IEEE Transactions on Antennas and Propagation 2017 vol.65 N4, pages 2009-2019

Analysis and Simulation of Channel Nonreciprocity in Meteor-Burst Communications

Sulimov A., Karpov A., Lapshina I., Khuzyashev R.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 1963-2012 IEEE. This paper addresses the problem of nonreciprocity of propagation conditions in meteor-burst communication systems (MBCSs). In prior publications, this problem has not gained appropriate attention. The channel nonreciprocity may have a significant impact on such advanced communication systems as meteor synchronization systems with nanosecond precision and meteor key distribution systems intended to securely create two identical copies of a shared secret key at both channel sides. These systems are based on the processing of phase characteristics of meteor radio reflections that need to be accurately modeled. We propose a new MBCS simulation model that is based on a rigorous solution to the problem of oblique diffraction of radio waves on ionized meteor trails. Our diffraction approach allows more accurate simulation of the amplitude and phase characteristics of oppositely propagating signals that makes possible detailed investigation of the channel nonreciprocity effects. Using this approach, we present some preliminary simulation results on the channel nonreciprocity at meteor-burst propagation that prove satisfactory immunity of MBCS to ionospheric disturbances even while operating in severe conditions of polar regions.

http://dx.doi.org/10.1109/TAP.2017.2669730

Keywords

Diffraction of radio waves, meteor-burst communications, nonreciprocal wave propagation, radio propagation

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