**"Gyroskopiya i Navigatsiya" №4, 2004**

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| The Global Differential GPS (GDGPS) system developed by JPL aims at seamless global real-time positioning at the dm accuracy level for dual-frequency receivers either static or mobile, anywhere and at any time. The GDGPS system relies on GPS data transmitted in real-time to a central processing center at JPL from a global network of permanently operating GPS dual-frequency receivers. At the processing center, the Internet-based Global Differential GPS (IGDG) system, the heart of JPL's GDGPS, generates and disseminates over the open Internet special 1-second global differential corrections (IGDG corrections) to the GPS broadcast ephemerides. The IGDG corrections enhance the accuracy of GPS broadcast orbits and clocks down to the dm level and are the key-factor in high-precise real-time positioning of a stand-alone receiver. An independent experimental verification of the dm positional accuracy of IGDG system was carried out, by means of both a static and a kinematic test in the Netherlands. In the static test, the means of the position coordinates, taken over individual days of data, agree with the known reference at the 1-2 cm level confirming that the IGDG position solutions are free of systematic biases. The standard deviation of individual real-time position solutions turned out to be 10 cm for the horizontal components and 20 cm for the vertical component. In the kinematic test, carried out with a small boat, the means of coordinate differences with an accurate ground-truth trajectory, are at 1-2 dm level over the almost 3 hour period; the standard deviations of individual positions were similar to values found in the static test, 10 cm for the horizontal components, and 20 cm for the vertical component. More than 99% of the IGDG-corrections were received in the field with the nominal interval of 1 second, using a GPRS cellular phone. The latency of the corrections was generally 7 to 8 seconds. | |  |

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| This paper describes the design, operation, and test results of a miniature, low cost integrated GPS/inertial navigation system that uses commercial off-the-shelf Micro-Electro-Mechanical System (MEMS) accelerometers and gyroscopes. The MEMS inertial measurement unit (IMU) is packaged in a small size and provides the raw IMU data through a serial interface to a processor board where the inertial navigation solution and integrated GPS/inertial Kalman filter is generated.  The GPS/inertial software integration is performed using NAVSYS' modular InterNav software product. This allows integration with different low cost GPS chip sets or receivers and also allows the integrated GPS/inertial navigation solution to be embedded as an application on a customer's host computer. This modular, object oriented architecture facilitates integration of the miniature MEMS GPS/INS navigation system for embedded navigation applications and is designed to handle the large errors characteristic of a low grade MEMS IMU.  Test results are presented in this paper showing the performance of the integrated MEMS GPS/inertial navigation system. Data is provided showing the position, velocity and attitude accuracy when operating with GPS aiding and also for periods where GPS dropouts occur and alternative navigation update sources are used to bound the MEMS inertial navigation error growth. | |  |

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| Using long total dwell times, acquisition and weak GPS signal tracking in degraded signal environments are possible. A technology utilizing such long integration methods is called High Sensitivity GPS (HSGPS). A previous hardware in-the-loop GPS signal simulator test has demonstrated that, for a stand-alone HSGPS implementation provided by SiRF Technologies Inc., signals as weak as -186 dBW could be tracked by the receiver (MacGougan et al., 2002). This corresponds to 25-30 dB weaker signals than the typical outdoor line-of-sight GPS signals. However, measurement noise increases as signal power decreases and the receiver tracking loops become susceptible to possible tracking of cross-correlation or echo-only signals that can lead to severe position and velocity estimation errors.  This paper presents the results of the accuracy analysis of the sensor aided HSGPS receiver for pedestrian navigation in signal-degraded environments. Description of the downtown test and the equipment used is given. Analysis of the stand-alone HSGPS results with Receiver Autonomous Integrity Monitoring (RAIM) techniques is presented. Brief analysis of gyro bias estimation problems with GPS is presented. Kalman filter integration methodology is presented and the results are analyzed. | |  |

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