Simulated Adaptive Optics Correction of Phase Errors Caused by the Segmented Primary Mirror of Large Telescopes

Donald Cox

Jet Propulsion Laboratory
Senior Scientist Advisor: Mitchell Troy
Home Institution: California State Polytechnic University, Pomona

The residual aberrations of the 10-meter Keck Telescopes after correction by an adaptive optics (AO) system are determined via simulation. The ability of the AO deformable mirror to fix various spatial frequency errors under static conditions is simulated by applying a phase filter to a high-spatial frequency phase map of the measured Keck segmented primary mirror phase errors. A simulation was designed in C++ using the Arroyo Library (developed by Matthew Britton of Caltech) to correct for residual errors. While the gray pixel approximation (developed by Mitchell Troy of Jet Propulsion Laboratory) was used to model the segment gaps. Three types of errors were studied: the initial tip/tilt and piston alignment of the segments, segment aberrations, and misalignment by the segment control system. The implementation of the simulation shows the deformable mirror can perform reasonable improvement on all three types of segment errors and thus improve the image peak intensity. These results will help in understanding the current Keck AO system performance and in planning the next generation of AO systems.