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Derivation of Bathymetry from High-resolution Optical Satellite Imagery and USV Sounding Data

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ABSTRACT

Remote sensing bathymetry inversion can quickly obtain water depth data of large areas, but this process relies on a large number of *in-situ* depth data points. USV-based (Unmanned Surface Vehicle) technique can obtain the bathymetry data of shallow water where ordinary ships are inaccessible, but this technique is inefficient and generally only data along survey line can be collected. The combination of USV and high-resolution remote sensing provides a new solution for water depth surveying and mapping around an island. This paper focuses on the key techniques, using USV sounding data and GeoEye-1 multispectral remote sensing images covering the region of Wuzhizhou island in the experiment. The results show that the MAE (Mean Absolute Error) of USV sounding is 0.25 m, while the MRE (Mean Relative Error) is 1.41%, and the MRE of remote sensing bathymetry aided by USV sounding can be controlled within 20%. Errors are mainly from areas shallower than 5 m, and are also affected by the USV sounding position accuracy. It shows that it is feasible to combine the USV sounding and high-resolution remote sensing bathymetry, and this technique has broad application prospects in the field of bathymetry in large shallow areas.

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KEYWORDS
Combined bathymetry; remote sensing; USV

1. Introduction

The water depth is a crucial topographic factor in the shallow sea area around island and coastal zone. It is crucial for the management of the coastal zone and island, shipping, offshore engineering, tidal zone development, etc. Traditional depth measurement method can achieve very high accuracy, but it is inadequate in the data synchronization, economy, and flexibility. Moreover, traditional techniques are hard to be applied in offshore reefs or shallow water area due to environmental limitations.

Remote sensing technology in the field of bathymetry emerged and developed in the 1960s. Since then the multi-spectral remote sensing research and application have been carried out extensively and deeply by scholars around the world. Uptil now, three kinds of bathymetry inversion models have been put forward: theoretical model (Lyzenga 1985; Ping 1982; Li et al. 1991; Chen et al. 2012), semi-analytical model (Polcyn and Sattinger 1969;

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