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PC-BASED ECHO INTEGRATION SYSTEM FOR FISH BEHAVIOUR STUDIES

by

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ABSTRACT

An echo integration system presenting the distribution and vertical and horizontal movements of fish in net pens, is described. The system can be configured to multiplex up to 16 transducers sequentially. The number of integration layers and pings integrated are optional. Results are presented in real-time on a color monitor and saved on disk for later analysis. Based on standard personal computer technology, the method is inexpensive compared to other methods.

INTRODUCTION

The experience from echo integration at sea has given new aspects for using this technique in order to observe the behaviour of fish. Experimental setups for fish behaviour studies, where stimuli were imposed on fish and reaction observed, have been carried out using traditional equipment manufactured for use on moving vessels (Ona and Beltestad 1986). This equipment served the purpose, but in a rather cumbersome way. Readings of integrated values and switching between transducers had to be done manually, and the accuracy became quite rough.

Also in aquaculture, knowledge about the distribution and vertical and horizontal movements of fish in the pens, is important in connection with e.g. development of optimal feeding regimes. The possibility of using several transducers, choosing the number of pings in each integration period, and how many layers the integration interval is devided into, are here important features.

SYSTEM DESCRIPTION

With our requirements for a flexible system, where data also should be easily saved and retrieved, the idea of using PC-based equipment was natural. Thorfinn Lindem, Department of Physics at Oslo University had been working with this technology for many years. In cooperation with us, a system especially designed for aquaculture studies was made (Fig.1). This system gives the option of using many transducers and can easily be configured for special setups.

Acoustics:

In our experiment, two 70 kHz transducers with a beam angle of 22° are connected to one Simrad EY-M echosounder via a multiplexer. The multiplexer enables us to monitor up to 16

fish pens with only one echosounder. They are mounted on a gyro suspension 4 meters under the pen.

Interfaces:

The echosignal is fed through an interface which filters and converts it to a DC signal. Both signal gain and trigger level are adjustable. The envelope curve and trigger pulse from the interface goes to an A/D-card in the PC. This interface is an interrupt controlled card with a sampling rate of 10 kHz. To choose transducers, a digital output card is used. This card also triggers the echosounder.

Computer / software:

The computer used in this system is an IBM-compatible PC which controls the multiplexer and captures data from the A/D-card (Fig. 2). All samples are squared and summed for each depth interval. Minimum sampling interval is 7 cm, but since the pulse length of our echosounder is .6 milliseconds (equivalent to .86 m.), the integration layers should be at least 1 meter.

Each transducer is scanned sequentially, and the program calculates the integrated value per layer for a specified number of pings. The results are saved on disk with a timestamp for later retrieval and analysis. At the same time the user is given a real-time presentation of the fish distribution. For further analysis, standard PC-software can be used.

PRELIMINARY RESULTS

In experiments in marine net pens where environmental events and parameters have been registered in conjunction with fish movements, the system has given interesting results in the short period it has been used. Diurnal variations in fish distribution and the effect of environmental variation, are

being studied e.g. in connection with different feeding strategies.

With automatic switching of transducers and logging of data on disk, the system can work continuously, without human interaction between initialization and stopping. Online graphical presentation on a color monitor, and possibility of using the PC when analysing the data, e.g. with a spreadsheet program, makes it a powerful tool in behavior studies. It is also very inexpensive compared to traditional equipment (10 - 20%).

A flexible system as described, would also be convenient when used on a moving ship. We are currently working on a system designed for use on our small research vessel, where speed log and bottom stop is included.

REFERENCES

Ona, E. & Beltestad, A.K., 1986. Use of acoustics in studies of fish reaction to imposed stimuli. Modeling, Identification and Control, 1986, 7(4), 219-226.

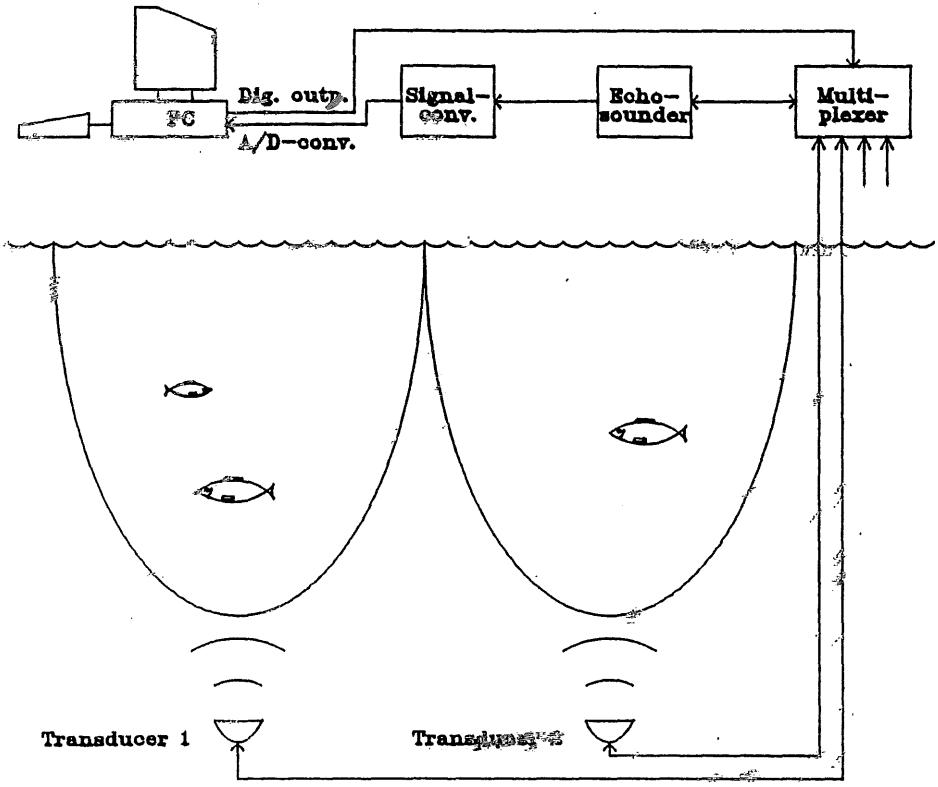
PC
Dig. outp.
A/D-conv.
Signal-conv.
Echo-sounder
Multi-plexer
Transducer 1

Figure 1.

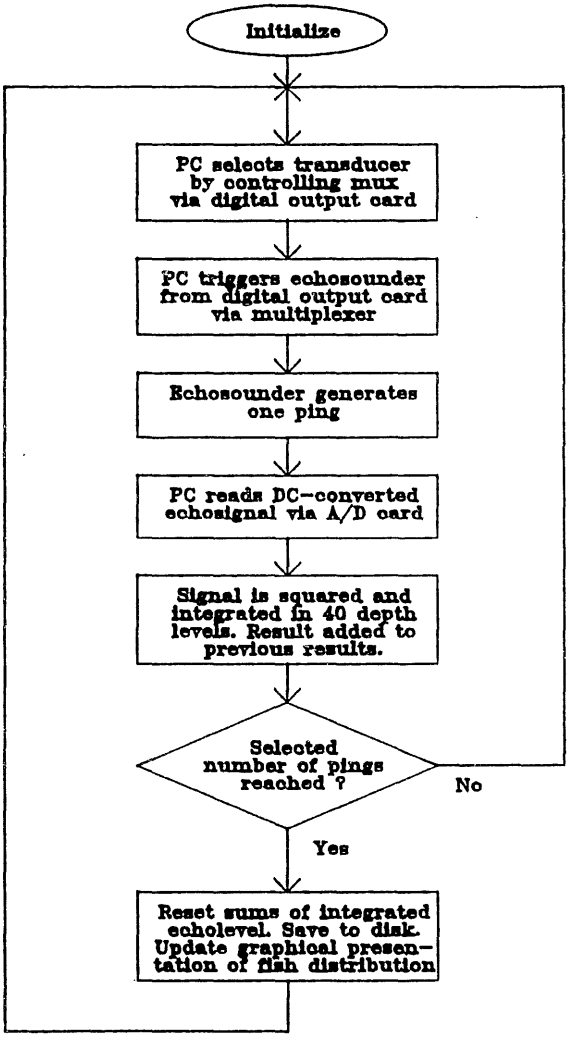
Initialize
PC selects transducer by controlling mux via digital output card
PC triggers echosounder from digital output card via multiplexer
Echosounder generates one ping
PC reads DC-converted echosignal via A/D card
Signal is squared and integrated in 40 depth levels. Result added to previous results.
Selected number of pings reached ?
No
Yes
Reset sums of integrated echolevel. Save to disk. Update graphical presentation of fish distribution

Figure 2.