ABSTRACT

This paper presents a novel measurement technique for cutting tool wear (attrition and abrasive) by using knife-edge interferometry (KEI) in a simple, high-accuracy, low-cost and convenient way. Unlike an amplitude splitting interferometry, such as the Michelson interferometry, the proposed KEI utilizes interference of a transmitted wave and a diffracted wave at the cutting tool edge.

In this study, a laser beam is incident on the cutting tool edge and the photodetector detected the interference fringes by scanning a cutting tool edge along the cutting direction. The relationship between the cutting tool wear and interferometric fringes generated by edge diffraction phenomena is established using the cross-correlation of KEI fringes of two different cutting tool edge conditions. The cutting tool wear produces the phase shift (attrition wear) and the decay of oscillation (abrasive wear) in the interferometric fringe. The wear characteristics of the cutting tool with a radius of curvature of 6 mm was investigated by measuring the interferometric fringes of the tool while cutting an aluminum workpiece in a lathe.

As a result, the attrition wear and lags of the KEI fringes between a new tool and used tool showed a linear relationship 5.62 lag/wear (μm), but abrasive wear and cross-correlation coefficient was not observed significant relationship under given cross-correlation conditions. This measurement technique can be used directly for cutting tool radius compensation in on-machine measurement applications, and possible for a high-resolution diagnosis of precision cutting tool wear.
BIOGRAPHICAL SKETCH

Seongkyul Jeon has background skill of Electrical Engineering (Bachelor of science degree in Electrical engineering from Ho-Seo University) and joined in Precision Engineering Group in Jan, 2016 as Tennessee Technological University Master student. He has worked NSF project (Award Number: CMMI 1463502) which is 'Cutting tool wear monitoring' using 'Knife edge diffraction'. And also he submitted journal paper (Title: Knife-Edge Interferometry For Cutting Tool Wear Monitoring) at Precision Engineering.

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