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Paper Title:

Testing and Improvement of Well Layout Optimisation Methods for Geothermal Reservoir Production

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Abstract:

Objectives/Scope: The development and management of geothermal reservoirs is complicated and expensive, the maximum potential geothermal energy recovery is highly depending on the optimal well location. Within the framework of a multidisciplinary research platform for the exploration and development of high geothermal energy in fractured reservoirs, a method has been developed to optimise well layouts (location and depth) based on geothermal reservoir production performance criteria (objective functions). Objective functions such as available thermal exergy, electrical power output, leftover energy rate and simplified net present value are proposed in this paper to be used as performance criteria for locating the optimal well layouts.

Methods, Procedures, Process: The optimisation method uses the principle of superposition as proxy-based method to simulate the production of a well layout by summing the effects of individual injection and production wells of the layout simulated separately. Using this method, the computation time required to search for an optimal well layout design is significantly reduced. The well layouts are defined based on a number of injection and production wells to be selected among many possible well locations and depths. They are all simulated using the principle of superposition and ranked according to the selected objective function. The optimal well layout is the one maximising the objective function.

Results, Observations, Conclusions: Data from an actual case study are used to evaluate the method. The four objective functions are tested using reservoir simulations and sensitivity analysis based on various production parameters. The results show that the proxy-based method can simulate the performances of well layouts with sufficient accuracy, the discrepancy between proxy-based simulations and full simulations increasing with production rate. More important, the method proves to be consistent by preserving the ranks of the top one hundred well layouts under all high, medium and low production/injection rates. Preserving the ranks is the required condition that makes the proposed method reliable for seeking optimal well layouts in geothermal reservoirs. The choice of an objective function does not drastically change the areas that are recognised as good or bad for production or injection wells.

Novel/Additive Information: Provided relevant data are available as input to the most comprehensive objective functions (i.e., electrical power output, simplified net present value), this study concludes that the proposed method is highly reliable to be used for the search of optimum well layouts in geothermal reservoirs in a relatively short computation time.