

On-line Automatic Workpiece Centering Using an Impact Actuator for Ultra-Precision Turning

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In this paper, we introduces an automatic workpiece centering system using an impact actuator for future use of automating centering process which is currently done by time-consuming manual process. We were aimed to develop an actuator and automatic process to align workpiece center less than 1 μm within 20 seconds. An impact actuator was designed to generate force to move work small displacement by continuously impacting during rotation. The proposed impact actuator has a voice coil motor for generating movements of two masses which are guided by miniature motion guides, and mass with smaller weight contacts workpiece. The measured eccentricity of the workpiece by a displacement was estimated on-line through LMS tracking method, and magnitude of excitation was calculated based on the tracked eccentricity. The actuator and control process were analyzed numerically considering dynamics. The proposed actuator was manufactured and integrated with a control system using low-cost micro-processor. Through simple test rig for impact force measurement, and it was shown enough impact force were generated. The automatic centering actuator system was applied to a diamond turning machine for a micro lens core mold with continuous rotating speed of 60 rpm and 20 Hz of excitation frequency. It was demonstrated experimentally that centering workpiece was possible within 1 μm and no more than 20 seconds.
