Co-phasing of Segmented Mirrors Using the Dispersed Fringe Sensor

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Abstract

The segmented mirror technology is being extensively used these days to have telescopes with large primary mirrors. In order to achieve the desired resolution, equivalent to that of a monolithic mirror, it is important to align each of the segments very precisely to the order of small fractions of the observing wavelength. The co-phasing of segments deals with the removal of piston errors. The Dispersed Fringe Sensor (DFS) is a phasing technique in which the broad band light is sampled from the inter-segment regions and then a dispersive element is used to get a spectra on the detector plane. In presence of the piston error, this spectra is modulated by fringes. The periodicity and tilt of these DFS fringes can be directly related to the piston errors. Due to its large measurement range, DFS is conventionally used as a coarse phasing technique (piston errors$> \lambda/2$). However, by making use of the Dispersed Fringe Accumulation based Left Subtract Right (DFA-LSR) method, DFS can be used for fine piston measurements as well. We have developed a python-based simulation code which can generate realistic DFS fringe images for the telescope + alignment and phasing system. Through our simulations and lab experiments, we have tried to use the DFS for fine piston measuremnts. A piston measurement accuracy of 2-3nm was obtained in the lab experiments.

Keywords: Phasing, Segmented mirrors, Alignment, Dispersed Fringe Sensor

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