Development and Characterization of Fast Deformable Mirrors: A Control Model using the Influence Function (IF) Approach

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Introduction

Adaptive Optics (AO) systems often incorporate deformable mirrors (DM) for dynamic phase distortion compensation of optical wavefronts transmitted through the atmosphere. When fast (~ 10 μs) convergence is required, "closed-loop" approaches are often not applicable. In contrast, by an "open-loop" approach high operation bandwidth could be achieved if accurate WF measurements, data transfer, and *exact control* of the DM response are fulfilled. In this report, a DM control model based on the influence function (IF) approach for hexagonally arranged 61 piezo-actuator (PA) DM will be described theoretically for "open-loop" applications. Two model cases with- and without crosstalk between the neighboring PAs in the DM will be discussed. Experimental verification of the DM "open-loop" operation control using the IF approach will be presented for a home-made, 19PA DM.

Results

We have experimentally determined the IFs for 19 PAs and incorporated them into an influence matrix ***M***. An experimental setup for performance characteristics of the 19PA DM (Fig. 1) was constructed. The DM surface shape was characterized by the ZYGO interferometer (Fig. 1(c)). Some selected results are presented in Fig. 1 (right panel). It is experimentally demonstrated that when the crosstalk between the neighboring PAs is not negligible, it must be taken into consideration for successful control and operation of the real DM.

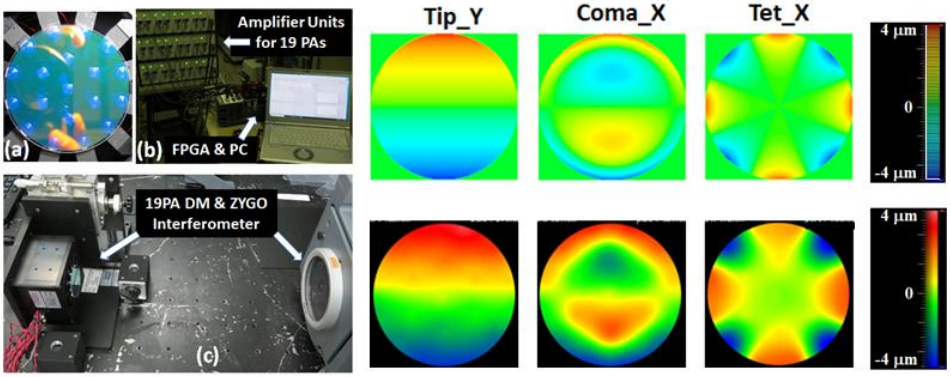

Fig. 1. (a) 19PA DM; (b) FPGA system; (c) DM & interferometer (right) calcul. (top) vs. meas. (bottom) WFs.

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