InterWell is Beicip-Franlab’s seismic inversion and reservoir characterization software. Available on Windows and Linux platforms.

InterWell unified workflow offers the following key stages:

- **Seismic data QC and conditioning**
- **Multi-well wavelet estimation and multi-cube well-to-seismic calibration**
- **Prior impedance modeling for elastic parameters**
- **Deterministic acoustic/elastic inversion**
- **VTI deterministic elastic inversion**
- **Acoustic/elastic geostatistical inversion**
- **Multi-component, azimuthal and 4D inversion workflows**
- **Lithology prediction and trend modeling**

### Software Presentation

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### Functionalities & Algorithms

#### ELASTIC SEISMIC DATA REGISTRATION
- Residual NMO Misalignment QC and correction between angle stacks using a volumetric analysis and optimization method.
- Generation of cube-to-cube cross-correlation and noise maps.

#### MULTI-TRACE COHERENCY ANALYSIS
- Estimation of seismic signal, noise and seismic bandwidth.
- Seismic signal spectral analysis.
- Statistical estimation of wavelet amplitude spectrum.
- Can be performed in constant time windows or along an horizon.

#### WELL-TO-SEISMIC CALIBRATION
- Hybrid approach for wavelet estimation (statistical and deterministic).
- Multi-well wavelet extraction and optimization.
- Time shift estimation through envelop of intercorrelation.
- Wavelet phase & energy determination via multi-trace & multi-well analysis.
- Variable phase and amplitude wavelet estimation using a least square optimization method.
- Inter-bed multiple modeling option to detect multiple generator and maximize calibration accuracy.
- Flexible editing of calibrated wells location and time-shift.
- Energy normalization map from wells using several interpolation methods.

#### MULTI-CUBE CALIBRATION
- Well-to-seismic calibration and determination of optimal well position taking into account different single-volume calibration sessions.

#### PRIOR IMPEDANCE MODELING

- **Structural framework definition**
- Building a geological framework for elastic parameter modeling.
- Step by step integration of horizons in a structural model.
- Geological macro-units.

### Model definition

- Depositional model definition within each macro-unit.
- Creation of an a priori distribution of impedance and density.
- Well data interpolation along structural and stratigraphic features.
- Modeling of low frequency component using seismic velocity data.

### DETERMINISTIC INVERSION

#### Acoustic and Elastic seismic inversion with Bayesian approach

- Inversion products: IP, IS, RHO, synthetic seismic, reflection coefficients and residuals seismic for each angle stack.
- Taking into account data quality and influence by tuning inversion parameters:
  - Parameterization of inversion algorithm using prior uncertainty assessments.
  - Balancing the influence of input seismic data volumes.
  - Optimization through a multi-channel conjugated gradient method.
  - Monitoring of inversion cost function.
  - Inversion on full-cube, sub-cube or around a surface.
  - Fast full-seismic option available.

### Advanced inversion capabilities

- HPC capabilities to minimize computing time.
- Inter-Bed Multiple Modeling (IBMM) technology to attenuate the impact of multiples from a contaminated dataset on the inversion results.
- Laterally variable wavelet energy.
- Integration of VTI (Rüger) anisotropy model for enhanced inversion results.

### GLOBAL STOCHASTIC INVERSION

- Geostatistical inversion algorithm developed in partnership with Cerena (Instituto Superior Tecnico).
- Use of direct stochastic sequential simulations.
- Global optimization technique based on the trace-to-trace mismatch between real and synthetic seismic.
- Possibility to use deterministic inversion results as secondary variable.
- Possibility to use external distributions to constrain the simulations.
- Uncertainty analysis through the analysis of several simulations.

### AZIMUTHAL INVERSION

- Complete sequential multi-azimuth inversion workflow.
- Determination of isotropic and anisotropic contributions.
- Assessment of horizontal anisotropy parameters via statistical ellipse fitting.

### TIME-LAPSE 4D JOINT INVERSION

- Complete workflow for Time-lapse inversion.
- A priori warping using a multi-channel correlations method.
- Physical warping process integrating both P-waves cinematic and impedance variations.
- Multi-vintage acoustic and/or elastic post- and/or pre-stack inversion.

### MULTICOMPONENT JOINT INVERSION

- Complete workflow for multicomponent (PP, PS, SV, SH) inversion.
- Scaling law computation for the different domains.
- Multicomponent post- or pre-stack inversion.
Results Analysis

AUTOMATED DEDICATED QC

• Wells
  - Sections with customizable well projection
  - Automatic display for comparison between initial logs and inversion results
  - Available for blind wells testing

• Wavelets
  - Display of the envelop of inter-correlation functions between observed and synthetic traces (time-shift detection)
  - Cross-plots and histograms integrating all wells or sub-sets of wells for optimizing the time shift, the phase and the energy
  - Mapping of estimated parameters and corresponding correlations of observed vs. synthetic trace, to check the accuracy of the estimated parameters in the vicinity of the wells / intersections
  - Correlation coefficient, Phase, Time Shift and Energy maps around wells
  - Average calibration attribute maps (multi-cube calibration)
  - Wavelet and corresponding phase & amplitude spectrum
  - Display of multiple wavelets, comparison of amplitudes spectra, available for multi-cube stability analysis or input versus inversion results QC

• Sections
  - Automatic combined sections display showing a user-defined selection among inversion results, input seismic and prior models

• Cross-plots
  - Cross-plots between inverted parameters such as IP vs. IS (or calculated Vp/Vs or PR), and between inverted traces and well logs.

• Maps
  - Fast and accurate extractions of various attributes along/between horizon(s)
  - Display of isolines over any map view
  - Design of arbitrary lines stored as a survey data

SEISMIC CHARACTERIZATION TOOLS

Comprehensive set of functionalities and attributes

• Filters
  - Available for horizons and seismic data

• Advanced calculator
  - Available for horizon and seismic data

• Seismic data QC
  - Noise maps and energy maps
  - Using a constant time window or around an horizon

• Inversion QC
  - Cross-correlation maps between two sections/volumes
  - Energy ratio maps between two sections/volumes
  - Noise maps before/after inversion

• Frequency analysis on maps
  - Minimum, maximum, dominant frequency, analysis at -6dB or -10dB
  - Spectral decomposition

• Statistics maps extraction
  - Average, minimum, maximum, variance, standard deviation, RMS
  - Available around one horizon or in an interval defined by two horizons
  - Possible use of threshold to derive proportion maps in an interval

• Fast-track AVO analysis
  - R0-G cross-plots and direct highlight on seismic data

LITHO SEISMIC CHARACTERIZATION AND SEISMIC CONSTRAINTS GENERATION

Complete workflow for litho-seismic characterization from inversion results

• Dominant lithology prediction using discriminant analysis
• Generation of volumes of dominant lithology and associated probabilities of good assignment
• Trend modeling to derive maps of key reservoir properties combining inversion results and well data

DEDICATED CHARACTERIZATION OPTIONS FOR ADVANCED WORKFLOWS

• Ellipse fitting for anisotropy intensity and orientation quantification in azimuthal workflows
• 4D effects quantification modules
• Discriminant analysis using 3 variables in multi-component workflows

Data Management

InterWell integrated survey migrator automatically ensures compatibility with databases and runs from previous versions.

DATA IMPORT/EXPORT

• 2D/3D seismic, velocity, and anisotropy data in SEG-Y and binary files format
• 2D/3D seismic gather in SEG-Y format
• Well data in LAS format (3.0), automatic projection on 2D lines
• Horizons, maps, tables, and pointsets in ASCII format
• Wavelet in ASCII format
• 2D/3D anisotropy parameters and attribute data
• Direct connection with EasyTrace database for transfer of input well logs/results extracted at wells tables for Discriminant Analysis training data/external distributions for geostatistical inversion

DATA EDITING AND QC

• Horizon edition through various gridding, smoothing, merge options
• Data extraction and calculators for wells, maps, sections and volumes
• Automated QC displays on wells, maps, sections and volumes

Extensions & Customization

Based on the open Java™-based INT platform (http://intviewer.net/products/intviewer.html) allowing a high level of customization and extensions

• Powerful and flexible GUI
• Based on the open source Netbeans Rich Client Platform (RCP) for creating and managing plugin functionality
• Existing plug-ins available among spherical divergence correction, Butterworth filter, binning 4D.
• Interoperability with Python and the Seismic Workbench

System Requirements

• PC Windows 7 and Windows 10
• PC Linux 64 bits RedHat6 or RedHat 7 or compatible
• RAM: 16 GB or more (minimum: 8 GB)
• CPU: x86 and x86-64 processors
• Graphics board: NVIDIA recommended (or any graphic card compatible with OpenGL)