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Preliminary of spindle axial and angular motions measurement using plane mirror interferometer

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The industrial processes for high-precision engineering and metrology require the fine quality control of products. The precision of rotary spindle is also required to enhance the accuracy of spindle motions to the nanometer and sub-μradian levels. Spindle measurements by conventional methods will have contributions from the spindle motion error and the form error of the target artifact. In the conventional methods to measure axial and angular motions, a complicated artifact is required. Small volume artifact is favorable from the viewpoint of the accurate and practical measurement. This paper describes a method of spindle axial and angular motions using plane mirror interferometer. In the method, the plane mirror is a reference artifact, and it is installed on top of the spindle of interest. Three optical sensors are fixed above the plane mirror to observe the proper positions of the mirror. The optical sensor consists of a laser as a light source, and an interferometer. The interferometer observes an interference fringe between a reflection light form a fixed mirror and a reflection light from the plane mirror for vertical displacement measurement. Using three optical sensors, three vertical displacements of the mirror can be measured. From these measured displacements, axial and angular motions of the mirror, i.e. the spindle, can be calculated concurrently. In the paper, a measurement principle, instrumentation and experimental results are discussed.

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