ID: 9.1f

Title: An Identification of Geological Boundaries Using First-order Adjoint Equation Method

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The purpose of this research is an identification of geological boundaries of the elastic body using first-order adjoint equation method. In this research, we employ the analytical domain which has two variant elastic moduli separated by the boundary plane located in the domain. In this paper, the position of boundary plane is identified. The zonation problem is considered as a minimization problem to find the boundary potions so as to minimize the performance function. The performance function is defined by the square sum of discrepancy between the calculated and observed velocity. In order to determine the boundary plane minimized the performance function, it is necessary to calculate the gradients with respect to the propagation quantities of the boundary plane. Therefore, we introduce the extended performance function using the Lagrange multiplier. In order to minimize the performance function, the first variation of the extended performance function should be zero. It is called stationary condition. Following the condition, the adjoint equation, terminal conditions, and the gradients can be obtained. Then, applying the wighted gradient method as a minimization technique, the boundary plane minimized performance function is found. In this research, to express geological characteristic of the ground, linear equations are employed. The finite element method and the Newmark beta method are applied as the spatial and temporal discretizations, respectively. We carry out following the numerical study. We verify the identification method. In the verification, the observed velocity is computed by the dynamic analysis of application model. In the dynamic analysis, we set the boundary plane as the target values. We verify whether the position of boundary plane is coincided with the target values or not from the assumed initial values.