History Matching and Uncertainty Modelling

ResAssure offers users a complete Stochastic Reservoir Simulation workflow, which enables dynamic reserves estimation and history matching.

Its innovation in reservoir simulation lies in solving fully-implicit, dynamic three-phase fluid flow equations for every geological realisation. ResAssure marks a significant milestone in the history of reservoir simulation, leading technological advancements in the oil and gas industry. It has been developed to work with all standard reservoir simulation package datasets.

Incredible Speed-up of ResAssure

ResAssure's core simulator is built for achieving tremendous simulation speeds using various advanced mathematical techniques. ResAssure's exceptional speed is achieved by a combination of proprietary algorithms, polygonal gridding and aggressive spatial coarsening and time stepping, based upon a conventional finite-difference discretization of the reservoir.

It provides fully implicit simulation realisations without using proxy or approximation techniques and is able to achieve overnight what, until now, would take reservoir engineers years using conventional simulation technology.
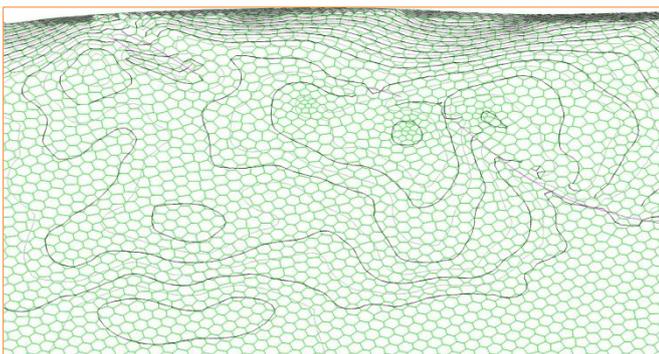

Figure 1 - An Example of Polygonal grids used in ResAssure

Technical Specification

Every geological realisation of ResAssure is modelled using a fully-implicit reservoir simulation algorithm incorporating:

- Multi-zone well model

- Well-bore gravity head and back-flow
- Mixed well constraints including rate, voidage and tubing flow to a common manifold
- User-defined, Corey or LET relative permeability
- User-defined, Brooks-Corey or LET capillary pressure
- User-defined or correlation PVT relations
- Equilibrium initialisation and dynamic simulation using pseudo-capillary pressure
- End-point scaling for relative permeability and capillary pressure
- Fault juxtaposition and transmissibility modification
- Cartesian or polygonal grids (including pebi)
- Mismatch function calculation by field, region or well including rate, water-cut, GOR and fractional flow.
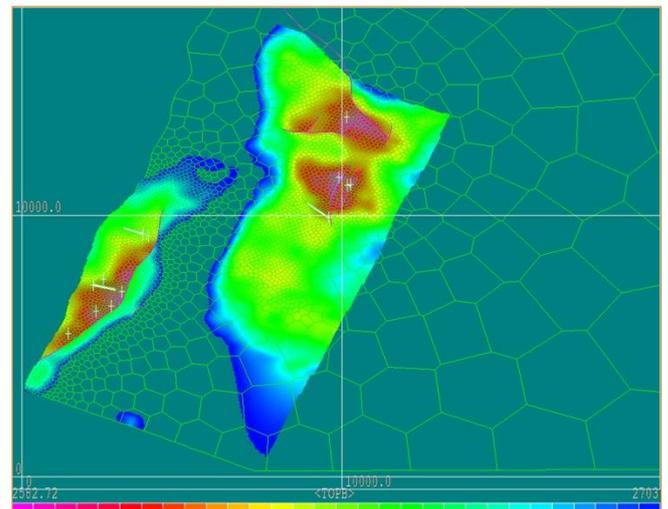

Figure 2 - ResAssure Polygonal Grid

What does it mean to reservoir engineering?

This technological breakthrough pushes the boundaries of handling subsurface uncertainties. Oil and gas companies and consulting firms using ResAssure can benefit from:

- overnight automatic history matching
- faster & better understanding of reservoir uncertainty
- optimised recovery and production
- evidence-based decision support
- better investment decisions.

Managing Uncertainties

Oil and gas projects always progress with the presence of uncertainties, from subsurface to markets. All subsurface

uncertainties are considered to be high risk as they have a direct impact on monetary value.

The stochastic simulation of hydrocarbon reservoirs provided by ResAssure reduces risk in the development of oil and gas fields and narrows the range of uncertainty in resource estimates. This reduces the potential for over- or under-investment and provides an unprecedented level of certainty for oil and gas reserves and project profitability.

Sensitivities

An unlimited number of simultaneous sensitivities can be generated using ResAssure. These sensitivities can be applied by region, stratum, layer, fault block or well location – examples include:

- Pore volume scaling
- Permeability, anisotropy & vertical permeability scaling
- OWC and GOC variation
- Relative permeability end-point scaling
- Layer thickness and net-gross
- Depth e.g. flexing between multiple structure maps
- Flexing between multiple geo-statistical realisations
- Fault transmissibility and distance to fault

Reduce Uncertainty for Mature Fields

Historical production data is used as a quality check for the existing reservoir models. Current history matching methods to identify good sets of history matched models are limited. As the industry is moving away from a single deterministic representation of reservoir, the existing methods (ensemble or gradient based approaches) struggle to solve the inverse problem. The non-uniqueness in the history matched solution has been accepted in recent years but long iterative processes requiring a number of simulation runs makes the process difficult.

Figure 3 - A history match solution from ResAssure

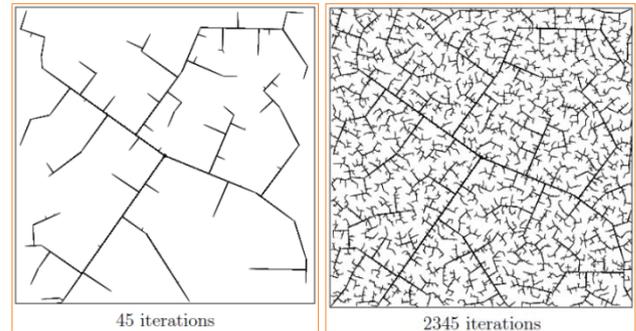## Example of ResAssure Sampling Techniques

Figure 4 - Rapidly Exploring Random Tree

Cloud Offering

ResAssure is available as a standard Enterprise package or on Software as a Service (SaaS) basis, running core processing and storing results on our secure cloud server.

This enables quick, dynamic product improvements.

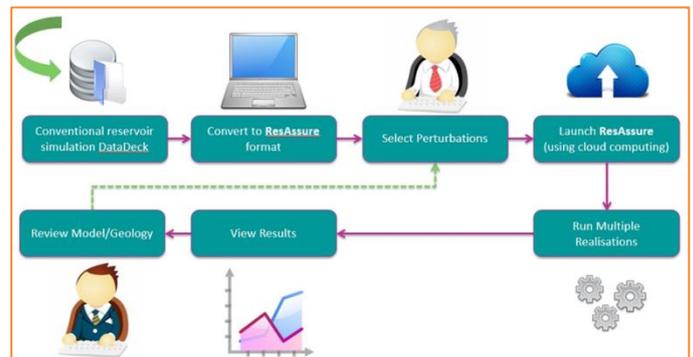The ResAssure GUI must be installed locally on a PC.

Figure 5 – ResAssure workflow

Hardware/Software Requirements

ResAssure will run on Microsoft Windows 7 and 8. It requires a minimum of 6 GB of RAM.

Pilot Study

Stochastic Simulation offers flexible pilot studies, where our expert engineers can assist you in developing a preliminary model – contact the team info@stochasticsimulation.com.