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Estimation of GBAS Ionospheric Threat Model Parameters Using Continuous GNSS Observations for Category I Operations

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In this work an estimation of GBAS model parameters has been performed for Category I (CAT I) operations using GPS and GLONASS observations which have been collected from Turkish National Continuous Operating Network. CAT I operations are referred to as a precision instrument approach and landing with a decision height of more than 60 meters and runway visual range of more than 550 meters. The ionospheric anomaly threat model can be simplified as a semi-infinite wave-front with constant propagation speed which is defined by three parameters namely slope, width and velocity of the front.

The estimation process is based on two approaches. The first one makes use of an ideal plane wave motion in order to estimate the velocity of the ionospheric wave front within a Gauss Markov model on the basis of the least squares estimation. The remaining parameters namely slope and width are determined by employing the rate of change gradients. The rate of change gradients are in turn obtained from the temporal gradients and the difference between the estimated velocity of the front and the ionospheric piercing point (IPP) velocity. In the second approach speed and orientation of the wave-front are estimated by applying the same procedure as in the first approach while the maximum value of station-pair gradients deliver directly the slope of the wave-front.

Calibration of GPS and GLONASS STEC observations is implemented by applying a regional modeling of VTEC in a multi-dimensional approach based on Euclidian quadratic B-Splines. Variance component estimation has been performed to combine both observations optimally with respect to their weights in the stochastic model. The observations from three days have been used to connect arcs at midnights for achiving more reliable gradients. Finally threat model parameters for CAT I operations have been assessed for special days having high geomagnetic activities and the results from both approaches have been discussed.