

Mc3

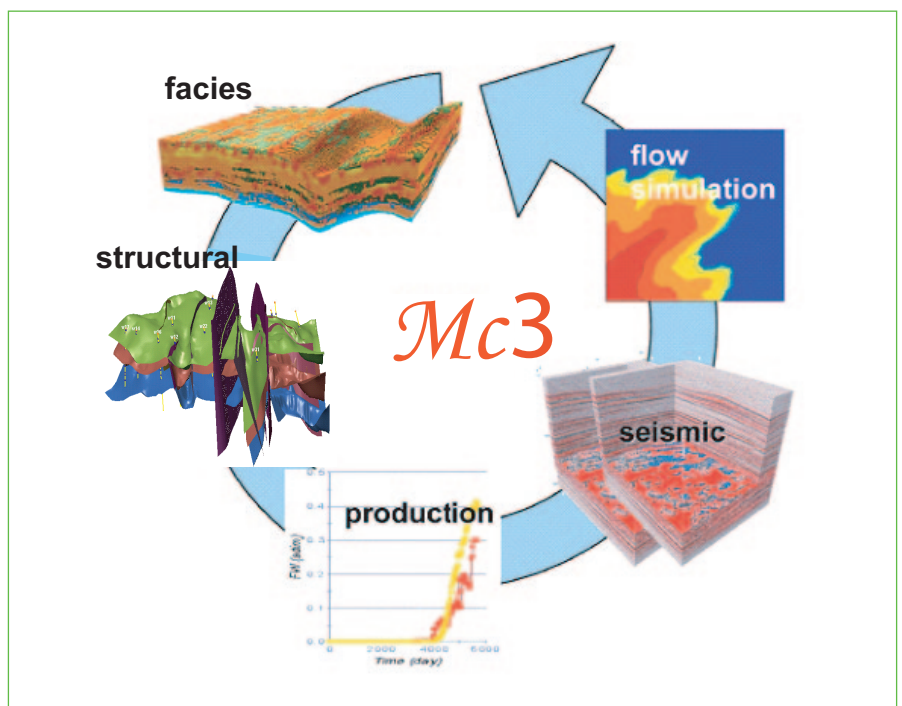
Monitor-Condor 3

A Joint Industry Project

Advanced methods for integrated reservoir studies

Objectives

Since data-consistent models yield better production forecasts, the ideal is to build reservoir models consistent with all available data - geological, geophysical and reservoir data. Creating asset teams with geologists, geophysicists and reservoir engineers is a first step towards integration, but is not sufficient. History-matching has been developed to compel reservoir models to fit production data. It is an iterative process, aimed at reconciling the available data in a model representative of the actual reservoir. The history-matching must be done while maintaining an integrated framework. The parameters of the reservoir and flow models cannot be changed just anyhow. Instead, all reservoir modeling steps must be incorporated in a consistent and continuous workflow. Then, parameter modifications must be properly propagated through this workflow. When this is done, the final model remains consistent with



geological, geophysical and reservoir engineering knowledge.

The Monitor-Condor (Mc) project is a specialized Joint Industry Project (JIP) to develop

methodologies for an engineering-consistent integration of production and 4D-seismic related data in reservoir modeling. The Mc3 JIP is a logical follow-up of the Mc2 JIP; it is open to new partners.

The overall main objectives of the Mc3 JIP are:

- to actively pursue the development of an efficient integrated methodology to constrain reservoir models to production and 4D-seismic related data;
- to facilitate the use by partners of prototype software deliverables.

Program

We will actively pursue the development of an integrated and efficient methodology to constrain reservoir models to production and 4D-seismic related data. We intend to focus on the following four work packages.

Work package 1 – Rebuilding existing models

Reservoir models must be fully updateable. To make this possible, the gradual deformation method must be applied to the random numbers used to generate the petrophysical properties. However, very often, these random numbers are no longer available when existing reservoir models have to be updated. Therefore, we will develop methods for identifying the required random numbers and reconstructing the existing reservoir models, whatever the number of facies.

Work package 2 – Seismic modeling

- **Petro-elastic model:** improvement in the forward modeling of numerical

4D-seismic responses such as seismic velocities, impedances, time-shifts, etc.

- **Seismic upscaling:** taking account of the scale difference between the geological model and the seismic data in the modeling workflow.
- **Parameterization:** improvement in geostatistical-based parameterizations. The use of pragmatic techniques will be emphasized: definition of sub-domains with given simple geometries, variations in the sub-domain geometries, combination of existing deformation methodologies with the pilot point method, etc.
- **Quantification of 4D-seismic data mismatch:** investigation of a new formulation for the seismic term in the objective function, because a grid-block to grid-block formulation may be inappropriate for 3D data grids due to noise.

Work package 3 – Optimization

Development of an advanced optimization module as a new prototype patched on the CondorFlow™ industrial software. This will include improvements in terms of robustness, performance and enhanced functionality in the existing SQPAL algorithm as well as the development of new optimization methods such as derivative-free optimization techniques and Bayesian formalism.

Work package 4 – Structural uncertainty

Definition of the structural uncertainty as a parameter for history-matching. We will investigate the parameterization of the displacement of the geological objects using known parameterization techniques such as pilot points or approaches rooted in the gradual deformation method.

Deliverables

- software prototype deliverables on Condor prototype software or through patches to CondorFlow™, whenever feasible. Periodic releases including the new developments;
- organization of periodic meetings and workshops with the project partners at least once a year;
- presentations of methodologies and research issues during meetings. Organization of training sessions for Condor users;
- presentation and reports including validation results, description of test cases, and software documentation. Meeting materials available on website.

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