On Path Feed Forward Performance of an Astrometric 3-BL Interferometer Test Bed (STB-3): Mitigating Atmospheric Effects

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Poster Presentation

BIOGRAPHY

Oscar S. Alvarez-Salazar (Ph.D. Electrical-Engineering, UCLA, 1999) joined TRW in 1990 where he conducted R&D work in Smart/Active Systems. In 1994 he was awarded the UCLA Regents and the TRW Doctoral Fellowships. In 1995 he joined UCLA's FSRC as PI of a joint 3-year flight program with NASA-Dryden to investigate on-board gust monitoring via laser-beam scattering. Dr. Alvarez-Salazar is currently with TRW on assignment at JPL (SIM/STB-3).

ABSTRACT

The Space Interferometry Mission's (SIM) 3-baseline astrometric interferometer System Test Bed 3 (STB-3) has been constructed at JPL. STB-3's objective was to use two of its three interferometers (guides) to track changes in the optical path difference (OPD) of the third interferometer (science). This *open loop fringe tracking* approach - being proposed for the first time in the context of space based observatories – is needed given the dim nature of stars to be observed by SIM.

In the STB-3 lab environment, OPD variations are mostly due to the induced rigid body motion of the test bed relative to a pseudo-star, with the inevitable exception of atmospheric fluctuations. OPD changes tracked by the guide interferometers are fed forward to the science interferometer active delay line to keep the OPD within fractions of a wavelength of its central fringe. Since OPD changes due to atmospheric fluctuations are random and not correlated between the three interferometers, the variance of these fluctuations must be reduced so that the noise floor of the science interferometer OPD fluctuations during path feed forward (PFF) tests may also be reduced. The OPD rejection level that is required for STB-3 using PFF in the atmosphere is greater than 50 dB (nm^2/Hz) below 1 Hz. In fact, SIM needs at least 80 dB in space. If the noise floor is too high, the true performance of the instrument may not be observed or improved. In this paper, we discuss the consequences of not reducing the variance of atmospheric fluctuations in the lab, the effects of residual atmospheric fluctuations on PFF performance, and the steps taken to successfully mitigate atmospheric fluctuations and attain better than 50 dB of OPD rejection.

KEY WORDS: Interferometry, atmospherics, real-time control, testbed

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