

Developing Predictive Wavefront Control at Keck II: Kalman Filtering for Tip-Tilt Correction

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Abstract

1 Tip-Tilt Correction

The tip and tilt modes of optical aberrations are the

2 The Kalman Filter

Kalman filtering is a method to obtain the optimal linear state estimate of a dynamic system. It combines a physical estimate of the system state with noisy measurements that are linear in the state to obtain the state estimate having the minimum mean-squared error at any given time.

Consider a discrete-time dynamic system with a state-transition rule

$$\vec{x}[k+1] = A[k]\vec{x}[k] + \vec{w}[k] \quad (1)$$

with $w[k]$ white noise. The impact of the white noise on the state prediction can be captured in a state covariance matrix P , with state-transition rule

$$P[k+1] = A[k]P[k]A[k]^T + Q[k] \quad (2)$$

where $Q[k]$ is a matrix describing the process noise. Suppose

3 System Identification

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4 Dual Kalman-Filter Fitting

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