PREDICTIVE TECHNIQUES FOR MARINE MULTIPLE SUPPRESSION

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ABSTRACT

Standard predictive multiple suppression techniques in marine reflection seismology usually resort to one-dimensional assumptions about the underlying earth model. This thesis develops a number of predictive suppression methods based on a multiple model which relaxes these requirements of zero offset and zero dip, yet assumes vertical incidence propagation in the water layer. This culminates in a method called "seafloor-consistent multiple suppression" - a name chosen by analogy to the "surface-consistent statics" problem of reflection seismology.

The seafloor-consistent method models each seismic trace as a convolution of an average frequency response with anomalous shot, geophone, midpoint and offset responses. In the log-frequency domain, this becomes a separable, additive model which can be solved by linear least-squares techniques. The anomalous responses are solved for each frequency in "shot-receiver" space with frequency as the outer loop of the algorithm. Since one can argue on physical grounds that the reverberation response for any particular trace must be minimum phase, it suffices to solve only for amplitude responses and ignore phase contributions.

The method is applied to a marine seismic line from the Flemish Cap area of the Labrador Sea with extremely encouraging results.

The second part of this thesis uses the concept of a replacement medium - specifically, a replacement impedance medium, to develop a theory of multiple suppression valid for all angles of offset and dip. A generalized wave equation dereverberation operator is derived which includes the effects of wave propagation, seafloor reflectivity, and shot and receiver ghost responses. Most current methods of predictive multiple suppression are shown to be approximations to this general operator.

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TABLE OF CONTENTS

LIST OF FIGURES