OptaSense®
A LUNA company

OptaSense Microseismic Monitoring Service

Fiber Optic Microseismic and Strain Determine Fracture Geometries

Microseismic monitoring is an established industry tool for evaluating treatment during fracture stimulations. Microseismic results aid engineers and geoscientists in measuring:

- The fracture propagation and its dimensions in length, width, and height
- Well to well treatment overlap
- Stage to stage treatment overlap for subsequent stages
- Stimulated reservoir volume
- The size and distribution of event magnitudes

The ability to quantify these metrics has proven to be incredibly useful for operators in optimizing their treatment designs, increasing pad yields, and reducing waste.

The OptaSense Solution

OptaSense provides a unique solution for microseismic monitoring. Our fiber-optic interrogators allow for high fidelity microseismic monitoring in individual or multiple wells and can be deployed outside casing as permanent installations or inside wells from retrievable fibers.

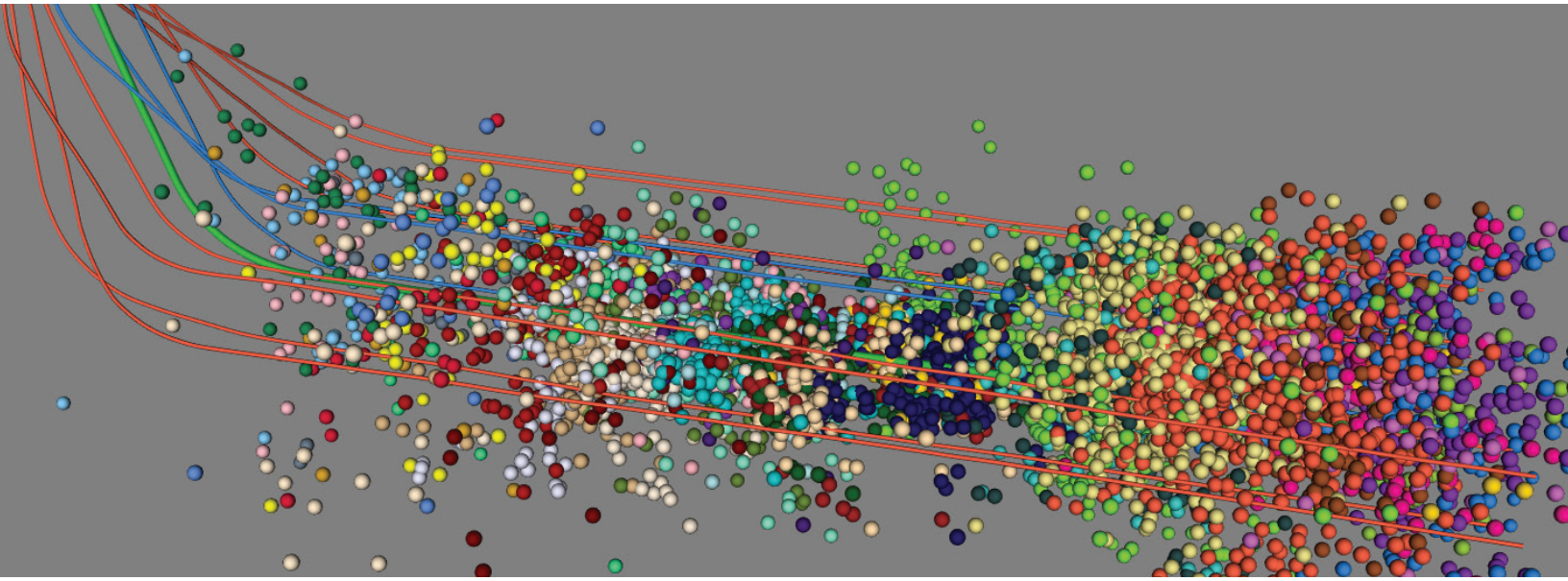
Retrievable fibers sacrifice little and have the advantage of scalable deployment. Retrievable fibers can be deployed temporarily to monitor a subset of stages and therefore contribute to cost reductions. Additionally, fibers can be moved from one well to another, or deployed in tandem, resulting in bespoke monitoring programs to help meet project objectives.

Fiber recorded microseismic is evenly sampled over the full length of a monitoring horizontal. This even and wide aperture sampling allows for a greater level of accuracy in microseismic source locations. Additionally, this even sampling results in little array bias and allows for a more representative distribution of events from toe to heel.

Optasense's real-time solution provides event locations and magnitude estimates autonomously to illuminate the fracture initiation and development. Results are visualized in real-time with optional pumping data, strain data, and temperature measurements.

OptaSense Advantages

- 3D Microseismic Mapping
- Real-time Mapping Services
- Record Microseismic & Crosswell Strain on Single Fiber
- Permanent or Retrievable Fiber Monitoring Solutions
- Reduced Operational Risk
- Reduced HSE Risk



Magnitude calculations via fiber-optic benefit from a flat system response to DC. This response enables joint microseismic and crosswell strain acquisition. The lack of signal aliasing at low frequencies allows for better magnitude calculations for on pad events with no effective upper limit. This enhancement potentially reduces the need for supplemental surface equipment for magnitude calculations.

How It Works

Optasense's fiber-optic interrogators monitor distortions along the length of a fiber. This is achieved by emitting rapid light pulses that travel the length of the fiber. Those pulses interact with small imperfections in the glass that result in some light being reflected back to the surface. The position of those reflectors is easily determined by knowing the time of reflection arrival, the speed of light, and the refractive index of the glass. The amplitude and phase shift of those signals are recorded over the full length of the fiber allowing a highly detailed map of the fiber response to be imaged.

Microseismic signals traveling through the earth deform the mediums they travel though. Geophones measure these deformations by the way of a solenoid while fiber-optic measures these deformations as axial compression and tension along the fiber. A simple analogy is to visualize a microseismic fiber-optic array as a dense single component geophone array, with geophones stacked end to end from surface to the termination of the fiber at depth.

Microseismic events detected at the fiber are located in space using the arrivals times of the P and S waves, as well as their moveouts. Unlike geophone arrays that have limited aperture for monitoring, fiber-optic arrays make use of the full aperture of the well. The additional resolution increases location accuracy for those microseismic events with defined moveouts.

Mapping of microseismic events depends on fiber geometry and number of fibers. OptaSense Microseismic Services handle any fiber geometry and deployment. Detected events on a single fiber are mapped with reference to treatment wells with excellent and unbiased distribution along the axis of the well. 3D mapped events are obtained using multiple fibered arrays in separate horizontals and/or verticals (see figure above).

In addition to acquiring microseismic, OptaSense also acquires crosswell strain simultaneously. Strain data measures the tension and compression along the fiber that occurs from the opening and closing of hydraulic fractures during treatment. This combined microseismic and strain service enables a complete geomechanical view of the fracture network.

Delivered Value

Advancements in distributed acoustic sensing allow fiber-optic arrays to deliver high quality microseismic results with a fraction of the operational risk. Because fiber-optic deployments utilize the full horizontal, they deliver uniform sampling for the duration of treatment. In all OptaSense acquisitions, our fiber equipment has maintained recording for the duration of monitoring, and without the need of maintenance. Finally, OptaSense has the ability to record multiple unique datasets on a single fiber. For example, recording both strain and microseismic coincidently on the same fiber allows OptaSense to identify areas that experiencing more fluid driven deformation (strain) to areas that are experiencing stress and pressure driven deformation (microseismic). Microseismic, Crosswell Strain, Well Interference Production Profiling, etc., all being recorded by the same equipment for a more inclusive monitoring service to help understand completions and production.

For more information, please contact your OptaSense representative or visit www.optasense.com/oilfield-services

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