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On the dynamics of nonreciprocal properties of radio reflections from ionized meteor trails

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Abstract

© 2017 IEEE. Meteor burst propagation is based on scattering of radio waves of the meter range from the ionized trails left by fast meteor particles burning at the altitudes of 80-110 km. An interaction between radio wave and the meteor trail is a complex non-stationary process, which is determined by the polarization phenomena at the transmission, propagation, diffraction on the trail, and reception of the wave. These phenomena lead to non-Absolute reciprocity of the radio link both on amplitude and carrier phase. Scattering properties of the meteor trail and associated level of channel nonreciprocity have strong time dependence due to active expansion of the trail. The knowledge of such dependence would be crucial in predicting the moment of minimum channel nonreciprocity. This is particularly important for the implementation of meteor synchronization systems of nanosecond precision and meteor key distribution systems as all these systems rely on reciprocal properties of the channel. Based on a rigorous solution to the problem of oblique diffraction of radio wave on meteor trail, we simulate typical profiles of the dynamics of amplitude and phase nonreciprocity during a single meteor radio reflection. The results on correlation between the dynamics of amplitude nonreciprocity and dynamics of phase nonreciprocity of meteor burst channel are also presented.

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Keywords

Diffraction of radio waves, Meteor burst propagation, Meteor radio reflection, Nonreciprocity of radio propagation

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