Phase stability of photoreceivers in intersatellite laser interferometers

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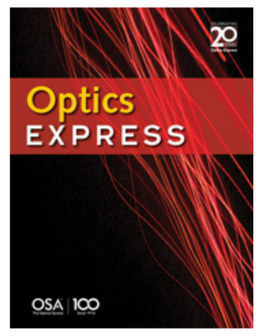

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Abstract

A photoreceiver (PR) is required for the opto-electrical conversion of signals in intersatellite laser interferometers. Noise sources that originate or couple in the PR reduce the system carrier-to-noise-density, which is often represented by its phase noise density. In this work, we analyze the common noise sources in a PR used for space-based interferometry. Additionally, we present the results from the characterization of the PRs in GRACE-FO, a mission which will pioneer intersatellite laser interferometry. The estimated phase noise is shot-noise limited at 10^{-4} rad/Hz$^{1/2}$ down to 10^{-2} Hz, almost 4 orders of magnitude below the instrument top level requirement (0.5 rad/Hz$^{1/2}$). Below 10^{-2} Hz, the PR finite phase response noise dominates but the levels still comply with the instrument requirement. The sub-mHz noise levels and the PR electronic noise have been identified as key design factors for the LISA PR.

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