

Design of GIS-based Marine Geographic Environment Analysis: A Case Study

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Abstract

The marine engineering and operation raised special requirements for the analysis tools and functions of Geographic Information System (GIS). Usually it's not easy to satisfy the data needs by only the basic analysis tools within a common GIS, especially when considering the representation of undersea terrain. An inter-layer data processing and analysis seems necessary to improve the performance of GIS-based analysis system.

We developed such an analysis system for a local area of South China Sea, where islands and undersea obstructions draw much attention in the design and planning as well as in the implementation of any undersea works. Basic analysis tools were combined and some functions were added to develop a satisfactory GIS-based application.

The article introduced the special requirements and design consideration of this project. After a brief explanation of the background of this project, the author discussed the design concerns and performance of this system, and tried to draw some general picture of the future evolvement for the project as a conclusion.

Introduction

Geographic Information System (GIS) technology has been increasingly used to assist in the marine engineering and in making environmental decisions. However, The applications of planning surveying engineering projects based upon the support of GIS are not as common. In the last year, a GIS-based geographic environment analysis package for marine surveying engineering was developed in cooperation with a technical group at the Dalian Naval Academy. The initial purpose of this cooperative research effort was to enforce the personnel and ordnance resource management in marine surveying planning through the use of a geographic information system.

Marine surveying project planning is a kind of decision-making job which needs much care of the geographic information, such as the tide, current, reef scating, etc. of the

working sea area. Till recently, the planning work is implemented merely with the assistance of charts as the geospatial data management tools, so difficult and inefficient a way to deal with the geospatial information that it seems quite clumsy.

Performance

The designing purpose of the project is to help to make a best assignment of the personnel and ordnance resource among different sub-areas. To achieve this object, the system assesses the relevant amounts of resources necessary to each sub-area according to the sub-area's geographic environment before making the final distribution plan.

The package takes four steps to finish this job:

1. Gathering the geographic information of each sub-area;
2. Assessing the amount of work needed to finish the sub-area, resulting in a value;
3. Calculating the relevant amount of resources, with the above values as weights;
4. Final distribution.

The GIS is mainly hired in the first step, when various geographic environmental data are derived from a local marine database and then analyzed to re-construct the spatial relationship between features in the sea area. Each of the phenomena that could affect the complex and difficulty of the whole job will be assessed and will add a portion to the final value. The assessment is mainly on an empirical basis right now but planned to develop the descriptive mathematical models in the future.

Throughout the project, the GIS program has been evolving to an integrated system of facilities, infrastructure, and natural resource based data. Some of the thematic layers of data residing in the GIS local database contains currently the following:

- Grid and reference data;
- Tides and Currents;
- Weather;
- Obstacles (known rocks, wrecks, shoals, etc.);
- Terrain data (contour and sounding data);
- Accommodation supporting (freshwater, ports, etc.);
- Main sea traffic routes;
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The GIS works as the spatial infrastructure provider of the working sea area as well. It contributes to the reasonable assessment of the work (showed as time needed) primarily on the basis of experience.

Conclusions

Future efforts include the broadening of the data sources, among which the real-time

data should especially be taken into consideration. Also, the theoretical aspect of the assessment should be enforced. The mathematical description of relationship should be soundly established between a change of the environmental factor, such as weather, currents and ranges from the ordnance center, and the relevant shift of the amount of work. Difference among sea areas and surveying ships should be taken into consideration. These can also expect the powerful help of GIS technology.

Reference

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