A Least Squares Method for Ensemble-based Multi-objective Oil Production Optimization -
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Despite a significant potential to improve industrial standards, practical applications of production optimization are
impeded by geological uncertainty. As a mean to handle the associated financial risks, the oil literature has devised a
range of ensemble-based strategies that seek to optimize proper combinations of sample-estimated risk measures to
balance the opposing objectives of risk and reward. Many of the associated optimization problems are naturally formulated
in terms of multi-objective optimization (MOO). Ideally, MOO problems should be solved by generating an approximation
to the efficient frontier of optimal tradeoffs between risk and return. However, the large-scale nature of real-life oil
reservoirs implies that formation of the frontier often becomes computationally intractable in practice. To meet this
challenge, this paper introduces a generalized least squares (LS) approach that provides an efficient and unified solution
strategy for ensemble-based multi-objective optimization problems. At its core, the LS method uses an a priori
characterization of desirable trade-offs that allows the method to focus on a single Pareto optimal point. Consequently, the
LS approach avoids the need to generate a representative of the efficient frontier. In turn, this significantly reduces
computational complexity compared to most MOO methods. As a result, the LS method poses a practical alternative to
conventional strategies when the efficient frontier is unknown and computationally intractable to generate.

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