Research and Implementation of Bistatic Sonar Positioning System Based on Vector Hydrophone

Introduction

This paper presents the research and design of active bistatic vector positioning system. The positioning system uses a low frequency active sound source. The vector hydrophone natural combined directivity is applied to suppress the strong direct path interference and the following reverberation. Simulation researches results and lake trials data processing demonstrate the effectiveness of these new methods.

Time-Reversal Correlation of the Symmetrical LFM Signal

Time-reversal correlation technique is adapted to detect target echoes, aiming to suppress noise and interference to improve the processing gain. And thereby, it can improve the target echo time-delay detection accuracy and orientation estimation accuracy.

The Suppression of Direct Path Interference

Vector hydrophone is combined by traditional and omni-directional pressure hydrophone and natural dipole independent on frequency. The vector hydrophone natural combined directivity is applied to suppress strong direct path interference. The vector hydrophone received acoustic signal can be expressed as:

\[
p(t) = x(t)
\]

Combine two orthogonal velocity parameters as:

\[
v_c(t) = \rho \psi \sin \psi \cos \beta + \rho \psi \sin \psi \sin \beta = s(t) \cos(\theta - \psi)
\]

Then, adjust the angle \( \psi = \beta \) and the above equation is equal to 0. Thus, the strong direct path interference can be suppressed.

Researches Results

The active bistatic vector positioning system designed in this paper is of great applications in engineering. Many methods proposed are applied in the designed system. The detectability of time-reversal correlation processor is better than the match-filter processing in underwater acoustic channels. Simulation researches results and lake trials data processing validate the effectiveness of these new methods.