

Estimation of reservoir rock properties from conventional well log data by using a hybrid particle swarm optimization and neural network approach

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1-Introduction

The geomechanical and petrophysical parameters of the reservoir such as shear wave velocity, porosity and permeability are regarded as the most important elements in estimating reserves, reservoir simulation, and overall field exploitation and development strategies. Recently, several different methods of artificial intelligence techniques have been used to predict this fundamental parameter by using well log data. However, predicting the characteristics of heterogeneous reservoirs always has been facing many problems and an appropriate response is rarely achieved. This study offers an improved approach for reservoir parameters estimation by integration of stochastic optimization in the structure of a neural network system.

2-Methodology

Cost function minimization is the main objective of an ANN, which is achieved by adjusting weights and biases in the training process. The classical ANN training methods, such as backpropagation (BP) is the strong dependence upon the initial guess. Some researchers have used evolutionary methods to train neural networks and found that implementation of hybrid techniques such as PSO-based ANN provide a better predicting ability than the standard backpropagation algorithm (Grimaldi et al., 2004; Chau, 2007; Karimi and Yousefi, 2012; Dhanarajan et al., 2014; Zahmatkesh et al., 2017). In a PSO-based ANN, each particle represents a possible solution for minimizing the MSE. So after neural network constructed, we feed training data to the network whose weights and biases are determined by the particle's position. In every iteration, network get the outputs and compare it the desired outputs. This procedure will continue until stopping criterion is satisfied, in the other words found a position (weights) so that the network trained by PSO generates computed outputs that match the outputs of the training data.

3- Results and discussion

Experimental results revealed that PSO-ANN outperforms the other models of GA-ANN, ANN and ANFIS in terms of reliability and the ability to achieve the minimum estimation error, and PSO algorithm can be used for the purpose of improving the computational efficiency and performance of a neural network system.

4- Conclusion

In this paper, a new methodology is presented for reservoir parameters (shear wave velocity, porosity and permeability) estimation by combining artificial neural network and Particle Swarm optimization (PSO) in Asmari formation of Mansuri oilfield. Performance of proposed hybrid scheme was evaluated by comparing the results with the most common Neural Network and Nero-Fuzzy methods as well as hybrid genetic algorithm–neural network strategy (GA–NNN). Comparison of the results shows that PSO-ANN outperforms all the other

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methods and it can be considered as a powerful tool for reservoir parameters estimation, especially in cases where a precise estimation criterion is crucial.

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