VALENTIN SULZER

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Carnegie Mellon University
5000 Forbes Ave, Pittsburgh, PA 15213

RESEARCH INTERESTS

Energy storage, mathematical modeling, scientific machine learning, asymptotic analysis

EMPLOYMENT

Postdoctoral Research Associate May 2021 - present
Carnegie Mellon University *Pittsburgh, PA*

- Viswanathan group
- Battery modeling with PyBaMM and Julia
- Hybrid physics-based/data-driven models with Scientific Machine Learning.
- Accelerated Computational Electrochemical systems Discovery (ACED)

Postdoctoral Research Fellow Oct 2019 - May 2021
University of Michigan *Ann Arbor, MI*

- Battery Control Group (Prof. Anna Stefanopoulou and Dr Jason Siegel)
- Physics-based machine learning for modeling of PEM fuel cells (in collaboration with Toyota Motor North America)
- Lithium-ion battery degradation modeling, state-of-health estimation and prognostics
- Multi-particle models for lithium-ion batteries

EDUCATION

PhD in Applied Mathematics Oct 2015 - Sep 2019
University of Oxford *Oxford, UK*

- Industrially Focussed Mathematical Modelling (InFoMM) CDT
- Thesis Topic: *Mathematical Modelling of Lead-Acid Batteries*
- Supervisors: Prof. S. Jon Chapman, Prof. Colin Please, Prof. Charles Monroe and Prof. David Howey

Master of Mathematics Oct 2014 - Jun 2015
University of Oxford *Oxford, UK*

- First-class honours; salutatorian
- Dissertation Topic: *Mathematical Modelling of the Bladder Uroepithelium*
- Supervisors: Prof. Derek Moulton, Prof. Sarah Waters and Prof. Helen Byrne

BA in Mathematics Oct 2011 - Jun 2014
University of Oxford *Oxford, UK*

- First-class honours

PUBLICATIONS

Links to papers, preprints, and code available at
https://sites.google.com/view/valentinsulzer/publications

Preprints and Submitted Manuscripts

[J17] **Sulzer, V.**, Mohtat, P., Pannala, S., Siegel, J. B., Stefanopoulou, A. G. (2021). "Accelerated battery lifetime simulations using adaptive inter-cycle extrapolation algorithm". *ECSarXiv, submitted to Journal of the Electrochemical Society.*

[J16] Mohtat, P., Pannala, S., **Sulzer, V.**, Siegel, J. B., Stefanopoulou, A. G. (2021). "An Algorithmic Safety VEST For Li-ion Batteries During Fast Charging". *arXiv preprint arXiv:2108.07833, submitted to Modeling, Estimation and Control Conference 2021.*

[J15] Zubov, K., McCarthy, Z., Ma, Y., Calisto, F., Pagliarino, V., Azeglio, S., Bottero, L., Luján, E., **Sulzer, V.**, Bharambe, A. and Vinchhi, N., Balakrishnan, K., Upadhyay, D., Rackauckas, C. (2021). "NeuralPDE: Automating Physics-Informed Neural Networks (PINNs) with Error Approximations". *arXiv preprint arXiv:2107.09443.*

Journal Articles

[J14] Weng, A., Mohtat, P., Attia, P. M., **Sulzer, V.**, Lee, S., Less, G., Stefanopoulou, A. G. (2021). "Predicting the Impact of Formation Protocols on Battery Lifetime Immediately After Manufacturing". *Joule.*

[J13] Mistry, A., Verma, A., Sripad, S., Ciez, R., **Sulzer, V.**, Brosa Planella, F., Timms, R., Zhang, Y., Kurchin, R., Dechent, P., Li, W., Greenbank, S., Ahmad, Z., Krishnamurthy, D., Fenton, A. M., Tenny, K., Patel, P., Juarez Robles, D., Gasper, P., Colclasure, A., Baskin, A., Scown, C. D., Subramanian, V. R., Khoo, E., Allu, S., Howey, D., DeCaluwe, S., Roberts, S. A., Viswanathan, V. (2021). "A Minimal Information Set To Enable Verifiable Theoretical Battery Research". *ACS Energy Letters*,no. Table 1, pp. 3831–3835.

[J12] **Sulzer, V.**, Mohtat, P., Aitio, A., Lee, S., Yeh, Y.T., Steinbacher, F., Khan, M.U., Lee, J.W., Siegel, J.B., Stefanopoulou, A.G. and Howey, D.A. (2021). "The challenge and opportunity of battery lifetime prediction from field data". *Joule,* 5 (8), 1934-1955.

[J11] **Sulzer, V.**, Marquis, S.G., Timms, R., Robinson, M., Chapman, S.J. (2021). "Python Battery Mathematical Modelling (PyBaMM)" *Journal of Open Research Software,* 9 (1), 14.

[J10] Timms, R., Marquis, S.G., **Sulzer, V.**, Please, C.P., Chapman, S.J. (2021). "Asymptotic Reduction of a Lithium-ion Pouch Cell Model". *SIAM Journal on Applied Mathematics*, 81 (3), 765-788.

[J9] Marquis, S.G., Timms, R., **Sulzer, V.**, Please, C.P., Chapman, S.J. (2020). "A Suite of Reduced-Order Models of a Single-Layer Lithium-ion Pouch Cell". *Journal of the Electrochemical Society*, 167 (14), 140513.

[J8] Tranter, T.G., Timms, R., Heenan, T., Marquis, S., **Sulzer, V.**, Jnawali, A., Kok, M.D., Please, C.P., Chapman, S.J., Shearing, P.R. and Brett, D. (2020). "Probing heterogeneity in Li-ion batteries with coupled multiscale models of electrochemistry and thermal transport using tomographic domains". *Journal of the Electrochemical Society*, 167 (11), 110538.

[J7] Mohtat, P., Lee, S., **Sulzer, V.**, Siegel, J.B., Stefanopoulou, A.G. (2020). "Differential Expansion and Voltage Model for Li-ion Batteries at Practical Charging Rates" *Journal of The Electrochemical Society*, 167 (11), 110561.

[J6] Marquis, S.G., **Sulzer, V.**, Timms, R., Please, C.P., Chapman, S.J. (2019). "An asymptotic derivation of a single particle model with electrolyte". *Journal of The Electrochemical Society*, 166 (15), A3693-A3706.

[J5] **Sulzer, V.**, Chapman, S.J., Please, C.P., Howey, D.A., Monroe, C. W. (2019). "Faster Lead-Acid Battery Simulations from Porous Electrode Theory: I. Physical Model". *Journal of The Electrochemical Society*, 166 (12), A2363-A2371.

[J4] **Sulzer, V.**, Chapman, S.J., Please, C.P., Howey, D.A., Monroe, C. W. (2019). "Faster Lead-Acid Battery Simulations from Porous Electrode Theory: II. Asymptotic Analysis". *Journal of The Electrochemical Society*, 166 (12), A2372-A2382.

[J3] Moulton, D.E., **Sulzer, V.**, Apodaca, G., Byrne, H.M., Waters, S.L. (2016). "Mathematical modelling of stretch-induced membrane traffic in bladder umbrella cells". *Journal of Theoretical Biology*, 409, 115-132.

Conference Proceedings

[J2] **Sulzer, V.**, Mohtat, P., Lee, S., Siegel, J.B., Stefanopoulou, A.G. (2021). "Promise and Challenges of a Data-Driven Approach for Battery Lifetime Prognostics". *2021 American Control Conference, IEEE.*

Other Articles

[J1] Howey, D.A., Roberts, S. A., Viswanathan, V., Mistry, A., Beuse, M., Khoo, E., DeCaluwe, S. C., **Sulzer, V.** (2020)., "Free Radicals: Making a Case for Battery Modeling." *Electrochemical Society Interface 29*, 30.

SELECTED OPEN-SOURCE SOFTWARE

[S1] Python Battery Mathematical Modelling (PyBaMM): Fast and flexible physics-based electrochemical models in Python [pybamm.org]. Co-creator and core developer.

TECHNICAL REPORTS

[R3] Carter, J., Greenbank, S., Holderbaum, W., Marquis, S., Merino-Aceituno, S., Merla, Y., Millar, R., Please, C., Scalas, E., Shi, H. **Sulzer, V.** (2018). "Electric Vehicle Battery Degradation Study".

[R2] Croci, M., Morawiecki, P., **Sulzer, V.** Theil, F. (2017). "Classification of Two-Dimensional Gas Chromatography Data".

[R1] Bejan, A., Budd, C., Hall, C., Kavallaris, N., McPhail, M., Please, C.P., Roper, I., **Sulzer, V.** Wood, D. (2016). "How can we better understand drivers of predicted environmental concentrations of chemicals across the EU?".

PRESENTATIONS

[C16] 240$^{\text{th}}$ ECS Meeting, virtual — Oct 2021
Fast simulations of lithium-ion battery degradation

[C15] Canadian Applied and Industrial Mathematics Society, virtual — Jun 2021
Fast simulations of lithium-ion battery degradation

[C14] Battery Intelligence Lab Group Meeting, virtual — Jun 2021
Promise and Challenges of a Data-Driven Approach for Battery Lifetime Prognostics

[C13] American Control Conference, virtual — May 2021
Promise and Challenges of a Data-Driven Approach for Battery Lifetime Prognostics

[C12] ECS PRiME 2020, virtual — Oct 2020
Electrochemical Modeling of PEM Fuel Cells

[C11] Battery Modeling Webinar Series, virtual — Sep 2020
Open-source battery modeling with PyBaMM

[C10] SIAM/CAIMS Annual Meeting, Toronto, Canada [cancelled] Jul 2020

[C9] International Congress on Industrial and Applied Mathematics, Valencia, Spain Jul 2019
Modelling Overcharge of a Lead-Acid Battery

[C8] Oxford Mathematics Three-Minute Thesis Competition, Oxford, UK Nov 2018
Smarter Batteries for a Clean Energy Future

[C7] SIAM Annual Meeting, Portland, OR Jul 2018
Reduced-order Models for Lead-Acid Batteries Using Asymptotic Methods

[C6] European Consortium for Mathematics in Industry, Budapest, Hungary Jun 2018
Battery Modelling: Why 2D Matters

[C5] InFoMM CDT Annual Meeting, Oxford, UK Mar 2018
Electrochemical Modelling of Lead-Acid Batteries for Off-Grid Energy Storage Systems

[C4] University of Warwick Applied Mathematics Seminar, Warwick, UK Dec 2017
Electrochemical Modelling of Lead-Acid Batteries for Off-Grid Energy Storage Systems

[C3] Oxford University ECS Student Chapter Conference, Oxford, UK Jun 2017
Approximate Analytical Solutions of the Newman Porous Electrode Model for Lead-Acid Batteries

[C2] Oxford University SIAM Student Chapter Conference, Oxford, UK Jun 2017
Electrochemical Modelling of Lead-Acid Batteries for Off-Grid Energy Storage Systems

[C1] Junior Applied Mathematics Seminar, Oxford, UK Jun 2017
Electrochemical Modelling of Lead-Acid Batteries for Off-Grid Energy Storage Systems

POSTERS

[P5] Oxford Battery Modelling Symposium, virtual Mar 2021
PyBaMM - Python Battery Mathematical Modeling

[P4] Oxford Battery Modelling Symposium, virtual Mar 2020
PyBaMM - Python Battery Mathematical Modeling

[P3] Oxford Battery Modelling Symposium, Oxford, UK Mar 2019
An Asymptotic Framework for Battery Modelling

[P2] British Applied Mathematics Colloquium, Guildford, UK Apr 2017
Electrochemical Modelling of Lead-Acid Batteries for Off-Grid Energy Storage Systems

[P1] InFoMM CDT Annual Meeting, Oxford, UK Mar 2017
Electrochemical Modelling of Lead-Acid Batteries for Off-Grid Energy Storage Systems

GRANTS, PRIZES & AWARDS

· St Anne's Graduate Student Travel Grant (£500) May 2018

· SIAM Student Chapter Travel Award ($500) Feb 2018

· Sponsorship for the Oxford SIAM Student Chapter (G-Research, £2,500) Sep 2017 – Aug 2018

· EPSRC Doctoral Grant (EP/L015803/1) Oct 2015 – Sep 2019

· Gibbs Prize for performance in 4th year exams – top two in Mathematics (£200) Jul 2015

· IMA Prize for performance in 4th year exams – best in Applied Mathematics Jul 2015

· Mary Kearsley prize for excellence in Applied Mathematics (£200) May 2015

· St Anne's Vacation Laboratory Studentship (£950) Jun-Sep 2014

STUDENT SUPERVISION

- **Saransh Chopra**, Cluster Innovation Centre, University of Delhi (via Google Summer of Code), Summer 2021
- **Priyanshu Agarwal**, Symbiosis Institute of Technology, Pune (via Google Summer of Code), Summer 2021
- **Mohit Yadav**, IIT Kanpur (visiting University of Michigan), Summer 2020
  Mohit joined an AI startup as an intern.
- **Daniel Albamonte**, University of Michigan, Summer 2020
  Daniel joined EDF Renewables North America as an Energy Storage Engineer.

TEACHING EXPERIENCE

- Fluids and Waves
- Applied Partial Differential Equations
- Elasticity and Plasticity

ACADEMIC SOCIETIES & SERVICE

Society Membership

- Institute of Electrical and Electronics Engineers (IEEE)
- Society for Industrial and Applied Mathematics (SIAM)
- Electrochemical Society (ECS)
- Institute of Mathematics and its Applications (IMA)

Leadership

- President, Oxford University SIAM-IMA Student Chapter (2017-18)
- Organiser and Chair, Oxford University SIAM-IMA Student Chapter Conference (2018)
- Secretary, Oxford University SIAM-IMA Student Chapter (2016-17)

Reviewer

- SIAM Journal on Applied Mathematics
- Applied Energy
- IEEE Conference on Decision and Control
- Applied Sciences
- Electrochemica Acta
- eTransportation
- Journal of Energy Storage

SKILLS

Programming	Python, MATLAB, Julia, Git, LaTeX, Linux
Languages	French (native), Spanish (conversational), Italian (basic)