# Fiber-Optic Strain Sensing for Geophysical Imaging and Fluid-Flow Assessment

## Research Themes

We have been given access to a DAS VSP survey from a proprietary location in West Texas by Fotech Solutions Ltd. Using VISTA software, we have processed this dataset using an industry standard VSP workflow. This includes signal enhancement, analyzing the direct P-wave arrivals and creating velocity profiles, separating upgoing waves and flattening them into two way travel time, and creating corridor stacks. We have also assessed the signal-to-noise improvement due to vertical stacks of repeated source sweeps. We have also begun investigating whether the data contains signals from different modes such as P-S, S-S, S-P converted waves and direct S-waves, using forward modeling to help constrain our interpretations. Further work in these areas is planned, as well as further analysis of the signal amplitude decay, comparing it with theories of geometric spreading and attenuation.

A second chapter to our project is a lab experiment to monitor flow of a fluid through a pipe using fiber-optics. In the AGL laboratory, a water pipeline has been installed with two Fiber Bragg Gratings (FBGs), one radially around the circumference of the pipe and one axially parallel with the pipe. These gratings act as localized strain gauges, and initial experiments have shown that they register expansion or contraction of the pipe when the flow rate changes and the vibrations of the pipe that is also influenced by the flow rate. Further experiments and analysis will be done to attempt to determine a relationship between the FBG response and a quantitatively measured flow rate, and relationship between the responses compared to a mathematically derived hoop strain rate.

## Recent Accomplishments

Some of this work was presented in October 2016 at the Society of Exploration Geophysicists (SEG) 86th Annual Conference post-convention workshop on fiber-optic sensing for exploration and monitoring.

## Issues

The pipe-flow monitoring project is in its early stages as of November 2016, the preliminary results show encouraging proof of concept but the direction of the project could go in one of several directions depending on funding and spheres of interest.


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