Dr. Qi Zhang

ORCID: 0000-0002-4637-6308

Email: q7zhang@polyu.edu.hk

Website: qizhang94.github.io

Block Z, ZS904, PolyU
11 Yuk Choi Rd
Hung Hom, Kowloon
Hong Kong

Professional Appointments

2022 – on **Research Assistant Professor**
Department of Civil and Environmental Engineering
Faculty of Construction and Environment
The Hong Kong Polytechnic University, Hong Kong

2021 – 2022 **PolyU Distinguished Postdoctoral Research Fellow**
Department of Civil and Environmental Engineering
Faculty of Construction and Environment
The Hong Kong Polytechnic University, Hong Kong

Education

2018 – 2021 **Ph.D. in Department of Civil and Environmental Engineering**, Stanford University, USA

2016 – 2018 **M.Sc. in Department of Civil and Environmental Engineering**, Stanford University, USA

2012 – 2016 **Undergraduate Minor in Applied Mathematics**, Tongji University, China

2012 – 2016 **B.Eng. in Civil Engineering**, Tongji University, China

Interests

Academic   I am interested in understanding and controlling the fundamental poro-mechanical processes that determine the formation and recovery of earth resources from sedimentary rocks to achieve energy and environmental sustainability. At present, my research is focused on formulating innovative theories and developing advanced numerical methods to investigate the **multi-scale** pore structures, **multiple** fluid flow patterns, and complex **multi-physics** processes. Additionally, I am exploring the effects of bedding-induced **anisotropy**. This comprehensive investigation is aimed at facilitating a transition towards sustainable energy practices, and our results should be applicable to general porous media with slight modifications. By integrating rock experimental testing data (such as the poroelasticity constants) with poromechanics and solid mechanics theory, my team and I aim to build predictive models that can enhance our understanding of shale behavior and contribute to more efficient and sustainable energy extraction practices.

Teaching   My primary teaching objective is to equip students with a solid foundation in geomechanics, fostering their ability to think critically and innovatively. This will enable them to meet the increasing societal demands for energy and environmental sustainability. I am passionate about nurturing their capabilities and enthusiasm for advancing fundamental knowledge in geomechanics. I am keen on teaching both fundamental and applied courses in areas such as rock and soil mechanics, solid mechanics, finite element method, and elasticity and inelasticity. I also aim to offer general courses in geotechnical engineering to cultivate the upcoming generation of leaders in the field of geomechanics.

Grants & Fellowships

2023 – 2024   "Development of a novel geomechanical model for MHBS that incorporates effects of viscoplasticity, temperature, anisotropy, and non-Darcy flow". **PI**: **Zhang, Q.** Main Funding Body: Start-up Fund for RAPs under the Strategic Hiring Scheme. Award Number: P0043879. Total Awarded Amount: HK$250,000

2022 – 2025   "Finite-Discrete modeling of mechanical behaviors of heterogeneous rocks with irregular inclusion or voids from micro to macro with experimental validation". PI: Yin, Z.-Y.; **Co-I**: **Zhang, Q.** Main Funding Body: Shenzhen Poxon Machinery Technology Co.,Ltd. Award Number: P0038726. Total Awarded Amount: HK$360,000

2022   RGC Postdoctoral Fellowship Scheme (PDFS). **Zhang, Q.** Main Funding Body: University Grants Committee (UGC). More information: [List of Awardees (2022/23)](#). The **first awardee** in the Department of Civil and Environmental Engineering at PolyU.

2021   PolyU Distinguished Postdoctoral Fellowship. **Zhang, Q.** Associated Project Title: "On the Constitutive Modeling of Natural Gas Hydrate Bearing Sediment and Multi-physics Coupling in Gas Production".

Pending   "Computational thermo-hydro-chemo-mechanics for multiphase reactive porous media in the finite deformation range". **PI: Zhang, Q.**; Co-I: Yin, Z.-Y., Jha, B. Main Funding Body: Research Grants Council General Research Fund (RGC-GRF). RGC Ref. Number: 15211124.

Open Science

Open-source Software

2022 – on   **GEOKEYFEM_HM** |
Smoothed Finite Element Methods (S-FEM) tools for hydromechanical analysis that could consider rigid-to-soft contact, transverse isotropy induced by sedimentary rock bedding, double porosity, and gas compressibility.
Role: Creator, main developer, project leadership

2021 – on   **COMSOL for double porosity** | gitee.com/qzhang94/source-code-arXiv-2311.12877
COMSOL Mutliphysics implementation for the preferential flow patterns induced by transverse isotropy and non-Darcy flow in double porosity media.
Role: Creator, main developer, project leadership

Academic Service

Editor

2022   Guest Editor of Special Feature Multiscale Multiphysics Modeling in Geotechnical Engineering, *Journal of Zhejiang University - SCIENCE A*
Yin, Z.-Y., **Zhang, Q.**, LAOUAFA, F.

2022   Guest Editor of Special Issue Exploitation of Geological Resources in Unconventional Reservoirs, *Energies*
Yan, X., **Zhang, Q.**, Liu, L.

2021 – 2023   Youth Editorial Board, *Advances in Geo-Energy Research*

Memberships in Professional Societies

2016 – 2020   Student member, *Chinese Society for Rock Mechanics & Engineering*.

Reviewer

- Acta Geotechnica
- Applied Energy
- Computers and Geotechnics
- European Journal of Environmental and Civil Engineering
- Gas Science and Engineering (Formly known as *Journal of Natural Gas Science and Engineering*)
- Geoenergy Science and Engineering (Formly known as *Journal of Petroleum Science and Engineering*)
- Géotechnique Letters
- International Journal for Numerical and Analytical Methods in Geomechanics
- International Journal for Numerical Methods in Engineering
- International Journal of Environmental Science and Technology
- International Journal of Rock Mechanics and Mining Sciences
- Journal of Cleaner Production
- Journal of Zhejiang University-SCIENCE A
- KSCE Journal of Civil Engineering
- Mathematical Methods in the Applied Sciences
- NeurIPS ML4PS workshop (ml4physicalsciences.github.io)
- Renewable Energy
- Rock Mechanics and Rock Engineering
- Soils and Foundations

Conference Convener

2024   Mini-symposium: Computational Geomechanics.
Wang, Y.T., Wang, Y.D., Liu, F.S., Zhu, C.W., **Zhang, Q.**, Semnani, S.J., Wu, W., Borja, R.I.
EMI 2024 IC, TU Wien, Vienna, Austria.

2023   Mini-Symposium S25: Computational Geomechanics and Multiphysics Coupling in Porous Media.
Zhang, Q., Yan, X., Zhang, K., Zhang, Z., Jin, Y.-F.
ICCES2023, Shenzhen, China.

Awards & Honors

2020 – 2021	**John A. Blume Research Fellowship**, Stanford University
2018 – 2020	**Charles H. Leavell Graduate Student Fellowship**, Stanford University
2016 – 2018	**Stanford School of Engineering Graduate Fellowship**, Stanford University
2016	**Outstanding Bachelor Thesis Award**, Chinese Society for Rock Mechanics & Engineering
2016	**Excellent Graduate of Shanghai**, Shanghai Municipal Education Commission
2014 – 2015	**National Scholarship of China** ×**2**, Ministry of Education of the People's Republic of China
2013 – 2015	**First-Class Academic Scholarship of Tongji University** ×**3**, Tongji University
2013	**Excellent Student of Tongji University**, Tongji University
2015	**First Prize** in the National Pei-Yuan Zhou **Mechanics Contest** of Shanghai Division, Chinese Society of Theoretical and Applied Mechanics
2014	**First Prize** in the National **Mathematics Contest** (Finals), Chinese Mathematical Society
2013	**First Place** in the National **Mathematics Contest** of Shanghai Division, Shanghai Mathematical Society
2013	**First Prize** in the Regional College Students **Physics Contest**, Shanghai Physical Society

Teaching

Graduate Courses

2023 – 2024	CSE583: Analytical and Numerical Methods in Geotechnical Engineering Teaching introductions to vectors and tensors, fundamentals of solid mechanics, ultimate state analysis, and slope stability analysis. (40% of module) *The Hong Kong Polytechnic University*	
2023 – 2024	CE620: Research Methods Teaching basics of probability, point estimation, confidence interval, and hypothesis testing. (25% of module) *The Hong Kong Polytechnic University*	
2022 – 2023	CSE583: Analytical and Numerical Methods in Geotechnical Engineering Teaching introductions to vectors and tensors, fundamentals of solid mechanics, ultimate state analysis, and slope stability analysis. (40% of module) *The Hong Kong Polytechnic University*	Teaching evaluation 4.8/5.0

Teaching Assistant

2018	CEE 294: Computational Poromechanics Give tutorials on the use of ANSYS to solve boundary-value problems, hold weekly office hours, and grade homework submissions. *Stanford University*

Student Supervision

Ph.D. mentored

2021 – on   Xian-han WU
Research topic: *Implicit SNS-PFEM with dual mortar method for thermo-hydro-mechanical large deformation submarine pipeline-soil interaction problems*.
The Hong Kong Polytechnic University & Southern University of Science and Technology
Advisor: Prof. Yin, Z.-Y.; Prof. Feng, W.Q.

2023 – on   Zi-qi TANG
Research topic: *Coupled thermo-hydro-chemo-mechanical modeling in gas hydrate production*.
The Hong Kong Polytechnic University
Advisor: Prof. Yin, Z.-Y.

M.Sc. in Civil Engineering

2023 – on   Zi-kang HUANG
Thesis: *Formulation and implementation of fully implicit 2D reservoir simulator considering permeability anisotropy and heterogeneity*.
The Hong Kong Polytechnic University

Publications

Peer-reviewed Papers

2024   **Zhang, Q.**, Yin, Z.-Y., Yan, X., Anisotropic continuum framework of coupled gas flow - adsorption - deformation in sedimentary rocks, *International Journal for Numerical and Analytical Methods in Geomechanics*, doi:10.1002/nag.3674. ⬡

2023   **Zhang, Q.**, Yin, Z.-Y., Yan, X., Material Constants of Anisotropic Poroelasticity and Its Impacts on Shale Gas Production, *Energy & Fuels*, doi:10.1021/acs.energyfuels.3c02656.

2022   **Zhang, Q.**, Wang, Z.-Y., Yin, Z.-Y., Jin, Y.-F., A novel stabilized NS-FEM formulation for anisotropic double porosity media, *Computer Methods in Applied Mechanics and Engineering*, doi:10.1016/j.cma.2022.115666. ⬡

Wang, Z., **Zhang, Q.**∗, Zhang, W., A novel collaborative study of abnormal roof water inrush in coal seam mining based on strata separation and wing crack initiation, *Engineering Failure Analysis*, doi:10.1016/j.engfailanal.2022.106762.

Zhang, Q., Yan, X., Li, Z., A mathematical framework for multiphase poromechanics in multiple porosity media, *Computers and Geotechnics*, doi:10.1016/j.compgeo.2022.104728.

2021   Wang, Z., **Zhang, Q.**, Shao, J., et al., Mathematical Evaluation on the Control of Mining-Induced Ground Subsidence in Thick Loose Strata, *ACS Omega*, doi:10.1021/acsomega.1c04970. ⅊

Zhang, Q., Strip load on transversely isotropic elastic double porosity media with strong permeability contrast, *Advances in Geo-Energy Research*, doi:10.46690/ager.2021.04.02. ⅊

Zhang, Q., Wang, Z., Spatial prediction of loose aquifer water abundance mapping based on a hybrid statistical learning approach, *Earth Science Informatics*, doi:10.1007/s12145-021-00640-3.

Zhang, Q., Yan, X., Shao, J., Fluid flow through anisotropic and deformable double porosity media with ultra-low matrix permeability: A continuum framework, *Journal of Petroleum Science and Engineering*, doi:10.1016/j.petrol.2021.108349.

Zhang, Q., Borja, R.I., Poroelastic coefficients for anisotropic single and double porosity media, *Acta Geotechnica*, doi:10.1007/s11440-021-01184-y.

Yan, X., Sun, H., Huang, Z., Liu, L., Wang, P., **Zhang, Q.**, Yao, J., Hierarchical Modeling of Hydromechanical Coupling in Fractured Shale Gas Reservoirs with Multiple Porosity Scales, *Energy & Fuels*, doi:10.1021/acs.energyfuels.0c03757.

Shao, J., **Zhang, Q.**[*], Zhang, W., et al., Effects of the borehole drainage for roof aquifer on local stress in underground mining, *Geomechanics and Engineering*, doi:10.12989/GAE.2021.24.5.479.

2020   Wang, Z., **Zhang, Q.**, Shao, J., et al., New Type of Similar Material for Simulating the Processes of Water Inrush from Roof Bed Separation, *ACS Omega*, doi:10.1021/acsomega.0c03535.

Zhang, Q., Hydromechanical modeling of solid deformation and fluid flow in the transversely isotropic fissured rocks, *Computers and Geotechnics*, doi:10.1016/j.compgeo.2020.103812.

Shao, J., **Zhang, Q.**, Wu, X., et al., Investigation on the Water Flow Evolution in a Filled Fracture under Seepage-Induced Erosion, *Water*, doi:10.3390/w12113188.

Yan, X., Huang, Z., **Zhang, Q.**, et al., Numerical Investigation of the Effect of Partially Propped Fracture Closure on Gas Production in Fractured Shale Reservoirs, *Energies*, doi:10.3390/en13205339.

Zhu, X., **Zhang, Q.**, Zhang, W., et al., Experimental Study on the Basic Properties of a Green New Coal Mine Grouting Reinforcement Material, *ACS Omega*, doi:10.1021/acsomega.0c01626.

Shao, J., **Zhang, Q.**, Sun, W., et al., Numerical Simulation on Non-Darcy Flow in a Single Rock Fracture Domain Inverted by Digital Images, *Geofluids*, doi:10.1155/2020/8814327.

2019   **Zhang, Q.**, Choo, J., Borja, R.I., On the preferential flow patterns induced by transverse isotropy and non-Darcy flow in double porosity media, *Computer Methods in Applied Mechanics and Engineering*, doi:10.1016/j.cma.2019.04.037.

2018   **Zhang, Q.**, Zhu, H., Collaborative 3D geological modeling analysis based on multi-source data standard, *Engineering Geology*, doi:10.1016/j.enggeo.2018.10.001.

Peer-reviewed Conference Proceedings

2020   **Zhang, Q.**, Chen, Y., Yang, Z., Darve, E., Multi-Constitutive Neural Network for Large Deformation Poromechanics Problem, Presented at the *Proceedings of the Machine Learning and the Physical Sciences Workshop, 34th Conference on Neural Information Processing Systems (NeurIPS)*.

Editorial

2023   Yin, Z.-Y., **Zhang, Q.**, LAOUAFA, F., Multiscale multiphysics modeling in geotechnical engineering, *Journal of Zhejiang University - SCIENCE A*, doi:10.1631/jzus.A22MMMiG.

Preprints

2023   **Zhang, Q.**, Yin, Z.-Y., Yan, X., Wang, X., Gas flow and solid deformation in unconventional shale.

Shao, J., **Zhang, Q.***, Zhang, W., Evolution of mining-induced water inrush disaster from a hidden fault in coal seam floor based on a coupled stress-seepage-damage model, *Geomechanics and Geophysics for Geo-Energy and Geo-Resources*, Under Review.

Shao, J., **Zhang, Q.***, Zhang, W., Experimental study on mechanical and seepage properties of sandstone samples under axial unloading-reloading conditions, *European Journal of Environmental and Civil Engineering*, Under Review.

Jin, Y.-F., Wang, Z.-Y., Yin, Z.-Y., **Zhang, Q.**, Wang, Y.-Z., A novel approach for hydromechanical soil-structure interaction analysis with stable node-based smoothed PFEM, *International Journal for Numerical Methods in Engineering*, Under Review.

Wu, X.-H., **Zhang, Q.**, Yin, Z.-Y., Feng, W.Q., Implicit SNS-PFEM with dual mortar method for thermo-hydro-mechanical large deformation submarine pipeline-soil interaction problems, *Ocean Engineering*, Under Review.

2020   **Zhang, Q.**, Chen, Y., Yang, Z., Data Driven Solutions and Discoveries in Mechanics Using Physics Informed Neural Network. doi:10.20944/preprints202006.0258.v1

Thesis

2021   **Zhang, Q.**, Mathematical Modeling of Unconventional Geomaterials, *Stanford University Ph.D. Thesis*, Dissertation Reading Committee: Prof. Ronaldo I. Borja (Primary Advisor), Prof. Louis J. Durlofsky (NAE member), Prof. Christian Linder.

2016   **Zhang, Q.**, Multi-source data standard of road tunnel and three-dimensional geological modeling analysis (in Chinese), *Tongji University Final Year Project*, Advisor: Prof. Hehua Zhu (CAE member).

Presentations

Invited

2023   The Third Energy Science and Engineering Young Scholars Forum, China University of Petroleum (East China).

2022   *On the poroelastic coefficients and low-velocity non-Darcy flow of shale*, SPE Student Chapter, China University of Petroleum (East China).

2021   *Mathematical Modeling of Unconventional Geomaterials*, Geoinvention Group, The Hong Kong Polytechnic University.

2019   *Multiscale poromechanics: double porosity, transverse isotropy, and non-Darcy flow*, College of Energy and Mining Engineering, Shandong University of Science and Technology.

Topical Conferences and Meetings

2023   **Zhang, Q.**, Yin, Z.-Y., Yan, X. Anisotropic poromechanics of gas flow in sedimentary rocks, *COMPLAS 2023*, Barcelona, Spain. [Talk]

2020   **Zhang, Q.**, Chen, Y., Yang, Z., Darve, E. Multi-constitutive neural network for large deformation poromechanics problem, *Proceedings of the Machine Learning and the Physical Sciences Workshop, 34th Conference on Neural Information Processing Systems (NeurIPS)*, Virtual (Online). [Poster]

          Zhang, Q., Borja, R.I. Fluid flow through anisotropic and deformable double porosity media with ultra-low matrix permeability: A continuum framework, *InterPore2020*, Virtual (Online). [Talk]

2019   **Zhang, Q.**, Choo, J., Borja, R.I. Multiscale poromechanics: double porosity, transverse isotropy, and non-Darcy flow, *Engineering Mechanics Institute Conference 2019*, Caltech, Pasadena, California, USA. [Talk]

2018   **Zhang, Q.**, Choo, J., Borja, R.I. Multiscale poromechanics: double porosity, transverse isotropy, and non-Darcy flow, *6th Berkeley/Stanford CompFest 2018*, Stanford University, USA. [Talk]

Glossary

These are the meanings of the symbols used throughout this document:

   ⚯   Indicates that a publication is open-access

   ⌨   Link to a code repository on GitHub

   📄   Link to an open-access PDF, usually a preprint or postprint

   ▶   Link to a video on YouTube

   📈   Link to a data archive

   🖥   Link to presentation slides

   🖼   Link to a poster