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Quantitative Visualization of Spatial Uncertainty in 3-D Structural Models

Sound commercial decisions depend on a realistic understanding of the actual uncertainty in technical data. The crisp images produced by current computer aided interpretation, modeling and visualization tools typically inspire a degree of confidence in the results than may not be justified by the data quality and the uncertainty inherent in the measurement - such as reflection seismic or well trajectories. Spatial uncertainty is not typically incorporated into the construction of structural frameworks, but by doing so the geologist can gain a greater appreciation of the reliability of any subsequent analyses such as fracture models derived from geometric attributes such as curvature or highly sensitive hydrocarbon migration predictions.

Spatial uncertainly in interpretation of seismic data will comprise random measurement uncertainty (noise), data resolution (frequency), systematic error caused by geological and seismic anisotropies, migration uncertainty, error introduced by human interpreters and positional errors in well ties. These errors are quantifiable and the resulting uncertainties may be carried through the structural modeling process by pervasively incorporating error analysis into the computational geometry underlying the structural model building and manipulation tools. This provides a measure of confidence in the modeling result, highlighting spatial variations in uncertainty.

Examples demonstrate how novel uncertainty visualization techniques can deliver an appreciation of the positional uncertainty inherent in their geometric model allowing well planners to reduce the risk involved in aiming for apparently 'fuzzy' targets.