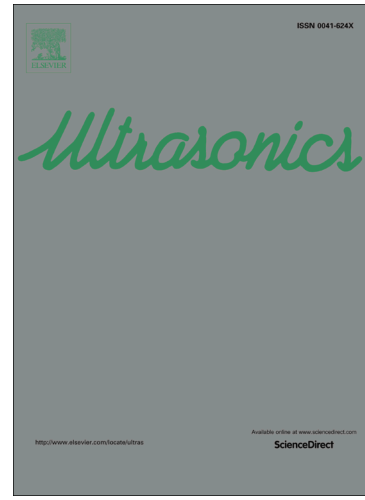

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Temperature Compensation of the SAW Yarn Tension Sensor

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Abstract

The objective of this research was to investigate the possibility of the temperature compensation for the surface acoustic wave (SAW) yarn tension sensor. The motivation for this work was prompted by the oscillation frequency of the SAW yarn tension sensor varying with the temperature.

In this paper, we deduce the functional relationship between the temperature variation and the oscillation frequency shift caused by the temperature. This functional relationship and the temperature sensor are used to get the oscillation frequency shift caused by the temperature, so that we can use the oscillation frequency shift caused by the temperature to implement the temperature compensation of the SAW yarn tension sensor. In this paper, we also get the relative error of the temperature compensation. The theoretical and experimental results confirm that this temperature compensation method can implement the temperature compensation of the SAW yarn tension sensor.

Keywords: temperature compensation, yarn tension sensor, surface acoustic wave (SAW)

1. Introduction

In the production process of the yarn and fabrics, the yarn tension is a very important factor, and it directly affects the quality of semi-finished and finished products. The excessive yarn tension makes the yarn lengthen, so that the yarn suffers, and the yarn decapitations are increased. If the yarn tension is too small, the roll forming will be affected. In addition, the yarn tension is not a constant but a fluctuating quantity [1-3]. In order to truly reflect the magnitude of the yarn tension and its variation, the yarn tension sensor should have high sensitivity, high stability, fast response time, and so on [4].

Many sensors such as yarn tension sensor using resistance strain, yarn tension sensor using capacitance and yarn tension sensor using magnetic induction are commonly used in the measurement of the yarn tension [4].

Yarn tension sensor using resistance strain is composed of bridge circuit for resistance strain gauges. In yarn processing, the cantilever strain varies with the yarn tension, so that resistance strain gauges also vary with the yarn tension. Therefore, the goal of measuring the yarn tension is reached. When the strain gauges are pasted, there is a lot of manual labor, so that the product quality is unstable. In addition, because the output signal of yarn tension sensor using resistance strain is an analog signal, it is susceptible to interference [5, 6].

Yarn tension sensor using capacitance is the sensor of differential capacitance, which converts the yarn tension variation into the capacitance variation, so the measurement of the yarn tension is implemented. Because the output signal of yarn tension sensor using capacitance also is an analog signal, it is easily affected by interference signals [7-9].

In yarn tension sensor using magnetic induction, the yarn tension causes the variation of magnetic field, so as to achieve the purpose of measuring the yarn tension. The output signal of yarn tension sensor using magnetic induction is also an analog signal, so that interference signals have an influence on this output signal [10, 11].

Through analysis and research, we found that SAW oscillators can implement the yarn tension sensor [12]. The new yarn tension sensor using SAW oscillators is the creative development of the existing yarn tension sensors, and can overcome the shortcomings of the existing yarn tension sensors. In this paper, we deduce the functional relationship between the temperature variation and the oscillation frequency shift caused by the temperature. This functional relationship and the temperature sensor are used to get the oscillation frequency shift caused by the temperature, so that we can use the oscillation frequency shift caused by the temperature to implement the temperature compensation of the SAW yarn tension sensor. In this paper, we also get the relative error of the temperature compensation.

This new SAW yarn tension sensor can benefit from the excellent properties of the SAW oscillator, namely, small size, high reliability and reproducibility, excellent stability, high sensitivity, and fast response time. The output signal of the

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