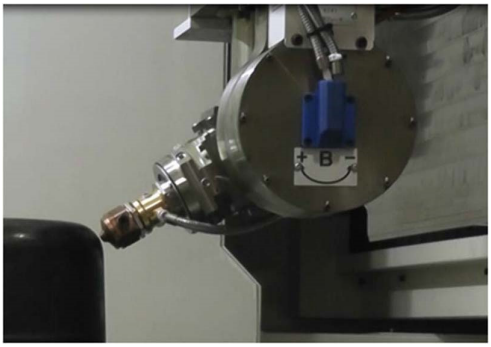
Introduction of Measuring Method Applied to 3D Laser Machining



Sales Department, Machine Tool Division,
Machinery, Equipment & Infrastructure

In high-accuracy, high-quality machining with a three-dimensional laser processing machine, focal position adjustment at the machining laser head is a particularly important element. Conventionally, a measurement head separate from a machining laser head has been used to measure the machining surface position, and based on measurement results, focal position adjustment has been made at the machining laser head. This has been a factor requiring more time for measurement, namely, non-machining, than machining, thereby spoiling productivity. For higher productivity, it is necessary to accurately measure the machining surface position needed in focal position adjustment and shorten the focal point positioning time.

By taking advantage of the expertise we have cultivated for machine tools, Mitsubishi Heavy Industries, Ltd.'s (MHI) laser processing machines have made it possible to specify the machining surface position at a high speed with high accuracy for positioning the focal point. This paper introduces a measurement head arranged on the same axis as that of the machining laser as a development by MHI for higher productivity, together with technology to shorten the time for the measurement of machining surface position.

1. Measurement head arranged on the same axis as that of the machining laser

Figure 1 shows the configuration of MHI's laser processing machine's machining laser head. MHI's machining laser head has a laser interference-type length measuring sensor integrated into the same optical system as that of the machining laser head as a solution for the accurate and fast measurement of the focal position. The integration of measuring equipment into the same optical system makes both machining and measuring positions identical, thereby enabling highly accurate measurement. Furthermore, when moving to the next machining position at the end of measurement, the wasteful motion for measuring the machining surface position can be omitted and thus non-machining time can also be saved.

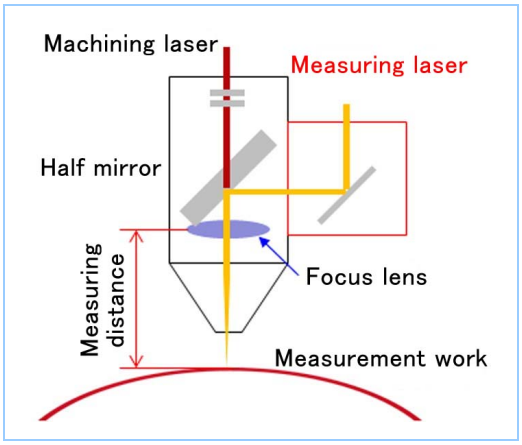


Figure 1 Machining laser head configuration

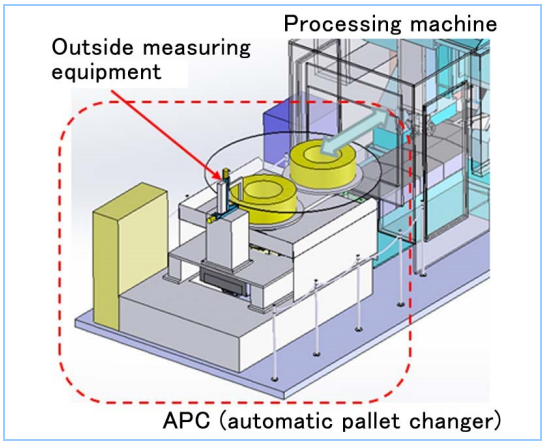


Figure 2 Outside measuring (equipment example)

2. Technology to save measurement time

(1) Outside measuring equipment

The adoption of an APC (automatic pallet changer) and equipment of an outside measuring device on the set-up station as shown in **Figure 2** have enabled machining surface positions to be measured outside the machine.

In the measuring equipment, a highly reliable triangulation sensor is employed to measure the workpiece shape outside the machine during a machining cycle. The correction is automatically calculated at the time of machining laser head movement based on machining surface position information obtained from measurements, and laser head positioning time has been reduced substantially.

(2) Highly accurate measurement against a glossy surface

If the machining surface is glossy, laser measurement is regarded as difficult. Optimum tuning in accordance with the material and glossiness of a target workpiece has realized highly accurate measurement with a tolerance of ±0.05 mm or less.

(3) Shape scanning function

When a workpiece has many holes machined on it, it takes considerable time to measure the workpiece's hole positions. A shape scanning function is applied to workpieces with plane or axisymmetric machining surfaces, thereby substantially contracting measurement time (**Figure 3**).

The shape scanning function is a function for estimating the surface position from nearby measuring points instead of directly measuring the surface position at the machining point to calculate the surface position at the machining point by interpolation. This function enables all of the machining surface positions of a workpiece with many machining points to be calculated from a small number of measuring points.

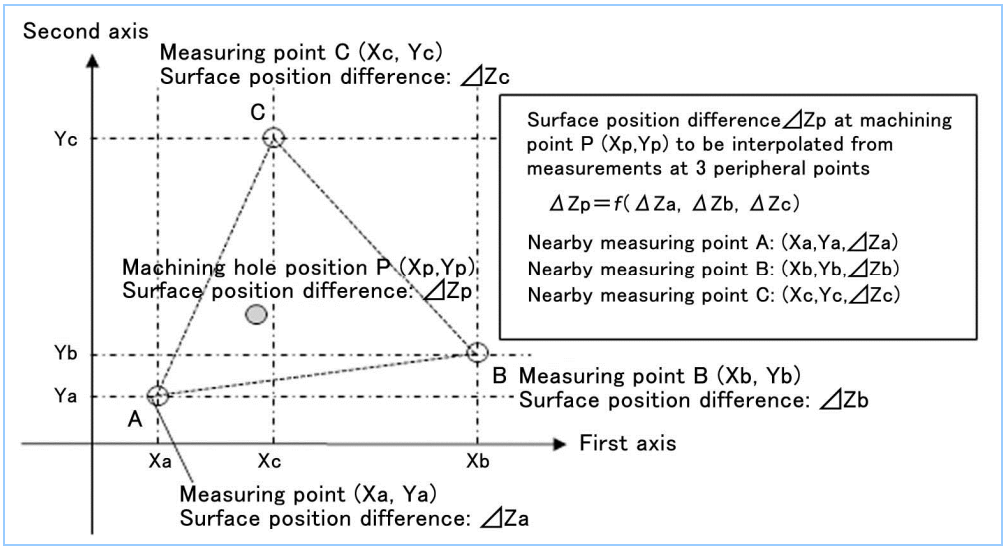


Figure 3 Shape scanning mode

3. Future outlook

At present, workpiece shapes for which the shape can be scanned are limited to plane surfaces or axisymmetric parts. We will develop a shape recognition system using a three-dimensional scanner so that shape scanning can become compatible with any desired three-dimensional surface, and thereby seek to expand the applicable shapes and further reduce measuring time.