Flexible interferometric form measurement

with multiple light sources

A.F. Müller[1], C. Falldorf[1], R.B. Bergmann[1,2]

[1]BIAS - Bremer Institut für angewandte Strahltechnik GmbH, Klagenfurter Str. 5, 28359 Bremen, Germany

[2]University of Bremen, Faculty Physics and Electrical Engineering and MAPEX, 28359 Bremen, Germany

amueller@bias.de

Abstract

Multiple Aperture Shear-Interferometry (MArS) is a form measurement technique for aspheres and freeform surfaces which combines the large illumination aperture and flexibility of geometric-optical methods such as deflectometry with the high precision of interferometric methods. It overcomes problems associated with limited observation apertures of conventional interferometric techniques by measuring overlapping subapertures of multi-spot LED illumination simultaneously. The multi-spot illumination enables a flexible full-field measurement of complex surfaces such as aspheres and freeforms since the illumination does not have to be adjusted over a wide range of specimen.

Using shear interferometry, MArS utilizes the mutual coherence function as the primary measurand, which is still well defined for the superposition of independent wave fields. From the mutual coherence function MArS obtains wave vector distributions which are assigned rays that were reflected by the specimen. Based on the ray distributions we reconstruct the surface topography of the specimen using an inverse ray tracing approach and prior knowledge about the individual source locations.

The determination of the light source position is integral in improving the measurement uncertainty of MArS. We thus present the measurement of the light source positions using a known reference surface as the specimen as well as external measurement of the light sources using fringe projection which introduces unambiguity in the absolute distance between light sources and measurement plane. Additionally, we present a review of the measurement principle of MArS and the inverse ray tracer as well as several applications of MArS, including the topographic measurement of two aspheric lenses with different global curvature radii measured with the same identical reflection setup. Furthermore, we examine the achievable accuracy of the wave vector measurement using a single light source to find physical limits of MArS.

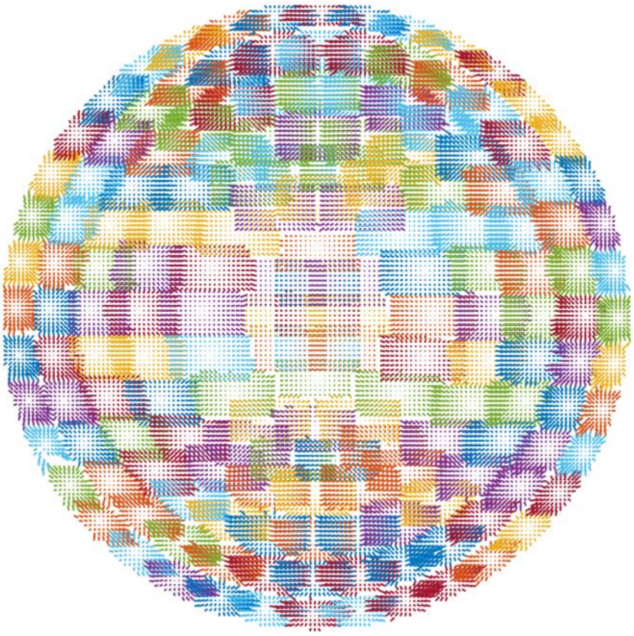

Figure 1: Measured wave vectors from multiple independent wave fields