

Nestor V. Queipo, Javier Goicochea, and Salvador Pintos. "Surrogate modeling-based optimization of SAGD processes", International Journal of Petroleum Science and Engineering, Vol. 35/1-2 pp. 83-93, July (2002)

ABSTRACT

This paper presents a solution methodology for the optimization of geometrical and operational parameters of SAGD processes in a heterogeneous and multiphase petroleum reservoir. The optimization refers to the maximization or minimization of performance measures such as net present value, cumulative oil production or cumulative steam injected.

The solution methodology includes the construction of a "fast surrogate" of an objective function whose evaluation involves the execution of a time-consuming mathematical model (i.e. reservoir numerical simulator) based on neural networks, DACE modeling, and adaptive sampling. Using adaptive sampling, promising areas are searched considering the information provided by the surrogate model and the expected value of the errors.

The proposed methodology provides a global optimization method, hence avoiding the potential problem of convergence to a local minimum in the objective function exhibited by the commonly Gauss-Newton methods. Furthermore, it exhibits an affordable computational cost, is amenable to parallel processing, and is expected to outperform other general-purpose global optimization methods such as, simulated annealing, genetic algorithms, and pattern search methods.

The methodology is evaluated using a case study with vertical spacing, steam injected enthalpy, injection pressure and subcooling as the sought parameter values in a SAGD process that optimize a weighted sum of cumulative oil production and cumulative steam injected for a selected reservoir. From the results, it is concluded that the methodology can be used effectively and efficiently for the optimization of SAGD processes. In addition, the optimization approach holds promise to be useful in the optimization of objective functions involving the execution of computationally expensive reservoir numerical simulators, such as those found, not only in oil recovery processes, but also in other areas of petroleum engineering (e.g. hydraulic fracturing).

Keywords: thermal oil recovery, steam oil recovery, SAGD, surrogate modeling-based optimization, SAGD optimization.