C-Nav® GNSS Correction Services

Precise point positioning (PPP) correction technology

FEATURES

- Two simultaneous correction messages
- Six Inmarsat satellites for L-band delivery
- High reliability and maximum uptime
C-Nav® GNSS Correction Services
Precise point positioning (PPP) correction technology

The Oceaneering® C-Nav® PPP correction service offers unparalleled levels of redundancy, integrity, and reliability. This is achieved by using a large reference station network, two processing centers, unique solutions, and delivery options of either six Inmarsat satellites or the Internet. With 15 years of experience, 150,000 users, and worldwide 24/7 support, our system is unsurpassed.

C-Nav® Services
» SF2 – C-NavC¹ and C-NavC² correction streams at optimum sub-decimeter accuracy from six Inmarsat L-band satellites
» SF1 – C-NavC¹ and C-NavC² correction streams at sub-meter accuracy from six Inmarsat L-band satellites
» Internet – C-NavC² correction stream available at 1-second, 15-second, and 60-second update rates

Features
» C-NavC¹ GPS correction, and C-NavC² GPS and GLONASS corrections on satellite-delivered services
» Over 55 dual GPS/GLONASS reference sites
» Ten network monitoring sites
» Six user-access monitoring sites

Redundancy in Key Areas:
» System performance can be maintained even with a loss of up to 30% of monitoring stations
» Multiple receivers and communications links to processing centers
» Two geographically separated processing centers with redundant communications links to the Inmarsat uplink sites

» Two unique correction calculation methods available to all users
» Six Inmarsat satellites send corrections, with a choice of two Inmarsat satellites for most users

A PPP correction system consists of:
» Reference network – Measures the range to each satellite from multiple locations
» Processing center – Provides algorithms that are used to compute the clock and orbit errors of each satellite
» Delivery system – Sends corrections to users
» User equipment – Uses the correction data to produce high-accuracy, stable-position data

Reference Network
C-Nav® GNSS correction system satellite tracking stations include a minimum of two active receivers at each site, and also comprises:

» Worldwide network of dedicated sites
» Redundant A and B dual-frequency receivers at each site
» Simultaneous observations to each tracked satellite from typically seven stations

» Secure, multi-routed communication links to processing centers
» Monitoring sites with feedback to the processing centers
**Processing Centers**

We have two identical processing centers, one in California and one in Illinois. At each processing center, two unique correction solutions are calculated: C-NavC\(^1\) (the GPS-only solution) and C-NavC\(^2\) (the GPS and GLONASS solution). Each processing center:

» Receives the full complement of C-Nav\(^\circ\) reference station data (both A and B receivers)
» Compares the observables from each A and B receiver and independently selects the optimum solution
» Calculates C-NavC\(^1\) and C-NavC\(^2\) solutions, which handle the data cloud independent of each other, producing two independent sets of PPP corrections

» Continuously monitors PPP correctors for quality assurance
» Is fed by resilient and spatially diversified communication routing links
» Sends correctors to the Land Earth Station (LES) network for uplink to the C-Nav\(^\circ\) Inmarsat satellites (Net-1 and Net-2) and via dedicated servers to the Internet

**Delivery Systems**

The C-Nav\(^\circ\) satellite delivery system has six geostationary satellites providing global, high-power L-band signals. A minimum of two satellites are visible to most C-Nav\(^\circ\) PPP corrections users. The six-satellite constellation is divided into Net-1 and Net-2 to simplify redundancy settings on the user equipment.

» Correction data from both processing centers are compared, and the best is sent to the satellite.
» Secure, high-speed cable and VSAT with ISDN backups are used for data flow between the processing centers and the uplink sites.

» The Inmarsat satellites are constantly monitored to ensure service continuity and quality.
» Backup channel capacity is available on adjacent satellites covering the same regions.
» Since the expansion of Net-1 and Net-2 to six satellites, the uptime of the combined system has been 100%.

**User Segment Receiver Technology**

C-NavC\(^1\) and C-NavC\(^2\) subscription services can be used by the C-Nav5000\(^\text{™}\), C-Nav3050\(^\circ\), and C-Nav7000\(^\circ\) GNSS receivers. The C-NavC\(^1\) service is used by C-Nav legacy receivers (the C-Nav2050 and C-Nav2000).

Because these receivers are designed by the same experts that developed the correction algorithms, they make optimum use of the data to produce outstanding stable, reliable, and accurate results.