Error Analysis of Inverse Algorithms for Reconstructing the Acoustic Parameter Profile of Layered Media

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Abstract: Reconstructing the parameter profile of layered media is concerned with the telemeter of tiny structure in hydrology, oil exploration and the position selection of petroleum platform in the ocean. An inverse scattering experiment of thermocline has been done in 1992. The inverse results by the sample iteration algorithm and DC algorithm quite agreed with the data measuring by the CTD instrument. A deep going discussion in the aspect of reliability is presented in this paper. The result of a model inverse experiment shows that the errors cause by algorithms itself and signal processings are not so critical if the improper problem was not pay attention enough.

1. INTRODUCTION

Reconstructing the parameter profile of layered media is concerned with the telemeter of tiny structure in hydrology, oil exploration and the position selection of petroleum platform in the ocean.

An inverse scattering experiment of thermocline has been done in 1992. Fig. (1) A and B are the inverse results by the sample iteration algorithm and DC algorithm. Both of them agreed approximately with the dotted line measuring by the CTD instrument. But it is still an open question. In this paper, an analysis on the aspect of reliability is presented.

2. ANALYSIS OF INVERSE ERRORS

The major reasons causing inverse errors are:
[2.1] Inverse errors cause by algorithms themselves.
[2.2] Inverse errors cause by the signal processing
[2.3] Inverse errors cause by improper problems

In order to observe the influence upon the inverse error cause by improper problems, a model experiment has been done in a multistage sound tube. Its basic frame is shown as Fig.(2). The material in (a) layer is water. The second layer (b) is filled of glycerine and the third layer (c) is the pedestal. Fig.3 is the inverse result with the underwater spark source. It shows that the parameter value of the profile in second layer was risen progressively.
For searching the reason Brekhovskikh's method \(^5\) was adopted to create scattering emulation signals as Fig.4. If the sound absorbility \(\alpha\) in second layer was set from zero rise to \(11 \times 10^{-15} \text{NP} \cdot \text{S}^2/\text{M}\). The correlation between the measured signal and the emulative signal will increase from 0.879 to 0.973. So we infer that the parameter profile rising in second layer is causing by the absorbability in glycerine. It goes without saying that the errors cause by algorithms itself and signal processings are not so critical if the improper problem was not pay attention enough.

REFERENCES