Hamidreza Movahedi (Hamid)

Curriculum Vitae

Postdoctoral Researcher, Department of Electrical Engineering, Eindhoven University of Technology
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Academic Appointments

Postdoctoral Researcher, Eindhoven University of Technology, The Netherlands *2026 – present*
Control Systems Group, Department of Electrical Engineering.

- Develop physics-based battery models and parameter estimation methods for on-board battery management systems, with attention to compute and memory constraints.
- Work on early fault detection and state-of-safety estimation to support controlled derating.

Postdoctoral Research Fellow, University of Michigan, Ann Arbor, USA *2022 – 2026*
Department of Mechanical Engineering, with Prof. Anna G. Stefanopoulou.

- Modeled and simulated degradation of Li-ion batteries during Vehicle-to-Grid (V2G) services and evaluated benefits and harm of joining these services for EV owners. Introduced the Throughput vs. Days Lost (TvD) metric.
- Modeled mechanical degradation of Li-ion batteries due to fatigue during cycling, and contributed to a unified physics-based model of capacity fade, resistance growth, and expansion.
- Analyzed observability of degradation models during calendar aging tests and designed optimal experiments for accurate parameter estimation.
- Modeled, analyzed, and devised estimation techniques to detect and quantify internal short circuits in parallel-connected cells using an Interacting Multiple Model framework.
- Developed a dynamic-system-oriented approach (deepSOH) to analyze degradation of Li-ion batteries, introducing measurements that resolve mechanism-level health states for remaining useful life prediction.

Graduate Research Assistant, University of Minnesota, Twin Cities, USA *2017 – 2022*
Department of Mechanical Engineering, with Prof. Rajesh Rajamani.

- Designed a nonlinear observer to estimate state-of-charge of Li-ion batteries using terminal voltage and bulk force measurements; demonstrated improved performance over EKF. Designed a hybrid observer for non-monotonic outputs in collaboration with the University of Michigan.
- Modeled hysteresis in Li-ion batteries using a modified Preisach model and showed that hysteresis compensation improves state-of-charge estimation, in collaboration with the University of Kansas.
- Conducted experiments and designed estimation techniques to estimate position in smart actuators using magnetometers, and developed a methodology for optimal sensor placement.
- Demonstrated the necessity of switched-gain observers for non-monotonic dynamic systems.
- Analyzed COVID-19 data in Minnesota to model disease spread and estimate the basic reproduction number.

Research Assistant, Sharif University of Technology, Tehran, Iran *2010 – 2013*
Department of Mechanical Engineering.

- Dynamically modeled a pressure-compensated swash plate pump and simulated flow rate in the compensation spool valve. Analyzed effects of valve dimensions on the working curve, response time, and oscillations of the pump.

Education

Ph.D. in Mechanical Engineering, University of Minnesota, Twin Cities, USA *2017 – 2022*
Advisor: Prof. Rajesh Rajamani | Cumulative GPA: 4.0/4.0
Thesis: Observer Design for Non-Monotonic Nonlinear Systems and Interesting Contemporary Applications.

M.Sc. in Mechanical Engineering, Sharif University of Technology, Tehran, Iran *2010 – 2013*
GPA: 18.01/20
Thesis: Modeling and Sensitivity Analysis of a Pressure-Compensated Swash Plate Pump.

B.Sc. in Mechanical Engineering, Sharif University of Technology, Tehran, Iran *2005 – 2010*
GPA: 17.30/20
Thesis: Finite Element Analysis of a Car Seat During Crash.

Research Interests

Estimation and sensing; nonlinear control and dynamics; energy storage systems and battery management; fault diagnosis; sustainable energy applications; observer design under sparse and indirect measurements; physics-informed and data-driven degradation modeling; health-aware control of grid-connected and electrified systems.

Research Supervision and Leadership

Graduate student supervision, University of Michigan
Supervised two Ph.D. students and one master's student day to day in Prof. Anna G. Stefanopoulou's group. Prof. Stefanopoulou and Dr. Jason Siegel held the appointed supervisory roles.

- Internal short circuits and thermal runaway in parallel-connected cells. Student-led papers at ACC 2026 and CCTA 2026.
- Remaining useful life of second-life batteries. Student-led paper at ACC 2025.
- Health-aware scheduling of grid-connected storage with solar and fast chargers. Student-led manuscript submitted to the Journal of Energy Storage.

Project leadership, University of Michigan
Day-to-day technical lead on the fault detection and V2G degradation projects in Prof. Stefanopoulou's group, including study planning and coordination with academic and industry collaborators.

Honors and Awards

University of Minnesota Informatics Institute Graduate Fellowship Award *2021*
Charles and Maryanne Lo Fellowship, University of Minnesota *2017*
Iranian National Elites Foundation financial support *2008 – 2012*

Publications

Submitted

- Choi, W., Jung, E., **Movahedi, H.**, & Jeon, W. Adaptive multi-IMU fusion for mobile robot navigation under IMU faults. *2027 American Control Conference (ACC)* (2027 submitted).
- Han, J., **Movahedi, H.**, Stefanopoulou, A., Avestruz, A., Namou, A., & Zhu, C. (2026). A frugal realization of optimal demand management for a grid-connected and solar-integrated battery energy storage system. Submitted to *Journal of Energy Storage*.

Journal Articles

- Wan, Z., Weng, A., Pannala, S., **Movahedi, H.**, Garrick, T. R., Offer, G. J., Siegel, J. B., & Stefanopoulou, A. G. (2026). Managing silicon burn-out via onboard material diagnostics for durable high-energy density batteries. *Joule*, 102531.
- Wong, C., Weng, A., **Movahedi, H.**, Choi, J., Yang, S. Y., Jin, H., Siegel, J., & Stefanopoulou, A. (2026). Quantifying imbalances in parallel-connected cell groups using group voltage and current. *Journal of Energy Storage*, *150*, 120507.
- **Movahedi, H.**, Ooi, X. H., Tran, V. V., Jeon, W., Siegel, J. B., & Stefanopoulou, A. G. (2026). Interacting multiple-model method for fault detection and short resistance estimation in parallel-connected lithium-ion batteries. *Journal of Dynamic Systems, Measurement, and Control*, *148*(2), 021013.

- **Movahedi, H.**, Zemouche, A., & Rajamani, R. (2026). Comparative analysis of the performances of a nonlinear observer and nonlinear Kalman filters in the presence of non-Gaussian disturbances. *International Journal of Robust and Nonlinear Control*, *36*(7), 3896–3913.
- **Movahedi, H.**, Pannala, S., Siegel, J., Harris, S. J., Howey, D., & Stefanopoulou, A. (2024). Extra throughput versus days lost in V2G services: Influence of dominant degradation mechanism. *Journal of Energy Storage*, *104*, 114242.
- Pannala, S., **Movahedi, H.**, Garrick, T. R., Stefanopoulou, A. G., & Siegel, J. B. (2024). Consistently tuned battery lifetime predictive model of capacity loss, resistance increase, and irreversible thickness growth. *Journal of The Electrochemical Society*, *171*(1), 010532.
- Weng, A., **Movahedi, H.**, Wong, C., Siegel, J. B., & Stefanopoulou, A. (2024). Current imbalance in dissimilar parallel-connected batteries and the fate of degradation convergence. *Journal of Dynamic Systems, Measurement, and Control*, *146*(1), 011106.
- **Movahedi, H.**, Tian, N., Fang, H., & Rajamani, R. (2021). Hysteresis compensation and nonlinear observer design for state-of-charge estimation using a nonlinear double-capacitor Li-ion battery model. *IEEE/ASME Transactions on Mechatronics*, *27*(1), 594–604.
- **Movahedi, H.**, Zemouche, A., & Rajamani, R. (2021). Magnetic position estimation using optimal sensor placement and nonlinear observer for smart actuators. *Control Engineering Practice*, *112*, 104817.
- Rajamani, R., Jeon, W., **Movahedi, H.**, & Zemouche, A. (2020). On the need for switched-gain observers for non-monotonic nonlinear systems. *Automatica*, *114*, 108814.
- **Movahedi, H.**, Figueroa-Santos, M. A., Siegel, J. B., Stefanopoulou, A. G., & Rajamani, R. (2020). Hybrid nonlinear observer for battery state-of-charge estimation using nonmonotonic force measurements. *Advanced Control for Applications: Engineering and Industrial Systems*, *2*(3), e38.

Book Chapter

- Roy, A., **Movahedi, H.**, & Stefanopoulou, A. G. (2025). Electric vehicle batteries: Repurposing for second life. In M. Galyen & D. Menchaca (Eds.), *Electric Vehicle Batteries: From Sourcing to Second Life and Recycling* (pp. 149–187). Wiley.

Conference Proceedings

- Ooi, X. H., **Movahedi, H.**, Siegel, J. B., & Stefanopoulou, A. G. (2026). Detectability of internal short circuits in parallel-connected lithium-ion cells. In *2026 IEEE Conference on Control Technology and Applications (CCTA)* (pp. 861–866). IEEE.
- Ooi, X. H., **Movahedi, H.**, Siegel, J. B., Stefanopoulou, A. G., Tang, W. S., & Rikka, V. (2026). Assured fault detection: Is cell-level temperature sensing worth it? In *2026 American Control Conference (ACC)* (pp. 2552–2557). IEEE.
- Wan, Z., **Movahedi, H.**, Liu, W., Ma, J., Siegel, J. B., Weng, A., & Stefanopoulou, A. G. (2026). Modeling and estimation of solid electrolyte interphase during formation in battery manufacturing. In *2026 American Control Conference (ACC)*. IEEE.
- Roy, A., Alghalayini, M. B., **Movahedi, H.**, Siegel, J. B., Harris, S. J., & Stefanopoulou, A. G. (2025). Predicting battery remaining useful life for EV resale: Switching from/to cold/hot temperature. In *2025 American Control Conference (ACC)* (pp. 1476–1481). IEEE.
- **Movahedi, H.**, Weng, A., Pannala, S., Siegel, J. B., & Stefanopoulou, A. G. (2024). The case for deepSOH: Addressing path dependency for remaining useful life in Li-ion batteries. *IFAC-PapersOnLine*, *58*(28), 798–803.
- **Movahedi, H.**, Pannala, S., Siegel, J. B., & Stefanopoulou, A. G. (2023). Physics-informed optimal experiment design of calendar aging tests and sensitivity analysis for SEI parameters estimation in lithium-ion batteries. *IFAC-PapersOnLine*, *56*(3), 433–438.
- Roy, A., **Movahedi, H.**, Siegel, J. B., & Stefanopoulou, A. G. (2023). Empirical modeling of degradation in lithium-ion batteries and validation in complex scenarios. *IFAC-PapersOnLine*, *56*(3), 457–462.
- **Movahedi, H.**, Zemouche, A., & Rajamani, R. (2023). Comparative analysis of a nonlinear observer and nonlinear Kalman filters for magnetic position estimation. In *2023 American Control Conference (ACC)* (pp. 1030–1035). IEEE.

- **Movahedi, H.**, Tian, N., Fang, H., & Rajamani, R. (2021). Hysteresis compensation in state-of-charge estimation with a nonlinear double-capacitor Li-ion battery model. In *2021 American Control Conference (ACC)* (pp. 3108–3113). IEEE.
- **Movahedi, H.**, Zemouche, A., & Rajamani, R. (2021). Estimation of the basic reproduction number for the COVID-19 pandemic in Minnesota. *IFAC-PapersOnLine*, *54*(20), 251–257.
- Rajamani, R., Jeon, W., **Movahedi, H.**, & Zemouche, A. (2020). Vehicle motion estimation using a switched gain nonlinear observer. In *2020 American Control Conference (ACC)* (pp. 3047–3052). IEEE.
- **Movahedi, H.**, Zemouche, A., & Rajamani, R. (2019). Linear position estimation on smart actuators using a nonlinear observer. In *2019 American Control Conference (ACC)* (pp. 453–458). IEEE.

Conference Abstracts

- Wan, Z., Weng, A., Pannala, S., **Movahedi, H.**, Garrick, T. R., Offer, G. J., Siegel, J., & Stefanopoulou, A. (2026). On-board estimation of silicon burn-out in lithium-ion batteries with silicon-graphite composite anodes. *ECS Meeting Abstracts*, *249*, 91.
- Liu, W., **Movahedi, H.**, Siegel, J., & Stefanopoulou, A. (2026). (Invited) Thermal runaway propagation modeling of series-connected battery strings considering changes in insulation performance as cells swell. *ECS Meeting Abstracts*, *249*, 116.
- Roy, A., Tran, V., Wan, Z., Ooi, X. H., **Movahedi, H.**, Siegel, J., & Stefanopoulou, A. (2026). Voltage-based features for highly accurate and sensitive anomaly detection in nearly 100 retired battery packs. *ECS Meeting Abstracts*, *249*, 667.
- Ooi, X. H., **Movahedi, H.**, Stefanopoulou, A., & Siegel, J. (2025). Sensitivity of observable temperature and voltage changes for detection of internal short-circuit in parallel connected cells. *ECS Meeting Abstracts*, *248*, 155.
- Roy, A., Alghalayini, M., **Movahedi, H.**, Siegel, J., Harris, S. J., & Stefanopoulou, A. (2024). Forecasting electrode state of health (eSOH) for managing battery lifetime using domain-knowledge-informed machine learning. *ECS Meeting Abstracts*, *MA2024-02*(3), 383.
- **Movahedi, H.**, Pannala, S., Siegel, J., & Stefanopoulou, A. (2024). Benefit to harm (B2H) ratio for bulk vehicle to grid (V2G) services using lifetime degradation digital twin: Emulating various dominant degradation mechanism. *ECS Meeting Abstracts*, *245*, 416.
- Pannala, S., **Movahedi, H.**, Stefanopoulou, A., & Siegel, J. (2024). (Invited) Lifetime predictive model of capacity loss, resistance increase, and irreversible thickness growth. *ECS Meeting Abstracts*, *245*, 514.
- Wan, Z., Pannala, S., **Movahedi, H.**, Wong, C., Solbrig, C., Siegel, J., & Stefanopoulou, A. (2024). Impact of pretension and cycling window on degradation of graphite/silicon composite anodes. *ECS Meeting Abstracts*, *245*, 713.

Grant Proposal Experience

- Contributed to the proposal and the technical work of a battery lifetime and health modeling project sponsored by LG Energy Solution at the University of Michigan. Principal investigator, Prof. Anna G. Stefanopoulou.
- Contributed technical content to a U.S. Department of Energy proposal prepared with industry partners at the University of Michigan. Principal investigator, Prof. Anna G. Stefanopoulou.

Research Collaborations

- **Industry:** LG Energy Solution and General Motors through the University of Michigan, and TNO through Eindhoven University of Technology.
- **Academic:** David Howey (University of Oxford) and Stephen J. Harris (Lawrence Berkeley National Laboratory) on V2G and remaining useful life; Ali Zemouche (CRAN, Université de Lorraine) on nonlinear observer theory; Huazhen Fang (University of Kansas) on hysteresis-aware state-of-charge estimation; Al-Thaddeus Avestruz (University of Michigan) on health-aware scheduling of storage, solar and fast chargers.

Teaching Experience

Teaching Assistant, Advanced Control System Design II, University of Minnesota *2022*

- Graduate course on control design for nonlinear systems. Held office hours, graded assignments, and supported students with course projects.

Teaching Assistant, Motion Control Lab, University of Minnesota *2018 – 2020*

- Modernized the Motion Control Laboratory by selecting and installing new data acquisition cards and updating supporting code and operating systems.
- Taught senior-level concepts in modeling and closed-loop control, including digital filtering, system identification, basic C coding, feedback control, and PLC programming.

Teaching Assistant, Engineering Mathematics, Sharif University of Technology *2008 – 2009*
Department of Mathematical Sciences.

Professional Development

University of Michigan Postdoctoral Short Course on College Teaching in STEM *2024*
Covered learner-centered syllabus design, evidence-based teaching strategies, and assessment.
Coursework in machine learning and artificial intelligence *2026*

Professional Service

Editorial Service

- Associate Editor, Modeling, Estimation, and Control Conference (MECC) 2025 & 2026.
- Associate Editor, special issue of *Energies*: Advanced Modeling and State Estimation Technologies for Next-Generation Battery Management.

Journal Reviewer

- Automatica; Nonlinear Dynamics; IEEE Transactions on Industrial Electronics; IEEE Transactions on Control Systems Technology; IEEE Open Journal of Control Systems; ASME Journal of Dynamic Systems, Measurement, and Control; ASME Letters in Dynamic Systems and Control; Optimal Control Applications and Methods; Journal of The Electrochemical Society; eTransportation.

Conference Reviewer

- American Control Conference (ACC); IEEE Conference on Decision and Control (CDC); SAE International; Modeling, Estimation, and Control Conference (MECC).

Professional Experience

Design Engineer, Sefidrood-e Guilan Consulting Engineers Company, Rasht, Iran *2014 – 2016*

- Designed pumping stations, water storage facilities, and pipelines of water supply networks.
- Oversaw construction operations and verified statements of work.

Skills and Languages

- **Programming:** Python, C/C++, MATLAB, Bash. Version control with Git. Linux working environment.
- **Engineering software:** MATLAB / Simulink, PyBaMM (battery modeling), Maple, ANSYS Fluent, ANSYS Mechanical.
- **Documentation:** LaTeX, Microsoft Office.
- **Languages:** Persian (native), English (fluent).

References

Prof. Anna G. Stefanopoulou, University of Michigan, Ann Arbor, USA
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Prof. Rajesh Rajamani, University of Minnesota, Twin Cities, USA
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