Xing Liu

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RESEARCH INTERESTS

My Mission is to design *more mechanically resilient* engineering materials and structures (with exceptional strength and fracture/fatigue resistance) for aerospace and energy applications while enabling *more socioresilient* utilization of these materials throughout their *entire* life cycle. The success of the mission hinges on the integration of *multiscale modeling* (*e.g.*, atomistic modeling, crystal plasticity modeling, phase field modeling), *advanced machine learning* (*e.g.*, generative AI), and *multiscale materials characterization*.

Scientific Endeavors that underpin my mission include i) advancing *theories of strength* for materials exhibiting exceptional structural, microstructural, and/or compositional *heterogeneity*, *e.g.*, complex concentrated alloys, additively manufactured materials, ceramic composites, ii) developing experimentally validated models with *uncertainty quantification* to predict the *inelastic* deformation and *fracture* of materials under *normal* and *extreme* conditions, iii) devising *multiphysics* methodologies for *manipulating* material microstructures and for *rejuvenating*, *repairing*, and *recycling* damaged heterogeneous materials.

Concurrently with the research thrust described above, I am committed to constructing a machine learning-enabled open-access platform for materials characterization.

SCIENTIFIC SKILLS

- **Programming**: Python, Fortran, Matlab, TensorFlow, Scikit-learn, LaTeX
- **Computational**: ABAQUS, ANSYS, FEAP, FEniCS, LAMMPS, VASP, Creo Parametric, HyperMesh
- **Experimental**: Instron Testing Machine, Nano-indentation, Digital Image Correlation

EMPLOYMENT HISTORY

Georgia Institute of Technology, USA
Postdoctoral Fellow, George W. Woodruff School of Mechanical Engineering August 2022 – Present
Working with Prof. Ting Zhu

Brown University, USA
Postdoctoral Research Associate, School of Engineering February 2022 – July 2022
Working with Profs. Brian W. Sheldon, Nitin P. Padture, Huajian Gao

Brown University, USA
Graduate Research Assistant, Solid Mechanics, School of Engineering 2014 – December 2021
Working with Prof. Huajian Gao

EDUCATION

Ph.D. **Brown University, USA** 2014 – December 2021
Research Assistant, Solid Mechanics, School of Engineering
Dissertation: *Integrated simulation, machine learning and experimental approaches in small-scale mechanical characterization of materials*
Dissertation Committee: Prof. Huajian Gao (advisor), Prof. Brian W. Sheldon, Prof. Nitin P. Padture

B.E. **Tsinghua University, CHINA** 2010 – 2014
Tsien Hsue-Shen Elite Class in Mechanics, Department of Engineering Mechanics

AWARDS & HONORS

- **Outstanding Reviewer Award**, Acta/Scripta Materialia 2022

TEACHING EXPERIENCE

- Guest Lecturer, Statics (Instructor: Prof. Ting Zhu) Spring 2023
- Teaching Assistant, Advanced Engineering Mechanics (Instructor: Prof. Huajian Gao) Spring 2017

PEER REVIEWED JOURNAL PUBLICATIONS († AUTHORS WITH EQUAL CONTRIBUTIONS)

[1] X. Liu, C.E. Athanasiou, C. López-Pernía, T. Zhu, N.P. Padture, B.W. Sheldon, H. Gao, "Tailoring the toughening effects in two-dimensional nanomaterial-reinforced ceramic matrix composites", ***Journal of Applied Mechanics*** (Accepted).

[2] Z. Dai, M.C. Doyle, X. Liu, M. Hu, Q. Wang, C.E. Athanasiou, Y. Liu, B.W. Sheldon, H. Gao, S.F. Liu, N.P. Padture, "The mechanical behavior of metal-halide perovskites: Elasticity, plasticity, fracture, and creep", ***Scripta Materialia*** (2023).

[3] C.E. Athanasiou†, X. Liu†, B. Zhang†, T. Cai, C. Ramirez, N.P. Padture, J. Lou, B.W. Sheldon, H. Gao, "Integrated simulation, machine learning, and experimental approach to characterizing fracture instability in indentation pillar-splitting of materials", ***Journal of the Mechanics and Physics of Solids*** (2022).

[4] C.E. Athanasiou†, X. Liu†, M.Y. Jin, E. Nimon, S. Visco, C. Lee, M. Park, J. Yun, N.P. Padture, H. Gao, B.W. Sheldon, "Rate-dependent deformation of amorphous sulfide glass electrolytes for solid-state batteries", ***Cell Reports Physical Science*** (2022).

[5] Z. Dai, S. Li, X. Liu, M. Chen, C.E. Athanasiou, B.W. Sheldon, H. Gao, P. Guo, N.P. Padture, "Dual-interface reinforced flexible perovskite solar cells for enhanced performance and mechanical reliability", ***Advanced Materials*** (2022).

[6] X. Liu†, C.E. Athanasiou†, N.P. Padture, B.W. Sheldon, H. Gao, "Knowledge extraction and transfer in data-driven fracture mechanics", ***Proceedings of the National Academy of Sciences*** (2021).

[7] B. Zhang†, X. Liu†, H. Guo†, K. Yang, G. Gao, B.W. Sheldon, H. Gao, J. Lou, "Quantitative in-situ study of strength-governed interfacial failure between h-BN and polymer-derived ceramic", ***Acta Materialia*** (2021).

[8] X. Liu, C.E. Athanasiou, N.P. Padture, B.W. Sheldon, H. Gao, "A machine learning approach to fracture mechanics problems", ***Acta Materialia*** (2020).

[9] A.K. Dickerson, X. Liu, T. Zhu, D.L. Hu, "Fog spontaneously folds mosquito wings", ***Physics of Fluids*** (2015).

INVITED/CONTRIBUTED CONFERENCE TALKS

[1] **X. Liu**, "**Keynote** Talk − Integrated Simulation, Machine learning, and Experimental Approaches in Small-Scale Mechanical Characterization of Materials", *The Society of Engineering Science (SES) Annual Technical Meeting*, October 2022.

[2] **X. Liu**, C.E. Athanasiou, T. Zhu, N.P. Padture, B.W. Sheldon, H. Gao, "Contributed Talk − Tailoring toughening effects in two-dimensional nanomaterial-reinforced ceramic matrix composites", *The Society of Engineering Science (SES) Annual Technical Meeting*, October 2023.

[3] **X. Liu**, T. Zhu, "Contributed Talk − Investigating precipitate hardening through discrete dislocation analysis", *The Society of Engineering Science (SES) Annual Technical Meeting*, October 2023.

[4] **X. Liu**, C.E. Athanasiou, "Contributed Talk − Integrating Simulation, Machine Learning, and Experimental Approaches for High-Throughput Small-Scale Fracture Investigations", *15th International Conference on Fracture (ICF15)*, June 2023.

[5] **X. Liu**, C.E. Athanasiou, N.P. Padture, B.W. Sheldon, H. Gao, "Contributed Talk − Knowledge extraction and transfer in data-driven fracture mechanics", *ASCE Engineering Mechanics Institute (EMI) Conference*, June 2023.

[6] **X. Liu**, C.E. Athanasiou, N.P. Padture, B.W. Sheldon, H. Gao, "Contributed Talk − Integrating Simulation, Machine Learning, and Experimental Approaches in Small-Scale Mechanical Characterization of Materials", *The Minerals, Metals & Materials Society (TMS) 2023 Annual Meeting & Exhibition*, March 2023.

[7] **X. Liu**, C.E. Athanasiou, B. Zhang, N.P. Padture, J. Lou, B.W. Sheldon, H. Gao, "Contributed Talk − Integrated cohesive zone and J-integral approaches to characterizing indentation-induced pillar fracture instability", *19th U.S. National Congress on Theoretical and Applied Mechanics (USNC/TAM)*, June 2022.

[8] **X. Liu**, C.E. Athanasiou, N.P. Padture, B.W. Sheldon, H. Gao, "Contributed Talk − A machine learning approach to fracture mechanics problems", *2020 Virtual Materials Research Society (MRS) Fall Meeting & Exhibit*, November 2020.

ADVISING & MENTORING EXPERIENCE

Zhiming Dai & Cheng Wan, Master students, Georgia Tech — Fall 2023

Co-advising with Prof. Christos E. Athanasiou (Georgia Tech) on renovating and advertising our Machine Learning-Enabled Open-Access Platform/Website for Mechanical Testing of Materials.

SERVICE ACTIVITIES

Journal Reviewer:

Journal of the Mechanics and Physics of Solids, Acta Materialia, Scripta Materialia, Mechanics of Materials, Geoenergy Science and Engineering, Engineering with Computers, Engineering Applications of Artificial Intelligence

Symposium Scribe:

AmeriMech Symposium Series on *Machine learning in heterogeneous porous materials*, October 2021, sponsored by the National Academies of Sciences, Engineering and Medicine and the U.S. National Committee on Theoretical and Applied Mechanics.

Ongoing commitment to co-authoring a review article titled "A century of fracture mechanics: from Griffith theory to machine learning" with Prof. Huajian Gao (Nanyang Technological University, Singapore; IHPC, A*STAR, Singapore), Prof. Markus J. Buehler (MIT), Prof. George Em Karniadakis (Brown University), Prof. Pania Newell (University of Utah), and Dr. Hari Viswanathan (Los Alamos National Laboratory).

Commitment to Building a Machine Learning-Enabled Open-Access Platform for Mechanical Testing of Materials:

My web-based platform has been available online since 2019 (https://hint1412.github.io/XLiu.github.io/SIF/).