

عنوان مقاله:

Ionospheric electron density reconstruction over central Europe using neural networks: A comparative study

محل انتشار:

مجله علوم و مهندسی هوافضا، دوره 17، شماره 1 (سال: 1403)

تعداد صفحات اصل مقاله: 13

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خلاصه مقاله:

Computerized Ionospheric Tomography (CIT) is a method to reconstruct ionospheric electron density image by computing Total Electron Content (TEC) values from the recorded GPS signals. Due to the poor spatial distribution of GPS stations, limitations of signal viewing angle and discontinuity of observations in time and space domain, CIT are an inverse ill-posed problem. In order to solve these problems, two new methods are developed and compared with the initial method of Residual Minimization Training Neural Network (RMTNN). Modified RMTNN (MRMTNN) and Ionospheric Tomography based on the Neural Network (ITNN) is considered as new methods of CIT. In all two methods, Empirical Orthogonal Functions (EOFs) are used to improve accuracy of vertical domain. Also, Back Propagation (BP) and Particle Swarm Optimization (PSO) algorithms are used to train the neural networks. To apply the methods for constructing a 3D-image of the electron density, ۳ GPS measurements of the International GNSS Service (IGS) with different geomagnetic indexes are used. For validate and better assess reliability of the proposed methods, ۴ ionosonde stations have been used. Also the results of proposed methods have been compared to that of the NeQuick empirical ionosphere model. Based on the analysis and comparisons, the RMSE of the ITNN model at high geomagnetic activity in DOUR, JULI, PRUH and WARS ionosonde stations are ۱.۲۲، ۱.۴۶، ۱.۱۸ and ۱.۱۹ (۱۰۱۱ ele./m³), respectively. The results show that RMSE of the ITNN model is less than other models in both high and low geomagnetic activities and in ionosonde stations.

کلمات کلیدی:

Total electron content, Tomography, Residual Minimization Training Neural Network, Ionospheric Tomography based on the Neural Network, GPS

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