A03 – V2.42 Update Notes

This chapter gives a concise reference for the new options in V2.42 and can provide a jump-start for V2.40 users. Section A03.1 gives a complete list of additions/modifications, while A03.2 describes in details the new FSI options and processing. Please note that the on-line help has been updated and contains a full reference for the new facilities.

A03.1 • What's new in Emeraude 2.42?

New/Info access logic for a Survey or an Interpretation

The two functions used to be accessed from a single button within the suitable control panel. They are now separated into two different options:

- Creation of a new Survey/Interpretation: Use the respective survey and interpretation (PL or PNL) icons from the main Emeraude toolbar 

.
- Edition of the active Survey/Interpretation: Use the icon from the suitable Survey, PL Interpretation, or PNL Interpretation control panels.

The icon stills allows you to create the first survey for the current document. However to create a new survey after one exists, you need to use the "create survey" icon in front of the survey drop list of the main toolbar. The same logic applies for the creation of the first PL or PNL interpretation: (PL or PNL).

Zone Rate dialog

- Legend & axis labels have been added to the zone rate plot for better clarity (see Fig A03.1).
- In the "Contribution" page, it is now possible to visualize the surface contributions corresponding to the current solution using the Show s.c. values (read only mode) check box (see Fig A03.2).
- In the "Contribution" page, an "Update calculation of schematic rate logs" option has been added (see Fig A03.2).

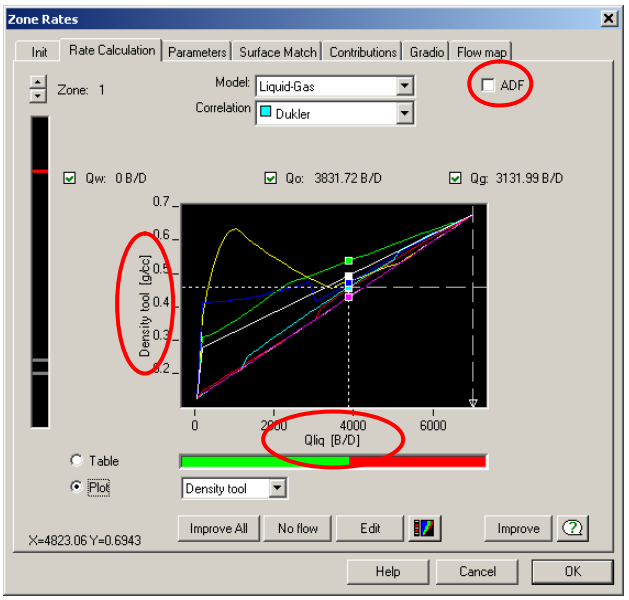


Fig A03.1; Zone rates - Rate Calculation page

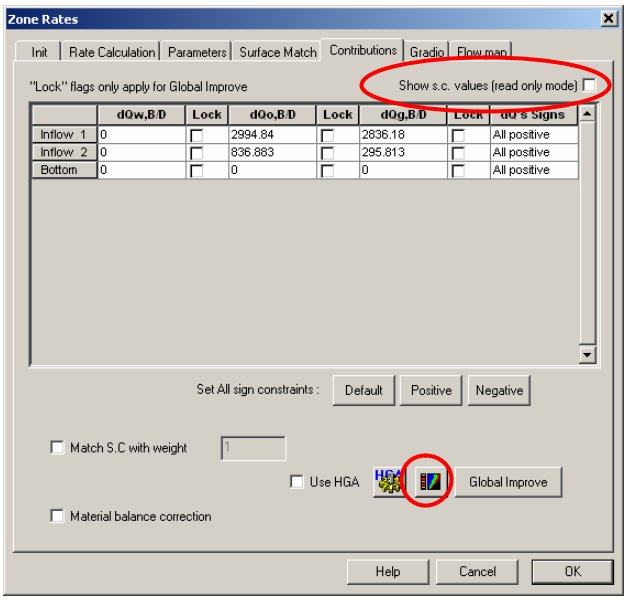


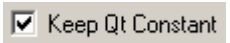
Fig. A03.2; Zone rates – Contributions page

- Apparent downflow: the "ADF" option is now offered regardless of the sign of the apparent velocity Vapp. When the 

option is selected, the Vapp input reference channel is disregarded (set to absent value) and the user has now the capability to edit and modify the C_{ADF} and V_{ADF} coefficients in the equation used to derive the rate of the light phase:

$$Q_{light} = C_{ADF} \times (V_s + V_{ADF}) \times (1 - Y_{heavy}) \times A_{pipe}$$



- "Edit zone" dialog, "Q, downhole" section (Fig. A03.3): a check box 

has been added. When a phase rate is changed, and provided that the new value for that phase does not exceed the current Qt, the other rates are modified according to the following logic:

  1. When the modified phase is part of a pseudo phase (Liquid or Hydrocarbon), Emeraude tries to keep the pseudo phase rate (respectively $Q_{Pseudo} = Q_w+Q_o$ or $Q_{Pseudo} = Q_o+Q_g$) constant if possible.
  2. When the modified phase is not part of a pseudo phase, the other rates are adjusted so that the proportion within the pseudo phase is kept as before.

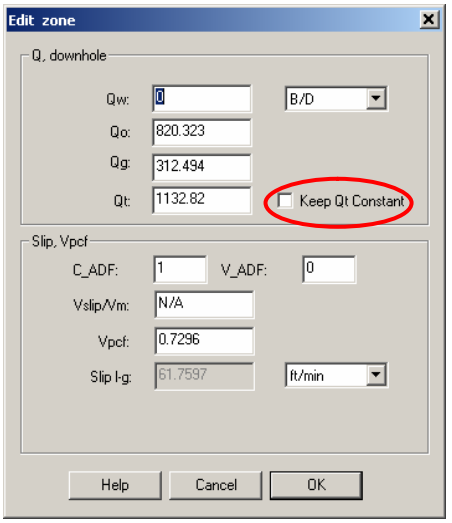


Fig A03.3; Edit Zone

- "True friction for lateral average" option in the "Gradio" page (see Fig A03.4): when using this option, Emeraude reads the info string of the density reference channel, calculates the tool friction for all input channels with the associated cable speed, and makes a lateral average of the tool friction results.

  This option is un-checked by default. Emeraude then computes a lateral average of the different cable speeds (corresponding passes used to define the density reference channel) and use the result to derive the tool friction.

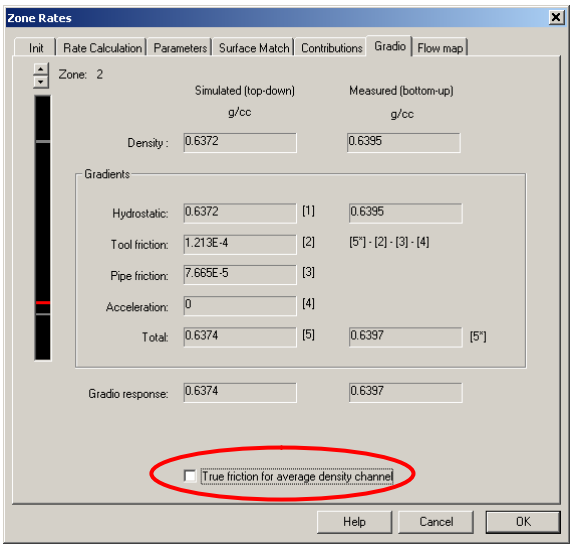


Fig A03.4; Zone Rates – Gradio page

Browser additional level for MPT raw channels

Another level of hierarchy has been added in the Data Browser: the "MPT raw channels" node will gather all the mnemonics that are used in the definition of an MPT tool (see Fig A03.5 below).

MPT cross section

The MPT cross section ring image is now thicker (simple average option). Besides, caliper and holdup values have been added and are displayed on the plot (see Fig A03.6 below).

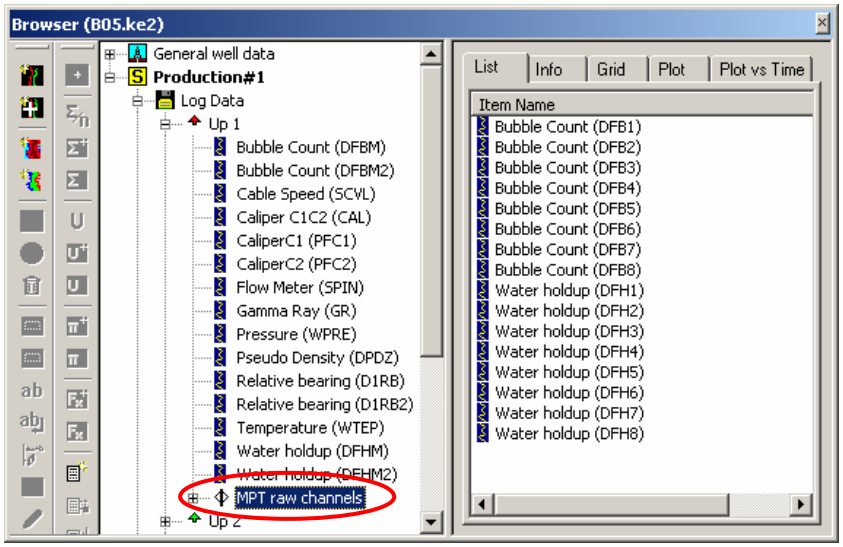


Fig A03.5; Data Browser - MPT raw channels

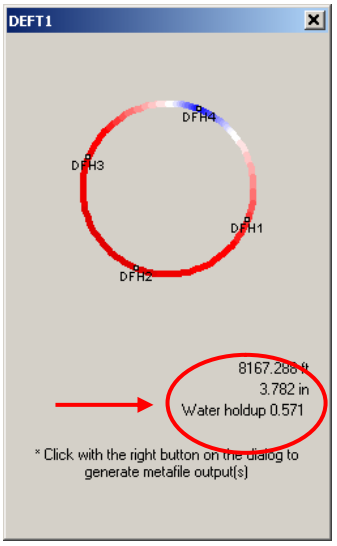


Fig A03.6; MPT Cross Section

Possibility to visualize a deviation corrected density (Schlumberger PTS gradiomanometer) before interpreting

It is now possible to correct a density measured by a Schlumberger PTS gradiomanometer for deviation before interpreting. In “Data Store” within the Data Browser, create a "User function object" corresponding to “PTS correction / PTScor.dll (Fig A03.7)

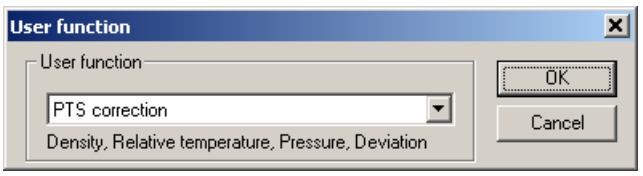


Fig A03.7; User function object

Input channels: Density, Temperature, Pressure, Deviation

Input parameters: None

Output mnemo: DRHO

Function detail:

$$r_{out} = r_{in} - r_{so} \times \frac{1-\cos(deviation)}{\cos(deviation)} \qquad r_{so} = r_{so}(Temperature, \Pr essure)$$

Gas composition input interface revised

The old dialog used to define the Gas composition input components (Compute from Composition option from the “Gas properties” main dialog) has been replaced by an editing grid (see Fig A03.8).

When setting the Sum to Unity check box “ON”, Emeraude will try to derive the “C7+” part so that all compositions sum to unity. Any incoherence will be detected when trying to exit the dialog and the warning message Compositions do not sum to 1 will be displayed at the bottom of the window.

The “C7+” component can be characterized by using the associated calculator icon .

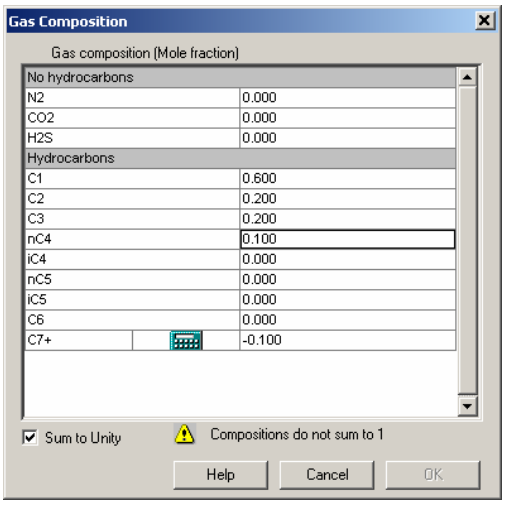


Fig A03.8; Gas Composition input

Lateral average channel information string

When performing a lateral average (Compute from object , or Compute from list , or Define an input reference channel using the Average: search in Up and Down passes option), a standard deviation is automatically computed and displayed in the “Info” page for the derived channel (see Figure A03.9).

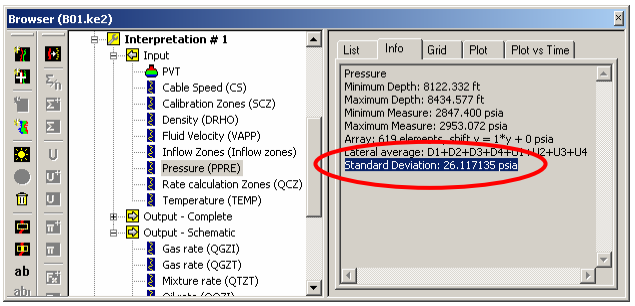


Fig A03.9; Data Browser - Standard Deviation Info

SIP miscellaneous additions

- More colors to cycle through (it has been increased from 7 to 13 colors).
- Current active zone is highlighted in yellow.
- Zone names are being used when available.
- Standard deviation is computed for any IPR straight line.

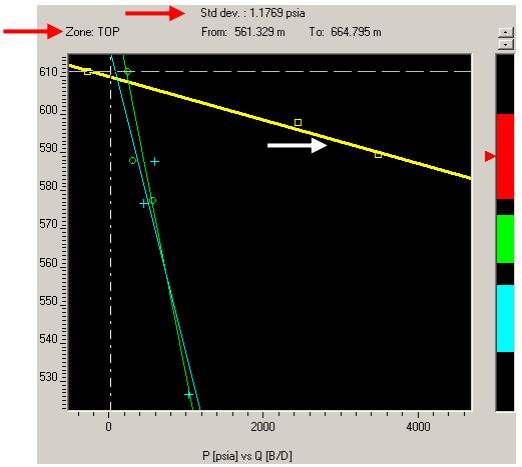


Fig. A03.10; SIP Plot

Up/Down passes visualization

Dedicated icons have been added to the "Pass" toolbar. They allow you to activate/deactivate all up  or down  passes at the same time.



GWD can accept any type of data

No more limitation on the type of property/mnemonic you can load or drop into the "General well data" Node.

Calibration plot

In the "Edit Slope" or "Edit Intercept" dialog, the source of the slope (positive or negative) is the same as the current one.

Caliper C1C2

When loading a set of X-Y calipers (CaliperC1 and CaliperC2), the mnemonic derived from the merge has been changed from CAL to C1C2.

$$C1C2 = \sqrt{C1 \times C2}$$

Stationary data tool shift

When loading stationary files, different measurements are usually loaded versus time at a single depth. However, those measurements have been recorded at different measure points on the tool string, and should not be loaded at the same depth. In order to be able to correct for this, a special tool shift has been implemented: "Stationary data tool shift". It follows the same logic as the standard Tool shift, but applies only to the stationary passes. This parameter can be accessed in the "Tool Shift" dialog.

Print out log header appearance

A new control has been added 

in the "User view channel aspect" page of the "Print settings" dialog. Default setting is ON by default. When OFF, curve aspect does follow the settings but curve names and scale values are in black color. This option applies to the print output only (it does not affect the screen display).

Plots

For plot items such as Vertical grid lines, Fill area, Data (channel curves), and Horizontal grid lines, the drawing order (front to back) can be changed and customized (see Fig. A03.11).

This option is available in the "Plots" page of the "Workspace settings" (accessed from the "Settings" control panel).

This capability solves for the issue regarding a filled area masking part of a curve thickness trace.

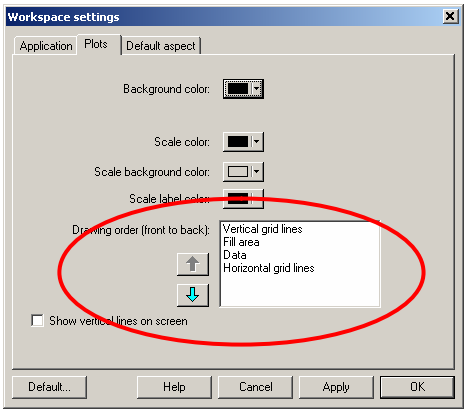


Fig. A03.11; Plots settings - Drawing order

Single phase reporting

- Summary table: surface rates are now available.
- Template Word report: all individual phase contributions are properly initialized (no more N/A values).

A03.2 • FSI processing

The following sections describe the options added in Emeraude 2.42.01 to handle the FSI tool and give the workflow required to complete the interpretation of FSI logs.

A03.2.1 • Settings – MPT

As a natural extension of what was done in earlier version for the Multiple Probe Tools (MPT), the first addition is the inclusion of an FSI tool among the "Settings-MPT" option. Recall that the main objective of this option is to define the proper mnemonic association.

A new type has been created, called "Multi-measure" and among this type is a new tool named "FSI". This default tool is defined as indicated in the dialog on Fig. A03.2.12:

- The mnemonics are SPIFx_FSI (spinners), DFHFx_FSI (water holdups), GHHFx_FSI (gas holdups), and RB_FSI (relative bearing).
- The indices start at 0.
- The numbering is from bottom to top.

In order to handle a different set of mnemonics or order them in your own way, you can "Copy" this definition and customize it as required.

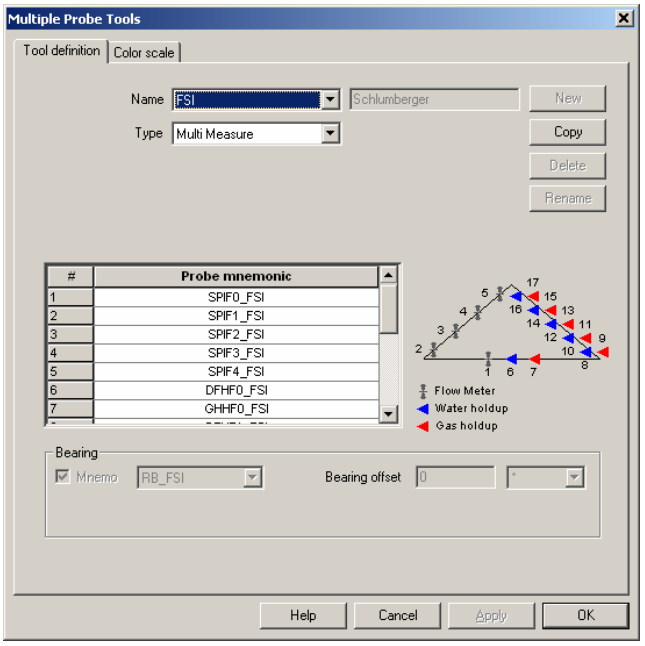


Fig. A03.12; FSI built-in definition

A03.2.2 • Survey - Tool Info

Once the data is loaded, and provided a suitable definition exists in the "Settings-MPT", you can check that Emeraude recognizes the loaded data in the "Survey-Tool info" dialog. In this option, activate the "Multiple probe" tool tab: in the tool list you will the see the "FSI" (or whatever name you have given the tool).

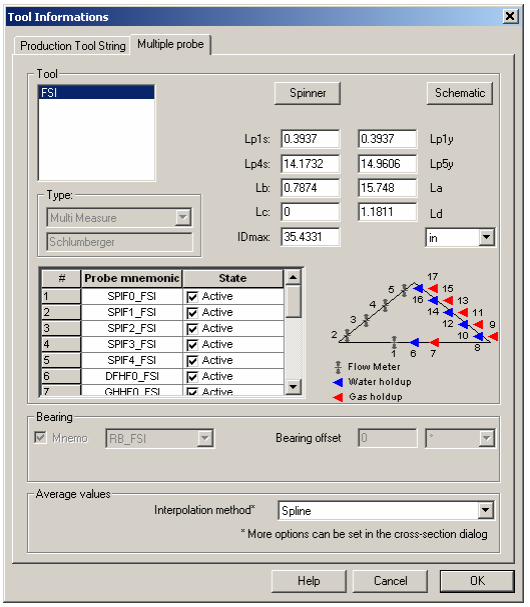


Fig. A03.13; FSI Tool Information

What can be done in this dialog?

- Define the tool dimensions: by clicking on “Schematic” you can view the different parameter definition, see Fig. A03.2.14 below.

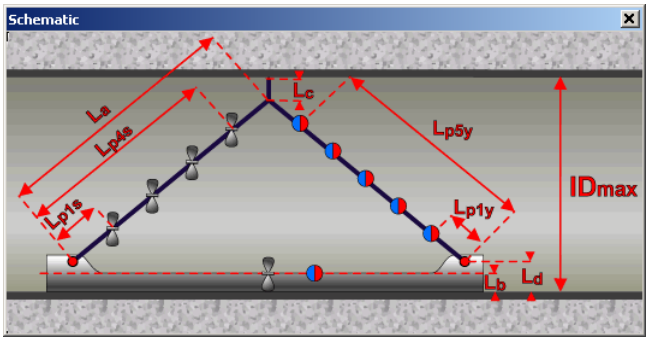
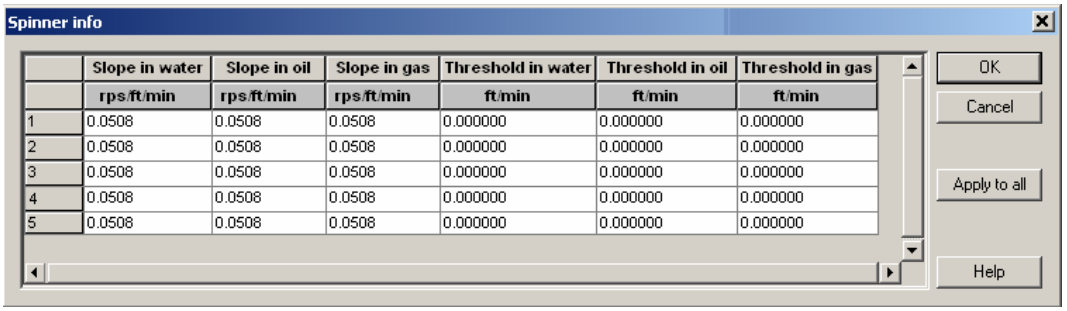


Fig. A03.14; FSI Schematic

- Define the probe status: Active or Disable (no Ignore status is offered). When a probe is set to “Disable”, interpolation occurs between its neighbors. You can change the probe status from the grid or interactively from the tool schematic (a mouse click on a specific probe will do).
- Select the interpolation mode among Linear, Spline, and Smooth spline (see section A03.2.4 for more details).

View/Edit the spinner calibration parameters: slope and threshold values for each spinner, for each fluid phase (5 x 3 x 2 = 30 parameters) as shown in Fig.A03.15 below. The parameters are entered a priori but can be checked against the acquired data through an in-situ calibration (see later section A03.2, Spinner calibration)



	Slope in water	Slope in oil	Slope in gas	Threshold in water	Threshold in oil	Threshold in gas
	rps/ft/min	rps/ft/min	rps/ft/min	ft/min	ft/min	ft/min
1	0.0508	0.0508	0.0508	0.000000	0.000000	0.000000
2	0.0508	0.0508	0.0508	0.000000	0.000000	0.000000
3	0.0508	0.0508	0.0508	0.000000	0.000000	0.000000
4	0.0508	0.0508	0.0508	0.000000	0.000000	0.000000
5	0.0508	0.0508	0.0508	0.000000	0.000000	0.000000

Fig. A03.15; Spinner calibration parameters

All velocities are calculated with slopes and thresholds obtained as a volume weighted average of the slopes and thresholds for the individual phases. Namely when a velocity is sought at a given location with holdups yw, yo, and yg, the local spinner slope and threshold are taken as:

$$Slope = Slope_w \times y_w + Slope_o \times y_o + Slope_g \times y_g$$

$$Threhsold = Threshold_w \times y_w + Threshold_o \times y_o + Threshold_g \times y_g$$

A03.2.3 • Image views

Image views can be created through the data browser for a particular pass: a click on the "New image view" icon  from the Data Browser will open the" Image View Properties" dialog shown in Fig. A03.16.

An FSI image view is the reunion of 6 different holdup views corresponding to the 6 levels of holdup (water and gas) measurements. This is illustrated in Fig. A03.17 below.

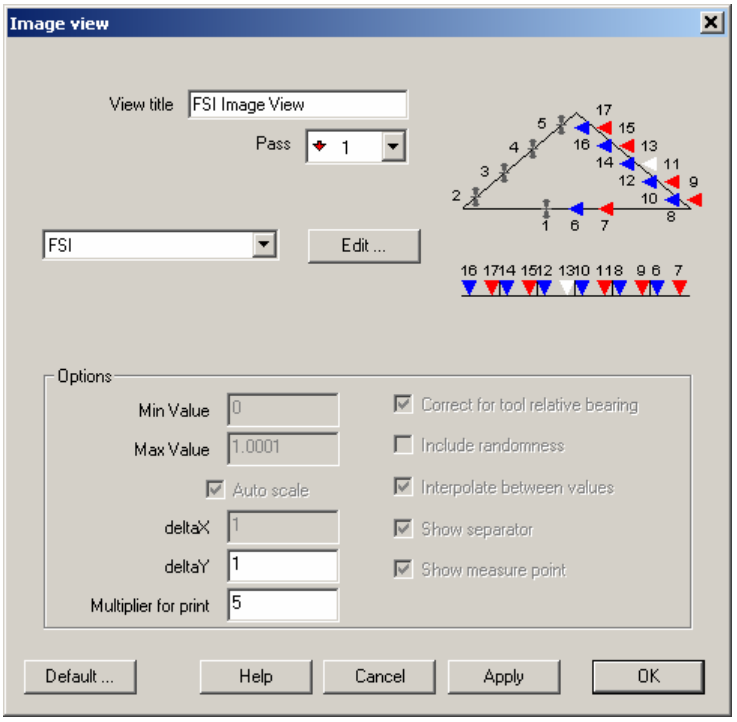


Fig. A03.16; FSI Image View Properties dialog

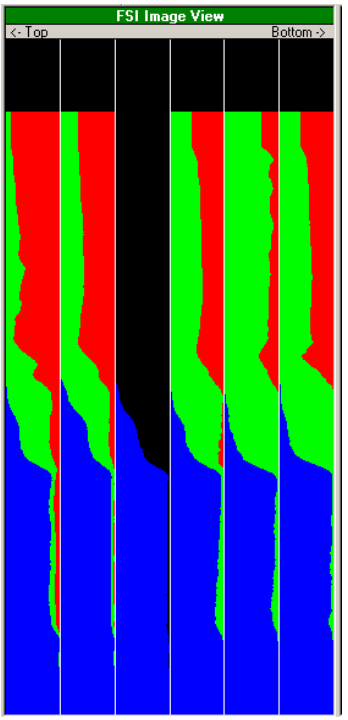


Fig. A03.17; FSI Image View plot

The image view provides a way of visually checking all the holdup measurements for a particular pass. If a probe status is set to "Disable" the info linked to that measure is not displayed (eg GHH3 above was set to "Disable").

A03.2.4 • Cross Section

A right-click on an image view gives access to the plot popup menu; the Cross-section... option opens up the "FSI cross-section" dialog, as shown in Fig. A03.17 next page.

The plot is made at a particular depth and indicates the value of the readings as well as the profile obtained by interpolation. This profile will be the basis for all the calculations.

If the tool bearing is used, all calculation are made in a vertical plane, and the plot shows a projection on that plane. When the tool bearing is not used calculations proceed in the "tool plane".

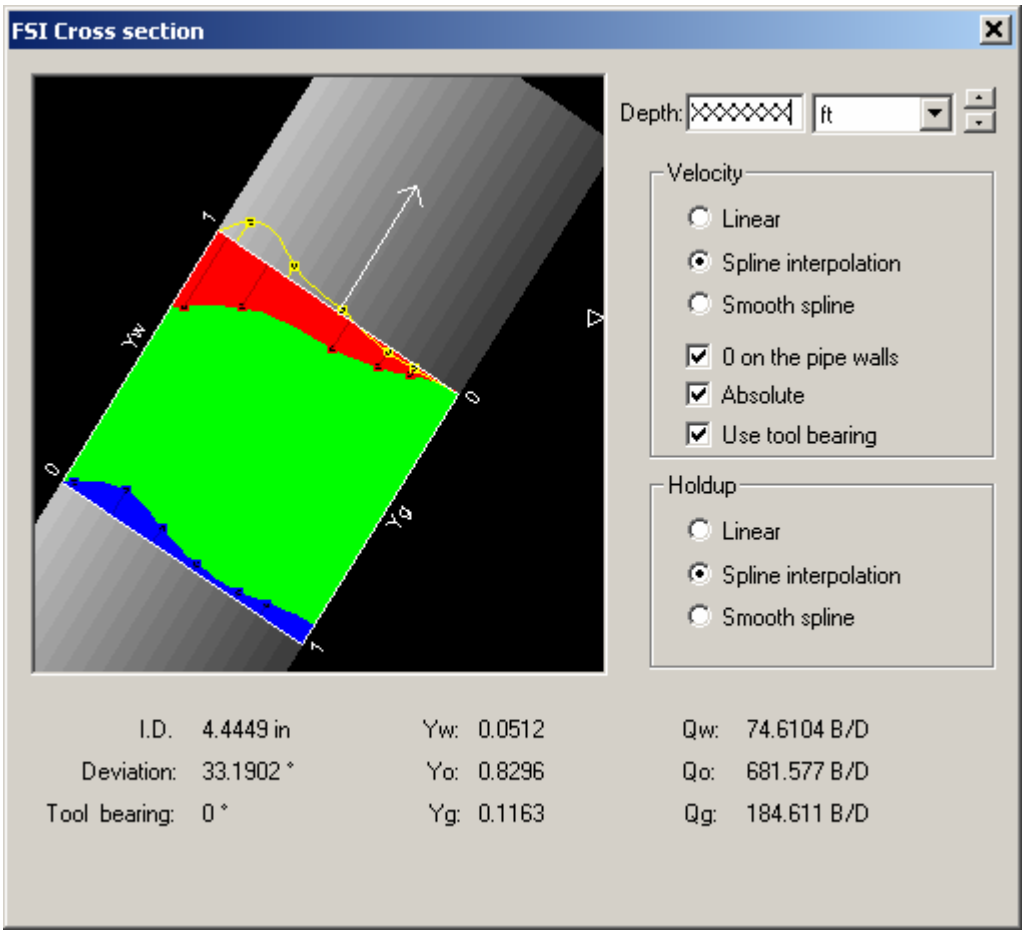


Fig. A03.17; FSI cross-section

Plot definition

On the plot, the pipe is represented with grey shadings, tilted at the local deviation angle. Within the pipe a box is drawn to show the holdup values:

- Each probe position is calculated based on the local ID (and the tool bearing).
- The Yw values are 0 on the left side of the box, 1 on the right.
- The Yg values are 1 on the left side of the box, 0 on the right.
- The velocities are drawn with a 0 on the right side of the box. The maximum value is at the end of the arrow. The velocity can be drawn in “Absolute mode” in which case the maximum value is the maximum value on the whole pass. Alternatively, in relative mode, the maximum value is the maximum velocity at the particular depth. Please note that the velocities are calculated based on the calibration values (viewed/edited in the “FSI Tool Information” dialog, see Fig. A03.13) and the holdups interpolated at the spinner location (thus dependent on the interpolation mode).

Interpolated curves

There are 3 possible interpolation modes:

1) Linear: simple linear interpolation, linear extrapolation outside.

2) Spline: cubic spline though all the points with no curvature at the end points.

3) Smooth spline: cubic spline though the end points and one point along each intermediate segment. A non-linear regression is then run and allows the intermediate nodes to slide along the segments in order to minimize the curvature. This process eliminates erratic peaks however it never questions the end points.

For velocity, there is an option to force null values on the pipe walls.

In practice, the cross-section dialog is used for a QAQC of the measurements. While holding the "Shift" key, one can move the mouse up or down in the parent view and see the cross section continuously updated.

When a probe reading looks erroneous, you can move the cursor above the point to see the mnemonic in the small popup. Through the "FSI Tool Information" dialog, the probe status can then be set to "Disable", and interpolation will ignore it completely.

Average values

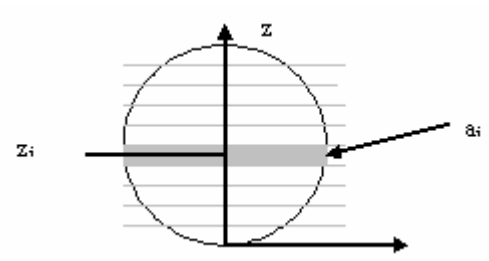
The interpolation provides continuous values of holdups and velocity along the vertical axis. By integration Emeraude then calculates average values. This calculation is done for Yw, Yg, by deduction for Yo, for the average velocity, and also for the rates.

In the calculation, the cross section is sub-divided into small horizontal bands of areas a_i. The average values are obtained as follows:

$$y_p = \frac{\sum_i a_i \times y_p(z_i)}{\sum_i a_i}$$ where p is the phase

$$V_m = \frac{\sum_i a_i \times V(z_i)}{\sum_i a_i}$$

$$q_p = \sum_i a_i \times y_p(z_i) \times V(z_i)$$



Beyond the interpolation method the assumptions are therefore that:

1) The value of a given property at a horizontal level "z" on the center axis is the same at any other lateral position at that level.

2) The rates are calculated with the assumption that the local velocity is the phase velocity, or in other words, with the assumption that there is no local slippage velocity. This may be fine in segregated flow, certainly not if the flow is distributed.

Above all, recall that all velocities are based on the values of calibration defined a priori. The next section explains how those values can be modified or checked.

A03.2.5 • Interpretation

The previous sections have been concerned essentially with the display of the values and QAQC of the logs. To practically use the readings inside an interpretation, one needs to create logs of average values. Before doing so, however, one needs to check/change the calibration values. In the "Interpretation Settings" dialog an option has been introduced for the FSI, as shown in Fig. A03.18 below.

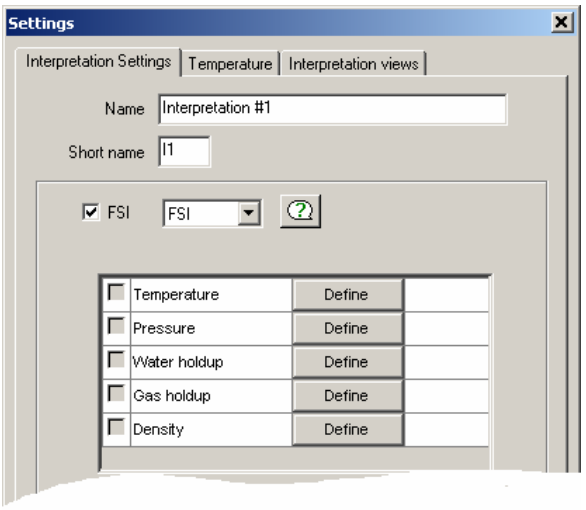


Fig. A03.18; FSI Processing activation

The sole effect of this option is to change the calibration behavior. *Note that after checking "FSI" you need to select the desired FSI tool.*

Spinner Calibration

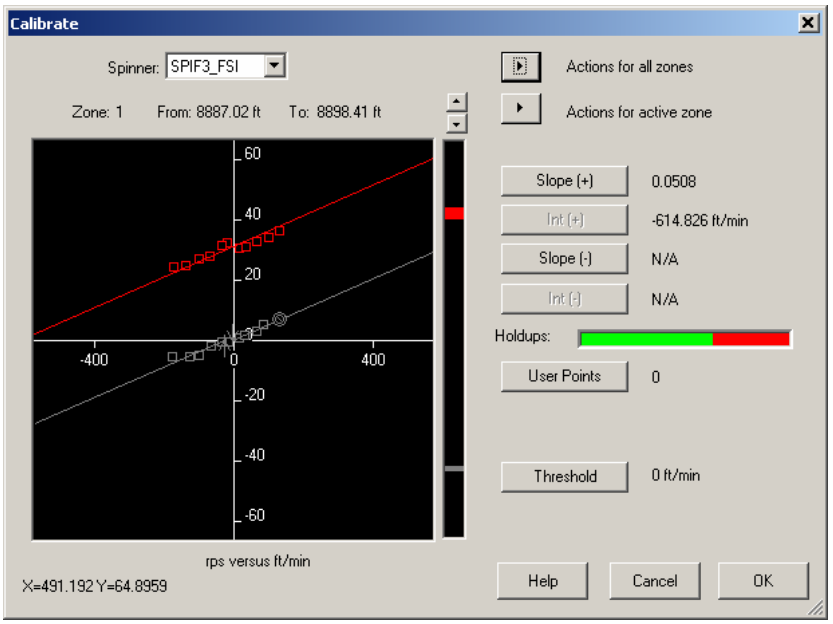


Fig. A03.19

With the FSI mode activated, the calibration dialog includes some specific controls (see Fig. A03.19 above):

- A drop list to scan through the spinners.
- A holdup schematic (shows the average holdups for all the passes, at the zone mid depth, interpolated at the spinner position).

Unlike with conventional tools, the FSI calibration systematically resets the positive and negative lines for each calibration zone.

The calculation proceeds as follows:

1) The local slope and threshold are estimated from the holdups as follows:

$$Slope = Slope_w \times y_w + Slope_o \times y_o + Slope_g \times y_g$$

$$Threhsold = Threshold_w \times y_w + Threshold_o \times y_o + Threshold_g \times y_g$$

2) A least square is run with only a variable intercept (slope is fixed).

A few points should be noted:

- The line calculation has no impact on any of the subsequent interpretation results. It is given only to compare the predicted response with the measurements.
- The whole process is viable only if the holdups do not vary too much from one pass to the next at the spinner location/depth.
- The line fit takes into account the individual point status (included/excluded).

You can change the tool calibration parameters using the “Slope” and “Threshold” buttons. They call the following dialogs (Fig. A03.2.20):

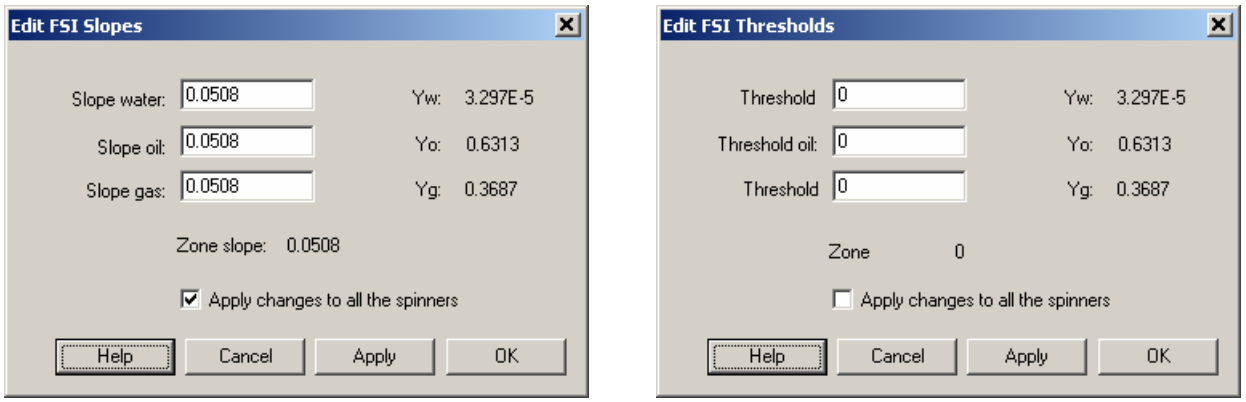


Fig. A03.20. Slopes and Thresholds edition

The change can be for the particular spinner only, or it can be applied to all of them.

After the calibration, there is no generation of mixture velocity as this is done as part of the single process to build the FSI average channels.

In the report, one page is automatically output per spinner (or rather one calibration section per spinner).

Input channel construction and selection

At this stage the tool parameters have been checked/edited, the interpolation method has been selected, probe status set to disable for faulty probes. In the data browser, average channels are calculated by selecting a pass, and after a right click by choosing the option "Fsi processing…" from the popup menu. This option calls the dialog Fig. A03.21.

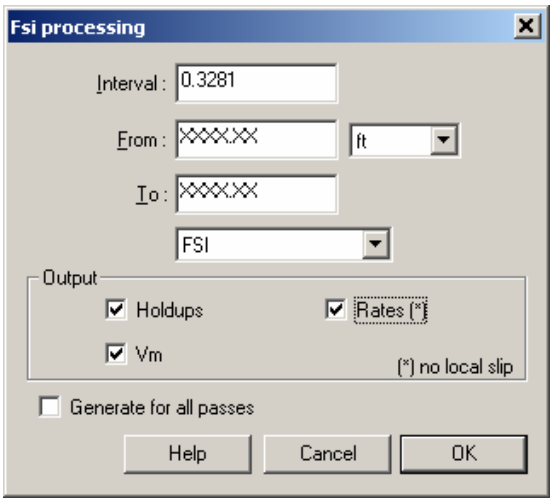


Fig. A03.21; FSI Processing settings

Average values are calculated as described in section A03.2.1. The resulting logs are created in the source pass. They are given the following mnemonics:

Holdups: YW_FSI, YG_FSI

Velocity: VT_FSI

Rates: QW_FSI, QO_FSI, QG_FSI

The selection of the average channels is done as usual through the "Interpretation Settings" dialog, using the Define button.

After they are defined, the interpretation proceeds as normal. In a case where the assumption of the local slip velocity holds (segregated flow) you can input the rates directly to the interpretation. Since slippage velocity models then become unnecessary, you need to set the correlations to "Constant slippage" to let Emeraude include the slippage velocities among the variables.

A03.2.6 • Workflow review

1) Check in "Settings-MPT" that the proper tool definition exists. Create if it does not.
2) Load the log data.
3) "Survey – Tool" Info dialog:
   a. check that the tool is identified,
   b. enter the tool dimensions,
   c. enter the spinner calibration values.
4) Browser: Image views / Cross section:
   a. Check/change the probe status,
   b. Check/change the interpolation mode/settings.
5) PL Interpretation: set to FSI and select the tool.
6) Spinner calibration: check/change the spinner calibration values.
7) Browser: create the FSI average channels.

8) PL Interpretation Infos: “Define” the input channels .

9) Interpretation “as usual”: remember to use the “Cte Slippage” model to instruct Emeraude to determine the slippage velocities from the data when they are sufficient.

A03.2.7 • Calculation summary

The main calculation is the creation of average channels (Data browser: “Fsi processing option”, also displayed in the cross-section dialog). For a given pass, at each depth the calculation steps are:

1) From the local ID and tool bearing, the tool dimensions calculate the exact measurement positions. Project all positions on the vertical axis. From this point on, calculations are all done along this axis. Note that if the toll bearing is not used, all calculations are done in the tool plane.

2) Interpolate the holdups at the spinner positions and calculate the corresponding slopes and thresholds.

$$Slope = Slope_w \times y_w + Slope_o \times y_o + Slope_g \times y_g$$

$$Threhsold = Threshold_w \times y_w + Threshold_o \times y_o + Threshold_g \times y_g$$

3) Calculate the velocity for each spinner.

4) Calculate the average values by integration along the vertical axis:

$$y_p = \frac{\sum_i a_i \times y_p(z_i)}{\sum_i a_i};\quad V_m = \frac{\sum_i a_i \times V(z_i)}{\sum_i a_i};\quad q_p = \sum_i a_i \times y_p(z_i) \times V(z_i)$$

where p is the phase.

