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Analysis on a Deformed Removal Profile in FJP under High Removal Rates to Achieve Deterministic Form Figuring

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Highlights

- Study on the applicability of a deformed removal profile, i.e., a double-W shape, under high material removal rates .in FJP.
- Investigation on the mechanism of removal profile deformation under high removal rates with experiments and simulations.
- A 'rotate function' was proposed so that the deformed removal profile or the double-W shape, can be directly used in a simple vertical jet setup, replacing the eccentric rotation jet device.
- The applicability of the deformed removal profile in deterministic surface form figuring has been verified both theoretically and experimentally.

Abstract: Fluid jet polishing (FJP) technology has been developed in recent years for correcting the form errors of precision optical components. Previous studies mainly focused on the material removal mechanism, surface quality control and the applicability of FJP as a corrective figuring method to improve the form accuracy of pre-machined parts, whilst the low material removal rates achieved by FJP seems to be a limiting factor for the application of FJP as a competitive approach in industrial environment. The present work studied the influence of nozzle outlet diameter and jet pressure on the removal rate and the applicability of a deformed removal profile in deterministic surface figuring under high removal rates. It was found that the cross-sectional profile of the machined spot changed from W shape to double-W shape, along with the increase of the spot depth under higher jet pressure. A rotate function' was proposed so that the deformed removal profile or the double-W shape, can be directly used in a simple vertical jet setup, replacing the eccentric rotation jet device, and the applicability of the deformed removal profile in deterministic surface form figuring has been verified both theoretically and experimentally. It has been proved that this method can be used with a simple vertical jet setup to achieve high form accuracy.

Keywords: Fluid jet polishing (FJP), High efficiency removal, Removal mechanism

1、Introduction

Precision optical components are widely used in various instruments and devices, supporting scientific and industrial applications in astronomy, aerospace, information technology and life