Modeling of Indian Ionosphere using Planar Fit method with Adaptable Decorrelation Function for GAGAN

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With the advent of Global Position System (GPS), there has been significant change in the Aircraft navigation. However the standalone, single frequency GPS receiver cannot provide positional accuracy required for Category-I precision approach for aircraft landing due to several errors. In India, Indian Space Research Organization (ISRO) and Airport Authority of India (AAI) are jointly developing a satellite based augmentation system called GPS And Geo Augmented Navigation (GAGAN) system to cater the needs of civil aviation. GAGAN consists of about 20 Wide area Reference Stations (WRS), which are deployed throughout the country. WRSs measure pseudorange, carrier phase and Total Electron Content (TEC) from GPS satellites and pass on this data to Master Control Center (MCC). MCC analyzes, estimates the corrections and transmits to geostationary satellite through Uplink station. The ionospheric delay is a major contributor in the error budget of GAGAN. As the Indian ionosphere is characterized by large gradients, intense irregularities and an equatorial anomaly condition, a suitable ionospheric model has to be developed. Grid models best suit to define ionosphere of a given region with less number of coefficients. One such grid model is planar fit model. This model was tested using GAGAN data, which is giving reasonably good results on quiet days. But the performance of the model is not satisfactory during disturbed days.

This paper focuses on the development a Planar fit model for Indian Ionospheric region, which is supplemented with an irregularity detector and a decorrelation adaptor. It was found that the decorrelation function value is the function of region and time. Hence, decorrelation value was obtained at every instant for each IGP. Chi Square test is used to detect irregularities by checking the consistency of estimates and measurements made at Ionospheric Pierce Points (IPP). These irregularities decrease the correlation between the estimated and measured IPP delays. Also, this test is useful in estimating the correctness of the model. With these modifications, significant improvement has been achieved in accurate estimation of ionospheric vertical delay during disturbed conditions, where existing planar fit model fails.