Evaluation of a self-calibrated optical chip interferometer for high precision online surface measurement

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Introduction

The aim of the research is to develop an optical chip interferometer for online surface measurement. The working of metrology tool is based on wavelength scanning interferometry. In this work we investigate the performance of the integrated tuneable laser which forms an important part of the whole measurement system.

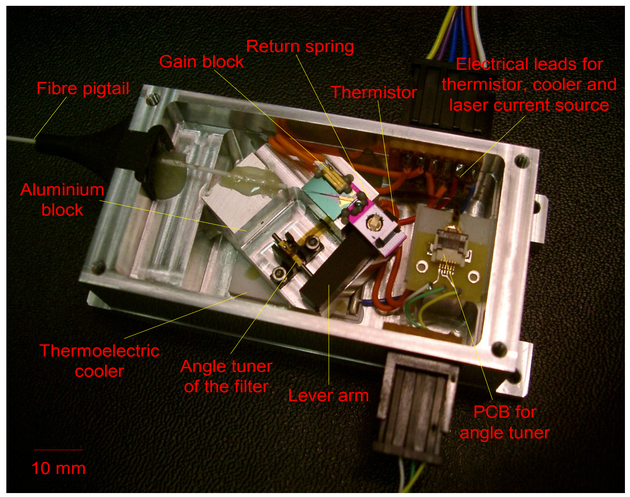

Figure 1: The tunable laser module

Objectives

- Design, fabricate and assembly technology for building an optical chip interferometer device that can measure surfaces at ultra/high-precision (nm vertical resolution, several mm vertical range).
- The testing and performance review of the sensor system as a metrology tool.

Experiment

- A Fizeau interferometer setup is used to test the performance of laser with a glass slide of thickness of 0.14mm (figure 3).
- Injection current and laser case temperature was kept at 450 mA and 23^{0}C respectively. A laser scan is performed over the range of 20 nm (1540-1560 nm).
- To study the modal behaviour laser drive motor stepped at 2 µm increments and the output is recorded using an optical spectrum analyser.

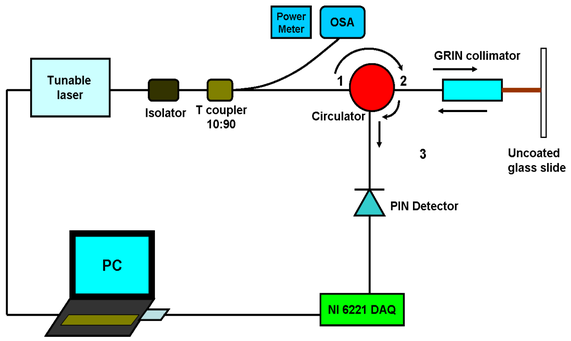

Figure 2: Experimental setup for testing the integrated-optic chip tuneable laser

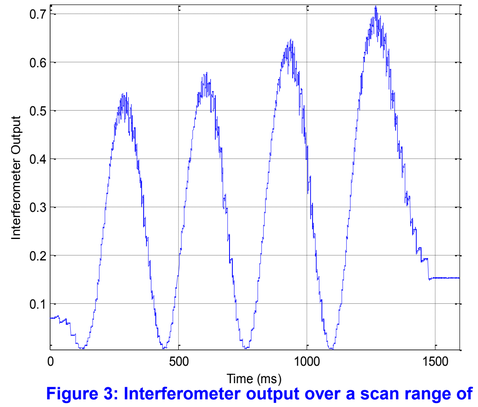

Figure 3: Interferometer output over a scan range of 20nm (1540-1560 nm).

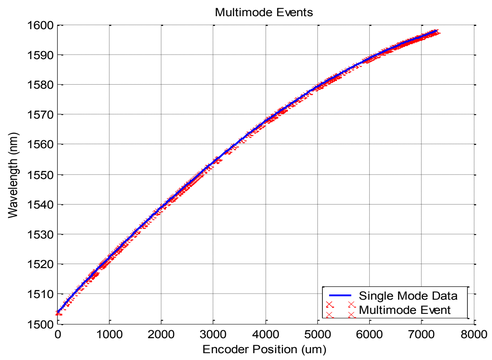

Figure 4: Multimode events occurring over scan range

Results and Discussions

- Output sinusoid is inconsistent throughout the scan suggesting nonlinear tuning behaviour of the laser (figure 3).
- Secondary structures appearing as spikes in the waveform and is due to secondary interference occurring in the system (figure 3).
- The tuneable laser exhibits multimode behaviour , ~17% of all longitudinal modes (figure 5).

Future Work

- Investigate methods of improving the laser performance in terms of reducing multimode behaviour and secondary structures.
- Optical probe design and prototype to complete the metrology tool.
- Development of suitable software routines for control and signal processing.
- Evaluation of the metrology tool.

Acknowledgements

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References

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