Phase matched filters to remove surface wave noise from converted P-SV data

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INTRODUCTION

One of the greatest difficulties in obtaining and processing good quality shear wave sections is overcoming the effects of surface waves (Corbin et al., 1983). Generally, in land seismic exploration, surface waves (ground roll) should be attenuated by geophone arrays. Due to varying physical surface conditions, the desire to record non-normal incidence signal and the expense of three-component geophone arrays, the procedures in the field may be inadequate for eliminating this unwanted noise from the seismic records. Processing techniques such as frequency filters, multichannel filters and polarization analysis is often required. Conventional frequency and multichannel filters often effect the vertical resolution of seismic data due to the overlap frequencies of ground roll and reflection data (Saatçilan and Canitez, 1988).

Rayleigh waves are the dominant surface waves recorded on vertical and radial components found in exploration seismology. These waves are nondispersive in the classical case of propagation along the surface of an isotropic homogeneous half space. However for the real earth case of layered medium Rayleigh waves are dispersive and multiple modes are possible (René et al., 1986). An example of these modes for the vertical component of walk away data is shown in Figure 1.

It is well established that P-wave, S-wave, Rayleigh waves and Love waves have distinct polarization patterns. (Aki and Richards, 1980) Three dimensional polarization analysis of the vertical, radial and horizontal components can separate the elliptically polarized Rayleigh waves from the radial component seismic data (Vidale, 1986, Samson and Olson, 1981).

A more recent method of ground roll attenuation makes use of the dispersive character of the Rayleigh wave (Bereford-Smith and Rango, 1988, Saatçilan and Canitez, 1988). These ideas were originally applied to earthquake seismology to identify and enhance Rayleigh wave signals (Herrin and Goforth, 1977). By applying one dimensional, linear frequency modulated matched filters promising results have been demonstrated for compressional wave data as shown in figure 2. The vertical resolution is not compromised. Further, the uniform weighted stacking assumed in multichannel filters (such as a velocity filter or radon transforms) is not made.

PROPOSAL

It is proposed to study the use of phase matched filtering for P-SV converted wave sections to remove unwanted surface wave noise. In addition the polarization analysis may readily identify these dispersive waveforms to automatically determine the adaptive phase matched filters.

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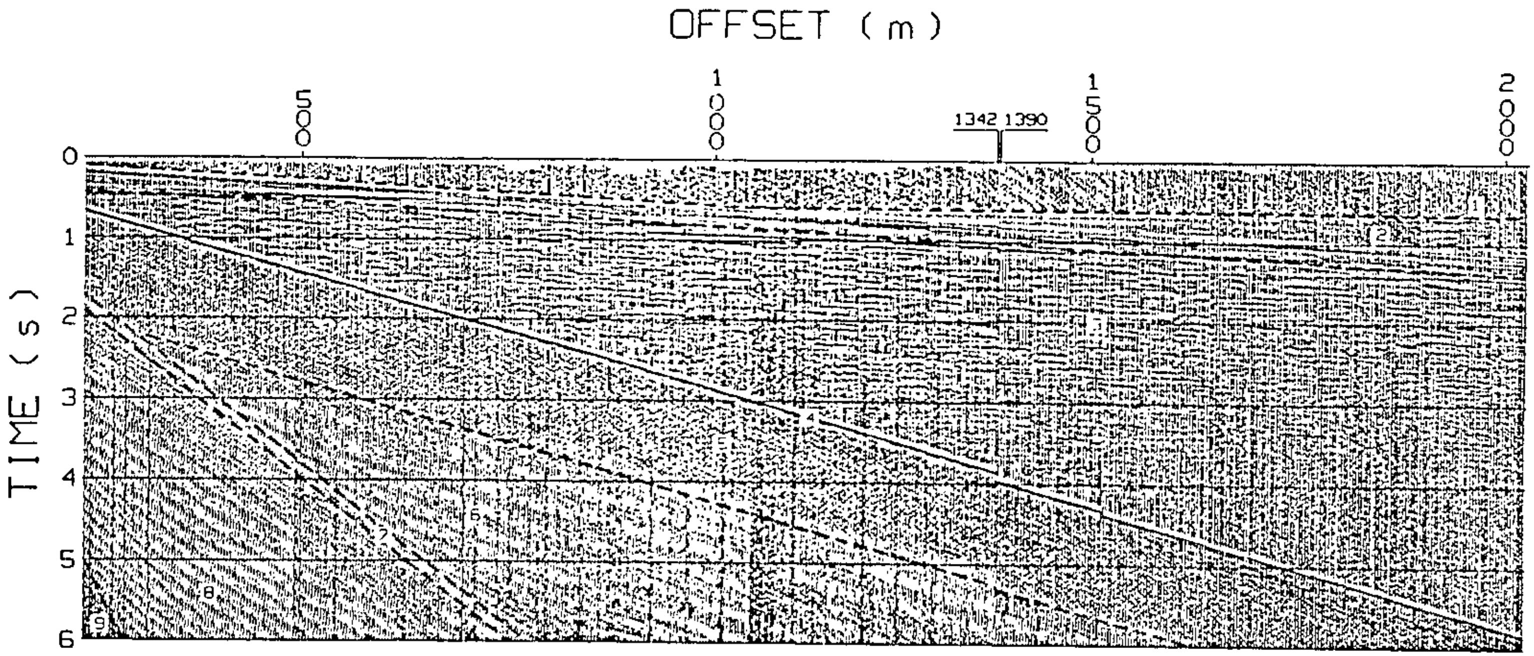
FIGURE CAPTIONS

Figure 1. Vertical component walkaway data (after René et al., 1986).

Figure 2. a) an example of a seismogram with ground roll
b) output after linear frequency modulated matched filters (top) and difference

Fig. 1



Vertical component walkaway data obtained by detonating explosives above a mud flat in the Great Salt Lake Desert, Utah. Nine zones are indicated: (1) ambient noise; (2) signal comprising direct, critically refracted, and primary reflection events; (3) noise, including multiples and diffractions; (4) air wave; (5) air-coupled waves; (6) M_2 Rayleigh wave; (7) Airy phase of the M_2 mode; (8) M_1 mode; and (9) ambient noise.

Fig. 2