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# Tingting Xu

## EDUCATION AND EMPLOYMENT

2023–present **Postdoctoral Fellow**, *Mechanical Engineering & Civil Engineering*, Johns Hopkins University, Baltimore, MD, USA.
**Supervisors**: **Thao (Vicky) Nguyen & James Guest**
**Project:** Computational optimization of Liquid Crystal Elastomers (LCEs)

2018–2022 **Ph.D.**, *Civil Engineering*, Georgia Tech, Atlanta, GA, USA.
**Supervisor**: **Chloé Arson**
**Thesis title:** Homogenization of coupled deformation, damage and diffusion processes in rocks and finite element applications in geomechanics and geomorphology

2019–2022 **M.Sc.**, *Computational Science and Engineering*, Georgia Tech, Atlanta, GA, USA.
**Core courses:** Numerical Linear Algebra; Computational Science and Engineering Algorithms; Modeling and Simulation; Computational Data Analysis

2015–2018 **M.Sc.**, *Civil Engineering*, Zhejiang University, Hangzhou, China.
**Supervisor**: **Zhongxuan Yang**
**Thesis title**: The development of soil constitutive models considering fabric evolution

2011–2015 **B.Sc.**, *Civil Engineering*, China University of Geosciences, Wuhan, China.
**Supervisor**: **Kunlong Yin, Rank: $1^{st}$/120**
**Thesis title**: Spatial prediction of landslide susceptibility in Wanzhou County, Three Gorges Reservoir, China

## RESEARCH INTERESTS

- **Polymer mechanics:** constitutive modeling, finite-strain formulation, and numerical implementation.
- **Computational optimization:** nonlinear optimization techniques for material design and performance enhancement.
- **Multiphysical modeling:** development of coupled chemo-mechanical frameworks.
- **Microporomechanics and upscaling:** mean-field and full-field homogenization methods for heterogeneous materials.
- **Fracture mechanics:** numerical modeling of crack initiation and propagation using cohesive element methods.

## TEACHING & MENTORING

### Teaching Experience

- Instructor, Engineering Mechanics and Materials (sophomore- and junior-level) *Spring 2025*
  Led lectures, designed coursework, and held office hours.
- Teaching Certificate, Georgia Tech *Associate Level, Fall 2022*
  Training in student-centered instruction, assessment, and classroom management.

- Student Instructor, Mechanics of Deformable Bodies (junior-level) *Fall 2021*
  Delivered lectures, designed coursework, and held office hours.
- Grader, Mechanics of Deformable Bodies (junior-level) *Fall 2019 & Fall 2020*
  Held office hours, graded coursework, and provided feedback.

**Mentoring Experience**

- Sofie Lehtikoski — Finite element analysis of cavity expansion and machine learning model prediction, Spring 2021 & Fall 2021.
- Mark A. Rotolo — Clustering of granite minerals using the k-means model, Spring 2020 & Fall 2020.
- Maxwell R. Koerner — Clustering of granite minerals using the Gaussian mixture model, Fall 2019.

## PUBLICATIONS

**Peer-reviewed publications**

1. **Xu, T.**, Nguyen, T.D., and Guest, J.K.
   Computational optimization of director patterns in liquid crystal elastomers.
   ***Journal of the Mechanics and Physics of Solids***, 106369, 2026. Link
2. Reed, M.M., Ferrier, K.L., Nachlas, W.O., Schneider, B., Arson, C., **Xu, T.**, Shen, X., and West, N.
   A free, open-source method for automated mapping of quantitative mineralogy from energy-dispersive X-ray spectroscopy scans of rock thin sections.
   ***Geoscientific Instrumentation, Methods and Data Systems***, 14(2), 2025. Link
3. **Xu, T.**, and Arson, C.
   Feedback mechanisms between weathering advancement and cohesive fracture propagation in granite.
   ***Journal of Geophysical Research: Earth Surface***, 130(8), 2025. Link
4. **Xu, T.**, and Arson, C.
   Interface homogenization approach for mechanical healing driven by pressure solution.
   ***Journal of Engineering Mechanics***, 149(10), 2023. Link
5. **Xu, T.**, Shen, X., Reed, M.M., West, N., Ferrier, K.L., and Arson, C.
   Anisotropy and microcrack propagation induced by weathering, regional stresses, and topographic stresses.
   ***Journal of Geophysical Research: Solid Earth***, 127(7), 2022. Link
6. Wu, Z., **Xu, T.**, and Arson, C.
   Effect of the intermediate principal stress on pre-peak deformation and damage in hard rock under true triaxial compression.
   ***Rock Mechanics and Rock Engineering***, 55(10), 6475–6494, 2022. Link
7. **Xu, T.**, and Arson, C.
   Self-consistent approach for modeling coupled elastic and visco-plastic processes induced by dislocation and pressure solution.
   ***International Journal of Solids and Structures***, 238, 111376, 2022. Link
8. Liao, D., Yang, Z., and **Xu, T.**
   J2-deformation-type soil model coupled with state-dependent dilatancy and fabric evolution: multiaxial formulation and FEM implementation.
   ***Computers and Geotechnics***, 129, 103674, 2021. Link

9. Pan, K., **Xu, T.**, Liao, D., and Yang, Z.
Failure mechanisms of sand under asymmetrical cyclic loading conditions: experimental observation and constitutive modelling.
***Géotechnique***, 1–14, 2020. Link

10. Yang, Z., Liao, D., and **Xu, T.**
A hypoplastic model for granular soils incorporating anisotropic critical state theory.
***International Journal for Numerical and Analytical Methods in Geomechanics***, 44(6), 723–748, 2020. Link

11. Wu, Q., **Xu, T.**, and Yang, Z.
Diffuse instability of granular material under various drainage conditions: discrete element simulation and constitutive modeling.
***Acta Geotechnica***, 1–16, 2019. Link

12. Yang, Z., **Xu, T.**, and Li, X.
J2-deformation-type model coupled with state-dependent dilatancy.
***Computers and Geotechnics***, 105, 129–141, 2019. Link

13. Pan, K., Yang, Z., and **Xu, T.**
Impact of static preshearing on undrained anisotropy and shear characteristics of sand.
***International Journal of Geomechanics***, 18(12), 04018162, 2018. Link

14. Yang, Z., **Xu, T.**, and Chen, Y.
Unified modeling of the influence of consolidation conditions on monotonic soil response considering fabric evolution.
***Journal of Engineering Mechanics***, 144(8), 04018073, 2018. Link

**Contributions to conferences**

1. **Xu, T.**, and Arson, C.
Coupling between weathering and fracture: finite element modeling of granite weathering using cohesive elements.
***58th US Rock Mechanics/Geomechanics Symposium***, 2024. Link

2. **Xu, T.**, Shen, X., Reed, M.M., West, N., Ferrier, K.L., and Arson, C.
Competition between biotite weathering and regional stresses: insights from homogenization and finite element simulation.
***56th US Rock Mechanics/Geomechanics Symposium***, 2022. Link

## PRESENTATIONS

**Invited Talks**

1. Multiscale Modeling of Coupled Mechanisms in Geomechanics.
*Boase Seminar Series in Geomechanics / Rocky Mountain Mechanics Seminar Series, University of Colorado Boulder*, 2024, Boulder, CO.

2. Computational Modeling of Coupled Processes in Geomaterials.
*Department of Civil Engineering, McMaster University*, 2024, Hamilton, ON, Canada.

**Conference**

1. Computational optimization of director patterns in liquid crystal elastomers.
*2025 SES Annual Technical Meeting*, October 13–15, 2025, Atlanta, GA.

2. Coupling between weathering and fracture: finite element modeling of granite weathering using cohesive elements.
*58th U.S. Rock Mechanics/Geomechanics Symposium*, June 23–26, 2024, Golden, CO.

3. Topology optimization of liquid crystal elastomer materials with a nonuniform director field.
   *Engineering Mechanics Institute Conference and Probabilistic Mechanics & Reliability Conference (EMI/PMC 2024) Minisymposia*, May 28–31, 2024, Chicago, IL.
4. Homogenization model for layered media: coupling effects of bedding direction and mineral fabric.
   *Conference of the Engineering Mechanics Institute*, June 6–9, 2023, Georgia Institute of Technology, Atlanta, GA.
5. Competition between biotite weathering and regional stresses: insights from homogenization and finite element simulation.
   *56th U.S. Rock Mechanics/Geomechanics Symposium*, June 26–29, 2022, Santa Fe, NM, USA.
6. A self-consistent approach to interfaces of variable stiffness in polycrystalline materials subject to pressure solution.
   *Conference of the Engineering Mechanics Institute*, May 31–June 3, 2022, Johns Hopkins University, Baltimore, MD.
7. Anisotropy induced by microcrack propagation under weathering and regional stresses.
   *Biot-Bazant Conference on Engineering Mechanics and Physics of Porous Materials*, June 1–3, 2021, Northwestern University, Evanston, IL.
   Video proceedings archived in Figshare. DOI: 10.6084/m9.figshare.14773599.v1.
8. Multiscale modeling of the competition between mechanical damage and healing in salt polycrystals.
   *Conference of the Engineering Mechanics Institute and the Geo-Institute*, June 18–21, 2019, California Institute of Technology, Pasadena, CA.

## SERVICES

**Conference**

Session Chair: "Damage Mechanics: Experimental and Numerical" — *58th & 59th U.S. Rock Mechanics/Geomechanics Symposium*

**Peer Review**

Reviewer for journals: *International Journal of Rock Mechanics and Mining Sciences; Physical Review E; Rock Mechanics and Rock Engineering; Géotechnique Letters; International Journal for Numerical and Analytical Methods in Geomechanics; Journal of Geophysical Research: Solid Earth; Journal of Engineering Mechanics*.

Reviewer for conferences: *58th U.S. Rock Mechanics/Geomechanics Symposium; 57th U.S. Rock Mechanics/Geomechanics Symposium*.

**Professional Service**

2024–present Poromechanics Committee, Engineering Mechanics Institute (EMI), ASCE

2019–2022 Graduate Student Advisory Council, School of Civil and Environmental Engineering, Georgia Tech

## AWARDS AND GRANTS

2025–2030 NSERC Discovery Grant (5-Year) — *Advancing Geological Carbon Storage: From Multiphysical Modeling to Field Optimization* Natural Sciences and Engineering Research Council of Canada (NSERC) *[Awarded; activation pending]*

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| 2026–2027 | Postdoctoral Fellowship ($100K) | Gordon and Betty Moore Foundation |
| 2025 | SES 2025 Student/Postdoc Travel Award | NSF–MoMS |
| 2019 | Outstanding Graduate Fundamental Research Award | Georgia Tech |
| 2015 | Excellent Bachelor's Dissertation | Hubei Provincial Department of Education |
| 2013 | National Scholarship | Ministry of Education of the P.R. China |