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Tide and Wave Measurement Application Researches Based on GNSS Technology

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Nowadays the development of Global Navigation Satellite System (GNSS) has been increasing rapidly. GNSS has such advantages as all-weather working and high precision, widely applied in the field of crustal movement monitoring and high-rise building dynamic feature monitoring. However, GNSS is rarely used in the field of tide and wave monitoring.

Wave and tide, as important movement phenomena in the ocean, have an impact on human activities at sea and nearshore. In this paper, the inversion of wave parameters and tide level changes using high-frequency dynamic GNSS has been studied. The main work is as follows:

(1)Tide measurement by using GNSS technology

Combined with GNSS dynamic positioning technology (RTK, PPP, PPK modes), the shipborne GNSS positioning data is solved and the elevation change is corrected. Random noise and the influence of wave are eliminated by threshold filtering to obtain the change of tide level based on the WGS84 ellipsoid at each measuring point. Using the nearshore control points, the geoid-like model was constructed based on the EGM2008 model to realize height conversion and obtain the tide level changes based on the local tide datum. Then the result is applied to the tide level correction in multi-beam water depth measurement. This method can greatly improve the efficiency of water depth measurement and tide correction accuracy.

(2)Wave measurement based on single-point GNSS velocity information

Use the GNSS carrier phase data through the epoch difference to establish a high-precision GNSS single-point velocity model. After eliminating the zero drift caused by velocity integral through the sliding average processing, the high-precision surface wave motion can be obtained. Based on the spectral analysis, the wave power spectrum can be calculated to obtain wave period and wave height, which are well consistent with the results of the existing wave gauge and tide gauge. A single GNSS sensor for ocean wave measurement greatly reduces the cost of maintenance thanks to its ability to obtain location information at the measurement point and the wave parameters without the aid of other external sensors. The GNSS single-point velocity mode cannot be limited by the operating range and the velocity accuracy is not subject to position accuracy constraints, thus especially appropriate for open sea applications. In this paper, the wave and tide measurement method has been realized based on GNSS single-point velocity measurement.