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Simulation of Spatial Correlation of Polarization Characteristics for Meteor Radio Reflections

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Abstract

The paper relates to a spatial correlation of polarization characteristics of radio waves scattered from ionized meteor trails. The accurate modeling of polarization of meteor radio reflections is achieved through a separate consideration of oblique diffraction on meteor trails of both the longitudinal and the transverse components of the electric field of incident radio waves. The Faraday polarization twist due to propagation in the ionosphere is also taken into account. By a computer simulation of two typical meteor radio links, we assess a correlation between the polarizations of the radio reflections received at two separate antennas spaced at various distances and along various azimuth directions. It is shown that, in some cases, a coherence radius of the polarization characteristics may exceed 100 km, and its main limiting factor is an inhomogeneity of scattering properties along the meteor trail. The obtained spatial correlation curves are crucial for assessing secrecy of the shared encryption keys generated from the measurements of random polarizations of meteor radio reflections. Our estimates reveal a certain vulnerability of the polarization-based key generation systems to the channel eavesdropping.

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Keywords

correlation, diffraction, encryption key, meteor burst communication, meteor trails, physical layer security, polarization, space-diversity radio reception

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