MATHEMATICAL METHODS FOR THE SEISMIC INVERSION PROBLEM

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1. INTRODUCTION

The class of problems known as geophysical inversion problems is one in which measurements are made at points on or above the earth's surface, and mathematical techniques are used to infer something about the geophysical properties of the region under study from these measurements. One example is the problem of simultaneous earthquake hypocentre location and velocity structure determination. The data consists of seismic measurements taken at an array of recording stations on the surface. The "velocity structure" refers to the velocity of propagation of compressional shock waves through each point of the three-dimensional region in which the earthquakes and recording stations lie.

The problem (hereafter referred to as the seismic inversion problem) is essentially one of fitting the data obtained from hypothetical velocity structure and earthquake locations, to the observed data. Since in general it is impossible to completely specify the velocity structure using a finite number of parameters, we will always have an infinitely underdetermined problem. One approach, then, is to apply the parameter separation technique of Pavlis & Booker [9] to obtain a set of equations in which the velocity structure is the only unknown. These equations are used to parametrize a number of three-dimensional subvolumes (or "windows") within the region of interest, and to estimate the average velocity within each of these subvolumes. Parametrization of the unknown function which describes the velocity model is not directly attempted. This