TEC Measurements through GPS and Artificial Intelligence

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The ionosphere is a very dynamic region that couples strongly with thermosphere and magnetosphere systems. Due to its dispersive nature, GPS differential code and carrier phases at L1/L2 frequencies can be computed. From these, the Total Electron Content (TEC) may be derived as the integral of the local electron density along the path between the satellite and the receiver. TEC, in fact, is defined as the total number electrons in the ionized plasma contained in an imaginary tube ($1\,\mathrm{m}^2$ cross section) between a GPS satellite and the GPS receiver. As the plasma density changes with time of day, season and solar activity, changes in TEC reflect of near-Earth space dynamics. The amount of TEC is very important because it provides two-dimensional cross-section maps of the ionosphere's electron density, with significant improvements in: mono-frequency satellite measurement; GPS and SAR imagery of geophysical phenomena (volcano deformations or subsidence detection); detection of ionospheric disturbances like geomagnetic storms, ionospheric scintillation and post-seismic perturbation, with space weather implications.

Nowadays, Kalman filters and stochastic estimations are used to calculate TEC, in order to obtain empirical ionospheric model. In our work, a new solving method is proposed; it involves Artificial Intelligence algorithms and structures in order to improve calculation performances and to reduce calculation elapsed times.