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Title: **NEW GROUND AND SPACE-BASED GPS TRACKING TECHNIQUES FOR HIGH-EARTH AND DEEP SPACE ORBIT DETERMINATION APPLICATIONS**

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Satellites of the Global Positioning System (GPS) can bc used to provide precise position and velocity information for receivers on the surface of the Earth, in aircraft, or in low-Earth orbit. At altitudes above 5000 km, however, relatively few GPS satellites arc visible. Yet GPS can still provide a precise navigation and positioning capability, even for Earth orbiters at altitudes well above the altitude of the downward broadcasting GPS satellites. In fact, GPS data can even play an important role in interplanetary spacecraft navigation.

This paper discusses error analysis and field test results for use of GPS technology to provide orbit determination for satellites at altitudes of 40000-100000 km. An experiment being carried out by JPL in late 1993 and early 1994 will demonstrate how GPS-like tracking can help provide an operational orbit determinat ion capability for geosynchronous satellites, such as TDRS. The field experiment for TDRS tracking utilizes 3 modified GPS ground receivers in a small, local network. These receivers have been modified to track carrier phase from TDRS as well as GPS L-band carrier phase and pseudorange. This new approach offers a low-cost alternative to more conventional tracking systems for geosynchronous satellites, For the TDRS demo, no new space hardware was needed. The goal for TDRS is 50-m near-real time accuracy.

For orbit accuracy at the few-meter level at altitudes up to 100000 km, a larger, global network of receivers is needed, The high-Earth satellite need only broadcast a suitable signal (not necessarily at GPS 1.-band) which can be tracked in the modified GPS ground receivers along with GPS 1.-band carrier phase and pseudorange. With appropriate system design, meter-level performance should be possible.

New deep space tracking applications of the Global Positioning System will also be discussed in this paper. They are essentially a variation on the high-Earth orbiter tracking technique utilizing a ground GPS receiver which can track both GPS and non-GPS spacecraft. In many deep space scenarios, however, it is not practical to track both GPS satellites and interplanetary spacecraft in the same ground system. Even so, GPS ground receivers co-located with the deep space tracking antennas and running off the same oscillator can provide precise, continuous and timely calibrations for geodetic, atmospheric, and clock parameters which are critical to interplanetary navigation. The incorporation of GPS into NASA's Deep Space Network offers a number of significant operational and economical advantages over systems which rely on other techniques to obtain these calibration products.