POSITIONING ALGORITHMS AND IONOSPHERE TEC ESTIMATION BASED ON GNSS REGRESSION MODELS

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The present thesis proposes positioning algorithms and ionosphere Total Electron Content (TEC) estimation based on Global Navigation Satellite System (GNSS) regression models.
First, mathematical models of the pseudorange and carrier phase measurements, which are basic equations for positioning, are derived. Here, fundamental measurements of L1 and L2 carrier phases and pseudoranges based on C/A and P(Y) codes are formulated using novel GNSS regression models. In addition, GNSS regression models for known and unknown positions are derived.
Second, a new approach to obtaining a carrier-phase-based precise point positioning (PPP) algorithm without linear combinations of the pseudorange or carrier phase measurements is introduced. Furthermore, in order to achieve rapid and accurate positioning, the derived PPP algorithm is extended to Very Precise Point Positioning (VPPP) using multiple antennas with common clock errors and the known distances among receivers. Then, based on recursive Kalman filtering, algorithms for the estimation of the mid-position of the antennas with the constraints of the distances among antennas were developed. The experimental results of the present PPP and VPPP algorithms using real receiver data collected in static environments are shown.
Finally, using the GNSS regression models for GNSS observables in the case of known positions (in the reference stations), a method by which to estimate the ionosphere TEC, as well as the phase ambiguities contained in L1 and L2 band carrier-phase data at the reference stations, is derived. The accuracy of the estimated Vertical Total Electron Content (VTEC) is also examined by comparing it with the Klobuchar model and with Global Ionosphere Maps (GIM) provided by the International GNSS Service (IGS).