IONOSPHERIC SCINTILLATION INCIDENCE PROBABILITY FOR DIFFERENT LEVELS OF SOLAR AND MAGNETIC ACTIVITIES OVER BRAZILIAN TERRITORY

Felipe Pellegrini Hernandez[1], Alison de Oliveira Moraes[2,4], Eurico R. de Paula[3], Waldecir Perrella[4]

1- EMBRAER, Brazilian Aeronautics Company, São José dos Campos, SP
2- IAE, Institute of Aeronautics and Space, São José dos Campos, SP
3- INPE, National Institute for Space Research, São José dos Campos, SP
4- ITA, Institute Technological of Aeronautics , São José dos Campos, SP

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Abstract

The navigation and Positioning using satellite became essential in many areas, for instance in the terrestrial navigation, precise agriculture, aircraft landing, no manned aircraft control, petroleum prospection, between many other applications. Many factors can affect the performance of these navigation systems, like inclement weather, multipath, the troposphere, the ionosphere and even jammings. These interferences, depending of their severity intensity can degrade the positioning systems and even to interrupt the navigation, what can eventually affect one substantial number of users.

Between the sources of positioning errors using GPS, the ionosphere in the Brazilian territory is probably the most important factor that has influence over the positioning. The ionosphere causes delays and advances in the carrier and code signal, that result in pseudorange errors. Besides those effects, the GPS signal, when crossing the ionospheric bubbles with depleted densitites, suffers variations in the amplitude and phase, what is named ionospheric scintillation. The scintillation affects the receiver performance through signal distortions that produce positioning errors or in extreme events can interrupt the system operation. In this work it is presented one ionospheric scintillation analysis of the GPS signal based on the scintillation occurrence intensity during the spring and summer solstice for the 2013 to 2016 years. The analyzed data were obtained from two stations located at Presidente Prudente and São José dos Campos, both in the São Paulo state. These stations are located in a region suitable for this kind of study since they are located in low latitude and under the crest of the equatorial ionization anomaly. The aim of this work is to propose a set of equations to represent the scintillation occurrence probability in these stations during two seasons of the year.

The input parameters for the proposed approximations are the Kp index representing the magnetic intensity and the F10.7 cm representing the solar flux level. The proposed equations representing the scintillation estimative are validated not only with Presidente Prudente and São José dos Campos data, but also using data from the station of Inconfidentes in the Minas Gerais state. So this model will allow users to estimate the expected scintillation night-by-night based on the Kp and F10.7 values and they will be able to predict its incidence and consequently to reduce its impact mainly during more severe scintillation events.