

Popular science abstract

The GNSS (Global Navigation Satellite System) technology is nowadays widely used in a broad spectrum of applications such as navigation, geodesy, geodynamics, land surveying, agriculture and many others. The efficiency of the positioning may be improved in a great extent by the mitigation of the atmospheric propagation errors and application of the greater number of the GNSS signals not only from the existing GPS and GLONASS systems, but also from constellations being under development such as BDS and Galileo. Regarding to the propagation of the signals through the atmosphere, the ionized part – ionosphere – is the factor which mostly deteriorates the GNSS signals. On the other hand, taking advantage of the multi frequency GNSS signals and the dispersive nature on the ionosphere, application of GNSS observables make possibility of modelling and detecting of the disturbances occurring in this part of the Earth's atmosphere. Thus, here we can see a direct feedback between ionosphere modelling and GNSS signals' processing.

As a consequence of increasing number of permanent stations, which belong to many international networks, it has also become possible to monitor of high latitude ionosphere as well. This region of upper atmospheric layers is strongly affected by the occurrence of different-scale irregularities of electron content, being an effect of space weather conditions and interaction in the coupled system of magnetosphere and ionosphere. Due to these dependencies, circumpolar ionosphere can be treated as a sensitive sensor of conditions in near-earth space driven by violent process prevailing at the surface of the Sun. This fact is widely used in space weather studies aimed at providing information on geophysical processes within Sun-Earth system which may also have an impact on human daily life. The main goal of the proposed project is the utilization of the multi constellation GNSS signals for describing of the different-scale ionospheric disturbances during geomagnetic storms. This task will be performed with supporting of current methods of ionosphere monitoring by a new algorithm allowing large-scale structure detection and characterization. The combined results both methods should enable as high as possible comprehensive studies on behavior of high-latitude ionosphere. As a feedback, the information on irregularities, supported by measurements of new GNSS systems, will be applied for development of the original algorithms allowing for mitigation of the ionospheric disturbances in the precise GNSS positioning. Apart from main research objective, in the project are planned several intermediate goals. One of these is the development of the optimal method for multi GNSS signals integration in a single functional model of precise positioning. The next one is the utilization of the multi GNSS signals for assessing of the influence of the ionospheric disturbances on the GNSS positioning.

Application of the multi GNSS constellation signals and new developed algorithm will allow for reliable detection, characterization and modelling of ionospheric disturbances. Moreover, studies on the occurrence of ionospheric disturbances and their features should lead to better understanding of the space weather impact on the Earth. The information on the scale of electron content variations, combined with new algorithms suited for integration of multi constellation signals in precise GNSS positioning, will also lead to improve accuracy, integrity and reliability of the coordinate estimation.