

# Matthew D. Murbach

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## Education

University of Washington SEATTLE, WASHINGTON  
**Ph.D. in Chemical Engineering + Adv. Data Science Option** 2013 – 2018  
Thesis: *Linear and Nonlinear Electrochemical Impedance Spectroscopy for Lithium-ion Batteries*  
Advisor: Professor Daniel T. Schwartz  
Committee: Prof. David Beck, Prof. Venkat Subramanian, and Prof. Devin MacKenzie

University of California, San Diego LA JOLLA, CALIFORNIA  
**B.S. in Chemical Engineering — Cum Laude** 2009 – 2013  
GPA – 3.76    Huppert Memorial Outstanding Senior

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## Experience

Battery Informatics, Inc. SEATTLE, WASHINGTON  
**Cofounder and Chief Technology Officer** 2015 – 2018

- Developed testing and analysis framework for advanced battery diagnostics using battery cycling and impedance spectroscopy.
- Built BMS software and remote monitoring, developed diagnostic protocol for “second-use” batteries, and installed 10kWh lithium-ion system to provide storage for a solar microgrid.

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## Research

Graduate Researcher *January 2014 – present*  
**Advisor: Professor Daniel T. Schwartz (UW Chemical Engineering)**

- Developing experimental methods and computational techniques for probing the internal state of lithium-ion batteries using nonlinear EIS (NLEIS).
- Building open-software tools to enable deeper insight from experimental impedance analysis. Developer of [impedance.py](#) and the [ImpedanceAnalyzer](#).

Undergraduate Researcher *Spring 2012*  
**Advisor: Professor Todd Martz (UCSD Scripps Institute of Oceanography)**

- Developed an automated, photometric method for precise titration of calcium in sea water
- **Skills:** RS-232 communication, LabVIEW, data analysis, titration

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## Select Presentations

- **M. D. Murbach** and D. T. Schwartz, “(Invited) Open-Software Tools for the Analysis of Electrochemical Impedance Spectra”, [234th Electrochemical Society Meeting](#) (Cancun, Mex) October 2018
- **M. D. Murbach** and D. T. Schwartz, “Data science tools for the physics-based analysis of lithium-ion battery impedance spectra”, [UW Chemical Engineering Department Seminar](#) (Seattle, WA) February 2018
- **M. D. Murbach** and D. T. Schwartz, “Commercializing battery management and diagnostics: From UW research to cleantech startup.”, [2+2 Clean Energy Forum](#) (Chengdu, Sichuan, China) September 2017
- **M. D. Murbach** and D. T. Schwartz, “Unlocking Insights into Battery Systems: A Data Science Approach to Impedance Analysis.”, [231st Electrochemical Society Meeting](#) (New Orleans, LA) May 2017
- **M. D. Murbach** and D. T. Schwartz, “Linear and Nonlinear Electrochemical Impedance Spectroscopy: A Data Science Perspective.”, [230th Electrochemical Society Meeting](#) (Honolulu, HI) October 2016

## Publications and Patents

- **M. D. Murbach**,<sup>1</sup> V. W. Hu,<sup>2</sup> and D. T. Schwartz. Nonlinear electrochemical impedance spectroscopy of lithium-ion batteries: Experimental approach, analysis, and initial findings. *Journal of The Electrochemical Society* 165, A2758–A2765 (2018). doi: [10.1149/2.0711811jes](#).
- M. Pathak, **M. D. Murbach**, C. Pathak, T. Jang, Y. Qi, D. T. Schwartz, and V. R. Subramanian. Fast Impedance Simulation of Lithium-Ion Batteries with Pseudo-Two Dimensional Electrochemical Models. *Journal of The Electrochemical Society* 165, A1324–A1337 (2018). doi: [10.1149/2.0831805jes](#).

- **M. D. Murbach** and D. T. Schwartz. Analysis of Li-ion battery electrochemical impedance spectroscopy data: An easy-to-implement approach for physics-based parameter estimation using an open-source tool. *Journal of The Electrochemical Society* 165, A297–A304 (2018). doi: [10.1149/2.1021802jes](https://doi.org/10.1149/2.1021802jes).
- **M. D. Murbach** and D. T. Schwartz. Extending Newman’s Pseudo-Two-Dimensional Lithium-Ion Battery Impedance Simulation Approach to Include the Nonlinear Harmonic Response. *Journal of The Electrochemical Society* 164, E3311–E3320 (2017). doi: [10.1149/2.0301711jes](https://doi.org/10.1149/2.0301711jes).
- M. R. Sarker, **M. D. Murbach**, D. T. Schwartz and M. A. Ortega-Vazquez. Optimal Operation of a Battery Energy Storage System: Trade-off between Grid Economics and Storage Health. *Electric Power Systems Research* 152, 342–349 (2017). doi: [10.1016/j.epsr.2017.07.007](https://doi.org/10.1016/j.epsr.2017.07.007).
- **M. D. Murbach** and D. T. Schwartz, Electrochemical cell diagnostic systems and methods using second order and higher harmonic components, *US App. No. PCT/US2016/022119*, filed on March 11, 2016.

## Awards and Honors

- **2018 Lawrence Award**, UW Chemical Engineering *June 2018*
- **2018 CEI Clean Energy Prize**, UW Environmental Innovation Challenge *March 2018*
- **Forbes’ 30 Under 30 2018: Energy**, Forbes *November 2017*
- **Best Clean Energy Research Poster**, UW Graduate Student Symposium *September 2016*
- **Honorable Mention**, UW Environmental Innovation Challenge *April 2015*
- **Data Science IGERT Fellowship**, US National Science Foundation *August 2014*
- **GAANN Fellowship**, US Department of Education *March 2014*
- **Clean Energy Institute Fellowship**, UW Clean Energy Institute *December 2013*

## Teaching and Mentorship

- Teaching Assistant**, University of Washington *Winter and Spring 2015*  
**CHEM E 497: Special Projects in Chemical Engineering Design**
- Undergraduate special senior design course using Chemical Engineering principles to design businesses and products by commercializing lab research.
  - Prepared and taught weekly lectures, mentored students in lab research, organized group meetings, evaluated coursework and research progress, and led teams participating in multiple UW business plan competitions. Directly mentored 4 students (16 total).
- Add’l Undergraduates Mentored: Matthew Canin, Stephanie Reusch, Cleo Tsang, and Alek Lazarski

## Outreach and Service

- Co-organizer**, [Electrochemical Society Data Science Hack Week](#) *May 2018*
- ECS Hack Week was a week-long event at the 233rd ECS Meeting in Seattle, WA focused on building an electrochemical data sciences and open source community through a mix of introductory and advanced tutorials as well as open-source project “hacking” to create new tools and data sets. ([OSF Page](#))
  - Organized invited speakers, ran attendee application and selection, and developed [Python and Open Science curriculum](#).
- Co-organizer**, [Electrochemical Society Hack Day 2017](#) *October 2017*
- Founding Chair**, [ECS@UW](#) (Electrochemical Society Student Chapter) *2015 – 2017*
- Started an ECS student chapter at the UW with the mission of bringing together students, postdocs, and faculty interested in electrochemistry and solid-state science across campus.
  - Organized biweekly educational meetings where students teach students, professional development events to help students prepare for academic and non-academic jobs, as well as “[Enginearrings](#)” demonstrations to increase excitement in STEM at local science fairs.

## Add’l Memberships and Interests

**Memberships:** [Diversity in Clean Energy](#), [Women in Chemical Engineering](#), [The Electrochemical Society](#)  
**Interests:** hiking/camping, learning new languages, cooking vegetarian food, tinkering with electronics