

Distributed Fiber Optic Sensing in Geomechanical Applications

HFC Workshop, June 26, 2022, Santa Fe, NM

8:00 am – 8:15 am Opening Remarks & Welcome (John McLennan)

8:15 am – 10:00 am Introduction to Fiber Optics
Session chair: Kan Wu, Kyle Frieauf

This session will start with an introduction to distributed fiber optic sensing (DFOS), including fiber optic components, measurement principles, deployment options, signal processing, and general applications. Following that, speakers will discuss field measurements for three fiber applications in geomechanics; i.e., microseismicity monitoring using distributed acoustic sensing, cross-well strain measurement during stimulation, and strain change measurement during production.

- **8:15 am-8:45 am:** Introduction to Fundamentals of Distributed Fiber Optic Sensing (Ge Jin, Colorado of School Mine)
- **8:45 am-9:10 am:** DAS-Microseismic from Single to Multiple Fibers (Andres Chavarria, OptaSense)
- **9:10 am-9:35 am:** DAS Strain Rate Measurement (Mahmoud Farhadiroushan, Silixa)
- **9:35 am-10:00 am:** Application of RFS-DSS based Measurements for Detection of Near-wellbore Strain Changes during Production (Artur Guzik, Neubrex)

10:00 am – 10:15 am Coffee Break

10:15 am – 12:15 pm Fiber Optic Applications & Data Interpretation
Session chair: Shawn Maxwell, Ge Jin

Recently, the application of fiber optic sensing in geomechanics has significantly expanded, however, uncertainties and assumptions related to fiber deployment and data acquisition are not yet fully understood. The speakers in this session will discuss the advantages and limitations of different DFOS measurements, including mechanical coupling, sensitivity, and resolution. The data processing and interpretation of VSP and strain measurements will also be discussed.

- **10:15 am-10:40 am:** Borehole and Surface Seismic Surveillance with DAS (Steve Cole and Paul Clarkson, OptaSense)
- **10:40 am-11:05 am:** FO Cable Mechanical Coupling - Laboratory Experiments (Thomas Coleman, Silixa; Matt Becker, California State University Long Beach)
- **11:05 am-11:30 am:** Fiber-optic Sensing for Monitoring Hydraulic Fracturing at Mesoscale at the EGS Collab Experiment (Veronica Rodriguez Tribaldos, Lawrence Berkeley National laboratory)
- **11:30 am-12:15 pm:** Catalogue of Modeled and Field Examples of Far-field FO Strain-rate Fracture Driven Interactions (FO Strain Rate FDI) (Gustavo Ugueto, Shell)

12:30 pm – 1:30 pm Lunch

1:30 pm – 3:10 pm Geomechanical Modeling
Session chair: Gustavo Ugueto, Mukul Sharma

This session will let speakers share and discuss leading edge work in quantitative interpretation of measured strain data. Geomechanical modeling and inversion algorithms will be presented to improve understanding of measured signals and quantitatively characterize fracture geometry. The workflow on constraining fracture-reservoir modeling using measured strain data will also be discussed.

- **1:30 pm-1:55 pm:** Fracture Performance Evaluation from High-resolution Distributed Strain Sensing Measurement during Production (Kan Wu, Texas A&M University)
- **1:55 pm-2:20 pm:** Integrated Fracture Height Interpretation in Permian and its Implication for the Vertical Stress Profile (Alexei Savitski, Shell)
- **2:20 pm-2:45 pm:** An Efficient Inversion Algorithm for Quantitative Hydraulic Fracture Characterization using LF-DAS Strain Data (Yongzan Liu, Lawrence Berkeley National laboratory)
- **2:45 pm-3:10 pm:** Constraining Frac Modeling Results using FO Strain-rate Data (Mark McClure, ResFrac)

3:10 pm – 3:25 pm Coffee Break

3:25 pm – 4:55 pm Case Studies – Unconventional Reservoirs
Session chair: Alexei Savitski, Andres Chavarria

The integration of DFOS measurements with other diagnostic methods for completion and production optimization is essential. This session will explore the lessons learned from several case studies, as well as the impact that DFOS measurements is having on understanding hydraulic fracturing and on the development of unconventional reservoirs.

- **3:25 pm-3:55 pm:** Frac Geometry Learnings in HFTS#2 Projects from the Integration of FO Strain-rate, Microseismic and Other Diagnostics in HFTS#2 - Integrated Fracture Geometry (Gustavo Ugueto, Shell)
- **3:55 pm-4:25 pm:** Frac Ovintiv Approach to Acquiring and Analyzing Cross-well Strain (Orlando Teran, Ovintiv)
- **4:25 pm-4:55 pm:** Monitoring Well Application of Distributed Strain Sensing via Rayleigh Frequency Shift: Measuring Effective Fracture Dimensions (Kyle Frieauff, ConocoPhillips)

4:55 pm – 5:00 pm Wrap up (Kan Wu, Ge Jin)