



New developments in Vibroseis Source Technology

C. Jason Criss and Zhouhong Wei, INOVA Geophysical
jason.criss@inovageo.com

Keywords

Vibroseis
Broadband
Low frequency
Harmonic distortion

Summary

New vibroseis technology extends the low frequency range of seismic projects. Field trials help validate the performance.

Introduction

Pushing Vibroseis data bandwidth towards low frequencies (below 5 Hz) is becoming very attractive to land seismic exploration. Due to mechanical and hydraulic limitations most conventional vibrators cannot generate sufficient ground force-energy at these very low frequencies. Recent developments in the new generation low frequency vibrator combined with the vibrator control electronics aiming to reduce harmonic distortion have resulted in definite improvements to acquire low frequency seismic data. Pursuant to these new developments, the topics discussed in this paper are advances of the new generation low frequency vibrator and harmonic distortion reduction in the transmitted ground-force signal using an improved vibrator controller.

Wei et al. (2018) have demonstrated a design and experimental verification of a new generation low frequency vibrator (TITAN). Experimental tests from their paper show that this new low frequency vibrator has significantly improved the ground force at the low frequency range (< 10 Hz) as well as the normal frequency range (10 – 100 Hz).

To further validate the vibrator performance, a field test was carried out in Middle-East desert environment. For purpose of comparison, an 80,000-lbs commercial vibrator (AHV-IV Model 380) was also used in the test. Both vibrators were driven with a VibPro HD controller using a low dwell sweep from 1.5 Hz to 86 Hz in 9s.

Improved Low Frequency Force-Energy from a New Generation Low Frequency Vibroseis

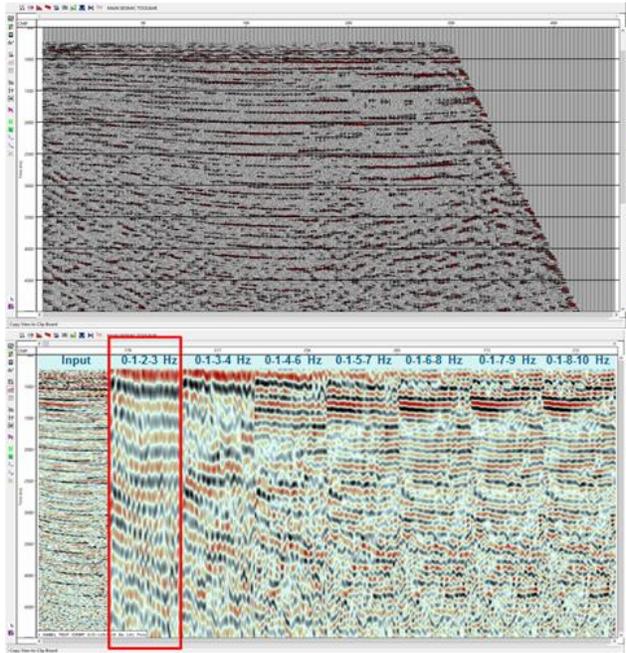
Figure 1 shows an example of brute stacks with band-pass filters. It can be clearly seen that the new generation low frequency vibrator produces more broadband energetic force than the 80,000-lbs commercial vibrator. With the band-pass filter of 0-1-2-3 Hz solid and continuous reflections in the frequency range from 1 Hz to 2 Hz (highlighted using red rectangles) is observed from the new generation low frequency vibrator.

Figure 2 shows seismic data comparisons using a vibrator controller embedded with harmonic distortion reduction (HDR) techniques. It can be easily observed that HDR eliminates the noise of air blast and improves the reflections as well (highlighted in red rectangles).

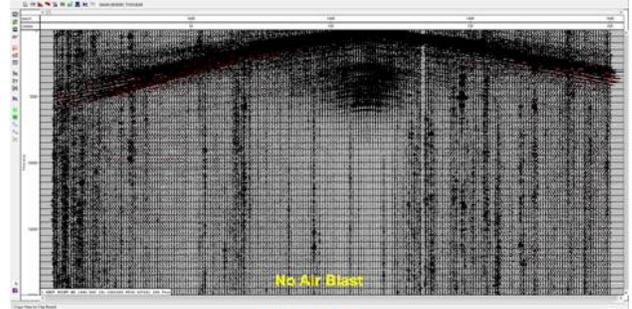
Conclusions

Field tests show that the new generation low frequency vibrator has significantly improved the ground-force energy resulting in a broadband seismic data with good S/N ration. The frequency range from 1 to 2 Hz can be seen. The vibrator controller with HDR technology reduces air blast and improves reflection signals.

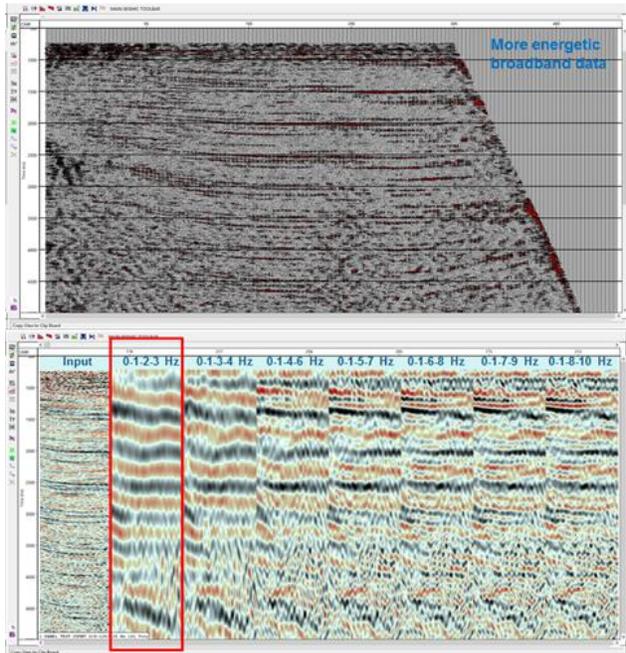
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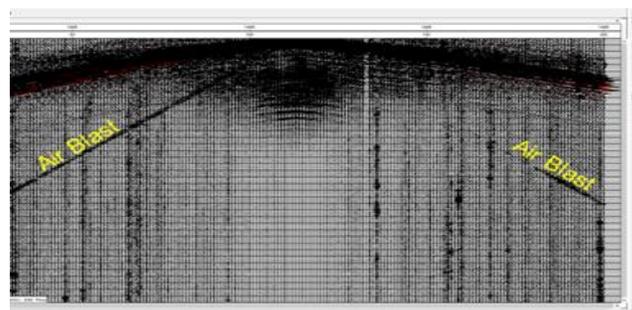
The 80,000-lbs commercial vibrator



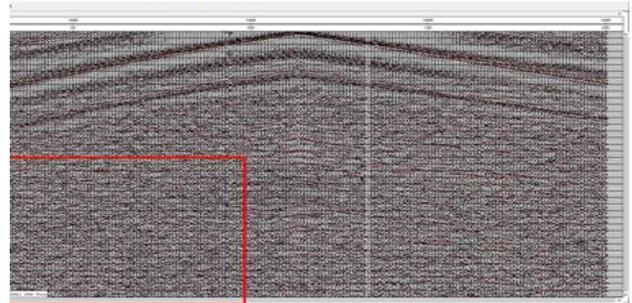
HDR ON



The new generation low frequency vibrator



HDR OFF



HDR technology reduces the noise of airblast and improves the reflections



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References

Wei, Z., J. Criss, A. Bull, F. Liang and Y. Wu, 2018,
The low-frequency seismic vibrator: design and
experimental verification: First Break, 36, 77 – 84.

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