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(This is an abstract)

30141. Application of Simultaneous Perturbation Stochastic Approximation to Well Placement Optimization under Uncertainty

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Main objectives

Well placement, Uncertainty, Computation time reduction

New aspects covered

Using stochastic and robust methods in optimization of well locations and trajectories under uncertainty

Summary

Optimizing the location of wells to achieve the full production potential of a hydrocarbon reservoir is a crucial task in field development. However, because subsurface flow simulations are computationally demanding, implementing model-based optimization procedures to aid the search for optimal well locations can be overly time-consuming. Moreover, to account for model uncertainty, we often need to evaluate the performance of well configurations over multiple geological realizations, which calls for efficient strategies to reduce computation. To this end, we propose a robust optimization procedure in which at each iteration of the optimization procedure, instead of evaluating the well configuration over all available realizations, we approximate the expected performance using a small subset of randomly selected model realizations. Since the samples are selected randomly, we expect all samples to eventually be included in the performance evaluation after a certain number of iterations. However, using only a few random realizations increases the noise level of the computed objective function, necessitating the use of a stochastic optimizer. We use the Simultaneous Perturbation Stochastic Approximation (SPSA) algorithm, which is known to be robust against noise in the objective function. The SPSA algorithm is a local optimization method that uses an efficient stochastic gradient approximation which is easy to implement. Discrete versions of SPSA have been used for vertical well placement optimization. In this work, we implement a continuous version of the SPSA algorithm for optimizing well locations and trajectories. Moreover, we demonstrate incorporating a Hessian approximation in the SPSA implementation can improve its performance. In this paper, the performance of different forms of the SPSA algorithm (discrete, continuous, and adaptive) is evaluated using several numerical experiments, followed by a discussion of the properties of the proposed approach in comparison with global optimization techniques. Finally, the method is applied to several numerical experiments, including case studies involving both vertical and horizontal wells, to demonstrate its applicability and computational efficiency.

Topic(s)

1. Optimisation (Production Scenarios, Well Positions)
2. Statistical and Stochastic Methods
3. Closed-loop Reservoir Management, Smart Fields

Presentationtype

Prefer Oral but accept Poster

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