Yongzan Liu

Address: One Hampshire St, Cambridge, MA 02139
Phone: +1 979-5716989
Email: yliu133@slb.com
Website: `http://yongzanliu.github.io`

Education

Texas A&M University *2017/09 - 2021/08*
Ph.D. in Petroleum Engineering (specialized in reservoir geomechanics)
Thesis: Hydraulic-Fracture Geometry Characterization Using Low-Frequency Distributed Acoustic Sensing (LF-DAS) Data: Forward Modeling, Inverse Modeling, and Field Applications
Advisors: Dr. Kan Wu and Dr. George Moridis

University of Alberta *2014/09 - 2017/05*
M.S. in Petroleum Engineering
Thesis: Modeling of Recovery and In-Situ Distribution of Fracturing Fluid in Shale Gas Reservoirs Due to Fracture Closure, Proppant Distribution and Gravity Segregation [link]
Advisor: Dr. Juliana Leung

China University of Petroleum (East China) *2010/09 - 2014/06*
B.S. in Petroleum Engineering

Memorial University of Newfoundland *2014/01 - 2014/06*
Undergraduate Visiting Student in Memorial University of Newfoundland, Canada

Employment

Schlumberger-Doll Research, Cambridge, MA *2022/06 - present*
Research Scientist
Topic: Modeling and Interpretation of Deep Measurements

Lawrence Berkeley National Laboratory, Berkeley, CA *2021/09 - 2022/06*
Postdoc Scholar (supervisor: Dr. Matthew Reagan)
Topic: System Behaviors of Hydrate-Bearing Sediments during Gas Production

IFDATA LLC, Houston, TX *2021/05 - 2021/08*
Petrophysics Research Intern
Topic: Production Profiling Using Distributed Temperature/Acoustic Sensing (DTS/DAS) Data

ZFrac LLC, Houston, TX *2020/12 - 2021/01*
Petroleum Engineering Intern
Topic: Modeling and Analysis of Low-Frequency DAS Data for Hydraulic Fracture Characterization

Research Interests

- **Numerical Modeling**: Computational Geomechanics; Multi-Phase Flow in Fractured Porous Media; Coupled Thermal-Hydraulic-Mechanical Modeling
- **Subsurface Monitoring and Diagnostics**: Fracture Propagation; Distributed Acoustic Sensing (DAS); Distributed Temperature Sensing (DTS); Distributed Strain Sensing (DSS); Microseismicity
- **Fractured Reservoir Characterization**: History Matching; Flowback/Production Data Analysis; Inversion Algorithms

Research Projects

System Behaviors of Hydrate-Bearing Sediments *2021/09 - 2022/06*
- Developed coupled numerical model for hydrate-bearing sediments development
- Analyzed system behaviors during long-term gas production from hydrate accumulations

Hydraulic-Fracture Geometry Characterization Using LF-DAS Data *2019/09 - 2021/08*

· Developed an efficient 3D geomechanical model to simulate LF-DAS strain/strain-rate response
· Proposed a guideline for fracture-hit detection using LF-DAS data and applied to several field case studies
· Developed an inversion algorithm for quantitative hydraulic-fracture geometry characterization
· Outputs of this project provide critical insights for quantitative hydraulic-fracture geometry characterization

Coupled Multiphase Flow and Geomechanics Modeling of Fractured Reservoirs *2017/09 - 2019/09*
· Developed efficient coupled multiphase flow and geomechanics models for deformable fractured reservoirs
· Fractures modeled explicitly by either Discrete Fracture Model (DFM) with unstructured meshing or Embedded Discrete Fracture Model (EDFM)
· Used Fixed-stress iterative coupling scheme to increase the computational efficiency and application flexibility

Coupled Thermal-Hydraulic-Mechanical (THM) Modeling of Geothermal Reservoirs *2017/09 - 2019/09*
· Developed a coupled THM model for geothermal reservoirs with shear fractures
· Validated against benchmark problems in the 'Numerical Code Comparison' Project under the direction of DOE's Geothermal Reservoir Engineering Management Program (GREMP)
· Ongoing research includes simulation and evaluation of geothermal reservoir performance

Fracturing Fluid Flowback and In-Situ Distribution in Unconventional Reservoirs *2015/08 - 2017/06*
· Developed comprehensive numerical models that incorporate essentially all the dominant mechanisms controlling fracturing fluid flowback characteristics
· Investigated the impacts of various physical mechanisms on fracturing fluid flowback and in-situ distribution and their subsequent influences on well performance
· Identified flowback signatures under different fracture geometries that help to better utilize flowback data for hydraulic fracture characterization

Publications

Feature Article – monthly feature in *JPT*

1. Wu, K., **Liu, Y.**, Jin, G., Moridis, G. J. (2021). Fracture Hits and Hydraulic-Fracture Geometry Characterization Using Low-Frequency Distributed Acoustic Sensing Strain Data. *Journal of Petroleum Technology.* **73** (07): 39-42. SPE-0721-0039-JPT. [link]

Journal Article – * denotes corresponding author

14. Moridis, G. J., Reagan, M. T., **Liu, Y.** (in press) Numerical simulations in support of a long-term test of gas production from hydrate accumulations on the Alaska North Slope: Reservoir response to interruptions of production (shut-ins). *Energy & Fuels.* [link]
13. **Liu, Y.**, Jin, G., Wu, K. 2022. New Insights on Characteristics of the Near-Wellbore Fractured Zone from Simulated High-Resolution Distributed Strain Sensing Data. *SPE Reservoir Evaluation & Engineering.* **25** (01): 99-112. SPE-208587-PA. [link]
12. Li, J., **Liu, Y.**, Wu, K. (in press). A New Higher Order Displacement Discontinuity Method Based on the Joint Element for Analysis of Close-Spacing Planar Fractures. *SPE Journal.* SPE-208614-PA. [link]
11. **Liu, Y.**, Jin, G., Wu, K., Moridis, G. J. (in press). Quantitative Hydraulic-Fracture Geometry Characterization with LF-DAS Strain Data: Fracture-Height Sensitivity and Field Applications. *SPE Production & Operations.* SPE-204158-PA. [link]
10. **Liu, Y.**, Jin, G., Wu, K., Moridis, G. J. 2021. Hydraulic-Fracture-Width Inversion Using Low-Frequency Distributed-Acoustic-Sensing Strain Data. Part II: Extension for Multifracture and Field Application. *SPE Journal.* **26** (05): 2703-2715. SPE-205379-PA. [link]
9. **Liu, Y.**, Wu, K., Jin, G., Moridis, G. J., Kerr, E. et al. 2021. Fracture-Hit Detection Using LF-DAS Signals Measured during Multifracture Propagation in Unconventional Reservoirs. *SPE Reservoir Evaluation & Engineering.* **24** (03): 523-535. SPE-204457-PA. [link]
8. **Liu, Y.**, Jin, G., Wu, K., Moridis, G. J. 2021. Hydraulic-Fracture-Width Inversion Using Low-Frequency Distributed-Acoustic-Sensing Strain Data. Part I: Algorithm and Sensitivity Analysis. *SPE Journal.* **26** (01): 359-371. SPE-204225-PA. [link]
7. **Liu, Y.**, Liu, L., Leung, J. Y., Wu, K., Moridis, G. J. 2021. Coupled Flow/Geomechanics Modeling of Interfracture Water Injection To Enhance Oil Recovery in Tight Reservoirs. *SPE Journal.* **26** (01): 1-21. SPE-199983-PA. [link]
6. **Liu, Y.**, Wu, K., Jin, G., Moridis, G. J. 2020. Rock Deformation and Strain-Rate Characterization during Hydraulic Fracturing Treatments: Insights for Interpretation of Low-Frequency Distributed-Acoustic Sensing Signals. *SPE Journal.* **25** (05): 2251-2264. SPE-202482-PA. [link]

5. **Liu, Y.**, Liu, L., Leung, J. Y., Moridis, G. J. 2020. Sequentially Coupled Flow and Geomechanical Simulation with a Discrete Fracture Model for Analyzing Fracturing Fluid Recovery and Distribution in Fractured Ultra-Low Permeability Gas Reservoirs. *Journal of Petroleum Science and Engineering* **189**: 107042. [link]
4. Liu, L., **Liu, Y.***, Yao, J., Huang, Z. 2020. Mechanistic Study of Cyclic Water Injection to Enhance Oil Recovery in Tight Reservoirs with Fracture Deformation Hysteresis. *Fuel* **271**: 117677. [link]
3. Liu, L., **Liu, Y.***, Yao, J., Huang, Z. 2020. Efficient Coupled Multiphase-Flow and Geomechanics Modeling of Well Performance and Stress Evolution in Shale-Gas Reservoirs Considering Dynamic Fracture Properties. *SPE Journal*. **25** (03): 1523-1542. SPE-200496-PA. [link]
2. **Liu, Y.**, Leung, J. Y., Chalaturnyk, R., Virus,C. J. J. 2019. New Insights on Mechanisms Controlling Fracturing-Fluid Distribution and Their Effects on Well Performance in Shale-Gas Reservoirs. *SPE Production & Operations* **34** (03): 564-585. SPE-185043-PA. [link]
1. **Liu, Y.**, Leung, J. Y., Chalaturnyk, R. 2018. Geomechanical Simulation of Partially Propped Fracture Closure and Its Implication for Water Flowback and Gas Production. *SPE Reservoir Evaluation & Engineering* **21** (02): 273-290. SPE-189454-PA. [link]

Conference Paper – full length

9. **Liu, Y.**, Wu, K., Jin, G., Moridis, G. J. 2021. Quantification of Thermal Effects on Cross-Well Low-Frequency Distributed Acoustic Sensing Measurements. SPE/SEG/AAPG Unconventional Resources Technology Conference, Houston, Texas, US, 26-28 July.
8. **Liu, Y.**, Jin, G., Wu, K., 2021. New Insights on Near-Wellbore Fracture Characteristics from High-Resolution Distributed Strain Sensing Measurements. SPE/SEG/AAPG Unconventional Resources Technology Conference, Houston, Texas, US, 26-28 July.
7. **Liu, Y.**, Jin, G., Wu, K., Moridis, G. J. 2021. Quantitative Hydraulic-Fracture Geometry Characterization with LF-DAS Strain Data: Numerical Analysis and Field Applications. SPE Hydraulic Fracturing Technology Conference and Exhibition, The Woodlands, Texas, USA. 2-4 February. SPE-204158-MS.
6. **Liu, Y.**, Liu, L., Leung, J. Y., Wu, K., Moridis, G. J. 2020. Coupled Flow and Geomechanics Modeling of Inter-Fracture Water Injection to Enhance Oil Recovery in Tight Reservoirs. SPE Canada Unconventional Resources Conference, Virtual, 15-16, September.
5. **Liu, Y.**, Wu, K., Jin, G., Moridis, G. J., Kerr, E. et al. 2020. Strain and Strain-Rate Responses Measured by LF-DAS and Corresponding Features for Fracture-Hit Detection during Multiple-Fracture Propagation in Unconventional Reservoirs. Unconventional Resources Technology Conference, Virtual, 20-22 July.
4. **Liu, Y.** Liu, L., Leung, J. Y., Wu, K., Moridis, G. J. 2020. Numerical Investigation of Water Flowback Characteristics for Unconventional Reservoirs with Complex Fracture Geometries. Unconventional Resources Technology Conference, Virtual, 20-22 July.
3. **Liu, Y.**, Wu, K., Jin, G., Moridis, G. J. 2020. Hydraulic Fracture Modeling of Fracture-Induced Strain Variation Measured by Low-Frequency Distributed Acoustic Sensing (LF-DAS) along Offset Wells. 54^{th} US Rock Mechanics/Geomechanics Symposium, Golden, Colorado, USA (canceled). 28 June-1 July.
2. Liu, L., Huang, Z., Yao., Yuan, D., Wu, Y. S., **Liu, Y.** 2020. An Efficient Coupled Hydro-Mechanical Modeling of Two-Phase Flow in Fractured Vuggy Porous Media. 54^{th} US Rock Mechanics/Geomechanics Symposium, Golden, Colorado, USA (canceled). 28 June-1 July.
1. **Liu, Y.**, Leung, J. Y., Chalaturnyk, R., Virus,C. J. J. 2017. Fracturing Fluid Distribution in Shale Gas Reservoirs Due to Fracture Closure, Proppant Distribution and Gravity Segregation. SPE Canada Unconventional Resources Conference, Calgary, Alberta, Canada. 15-16, February. SPE-185043-MS.

Technical Skills

- **Numerical Method**: Finite Element Method, Finite Volume Method, Boundary Element Method
- **Programming Language**: fluent in FORTRAN, Python, MATLAB; competent in C++
- **Numerical Modeling/Open Source Package**: CMG, StimPlan, FLAC, deal.II
- **Visualization Software**: Paraview, Tecplot

Awards & Honors

- SPE Journal Excellent Technical Reviewer Award *2021/10*
- Winner of TAMU ARMA Graduate Research Competition *2021/03*
- Third Place Winner of TAMU SPE Student Paper Contest (PhD Division) *2021/01*
- Nomination for TAMU College of Engineering Outstanding Graduate Student *2020/10*

· University of Alberta Graduate Research Assistant Fellowship *2014/09 - 2017/06*
· University of Alberta Travel Award *2017/02*
· Excellent Undergraduate Student Award *2014/01*
· China University of Petroleum Technology Innovation Awards *2013/09*
· China National Inspiration Scholarship *2012/09*

Invited Talks

Lawrence Livermore National Laboratory *2021/07/08*
Title: Hydraulic Fracture Characterization and Advanced Fractured Reservoir Simulation

Lawrence Berkeley National Laboratory *2021/06/10*
Title: Sequentially Coupled Multiphase Flow and Geomechanics Modeling of Hydraulically Fractured Unconventional Reservoirs

Teaching Experience

Supervision of PhD Student – help Dr. Kan Wu supervise graduate students *2021/09 - now*
Aishwarya Srinivasan, PhD Candidate at Texas A&M University

LF-DAS Software Training *2021/04*
Two-hour LF-DAS software demonstration and training to about 15 attendees

Texas A&M University - PETE 410: Production Engineering *2020/01 - 2020/05*
Teaching Assistant: grade assignments; office hours

Texas A&M University - PETE 401: Reservoir Simulation *2019/01 - 2019/05*
Teaching Assistant: lab session (using CMG); grade assignments; office hours

Professional Services & Affiliations

Major Professional Activities
Organizing Committee Member, 55th ARMA Rock Mechanics/Geomechanics Symposium
Session Developer, 56th ARMA Rock Mechanics/Geomechanics Symposium
Judge, 2021 SPE ATCE Student Paper Contest (PhD Division)

Journal Technical Reviewer
International Journal of Rock Mechanics and Mining Sciences, *Rock Mechanics and Rock Engineering*, *Water Resources Research*, *International Journal for Numerical and Analytical Methods in Geomechanics*, *SPE Journal*, *SPE Reservoir Evaluation & Engineering*, *SPE Production & Operations*, *Fuel*, *Energy & Fuel*, *Journal of Petroleum Science and Engineering*, *Engineering Computations*, *ACS Omega*

Professional Member
Society of Petroleum Engineer (SPE)
America Rock Mechanics Association (ARMA)

Student Organization
Founder & President, ARMA-TAMU Student Chapter