TECHNICAL SPECIFICATIONS

CougarFlow™
Risk & Sensitivity Analysis
for Basin Modeling & Forward Stratigraphic Modeling
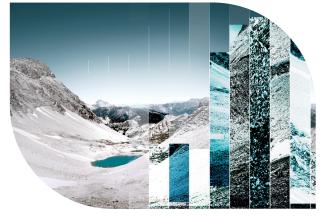
Software Presentation

Through a multiple realizations approach based on experimental design and state of the art optimization algorithms, CougarFlow aims at reducing the number of simulation runs to properly explore the possible solutions of a model. CougarFlow is seamlessly linked to DionisosFlow and TemisFlow on the OpenFlow Suite platform to allow:

• **A thorough screening of uncertainties** on a given range of input parameters and their influence on key simulation outputs;

• **Uncertainty analysis** for quantifying parameters impact and associated optimization.

Functionalities and Algorithms

UNCERTAIN PARAMETERS

• Scalars such as diffusion coefficients, thermal conductivities...

• Curves such as sea level curve, permeability/porosity curve...

• Maps such as bathymetry maps, initial TOC maps...

• Possibility to group parameters with metaparameter option

EXPERIMENTAL DESIGN

• From the simplest to the more complex: Classical, Full, User defined, Latin Hypercube, and D-Optimal designs for uncertain domain sampling

• Responses of interest: scalar or multi-age results of interest originated from grid results

RESPONSE SURFACE APPROACH

• Algorithms to compute Parametric (Least Angle Regression Square) and Non-Parametric Response Surface Models (Kriging)

• QC tools to analyze and validate the Predictivity of Response Surface Model: Spider and Tornado plots, Cross plot and Quality Indicators such as Predictivity Q2 and Predictivity with confirmation runs Q2 conf (blind tests)

GLOBAL SENSITIVITY ANALYSIS

• Qualitative and quantitative sensitivity analysis to determine the most influential parameters

• Automatic calculation of interactions between parameters

RISK QUANTIFICATION

• Uncertainty propagation to determine the range of potential values for a response (P10, P50, P90)

• Controllable uncertainty optimization to find a minimum on the surface response for an aid to calibration

EXTRAS

• Seamless link with DionisosFlow™ and TemisFlow™

• Link with third-party geo-modelers: Petrel™

Results Analysis

• Many viewers are available: histograms, cross-plots, graphs, logs, maps, cross-sections, 3D inherited histograms OpenFlow platform

• Filters and graphic settings

• Specific plots for uncertainty analysis: cross-plots, tornado plot, spider plot, Pareto plot

Data Management

DATA IMPORT/EXPORT

The following formats are available:

• Templates, preferences and color scales from OpenFlow

• Groovy scripts & packages

• Data exchange between OpenFlow Suite projects

DATABASE

• MySQL or Oracle database

• Improved data security and integrity, reduced data storage

• User and project administration

OTHER FACILITIES

• Unit system management

• Workflow manager: create, delete, configure, start, stop, load, restart, monitor a workflow...; manual and automatic launch/stop/restart/load

• Help through an online reference manual and contextual information

• Search tool

• Perspectives for display

• Workflow tree

• Host & Activity settings

Extensions and Customization

• Direct link to transfer data between Petrel and OpenFlow using an Ocean plugin

• Scripting facility based upon Groovy language

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System Requirements

- **Operating Systems**:
    - Windows Seven 64 bits service Pack 1 and Windows 10
    - Linux RedHat 6.6
- **RAM**: 16 Gb or more recommended, 8Gb minimum
- **Minimum free disk space**: 5 Gb (for installation)
- **CPU**: x86-64 processors (Opteron, CoreDuo, Core2Duo, Xeon & EMT64, Nehalem, Westmere, Sandy Bridge, Core i3, i5, i7)
- **Dualcore or Quadcore**: 2 GHz or more recommended
- **Graphics board**: NVIDIA (except Quadro FX 1000, Quadro FX 3500, Quadro NVS 110 M and Quadro NVS 280 SD) with recent driver (at least OpenGL 3.3 -driver 330 or later)
- Openmotif rpm package must be installed on Linux
- **Database**: MySQL 5.5 or 5.6.X (with X superior to 22) and Oracle 11g or 12c
- FlexLM 11.13.1.3 server for licensing

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