The Application of GPS Height Data for Bathymetric Survey

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ABSTRACT

In ocean-related research, the measurement of tidal elevation and the extraction of accurate tidal information are the key tasks for engineers. In the past, the measurement technique has primarily involved the installation of tide gauge at coastal region to measure tidal height for tidal correction. However, this type of technique has limitation, as it requires manpower and long-term information collection to achieve results with the expected accuracy. Furthermore, it is common for coastal tidal stations to be located far from the survey site and as a result, the accuracy of the predicted value decreases. An alternative way is to install a tide gauge inside the survey area to obtain local tidal information. However, this method will face the meteorological condition and fishing activity at the survey area, as both of them can lead to damage or loss of the tidal measurement equipment and insufficiency of data collection. Either insufficiency or inaccuracy of the tidal information being collected can often affect the quality of the survey result. The focus of this article is to introduce the application of DGPS data and the inertial motion sensor data collected by typical survey ship, combined with nearby satellite base station differential data or downloaded satellite historical almanac to compute tidal height during offshore bathymetric survey.

KEY WORDS: Tide Gauge; Inertial Motion sensor; GPS Base Station; GPS Almanac.

INTRODUCTION

In recent years, coastal countries have consistently pursued marine development on ocean based industries and resources. Offshore or inshore leisure activities, construction, fishing, and underwater resource development are all closely tied to ocean phenomena. Natural phenomena, such as tidal movement, wave, current and so on, will affect the safety of the activities at sea and constitute a critical factor in the success of the development of coastal areas.

Water level change induced by tidal movement is an extremely important parameter in the coastal engineering. Engineering and construction at sea or on coasts requires consideration of the effects or elevations associated with tides. For example, tidal movement will affect the measurement of the water level of river, lake, and reservoir, as well as the construction and monitoring of reservoir, hydroelectric plant, river embankments, seawall, irrigation system, drainage system, and marine sewage discharge system. The same consideration apply to the planning, construction, and monitoring of river cleanup and flood prevention. All of these activities must make use of constant and unified standardized tidal data.

In Taiwan, the tidal height of the forecasted or measurement tidal data delivered by the Central Weather Bureau is calculated from the mean sea level of Keelung Harbor, which is located at the northeastern corner of Taiwan; however, as Taiwan is surrounded by ocean, it is subject to seasonal wind, ocean current, and difference in coastal terrain, causing tidal difference from location to location. Adopting the tidal level standards of the Keelung Harbor Bureau for universal use throughout Taiwan will inevitably lead to large difference with actual tidal level in the survey site. Installing tide gauges in offshore areas only provides data on local tidal level and does not provide comparison between local tidal level and the average water level measured by the Keelung Harbor Bureau. These issues have consistently caused problem in high precision water depth measurement. Accurately obtaining tidal levels of the same datum is therefore becoming the primary goal of ocean engineers. In the past, the tidal prediction is usually based on the harmonic analysis; however, this method requires long-term data to ensure accurate prediction. Data insufficiency negatively impacts prediction quality. It is quite common that the insufficiency of historical data at the site where the construction is intended, and therefore lead to the difficulty of the application harmonic analysis of tidal data. This study, therefore, is intended to establish a calculation method that provides accurate tidal level data using short term measurement data.

With the rapid advance of the radio navigation technology, the global positioning system (GPS) has been widely used for high precision position measurement both on land and at sea. However, implementation of tidal corrections using GPS height has yet to be researched to obtain precise survey result. This study shows the difference of outputs generated by using two different GPS height correction algorithms to post-process the raw DGPS data collected during the survey off the coast of Taoyuan, in comparison with the actual tidal data.