TECHNICAL SPECIFICATIONS

FracaFlow™
Fractured Reservoirs

Software Presentation

FracaFlow is Beicip-Franlab's software to characterize and model fractured reservoirs, fully integrated inside the OpenFlow platform.

Our workflow covers the following key stages:
- Static and dynamic data analysis
- Fracture modeling and DFN generation
- Dynamic calibration
- Equivalent fracture properties computation

FracaFlow offers an unchallenged variety of data analysis capabilities and the most advanced modeling capabilities with 10 different models and no limitation on the number of fractures.

On the dynamic side, it also benefits from a unique multi-well calibration method, proposes the best-in-class upscaling methods, both analytical and numerical, and is fully integrated with other software of the OpenFlow platform (PumaFlow, CougarFlow)

Functionalities and Algorithms

FRACTURE AND FAULT CHARACTERIZATION

FRACTURE ANALYSIS
- Identification of fracture sets
- Computation of their dip and dip azimuth distribution
- Identification of fracture corridors in wells
- Automatic gathering algorithm
- Several options for display and statistics

FAULT ANALYSIS
- Identification of fault sets
- Computation of their dip and dip azimuth distribution
- Computation of their length distribution law
- Computation of their fractal dimension
- Computation of the throw profile (polygons)
- Computation of 2D and 3D attributes (density, strike, distance to nearest fault, etc.)
- Automatic gathering algorithm
- Several options for display and statistics

FRACTURE DENSITY LOG COMPUTATION
- Computation of fracture density logs for each set
- Four different available methods
- Analysis of facies control on density distribution

DYNAMIC ANALYSIS
- Analysis of flowmeter, well test, mud losses and production data
- Identification of productive fractures
- Early breakthrough screening
- Impact of faults on dynamic parameters
- Several display and statistics options

QUICK ASSESSMENT OF FRACTURING
- Combine dynamic analysis results with fracture density to assess the extent of fracturing in each well
- Build maps to identify zones of high/low fracturing

GEOMECHANICAL CONSTRAINT COMPUTATION
- Based on the perturbations of a remote stress field caused by the presence of faults
- Compute the distance perpendicular to the failure criterion, the principal stress values and axes and the plane orientations/dip
- Use the results to correct the conductivity parameter in Fracture models

STRESS ANALYSIS
- Based on well stress measurements and a Mohr-Coulomb criterion
- Identify critically stressed fractures in wells
- Create a new label and model them differently

MAP EDITOR
- Compute attributes on horizons or property maps (curvature, illumination, slope, etc.)
- Perform basic computations, smoothing, interpolation, normalization
- Fault lineaments picking capabilities

CONNECTIVITY ANALYSIS
- Divide a DFN in several connected clusters of fractures
- Eliminate unconnected clusters from the DFN

FRACTURE AND FAULT MODELING
- Define properties of all fracture and fault sets at the grid scale: orientation, size, aperture, conductivity and spatial distribution
- Several distribution laws and even 2D or 3D properties can be used to define each property
- Three different conceptual models for diffuse fractures: facies-based stratabound, fault-based non-stratabound and attribute-based non-stratabound
- Four different models for stochastic faults: fault-related, fold-related, attribute-based or sub-seismic faults based on fractal geometry
- Deterministic faults from lineaments, surfaces or user-defined positions
- Generation of a DFN in any user-defined zone of the grid
- Constrained option to honour the fractures observed at wells

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DYNAMIC CALIBRATION

AUTOMATED KH CALIBRATION

- Calibration of fracture conductivities to match observed well KH
- Fast multi-well automatic optimization using an iterative genetic algorithm
- Based on analytical upscaling technique
- Possibility to link parameters
- Calibration of KL for horizontal wells
- Result analysis

WELL TEST AND FLOWMETER SIMULATION

- Explicit state-of-the-art unstructured meshing of all fractures inside a DFN
- Monophasic liquid or gas simulation inside this mesh
- Comparison of the match with observed pressure curve or flowmeter

EQUIVALENT FRACTURE PARAMETERS COMPUTATION

- Limited to a chosen zone of the grid or at the full field scale
- Full permeability tensor, diagonalized tensor or projected tensor on the grid local axis, fracture porosity, block size or shape factor
- Outputs for single or dual medium simulation
- Best-in-class analytical method based on Oda's formulation, and even a super-fast analytical method without DFN
- Connectivity index output
- Most accurate numerical upscaling method, allowing advanced sensitivity analysis
- Geometric method for block size computation

GEOSTATISTICAL WORKFLOW

FRACTURE DENSITY CONTROLLER

- Compute a fracture density driver based on a combination of grid properties and attributes
- Correlation identified through comparison at wells
- Method based on discriminant analysis
- Can be used in geostatistical simulations as an external constraint

GEOSTATISTICAL SIMULATIONS

- Tools for variography analysis
- Geostatistical simulation of fracture density by a Fast Fourier Transform – Moving Average method
- Respects input distribution and values at wells
- Possible use of an external constraint

LINK WITH OTHER SOFTWARE

- PumaFlow reservoir simulator directly integrated in the same platform
- Fracture and fault model properties can be handled as uncertain parameters by CougarFlow, our tool for uncertainties analysis and assisted history matching, thus allowing assessment of the uncertainty of those parameters
- Petrel link for direct maps, faults, wells and grids transfer

Results Analysis

- To display data many viewers are available: histograms, cross-plots, graphs, logs, maps, cross-sections, 3D
- Filters and graphic settings
- Zone of interest creation and management
- Posted maps

Data Management

FracaFlow benefits from all the capabilities of the OpenFlow platform and can be linked to Petrel through an Ocean plug-in.

Beicip-Franlab Headquarters
232, avenue Napoléon Bonaparte
92500 Rueil-Malmaison - France
Tel.: 33 1 47 08 80 00
Email: info@beicip.com

DATABASE MANAGEMENT

- Data and results are stored in a database MySQL 5.5 or 5.6.X (with X superior to 22) or Oracle 11g or 12c
- User and project administration

DATA IMPORT/EXPORT

- Grids in Eclipse .GRDECL format
- Wells and logs in LAS, Petrel or ASCII format
- Fracture interpretation logs in ASCII format
- Fault lineaments and polygons in CPS3 (ASCII or binary), Zmap+ or Fraca formats
- Fault surfaces in Earthvision or Gocad Tsurf formats
- Horizons and property maps in CPS3 (ASCII or binary), Zmap+, gocad Tsurf, Gmap, Fraca or ASCII cloud of points formats
- DFN in Gocad and Golder formats
- Rescue models in ASCII or binary (version 37) and ResQML 2.0 import
- Well dynamic data: flowmeters, well tests and perforations in ASCII format, OFM production history
- Templates, preferences and color scales from OpenFlow
- Groovy scripts & packages
- Data exchange between OpenFlow Suite projects

DATA EDITING AND QC

- Formula bar
- Cartesian grid creation
- Map attributes computation and fault picking
- Property mapping from a data support to another
- Fault surfaces and lineaments simplification
- Unit system management
- Help through an online reference manual and contextual information
- Perspectives for display
- 1D, 2D and 3D visualizations with interactive editing features

LINK WITH PETREL

- Direct exchange of data between FracaFlow and Petrel through an Ocean plug-in
- Transfer of input data to FracaFlow and retrieval of upscaling results back in Petrel
- Handles wells, well logs including fracture logs, grids and their properties, horizons, property maps, faults

Extensions and Customization

- Direct link to transfer data between Petrel and OpenFlow
- Scripting facility based upon Groovy language

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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