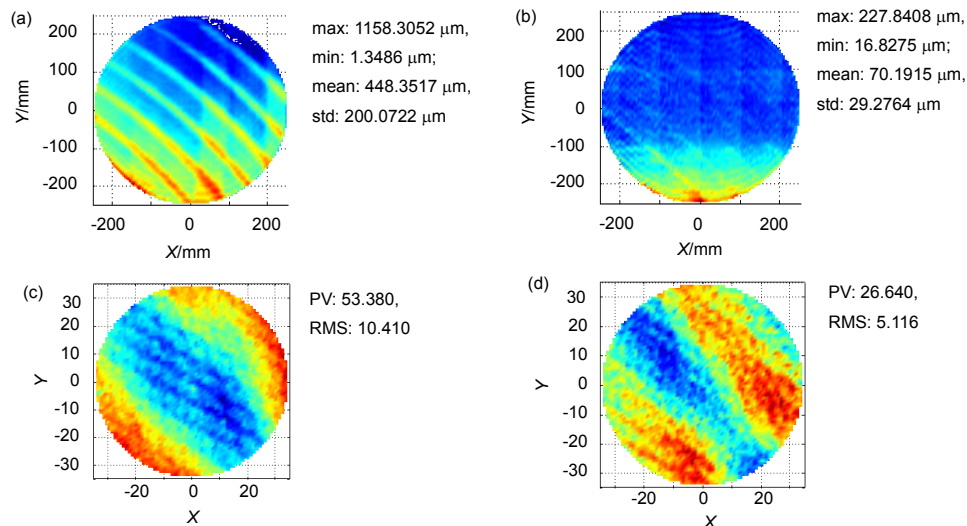


Measurement and analysis on positioning accuracy for optical processing robots

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(a) Positioning error before compensation. (b) Positioning error after compensation.
(c) Removal rate before compensation. (d) Removal rate after compensation.

Abstract: With the wide applications of optical systems, the demand for optical components is increasing. In order to meet the requirements of large quantity and low cost production of optical components, the optical manufacturing industry must find out a high-efficient, high-accuracy, economical and practical processing method. After years of development, many new technologies, such as ion beam, magneto-rheological fluid and air bag, have been produced in optical manufacturing. However, these processing equipments are often expensive, and some of these processing equipment cannot process large or complex workpieces because of space limitation. The high flexibility optical processing system based on the industrial robot, which combined industrial robot technology and computer numerical control technology, can process special optical components. Since the arm-rigid of now available robot is low, the defect of high positioning error in optical process leads to a lower processing efficiency and processing precision. This paper set the optical processing robot as the study object, and the following research works were carried out:

1) The positioning error of the polishing tool that fixed at the end of robot in circular flat area of $\Phi 500$ mm was measured in real-time by using an API Tracker 3 laser tracker. The spatial positions of dwell points were remeasured after the positioning error compensation. The measurement experimental results show that the positioning error of dwell points was reduced from 1158.3052 μm to 227.8408 μm .

2) According to above measurement of the positioning error before and after compensation, the dwell time error and the removal rate error caused by each group were calculated in optical processing simulation. The results show that after compensation, the removal rate error on 80% aperture was reduced from 3.68% to 0.90%.

3) A K9 material flat mirror of $\Phi 130$ mm was polished uniformly in the polishing experiment. The actual removal rate was obtained by subtracting surface data before and after processing. Based on the above measurements, the position error of dwell points was compensated. After replanning the processing trajectory, the removal rate error was reduced from 53.38 nm to 26.64 nm. The processing accuracy was improved by compensating the positioning error.

Keywords: optical processing robot; positioning accuracy; removal rate; polishing

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