URN etd-0407109-183702-103
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Statistics This thesis had been viewed 48 times. Download 0 times.
Department
Year 2005
Semester 1
Degree Master
Type of Document Master's Thesis
Language zh-TW.Big5 Chinese
Title Development of a 3D Nano Touch Trigger Probe
Date of Defense 0000-00-00
Page Count 75
Keyword
Touch trigger probe
Coordinate Measuring Machine
DVD pick-up head

Abstract
The main purpose of this study is to develop a three dimensional touch trigger probe with low cost and high precision. The development of touch trigger probe is consisted of three parts, which are the stylus with a tip ball, suspension mechanism, and sensors. The design of the touch trigger probe used a ruby ball, and took into consideration of the stylus features to compute the contact force based on the complete elastic collision theory, so as to be used as the reference in the design of stiffness for the suspension mechanism. For the design of the suspension mechanism, this study used micro beam design, and determined the length, width, and thickness of the micro beam, and the dimension of the suspension mechanism, according to the selected contact forces. The test results were analyzed and validated with finite element software ANSYS and the theoretic deduction of analytical formula. It proved that the suspension mechanism has the feature of inhibiting three degree of freedom, lowering the measurement error of the sensor, improving equal stiffness of the entire touch trigger probe with the selected probe length, and reducing the pre-travel error of the touch trigger probe due to different stiffness. The development of the sensor used optical displacement and angular sensor improved from the pick-up head inside the DVD player available on the market, and used it as the sensory device for the touch trigger probe. When the probe tip touches the surface of the object to be tested, the resulting contact force would be transmitted from the probe to the suspension mechanism, and lead to displacement or angular deviation generated by the stiff body connected to the probe, and the sensor records the displacement or angular deviation, and generates a touch-off signal when the deviation reaches the trigger threshold. It would be used as the reference for each axial displacement of the three-axis positioning platform.
Based on the experiment, the X/Y/Z measuring range of the touch trigger probe is ±3um*±3um*3um, the measuring uncertainty is 91.8nm, probing force is smaller than 0.1mN.
Advisory Committee Chih-Liang Chu - advisor

Files No Any Full Text File.
Date of Submission 2006-08-20