Design and Control of a Piezoelectric Driven 2-DoF Precision Stage for Suppressing Motion Induced Vibrations

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ABSTRACT: Suppression of motion induced vibration is critical for automatic optical inspection (AOI) systems. Due to the heavy mass of gantry system, it is better to incorporate a tiny stage for eliminating the relative vibration. In this work, a piezoelectric compliant stage and its associated PC-based *X-Y* axes control system was development as the carrier of AOI systems for both enhancing system bandwidth and reducing motion-induced vibration. By integrating feedback control with the stage, it is possible to suppress the vibration and therefore improve the inspection yields of AOI. The cascaded structure design can effectively reduce the system complexity and can be further extended for additional degrees of freedom. Based on the test results, the designed stage can achieve a closed loop bandwidth up to 100 Hz and a steady state resolution less than 50 nm using a model reference sliding mode controller. The study results can be further expanded to longer stroke and higher precision positioning system, and integrates with cutting edge technologies for more superior precise instrument in the future.

Keywords: Vibration control, Compliant stage, Piezoelectric systems, Sliding mode controllers