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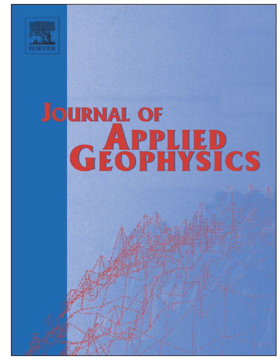


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**On the Estimation of Subsurface Petrophysical Properties using Different Stochastic Algorithms in Nonlinear Regression Well testing**

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**Abstract:**

Accurate characterization of the underground energy resources is necessary to accurately forecast their future pressure and rate behaviors. Well testing is one of the main operations used in the oil and gas industry to characterize the underground reservoirs. Among the various factors affecting well test analysis, robustness of the employed optimization algorithm is of great important. Hence, efficiency and computational time of four different population-based algorithms in solving the well testing regression problem are thoroughly investigated in this study. The employed algorithms consist of a biological evolutionary algorithm, GA (Genetic Algorithm), two swarm-based algorithms, PSO (Particle Swarm Optimization) and FA (Fireflies Algorithm), and a social-based algorithm, ICA (Imperialist Competitive Algorithm). These algorithms have been applied on two different reservoir models of homogenous, and heterogenous fractured systems. Performances of the employed algorithms are then evaluated both statistically and graphically. The comparison study unveiled that FA fails to handle the regression problem for both homogenous and heterogenous reservoirs. Although PSO, GA, and ICA end up with lower relative errors for the homogenous model, they cannot accurately predict the reservoir properties for all the state variables defined for the fractured reservoir. Based on the relative error and residual plots, it was concluded that PSO and ICA outperform the other algorithms due to their localized search capabilities. In detail, PSO and ICA end up with the R-squared values of 0.93 and 0.99 for the homogenous and heterogonous fractured models, respectively. Evolution of the error data over time unveiled that the examined algorithms have difficulties matching the transitional wellbore storage and infinite acting zones for the homogenous model and the transitional matrix-fracture zone for the dual porosity fractured