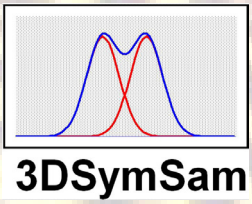
Geoscience course
3D seismic survey design



Instructor: Dr. Gijs Vermeer

Business context:

3D seismic surveys have become a standard ingredient for successful exploration and exploitation of hydrocarbons. Usually, the acquisition of these surveys is the most expensive step towards a clear picture of the subsurface targets. Therefore, an optimal choice of the survey parameters is essential. This course covers the choice of optimal survey parameters based on sound geophysical principles.

Who should attend?

Acquisition geophysicists and processing geophysicists, both in research and in operations.

Course content:

The book "3D seismic survey design – Second edition" authored by the instructor and published by the Society of Exploration Geophysicists is used as a basis for this course. The properties of the 3D acquisition geometries that are being used in 3D seismic data are analyzed. Insight into these properties allows a clear formulation of the sampling requirements, which ensure the best possible images of the subsurface with minimal migration artifacts. This theory is translated into practical guidelines for 3D seismic survey design. Case histories and modeling are used to illustrate the concepts.

The following subjects will be covered

- ❖ 2D seismic data acquisition
- ❖ 3D acquisition geometries
- ❖ Field data examples of 3D symmetric sampling
- ❖ Relation between acquisition geometry and imaging
- ❖ Guidelines 3D survey design
- ❖ Implementation aspects
- ❖ Marine 3D acquisition, time lapse
- ❖ Converted-wave 3D survey design

Participants should gain a thorough understanding of the following:

- ✓ the ways in which 3D seismic surveys can be acquired
- ✓ the selection of optimal parameters for these surveys based on geophysical, geological, and budgetary requirements
- ✓ the influence of the choice of parameters on the final imaged result

All sessions include exercises, whereas in a survey design workshop the students will design a survey for a real-life situation.

For further information please contact:

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PTO for course outline

Course outline

Day 1

Morning: 2D seismic data acquisition

Apparent velocity, reciprocity theorem, Shannon sampling theorem, aliasing, 2D symmetric sampling, field arrays, array response

Afternoon: 3D acquisition geometries

Subsets of 5D prestack wavefield, classes of 3D geometries, basic subsets of 3D geometries, minimal data sets, 3D symmetric sampling, parameters of orthogonal geometry (fold, line intervals, maximum inline and maximum crossline offset), geometry comparison (brick, slanted, zigzag, orthogonal, parallel, areal), stack responses, example of 3D microspread

Day 2

Morning: 3D acquisition geometries continued

The importance of regular sampling for proper imaging

Mechanics of Kirchhoff migration, effect of missing traces, Fresnel zone and zone of influence

Afternoon: Guidelines 3D survey design

Choice of geometry, meeting resolution requirements (frequency range, spatial sampling, field arrays, fold), selection of line intervals and maximum offset, AVO requirements, recording time

Day 3

Morning: Processing and imaging with minimal data sets and with offset-vector tiles (OVTs)

Cross-spread oriented processing, problematic use of absolute-offset gathers, generating OVT gathers, processing with OVT gathers, prestack migration with OVT gathers

Afternoon: Implementing 3D surveys

Good and bad templates, the importance of regular geometry, survey area versus area to be mappable (edge management), dealing with obstacles, sources and receivers, testing

Day 4

Morning: Marine 3D acquisition

Multisource multistreamer acquisition, effect of width of configuration on illumination, effect of feathering, air-gun arrays, source signature, source and receiver ghosts, the dip versus strike decision, steering for coverage, undershooting, multi- and wide-azimuth streamer acquisition, coil geometry, over/under techniques, dual-sensor streamer, quad-sensor streamer, variable-depth streamer, stationary receiver systems (OBC, OBN), suitable geometries; time-lapse acquisition, time shifts and amplitude variation, measure of non-repeatability, causes of non-repeatability, ways to improve repeatability

Afternoon: Survey design workshop

Students to analyze and tackle survey design problem

Day 5

Morning: Marine 3D acquisition continued

Afternoon: Converted-wave 3D survey design

Effect of asymmetry of raypaths on resolution and illumination, choice of geometry and its parameters

Single-point acquisition

MEMS sensors, single sensor versus geophone array versus MEMS sensor

All sessions include exercises, which help the students to familiarize themselves with the subject matter.