

Pengju Xing

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Education

- 2013-2017 PhD, Major: Civil Engineering, Minor: Mechanical Engineering
University of Pittsburgh, USA
- 2009-2012 M.Eng. in Structural Engineering
Tongji University, China
- 2005-2009 B.Eng. in Civil Engineering
Wuhan University, China

Research Interests

Geothermal, geomechanics, machine learning, computational mechanics, experimental rock mechanics, hydraulic fracturing, fracture mechanics,

Professional Experience

- 2023- **University of Utah** *Research Associate*
Work on energy related projects
- Hydraulic stimulation and fluid circulation in Enhanced Geothermal System
 - Combined physics and data-driven analysis on drilling in geothermal wells
 - Simulation of geothermal reservoirs, including hydrothermal and enhanced systems
 - Wellbore stability analysis in complex geological conditions
- 2022-2023 **Itasca Consulting Group** *Geomechanics Engineer*
Work on consulting projects for geothermal and mining industry, and development of XSite
- Numerical simulation of hydraulic stimulation for enhanced geothermal systems
 - Dynamic analysis of the slope stability of waste dump in open pit mine
 - Hydro-mechanical coupling analysis of the slope stability of open pit mine to advise the water management
 - Test and verify XSite functionalities in MPI (Linux system)
- 2019-2022 **University of Utah** *Postdoctoral Researcher*
Work on Frontier Observatory for Research in Geothermal Energy (FORGE) – a Enhanced Geothermal System (EGS), \$200 million DOE project
- Design of the hydraulic stimulation at FORGE site aided by the simulation, injection and drilling data
 - In-situ stress interpretations using cutting edge techniques such as flowback tests and temperature signatures for FORGE
 - Numerical simulation of stimulation for FORGE site with explicit representation of discrete fracture network (Xsite)
 - Thermal-poro-elasticity analysis of wellbore stability for geothermal wells
 - Using machine learning to predict geothermal reservoir properties
 - Control of fluid flow in EGS reservoir under coupled hydro-mechanical-thermal analysis
- 2018-2019 **W.D. Von Gonten Laboratories, LLC** *Geomechanics Engineer*
Geomechanical experiments and numerical simulation
- Hydraulic fracture experiments and numerical simulation to investigate the effect of interfaces
 - Developing new rock mechanics tests, such as fracture toughness test
 - Numerical modeling such as coring, wellbore stability and fault slip
 - Interface leakoff test with designed flow cell
 - Training and mentoring technicians in the lab.

- 2014-2017 **University of Pittsburgh Research Assistant**
Hydraulic fracture containment in layered reservoirs.
- Design, develop, and execute experiments on hydraulic fracture growth
 - Numerical simulation of the experiments using Itasca's XSite
 - Hydraulic fracture simulation with cohesive zone method in ABAQUS
 - Monthly written report and bi-monthly presentation of the project
- 2017 **University of Pittsburgh Research Assistant**
Development of FEM Code Coupled with TOUGH+HYDRATE for Thermal-hydrological mechanical Analysis in Hydrate Bearing Sediments.
- Develop finite element code including both displacement and pore pressure
 - Develop finite element code capable for non-linear material such as Mohr-Coulomb and Cam-Clay soil
- 2016 **ANSYS, Inc. Test Engineer (Intern)**
Software testing on partially saturated flow of coupled pore pressure and thermal (CPT) elements.
- Test the partially saturated flow of ANSYS CPT series elements
 - Comparing with analytical solutions and experimental results
- 2012-2013 **United Design Group Co. Ltd, Shanghai Structural Engineer (full time)**
Structural design for offices, schools, and railway stations, etc.
- 2010-2012 **Tongji University Research Assistant**
Numerical analysis of stability capacity of cable-stiffened single-layer latticed shell.
- Analysis of the structural features of different types of cable-stiffened single-layer latticed shells
 - Numerical study of the impact of semi-rigid joints on the overall stability of the new structure style using ANSYS

Teaching Experience

- Fall 2014 CEE 0109 (TA, Undergraduate Computer methods in civil engineering, Professor Jeen-Shang Lin)
- Spring 2014 CEE 0109 (TA, Undergraduate Computer methods in civil engineering, Professor David Sanchez)
- Fall 2013 CEE 0109 (TA, Undergraduate Computer methods in civil engineering, Professor Jeen-Shang Lin)
- Teaching undergraduate computer methods including AUTOCAD, MATLAB and MathCad
 - Teaching recitations
 - Holding regular office hours
 - Grading homework

Students Supervised

- 2021-2015- Zach Phelan, University of Utah, machine learning on prediction formation properties by drilling data
- 2015- Roslyn Scangas, University of Pittsburgh, experimental study of hydraulic fracturing

Publications

Journal articles

- 2023 Liu Y., Z. Hu, T. Xu, B. Feng, Y. Yuan, **P. Xing**. Discrete element modeling for the multistage hydraulic stimulation of a horizontal well in hot dry rock. *Computers and Geotechnics*, 156
- 2021 **Xing, P.**, J. McLennan, and J. Moore. In-situ Stress Measurement Using Temperature Signatures. *Geothermics*, 98, 102282.
- Propose a novel method to infer the in-situ stress based on downhole temperature data, which yields unambiguous interpretations.
- 2021 **Xing, P.**, B. Damjanac, J. McLennan, and J. Moore. Flowback Test Analyses at the Utah Frontier

Observatory for Research in Geothermal Energy (FORGE) Site. *Rock Mechanics and Rock Engineering*, 55, pages 3023–3040.

Flowback tests have the advantage of shorter closure time. This paper utilizes the flowback test to infer the in-situ stress, reservoir permeability, and compressibility in geothermal wells.

- 2020 **Xing, P.**, J. McLennan, and J. Moore. In-Situ Stress Measurements at the Utah Frontier Observatory for Research in Geothermal Energy (FORGE) Site. *Energies*, 13(21), p.5842.
Summarize and analyze the In-situ stress measurements of FORGE site and find the influence of poroelasticity and natural fractures.
- 2018 **Xing, P.**, K. Yoshioka, J. Adachi, A. El-Fayoumi, B. Damjanac, A. P. Bunger, Lattice Simulation of Hydraulic Fracture Containment in Layered Reservoirs. *Computers and Geotechnics*, 100, 62-75
Numerical analysis of hydraulic fracture containment using a lattice model, including comparison to experimental results and extension of the numerical parametric study.
- 2018 **Xing, P.**, K. Yoshioka, J. Adachi, A. El-Fayoumi, A. P. Bunger, Laboratory demonstration of hydraulic fracture height growth across weak discontinuities. *Geophysics*, 83 (2), MR93-MR105
Experimental results showing the impact of weak horizontal discontinuities on hydraulic fracture height growth.
- 2017 **Xing, P.**, K. Yoshioka, J. Adachi, A. El-Fayoumi, A. P. Bunger, Laboratory measurement of tip and global behavior for zero-toughness hydraulic fractures with circular and blade-shaped (PKN) geometry. *Journal of the Mechanics and Physics of Solids*, 104, 172-186.
Experimental validation of several theoretically-predicted asymptotic behaviors, namely for hydraulic fracture growth under conditions of negligible fracture toughness, with growth progressing from early-time radial geometry to large-time blade-like (PKN) geometry.
- 2014 Li, P., M. Wu, and **P. Xing**. Novel cable-stiffened single-layer latticed shells and their stabilities, *Journal of Constructional Steel Research*, 92, 114-121.
The numerical results indicate that the buckling load of single-layer latticed shells is improved significantly by the introduction of cables.
- Conference presentations**
- 2023 **Xing, P.**, B. Damjanac, Z. Radakovic-Guzina, M. Torres, A. Finnilla, R. Podgorney, J. Moore, J. McLennan, 2023, Comparison of Modeling Results with Data Recorded During Field Stimulations at Utah FORGE Site: Presented at 48th Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, February 6-8.
- 2023 Podgorney, R., L. Munday, J. Liu, A. Finnilla, B. Damjanac, **P. Xing**, Z. Radakovic-Guzina, 2023, Thermal-Hydraulic-Mechanical (THM) Modeling of Fluid Flow and Heat/Tracer Transport Between Injection and Production Wells at the Utah FORGE Site: Presented at 48th Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, February 6-8.
- 2022 **Xing, P.**, B. Damjanac, Z. Radakovic-Guzina, M. Torres, A. Finnilla, R. Podgorney, J. Moore, J. McLennan, 2022, Numerical Simulation of Stimulations at the Utah FORGE Site Using the Desinged Pumping Schedules: Presented at the *Geothermal Rising Conference*, Reno, Nevada, August 28-31.
- 2022 Phelan, Z., **P. Xing***, P. Panja, M. Torres, J. Moore, J. McLennan, 2022, Prediction of Formation Properties Based on Drilling Data of Wells at Utah FORGE Site Using Machine Learning: Presented at the *56th US Rock Mechanics/Geomechanics Symposium*, Santa Fe, New Mexico, June 26-29.
- 2022 **Xing, P.**, A. Wray, E.I.V. Arteaga, A. Finnilla, J. Moore, C. Jones, E. Borchardt, J. McLennan, 2022, In-situ Stresses and Fractures Inferred from Image Logs at Utah FORGE: Presented at 47th Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, February 7-9.
- 2021 **Xing, P.**, D. Winkler, L. Swearingen, J. Moore, J. McLennan, 2021, In-Situ Stresses and Permeability Measurements from Testings in Injection Well 16A(78)-32 at Utah FORGE Site:

Presented at the *Geothermal Rising Conference*, San Diego, California, October 3-6.

- 2021 **Xing, P.**, B. Damjanac, Z. Radakovic-Guzina, A. Finnilla, R. Podgorney, J. Moore, J. McLennan, 2021, Numerical Investigation of Stimulation from the Injection Well at Utah FORGE Site: Presented at the *Geothermal Rising Conference*, San Diego, California, October 3-6.
- 2021 **Xing, P.**, B. Damjanac, Z. Radakovic-Guzina, A. Finnilla, R. Podgorney, J. Moore, J. McLennan, 2021, Numerical Simulation of Hydraulic Fracturing Stimulation of the Enhanced Geothermal System Well at Utah FORGE Site: Presented at the *55th US Rock Mechanics/Geomechanics Symposium*, online, June 21-25.
- 2021 **Xing, P.**, B. Damjanac, Z. Radakovic-Guzina, A. Finnilla, R. Podgorney, J. Moore, J. McLennan, 2021, Numerical Simulation of Injection Tests at Utah FORGE Site: Presented at the *46th Workshop on Geothermal Reservoir Engineering*, Stanford University, Stanford, California, February 16-18.
- 2020 **Xing, P.**, Rickard, B., Winkler, D., Mann, M. and McLennan, J., 2020 Interpretation of In-Situ Stresses at the Utah FORGE Site Using Pressure and Temperature Signatures, E-poster in *2020 GRC Annual Meeting*.
- 2020 **Xing, P.**, Goncharov, A., Winkler, D., Rickard, B., Barker, B., Finnilla, A., Ghassemi, A., Podgorney, R., Moore, J. and McLennan, J., 2020, Flowback Data Evaluation at FORGE, In *54th US Rock Mechanics/Geomechanics Symposium*. American Rock Mechanics Association.
- 2020 **Xing, P.**, Suarez-Rivera, R. and Dontsov, E., 2020, Induced Fracturing During Coring and Core Retrieval in Unconventional Reservoirs, In *54th US Rock Mechanics/Geomechanics Symposium*. American Rock Mechanics Association.
- 2020 **Xing, P.**, D. Winkler, B. Rickard, B. Barker, A. Finnilla, A. Ghassemi, K. Pankow, R. Podgorney, J. Moore, J. McLennan, 2020, Interpretation of In-Situ Injection Measurements at the FORGE Site: Presented at the *45th Workshop on Geothermal Reservoir Engineering*, Stanford University, Stanford, California, February 10-12, 2020.
- 2019 Abell, B., **P. Xing**, A. Bungler, E. Dontsov, R. Suarez-Rivera, 2019, Laboratory investigation of leak-off during hydraulic fracturing into bedding interfaces: Presented at the *SPE/AAPG/SEG Unconventional Resources Technology Conference*, 22-24 July, Denver, Colorado, USA.
- 2017 Rho, S., S. Noynaert, A.P. Bungler, N. Zolfaghari, **P. Xing**, B. Abell, R. Suarez-Rivera, 2017, Finite-element simulations of hydraulic fracture height growth on layered mudstones with weak interfaces: Presented at the *51st US Rock Mechanics/Geomechanics Symposium*, 25-28 June, San Francisco, California, American Rock Mechanics Association. (ARMA-2017-0727).
- 2016 **Xing, P.**, A. P. Bungler, K. Yoshioka, J. Adachi, A. El-Fayoumi, 2016, Experimental study of hydraulic fracture containment in layered reservoirs: Presented at the *50th US Rock Mechanics/Geomechanics Symposium*, 26-29 June, Houston, Texas, American Rock Mechanics Association. (ARMA-2016-049).
- 2014 Lin, J.S., **P. Xing**, J. Rutqvist, Y. Seol, J.H. Choi, 2014, A new critical state model for geomechanical behavior of methane hydrate-bearing sands, *AGU Fall Meeting Abstracts*, 2014.

Invited Presentations

- 2021 Utah FORGE site field update and well 16A(78)-32 stimulation modeling, Co-presenter Branko Damjanac, Presentation to FORGE Modeling & Simulation Forum, Online Webinar
- 2020 Back-analysis of injection tests in zone 2 on well 58-32, Co-presenter Branko Damjanac and John McLennan, Presentation to FORGE Modeling & Simulation Forum, Online Webinar
- 2020 Interpretation of In-Situ Stresses at the Utah FORGE Site Using Pressure and Temperature Signatures, Co-presenter John McLennan, Presentation to Department of Civil & Environmental Engineering, the University of Pittsburgh, Graduate student seminar
- 2020 Treatment Design for FORGE Well 16A(78)-32, Co-presenter John McLennan, Presentation to FORGE Modeling & Simulation Forum, Online Webinar
- 2020 Using Flowback and Temperature for Closure Stress Diagnosis, Co-presenter John McLennan,

- 2019 Presentation to American Rock Mechanics Association HFC, ARMA Robe Talks, Online Webinar
Numerical Simulation of Hydraulic Fracturing in Layered Reservoirs, Presentation to Itasca
Consulting Group, Minneapolis, MN, USA
- 2019 Numerical Simulation of Hydraulic Fracturing in Layered Reservoirs, Presentation to EGI at
University of Utah, Salt Lake City, Utah, USA
- 2017 Investigation of Hydraulic Fracture Containment in Layered Reservoirs, Presentation to WDVG
Laboratories, Houston, TX, USA
- 2016 Experimental Investigation of Hydraulic Fracture Containment in Layered Reservoirs, Presentation to
Chevron, Houston, TX, USA

Academic activities

Reviewer of U.S. Department of Energy FORGE project proposals
Organizing committee, Discrete Fracture Network Engineering (DFNE) 2021
Session Chair, 46th Stanford Geothermal Workshop, 2021
Session Chair, 56th US Rock Mechanics/Geomechanics Symposium, 2022

Organizations and Societies

Society of Petroleum Engineers (SPE) Member
American Rock Mechanics Association (ARMA) Member
Geothermal Rising Member