



## **Positioning with the four GNSS systems: GPS, GLONASS, GALILEO and BEIDOU based on phase clocks**

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It is expected to have about 120 GNSS satellites in orbit around the year 2010 available for precise positioning, in particular the satellites of the four GNSS systems developed by US, Russia, Europe and China. The launch of the second GALILEO test satellite and the first two Chinese BEIDOU satellites is foreseen already for this year. In this paper we present processing of simulated data for all four GNSS constellations based solely on phase data and estimation of so-called phase clocks. We show how the standard global GPS parameters like Earth rotation, troposphere zenith delays and station coordinates are improved by combining GNSS systems allowing for almost fully isotropic and homogeneous positioning in the vicinity of the Earth. We present the optimal orbital design of the four GNSS constellations and show how orbits of each individual GNSS system can be improved by combined orbit determination of the satellites of all four GNSS systems. We analyze optimal time synchronization between these four GNSS systems and show how such a huge parameter estimation process can be performed in the near real time considering ambiguity resolution.