A02 – A guided tour of Emeraude V2.40

A02.1 • Purpose of this tour

This chapter gives a general idea of the program logic and interface, and is mainly intended for new Emeraude users. The guided sessions following this chapter will give you the opportunity to go through the main software features on real data sets.

A02.2 • Emeraude data structure

An Emeraude document contains several hierarchical levels:

Document level

A document corresponds to the way Emeraude stores data in individual files, *.ke2. A document will typically handle all data and interpretations of a PL survey on a given well. Typically a document will include data acquired during the different flowing and shut-in conditions of a test. A document will include the selected system of units, well information, general well data common to all surveys, and one or several surveys.

Survey level

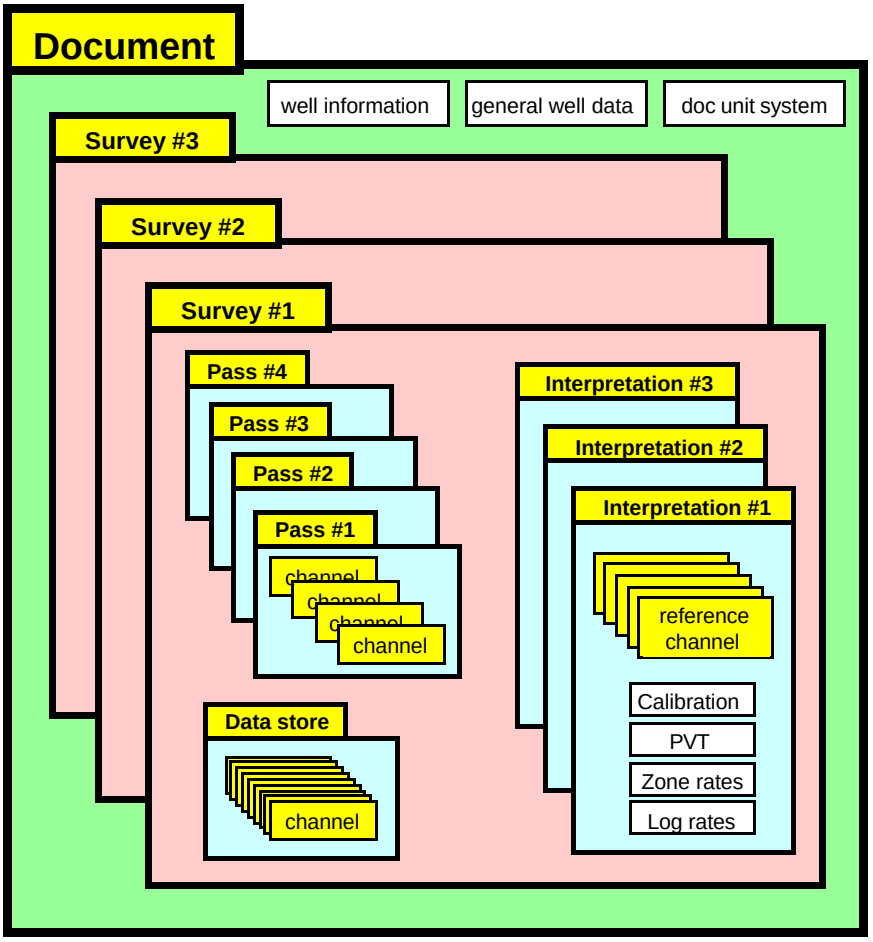
A survey is associated to a single flowing (one choke size) or shut-in period. This includes all data acquired during this condition and interpretations performed on this data. The raw data is split into passes that correspond to one sequence of the tool survey in a given direction and at (hopefully) a given cable speed. Each pass contains a set of channels, each channel containing the data of one tool during this pass. A data store also includes selected and edited channels. This enables storage for specific editing, for example averaging, filtering, etc. A survey will include the surface rate information (if available), the raw data from the various passes, any editing performed on the raw data, the data store and one or several interpretations.

PL Interpretation level

An interpretation contains all the processing and results corresponding to the calculation of a particular flow profile. An interpretation will include a set of selected tool channels, a calibration (optional), a choice of PVT, a set of calculation zones where detailed zone rates are calculated, and output rate logs.

PNL Interpretation level

This is the Pulsed Neutron equivalent of the PL interpretation, located at the same level in the hierarchy. An Emeraude document is structured as follows and this will be directly represented within the Emeraude browser (see A02.6 below):

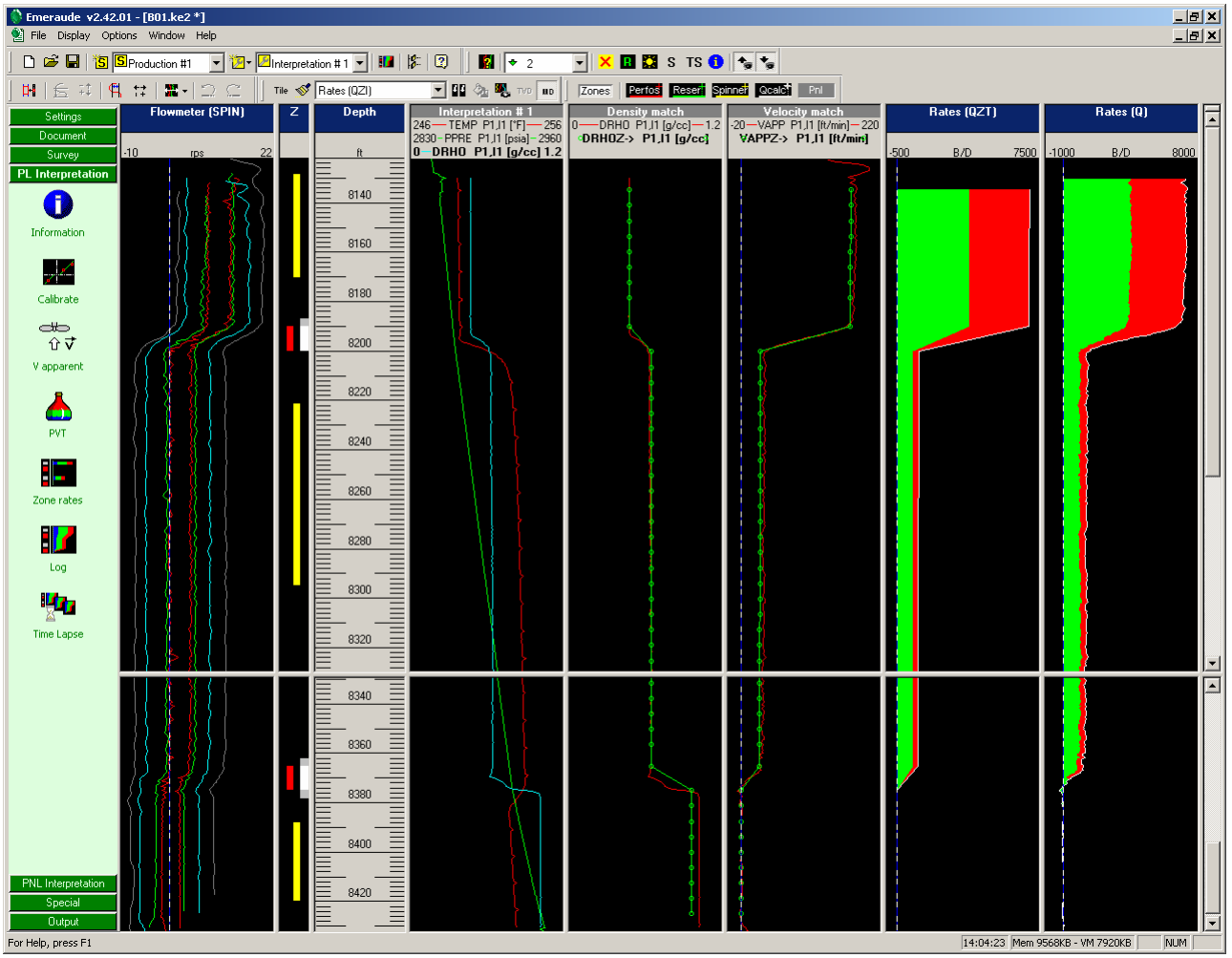


In the above example the depicted interpretation internal structure is for a PL interpretation (as opposed to PNL).

A02.3 • Program main window

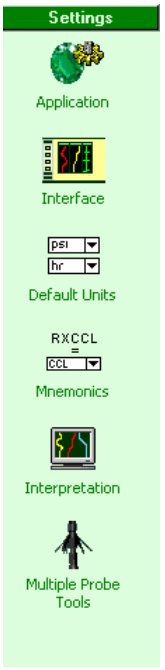
An example of Emeraude main window is given below. Some specific facilities will create a dialog that will pop up on top of this window, but when the facility is completed the program will return to the main window.
This Window consists of:

- A standard Windows menu bar
- A control panel similar to Microsoft Outlook ™
- The plot area where different logs are displayed



A02.4 • Emeraude control panel

A02.4.1 • Settings page >



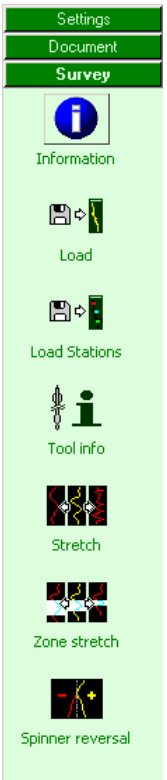
This page includes all facilities linked to user settings. The content of this page is NOT linked to any specific document. After adjustments to the machine and the user, this page should be very rarely opened. Settings include workspace settings (colors, background), user selected default units, database of mnemonics identified by Emeraude, interpretation settings (PVT and flow correlations enabled and used by default), and default aspect logic. The settings are stored in the Windows system registry.



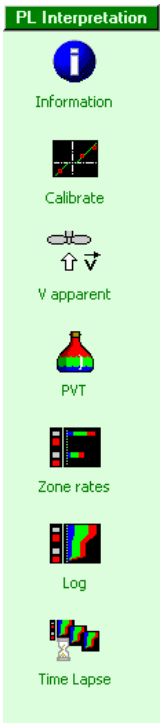
< A02.4.2 • Document page

This page includes all facilities linked to the active Emeraude document. When several documents are opened the active document may be selected from the Windows menu item. The document includes all information common to all surveys. The document page allows the edition of document units, and the load of general well data/information, for instance an open-hole gamma ray.

A02.4.3 • Survey page >

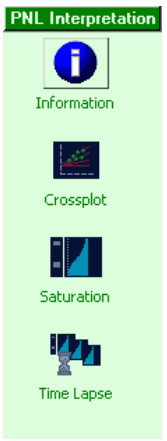


This page includes all facilities linked to a survey, and are applied to the active survey. When several surveys are created, the active survey may be selected from a droplist in the main toolbar. The survey page essentially allows the loading of the log data (Up/Down passes and stations) as well as the definition of the tool characteristics. Also included are some specific editing options: stretch, (zone or block) and spinner reversal.



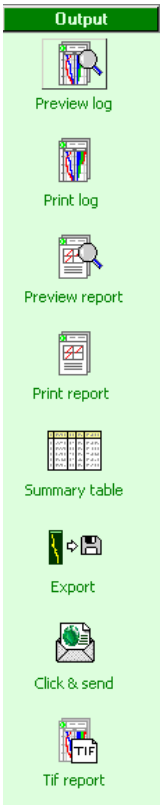
< A02.4.4 • PL Interpretation page

This page includes all facilities linked to a PL interpretation. They are applied to the active interpretation in the active survey. When several interpretations are created in the active survey, the active interpretation may be selected from a droplist in the main toolbar. The interpretation page allows the creation of interpretation reference channels, the calibration of a selected spinner, definition of the PVT model, zonal and continuous rate calculation.



A02.4.5 • PNL Interpretation page >

This page includes all facilities linked to a PNL interpretation. They are applied to the active interpretation in the active survey. When several interpretations are created in the active survey, the active interpretation may be selected from a droplist in the main toolbar. The interpretation page allows the creation of interpretation reference channels, zones and cross plot creation, Sw calculation, and Time lapse analyses.



< A02.4.6 • Output page

Log and report printout for the active interpretation. Export of LIS, LAS, and Ascii files. Click & Send file for support and/or crosscheck.



A02.4.7 • Special page >

Contains additional features:

- Interpretation of conductivity logs used in hydro-geology
- Selective Inflow Performance
- Formation testers data QAQC

A02.5 • Menu bar and toolbars

Menu bar

The menu bar includes the following items:

File: Usual options

Display: Show or hide toolbars and status bar, cursor and scroll settings, tile, log titles

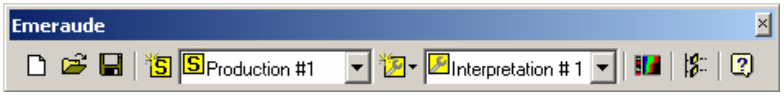
Options: Reproduces as a pop-up menu the full content of the control panel options

Windows: Usual size options, access to the browser, activate opened documents

Help: Usual help, and direct access to KAPPA WEB site

Toolbars

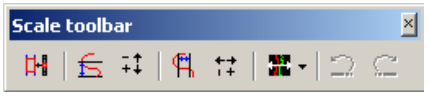
Toolbars may be moved, placed floating on top of the Emeraude window, or docked on any side of the Emeraude window. They may also be turned on and off using the “Display” item in the menu bar. There are 5 toolbars: main, display, pass, scale and zone toolbar:



The **main toolbar** includes the usual document access (new, open, save), the contextual help, the droplists selecting the active survey and the active interpretation, options to create a new survey/interpretation, shortcut to update schematic logs, and the access to the data browser (see A3.6 below).



With the **display toolbar** the user can tile the logs in the plot windows, refresh the screen, re-activate the hidden plots from a droplist, fill the area between two curves (user views only) or make a capture of the current screen layout.



The **scale toolbar** addresses the depth control and various ways to modify the scales, together with undo, and redo options.



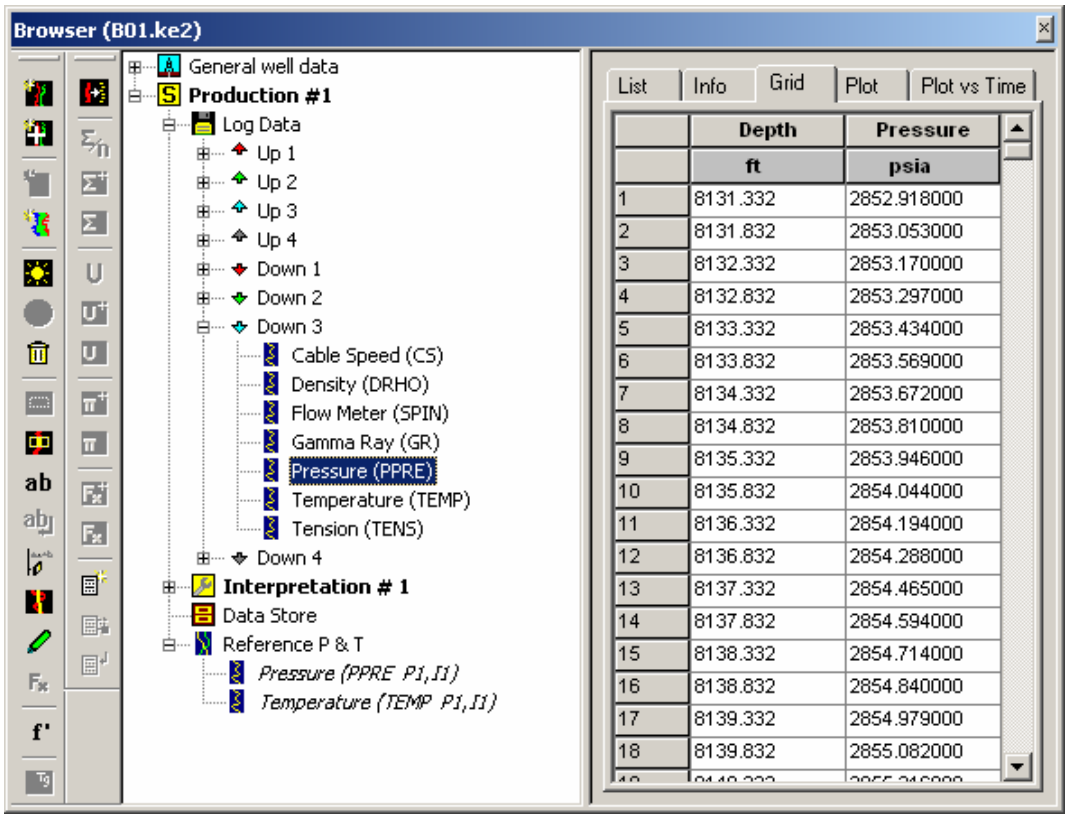
The **pass toolbar** contains the main facilities to activate and edit the passes: activation (graphical or via a droplist), hide, set as reference, highlight, shift, edit infos, show/hide all up/down passes.



The **zones toolbar** contains options to create and edit the various zones that are used in Emeraude, such as perforation intervals, spinner calibration zones, etc.

A02.6 • Data browser

Using the data browser is not strictly required to perform an interpretation. In practice experienced users will mostly work with it as its flexibility authorizes manipulations beyond what the "sequential" facilities in the control panel can do. Basically the data browser displays, moves, edits and deletes Emeraude data according to the data structure described in A02.2, in a graphical way similar to the Windows Explorer.



Actions that can only be performed from the Emeraude browser are:

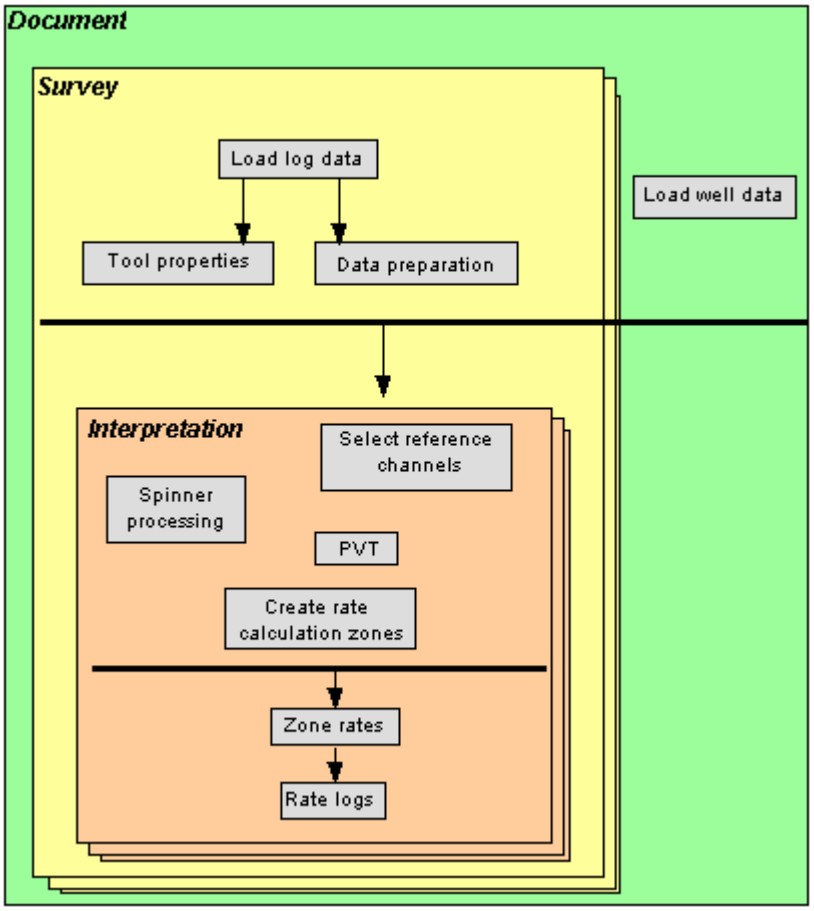
- Delete surveys, interpretations, channels
- Move or duplicate channels from one point in the data structure to another
- Create / Edit data in the data store
- Access the numerical values of the channels
- Filter, shift, graphically edit, fill gaps in data
- Create custom user views from channels anywhere in the data structure

- Create image views (multiple-probe tools)
- Create well view
- Flexible export of any data
- Calculate gradients, and in particular pressure gradients as an alternate to gradio data
- Channel multiplication
- Resample whole or part of the document data
- Group operations for depth / measure shift.
- Interactive creation / edition of the geothermal profile
- Call user functions in external DLL

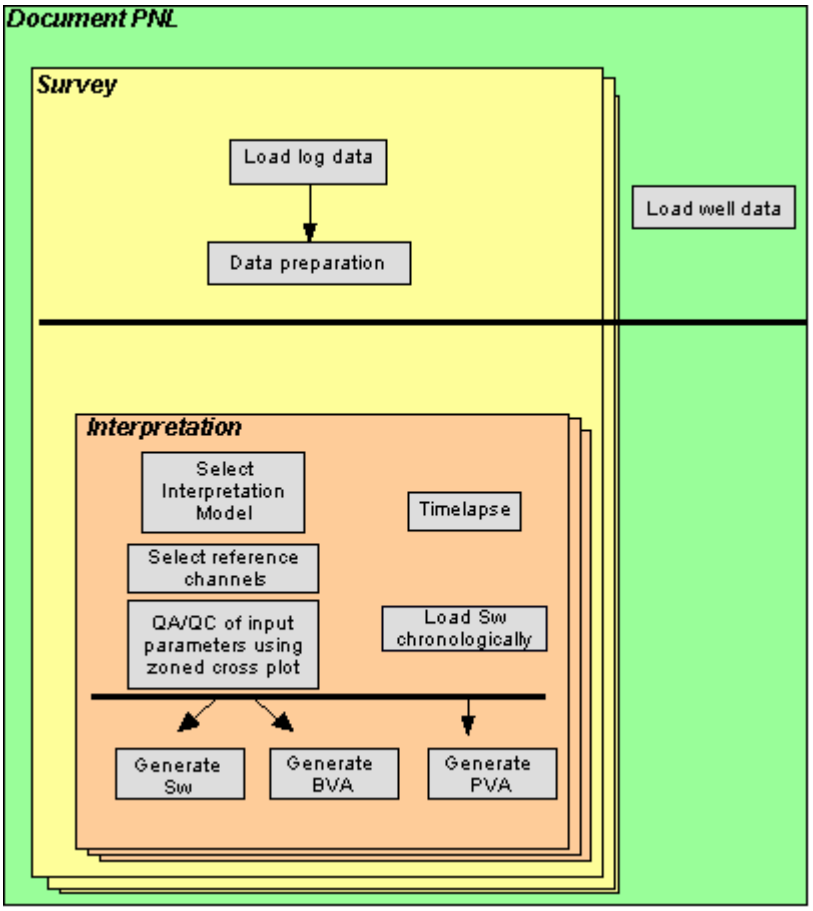
A02.7 • Software roadmap

The schematic below describe the typical Emeraude paths, for a Production Log or a Pulsed Neutron Log interpretations. When a logical order exists, it is indicated with an arrow. For items that are not interconnected, the respective level indicates a suggested order only.

PL Roadmap



PNL Roadmap



A02.8 • Methodology in Emeraude

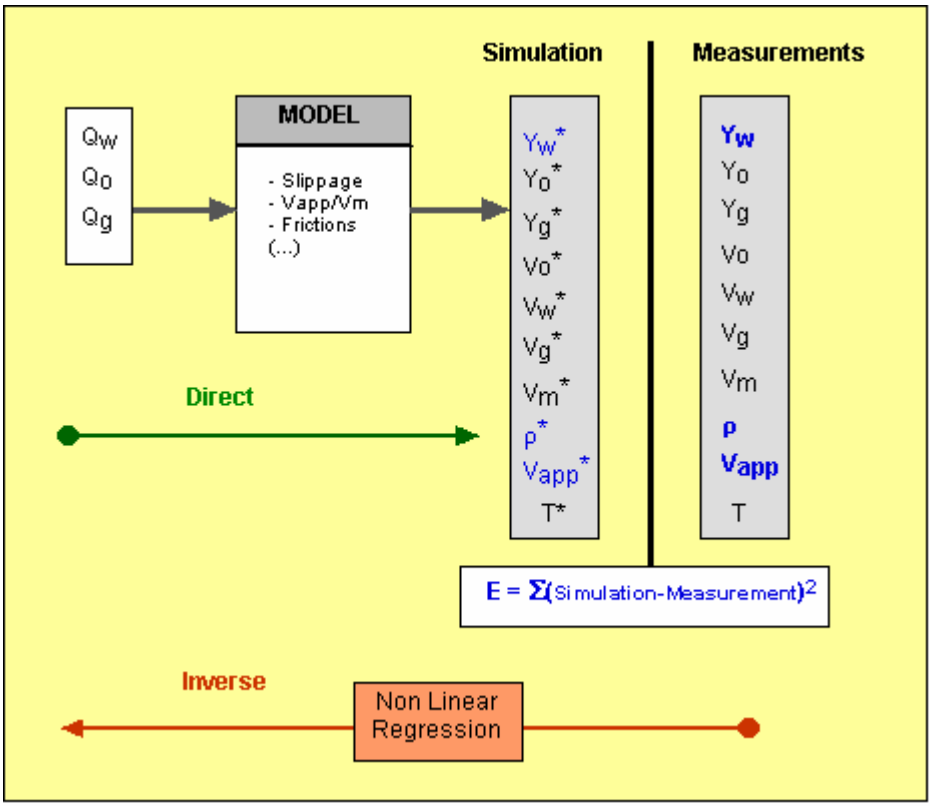
In Emeraude, the rate calculation is treated as a minimization problem and solved using non-linear regression. Unlike the conventional approach, non-linear regression offers full flexibility in the type and number of measurements that can be handled, as well as the possibility to include external constraints.

Non-linear regression

In its general form, a minimization problem is one where we consider some function y = F(x), where both x and y are vectors, the goal being to determine x such that F(x) is as close as possible to some known value y*. We say that we are solving an inverse problem since we seek a function input from its known output. The function to minimize, called the objective function, is taken as the sum of the squared differences between the entries in y and y*:

$$E = \Sigma_i (y_i - y^*_i)^2$$

For Production Log Interpretation, **x** represents the unknown rate values, whereas **y** is made of the relevant measurements (Vapp, density, holdups, etc.) as illustrated on the figure below. The **direct** problem is therefore the ability to calculate simulated measurements given the rates, and this can be done using a combination of correlations.



The notations used on the above figure for the simulated and actual values are described elsewhere. This figure illustrates a 3-phase calculation, where it is assumed that the available measurements are a water holdup Yw, a density ρ, and the apparent velocity Vapp. The objective function in this case becomes:

$$E = (Y_w^* - Y_w)^2 + (\rho^* - \rho)^2 + (V_{app}^* - V_{app})^2$$

Each particular term in E is called a **residual** and each residual can be assigned a particular **weighting**. Each residual corresponds to a particular tool and adding a new tool only amounts to adding the corresponding residual term. This approach obviously provides a lot of flexibility, as the calculation can easily be adapted to any sufficient set of measurements, even if some of them provide redundant information.
Another noticeable difference in this approach is that any required calculation step can be easily integrated in the Model to accurately simulate the measurements. For instance, when a gradio measurement is present, the model integrates the complete tool response accounting for frictions and the effect of deviation. In other words, frictions are added to the simulated hydrostatic head, whereas the conventional approach would try to remove frictions from the measured gradient.

Global vs. Local regression

The description above only deals with a single depth solution, whether this is used in zonal calculation, or for generating a continuous rate log. In addition Emeraude can solve simultaneously at several depths, while imposing the signs of the actual rate contribution. In this case, the regression is said to be Global, and its overall objective is the minimization of the error between simulated and measured values, while satisfying the imposed physical constraints.