Using Nonlinear Least Squares To Calibrate A Seismometer System

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The purpose of this paper is to provide a simple and quick method to parameterize the operational characteristics of a seismometer system. To this end the method of nonlinear least squares was implemented such that a seismometer systems response to a step force, or a calibration pulse, is modeled in the s domain. A bilinear transform of this model is then used to fit an observed calibration pulse in the time domain.

The method of nonlinear least squares calibration was tested by comparing the results of a sine wave calibration of the WWSSN seismometer systems located at French Village, Missouri to the results of a series of calibration pulses collected from the same seismometer systems. It was found that the low frequency aspect of the seismometer system fit very well, however the high frequency end of the seismometer system was poorly fit. This is due to the poor signal to noise ratio of the calibration pulse that were collected and due to the relative insensitivity of the method to the high frequency components of the calibration pulse. Further more, it was found that seismometers that have a great deal of inductance have a response that significantly differs from seismometers that have very little inductance. The method of nonlinear least squares was useful in modeling the effects of inductance on a seismometer systems response. The method of nonlinear least squares was also used to fit a seismometer system with a complex series of low pass filters. It

was found that the effects of low pass filters on the systems response must be modeled to obtain a good fit. Even in a system that has a good signal to noise ratio the exact parameters of a low pass filter with a high corner frequency may be poorly determined.