A STUDY OF THE USE OF ESTIMATION THEORY
IN
STRONG GROUND MOTION SEISMOLOGY

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A computational algorithm using the recursive filter method is constructed to recover ground motions from instrumental data. Three different filters are designed to determine the ground displacement, velocity, and acceleration within a frequency band. After applying these filters as well as the inverse transfer function of the instrument to a seismogram, the phase distortions introduced by these filters are rectified. The ground motions of seven 1982 Miramichi earthquakes in New Brunswick, Canada, are recovered from the Eastern Canada Telemetered Network (ECTN) data and form an empirical data set.

To apply random process theory in ground motion seismology, we use the ECTN data to find the validity of this theory within a presumed ergodic time window. The geometrical attenuation factor and anelastic attenuation of the main ground motion including major contributors of the direct *S* wave and supercritically reflected *S* waves within the ergodic window are modeled and compared to experimental results from synthetics. The influences of source depth and crustal structure on geometrical and anelastic attenuation of the main ground motion are discussed. After these propagation attenuation terms have been established, the source spectral parameters of the 1982 Miramichi earthquakes are inverted, and their scaling is examined. A least-squares method for nonlinear parameters is used to invert corner frequencies and seismic moments directly from the uncorrected ECTN data.

Finally, the peak ground displacements, velocities, and accelerations predicted from theoretical spectra by applying estimation theory are compared to the empirical data set. Also, the effects of source spectral scaling, source depth, and the crustal velocity and Q model on the peak ground motion are discussed from local to regional distances.