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SPATIAL PRESENTATION
OF SEA BOTTOM USING EMIF FORMAT

ABSTRACT

In the paper, there is presented a problem of search object drift during SAR operation. Presented method of conducting search takes into account probability of containment (POC) of searched object inside search area. Its also consider available endurance of SAR unit. Described method allows for achieving as good as possible average POC.

INTRODUCTION

The final aim of generating of digital sea bottom model is to represent ENC data graphically. So as to reach this goal, it is necessary to use a graphical user interface, which would enable users to visualize the sea bottom. It goes without saying that modelling without visualization is of no use for sailors. It has consequently been decided to set up an application that would both generate and display digital sea bottom models.

For many reasons, it has been decided to use C++ language to develop this application. First of all, C++ is one of the most commonly used languages in the world, its use is free, and this language is a multiplatform language. The fact that object--oriented programming is possible in C++ might also help dealing with data. But choosing C++ also enables the use of a powerful API that draws three-dimensional graphics, OpenGL (Open Graphics Library). Thanks to OpenGL it will be possible to display grids, surfaces or curves generated for modelling a 3D environment such as sea bottom. To recapitulate, a C++ application will deal with data, use them in various algorithms, create surfaces and display them in a graphic interface. This should of course be possible since we have information about S-57 ENC standard and numerical models of terrain generating methods.

INPUT DATA

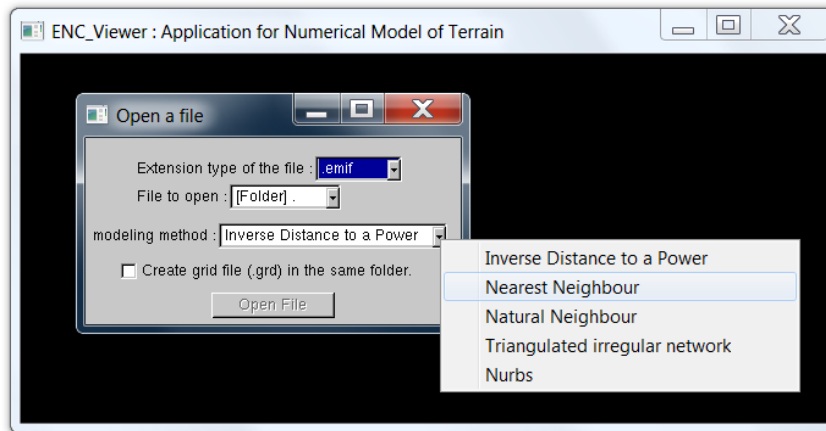The application that has been designed, called ENC Viewer, proposes different options to the user.

Fig. 1. ENC Viewer starting menu interface

First of all, users have to choose one of the three file extensions to open a new data source: text file, emif file or grid file. None of these extensions are ENC extensions (the one used by ENC is .000). Indeed, as ENC data are encrypted it is not possible to open it directly without using an expensive kernel or without creating and including a S-57 parser in the C++ application. But creating such a parser might be difficult if we want to have time to exploit the modelization results, as it needs a long process of reading binary data from ENC fies. So a set of softwares will be used to read data, but as much as possible, ENC Viewer should be independent. Figure 2 describes files that can be opened by ENC Viewer, and their origins.
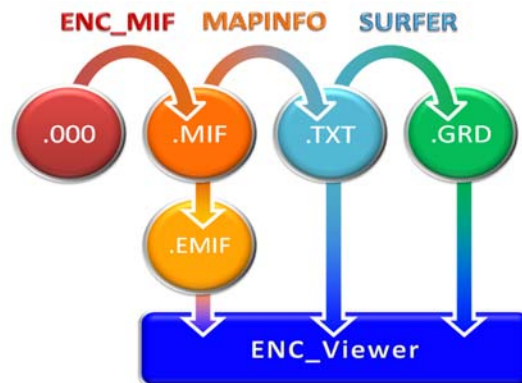

Fig. 2. Files opened by ENC Viewer and their origins

Text file

Using text files is the easiest way to transmit data. In fact, a simple file containing columns with X, Y and Z coordinates written as shown in figure 3 is enough. Such a file is very useful for testing the application, and to work on sea bottom created from scratch: simple terrains make analysis easier.
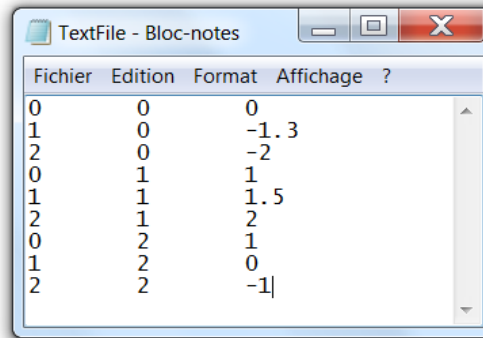

Fig. 3. Text files structure

Grid file

Some data files, with .grd extension, are called grid files. These files contain data which already have a grid structure, i.e. a grid method has been applied to original data and the resulting grid has been saved in a grid file. Opening such a file doesn't imply computing, it is ready to be drawn by the graphic interface. Thus, it is interesting to save results from grid methods as grid files after computation, so that results can be reused without computing again. That is why a checkbox in the starting menu interface suggests saving results as a grid file.

As grid files contain information from a grid, we don't need to save X, Y, Z values of each point. In fact, we just need to register the number of points in X and Y directions, the range of X, Y and Z values, and Z values themselves. It leads to the structure shown in figure 4.

The first line contains a header, so that the _le can be read by softwares such as Surfer. The second line contains the number of points in X and Y directions. The three following lines contain minimum and maximum X, Y, and Z values. This can be reused to set up the volume in which the sea bottom will be drawn. Then come all Z values, written as blocks. In this case, there will be 52 (number of points in Y direction) blocks of 100 (number of points in X direction) values.

Choosing to open _les with this extension will lead to a fast display of the sea bottom level, but no change in computation is possible (neither the modelling method nor the parameters).
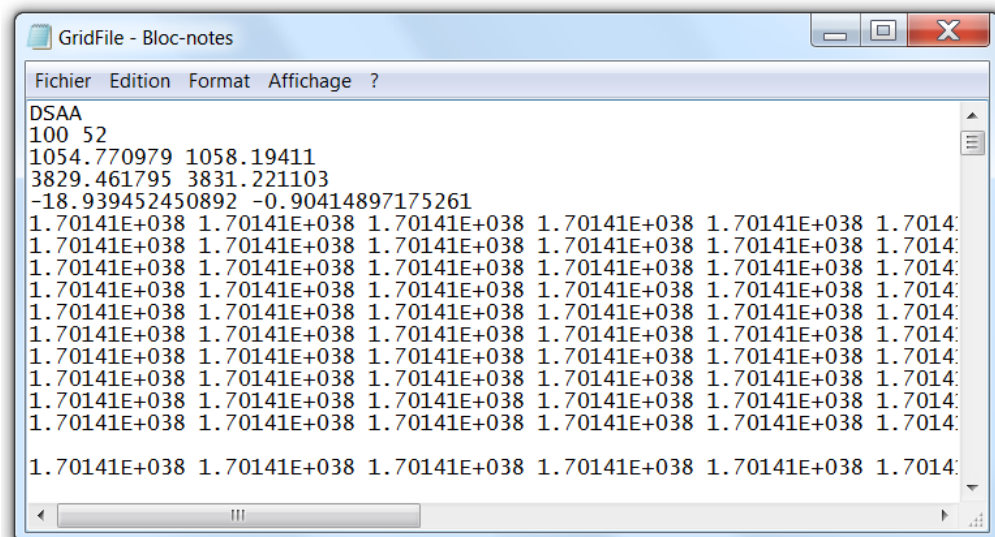
Fig. 4. Grid files structure

Emif file

ENC Viewer enables to open files with .emif extension. These files are generated from .mif files, which are the standard fies created by ENC MIF.

ENC MIF reads 'Land area', 'Depth area' and 'Depth contour' object classes (See appendix A) from ENC, and save data in a .mif file, so that it can be read by MapInfo software, a two-dimensional visualization application. But data contained in .mif files do not contain Z-coordinates, so it is necessary to add them in the file in order to read it by ENC Viewer.

Adding a Z-coordinate implies opening .mif file with MapInfo, then comparing curves from MapInfo and the real map to find the depth that corresponds to each curve. Modifying .mif files leads to the creation of a new extension, for the 'enhanced mif' file, so called .emif.
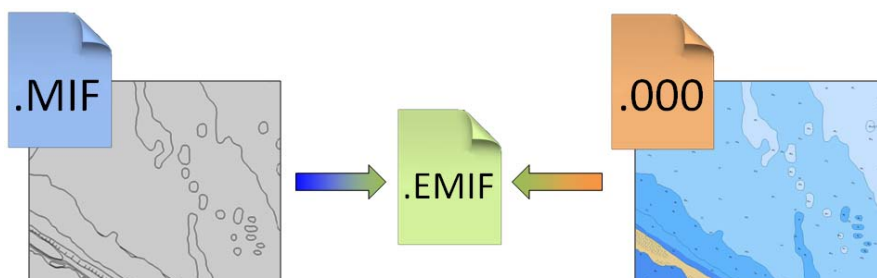

Fig. 5. Emif files creation process

Emif files have the same structure as .mif files, i.e. they are made of geo-metrical entities blocks containing: header of the block, number of points in the geometrical entity, a set of points, arguments for drawing the figure. But in addition to these information, a depth value has been added just after the header in .emif files, as it can be seen in figure 6.
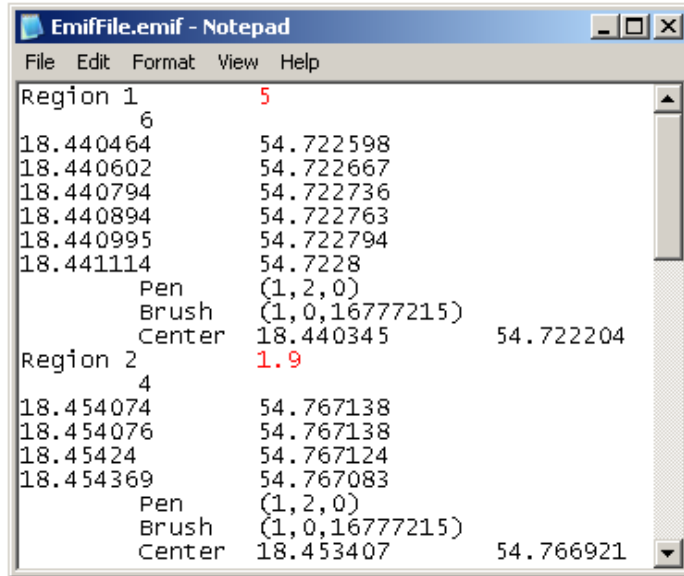

Fig. 6. Emif fies structure

VISUALIZATION OPTIONS

Developing a complex visualization interface is not the aim of the research, so visualization options are quite limited. However, a basic menu has been added to the visualization interface. As a consequence, it is possible to:

— draw wireframe surfaces, or filled ones;
— display land area or not;
— switch on/of light;
— display axes.

Moreover, keys enable displacement on the map, in X, Y and Z directions, and rotation around Z axis. Rotation around a horizontal axis is also possible so as to simulate looking up or down from the viewer's position.

OUTPUT DATA

Visualization is certainly the most important kind of output from generating of digital sea bottom model. But it is also possible, thanks to the checkbox mentioned above, to save data as a grid file. This choice has no impact on visualization, but reduces time for generating a future map, as all calculations are already made and saved.

Depending on the system used for generating, this gain of time might be quite important as computation could need from a few seconds to several minutes. This also depends on the method which is used for modelling: the nearest neighbour method is almost immediate, whereas the inverse distance to a power method can be long, especially if data sources contain a lot of points.

CONCLUSIONS

Generating digital sea bottom models dedicated to S-57 standard have been presented. Indeed, this specification which describes ENC structure is an important source of information for reusing spatial data in algorithms. But it was revealed that other elements could be later used in order to improve modelling: ENC database both contain spatial objects and feature objects that can both play a role in seabed numerical display.

Focusing on the use of spatial items, several ways of modelling appear, and each of them has its own advantages and gaps. Nearest neighbour method is the fastest, Inverse distance to a power is quite easy to set up for a good visualisation, whereas Triangulated Irregular Networks are more complex but the shapes of sea bottom such as peaks, holes or depth contours are well represented. As regards NURBS, they can lead to the more realistic aspect of the terrain, but need a large optimization work in order to be displayed.

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