Optimization of Well Operating Conditions

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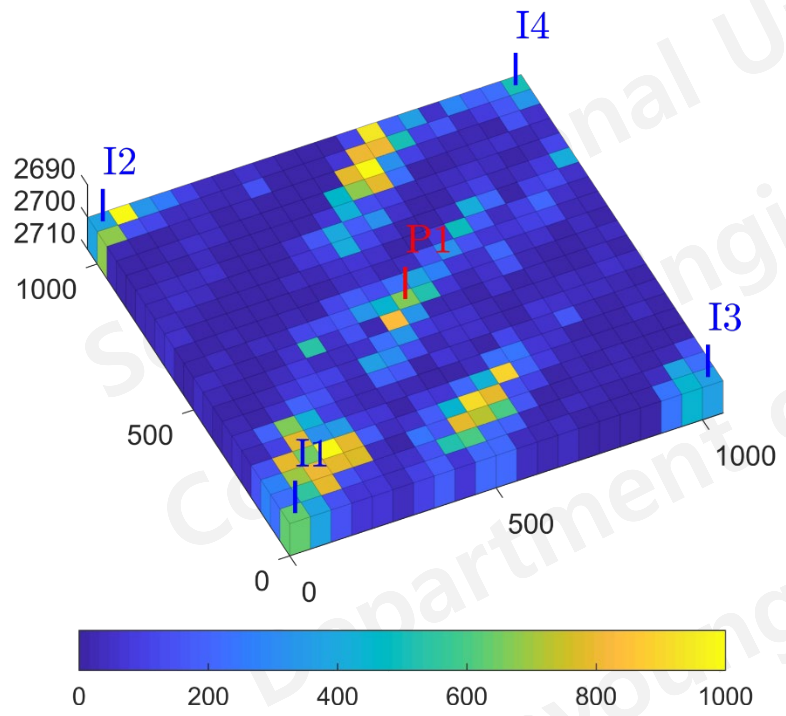
Introduction



Horizontal permeability (md)
21 by 21 by 1
Oil and water

- Optimizing q_w at I1 – I4
- Optimal q_w at I1 – I4?
  - ✓Maximizing NPV

$$NPV = discount(Oil\ prod \cdot Oil\ price$$
$$- Water\ prod \cdot Water\ treatment\ unit\ cost$$
$$- Water\ inj \cdot Water\ injection\ unit\ cost)$$

  - ✓Gradient-based optimization

Procedure (1)

① $X_k = [x_1 \ \cdots \ x_N]^T$

Generate an initial solution at $k = 0$

② Calculate the objective function

$J(x_k)$

i) Open the simulation data file

ii) Replace your keywords with $x_1, \cdots, x_N$

ex) In the data file

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I1 WATER 1* RATE [#QINJ_I1] 1* 5000 /

replace with x_1

iii) Run the simulation

iv) Read the result

time vs. oil production, water production

water injection, gas production

v) Discount the cash flow

vi) Calculate and return NPV

Procedure (2)

③ Calculate $\nabla J(x_k)$

FDM: $\nabla J(x_k) = \begin{bmatrix} \frac{J([x_1+\Delta x_1, \ldots, x_N]^T) - J([x_1, \ldots, x_N]^T)}{\Delta x_1} \\ \vdots \end{bmatrix}$

StoSAG: $C_x \nabla J(x_k)$

④ Update x_{k+1} using the steepest ascent method or the Newton method

⑤ Repeat ①~④ until convergence criteria are satisfied.