



Session

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Ionospheric Scintillation and Potential Techniques for Its Mitigation

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Abstract

Ionospheric scintillation is a major space weather impact on transionospheric RF propagation, especially in the equatorial region which spans much of the land mass of Latin America. Upon passage through ionospheric irregularities of 10's to 100's of meters in size, RF wavefronts from a distant transmitter become distorted in phase, and then eventually in both phase and amplitude, resulting in large fluctuations in signal strength at the receiver on the other side of the ionosphere. Scintillation occurs primarily as a spatial pattern, but due to the motion of the ionosphere and/or transmitter or receiver, it is experienced as a time series of signal amplitude and phase fluctuations, typically on time scales of a few seconds, although average power is preserved.

A number of efforts have been made to forecast and detect regions of scintillation, to facilitate avoidance, but few have attempted to exploit the physics of the phenomenon to mitigate or correct for the signal fluctuations. Spatial diversity, on either or both the transmit or receive sides is one possibility, although the required sizes are prohibitive. Frequency diversity is more amenable to realistic RF antennas and hardware, but faces spectrum management challenges.

In recent years, optical and laser microscopy techniques in the medical field have successfully addressed problems of propagating wavefronts through highly scattering media such as human skin. In particular, "diffraction free" optical beams also tend to be resistant to scatter by phase and/or amplitude objects.

While many of these techniques fall into the "spatial diversity" category, and are therefore not readily adaptable to RF applications, some have time-domain analogs that might prove useful. In light of typical optical devices being inherently "spatially diverse," while RF systems are typically "coherent," we will discuss several optical "wavefront repair" techniques which could potentially be applied to mitigation of ionospheric scintillation.

Scientific Session: Ionosphere and Upper Atmosphere

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