electrodes that operate without skin contact. The sensors can be embedded within comfortable layers fabric for unobtrusive use. The electrode is a direct replacement for conventional contact electrodes.

The non-contact electrode has been integrated into both a wearable ECG chest harness and EEG headband. We have also designed a compact, battery-powered, wireless data acquisition system to interface with multiple electrodes and monitor patient cardiac and neural signals in real time. In addition, the system also simultaneously acquires signals from conventional Ag/AgCl electrodes to provide a direct comparison of the non-contact electrode's signal quality.

Paper Session #9: Activity Monitoring

9.1 Monitoring Body Positions and Movements During Sleep using WISPs

Enamul Hoque (*University of Virginia, US*)
Robert Dickerson (*University of Virginia, US*)
John Stankovic, Ph.D. (*University of Virginia, US*)

Sleep monitoring is very important for elderly people as inadequate and irregular sleep are often related to serious diseases such as depression and diabetes. In many cases, it is necessary to monitor the body positions and movements made while sleeping because of their relationships to particular diseases (i.e., sleep apnea and restless legs syndrome). Analyzing movements during sleep also helps in determining sleep quality and irregular sleeping patterns. This paper presents a sleep monitoring system based on the WISP platform - active RFID-based sensors equipped with accelerometers. We show how our system accurately infers fine-grained body positions from accelerometer data collected from the WISPs attached to the bed mattress. Movements and their duration are also detected by the system. We present the results of our empirical study from 10 subjects on three different mattresses in controlled experiments to show the accuracy of our inference algorithms. Finally, we evaluate the accuracy of the movement detection and body position inference for six nights on one subject, and compare these results with two baseline systems: one that uses bed pressure sensors and the other is an iPhone application.

9.2 AndWellness: An Open Mobile System for Activity and Experience Sampling

John Hicks (*University of California Los Angeles, US*)
Nithya Ramanathan, Ph.D. (*University of California Los Angeles, US*)
Deborah Estrin, Ph.D. (*University of California Los Angeles, US*)

Advances in mobile phone technology have allowed phones to become a convenient platform for real-time assessment of a participant's health and behavior. AndWellness, a personal data collection system, uses mobile phones to collect and analyze data from both active, triggered user experience samples and passive logging of on-board environmental sensors. The system includes an application that runs on any Android-based mobile phone, server software that manages deployments and acts as a central repository for data, and a dashboard front end for both participants and researchers to visualize incoming data in real-time. Our system has gone through testing by researchers in preparation for deployment with participants, and we describe an initial qualitative study plus several planned future studies to demonstrate how our system can be used to better understand a user's health-related habits and observations.

Paper Session #10: Embedded Intelligence

10.1 Hierarchical Multiple Sensor Fusion using Structurally Learned Bayesian Network

Lei Zhang (*UtopiaCompression Corp., US*)

Tejaswi Tamminedi (*UtopiaCompression Corporation, US*)

Anurag Ganguli, Ph.D. (*UtopiaCompression Corporation, US*)

Guy Yosiphon, Ph.D. (*UtopiaCompression Corporation, US*)

Jacob Yadegar, Ph.D. (*UtopiaCompression Corporation, US*)

Multiple sensor fusion is very important for wireless health monitoring. Many existing sensor fusion approaches are based on a flat structure, where multiple sensor features are treated as in the same layer and are fused by the feature-level fusion. In this paper we present a systematic approach using structurally learned Bayesian Network (BN) for sensor fusion. The BN serves as a powerful framework that can integrate multiple sensor features in a hierarchy that is automatically learned via supervised learning. We present a hybrid structure learning approach that includes four steps and consists of both systematic global and local structure learning, as well as random perturbation for structure learning. Subsequent to the feature selection, we first learn an Augmented Bayesian Classifier (ABC) and it is followed by an extended K2 structure learning approach to search for a better structure in another structure subspace. Random structure learning is then performed to perturb the structure learning so as to avoid getting stuck in a local optimum. Finally, we perform local structure learning with hill-climbing by reversing or removing each link between sensor features. The proposed hierarchical sensor fusion solution outperformed some conventional approaches such as Naïve Bayesian Classifier and Support Vector Machine classifier that integrate multiple sensor features through a flat feature-level fusion.

10.2 An Intelligent and Portable Ambulatory Medical Toolkit for Automatic Detection and Assessment of Traumatic Brain Injuries

Priya Ganapathy, Ph.D. (*UtopiaCompression Corporation, US*)

Shantanu Joshi (*UtopiaCompression Corporation, US*)

Jacob Yadegar, Ph.D. (*UtopiaCompression Corporation, US*)

Niranjan Kamat (*UtopiaCompression Corporation, US*)

Calin Caluser (*Metritrack LLC, US*)

We propose to develop a portable, handheld, noninvasive solution for accurate screening and real-time monitoring of traumatic brain injury (BI) in ambulatory/emergency response scenarios. A layered sensing concept that unifies alternate modalities such as a) ultrasound (US), b) near infrared spectroscopy (NIRS), c) tonometry (IOP), to predict BI, their severity and mode of recommendations for emergency medical service (EMS) personnel is offered. Specifically, we aim to determine i) novel 3D morphometric parameters of optic nerve sheath that can predict elevated intracranial pressure from US data, ii) incidence of intracranial hematomas using NIRS, iii) intraocular pressure using a tonometer, iv) cerebral blood flow and blood oxygen content using other auxiliary non-invasive sensing modes and v) finally provide a sensor fused outcome of all i)-iv) combined. This decision-support system (DSS) will improve BI detection by incorporating accurate on-site measurements that accounts for individual baseline variations and monitors temporal manifestation of the injury. The data collected and the preliminary analysis performed by the DSS will be sent to an emergency department (ED) physician stationed at a nearby trauma center via a wireless 3G network. Based on the available bandwidth, either all the data including the preliminary analysis (US video, images, 1D measurements, etc) or only the refined signals (feature vector extracted during screening) along with the DSS diagnosis will be sent to the physician. If the DSS determined output is agreeable to the physician then the screening can be terminated and the physician/ED staff can prepare to perform advanced interventions (intubation, cerebral spinal fluid (CSF) drainage, etc). If not, the on-call physician can inform the medic to repeat the scans/take additional measurements to obtain a more concrete outcome via the DSS. In summary, such a knowledge-driven system will equip a novice or a trained medic with an easy-to-use tool to detect traumatic BI, reduce the diagnosis time involved (i.e., computed tomography (CT) scan, clinical evaluation) in ED before performing advanced interventions and thereby improve the prognosis.

D. HELEN GILL, Ph.D.

**Program Manager, Cyber-Physical Systems, National Sciences Foundation,
Directorate for Computer & Information Science & Engineering (Invited)**

Dr. D. Helen Gill is the Program Director for the Embedded & Hybrid Systems program of the National Science Foundation's Directorate for Computer and Information Science and Engineering (CISE) Division of Computer and Network Systems (CNS). Previously, she served as a Program Manager in the Information Technology Office of the Defense Advanced Research Projects Agency, where she developed programs in software-enabled control and hybrid systems and in programming technology for embedded systems.

At DARPA she also managed research in modeling and formal methods for software development and evolution. Previously she was a Principal Scientist with the MITRE Corporation and directed the National Science Foundation programs in Software Engineering and Programming Languages.

Dr. Gill received her B.A. degree in Mathematics from the University of Missouri (General Honors), M.S. in Computer Science from the University of Colorado, and Ph.D. in Computer Science from Auburn University. She is a member of Phi Beta Kappa. Her academic honors include Pi Mu Epsilon; Phi Kappa Phi; MU Curators, Powell B. McHaney, Burroughs, and CU Regents Fellowships. Her research publications are in graph decomposition for concurrency analysis, partitioning and scheduling software for parallel execution, distributed programming environments, and discrete event simulation. Her current research interests are in software for embedded systems, middleware, hybrid discrete and continuous systems, software analysis, applied formal methods, and technology for high confidence software and systems. She co-chairs coordinating group for High Confidence Software and Systems under the auspices of the Interagency Working Group for ITR&D.

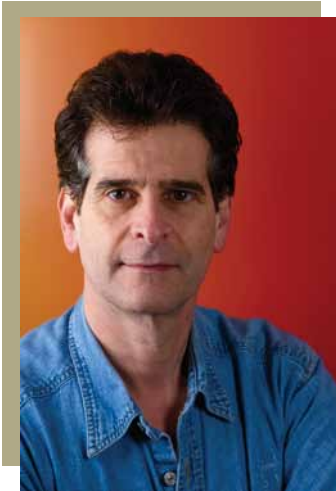


IRWIN MARK JACOBS, Ph.D.

Co-Founder, Qualcomm Incorporated

Irwin Mark Jacobs is a board member of QUALCOMM Incorporated, a company he co-founded in 1985. As CEO through 2005 and Chairman through 2009, he led the growth from startup to Fortune 500 Company. Qualcomm pioneered the development and commercialization of CDMA mobile wireless technology, now adopted for all third-generation cellular communications and in use by over eight hundred million consumers worldwide for voice and mobile broadband Internet access. He holds fourteen CDMA patents. For the 12th consecutive year, QUALCOMM has been named on Fortune's list of The 100 Best Companies To Work For, ranking 9th in 2010.

Dr. Jacobs previously served as co-founder, CEO and chairman of LINKABIT Corporation, leading the development of Very Small Aperture Earth Terminals (VSATs) and the VideoCipher® satellite-to-home TV system. LINKABIT merged with M/A-COM in August 1980, and Dr. Jacobs served as executive vice president and a member of the board of directors until his resignation in April 1985. Over 100 San Diego communications companies trace their roots to LINKABIT. Dr. Jacobs was named Chair of the Board of Trustees of the Salk Institute In November 2006 and Chair of the National Academy of Engineering in July 2008. He and his wife Joan have been cited by Business Week and Chronicle of Philanthropy among the 50 Most-Generous Philanthropists in the United States.



DEAN KAMEN

Founder, DEKA

As an inventor and physicist, Dean Kamen has dedicated his life to developing technologies that help people lead better lives. As an inventor, he holds more than 440 U.S. and foreign patents, many of them for innovative medical devices that have expanded the frontiers of health care worldwide. While still a college undergraduate, he invented the automatic, self-contained ambulatory pump designed to deliver precise doses of medication to patients with a variety of medical conditions. In 1976 he founded AutoSyringe, Inc., to manufacture and market the pumps. At age 30, he sold that company to Baxter International Corporation. By then, he had developed a number of other infusion devices, including the first wearable insulin pump for diabetics. Following the sale of AutoSyringe, Inc., he founded DEKA Research & Development Corporation to develop internally generated inventions, as well as to provide R&D for major corporate clients. Among Dean's proudest accomplishments is founding FIRST (For Inspiration and Recognition of Science and Technology), an organization dedicated to motivating the next generation to understand, use and enjoy science and technology.

Dean has received numerous awards and accolades including the Heinz Award in Technology, the Economy and Employment in 1998, the National Medal of Technology from President Clinton in 2000, the Lemelson-MIT Prize in 2002 for Invention and Innovation, the United Nations Association of the USA Global Humanitarian Action Award in 2006, the American Society of Manufacturing Engineers Medal in 2007, the 2008 LEGO Prize, the 2009 Committee for Economic Development Public Policy Award and honorary degrees from more than 25 colleges and universities. Dean was inducted into The National Inventors Hall of Fame in May 2005.



ROD PETTIGREW, Ph.D., M.D.

**Director, National Institute of Biomedical Imaging and Bioengineering,
National Institutes of Health (NIH)**

Roderic I. Pettigrew, Ph.D., M.D., is the first Director of the National Institute of Biomedical Imaging and Bioengineering at the NIH. Prior to his appointment at the NIH, he was Professor of Radiology, Medicine (Cardiology) at Emory University and Bioengineering at the Georgia Institute of Technology and Director of the Emory Center for MR Research, Emory University School of Medicine, Atlanta, Georgia.

Dr. Pettigrew is known for his pioneering work at Emory University involving four-dimensional imaging of the cardiovascular system using magnetic resonance (MRI). Dr. Pettigrew graduated cum laude from Morehouse College with a B.S. in Physics, where he was a Merrill Scholar; has an M.S. in Nuclear Science and Engineering from Rensselaer Polytechnic Institute; and a Ph.D. in Applied Radiation Physics from the Massachusetts Institute of Technology, where he was a Whitaker Harvard-MIT Health Sciences Scholar. Subsequently, he received an M.D. from the University of Miami School of Medicine in an accelerated two-year program, did an internship and residency in internal medicine at Emory University and completed a residency in nuclear medicine at the University of California, San Diego. Dr. Pettigrew then spent a year as a clinical research scientist with Picker International, the first manufacturer of MRI equipment. In 1985, he joined Emory as a Robert Wood Johnson Foundation Fellow with an interest in non-invasive cardiac imaging.



JONATHAN SACKNER-BERNSTEIN, M.D.

**Associate Director, Center for Devices & Radiological Health,
Food and Drug Administration (FDA)**

As Associate Center Director for Post Market Operations of FDA's CDRH, Dr. Sackner-Bernstein's portfolio currently focuses on the scientific, innovative and public health components of the Center's current strategic priorities. This includes leadership spanning from the Task Force focusing on using new science in regulatory decision making to the establishment of the Center's Council on Medical Device Innovation along with partners from eight federal agencies.

Sackner-Bernstein joined the Agency as part of its Post Market Transformation Initiative, serving as champion of the Center's initiative to reengineer as a matrix organizational structure. In parallel with his expertise in regulatory science and FDA operations, Dr. Sackner-Bernstein brings to his role 20 years of experience in clinical practice, medical research and healthcare management, with that research experience in pre-clinical, first-in-human, proof of concept, pivotal and post-approval studies, including drug and device therapies as well as diagnostics.

Previously, Sackner-Bernstein served as Chief Medical Officer at the CRO Clinilabs and on the faculty of Columbia University, with roles including that of Associate Chief of Cardiology at St. Luke's-Roosevelt Hospital as well as membership on the Columbia Faculty Council, the Scientific Review Committee of Columbia's GCRC and the Graduate Medical Education Committee.



PATRICK SOON-SHIONG, M.D.

Executive Chairman and Chief Executive Officer, Abraxis Health

Dr. Soon-Shiong is the Executive Chairman and Chief Executive Officer of Abraxis Health. He was recently appointed Executive Director of the UCLA Wireless Health Institute, and is Professor of Microbiology, Immunology, and Molecular Genetics Professor of Bioengineering at UCLA.

Dr. Soon-Shiong holds a degree in Medicine from the University of the Witwatersrand, Johannesburg, South Africa, and a Master of Science from the University of British Columbia. He is a fellow of the American College of Surgeons and the Royal College of Physicians and Surgeons of Canada. Dr. Soon-Shiong performed the world's first encapsulated islet transplant in a diabetic patient. He developed the first FDA approved protein nanoparticle delivery technology for the treatment of metastatic breast cancer and this drug is being developed for lung, melanoma, gastric and pancreatic cancer. He is a co-inventor of over 50 issued U.S. patents, has published more than 100 scientific papers, and founder of 2 publicly traded pharmaceutical companies, American Pharma Partners and Abraxis Bioscience.

In 2009 he was appointed to the President's Council at RAND Corporation, Chairman of the Steering Committee of Life Sciences of the X-Prize Foundation and Founding Board member to Dossia Foundation.



ERIC J. TOPOL, M.D.

Vice-Chairman of the Board and Chief Innovation Officer, West Wireless Health Institute; The Gary and Mary West Endowed Chair of Innovative Medicine; Director, Scripps Translational Science Institute; Chief Academic Officer, Scripps Health; General Chair of Wireless Health 2010 Conference

Eric J. Topol, M.D. is the Director of the Scripps Translational Science Institute, a National Institutes of Health funded program of the Clinical and Translational Science Award (CTSA) Consortium focused on advancing individualized medicine. He is the Chief Academic Officer of Scripps Health, a Senior Consultant cardiologist practitioner at Scripps Clinic, and Professor of Translational Genomics at The Scripps Research Institute.

Prior to coming to Scripps, he served on the faculty of Case Western as a professor in genetics, chaired the Department of Cardiovascular Medicine at Cleveland Clinic for 15 years and raised its status to rank #1 by US News and World Report for 11 consecutive years, and founded the Cleveland Clinic Lerner College of Medicine. He has been a medical innovator in wireless medicine, including wireless ECG, vital signs, remote monitoring for heart failure, and as co-founder and Vice-Chairman of the West Wireless Health Institute. Dr. Topol has been elected to the Institute of Medicine of the National Academy of Sciences, the American Association of Physicians and recognized by the Institute of Scientific Information (ISI) to be in the top 10 cited biomedical researchers in medicine in the past decade.



PROFESSOR CHRISTOFER TOUMAZOU, Ph.D., FRS, FRENG, FIEEE, FIET, DENG, CENG, PH.D.

Chris is the Founding Director of the Institute of Biomedical Engineering at Imperial College, London. At 33, Chris was one of the youngest ever professors to be appointed at Imperial. His research interests include high frequency analogue integrated circuit design for RF electronics and low-power electronics for biomedical applications. He has published over 500 research papers and holds 30 patents in the field, many of which are now fully granted PCT. Chris is the founder of three technology based companies with applications spanning ultra low-power, mobile and wireless health monitoring: Toumaz Technology (Toumaz Technology Ltd, UK) Digital Audio Broadcasting (Future-Waves Pte, Taiwan) and DNA Sequencing (DNA Electronics Ltd, UK). Chris is an advisor to many healthcare panels in the field of medical devices, including the Singapore Government and the Board of Grace Semiconductor in Taiwan, one of the largest semiconductor foundries in the world. In 2004, Chris raised £30 million in order to create an Institute of Biomedical Engineering at Imperial College London focusing on Personalised Medicine and Bionanotechnology. He is the recipient of the 2005 IEEE CAS Education Award for pioneering contributions to circuits and systems for biomedical applications and received the Royal Academy of Engineering Silver Medal in 2007 for pioneering contributions to British industry, the IET Premium best paper award and the IEEE CAS Outstanding Young Author award. He was elected to Academia Europea in 2006 and in 2007 was the recipient of the Royal Academy of Engineering Silver Medal. In 2007 he became a Fellow of the Royal Society and in 2008 was appointed to the Fellowship of the Royal Academy of Engineering. In 2009 Chris won the World Technology Award for Health and Medicine, sponsored by Time Magazine, and the Institute of Biomedical Engineering was awarded the Times Higher Award for Outstanding Contribution to Innovation and Technology.

JON AMES**Technology Group Senior Staff, QinetiQ North America**

Mr. Ames has been researching and developing health assessment technology for populations at risk on behalf of the Government and for private industry over the past 30 years. Mr. Ames has worked for medical companies like Zoll Medical, Hewlett Packard Medical and Agilent Medical and focused on projects to extend patient monitoring concepts out of the Hospital and into regional care networks to manage disease in lower cost settings.

Over the past decade, Mr. Ames has researched robust remote monitoring and detection of injury for Warfighters, DHS responders and civilian populations at risk for the U.S. Government. Efforts have included architecting systems to manage lives at risk from early training through injury and evacuation. This work emphasized concepts of discriminating valid information, smart alarms and adhoc collaborative incident management systems. These efforts have fused historical patient records, medic encounter, and real time monitoring information to support remote triage, ER/ED preparation, and logistics across low bandwidth radio networks. Recently Mr. Ames has recently transitioned back into the private sector and is employed by QinetiQ North America in Waltham Massachusetts developing textile integrated monitoring.

SHIROMI ARUNATILEKA, Ph.D**Senior Lecturer, University of Colorado School of Computing**

Dr. Shiromi Arunatileka is a Senior Lecturer in the University of Colombo School of Computing. She obtained her BSc (Hons) in Computer Science from the University of Colombo, Sri Lanka in 1994, the Master of Business Administration from the Postgraduate Institute of Management, University of Sri Jayewardenepura, Sri Lanka and her PhD from the University of Western Sydney, Australia. She has carried out extensive research in eBusiness Transformation for SMEs and her research interests are in e-Society and ICT for Social and Economic Development of developing countries. She has many publications to her credit on eBusiness Transformation and eHealth. She is currently involved in research and development of eHealth related applications. She is the co-Author of VIDUSUWA - a Patient Centric eHealth Strategy for Sri Lanka and Saukya.lk a social networking portal for all health related needs in Sri Lanka. Dr. Arunatileka is also a member of the Board of Study of the MSc in Bio Medical Informatics, Postgraduate Institute of Medicine of Sri Lanka.

AUDIE A. ATIENZA, Ph.D.**Scientific Advisor for Technology Partnerships, National Institutes of Health (NIH)**

Dr. Audie Atienza currently serves as Scientific Advisor for Technology Partnerships at the National Institutes of Health (NIH), Office of the Director, Office of Science Policy, Public-Private Partnership Program; and as a Behavioral Scientist at the National Cancer Institute, Behavioral Research Program. At NIH, Dr. Atienza has spearheaded research endeavors in electronic health (eHealth), mobile technology and health (mHealth), and real-time data capture, including serving as chair/organizer of national conferences: "The Science of Real-Time Data Capture conference (Sept 2003), "Capturing Physical Activity and Diet in Real-Time" expert panel workshop (June 2004), "Critical Issues in eHealth Research" national conference (June 2005), and "Critical Issues in eHealth Research: Toward Quality Patient Centered Care" national conference (September 2006). He is leading NIH's effort in organizing the 2010 mHealth Summit. He has over 40 peer-reviewed papers published in scientific journals, and has edited/co-edited several publications focused on eHealth. Dr. Atienza currently coordinates mHealth research activities across the NIH and serves as a NIH liaison to relevant stakeholder on issues relevant to mHealth.

STEVEN BAKER, Ph.D.
Principal Engineer, Welch Allyn Monitoring

Steven D. Baker is a principal engineer at Welch Allyn Monitoring, where he helped develop and deploy the first enterprisewide standards-based patient telemetry solution. Baker's work on 802.11 medical-grade wireless networks has continued for ten years. He is now developing embedded and system solutions for shared, real-time, life-critical medical networks, an area in which he holds several patents. He is a Senior Member of the IEEE, member of the AAMI, serves on the IEEE 11073 Committee for Health Informatics and is a primary contributor to the IEC/EN 80001 Guidance for Wireless Networks Incorporating Medical Devices. Prior to joining Welch Allyn, he worked at Schlumberger developing advanced electromagnetic sensors and communication methods for determining oil formation properties and spent time as a volunteer firefighter/EMT. He graduated magna cum laude from Utah State University and earned a Ph.D. in electrical engineering from Cornell University, where he developed space science instrumentation to study the Earth's ionosphere.

CYNTHIA BARRIGAN, RN, MPH
Special Assistant to Deputy Director and Portfolio Manager, International Health Programs, TATRC

Ms. Barrigan is a clinician, technologist and public health professional with fifteen years of experience developing and managing health sector IT programs—with a specific focus on military health and rural remote health systems. She currently serves as the Special Assistant to the Deputy Director and Portfolio Manager for International Health Programs at the Telemedicine and Advanced Technology Research Center (TATRC)—an organization within the US Army Medical Research & Material Command, Fort Detrick. In addition, she is a senior advisor to the US Army Consultant to the Surgeon General for medical informatics. In her current role, she is responsible for organizational strategy and planning, Health IT program development, information-sharing and coordination on global health IT development—across DOD and with other US Government Departments (DOS, HHS, USAID), non-governmental organizations (NGOs) etc—as well as, convening special events and meetings to advance important Health IT topics. She is an Army Veteran with prior service as a Captain in the US Army Nurse Corps. Ms. Barrigan received her Bachelor of Science in Nursing from the University of Florida, and is an honor graduate from the Johns Hopkins Bloomberg School of Public Health— with special studies in international health and humanitarian health information systems.

MAXIM BATALIN, Ph.D.
Research Program Manager, UCLA Wireless Health Institute

Dr. Maxim A. Batalin is a Research Program Manager at the UCLA Wireless Health Institute. In that role, he has led the development of the first of its kind system for remote monitoring and diagnosis, medical sensor/device automated management and patient feedback. He also is leading several programs in Human Motion monitoring with a broad set of applications including neurological rehabilitation, performance athletics, reduction of hospital stay via motion monitoring and intervention, general health and wellness, interventions and prevention of obesity and diabetes, and low-cost automation of the exercise equipment.

Dr. Batalin is also a Senior Technology Strategist at the UCLA Institute for Technology Advancement (ITA) with extensive expertise in Intelligent Information Technology (IIT) with specific emphasis on security, intelligent systems, sensor networking, biomedical systems, robotics and automation, embedded systems and IIT infrastructure design. At ITA He is working on behalf of UCLA on initiating large multidisciplinary programs, spearheading new collaborations with industrial and government partners, driving commercialization and technology transfer for innovative ideas. Dr. Batalin has led multiple technology development programs and has over 40 publications in leading journals and conference proceedings spanning the following areas: wireless health, sensor networks, robotics, information technology infrastructure design and intelligent systems.

MARK CARLSON, Ph.D.**Chief Medical Officer and Senior Vice President, St. Jude Medical**

Mark Carlson, M.D., joined St. Jude Medical in 2006 as Chief Medical Officer and Senior Vice President, Clinical Affairs, for the Cardiac Rhythm Management Division. He previously served as Professor of Medicine and Associate Vice President for Government Relations at Case Western Reserve University in Cleveland, Ohio. He also served on the Medical Devices Dispute Resolution Panel for the U.S. Food and Drug Administration (FDA), as well as on Medicare advisory committees.

Dr. Carlson has chaired several policy committees and conferences sponsored by the Heart Rhythm Society and the FDA, as well as a task force that developed policy recommendations on pacemaker and ICD performance and industry communications. In 2003, Dr. Carlson worked as a Robert Wood Johnson Fellow on the staff of Senate Judiciary Committee Chairman Orrin Hatch on issues related to Medicare and medical liability litigation reform. Dr. Carlson trained in cardiology and cardiac electrophysiology at Massachusetts General Hospital and at Harvard Medical School. Dr. Carlson's research on arrhythmias has resulted in more than 150 published articles.

SHU CHIEN, M.D., Ph.D.**Director, Institute of Engineering in Medicine, University of California, San Diego**

Shu Chien joined UCSD in 1988 and became the founding chair of the Department of Bioengineering in 1994. In 2008, Chien became the founding Director of UC San Diego's new Institute of Engineering in Medicine. As principal investigator on the Whitaker Foundation Development Award (1993) and Leadership Award (1998), he played a major role in establishing UCSD's bioengineering program as one of the top two programs in the country. As founding Director of the Whitaker Institute of Biomedical Engineering at UCSD, he helps foster collaborations among the faculty of UCSD and with research institutes and biomedical companies in San Diego. As founding Director of the UC System wide Bioengineering Institute in California, he has contributed to collaborations in research and education among the ten UC campuses. He was named the inaugural holder of the Y.C. Fung Endowed Chair in Bioengineering at the Jacobs School. He is a member of the National Academy of Engineering, Institute of Medicine, National Academy of Sciences, and American Academy of Arts and Sciences. Chien co-founded Celladon Corporation and serves as a consultant to AVIVA Biosciences and BioDuro. He received his M.D. from the National Taiwan University and his Ph.D. in Physiology from Columbia University, where he was a professor from 1969 to 1988.

BRUCE DOBKIN, M.D.**Co-Director, UCLA Stroke Center**

Dr. Dobkin co-directs the UCLA Stroke Center and is a member of the Brain Research Institute at UCLA. He is editor of the journal *Neurorehabilitation and Neural Repair*, which is ranked first in its field and has written 4 books on neurological diseases and efforts at recovery. He has been funded as a PI by the National Institutes of Health continuously for 15 years. While providing clinical care for patients, his research program studies new interventions to promote functional gains in patients with neurological impairments and disabilities. Recent collaborations with UCLA engineers and computer scientists has led to the development of sensors to monitor the activities and skills learning of patients and to create more reliable and meaningful outcome measurements.

He is on the Board of Directors of the American Society of Neurorehabilitation, a Fellow of the American Neurological Association and the American Academy of Neurology, in which he has served as Chair of the Section on Neural Repair and Rehabilitation, and is a managing director of the World Federation of NeuroRehabilitation. He is a Distinguished Fellow of the Royal College of Physicians

RICHARD GARFEIN, Ph.D.**Associate Professor, Global Public Health, UC San Diego**

Richard S. Garfein, PhD, MPH, is an Associate Professor in the Division of Global Public Health in the Department of Medicine at UCSD. He was trained as an infectious disease epidemiologist at San Diego State University, School of Public Health where he received his M.P.H. degree, and at Johns Hopkins University, School of Public Health where he received his Ph.D. His current research involves observational studies and behavioral intervention trials related to HIV and viral hepatitis prevention among injection drug users. Since joining the UCSD faculty in 2005, Dr. Garfein broadened his research activities to include studying the combined epidemics of tuberculosis and HIV in Mexico and developing interventions to prevent HIV transmission among methamphetamine-using men who have sex with men through research awards from the U.S. Agency for International Development and the U.S. Centers for Disease Control and Prevention, respectively. Dr. Garfein is also involved in two California Department of Health Services funded evaluation projects that have the potential to impact HIV prevention activities statewide.

HARINATH GARUDADRI, Ph.D.**Senior Staff Engineer, Qualcomm Incorporated**

Hari Garudadri obtained Ph.D from University of British Columbia in EE, specializing in speech perception and production in 1988. He has been with Qualcomm since 1997, where he is currently Senior Staff Engineer. Hari has worked on Voice Recognition, Speech Coding, Audio Coding, Video Coding, Packet Switched Video Telephony, Multimedia Standards and low power sensors and has over 35 peer-reviewed publications and over 35 issued/pending patents in these areas. His current interests include low power signal processing and telemetry of vital signs for wireless health and fitness applications.

ROOZBEH JAFARI, Ph.D.**Assistant Professor, Electrical Engineering, University of Texas at Dallas**

Roozbeh Jafari received his B.Sc. in Electrical Engineering from Sharif University of Technology in 2000. He received an M.S. in Electrical Engineering from SUNY at Buffalo, and an M.S. and a Ph.D. in Computer Science from UCLA in 2002, 2004 and 2006 respectively. He spent 2006-2007 in EECS department at UC Berkeley as a post-doctoral researcher. Dr. Jafari is currently an assistant professor in Electrical Engineering at the University of Texas at Dallas. His research is primarily in the area of networked embedded system design and reconfigurable computing with emphasis on medical/biological applications, their signal processing and algorithm design. He is the director of ESSP Lab.

DONALD JONES**Vice President, Health and Life Sciences, Qualcomm Incorporated**

Donald Jones serves as Vice President of Health and Life Sciences for Qualcomm Incorporated, a global leader in developing and delivering innovative digital wireless communications products and services. He is responsible for leading Qualcomm's expansion of wireless technologies into the consumer health, healthcare and medical device markets. In addition, Jones has multiple patents and patent pending applications around wireless health solutions. Jones is on the Boards of the Alliance Healthcare Foundation, the American Telemedicine Association, and is the founding board member of the Wireless Life Science Alliance. He holds degrees in biology and bioengineering, and law and business.

EMIL JOVANOV, Ph.D.**Associate Professor, Electrical and Computer Engineering, University of Alabama**

Dr. Emil Jovanov is an Associate Professor in the Electrical and Computer Engineering Department at the University of Alabama in Huntsville. He received his Dipl. Ing., MSc, and PhD from the University of Belgrade. He is recognized as the originator of the concept of wireless body area networks for health monitoring and he is one of the leaders in the field of wearable health monitoring. Dr. Jovanov is a Senior Member of IEEE, Associate Editor of the IEEE Transactions on Information Technology in Biomedicine, and IEEE Transactions on Biomedical Circuits and Systems, and a member of Editorial Board of Applied Psychophysiology and Biofeedback. He was Guest Editor of two special issues of IEEE TITB: "Body Sensor Networks: From Theory to Emerging Applications" and "mHealth Emerging Mobile Technologies for Health Applications." Dr. Jovanov is a member of EMBS Technical Committee on Wearable Biomedical Sensors and Systems, Corresponding Member of the IEEE Medical Technology Policy Committee (MTPC), and served in Academic and Medical Advisory boards of several startups. He has spent over 25 years in the development and implementation of application specific hardware, software, and systems. He has published 35 journal papers, 12 book chapters, and more than 120 conference papers.

YOGESAN (YOGI) KANAGASINGAM, Ph.D.**Research Director, Australian E-Health Research Centre**

Dr. Yogesan is the research director of the Australian E-Health Research Centre. Yogi is the inventor of the EyeScan device, the first low cost easy-to-operate imaging device used for diagnosis of multiple eye disease which is expected to replace the 150 years old direct ophthalmoscopes. In 2006, He obtained one of the Inventor of the Year awards for this device.

In addition, Yogi has received two inventor of the year awards in 2008 for the invention of computer-aided vision testing software for screening of children by trained healthcare workers and world's first eye information kiosks with tactile screens. These devices and software are installed at the Guide Dog Discovery Centre for use by school children and others. At present he is working on a screening device for the early detection of systemic disease such as Alzheimer's disease from the eye. He has introduced new digital technologies into rural eye screenings which can be operated by nurses. Yogi has implemented the world renowned remote eye care delivery in WA which is now benefiting thousands of West Australians living in rural and remote areas. Yogi is invited around the world to teach the implementation of such services.

ASHOK KAUL**Vice President, Healthcare Convergence, Wireless-Life Sciences Alliance**

Ashok has over 25 years of global marketing, sales and product development experience in healthcare with both larger, Fortune 100 companies such as GE Medical, Abbott Labs, Medtronic MiniMed, and St. Jude Medical, as well as with start-up companies. He has specific expertise and experience in international markets, with a successful career in sales, marketing, business, and product development.

JOHN LACH, Ph.D.**Associate Professor, Electrical and Computer Engineering, University of Virginia**

John Lach received the B.S. (1996) from Stanford University and the M.S. (1998) and Ph.D. (2000) in Electrical Engineering from UCLA. Since 2000, he has been on the faculty of the Charles L. Brown Department of Electrical and Computer Engineering at the University of Virginia and has held the rank of Associate Professor with tenure since 2006. His primary research interests are wearable technologies for biomedical applications, integrated circuit design techniques, dynamically adaptable and real time embedded systems, fault and defect tolerance, safety-critical system design and analysis, general purpose and application specific processor design, and field programmable gate arrays (FPGAs). He has been the PI or co-PI on over 25 grants and has published over 80 refereed papers, including two Best Paper Awards. He is currently a Steering Committee member and the Publicity Chair for Wireless Health 2010 and a Technical Program Committee Co-Chair for BSN 2011. From 2005-2010, he was an Associate Editor for the IEEE Transactions on Computers and the IEEE Transactions on Computer Aided Design of Integrated Circuits and Systems. He is a Senior Member of the IEEE, and a member of the ACM, IEEE Computer Society, IEEE Circuits and Systems Society, IEEE VLSI Systems and Applications Technical Committee, ACM SIGDA, and Eta Kappa Nu.

SCOTT MAKEIG, Ph.D.**Director, Swartz Center for Computational Neuroscience, UC San Diego**

Scott Makeig completed a Bachelors degree, 'Self in Experience,' at the University of California Berkeley in 1972. He received a Ph.D., 'Music Psychobiology,' from the University of California San Diego (UCSD) in 1985. After spending a year in Ahmednagar, India as a American India Foundation research fellow, he became a Psychobiologist at UCSD, and then a Research Psychologist at the Naval Health Research Center, San Diego. In 1999, he became a Staff Scientist at the Salk Institute, La Jolla, and moved to UCSD as a Research Scientist in 2002 to develop the Swartz Center for Computational Neuroscience, which he now directs. Dr. Makeig is a member of the Society for Neuroscience, the Cognitive Neuroscience Society, and the Society for Human Brain Mapping.

JALAL MAPAR**Program Manager, Department of Homeland Security Science and Technology Directorate**

Mr. Mapar is a Program Manager at the DHS Science and Technology Directorate. He manages a portfolio of S&T programs that provide capabilities for the nation's emergency preparedness and response community. His portfolio primarily focuses on technologies for First Responders: location and health monitoring and Integrated Modeling, Mapping, and Simulation, Training and Exercise, and Incident Management Enterprise systems. Since joining he has led the development of an advanced breaching tool (selected by Popular Science as one of the 2008 Innovations of the Year), an innovative concealable escape hood, and started S&T's 3-D Location Tracking and the Physiological Monitoring systems. Prior to joining DHS in 2005, Mr. Mapar was a VP/Division Manager in the RDT&E Group at SAIC in McLean, VA. Mr. Mapar holds a B.S. and M.S. in Aerospace Engineering from the University of Texas at Austin and has over 30 journal/conference publications in advanced technology topics.

ROBERT B. McCRAY**President & CEO, Wireless-Life Sciences Alliance**

Rob McCray is the President & CEO of the Wireless-Life Sciences Alliance, Chairman of Alliance Healthcare Foundation, Special Advisor to Triple Tree LLC, Member of Midmark Corporation Board of Directors, Member of Board of Directors of, CONNECT and an active advisor to several companies. Rob leverages over 25 years of experience as a business owner, senior operating executive, and legal and transactional advisor to private and public companies. Rob has served as President, COO and an early investor in Digital On-Demand, Inc., a retail services technology company that operates under the brand name RedDotNet in chains including Barnes & Noble, Circuit City, Best Buy, Blockbuster and Fred Meyer. Previously, he served as Chairman, President and CEO of HealthCap, Inc., a venture capital-backed physician practice management company that returned 90% CAGR to its investors. Rob also served as Managing Director of Caremark Physician Resources, directing its formation during its initial high-growth years prior to its sale to MedPartners, Inc. He also co-founded OnCall Medicine, Inc., a medical house calls company. Prior to his success as a business operator, he was a Managing Partner in his law firm and a partner in a predecessor and transactional legal and consulting services to the healthcare industry for over 20 years.

RAVINDRA MEHTA, M.D.**Professor of Medicine, UC San Diego**

Dr. Mehta is a Professor of Medicine in the Division of Nephrology and Associate Chair for Clinical Research in the Department of Medicine at UCSD where he directs the Acute Dialysis Program and the UCSD CREST and Masters in Clinical Research Program. He is an internationally recognized expert in the field of acute renal failure and has directed several clinical studies in the management of patients with kidney disease. He holds a patent for "Continuous Hemodialysis Using Citrate".

In addition to his clinical and research activities, he has worked with the American Society of Nephrology, National Kidney Foundation, Society of Critical Care Medicine, and the International Society of Nephrology in developing courses for fellows and practicing physicians in clinical nephrology and dialysis techniques. He has been recognized as one of the Best Doctors in San Diego and the US. In 2008 he was recognized by the American Nephrologists of Indian Origin for his achievements in nephrology.

WENDY NILSEN, Ph.D.**Health Science Administrator, NIH Office of Behavioral and Social Sciences Research**

Wendy Nilsen, Ph.D. joined the staff of the NIH Office of Behavioral and Social Sciences Research (OBSSR) as a health science administrator in June 2009. Wendy brings a strong background in clinical psychology and diverse research experience, including health services research and community consultation and training.

Wendy's primary focus at OBSSR is on the science of human behavior and behavior change, including: utilizing mobile technology to better understand and intervene, the science of adherence, and enhancing behavioral interventions in complex patients in primary care. More specifically, Wendy is very active in the area of mHealth research (i.e., mobile technology to improve health) and includes leading an upcoming mHealth training institute. She is also a member of the Science of Behavior Change executive working group. The project is an initiative funded through the NIH Director's Common Fund to develop a framework for understanding the mechanisms of behavior change. In addition to her primary responsibilities, Wendy is involved in many ongoing behavior change initiatives, both within NIH and with other federal agency partners.

JOHN A. ORR, Ph.D.**Professor of Electrical and Computer Engineering, Worcester Polytechnic Institute**

Dr. John A. Orr is Professor of Electrical and Computer Engineering at Worcester Polytechnic Institute and served as Provost of WPI from 2007 through June, 2010. Prior to this he held the position of Dean of Undergraduate Studies. During his time as dean and provost, he facilitated the growth of the undergraduate student body in size, academic quality, and diversity. He also oversaw the creation of the positions of Dean of Engineering, Dean of Arts and Sciences, and Dean of Business.

Dr. Orr began his professional career at Bell Laboratories and joined the faculty of WPI in 1977. He served as head of the Electrical and Computer Engineering department from 1988 to 2003. At WPI Dr. Orr's research interests span several aspects of digital signal processing. Recent work is in the area of tracking and positioning systems, particularly indoors. His other professional interest is in the area of engineering education where he has led the development of several innovative programs. Dr. Orr is a member of the ABET Engineering Accreditation Commission. He is a Fellow of the IEEE and of the American Society for Engineering Education.

ROBERTO PADOVANI, Ph.D.**Executive Vice President and Chief Technology Officer, Qualcomm Incorporated**

Dr. Roberto Padovani is Executive Vice President and Chief Technology Officer for Qualcomm Incorporated. In this role, he is responsible for the oversight of Qualcomm's overall research and development efforts. Dr. Padovani joined Qualcomm Incorporated in 1986, after two years at M/A-COM Linkabit where he was involved in the design and development of satellite communications systems, secure video systems and error-correcting coding equipment.

Over the past 20 years at QUALCOMM, Dr. Padovani has been involved in the research and development of digital communication systems with particular emphasis on Code Division Multiple Access (CDMA) wireless technology systems. He was involved in the initial design, development and standardization of IS-95 CDMA systems. His research and inventions in this field have led to the worldwide standardization and commercialization of CDMA technology for second- and third-generation cellular systems. More recently, he has led the design and development of CDMA2000 1xEV-DO an IP-based, high-speed wide-area wireless data technology, which has led to the deployment of multiple broadband wireless networks and services across the globe.

HOLLY PAVLISCAK**mCare Project Manager, TATRC**

Holly Pavliscsak, BS, MHSA serves as the mCare Project Manager for the Telemedicine and Advanced Technology Research Center (TATRC) out of the US Army Medical Research and Materiel Command (USAMRMC). She received a Bachelor of Science degree from Georgia Southern University and a Master of Health Services Administration degree from Armstrong Atlantic University. She is employed as a full time intergovernmental personnel act (IPA) employee for MRMC TATRC through The Geneva Foundation.

JULIEN PENDERS**Program Manager, Holst Centre/IMEC**

Julien Penders is Program Manager at the Holst Centre / IMEC, where he leads the activities on System Integration and Body Area Networks. He is responsible for the integration of technology research achievements into prototypes of wireless health monitors, development of embedded algorithms, and deployment of integrated prototypes for use in healthcare, sports and lifestyle. He has (co-) authored over 15 papers in the field of body area networks and autonomous wireless sensor networks, and is the author of one book chapter on the topic. He serves as a reviewer for the IEEE EMBS community. Julien holds a M.Sc. degree in Systems Engineering from University of Liege, Belgium (2004), and a M.Sc. degree in Biomedical Engineering from Boston University, MA (2006). His thesis research in Liege focused on non-linear physiological modeling of sleep, with application in improving sleep apnea treatment. He was a 2004/2005 fellow of the Belgian American Educational Foundation. From 2004 to 2006, he was a research assistant at Boston University, department of Biomedical Engineering. In Boston, his research focused on gene and metabolic networks, with application in bio-remediation and energy generation using bacterial cells. In 2006, he joined IMEC at the Holst Centre as a researcher in Body Area Networks where he created, in 2007, the system integration group.

COLONEL RON POROPATICH, M.D.**Deputy Director, TATRC**

Colonel Ron Poropatich, M.D. is the Deputy Director of the Telemedicine and Advanced Technology Research Center (TATRC), US Army Medical Research and Materiel Command (USAMRMC) at Fort Detrick, MD which manages over \$450 million/year in federally funded research in advanced medical technology. He also works towards wide-scale implementation of telehealth applications across the U. S. Army Medical Department. COL Poropatich is a Professor of Medicine at the Uniformed Services University of the Health Sciences in Bethesda, MD, and is the Chair of the NATO Telemedicine Expert Team. He is a former President and Board Member of the American Telemedicine Association and a practicing Pulmonary Medicine physician at the Walter Reed Army Medical Center, Washington, DC. He currently serves as an Associate Editor for the "Telemedicine and e-Health Journal".

DAVID PRICE, M.D.**Executive Director of Clinical Affairs, DexCom**

Dr. David Price became executive director of clinical affairs at DexCom in June, 2010. Among his many activities at DexCom, he is responsible for clinical trials, publications, and investigator- initiated studies. Prior to DexCom, since 2002, Dr. Price provided clinical input and clinical strategy for LifeScan product development and clinical trials. He is a diabetologist, held the position of clinical fellow at the Joslin Diabetes Center of New England Deaconess Hospital and Harvard Medical School, and managed a clinical practice for many years in Santa Rosa, CA. While in practice, he serves as an investigator for many pharmaceutical and device trials in diabetes, hypertension, and dyslipidemia. He is a fellow of the American College of Endocrinology and held a clinical faculty appointment at UCSF from 1990-2001. Dr. Price has lectured on diabetes related topics to physicians, nurses, and the general public across the globe and has authored numerous publications. His internship and residency were completed at the Maine Medical Center, medical degree from the Ohio State University College of Medicine and undergraduate training at Washington University in St. Louis, MO.

JEANETTE RASCHE**Technical Leader, mCare, TATRC**

Ms. Rasche is the technical leader for the Army's mCare project. She has a bachelor's degree from Hope College and a master's degree from the Medical College of Georgia and has been working in telemedicine and advanced technologies for more than 15 years. She works for Saint Francis University and assigned to the USA MRMC TATRC as a governmental IPA.

JOEL ROBERTSON, M.D.**Chief Executive Officer & President, Robertson Technologies**

Dr. Joel Robertson specializes in neuropharmacology, with concentrations in psychiatric and cardiovascular pharmacology. He is the author of eight books and multiple self-help audio series, and is widely published in professional journals. He received national acclaim for creation of a chemical dependency and psychiatric sub-acute care facility, has consulted with over 30 inpatient/outpatient chemical dependency and psychiatric facilities, and opened and administered two inpatient and three outpatient and day care facilities. Expanding his work in brain chemistry application from the clinical world to the corporate setting, Dr. Robertson has been widely sought by major companies to address executive and athletic performance. With over 20 years experience, and influencing over 14,000 individual lives through the use of brain chemistry treatment plans, he is globally recognized as a leader in brain chemistry science and therapeutics. It was in 1991, that Dr. Robertson obtained complete ownership of this corporation and expanded his publishing, consulting and training programs through Robertson Institute. As president of the Institute, Dr. Robertson consults with Fortune 100 companies, international associations, and professional athletic programs throughout the world.

MAJID SARRAFZADEH, Ph.D.**Co-director, UCLA Wireless Health Institute**

Majid Sarrafzadeh received his Ph.D. in 1987 from the University of Illinois at Urbana-Champaign in Electrical and Computer Engineering. He joined Northwestern University as an Assistant Professor in 1987. In 2000, he joined the Computer Science Department at University of California at Los Angeles (UCLA). He is currently a co-director of the UCLA Wireless Health Institute. His recent research interests lie in the area of Embedded and Reconfigurable Computing with emphasis on healthcare.

Professor Sarrafzadeh has published approximately 370 papers, co-authored 5 books, and is a named inventor on 6 US patents. Dr. Sarrafzadeh has collaborated with many industries in the past 25 years including IBM and Motorola and many CAD industries and was the architect of the physical design subsystem of Monterey Design Systems - Synopsys acquired the company. He was a co-founder of Hier Design, Inc. Hier Design was acquired by Xilinx in 2004. He has recently co-founded Medisens and BioAssyst: both companies in the area of Wireless Health.

LESLIE SAXON, M.D.**Professor, Clinical Medicine, Keck School of Medicine, USC**

Leslie A. Saxon, M.D., is a Professor of Clinical Medicine at the Keck School of Medicine of USC, specializing in the diagnosis and treatment of arrhythmias in patients with congestive heart failure. After serving as the director of the electrophysiology laboratory and implantable device services at UC San Francisco, Dr. Saxon was recruited to serve as the Chief of Cardiovascular Medicine at USC.

In addition to using state-of-the-art resynchronization devices in patients with arrhythmias, such as modified pacemakers and implantable defibrillators, Dr. Saxon also collaborates with medical device companies to evaluate the latest, most innovative interventional gadgets for patients with difficult-to-treat heart failure. Dr. Saxon has completed over 90 publications in various medical journals and is an active member of a multitude of organizations, including the American College of Cardiology, the Heart Rhythm Society, The American Heart Association, and the Heart Failure Society of America.

G CHANDRA SEKHAR, M.D.**Director, L V Prasad Eye Institute**

After receiving his basic medical degree in Kurnool, Andhra Pradesh, Dr G Chandra Sekhar completed his residency in ophthalmology at the All India Institute for Medical Sciences (AIIMS), New Delhi. He holds the position of Adjunct Assistant Professor at the State University New York, School of Optometry, and Clinical Professor at the University of Rochester Medical School, Rochester, USA. He has been a visiting Professor at the University of Wisconsin, Madison, USA, and University of Southern California, San Diego, USA. His research interests include optic disc imaging in glaucoma, psychophysical tests in glaucoma, plateau iris syndrome and angle closure glaucoma. Dr Chandrasekhar has been with LVPEI since its establishment in 1987. He helped build up the glaucoma service at the institute and was instrumental in setting up and running the Education Centre, which provides training to hundreds of medical and paramedical professionals each year through short and long term programs. Having specialized in orbital diseases, lid and adnexal diseases, glaucoma and cataract, Dr Chandra Sekhar handles a wide range of patients in the clinics, bringing to his work rare insight drawn from years of experience.

TAJANA ŠIMUNIĆ ROSING, Ph.D.**Computer Science Department, UC San Diego**

Tajana Šimunić Rosing is currently faculty in Computer Science Department at UCSD, a director of System Energy Efficiency Lab at UCSD and a head of the Large scale systems thrust as a part of the MuSyC center. Her research interests are energy efficient computing and embedded systems. Since starting her position at UCSD five years ago, she has been involved in a number of different projects as a PI, co-PI or senior personnel totaling approximately \$60M. She has published more than 80 papers and book chapters. Prior to this she was a full time researcher at HP Labs while working part-time at Stanford University. She finished her PhD at Stanford University, concurrently with completing her Masters in Engineering Management. Her PhD topic was Dynamic Management of Power Consumption. Prior to pursuing the PhD, she worked as a Senior Design Engineer at Altera Corporation. She has served at a number of Technical Paper Committees, and is currently an Associate Editor of IEEE Transactions on Mobile Computing. In the past she has been an Associate Editor of IEEE Transactions on Circuits and Systems.

DENISE SMITH, Ph.D.**Professor, Health and Exercise Sciences, Skidmore College**

Denise L. Smith is Professor of Health and Exercise Science at Skidmore College in Saratoga Springs, NY where she holds the Class of 1961 Term Chair and directs the First Responder Health and Safety Laboratory. Dr. Smith also serves as a Research Scientist at the University of Illinois Fire Service Institute. Dr. Smith earned her Ph.D. in Kinesiology with a specialization in Exercise Physiology from the University of Illinois at Urbana-Champaign in 1990. Her research is focused on the physiological strain of firefighting, particularly the cardiovascular strain associated with this occupational work. She has been awarded research grants from several governmental agencies (DHS, NIOSH, TSWG) and has published her findings in numerous peer-reviewed scientific journals. Dr. Smith is a coauthor on a major Exercise Physiology textbook, *Exercise Physiology: for Health, Fitness, and Performance*, now in its 3rd edition, an upcoming textbook, *Advanced Cardiovascular Exercise Physiology*, and a soon to be published Fire Service book on Live Fire Training. Dr. Smith is an advocate for Health and Safety in the Fire Service and frequently publishes her work in Fire Service journals and presents at national Fire Service conferences.

JOHN STANKOVIC, Ph.D.**Professor, Computer Science Department, University of Virginia**

Professor John A. Stankovic is the BP America Professor in the Computer Science Department at the University of Virginia. He is a Fellow of both the IEEE and the ACM. He won the IEEE Real-Time Systems Technical Committee's Award for Outstanding Technical Contributions and Leadership. He also won the IEEE Technical Committee on Distributed Processing's Distinguished Achievement Award (inaugural winner). He has won four Best Paper awards, including one for ACM SenSys 2006. He is ranked among the top 250 highly cited authors in CS by Thomson Scientific Institute. He has given more than 25 Keynote talks at conferences and many Distinguished Lectures at major Universities. Before joining the University of Virginia, Professor Stankovic taught at the University of Massachusetts where he won an outstanding scholar award. He has also held visiting positions in the Computer Science Department at Carnegie-Mellon University, at INRIA in France, and Scuola Superiore S. Anna in Pisa, Italy. He was the Editor-in-Chief for the IEEE Transactions on Distributed and Parallel Systems and was founder and co-editor-in-chief for the Real-Time Systems Journal. His research interests are in real-time systems, distributed computing, wireless sensor networks, and cyber physical systems.

COLONEL ROBERT VIGERSKY, M.D.**Diabetes Institute of the Walter Reed Health Care System; TATRC**

Dr. Vigersky graduated as Valedictorian from the 6-year Program in Liberal Arts and Medicine of Boston University in 1970. He completed an Internal Medicine Internship/Residency at The Johns Hopkins Hospital and a 3-year Endocrine Fellowship at National Institutes of Health where he remained on the staff until transferring to Walter Reed Army Medical Center. From 1984-2000, he was in private practice in Washington, D.C. and served as the Medical Director of the Diabetes Treatment Center at Georgetown University Hospital and the Washington Hospital Center. He was voted one of the Washingtonian Magazine's Top Doctors from 1991-99. In 2000, Dr. Vigersky re-entered the Army and holds the rank of Colonel. He established the Diabetes Institute of the Walter Reed Health Care System which is the premier diabetes program in the military. He has published 97 papers and 93 abstracts in his specialty. His particular interests are in the use of technology to improve outcomes for patients with diabetes. He is the Immediate Past-President of 14,000-member Endocrine Society which is the world's oldest, largest, and most active organization devoted to research on hormones and the clinical practice of endocrinology.

ROBERT WAGENAAR, Ph.D.**Professor, Physical Therapy and Athletic Training**

Robert C. Wagenaar, Ph.D. is a Professor in Physical Therapy and Athletic Training, Director of the ScD in Rehabilitation Sciences program, and Director of the Center for Neurorehabilitation (CEN) at the College of Health and Rehabilitation Sciences: Sargent College, Boston University. He has been conducting research on movement disorders since 1985, and has published widely on the development and implementation of clinical trials of rehabilitation with movement disorders as well as on theories of motor control and learning (i.e., dynamic systems theory) and its application to normal and disordered movement. In the last 5 years Wagenaar was involved in four research project funded by NIH, that is: 1) the effects of rehabilitation for self-management in PD (PI; Wagenaar); 2) Effects of perceptual, cognition and gait disorders on navigation (PI: Cronin-Golomb; Co-Investigator: Wagenaar), 3) Visual spatial function in PD (PI: Cronin-Golomb; Co-Principal Investigator: Wagenaar) and 4) Continuous monitoring of functional activities in the home and community based setting (PI Wagenaar; Co-Principal Investigator: Little). Currently, his research efforts on functional activity monitoring are also funded by the Wallace H. Coulter Translational Partners Research Program.

ALLEN YANG, Ph.D.**Research Scientist, UC Berkeley**

Dr. Allen Y. Yang is a Research Scientist in the Department of EECS at UC Berkeley. He also has served as a consultant to various major companies and startups in IT industry. His primary research areas include pattern analysis of geometric and statistical models in very high-dimensional data spaces and applications in motion segmentation, image segmentation, face recognition, and signal processing in heterogeneous sensor networks. He has published two books/chapters, nine journal papers and more than 20 conference papers. He is also the inventor of three US patents.

Dr. Yang received his BEng in Computer Science from the University of Science and Technology of China (USTC) in 2001. He also received an MS in Electrical Engineering in 2003, an MS in Mathematics in 2005 and a PhD in Electrical and Computer Engineering in 2006, all from the University of Illinois at Urbana-Champaign (UIUC). Among the awards he received are a Best Bachelor's Thesis Award from USTC in 2001, a Henry Ford II Scholar Award from UIUC in 2003, a Best Paper Award from the International Society of Information Fusion and a Best Student Paper Award from Asian Conference on Computer Vision in 2009.

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Qualcomm Incorporated (Nasdaq: QCOM) is a leader in developing and delivering innovative digital wireless communications products and services based on CDMA and other advanced technologies. Qualcomm plays a central role in the rapid adoption and growth of 3G and next-generation wireless around the world. Qualcomm's current intellectual property portfolio includes more than 11,000 United States patents for wireless technologies, with more than 175 telecommunications equipment manufacturers licensing them worldwide. Headquartered in San Diego, Calif., Qualcomm is included in the S&P 100 Index, the S&P 500 Index and is a 2009 FORTUNE 500 company.

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St. Jude Medical develops medical technology and services that focus on putting more control into the hands of those who treat cardiac, neurological and chronic pain patients worldwide. The company is dedicated to advancing the practice of medicine by reducing risk wherever possible and contributing to successful outcomes for every patient. St. Jude Medical is headquartered in St. Paul, Minn. and has four major focus areas that include: cardiac rhythm management, atrial fibrillation, cardiovascular and neuromodulation.

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The California Endowment is a private, statewide health foundation that was created in 1996 as a result of Blue Cross of California's creation of WellPoint Health Networks, a for-profit corporation. This conversion set the groundwork for our mission: The California Endowment's mission is to expand access to affordable, quality health care for underserved individuals and communities, and to promote fundamental improvements in the health status of all Californians.

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TMNG Global (NASDAQ: TMNG) is a leading provider of professional services to the converging communications industry. TMNG Global and its companies CSMG and Cartesian and its base of more than 600 consultants, have provided strategy, management and technical consulting, products and services to more than 1200 communications clients worldwide. The company's clients represent all areas of the communications industry including wireless and wireline service providers; entertainment, media and technology companies; and the supporting capital formation firms that support the industry. The company is headquartered in Overland Park, Kansas, with offices in Beijing, Boston, Chicago, London, New Jersey, New York, Shanghai and Washington, D.C.

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www.iehealthcare.com



INNERWIRELESS

InnerWireless is the premier end-to-end in-building wireless solution provider for healthcare, enterprise/government, hospitality, and new construction markets. Horizon™ - a broadband, converged wireless distributed antenna platform - is designed expressly for the delivery of mission- and life-critical wireless applications.

www.innerwireless.com



INSIGHT

Insight Product Development is a product-development firm with offices in the U.S. and China.

www.insightpd.com



INTOUCH HEALTH

InTouch Health provides comprehensive telemedicine solutions that enable physicians to perform real-time consults with hospital patients. Through a single interface, physicians can access a host of FDA-cleared Remote Presence devices to provide and document care into emergency rooms, critical care units, patient wards, and operating rooms. Where access to medical expertise is limited, InTouch Health's Remote Presence telemedicine solutions can effectively extend the physician's reach to manage patient care, thereby removing critical time and distance barriers.

The Company has more than 250 customers on six continents using Remote Presence to deliver specialty care services such as stroke, cardiology, trauma, pediatrics, neonatology, psychiatry, translation services, critical care coverage, patient rounds, clinical education, and surgical/procedure mentoring.

www.intouchhealth.com



INTRADO

For over 30 years, Intrado has played a key role in helping to define, build and maintain the complex emergency communications system in North America. Intrado provides the core of the 9-1-1 infrastructure and has supported over 1 billion 9-1-1 calls. Intrado is partnering with public safety agencies and telecommunications carriers to deliver the next generation of 9-1-1 technology and services.

www.intrado.com



JITTERBUG

Jitterbug is the leader in delivering a full range of wireless-based innovative, easy-to-use and life-enhancing services to people who seek simplicity. The company is differentiated from others through its high quality approach and through its ability to provide the best customer service experience and relationship possible. The company has been widely praised for its ability to deliver the benefits of innovation and technology in an easy to use format.

www.jitterbug.com



LANTRONIX

Lantronix®, Inc. (Nasdaq: LTRX) was founded in 1989 and is headquartered in Irvine, Calif. With worldwide locations and strong channel presence in Europe, Japan, Asia-Pacific, Latin American and Australia, we are a global leader in secure communication technologies that simplify remote access, management, and control of virtually any electronic device regardless of location. Our innovative solutions enable businesses to make better decisions based on real-time information and are utilized in almost every vertical market including: security, building and industrial automation, medical/healthcare, IT/data center, government, transportation, pro AV/signage, retail, power and utilities, and many others.

www.lantronix.com



MEDAPPS

MedApps is dedicated to providing innovative solutions for the collection, transmission and management of remote monitored patient data. MedApps is an acknowledged innovator in the field of telehealth and has been recognized with numerous awards and citations.

www.medapps.net



MIDMARK CORP.

Midmark Corporation brings efficient patient care to millions of people each day in the human and animal healthcare industries around the world. The most trusted name in medical, dental and veterinary healthcare equipment solutions, Midmark is committed to providing innovative products and services for the healthcare professional, integrating value-added technology into everything it does. With over 1,100 teammates worldwide, Midmark is dedicated to making a positive difference in the practice of healthcare. Headquartered in Versailles, Ohio, Midmark Corporation maintains four subsidiaries in the United States. To support international healthcare markets, it holds a subsidiary in France, and partners with a leading healthcare manufacturer in India.

www.midmark.com



MONTAGE SYSTEMS

Montage Systems is an enterprise of seasoned technology entrepreneurs focused on realizing emerging technology products. Montage Systems provides world-class design and manufacturing services to clients that market technology products. Montage collaborates with industry leaders as well as emerging growth companies to develop and commercialize their technology products.

www.montagesystems.com



MYCA

Myca Health™ is the power behind a revolution in health care. Its web-based technology, MycaHub™ is being adopted by customers of all types, from small primary care practices to large hospital systems and insurers, transforming the health care experience for providers and patients. Privately held, Myca Health is based in Quebec City and is led by a seasoned world-class team of doctors, technologists and managers with deep experience across the health care industry.

www.myca.com



NATIONAL INSTRUMENTS

National Instruments transforms the way engineers and scientists around the world design, prototype, and deploy systems for test, control, and embedded design applications. Using NI open graphical programming software and modular hardware, customers at more than 30,000 companies annually simplify development, increase productivity, and dramatically reduce time to market. From testing next-generation gaming systems to creating breakthrough medical devices, NI customers continuously develop innovative technologies that impact millions of people.

www.ni.com



OJ-BIO

OJ-bio Ltd is bringing to market a range of revolutionary wireless diagnostic devices & biochips for the rapid detection of disease. OJ-Bio products provide rapid detection and identification using simple, low cost products, with wireless connectivity. The component used for detection, a surface acoustic wave device (SAW), is mass manufactured by partners Japan Radio Co. Ltd for use in mobile phones and many other electronic devices. The OJ-Bio biochips will read swabs, blood, or urine samples, eliminating the delay caused by laboratory testing and providing rapid results. OJ-bio's products will revolutionise the way testing can be performed opening up the existing diagnostic market and create new applications in consumer diagnostics, pharmaceuticals, animal and environmental testing.

www.oj-bio.com



RESMED

ResMed is a leading developer, manufacturer, and distributor of medical equipment for treating, diagnosing, and managing sleep-disordered breathing and other respiratory disorders. We are dedicated to developing innovative products to improve the lives of those who suffer from these conditions and to increasing awareness among patients and healthcare professionals of the potentially serious health consequences of untreated sleep-disordered breathing.

www.resmed.com



ROCHE DIAGNOSTICS

Roche is a leader in research-focused healthcare with combined strengths in pharmaceuticals and diagnostics. Roche is the world's largest biotech company with truly differentiated medicines in oncology, virology, inflammation, metabolism and CNS. Roche is also the world leader in in-vitro diagnostics, tissue-based cancer diagnostics and a pioneer in diabetes management. Roche's personalised healthcare strategy aims at providing medicines and diagnostic tools that enable tangible improvements in the health, quality of life and survival of patients. In 2009, Roche had over 80,000 employees worldwide and invested almost 10 billion Swiss francs in R&D. Genentech, United States, is a wholly owned member of the Roche Group.

www.roche.com



SIERRA WIRELESS

Sierra Wireless provides mobile broadband modems, wireless modules, gateways and routers, and wireless asset management services for mobile computing and M2M. Sierra Wireless is expanding the wireless world with a comprehensive offering of hardware, software, and connected services for mobile lifestyles and machine-to-machine communications. Our customers count on us to help them succeed with innovative, reliable, high-performing solutions and early access to new wireless technologies. Founded in 1993, Sierra Wireless has a track record of leading the way with new wireless technologies and solutions. We focus on wireless devices and applications, offering a comprehensive portfolio of products and services that reduce complexity for our customers. With sales, engineering, and research and development teams located in offices around the world, we also offer a network of experts in mobile broadband and M2M integration to support customers worldwide.

www.sierrawireless.com



SOLIGIE

Soligie is the leading company to utilize high speed manufacturing to produce printed electronics with a variety of conductive, resistive and proprietary materials on flexible substrates such as PET, paper and foil. The Company is on the cutting edge of a new industry that merges nanotechnology, electronics and advanced printing technologies to enable production of printed electronic components using high speed, fully additive roll-to-roll processes. Soligie offers a full range of services from concept design, circuit design, design for manufacturability and final volume production, and currently serves the medical device, smart packaging, RFID and flexible interconnect markets. Soligie is located in Savage, Minnesota and is owned by the Taylor Corporation.

www.soligie.com



SOTERA WIRELESS

Sotera Wireless, Inc. is a medical device company dedicated to development, marketing and sale of a new generation of comprehensive vital signs monitoring. Sotera's mission is to improve patient safety by empowering clinicians to detect early signs of deterioration in virtually any care setting and enable rapid response and early intervention, all without limiting the patient's freedom of movement.

www.soterawireless.com



TELCARE

By creating an immediate two-way feedback loop between patient and caregiver, TELCARE's technology transforms the management of diabetes from inefficient and episodic contact between patient and caregiver to a continuous and empowering model that measurably improves clinical results, keeps the patient well, and simultaneously reduces cost of care.

www.telcare.com

VOCEL**VOCEL**

VOCEL has developed the next generation interactive messaging platform that engages users by delivering compelling mobile experiences that are actionable and immediately measurable.

www.vocel.com

wellcore**WELLCORE**

Headquartered in San Jose, CA, Wellcore Corporation's mission is to develop wireless products and services that improve wellness, safety and security for people. The company was founded in 2007 by leaders in the wireless industry, inspired to build technology that uses motion detection and advanced pattern recognition to help improve everyday life. Wellcore will unveil its first product, targeted at the aging population, in Spring 2010. Products addressing a broad range of market segments will follow.

www.wellcore.com

**WEST WIRELESS HEALTH INSTITUTE**

The West Wireless Health Institute is one of the first medical research organizations in the world supporting the exploration and application of wireless technologies to advance human health and well-being. The Institute is fostering an unprecedented convergence of science, medicine, engineering and technology to change the way health care is delivered. The West Wireless Health Institute is based in San Diego, California.

www.westwirelesshealth.org

**ZARLINK**

Zarlink Semiconductor delivers world-leading, mixed-signal chip technology for a broad range of communications, medical and optical applications. The Company's core expertise is in network timing for wireless and wired networks, line circuits enabling high-quality voice services over cable and broadband networks, telecom networking and voice processing products for converging infrastructures, and ultra-low power radios linking implanted and on-body medical devices with monitoring and programming equipment. Serving the world's largest equipment manufacturers, Zarlink's highly integrated solutions help customers simplify design, lower costs and reach market quickly.

www.zarlink.com



Wireless-Life Sciences
Alliance

Accelerating the Adoption of Wireless Health

SAVE THE DATES

May 11, 2011

Investor's Meeting and I Award[®] Program

Wireless health companies will be selected to present to an audience of venture capitalists, institutional investors and industry leaders. This event was sold out in 2010!

May 12, 2011

Commercialization Day

Hands-on workshops lead by top leaders in wireless health. Perfect opportunity for innovators to check design and business process ideas against proven models.

Location for both:

**Manchester Grand Hyatt
One Market Place
San Diego, CA 92101**

www.wirelesslifesciences.org



Wireless-Life Sciences
Alliance

Wireless Health 2010

Academic and Research Conference

Pre-Conference Workshop:

October 4, 2010

Johnson & Johnson

3210 Merryfield Row
San Diego, CA 92121

Conference Sessions:

October 5-7, 2010

Hilton La Jolla Torrey Pines

10950 North Torrey Pines Road
La Jolla, CA 92037