Single Star SCIDAR: Atmospheric parameters profiling using the power spectrum of scintillation.

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Abstract

Optical parameters of atmospheric turbulence have a significant impact on high angular resolution, adaptive optics, and site testing. The single star SCIDAR technique provides vertical profiles of these parameters, including the refractive index structure constant Cn 2 (h). Its is based on the analysis of single stars scintillation. This study introduces a new approach for real-time measurement of atmospheric parameters using the Single Star SCIDAR. The key element of this approach is the utilization of a modified power spectrum of atmospheric speckles, that have more significant variation with altitude. By using that modified power spectrum, an objective function is computed, and the minimization process is performed using the Active-Set algorithm. With this approach, we successfully obtained real-time vertical profiles of Cn 2(h) with good accuracy. The processing takes approximately 3 seconds per profile, and the recovery rate (i.e. sum of Cn 2(h)) is about 95%. The reliability of this approach is validated through simulation results and a comparison with data obtained from sounding balloons. These validations confirm the accuracy and credibility of this method, which can be useful in many practical applications.

Keywords: atmospheric effects, site testing, techniques: image processing, methods: numerical.

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