



## Education

### **University of California Berkeley**

Ph.D. Mechanical Engineering, Design  
M.S. Mechanical Engineering, Design

expected May 2021  
May 2018

### **Iowa State University**

B.S. Mechanical Engineering, Magna Cum Laude, Honors Program

December 2015

## Research Experience

### **Flexible Electronics, Devices, and Systems Lab**

*NSF Graduate Fellow*

2017-current

- Designed FPC printed interconnects and device architecture for a biodegradable wireless sensor node (modules in development)
- Developed a novel photothermal process to create conductive graphene/metal-ion hybrid structures within biodegradable substrates
- Co-wrote an accepted ARPA-E grant valued at \$1.69m

### **Advanced Manufacturing for Energy Lab**

*Graduate Student Researcher*

2016-2018

Master's Thesis: Model-based design and fabrication of a flexible closed-loop heating element for wearable comfort applications

- Optimized low-power thermistor ink slurries for electrical conductivity, rheology, surface profile, and overall performance with a factorial design of experiments
- Designed plastic wireless sensor node (WSN) packaging that adhere to DFM and DFA theory
- Wrote a custom finite element (FEM) code to compute heat generation to explore the design space of parametric device designs
- Wrote a genetic algorithm to search through the FEM results and find the best design based on the weighted value of several device features (cost of fabrication, size, efficiency, operating temperature)
- Developed and demonstrated a multi-material additive process to create low-cost (<\$1) wearable heaters with optimized thermal feedback control for consumer electronics. These devices were 99.6% accurate to the predicted values of the self-written design algorithm and self-written FEM simulation
- Designed and built a wind tunnel to characterize a microturbine energy harvester's flow profile and power output for powering remote sensing of data centers
- Prototyped a thermal capacitor to harvest energy from ambient temperature changes of an aircraft in flight
- Prototyped a suite of wirelessly-powered personal thermal-comfort devices including a heated insole, desktop fan, and wrist pad

### **Bio- Microfluidics and Optofluidics Laboratory**

*Undergraduate Student Researcher*

2012-2015

- Designed, fabricated, and characterized microfluidic microbial fuel-cells ( $\mu$ MFC) and environmental sensors
- Programmed NI data acquisition devices in LabVIEW
- Developed the first multilayered microfluidic channel templates using layer-by-layer LaserJet printing on thermoplastic sheets
- Fabricated hollow polymer microfibers from a microfluidic device without chemical or UV light cross-linking for biological cell growth
- Created Mastercam and manually-written G-code toolpaths to carve microfluidic channel templates that match COMSOL Multiphysics simulation with a vertical 3-axis micro-mill

### **Center for Catalysis**

*Undergraduate Student Researcher*

2013

- Synthesized silicon-core/carbon-shell structured platinum nanocatalysts by performing colloidal lithography on silicon core-shell nanoparticles with three separate carbon sources
- Installed an electrochemical workstation and developed a comprehensive step-by-step operation procedure for battery, fuel cell, and catalyst characterization for oxygen reduction and methanol oxidation half-cell reactions

## Industry Experience

### **HGA Architects & Engineers**

*Mechanical Design Engineer*

2014-2016

- Generated macro-scale energy models to optimize performance of large scale (100,000+ ft<sup>2</sup>) hospitals
- Automated AIA/ASHRAE minimum design performance calculations in an Excel spreadsheet, now used as standard company-wide

# Publications

## **Journals (Refereed)**

J.M. Lackore, N. Hashemi, F. Sharifi, **P.J. Goodrich**, M.L. Winchell, and N. Hashemi, "A Paper-Based Microbial Fuel Cell Operating under Continuous Flow Condition", *Technology*, 4, 98-103 (2016).

**P.J. Goodrich**, F. Sharifi, and N. Hashemi, "Rapid Prototyping of Microchannels with Surface Patterns for Fabrication of Polymer Fibers", *RSC Advances*, 5, 71203-71209 (2015).

J. Yang, S. Ghobadian, **P.J. Goodrich**, R. Montazami, and N. Hashemi, "Miniaturized Biological and Electrochemical Fuel Cells: Challenges and Applications", *Physical Chemistry Chemical Physics*, 15, 14147-14161 (2013). **Featured as Key Scientific Article on Renewable Energy Global Innovations.**

## **Conference Presentations**

**P.J. Goodrich**, A. Arias. "Model-based design and fabrication of micro- and milli- scale devices", Berkeley Wireless Research Center Summer 2018 Retreat, Sonoma, CA, May 24, 2018.

**P.J. Goodrich**, G. Fierro, V. Luu, H. Zhang, E. Arens. "Heating and cooling the human body with wirelessly-powered devices", PowerMEMS 2017, Kanazawa, Japan, November 14-17, 2017.

**P.J. Goodrich**, P. Wright. "Wireless Personal Comfort Devices", Berkeley Wireless Research Center Summer 2017 Retreat, Sonoma, CA, May 26, 2017.

**P.J. Goodrich**, M. Kiziriglou, P. Wright. "Dynamic Thermoelectric Generators for Powering Wireless Sensor Nodes", Berkeley Wireless Research Center Winter 2016 Retreat, Berkeley, CA, November 1, 2016.

**P.J. Goodrich**, F. Sharifi, and N. Hashemi. "Microfluidic channels for fabricating biocompatible polycaprolactone microfibers", Department of Energy Ames Laboratory Summer Science Intern Poster Presentation, Ames, IA, July 31, 2015.

**P.J. Goodrich**, F. Sharifi, and N. Hashemi. "Fast and Affordable Fabrication of Microfluidic Mold Templates with Complex Multilayer Geometry", ASME 2015 4th Global Congress on NanoEngineering for Medicine and Biology, Minneapolis, MN, April 19-22, 2015.

**P.J. Goodrich**, N. Hashemi, M. Winchell, J. Lackore, F. Sharifi, and N. Hashemi. "A Continuous Flow Paper-Based Microfluidic Microbial Fuel Cell", ASME 2015 4th Global Congress on NanoEngineering for Medicine and Biology, Minneapolis, MN, April 19-22, 2015.

**P.J. Goodrich**, C. Xiao, Z. Qi, and W. Huang. "Synthesis of Carbon Coated Platinum Nanocatalysts for Methanol Oxidation and Oxygen Reduction Reactions", Department of Energy Ames Laboratory Summer Science Intern Poster Presentation, Ames, IA, August 2, 2013.

## Awards and Honors

### **Academic**

National Science Foundation Graduate Research Fellowship  
Summer Grant Award and Block Grant Award  
Scholar of the Year  
Intro to Mechanical Design - Final Design Competition Award  
Inducted into the Golden Key International Honour Society  
Inducted into the Iowa State University Honors Program  
President's Award for Competitive Excellence  
Engineering Undergraduate Merit Award

National Science Foundation, 2017  
University of California Berkeley, 2017  
Sigma Pi Fraternity, 2015  
Iowa State University, 2013  
Golden Key, 2013  
Iowa State University, 2013  
Iowa State University, 2011  
Iowa State University, 2011

### **Miscellaneous**

Received blue belt in Brazilian jiu-jitsu  
Bring Back the Prairies Award  
OUSA Poetry Prize  
Richard Caplan Sketch Prize for Poetry

Bay Jiu-Jitsu, 2017  
League of Minnesota Poets, 2015  
Otago University Student Association, 2014  
Iowa State University, 2013

### Skills

DFA, DFE, DFM, HCD, LCA  
Solid modelling, FEM, simulation, and CAD  
Data processing and analysis  
Rapid prototyping  
Optimization of materials and processing  
Geometric dimensioning  
Mask design and lithography  
Failure and useful life analysis

### Software

Matlab  
Autodesk Suite  
SolidWorks Suite and ANSYS  
LaTeX  
Microsoft Office  
Adobe Illustrator and Photoshop  
COMSOL Multiphysics  
LabVIEW

### Equipment

3d-printers (Carbon, Makerbot, Objet, Stratasys, TypeA, Ultimaker)  
ULS and Fortec laser cutters  
Automatic film applicator, inkjet printer, screen printer, spin coater, and spray coater  
Rheometer and profilometer  
Oscilloscope, LCR probe, and 4-point probe  
Cleanroom and glovebox equipment  
Machine shop tools and CNC

## Graduate Level Coursework

Advanced system dynamics and controls  
Computer-aided design  
The finite element method  
Interdisciplinary design  
Modeling and simulation of advanced manufacturing processes

Advanced technical communications  
Design of basic electromechanical devices  
Human-centered design  
Mechanics of engineering materials  
Piezoelectric MEMS

Alternative energy  
Engineering economic analysis  
Interactive device design  
MEMS design (levels I and II)  
Principles of electrochemical processes

# Volunteerism & Social Design

## **Laboratory research mentorship**

*Research Mentor*

2017-current

- Managed and mentored five spectacular undergraduate students to date in mechanical engineering, material science, electrical engineering, computer science, and applied mathematics.
- Projects:
  - Printed complex electronics using laser-induced graphene and multi-material 3d-printing
  - Printed biodegradable humidity sensors
  - Printed water-purification cathodes
  - Magnetic field sensors by laser-induced graphene coils on polyimide
  - Product design of thermal comfort devices for the built environment
- Skills:
  - Laser-induced graphene synthesis and characterization
  - Electroactive ink and hydrogel synthesis
  - Doctor blade and stencil printing
  - Profilometry, optical microscopy, LCR probe, 4-point probe, clean room techniques and etiquette
  - CAD design and 3d-printing strategies for prototyping
  - Geometric tolerancing for 3d-printed and plastic injection molded snap-fit assemblies

## **Jacob's Institute for Design Innovation Student Advisory Board**

*Board Member*

2017-current

- Bi-annual review of 'spark' and 'ignite' grant proposals to finance student-led projects that align with the Jacob's Institute for Design Innovation mission statement (approximately 75 proposals reviewed to date).
- Participate in strategic planning and program development of the UC Berkeley's Jacob's Hall Maker Community, representing the opinions, needs, and interests of the student body

## **Students for Environmental Energy Development (SEED)**

*Tutor*

2016-2017

- Lead bi-weekly science experiments in an integrated high school physics class
- Planned curriculum and purchased supplies for a group science fair project

## **Engineers for a Sustainable World**

*President*

2015

- Led monthly all-hands meetings and bi-weekly meetings with six different project managers to ensure project success
- Initiated four new local development projects to grow unrepresented demographics and tripled club size

*Solar-powered light project manager*

2012-2014

- Led a team of multidisciplinary engineers to develop a low-cost solar/grid hybrid powered street light which was installed on campus and in rural Nicaragua

## **Minds of Tomorrow**

*Outreach Coordinator*

2011-2013

- Organized STEM outreach projects and demos to K-12 schools across Iowa
- Reviewed grant proposals to fund STEM projects