Harbor Structures Modeling using Multibeam Echo Sounder Data

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ABSTRACT

Recently active efforts are made to develop harbor areas to obtain waterfront spaces. Harbor areas thus suddenly increase in the number of harbor structures, whose deterioration makes it difficult to do effective management, understand the current state, and attempt modeling as they are underwater. This study set out to apply 3D GIS modeling techniques to embody harbor structures by using high-density echo-sounder data through MBES(Multibeam Echo Sounder), to examine their advantages and disadvantages, and to propose improvement measures.

Keywords : MBES, Modeling, Harbor Structures

1. Introduction

The structures located on the shore including the harbors are prone to sudden changes to the ocean and meteorological environment. In recently years, they have introduced a high-precision and density measuring system for harbor structures to prevent disasters, maintain them, and secure waterfront spaces. They have also tried to embody all kinds of objects in the ocean spaces with echo-sounder data only to face many limitations with precise 3D modeling for harbor structures due to the restrictions with the old 3D models.

2. MBES

The MBES(Multibeam Echo Sounder) system is a high-density position system comprised of the MBES sensor, motion sensor, gyro compass, and GPS. Installed on the exploring ship, MBES shoots out multiple sound saves to the seafloor like Figure 1 and measures the depth of water at a time, thus giving a precision description of the shape of the seafloor. MBES generally creates and shoots out fan-shape sound waves that are wide both sides and narrow on the stem. It then receives many beams perpendicular to the sound waves to obtain and treat data about the depth of water.

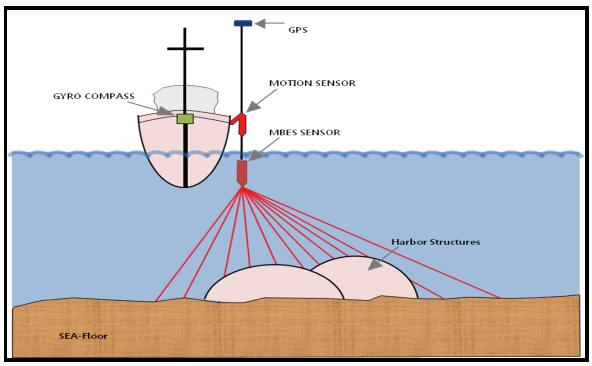

Figure 1. MBES System

3. Modeling

Modeling topography and structures based on the measurements is a very important part in the GIS and spatial information field.

There are two ways to model topography and structures; TIN(Triangular Irregular Network) and GRID model. They mostly employ the TIN model that is implemented by Delauny triangulation for irregular topography with multiple slopes.

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Table 1. Comparison of TIN & GRID

	TIN	GRID
Advantage	- Increasing the effects of 3D topographic expressions - Increasing the effects of topographic and spatial information expressions - Capable of regulating data density	- Precise topographic expressions - Easy and fast creation - Fast rendering
Disadvantage	- Long creation hours - Not fully expressing vertical walls - Expensive building and maintenance costs	- Difficult to express inside holes - Irregular boundaries - Low level of detail

4. Application

The subject of the study was Gwangyang Harbor located in Gwangyang City, Jeollanam Province. It was modeled through TIN and GRID with high-density water depth data obtained through MBES, which were modeled and visualized as 3D with the ArcGIS Desktop 9.x by ESRI.

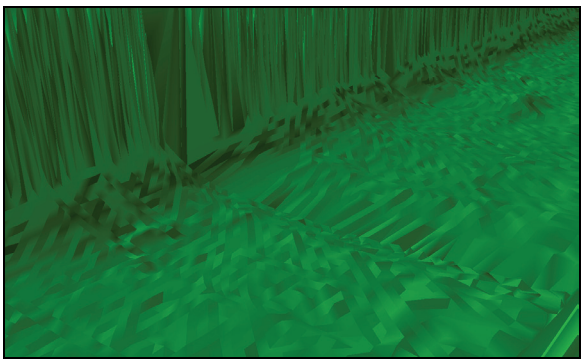

Figure 2. TIN Model

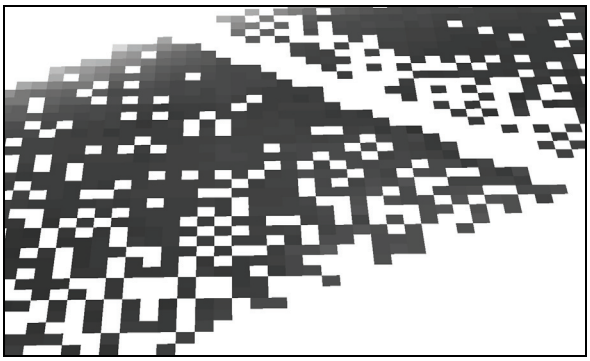

Figure 3. GRID Model

5. Conclusions

The study applied the representative 3D GIS modeling techniques to embody harbor structures with MBES water depth data, identified their advantages and disadvantages, and drew the following conclusions:

The TIN model was proper for continuous expressions but could not provide accurate modeling of vertical walls. The GRID model varied in density according to the grid size and was not capable of accurate modeling due to no data.

While the TIN model needed a modeling algorithm to accurately embody the vertical walls of harbor structures, the GRID model needed a grid size to accurately embody the objects with no errors and an interpolation algorithm proper for a conversion from points.

The results call for a need to study algorithm development to accurately model harbor structures to solve the problems.

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