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(54) Title: HIGH FIDELITY VIBRATORY SOURCE SEISMIC METHOD WITH SOURCE SEPARATION

(57) Abstract

A method of separating the effects of the earth response on vibratory energy from individual ones of multiple vibrators (Va-Vd) to geophones (G1-G5), in generating a seismic survey, is disclosed. According to the disclosed method, measurements of the actual vibrations generated at the source are made, in addition to the geophone measurements of the refracted and reflected vibrations, both over a number of frequency sweeps. The source (Va-Vd) and geophone (G1-G5) vibrations are first transformed into frequency domain representations, by way of Discrete Fourier Transforms. An inverse matrix of the recorded frequency-domain source vibrations is then generated for each frequency. When the number of sweeps equals the number of vibrators (Va-Vd), the inverse matrix is merely the multiplicative inverse of the source measurements; if the number of sweeps exceeds the number of vibrators (Va-Vd), the inverse matrix is the generalized inverse of the original matrix. The inverse matrix for the frequency is applied to the recorded geophone vibrations at that frequency, to derive the transfer function (ha-hd), corresponding to the earth response, for each vibrator-geophone path in the survey. A weighing factor may be used to discount the effects of poorly behaved sweeps, and may be based on the ratio of the maximum and minimum eigenvalues for the inverse matrix. Using the derived transfer functions (ha-hd), an earth reflectivity function may be derived for each vibrator-geophone path by applying a minimum phase filter to the separated vibrator-geophone transfer function over frequency.

