

A Computer-aided Method for Paper Chart Correction

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1. Introduction

For the safety of navigation, the chart must be accurate and new. But this is not the only matter. The published charts have to be updated by small corrections to keep them the newest to the changes in real world. The small corrections are usually implemented manually by the users according to the directions in "Notice to Mariners". A typical way to correct paper charts is like this:

- The correct or new chart representation (symbols, lines, texts, etc.) is drawn manually onto a medium, usually a piece of transparent paper;
- Many copies of the medium will be made, still onto pieces of transparent paper;
- Each of the copies will be attached to a Notice to Mariners and sent by mail to a sales agent or end user of the charts;
- The correction will be finished manually by the agent or end user according to the new chart presentation on the transparent paper and instructions in Notice to Mariners.

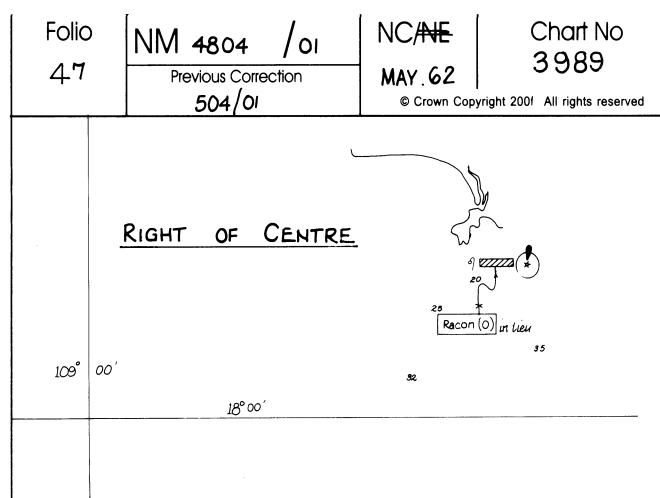


Figure 1. Transparent paper used for small correction

It has been a long dream of the chart publishers and mariners to implement the corrections by the computer automatically. Nevertheless, this problem is so complicated and difficult that no obvious improvement has been reported or seen until our system came into practical use.

2. System Design

The computer-aided paper chart correction system was developed on the support of MapX controls and VB6.0. It is composed of these modules:

- Chart mathematical elements processing module;
- Chart symbol display/drawing module;
- Related-charts automatic correction module;
- The printing/output module.

A control file named “index.ok” is used to record the necessary information for each of the correction figures. The contents of the control file include sheet number, sheet name, scale, projection, fundamental latitude, border, etc.

The chart mathematical elements processing module is one of the most important module of the system. It is designed to establish a satisfactory mathematical basis according to chart projection, based on the equi-distant cylindrical projection grid, which the MapX controls provide, so as to achieve the high precision of correction.

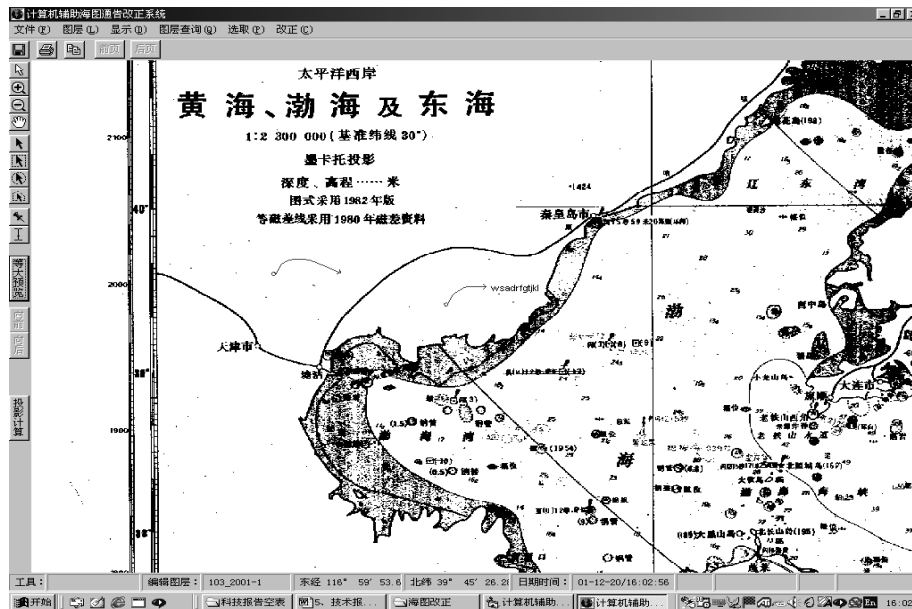


Figure 2. The main interface of the system

The chart symbol display/drawing module is designed in a way that symbols can be freely assembled by the user by means of providing tools to generate and parts of the symbols. This module provides a new method to display/drawing the chart symbol, which could improve the efficiency of this intractable work geminately.



Figure 3. Interface to select symbol by free assembling



Figure 4. Interface to select line styles

The related-charts auto-correction module finds the charts covering the same sea-area at different scale and corrects them in a run. The final result of calculation and manipulation will be printed/output by the printing/output module through a common stylus printer (or a special printer) onto pieces of stencil paper (transparent paper), which will then be sent to the sales agents and end users. The stencil paper will then be used to print the correction presentation onto the paper chart, successfully avoided the burdensome work of correcting the paper chart manually.

3. Tests and Conclusions

Once the system developed, we have tested it for many charts, both as a single sheet and as one of a chart series. The precision of correction on paper chart was also evaluated. The result shows that the position error is under 0.3mm; the printed figures and texts is clear enough to satisfy the requirements of national specifications and the needs of the user; the time consumed is less than current methods and independent of the chart complexity. Perhaps the only limitation to its spread is the steadiness of the stencil paper.

The main advantages and technical progress of the system includes:

- a) The progress of correction method from manual to computer-aided, which makes the work more efficiently;
- b) Providing positioning frame which is exactly the same to the corrected chart's geographical grid of latitude and longitude, at the same time when printing the chart presentation to correct;
- c) The improved efficiency and ease of paper chart correction in time consumed;
- d) The help to the standardization and regulation of chart correction;
- e) The help to the personnel training by decreasing the work complicity;
- f) The new correction method by printing the correct or new chart presentation to stencil papers by a common stylus printer;
- g) The related charts can be corrected in a bunch.

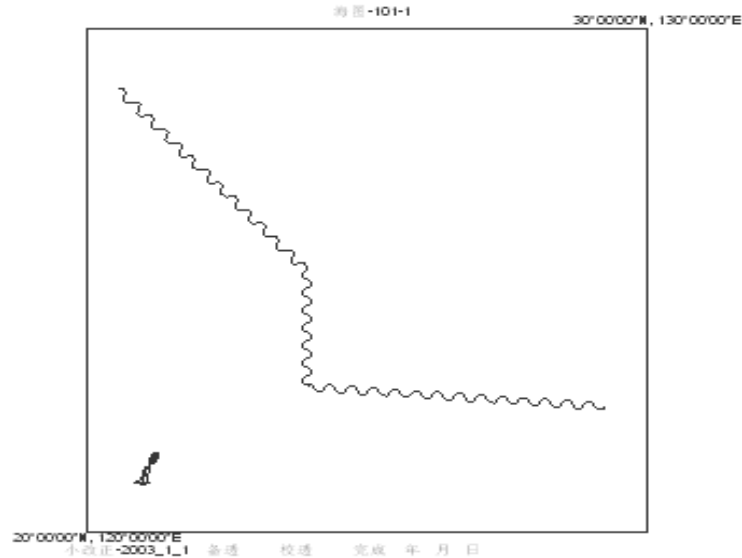


Figure5. The sample of the printed figures

4. References

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Biography

PENG Rencan, professor, Ph.D, Ph.D supervisor, majors in the theories and methods of charting, the development and application of military oceanic geographical information system, and the high precision models and methods of oceanic delimitation based on the earth ellipsoid.