Vibration Effect on the SMS Fiber Structure

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***Abstract* – We present a preliminary result on the singlemode-multimode-singlemode (SMS) fiber structure for a vibration sensor. The SMS fiber structure was placed in a macrobender within the mechanical transducer to detect the frequency of a vibration source. The time series of optical output power of the SMS fiber structure was measured and it was transformed into the frequency domain using the fast Fourier transform. It was demonstrated that the frequency of vibration source can be determined by using the mechanical transducer with the SMS fiber structure. It was also analyzed the distance effect between the source and the SMS fiber structure. It was shown that the frequency measurement of 20 Hz vibration source can be carried out in a range of 0 to 30 cm with an error frequency 0.1 Hz. This scheme is potential for the vibration measurement which offers inexpensive and simple configuration.**

***Index Terms* – SMS fiber structure, macrobending, vibration effect.**

INTRODUCTION

SMS fiber structure has been utilized for many applications such as strain sensor, load sensor, temperature sensor, and refractometer [1-4]. In this paper, the SMS fiber structure is proposed for an application of vibration measurement.

MATERIAL AND METHOD

Figure 1 shows a schematic diagram of the vibration measurement using the SMS fiber structure within the mechanical transducer. A macrobending technique was utilized to. The SMS fiber structure made of multimode graded index fiber which has core/cladding diameter of 62.5/125 µm, splice between two identical standard singlemode fiber (shown in Fig. 2). The vibration source is a water pump which has a vibration frequency of 20 Hz. The vibration source was set in distances of 20 cm, 30 cm and 40 cm from the SMS fiber structure. The vibration source produces acoustic emission and it would vibrate the mechanical transducer. This vibration will modulate the output power of SMS fiber structure. An intensity measurement scheme was employed by connecting the SMS fiber structure's both ends to a laser source of 1550 nm wavelength and an optical power meter. A computer was used to record the change of output power.

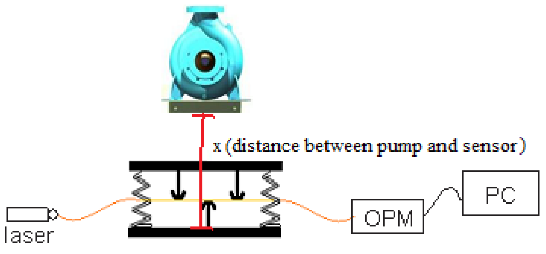

Figure 1. A schematic diagram of vibration measurement using the SMS fiber structure and a mechanical transducer

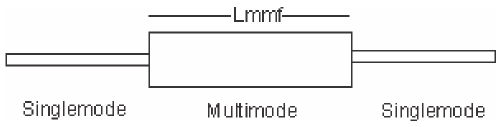

Figure 2. SMS fiber structure.

RESULT

Figure 3 shows the time series of optical output power of SMS fiber structure for a distance of 20 cm between the vibration source and the SMS fiber structure. The time series of output power was converted into the frequency domain using a fast Fourier transform. It is shown in Fig. 4 the corresponding frequency of 20 Hz from the time series of output power as in Fig. 3.

The measurement distance between the vibration source and the SMS fiber was varied. Figure 5 shows the error frequency as a function of the measurement distance. One can see the error frequency is about 0.1 Hz at the distance of 30 cm, and larger error for the greater distance.

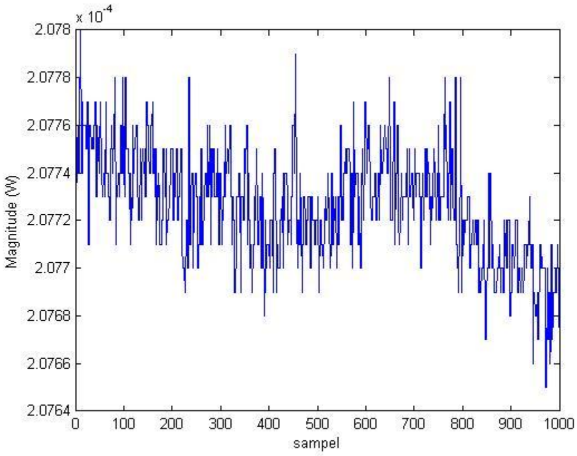

Figure 3. Output power signal of SMS fiber structure was recorded in 20 cm distance.

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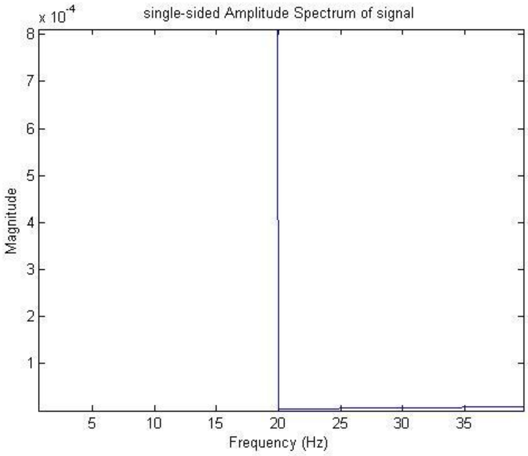

Figure 4. FFT result of the signal from Figure 2.

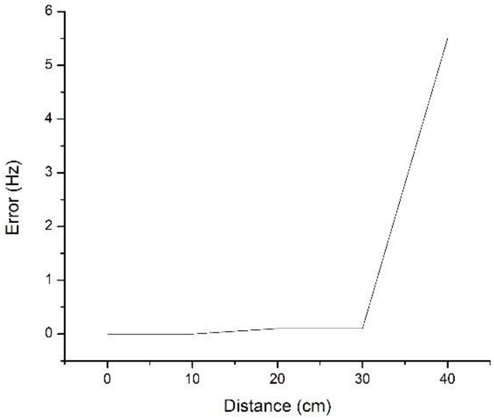

Figure 5. Error of vibration frequency measurement as a function of measurement distance.

CONCLUSION

The scheme of SMS fiber structure is potential for the vibration sensor which offers inexpensive and simple configuration. It was shown that the frequency measurement of 20 Hz vibration source can be carried out in a range of 0 to 30 cm with an error frequency 0.1 Hz.

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