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UNISIM-I-H: History Matching Benchmark Case

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Introduction

The UNISIM-I-H was created by UNISIM in 2014 as a benchmark case for history matching and uncertainty reduction studies.
The main idea is to provide an opportunity to test deterministic and probabilistic history matching techniques and to compare the solutions of research groups around the world.

UNISIM-I

The reference model, UNISIM-I, is a fine grid (3.5 million blocks) model (Avansi and Schiozer, 2015) which is based in Namorado Field, Campos Basin in Brazil.
The difference is that it is a known reservoir so solutions can be compared.

UNISIM-I-H

The simulation model was built using the information of UNISIM-I reservoir model. At time t1 (1461 days) the UNISIM-I-D was developed to represent a benchmark case for reservoir development.
The UNISIM-I-H model assumes the same characteristics from UNISIM-I-D in a second stage (t2 – 4018 days).
The simulation data set is available for download at http://www.unisim.cepetro.unicamp.br/unisim-i.
The study comprises two main approaches:

1. Deterministic history matching from a base model considering the uncertain attributes;
2. Probabilistic approach considering possible uncertainties reduction.

In the validation phase, concerning the use of the data set, any information, suggestions or problem are welcome and they can be provided by e-mail (unisim-benchmark@dep.fem.unicamp.br). Relevant information and updating will be transferred to the project subscriber users.

Uncertainties

The limits of the uncertain attributes described in the UNISIM-I-D should be taken into account. Any modification outside the defined ranges or the addition of new attributes should be reported and justified.
The main differences with respect to the UNISIM-I-D are:

- A new set of petrophysical properties realizations were generated and updated the model for the post-development phase, using a new package of information as a conditioning data, i.e., new wells were perforated;
- The structural model defined as uncertainty in UNISIM-I-D was assumed known after drilling new wells in the east block.

Deterministic approach

The objectives of the deterministic approach are:

1. Carrying out a history matching until 4018 days (t2) from the provided base model.
2. Carrying out production forecast until the final simulation time (tmax): 31/05/2043 (10957 days) without modification in the production strategy.
3. Performing modifications in the production strategy to improve it. Changes will be allowed under project restrictions and premises defined in UNISIM-I-D.

The observed data (well rates and pressure and, field rates and average pressure) is available in the data set. A random noise was added to the observed well data.
For the production prediction (Stages 2 and 3 listed above) all the production strategy characteristics concerning operational restrictions and economic model must be used.

Probabilistic approach

The objectives of the probabilistic approach are:

1. Reducing uncertainty in the production forecast;
2. Reducing uncertainties of the attributes;
3. Implementing probabilistic production forecast;
4. Defining production strategy selection considering the probabilistic approach.

For the probabilistic production forecast, the same aspects described in the deterministic approach, concerning operational restrictions, should be taken into account.

Expected Results

The UNISIM-I-H case is an opportunity to compare history matching solutions. In order to facilitate the comparison, the results from different research groups can be shown considering:

1. Attribute values corresponding to the best solution;
2. Process indicator data: chosen methods, number of simulations, computational effort and objective function evolution;
3. Plots comparing simulated and observed data;
4. Quality indicator: global objective function. Each group should report the global function chosen to measure the matching quality.
5. Matching quality indicator per well: simple (SD) and quadratic distance (QD) for oil, water and gas rate and pressure, using the equations specified in the study description (link above).

The probabilistic solution should also include:

1. New likely attributes uncertainty levels indicating possible (acceptable) solutions;
2. Process indicator data: chosen methods, number of simulations and computational effort;
3. Quality indicators for the found solutions: the same one that was previously illustrated.

References

Avansi, G. D., Schiozer, D. J., “UNISIM-I: Synthetic Model for Reservoir Development and Management Applications” submitted to the International Journal of Modeling and Simulation for the Petroleum Industry, 2015, Brazil.

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