Study of RTK technology and support infrastructure suitable for long-range instantaneous, centimeter-level positioning as related to the US NSRS network

Analysis of the ambiguity resolution, error modeling techniques and support infrastructure for nationwide three-frequency real-time kinematic (RTK) GPS positioning.

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The primary objective of these projects was to develop algorithms suitable for network-based real time kinematic (RTK) GPS positioning with cm-level (to sub-decimeter) accuracy, using the national Continuously Operating Reference Station (CORS) network. The desired station separation was up to 200 km. This study focused on a number of problems inherent in RTK technology and the support infrastructure necessary for instantaneous, centimeter-level positioning:

1. What is the maximum effective range for robust ambiguity resolution in either single epoch or multi-epoch modes?
2. What error sources must be considered, and what are the effects of their correlations on the accuracy derived?
3. Will precise absolute positioning be achieved with the enhancement of the RTK technology and mathematical models, or, what additional augmentation may be required?
4. Can real-time support products, such as high-resolution ionospheric grids, improve RTK algorithms?
5. Can virtual stations be used as additional reference stations for multiple stations ambiguity resolution and RTK positioning?

The project was completed in 2005 with a successful implementation of the RTK network-based algorithms and demonstration of the cm-level performance under normal to moderate ionospheric conditions. In the second phase of the project, the processing engine and the ionospheric error models were implemented in the rapid-static approach that is currently under testing and consideration by the NGS staff for implementation as new rapid-static module of the NGS OPUS (On-line Positioning User Service) system (OPUS-RS).