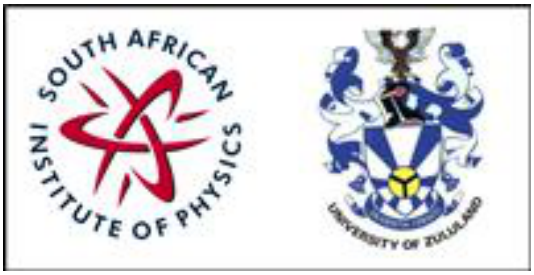

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A Theoretical Model and Simulation of Low-Reflectivity Active Linear Cavity for temperature and vibration sensing

Friday, 12 July 2013 10:50 (20 minutes)

Abstract content
   (Max 300 words)

A mathematical model describing the signal oscillation and amplification of an active linear cavity fibre sensor is presented. Passive low-reflectivity fibre Bragg grating (FBG) sensors have been developed and implemented in various applications. The major draw-back of these sensors is a low signal to noise ratio (SNR) when used in a noise prone environment. A mathematical model for low-reflectivity active linear cavity fibre sensor is reported. In our model, two identical FBG form the cavity. The cavity is made of an amplifying gain medium which in our model is an Erbium doped fibre (EDF). In the model, the F-P active cavity generates interference pattern. The interference pattern is captured on the detection system. An optical spectrum analyzer can be used as detection system for slow varying parameters such as temperature. For sensing dynamic parameters, a F-P tunable filter and a photo detector is used because of its scanning frequency which is in the order of kHz to MHz. In this model, the detected signal is demodulated using phase modulation. In phase modulation, a perturbation in the active sensor generates a change in its reflected interference pattern. The change of the reflected interference pattern produces a change in phase in its Fourier transform. By evaluating changes in phase, changes in the perturbation can be measured. Several sensors can be cascaded onto a single fibre using a well known frequency division multiplexing (FDM) with cavities of different lengths. The mathematical model parameters including gain, cavity length, pump power, absorption are optimized in our simulation. The results of the simulation present an improved performance of the SNR as compared to passive sensor. From simulation results, the model can apply to slow varying parameters (temperature) as well as dynamic parameters (vibration).

Index terms: Fabry-Perot cavity, signal-to-noise ratio, Erbium doped fibre.

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