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Please fill in your abstract title.	The Development and Field Test of Fiber Microseismic Fracturing Monitoring Technology

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Abstract

In this paper, the newly-developed fiber-optic accelerator based microseismic fracturing monitoring technology is demonstrated along with the development and the field test result presented. This technology can help to evaluate the effect of hydraulic fracturing, optimize the fracturing design and operation, and reduce field work cost as it is reusable. More importantly, as the downhole receivers is passive, the system can be applied in the harsh environment like high temperature and high pressure.

To realize this technology, we develop the downhole receiver array and the corresponding interrogation instrument. The downhole receiver array is composed of 10 receiver stations, each of which includes three fiber-optic accelerators supported by three perpendicular panels. The receiver, a fiber-optic accelerator used here has a really high sensivity of 200 rad/g. Compared to traditional moving-coil geophone, the receiver has other advantages such as immunity to electronic-magetic interference, high temperature resistant capacity (up to 120 ℃) and high pressure resistant capacity (up to 40 MPa). Using the space-domain multiplexing (WDM) and time-domain multiplexing (TDM) technique, all the receivers can be combined on two pairs of fibers, which are 4.5 km long. With the optical scheme proposted here, the scale of the downhole receiver array can be extended easily.

After deployment, the microseismic signals are captured by the receiver and send back to the interrogation instrument on the ground through the optic fibers. The interrogation instrument extracts the microseismic signal by special algorithm which is programmed in an FPGA (Field-Programmable Gate Array). Beside this, the interrogation instrument contains laser, modulator, photonic detectors, etc. to complete the optical signal modulation and demodulation. By constant improment and optimization, the system can reach a dynamic range larger than 120 dB and minimum detectable acceleration of 56 ng/$\sqrt{\mathrm{Hz}}$ in the frequency band from10 Hz to 1000 Hz. All the parameters means that the developed system fulfills the requirements of microseismic monitoring.

In the year of 2017 and 2018, the system was applied to 4 filed tests in Xinjiang oilfield. The perforation shot signals can be recorded clearly with a SNR (signal-to-noise ratio) of about 60 dB and the hypocenter location can be recovered accurately. In the hydraulic fracturing, plenty of microseismic singal are obtained by the system with the best SNR as high as 50 dB. Based on the data, the microseimic events distribution curve is given and is well matched with the field operation curve. Furtherly, the height, width, height and direction of fracture can be interpreted, which can be used to adjust and optimize the fracturing operation.

In conclusion, the optical fiber micro-seismic monitoring technology described here is successfully developed and has been proved reliable abd feasible though several field tests. It is a new monitoring technology which can be used in severe environment to evaluate the effect of hydraulic fracturing and reduce the test cost.