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Virtual Pivot Alignment Method and its Influence to Profile Error in Bonnet Polishing

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Abstract:

This paper proposes a measurement and adjustment procedure for virtual pivot errors using the R-test and investigates the influence of virtual pivot errors to the surface profile in bonnet polishing. Initially, kinematic modeling is carried out for describing the location errors of rotary axes and defining overall errors of the virtual pivot arm. Then, the R-test is introduced to measure the three-dimensional displacement of a sphere located at the virtual pivot point and identify location errors. The adjustment procedure for virtual pivot errors is developed by means of mathematical analysis. The measurement and adjustment approach is applied to an ultra-precision polishing machine, on which an adjustment experiment was conducted to validate the proposed method. Based on this, a contrastive polishing experiment on a concave lens is carried out under good and poor virtual pivot errors. The experiment result shows that the maximum form deviation of the polished surface profile is reduced from 241.0 nm to 89.6 nm when good alignment of virtual error is achieved. Analytical simulation based on a material removal model of the bonnet polishing tool

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