

# A Review of Some 3D and 2D Models Using Data Simulation

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## Overview

Acquisition geometries for 2D and 3D programs have been disputed and analyzed in the past. Frequently, our only source of discussion is the statistics generated (fold, offset distributions, etc.). The author has presented papers at several recent conventions and seminars outlining the benefits of simulating stacked data using modelled offset distributions in conjunction with real data in the form of selected common offset stacks. Several of these simulations will be presented using models of different popular geometries. These models will also be reviewed with regard to robustness under perturbation.

## Geometric Noise

Often referred to in 3D programs as “geometric imprinting” or “footprints of design”, geometric noise results from bin to bin (or CDP to CDP) variations in trace statistics. The primary controlling factor is source receiver offsets. Few acquisition geometries provide data that will result in stacked traces consisting of identical mixtures of offsets. The degree of offset heterogeneity may result in different signal-to-noise characteristics of the stacked traces. In fact, trace to trace variations will be seen not only as amplitude variations, but also as static and phase variations. This results when the contributing stacked data has different signal and noise characteristics at different offsets. Since most of our noise is source-generated, this should often (but not always) be expected. Data sets that exhibit stable signal and noise characteristics with offset are relatively insensitive to offset heterogeneity.

We refer to the amplitude, static and phase instabilities introduced by incomplete wavefield sampling as “geometric noise”. The impact of such noise is easy to evaluate through data simulation. We now rely strongly on a statistic based on the standard deviation of amplitude variations across a given time slice.

All survey designs (except “full stack array” in 2D and “full wavefield sampling” in 3D) result in some degree of amplitude variation independent of geologic changes. Can these instabilities be modelled and separated from final results? To what extent can various geometries mitigate these effects?

These are the questions whose answers we are working toward with the research presented in this paper.