Atmospheric outer scale models: a mathematical analysis and a comparison on adaptative optics telematry data

Sebastian Barrientos*[1,2], Clémentine Béchet[1,3], and Alberto Mercado[1,2]

[1]ACIP Millennium Nucleus – Chile
[2]Universidad Tecnica Federico Santa Maria – Chile
[3]Centre de Recherche Astrophysique de Lyon – École Normale Supérieure - Lyon, Université Claude Bernard Lyon 1, Institut National des Sciences de l'Univers, Centre National de la Recherche Scientifique, Institut national des sciences de lÚnivers, Institut national des sciences de lÚnivers, Institut national des sciences de lÚnivers, Institut national des sciences de lÚnivers, Institut national des sciences de lÚnivers, Institut national des sciences de lÚnivers, Institut national des sciences de lÚnivers, Institut national des sciences de lÚnivers – France

Abstract

In adaptive optics, to compensate for the distortion effects introduced along the propagation path between a light source and a receiver (telescope lens), it is important to estimate certain optical parameters of the turbulence, such as the outer scale L_0 and Fried's parameter r_0. The outer scale L_0 is however a model-dependent variable.

In this work, a theoretical analysis of the mathematical derivation and a comparison of the puntual covariances and the covariances of the arrival angles averaged over square apertures of finite size (called general) for each of the spectral models considered: Von Karmán, Greenwood, Exponential and the classical Kolmogorov model. An important difference between these covariances is that the general covariance has an associated validity limit depending on the external scale and the diameter of the apertures.

On the other hand, an empirical analysis has been carried out by fitting the theoretical models to data obtained from the telemetry of the Paranal AOF system. Empirical cross-sectional and longitudinal covariances are obtained from the AOF telemetry slope measurements. By fitting this set of empirical covariances we seek to estimate the turbulence parameters (r_0, L_0), the measurement error, $\sigma\_e, and the TT contribution of the laser guide star jitter, \sigma\_\{s\_\phi\}. The aim is therefore to determine which model provides the b$

$In conclusion, from the theoretical study it is possible to find an analytical solution for the puntual and general covariances fo$

$From the study of the data, the Von Karmán and Greenwood models on the exponential and the Kolmogorov model are of partic$

Keywords: Spectral models, Covariances, arrival angles, optics telematry data

*Speaker