On-machine, In-process Strobo-stereoscopy for Spatially Resolved 3D Surface Profiling of Rotating Part

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This paper introduces a new vision-based imaging technique for three-dimensional (3D) surface profiling of the rotating part by on-machine, in-process strobo-stereoscopy (SS) for rough surface targets and florescence-strobo-stereoscopy (FSS) for smooth surface targets. SS and FSS combine stroboscopy and stereoscopy, and enable in-process 3D imaging by synchronizing the illumination system and rotating system at a certain speed. The encoder outputs of the rotating system were feedback for the illumination system to control the light sources. To scan a whole surface area of the target, the phase of the illumination system was shifted at a constant degree interval, and the collected images were reconstructed and stitched in real-time to obtain the full view image. To achieve a high spatial resolution of 3D images, a feature-selective segmentation method that adaptively classifies and segments the features from the 3D images was applied. A whole imaging system combining SS, FSS, and feature-selective segmentation algorithm effectively recognized the desired structures and patterns with high spatial resolution while the machined part was rotating. Further, with the development of micro-stereoscopic technique combined with stroboscopy and an imaging processing method, and random feature classification, it can be applied for surface defects inspection on freeform-based structures. Also, the use of high-speed, high-resolution imaging systems will further improve the axial and spatial resolutions of the 3D images, extending the measurement capability for high-speed, on-machine, in-process surface profiling.

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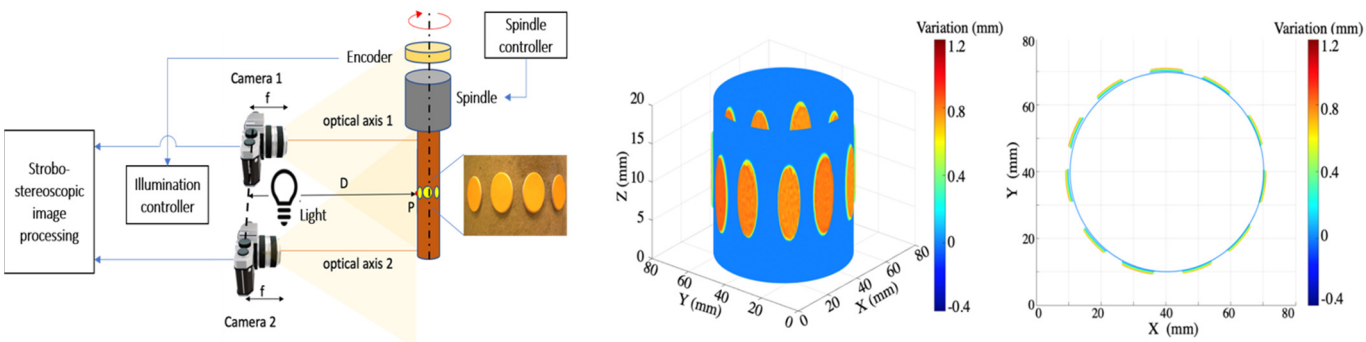

Fig. 1 The proposed 3D imaging systems (Left) and the recontructed images (Right)