Center for Remote Sensing, Inc.
Advancing Technology

ULTRA TIGHTLY COUPLED GPS/INS RECEIVER

Time and Space Position Information (TSPI) in an aviation environment demands stringent performance requirements from navigational receivers. The high-dynamics and varying attitude poses a highly dynamic environment for conventional receivers to be able to acquire and track GPS satellites. The signal environment is often further degraded by interference, jamming, and multipath. TSPI receivers must provide highly accurate estimations of the relevant parameters, such as positions, velocities, accelerations, attitude, roll, pitch, and yaw.

These receivers must track GPS signals under high dynamics, under poor SNR, and must maintain the track under signal obscuration and occasional signal interruptions caused by maneuvers and jamming. The receivers must also provide access to and record the internal parameters (such as pseudoranges, clock corrections, satellite parameter, and carrier phases). Basic observables from IMU and derived INS parameters (such as bias, drift, and raw outputs) must also be available. Most importantly, the receivers must have high-fidelity in preserving the truth.

In order to meet these demands, CRS has designed and developed an UTC receiver for TSPI applications. The UTC architecture allows navigation processing using the entire constellation (instead of individual satellites) and provides improved processing gain. Further improvements are achieved through the integration of the INS within the receiver feedback to correlators. These ensure centimeter level accuracies, superior dynamics, larger J/s, better multipath rejection, and most importantly the robustness of navigational solutions with degraded satellite signals, with loss of individual satellites to total loss of constellation.

UTC GNSS-INS systems enable high precision navigation in the presence of high-dynamics, high-jamming environments. The systems move away from the traditional GNSS receivers that use tracking loops to maintain lock on satellite signals. Improved performance is attained through the modifications of the pre-filter, to provide base level pseudorange error dynamics to the navigational filter instead of the processed pseudoranges. The navigation filter itself provides error estimates of position and velocity that are provided as feedback to the INS, code generation and correlators.

This approach essentially uses base level GPS measurements to calibrate and correct an INS, improving accuracy of navigation by elimination of tracking loops and constraining the INS with IMU error corrections.

The use of a software-reconfigurable receiver enables the receiver to dynamically reconfigure and respond to changing scenarios, i.e. the presence of a jammer or high G conditions. In this manner continuous tracking of the satellites is assured with precise navigation capabilities. This approach provides improved J/S performance significantly higher under high dynamic conditions.

The software-based UTC receiver can be easily reconfigured for various applications and can be integrated with different types of IMU, from MEM-based systems to FOGs. The TSPI receiver can be easily adapted for several applications ranging from ground based navigation, navigation in urban environments, airborne navigation, and various other applications demanding high accuracy and robustness.

PERFORMANCE PARAMETERS*:

Accuracy: Measured in ground environment using inexpensive IMU 300CC-100 (Crossbow)

Position: < 5 cm horizontal; < 10 cm vertical

Velocity: < 1 cm/s

Acceleration: <0-1 m/s^2

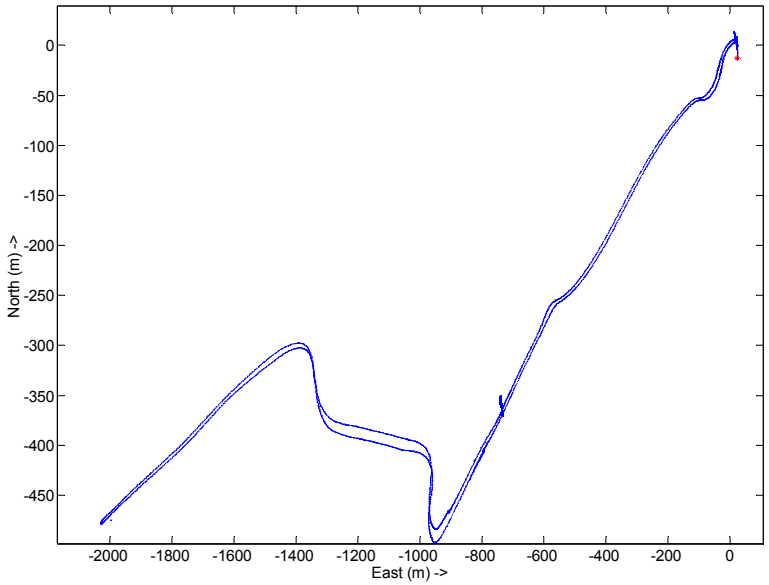
Attitude: < 1 m radian heading, pitch, and roll

Attitude Rate: < 30 m rad/sec

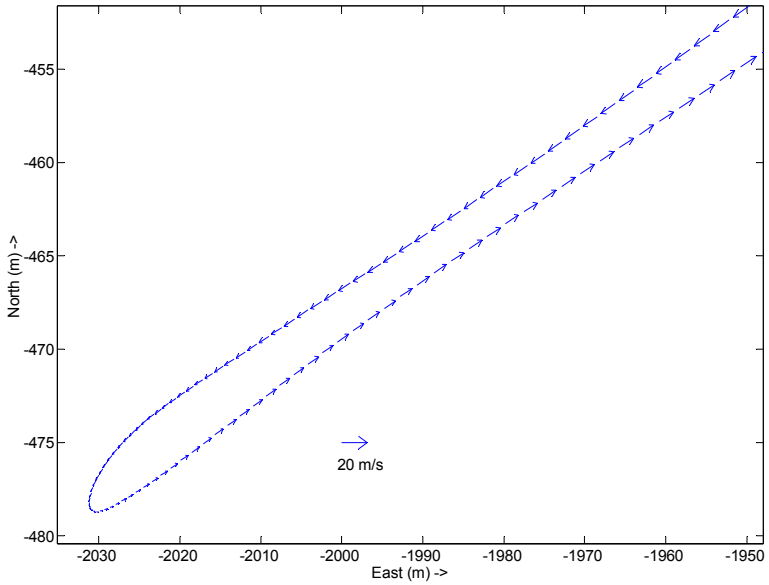
*Performance parameters are measured in a ground vehicle driving through the Fairfax, Virginia area. Improvements of an order of magnitude are anticipated in the airborne environment and using tactical grade IMUs.

Ultra Tightly Coupled GPS/INS Receiver

GROUND TESTS CONDUCTED IN FAIRFAX, VA FOR EDWARDS AFB:



Distance from CRS location in Fairfax measured by the UTC system during upleg and downleg of the route. Velocity vectors are indicated with small arrows.



U-turn at the end of the road (4 lane divided street).

For pricing and more details contact:

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