

## **The Development of a Long-Stroke Precision Positioning Stage for Micro Fabrication by Two-Photon Polymerization**

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### **Abstract**

This paper applies a combined precision stage to fabricate micro-structures by two-photon polymerization (TPP). The combined stage consists of PZT and stepper-motor stages to achieve precision positioning in long displacements. First, we derive the models of the stages by identification experiments. Second, we apply robust loop-shaping techniques to improve the positioning performance of the stages. Third, we integrate the stages and develop a multi-loop control structure to provide long-stroke and high precision. In addition, we propose coordinate transformation and anti-locking functions for further improvement of the system performance. Last, we apply the combined stage to a TPP system for fabricating micro-structures, and define performance indexes based on image processing and optical qualities. The obtained performance criteria can be used to adjust controller design to improve precision manufacturing.