Experimental Research on Temperature Characteristics of 2D Micro Scanner

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Outline

- Introduction
- 2D Micro Scanner
- Temperature Characteristics
- Conclusion
Introduction

- **2D Micro Scanner**
  - Micro/nano-satellite with MEMS technology
  - Space regional optical scanning and detection
  - Affected by the space environment with temperature changes

- **Motivation**
  - Research the temperature characteristics of 2D Micro Scanner
  - Test the space temperature adaptability
  - Provide the experimental evidence for space application
2D Micro Scanner

🌟 Structure and principle
- Piezoelectric actuation
- Resonant scanning
- Piezoresistors sensing

Twisting by y-axis
Bending by x-axis
2D Micro Scanner

☆ Piezoresistors

☆ Prototype
Characteristics

- **Scanning**

  - Twisting
  - Bending
  - Coupled

- **Piezoresistors**
Temperature Characteristics

Experimental method

- Dry temperature chamber
- Range of -20°C to 80°C and interval of 5°C
- Measure the two resonant frequencies and two piezoresistive Weatstone bridges characteristics
Temperature Characteristics

☆ Resonant frequencies
- Two resonant frequencies slowly decrease with a rise of temperature
- Twisting mode: ranges from 219Hz to 215Hz
- Bending mode: ranges from 468Hz to 460Hz

- The temperature change has litter effect on the two resonant frequencies of the 2D micro scanner
Piezoresistors performances

- In the temperature range, the piezoresistors have a good stress sensing performance. There are always linear relationships between Wheatstone bridge output and actuation displacement.
☆ Piezoresistors performances

- Measurement sensitivities
- Measurement linearities

Main reasons
- Temperature dependence of piezoresistive coefficient
- Temperature dependence of Young's modulus
- Thermal expansion of micro-structure
- Temperature dependence of damping coefficient
The space temperature adaptability and characteristics of the 2D micro scanner is tested in the temperature range of -20°C to 80°C.

In the range of 10°C to 30°C, the 2D micro scanner has two steady resonant frequencies, smooth piezoresistive measuring sensitivities and better linearities which are less than 2.5% and 1.6%, respectively.

The range of 10°C to 30°C is the optimal temperature range for space application.
Thank you!