



## Ilenia Battiato

Associate Professor of Energy Science Engineering  
Energy Science & Engineering

 Curriculum Vitae available Online

### Bio

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#### ACADEMIC APPOINTMENTS

- Associate Professor, Energy Science & Engineering

#### ADMINISTRATIVE APPOINTMENTS

- Postdoctoral Researcher, Max Planck Institute for Dynamics and Self-Organization (MPI-DS), Göttingen, Germany, (2010-2012)
- Research Fellow, SAMSI (Statistical and Applied Mathematical Sciences Institute), (2012-2012)
- Assistant Professor, Mechanical Engineering Department, Clemson University, (2012-2014)
- Assistant Professor, Mechanical Engineering Department, San Diego State University, (2014-2016)
- Assistant Professor, Department of Energy Science and Engineering, Stanford University, (2016- present)

#### HONORS AND AWARDS

- Acknowledgement of "excellent reviews", Transport in Porous Media, Vol 127, Issue 1, pp 1-5, Transport in Porous Media (2019)
- Department of Energy Young Investigator Award, Basic Energy Sciences Program (2015)
- GREW (Grants and Research Enterprise Writing) Fellowship, Sp15, San Diego State University (2015)
- Eastman Chemical Award for Excellence, Clemson University (2013)
- Research Fellowship Award, SAMSI (2012)
- 'Aci e Galatea' Award to career, Acireale (CT), Italy (2012)
- Travel Award, Fluxes and Structures in Fluids: Physics of Geospheres International Conference in Moscow, Russia (2009)
- Travel award, DOE-ERSP 4th Annual PI Meeting (2009)
- Outstanding Student Paper Award, AGU Fall Meeting (2008)
- Fellowship, RUI foundation - Politecnico di Milano (2000)

#### BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Referee, Water Resources Research (2012 - present)
- Referee, Transport in Porous Media (2012 - present)
- Referee, Geophysical Research Letters (2012 - present)
- Referee, Environmental Earth Sciences (2012 - present)
- Referee, Journal of Fluid Mechanics (2012 - present)
- Referee, Journal of Fluids and Structures (2012 - present)
- Referee, Physical Review E (2012 - present)

- Referee, Physical Review Letters (2012 - present)
- Referee, Chemical Engineering Journal, Meccanica (2012 - present)
- Referee, Advances in Water Resources (2012 - present)
- Referee, SIAM (MMS) Multiscale Modeling and Simulations (2012 - present)
- Referee, Revista Mexicana de Ingenieria Quimica (2012 - present)
- Panelist and ad-hoc reviewer, National Science Foundation (NSF) (2013 - 2013)
- Session Co-organizer, AGU Fall Meeting (2013 - 2013)
- Session Co-organizer, Interpore (2013 - 2013)
- Ad-hoc reviewer, American Chemical Society (ACS) Petroleum Research Fund (2014 - 2014)
- Session Co-organizer, American Geophysical Union (2014 - 2014)
- Session Co-organizer, Computational Methods in Water Resources (2014 - 2014)
- Scientific Committee Member, 9th Southern California Flow Physics Symposium (SDSU, San Diego) (2015 - 2015)
- Panelist and ad-hoc reviewer, National Science Foundation (NSF) (2015 - 2016)
- Scientific Committee Member, Computational Methods in Water Resources (University of Toronto, Canada) (2016 - 2016)

## PROFESSIONAL EDUCATION

- Ph.D., Mechanical & Aerospace Engineering Department, University of California, San Diego , Engineering Science w/spec Computational Science (2010)
- M.Sc., Mechanical & Aerospace Engineering Department, University of California, San Diego , Engineering Physics (2008)
- M.Sc. equivalent, Politecnico di Milano, Milano, Italy , Environmental Engineering (5-years Laurea, Summa cum Laude) (2005)

## LINKS

- Battiato Research: <https://battiato.stanford.edu/>
- Google Scholar: <https://scholar.google.com/citations?user=wncGEjgAAAAJ&hl=en&oi=ao>

## Research & Scholarship

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### CURRENT RESEARCH AND SCHOLARLY INTERESTS

Energy and environment (battery systems; superhydrophobicity and drag reduction; carbon sequestration); multiscale, mesoscale and hybrid simulations (multiphase and reactive transport processes); effective medium theories; perturbation methods, homogenization and upscaling.

## Teaching

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### COURSES

#### 2024-25

- Fluid Mechanics and Heat Transfer: ENERGY 297 (Aut)
- Mass and Energy Transport in Porous Media: ENERGY 120, ENGR 120 (Win)

#### 2023-24

- Fluid Mechanics and Heat Transfer: ENERGY 297 (Aut)
- Mass and Energy Transport in Porous Media: ENERGY 120, ENGR 120 (Win)

#### 2022-23

- ERE Master's Graduate Seminar: ENERGY 351 (Win)
- ERE PhD Graduate Seminar: ENERGY 352 (Win)

- Fluid Mechanics and Heat Transfer: ENERGY 297 (Spr)
- Fundamentals of Petroleum Engineering: ENERGY 120, ENGR 120 (Aut)

#### 2021-22

- Fluid Mechanics and Heat Transfer: ENERGY 297 (Aut)
- Fundamentals of Petroleum Engineering: ENERGY 120, ENGR 120 (Aut)

### STANFORD ADVISEES

#### Doctoral Dissertation Reader (AC)

Jillian Anderson, Jimin Zhou

#### Doctoral Dissertation Advisor (AC)

Marwah AlSinan

#### Doctoral (Program)

Matthew Ard, Mayuresh Bhattu, Kelvin Green, Zixin Ping, Ke Qin, Shufan Xia, Brandon van Gogh

## Publications

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### PUBLICATIONS

- **Enforcing global constraints for the dispersion closure problem: 2-SIMPLE algorithm** *ADVANCES IN WATER RESOURCES*  
Weber, R. M., Ling, B., Battiato, I.  
2024; 191
- **A mineral precipitation model based on the volume of fluid method** *COMPUTATIONAL GEOSCIENCES*  
Wang, Z., Battiato, I.  
2024
- **Unraveling residual trapping for geologic hydrogen storage and production using pore-scale modeling** *ADVANCES IN WATER RESOURCES*  
Yu, S., Hu, M., Steefel, C. I., Battiato, I.  
2024; 185
- **Automated upscaling via symbolic computing for thermal runaway analysis in Li-ion battery modules** *JOURNAL OF COMPUTATIONAL SCIENCE*  
Pietrzyk, K., Bucci, G., Behandish, M., Battiato, I.  
2023; 74
- **A deep learning upscaling framework: Reactive transport and mineral precipitation in fracture-matrix systems** *ADVANCES IN WATER RESOURCES*  
Wang, Z., Battiato, I.  
2024; 183
- **Non-intrusive hybrid scheme for multiscale heat transfer: Thermal runaway in a battery pack** *JOURNAL OF COMPUTATIONAL SCIENCE*  
Yao, Y., Harabin, P., Behandish, M., Battiato, I.  
2023; 73
- **Automated Symbolic Upscaling: 2. Model Generation for Extended Applicability Regimes** *WATER RESOURCES RESEARCH*  
Pietrzyk, K., Battiato, I.  
2023; 59 (7)
- **Automated Symbolic Upscaling: 1. Model Generation for Extended Applicability Regimes** *WATER RESOURCES RESEARCH*  
Pietrzyk, K., Battiato, I.  
2023; 59 (7)

- **Understanding flow dynamics in membrane distillation: Effects of reactor design on polarization** *SEPARATION AND PURIFICATION TECHNOLOGY*  
Yao, Y., Yu, S., Battiato, I.  
2023; 314
- **Lab on a chip for a low-carbon future.** *Lab on a chip*  
Datta, S. S., Battiato, I., Ferno, M. A., Juanes, R., Parsa, S., Prigiobbe, V., Santanach-Carreras, E., Song, W., Biswal, S. L., Sinton, D.  
2023
- **A level-set immersed boundary method for reactive transport in complex topologies with moving interfaces** *JOURNAL OF COMPUTATIONAL PHYSICS*  
Yousefzadeh, M., Yao, Y., Battiato, I.  
2023; 478
- **Impact of large-scale effects on mass transfer and concentration polarization in Reverse Osmosis membrane systems** *SEPARATION AND PURIFICATION TECHNOLOGY*  
Sitaraman, H., Battiato, I.  
2022; 303
- **Homogenization-Informed Convolutional Neural Networks for Estimation of Li-ion Battery Effective Properties** *TRANSPORT IN POROUS MEDIA*  
Weber, R. M., Korneev, S., Battiato, I.  
2022
- **Probing multiscale dissolution dynamics in natural rocks through microfluidics and compositional analysis.** *Proceedings of the National Academy of Sciences of the United States of America*  
Ling, B., Sodwatana, M., Kohli, A., Ross, C. M., Jew, A., Kavscek, A. R., Battiato, I.  
2022; 119 (32): e2122520119
- **Module-Fluidics: Building Blocks for Spatio-Temporal Microenvironment Control.** *Micromachines*  
Ling, B., Battiato, I.  
2022; 13 (5)
- **Chemical and Reactive Transport Processes Associated with Hydraulic Fracturing of Unconventional Oil/Gas Shales.** *Chemical reviews*  
Jew, A. D., Druhan, J. L., Ihme, M., Kavscek, A. R., Battiato, I., Kaszuba, J. P., Bargar, J. R., Brown, G. E.  
2022
- **Striving to translate shale physics across ten orders of magnitude: What have we learned?** *EARTH-SCIENCE REVIEWS*  
Mehmani, Y., Anderson, T., Wang, Y., Aryana, S. A., Battiato, I., Tchelepi, H. A., Kavscek, A. R.  
2021; 223
- **Upscaling and Automation: Pushing the Boundaries of Multiscale Modeling through Symbolic Computing An Introduction to Symbolica** *TRANSPORT IN POROUS MEDIA*  
Pietrzyk, K., Korneev, S., Behandish, M., Battiato, I.  
2021
- **Dynamic Modeling of Fouling in Reverse Osmosis Membranes** *MEMBRANES*  
Ling, B., Xie, P., Ladner, D., Battiato, I.  
2021; 11 (5)
- **Upscaling Reactive Transport and Clogging in Shale Microcracks by Deep Learning** *WATER RESOURCES RESEARCH*  
Wang, Z., Battiato, I.  
2021; 57 (4)
- **Concentration polarization over reverse osmosis membranes with engineered surface features** *JOURNAL OF MEMBRANE SCIENCE*  
Zhou, Z., Ling, B., Battiato, I., Husson, S. M., Ladner, D. A.  
2021; 617
- **Multi-Scale Microfluidics for Transport in Shale Fabric** *ENERGIES*  
Ling, B., Khan, H. J., Druhan, J. L., Battiato, I.

2021; 14 (1)

- **tau-SIMPLE Algorithm for the closure problem in homogenization of stokes flows** *ADVANCES IN WATER RESOURCES*  
Ling, B., Battiato, I.  
2020; 144
- **Scaling of two-phase water-steam relative permeability and thermal fluxes in porous media** *INTERNATIONAL JOURNAL OF MULTIPHASE FLOW*  
Picchi, D., Battiato, I.  
2020; 129
- **Suitability of 2D modelling to evaluate flow properties in 3D porous media** *TRANSPORT IN POROUS MEDIA*  
Marafini, E., La Rocca, M., Fiori, A., Battiato, I., Prestininzi, P.  
2020
- **A Data-Driven Multiscale Framework to Estimate Effective Properties of Lithium-Ion Batteries from Microstructure Images** *TRANSPORT IN POROUS MEDIA*  
Korneev, S., Arunachalam, H., Onori, S., Battiato, I.  
2020; 134 (1): 173–94
- **Impact of Pore-Scale Characteristics on Immiscible Fluid Displacement** *GEOFLUIDS*  
Mahabadi, N., van Paassen, L., Battiato, I., Yun, T., Choo, H., Jang, J.  
2020; 2020
- **Patch-Based Multiscale Algorithm for Flow and Reactive Transport in Fracture-Microcrack Systems in Shales** *WATER RESOURCES RESEARCH*  
Wang, Z., Battiato, I.  
2020; 56 (2)
- **Theory and Applications of Macroscale Models in Porous Media** *TRANSPORT IN POROUS MEDIA*  
Battiato, I., Ferrero, P. T., O'Malley, D., Miller, C. T., Takhar, P. S., Valdes-Parada, F. J., Wood, B. D.  
2019; 130 (1): 5–76
- **High order ghost-cell immersed boundary method for generalized boundary conditions** *INTERNATIONAL JOURNAL OF HEAT AND MASS TRANSFER*  
Yousefzadeh, M., Battiato, I.  
2019; 137: 585–98
- **Rough or wiggly? Membrane topology and morphology for fouling control** *JOURNAL OF FLUID MECHANICS*  
Ling, B., Battiato, I.  
2019; 862: 753–80
- **Contribution of Pore-Scale Approach to Macroscale Geofluids Modelling in Porous Media** *GEOFLUIDS*  
Romano, E., Jimenez-Martinez, J., Parmigiani, A., Kong, X., Battiato, I.  
2019
- **Bistability of buoyancy-driven exchange flows in vertical tubes** *JOURNAL OF FLUID MECHANICS*  
Suckale, J., Qin, Z., Picchi, D., Keller, T., Battiato, I.  
2018; 850: 525–50
- **Hydrodynamic dispersion in thin channels with micro-structured porous walls** *PHYSICS OF FLUIDS*  
Ling, B., Oostrom, M., Tartakovsky, A. M., Battiato, I.  
2018; 30 (7)
- **Downscaling-Based Segmentation for Unresolved Images of Highly Heterogeneous Granular Porous Samples** *WATER RESOURCES RESEARCH*  
Korneev, S. V., Yang, X., Zachara, J. M., Scheibe, T. D., Battiato, I.  
2018; 54 (4): 2871–90
- **Universal scaling-law for flow resistance over canopies with complex morphology** *SCIENTIFIC REPORTS*  
Rubol, S., Ling, B., Battiato, I.

2018; 8: 4430

- **Planning the process parameters for the direct metal deposition of functionally graded parts based on mathematical models** *JOURNAL OF MANUFACTURING PROCESSES*  
Yan, J., Battiato, I., Fadel, G. M.  
2018; 31: 56–71
- **Bistability of buoyancy-driven exchange flows in vertical tubes** *J. Fluid Mech.*  
Suckale, J., Qin, Z., Picchi, D., Keller, T., Battiato, I. T.  
2018
- **Hydrodynamic dispersion in thin porous channels with controlled microtexture** *Phys. Fluids*  
Ling, B., Oostrom, M. M., Tartakovsky, A. M., Battiato, I.  
2018
- **Physics-based hybrid method for multiscale transport in porous media** *JOURNAL OF COMPUTATIONAL PHYSICS*  
Yousefzadeh, M., Battiato, I.  
2017; 344: 320–38
- **Modeling variability in porescale multiphase flow experiments** *ADVANCES IN WATER RESOURCES*  
Ling, B., Bao, J., Oostrom, M., Battiato, I., Tartakovsky, A. M.  
2017; 105: 29–38
- **Design of injection nozzle in direct metal deposition (DMD) manufacturing of thin-walled structures based on 3D models** *INTERNATIONAL JOURNAL OF ADVANCED MANUFACTURING TECHNOLOGY*  
Yan, J., Battiato, I., Fadel, G.  
2017; 91 (1-4): 605–16
- **Multiscale Modeling Approach to determine Effective Lithium-Ion Transport Properties**  
Arunachalam, H., Korneev, S., Battiato, I., Onori, S., IEEE  
IEEE.2017: 92–97
- **Role of glycocalyx in attenuation of shear stress on endothelial cells: from in vivo experiments to microfluidic circuits**  
Battiato, I., Tartakovsky, D., Cabrales, P., Intaglietta, M., IEEE  
IEEE.2017
- **Vertical dispersion in vegetated shear flows** *WATER RESOURCES RESEARCH*  
Rubol, S., Battiato, I., de Barros, F. P.  
2016; 52 (10): 8066-8080
- **Dispersion controlled by permeable surfaces: surface properties and scaling** *JOURNAL OF FLUID MECHANICS*  
Ling, B., Tartakovsky, A. M., Battiato, I.  
2016; 801: 13-42
- **SEQUENTIAL HOMOGENIZATION OF REACTIVE TRANSPORT IN POLYDISPERSE POROUS MEDIA** *MULTISCALE MODELING & SIMULATION*  
Korneev, S., Battiato, I.  
2016; 14 (4): 1301-1318
- **DESIGN OF INJECTION NOZZLE IN DIRECT METAL DEPOSITION (DMD) MANUFACTURING OF THIN-WALLED STRUCTURES BASED ON 3D MODELS**  
Yan, J., Battiato, I., Fadel, G., ASME  
AMER SOC MECHANICAL ENGINEERS.2016
- **Multiscale models of flow and transport** *Handbook of Groundwater Engineering*  
Battiato, I.  
CRC Press.2016
- **OPTIMIZATION OF PROCESS PARAMETERS IN LASER ENGINEERED NET SHAPING (LENS) DEPOSITION OF MULTI-MATERIALS** *INTERNATIONAL DESIGN ENGINEERING TECHNICAL CONFERENCES AND COMPUTERS AND INFORMATION IN ENGINEERING CONFERENCE, 2015, VOL 1A*

- Yan, J., Masoudi, N., Battiato, I., Fadel, G.  
2016
- **On Veracity of Macroscopic Lithium-Ion Battery Models** *JOURNAL OF THE ELECTROCHEMICAL SOCIETY*  
Arunachalam, H., Onori, S., Battiato, I.  
2015; 162 (10): A1940-A1951
  - **Temperature-dependent multiscale-dynamics in Lithium-Ion battery electrochemical models** *2015 AMERICAN CONTROL CONFERENCE (ACC)*  
Arunachalam, H., Onori, S., Battiato, I.  
2015: 305-310
  - **An Analysis Platform for Multiscale Hydrogeologic Modeling with Emphasis on Hybrid Multiscale Methods** *GROUNDWATER*  
Scheibe, T. D., Murphy, E. M., Chen, X., Rice, A. K., Carroll, K. C., Palmer, B. J., Tartakovsky, A. M., Battiato, I., Wood, B. D.  
2015; 53 (1): 38-56
  - **Single-parameter model of vegetated aquatic flows** *WATER RESOURCES RESEARCH*  
Battiato, I., Rubol, S.  
2014; 50 (8): 6358-6369
  - **Effective medium theory for drag-reducing micro-patterned surfaces in turbulent flows** *EUROPEAN PHYSICAL JOURNAL E*  
Battiato, I.  
2014; 37 (3)
  - **Homogenizability conditions for multicomponent reactive transport** *ADVANCES IN WATER RESOURCES*  
Boso, F., Battiato, I.  
2013; 62: 254-265
  - **A reduced complexity model for dynamic similarity in obstructed shear flows** *GEOPHYSICAL RESEARCH LETTERS*  
Papke, A., Battiato, I.  
2013; 40 (15): 3888-3892
  - **Flow-induced shear instabilities of cohesive granulates** *PHYSICAL REVIEW E*  
Battiato, I., Vollmer, J.  
2012; 86 (3)
  - **Self-similarity in coupled Brinkman/Navier-Stokes flows** *JOURNAL OF FLUID MECHANICS*  
Battiato, I.  
2012; 699: 94-114
  - **From Upscaling Techniques to Hybrid Models** *Mathematical and Numerical Modeling in Porous Media: Applications in Geosciences*  
Battiato, I., Tartakovsky, D. M.  
CRC.2012
  - **Hybrid models of reactive transport in porous and fractured media** *ADVANCES IN WATER RESOURCES*  
Battiato, I., Tartakovsky, D. M., Tartakovsky, A. M., Scheibe, T. D.  
2011; 34 (9): 1140-1150
  - **Applicability regimes for macroscopic models of reactive transport in porous media.** *Journal of contaminant hydrology*  
BATTIATO, I., Tartakovsky, D. M.  
2011; 120-121: 18-26
  - **Elastic Response of Carbon Nanotube Forests to Aerodynamic Stresses** *PHYSICAL REVIEW LETTERS*  
Battiato, I., Bandaru, P. R., Tartakovsky, D. M.  
2010; 105 (14)
  - **On breakdown of macroscopic models of mixing-controlled heterogeneous reactions in porous media** *ADVANCES IN WATER RESOURCES*  
BATTIATO, I., Tartakovsky, D. M., Tartakovsky, A. M., Scheibe, T.  
2009; 32 (11): 1664-1673

- **The Impact of Pore-Scale Flow Regimes on Upscaling of Immiscible Two-Phase Flow in Geothermal Reservoirs** *Workshop on Geothermal Reservoir Engineering*  
Picchi, D., Battiato, I.  
2018