

YONGZAN LIU

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EDUCATION

Texas A&M University

2017/09 - 2021/05 (anticipate)

Ph.D. Candidate in Petroleum Engineering

Thesis: Hydraulic-Fracture Geometry Characterization Using Low-Frequency Distributed Acoustic Sensing (LF-DAS) Data: Forward Modeling, Width Inversion 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 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 Monitoring and Characterization Using LF-DAS Data

2019/09

- 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

- Developed efficient coupled multiphase flow and geomechanics models for deformable fractured reservoirs
- Fractures are modeled explicitly by either Discrete Fracture Model (DFM) with unstructured meshing or Embedded Discrete Fracture Model (EDFM)
- Various fracture constitutive models are 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

- 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

- 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 prove 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.**, Wu, K., Jin, G., and Moridis, G. J. 2020. Rock Deformation and Strain-Rate Characterization during Hydraulic Fracturing Treatments: Insights for Interpretation of LF-DAS Signals. *SPE Journal*. SPE-202482-PA. [link]
2. **Liu, Y.**, Liu, L., Leung, J. Y., Wu, K. and Moridis, G. J. 2020. Coupled Flow and Geomechanics Modeling of Inter-Fracture Water Injection to Enhance Oil Recovery in Tight Reservoirs. *SPE Journal*. SPE-199983-PA. [link]
3. **Liu, Y.**, Liu, L., Leung, J. Y., and 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. and Huang, Z. 2020. Mechanistic Study of Cyclic Water Injection to Enhance Oil Recovery in Tight Reservoirs with Fracture Deformation Hysteresis. *Fuel* **271**: 117677. [link]
5. Liu, L., **Liu, Y.***, Yao, J. and 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]
6. **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]
7. **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 (**a spotlight paper on Unconventional Resources**). [link]

Conference Paper – full length

8. **Liu, Y.**, Liu, L., Leung, J. Y., Wu, K. and 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, Calgary, Alberta, Canada. 15-16, September. SPE-199983-MS.
9. **Liu, Y.**, Wu, K., Jin, G., Moridis, G. J., Kerr, E. 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, Austin, Texas, USA. 20-22 July.
10. **Liu, Y.**, Liu, L., Leung, J. Y., Wu, K. and Moridis, G. J. 2020. Numerical Investigation of Water Flowback Characteristics for Unconventional Reservoirs with Complex Fracture Geometries. Unconventional Resources Technology Conference, Austin, Texas, USA. 20-22 July.
11. **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. 54th US Rock Mechanics/Geomechanics Symposium, Golden, Colorado, USA. 28 June-1 July.
12. Liu, L., Huang, Z., Yao, J., Yuan, D., Wu, Y. S., **Liu, Y.** 2020. An Efficient Coupled Hydro-Mechanical Modeling of Two-Phase Flow in Fractured Vuggy Porous Media. 54th US Rock Mechanics/Geomechanics Symposium, Golden, Colorado, USA. 28 June-1 July.
13. **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.

Submitted

14. **Liu, Y.**, Jin, G., Wu, K., Moridis, G. J. 2020. Hydraulic Fracture Width Inversion Using LF-DAS Strain Data. Part I: Algorithm and Sensitivity Analysis. (minor revision)

TECHNICAL SKILLS

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

AWARDS & CERTIFICATES

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|--|-------------------|
| · 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 |
| · China Scholarship Council Excellent Undergraduate Student Award | 2014/01 |
| · China University of Petroleum Technology Innovation Awards | 2013/09 |
| · China National Inspiration Scholarship | 2012/09 |

TEACHING EXPERIENCE

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|--|-------------------|
| 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

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)