

Sravan Pannala, Ph.D.

Research Fellow, Battery Control Lab, University of Michigan · Ann Arbor, Michigan

spannala@umich.edu · 858-291-2835 · ORCID 0000-0002-1847-6854 · linkedin.com/in/sravan-pannala

RESEARCH SUMMARY

My research links battery degradation to the dimensional changes it causes. I develop physics-based models that predict capacity loss, resistance growth, and irreversible expansion together across cycling conditions they were not trained on, along with the low-cost measurement hardware that makes expansion data available at scale. This work spans reduced-order electrochemical modeling, accelerated lifetime simulation, electrode state-of-health estimation, and sensor design.

EDUCATION

Ph.D., Mechanical Engineering 2025

University of Michigan, Ann Arbor, MI

- Dissertation: Modeling of Capacity, Resistance, and Expansion of Lithium-ion Batteries as they Degrade: Linking Expansion and Degradation (advisors: Jason B. Siegel, Anna G. Stefanopoulou)

M.S., Mechanical Engineering 2019

University of Michigan, Ann Arbor, MI

B.Tech., Mechanical Engineering 2015

Indian Institute of Technology Madras, Chennai, India

RESEARCH EXPERIENCE

Research Fellow Jan 2025 – Present

Battery Control Lab, University of Michigan

- Technical lead and proposal co-author on a \$206K MTRAC award to commercialize low-cost inductive expansion sensing for battery formation diagnostics, taking the sensor from a retired first-generation design to a fab-ready four-layer board with STM32 firmware, CAN-bus integration, and on-cell temperature measurement.
- Built and validated a 20-channel formation measurement rig: 99.95% logging completeness over an 18.4-hour unattended run, a 0.005–0.065 μm noise floor that sits 21–380 $\times$ below the movement it must resolve, and a signal-to-noise ratio of 199–1,542 $\times$ on the first live cell measurements.
- Diagnosed a 15% duplicate-row defect in the logging path from its data fingerprint alone and closed it in twelve lines, taking 100,072 rows to zero duplicates.
- Ran a two-session sensor calibration campaign six weeks apart and showed the response is 1.9 $\times$ nonlinear over 0.15 in (a linear fit misreads by up to 376 μm), establishing that a three-point quadratic with a per-fixture zero and a temperature term is required.
- Designed an 80-cell round-two test plan across four cathode/anode chemistry combinations, and wrote the operator run-book that let a month-long, non-repeatable formation campaign proceed while away.
- Developed physics-based calendar and cycling aging models for high-nickel cells under an industry sponsorship, including a vacancy-assisted cation-mixing mechanism that cut positive-electrode capacity-loss error by 59% across 18 storage conditions.
- Audited PyBaMM's lithium-plating models, showed an apparent C-rate inversion to be a voltage-cutoff artifact rather than a rate-law failure, and reported a genuine defect upstream to the maintainers: plating with no thermodynamic driving force, reproducing in 34 of 34 configurations.
- Mentoring graduate students on battery model development.

Graduate Research Assistant

Jun 2017 – Jan 2025

Battery Control Lab, University of Michigan

- Developed a physics-based degradation model that predicts capacity loss, resistance increase, and irreversible thickness growth together from a single consistent tuning, and validated it against cycling conditions it was never trained on.
- Linked cell-level mechanical expansion to the underlying degradation mechanisms (SEI growth, lithium plating, and particle fracture), making thickness a usable diagnostic signal rather than a nuisance.
- Designed and deployed a low-cost inductive expansion sensor and constant-pressure fixture, instrumenting 120 channels and monitoring 100+ cells simultaneously over two years at roughly 1/40th the cost per channel of the lab standard.
- Built an accelerated aging simulation method that resolves intra-cycle degradation while extrapolating between cycles, cutting lifetime simulation from days to minutes.
- Developed nonlinear observers estimating battery state from combined voltage, temperature, and expansion measurements under aging-induced parameter uncertainty.
- Contributed to a health-conscious optimal fast-charging framework.

Graduate Student Instructor

Jan 2020 – Dec 2024

University of Michigan

- Instructed control systems coursework across three years, authoring problem sets grounded in practical battery applications including pack balancing.
- Redesigned course logistics for online-only delivery during the pandemic, introducing weekly quizzes that measurably improved engagement.

Assistant Manager

Jun 2015 – May 2017

Energo Engineering Projects Limited

- Led on-site performance testing of thermal power plants.
- Analysed plant data to diagnose performance shortfalls.
- Ran cost-benefit analysis on efficiency improvement options.

FUNDING AND COMMERCIALIZATION

Democratizing battery expansion measurements

2025–2026

MTRAC Advanced Transportation, Michigan Economic Development Corporation / Michigan Strategic Fund · Technical lead and proposal co-author · PI Prof. Jason B. Siegel

- Translating low-cost inductive expansion sensing out of the lab and toward manufacturing use. Formation is where the SEI first grows, and it shows up as the cell's first irreversible expansion; measured on every cell, it can reveal defects and let formation protocols be shortened. Selected through a competitive process ending in an in-person pitch to an oversight committee of industry and venture professionals.
- Co-wrote the funded proposal and lead the technical programme: sensor hardware revisions, calibration and temperature correction, and the formation and cycle-life measurement campaign behind it.
- Built the market and competitive analysis, identifying research and pilot-scale labs as the beachhead where the cost gap matters most.
- Exploring licensing and startup pathways for the technology. No entity has been formed.

Customer discovery for battery expansion measurement

2026

NSF I-Corps Great Lakes, National Science Foundation · Entrepreneurial Lead

- Completed the University of Michigan Summer 2026 cohort, running 11 customer-discovery interviews across cell manufacturing and battery research to test the market hypotheses behind the expansion sensor.

PUBLICATIONS

14 peer-reviewed publications · 378 citations · h-index 10 · i10-index 12 (Google Scholar, Aug 2026)

Journal articles (5)

1. Z. Wan, A. Weng, **S. Pannala**, H. Movahedi, T. R. Garrick, G. J. Offer, J. B. Siegel, A. G. Stefanopoulou. Managing silicon burn-out via onboard material diagnostics for durable high-energy density batteries. *Joule*, 2026
2. Z. Wan, **S. Pannala**, C. Solbrig, T. R. Garrick, A. G. Stefanopoulou, J. B. Siegel. Degradation and expansion of lithium-ion batteries with silicon/graphite anodes: Impact of pretension, temperature, C-rate and state-of-charge window. *eTransportation* 24, 2025 · doi:10.1016/j.etrans.2025.100416
3. H. Movahedi, **S. Pannala**, J. B. Siegel, S. J. Harris, D. Howey, A. G. Stefanopoulou. Extra throughput versus days lost in V2G services: Influence of dominant degradation mechanism. *J. Energy Storage* 104, 2024
4. **S. Pannala**, H. Movahedi, T. R. Garrick, A. G. Stefanopoulou, J. B. Siegel. Consistently tuned battery lifetime predictive model of capacity loss, resistance increase, and irreversible thickness growth. *JES* 171(1) 010532, 2024 · doi:10.1149/1945-7111/ad1294
5. V. Sulzer, P. Mohtat, **S. Pannala**, J. B. Siegel, A. G. Stefanopoulou. Accelerated battery lifetime simulations using adaptive inter-cycle extrapolation algorithm. *JES* 168(12), 2021 · doi:10.1149/1945-7111/ac3e48

Peer-reviewed conference papers (9)

1. H. Movahedi, A. Weng, **S. Pannala**, J. B. Siegel, A. G. Stefanopoulou. The case for DeepSOH: Addressing path dependency for remaining useful life in Li-ion batteries. *IFAC* 58(28), 2024
2. C. Wong, A. Weng, **S. Pannala**, J. Choi, J. B. Siegel, A. G. Stefanopoulou. Differential voltage analysis and patterns in parallel-connected pairs of imbalanced cells. *ACC* 2024, 2024
3. H. Movahedi, **S. Pannala**, J. B. Siegel, A. G. Stefanopoulou. Physics-informed optimal experiment design of calendar aging tests and sensitivity analysis for SEI parameter estimation in lithium-ion batteries. *IFAC* 56(3), 2023
4. **S. Pannala**, V. Sulzer, J. B. Siegel, A. G. Stefanopoulou. Methodology for accelerated inter-cycle simulations of Li-ion battery degradation with intra-cycle resolved degradation mechanisms. *ACC* 2022, 2022 · doi:10.23919/acc53348.2022.9867654
5. **S. Pannala**, A. Weng, I. Fischer, J. B. Siegel, A. G. Stefanopoulou. Low-cost inductive sensor and fixture kit for measuring battery cell thickness under constant pressure. *IFAC* 55(37), 2022 · doi:10.1016/j.ifacol.2022.11.266 · **Best Paper Runner-Up**

6. A. Weng, **S. Pannala**, J. B. Siegel, A. G. Stefanopoulou. Parallel-connected battery current imbalance dynamics. *IFAC* 55(37), 2022 · doi:10.1016/j.ifacol.2022.11.158
7. P. Mohtat, **S. Pannala**, V. Sulzer, J. B. Siegel, A. G. Stefanopoulou. An algorithmic safety VEST for Li-ion batteries during fast charging. *IFAC* 54(20), 2021
8. **S. Pannala**, P. Valecha, P. Mohtat, J. B. Siegel, A. G. Stefanopoulou. Electrochemical battery state estimation under parameter uncertainty caused by aging using expansion measurements. *ACC* 2021, 2021 · doi:10.23919/acc50511.2021.9482886
9. T. Cai, **S. Pannala**, A. G. Stefanopoulou, J. B. Siegel. Battery internal short detection methodology using cell swelling measurements. *ACC* 2020, 2020 · doi:10.23919/acc45564.2020.9147956

Preprints (2)

1. H. Movahedi, A. Weng, **S. Pannala**, J. B. Siegel, A. G. Stefanopoulou. The case for DeepSOH: Addressing path dependency for remaining useful life. *arXiv*, 2024
2. H. Movahedi, **S. Pannala**, J. B. Siegel, S. J. Harris, D. Howey, A. G. Stefanopoulou. Extra throughput versus days lost in load-shifting V2G services: Influence of dominant degradation mechanism. *arXiv*, 2024

Thesis (1)

1. **S. Pannala**. Modeling of capacity, resistance, and expansion of lithium-ion batteries as they degrade: Linking expansion and degradation. *Ph.D. thesis*, 2025

Conference abstracts and presentations (12)

Non-archival meeting abstracts presented at ECS meetings.

1. Z. Wan, A. Weng, **S. Pannala**, H. Movahedi, T. R. Garrick, G. J. Offer, J. B. Siegel. On-board estimation of silicon burn-out in lithium-ion batteries with silicon-graphite composite anodes. *ECS Meeting Abstracts 249, 2026*
2. H. Movahedi, **S. Pannala**, J. B. Siegel, A. G. Stefanopoulou. Benefit-to-harm ratio for bulk vehicle-to-grid services using a lifetime degradation digital twin. *ECS Meeting Abstracts 245, 2024*
3. **S. Pannala**, H. Movahedi, A. G. Stefanopoulou, J. B. Siegel. (Invited) Lifetime predictive model of capacity loss, resistance increase, and irreversible thickness growth. *ECS Meeting Abstracts 245, 2024*
4. J. B. Siegel, **S. Pannala**, Z. Wan, A. G. Stefanopoulou, M. Jones, T. R. Garrick. Modeling degradation to predict capacity and cell-level reversible and irreversible expansion throughout life across various cycling conditions. *ECS Meeting Abstracts PRiME 2024, 2024*
5. V. Tran, X. H. Ooi, **S. Pannala**, A. G. Stefanopoulou, J. B. Siegel. (Invited) Impact of preload compression and aging on high-temperature Li-ion battery pouch cell venting. *ECS Meeting Abstracts PRiME 2024, 2024*
6. Z. Wan, **S. Pannala**, H. Movahedi, C. Wong, C. Solbrig, J. B. Siegel. Impact of pretension and cycling window on degradation of graphite/silicon composite anodes. *ECS Meeting Abstracts 245, 2024*
7. E. Olide, **S. Pannala**, V. Tran, H. Movahedi, J. B. Siegel, A. G. Stefanopoulou. On the unique parameterization of a single particle model using EIS and HPPC tests. *ECS Meeting Abstracts 243, 2023*
8. **S. Pannala**, E. Olide, R. Mollah, M. Jones, E. Efimoff, T. R. Garrick, S. T. Dix. An experimental correlation of degradation with cell reversible and irreversible expansion measurement in pouch cells. *ECS Meeting Abstracts 243, 2023*
9. **S. Pannala**, E. Olide, J. B. Siegel. Using reference electrodes to validate parameterization of individual electrode SOH in the single particle model with electrolyte. *ECS Meeting Abstracts 243, 2023*
10. **S. Pannala**, J. B. Siegel, A. G. Stefanopoulou. Impact of data window on prediction of battery aging and swelling. *ECS Meeting Abstracts 242, 2022*
11. V. Sulzer, P. Mohtat, **S. Pannala**, J. B. Siegel, A. G. Stefanopoulou. Fast simulations of lithium-ion battery degradation. *ECS Meeting Abstracts 240, 2021*
12. **S. Pannala**, M. Zhang, J. B. Siegel, G. B. Less, A. G. Stefanopoulou. Mechanical measurements for early detection of thermal runaway induced by an internal short circuit. *ECS Meeting Abstracts 233, 2018*

PATENTS

1. A. G. Stefanopoulou, V. Sulzer, P. Mohtat, **S. Pannala**, J. B. Siegel. Accelerated battery lifetime simulations using adaptive inter-cycle extrapolation algorithm. US App. 18/122,361 (pending), 2023.
2. A. G. Stefanopoulou, J. B. Siegel, **S. Pannala**, T. Cai, M. Zhang. Detection of an internal short circuit in a battery. US 11,355,824 B2, 2022.

INVITED TALKS AND PRESENTATIONS

1. Beyond voltage: Battery expansion measurement for optimizing formation and enhancing safety. Next-Gen Diagnostics session, 2026 (invited)
2. Battery expansion measurement for formation optimization. NAATBatt Annual Meeting, Tucson, AZ, 2026
3. A vacancy-assisted cation-mixing model for high-Ni cells: Capturing non-monotonic NMC811 calendar aging across state of charge. PyBaMM Conference 2026, 2026
4. Optimizing Li-ion battery formation through in-situ expansion measurement. SAE WCX 2026, Detroit, MI, 2026 (poster)
5. Modeling of capacity, resistance, and expansion of lithium-ion batteries as they degrade. Ph.D. dissertation defense, University of Michigan, 2025
6. Battery expansion as a lifetime diagnostic. Electric Vehicle Center Symposium, University of Michigan, 2025 (poster)
· Best Poster

7. Lifetime predictive model of capacity loss, resistance increase, and irreversible thickness growth. 245th ECS Meeting, 2024 (invited)
8. Tuning a degradation model against capacity, resistance, and expansion. Modeling, Estimation and Controls Conference, 2024 (poster)
9. Impact of preload compression and aging on high-temperature Li-ion pouch cell venting. PRiME 2024 (ECS), 2024 (invited)
10. Methodology for accelerated inter-cycle simulations of Li-ion battery degradation. American Control Conference, 2022
11. Low-cost inductive sensor and fixture kit for measuring battery cell thickness under constant pressure. Modeling, Estimation and Controls Conference, 2022 · Best Paper Runner-Up
12. Electrochemical battery state estimation under parameter uncertainty caused by aging. American Control Conference, 2021

HONORS AND AWARDS

2025: Best Poster, Electric Vehicle Center Symposium, University of Michigan

2022: Best Paper Runner-Up, Modeling, Estimation and Controls Conference (MECC). Low-cost inductive sensor and fixture kit for measuring battery cell thickness

2021: Best Paper Runner-Up, Modeling, Estimation and Controls Conference (MECC)

2010: KVPY Scholar, Department of Science and Technology, Government of India. National fellowship for scientific research aptitude

2008: National Cyber Olympiad, 8th nationally, Science Olympiad Foundation, India

2007: Infosys Catch Them Young, Infosys. Selected for technology leadership programme

TECHNICAL SKILLS

Modeling & simulation: PyBaMM, Reduced-order electrochemical models (SPM, SPMe, DFN), Degradation and lifetime modeling, Parameter estimation, State estimation and nonlinear observers, Optimal control

Programming: Python, MATLAB, Simulink, C/C++, R, Git, Linux

Data & ML: NumPy, pandas, SciPy, scikit-learn, JAX, PyTorch, Large-scale test-data pipelines

Experimental & hardware: Battery cycling and characterization (EIS, HPPC, RPT), Expansion and pressure measurement, Sensor and fixture design, Arduino, Raspberry Pi, LabVIEW, Voltaiq, SolidWorks

TEACHING AND MENTORING

Research mentor, Battery model development

2022, 2023, 2024, 2025, 2026

Battery Control Lab, University of Michigan

- Mentoring graduate and undergraduate researchers on battery modeling, expansion measurement, and test-stand instrumentation.

Graduate Student Instructor, Control systems

2020, 2021, 2024

University of Michigan

- Authored problem sets grounded in practical battery applications including pack balancing; redesigned course logistics for online-only delivery during the pandemic.

SERVICE AND OUTREACH

Maintainer, ARM edition, EndeavourOS

2020–present

- Develop and maintain the ARM edition of the EndeavourOS Linux distribution for Raspberry Pi and Odroid N2+.

Reviewer, Journal of The Electrochemical Society · Ionics · IEEE Transactions

2024–present

- Manuscript review on battery degradation modeling, internal-short detection, and low-temperature aging.

Open-source contributor, PyBaMM

2026

- Identified a reproducible defect in the lithium-plating submodels and reported it to the maintainers with a minimal reproducing case: plating proceeds with no thermodynamic driving force, across 34 of 34 cell, model, and temperature combinations.

Battery advisor, University of Michigan Solar Car Team

2018–2021

- Supported safe battery pack testing and characterization, and monitored pack data for voltage mismatch and cell-level safety limits.

Coordinator, Sustainability Network, IIT Madras

2013–2015

- Led e-waste awareness and collection initiatives.

Volunteer, Tau Beta Pi, University of Michigan

2018–2020

- Instructor for middle-school science camps; blood drive volunteer.