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Development of Advanced Precise Positioning System (APPS) for Automated Geodetic GPS Processing

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The most accurate positioning using GPS can be achieved by the analysis of the small number of geodetic specialist. State of the art GPS data analysis can achieve 2-5 mm horizontal and 1-3 cm vertical accuracy over baselines 1-1000 km. To obtain these kinds of results, multi-hour static data sets of high quality dual-frequency GPS data, the use of high quality GPS orbits and earth rotation parameters, highly sophisticated software, and a high level of data processing expertise are required [Rocken and Johnson, 1999]. We are developing an automatic GPS analysis system named Advanced Precise Positioning System(APPS). APPS enables everybody to obtain accurate GPS solutions without requiring geodetic understanding, the operation of the sophisticated GPS software, or complicated data handling. Users can submit static single point or multi-station network GPS data in a archived form such as compress (*. Z) and gzip (*. gz) to the APPS analysis server by e-mail and receive the analyzed results back by e-mail after a few minutes. Users can also upload multiday data files. If users have huge number of data set, APPS can automatically download them from the anonymous ftp server prepared by the users. At present we open the mail-based APPS analysis server to access the limited number of users in order to help to revise the system and we are developing the web site service of APPS. The APPS consists of two parts. One handles data automatically and includes the database, a quality check of the data set, and a process for extracting the RINEX files and orbit files. This part is a modified version of the GARDII (GPS Automatic Remote Data Processing II) developed by Nippon GPS Solutions Corporation (NGS). The other part is the GPS analysis using the Bernese software [Rothacher et al., 1996], which is the one of the best-known GPS analysis packages. The Bernese software reliably achieves the highest accuracy because of its robust data editing and cycle slip correction algorithms, and its sophisticated models of the GPS observations and orbits. While the software has a menu-driven user interface it still requires significant time to master. The users receive a report by e-mail after the analysis. The data length, the station coordinates, coordinate formal errors, and an error log are e-mailed to the user. Results for a single station are typically mailed within 5 minutes, and a multi-station network may take 10 minutes. The coordinates and baselines are currently provided in cartesian (x, y, z) and geodetic (latitude, longitude, height) representation in ITRF2000. Other information such as baseline length, tropospheric parameters (zenith path delays and tropospheric gradients) are also added and a site location geographical map via Internet mapping service. In particular, since users can obtain tropospheric parameters with any time resolution, the APPS is useful for not only geodetic purpose but also meteorological and climatological purposes. In the near future estimated ionospheric information will be provided. On the other hand, there are significant necessity of the monitoring of the plate motions, sea level changes, atmospheric and ionospheric monitoring and Tsunami detection using GPS measurements in the Asia Pacific region. We expect that the APPS will play an important role to support studies of natural hazards as a core technology in monitoring the earth's environment by combining with a space-based TCP/IP link via satellite communication system.