

# Comparison of an EKF based Processing System with a Standard Hydrographic Software Tool using a Low Cost Bathymetric Multi Sensor Platform

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**Key words:** Coastal Zone Management; GNSS/GPS; Hydrography; Low cost technology; Positioning; Multi Sensor System, Extended Kalman Filter, Generic Sensor Format

## SUMMARY

The investigation and surveying of shallow water areas plays a crucial role in various environmental, navigational and research applications. For the purpose of a broad user-oriented application to map coastal and inland waters a low cost Multi-Sensor System has been built up. The Multi-Sensor System (MSS) is equipped with an Inertial Measurement Unit (IMU), Global Navigation Satellite System (GNSS) and a Single Beam Echo Sounder (SBES), designed to provide an affordable solution for generating bathymetry data in shallow water environments: By integrating IMU, GNSS, and SBES technologies, it enables the acquisition of three-dimensional point data in a geodetic coordinate frame, expanding the availability of bathymetric data on platforms like "OpenSeaMap." Tests in inland waters show that the MSS is able to acquire consistent bathymetric datasets which can then undergo two separate post-processing methods. The first approach involves Extended Kalman Filtering (EKF), which combines the GNSS and IMU parameters to estimate state variables of the MSS system. Bathymetric points are then represented as one of the state variables within the EKF framework. This technique enhances the precision of the bathymetric data and minimizes inaccuracies induced by sensor outlier measurements during data collection. The advantages of this method are a case sensitive system model with its known inaccuracies which can be set up by the user.

The second post-processing method involves converting the MSS results into a generic sensor file format and afterwards processing the data in QPS Qimera, a Software package widely used in the field of hydrographic surveying. Like this the dataset can be thoroughly analyzed for each timestep and exported into various formats. Furthermore, it reduces the effort within the processing workflow as establishing an own EKF is not needed any further.

In order to validate the quality and to compare the two post processing methods the GSF dataset and

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the EKF calculated points are statistically analyzed according to their precision, reliability and consistency since a ground truth dataset appears has not been available under water.

This application of a Multi Sensor System for surveying shallow water areas provides a broadly usable opportunity for surveyors with a comparably small budget and can help to establish a user data based mapping system for coastal areas.

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