Bay Area Geophysical Society Seminar Series

Michael Hoversten

Chevron

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MCMC Stochastic Inversion for a West Africa Reservoir

Abstract: We define the Bayesian posterior probability distribution in terms of the data likelihood, the prior distributions of unknown parameters, the prior distribution of lithology indexes and the prior distribution of data signal to noise. The prior distribution of lithology indexes is represented as a 3D Markov random field where the cell to cell coupling is parameterized using 3D Kriging parameters of angles and ranges. We show that the resulting PDFs of the geophysical parameters (Acoustic Impedance, Vp/Vs, and density) can be non-Gaussian (multi-modal).

We compare the MCMC inversion predictions of oil in place (OIP) and net-to-gross (NTG) to an industry standard work flow of simultaneous (SI) elastic joint inversion followed by Bayesian inference for porosity prediction. For the data set considered, which is representative of most West Africa data sets, the sampling based MCMC algorithm provides superior prediction of lithology and porosity, the two parameters that drive drilling decisions. Comparisons at two blind wells show that the MCMC NTG and OIP predictions are ~ 5x better, in terms of % error, than the SI workflow. In this example an industry standard SI algorithm and workflow would significantly underestimate the OIP, which could have significant impact on a prospect's viability.

Speaker Bio:

G. M. Hoversten received his Ph.D. from UC Berkeley in Engineering Geoscience in 1981, followed by 2 years as a research scientist in numerical algorithm development within the same group. In 1983 he joined Sohio Petroleum and later British Petroleum, where he worked in both seismic and non-seismic methods in exploration. In 1993 he re-joined the Engineering Geoscience group at UC Berkeley as a research geophysicist primarily concerned with the integration of seismic and non-seismic methods in petroleum exploration. In 1998 he joined Lawrence Berkeley National Laboratory as a staff scientist. In 2005 he joined Chevron Energy Technology Company. Current research projects include 1) the use of electromagnetic in exploration and production, 2) joint inversion of seismic and electromagnetic data for reservoir description, 3) coupled flow/geomechanical/geophysical modeling and inversion for reservoir monitoring and hydraulic fracture monitoring, and 4) integrated electromagnetic/seismic techniques for structural mapping in sub-basalt and sub-salt areas and 6) Markov Chain Monte Carlo inversion of seismic AVA and CSEM data.