UDC 629.7.067 (043.2)

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REDUCING OF GPS POSITIONING ERROR BY REAL TIME IONOSPHERE ACTIVITY MONITORING

Global navigation satellite system (GNSS) is a primary in positioning for aviation. Accuracy monitoring and availability estimation of GNSS are the main questions that being discussed now. Accuracy of GNSS depends on different factors. The main of them is ionosphere influence. Ionosphere is an upper layer of atmosphere. It has valuable affects into propagation of radio signal because it contains free electrons created by ionization process.

Ionosphere has been ionised by ultraviolet and other emissions from the sun. The Earth rotation changes quantity of solar ultraviolet during the 24 hours of day. But solar activity is not stable. In result influence of sun radiation into the ionosphere will be different for different days. Usually solar activity is described by number of duck spot which indicate number of explosions into the sun surface and as a result quantity of sun radiation. GNSS used L band diapason of radio waves. Ionosphere produces three main effects on the propagations of the signal between satellite and GNNS receiver stations: delay, ionosphere scilations and Faraday rotation of signal. The most important for navigation is delay of signal because it produces distance errors in positioning equations. Delay signal in ionosphere is different for different regions and different time and depends from multiple factors. One of the most valuable parts of ionosphere delay is result of solar activity. Nowadays positioning system on board of aircraft usually uses GPS L1 frequency receiver. This type of equipment uses specific models of ionosphere which is represented by some specific coefficients in navigation equations. Different models provide advection representation of ionosphere delay in the average value, but unfortunately it is not useful in anomalous ionosphere activity period. Currently SBAS techniques are used to correct ionosphere influence for single frequencies avionics receivers. Ground station of SBAS uses dual frequencies psevdorange and carried phase measurements to estimate ionosphere delay and than broadcast by SBAS geostationary communication satellite to users. But SBAS services represented by EGNOS, WAAS, MSAS do not provide a global coverage. Other side of this problem lies in the fact that many aircraft don’t have SBAS support functionality. Ground base augmentation system (GBAS) combines data from multiple sources and provides adecvation corrections for single-frequency GBAS avionics systems. Correction will be suitable to meet requirements for category I precision approach operation. Approach and landing are the most important and dangerousness phases of the flight. Systems which provide precision approach work under heigh level accuracy monitoring for lateral and spatial for vertical positioning. In this case ionosphere monitoring is extremely important for aviation.

The main point of ionosphere delay monitoring is ionosphere threat model assessment. This model describes anomalous state of ionosphere as moving ionosphere front. Front parameters estimation is the most important task for reducing positioning errors.