Thomas Heldt

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Institute for Medical Engineering & Science
Massachusetts Institute of Technology
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77 Massachusetts Avenue
Cambridge, MA 02139

EDUCATION

Massachusetts Institute of Technology, Cambridge, MA, USA   **1997 − 2004**
Harvard − MIT Division of Health Sciences and Technology
Ph.D. Medical Physics, September 2004
Thesis title: *Computational Models of Cardiovascular Response to Orthostatic Stress*

Yale University, New Haven, CT, USA   **1995 − 1997**
M.S.   Physics, June 1997
M.Phil. Physics, December 1998

Johannes Gutenberg-Universität, Mainz, Germany   **1994 − 1995**
First-year medical studies

Johannes Gutenberg-Universität, Mainz, Germany   **1992 − 1995**
Diplomvorprüfung Physics, June 1994
Passed Diplomvorprüfung in Physics *with honors*

EXPERIENCE

Associate Professor of Electrical and Biomedical Engineering   **07/2017 − present**
Massachusetts Institute of Technology
Department of Electrical Engineering and Computer Science

W.M. Keck Career Development Professor in Biomedical Engineering   **07/2016 − present**
Massachusetts Institute of Technology

Member of the Affiliate Faculty of Health Sciences & Technology   **05/2014 − present**
Harvard Medical School

Core Faculty Member   **07/2013 − present**
Massachusetts Institute of Technology
Institute for Medical Engineering and Science

Principal Investigator   **07/2013 − present**
Massachusetts Institute of Technology
Research Laboratory of Electronics

Hermann L.F. von Helmholtz Career Development Professor   **07/2013 − 06/2016**
Massachusetts Institute of Technology
Institute for Medical Engineering and Science

Assistant Professor of Electrical and Biomedical Engineering   **07/2013 − 06/2017**
Massachusetts Institute of Technology
Department of Electrical Engineering and Computer Science

Principal Research Scientist   **07/2012 − 07/2013**
Massachusetts Institute of Technology
Computational Physiology and Clinical Inference Group

Research Laboratory of Electronics

Research Scientist **05/2010 − 06/2012**
Massachusetts Institute of Technology
Computational Physiology and Clinical Inference Group
Research Laboratory of Electronics

Postdoctoral Associate **09/2004 − 04/2010**
Massachusetts Institute of Technology
Laboratory for Electromagnetic and Electronic Systems
Advisor: Professor George C. Verghese, Ph.D.

Research Assistant **01/1998 − 09/2004**
Massachusetts Institute of Technology
Laboratory for Computational Physiology
Advisor: Professor Roger G. Mark, M.D., Ph.D.

Research Assistant **05/1996 − 09/1997**
Yale University
Center for Laser Diagnostics
Advisor: Professor Richard K. Chang, Ph.D.

Research Assistant **Summer 1996**
II. Medizinische Klinik und Poliklinik, Universität Mainz
Biomedical Computing Laboratory
Advisor: Professor Hans-Jürgen Rupprecht, M.D.

Courtesy Appointments

Boston Medical Center **12/2015 − present**
Research Affiliate in the Department of Neurosurgery

Massachusetts General Hospital **04/2015 − present**
Research Staff in the Department of Emergency Medicine

Beth Israel Deaconess Medical Center **08/2012 − 02/2016**
Research Fellow in Neonatology

Boston Children's Hospital **04/2009 − present**
Associate Scientific Research Staff in Neurology

Harvard Medical School **04/2009 − 05/2014**
Research Fellow

Awards and Honors

Visiting Professor **05/2018 − 08/2018**
Eidgenössische Technische Hochschule, Zürich, Switzerland

Louis D. Smullin ('39) Award for Teaching Excellence **2016**
Massachusetts Institute of Technology

Asscociate Scientific Advisor **2015**
Science Translational Medicine

Leonard and Isabelle Goldenson Fellow Award **2010**

Harvard Medical School
(Not taken up because of visa restrictions at the time.)

Co-recipient of 'Most Innovative Research Award'	**October 2009**

Center for the Integration of Medicine and Innovative Technologies
2009 Annual Innovation Congress

Cambridge Science Foundation Travel Grant	**August 2003**

Travel award to present work at two conferences in Australia.

Lee and Harris Thompson Fellowship	**2001 − 2002**

Research fellowship administered by the Harvard − MIT Division of Health Sciences
and Technology.

Hugh Hampton Young Fellowship Award	**2001**

Graduate fellowship administered by the Office of the Dean of Graduate Students at
the Massachusetts Institute of Technology.

HST Student Leadership Award	**2001**

*"Bestowed annually upon the student who contributes most to the personal growth and
professional development of his/her fellow students in the Harvard − MIT Division of
Health Sciences and Technology."*

Gottlieb Daimler- und Karl Benz-Stiftung Fellowship	**1999 − 2000**

Doctoral research fellowship.

Studienstiftung des deutschen Volkes Fellowship	**1995 − 1999**

German National Academic Foundation; fellowships are awarded to less than one
quarter of a percent of the German university-level student population.

Klee Prize Recipient	**1997**

Awarded by the Stiftung Familie Klee, Frankfurt/Main, Germany, the Klee Prize is
bestowed annually upon a student who shows extraordinary promise to tackle problems
at the interface of medicine and technology.

University Fellowship	**1995 − 1997**

Yale University

Service & Professional Membership

Advisory Board Member	**2017 − present**

Digital Biomarkers, Karger Publishing

Chair, Cardiopulmonary Systems Technical Committee	**2017 − present**

IEEE Engineering in Medicine and Biology Society

Track Chair, Engineering in Medicine and Biology Conference	**2016 − present**

IEEE Engineering in Medicine and Biology Society

Associate Scientific Advisor	**2015 − 2016**

Science Translational Medicine

Member, National Institutes of Health Merit Review Panel	**2014 − present**

Clinical Neurophysiology, Devices, Neuroprosthetics and Biosensor Small
Business Special Emphasis Panel

Member, Cardiopulmonary Technical Committee	**2012 − present**

IEEE Engineering in Medicine and Biology Society

Member, Merit Review Panel	**2012 − 2015**

Forward Surgical and En Route Care, U.S. Army Medical Research and Materiel
Command, U.S. Department of Defense

Senior Member, IEEE	**2011 − present**
Member, Student Paper Competition Committee	**2011 − present**
IEEE Engineering in Medicine and Biology Society	
Associate Editor	**2011 − present**
IEEE Engineering in Medicine and Biology Society, Conference Editorial Board, Cardiovascular and Respiratory Systems Engineering Theme	
Reviewer	**2010 − 2011**
Austrian Science Fund	
National Research Foundation, Republic of Korea	
Portuguese Foundation for Science and Technology	
Member, Merit Review Panel	**2008 − 2010**
Office of the National Coordinator for Health Information Technology, United States Department of Health and Human Services	
United States National Science Foundation (NSF)	
Member, IEEE	**2007 − 2011**
Reviewer	**2002 − present**
Reviewer for leading international journals, including Nature Medicine, Science Translational Medicine, Critical Care Medicine, IEEE Transactions on Biomedical Engineering, Journal of Applied Physiology, American Journal of Physiology, Annals of Biomedical Engineering, and other leading journals in biomedical engineering, physiology, and clinical medicine.	

TEACHING EXPERIENCE

Course Director, 6.021J: Cellular Neurophysiology and Computing	**09/2016 − present**
MIT, Department of Electrical Engineering & Computer Science	
Course Director, Short Course on Quantitative Cardiovascular Physiology with Clinical Applications for Engineers	**06/2015 − present**
MIT Professional Education	
Recitation Instructor, 6.011: Communication, Control, and Inference	**01/2015 − 05/2015**
MIT, Department of Electrical Engineering & Computer Science	
Co-Lecturer, 6.021J: Cellular Biophysics and Neurophysiology	**09/2013 − 12/2015**
MIT, Department of Electrical Engineering & Computer Science	
Co-Lecturer, 6.022J: Quantitative Physiology	**01/2006 − present**
MIT, Department of Electrical Engineering & Computer Science and Harvard-MIT Division of Health Sciences and Technology	
Course Director, Short Course on Cardiovascular Modeling	**09/2010 − 10/2010**
Politecnico di Milano, Department of Biomedical Engineering Milan, Italy	
Lecturer, Cardiovascular Modeling	**July 2007**
European Union Marie Curie Training Course and Workshop on Biomedical Modeling and Cardio-Respiratory Control, Graz, Austria	
Guest Lecturer, 16.423J: Space Biomedical Engineering & Life Support	**2001 − 2006**
MIT, Department of Aeronautics and Astronautics	

Teaching Assistant, HST-090: Cardiovascular Pathophysiology   **09/2000 − 01/2001**
MIT, Harvard – MIT Division of Health Sciences and Technology

Teaching Assistant, Physics 608b: Quantum Mechanics II   **02/1997 − 06/1997**
Yale University, Physics Department

Teaching Assistant, Physics 508a: Quantum Mechanics I   **09/1996 − 01/1997**
Yale University, Physics Department

Teaching Assistant, Physics 181b: Advanced General Physics   **02/1996 − 06/1996**
Yale University, Physics Department

Teaching Assistant, Physics 180a: Advanced General Physics   **09/1995 − 01/1996**
Yale University, Physics Department

Current Research Supervision

Mattie Wasiak (Electrical Engineering & Computer Science)   **08/2018 − present**
Oxygenation Patterns in the Pre-term Neonate
Role: superUROP research advisor

Melinda Szabo (Electrical Engineering & Computer Science)   **08/2018 − present**
Unobtrusive Estimation of Blood Pressure Variation
Role: superUROP research advisor

James C. Lynch (Electrical Engineering & Computer Science)   **08/2018 − present**
Modeling the Capnogram for Detection of Asthma Exacerbation
Role: SM Thesis advisor

Daisuke Horiguchi, SM   **04/2018 − present**
Reduction of False Monitoring Alarms
Role: Visiting Scientist research supervisor

Rajib Mondal (Electrical & Information Engineering, RWTH Aachen, Germany)   **03/2018 − present**
Ultrasound-based Embolus Characterization in a Flow Simulation
Role: Master's Thesis advisor

Daniel Teichmann, PhD   **03/2018 − present**
Modeling and Monitoring of Intracranial Elastance in Brain Injured Patients
Role: Postdoctoral advisor

Syed M. Imaduddin (Electrical Engineering & Computer Science)   **01/2018 − present**
Determination of Embolic Load in a High-Risk Pediatric Patient Population
Role: PhD thesis advisor

Sungkwon Lee (Department of Mechanical Engineering)   **09/2017 − present**
Fluid Dynamics of Hydrocephalus Shunt Catheters
Role: S.M. thesis co-advisor (with Prof. Lydia Bourouiba)

Jonathan Birjiniuk (Electrical Engineering & Computer Science)   **05/2017 − present**
Coupling of Cortical and Cardiac Electrical Activity in Hypoxic Ischemic Encephalopathy
Role: Ph.D. thesis advisor

Rohan Jaishankar (Electrical Engineering & Computer Science)   **05/2017 − present**
Frequency-domain based Noninvasive Estimation of Intracranial Pressure

Role: Ph.D. thesis advisor

Nicholas Kwok (Harvard Medical School)   **01/2017 − present**
Understanding the Fluid Dynamics of Hydrocephalus Shunt Catheters
Role: MD thesis advisor (with Prof. Lydia Bourouiba)

Gladynel Saavedra Peña (Electrical Engineering & Computer Science)   **01/2017 − present**
Digital Biomarkers for Tracking of Neurodegenerative Diseases
Role: SM thesis co-supervisor (with Prof. Vivienne Sze)

Hsin-Yu Lai (Electrical Engineering & Computer Science)   **01/2017 − present**
Embedded Platform for Tracking of Saccadic Eye-Movement Patterns
Role: PhD thesis co-supervisor (with Prof. Vivienne Sze)

Frederick Vonberg, MBBS   **08/2015 − present**
Clinical Research Fellow, Boston Children's Hospital
Role: Postdoctoral co-advisor (with Dr. Robert Tasker, Boston Children's
Hospital)

Varesh Prasad (Health Sciences & Technology)   **09/2013 − present**
Prediction of Patient Deterioration in Perioperative Care
Role: Ph.D. advisor
Recipient of a National Defense Science and Engineering Graduate Fellowship

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Completed Research Supervision

Sara Hensley (Electrical Engineering & Computer Science)   **08/2017 − 05/2018**
Characterization of Monitoring Alarms in a Community Hospital Intensive Care
Unit
Role: MEng Thesis advisor

Tiffany Ho (Brown University School of Medicine)   **08/2017 − 03/2018**
Improving Adherence to Oxygenation Targets in Preterm Neonates
Role: Research advisor

Gladynel Saavedra Peña (Electrical Engineering & Computer Science)   **01/2017 − 08/2018**
Digital Biomarkers for Tracking of Neurodegenerative Diseases
Role: SM thesis co-supervisor (with Prof. Vivienne Sze)

Syed M. Imaduddin (Electrical Engineering & Computer Science)   **09/2016 − 01/2018**
Pseudo-Bayesian Approach to Noninvasive Estimation of Intracranial Pressure
Role: SM Thesis advisor
Recipient of the Ernst A. Guillemin SM Research Award for outstanding Master's
thesis research in Electrical Engineering at MIT.

Jonathan Birjiniuk (Electrical Engineering & Computer Science)   **09/2015 − 05/2017**
Assessing Brain Injury via Baroreflex Control and ECG Variability
Role: MEng Thesis advisor

Rohan Jaishankar (Electrical Engineering & Computer Science)   **09/2015 − 05/2017**
Frequency-domain Approach to Noninvasive Intracranial Pressure Estimation
Role: SM Thesis advisor

Amanda Zhou (Electrical Engineering & Computer Science)   **09/2015 − 06/2016**
Predicting Migraines via Mobile-focused Data Collection and Machine Learning
Role: EECS superUROP advisor

Jonathan Matthews (Electrical Engineering & Computer Science)   **09/2015 − 06/2016**
Microprocessor-based, Real-time Estimation of Intracranial Pressure

Role: MEng Thesis advisor

Minoru Matsushima, PhD   **09/2014 − 03/2018**
Visiting Scientist, IMES, MIT
Role: Research supervisor

Taibo Li (Electrical Engineering & Computer Science)   **09/2014 − 09/2015**
Reduction of False Bedside Monitoring Alarms in Intensive Care
Role: EECS superUROP advisor
Recipient of the Henry Ford II Scholar Award, MIT School of Engineering, and a Peter
J. Eloranta Undergraduate Summer Fellowship.

Zixi Liu (Electrical Engineering & Computer Science)   **09/2014 − 05/2015**
Oxygentation Patterns in Preterm Neonates
Role: EECS superUROP advisor

Eun Cho (Electrical Engineering & Computer Science)   **09/2014 − 05/2015**
Modeling the Morphology of the Intracranial Pressure Waveform
Role: EECS superUROP advisor

James Noraky (Electrical Engineering & Computer Science)   **09/2013 − 05/2014**
Noninvasive Intracranial Pressure Monitoring
Role: MEng Thesis supervisor

Andrea Fanelli, PhD   **05/2013 − 05/2017**
Postdoctoral Associate, Research Laboratory of Electronics, MIT
Role: Postdoctoral advisor

Aditya Kalluri (Electrical Engineering & Computer Science)   **09/2012 − 05/2013**
Visual Impairment and Intracranial Hypertension in Astronauts
Role: superUROP supervisor

Ehinwenma Nosakhare (Electrical Engineering & Computer Science)   **01/2012 − 08/2014**
Electrocardiographic Markers of Brain Injury in Pediatric Patients
Role: SM Thesis co-advisor (with G. Verghese)

Rebecca Mieloszyk (Electrical Engineering & Computer Science)   **01/2011 − 08/2016**
Capnographic Analysis for Disease Classification
Role: Ph.D. co-advisor (with G. Verghese)
Recipient of a National Defense Science and Engineering Graduate Fellowship, the
Helen Carr Peake Fellowship at MIT's Research Laboratory of Electronics, and the
Jin-Au Kong Award for Best PhD Thesis in Electrical Engineering, MIT.

Gregory Ciccarelli (Electrical Engineering & Computer Science)   **09/2011 − 01/2013**
Early Warning of Patient Deterioration in the In-Patient Setting
Role: S.M. Thesis co-advisor (with G. Verghese)

Priya Ramaswamy (Electrical Engineering & Computer Science)   **05/2010 − 05/2011**
Electrocortical and Electrophysiological Activity in Brain-Injured Neonates
Role: M.Eng. Thesis co-advisor (with G. Verghese)

Ekavali Mishra (Electrical Engineering & Computer Science)   **05/2010 − 05/2011**
Analysis of Blood Pressure Signals to Predict Adverse Outcomes after Surgery
Role: M.Eng. Thesis co-advisor (with G. Verghese)

Bryan Haslam (Electrical Engineering & Computer Science)   **01/2010 − 05/2011**
Analysis of a Wearable Cardiac Monitor: A Model for Extracting
Clinically-Relevant Data from Ambulatory Medical Sensors
Role: S.M. Thesis co-advisor (with G. Verghese)

Faisal M. Kashif (Electrical Engineering & Computer Science)   **09/2006 − 03/2011**

Modeling and Estimation for Monitoring of Intracranial Pressure and Cerebrovascular Autoregulation (Recipient of the Helen Carr Peake Research Prize of the Research Laboratory of Electronics for his dissertation.)
Role: Ph.D. Thesis co-advisor (with G. Verghese)

Tushar A. Parlikar (Electrical Engineering & Computer Science)   **09/2003 − 06/2007**
Modeling and Monitoring of Cardiovascular Dynamics for Patients in Critical Care
Role: Ph.D. Thesis co-advisor (with G. Verghese)

Shirley X. Li (Electrical Engineering & Computer Science)   **06/2006 − 06/2007**
Probabilistic Network Models for Cardiovascular Monitoring
Role: M.Eng. Thesis co-advisor (with G. Verghese)

S. Ahmad Zamanian (Electrical Engineering & Computer Science)   **09/2005 − 06/2007**
Cardiovascular Response to Short-radius Centrifugation
Role: S.M. Thesis co-advisor (with G. Verghese)

Eva Enns (Electrical Engineering & Computer Science)   **09/2005 − 06/2006**
Signal Processing Algorithms for Early Detection of Impending Hemodynamic Crisis of Intensive Care Unit Patients
Role: Advisor, Undergraduate Research Project (with G. Verghese)

Jennifer M. Roberts (Electrical Engineering & Computer Science)   **02/2005 − 06/2006**
Bayesian Networks for Cardiovascular Monitoring
Role: S.M. Thesis co-advisor (with G. Verghese)

Zaid Samar (Electrical Engineering & Computer Science)   **09/2003 − 05/2005**
Cardiovascular Parameter Estimation using a Computational Model
Role: S.M. Thesis co-advisor (with G. Verghese)

Jinn-Jiau S. Chen (Electrical Engineering & Computer Science)   **09/2002 − 07/2003**
Analytical Solution to a Simplified Circulatory Model Using Piecewise Linear Elastance Function
Role: S.M. Associate thesis advisor (with G. Verghese)

Jolie L. Chang (Electrical Engineering & Computer Science)   **09/2001 − 05/2002**
Cycle-Averaged Models of Cardiovascular Dynamics
Role: Supervising graduate student (with G. Verghese)

Thesis Reader & External Examiner

Federico Wadehn, ETH Zürich, Switzerland   **09/2017 − present**
Thesis title TBD
Thesis advisor: Prof. Hans-Andrea Loehliger

Christoph Hook Antink, RWTH Aachen, Germany   **09/2017 − present**
On Sensor Fusion for Multimodal Cardiorespiratory Signals
Thesis advisor: Prof. Steffen Leonhardt

Mohammad Ghassemi (Electrical Engineering & Computer Science)   **03/2016 − present**
Improved Prognostication of Patient Outcome after Anoxic Coma
Thesis advisors: Profs. Roger Mark and Emery Brown

Margaret Delano (Electrical Engineering & Computer Science)   **09/2015 − present**
Wearable Sensor for Congestive Heart Failure Monitoring
Thesis advisor: Prof. Charlie Sodini

Sabino Pietrangelo (Electrical Engineering & Computer Science)   **01/2015 − 10/2016**
Phased-array Approach to Transcranial Doppler Ultrasonography
Thesis advisors: Profs. Charlie Sodini and Harry Lee

Yun Liu (Health Sciences & Technology)   **01/2015 − 05/2016**
*Applying Domain Knowledge to Medical Predictive Models: Manual and
Automated Approaches*
Thesis advisors: Profs. John Guttag and Collin Stultz

Ana Diaz Artiles (Aeronautics & Astronautics)   **09/2014 − 05/2015**
Exercise under Artificial Gravity – Experimental and Computational Approaches
Thesis advisor: Prof. Lawrence Young

Andrea Fanelli, Politecnico di Milano, Italy   **04/2013**
*Telefetal Care: Development of a Wearable System for Fetal Monitoring During
Pregnancy*
Thesis advisor: Prof. Maria-Gabriella Signorini, Politecnico di Milano, Italy

Serena Fiocchi, Politecnico di Milano, Italy   **04/2013**
*Exposure Assessment of Electromagnetic Fields on Children, Newborns, and
Fetuses due to RFID Devices*
Thesis advisor: Prof. Paolo Ravazzani, Politecnico di Milano, Italy

Jacopo Lamanna, Politecnico di Milano, Italy   **04/2013**
*Fractal Behavior at Central Synapses: Characterization of Quantal Release after
Long-term Potentiation*
Thesis advisor: Prof. Maria-Gabriella Signorini, Politecnico di Milano, Italy

Manon Ranger, School of Nursing, McGill University   **05/2009 − 10/2011**
Nociception Following Noxious Stimuli in Critically Ill Infants
Thesis advisor: Prof. Celeste Johnson, McGill University

Tatsuya Arai (Aeronautics and Astronautics)   **02/2011 − 04/2011**
*Estimation of Cardiovascular Indices by Analysis of Arterial Blood Pressure
Waveforms*
Thesis advisor: Prof. Richard Cohen

Jaime Mateus (Aeronautics and Astronautics)   **12/2009 − 04/2011**
*Non-invasive Measurement of Bone Blood Flow Response to Changes in External
Pressure*
Thesis advisors: Profs. Dava Newman and Alan Hargens (UCSD)

Books and Book Chapters

1. **Heldt, T** (ed.). "Intracranial Pressure and Neuromonitoring XVI," Springer Verlag, 2018.

2. **Heldt T**, Verghese GC, Mark RG. Mathematical modeling of physiological systems. In "Mathematical Modeling and Validation in Physiology: Applications to the Cardiovascular and Respiratory Systems" JJ Batzel, M Bachar, F Kappel (eds.), Lectures Notes of Mathematics, Springer Verlag, 2013.

Refereed Journal Papers

1. Filbin MR, Thorsen JE, Lynch JC, Gillingham TD, Pasakarnis C, Capp R, Shapiro NI, Mooncai T, Hou PC, **Heldt T**, Reisner AT. Challenges and Opportunities for Emergency Department Sepsis Screening at Triage. *Scientific Reports* 8(1): 11059, 2018.

2. Jinadasa SP, Mueller A, Prasad V, Subramaniam K, **Heldt T**, Novak V, Subramaniam B. Blood pressure coefficient of variation before, during, and after cardiopulmonary bypass and its association with cardiac surgical outcomes. *Anesthesia & Analgesia* 127(8): 832-839, 2018.

3. Li T, Matsushima M, Timpson W, Young S, Miedema D, Gupta M, **Heldt T**. Epidemiology of bedside monitoring alarms in the neonatal intensive care unit. *Journal of Perinatology* 38(8): 1030-1038, 2018.

4. Filbin MR, Gillingham TD, Lynch JC, Thorsen JE, Pasakarnis C, Nepal S, Matsushima M, Rhee C, **Heldt T**, Reisner AT. Presenting symptoms independently predict mortality in septic shock: Importance of a previously unmeasured confounder. *Critical Care Medicine* 46(10): 1592-1599, 2018.

5. Diaz-Artilles A, **Heldt T**, Young LR. Short-Term Cardiovascular Response to Short-Radius Centrifugation with and without Ergometer Exercise. *Frontiers in Physiology* 9:1492, 2018.

6. Matthews JM, Fanelli A, **Heldt, T.** An Embedded Device for Real-time Noninvasive Intracranial Pressure Estimation, Acta Neurochirurgica Scandinavica Supplement 162: 85-88, 2018.

7. Fanelli A, Jaishankar R, Filippidis A, Holsapple J, **Heldt, T.** A Waveform Archiving System for the GE Solar 8000i Bedside Monitor, Acta Neurochirurgica Scandinavica Supplement 162: 173-178, 2018.

8. Prasad V, Guerrisi M, Dauri M, Coniglione F, Tisone G, De Carolis E, Cillis A, Canichella A, Toschi N, **Heldt T.** Prediction of post-operative outcomes using intraoperative hemodynamic monitoring data. Scientific Reports 7(1):16376, 2017.

9. Abid A, Mieloszyk RJ, Verghese GC, Krauss BS, **Heldt T**. Model-Based Estimation of Respiratory Parameters from Capnography, with Application to Diagnosing Obstructive Lung Disease. *IEEE Transactions on Biomedical Engineering* 64(12):2957-2967, 2017. (cover feature)

10. Dias-Artilles A, **Heldt T**, Young LR. Effects of artificial gravity on the cardiovascular system: A computational approach. *Acta Astronautica* 126:395-410, 2016.

11. Noraky J, Verghese GC, Searls DE, Lioutas V, Sonni S, Thomas A, **Heldt T**. Noninvasive intracranial pressure determination in patients with subarachnoid hemorrhage. *Acta Neurochirurgica Supplement* 122: 65–68, 2016.

12. Asher RJ, Verghese GC, Deitch K, Cooney B, Khalid A, Mirre-Gonzalez MA, **Heldt T**, Krauss BS. Automated quantitative analysis of capnogram shape for COPD-Normal and COPD-CHF classification. *IEEE Transactions on Biomedical Engineering* 61(12):2882-2890, 2014.

13. Subramaniam B, Khabbaz KR, **Heldt T**, Lerner AB, Mittleman MA, Davis RB, Goldberger AL, Costa MD. Blood pressure variability: Can nonlinear dynamics enhance risk assessment during cardiovascular surgery? *Journal of Cardiothoracic and Vascular Anesthesia* 28(2):392-397, 2014.

14. Reisner AT, **Heldt T**. A computational model of hemorrhage and dehydration suggests a pathophysiological mechanism: Starling-mediated protein trapping. *American Journal of Physiology (Heart. Circ. Physiol.)* 304(4): H620-H631, 2013.

15. Ranger M, Johnston CC, Rennick JE, Limperopoulos C, **Heldt T**, du Plessis AJ. A multi-signal approach to pain assessment in critically ill infants during a painful procedure. *Clinical Journal of Pain* 29(7): 613-620, 2013.

16. Kashif FM, Verghese GC, Novak V, Czosnyka M, **Heldt T**. Model-based noninvasive continuous monitoring of intracranial pressure from cerebral blood flow velocity and arterial blood pressure. *Science Translational Medicine* 4: 129ra44, 2012. (Publication accompanied by an editorial entitled *From Lundberg to SIM-ICP: Computational Physiology and Modeling Intracranial Pressure.*)

17. **Heldt T**, Kashif FM, Sulemanji M, O'Leary HM, du Plessis AJ, Verghese GC. Continuous quantiative monitoring of cerebral oxygen metabolism in neonates by ventilator-gated analysis of NIRS recordings. *Acta Neurochirurgica Supplement* 114: 177-180, 2012.

18. Saeed M, Villaroel M, Reisner AT, Clifford GD, Lehman L, Moody GB, **Heldt T**, Kyaw TH, Moody B, Mark RG. MIMIC II: A public-access ICU database. *Critical Care Medicine* 39(5): 952–960, 2011. (Published as a featured article and accompanied by an editorial entitled *Putting intensive care unit data into the public domain – And using it effectively*)

19. **Heldt T**, Mukkamala R, Moody GB, Mark RG. CVSim: A cardiovascular simulator for teaching and research. Accepted for publication in *The Open Pacing, Electrophysiology, and Therapy Journal* 3: 45-54, 2010.

20. Sun JX, Reisner TA, Saeed M, **Heldt T**, and Mark RG. The cardiac output from blood pressure algorithms trial. *Critical Care Medicine* 37(1): 72–80, 2009. (An editorial by RM Gardner and RJ Beale entitled *Pressure to perform: Is cardiac output estimation from arterial waveforms good enough for routine use?* accompanied the publication of this article in the same issue of the journal.)

21. Parlikar TA, **Heldt T**, and Verghese GC. Cycle-averaged models of aardiovascular dynamics. *IEEE Transactions on Circuits and Systems I: Fundamental Theory and Applications* 53 (11): 2459–2468, 2006. (Special Issue on Advances in Life Science Systems and Applications.)

22. **Heldt T**, Chang JL, Chen JJS, Verghese GC, and Mark RG. Cycle-averaged dynamics of a periodically-driven, closed-loop circulation model. *Control Engineering Practice* 13(9): 1163 – 1171, 2005. (PMID:16050064)

23. **Heldt T**, Shim EB, Kamm, RD, and Mark RG. Computational modeling of cardiovascular response to orthostatic stress. *Journal of Applied Physiology* 92: 1239-1254, 2002. (PMID: 11842064)

24. Shim EB, Youn CH, **Heldt T**, Kamm RD, and Mark RG. Computational modeling of the cardiovascular system after Fontan procedure. *Lecture Notes in Computer Science* 2526: 105-114, Springer-Verlag, 2002.

Editorials

1. **Heldt T.** Fluid dynamics of disease transmission. *Science Translational Medicine* 8 (328): 328ec36, 2016.

2. **Heldt T.** Know the shunt flow. *Science Translational Medicine* 7(316): 316ec208, 2015.

3. **Heldt T.** Beep, beeep, beeeep, beeeeep. *Science Translational Medicine* 7(310): 310ec181, 2015.

4. **Heldt T.** Ultrasound imaging made easy. *Science Translational Medicine* 7(298): 298ec130, 2015.

5. **Heldt T.** Monitoring blood pressure with your bathroom scale. *Science Translational Medicine* 7(292): 292ec101, 2015.

6. **Heldt T.** Toward personalized medicine for the tiniest patients. *Science Translational Medicine* 7(290): 290ec91, 2015.

7. **Heldt T.** Continuous blood-pressure derived cardiac output monitoring – Should we be thinking long-term? Invited Editorial. *Journal of Applied Physiology* 101: 373-374, 2006 (PMID: 16690788).

Refereed Conference Papers

1. Lai H-Y, Saavedra-Peña G, Sodini CG, **Heldt T**, Sze V. Enabling saccade latency measurements using consumer-grade cameras for monitoring of neurodegenerative disease progression. 2018 IEEE International Conference on Image Processing, pp. 3169-3173, 2018.

2. Saavedra-Peña G, Lai H-Y, Sze V, **Heldt T**. Determination of saccade latency distributions using video recordings from consumer-grade devices. Proceedings of the 40th Annual Conference of the IEEE Engineering in Medicine and Biology Society,

3. Karasan E, Abid A, Mieloszyk R, Krauss B, **Heldt T**, Verghese GC. An enhanced mechanistic model for capnography, with application to CHF-COPD discrimination. Proceedings of the 40th International Conference of the IEEE Engineering in Medicine and Biology Society.

4. Shim EB, **Heldt T**. A fluid-structure interaction model for the analysis of cerebral venous hemodynamics. Proceedings of the 40th International Conference of the IEEE Engineering in Medicine and Biology Conference.

5. Birjiniuk J, Gordhandas A, Verghese GC, **Heldt T**. A fiducial scaffold for ECG compression in low-powered devices. Proceedings of the 40th Annual Conference of the IEEE Engineering in Medicine and Biology Society.

6. Imaduddin SM, **Heldt T**. Model-based estimation of radial artery blood pressure from recordings of the Nexfin monitor. *Proceedings of the 39th Annual Conference of the IEEE Engineering in Medicine and Biology Society.*

7. Prasad V, Lynch JC, Pasakarnis CL, Thorsen JE, Filbin MR, Reisner AT, **Heldt T**. Classification models to predict vasopressors administration for septic shock in the emergency department. *Proceedings of the 39th Annual International Conference of the IEEE Engineering in Medicine and Biology Conference.*

8. Fanelli A, Vonberg FW, Jaishankar R, Syed IM, Tasker RC, **Heldt T**. Regression-based noninvasive estimation of intracranial pressure. *Proceedings of the 39th Annual International Conference of the IEEE Engineering in Medicine and Biology Conference.*

9. Dekimpe R, **Heldt T**. "Reducing false asystole alarms in critical care." *Proceedings of the 39th Annual International Conference of the IEEE Engineering in Medicine and Biology Conference.*

10. Mieloszyk RJ, Krauss BS, Montagu D, Andalfatto G, Barbi E, Verghese GC, **Heldt T**. "Age dependence of the normal capnogram – A quantitative analysis." *Proceedings of the 39th Annual International Conference of the IEEE Engineering in Medicine and Biology Conference.*

11. Diaz A, **Heldt T**, Young LR. Cardiovascular response to artificial gravity combined with exercise. *Proceedings of the 2015 IEEE Aerospace Conference*, pp. 1–11, 2015.

12. Dunitz M, Verghese GC, **Heldt T.** Predicting hyperlactatemia in the MIMIC II database. *Proceedings of the 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Conference*, pp. 985–988, 2015.

13. Abid A, Mieloszyk R, Verghese GC, Krauss BS, **Heldt T.** Model-based estimation of pulmonary compliance and resistance parameters from time-based capnography. *Proceedings of the 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Conference*, pp. 1687–1690, 2015.

14. Mieloszyk R, Guo M, Verghese GC, Andolfatto G, **Heldt T**, Krauss BS. Clustering capnogram features to track state transitions during procedural sedation. *Proceedings of the 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Conference*, pp. 1699–1702, 2015.

15. Prasad V, Toschi N, Canichella A, Marcellucci M, Coniglione F, Dauri M, Guerrisi M, **Heldt T.** Intraoperative hemodynamics predict postoperative mortality in orthotopic liver transplantation. *Proceedings of the 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Conference*, pp. 989–992, 2015.

16. Nosakhare E, Verghese GC, Tasker RC, **Heldt T**. QT interval adaptation to changes in autonomic balance. *Computing in Cardiology*, 41: 605-609, 2014.

17. Lehman LW, Nemati S, Moody GB, **Heldt T**, Mark RG. Uncovering clinical significance in vital sign dynamics in critical care. *Computing in Cardiology*, 41: 1141-1144, 2014.

18. Fanelli A, **Heldt T**. Signal quality quantification and waveform reconstruction of arterial blood pressure recordings. *Proceedings of the 36th Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, 2014.

19. Fanelli A, Signorini MG, **Heldt T**. Extraction of fetal heart rate from maternal surface ECG with provisions for multiple pregnancies. *Proceedings of the 34th Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, pp. 6165–6168, 2012.

20. Haslam B, Gordhandas A, Ricciardi C, Verghese GC, **Heldt T**. Distilling clinically important information from data collected on next-generation wearable monitors. *Proceedings of the 33rd Annual Conference of the IEEE Engineering in Medicine and Biology Society*, pp. 1729–1732, 2011.

21. Gordhandas A, **Heldt T**, Verghese GC. Real-time extraction and analysis of key morphological features in the electrocardiogram, for data compression and clinical decision support. *Proceedings of the AAAI Spring Symposium on Computational Physiology*, pp. 15–18, 2011.

22. Haslam B, Gordhandas A, Ricciardi C, **Heldt T**, Verghese GC. Relating noninvasive cardiac output and total peripheral resistance estimates to physical activity in an ambulatory setting. *Proceedings of the AAAI Spring Symposium on Computational Physiology*, pp. 27–31, 2011.

23. **Heldt T**, Verghese GC. Model-based data integration for clinical environments. *Proceedings of the 32nd Annual Conference of IEEE Engineering in Medicine and Biology Society*, pp. 5209–5212, 2010.

24. He DD, Winokur ES, **Heldt T**, Sodini CG. The ear as a location for wearable vital signs monitoring. *Proceedings of the 32nd Annual Conference of IEEE Engineering in Medicine and Biology Society*, 6389–6392, 2010.

25. **Heldt T**, Verghese GC, Long WL, Szolovits P, Mark RG. Integrating data, models, and reasoning in critical care. *Proceedings of the 28th IEEE EMBS International Conference*, 350–353, 2006.

26. Roberts JM, Parlikar TA, **Heldt T**, Verghese GC. Bayesian network models for patient monitoring. *Proceedings of the 28th IEEE EMBS International Conference*, 205–208, 2006.

27. Kashif FM, **Heldt T**, Verghese GC. Model-based estimation of intra-cranial pressure and cerebral autoregulation. *Computers in Cardiology* 35:369 – 372, 2008.

28. Parlikar TA, **Heldt T**, Ranade GV, and Verghese GC. Model-based estimation of cardiac output and total peripheral resistance. *Computers in Cardiology* 34:379–382, 2007.

29. Zong W, Saeed M, **Heldt T**. A QT-interval detection algorithm based on the ECG curve-length transform, *Computers in Cardiology* 33: 377–380, 2006.

30. **Heldt T** and Chernyak YB. Analytical solution to a minimal cardiovascular model. *Computers in Cardiology* 33: 785–789, 2006.

31. **Heldt T** and Mark RG. Understanding post-spaceflight orthostatic intolerance – A modeling study. *Computers in Cardiology* 32:631–634, 2005.

32. Samar Z, **Heldt T**, Verghese GC, Mark RG. Model-based parameter estimation in the intensive care unit. *Computers in Cardiology* 32:635–638, 2005.

33. **Heldt T** and Mark RG. Scaling cardiovascular parameters for population simulations. *Computers in Cardiology* 31: 133–136; 2004.

34. **Heldt T**, Oefinger M, Hoshiyama M, and Mark RG. Circulatory response to passive and active changes in posture. *Computers in Cardiology* 30: 263–266, 2003.

35. Chen JJS, **Heldt T**, Verghese GC, and Mark RG. Analytical solution to simplified circulatory model using piecewise linear elastance. *Computers in Cardiology* 30: 259–262, 2003.

36. Zong W, **Heldt T**, Moody GB. An open-source algorithm to detect onset of arterial blood pressure pulses. *Computers in Cardiology* 30: 45–48, 2003.

37. **Heldt T**, Chang JL, Verghese GC, and Mark RG. Cycle-averaged models of cardiovascular dynamics. *Proceedings of the 5th IFAC Symposium on Modelling and Control in Biomedical Systems*, 387-392, 2003.

38. **Heldt T**, Shim EB, Kamm, RD, and Mark RG. Model-based parameter estim ation using cardiovascular response to orthostatic stress. *Computers in Cardiology* 28: 337-340, 2001.

39. **Heldt T**, Shim EB, Kamm, RD, and Mark RG. Computational model of cardiovascular function during orthostatic stress. *Computers in Cardiology* 27: 777-800, 2000. (PMID: 11806418)

40. Shim EB, Kamm RD, **Heldt T**, and Mark RG. Numerical analysis of blood flow through a stenosed artery using a coupled multiscale simulation method. *Computers in Cardiology* 27: 219-222, 2000.

41. **Heldt T**, Shim EB, Kamm RD, and Mark RG. Computational models of cardiovascular function for analysis of post-flight orthostatic intolerance. *Computers in Cardiology* 26: 649-652, 1999.

42. **Heldt T**, Shim EB, Kamm, RD, and Mark RG. Computational model of cardiovascular function for analysis of orthostatic intolerance. 2001 Bioengineering Conference, ASME, BED-Vol. 50:895-896, 2001.

43. Shim EB, Kamm RD, **Heldt T**, and Mark RG. Computational modeling of cardiovascular system after the Fontan procedure. 1999 Bioengineering Conference, ASME, BED-Vol. 42:15-16, 1999.

Selected Conference Abstracts

1. Timpson W, Lynch JC, Miedema D, Vinci C, Waldo K, Wasiak M, Young S, **Heldt T**, Gupta M. Responding to an alarming problem: Decreasing alarm burden and increasing safety in the NICU. Annual Meeting of the American Academy of Pediatrics, 2018.

2. Prasad V, Lynch JC, Gillingham TD, Nepal S, Filbin MR, Reisner RT, **Heldt T**. Prediction of initiation of vasopressor administration in emergency department patients at risk of septic shock. Annual Conference of the American Medical Informatics Association, San Francisco, November 2018.

3. Wadehn F, Mack DJ, Keller E, **Heldt T**. A multiscale intracranial pressure simulator. Annual Computing in Cardiology Conference, Maastricht, The Netherlands, September 2018.

4. Ho T, Matsushima M, Gupta M, **Heldt T**, Timpson W. Clinical correlates of out-of- target oxygen saturation in the preterm neonate. Annual Meeting of the Pediatric Academic Societies, Toronto, CA, May 2018.

5. Wahden F, Fanelli A, **Heldt T**. Binary classification of cerebral blood flow velocity waveforms. IEEE Engineering in Medicine and Biology Conference, Orlando, FL, August 2016.

6. Fanelli A, Peterson J, **Heldt T**. Challenges in recording multi-parameter waveform signals in the neuro ICU. 16th International Conference on Intracranial Pressure & Neuromonitoring, Cambridge, MA, June 2016.

7. Li T, Matsushima M, Gupta M, Timpson W, Young S, **Heldt T**. Epidemiology of bedside monitoring alarms in neonatal critical care. Pediatric Academic Societies Meeting, Baltimore, MD, April 2016.

8. Prasad V, Ha A, Mujica F, Henriques T, Mueller A, Novack V, Khabbaz K, **Heldt T**, Subramaniam B. Measuring intraoperative BP variability via Poincare plots to assess cardiac surgical outcomes. Society of Cardiovascular Anesthesiologists Annual Meeting 2016. San Diego, CA, April 2016.

9. Ha A, Prasad V, Mujica F, Mueller A, Mathur P, Lerner AB, Khabbaz K, Novack V, **Heldt T**, Subramaniam B. Measuring Intraoperative Blood Pressure Variability with the Coefficient of Variation to Assess Cardiac Surgical Outcomes. Society of Cardiovascular Anesthesiologists Annual Meeting 2016. San Diego, CA, April 2016.

10. Mujica F, Ha A, Prasad V, Mueller A, Mathur Pooja, Lerner AB, Khabbaz K, **Heldt T**, Subramaniam B. Intraoperative Beat-by-Beat Blood Pressure vs. 15-Sec Sampling Variability: Does Resolution Matter? Society of Cardiovascular Anesthesiologists Annual Meeting 2016. San Diego, CA, April 2016.

11. Fanelli A, **Heldt T.** Neurocritical care informatics: Leveraging data and models to improve the care for brain-injured patients. 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Conference, Milan, Italy, 2015.

12. Sodini CG, Seo J, Pietrangelo S, **Heldt T**, Winokur ES, He DD, Lee HS. Mean arterial pressure and pulse pressure wave measurement with low cost technologies. 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Conference, Milan, Italy, 2015.

13. Mujica F, Prasad V, Mathur P, Lerner AB, Khabbaz K, **Heldt T**, Subramaniam B. Intraoperative beat-by-beat blood pressure variability and postoperative outcome in cardiac surgery. A pilot study. 37th Annual Meeting of the Society of Cardiovascular Anesthesiologists, Washington DC, 2015.

14. Filippidis A, Binello E, Holsapple J, Fanelli A, **Heldt T**. Noninvasive intracranial pressure monitoring in a hospital-wide setting. Challenges met. 2015 Annual Scientific Meeting of the American Association of Neurological Surgeons, Washington, DC, 2015.

15. Hwang I, Kashif FM, Czosnyka M, **Heldt T**, Verghese GC. A frequency-domain approach to model-based noninvasive intracranial pressure estimation from arterial pressure and cerebral blood flow velocity. 34th Annual International Conference of the IEEE Engineering in Medicine and Biology Conference, San Diego, USA, 2012.

16. Kashif FM, **Heldt T**, Novak V, Czosnyka M, Verghese GC. Noninvasive continuous estimation of intracranial pressure: a model-based, patient-specific, and calibration-free approach. 14th International Conference on Intracranial Pressure and Brain Monitoring, Tübingen, Germany, 2010.

17. **Heldt T**, Kashif FM, O'Leary HM, Suleymanci M, du Plessis AJ, Verghese GC. Comprehensive continuous cerebral oxygen metabolism monitoring through ventilator-gated analysis of cerebral near-infrared spectroscopy. 14th International Conference on Intracranial Pressure and Brain Monitoring, Tübingen, Germany, 2010.

18. Kashif FM, **Heldt T**, Novak V, Czosnyka M, Verghese GC. Non-invasive cerebrovascular monitoring. *Stroke* 41: e237, 2010.

19. Ranger M, **Heldt T**, O'Leary H, Suleymanci M, Johnston C, du Plessis AJ. Description of global cerebrovascular activation during noxious stimulus in critically ill preterm infants. *8th International Symposium on Pediatric Pain*, Acapulco, Mexico.

20. Ranger M, **Heldt T**, O'Leary H, Suleymanci M, du Plessis A. Description of global cerebrovascular activation during noxious stimulus in critically ill preterm infants. *5th International Conference on Brain Monitoring and Neuroprotection in the Newborn*, Clearwater Beach, FL.

21. Kashif FM, **Heldt T**, Novak V, Czosnyka M, Verghese GC. Non-invasive model-based cerebrovascular monitoring for neurotrauma. *2009 CIMIT Innovation Congress*.

    (Contribution won award for *Most Innovative Research* — the highest award presented at the conference.)

22. **Heldt T**, Verghese GC. Subset selection and reduced-order parameter estimation. *SIAM Conference on Life Science*, Montreal, Canada, August 2008.

23. **Heldt T**, Parlikar TA, Zamanian SA, Verghese GC. Modeling cardiovascular response to spaceflight and patient monitoring, *Biomedical Engineering Society*, Annual Conference, Los Angeles, CA, 2007.

24. **Heldt T**, Kamm RD, Verghese GC, and Mark RG. Computational models of cardiovascular function for simulation, data integration, and clinical decision support. *USRA Bioastronautics Investigators' Workshop*, January 2005.

25. **Heldt T** and Mark RG. Modeling cardiovascular response to orthostatic stress. *55th International Astronautical Congress*, IAC-05-G.1.01, October 2004.

26. **Heldt T**, Verghese GC, and Mark RG. Computational models of cardiovascular response to orthostatic stress, *6th Society of Industrial and Applied Mathematics (SIAM) Meeting on Control and Its Applications*, MS-1, New Orleans, LA, 2005.

27. **Heldt T**, Verghese GC, Kamm RD, and Mark RG. Modeling cardiovascular response to gravitational stress – Combined forward and inverse approach. *IFMBE Proceedings – World Congress on Medical Physics and Biomedical Engineering*, 2003.

28. Kamm RD, Shim EB, Shirai A, Bathe M, **Heldt T**, Younis H, Isasi A, Kaazempour-Mofrad M, Hwang W. Multiscale simulation in biological systems. *Proceedings of the First International Symposium on Advanced Fluid Information*, 2001.

29. Chen G, **Heldt T**, Chang RK, Hill SC, Pinnick RG. Discrimination of bioaerosols from non-bioaerosols with fluorescence techniques. 16th Annual Conference of the American Association for Aerosol Research, Denver, CO. Reference Number 7D3, 1997.

Publications — Thesis

1. *Computational Models of Cardiovascular Response to Orthostatic Stress*, Doctoral Dissertation, Harvard University–MIT Division of Health Sciences and Technology, Massachusetts Institute of Technology, 2004. Electronically available through http://dspace.mit.edu.

Patents

1. Imaduddin S, Fanelli A, Heldt T, *System and Methods for Model-based Estimation and Tracking of Intracranial Pressure.* U.S. Provisional Patent Application 62/665,996 filed May 2018.

2. Heldt T, Filbin MR, Reisner AT. *System and Methods for Sepsis Care Task Management.* U.S. Provisional Patent Application No. 62/117,020, filed February 17, 2015; full Patent Application and PCT filed on February 16, 2016. (Licensed by Nihon Kohden Corporation, Japan.)

3. Heldt T, Filbin MR, Reisner AT, Verghese GC, Dunitz M. *System and Methods to Predict Serum Lactate.* U.S. Provisional Patent Application 62/204,292 field August 2015.

4. Asher RJ, Heldt T, Verghese GC, Krauss BS. *System and Methods for Quantitative Capnogram Analysis.* U.S. Patent Application No. 13/849,284 filed March 2014.

5. Kashif FM, Heldt T, Verghese GC. *Systems and Methods for Cerebrovascular Modeling and For Noninvasive or Minimally-Invasive Estimation of Intracranial Pressure and Autoregulation*, U.S. Patent 8,821,402 September 2014.

6. Kashif FM, Heldt T, Verghese GC. *Systems and Methods for Cerebrovascular Modeling and For Noninvasive or Minimally-Invasive Estimation of Intracranial Pressure and Autoregulation*, U.S. Patent 8,366,627 February 2013.

7. Parlikar TA, Ranade GV, Heldt T, and Verghese GC. *Model-based Method for Continuous Determination of Cardiac Output and Peripheral Vascular Resistance.* U.S. Patent 8,282,564, 10/09/2012; licensed by Philips Electronics North America Corporation January 2008.

8. Parlikar TA, Heldt T, Mark RG, and Verghese GC. *System and Method for Prediction and Detection of Circulatory Shock.* U.S. Patent 8,262,579, 09/11/2012.

9. Parlikar TA, Heldt T, Mukkamala R, and Verghese GC. *Model-based Method for Continuous Determination of Cardiac Ejection Fraction and Ventricular End-diastolic Volume.* U.S. Patent 8,235,910, 08/07/2012. (Licensed by Philips Electronics North America Corporation.)

Invited Presentations

1. October 2018, *Neuromonitoring – From Critical Care to the Home*, 14th Epoch Foundation Symposium, Cambridge, MA.

2. June 2018, *Model-based Estimation and Instrumentation for Cardiorespiratory and Neuromonitoring*, 13th IEEE-EMBS International School and Symposium on Medical Devices and Biosensors, Macau, China.

3. June 2018, *Model-based Estimation for Improved Neurocritical Care*, Gordon Research Conference on Integrating Informatics with Sensing, Imaging and Robotics for Health, Hong Kong, China.

4. June 2018, *The Digital-Health Continuum: From sensing, modeling and data analytics to translation*, Winstron Corporation, Yonglin Biotech/Foxconn, Via Technologies, and Epoch Foundation, Taipei, Taiwan.

5. March 2018, *Neurocritical Care Informatics: Modeling, Estimation, and Machine Learning*, Department of Electrical Engineering, Chinese University of Hong Kong, Hong Kong.

6. March 2018, *Neurocritical Care Informatics: Modeling, Estimation, and Machine Learning*, Joint Seminar by the Departments of Electronic & Computer Engineering and Chemical & Biological Engineering, The Hong Kong University of Science and Technology, Hong Kong.

7. March 2018, *Neurocritical Care Informatics: Modeling and Estimation for Improved Clinical Decision Making*, Signal Processing, Imaging, Reasoning, and Machine Learning Seminar, Department of Electrical and Computer Engineering, Northeastern University, Boston, MA.

8. February 2018, *Integrative Neuromonitoring*, 28. Symposium Intensivmedizin + Intensivpflege, Bremen, Germany.

9. November 2017, *Mathematische Physiologie und Medizinische Elektronik für die Neurointensivmedizin,* Begeisterer Begeistern, MIT Club of Germany, Dresden, Germany.

10. October 2017, *Model-based Patient Monitoring,* Nihon Kohden Innovation Center, Cambridge, MA.

11. October 2017, *Epidemiology of Patient Monitoring Alarms in the Neontal Intensive Care Unit*, Department of Neonatology, Beth Israel Deaconess Medical Center, Boston, MA.

12. July 2017, *Big Data Analytics in Medicine*, Nihon Kohden Corporation, Tokorozawa, Japan.

13. July 2017, *Taking Mathematical Models to the Point-of-Care – Applications in Patient Monitoring*, LG Sensor Lab, Seoul, Republic of Korea.

14. July 2017, *Taking Mathematical Models to the Point-of-Care – Applications in Patient Monitoring*, Quanta Computer, Taipei, Taiwan.

15. July 2017, *Neurocritical Care Informatics*, Department of Neurosurgery, Jiangsu Jiangyin People's Hospital, Wuxi, China.

16. July 2017, *Neurocritical Care Informatics*, Department of Neurosurgery, Wuxi No. 2 People's Hospital, Wuxi, China.

17. July 2017, *Model-based Patient Monitoring*, Wuxi Regional Government, Wuxi, China.

18. March 2017, *Model-based data integration and analysis in the neurocritical care unit*, Neurosciences in Critical Care International Symposium, Washington, DC.

19. February 2017, *Cardiovascular Parameter Estimation: from microgravity to the intensive care unit*, Invited Keynote Lecture, Biomedical Research Day, Faculty of Medicine, American University of Beirut, Beirut, Lebanon.

20. February 2017, *Taking (small) mathematical models to the bedside for point-of-care personalized medicine*, Invited Keynote Lecture, Biomedical Engineering Winter School, Center for Advanced Mathematical Sciences, American University of Beirut, Beirut, Lebanon.

21. October 2016, *Viscoelastic properties of the cerebrospinal system*, International Hydrocephalus Imaging Working Group Meeting, International Hydrocephalus Conference, Cartagena, Colombia.

22. October 2016, *Taking (small) mathematical models to the bedside for point-of-care personalized medicine*, Institute for Computational Medicine, Johns Hopkins University, Baltimore, MD.

23. August 2016, *Low-cost Microelectronic Ultrasound System for Unobtrusive ABP Measurement*, NIBIB US/India Workshop on Developing Passive, Cuffless, and Noninvasive Blood Pressure Measurement Technologies, Orlando, FL.

24. July 2016, *Monitoring Intracranial Pressure Noninvasively*, Department of Neurosurgery, Boston Children's Hospital, Boston, MA.

25. May 2016, *The Importance of Pulsatility vs. Bulk Flow in the Pathogenesis of Hydrocephalus: A focused discussion*, International Hydrocephalus Imaging Working Group, American Society for Neuroradiology Annual Meeting, Washington, DC.

26. April 2016, *Public Databases Accelerate Progress in Patient Care: The MIT-BIH Arrhythmia Database and the MIMIC-II Experience*, Harvard University Radcliffe Institute for Advanced Studies, Workshop on Neurocritical Care Informatics: Leveraging Data and Models to Monitor and Understand the Physiology of the Injured Brain, Harvard University, Cambridge, MA.

27. April 2016, *Neurocritical Care Data Analytics and Physiologic Modeling*, Harvard University Radcliffe Institute for Advanced Studies, Workshop on Neurocritical Care Informatics: Leveraging Data and Models to Monitor and Understand the Physiology of the Injured Brain, Harvard University, Cambridge, MA.

28. December 2015, *The Problem of Patient Monitoring Alarms*, Winchester Hospital, Winchester, MA, USA.

29. November 2015, *Low-cost Microelectronic Ultrasound System for Unobtrusive Blood Pressure Monitoring*, National Institute for Biomedical Imaging and Bioengineering, National Institutes of Health, Bethesda, MD, USA.

30. July 2015, *Noninvasive Brain Monitoring*, Annual Meeting of the Brazilian Society for the Advancement of Science, São Carlos, Brazil.

31. July 2015, *Noninvasive Brain Monitoring*, University of São Paulo, Riberao Preto, Brazil.

32. March 2015, *Noninvasisve Intracranial Pressure Determination*, Philips Research North America, Briarcliff Manor, NY, USA.

33. January 2015, *Leveraging Data, Models, and Physiology for Improved Patient Care*, GE Global Research, Niskayuna, NY, USA.

34. December 2014, *Modeling, Model Identification, and Model Reduction for Applications in Biomedicine*, Department of Computer Science, University of Massachusetts Lowell, Lowell, MA, USA.

35. November 2014, *Integrative Neuromonitoring and Neurocritical Care Informatics*, Department of Neurology, Boston Medical Center/Boston University School of Medicine, Boston, MA, USA.

36. November 2014, *Mathematical Modeling for Improved Neurocritical Care*, Biomedical Engineering Society, Massachusetts Institute of Technology, Cambridge, MA, USA.

37. October 2014, *Microelectronic and Nanosystems in Medicine*, MTL¿30 Symposium, Microsystems Technology Laboratory, Massachusetts Institute of Technology, Cambridge, MA, USA.

38. October 2014, *Neurocritical Care Informatics: Leveraging data and models to understand the physiology of the injured brain*, Distinguished Lecture Series, Department of Electrical and Computer Engineering, Michigan State University, MI, USA.

39. May 2014, *Noninvasive, Model-based Intracranial Pressure Monitoring in Hydrocephalus Patients*, International Hydrocephalus Imaging Working Group, Annual Meeting of the American Society of Neuroradiology, Montreal, Canada.

40. May 2014, *Neurocritical Care Informatics, Noninvasive Intracranial Pressure Monitoring, and Transcranial Doppler Ultrasonography*, Stroke Service, Massachusetts General Hospital, Boston, MA.

41. January 2014, *Advanced Patient Monitoring – Addressing healthcare challenges through data integration* 12th MIT ILP Japan Conference, Tokyo, Japan. (also Nihon Kohden, Fuji Film, and Hitachi, Tokyo, Japan)

42. January 2014, *Neurocritical Care Informatics: Leveraging data and models to understand the physiology of the injured brain*, International Physiome Symposium 2014 – Towards Physiome-based Therapeutics, Korean Physiome Society, Seoul, Republic of Korea.

43. November 2013, *Noninvasive Intracranial Pressure Determination in Patients with Subarachnoid Hemorrhage*, 15th International Conference on Intracranial Pressure and Brain Monitoring, Singapore.

44. October 2013, *Whole Body Models, Model Exploration, Model Identification, and Model Reduction*, Cardiac Physiome Workshop, Bar Harbor, Maine.

45. May 2013, *Merging Models and Data to Improve Neurocritical Care*, Universidad Tecnologica Nacional, Buenos Aires, Argentina.

46. May 2013, *Modeling and Model Analysis in Patient Monitoring*, Invited keynote speaker, IV Congress of Applied, Computational and Industrial Mathematics, Society for Industrial and Applied Mathematics (SIAM), Buenos Aires, Argentina.

47. January 2013, *Noninvasive Intracranial Pressure Monitoring: Fiction or Reality?*, Boston University/Boston Medical Center Joint Neurology-Neurosurgery Grand Rounds, Boston, MA.

48. December 2012, *Challenges (and some solutions) in patient monitoring*, Samsung Advanced Institute of Technology, Yongin, South Korea.

49. November 2012, *Model-based noninvasive estimation of intracranial pressure*, Medical Electronics Workshop, National Taiwan University, Taipei, Taiwan.

50. September 2012, *Model-based neuromonitoring*, University of Maryland Shock Trauma Center, University of Maryland School of Medicine, Baltimore, MD, USA.

51. September 2012, *A frequency-domain approach to model-based noninvasive intracranial pressure estimation from arterial blood pressure and cerebral blood flow velocity*, Mini-symposium on Information Derived from the Arterial Pressure Waveform and its Clinical Significance, IEEE Engineering in Medicine and Biology Conference, San Diego, CA, USA.

52. June 2012, *Model-based noninvasive intracranial pressure estimation*, Joint Grand Rounds presentation to the U.S. Army Medical Research and Materiel Command and the U.S. Army Telemedicine and Advanced Technology Research Center, Ft. Detrick, MA, USA.

53. July 2011, *Data sharing via PhysioNet*, Inaugural meeting of the Cerebrovascular Autoregulation Research Network, Imperial College London, UK.

54. July 2011, *Model-based brain monitoring*, Department of Neurosurgery, Addenbrooke's Hospital, University of Cambridge, UK.

55. May 2011, *Noninvasive Estimation of Intracranial Pressure*, Medical Electronic Device Realization Center Workshop, Massachusetts Institute of Technology, Cambridge, MA, USA.

56. September 2010, *Model-based Signal Processing for Patient-Monitoring Applications*, Department of Bioengineering, Politecnico di Milano, Milan, Italy.

57. August 2010, *Integrating Data, Models, and Reasoning in Critical Care: Developing the Next-Generation Patient Monitoring System*, Advanced Technology Applications in Combat Casualty Care Conference, St. Pete Beach, FL, USA.

58. May 2010, *Continuous Cardiac Output Estimation*, Annual Conference of the Pediatric Academic Societies, Vancouver, Canada.

59. April 2010, *Multiparameter Data Archiving — Implications for Outcome Analysis* Grand Rounds, Department of Anesthesia, Beth Israel Deaconess Medical Center, Boston, MA, USA.

60. October 2009, *Model-based Estimation in Biomedicine*, Workshop on Computational Challenges in Integrative Biological Modeling, Mathematical Biosciences Institute, Ohio State University, Columbus, Ohio, USA.

61. March 2009, *Caring for the Micro-Patient: Device Needs in the Neonatal Intensive Care Unit*, Microsytems Technology Laboratory, Massachusetts Institute of Technology, Cambridge, MA, USA.

62. February 2009, *Cardiac Output Estimation: A Signal Processing Perspective*, Workshop on Safe and Effective Devices for Use in the Neonatal Intensive Care Unit, Eunice Kennedy Shriver National Institute of Child Health and Human Development, National Institutes of Health, Washington, DC, USA.

63. August 2008, *Model-based Estimation in Biomedicine*, Department of Biotechnology, Indian Institute of Technology Madras, Chennai, India.

64. August 2008, *Subset Selection for Reduced-Order Parameter Estimation*, Society of Industrial and Applied Mathematics (SIAM) Meeting on Advances in Life Science, Montreal, Canada.

65. June 2008, *Modeling and Simulating Human Cardiovascular Response to Short-Radius Centrifugation*, Man-Vehicle Laboratory, Department of Aeronautics and Astronautics, Massachusetts Institute of Technology, Cambridge, MA, USA.

66. February 2008, *Modeling the Cardiovascular Response to Tilt, Lower Body Negative Pressure, and Short-radius Centrifugation*, Digital Friend Workshop, Deutsches Zentrum für Luft- und Raumfahrt, Institut für Luft- und Raumfahrtmedizin, Cologne, Germany.

67. September 2007, *Modeling Cardiovascular Function for Orthostatic Stress Simulations and Clinical Decision Support*, Short-term Cardio-Respiratory Regulation: Mathematical Modeling and Clinical Applications, Annual Meeting of the Biomedical Engineering Society, Los Angeles, CA, USA.

68. July 2007, *Modeling and Model Validation of the Cardiovascular Control System*, European Union Marie Curie Training Course and Workshop on Biomedical Modeling and Cardiovascular-Respiratory Control: Theory and Practice, Graz, Austria.

69. June 2007, *Computational Models of Cardiovascular Response to Orthostatic Stress*, Workshop on Model-based Estimation, Philips Research North America, Briarcliff Manor, NY, USA.

70. October 2006, *Modeling Complex Systems: The Cardiovascular System*, Workshop on Short-term Cardiovascular-Respiratory Control Mechanisms, American Institute of Mathematics, Palo Alto, CA, USA.

71. June 2006, *Next-generation Patient Monitoring for the Intensive Care Unit*, Division of Respiratory Medicine, Department of Medicine, Faculty of Medicine, National University of Singapore / National University Hospital, Singapore.

72. June 2006, *Next-generation Patient Monitoring for the Intensive Care Unit*, Neurosurgical Intensive Care Unit, National Neuroscience Institute, Singapore.

73. June 2006, *Model-based Integrative Monitoring in the Intensive Care Unit*, Medical Computing Laboratory, School of Computing, National University of Singapore, Singapore.

74. June 2006, *Integrating Data, Models, and Reasoning in Critical Care*, School of Computing, National University of Singapore, Singapore.

75. June 2006, *Computational Models of Cardiovascular Function for Simulation, Data Integration, and Clinical Decision Support*, 2nd Annual Symposium of the Korean Physiome Society, Chuncheon, Republic of Korea.

76. August 2005, *Computational Models of Cardiovascular Function for Simulation, Data Integration, and Clinical Decision Support*, USRA Digital Astronaut Workshop, NASA Ames Research Center, Mountain View, CA, USA.

77. July 2005 *Computational Models of Cardiovascular Response to Orthostatic Stress*, Mini-symposium on Cardiovascular and Respiratory Control Models, 6th Society of Industrial and Applied Mathematics (SIAM) Meeting on Control and Its Applications, New Orleans, LA, USA.

78. January 2005, *Computational Models of Cardiovascular Function for Simulation, Data Integration, and Clinical Decision Support*, NASA Bioastronautics Investigators' Workshop, Galveston, TX, USA.

79. October 2004, *Computational Models of Cardiovascular Response to Orthostatic Stress*, Man Vehicle Laboratory, Department of Aeronautics and Astronautics, MIT, Cambridge, MA, USA.

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