Vladislav V Demyanov et al., J Aeronaut Aerospace Eng 2018, Volume 7
DOI: 10.4172/2168-9792-C1-022

GNSS carrier phase noise as a promising means to reconstruct fine structure of the ionosphere

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Ionospheric activities and natural hazard events are accompanied with ionospheric disturbances at different spatial and temporal scales. For example, multi-scale-ionospheric GNSS-TEC (Global Navigation Satellite Systems- Total Electron Content) disturbances are observed during certain periods of time before and after the main phase of geomagnetic storms and earthquakes. Rocket launches are also accompanied with TEC-waves of different scales. Earlier it was revealed that both existence time and propagation distances are substantially different for the ionospheric waves at different scales. The small-scale ionospheric turbulences have weaker intensity, but they live longer and propagate with different speeds in comparison to the large-scale ionospheric disturbances. Thus, we could consider small-scale ionospheric disturbances as an additional means to improve the efficiency and reliability of ionospheric activity monitoring. In this report, the second-order derivative of the GPS signal phase is considered as a promising means to detect the small-scale weak ionospheric disturbances. Our modeling and experimental results show that the second-order derivative of the GPS-signal phase can be utilized to detect the weak small-scale ionospheric disturbances with size of decades and hundreds of meters. As the single-frequency data interpreting strictly depends on the L2P(Y) or L2C data were processed we discuss the likely cause for these differences: L1-aided tracking used to track both the L2P(Y) and L2C signals as well.

Recent Publications

1. V V Demyanov (2012) Ionospheric super-bubble effects on the GPS positioning relative to the orientation of signal path and geomagnetic field direction. GPS Solutions. 16:181-189. Doi:10.1007/s10291-011-0217-9.
2. E L Afraimovich et al. (2013) A review of GPS/GLONASS studies of the ionospheric response to natural and anthropogenic processes and phenomena. J. Space Weather Space Clim. 3:1-19 Doi:10.1051/swsc/2013049.
3. V V Demyanov and R V Likhota (2015) The method of GNSS positioning availability control for transportation applications. Machines, Technologies, Materials. Issue (5):11-13. ISSN 1313-0226.
4. V.V. Demyanov, Yu. V. Yasyukevich, T.V. Kashkina, I.F. Gamayunov Non-stationary variations of the carrier phase acceleration of the trans-ionospheric satellite signals of GPS and GLONASS // Electromagnetic Waves and Electronic Systems (2015) 2 (Vol.20): 22-31.
5. V V Demyanov, Yu V Yasyukevich and S G Jin (2013) Effects of Solar Radio Emission and Ionospheric Irregularities on GPS/GLONASS Performance. In Geodetic Sciences - Observations, Modeling and Applications. ISBN: 978-953-51-1144-3.

Biography

Vladislav V Demyanov, DrSc in Engineering, has been working as a Full Professor of Irkutsk State Transport University since November, 2009. He works as a Senior Research Scientist of the GNSS Remote Sensing Research Group, Institute of Solar and Terrestrial Physics (Siberian Branch of Russian Academy of Science). His research interest include: space weather- geomagnetic storms and solar radio flares and their impact on GNSS and SBAS performance; GNSS\SBAS integrity and positioning availability control under irregular external impacts; GNSS remote sensing of the ionosphere; GNSS application on transportation.

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