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Linear Error Elimination Procedure for 2D stitching metrology

We present a new 2D stitching method that effectively removes the systematic errors introduced by the reference flat, as well as any other additive measurement error constant across the sub-aperture measurements. This method, referred to as Linear Error Elimination Procedure (LEEP), can provide the two-dimensional error map for a wide range of X-Ray mirror lengths and figures, with sub-nanometer accuracy and lateral resolution well below the millimeter. We discuss the main features of LEEP, including the conditions required for the measurement routine. A main condition is that the scan trajectory along the surface under test must be two-dimensional, i.e. not a straight line, in order to allow for 2D reconstruction. In addition, it must have a non-constant stitching step, to avoid periodic errors in the reconstructed surface. We will prove that, in order to determine the curvature and twist of the surface under test, one can track the orientation of the interferometer at every step. We provide experimental results that show the effective error suppression by means of the proposed method, applied to several mirrors, and that allow estimating the systematic errors with a repeatability of 40 picometers.

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