Research on Measurements Method for Fish School Migration Velocity Based on Five-beam Phased-array

Chao Li, Haisen Li, Weidong Du*
Acoustic Science and Technology Laboratory, Harbin Engineering University
dwd361@163.com

Introduction

The frequency shift in a transmitted signal caused by movement of fish schools relative to a signal acoustic projector (fd) was used to study radial swimming velocities relative to the water as a function of time:

\[ f_D = f \frac{v(t)}{c} \]

\( f \) is the frequency of the transmitted signal and \( c \) is the speed of sound in the water. If the fish velocity vectors were at an angle to the acoustic beam axis \( \alpha \), a Doppler shift would have resulted:

\[ f_D = 2f \frac{v(t)}{c} \cos(\alpha) \]

Methods

Scheme of five-beam phase-controlled transmitting and receiving. According to simulation results, when the weighting factor is 0.35, phase-controlled beam pattern obtained is shown in Fig(a), and transmitting scheme of phased-array is given in Fig(b).

Aim

In order to obtain the migration direction and velocity of fish school and other information, it is an effective way using Doppler effect generated during the migration.

Advantage

To overcome the restrictions of traditional Janus configuration transducer only have four peripheral beams, five-beam phase-controlled method of plane phased-array used by fish-finder is presented.

The acoustic scattering model of fish is established, the echo of fish school contained velocity is simulated. Velocity information is obtained through calculating frequency shift for simulated echo of fish school.

Conclusion

The five-beam transmitting and receiving of phased-array is presented, the problem that traditional phased-array can transmit only four peripheral beams is solved effectively, the measured results show that this method is effective. Then, the acoustic scattering model of fish school is established containing swimming speed information, frequency shift for echo of fish school is calculated, thereby velocity of fish school is obtained, which indicates that the method is reliable.