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SCINTILLATION MODEL OF LASER BEAM PROPAGATION IN SATELLITE-TO-GROUND ATMOSPHERIC LINKS

Abstract

This paper discusses a scintillation model of laser beam propagation in satellite-to-ground atmospheric links. The frequency characteristics of the downlink are theoretically derived based on the results measured in a low earth orbit (LEO) satellite-to-ground laser communications experiments. The speckle patterns were averaged and the frequency response of the received optical signal was filtered by the telescope aperture. The parameters are compared and fitted to the measured results. The proposed model can generate time-varying optical signals based on the von Karman spectrum for space-to-ground laser links. The scintillation index is estimated based on the modified Hufnagel-Valley (HV) model which is newly obtained by the real measurements. The probability density function is fitted by the estimated scintillation index and compared to the gamma-gamma distribution under strong turbulence. The simulated results are presented in this paper. The proposed scintillation model can contribute to the fading simulation of satellite-to-ground communication links as well as the standardization such as the Consultative Committee for Space Data Systems (CCSDS) in the future.