

Thomas A. Petersen

Assistant Professor

University of Southern California

Sonny Astani Department of Civil and Environmental Engineering

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Education

Massachusetts Institute of Technology Cambridge, MA
Ph.D. in Mechanics of Materials June 2019
Thesis title: Continuum Modeling of Reactive Colloids: Transformation of Cement Paste from Sol to Cohesive Gel (dspace.mit.edu/handle/1721.1/123231)
Thesis advisor: Franz-Josef Ulm

Massachusetts Institute of Technology Cambridge, MA
S.M. in Civil and Environmental Engineering June 2015
Thesis title: Chemo-Poro-Elastic Fracture Mechanics of Wellbore Cement Liners: The Role of Eigenstress and Pore Pressure on the Risk of Fracture (dspace.mit.edu/handle/1721.1/99577)
Thesis advisor: Franz-Josef Ulm

North Carolina State University Raleigh, NC
B.S. in Civil Engineering, *Summa Cum Laude, Valedictorian* December 2011
Minor in Mathematics

Experience

University of Southern California, Assistant Professor, Los Angeles, CA Aug 2022-Present
ExxonMobil, Research Engineer, Spring, TX 2019-2022
Schlumberger, Stagiaire, Clamart, France Summer 2014
MIT-Concrete Sustainability Hub, Graduate Research Assistant, Cambridge, MA 2013-2019
North Carolina State Climate Office, Intern, Raleigh, NC Jan 2012-June 2012
NCSU, Undergraduate Research Assistant, Raleigh, NC 2010-2012

Research Interests

- Fluid and solid mechanics of reactive and/or porous materials
- Electrochemistry in reactive, porous materials
- Upscaling of systems composed of discrete building-blocks (colloidal particles, platelets, polymers) to the continuum material scale
- Modeling mechanical properties of reactive, cementitious materials
- Residual stresses and volume changes accompanying liquid to solid phase transitions

Awards

USC CEE - Oliveri Sustainable Prosperity Fund 2026

- \$16,000 seed funding for preliminary data collection on “Size-dependent transport mechanisms of contaminants through porous media”

MIT-France Fellowship to attend workshop in Marseille 2015

- \$2,000 travel grant
- National Science Foundation Graduate Research Fellowship** *2012-2015*
- Three-year annual stipend of \$30,000
- MIT Schoettler Fellowship** *2012-2013*
- One-year 50% tuition remission.

Teaching Experience

- USC CE/AME 507 – Mechanics of Solids (4 Units)**
 Graduate solid mechanics course
 Enrollment: 34 (17 DEN*, 17 in-person), Course Evaluation: 3.58/4.00 *Fall 2025*
 (Response Rate: 8/34)
- USC CE 330 (Formerly CE 402) – Computational Methods for CEE (2 Units)**
 Undergraduate numerical methods course
 Enrollment: 14, Course Evaluation: 3.41/4.00 (Response Rate: 9/14) *Spring 2025*
 Enrollment: 18, Course Evaluation: 3.40/4.00 (Response Rate: 10/18) *Spring 2024*
- USC CE 309 – Fluid Mechanics (4 Units)**
 Undergraduate introductory fluid mechanics course
 Enrollment: 38, Course Evaluation: 3.66/4.00 (Response Rate: 19/38) *Spring 2025*
 Enrollment: 41, Course Evaluation: 3.19/4.00 (Response Rate: 10/41) *Spring 2024*
 Enrollment: 39, Course Evaluation: 3.47/4.00 (Response Rate: 30/39) *Spring 2023*
- USC CE 599 – Soft Matter in CEE (2 Units)** *Fall 2023*
 Graduate-level course on mechanics of soft matter (*e.g.*, polymers, colloids, gels)
 Enrollment: 5, Course Evaluation: 4.00/4.00
- NSF Workshop: Engineering Mechanics Education** *June 2023*
 ASCE EMI Conference, Georgia Institute of Technology, Atlanta, GA
 Participant
- USC Center of Excellence in Teaching: 8-week **Faculty Teaching Institute Workshop** *Fall 2022*
- 1.050 Engineering Mechanics I:** *Fall 2015*
 Teaching Assistant for undergraduate introductory mechanics course in the Department of Civil and Environmental Engineering
- Teaching and Learning Laboratory at MIT** *Fall 2015*
 Teaching Certificate Program
- 2.002 Mechanics and Materials II:** *Spring 2013*
 Teaching Assistant for advanced undergraduate mechanics course in the Department of Mechanical Engineering (90+ students enrolled)

Professional Committees

- ASCE Engineering Mechanics Institute – *October 2022 - Present*
 Poromechanics Committee Member

* Distance Education Network

Peer-Reviewed Journal Papers

Petersen, T., Golchin, P., Im, J., de Barros, F.P.J. Electrokinetic Effects on Flow and Ion Transport in Charge-Patterned Corrugated Nanochannels. *Journal of Fluid Mechanics*, submitted October 26, 2025. <https://doi.org/10.48550/arXiv.2510.22182>

Petersen, T. (2024) Toward Modeling the Structure of Electrolytes at Charged Mineral Interfaces using Classical Density Functional Theory. *Journal of Physical Chemistry B*. 128 (16), 3981-3996.

Petersen, T., Bažant, M.Z., Pellenq, R.J.M., Ulm, F.-J. (2018) Phase separation of stable colloidal clusters. *Physical Review Materials*. 2 (9), 095602.

Petersen, T., Valenaire, P.-L., Pellenq, R.J.M., Ulm, F.-J. (2018) A reaction model for cement solidification: Evolving the C-S-H packing density at the micrometer-scale. *Journal of the Mechanics and Physics of Solids*. 118, 58-73.

Petersen, T., Devineni, N., Sankarasubramanian, (2018) Monthly hydroclimatology of the continental United States. *Advances in Water Resources*. 114, 180-195.

Abuhaikal, M., Iouannidou, **Petersen, T.**, Pellenq, R.J.M., Ulm, F.-J. (2018) Le Châtelier's conjecture: Measurement of colloidal eigenstresses in chemically reactive materials. *Journal of the Mechanics and Physics of Solids*, 112, 334-344.

Petersen, T., Ulm, F.-J. (2016) Early-age stress and pressure developments in a wellbore cement liner: Application to eccentric geometries. *Journal of Applied Mechanics*. 83 (9).

Petersen, T., Ulm, F.-J. (2016) Radial fracture in a three-phase composite: Application to wellbore cement liners at early ages. *Engineering Fracture Mechanics*, 154, 272-287.

Petersen, T., Devineni, N., Sankarasubramanian, A. (2012) Seasonality of monthly runoff over the continental United States: Causality and relations to mean annual and mean monthly distributions of moisture and energy. *Journal of hydrology*, 468, 139-150.

Peer-Reviewed Conference Papers

Petersen, T., Wu, Q., Liu, N., O'Donnell, B. J., Korn, G., Hewitt, P., Zhou, C. (2022) Compressible Carbon: Particle Behavior in Drilling Fluids and Field-Scale Deployment. In *Offshore Technology Conference*. OnePetro.

Petersen, T., Ulm, F.-J. (2018) Phase-field modeling of cement paste: Where particle physics meets continuum mechanics. *Computational Modeling of Structures*, 79-86.

Louhghalam, A., **Petersen, T.**, Ulm, F.-J. (2018) Translating environmentally-induced eigenstresses to risk of fracture for design of durable concrete pavements. *Computational Modeling of Structures*, 265.

Ulm, F.-J., Abuhaikal, M., **Petersen, T.**, Pellenq, R.J.M. (2014) Poro-chemo-fracture-mechanics...bottom-up: Application to risk of fracture design of oil and gas cement sheath at early ages. *Computational Modelling of Concrete Structures*, 61.

Patents and Patent Applications

US20250146386A1 “Methods for Managing Pressure Buildup Within Subsea Production Equipment Using Compressible Particles”, May 8, 2025 Inventors: Sterling, L., Templeton-Barrett, E., Huhn, S., **Petersen, T.**

US20230235642A1, “Casing attachment system for attenuating annular pressure buildup”, July 27, 2023 Inventors: **Petersen, T.**, Datta, S., White, S., Veselka, A., Morris, W., Narhi, W.

US11814932B2, “Method of attenuating annular pressure buildup using compressible particles”, November 14, 2023 Inventors: White, S., **Petersen, T.**, Templeton-Barrett, E., Zeilinger, S., Ivan, C., Gordon, P., Mayer, C.

US11649389B2, “Compressible Carbon Particles, and Method of Attenuating Annular Pressure Buildup Using Compressible Particles”, May 16, 2023 Inventors: Gordon, P., **Petersen, T.**, White, S., Templeton-Barrett, E., Mayer, C.

Invited Talks

Electrokinetic Phenomena in Nanochannels: From Molecular Structure to Flow Control (Dec. 3rd, 2025). Department of Aerospace and Mechanical Engineering, *University of Southern California*

Conferences and Industry Presentations

Petersen, T., Golchin, P., Im, J., de Barros, F. P. J. (2025) Electrochemical Flow through Charge-Patterned Wavy Nanochannels. *American Geophysical Union 2025*, New Orleans, LA.

Petersen, T. (2025) Electrochemical Flow through Charge-Patterned Wavy Nanochannels. 8th *Biot Conference on Poromechanics*, Salt Lake City, UT.

Golchin, P., **Petersen, T.** (2025) Flow and Dispersion in Active Pore Channels: A Numerical Investigation. *American Society of Civil and Environmental Engineering, Engineering Mechanics Institute Conference*, Anaheim, CA.

Viyas, P., **Petersen, T.**, Nweke, C. (2025) Modeling and Validating Reaction Dynamics in Enzyme-Induced Calcite Precipitation: Insights from Microfluidic Experiments. *American Society of Civil and Environmental Engineering, Engineering Mechanics Institute Conference*, Anaheim, CA.

Rabiee, A., **Petersen, T.** (2025) The Role of Disorder in Solute Transport through Poroelastic Networks with Inclusion-Matrix Morphologies. *American Society of Civil and Environmental Engineering, Engineering Mechanics Institute Conference*, Anaheim, CA.

Petersen, T. (2025) Non-equilibrium Modeling of Liquid-Vapor Transport through Direct Contact Distillation Membranes. *American Society of Civil and Environmental Engineering, Engineering Mechanics Institute Conference*, Anaheim, CA.

Petersen, T. (2024) Modeling Disjoining Pressure between Mineral Surfaces using Density Functional Theory. *American Geophysical Union 2024*, Washington, DC.

Petersen, T. (2024) Modeling Electrolytes at Charged Mineral Interfaces Using Classical Density Functional Theory, *The 8th International Soft Matter Conference*, Raleigh, NC

Petersen, T. (2023) Forces between Calcium-Silicate-Hydrate Surfaces: A Density Functional Approach, *American Society of Civil and Environmental Engineering, Engineering Mechanics Institute Conference*, Georgia Institute of Technology, Atlanta, GA.

Petersen, T. (2023) Ion Layering at Charged Mineral Surfaces: A Classical DFT Approach, *SoCal Solids*, Lightning Talk, USC, Los Angeles, CA.

Petersen, T. (2022) Compressible Carbon Solutions for Annular Pressure Build-Up in Sus-sea Wells, ExxonMobil, *Upstream Innovation Forum*, Spring TX. *Ted Talk-style presentation broadcast to entire ExxonMobil Upstream Organization.*

Petersen, T., Bažant, M., Pellenq, R., Ulm, F.-J. (2018) Precipitation, Aggregation, and Gelation of Colloids: Application to Cement Paste, *EURO-C*, Bad Hofgastein, Austria.

Petersen, T., Valdenaire, P.-L., Ulm, F.-J. (2017) Cement as a colloid: From hydration kinetics to mechanics, *American Society of Mechanical Engineers, International Mechanical Engineering Congress and Exposition*. Tampa, FL.

Petersen, T., Ulm, F.-J. (2016) Chemo-Poro Elastic Fracture Mechanics of Wellbore Cement Liners, *American Society of Civil Engineering, Engineering Mechanics Institute Conference*, Nashville, TN

Petersen, T., Ulm, F.-J. (2015) Chemo-Poro-Elastic Fracture Modeling of Wellbore Cement Liners: The Risk of Impairment due to Pore-Pressure and Eigenstress Development, *Groupement de Recherche International, Centre national de la recherche scientifique*, Cambridge, MA

Petersen, T., Ulm, F.-J. (2014). Poro-chemo-elastic stress and pressure developments in an eccentric cement sheath. *American Society of Mechanical Engineers, International Mechanical Engineering Congress and Exposition*. Montreal, Canada.

USC Service

Faculty Advisor – Engineers Without Borders	<i>Fall 2025-Present</i>
SoCal CEE Research Symposium, Poster Judge	<i>Spring 2025</i>
Annual Faculty Review Committee	<i>Fall 2024 - Spring 2025</i>
CEE Ph.D. Visit Day Organizer (In-Person & Virtual)	<i>2025</i>
Structural Masters Program Revision Committee	<i>Fall 2024</i>
ASCE Daniel W. Mead Prize Paper Competition, USC Selection Reviewer	<i>Spring 2024</i>
SoCal CEE Research Symposium, Poster Judge	<i>Spring 2024</i>
Adjunct Research Prof. Appointment Committee	<i>Spring 2024</i>
Dr. Xiao and Dr. Todorovska Reappointment Committee	<i>Spring 2024</i>
CEE Ph.D. Visit Day Organizer (In-Person & Virtual)	<i>2024</i>
USC Presidential Sustainability Solutions Postdoctoral Fellowship Reviewer	<i>2023</i>
DS, ML, & AI Undergraduate Program Revision Committee	<i>Summer 2023</i>
SoCal CEE Research Symposium, Poster Judge	<i>Spring 2023</i>
Das Family Travel Award Selection Committee	<i>Spring 2023</i>
CEE Ph.D. Visit Day Organizer (In-Person & Virtual)	<i>2023</i>

External Service

NSF Proposal Reviewer	<i>Spring 2026</i>
Journal of Fluid Mechanics, Paper Reviewer	<i>2025-Present</i>
Journal of Engineering Mechanics, ASCE, Paper Reviewer	<i>2022 - Present</i>

Journal of Physical Chemistry, ACS, Reviewer	2025-Present
Swiss National Science Foundation, Proposal Reviewer	2025
ACS, Petroleum Research Fund, Proposal Reviewer	Spring 2024
NSF Panel Reviewer	Spring 2024
Polytechnica, Springer, Paper Reviewer	2022

Current Research Group

Olesia Zelenina, <i>Ph.D. Student</i>	Incoming Fall 2026
Nusrat Jahan, <i>Ph.D. Student</i>	2025-Present
Tarikul Islam, <i>Ph.D. Student</i>	2024-Present
Pouya Golchin, <i>Ph.D. Student</i>	2023-Present
Amirmahdi Rabiee, <i>Ph.D. Student</i>	2023-Present

Masters Research Advisees

Fai Almulla, <i>M.S. Student</i>	2025
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Undergraduate Research Advisees

Luke Bayliss, <i>SURE Fellow</i>	Summer 2025
Landon Allen, <i>CURVE Fellow</i>	2024-2025
Jana Fladd, <i>CURVE Fellow</i>	2023-2024
Sophia Li, <i>CURVE Fellow</i>	2023-2024
Kevin Kumar, <i>CURVE Fellow</i>	2023-2024

Ph.D. Thesis Exam Committee Member

Haixu Du (Advisor: Qiming Wang)	2026
Martijn Bindels (Advisor: Amy Childress)	2025
Yanchu Zhang (Advisor: Qiming Wang)	2025
Shounak Joshi (Advisor: Amy Childress)	2025
Hu Xu (Advisor: Paul Plucinsky)	2025

Ph.D. Qualification Exam Committee Member

Raven Althouse (Advisor: Adam Smith)	2026
Haoxiang Deng (Advisor: Qiming Wang)	2026
Zihao Wang (Advisor: Lucio Soibelman)	2026
Martijn Bindels (Advisor: Amy Childress)	2025
Patrick Rodriguez (Advisor: Lucio Soibelman)	2024
Shounak Joshi (Advisor: Amy Childress)	2024
Yanchu Zhang (Advisor: Qiming Wang)	2024
Hu Xu (Advisor: Paul Plucinsky)	2024
Ketian Li (Advisor: Qiming Wang)	2023
Maile McCann (Advisor: Patrick Lynett)	2023