

THE EFFECT OF PHASE LOOP AND PREDICTIVE GAIN ADJUSTMENTS ON HARMONICS GENERATED BY THE CREWES ENVIROVIBE

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ABSTRACT

Harmonic distortions in Vibroseis data are a well known issue in seismic data acquisition. Poor ground coupling, equipment variances, and nonlinear effects in the earth contribute to harmonic generation. These harmonics have traditionally been treated as noise to be attenuated. One method of attenuating these harmonics is through phase control systems within the vibrator. Currently CREWES and POTSI are jointly researching methods of decomposing Vibroseis sweeps into their fundamental and harmonic components. It is proposed that these separate components and their higher frequencies can be used as a source signal rather than filtered out of seismic data. An experiment was conducted at University of Calgary to assess how adjustments in the phase loop and predictive gain of the CREWES EnviroVibe affect harmonic generation.

INTRODUCTION

Nonlinear effects in the earth and the Vibroseis machinery itself contribute to the generation of higher order harmonics and even sub-harmonics which appear in seismic data. Using conventional processing of Vibroseis data, these harmonics will produce non-zero phase Klauder wavelets if they are not filtered from the correlation sweep. Both acquisition and processing techniques have been developed to better attenuate these higher order harmonics. The experiment described in this paper is concerned with the phase control systems which have been developed in modern vibrators to compensate for the phase shift and harmonic generation. It is proposed that varying the parameters of the phase control system can maximize the production of harmonics to coincide with the current CREWES and POTSI research attempting band width expansion of seismic data through utilization of higher order sweep generated harmonics.

EXPERIMENT

On September 29th 2011 the CREWES EnviroVibe was deployed to the west campus of the University of Calgary to test the affect that adjusting phase loop and predictive gain would have on harmonic generation. 54 sweeps were shot mid morning varying the phase loop and predictive gain between 50 and their max values of 200 to observe how harmonic generations is affected. The sweeps generated had a frequency range of 5 to 250 Hz. The day was clear and reasonable ground coupling appeared to have been achieved. Audible changes in the Vibroseis truck were noted by operators. The details of the EnviroVibe are shown in Table 1.

Total Weight	17400 lbs
Max theoretical peak force	15000 lbs
Reaction mass weight	1750 lbs

Table 1. Details of the CREWES EnviroVibe

FUTURE WORK

All sweeps that were shot will be decomposed into their respective fundamental and harmonic components. The power of each component will be plotted with respect to their phase loop and predictive gain adjustments.