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Characterization of the Ionospheric Scintillations at High Latitude Using GPS Signal

Abstract:
Transionospheric radio signals experience both amplitude and phase variations as a result of propagation through a turbulent ionosphere; this phenomenon is known as ionospheric scintillations. As a result of these fluctuations, GPS receivers lose track of signals and consequently induce position and navigational errors. Therefore, there is a need to study these scintillations and their causes in order to not only resolve the navigational problem but in addition develop analytical and numerical radio propagation models.

In order to quantify and qualify these scintillations, we analyze the probability distribution functions (PDFs) of L1 GPS signals at 50 Hz sampling rate using the Canadian High arctic Ionospheric Network (CHAIN) measurements. The Raw signal is detrended using a wavelet-based technique and the detrended amplitude and phase of the signal are used to construct probability distribution functions (PDFs) of the scintillating signal. The resulting PDFs are non-Gaussian. From the PDF functional fits, the moments are estimated. The calculated higher-order moments of the amplitude and phase distribution functions will help quantify some of the scintillation characteristics and in the process provide a base for forecasting, i.e. develop a scintillation climatology model. This statistical analysis, including power spectra, along with a numerical simulation will constitute the backbone of a high latitude scintillation model.