MULTI-CHANNEL PROCESSING OF DISPERSED SURFACE WAVES

David R. Russell, B.Sc, M.Sc

A Digest Presented to the Faculty of the Graduate School of Saint Louis University in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

1987

DIGEST

A multi-channel phase-matched filter is developed for the extraction of phase velocity dispersion from seismic events recorded on multi-channel receivers, under conditions of extremely high incoherent noise levels. Methods of inverting the dispersion for intrinsic earth structure are thoroughly reviewed, with emphasis on determining earth structure where little *a priori* knowledge exists.

To test the theory, data were obtained from a refraction survey of the Saudi Arabian shield, conducted in 1978 by the U.S. Geological Survey. The data are composed of short period (0.1 - 1.0 sec) fundamental mode Rayleigh waves, digitally recorded from 20 (2 hz) seismometers, located between 6 and 45 kilometers from an explosive source. The multi-channel data were processed, and synthetic seismograms were produced to compare with the recorded data. High levels of Gaussian noise were then added to the synthetic seismograms, to demonstrate the viability of the multi-channel technique under low signal-to-noise conditions.

Results of the tests show that the multi-channel phase-matched filter successfully identifies phase-velocity dispersion, even in data sets where the signal-to-noise ratio is so low that surface waves cannot be distinguished from background noise levels. In addition, inversion results indicate that variances predicted by the multi-channel filter map correctly into intrinsic velocity variances of the earth model.

Two potential applications for the multi-channel phase-matched filter are the extraction of Stonely wave dispersion in acoustical well logging, and the identification of shallow structure from Rayleigh-wave ground

roll in seismic reflection exploration.