MEASUREMENT OF OPTICAL PATH DIFFERENCE OF WHITE LIGHT FIBRE INTERFEROMETER USING PEAK TRACKING METHOD

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INTRODUCTION

The major emphasis in the field of interferometry is the determination of optical path difference of the interferometer. This study seeks to evaluate the peak tracking method for computing the optical path difference of the Mach-Zehnder fibre interferometer.

This study narrows the scope for Mach-Zehnder configuration and the use of neutral white light LED as the light source. Spectrometer model Ocean Optics' USB4000 is employed as the detector. The Mach-Zehnder fibre interferometer is constructed using two 2 x 2 fibre couplers both with 50:50 splitting ratio at 532 nm. Schematic of the fibre interferometer is shown in Figure 1.

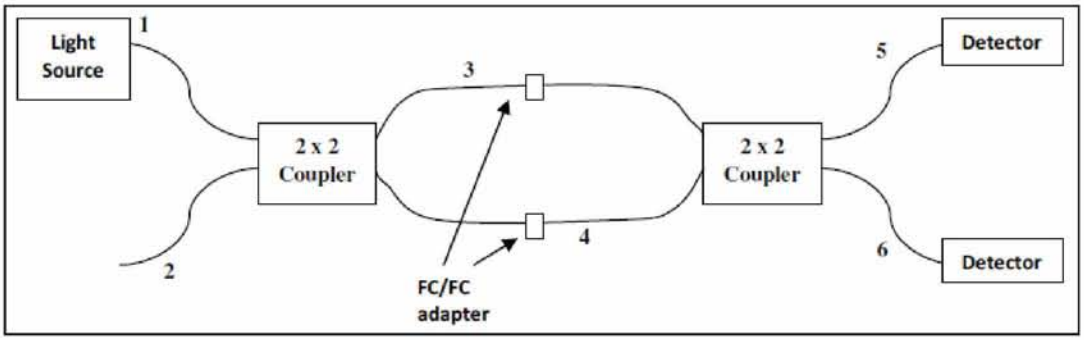
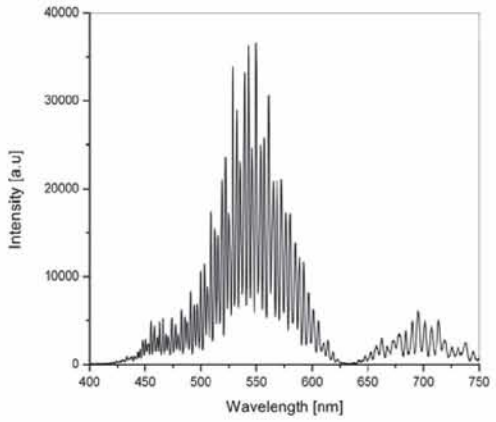


Figure 1. Schematic of Mach-Zehnder fibre interferometer.

Output spectra of the interferometer are simulated in MATLAB, details of the simulation is outline in [1]. From the simulated and experimental results, the peak tracking method [2,3] is employed to determine the optical path difference. As suggested in [4], the change in average fringe period with optical path difference allows the system to be used as a sensor which utilizes the fringe period shift as interrogation technique. A total of 50 experimental interference spectra are recorded from each output at port 5 and 6 with the detector setting at 100 ms exposure time and dark background corrected. In each individual spectrum, 20 values of optical path difference are computed from 21 peaks that represents the bright fringes.

MAIN RESULTS

The interference spectrum from port 6 is illustrated in Figure 2a, and the plot of average fringe period versus the inverse of path difference is shown in Figure 2b.



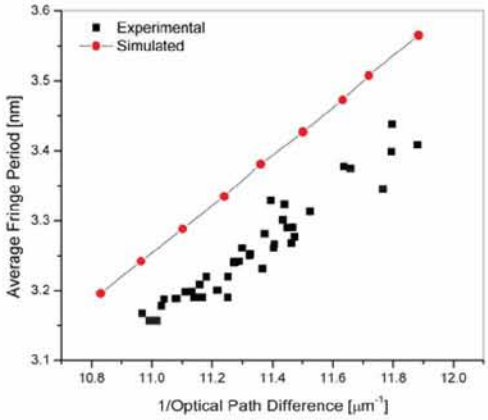


Figure 2a (left). Interference spectrum from output port 6.
Figure 2b (right). Average fringe period versus the inverse of path difference for experimental and simulated data.

The value of the optical path difference determined from peak tracking method has an uncertainty of about 6 percent as measured from the standard deviation of the simulated results and at most 15 percent uncertainty for experimental data due to noise and the resolution of detector that limits the accuracy in measurement of the peak values. Average fringe period varies linearly with the inverse of optical path difference however the experimental data suggest that the use of fringe period may not be suitable for sensing purpose due to low repeatability shown by the system.

Acknowledgment: This study is supported by Research University Grant (GUP) with Project No 02J40.

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