

ADAPTIVE OPTICS AND WAVEFRONT CONTROL IN THE HARD X-RAY DOMAIN - PAST, PRESENT AND FUTURE

R. Signorato

ACCEL instruments, Friedrich-Ebert Strasse 1, Bergisch-Gladbach, GERMANY.

Since their first presentation at SRI 1997 in Himeji, Japan, modular bimorph mirrors have undergone a complete upgrading and characterization program and have nowadays become an established, proven and reliable device, being currently used at all major third generation SR sources worldwide. More than 50 such mirrors have been built and the majority of them are already routinely used at beamlines in users service mode. The available optical lengths range from 150 mm up to 1000 mm and focusing lengths from hundred of mm to tens of meters are already implemented.

A customized, dedicated, high stability High Voltage Bipolar Power Supply system has been designed and built in collaboration with ELETTRA and is currently routinely used at several beamlines. An user-friendly GUI allows simple, reliable and safe operation of the adaptive mirrors and also offers the possibility to interface to the beamline control system via EPICS or TANGO..

This overview talk will review the main results obtained by several different users of bimorph mirrors and will report examples of adaptive wavefront correction in the hard X-ray regime. I will report experimental data showing how bimorph mirrors can be uniquely used not only to optimize the beam focusing and the Strehl ratio, but also the X-ray beam properties outside of the focal plane. It has been proven that the effect of striations (intensity modulations) in the measured beam profile can be strongly reduced, if not totally eliminated, by a proper setting of the adaptive mirror. This unique capability of bimorph mirrors has proven to be of uttermost interest to operate X-ray beamlines either with variable focal spot size or to perform experiments where the sample may be located far from the mirrors focus.

I will also briefly report experimental results showing demonstrating the possibility to perform the focusing/wavefront optimization procedure of the adaptive mirrors by using a simple Beam Position Monitor, a set of slits and a correction algorithm based on the use of the interaction/control matrix of the (mirror + photon beam) system. This straightforward process can be simply automated and is of great help in optimizing the beamline performances while making full use of the powerful capabilities offered by the adaptive bimorph mirrors hardware.

Finally, some possible R&D strategies for the near future involving both the mirror hardware/software and the substrate polishing will be outlined.

References

- [1] R. Signorato, O. Hignette, J. Goulon “*Multi-segmented piezoelectric mirrors as active/adaptive optics components*”, Journal of Synchrotron radiation **5**, pp 797 - 800, 1998

Dr. Riccardo Signorato
Email: signorato@accel.de