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ACCEPTED MANUSCRIPT

A machine vision system for micro-milling tool condition monitoring

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Highlights:

- An automated on-machine vision system for micro-tool wear inspection is proposed.
- Novel parameters for micro-tool wear indication are suggested and verified.
- Tool condition monitoring and its utilization in subsequent machining are presented.
- Algorithms for tool wear extraction from images are developed.

Abstract

Tool condition monitoring is a key issue in micromachining for part quality control because the excessive tool wear and abnormal tool conditions will significantly decrease the size accuracy of part and shorten the tool durability as well. In view of this, a novel configuration of machine vision system for online tool condition monitoring is presented to improve the part quality and extend the micro tool life. The vision system is committed to automated on-machine vision inspection for monitoring the progressive wear. This inspection system uses a telecentric lens with light source and a camera to minimize the errors in imaging. The control system drives a three dimensional motion platform carrying the imaging device to probe and grab in-focus image at the predetermined time interval of machining. In addition to the flank wear, three new wear variables are explored to enhance the robustness in prediction of tool wear state. Effective image processing algorithms are developed to reduce downtime. The effectiveness of the prototype system and the developed algorithms for tool wear extraction are verified by cutting experiments using two-flutter micro-milling tools, and the experimental results show that this novel on-machine vision inspection system is convenient and effective to measure the amount of progressive wear and reflect the trend of tool life.

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