Fibre optic hydrophone based on pressure sensitive microstructured optical fibre

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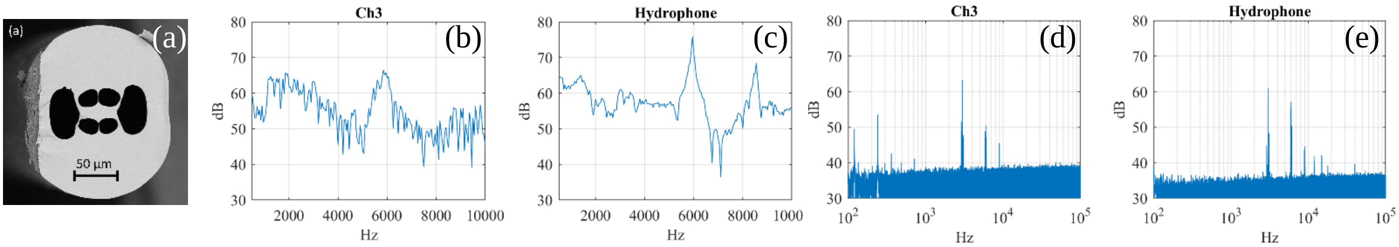
Fibre optic hydrophone (FOH) as a new generation of underwater surveillance tool has shown great potential for both military and civilian applications [1]. Recently, phase-sensitive optical time domain reflectometer (Φ-OTDR) based FOH has shown great success [2]. However, like any OTDR system, the signal to noise ratio (SNR) of the FOH is fundamentally limited by thermal noise [3]. Therefore, to improve the performance of the FOH, the most straightforward option is to increase the optical fibre's phase sensitivity to acoustic vibrations. Here, we propose to use a phase sensitive structural design to fabricate a microstructured optical fibre and use it in FOH. In this paper, we show preliminary results of the pressure-sensitive MOF (fig. a) in a basic FOH configuration (homodyne detection) and compare it to a commercially available piezo-electric based hydrophone (Teledyne Marine TC4013). In our work, a low phase noise laser was split 50/50 into two fibres. One fibre was spliced to a pressure-sensitive MOF and then recombined with the other fibre through another 2×2 coupler. The two outputs of the 2×2 coupler were sent to a differential detector where the detector output was digitized by an oscilloscope. A computer speaker was attached to the side of the water tank acting as a sound transducer. The commercial hydrophone was placed next to the MOF in the water tank. The hydrophone output was connected to a signal amplifier and then to the same oscilloscope. A MATLAB control program



was written to control the hardware and instruments to perform frequency scans for testing. We demonstrated the sensitivity of the pressure-sensitive MOF to acoustic signals in water by sending sine waves at different frequencies to the sound transducer and simultaneously capturing the outputs from the commercial and FOH. The FOH showed sensitive response to the acoustic signals at a similar level as the commercial hydrophone (fig. b & c). An example of the acoustic spectra comparison for a 3 kHz sine wave signal is shown (fig. d & e). We see the FOH has similar SNR (≈ 25 dB) to the commercial hydrophone with a slightly higher noise background (< 5dB).

Funding: Defence Innovation Partnership Collaborative Research Fund. ARC Future Fellowship [FT200100154].

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