HYDROGRAPHIC AUTOMATION : A REPORT FROM SEA

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INTRODUCTION

The purpose of this article is to render a report from sea, as suggested by Admiral RITCHIE [1], on the automatic guidance and logging system (figure 1), as fitted in S.A.S. *Protea*, which was described by the Hydrographer of the South African Navy [2]. The system was designed by the British firms Decca and Hovermarine for high speed control and logging in a hovercraft. It will be discussed under the following three general headings: Control, Logging, and Planning.

CONTROL

The system offers ship guidance in three different modes which can be loosely termed:

(a) *Pattern guidance* in which the ship is automatically constrained to any Decca main chain or Decca Lambda lane line specified by the surveyor. It contains a preset rate of turn, in degrees per second to the next lane, on the Seatrack Unit.

(b) *Parallel track guidance* where the extremities of a central track, together with the track separation distance, are specified to the Decca Omnitrac type 70 computer. The surveyor can then select any one of 21 parallel tracks. The ship will automatically acquire the selected line, and at the end of it turn onto the next selected line.

(c) *Ferry mode* where the surveyor defines three way-points by supplying the computer with their coordinates or pointing out the position to it on a true-to-scale chartlet. When the ship arrives at way-point 2, the computer updates; way-point 2 becomes the new way-point 1 and 3 becomes 2. A new way-point 3 can then be specified.

The equipment was designed to control the ship with both Decca Lambda and the main navigational Decca chains around the coast of the

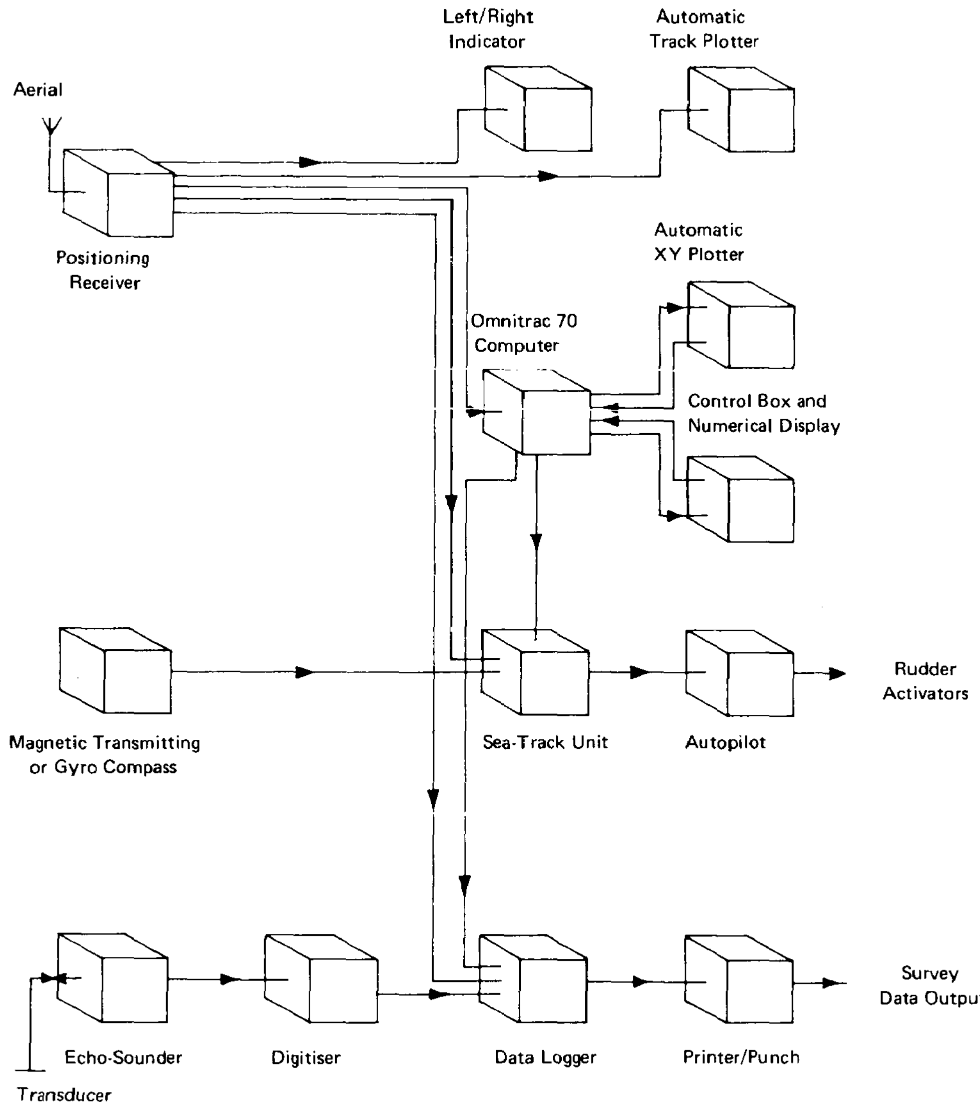

FIG. 1. — Main equipment.

Republic of South Africa. In practice it was found, however, that because of the positioning and orientation of the main chains on these coasts it was not sensitive enough for positive control. Because a large proportion of the ship's tasks consists of investigating reported shoal soundings, this is very disappointing. It is normal to make use of the main chain facility during these investigations because of the time and labour involved in erecting and/or shifting the ship's own Lambda chain.

Line acquisition, particularly in pattern guidance, is a hit and miss affair. Before acquiring a lane the ship must be within 25 hundredths of a lane and within two and a half degrees of the course to be steered on the lane before the system will lock on without difficulty. Even then the ship sometimes has a nasty tendency to take a sheer before settling down, because the incoming signal from the navigational aid does not appear to be smoothed before it enters the Seatrack Unit. A smoothing circuit is fitted in the Seatrack Unit but appears not to function properly. This results in occasional violent reactions by the autopilot on the rudder.

To overcome this difficulty it was necessary to restrict severely the rudder angle on the autopilot once the lane is acquired. This necessitated lengthening the lines by at least one mile so that the ship would have settled down by the time the survey area is entered. The present rate of turn on the Seatrack Unit could preferably have been defined in terms of rudder angle instead of degrees per second.

In *parallel track* the line acquisition was easier by following a set procedure. Whilst on a line it is again necessary to restrict the rudder angle to prevent a large rudder movement upsetting the control during a momentary invalid signal. At the end of a line it also needed that extra mile for settling down onto the next line. For long lines between 10 and 30 miles, normally run by the ship in her coastal survey role, this is acceptable. On shorter lines the visible waste of time at the ends of lines leads to frustration.

Ferry mode guidance was successful during initial trials in the Firth of Clyde and off Portland in British waters, where the control by the Decca main chains was reasonably positive. It was found that the settings on the Seatrack Unit had to be very sensitive which then initiated a turn a little too early and slid the ship only gradually onto the new line. This is certainly more accurate than normal navigation. On the South African seaboard guidance is sufficiently positive only with Lambda control, so few opportunities have been presented to test this mode; it is felt however that it offers few advantages.

To assist in the guidance there are two plotters, the pictorial display-head and the Decca type 8991C track plotter, which respectively give true-to-scale and relative hyperbolic position. Because of the system employed, the track plotter cannot be used with Decca Lambda in the range - range mode, and only on very large scales in the hyperbolic mode. It can be likened to a clever tartan plot and is very useful in that role.

The display-head, of aircraft roll-chart design, is very useful. The roll-chart can be laid over any navigational chart or relative plot and the information traced. The coordinates of the two extreme points are then defined on the computer. The chartlet then becomes a true-to-scale plot, and the actual scale can be obtained from the computer. The major drawback of this plotter is its size. It is only 22 cm wide; a more useful size would have been a width of about 60 cm.

In conclusion it can be said that although the control equipment was designed for a fast craft it is equally adaptable to a slow one. All the problems encountered could be solved by altering the degree of sensitivity and the rates of applying rudder and counter-rudder on the Seatrack Unit.

LOGGING

The logging of data, time against position (both hyperbolic and x, y) and depth, is accomplished by a Decca punchlog driving a paper punch. For a check on the logging side a duplicate logger, the Decca printlog driving a Creed teleprinter, is supplied. This supplies a printed copy of the information but can also punch paper tape. Reference has been made by WEEKS [3] to the inherent inefficiency of this particular system because it is a logging system only.

The printlog does not of course supply a check on what is being recorded because it is a completely separate system. The only check on what is being recorded by the punch is that the information received at the punchlog can be displayed visually on it, one parameter at a time. This leaves the ship with only one logging system, and the consequences of its failure are obvious.

A problem not foreseen at the time of installation is that of vibration. To increase the speed of the original design the ship's propulsion was changed from diesel-electric drive to a straight diesel drive into a central gearbox and a single KaMeWa controllable pitch propeller. This modification causes severe vibration throughout the whole ship, and it is of course known that punch mechanisms do not like vibration. The problem of humidity is overcome by a duplicated system of air conditioning in the bridge plotting room.

The system was recently converted to supply a check on what is being recorded, the punch of the punchlog being replaced by another Creed Envoy teleprinter. These printers are also used in the wireless office and do not appear to be affected by the vibration; however, they are individually shock mounted. A switch isolates the print side from the punch. The information to be logged will then be punched by the teleprinter. To take a direct sample of what is being recorded it is necessary only to switch in the print side to get a printout of the sequence being recorded by the punch. Sections of the recorded tape can be run through another printer to sample the actual functioning of the punch if necessary.

Immediately objections will be raised that both the printlog and the Creed Envoy printer are too slow to record all the necessary information for successful processing of the data. The answers are that the system had been designed for a vehicle travelling at 30 knots plus, whereas the ship operates at 13 knots. It must also be considered that the ship invariably operates in deep water, using scale 3 of either the shallow Atlas echo sounder (0-280 m) or the deep Atlas echo sounder (0-1 400 m). On these scales the sampling rates of the echo sounders are respectively 2.5 soundings per second and one sounding every two seconds.

Virtually all z coordinates can therefore be coped with in this system for all practical purposes. If necessary, only hyperbolic coordinates need to be logged, and the x and y coordinates can be dispensed with. This will reduce the contents of a recording sequence by 16 digits and increase the speed of recording correspondingly.

PLANNING

The programming of the computer to process the data ashore is going ahead without any major drawback. It is of course a new field for the data processing people, and the usual teething troubles are being experienced. It is thought that for at least the initial stages of the programming, a person with the appropriate background should have a hand in the operation. For this reason a South African Navy survey officer recently completed training to speak the same "language" as the computer people, and this has proved of great value. It also helped to overcome a fear that quality is sacrificed in the course of processing.

Still at the planning stage is an on-line computer for the onboard system. With the computer it will be possible to perform initial editing of the z coordinates before logging. In this way considerably more z coordinates can be processed without overloading the shore facilities. This should also ensure a more accurate end result.

The on-line computer will also drive a plotter to present the logged, edited data visually to the surveyor. This will bring control of a survey back into the hands of the man on the spot, who is best qualified to make the necessary decisions. It has not yet been decided whether it will be a flatbed or a drum plotter. For reasons of cost, space and computer matching it will probably be a drum plotter. More confidence will thus be generated in the system.

REFERENCES

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[3] WEEKS, C.G. McQ. : Autocarta for hydrographic surveying. *Int. Hyd. Rev.*, Vol. LI, No. 1, page 175, January 1974.