USING THE SLOPE MEASURING PROFILER TO OPTIMIZE THE SHAPE OF ADAPTIVE BIMORPH OPTICS

S. G. Alcock, K. J. S. Sawhney, C. Nicklin, and T. Arnold.
Diamond Light Source Ltd, Harwell Science & Innovation Campus, OX11 0DE, Oxfordshire, United Kingdom.
R. Signorato.
ACCEL Instruments GmbH, Friedrich-Ebert-Str. 1, D-51429 Bergisch Gladbach, Germany.

A suite of four, high precision instruments [1] are used in the temperature controlled, Optics & Metrology cleanroom, to characterize the surface topography of synchrotron optics before they are installed and used on the beamlines at Diamond Light Source (DLS). One such instrument is the Slope Measuring Profiler (SMP), inspired by the "NOM" machine [2] and designed in collaboration with staff from the BESSY synchrotron. The SMP is a non-contact instrument, which utilizes a high grade pentaprism, and computer controlled air bearing stages, to scan a narrow beam of visible light across the surface under test. An electronic autocollimation telescope measures the angular deviation of the light reflected from the surface under test. Height information, with nanometre scale resolution, is extracted by integrating the angular slope data over the entire 2D surface of the optic. Optics, and associated mechanics, up to 1.5m in length and weighing hundreds of kilograms, can be mounted on the SMP. Lateral spatial errors in the range of 1mm to 1500mm are obtained by operating in "flyscan" (continuous) or "step scan" (discrete) mode. Slope errors <0.3μrad r.m.s have been routinely measured using the SMP, and repeatability (the angular difference between two similar scans, separated by a period of ~40 hours) has been recorded at 68nrad r.m.s (see Figure 1). Further technical details about the performance of the SMP, and the stability of its environment, will be presented. The SMP has now successfully measured numerous synchrotron optics, and we will show how the SMP was used to characterize a vertically focusing, thirty two piezo element, bimorph optic [3], purchased from ACCEL GmbH. This bimorph optic, and associated high voltage power supply, will be installed on the "Surfaces and Interfaces" (I07) beamline at DLS. An iterative, correction matrix algorithm, developed by R. Signorato & staff at the Elettra synchrotron, was employed, whilst the SMP actively monitored the shape, stability, and repeatability of the bimorph optic. Using this technique, the r.m.s tangential height error, over the 550mm active surface, was reduced from 83.7nm to 9.5nm; the corresponding r.m.s slope error was minimized from 1.54μrad to 0.6μrad.

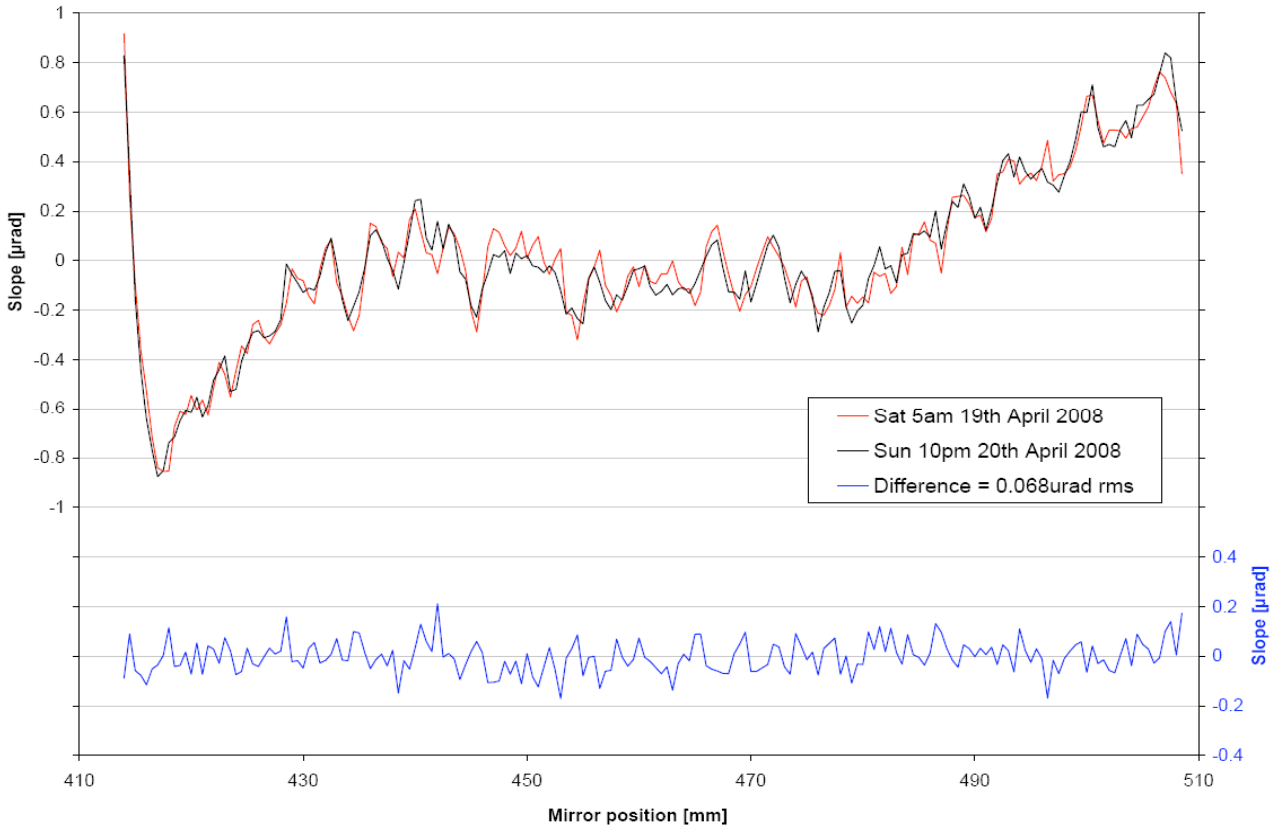

Figure 1: The repeatability of the DLS Slope Measuring Profiler

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References

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Corresponding author: simon.alcock@diamond.ac.uk