



## Non-contact three-dimensional profiler with sub-nanometer precision using normal vector method.

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Optical instruments ranging from telescopes that are used to observe large objects such as the galaxies to microscopes that are used to examine small targets including cells are indispensable for the development of fundamental science and advanced industries. The performance of cutting-edge optical instruments is determined by optical components, such as lenses and mirrors, which have a freeform and precision that can closely approach atom-scale precision. The innovation of such advanced optical components, whose function is increased up to its physical limit, requires the development of absolute metrology. To innovate advanced freeform optical components, the form error from the ideal shape is measured by absolute metrology. Such innovation of advanced optical components allows for the observation of new physical phenomena, opens up new avenues in science, and furthers the development of advanced industries globally. For innovative optical elements, the repeatability of shape measurement is required to be sub-nanometer. In the future, optical elements (lenses, mirrors) whose surface shapes are determined by nanoscale uncertainty while being free-form will be developed. In order to manufacture such a high-accuracy optical element, a shape measurement method with guaranteed accuracy and sufficient repeatability is necessary. In this talk, we will propose a noncontact sub-nanometer shape measurement system for tracking the normal vector of the sample surface based on light straightness. When several shapes of optical surface was three-dimensionally measured. This experiment proved that measurement repeatability of sub-nanometer can be obtained.

### SHORT BIO:

Katsuyoshi Endo is the Director of Ultra Precision Science Research Center, Graduate School of Engineering, Osaka University. He completed Master Degree in Precision Engineering, Graduate School of Engineering, Osaka University at 1982. From 1982 to 1986, he was an assistant professor at Department of Precision Engineering, Faculty of Engineering, Kanazawa University. He was a professor in Osaka University at 2001. He is the vice-president of Japan Society of Precision Engineering.