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微纳技术与精密机械

调幅式电容位移传感器的峰值检波电路设计

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摘要： 针对调幅式电容位移传感器解调过程中由系统不确定相移导致的信号解调不准确问题,提出了一种基于改进的峰值保持电路的调幅式电容位移传感测量方法。首先,分析了调幅式电容位移传感器及其检测电路的工作原理,在研究调幅信号附加相移产生机理的基础上,提出了延迟反馈式峰值保持电路,用以去除附加相移对峰值解调的影响。然后,设计并制作了调幅式电容位移传感器,并对其各个性能指标进行了测试。最后,对实验结果和误差进行了分析。实验显示,提出的峰值保持电路的输出线性度优于0.05%,制作的传感器在0~25 μm内数据测量稳定性优于10 nm/30 min,传感器测量偏差最大值为36 nm。结果表明,采用延迟反馈型峰值保持电路有效地解决了系统不确定相移带来的峰值检波不准确的问题,所制作的电容传感器满足了高精度测量的要求。

关键词： 位移传感器 电容传感器 延迟反馈 相位延迟 峰值检波电路

Design of peak detector circuit for AM capacitive displacement sensor

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Abstract: To solve the problem of inaccurate peak demodulation resulted from the system uncertain phase shift in Amplitude Modulation (AM) for a capacitive displacement sensor, an AM capacitive displacement sensor based on an improved delayed feedback peak detector circuit was proposed and its applied functional blocks and circuits were investigated. Firstly, the measurement principles of the AM capacitive displacement sensor and its detection circuit were analyzed. Based on generation principle of phase shift with the AM signal, an improved delayed feedback peak detector was presented against the problem of inaccurate peak demodulation. Then, the AM capacitive displacement sensor was prototyped using printed circuit boards and its performance indicators were tested as well. Finally, experimental results and errors were discussed. It indicates that the linearity of the delayed feedback peak detector circuit is better than 0.05%, the data shift of prototyped sensor is less than 10 nm/30 min, and the maximum deviation of sensor is 36 nm within the measuring range of 0~25 μm. It concludes that the delayed feedback peak detector circuit can effectively solve the problem of inaccurate peak detector resulted from the system uncertain phase shift, and the proposed AM capacitive sensor can satisfy the requirements of high precision measurement.

Keywords: displacement sensor capacitive sensor delayed feedback phase shift peak detector circuit

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