P054 WEATHERED LAYER CORRECTIONS IN COMBINATION WITH WAVEFIELD DECOMPOSITION

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Introduction

The disturbing influence of the weathered layer can deteriorate the result of all further data processing steps significantly. It is therefore important to remove these influences in the surface-related pre-processing step. Traditionally these corrections are called 'static' corrections, because they generally consist of time shifts applied to the seismic data. In more advanced schemes weathered layer corrections are not restricted to time shifts only. Also amplitude decay and occasionally, when detailed information about the weathered layer is available, a wave equation based correction is carried out. In this paper we investigate to what extend the conventional static corrections are adequate and how an elastic wave equation based solution of the weathered layer should be implemented as part of a pre-processing scheme.

Correction techniques

In solving the weathered layer propagation problem three principal aspects can be distinguished:

- Estimation of the propagation parameters of the weathered layer.
- Elimination of the propagation effects.
- Transformation to a new datum.

Conventionally the static correction process consists of time-shifting every seismic trace independently, assuming vertical propagation through the weathered layer. Generally it is sufficiently accurate in cases of low weathering velocities and a thin replacement layer. In other cases a more exact method should be used.

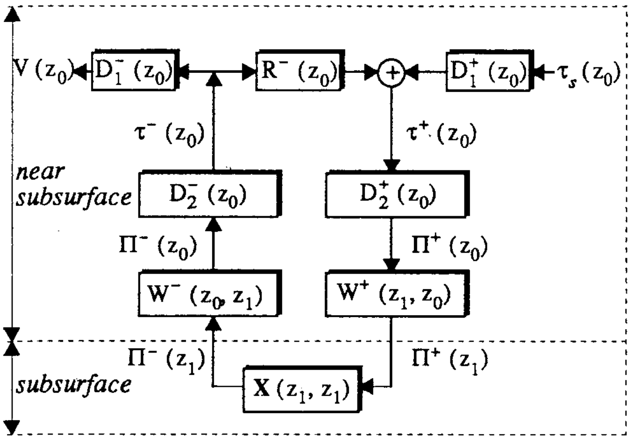
Forward models

In Fig. 1 a forward model is given (the so-called DELPHI model) which includes the propagation influence of the weathered layer. In this model $\mathbf{D}_1$ and $\mathbf{D}_2$ are the first and second decomposition operators that decompose the total wavefield in up- and down going waves, and P- and S-waves respectively. $\mathbf{R}^- = -\mathbf{I}$ is the traction reflection matrix of the free surface. $\vec{\Pi}$ represents the P- and S-wave fields and $\vec{\tau}$ the traction wave fields. According to Fig. 1 the weathered layer influences are defined by

$$\vec{\Pi}^+(z_1) = \mathbf{W}^+(z_1, z_0)\vec{\Pi}^+(z_0), \tag{1}$$

$$\vec{\Pi}^-(z_0) = \mathbf{W}^-(z_0, z_1)\vec{\Pi}^-(z_1). \tag{2}$$

Alternatively we can place the weathered layer propagation operators before the decomposition operator $\mathbf{D}_2^+$ at the source side and after the decomposition operator $\mathbf{D}_2^-$ at the receiver side (see Fig. 2). The weathered layer propagation matrices $\mathbf{W}^{\pm}$ have in this scheme not a simple expression, because the propagation is now carried



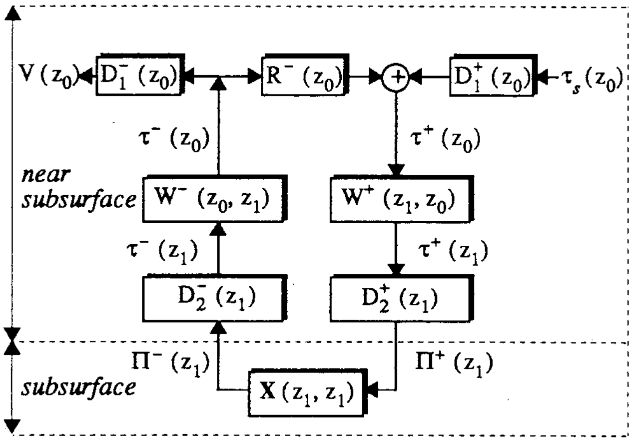


Fig. 1 The forward model which includes the weathered layer influences.

Fig. 2 An alternative forward model with the weathered layer influences placed in it.

out on traction fields in stead of on P and S waves. On the other hand the second decomposition into P- and S-waves is now done at the depth level z_1, which lies below the disturbing weathered layer.

The propagation matrices $\mathbf{W}^{\pm}$ have in the conventional static shift technique a simple structure; only the diagonal elements of the propagation matrices contain non-zero elements. This simple structure is due to the assumption of vertical propagation through the weathered layer. If non-diagonal elements were present in the matrix then non-vertical propagation would be taken into account.

Another consequence is that by assuming vertical propagation the structure of the propagation matrices $\mathbf{W}^{\pm}$ in the forward models given in Fig. 1 and Fig. 2 is not different anymore. The position of the propagation matrix could then be interchanged with the decomposition operator $\mathbf{D}_2^{\pm}$ due to their diagonal structure.

The advantages and disadvantages of the models given in Fig. 1 and Fig. 2 will be further described during the presentation.

References

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