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## Polarisation Based Interferometric Optical Fibre Geophone Sensor Designed for High Resolution Seismic Detection

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Geophones are essential for monitoring seismic activity to study the structure of the earth for ground surveys, mineral exploration and early warning detection of geo-hazards. Traditional electromagnetic based geophones are fairly effective in detecting micro-seismic activity and ambient signals. Their induction based mass-spring sensing mechanism can however be somewhat performance limiting. Limitations include reduced frequency response, resolution and recovery times between successive activities. This ultimately impacts the sensitivity and performance of the device. In this paper, we present a novel optical fiber geophone sensor that addresses these issues through superior sensitivity, performance and ease of deployment. Our optical fiber geophone is polarization based, single ended and operates on a Michelson interferometric principle. Tests were performed to compare the performance of our optical fibre geophone to that of a commercial electromagnetic geophone. Vibrations of varying magnitude were remotely generated at 1.065 m from both devices. Sensor signal responses to disturbances of energy lower than 1.1 mJ were plotted and analysed. Observed traces from the sensor responses were compared, showing that the fiber geophone has significantly shorter response and recovery times. As a result, the resolution between rapidly succeeding signals is considerably greater for the optical fiber geophone. Sensitivity plots of the amplitude response to the vibration energy gave a scatter of points depicting a higher degree of precision and accuracy for the fiber geophone. Response slopes of 11.70 a.u/mJ and 10.31 a.u/mJ respectively were obtained for the sensitivity of the optical fiber geophone versus the electromagnetic geophone. While the typical spurious frequency is close to 150 Hz for the traditional geophone, the bandwidth of the optical fiber geophone is an order of magnitude greater.

Keywords- Geophone, Optical fibre, Polarisation, Michelson Interferometer