BIOGRAPHICAL SKETCH

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NAME: Jacobs, Peter G.

eRA COMMONS USER NAME (credential, e.g., agency login): petejacobs

POSITION TITLE: Assistant Professor, Department of Biomedical Engineering

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Swarthmore College, Swarthmore PA	B.S.	1995	Engineering
University of Wisconsin, Madison, WI	M.S.E.E.	1998	Electrical and Computer Engineering
Oregon Health & Science University	Ph.D.	2010	Electrical Engineering

A. Personal Statement

My background is in the field of electrical and computer engineering with a focus on biomedical engineering applications. My lab is researching, designing, and translating novel medical devices and systems for use by patients with type 1 diabetes within natural living environments. Current members of my lab include 2 PhD students, 3 full time engineers, a post-doctoral scholar, a senior scientist, and a clinical coordinator funded off of grants from NIH on which I am either PI (3 grants) or co-investigator (3 grants). We have numerous projects ongoing within my laboratory, which fit broadly within the following two areas (1) medical device and algorithm development primarily in the area of diabetes technologies and (2) ubiquitous computing for delivering home-based health care solutions. A primary objective of the laboratory is to create new technologies and translational science discoveries that can be used to improve patient care and health outcomes. A number of our discoveries and engineering development efforts have resulted in licensing to commercial partnerships and through our own spin-off companies including a recent phase 2 STTR involving the development and commercialization of a mobility assessment system called Fio. My colleagues and I have also participated as co-founders of Pacific Diabetes Technologies, a Portland start-up developing a glucose sensing catheter. Results from this and other work have generated several key publications relevant to the field.

1. Jacobs PG, Resalat N, El Youssef J, Reddy R, Branigan D, et al. Incorporating an exercise detection, grading, and hormone dosing algorithm into the artificial pancreas using accelerometry and heart rate. *Journal of diabetes science and technology*, 9(6): 1175-1184, 2015.
2. Castle JR, El Youssef J, Bakhtiani PA, Cai Y, Stobbe JM, Branigan D, Ramsey K, Jacobs P, Reddy R, Woods M, Ward, KM. Effect of Repeated Glucagon Doses on Hepatic Glycogen in Type 1 Diabetes: Implications for a Bi-Hormonal Closed-loop System. *Diabetes care*, 38(11): 2115-9, 2015.
3. Jacobs PG, El Youssef J, Castle J, Bakhtiani P, Branigan D, Breen M, Bauer D, Preiser N, Leonard G, Stonex T, Ward WK. Automated control of an adaptive bihormonal, dual-sensor artificial pancreas and evaluation during inpatient studies. *IEEE Trans Biomed Eng*. 2014 Oct;61(10):2569-81. doi: 10.1109/TBME.2014.2323248. Epub 2014 May 13. PubMed PMID: 24835122; PubMed Central PMCID: PMC4175028.
4. Gilligan, B.J., Shults M., Rhodes, B., Jacobs, P.G., Brauker, J.H., Pintar, T.J., Updike, S.J. Feasibility of continuous long term glucose monitoring from a subcutaneous glucose sensor in humans. *Diabetes Technology and Therapeutics*. 2004;6(3)378-386.

B. Positions and Honors

Positions and Employment

1995-1997 Associate Engineer, Lockheed Martin Corporation, Denver, CO
1997-2000 Hardware/Software Design Engineer, Markwell, Medical Corporation, Madison, WI
1998-2001 Founder and President, CyberCivic LLC, Madison, WI
2000-2002 Software Manager, Dexcom Inc., Madison, WI / Portland, OR
2002-2004 Director of Engineering, iSense Corporation, Portland Oregon
2002- Principal, Jacobs Technologies LLC, Portland, OR
2005-2010 Biomedical Engineer, National Center for Rehabilitative Auditory Research Portland VA Medical Center, OR
2007- Principal / founder, EmbedRF LLC, Portland OR
2011- Co-founder, Pacific Diabetes Technologies Inc., Portland OR
2011- Research Investigator, National Center for Rehabilitative Auditory Research Portland VA Medical Center, OR
2011- Assistant Professor in the Department of Otolaryngology at the Oregon Health & Science University
2012- Assistant Professor in the Department of Biomedical Engineering at the Oregon Health & Science University

Other Experience and Professional Memberships

1992- Member Instutute of Electrical and Electronics Engineers (IEEE)
2005- Member IEEE Signal Processing Society (includes Transactions on Speech & Audio Processing)
2007- Member IEEE Engineering in Medicine and Biology Society
2008- Member of the American Auditory Society
2009- Member of the Acoustical Society of America

Patents

2003 U.S. Patent #6,558,321: "Systems and methods for remote monitoring and modulation of medical devices"
2012 U.S. Patent #8,317,700: "Method and Device for Non-Invasive Analyte Measurement".
2011 U.S. Patent #7,976,466: "Use of Multiple Data Points and Filtering in an Analyte Sensor"
2011 U.S. Patent #8,810,388: "Position tracking and mobility assessment system"
2011 U.S. Patent Pending (61/570382): A dual-use subcutaneous catheter for ameperometric glucose sensing and hormone delivery
2013 U.S. Patent #9,480,418: Systems and methods for hearing loss screening and monistoring
2014 U.S. Patent Pending (8810388): Passive in-home estimation of gait velocity from motion sensors

Honors

1995 Tau Beta Pi Engineering Honor Society
1995 Sigma Xi Research Honor Society
1995 Graduated from Swarthmore College with Distinction

Committees and Conference Organization

2012-2013 Program co-chair, National Center for Rehabilitative Auditory Research Biennial Conference, "Beyond the audiology clinic: innovations and possibilities of connected health"
2012-2015 ORCATECH Executive Committee

Membership in Professional Societies

1992-present Member Instutute of Electrical and Electronics Engineers (IEEE)
2005-present Member IEEE Signal Processing Society (includes Transactions on Speech & Audio Processing)
2007-present Member IEEE Engineering in Medicine and Biology Society
2008-present Member of the American Auditory Society
2009-present Member of the Acoustical Society of America

Granting Agency Review Work

2006 Ad hoc reviewer: IEEE Signal Processing Letter
2010-present Reviewer for Office of Naval Research STTR Grant Proposals and progress reports.
2010-present Reviewer for Office of Naval Research STTR Grant Proposals and progress reports.
2013-present Department of Education, RERC center grants and training grants reviewer

2014 NIH, Bioinformatics study section

Editorial and Ad Hoc Review Activities

IEEE Transactions on Biomedical Engineering
IEEE Sensors
Diabetes Obesity and Metabolism
Diabetes Technology and Therapeutics
IEEE Signal Processing Letter
Neuroscience Letters
Audiology & Neurotology
Electronics
Processes
International Journal of Nonlinear Dynamics and Control

Research: 70%, Teaching/Mentoring: 25%, Administration: 5%

C. Contribution to Science

1. Diabetes technology and artificial pancreas research: A major area of research within my laboratory is on the topic of bihormonal artificial pancreas (AP) design, development, and evaluation. I am co-PI along with endocrinologist Dr. Jessica Castle on a grant titled "Mitigating risk in a closed loop system by exercise detection and miniaturization" (NIH/NIDDK 1DP3DK101044-01). This is a grant in which we are attempting to solve two of the major issues preventing successful widespread use and commercialization of an AP. The issues that we address in this grant are (1) handling exercise as a disturbance to closed loop control and (2) miniaturizing the AP and reducing the components required for a wearable AP. When a person with type 1 diabetes exercises, there can be clinically significant changes (increases) to their insulin sensitivity and to glucose uptake within their body that can lead to hypoglycemia (low blood sugar) both during and post-exercise. An AP needs to be able to detect and grade the exercise so as to properly adjust dosing of insulin and glucagon to help avoid such hypoglycemic events. We have described this technical algorithm recently (Jacobs et al. 2015). We concluded a 21-patient study that involves patients with T1D using our bihormonal AP for 22 hours that showed that the automated glucagon and insulin dosing during and following exercise described above reduced hypoglycemia compared with no adjustment of doing (Jacobs et al. 2016). We also recently published a new model predictive control algorithm that includes an exercise model to reduce exercise-induced hypoglycemia (Resalat et al. 2016). On the integration and miniaturization front, we are developing an integrated glucose sensing catheter that will be capable of delivering both hormones through a single catheter while sensing glucose using a printable enzyme sensor printed directly on the catheter (Du et al. 2015). Now rather than requiring two pump catheters and a sensor inserted subcutaneously, only a single sensing-catheter must be inserted. We plan to test this in year 4 of our grant in Q2 of 2017. This technology is being developed in collaboration with a company that I have cofounded called Pacific Diabetes Technologies (Portland).
    5. Jacobs P, El Youssef J, Reddy R, Resalat N, Branigan D, Condon J, Castle J, Randomized trial of a dual-hormone artificial pancreas with dosing adjustment during exercise compared with no adjustment and sensor-augmented pump therapy. *Diabetes, Obesity, and Metabolism*, in press 2016.
    6. Bakhtiani, P., El Youssef, J., Jacobs P.G., Branigan, D., Castle, J., Ward, K., Factors affecting the success of glucagon delivered during an automated closed-loop system in type 1 diabetes, *Journal of Diabetes and its Complications*, 2015, 29(1), 93-98. PMID: 25264232
    7. Du X, Durgan CJ, Matthews DJ, Motley JR, Tan X, Pholsena K, Armadottier L, Castle JR, Jacobs PG, Cargill RS, Ward WK, Conley JF, Herman GS. Fabrication of a Flexible Amperometric Glucose Sensor Using Additive Processes. *ECS J. Solid State Sci. Technol*. 2015; 4(4):3069-3074
    8. Resalat, N., El Youssef, J.E., Reddy, R., Jacobs, PG. "Design of a dual-hormone model predictive control for artificial pancreas with exercise model", *Annual International Conference of the IEEE Engineering in Medicine and Biology Society in Orlando*, 2016, in press.
2. Ubiquitous sensing for in-home monitoring of mobility and falls: Besides diabetes, the other key focus area of my lab is in the area of ubiquitous sensing and adaptive intelligent systems for monitoring human behavior and health. We have received several grants in this area from NIH/NIA, Alzheimer's Association, and the Department of Veterans Affairs. Projects include automated and passive ways of tracking a person's movements around the home including gait to detect health anomalies, sickness, falls, or sensory changes (hearing changes, neuropathy changes etc). On one project, I am collaborating with Eric A. Wan, Ph.D., a research associate professor at Portland State University, to

develop a mobility assessment system for monitoring movement and activity within a home using wireless transceivers and an RF finger-printing technique (Jacobs et al. 2011, Wan et al. 2012, Paul et al. 2014). The system we are developing can track movement without requiring the person being tracked to wear any device. If the person being tracked chooses to wear a device, higher accuracy can be achieved using a small sensor worn on the body that tracks them as they move around the home using a time-of-flight measure in combination with a sigma-point Kalman filtering algorithm (Paul et al. 2011) A recent grant that has been awarded to our group in collaboration with Michelle Cameron, MD, is to use this tracking system to detect and localize falls in a natural living environment (Department of Veterans Affairs, Comprehensive Fall Prevention and Detection in MS, 1l01RX001831-01A1). This system has been spun off and licensed to a company that I co-founded called MotioSens (Portland OR).

9. Jacobs PG, Wan EA, Schafermeyer E, Adenwala F, Paul AS, Preiser N, Kayez J. Measuring in-home walking speed using wall-mounted RF transceiver arrays. *Conf Proc IEEE Eng Med Biol Soc.* 2014 Aug;2014:914-7. doi: 10.1109/EMBC.2014.6943740. PubMed PMID: 25570108; PubMed Central PMCID: PMC4288466.
10. Jacobs PG, Paul A. Wan EA. EmbedRF Position Tracking and Mobility Assessment System: A Low-power and Low-cost System for Indoor Pedestrian Tracking and Mobility Assessment. *The Institute of Navigation GNSS 2011*, Portland OR, September 2011, pp. 1409-1506. ISBN: 9781618394750
11. Shastry, S.C., Asgari, M., Wan, E.A., Leitschuh, J., Preiser, N., Folsom, J., Condon, J., Cameron, M., Jacobs, PG. 38th "Conext-aware fall detection using inertial sensors and time-of-flight transceivers", *Annual International Conference of the IEEE Engineering in Medicine and Biology Society in Orlando, 2016*, in press.
12. Paul, A.S., Wan, E.A., Schafermeyer,E., Adenwala, F., Preiser, N., Kaye, J., Jacobs, P.G. "MobileRF: A robust device-free tracking system based on a hybrid neural network HMM classifier." *The 2014 ACM International Joint Conference on Pervasive and Ubiquitous Computing, 2014*, 159-170 (nominated best paper). doi:10.1145/2632048.2632097

3. Other signal processing and machine learning: Also within the field of ubiquitous sensing, I am co-PI on a grant from NIH/NIHLB (2R01HL098621-04A1) titled "Unobtrusive measurement of sleep disordered breathing in the home" along with clinical co-PI Dr. Chad Hagen, assistant professor in the Department of Psychiatry at OHSU. In this grant, we are investigating whether passive sensors easily mounted on a bed, can passively monitor breathing disorders in people suffering from sleep apnea. We are developing custom load-cell based sensors that enable us to monitor individual breathing (Beattie et al. 2015), real-time heart rate, body position, and individual apneas with clinical precision, even when there is more than one person sleeping in the bed. We are using advanced signal processing and machine learning techniques including informed independent component analysis (ICA), reinforcement learning, and a number of supervised and semi-supervised techniques to better extract various physiologic parameters and match them with clinical diagnoses. Our machine learning and signal processing methods have also been applied towards multi-person tracking in a home (Schafermeyer et al. 2015), walking speed estimation using passive sensors (Rana et al. 2016), and automatic detection of loneliness using smart home sensors (Austin et al. 2016).

13. Beattie Z, Jacobs PG, Riley T, Hagen C. A Time-Frequency Respiration Tracking System using Non-Contact Bed Sensors with Harmonic Artifact Rejection. 37th *Annual International Conference of the IEEE Engineering in Medicine and Biology Society in MiCo*.: 8111-8184, 2015.
14. Schafermeyer, E., Wan, E., Samin, S., Zentzis, N., Preiser, N., Condon, J.P., Folsom, J., Jacobs, P.G., "Multi-Resident Identification using Device-free IR and RF Fingerprinting", *37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society in MiCo*, Milano Conference Center, Milano, Italy, August 25-29, 2015, 5481-4, doi: 10.1109/EMBC.2015.7319632.
15. Austin J, Dodge HH, Riley T, Jacobs PG, Thielke S, Kaye J, A Smart-home System to Unobtrusively and Continuously Assess Loneliness in Older Adults, *Journal of Translational Engineering in Health and Medicine*, in press 2016.
16. Rana R, Austin D, Jacobs P, Kaye J, Karunanithi M. Gait velocity estimation using time-interleaved between consecutive passive IR sensor activation, *IEEE Sensors Journal*, in press 2016. DOI: 10.1109/JSEN.2016.2577708.

Complete List of Published Work in MyBibliography:
http://www.ncbi.nlm.nih.gov/sites/myncbi/peter.jacobs.1/bibliography/46768741/public/?sort=date&direction=ascending

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D. Research Support

ACTIVE

DP3DK101044-01 (Jacobs, Castle) 09/30/13 - 06/30/17
NIH/NIDDK
Mitigating risk in a closed loop system by exercise detection and miniaturization
Role: PI
Annual Direct: $500,000
The objective of this project is to improve treatments for type 1 diabetes via optimization of a closed loop artificial pancreas system by 1) incorporating exercise detection to reduce the risk of hypoglycemia and 2) improving usability by reducing the number of system components.

R01 HL098621 (Jacobs, Hagen) 12/01/13 -12/31/16
NIH/NHLBI
Role: Co-PI
Annual Direct: $250,000
Unobtrusive measurement of sleep disordered breathing in the home
The major goal of this project is to develop algorithms for detecting sleep disordered breathing and sleep efficiency from unobtrusive bed sensor data.

1l01RX001831-01A1 (Cameron) 7/1/15 – 6/30/19
VA RR&D
Role: Co-I
Annual Direct: $250,000
The objective of this grant is to develop and evaluate a fall detection and localization system that my research team is currently developing. The evaluation will be within a cohort of patients with MS who tend to fall often.

Discovery & Development Partnership (Castle, Jacobs, Prestrelski) 1/1/16-12/31/17
JDRF
Role: Co-I
Annual Direct: $150,000
Non-aqueous glucagon formulation to enable outpatient studies with a bi-hormonal pump
The goal is to test a bi-hormonal closed-loop system utilizing two omnipods, one to deliver aspart insulin and one to deliver stabilized glucagon (formulated by Xeris) as compared to an insulin alone closed-loop system and as compared to standard of care (sensor-augmented pump) in the outpatient setting.

OHSU / OCTRI Catalyst Grant (Jacobs) 9/1/16-8/31/17
OHSU
Role: PI
Annual Direct: $75,000
iPancreas: Internet based on-demand artificial pancreas app-generator to accelerate clinical trials research
The objective of this project is to create a semi-custom app generator for people doing research on the AP to integrate their control algorithms, alerts, and semi-custom GUI into an Android-based artificial pancreas app using the OHSU iPancreas server.