Stanford



Ilenia Battiato

Associate Professor of Energy Science Engineering

Energy Science & Engineering

Curriculum Vitae available Online

Bio

ACADEMIC APPOINTMENTS

- Associate Professor, Energy Science & Engineering

ADMINISTRATIVE APPOINTMENTS

- Postdoctoral Researcher, Max Planck Institute for Dynamics and Self-Organization (MPI-DS), G¨ottingen, 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

- Google Scholar: https://scholar.google.com/citations?user=wncGEjgAAAAJ&hl=en&oi=ao
- Multiscale Physics in Energy Systems Group: https://battiato.stanford.edu/

Research & Scholarship

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

COURSES

2026-27

- Fluid Mechanics and Heat Transfer: ENERGY 297 (Aut)
- Mass and Energy Transport in Porous Media: ENERGY 140, ENGR 120 (Win)

2025-26

- ESE Graduate Seminar: ENERGY 352 (Aut)
- Fluid Mechanics and Heat Transfer: ENERGY 297 (Aut)
- Mass and Energy Transport in Porous Media: ENERGY 120, ENGR 120 (Win)

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)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Sarah Sausan, Ge Zhang

Doctoral Dissertation Advisor (AC)

Marwah AlSinan, Mayuresh Bhattu, Zixin Ping, Ke Qin

Master's Program Advisor

Morgan Wyatt

Doctoral (Program)

Matthew Ard, Kelvin Green, Ashley Wang, Shufan Xia, Brandon van Gogh

Postdoctoral Research Mentor

He Shan

Publications

PUBLICATIONS

- **From theory to engineering: A physically consistent numerical framework for multiscale modeling of lithium-ion batteries** *JOURNAL OF POWER SOURCES*
  Pontillo, A., Boccardo, G., Marchisio, D., Battiato, I.
  2027; 699
- **Hot-spot index: A general framework for quantifying reactive hotspots** *ADVANCES IN WATER RESOURCES*
  Farhat, S., Bolster, D., Battiato, I.
  2026; 215
- **H₂ and CO₂ underground storage: Do they share the same multiscale** *ADVANCES IN WATER RESOURCES*
  Yu, S., Battiato, I.
  2026; 213
- **Homogenization-informed convolutional neural network to predict permeability and dispersion in porous media** *ADVANCES IN WATER RESOURCES*
  Weber, R. M., Battiato, I.
  2025; 203
- **Non-intrusive auto-detecting and adaptive hybrid scheme for multiscale heat transfer: Thermal runaway in a battery pack** *INTERNATIONAL JOURNAL OF HEAT AND MASS TRANSFER*
  Yao, Y., Battiato, I.
  2025; 247
- **Integrated physics-based modeling and microfluidics for quantifying multiphase carbonate dissolution in rocks.** *Lab on a chip*
  Hwang, J., Yu, S., Ross, C. M., Battiato, I.
  2025
- **A percolating path to green iron.** *Cell reports. Physical science*
  Paul, S., Kanesalingam, B., Ma, Y., Villanova, J., Requena, G., Akpu, S. C., Raabe, D., Battiato, I., Dresselhaus-Marais, L.
  2025; 6 (8): 102729

- **Enforcing global constraints for the dispersion closure problem: i 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., Kovscek, 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., Kovscek, 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., Kovscek, 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