Capability verification of the measurement with a large-range nanopositioning stage

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Abstract

The NanoPla is a large-range nanopositioning stage which is intended for the metrological characterization of large surfaces at a submicrometre scale. The NanoPla consists of three main layers, an inferior and a superior base that are fixed, and a moving platform that is placed in the middle. In metrological applications, the measuring instrument is attached to the moving platform, while the sample is placed at the sample holder of a commercial piezo stage fixed to the inferior base. In this work, the metrological instrument is a confocal sensor. The moving platform is levitated by three airbearings and performs frictionless planar motion along a range of 50 mm × 50 mm. Four Hallbach linear motors are used as actuators, while a 2D laser system measures the position of the moving platform in the XY-plane. Spurious displacements of the moving platform in Z-axis and rotations around X and Y-axes are measured by three capacitive sensors, and, then, corrected in the final measurement.

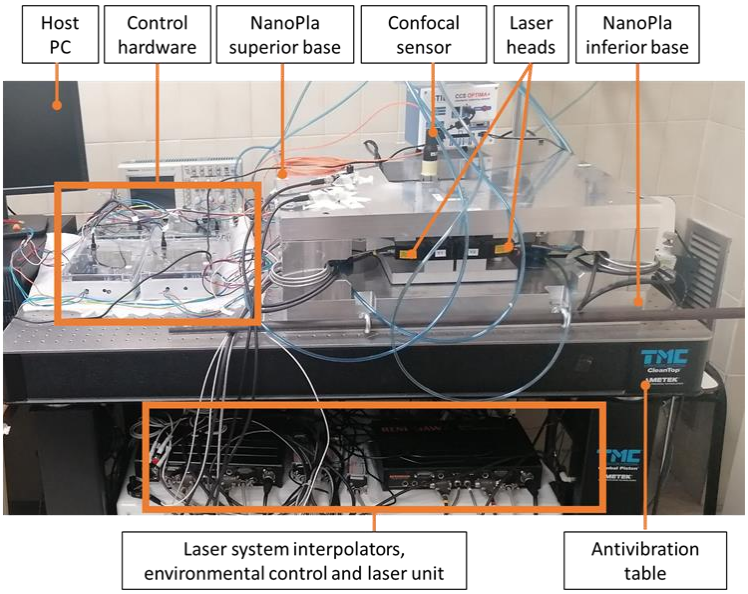

Figure 1: Picture of the NanoPla real setup.

In this work, the measurement capability of the NanoPla is experimentally verified by measuring a 2000-µm step standard with the confocal sensor integrated in the NanoPla and comparing its results with the calibration certificate of the standard, and with the measurements of other metrology

systems: the confocal sensor integrated in an external setup and a focus variation microscope from Alicona. The step is measured according to the ISO 25178-70:2014 standard. Figure 2 shows the measuring results and the corresponding expanded uncertainties of each system. The expanded uncertainties of the measurements in the three systems are calculated according to the ISO 15530-3:2011 standard. As shown, there is a satisfactory agreement between the results. In addition, it is proven that the compensation of the spurious motions measured by the capacitive sensors do not increase significantly the NanoPla measuring uncertainty.

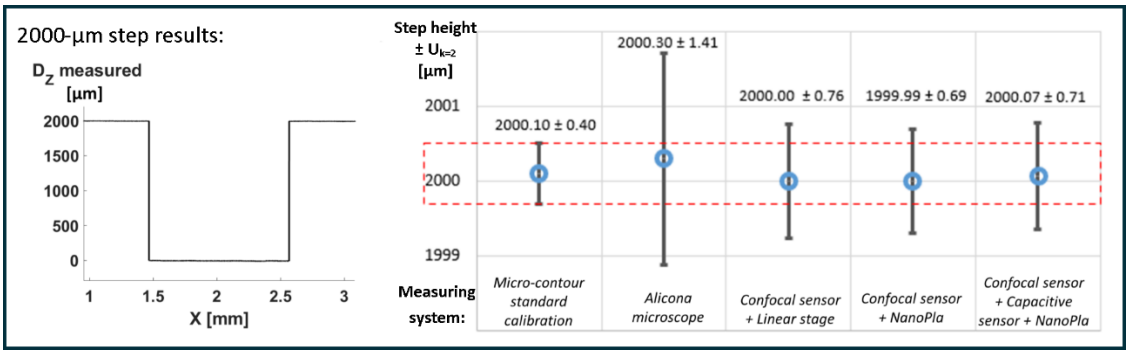

Figure 2: Experimental results and expanded uncertainty for the measurement of a 2000-µm step.