Yongzan Liu

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Education

Texas A&M University *2017/09 - 2021/08*
Ph.D. in Petroleum Engineering
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]
Advisors: Dr. Juliana Leung and Dr. Rick Chalaturnyk

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

Research Interests

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

Research Projects

Hydraulic-Fracture Geometry Characterization Using LF-DAS Data *2019/09 - now*
- Developed an efficient 3D geomechanical model based on Displacement Discontinuity Method (DDM)
- Investigated the mechanisms for LF-DAS strain/strain-rate responses during hydraulic fracturing
- 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 - now*
- 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)
- Various fracture constitutive models implemented accounting for proppant embedment, deformation hysteresis, and shear dilation
- Fixed-stress iterative coupling scheme is used to increase the computational efficiency and application flexibility
- The developed models have been applied to investigate the flowback/well performance of fractured unconventional reservoirs, production-induced stress evolution, Huff-n-Puff EOR, and novel displacement-type EOR scheme in tight reservoirs.

Coupled Thermal-Hydraulic-Mechanical (THM) Modeling of Geothermal Reservoirs *2017/09 - now*
- 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 productivity of geothermal reservoirs

Fracturing Fluid Flowback and In-Situ Distribution in Unconventional Reservoirs *2015/08 - now*

· 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

· Field case studies proved that incorporation of flowback behaviors could improve the accuracy of numerical models for history matching and the reliability of ensuing forecasting

Publications

Journal Article – * denotes corresponding author

1. **Liu, Y.**, Jin, G., Wu, K., Moridis, G. J. (accepted). Hydraulic Fracture Width Inversion Using LF-DAS Strain Data. Part II: Extension for Multifracture and Field Application. SPE Journal.
2. **Liu, Y.**, Wu, K., Jin, G., Moridis, G. J., Kerr, E. et al. (in press). Fracture-Hit Detection Using LF-DAS Signals Measured during Multifracture Propagation in Unconventional Reservoirs. *SPE Reservoir Evaluation & Engineering*. SPE-204457-PA. [link]
3. **Liu, Y.**, Jin, G., Wu, K., Moridis, G. J. 2021. Hydraulic Fracture Width Inversion Using LF-DAS Strain Data. Part I: Algorithm and Sensitivity Analysis. *SPE Journal*. SPE-204225-PA. [link]
4. **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*. SPE-199983-PA. [link]
5. **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]
6. **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]
7. 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]
8. 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]
9. **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]
10. **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

1. **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.
2. **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.
3. **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.
5. **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.

6. 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.
7. **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 & Certificates

- 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*
- Schlumberger MEPO History Matching Course Completion Certificate *2015/04*
- Stanford Reservoir Geomechanics Course Completion Certificate *2014/06*
- Excellent Undergraduate Student Award *2014/01*
- China University of Petroleum Technology Innovation Awards *2013/09*
- China National Inspiration Scholarship *2012/09*

Teaching Experience

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

Journal Technical Reviewer
Rock Mechanics and Rock Engineering
Water Resources Research
SPE Journal
SPE Reservoir Evaluation & Engineering
SPE Production & Operations
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