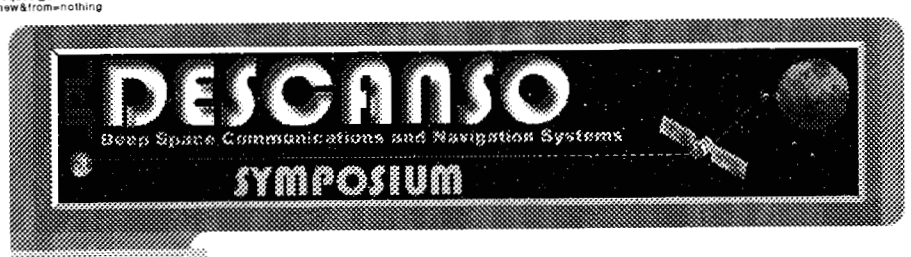

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Topic:
Challenges in Earth/Deep-Space Optical Communication

Abstract:
Optical telecommunications is expected to be an important technological capability in Earth-to-space communication in the next decade. New and interesting challenges must be met. The performance of an Earth-space optical telecommunications link is limited by currently-available optical power and, more fundamentally, by distortion (scintillation and tilt) of the beam as it propagates through the turbulent atmosphere. We discuss here two methods to meet these challenges. First, with respect to errors on an uplink, uncorrected scintillation and tilt errors will severely degrade an optical uplink. Conventional approaches to correct distortions based on natural or artificial guide stars, which are useful in. e.g., astronomical imaging, have practical difficulties or are not appropriate to correct the distortions important for Earth-to-deep- space optical links. We outline a beam-relay approach to address this problem: a downward-directed laser near an orbiting relay mirror provides a reference source for measuring and correcting atmospheric distortion. The ground station pre-processes its uplink communications beam such that, after passage through the atmosphere, uplink propagation effects are removed, delivering a diffraction limited beam to the mirror. The orbiting mirror then directs the corrected beam to the distant spacecraft. Second, small space probes will necessarily be power (thus telecommunications range/bandwidth) limited. We propose to overcome this limitation through the use of a network of space-based relay stations. If many small probes were deployed in the solar system, each would not need to have its own long-range optical communication system: they could communicate with a network whereby signals are redundantly relayed from the probes to the earth. Reference: Armstrong, Yeh, and Wilson, Optics Letters, 23, 1087-1089 (1998)

Keywords:
optical communications

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