Search and Identification of a Sunken Ship Using a Multibeam Sounding System for Shallow Water – SEABAT

Minoru Tozawa, Coastal Survey and Cartography Division, Hydrographic Department, Japan Coast Guard

The Hydrographic Department of the 4th Regional Coast Guard Headquarters commissioned the survey vessel Iseshio on March, 1999. On June 29 to 30, 1999, the department sent her to search for a sunken cargo ship (497 tons, length 73.4 m, width 11.7 m, and height 7.0 m) in the Irako strait, using a narrow multibeam echo sounder for shallow waters Reson's SEABAT.

This paper reports on the procedure of identifying the sunken ship using the SEABAT system. Remarks on the efficiency of the system applied for identification of a sunken ship have already been reported (Furuichi and Masaoka, 1997). The specifications of the SEABAT system are described in an earlier paper (Kokuta and Nagano, 1996). However, the system (SEABAT8101) on the survey vessel Iseshio was modified with the following features, that differ from the previous SEABAT9001 (mobile type):

- The bathymetric sonar is fixed at the bottom of the vessel
- Frequency: 240 kHz
- Swath width: 150°
- Footprint 1.5° x 1.5° (total 101 beams)
- Bathymetric measurement speed: 10 knots

Discovery of the Sunken Ship

The accident occurred on June 29, 16:56, 1999 in the Irako Strait. The survey vessel Iseshio was dispatched immediately to the accident site, and began the search operation for the sunken ship at 19:50. It was stormy, with an east wind of 18-20 m/s, wave direction was east and state was 5-6, swell direction was east and state was 3. The search operation ceased at 20:30, because the narrow multibeam data obtained on the southerly courses were not good on such conditions. On the next day, June 30, the operation was resumed at 08:50. We searched the area where oil leakage was reported by a patrol boat and an aircraft, and finally recorded the estimated position of the sunken ship on the sea floor of the water depth of 70m at 13:29. We identified the sunken ship by the ship's name using video recording from an ROV during July 1-4, 1999.

Onboard Identification Process

The basic onboard procedures for the search operation included the following:

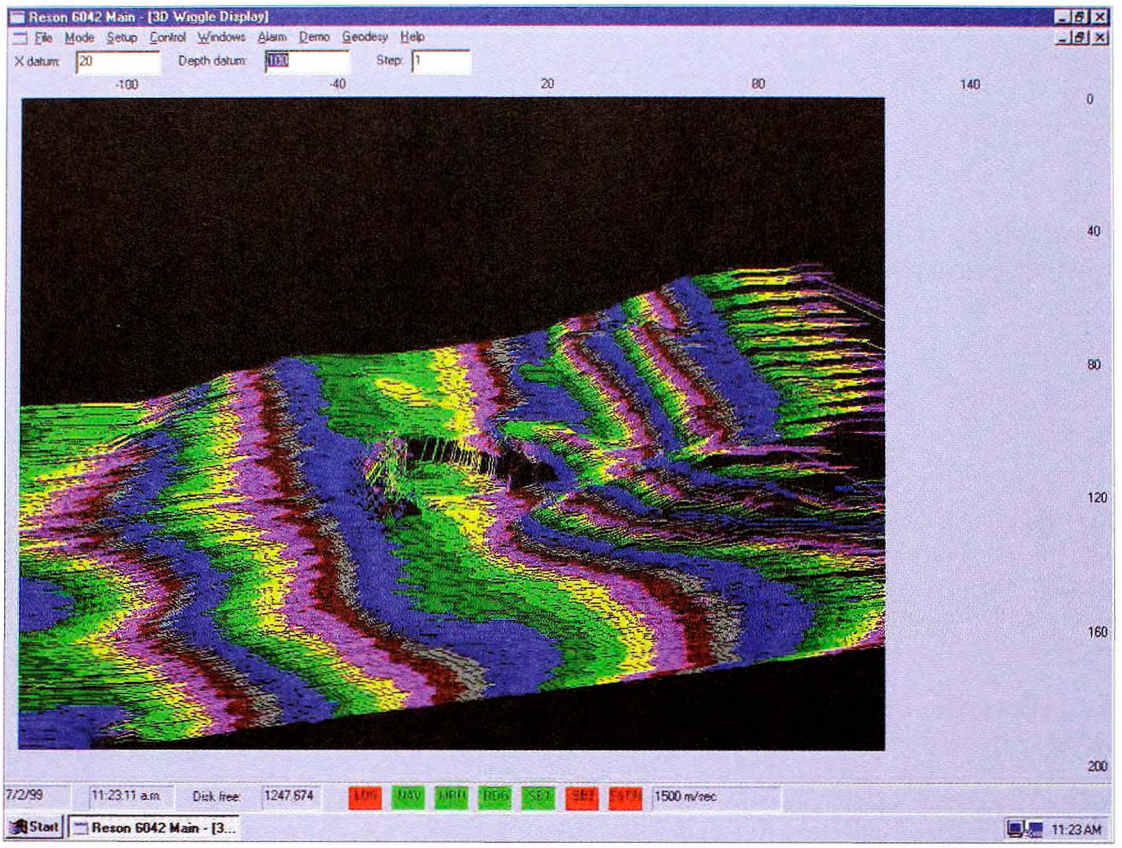

Figure 1: Real time display (3D Wiggle image) of the sunken ship (in the centre)

- Determination of the position of the sunken ship.
- Documentation of the condition of the sunken ship.

In order to determine the position of the sunken ship, a real time display mode (3D Wiggle mode) (Fig. 1) of SEABAT was used for identifying and digitising the sunken ship image (in the middle of the display; Fig. 1).

In order to document the status of the sunken ship on the sea floor, the following charts were prepared from the SEABAT bathymetric data:

- Iso-depth chart
- Bathymetric chart
- 3D image chart
- Perspective chart (a whale eye view image)

Iso-depth Chart

1 m grid bathymetric grid data were employed for the iso-depth chart whose scale is 1/200. The ship outline was drawn to understand the general status of the sunken ship.

Bathymetric Chart

Two bathymetric charts, 1 m stepwise drawn colour mode (Fig. 2) and horizontal curved line mode (Fig. 4), were made. In the stepwise drawn colour mode, the ship's shape is explicitly recognised with the bow (31 m long), central part of the hull (13 m long), and the stern with bridge (20 m long). Careful colour selection provides a good effect for recognising the ship's outline. The bathymetric chart by the horizontal curved line mode was made by a GIS software MicroImage's TNTmips, and shows the difference

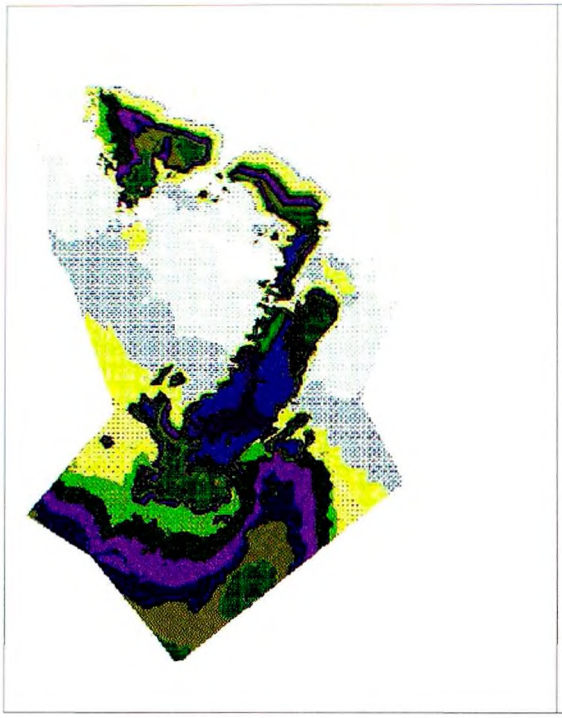

Figure 2: The sunken ship in a stepwise drawn colour mode

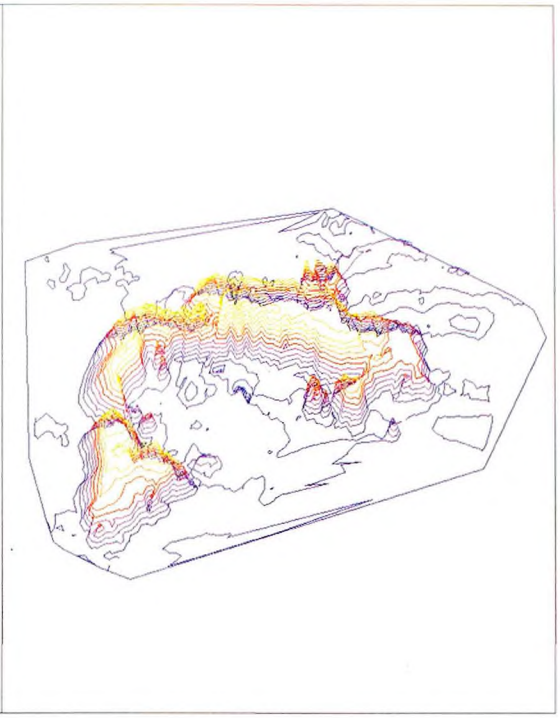

Figure 3: Stereographic view image (from the west)

between the bathymetric data (1 m x 1 m grid interval) before and after the accident. The positions of the bridge and hatch were determined by the profiling function of TNTmips, and are drawn in green. The outline of the hull of the sunken ship is drawn in watery blue, showing the jagged concave damage at the bottom of the bow and a bend of 10° in the centre of the bow.

3D Image Chart

The 3D image chart (Fig. 3) shows a 3D expression of the horizontal curved line mode, using a GIS program TNTmips.

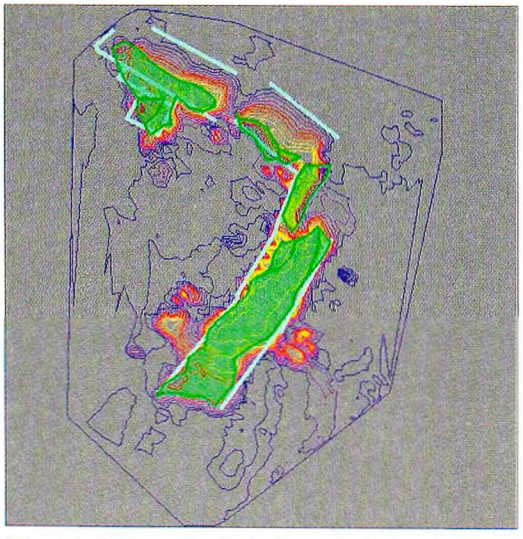

Figure 4: Contoured display of the sunken ship

Perspective chart (Whale Eye View Chart)

The perspective chart (whale eye view chart) (Fig. 5) was made at the Ocean Research Laboratory of the Hydrographic Department using the SEABAT bathymetric data. An explanatory outline of the sunken ship is added on the image.

Recommended Documentation for Sunken Ship Search Operations

We could successfully carry out the sunken ship search operation under the severe weather condition this time. This is because the system reported this time needs no towed objects, which is in contrast to the conventional method using side-scan sonar. It is necessary to identify if the SEABAT data obtained are for the sunken ship we are searching or not. As for this

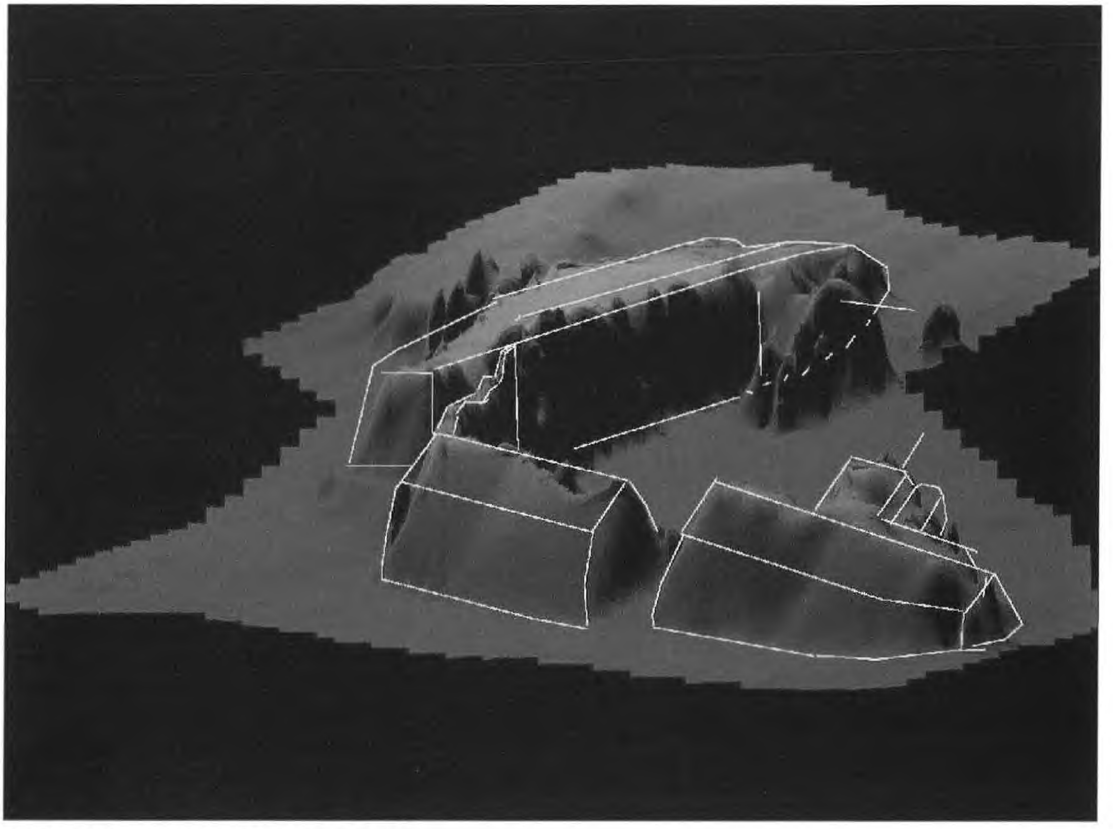

Figure 5: Whale eye view chart (from north)

time, we happened to survey the same area as the ship sunken a week before the accident. Thus, the previous bathymetric data enabled us to identify the sunken ship by comparing the newly acquired data in the early time of the search operation. In the real time display mode (3D Wiggle mode) (Fig. 1), the sunken ship is expressed in black and steeply rises from the sea floor, contrasting from the natural sea floor feature (rocky terrain) on the right. This black colour is a guide to identify a sunken ship during a search operation. The first step for the sunken ship search operation should make a stepwise drawn colour mode bathymetric chart. This will enable us to recognise the condition of the sunken ship, which is an initial goal of the operation. The second step will involve detailed analyses of the inclination of the ship's hull etc., using a horizontal curved line mode bathymetric chart made by TNTmips. As for the stereographic chart, the perspective chart (whale eye view chart) gave a better expression than the iso-depth line stereographic chart for showing the incident to those who were concerned.

Acknowledgement

For the whale eye view chart, the authors appreciate very much the assistance of Dr. A. Asada in supplying the original drawings and final chart.

Biography

Minoru Tozawa is senior coastal survey officer of Coastal Survey and Cartography Division, JHD. He served as Chief of Hydrographic Division of Regional Hydrographic Department in Nagoya.