

Kelilah Louise Wolkowicz, PhD

Assistant Professor of Mechanical Engineering

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Professional Preparation

Roger Williams University	Mechanical Engineering	B.S., 2012
The Pennsylvania State University Dissertation: Preparing the Automated Future for Wheelchair Users Through Motion Prediction and User Input -Based Intent Inference	Mechanical Engineering	M.S., 2016; Ph.D., 2018

Academic Appointments

2020 – Present	Assistant Professor	University of Massachusetts Lowell
2018 – 2020	Postdoctoral Fellow Biomedical Control of an Artificial Pancreas to Enhance Automated Insulin Delivery	Harvard John A. Paulson School of Engineering and Applied Sciences Harvard University

Honors and Awards

Participant in WPI STEM Faculty Launch Program Hosted by <i>Worcester Polytechnic Institute</i> , Worcester, MA	2019
Participant in Rising Stars in Mechanical Engineering Workshop Hosted by the <i>Massachusetts Institute of Technology</i> , Cambridge, MA	2018
Gabron Graduate Fellowship in Mechanical Engineering	2016
Participant in NextProf Fall Engineering Workshop Hosted by <i>University of Michigan College of Engineering</i> , Ann Arbor, MI	2015
National Science Foundation Graduate Research Fellow	2012 – 2015
Alpha Chi National College Honor Society – top 5% of students in Engineering	2010 – 2012
Kappa Mu Epsilon Math Honor Society	2010 – 2012
Roger Williams University Dean's List; Roger Williams University Honors Program (distinguished scholarly achievement); Provost Scholarship (distinguished scholarly achievement); Leadership Award (academic achievement and substantial dedication to creating an inclusive community)	2008 – 2012

Professional Interests

Research

Designing a STEM educational framework that addresses active learning pedagogies, pragmatic laboratory learning, and diversity in engineering. My expertise and experience include work with robotics, as well as dynamic systems and controls, which includes real-time embedded systems, mechanical system design, physiological data acquisition and analysis.

Teaching

Robotics/Mechatronics; Dynamic Systems and Controls; Engineering Design

Notable Projects

- Postdoctoral Fellow:** *'Development of a Microneedle-based Multi-sensor to Enhance Automated Insulin Delivery'* **2018 – present**
Harvard John A. Paulson School of Engineering and Applied Sciences, Cambridge, MA
Principle Investigator: Eyal Dassau, Ph.D.
 Researcher in the Doyle Group focusing on the biomedical control of an artificial pancreas system for automated insulin delivery for Type 1 diabetes (T1D).
- Automate treatment by artificially recreating the glucose-insulin feedback control loop.
 - Integrate measurements of insulin with glucose concentration from interstitial fluid to derive and validate patient-specific glucose-insulin interaction models.
 - Apply zone model predictive control to develop an algorithm that safely and effectively delivers insulin for healthy blood glucose management.
 - Design and integrate an estimator to predict values of continuous glucose measurements, insulin, cortisol, and lactate to better determine appropriate insulin dosage in the context of T1D.
- Graduate Research Fellow Masters/PhD Project:** *'Preparing the Automated Future for Wheelchair Users Through Present Motion Prediction and User Input-Based Intent Inference'* **2014 – 2018**
The Pennsylvania State University, University Park, PA | **Principle Investigator:** Sean Brennan, Ph.D.
 Researcher in the Precision Medical Instrument Design Lab and the Intelligent Vehicles and Systems Group focusing on the design and control of an autonomous wheelchair platform with the integration of the following:
- Coordinated motion events with user decision-making measurements via dual joysticks and biopotentials.
 - Implemented motion models for human control, open-loop kinematics, and closed-loop (PID) control.
 - Created algorithms for obstacle detection and avoidance.
 - Input/output monitoring via a joystick interface that can also be used in a simulated environment.
 - External position estimates via high fidelity sensor systems.
 - External position estimates via magnetometers; magnetic field measurements to quantify map variability.
 - Software-based fault detection.
 - **Published: ASME Journal of Dynamic Systems, Measurement and Control 141(12) (2019)**
 - **Published: 8 conference papers**
- Worked in multi-disciplinary teams and collaborate with faculty from various programs, including:
- The Penn State Engineering Science and Mechanics Department
 - The Penn State Center for Neural Engineering
 - The Department of Neurosurgery within the Penn State College of Medicine at Hershey Medical Center
- Graduate Research Fellow:** *'Controlled Flexible Microneedle Insertion'* **2012 – 2013**
The Pennsylvania State University, University Park, PA | **Principle Investigator:** Jason Moore, Ph.D.
 Researcher in the Precision Medical Instrument Design Lab for the design of minimally invasive medical instruments focusing on minimizing the deflection of a silicon microneedle during tissue insertion in order to control insertion force and overcome microneedle structural material limitation.
- Measured deflection thresholds using an ultrasonic distance sensor in conjunction with a feedback system to prevent fracturing.
 - Derived a mathematical model to calculate the deflection of a microneedle as a function of insertion force.
- Graduate Research Fellow:** *'Novel Pneumatic Device for High Speed Needle Insertion in Brachytherapy'* **2012 – 2013**
The Pennsylvania State University, University Park, PA | **Principle Investigator:** Jason Moore, Ph.D.
 Researcher in the Precision Medical Instrument Design Lab for the design of minimally invasive medical instruments focusing on the design of a novel pneumatic device using high-speed needle insertion to improve accurate needle placement in brachytherapy.
- Investigated insertion force experienced by tissue-based on needle insertion speed using a high-speed pneumatic device.

- Determined the optimum insertion speed to allow for improved needle placement accuracy.
- Summarized findings in a technical poster presentation at the annual Design of Medical Devices (DMD) Conference at the University of Minnesota in Minneapolis.
- **Published: Journal of Medical Devices 7(3), 030945 (Jul 03, 2013)**
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Materials Processing Center and Center for Materials Science and Engineering Research Intern: 2011

'Injectable pH Dependent MR Sensors'

The Massachusetts Institute of Technology, Cambridge, MA | **Principle Investigator:** Michael Cima, Ph.D.

Research intern at the David H. Koch Institute for Integrative Cancer Research focusing on the fabrication of injectable hydrogel devices to be implanted in/around tumor cells via a simple injection with no surgical intervention or large bore needles required.

- Compared a snap-on device, polymer discs, and injectable polymer that gels in-situ.
- Characterized injectable hydrogel devices via measurements of pH response and MRI images.
- Summarized analysis and presented findings in a technical poster presentation.

Institute for Energy and the Environment Environmental Design Contest: 2011 – 2012

'PROTEUS: Pretreatment for Reverse Osmosis That is Effective, User-friendly, and Safe'

Roger Williams University, Bristol, RI and *New Mexico State University*, Las Cruces, NM

Senior thesis project that developed and demonstrated a more sustainable alternative to disposable filters for pretreating turbid water prior to reverse osmosis desalination.

- Process addressed particle size down to 0.1 microns.
- Process predicted to endure for at least four months upon sea-going ships.
- **Awarded 2nd place for best overall research paper and most scalable design.**

Professional Society Memberships

The New York Academy of Sciences (NYAS) , Member	2017 –
American Society of Mechanical Engineers (ASME) , Member	2011 –
Institute of Electrical and Electronics Engineers (IEEE) , Member	2011 –
Society of Woman Engineers (SWE) , Member	2008 –

Educational Leadership

Teaching Experience

Lecturer, Tufts University, Medford, MA Spring 2020

ME 80 System Dynamics and Controls, a fully revised course introducing methods for analysis and control of dynamic systems.

- Restructuring, planning, organizing, and implementing the design of course format, including curriculum development, laboratory-based activities, homework assignments, team-based design projects, and enhancing lecture structure.

Teaching Fellow and Laboratory Instructor, Harvard University, Cambridge, MA 2016 – 2019

Harvard University: MS/MBA Engineering Sciences Technology Venture Immersion course, a newly designed intensive, hands-on, project-based course covering the engineering design process, as well as mechanical, electrical, and software prototyping.

The Pennsylvania State University: ME 340 Mechanical Engineering Design Methodology, a fully revised course covering the design process, problem definition, conceptual design, system design, detail design, evaluation and testing, implementation, documentation, and communication.

- Restructured, planned, organized, and implemented the design of course format, including curriculum development, laboratory activities, homework assignments, team-based design projects, and enhancing lab and lecture structure.

- Discussion leader and instructor for mechanical engineering laboratory sections of ~30 students with hands-on experience emphasizing the course objectives.
- Created laboratory presentations and activity guides to connect hand-on activities with lecture material.

Scientific Writing and Presentation Instructor, *The Pennsylvania State University*, University Park, PA **2017**
 Penn State's Leonhard Center for Enhancement of Engineering Education in collaboration with the Simula School of Research an Innovation (SSRI) and the University of Oslo, Norway

- Edited ten scientific papers (literature reviews, conference papers, journal papers, and PhD dissertations).
- Edited 13 written grant proposals.
- Reviewed and provided feedback for four proposal presentations.
- Instructed a workshop designed to help graduate students make their research communications more understandable, memorable, and persuasive.

Teaching Assistant, *The Pennsylvania State University*, University Park, PA **2015**
 ME/IE 456 Industrial Robot Applications, an introduction to robotics with emphasis on robot selection, programming, and economic justification for manufacturing applications.

- Demonstrated fieldwork techniques and assisted in preparing and presenting lectures.
- Explained the challenges of integrating sensor systems and reference coordinate transformations with robotic systems and designed a complimentary lab component for the final project.
- Evaluated homework, quizzes, exams, and lab milestones; held office hours to ensure students understand course concepts.

Science Tutor, *Roger Williams University*, Bristol, RI **2011 – 2012**
 Tutor for Physics I & II, Chemistry I & II, and Biology I.

Hebrew/Religious School Teacher, *Temple Beth Israel Rabin Religious School*, Plattsburgh, NY **2005 – 2008**
 Created weekly lesson plans to teach children ages 4-13 the Hebrew Aleph-Bet and used that knowledge to read and write Hebrew words and phrases; introduced and reviewed the moral concepts related to religious stories.

Pedagogical Training

Reimagining General Education: Design Thinking and Intrinsic Motivation Perspectives **2019**
Practical Ideas for Improving your Teaching Goals & Strategies: Active Learning and Backward Design **2018**
Promoting Diversity and Inclusion in STEM: Voices for Diversity in STEM Speaker Series; Project on Race & Gender in Science & Medicine **2018**
Community Engaged Learning in Engineering: Science of Learning Speaker Series **2018**
Harvard University, Cambridge, MA
The Future of Mechatronics & Robotics Education (FoMRE) Workshop **2018**
Dynamic Systems and Controls Conference, Atlanta, GA
Lecturing Can Be Active Learning: A New Evidence-Based Approach to an Old Debate **2018**
Ten Tips for Getting Started with Teaching Workshop **2018**
Teaching So All Your Students Are Included Workshop **2018**
Feeling Like a Fake: Overcoming the Imposter Phenomenon Workshop **2018**
Handling Challenging Situations in the Classroom Workshop **2018**
Getting through the Stack: Grading Fairly and Efficiently Workshop **2018**
Preparing a Teaching Demo for a Job Interview Workshop **2018**
Writing your Teaching Philosophy Statement Workshop **2017**
Schreyer Institute for Teaching Excellence, The Pennsylvania State University, University Park, PA

Advising and Mentoring

- Director and Mentor for over 10 Undergraduate Research Students** **2014 – 2019**
- Outlined research plans and undergraduate theses; edit publications and theses.
 - Provided weekly individual instruction, guidance, and research assistance.

Undergraduate Honors Theses Mentees

- Taylor E. Baum**, *Development of Assistive Technologies: Improvement of a Robotic Wheelchair Safety System and Integration of a Robotic Wheelchair with Biosensing Devices* (Recipient of NSF GRFP; Recipient of Goldwater Scholarship; Recipient of Astronaut Scholarship; Recipient of Pennsylvania Associate of Colleges and Employers (PennACE) JoAnne Day Student of the Year Award in STEM; Recipient of Penn State College of Engineering Research Initiative Grant; Recipient of Madden Honors Scholarship; Recipient of Doris N. McKinstry Scholarship; Recipient of Sinha Family Trustee Scholarship) Biology (Neuroscience Option) and Electrical Engineering, *The Pennsylvania State University*. (Current position: PhD candidate at the Massachusetts Institute of Technology) **2016 – 2018**
- Kathleen E. Blundi**, *In-Use Estimation of the Yaw-Rate Motion Output of a Wheelchair Using Joystick Inputs*, Mechanical Engineering (2017-2018) **2017 – 2018**
- Christopher X. Miller**, *A State-of-Charge Estimator for a Semi-Autonomous Electric Wheelchair*, (Recipient of NSF GRFP; Recipient of NDSEG; Recipient of Rodney A. Erickson Research Discovery Grant; Recipient of 3rd Place Penn State Engineering Undergraduate Research Symposium; Recipient of Penn State College of Engineering Research Initiative Grant; Recipient of PA Space Grant Consortium Summer Research and Travel Grant) Electrical Engineering, *The Pennsylvania State University*. (Current position: PhD candidate at Northwestern University) **2014 – 2016**
- Anthony Trezza**, *Simultaneous Localization and Mapping of Indoor Robots Using Permanent Magnetic Fields*, (Recipient of PA State Capitol Undergraduate Research Poster Conference) Mechanical Engineering, *The Pennsylvania State University*. (Current position: Lockheed Martin Advanced Technology Laboratories) **2014 – 2015**

Undergraduate Mentees

- Harvard University*: **Varuni Sarwal**, Biochemical Engineering **2019**
- The Pennsylvania State University*: **Joseph P. Chobot**, Electrical Engineering (ASRC Federal); **Yifeng (Carl) Shi**, Mechanical Engineering (NanTu Technology); **Dhananjay Bhaskar**, Mechanical Engineering (Merck); **Aditya Agarwal**, Computer Engineering (Microsoft); **Nadine Geagea**, Industrial and Manufacturing Engineering and Engineering Leadership Development (Recipient of Penn State College of Engineering Research Initiative Grant) (Flexport); **Colin Nitroy**, Mechanical Engineering, (The Pennsylvania State University Center for Exoplanets and Habitable Worlds); **Susmita Sanyal**, Computer Engineering, (Recipient of Penn State College of Engineering Research Initiative Grant) (iRobot); **Shen Li**, Computer Engineering (Recipient of Penn State College of Engineering Research Initiative Grant) (Current position: PhD candidate at the Massachusetts Institute of Technology) **2012-2018**
- Student Advocate**, *Roger Williams University*, Bristol, RI **2010 – 2012**
Mentored freshman and sophomores through their transition into college.

Professional Service

Educational Service

- Faculty Mentor DifferenceMaker**, engage UMass Lowell students in creative problem solving, innovation, and entrepreneurship **2020 –**
- Faculty Advocate River Hawks Scholars Academy (RHSA)**, promote academic success and foster active campus engagement for full-time, first year UMass Lowell students who identify as first-generation college students **2020 –**
- Faculty Advisor SWE UMass Lowell Chapter** **2020 –**

Leadership Experience

- President**, Mechanical and Nuclear Engineering Graduate Student Council **2016 – 2017**
- Chair of Athletics and Social Events**, Mechanical and Nuclear Engineering Graduate Student Council **2014 – 2016**

Vice President , Society of Women Engineers Roger Williams University Chapter	2010 – 2012
Secretary , Presidential Student Ambassadors	2009 – 2012
Representative of the school and the office of the university president, worked campus events.	
Engineering Ambassador	2009 – 2012
Assisted with tours and information sessions for perspective students and their families.	

Educational Outreach

Cambridge 8th Grade Science & Engineering Showcase	2019
Invited speaker for two groups of 200 middle school students on the “nonlinear trajectories” from middle school to college and beyond, as well as on current state-of-the-art artificial pancreas systems	
Discovery Space stEMPOWERed Girls	2018
Designed easy-to-understand hands-on mechatronics and virtual environment activities to promote Mechanical Engineering to an after school girl’s program.	
Penn State Exploration-U	2014 – 2018
Designed easy-to-understand hands-on activities to promote STEM education in local schools.	
Penn State Artificial Intelligence vs. Science-U Summer Camp	2014 – 2015
Assisted with teaching programming and ground robotic control algorithms to high school students.	
Volunteer at Shaver’s Creek Environmental Center	2013 – 2018
Volunteer for the annual Fall Harvest Festivals, Maple Harvest Festivals, and general trail maintenance.	

Invited Lectures and Presentations

The Intersection between Engineering and Healthcare: Robotic Wheelchairs and an Artificial Pancreas	2020
Invited speaker for the Roger Williams University Marine & Natural Science Seminar Series; invited to speak with the current NSF S-STEM scholarship students following the seminar	
Cambridge 8th Grade Science & Engineering Showcase	2019
Invited speaker for two groups of 200 middle school students on the “nonlinear trajectories” from middle school to college and beyond, as well as on current state-of-the-art artificial pancreas systems	

Technical Publications and Presentations

Edited Book Chapter

K. Wolkowicz, F. J. Doyle, III, E. Dassau, “Control of Drug Delivery for Type 1 Diabetes Mellitus,” In: Baillieul J., Samad T. (eds) *Encyclopedia of Systems and Control*. Springer, London. 2020. https://doi.org/10.1007/978-1-4471-5102-9_100058-1

Peer Reviewed Journal Publications

E. Aiello, **K. Wolkowicz**, J. Pinsker, E. Dassau, F. J. Doyle III, “A novel model-based estimator for real-time prediction of insulin-on-board.” To appear in *Chemical Engineering Science*.

E. Aiello, S. Deshpande, B. Ozaslan, **K. Wolkowicz**, E. Dassau, F. J. Doyle III, “Review of Automated Insulin Delivery Systems for Individuals with Type 1 Diabetes: Tailored Solutions for Subpopulations.” *Current Opinion in Biomedical Engineering*. June 2021; 19: 100312. <https://doi.org/10.1016/j.cobme.2021.100312>

K. Wolkowicz, E. Aiello, E. Vargas, H. Teymourian, F. Tehrani, J. Wang, J. Pinsker, F. J. Doyle III, M-E. Patti, L. Laffel, E. Dassau, “A Review of Biomarkers in the Context of Type 1 Diabetes: Biological Sensing for Enhanced Glucose Control,” *Bioengineering & Translational Medicine*, e10201, 2020. <https://doi.org/10.1002/btm2.10201>

K. Wolkowicz, R. Leary, J. Moore, S. Brennan, “Statistical Determination of Decision-Making Regions for Branching Paths: An Algorithm with a Wheelchair Assistance Application,” *ASME Letters of Dynamic Systems and Control*, 1(1):1-6, 2020. <https://doi.org/10.1115/1.4046578>

K. Wolkowicz, J. Pentzer, C. Miller, J. Moore, S. Brennan, "An Instantaneous Center of Rotation-Based Extended Kalman Filter Approach for the On-Line Estimation of Wheelchair Tire Slip," *ASME Journal of Dynamics Systems, Measurement and Control*, 141(12), 2019.

K. Wolkowicz, J. Moore, P. McLaughlin, "Novel Pneumatic Device for High Speed Needle Insertion in Brachytherapy," *Journal of Medical Devices*, 7(3):030945, 2013.

Peer Reviewed Conference Proceedings

K. Wolkowicz, S. Deshpande, F. J. Doyle, III, E. Dassau, "Towards Insulin Monitoring: Infrequent Kalman Filter Estimates for Diabetes Management," to appear in *Proceedings of IEEE 2020 International Federation of Automatic Control* (Berlin, Germany).

K. Wolkowicz, R. Leary, J. Moore, S. Brennan, "Real-Time Path-Based Fusion of Spatial Databases with Temporal Control Inputs for Assistive Operation of Wheelchairs," *Proceedings of ASME 2019 Dynamic Systems and Control Conference* (Park City, UT).

K. Wolkowicz, R. Leary, J. Moore, S. Brennan, "Discriminating Spatial Intent from Noisy Joystick Signals for Wheelchair Path Planning and Guidance," in *Proceedings of ASME 2018 Dynamic Systems and Control Conference* (Atlanta, GA), V003T37A010.

T. Baum, **K. Wolkowicz**, S. Brennan, "Negative Obstacle Detection Using LiDAR Sensors for a Robotic Wheelchair," in *Proceedings of ASME 2018 Dynamic Systems and Control Conference* (Atlanta, GA), V003T37A011.

H. Sun, J. Liu, **K. Wolkowicz**, X. Zhang, B. Gluckman, "Low-Cost, USB Connected and Multi-Purpose Biopotential Recording System", in *Proceedings of IEEE Engineering and Medicine and Biology Society Conference 2018* (Honolulu, HI), pp. 4359-4362.

K. Wolkowicz, J. Pentzer, C. Miller, J. Moore, S. Brennan, "On-Line Estimation of Wheelchair Tire Slip Utilizing an Instantaneous Center of Rotation Extended Kalman Filter," in *Proceedings of ASME 2016 Dynamic Systems and Control Conference* (Minneapolis, MN), V001T06A002.

C. Miller, **K. Wolkowicz**, J. Safi, S. Brennan, "State of Charge Estimation for an Electric Wheelchair Using a Fuel Gauge Model," in *Proceedings of ASME 2016 Dynamic Systems and Control Conference* (Minneapolis, MN), V001T06A005.

A. Trezza, N. Virani, **K. Wolkowicz**, J. Moore, S. Brennan, "Indoor Mapping and Localization for a Smart Wheelchair Using Measurements of Ambient Magnetic Fields," in *Proceedings of ASME 2015 Dynamic Systems and Control Conference* (Columbus, OH), V003T42A005.

Presentations

K. Wolkowicz, E. Vargas, H. Teymourian, F. Tehrani, J. Pinsker, M. Church, M. Piper, F. J. Doyle III, M-E. Patti, L. Laffel, J. Wang, E. Dassau, "Towards Point-of-Care Devices: First Evaluation of an Insulin Immunosensor for Types 1 Diabetes", selected oral abstract presentation at the *American Diabetes Association's 80th Scientific Sessions*, Chicago, IL, Jun. 12-16, 2020.

V. Sarwal, **K. Wolkowicz**, S. Deshpande, J. Wang, J. Pinsker, L. Laffel, M.E. Patti, F. Doyle III, E. Dassau, "Investigating Effects of Insulin Estimation on Future Insulin Sensors' Design and Implication for Diabetes Management", poster presented at *Advanced Technologies & Treatments for Diabetes*, Madrid, Spain, Feb. 19-22, 2020.

K. Wolkowicz, H. Sun, A. Geronimo, Z. Simmons, B. Gluckman, J. Moore, S. Brennan. "Establishing a correlation between left/right brain signals and left/right joystick motion using simulated and real-world robotic wheelchair guidance," poster presented at the *4th ASU Rehabilitation Robotics Workshop*, Arizona State University, Tempe, AZ, Feb. 8-9, 2016.

K. Wolkowicz, "Novel Pneumatic Device for High Speed Needle Insertion in Brachytherapy," poster presented at the *2013 Design of Medical Devices Conference, University of Minnesota*, Minneapolis, MN, Apr. 2013.
