Marine Benefits from NASA's Global Differential System: Sub-Meter Positioning, Anywhere, Anytime

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Abstract

Precise real-time, onboard knowledge of a platform's state (position and velocity) is a critical component in many marine applications. This article describes a recent technology development that provides a breakthrough in this capability for platforms carrying a dual-frequency GPS receiver – seamless global coverage and roughly an order of magnitude improvement in accuracy compared to state-of-the-art.

Our reference network is a subset of NASA's Global GPS Network (GGN), consisting of geodetic quality dual-frequency receivers. Using novel internet-based technology for editing and real-time streaming of data from the GGN as input to a real-time orbit determination software, JPL's new global differential system has demonstrated ~10 cm horizontal and ~20 cm vertical real time positioning accuracy for a ground-based dual-frequency GPS receiver [Muellerschoen et al., 2000]. This performance is roughly an order of magnitude better than any differential service currently available. Although a number of private and government organizations provide localized real-time positioning services to users on or near the ground, a global system such as demonstrated here, capable of supporting global users far away from any ground reference site, has never been achieved nor attempted due to the perceived technical and cost challenges.

This technology will enable NASA to provide cm level onboard, real-time orbit determination for Earth orbiting satellites, and 10 cm level real-time positioning accuracy for air-borne, ground, and marine platforms anywhere in the world. The system provides seamless global coverage, with uniformly valid GPS correction messages. The technology carries broad benefits to society in general as it revolutionizes our ability to sense and respond in a timely manner to natural hazards such as earthquakes and volcanic eruptions.

The dissemination of the differential corrections to authorized users is currently enabled with specially developed Internet tools. An effective global communications system that will relay the differential corrections to users anywhere on the ground and in space is currently under development.

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