AAPG Datapages/Search and Discovery Article #90254 ©2016, GEO-2016, 12th Middle East Geosciences Conference & Exhibition, Manama, Bahrain, March 7-10, 2016

Reservoir Property Prediction using Least Square Support Vector Machine

Jinsong Wang[1], Saleh Al-Dossary[1]

[1]Exploration applications and services, Saudi Aramco Oil Company, Dhahran, SAUDI ARABIA

ABSTRACT

We propose a least square regression algorithm based on the well-known support vector machine (SVM) to predict reservoir properties such as porosity or pore pressure from seismic attributes and well logs. We extend SVM's conventional pattern recognition usage to regression problems and adopt a least square approach to minimize the error of the regression.

Prediction of reservoir properties from seismic in areas of limited well control is challenging, but is also frequently required to create the initial reservoir characterization for reservoir modeling and evaluation. Conventional geo- statistical and neural network approaches can be easily "over-trained" resulting in "over-fitting" and poor predictions.The proposed SVM approach overcomes over-fitting and miss-fitting in areas of limited well control, producing higher quality reservoir property predictions. Prediction is achieved by the following steps: First, select the most relevant attributes through cross-correlating all available seismic attributes with the target reservoir property; Second, |Choose the Radial Basis Function (RBF) as the SVM kernel due to fewer numerical difficulties, and finally optimize the penalty parameter (C) and simulation factor (to build the best RBF prediction model by supervised training of the SVM using well logs through cross-validation and grid searches. To reduce computational cost, a coarse grid-search is performed to determine the parameter range, followed by a finer search. In each search step, a subset of well logs is cross validated against the predicted values to avoid over-fitting and miss-fitting and ensure the best SVM was found.

A synthetic data test using the theoretical function is presented. SVM is trained using every fourth x point and then all x points are predicted. The predicted points compare favorably to the theoretical points, supporting the robustness of SVM for this type of data. Next we present a case study with real seismic and log data to predict porosity using three well logs and five seismic attributes: amplitude, frequency, coherence, bandwidth and acoustic impedance. In this case study the SVM-predicted porosity was excellent, with a mean square error at the well locations of 0.0049 and the reservoir prediction is consistent with measured impedances value that negatively correlated with porosity, further validating the effectiveness of using SVM for reservoir property prediction.