Stanford

Ross Weber

Ph.D. Student in Energy Resources Engineering, admitted Spring 2019

Bio

BIO

I am a PhD Student and Research Assistant at Stanford University in Energy Science and Engineering. My research focus is improving electrochemical Lithium-ion battery models through first-principles physics and machine learning. The models I create give accurate real-time predictions of battery health and can improve safety and cycle life.

Additionally, I work as a Battery Performance Analyst for a tech startup called Greenvolt Nano, which uses advanced nanotechnology to improve energy storage and create a unibody structural battery. I use experimental results and numerical simulations to quantify battery performance metrics and improve the product.

I graduated from Vanderbilt University ('17) as a double major in Mechanical Engineering and Economics. There, I was a part of a national award-winning Aerospace Engineering team (VADL) where we designed, built, and launched 2 rockets for the NASA Student Launch Competition that used cold-gas thrusters to control the rotation of the rocket during flight.

HONORS AND AWARDS

- Frank G. Miller Fellowship Award, Department of Energy Resources Engineering, Stanford University (May 2018)
- Special Research Recognition Award, Department of Mechanical Engineering, Vanderbilt University (May 2017)
- Educational Engagement Award, NASA Student Launch Competition (April 2017)
- Payload Design Award, NASA Student Launch Competition (April 2017)
- Rocket Fair Presentation Award, NASA Student Launch Competition (April 2017)

PROFESSIONAL AFFILIATIONS AND ACTIVITIES

- Social Chair, SPE (2019 - present)
- Treasurer, SPE (2018 - 2019)

EDUCATION AND CERTIFICATIONS

- M.S., Stanford University , Energy Resources Engineering (2019)
- B.E., Vanderbilt University , Mechanical Engineering & Economics (2017)

PERSONAL INTERESTS

Skiing, Basketball

LINKS

- LinkedIn: https://www.linkedin.com/in/ross-weber/

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

I combine machine learning and physics-based modeling to develop algorithms for quantifying microstructural effects in Lithium-ion battery electrodes in computationally efficient ways. This can enable Battery Management Systems (BMS) to access real-time microscale information, which can allow for optimal battery control for improved safety and prolonged lifetime.

I have developed a framework for predicting electrochemical transport coefficients from XCT/SEM images of an electrode microstructure using a Convolutional Neural Network (CNN). The CNN accurately and quickly computes effective properties so that the BMS can capture the effects of cycling and aging during operation. This framework combines first-principles physics and machine learning algorithms to efficiently characterize microscructure properties, and it achieves significantly higher accuracy than conventional methods.

Additionally, I investigate uncertainty in electrochemical models of Li-ion batteries, such as the enhanced Single Particle Model (eSPM). I have developed a novel method for analytically quantifying model uncertainty ("process noise"). This method is derived by observing the truncation error when going from fully resolved pore-scale models to simplified ones, and it also takes into account the parametric uncertainty that results from heterogeneities in the microstructure. This method has been applied in both an extended Kalman Filter (EKF) and Bayesian Filter (BF) to predict state-of-charge (SOC) in real-time from current and voltage measurements.

LAB AFFILIATIONS

- Ilenia Battiato, Multiscale Physics in Energy Systems Group (9/25/2017)

Professional

WORK EXPERIENCE

- Project Management, Engineering & Diagnostics Intern - SoCore Energy (May 2015 - August 2017)
- Design Engineer - Vanderbilt Aerospace Design Lab (August 2016 - May 2017)
- Commercialization Intern - Vanderbilt Center for Technology Transfer and Commercialization (September 2016 - April 2017)
- Research & Design Intern - Argonne National Laboratory (May 2014 - August 2014)

Publications

PUBLICATIONS

- **Process noise quantification in Kalman filters with application to electrochemical Lithium-ion battery state estimation**
  Weber, R. M., Spragg, R., Hoffmann, K., Onori, S., IEEE
  IEEE.2019: 1995–2000

PRESENTATIONS

- Estimation of Li-Ion Battery Effective Properties through Convolutional Neural Networks - SIAM Conference on Computational Science and Engineering (CSE19) (March 1, 2019)
- Process noise quantification in Kalman filters with application to electrochemical Lithium-ion battery state estimation - IEEE International Symposium on Industrial Electronics (ISIE2019) (June 12, 2019)