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Optimal use of LTP or Interferometer Data for the Adjustment of Bendable Mirrors

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We report on a new fast and effective method for the precise adjustments of bendable mirrors to achieve an optimal elliptical figure for synchrotron radiation applications. The bendable mirrors are of the type having independent upstream and downstream bend mechanisms attached to the mirror ends. The method uses long spatial wavelength data from Long Trace Profilers or standard Fizeau interferometers. The procedure allows for a significant decrease in the total number of sequential adjustments required to precisely tune a mirror to the desired shape – usually an ellipse.. Previous methods in our lab fitted a measured mirror shape, which varied as the adjustment sequence proceeded, to the desired tangential ellipse. The trace of the shape error was used to predict by eye, the settings for the next tune of the mirror bending mechanisms. Such a procedure could easily require many dozens of sequential adjustments before the appropriate shape was obtained. Such multiple measurements could take a whole day; the aim of this new method is to reduce this time. The new method makes use of the significant independence of the two bending mechanisms, where one end bender mainly effects the curvature of the adjoined part of the mirror. In this method, the calculated desired ellipse is subdivided into three regions and the best-fit values of curvature of these regions are found. In the course of the mirror adjustments, the current values of the mirror curvature for the same regions are extracted from the measured trace and are separately compared with the corresponding desired values. This comparison, based on the radius of curvature for the total tangential length, and on the 3 sub-regions, allows swift and certain adjustment of the bendable mirror in just a few iterations. In order to predict the next setting of a bender, the dependence (usually linear) of curvature of the bender adjoined region on the bender setting is found and extrapolated to the desired curvature. As a crosscheck, a deterministic ray trace using the same experimental slope or height data confirms the rapid convergence of the method of adjustment, and predicts the final result that will be obtained on the beamline. An example of a KB mirror which achieved ~1 micron focusing at the ALS is presented. The code is written in easily transportable IDL [1] and inputs ASCII data output from the metrology tool. We expect to make the software generally available for use at other facilities as requested.

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[1] IDL – RSI, Boulder, CO, USA. (http://www.rsinc.com/idl)

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