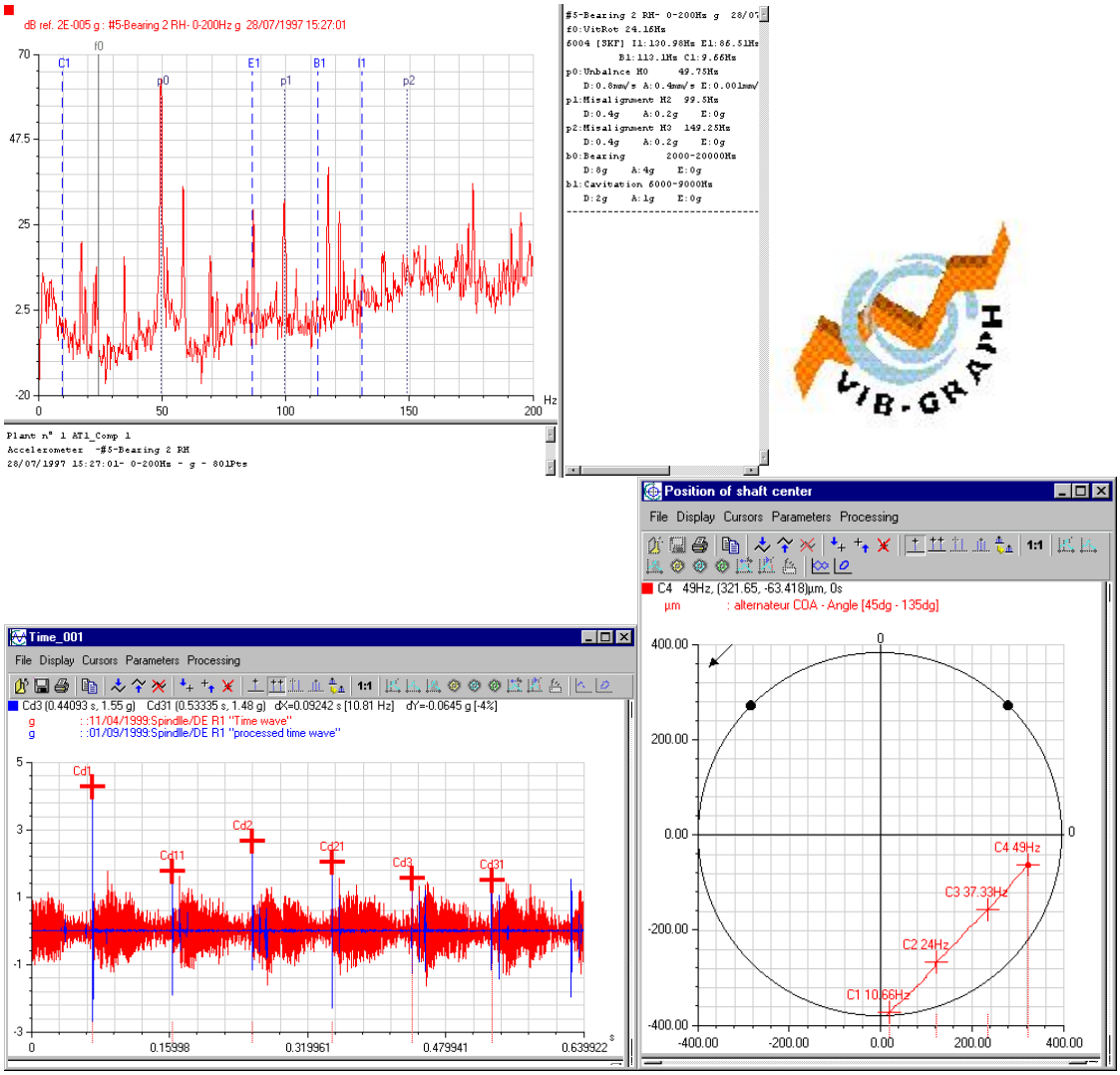
Lifetime Reliability

USER MANUAL

vib-Graph Analysis Graphic Tool



USER MANUAL

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Ref. OPS42.vibGraph.NUT.096.B – April 2012

Specifications are subject to change without notice.

TABLE OF CONTENTS

1. PREFACE

1.1. Welcome to the users group of 01dB-Metravib software

Thank you for choosing 01dB-Metravib software.

This graphics tool accompanies DIVA and SURVAODIAG software packages and offers a large range of tools (cursors, zooms...) to analyse your signals: spectra, time wave, trend.

1.2. Public concerned

This handbook is for all those, who wish to use this tool in a Windows environment.

1.3. Prerequisite

You must have the basic knowledge to use Microsoft Windows.

Under Windows, you must be familiar with certain programs, such as the Browser, the task bar and the register base.

1.4. How to use this handbook

This handbook is part of the documentation for 01dB- Metravib software products. Use this handbook when you are beginning to use vib-Graph, or for any question relating to this tool. For information concerning Windows specificity, refer to associated documentation.

1.5. How is organised this handbook

This document describes the various concepts first of all being able to be specific to the tool, then the whole of its functions in detail.

1.6. Convention

Following typographical conventions are used in this handbook:

Type text	Description
Fixed width text	Fixed width text indicates a command that needs to be entered exactly as specified. The combinations of key keyboard are also shown with this type text.
Small letters	Small letters in a command represent a variable having to be replaced by an adequate value.
CAPITAL LETTERS	The characters in capital letters represent a name of command, a reserved word or a keyword.
Punctuation	The commands, the punctuation or the apostrophes must have entered exactly as stipulated.
\DIRECTORY	A character ' \ ' in front of the name of a directory indicates that this directory is under directory.
C>	C > is the Prompt indication of DOS. It can differ according to the current directory.
DOS	This term refers to Microsoft DOS (MS-DOS).

1.7. Regarding directory names

This handbook refers to the default directory names defined at the time of the product installation. If you change the name of these directories, substitute these names for those of this handbook.

1.8. Reference documents

The reference materials are those of the software product using this graphic tool. The installation of vib-Graph being integrated into that of Divadiag, Survaodiag or eDiag, the handbooks of respective installation and user will have to be used like reference documents.

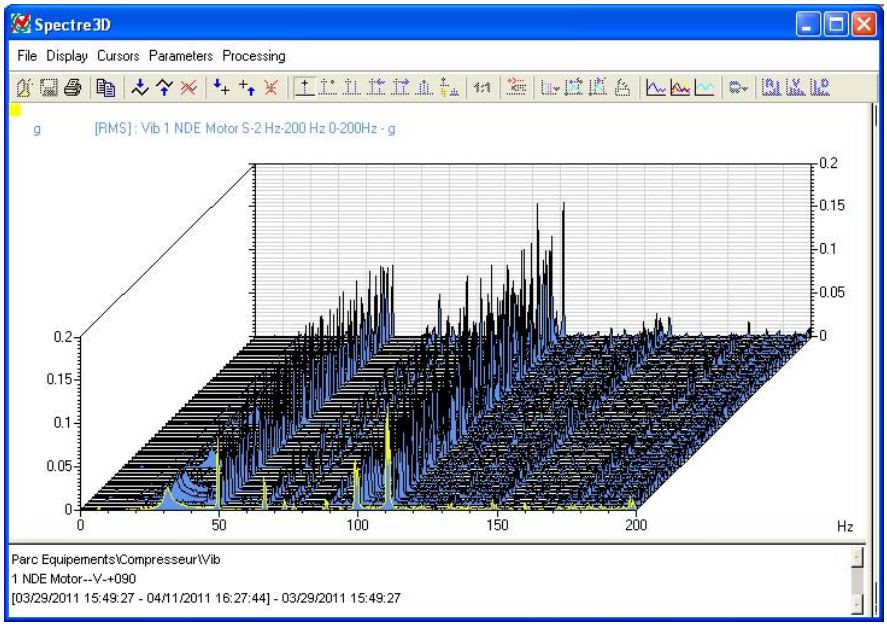
1.9. Your comments are welcome

01dB-Metravib is aware of the importance of a good documentation. A means of reaching that point is to take your remarks into account.

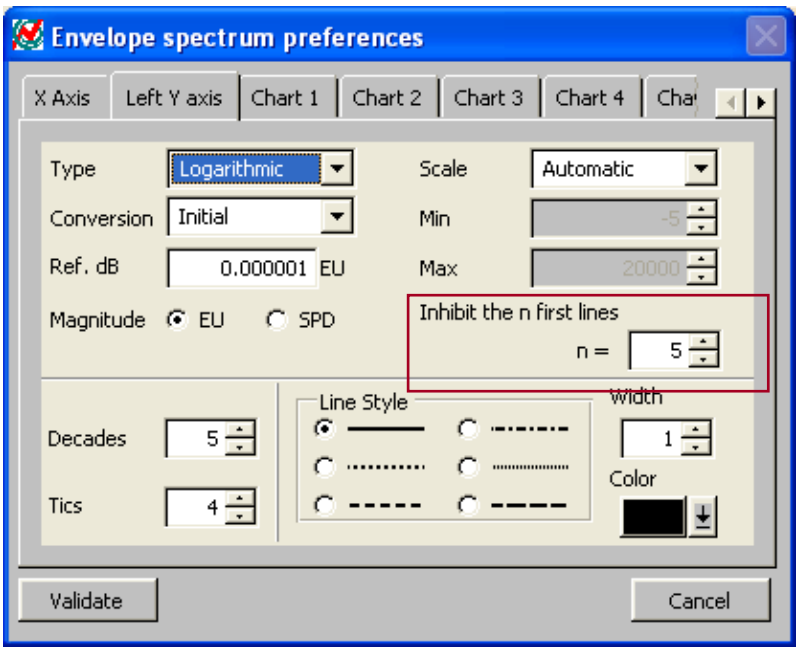
If you have comments on this handbook or any other part of this documentation, please contact your supplier.

1.10. Main new functions of version 7.6

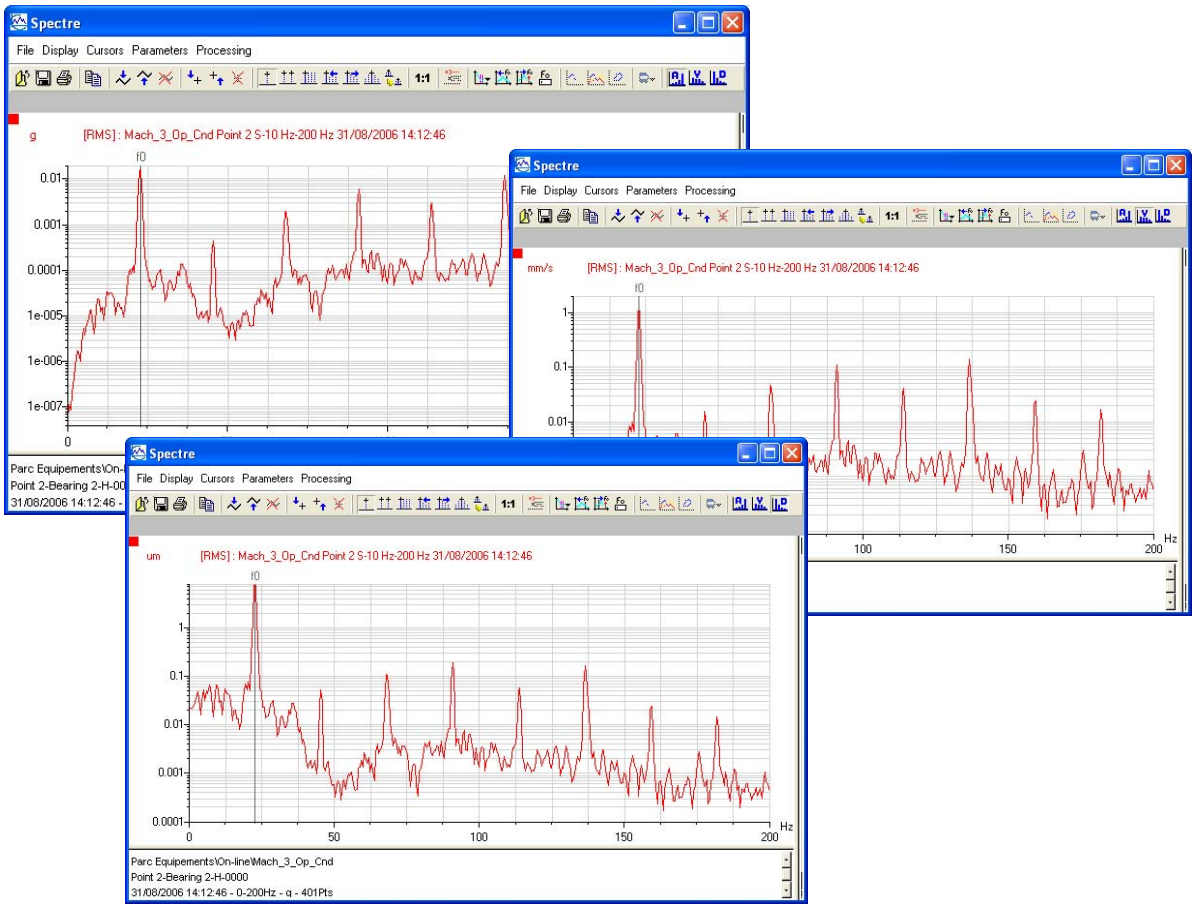
- 3D visual display of spectra: see § 5.6.4



- Envelope spectrum: possible masking of the line at 0 Hz from the Display Preferences of the envelope spectrum



- Spectrum: direct selection of the display in acceleration, velocity or displacement 



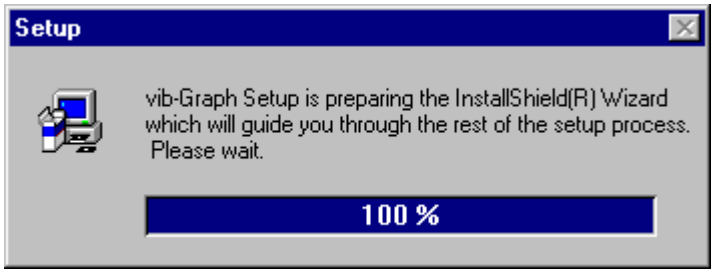
- Possibility to set a harmonic cursor on the expected frequencies (bearing frequencies, peak extractions)
- Cepstrum & Time signal: the simple cursor also shows 1/T in Hz
- The broad-band and narrow-band “hard” parameters of the OneProd MVX acquisition systems can be displayed as the other expected frequencies.
- Access to intelligent filtering (SFI) in post-processing mode in vibGraph for easier identification of shocks in a time signal: see § 4.8.2
- Filtering of measurements in OneProd XPR: see § 3.1.6
- Direct copy to the paper-board: see § 3.1.6

2. INSTALLATION

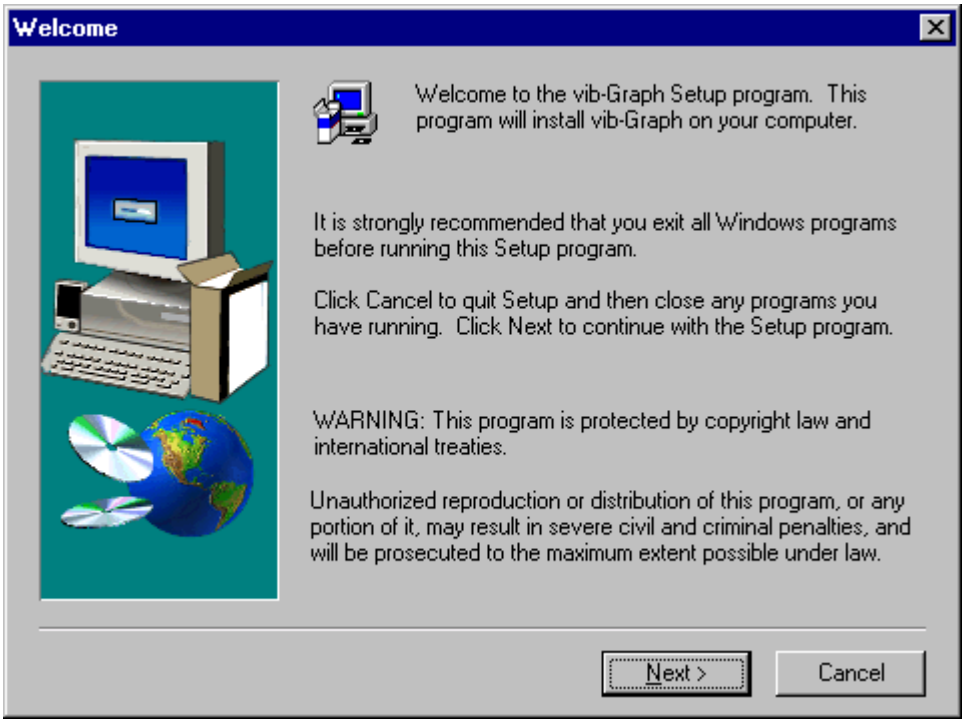
Stop all the software under Windows. Then:

1. Insert the CD-ROM in the drive.
2. Choose *Execute* in the 'Start' menu of the task bar.
3. Enter **x:\vib-Graph\Disk1\SETUP.EXE**, X being your CD-ROM drive.
4. Select the language: French or English.

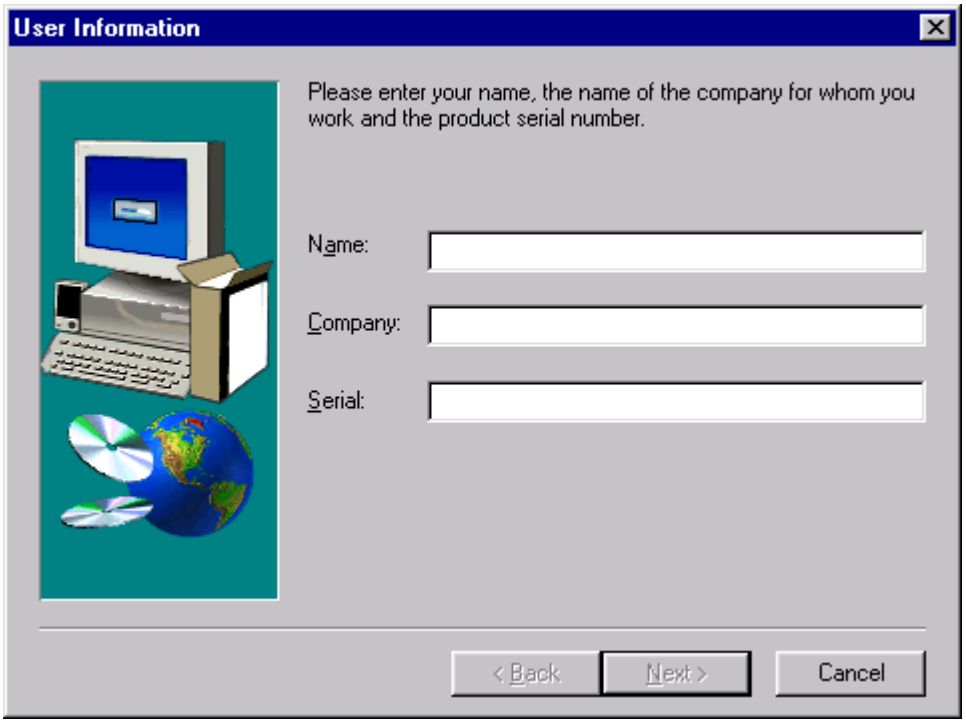
5. The following box appears:



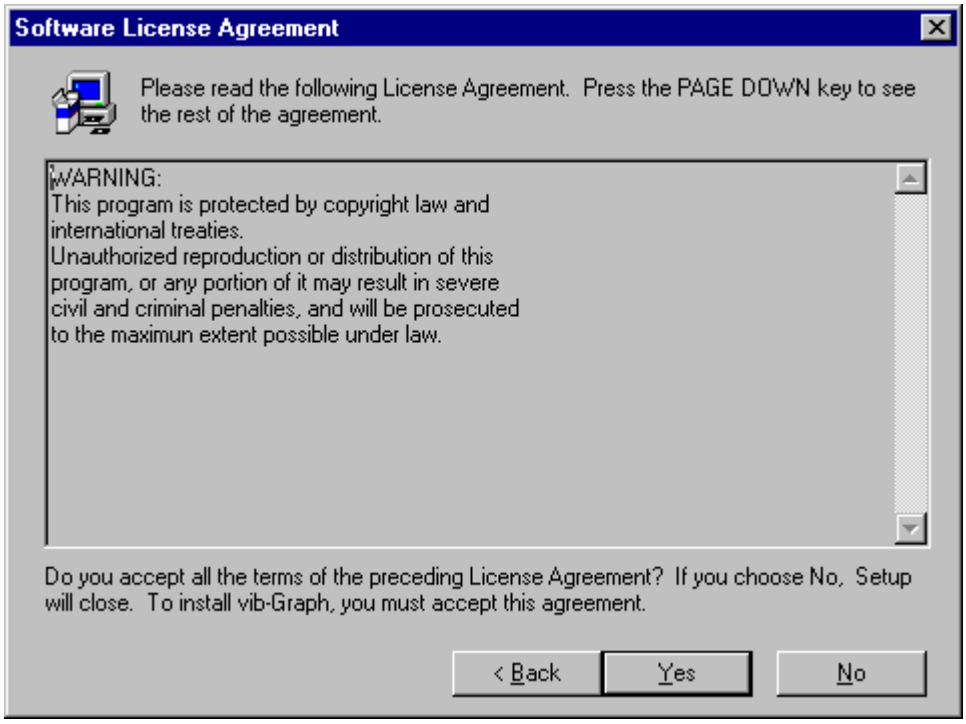
6. **InstallShield** is preparing the installation assistant. The ***Welcome box*** then appears:



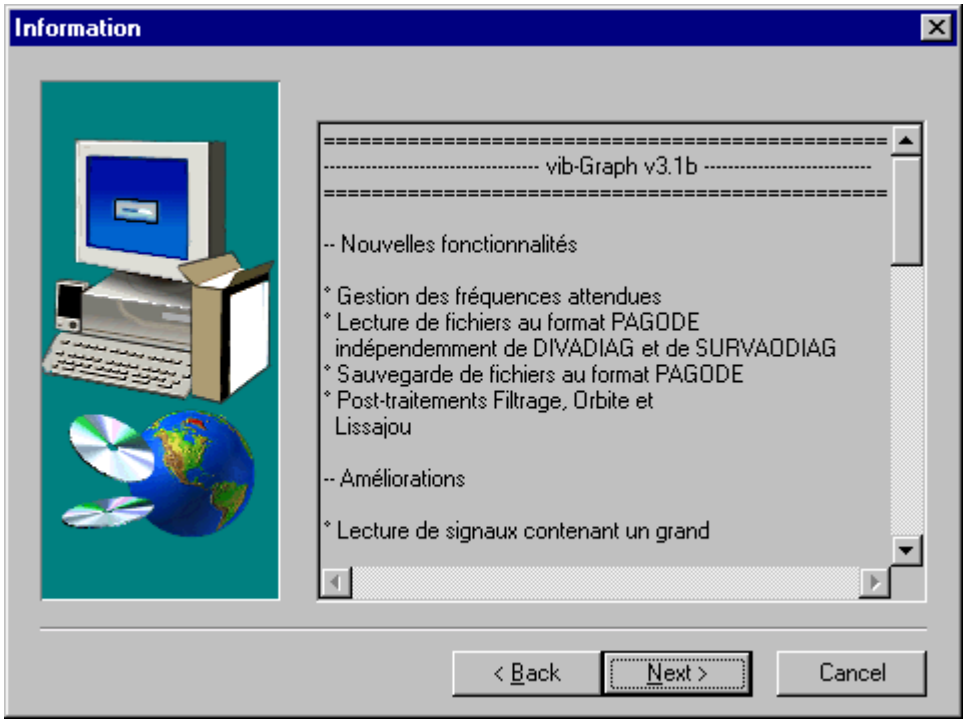
7. Click on Next. Enter your Name, and the licence number assigned to your copy of the software. If used with OneProd XPR "0" can be used as licence number.



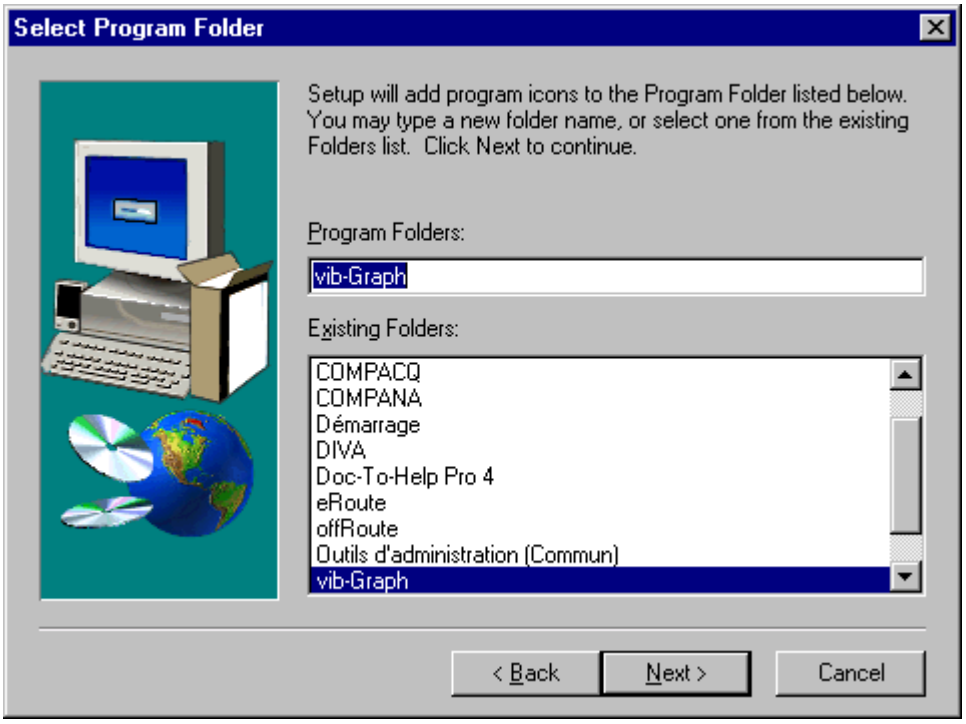
8. Click on *Next* to display the software license agreement box appear:



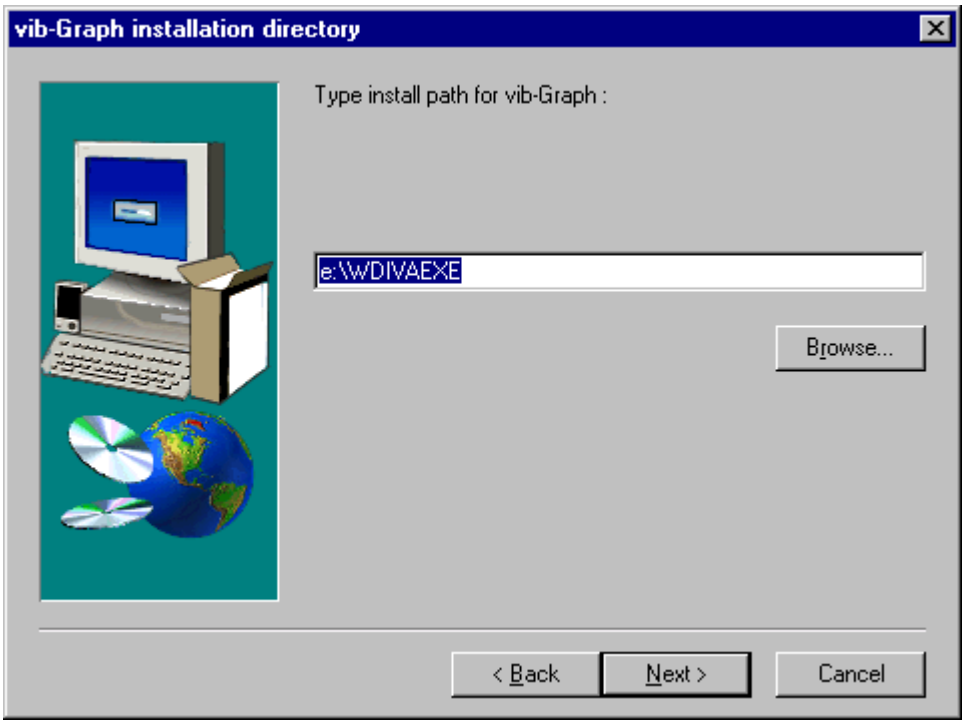
9. Click on ***Yes*** if you accept the terms of the license.



10. Click on ***Next*** .
11. The next screen allows the user to choose the program folder in which **vib-Graph** will be installed:



12. The next window allows selection of the installation directory of vib-Graph files:



13. Once all parameters are defined, the installation starts after validation of this window: The copy of files starts.

3. CONCEPTS

3.1. Interface user

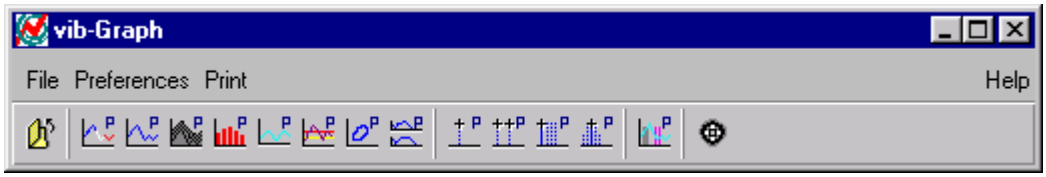
Vib-Graph runs as a " background task ". It answers any request for graphic display resulting from its associated software (Divadiag, Survaodiag or XPR). It can also be a stand-alone module as it includes a file browser (accessibility according to licence).

The user interface of vib-Graph is independent of the associated software. Thus, the user must carry out certain operations of inter-windows navigation in order to display the desired graphics. These operations of inter-windows navigation are Windows compatible: ALT+tab, scrolling in the list of the tasks.

There are three types of windows in vib-Graph:

- the main window,
- the graphic window,
- the information window.

3.1.1. Main window



This window appears during the starting of vib-Graph. Its role is to make it possible to the user to define the preferences of operation. These preferences are stored and applied to each new graphic window.

3.1.2. The menu of functions

Functions Menu	Description
File/Open File/Create a campaign File/File list File/Quit	To select a file and display it (accessibility according to licence) Create a new campaign Allows for a quick access to the last files opened by the user Allows to stop vib-Graph
Preference/Screen background	Select a background for all vib-Graph windows
Preferences/Window: Background colour Character set/Cursor Information area Character set/Curve Information area	Edit display preferences: The preferences of Background colour will be applied for all new graphic windows. The character set can be changed for each area.
Preferences/Type of chart Concatenated Spectrum Single Spectrum Octave and 1/3 Octave Time 2DG Trend Lissajou Bode Diagram	Allows the edition of the preferences of the types of graphics. Each type of graphic can have particular preferences of display: colours, graduations, scales...
Preference/Cursors Simple Double Harmonic Side band	Allows the edition of the preferences of the cursors. Each type of cursor has a whole of parameters defining its behaviour on the signal. The preferences of cursor make it possible to specify the default values of these parameters.
Preference/Grid	The preferences of grids make it possible to specify the aspect of the horizontal and vertical grids.
Preference/Expected frequencies	Definition of defect line style and colour of expected frequencies (peaks, bands and bearings)
Preference/Type of display	Definition of display management of multiple selection with file browser
Preference/Unit management	Select RMS, Peak or Peak-Speak for spectra. Select British or metric units for overall levels. Select frequency unit : Hz, RPM, Order
Preference/Post processing	Definition of filtering parameters for orbit, cepstrum and circular view post-processing.
Preference /Save	Selection of the format of file created by vib-Graph (menu 'save as' of graphic window): binary (smaller file) or ASCII (can be read by other software)
Preference/Axis graduation format	The preferences of display of the axis make it possible to define the numerical format of the values for each axis.
Print/Margins	The preference of the printing margins makes it possible to define the position and the size of the graphics on an A4 sheet.

Each function gives access to an interface of definition of parameters making it possible to modify the preferences of graphic.

Each type of signal and type of cursor can thus be customised.

Each user defines his preferences thus. They are stored and will be automatically recalled during its next use.

3.1.3. The horizontal tool bar

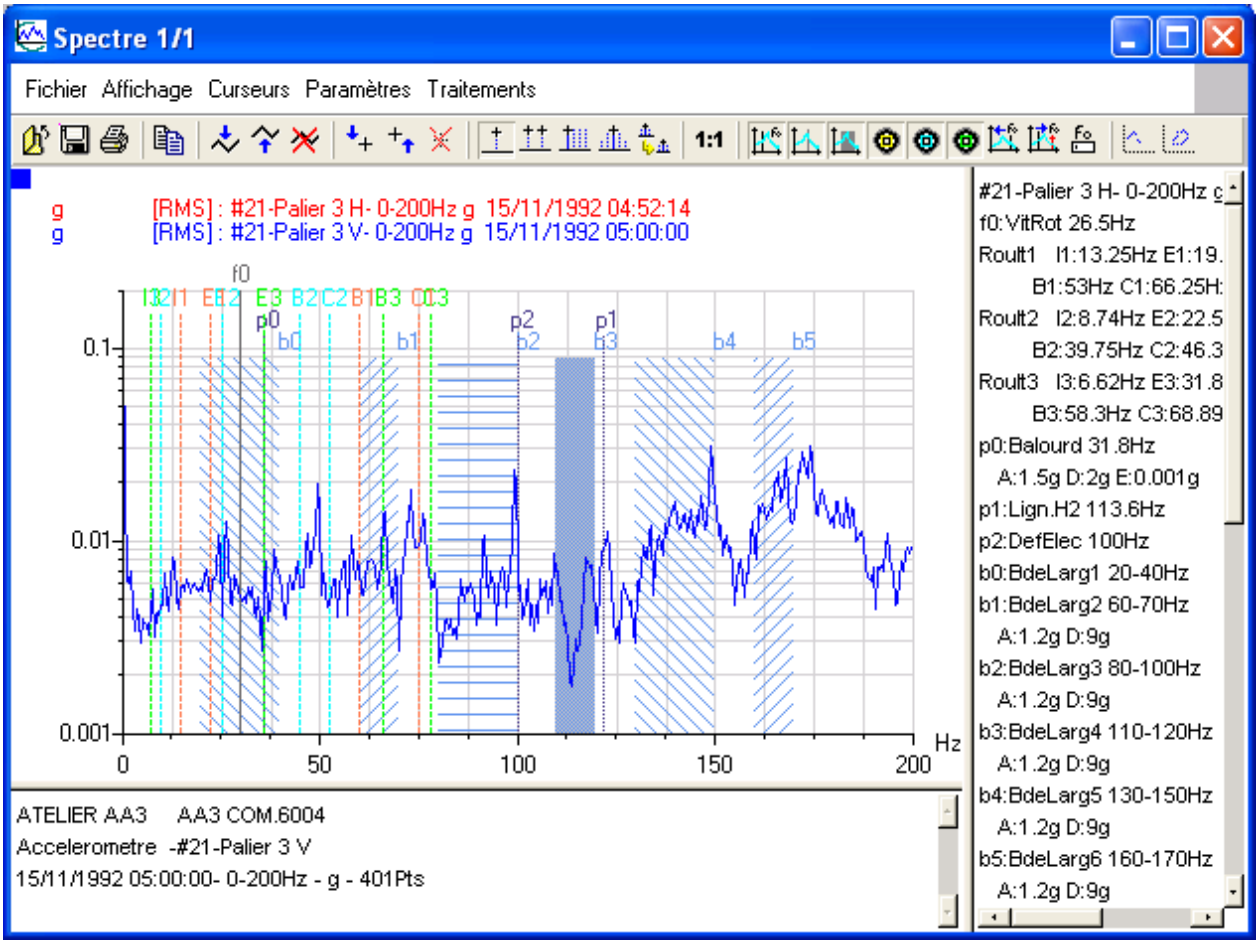
This tool bar allows direct access to certain functions.

From left to right, the following functions are available:

- Open a signal file
- Preference of Concatenated spectrum
- Preference of single spectrum
- Preferences of waterfall spectrum
- Preference of octave and 1/3 octave
- Preference of Time Signal
- Preference of 2DG Trend
- Preference of Lissajou
- Preference of Bode Diagram
- Preference of Single Cursor
- Preference of Double Cursor
- Preference of Harmonic Cursor
- Preference of Side band Cursor
- Run RoulDiag
- Close all graphics windows with one click

3.1.4. Graphics window

The graphic window is the window containing the useful signal. This window includes a menu, a horizontal tool bar, a curve plot, a “Cursor information” section (left of the plot) and a “Curve information” section (under the plot).



3.1.5. Functions menu

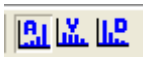
This menu is used to change, in the active window only, plotting preferences for cursors, axes, etc. These modifications will not be saved in the default preferences of vib-Graph.

Function Menu	Description
File/Open	Read a signal stored on the disk. (accessibility according to licence)
File/Save as...	Save the windows content into a file.
File/Save in current session	Save the window content in the current session.
File/Print	Print the graphics window content on a properly configured printer.
File/Postscript	Print the graphics window content into a Postscript file.
Display/Zoom	Move the zooming tool ion the current graph. Icons are used to apply a zoom factor of +25% on X, of –25% on X, of +25% on Y, of –25% on Y, to display full scale for X, for Y or for XY, respectively.
Display/Horizontal grid	Show a horizontal grid in the graphics window.
Display/Vertical grid	Show a vertical grid in the graphics window.
Display/Save window size and position	Save a window's size and position for each type of plot.
Display/Font/Cursor information	Define the font used in each information box.
Display/Font/Curve information	
Cursor/Insert Simple Double Harmonic Sideband	Insert a cursor in the current curve. Select the cursor type from the list.
Cursors/Harmonic Auto Imposed Reset	Select the type of harmonic cursor to insert.
Cursors/Sideband Imposed Reset	Select the type of sideband cursor to insert

Parameters/Axes Parameters/Curves Parameters/Curve name Parameters/Grids Parameters/Background colour	Change axis and curve preferences (aspect), name of active curve, grid preferences (colour, width) and background colour, respectively.
Processing/Filtering Processing/Lissajou Processing/Orbit Processing/AutoSpectrum Processing/Cepstrum Processing/Resampling Processing/Gain and Offset Processing/Position Processing/Circular view	Apply the following processing to time signals: Filtering (High-Pass, Low-Pass, Band-Pass, Band-Cut), Orbit (Non Filtered, Order filtered, Low-pass filtered), AutoSpectrum, Resampling, Gain and Offset and Position; Apply Lissajou processing to trend files; Apply Cepstrum processing to a spectrum.

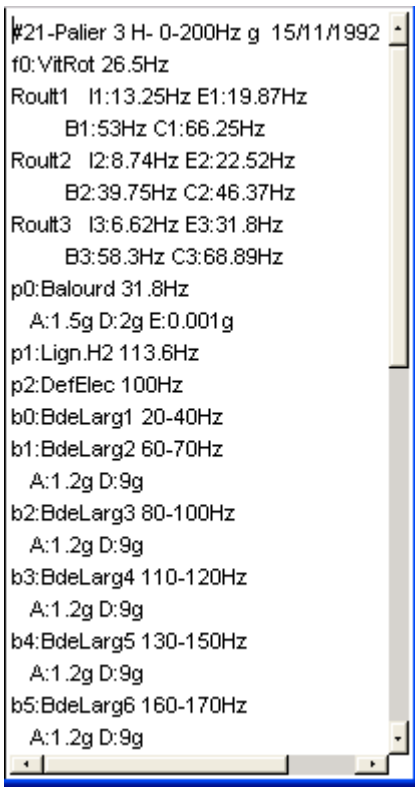
3.1.6. Horizontal toolbar

This toolbar contains shortcuts for some customisation functions of the graphics window. A tool tip displays information on the function of each icon when the mouse is moved over.

-  : Open, save, print
-  : Copy view to paperboard
-  : Activate previous/next curve; Delete active curve
-  : Select cursor type (simple, double, harmonic, sideband, cursor)
-  : Activate previous/next cursor; Delete cursor
-  : Reset view (cancel zoom)
-  : Filter measurements in XPR on selected points of this curve only (applicable for a trend only)
-  : Display characteristic frequencies (rotation frequency, peaks, band, bearings…)
-  : Go back to initial rotation frequency
-  : Update rotation frequency to the frequency of the active cursor on the active curve
-  : Manual update (input of value) of the rotation frequency
-  : Select characteristic frequencies to display (ESA only)
-  : Display acceleration, velocity or displacement

3.1.7. Cursor window

This window, located to the right of the plot, lists the respective values of each cursor in the associated graphics window.

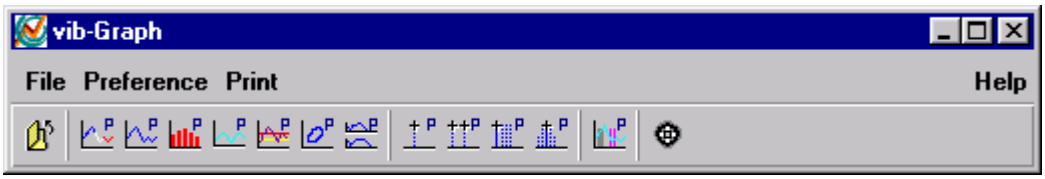


Type-specific information is available for each cursor.

Each cursor type will be fully described further along in this manual.

4. REFERENCES

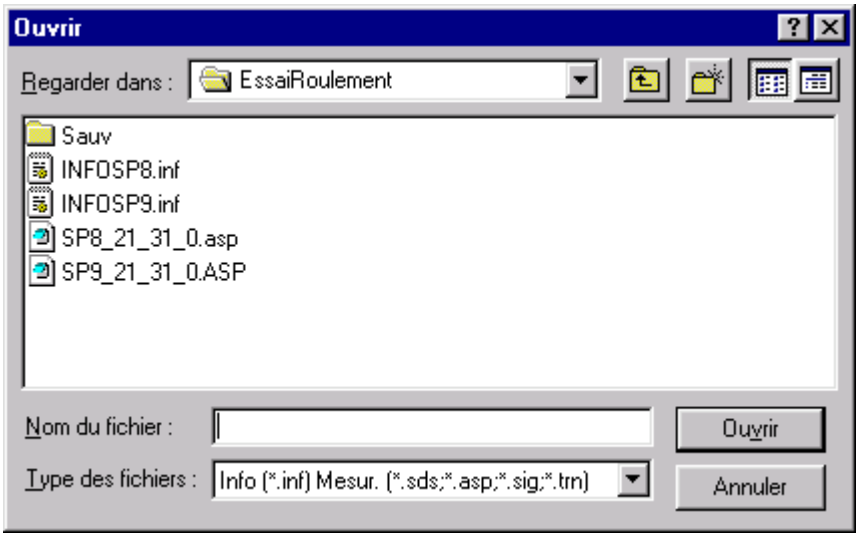
4.1. Main menu of Vib-Graph



4.1.1. File

Open *(accessibility according to licence)*

It allows opening one or several files using Windows file browser.



Files compatible with vib-Graph are:

- Time wave files (.SIG)
- Spectrum files (.ASP).
- Trend files (.TND)
- Transient analysis files (.TRN).
- dBFA session (campaign) files (.CMG)
- Sony PCScan files (.LOG)
- Sound files (.WAV)
- Teac files (.DAT, .HDR)
- Files in MP3 format (.MP3)
- INFO files (.INF) including additional information about the signal as rotation frequency, bearing frequencies... When vib-Graph creates a new file, additional information is also stored in this type of file.

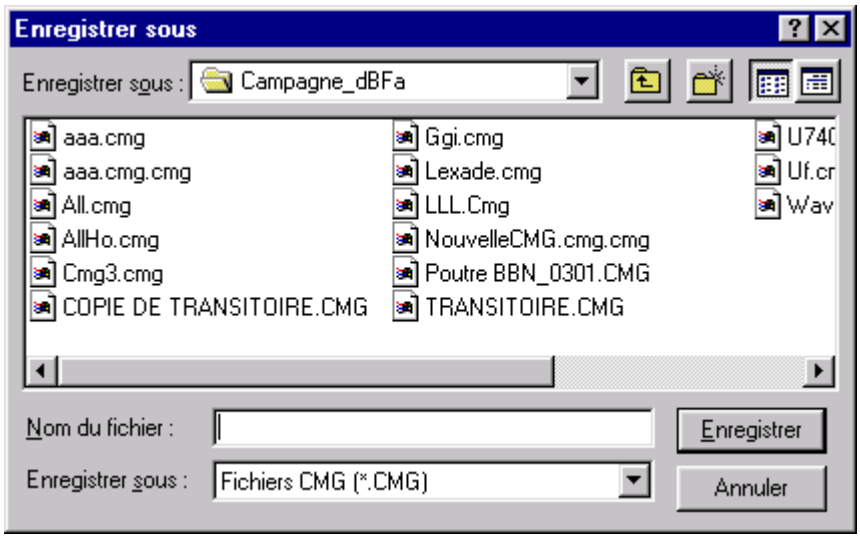
Use Preference/Type of display menu to define how selected information must be displayed.

Some types of files can only be accessed in EXPERT mode.

4.1.2. Create a session

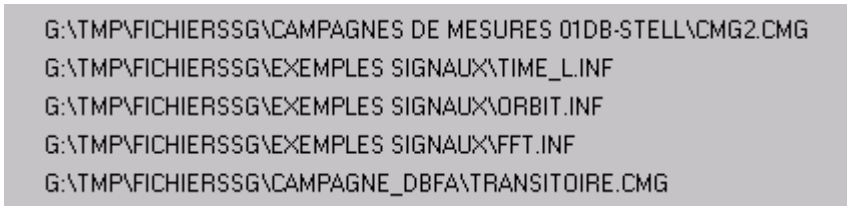
This menu is used to create a new session.

It launches Windows Explorer in order to select the storage directory and to name the session.



Once the session is created, a dialog box entitled "Session contents" is displayed. It is used to import measurement data with the Import button or from the graphics window (see chapter on Measurement sessions).

List of most recent files

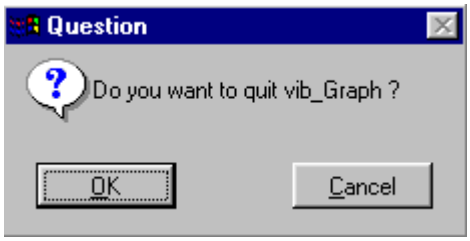


This file list allows for a quick access to the most recently opened files.

Quit

This heading makes it possible to stop vib-Graph manually. With its closing, all the windows are automatically closed, and the temporary data of the communications protocol are purged.

A window of confirmation appears:



4.1.3. Preferences

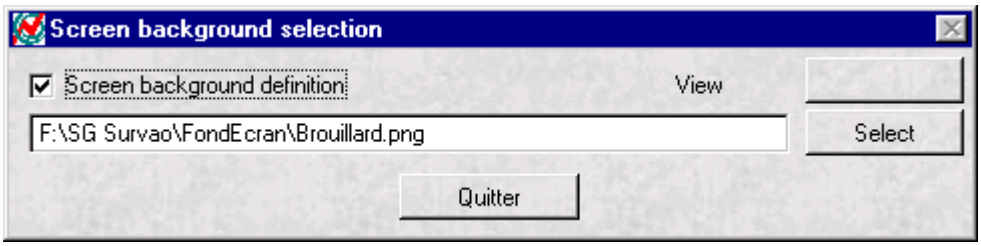
Vib-Graph has a manager of preferences making it possible to each user to adjust the various parameters, then to memorise them.

The preferences defined in this level are those recalled systematically with the display of a new graphic window.

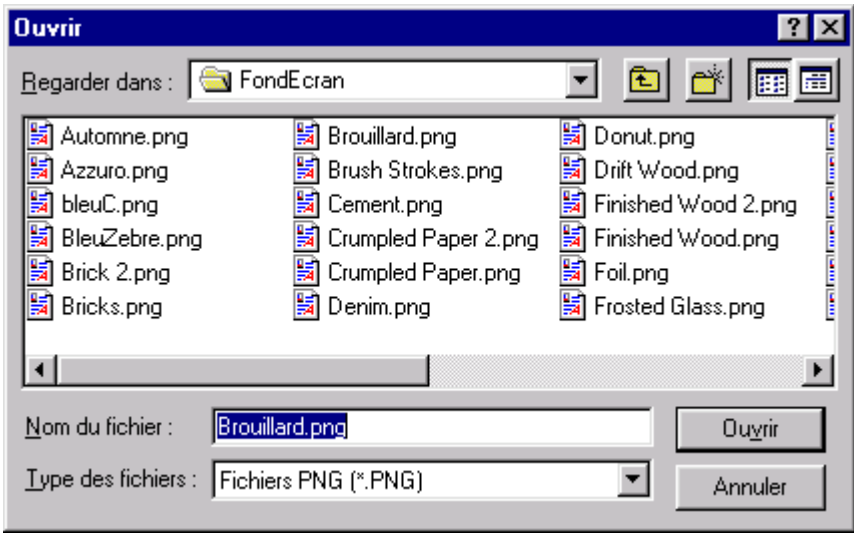
Notes

- Only these preferences are memorised
- Each user has his own preferences.

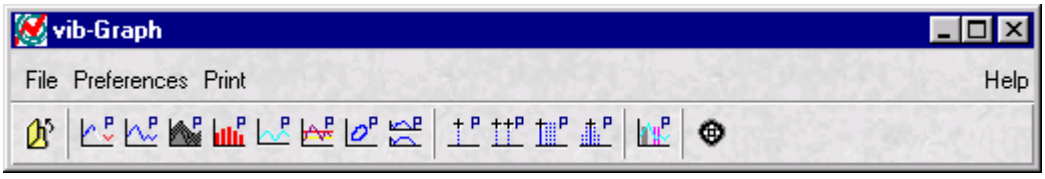
Screen background



A single background may be set for all vib-Graph windows. Simply click on “Select” to select the appropriate screen background.



All vib-Graph windows will then look similar, as selected by the user. For instance, the main window will be displayed as follows:



To delete a screen background, uncheck the *Screen Background definition* option.

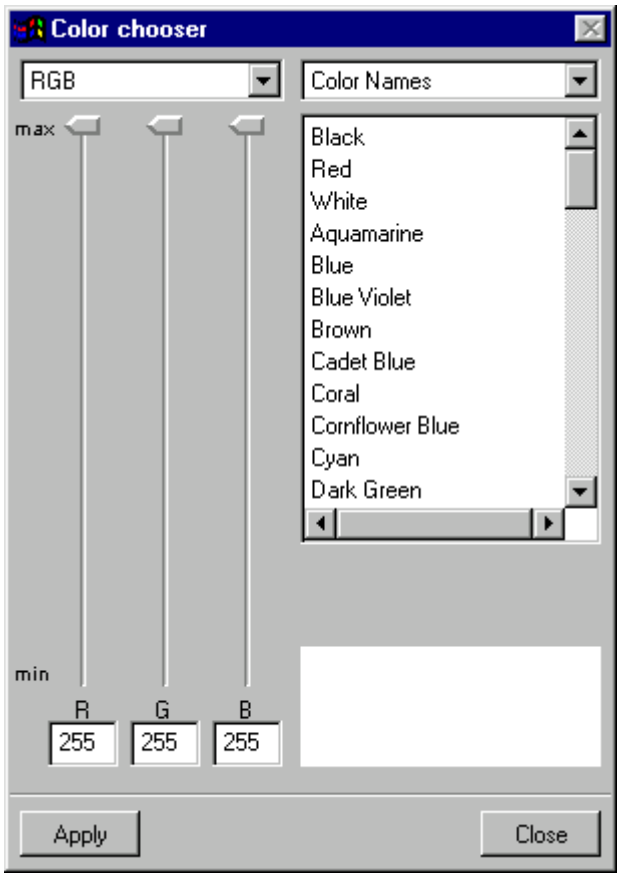
Window

Background

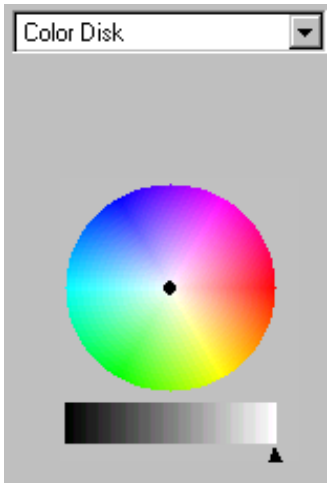
This function allows defining the prime coat of each graphic window.

A selector RGB (or HSV) makes it possible to define the elements of colour manually to be applied like melts of window.

A list of colour is also available; a simple selection applies the selected colour.

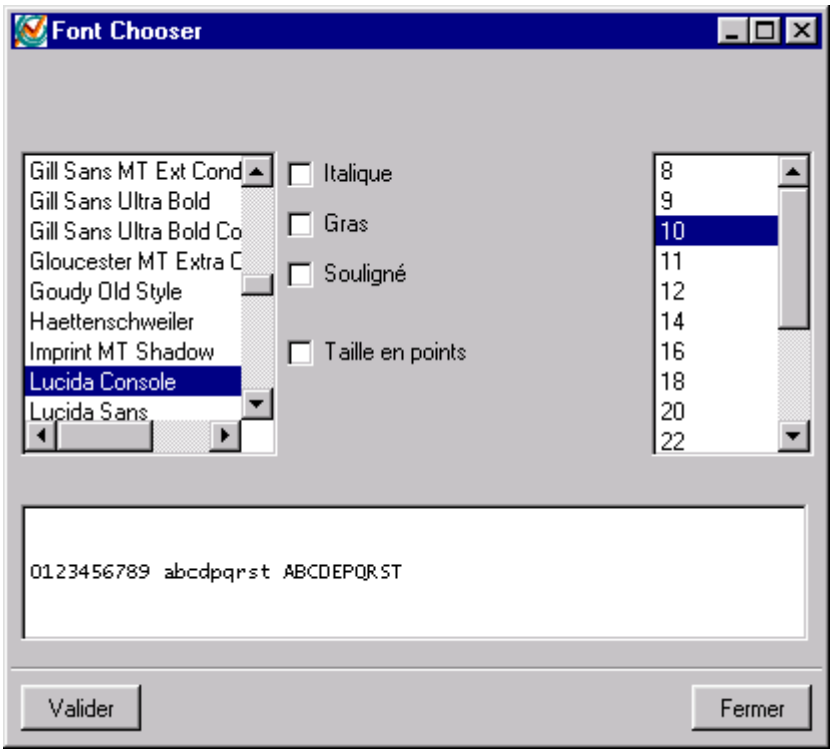


A graphic selector also makes it possible to visually choose the desired colour:



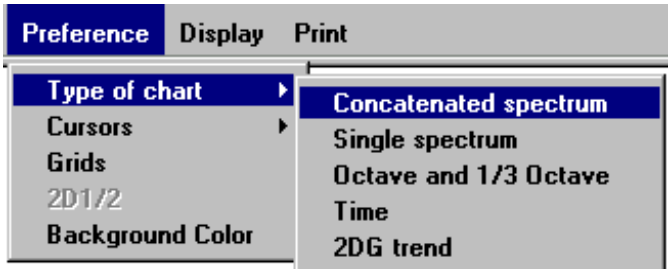
Character set

The character set of each area can be selected in this menu through following window:



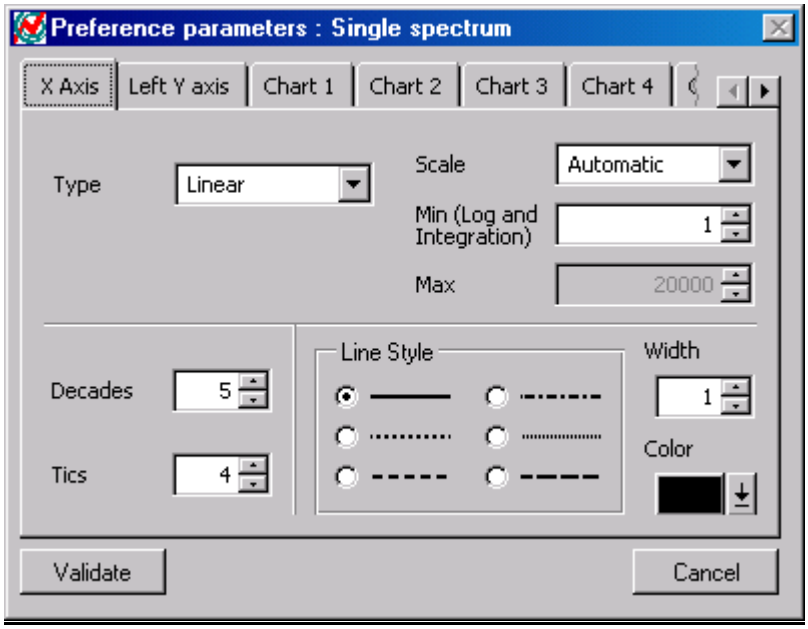
Select the character set (left-hand list) and the size (right hand one).

Graphics type



Whatever the type of graphic, the following interfaces are used to adjust the chart.

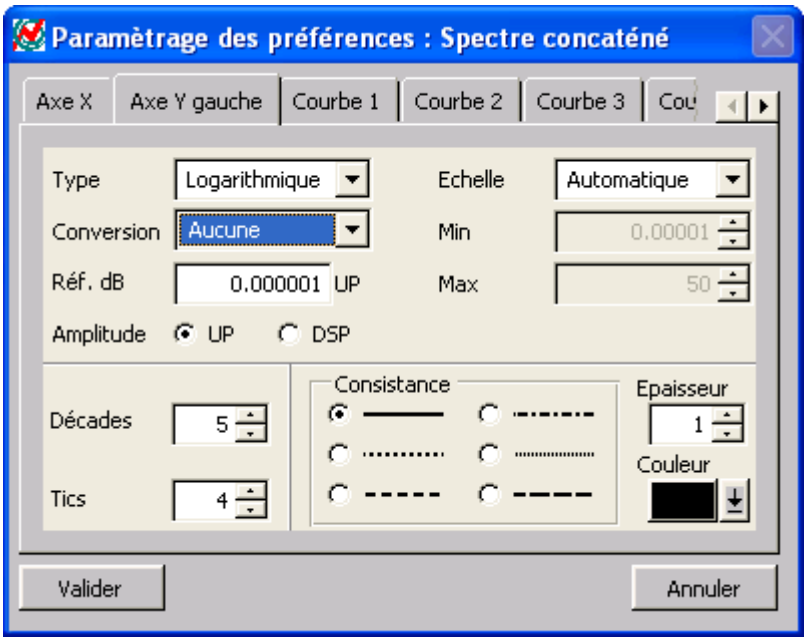
X axis



Management of the display mode along the X axis:

- **Type**: Lin, Log
- **Scales**: automatic, manual
- **Min:** minimal value of the manual scale
- **Max:** maximum value of the manual scale
- **Decades:** a number of displayed decades
- **Tics:** a number of graduations per decade
- **Line style:** Line style of the axis
- **Width:** width of the axis
- **Colour:** colour of the axis.

Y axis



Management of the display mode in Y:

- **Type:** Lin, Log, dB
- **Conversion:** None, Acceleration, Velocity, Displacement
- **Ref. dB:** reference value for the calculation of the dB (decibel) - see Formula n°1.
- **Amplitude:** EU, SPD - see Formula n°2.
- **Scales:** automatic, manual.
- **Min:** minimal value of the manual scale
- **Max:** maximum value of the manual scale
- **Decades:** a number of displayed decades
- **Ticks:** a number of graduations per decade
- **Line style:** Line style of the axis
- **Width:** with of the axis
- **Colour:** colour of the axis.

Formula n°1: $$AMP_{dB} = 20 \cdot Log_{10}\left(\frac{AMP_{lin}}{Réf\ dB}\right)$$

Formula n°2: $$AMP_{dB} = DSP_{dB} + 10 \cdot Log_{10}(\alpha \cdot \Delta f)$$

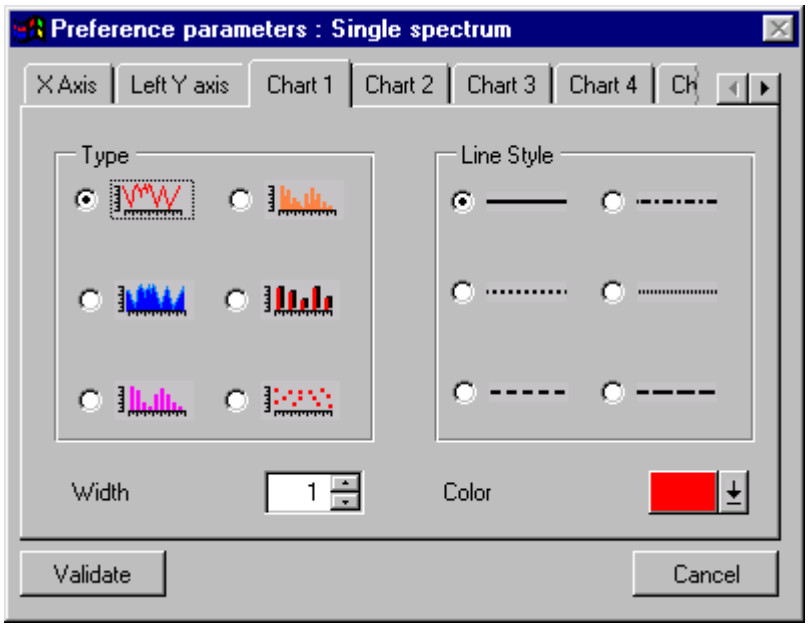
α = coefficient of window (ex: Hanning = 15).

Δf = frequency resolution of the spectrum

Note

The parameter “Conversion” makes it possible to choose the display unit of the signal. The operations of integration or derivation necessary are automatically applied.

Chart N

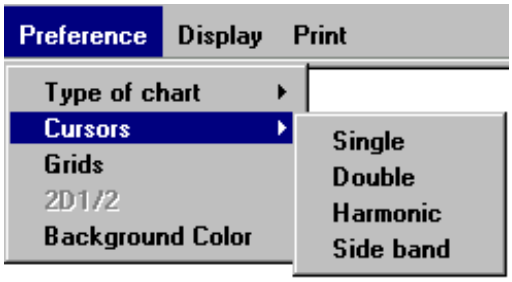


Management of the aspect of the Nth plotted curve

- **Type:** type of curve (milked fine, graph bars...)
- **Line style:** line style of the curve
- **Width:** width of the curve
- **Colour:** colour of the curve.

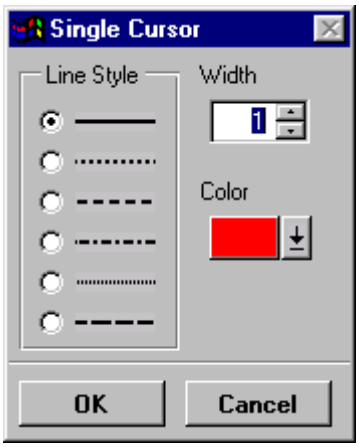
Cursors

These preferences make it possible to adjust the default settings of each type of cursor that can be applied to a curve.



Each type of cursor has an interface of parameter setting making it possible to define its aspect and its behaviour during its positioning on a curve.

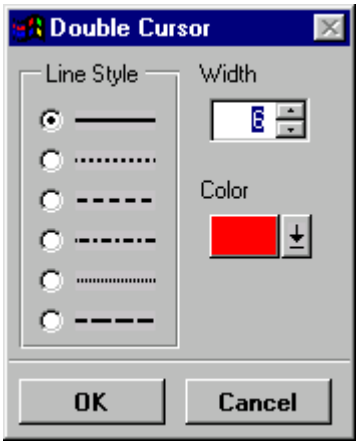
Single Cursor



Management of the aspect of the single cursor:

- **Line style:** type of marker
- **Width:** width of the marker
- **Colour:** colour of the marker

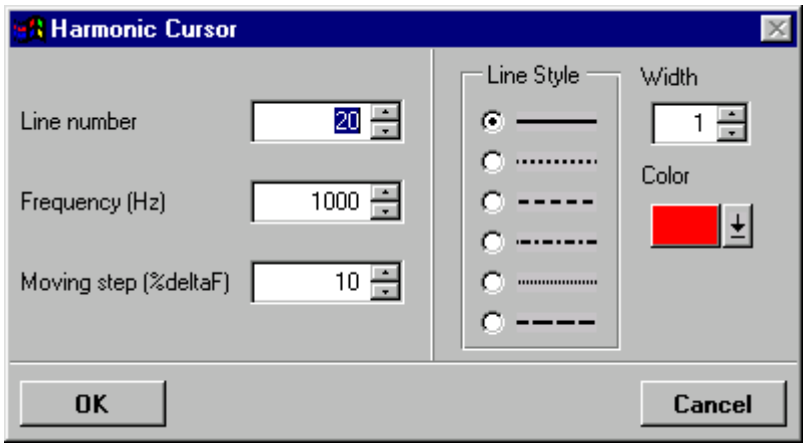
Double Cursor



Management of the aspect of the double cursor:

- **Line style:** type of marker
- **Width:** width of the marker
- **Colour:** colour of the marker

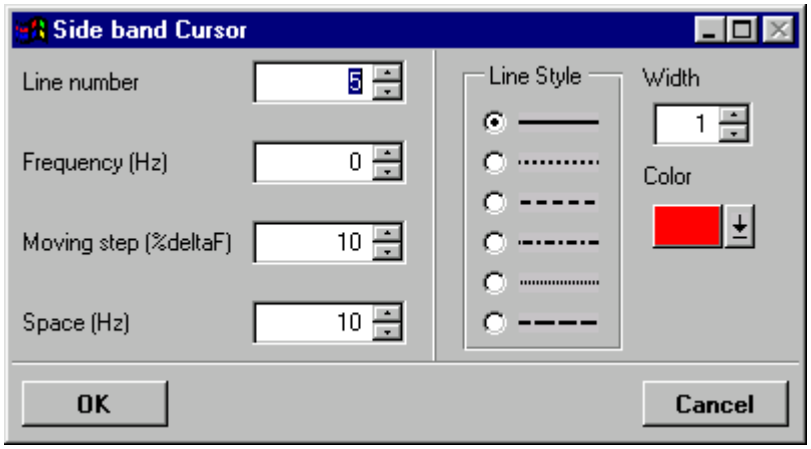
Harmonic Cursor



Management of the aspect of the harmonic cursor:

- **Number of lines**: number of required harmonics
- F**requency (Hz):** frequency by defect in hertz of fundamental (only manual harmonic cursor)
- **Moving step (%deltaF):** value expressed as a percentage of the frequency resolution for the step of advance of the fundamental cursor during its displacement using the ← → keys. A step of 100% specifies a sample by sample displacement.
- **Line style:** type of marker
- **Width:** width of the marker
- **Colour:** colour of the marker

Side band Cursor

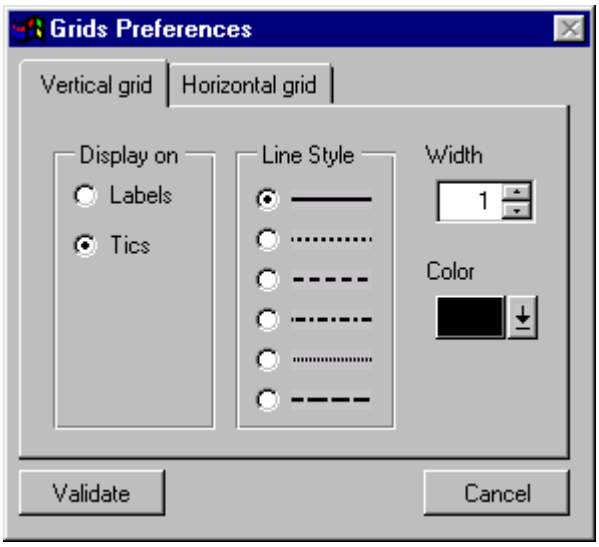


Management of the aspect of the lateral cursor:

- **Number of lines:** number of lines required on each side (central line included)
- **Frequency (Hz):** default frequency in Hertz of the central line (only manual sideband cursor)

- **Moving step (%deltaF):** value expressed as a percentage of the frequency resolution for the step of advance of the fundamental cursor during its displacement using the ← → keys. A step of 100% specifies a sample by sample displacement.
- **Space:** spacing in Hertz between the central line of the cursor and its first sideline.
- **Line style:** type of marker
- **Width:** width of the marker
- **Colour:** colour of the marker

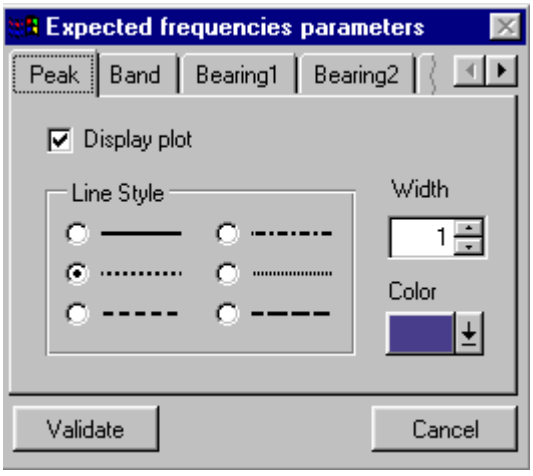
Grids



Management of the aspect of the grids:

- **Display on**: Labels, Ticks. Allows tracing the grid (horizontal or vertical) starting from each principal graduation (label) or secondary graduation (tic).
- **Line style**: type of graphic of the grid
- **Width**: width of the lines
- **Colour**: colour of the lines.

Expected frequencies



For each type of frequency, you can set following parameters:

- Display plot: if selected this type (peak, band...) will be displayed with the signal
- Line style
- Width
- Colour

Type of display

This screen sets how signals are displayed when selected by the file browser (Menu: File/Open).

You can select:

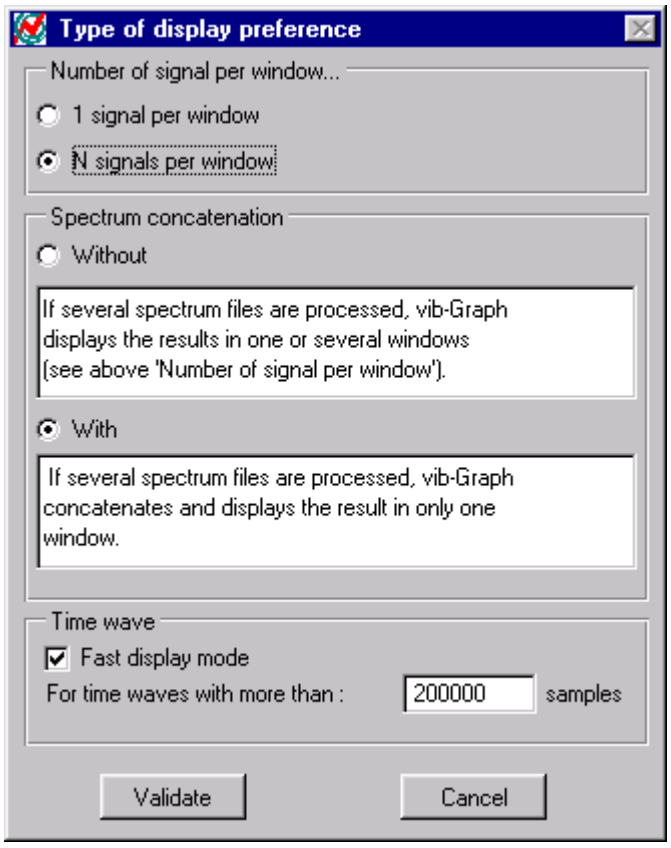
- if selected signals are displayed in one or several windows
- if, in case of spectrum file type (.ASP), concatenation algorithm is applied.

In order to speed up the display of long time signals, the user can opt to display the spectrum in Preview mode.

The Preview mode is a rough mode on which all points on the graph are not plotted. An algorithm is used to display a reduced number of points (depending on the window size and the number of points in the plot). The signal shape is then maintained.

The user may select the number of points the algorithm should use.

Type of display screen:



Example: with above selection, if you choose 3 spectrum files, they are superimposed in the same window.

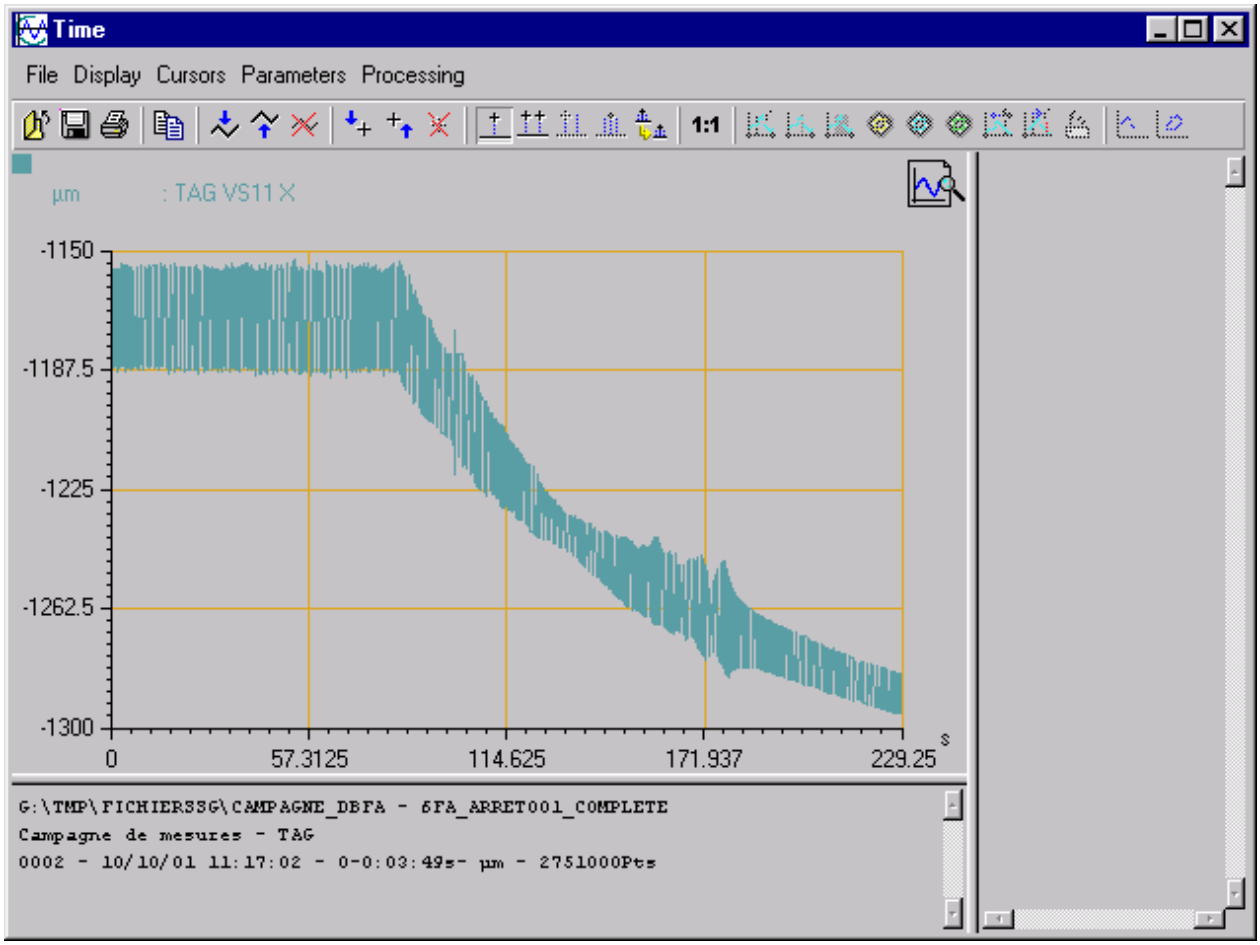
To concatenate them, you must select 'with concatenation'

To have each spectrum in a different window you must select '1 signal per window'.

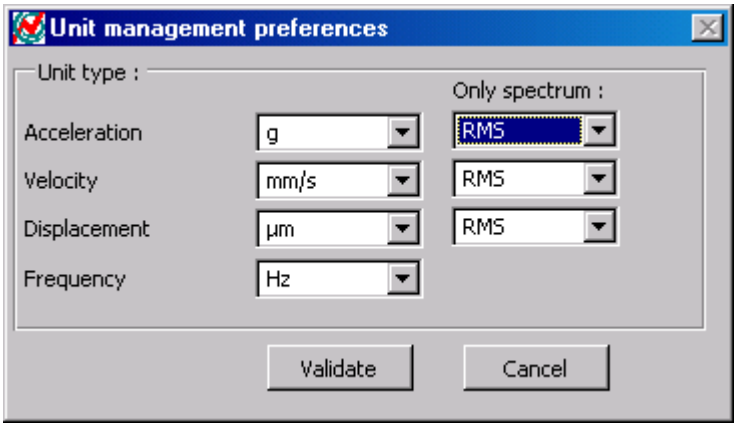
Time signals containing more than 200 000 points will be displayed in Preview mode.

The  icon indicates the Preview mode in the graphics window.

Example of a plot displayed in *Preview* mode:



Unit management



This menu is used to set units of vibration amplitude:

- acceleration: g or m/s2
- velocity: mm/s or ips
- displacement : µm or mils

and to define the type of spectrum calculation: RMS, Peak and Peak/Peak.

For frequency, the unit can be set to Hz, RPM or order.

Post-processing

This menu is used to set post-processing values.

The Orbit post-processing is available form a graphics window containing at least two time signals.

The Cepstrum post-processing is available from a spectrum plot.

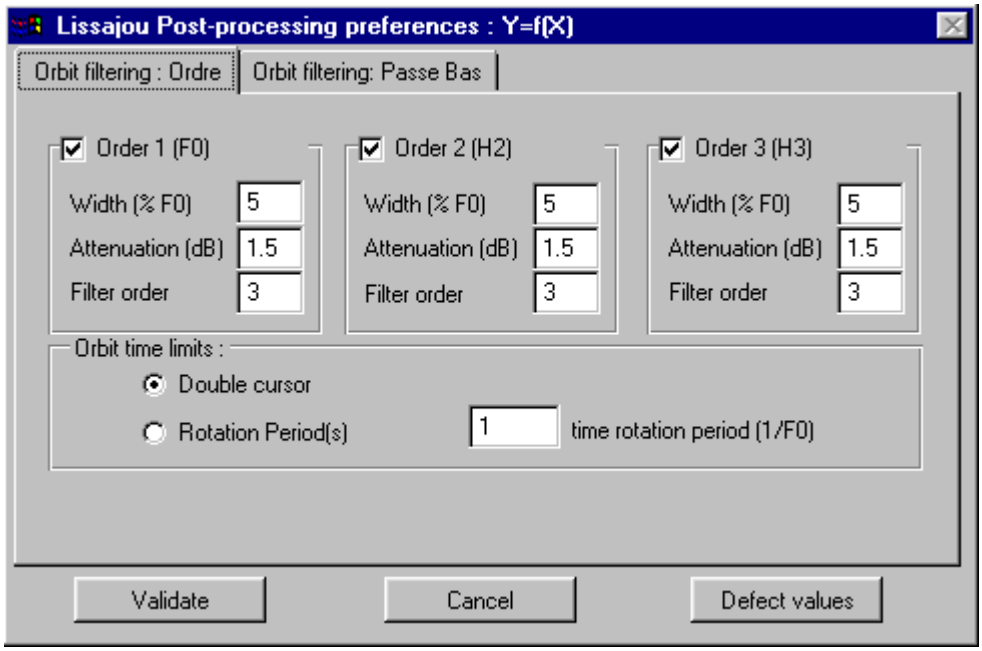
The Circular view post-processing is available from a graphics window containing two time signals.

Orbit post-processing

This window shows two parts:

- The first one to set the order filtered orbit (F0, H2, H3): selection of frequencies to filter (band-pass), filtering width, etc.
- The second is to set a low pass filter and corresponding characteristics (cut-off frequency, attenuation, etc.).

Orbit post-processing screen: order filtering:



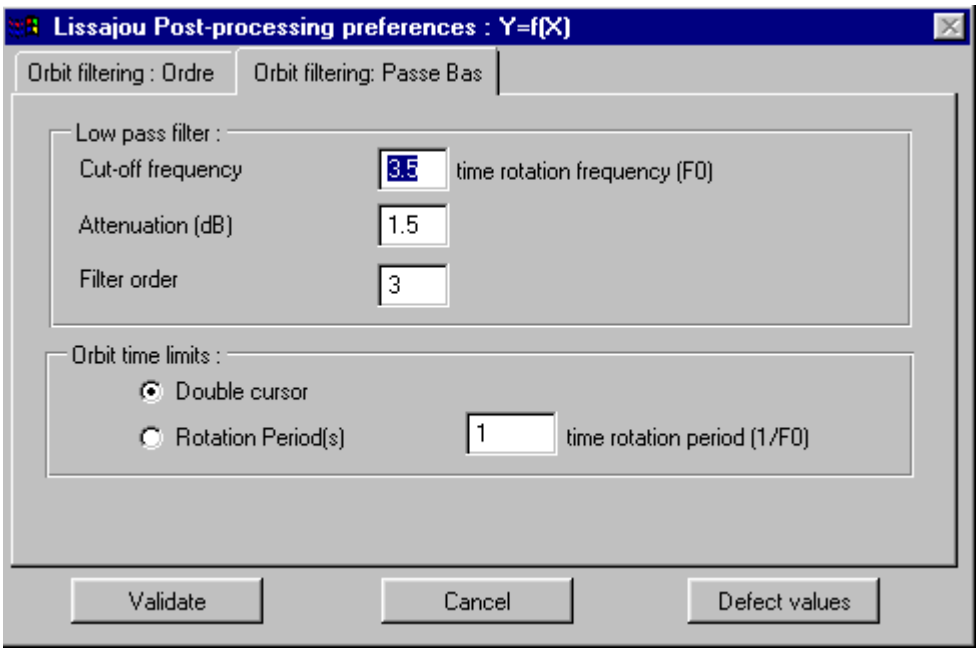
Check/uncheck the Order 1 (F0), Order 2 (H2) and Order 3 (H3) boxes to define the orbits to display after the (F0, H2, H3) Filtered Orbit processing.

For each frequency, the filtering bandwidth, the attenuation and the filter order can also be defined.

The time limits of the orbit can be associated to the double cursor or directly to the rotation period.

Example: with above screen, order filtered processing will open a new window with F0, H2 and H3 orbits superimposed. The time limit will depend on the active double cursor. If no double cursor is active the whole time period is used to build up the orbits.

Orbit post-processing screen: low pass filtering:



Cut-off frequency is set as a multiple of the rotation frequency. You can also adjust other characteristics of the filter.

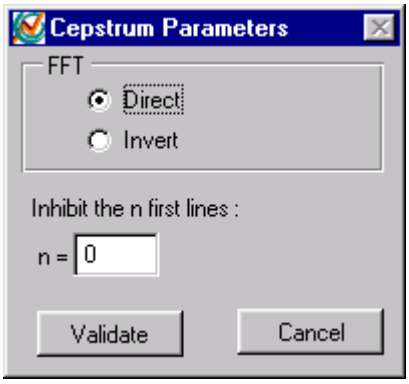
The time limits of the orbit can be associated to the double cursor or directly to the rotation period.

Example: with above screen, low-pass filtered processing will open a new window with one orbit. The time limit will depend on the active double cursor. If no double cursor is active the whole time period is used to build up the orbits.

Cepstrum post-processing

The window allows setting up the type of Cepstrum (Direct or Invert FFT), which will be used from spectrum window.

Cepstrum Post-processing Preferences Menu



This processing allows the search for periodicity in a spectrum.

Methods: The signal operands are supplemented with 2n points for the calculation of FFT. Two methods are proposed:

- By direct FFT (Rensenblatt 1963): Ce = ½TF (Ln Gxx(f))^{½}2
  Advantage: representation in dB scale

Disadvantage: result on 2n / 2 points = > loss of resolution

- By opposite FFT (today): This = TF1 [Ln Gxx(f)]
  Advantage: result on 2n points (preserved resolution)

Disadvantage: linear scale only

The result generally gives very significant values in the first lines that hide the following lines. To reduce this effect it is possible inhibit the first lines. The n selected lines are forced with the value of the line n+1.

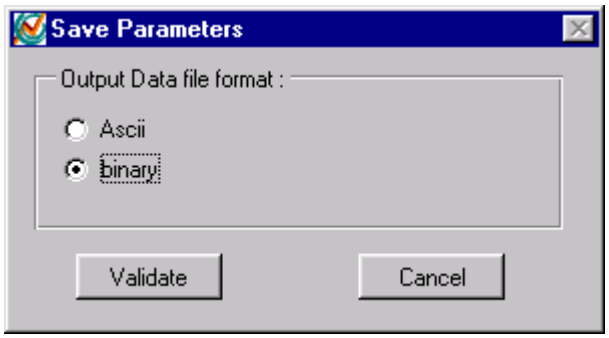
Circular View post-processing

Use the dialogue box to define a circular view of Cepstrum type (direct or reverse FFT), which will be used in the spectrum plot window.

Save

The menu allows choosing the format of the files of measurement that will be generated at the time you save the contents of a graphic window.

Preferences of saved file Format



If ***ASCII*** is selected, the measurements files will be in ASCII and can be opened with a text editor (NOTEPAD, WORDPAD...).

If ***binary*** is selected, the measurements files will be into binary format. They will take up less disk space on the disk.

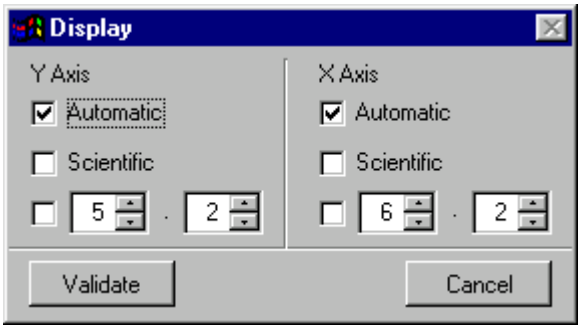
Axis graduation format

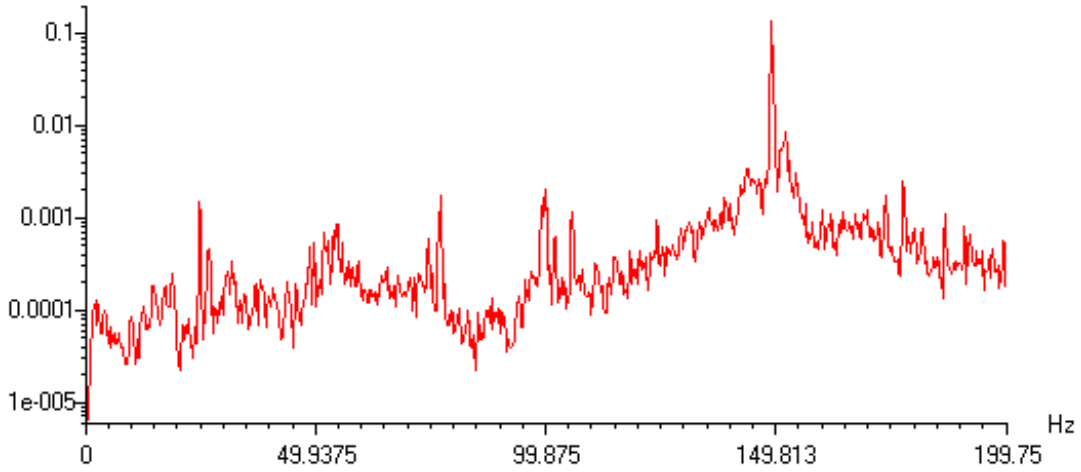
This heading makes it possible to define the numerical format of the graduation of axes in order to allow a perfect reproducibility of the graphics.

By default, the axes use the automatic format allowing an implicit management of the numerical formats (whole, decimal, real). The scientific format makes it possible to define the number of significant digits for the whole part and the decimal part:

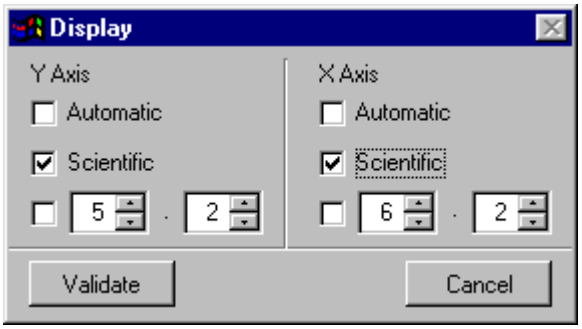
Examples:

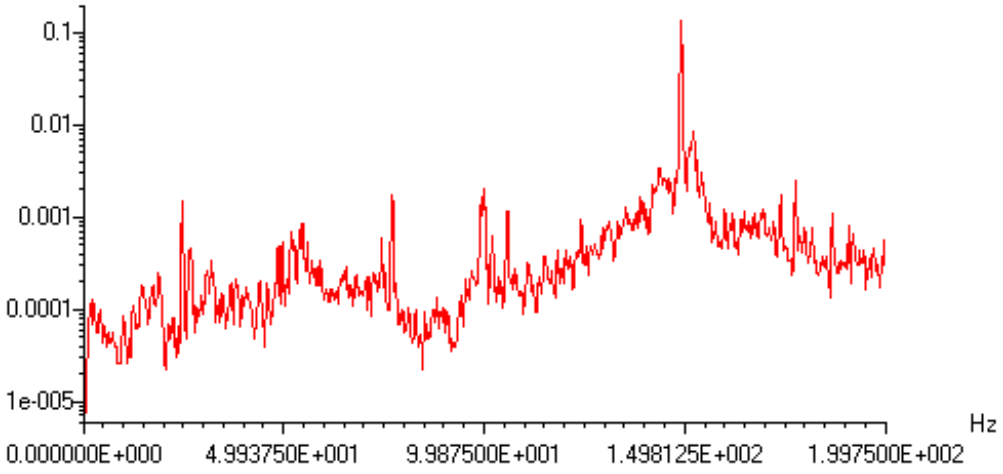
Automatic format in X and Y:



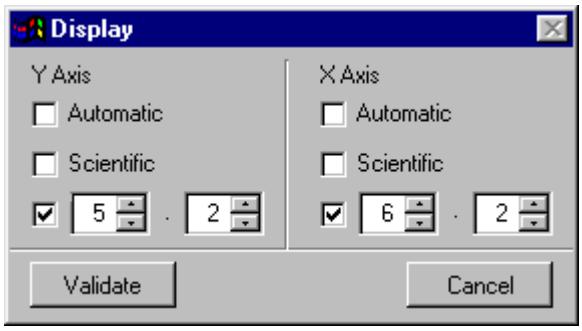


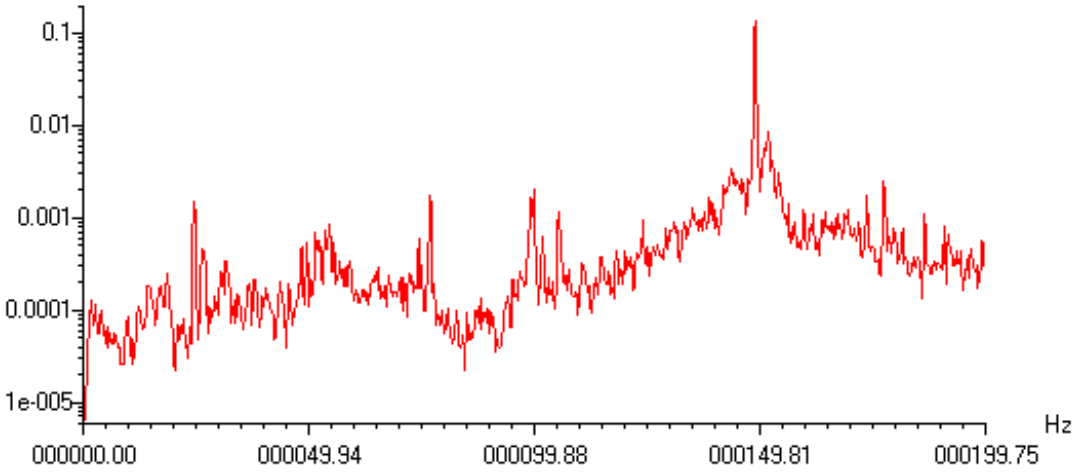
Scientific format in X and Y:





Manual format in X and Y:

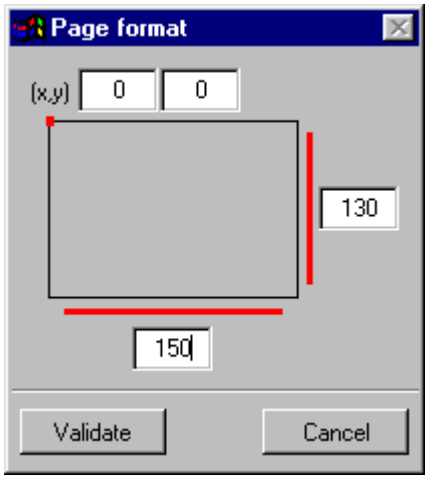




4.1.4. Print

This function makes it possible to define the print area on the printed paper sheet.

For that, position (x, y) then the dimensions (L, H) of the graph must be specified in millimetres in the following interface.



The position of the graphic is defined compared to the edge of page (except margins of printer).

CAUTION: The format parameters do not control the landscape or portrait printing format; this choice must be specified on the level of the printer properties, and the values of position and dimension of graphics must be coherent with the selected format.

4.1.5. Help

This function gives access to the on line help of vib-Graph, as well as to the “About” section.

The on line help is a data-processing version of this user's manual.

4.2. Management of the graphics window

4.2.1. General information

At the time of a request for graphic of measurement, the graphic window appears and presents the data of selected measurement.

4.2.2. Functions menu

The principal menu of the graphic window makes it possible to redefine the preferences of vib-Graph locally; these new parameters are not memorised.

4.2.3. Tool bar

The tool bar gives access quickly to the principal tools for graphic analysis, such as zooms and cursors. The icons are gathered by functional families.

 These icons are used to Open, Save or Print signal files.

 These icons are used to manage the active curve: to select next curve, to select previous curve, to erase the active curve of the graphics.

The active curve is that whose colour code is recalled in on the left top corner of the graphics.

The active curve is selected among the list of superimposed curves. A single curve is necessarily active.

 These icons are used to manage the existing cursors on the active: to select the next or the previous cursor as the active cursor or to remove the active cursor.

The name and values of the active cursor are displayed on the top left corner of the active curve.

 These icons give access quickly to the various types of cursors: to select a single cursor, a double cursor, a harmonic cursor, and a side band cursor, to duplicate the last inserted cursor (double or side band only).

After selection of the type of cursor, the creation on the signal is carried out by right clicking next to the destination point on the curve.

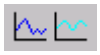
The cursors are always associated with the current curve.

The duplication of cursor makes it possible to create several cursors with the step (double or side band cursors only).

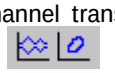
This icon is used to return to full scale after a zooming operation.

The zoom can also be directly carried out on a portion of curve by selecting this portion with the mouse by maintaining the right click (drag and drop).


These icons make it possible to manage 'Expected frequencies'


This icon makes it possible to display from a Bode diagram the corresponding spectra or time signal:

- At the frequencies of the single cursors if the active cursor is a single cursor.
- At the frequencies between the double cursor if the active cursor is a double cursor

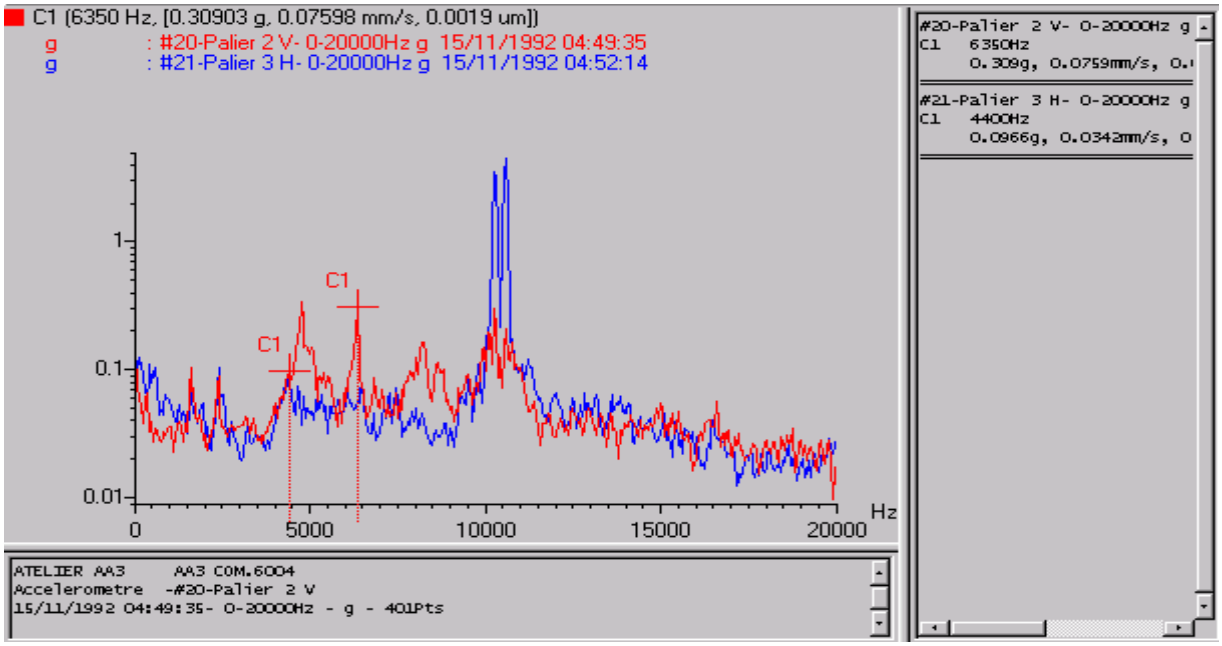
In case of dual channel transient display, these icons are replaced by the following ones: 

They will be used to access the "Ellipse" spectrum and the orbit at the selected speeds.

4.2.4. Graphics window

The graphics window has several areas:

- Heading area, 1st part containing the colour code of the active curve and the value of the active cursor of this curve.
- Heading area, 2nd part containing the name of each superimposed curve, their respective unit and the respective colour code.
- Graphics area.
- Text zone on the left containing the name of measurement and the date of measurement.
- Text zone on the right containing complementary information (depend on associated software) and free area in order to enter additional data This information is not stored in the database but may be printed with the graphics.



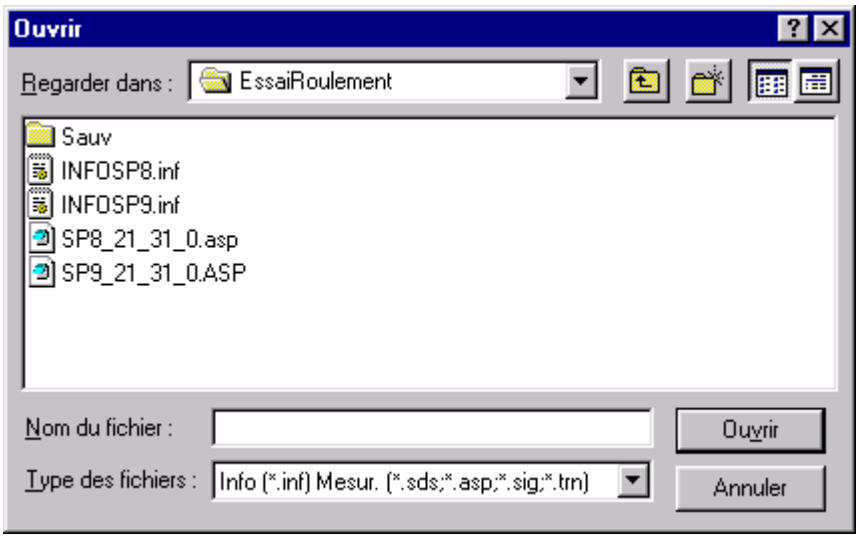
The position of the window and the dimension of each zone can be redefined by moving the mouse, and save with menu **Display / Save window size and position**.

4.3. Open files and Save displayed signals

4.3.1. Open files (accessibility according to licence)

To open a signal file use the File/Open menu or the following icon ().

The Windows file browser is then displayed:

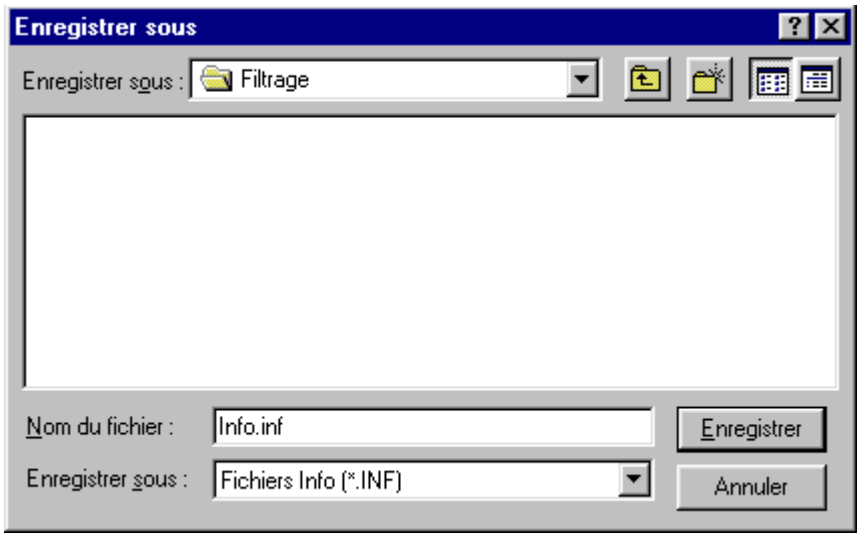


You can then select one or several files to be superimposed in the current window. (Use key Ctrl or Shift to make multiple selections).

4.3.2. Save displayed signal

Use the File/Save as... menu or the following icon ().

The Windows file browser is then displayed:



You can select the directory and the name of the file to store displayed signal.

4.3.3. Store the displayed data into the current session

Use the File/Save in current session menu to save the displayed data into the current session.

4.4. Cursor parameters

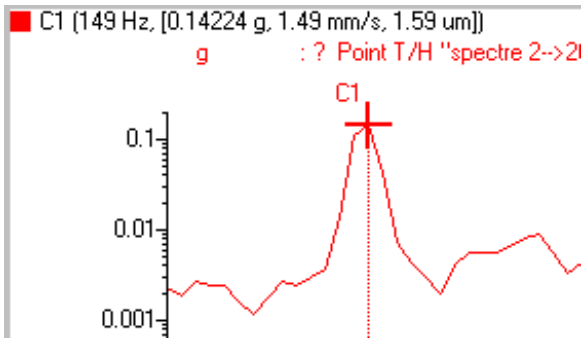
4.4.1. Single Cursor

Definition

The insertion of a single cursor is carried out by selecting the type of cursor in the " Cursor->Insert->Single " list or with the corresponding icon, then by click on the left button of the mouse. The cursor is created on the nearest point to the click.

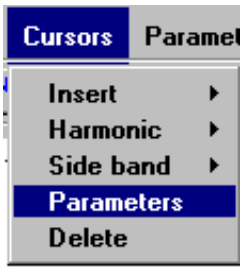
The values of the ordinate Y of the cursor are expressed in acceleration, velocity and displacement when the curve is a spectrum.

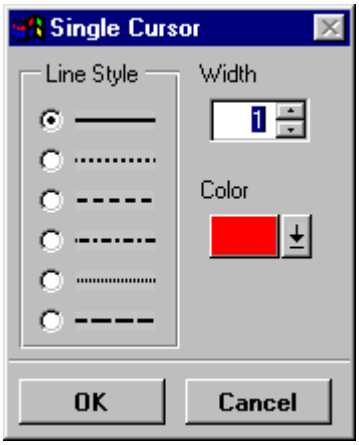
The cursor can be moved with the ⇦ and ⇨ keys sample by sample. A fast displacement can be done by using the ⇧ and ⇩ keys.



Parameter setting

The default settings of the cursor come from the general preferences of vib-Graph, and can be modified locally in the graphics window using the "Cursor-> Parameter setting" menu:

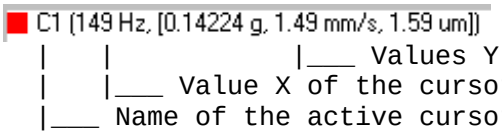




Any parameter setting operation of this type is related to the active cursor.

Information

Information of the active cursor:



Nomenclature of the cursor name:

C<i> Where 'i' represents the number of the cursor (command of creation).

The selection of the active cursor is obtained by the  buttons of the tool bar. A click using the mouse on one of the two icons makes it possible to change active cursor.

To remove a single cursor, it is necessary to select the cursor so that it becomes the active cursor, then press the button  or by selecting the "Cursor->Delete" function in the menu.

Note

The single cursor is the **default cursor**.

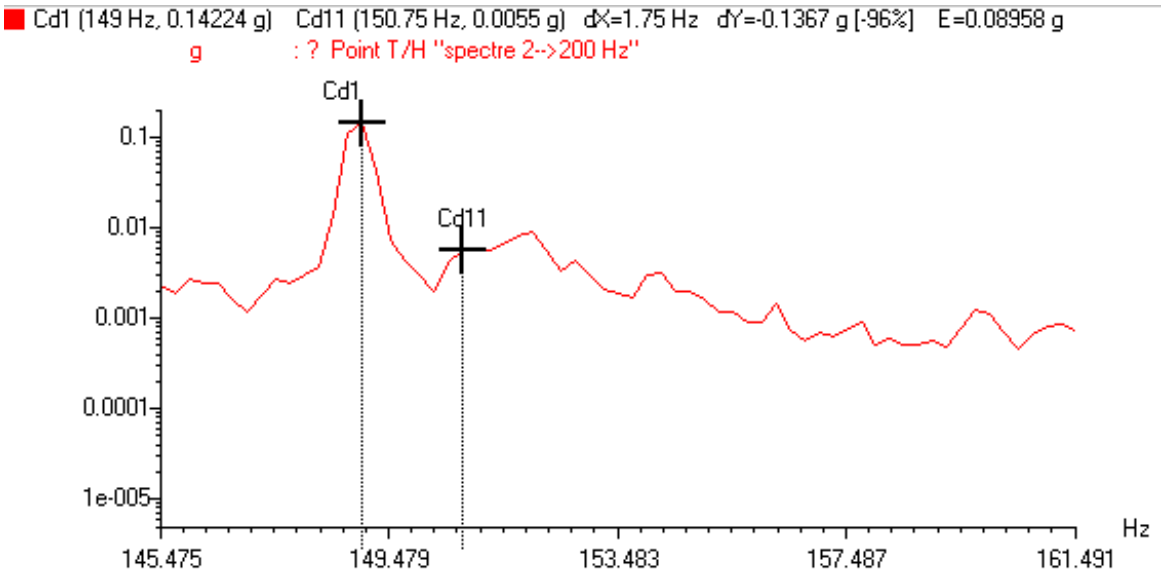
4.4.2. Double Cursor

Definition

The double cursor makes it possible to obtain two single cursors interdependent one of the other, moving of a same step on the same curve.

To create a single cursor, it is necessary to select the type of cursor in the list " Cursor->Insert->Double " or click on the corresponding icon. Then click one first time on the curve with the left button of the mouse to position the 1st cursor and click one 2nd time to position the 2nd cursor.

The double cursor can be moved with the ⇦ and ⇨ keys. A fast displacement can be carried out by using the⇧ and ⇩ keys.



The spacing of the 2 cursors is adjustable by combining the SHIFT and CTRL keys with the ⇦ and ⇨ keys:

Ex: SHIFT+ ⇨: moves the cursor Cd1 towards the right

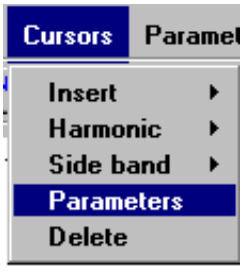
SHIFT+ ⇦: moves the cursor Cd1 towards the left

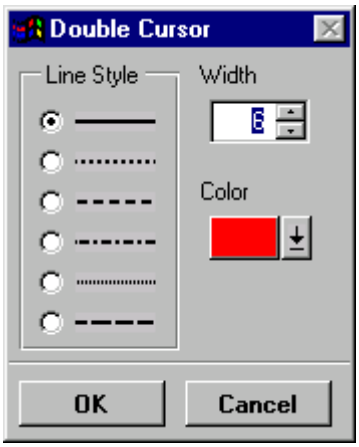
CTRL+ ⇨: moves the cursor Cd11 towards the right

CTRL+ ⇦: moves the cursor Cd11 towards the left

Parameter Setting

The default settings of the cursor come from the general preferences of vib-Graph, and can be **modified locally** in the graphic window via the “Cursor/Parameters” menu:

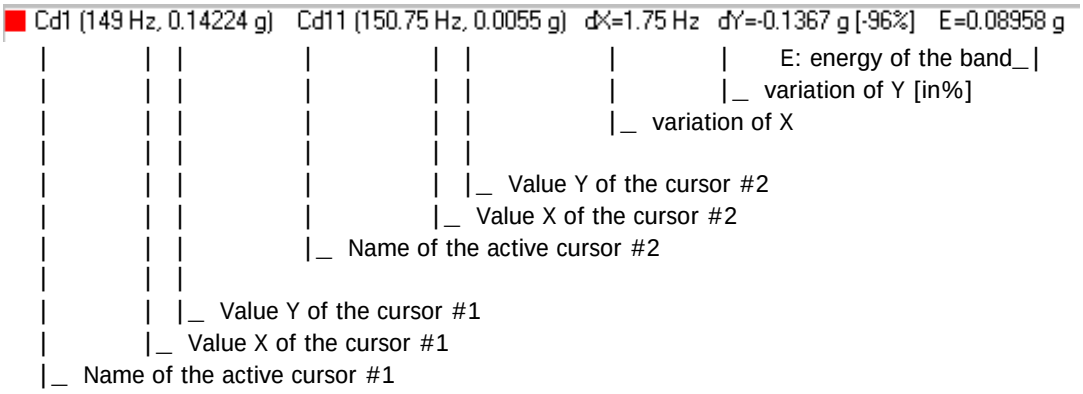




Any parameter setting operation of this type necessarily relates to the active cursor.

Information

Information on the active cursor:



The values Y displayed are those of the samples of the curve.

Nomenclature of simple name of cursor:

Cd<i><j> where 'i' represents the number of the cursor (order of creation), and j the order of the elementary cursor in the double cursor

The selection of the active cursor is obtained by the  buttons of the tool bar. A click using the mouse on one of the two icons makes it possible to change the active cursor.

To delete a double cursor, it is necessary to select the cursor so that it becomes the active cursor, then click on the  button or select the "Cursor->Delete" function in the menu.

4.4.3. Harmonic Cursors

Definition

The harmonic cursor makes it possible to very quickly locate the harmonics of a spectrum. The insertion of a harmonic cursor is carried out by selecting the type of cursor in the list "Cursor->Insert->Harmonic " or with the corresponding icon, then with click on the left button of the mouse. The cursor is created on the nearest point to the click.

This cursor is used on a single or concatenated spectrum.

The harmonic cursor can be moved using the keys ⇦ and ⇨. A fast displacement can be done by using the keys ⇧ and ⇩.

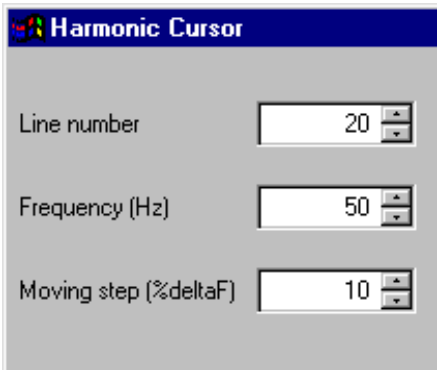
Operating modes

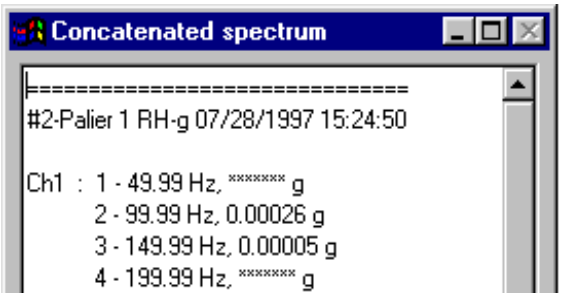
A harmonic cursor has **three operating modes**: automatic, semi-auto or manual.

The *automatic mode* makes it possible to position automatically the fundamental cursor on the peak nearest to the area of the mouse click. The exact value in X is obtained by interpolation between the samples.

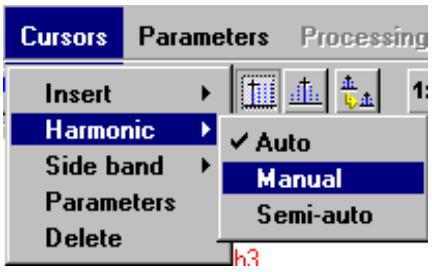
The *semi-auto mode* allows a displacement of the cursor by fine steps "%delta F"

The *manual mode* is very close to the semi-auto mode except the fundamental cursor is imposed on a frequency defined in the parameters of the cursor:



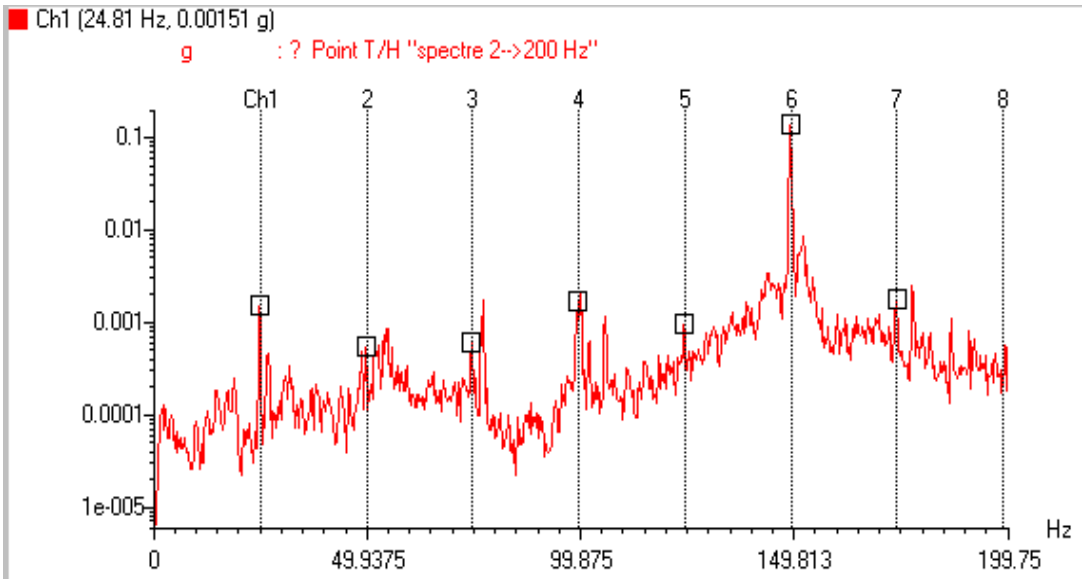


The operating mode is selected before the insertion of the menu "cursors" of the graphics window:



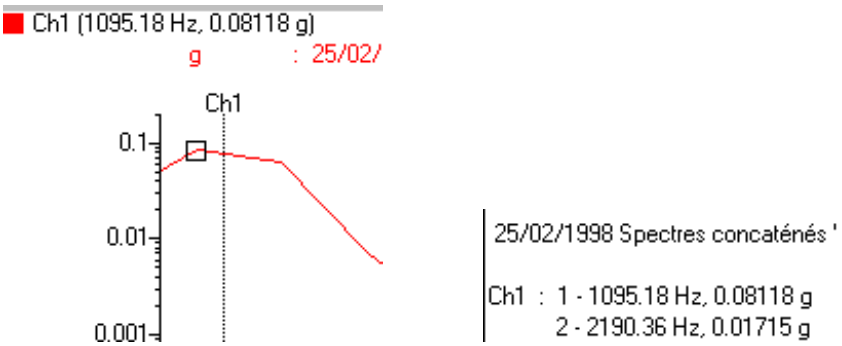
Method of detection of harmonics

During the insertion of a harmonic cursor, an **automatic detection** of the peaks in coincidence is done. There is coincidence when the difference between a peak of the spectrum and a calculated harmonic is lower than the half of frequency resolution.



The fundamental of the harmonic cursor is obtained by **interpolation**. This one makes it possible to obtain the exact frequency of the peak. It is made by taking to account the shape of the weighting window used, as well as the value of the samples located near the selected frequency.

The displayed frequency is consequently the interpolated true value represented on the graphic by a vertical dotted line:



The “square” marks the sample representing the detected peak; its value in Y will be retained like that of the harmonic.

The harmonics of order N are displayed only if one peak is detected on the fundamental one (Ch0).

Information

Information of the active cursor:

Ch1 (99.53 Hz, 0.01425 g)

| | | |_Value Y of the cursor Ch1 (fundamental)

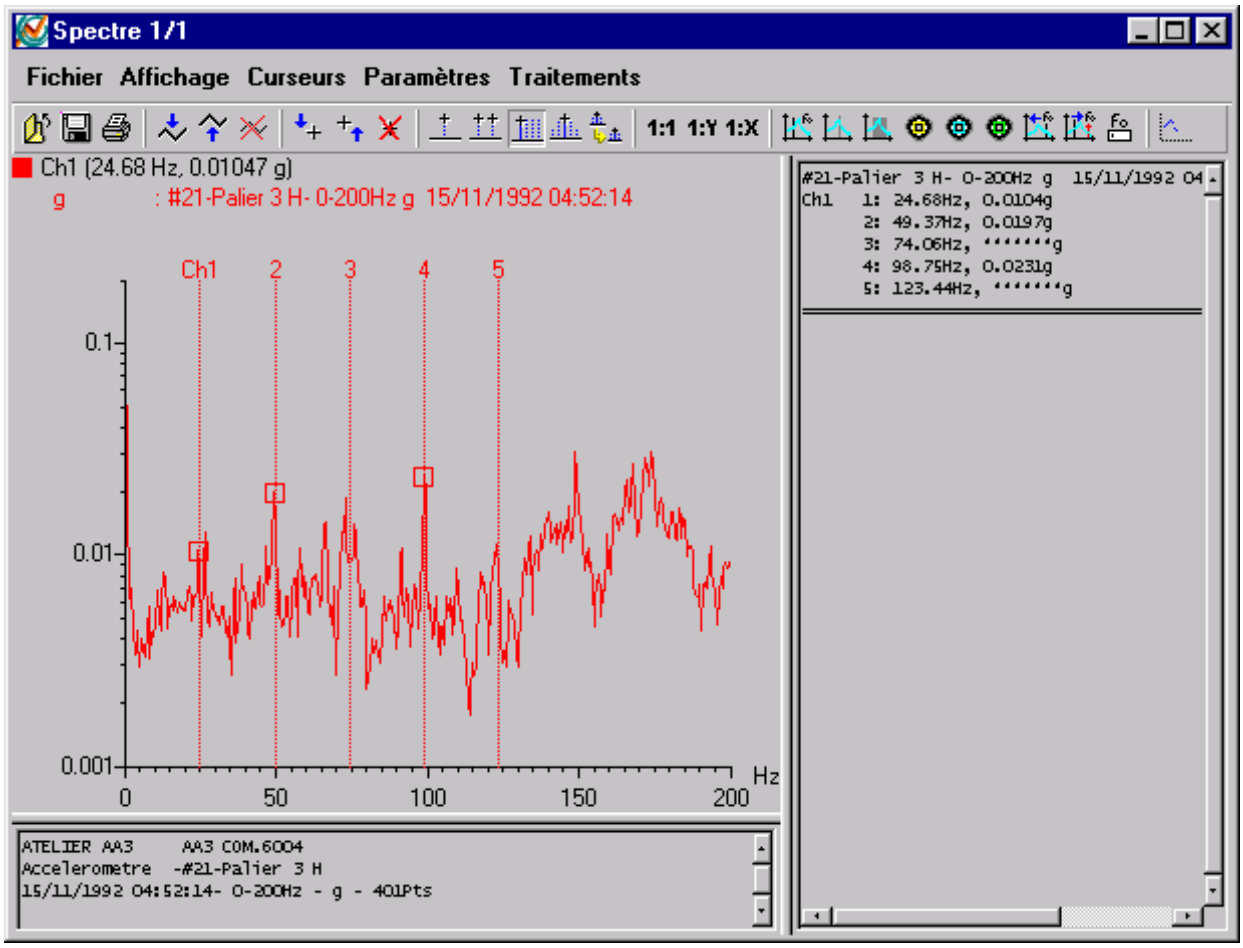
| | |_Frequency of the cursor Ch1 (fundamental)

| |_ Name of the harmonic cursor

Nomenclature of the names of the harmonic cursor:

Ch<i> where 'i' represents the creation order of the followed harmonic.

Graphic window:



4.4.4. Sideband cursor

Definition

From a given frequency, the side band cursor seeks the multiple lines on both sides specified centre frequency, and carries out the reading amplitude/frequency of each line.

To create a side band cursor, it is necessary to select the type of cursor in the list " Cursor->Insert->Side band ", to choose the operating mode of the cursor in the list " Cursor->side band ->Manual, Semi-auto " then click on the left button of the mouse to position the cursor.

This cursor is used on a single or concatenated spectrum.

The cursor can be moved with the ⇦ and ⇨ keys. A fast displacement can be carried out by using the ⇧ and ⇩ keys.

Operating modes

Same as harmonic cursor.

Method of detection of peaks

Same as harmonic cursor.

Information

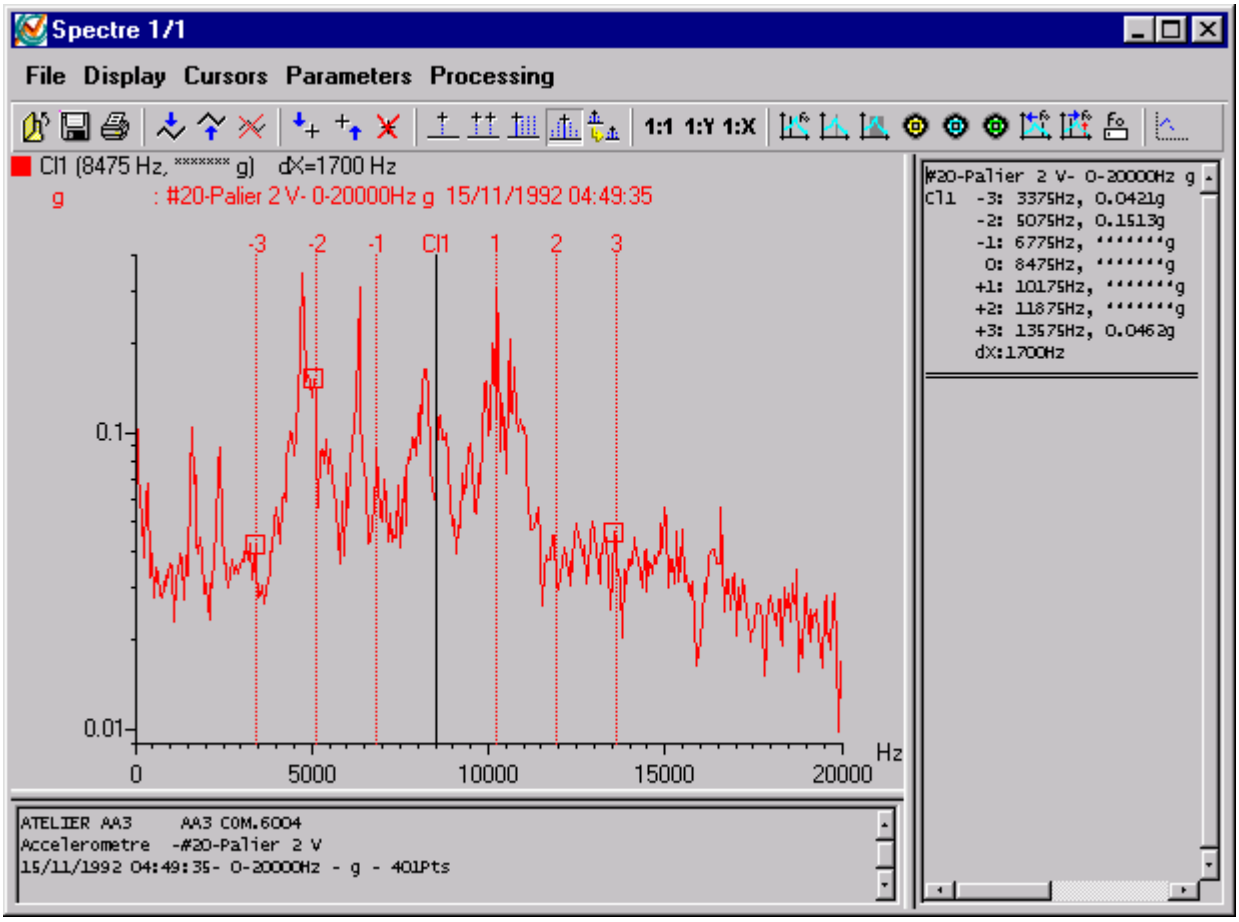
Nomenclature of the names of side band cursor:

Cl<i> where 'i' represents the creation order of the cursor.

Information of the active cursor:

Cl1 (646.85 Hz, 0.00755 g) dX=148.12 Hz
| | | |_ Variation in X between central cursor and first side band
| | |_ Value Y of the cursor
| |_ Position in X of the cursor
|_ Name of the cursor

Graphics window:



4.5. Management of the zoom

4.5.1. Manual Zoom

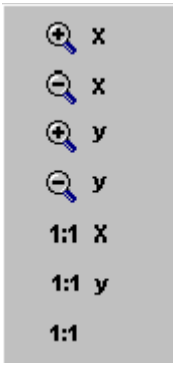
On the level of each graphic window, it is possible to define a manual zoom making it possible to increase an area of the graphic.

For that, it is enough to select the useful area with the mouse by maintaining the right button; a dotted framework appears in order to symbolise the zoom area. Once finished, to release the button of the mouse, the useful area appears full window; the zoom is applied.

4.5.2. Assisted Zoom

At the level of each graphic window, it is possible to use various functions to apply pre-programmed zooms to the graphic.

The « Zoom » menu makes it possible to choose in the following list:



- From top to bottom, one distinguishes the following functions:
- zoom in X of the current scale
- unzoom in X of the current scale
- zoom in Y current scale
- unzoom in Y current scale
- to display full scale in X
- to display full scale in Y
- to display full scale in X and Y

The tool bar presents short cuts on certain zooms.

From left to right one distinguishes the functions from display full scale, display full scale in Y and display full scale in X.

4.6. Expected frequencies

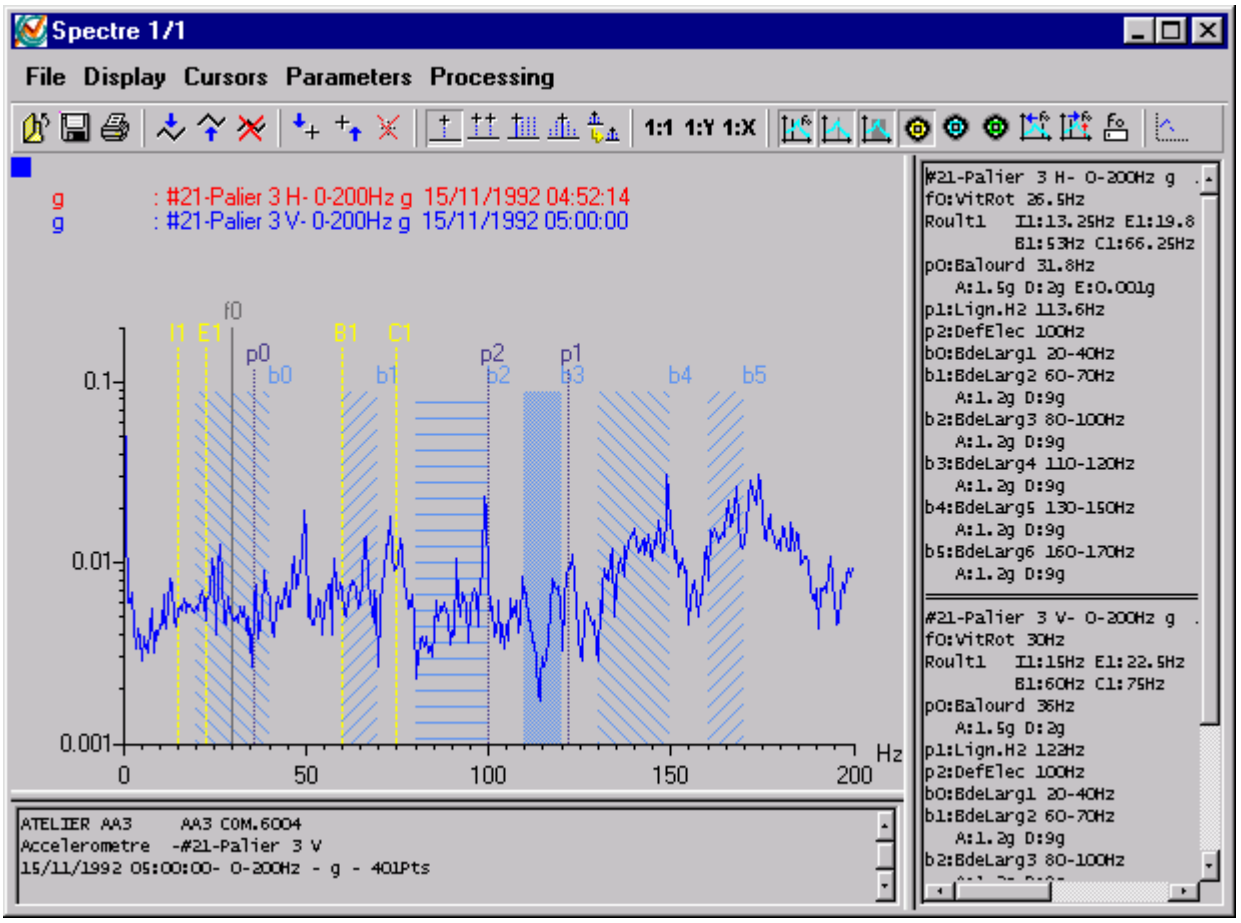
4.6.1. Main characteristics

When used with Divadiag or Survaodiag, vib-Graph can display for types of frequencies named expected frequencies. They are:

- Machine rotation speed
- Peaks
- Bands
- Bearing frequencies

Display mode of those frequencies can be adjusted from the menu *Preference/Expected frequencies*

Example with Expected frequencies



In the above example:

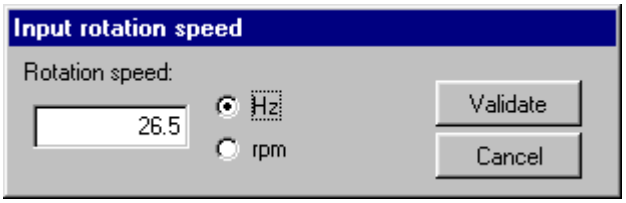
- Rotation speed is a continuous black line marked f0
- Peaks have two dotted lines indicating the search area marked p0, P1...
- Bands are dashed areas with b0, b1 at the right hand upper corner
- Bearing frequencies are dashed lines marked I1 (internal track), E1(External track) B1(Ball), C1(Cage) for Bearing number 1

The display can be modified from the 'Expected frequencies' icons:

Description from right to left hand:

- Display or not rotation frequencies
- Display or not peak frequencies
- Display or not bands
- Display or not bearing 1 frequencies.
- Display or not bearing 2 frequencies.
- Display or not bearing 3 frequencies.
- Reset initial rotation frequency of the machine.

- Set rotation frequency of the machine with current single cursor (Modification is only valid for the active curve). All parameters related to rotation frequency are adjusted.
- Set rotation frequency using keyboard (Modification is only valid for the active curve). All parameters related to rotation frequency are adjusted.



All information related to expected frequencies is also listed in the information window.

If mouse remains above an expected frequency related information is also displayed.

4.7. Post-Processing

vib-Graph can apply post-processing on time waves or trends. This function is accessible through the menu Processing

4.7.1. Filtering

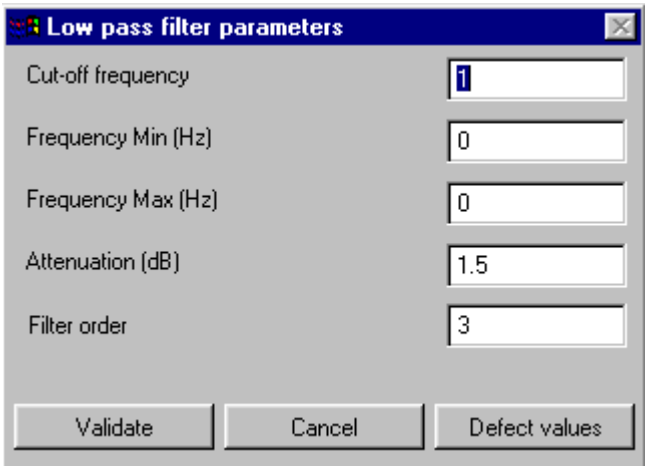
Filtering is only possible with time wave files.

It is accessible through the menu Processing/Filtering

Possible filters are:

- Low pass
- High pass
- Band pass
- Band stop

A window allows adjusting filter characteristics:



The 'Cut-off frequency' field is for Low-pass and High-pass filters. It is not accessible for Band-pass and Band-stop filters.

'Frequency Min' and 'Frequency Max' fields are for Band-pass and Band-stop filters. They are not accessible for Low-pass and High-pass filters.

Filtered waves are displayed in a new window.

It is also possible to apply the filter only on a part of the signal using the double cursor for selection.

4.7.2. SFI

vibGraph now offers the possibility to get, through post-processing, a filtering achieved automatically and in an embedded way, by OneProd MVX in order to detect shocks on shafts with slow rotation speeds.

Application of this filter allows evidencing the shock pulses hidden in the time signal.

Important notes:

- This filter is relevant only for elements with low rotation speeds.
- The signal to process must have a high enough resolution to guarantee the relevance of the filter (typically, a time signal of 10 seconds at 51.2 kHz).
- The settings of this filter are not accessible to the user.

4.7.3. Lissajou

Lissajou processing is possible only for trend data.

It is accessible through the Processing/ Lissajou menu.

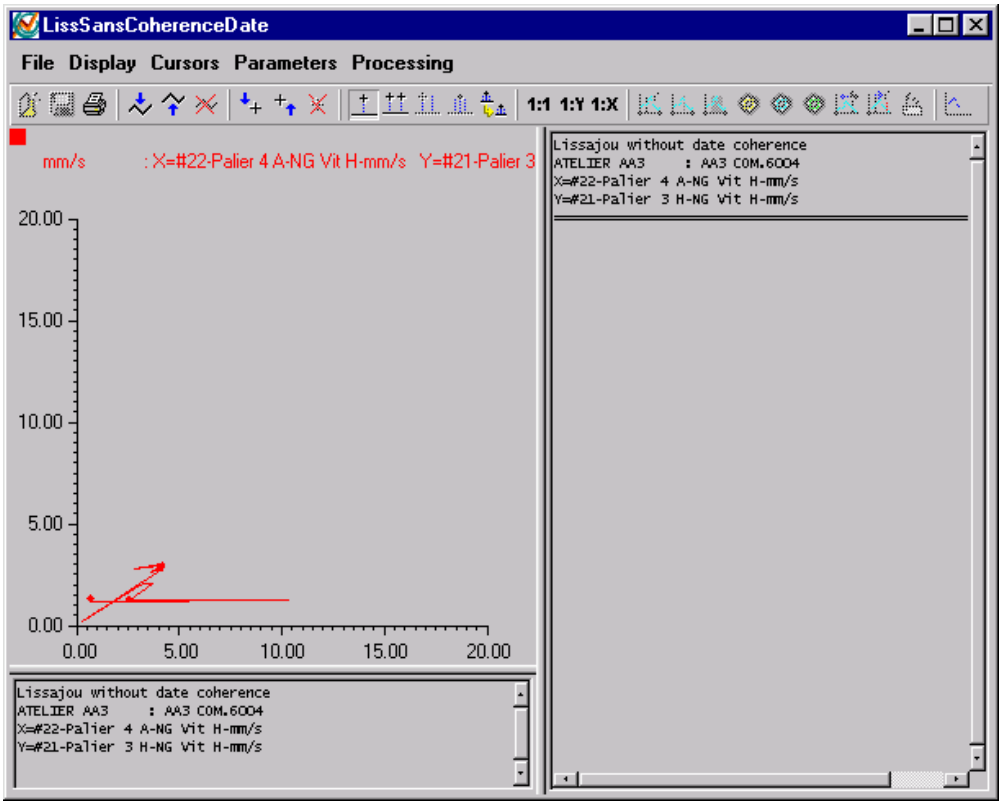
This type of processing is valid only if:

- The current window includes two trends,
- Y axis units are the same.

It is also possible to apply Lissajou processing on a part of the signal only using the double cursor for selection.

If the numbers of points of each trend are different vib-Graph displays a warning message but still draws the Lissajou for the first points.

Lissajou display



4.7.4. Orbit

Orbit processing is possible only for trend data. It is accessible through the Processing/ Orbit menu.

This type of processing is valid only if:

- The current window contains two time waves.
- Y axis units are the same.
- Number of samples and sampling frequency are the same for both waves.

For Filtered Orbit processing, the rotation frequency must be available.

The Orbit is the plot of Y(t) versus X(t). The X wave is the active curve.

If you set 'Orbit time limits = Double cursor' in Preference/ Post-processing of the Main module, you can select the time period with the active Double cursor. If no Double cursor is active the orbit is done on all time waves.

The orbit time limits can also be adjusted with the period of rotation.

Three types of processing are possible:

- Unfiltered orbit: vib-Graph displays the active row time wave versus the second one
- Filtered (F0, H2, H3): vib-Graph displays requested orbits superimposed in a new window (see Preference/Post-processing).
- Low-pass filtered: the low pass filter defined in Preference/Post-processing is applied on both time waves before orbit display.

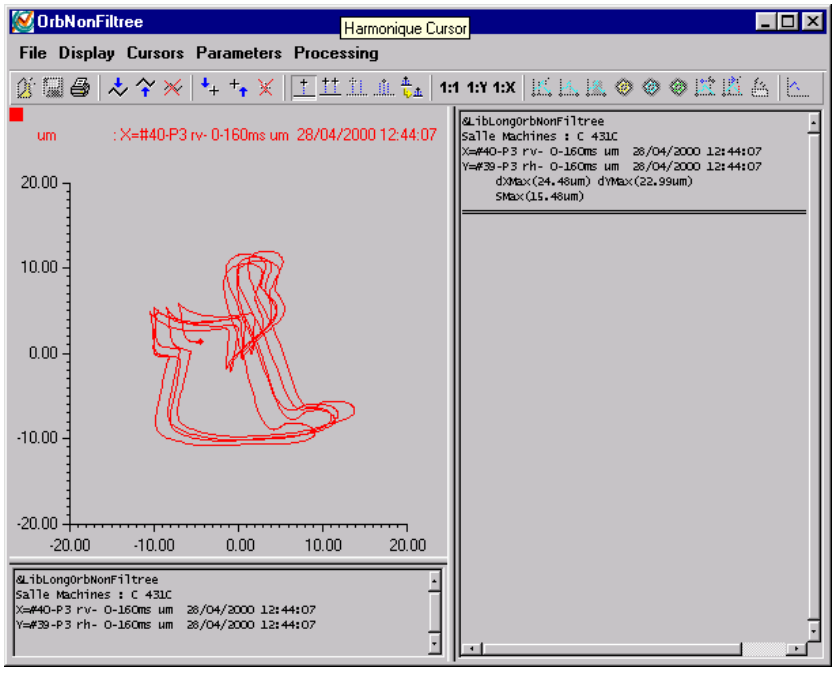
Orbit display

Lissajou display cannot be resized and information window is always included.

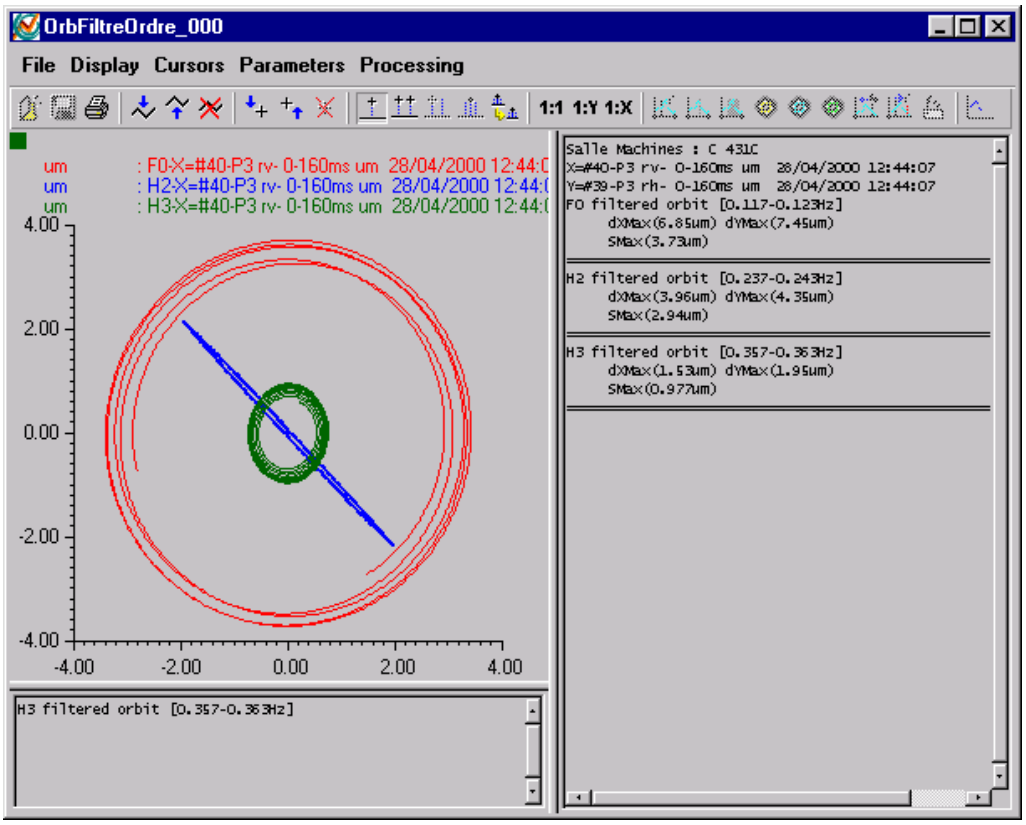
Information window shows the title of the curve and following values:

- (dXMax): difference between the greatest and smallest values on X axis.
- (dYMax): difference between the greatest and smallest values on Y axis.
- Smax of the orbit

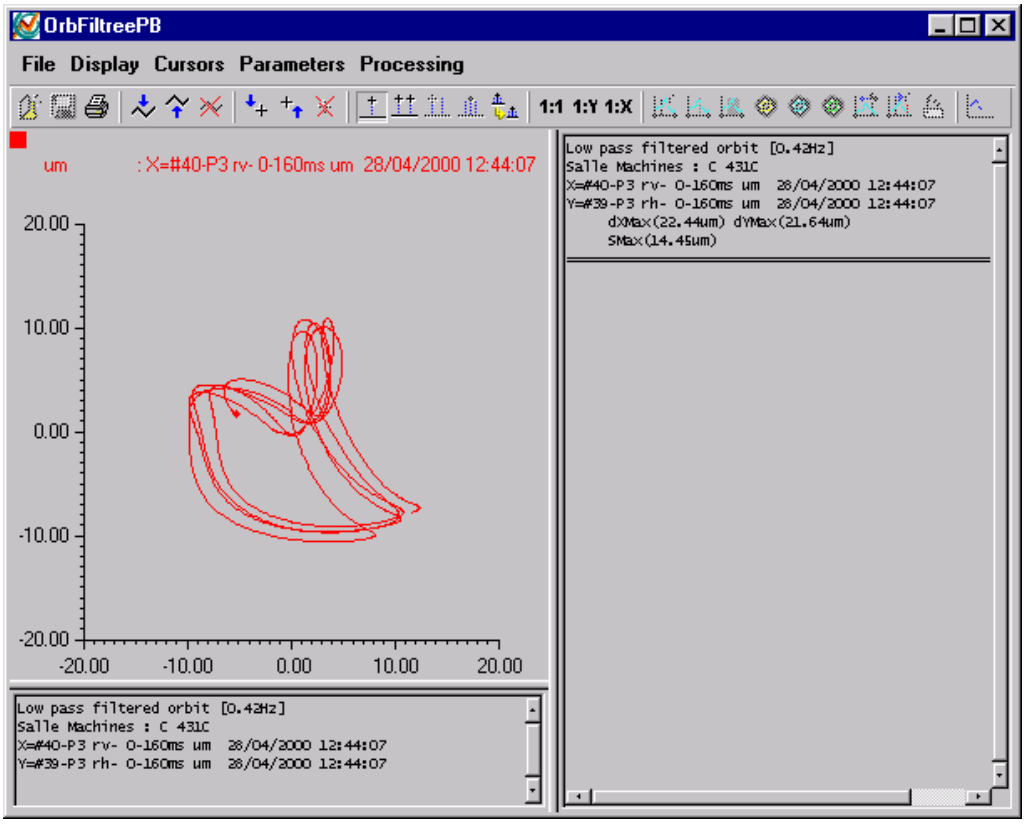
Unfiltered orbit



Filtered (F0, H2, H3) orbits



Low-pass filtered orbit

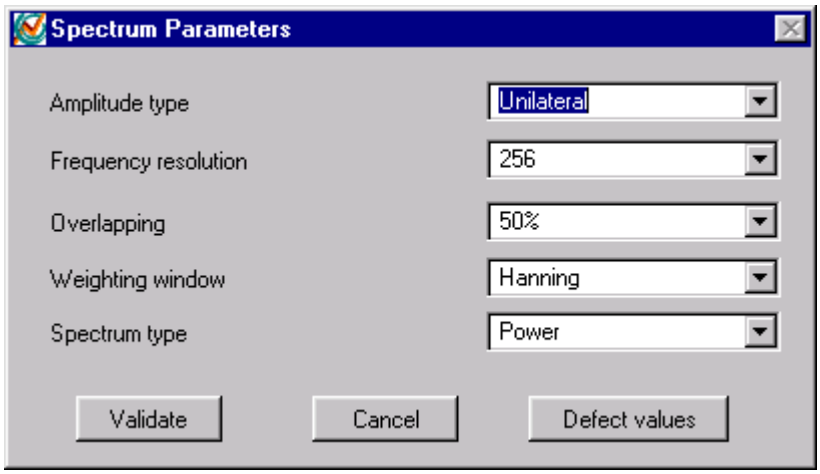


4.7.5. AutoSpectrum

Operation

The spectrum processing is possible on time waves.
This functionality is accessible via Processing/Spectrum menu.

Spectrum parameters:



This processing computes various types of spectra starting from a time signal. The algorithm is based on the Welch method:

- Segmentation with overlapping of the operand signal
- Calculation of the instantaneous spectra
- Average of the spectra
- Standardisation according to the type of spectrum and amplitude

Parameters:

- Amplitude: Bilateral, Peak, Unilateral
- Frequency resolution: time segment size of each average
- Overlapping in %
- Weighting window: Bartlett, Hanning, Flat Signal, Hamming, Rectangular
- Type of spectrum: Power spectrum density (PSD), Spectrum density (SPD), Power spectrum, Linear spectrum

Standardisation of the amplitude results: For a sinusoidal signal of amplitude peak A and period T, one obtains:

- Power spectrum, bilateral: $A^2/4$
- Power spectrum, unilateral: $A^2/2$
- Power spectrum, peak: A^2
- Linear spectrum, bilateral: $A/2$
- Linear spectrum, unilateral: $A/2^{1/2}$
- Linear spectrum, peak: A
- PSD, bilateral: $A^2/4Df$
- PSD, unilateral: $A^2/2Df$

- PSD, peak: A^2/Df
- SPD, bilateral: $A^2T/4Df$
- SPD, unilateral: $A^2T/2Df$
- SPD, peak: A^2T/Df

Df = frequency resolution

Signal operand: if a double cursor is active the processing is applied starting on the signal delimited by the cursor. By default the processing is applied to the whole signal.

4.7.6. Cepstrum

Operation

Cepstrum postprocessing is based on the preference parameters (***Preference/Processing/Cepstrum***).

Cepstrum is possible from spectra.

This function is accessible via Processing/Cepstrum menu.

Signal operand: if a double cursor is active the processing is applied starting on the signal delimited by the cursor. By default the processing is applied to the whole signal.

4.7.7. Resampling

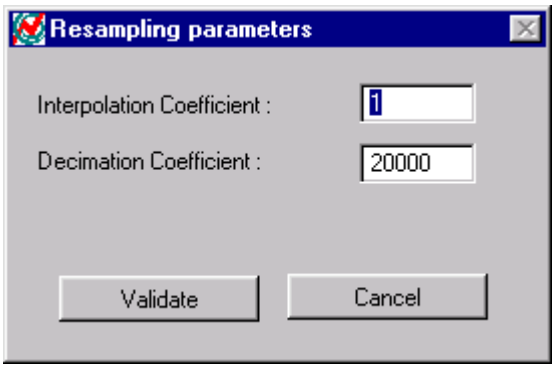
Operating mode

Resampling can be performed on time signals only.

This function is run from the Processing/Resampling menu.

It is used to perform interpolation or undersampling on a time signal.

Parameter dialog box:



4.7.8. Gain and Offset

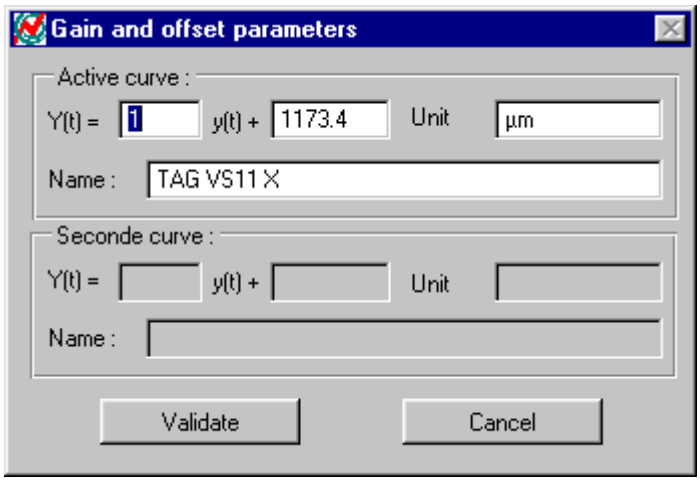
Operating mode

The “Gain and Offset” processing can be performed on time signals only.

It is accessible from the Processing/Resampling menu.

It is used to apply a gain and an offset and to modify the unit and the name of the input signal(s).

Parameter dialog box:



The dialog box is used to define the gain and the offset to be applied to the input signal(s), but also to modify the unit and the name of the resulting graph. By default, the offset is reset to the value of the first point on the graph.

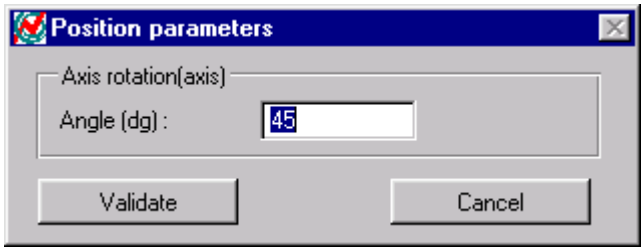
4.7.9. Position

Operating mode

The *Position* processing may be performed on two time signals only. It is used to rotate an axis by entering the rotation angle (in degrees).

This function is accessed from the Processing/Position menu.

Dialog box:



4.7.10. Circular view / Roller profile

Introduction

This processing aims at representing a time signal according to a circular view called “roller profile” in the paper industry. This type of representation can also be used to study speed-reducing gears.

For this type of plot, the roller rotation speed is required in order to convert time into angular degrees.

Moreover, if the signal is measured following a trigger input, the graph origin can be correlated to a mark on the roller. In this case, a synchronous averaging may also be calculated, thus allowing to reduce the influence of the vibrations from parts that rotate at a different (non multiple) speed.

Formulation and display

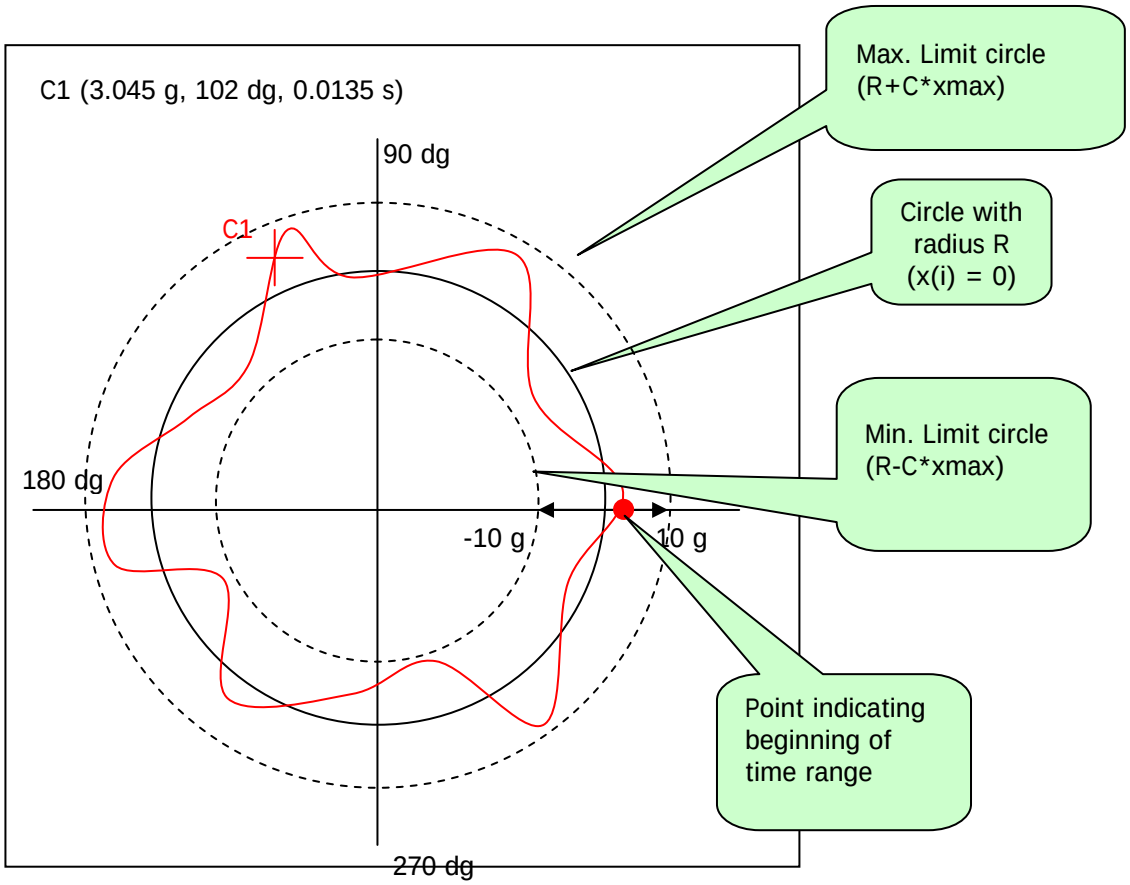
Let x(i) be a time signal of Nech samples with a rotation frequency Frot (Hz):

The angular position “a” of sample “ i ” is: a = i*360*Frot/Fech. (modulo 360).

Signal x(i) is used to represent a “mode shape” of a circle of radius R. Let C be the scaling coefficient, then the points to plots are:

In polar coordinates: R + C*x(i), a

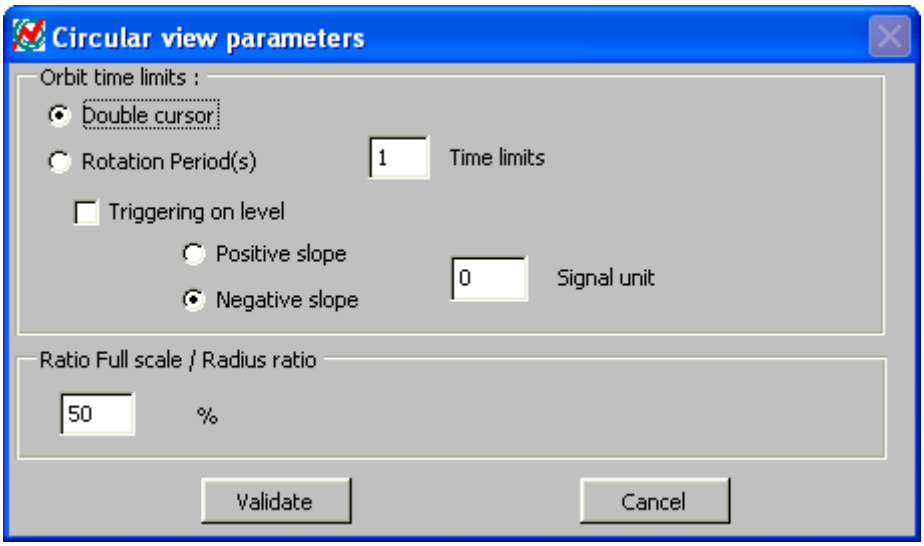
In rectangular coordinates: Cos(a)*(R + C*x(i)), Sin(a)*(R + C*x(i))



Note: like for orbit displays, the scale is the same for both axes (X and Y).

Circular view preferences

Vib-Graph general menu / Preferences / Post-processing / Circular view.



Plotting limit of signal:

- Either using the double cursor
- Or in rotation period(s): X.X. In this case, X.X is a real number indicating the number of revolutions to display from the signal's origin.

Full scale/Radius ratio:

- XX%. This ratio is used to define C*xmax/R.

Example with 50%:

Min. radius = 0.5

Radius "x=0" = 1

Max. radius = 1.5

Example with 30%:

Min. radius = 0.7

Radius "x=0" = 1

Max. radius = 1.3

Cursor on the circular view

The single cursor shows : the angle (deg.), the time (sec.) and the signal amplitude in EU.

The double cursor shows:

On the first line: T1 in seconds, A1 in EU

On the 2nd line: T2 in seconds, A2 in EU

On the 3rd line: delta T (T2-T1) and associated frequency (1/dT)

Display Circular view

This type of representation results from the post-processing of a time signal plot. The processing is carried out:

- Either on the section defined by the double cursor, or on the whole signal is no double cursor is active;
- Or over a time calculated from the rotation frequency;

Depending on the parameters defined in the Preferences menu.

To display the circular view, one must superimpose 2 time signals in the active window and select "Circular view" in the Processing menu of the plot.

4.8. Transient analysis

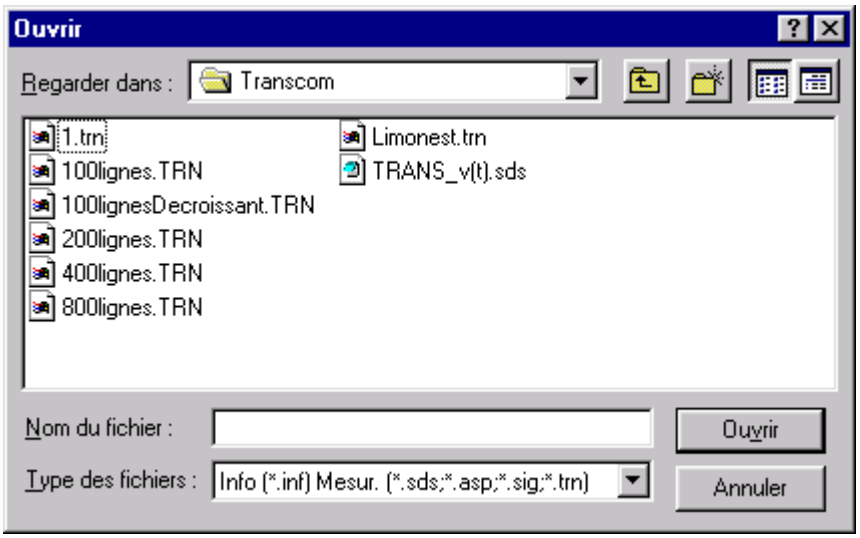
4.8.1. Transcom File

Vib-Graph can display the transient data measured by Movilog2 and unloaded by the trans-Com utility. You can thus display information on the selected test:

- a Bode of harmonic N
- a superposition of elementary spectra
- rotation speed versus time

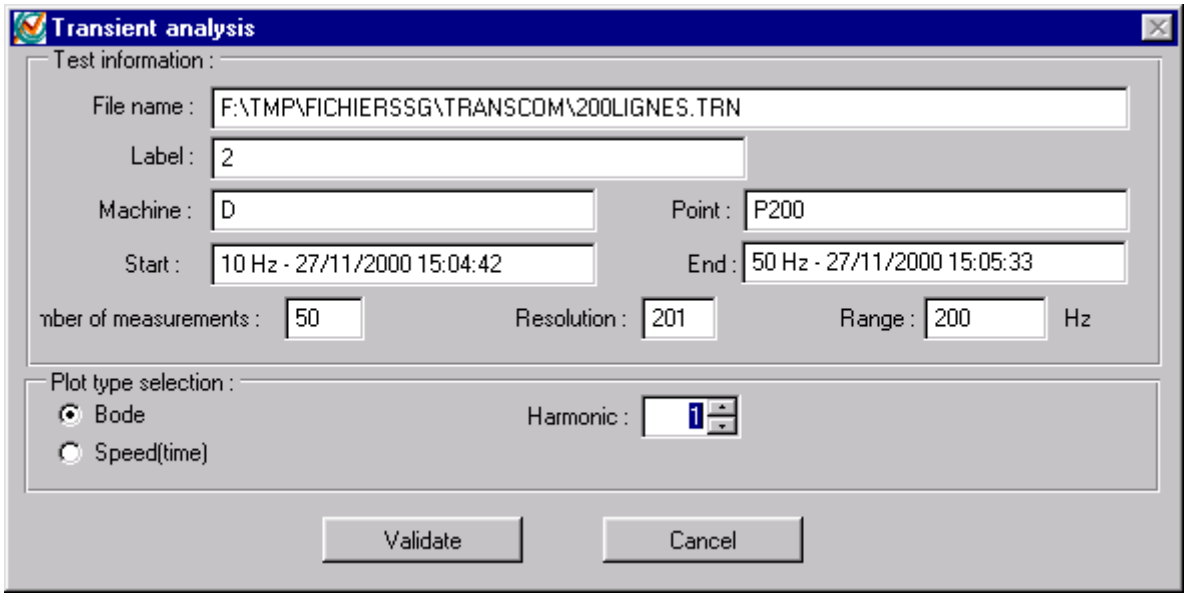
4.8.2. Selection of the test file

The selection of the file is done with the ***File/Open*** menu in the main window:



The files generated by trans-COM have a TRN extension.
The user selects the desired file and clicks on ***Open.***

The following IHM appears:



It gives information on the selected test and displays:

- Bode diagram (Amplitude/Phase) of harmonic N
- Rotation speed versus time

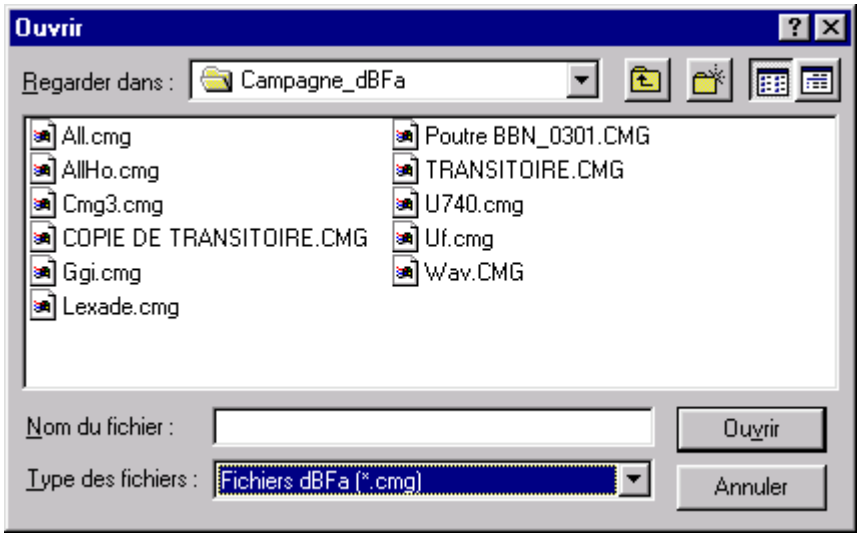
4.8.3. Session files

The user can read session (campaign) files (in .CMG format).

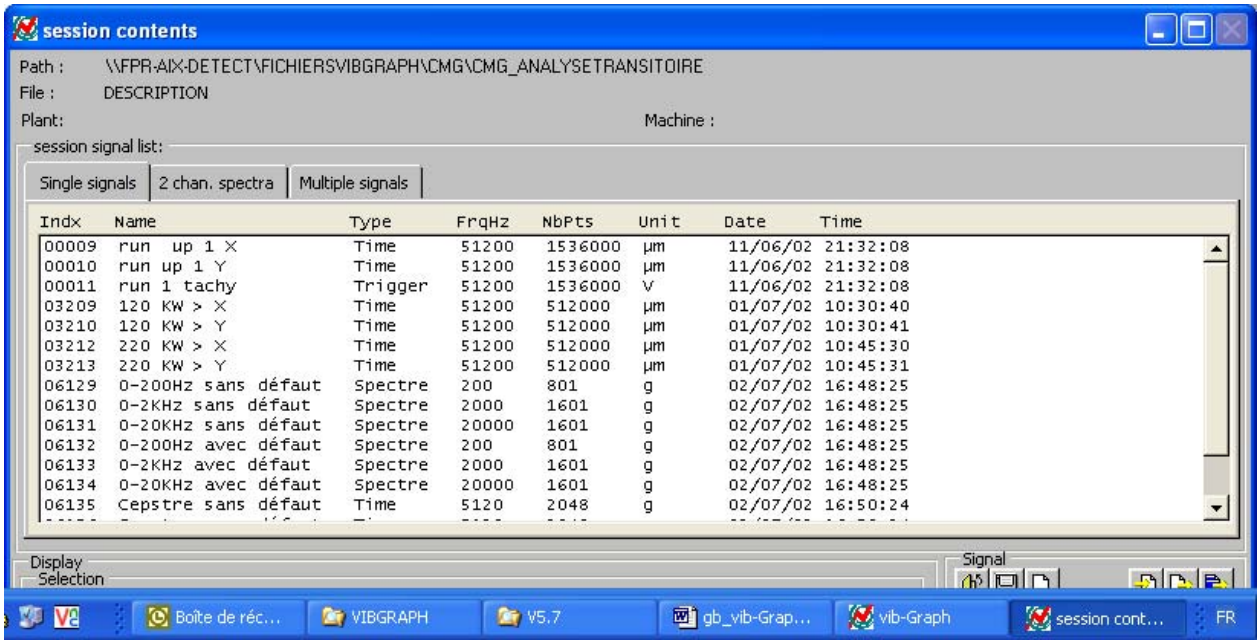
A session file may contain several signals of different types: time, spectra, history, orbit, multispectra, etc.

Use the *File/Open* menu in the main window to select a campaign file.

The following dialog box is displayed:



Once the file is selected, the dialog box below displays the file content:



Description of the "Session content" dialog box

Path and file

The *Path* and *File* fields give information on the location and the name of the session.

Site and machine

The *Site* and *Machine* fields are used during the vibration analysis of a run-up or coast-down phase on a machine. They display the names of the site and of the machine generating the signal.

List of single signals

2 tabs give access to the different types of signals:

Simple signals:

- Spectrum,
- Concatenated spectra,
- Time signal,
- Orbit,
- and History.

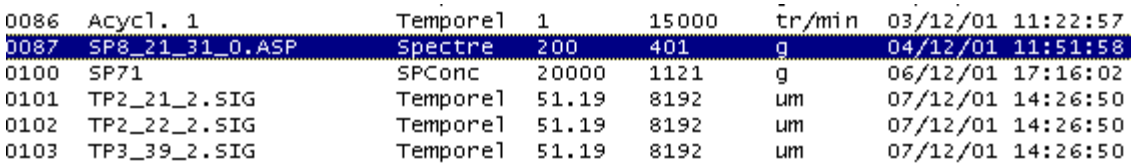
Multiple signals:

- Multispectra: Simple spectra with time history
- Phased multispectra: complex spectra with time history
- Transcom multispectra: Importation of a TRN Movilog II file. Complex spectra with time history with information on speed.
- Transient: Complex spectra with time history with information on speed and GAP.

Selecting signals to plot

Simple selection: just click on the appropriate signal.

Example:



Multiple selection:

If the signals to select follow one another in the list:

- Click on the first signal in the list and while holding down the right button of the mouse, drag the mouse to select all files thereafter.
- Click on the first signal, then press the <SHIFT> key and while holding it down, click on the last signal in the list. All signals in-between will thus be selected.

Example:

0087	SP8_21_31_0.ASP	Spectre	200	401	g	04/12/01 11:51:58
0100	SP71	SPConc	20000	1121	g	06/12/01 17:16:02
0101	TP2_21_2.SIG	Temporel	51.19	8192	um	07/12/01 14:26:50
0102	TP2_22_2.SIG	Temporel	51.19	8192	um	07/12/01 14:26:50
0103	TP3_39_2.SIG	Temporel	51.19	8192	um	07/12/01 14:26:50
0104	TP3_40_2.SIG	Temporel	51.19	8192	um	07/12/01 14:26:50
0119	X=TP2_22_2.SIG Y=T	Orbite		8192	um	14/01/02 14:13:09
0120	[21-7-2000 19H33] T2	Temporel	5120	1024	g	16/01/02 16:27:36

If signals are not following each other in the list, the user should use the <CTRL> key and the mouse.

Example:

0101	TP2_21_2.SIG	Temporel	51.19	8192	um	07/12/01 14:26:50
0102	TP2_22_2.SIG	Temporel	51.19	8192	um	07/12/01 14:26:50
0103	TP3_39_2.SIG	Temporel	51.19	8192	um	07/12/01 14:26:50

Selecting the representation

For simple signals, the representation depends on the type of signal. For instance, if the selected signal is a time signal, then the representation will be a time representation.

For multiple signals, the type of representation is selected in the *Representation* section of the dialog box:

The different types of representation are as follows:

- Single-channel representation:
  - Bode
  - Nyquist
  - Ampl(C*rpm)
  - Waterfall
  - Speed(t)
  - Position(rpm)
  - Position(t)
  - Process(rpm)
  - Process(t)
- Two-channel representation:
  - Bode Ellipse(C*rpm)
  - Waterfall Emax
  - Position

The different fields are accessible (or not) depending on the requested representation.

The *Harmonic/Constant* field is used to enter the harmonic (for Bode, Nyquist and Bode Ellipse(C*rpm) diagrams) or the constant to apply to the speed (Ampl(C*rpm) plot). By default this constant is equal to 1.

Speed/Time, *Start* and *End* fields are used to enter a search range for the other plots. By default, vib-Graph displays all signals.

Plotting selected signals

The user can double click on the signal. The selected signal will then be displayed in a new window.

In case of multiple signals, the default plot is used (Bode diagram).

To display selected signals, use the buttons at the bottom of the dialog box:

The *1 signal per window* button is used to plot each selected signal in a different window.

The *N signals per window* button is used to superimpose selected signals to those of the active window (provided the types of plot are compatible).

The *N signals in new window* button is used to superimpose selected signals in a new window.

The *Spectrum concatenation* check box is used to concatenate selected spectra rather than display them separately.

For instance, if the *Spectrum concatenation* box is not checked and if 3 spectra are selected, clicking on *N signals in new window* will display superimposed spectra in a new window.

On the contrary, if the same operation is performed while the *Spectrum concatenation* box is checked, then the concatenation of the selected spectra will be displayed in a new window.

Session management

 buttons are used to:

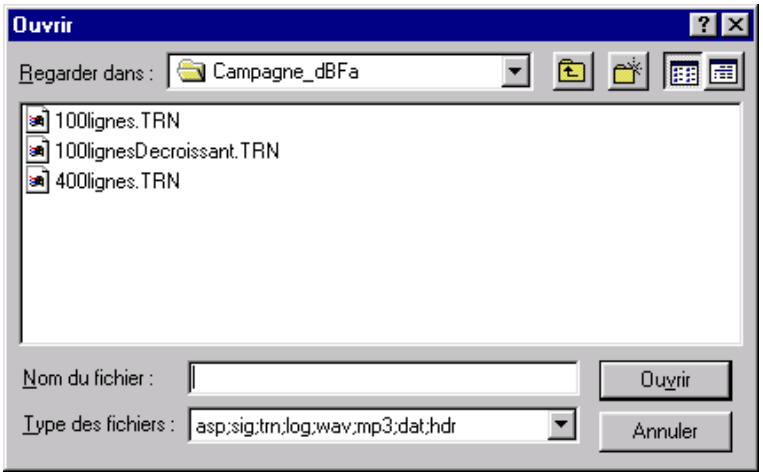
- Open a session file stored on the disk
- Save the current session on the disk
- Create a new session.

Signal import/export

 buttons are used to:

- Import signals into the campaign
- Export time signals and simple spectra of the campaign in UFF format
- Export selected items in UFF format

The dialog box shown below is used to select files to be imported.



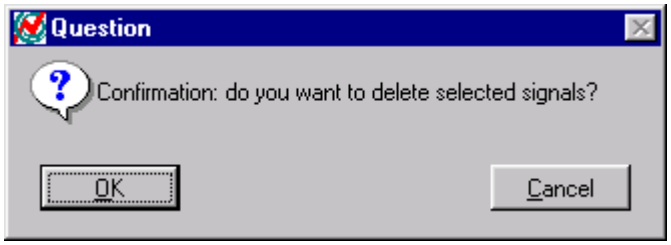
Files to import are of the following types:

- Spectrum (.ASP) and time (.SIG) Pagode files
- Movilog Trans-com files (.TRN)
- Sony PC Scan files (.LOG)
- Sound files (.WAV, .MP3)
- GX1 files (.HDR)

Deleting signals

Select first the files to delete and then click on: 

Click on OK to confirm file deletion.



Files will then be definitively deleted from the campaign.

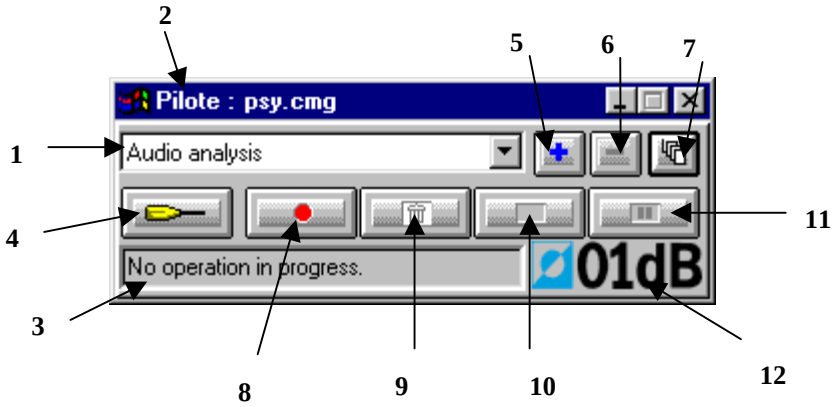
Signal post-processing

Post-processing may be performed on one signal only or on a set of signals.

Post-processing applied to one signal (accessibility according to licence)

First select the appropriate signal and click on the following button:

The dialog box below is displayed:



1-List of scripts: this list shows all analysis scripts that are compatible with the data items selected in the measurement session datafile. According to the status of the calculation server (analysis in progress, waiting, and pause) and the user actions (stop analysis, activate an analysis), these scripts are accessible for edition and configuration.

2-Pilot measurement session: the title of the window indicates which document (given measurement session or locked items during a batch analysis) is currently controlling the calculation. When selecting items in a measurement session (or when locking up items for a batch analysis), the calculation server gives only access to the analysis scripts that are compatible with the data items to analyse. The user may then select a script by selecting it in the list.

3-Status bar: this zone shows, when a script is being executed, the name of the active operator as well as the ID of the data item currently being analysed.

4-Configuration of a script: click on this key to display the script configuration dialog box.

5-Duplication: click on this key to duplicate a default script of the application software in order to rename it, to select different operators or to change analysis parameters.

For example, the application software may offer only one script for audio data analysis. If the user wishes to keep this script with the current settings, he (or she) can duplicate the script and define different analysis types and analysis parameters. The default and user-defined scripts are automatically saved for any subsequent analysis.

6-Cancellation: click on this key to delete a user-defined script (obtained after duplication) from the calculation server. Default scripts cannot be deleted.

7-Access all scripts: click on this key to display and access all the analysis scripts contained in the calculation server, and not only the scripts compatible with the data items selected in the measurement session. In this mode, no analysis can be performed. Click again on the same key to unlock the calculation server and perform an analysis.

8-Click on this key to **launch** the analysis process according to the selected script and for the selected data items.

9-Abort: the script currently being executed is stopped. The analysis is thereby aborted. No result is saved in the measurement session datafile.

10-Interrupt: click on this key to interrupt the analysis process. The partial results are saved into the active measurement session datafile.

11-Pause: click on this key to temporarily stop the analysis process. The analysis will be carried out again when this key is pressed again.

12-Logo /Computation progress: this part of the dialog box shows the current progress in the computation for the operator displayed in the status bar. According to the type of operator, this zone may take different aspects:

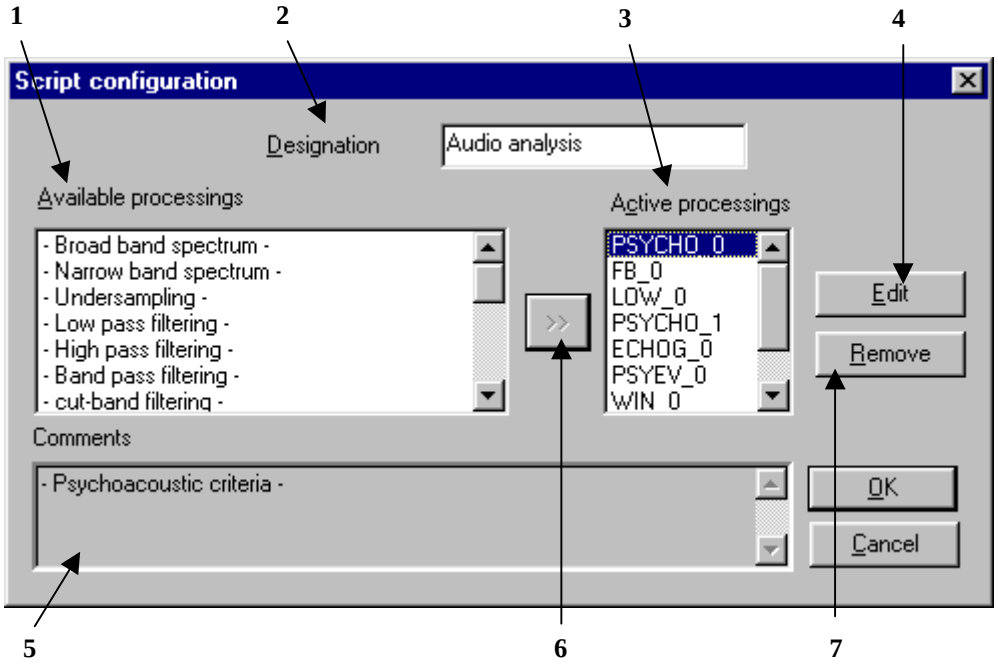
- **Proportional bar:** it notifies the user of the computation progress with a scale raging from 0 to 100 % (figure on the left hand side)

- **Symbol bar:** it shows the computation progress of the current task, for operators made of several operations (figure on the right hand side). Because of the complexity of some calculations (such as computation of psychoacoustic criteria), the server cannot know in advance how much time is required to complete the calculation). The task currently being processed and an overall progress bar are therefore shown on screen.

As explained in the description of area 3, the active operator, the measurement campaign and the element currently analysed are indicated.

Presentation and configuration of analysis scripts

Click on the icon  to access to the script configuration dialog box shown below. This dialog box is used to select and configure each single operator of the script.



1-List of **available processings**: it shows all the types of processings compatible with the active script. The same operator can be used several times with different parameters to process the same items.

2-Designation: give a name to the script. A user-defined name can be specified.

3-Set of **active processings** currently part of the script. These operators will be activated to analyse independently the same set of items when running the script.

4-Edit the parameters of the selected operator (in the list of available processings). Each operator shows its own configuration dialog box.

5-Comments describing the operator selected in the available processings' list. If an operator from the active processings' list is selected, the comment field shows the type of the operator.

6-Key >> that allows adding an operator into the active processings' list. Different operators of the same type may be added (the user may for example

define a multispectrum analysis in third octave band with different time steps in the same script). A generic name for each operator is given by default.

7-The key **remove** allows the user to remove an operator from the list of the active processings.

Once the list of active processings has been defined, edit each one of them to define the calculation parameters.

To do so, select the adequate operator in the list and press the **Edit** key.

Presentation and configuration of operators (processing functions)

An operator is used to perform an analysis on a single element or on a data set. Each operator has its own name (that the operator can modify), analysis parameters and information on computation progress.

When an operator processes an input element, it is locked into the active document, which makes it impossible to delete it or to close the document. The abort or the end of the processing unlocks the input data.

The next paragraphs describe each operator: functions, configuration parameters, restrictions relative to input data, result computation. They are presented as follows:

Spectral analysis

Theory, narrow band spectra and multispectra.

Arithmetic operations

Theory, addition, subtraction and averaging.

Audio data export

Theory, export to MATLAB.

Spectral analysis

Theory

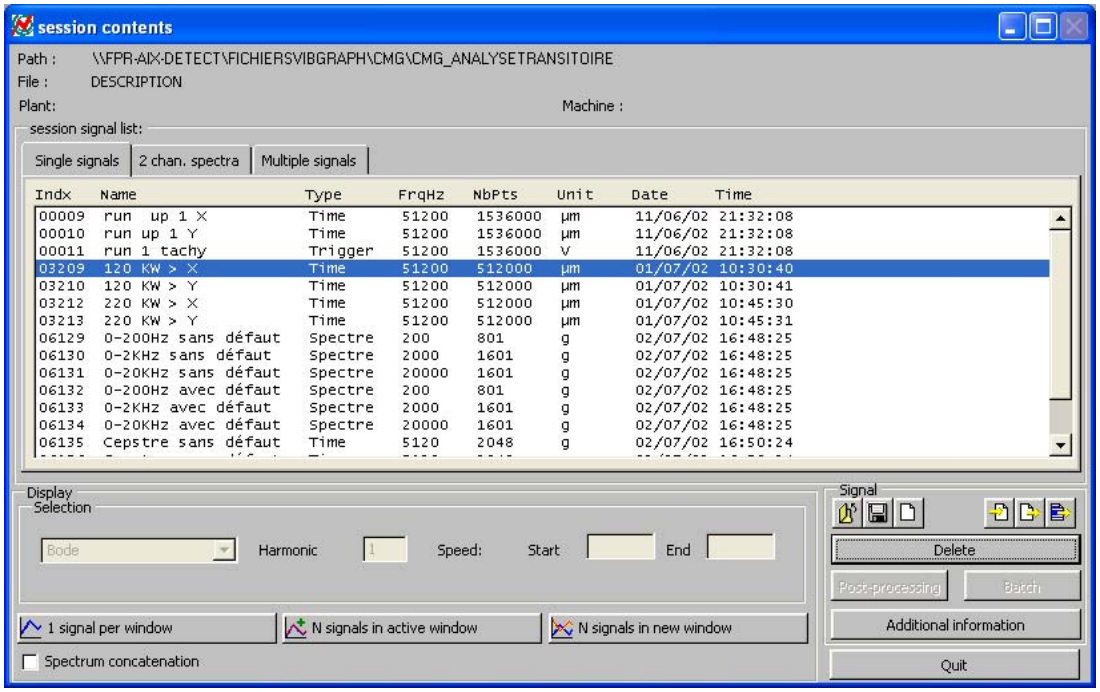
There are two types of analysis to know the average or instantaneous frequency of a signal: **narrow band analysis** and **broad band analysis**.

Narrow band analysis, based on a classical periodogram (Welch-Wosa) or Gabor analysis, with selection of an overlap, a weighting window and a zoom factor. Time integration can be selected to generate a multispectrum. This analysis can be applied to a couple of input quantities, in order to calculate a cross-spectrum.

Narrow band spectrum operator [NB]

This operator is used to obtain a narrow band spectrum with time history capability and frequency zoom. The dialog box shown below is displayed.

The **Configuration** tab is used to define the following analysis parameters:



FFT window. Select the weighting window to be applied during the analysis: Hanning, Rectangular, Hamming, Kaiser-Bessel or Flat Top.

Overlap. Define the overlap factor to be applied during the analysis: 0%, 25%, 50% or 75%.

In a FFT analysis, the overlap factor represents the percent samples used in two adjacent data blocks.

Max. frequency. Select the frequency band in Hz. The bandwidth defines the analysis maximum frequency.

Lines. Select the number of lines in the FFT analysis among the values displayed in the list: 101, 201, 401, 801, 1601 or 3201.

The greater the number of lines (i.e., the higher the FFT order), the higher the frequency resolution.

Multispectra: If this option is activated, the time history (over the time of the recording) of the spectra will be displayed. The time step may range from 1 ms to 999 seconds.

The curve is a graphic representation of the analysis parameters. Maximum and minimum frequencies, resolution (in Hz) and time (in seconds) of the analysis, as well as the centre frequency Fc when using the **zoom** function, are displayed.

The information bar (lower part) shows (in red) the analysis band, while the spectrum shows the selected bandwidth.

To modify the centre frequency or the minimum frequency (when the **Zoom** option is active), move the right cursor and the left cursor, respectively. Zoom parameters can also be modified by defining the **zoom factor** and **the centre frequency** in the right section of the dialog box.

The **Operator** tab presents a detailed description of this type of processing and allows to modify its name. The **Notification** tab is used to define parameters related to notification of computation progress.

Default script	**Audio analysis**
Default name	**FB_0**
Active for	**Audio, impulse response families**
Restrictions	**Only apply for one item** **The requested time resolution should be smaller than the signal duration**
Result family	**Autospectrum**

Batch post-processing

Click on 

to display the batch management dialog box along with the calculator.

Theory

This dialog box is used to launch a batch processing on a selection of elements.

For instance, if the user needs to run the same audio processing script on a set of audio recordings included in the same measurement campaign, he/she just needs to create a collection of input data set on which the script will be automatically processed, one set after the other.

Full procedure

1/ Launch the batch processing

2/ Select the elements to be processed using the “Campaign display” dialog box.

3/ Import selected elements by clicking on the  button in the Batch dialog box.

The following functions are available if needed:

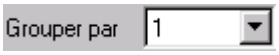
 Select the order for element analysis

 Reset the batch processing. The status of all elements is reset to “to be processed”.

 Activate/Deactivate processing for selected element. (The status bar indicates either “inactive” or “to be processed”).

 Delete selected element from batch.

 Delete all elements from batch.



Grouping elements may be useful to perform a sequence analysis with a transient analysis script (thus requiring two audio elements), etc.

If the number of elements to process is not a multiple of the group size, then the last element becomes inactive in the batch (and will not be processed).

The script server lists the scripts available to process the elements in the batch, like for a campaign.

The title bar of the calculation server should display **.

4/ Select now the processing to perform on each data set in the batch using the calculator or the operation server.

For more information, consult the Use / Configuration page of the operation server.

5/ Click on  to launch data processing.

The status of the process is displayed for each element, as well as its origin (target campaign) and its identification number in the campaign.

The number of elements remaining to be processed is displayed in the title bar.

The batch process may be interrupted at any time via the script server. Interrupting or aborting the script has the same result: the batch process is definitively stopped.

Calculated elements are added to the campaign.

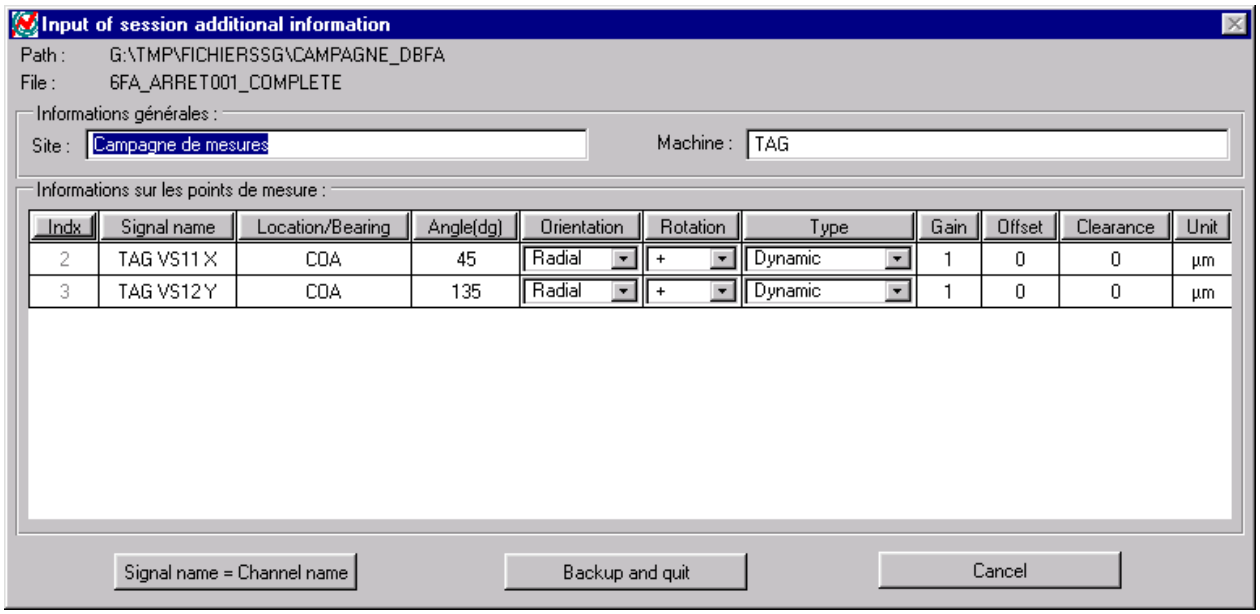
Additional information

The user may add information for some signals.

This function is used in the case of transient analysis for instance, in order o set gains and offset, sensor positions, bearing clearance, etc.

First select the files into which you want to add information and click on: 

The following dialog box is then displayed:



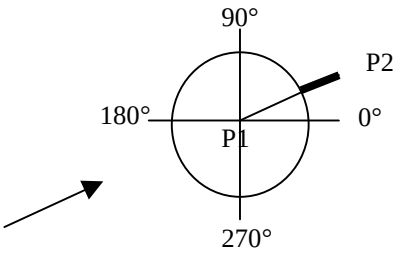
Selected signals are listed. The following parameters can be set for each signal:

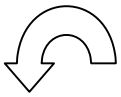
- Signal name
- Place/bearing on which the sensor is fixed
- Sensor angle
- Sensor orientation: Radial or Axial
- Rotation direction: Positive or Negative
- Channel type: dynamic, process or tachometric

- Corrective gain
- Offset
- Bearing clearance
- Signal unit

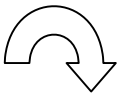
The angle and direction of rotation are defined using the following conventions:

- Bearings are numbered starting from the driving element to the driven element.
- Machine viewed along the bearing 1 – bearing 2 direction: 0° at 3 o'clock.





Positive direction = counterclockwise



Negative = clockwise

The gain is a multiplying coefficient applied to recorded data for display. It is a way to take into account the sensitivity of the measurement channel and thus obtain a representation in physical unit.

The offset is used to correct the continuous component of the signal. This correction is carried out after the gain has been applied. It is taken into account for time, orbit and position plots. The offset is mostly used to adjust the position of the shaft in the bearing for orbit and position displays. The best method is to perform the adjustment from a measurement on a shut down machine. The shaft should then lie at the bottom of the bearing.

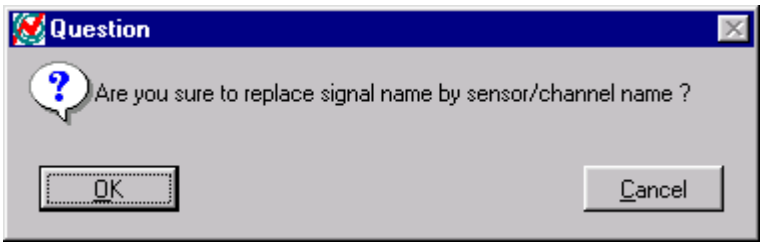
The bearing clearance is used for journal bearing. It is represented by a circle of the same diameter in position and orbit plots. The shaft position in the bearing and the thickness of the oil film can thus be monitored.

Remark: Bode ellipse, Emax waterfall and Position representation can be requested only for 2 channels located 90° apart, in radial direction and having the same Location/Nearing, rotation, clearance and unit.

This dialog box may also be used to modify the site and machine names.

Click on the Signal name = Channel name button to set the signal name as the channel name. This function is used in the case of a Sony DAT file import.

Click on OK to proceed.



Click on Backup and quit to save modifications and close the dialog box.

Click on Cancel to quit the dialog bow without any modifications.

4.9. Transient analysis diagrams

4.9.1. Single-channel representation

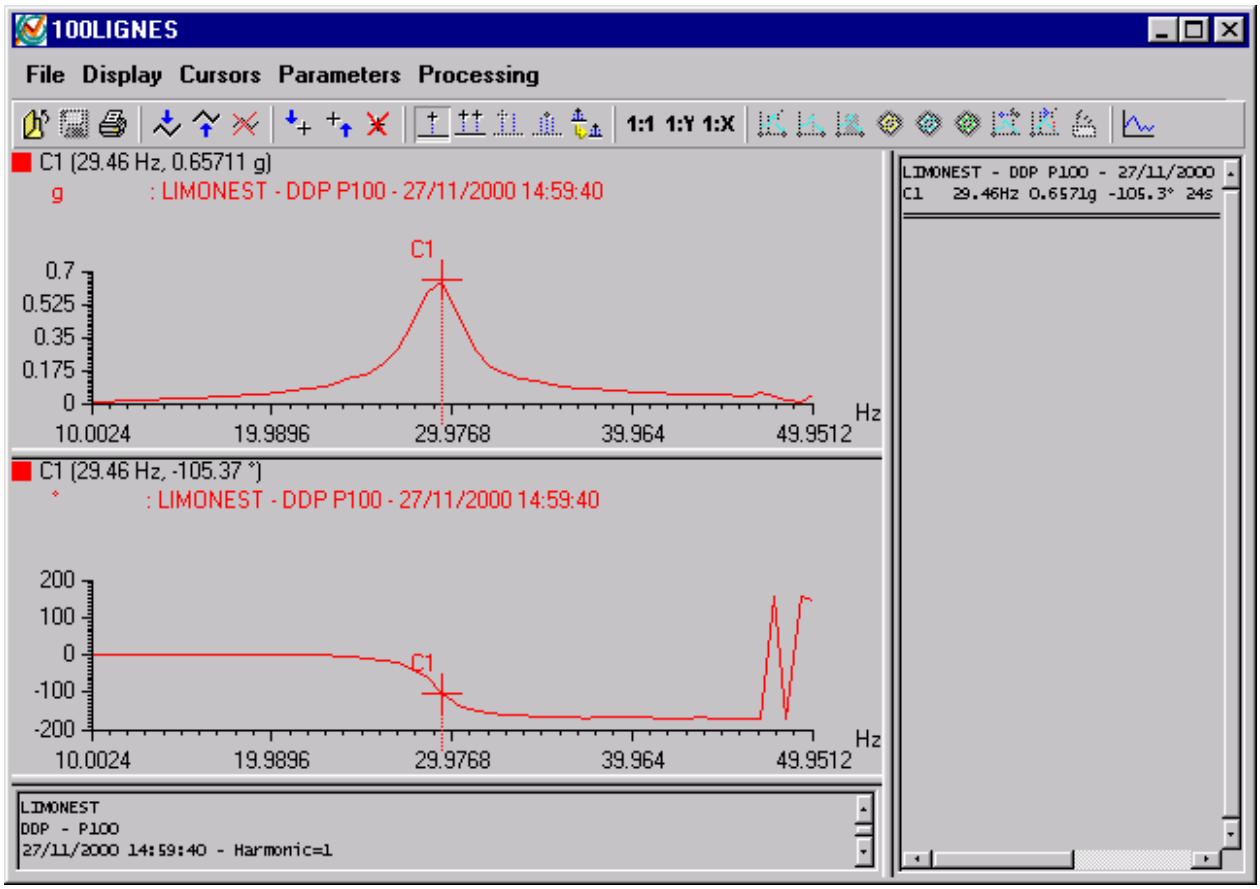
Bode diagram

Purpose

The frequency, amplitude and phase of selected harmonic N, along with the measurement time of the spectrum are extracted from each spectrum.

Representation

Upon request of a Bode diagram, a window representing amplitude and phase versus speed is displayed.



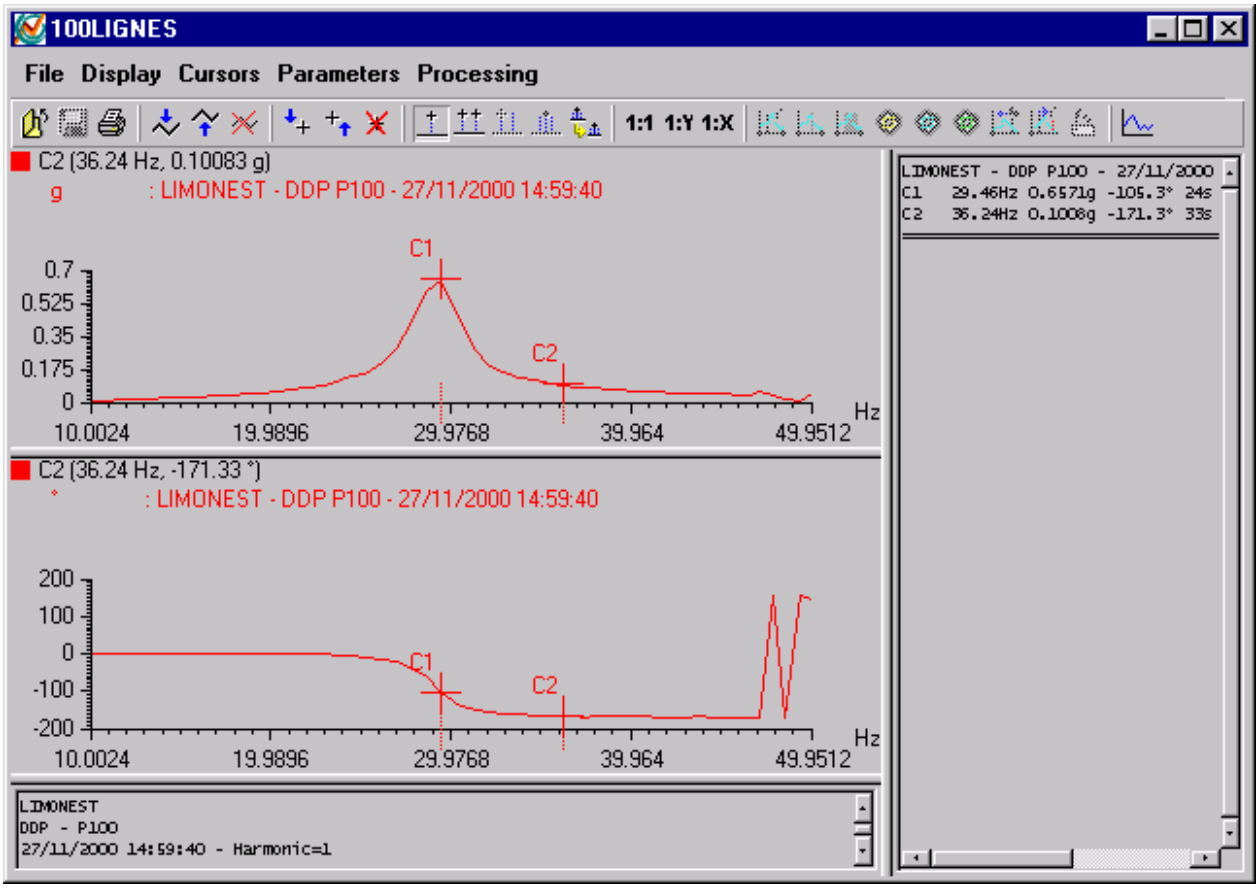
Display of spectra associated with the Bode diagram.

To display the spectra from which the Bode results, the user must click on the button  of the icon bar while having selected beforehand single cursors or a double cursor.

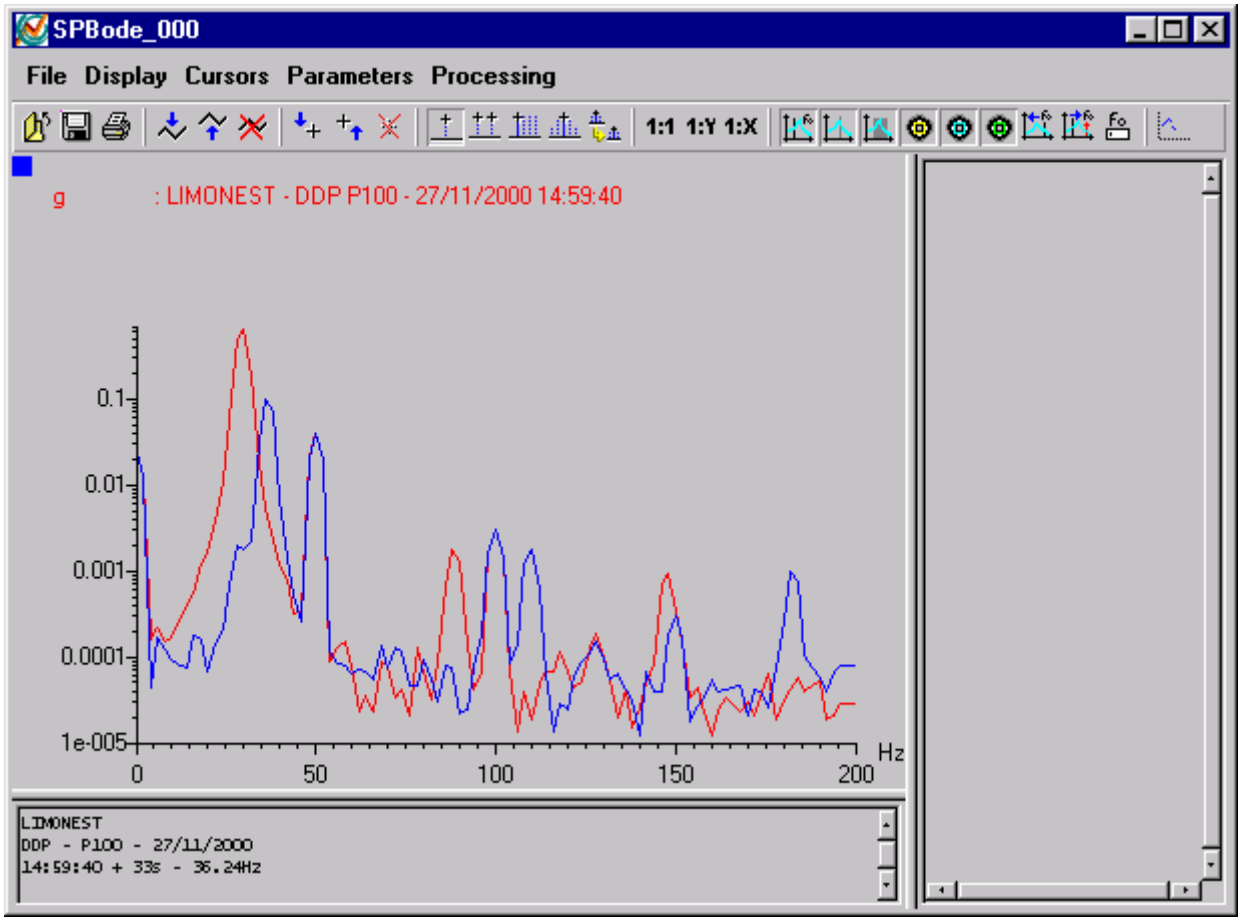
Use of single cursors

If the active cursor is a single cursor, then vib-Graph will trace all the spectra of all the curves at the frequencies of the cursors.

Example:



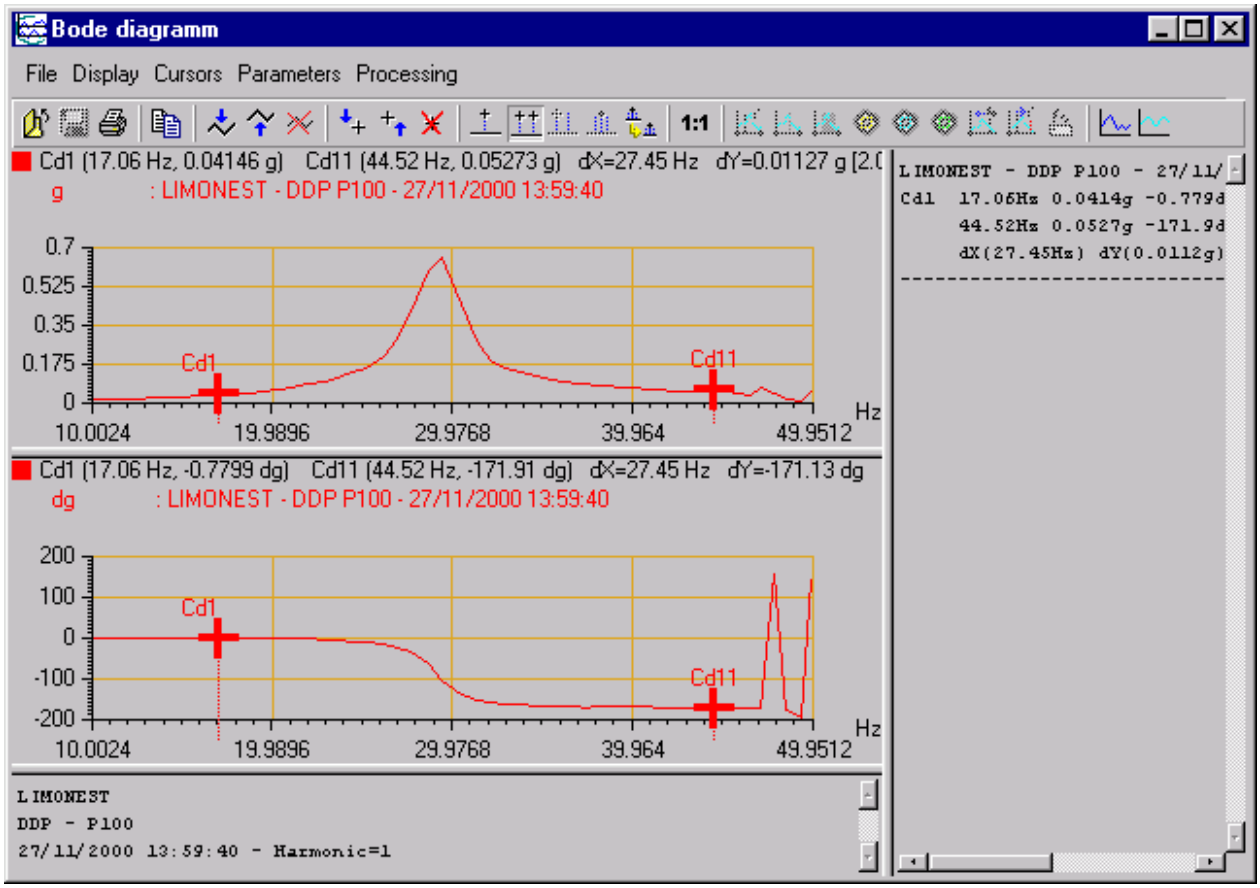
From the Bode diagram above, if the user clicks on the button, vib-Graph will display the spectra measured at speeds 29.46 Hz and 36.24 Hz:



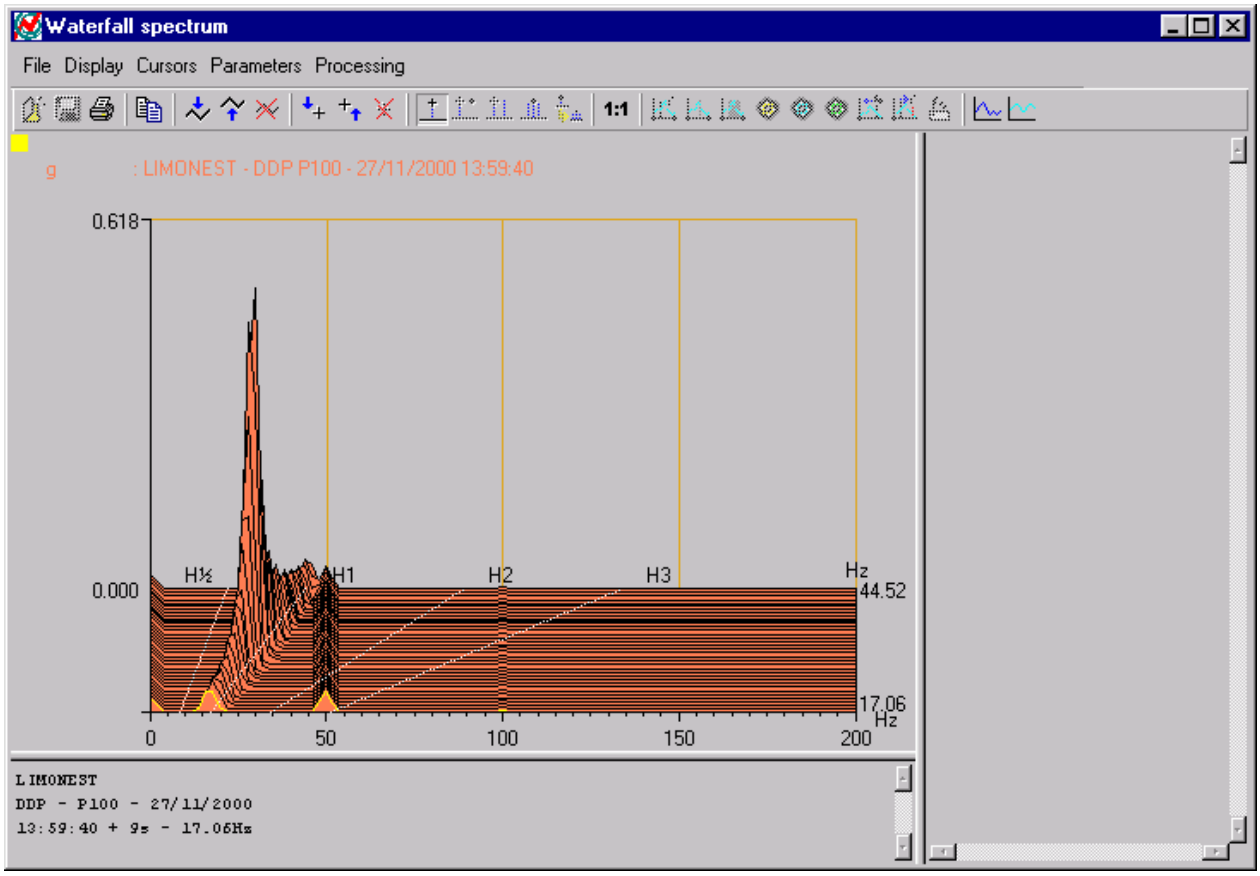
Use of the double cursors

If the active cursor is a double cursor, vib-Graph will plot all spectra between the two limits of the double cursor. The representation will be of the waterfall type.

Example:



In the Bode diagram above, if the user clicks on the button, vib-Graph will display spectra measured between speeds 17.06 Hz and 44.52 Hz:



Display of time signals associated with the Bode diagram.

This function is accessible only if time signals from which the spectra originate are present.

To view the time signal generating the plot, click on the button in the icon bar, after having set single or double cursor(s).

Nyquist

Purpose

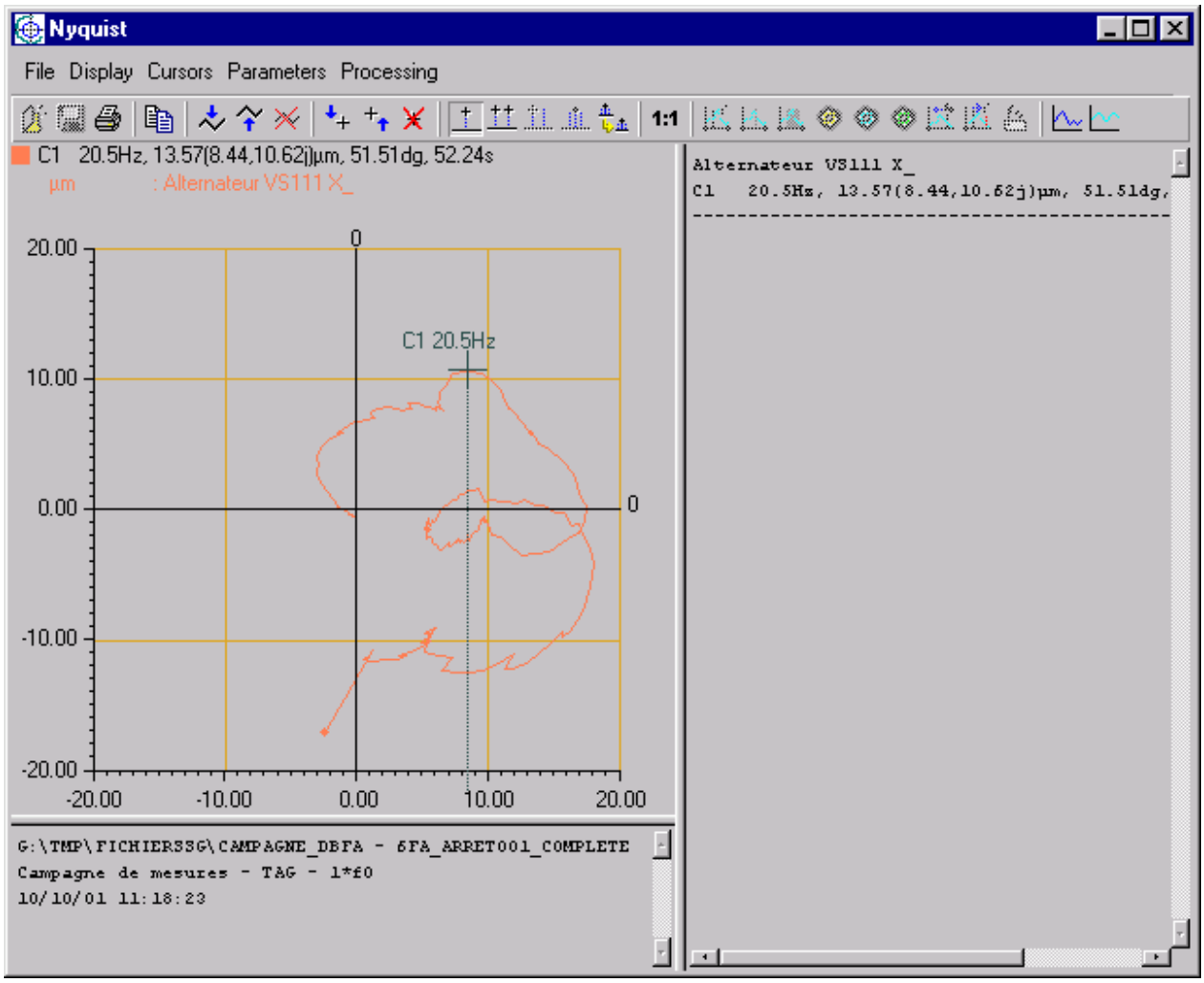
The purpose of this processing is to extract from each spectrum the frequency, the amplitude, the phase of harmonic N and the measurement time of the spectra.

It yields a polar representation with:

- Xi = Ai*cos(Phi)
- Yi = Ai*sin(Phi)

Representation

Upon request of a Nyquist plot, the following window is displayed:



The single cursor gives the polar coordinates of the vector, along with the acquisition speed.

As for the Bode diagram, selecting simple or double cursor(s) and clicking on  will display simple spectra, waterfall spectra and time signals.

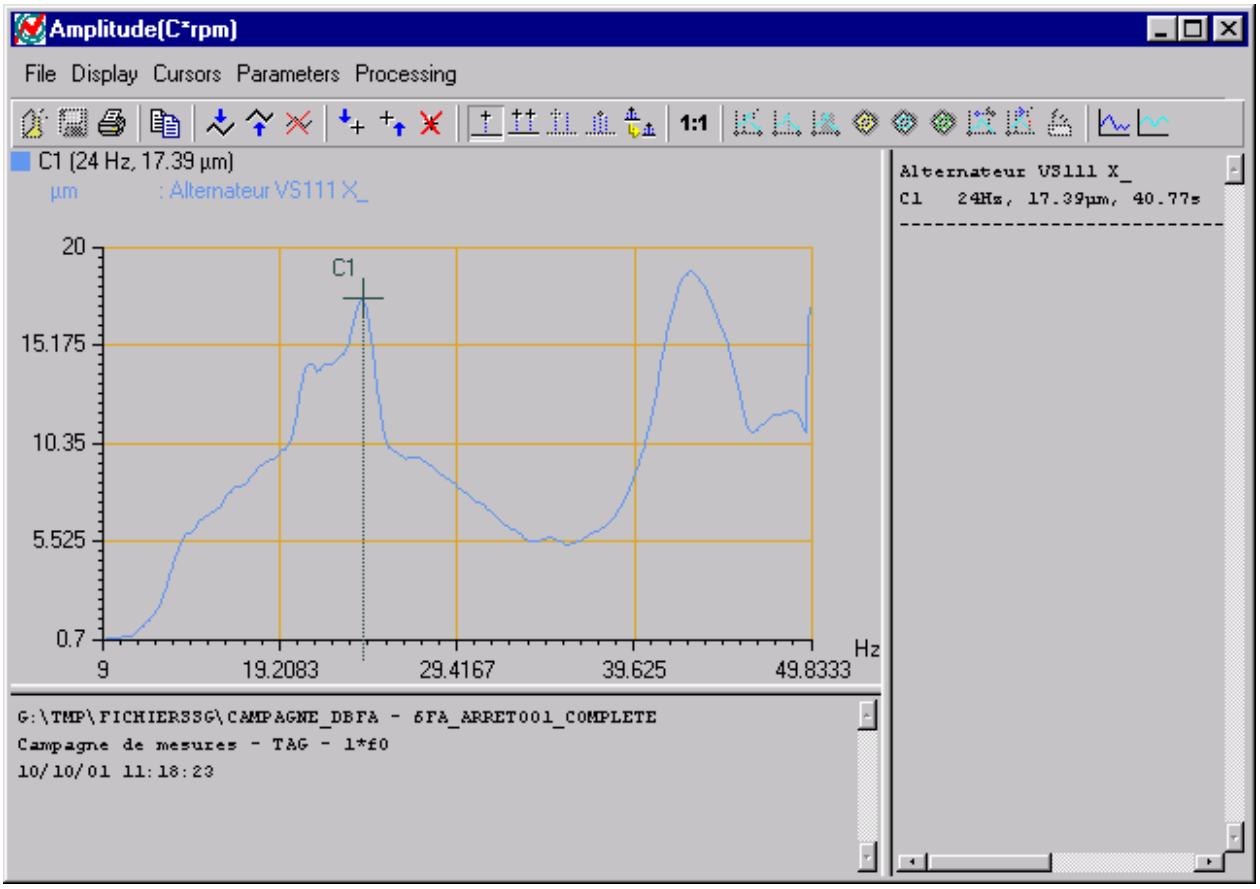
*Amplitude(C*rpm)*

Purpose

Same as Bode but with no phase plot. Constant C is not necessarily an integer (whirl or shaft analysed on another axis than that of the trigger input).

Representation

Upon request of an Amplitude(C*rpm) plot, the following window is displayed:



As for the Bode diagram, using simple or double cursors and clicking on  will display simple spectra, waterfall spectra and time signals.

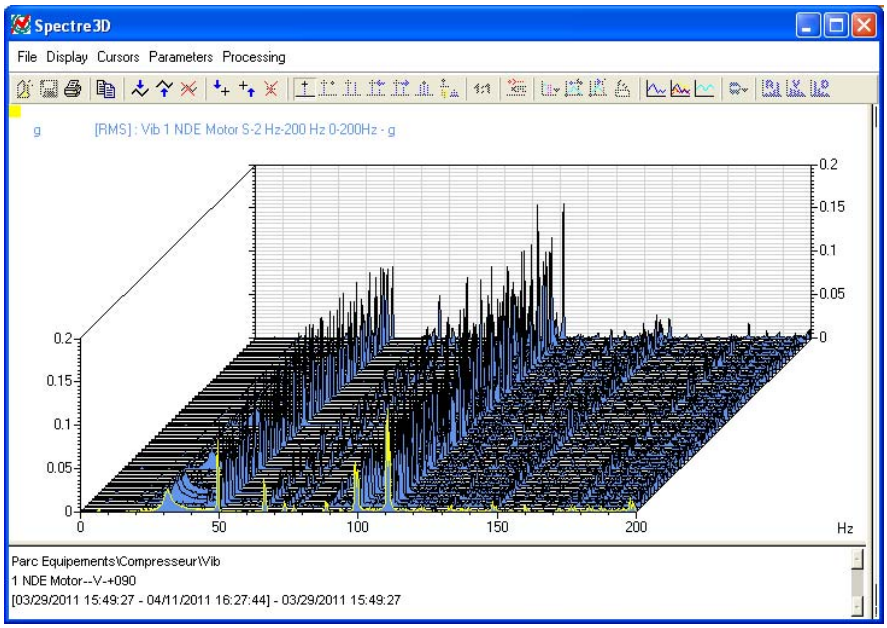
Waterfall spectra

Purpose

Represent the series of amplitude spectra on the same graph.

Representation

Upon request of a Waterfall representation, the window below is displayed:



Using the  icons, the user may go from one graph to the other.

The keyboard can also be used for that purpose:

- *Page Top*: Go to the next graph
- *Page Bottom*: Go to the previous graph
- *Start:* Go to first curve on top of Y axis
- *End:* Go to last curve at the bottom of Y axis

Like for the Bode diagram, place the cursor on the selected spectrum and click on the *Spectrum* button to display simple spectra.

Selecting single cursor is performed on the current curve.

Case of spectra associated with a speed:

- Straight lines for Harmonics H½, H1, H2 and H3 are also plotted on the graph.
- On the right of the plot, there is a Speed axis indicating the min and max speeds.

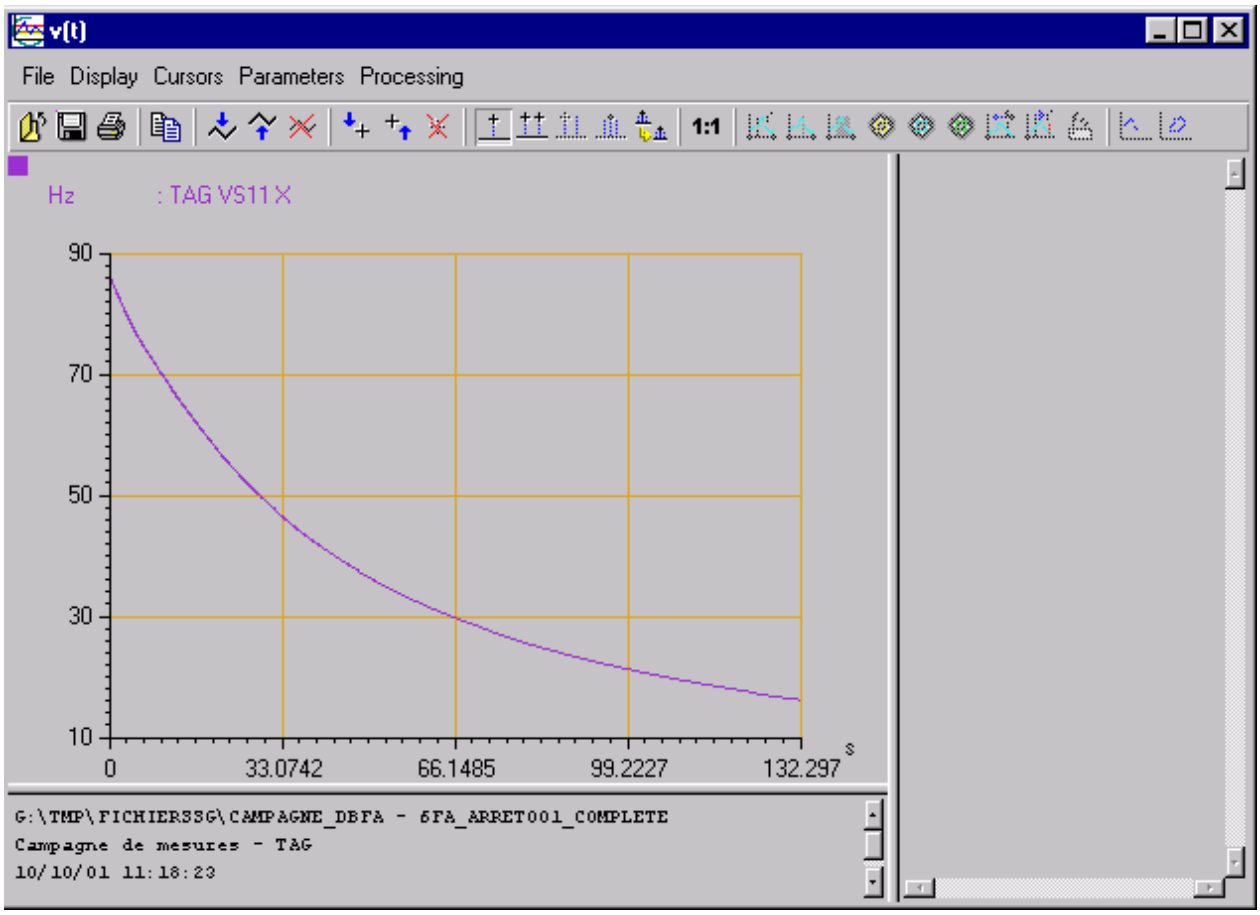
Speed versus time

Purpose

Represent the run-up or coast-down speed of a machine versus time.

Representation

Upon request of this type of representation, the window shown below is displayed.



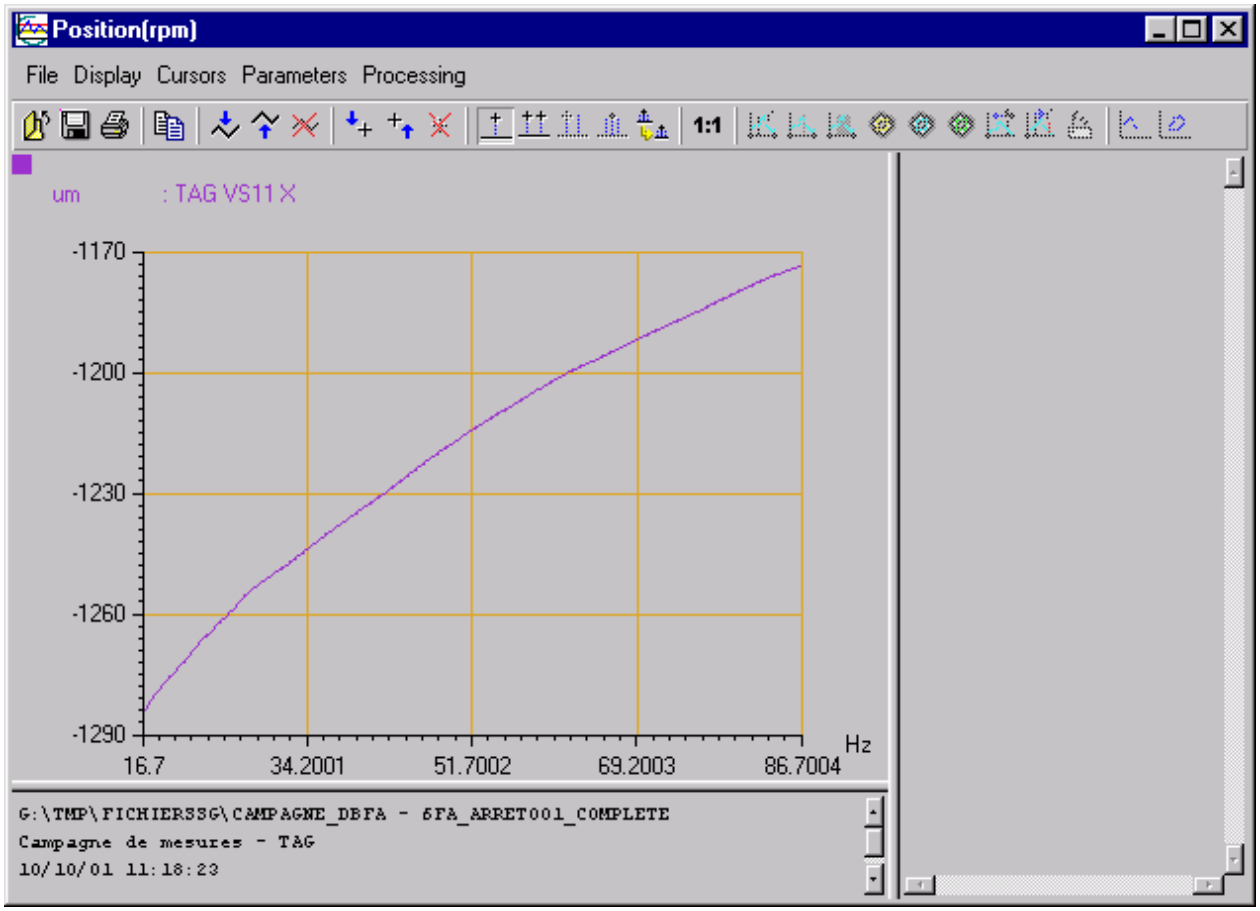
Position (RPM)

Purpose

Represent the run-up or coast-down of a machine versus time.

Representation

Upon request of this type of representation, the window shown below is displayed:



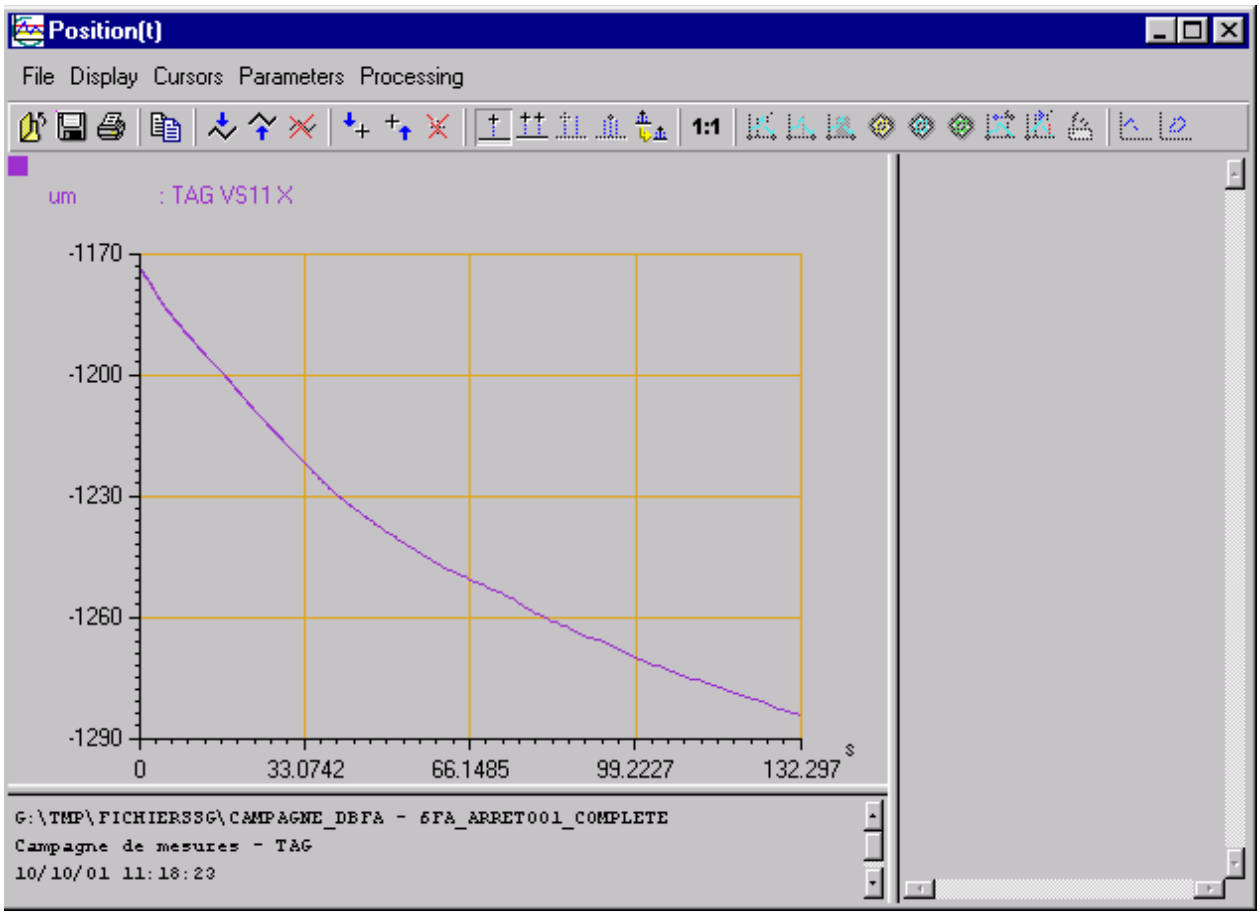
Position(t)

Purpose

Represent the run-up or coast-down of a machine versus time.

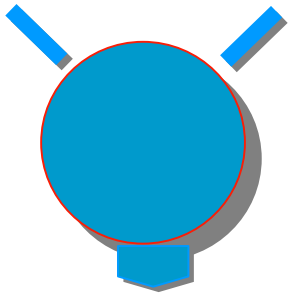
Representation

Upon request of this type of representation, the window shown below is displayed:


Position(t)
File Display Cursors Parameters Processing
1:1
um
: TAG VS11 X
-1170
-1200
-1230
-1260
-1290
0
33.0742
66.1485
99.2227
132.297
s
G:\TMP\FICHIERSSG\CAMPAGNE_DBFA - 6FA_ARRET001_COMPLETE
Campagne de mesures - TAG
10/10/01 11:18:23

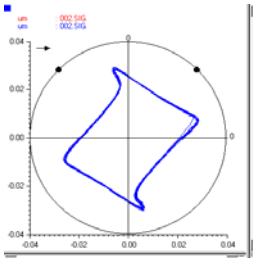
4.9.2. Two-channel "Ellipse" representation

Theory

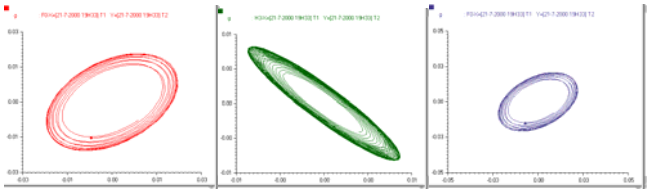


When a bearing is equipped with radial sensors set 90° apart form each other, it is possible to plot the orbit representing the path of the measured element in the plane defined by the two sensors.

The same way a spectral analysis decomposes a time signal into a sum of sinusoidal signals, this path can be decomposed into a sum of ellipses.

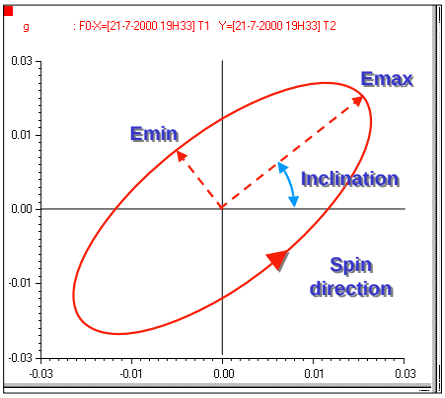


= SUM of the following ellipses:



Each ellipse can be defined by the following 3 parameters:

- Emax: maximum radius
- Emin: minimum radius
- Phase: combination of:
  - Path direction represented by the phase sign (+ / -)
  - Inclination (from 0 to 180°)



These parameters can be viewed on three types of representations:

Ellipse spectra: it represents the spectral decomposition for Emax and Emin values. The phase can be accessed by the cursor.

Emax waterfall: this representation is useful to monitor the evolution of the Emax spectrum during a transient phase. It is used to detect the vibration maxima (order, frequency, and rotation speed) regardless of the sensor position.

Ellipse Bode: this representation allows to monitor the evolution of the elementary ellipse associated with the rotation frequency or any of its multiples during a transient phase.

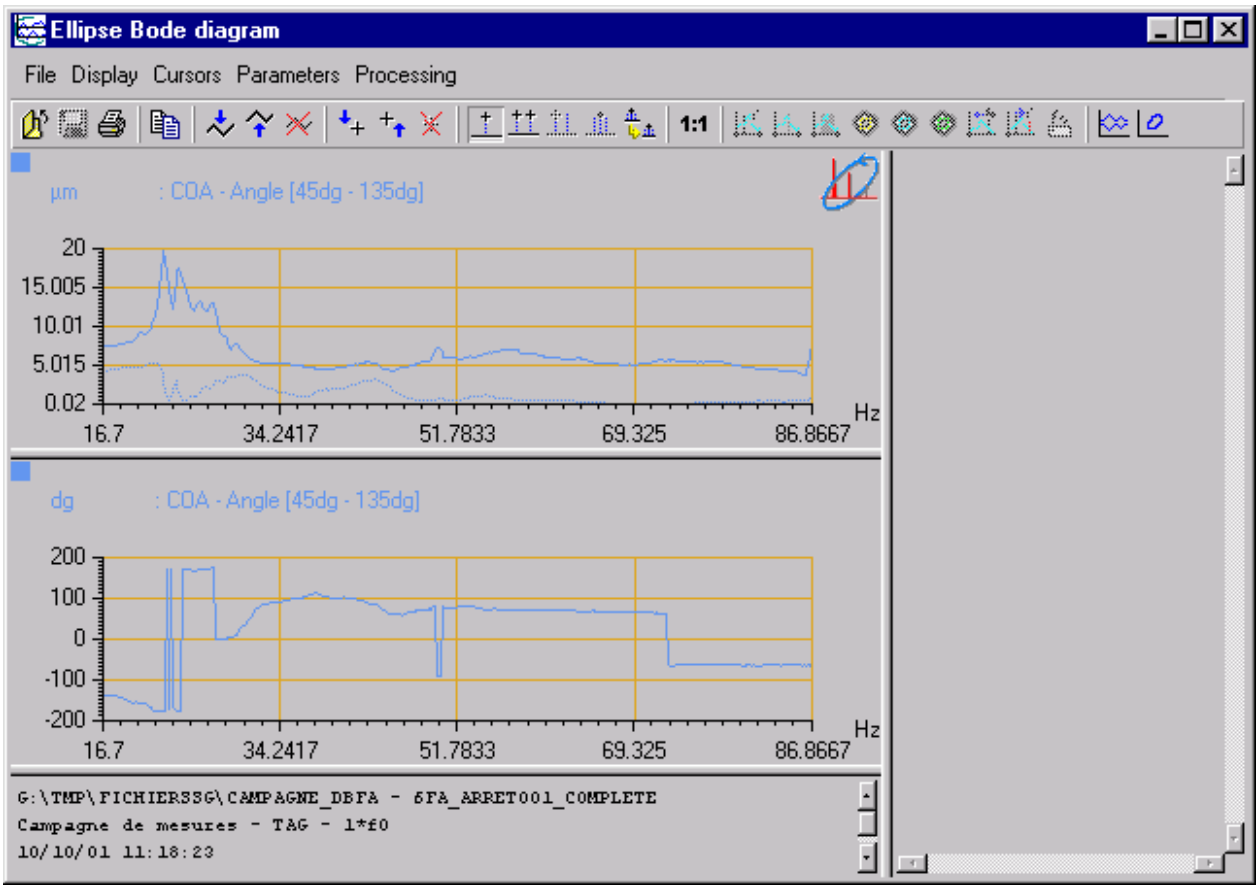
*Plot in Ellipse Bode mode (C*rpm)*

Purpose

This type of representation aims at analysing the orbit shape of a given harmonic versus the frequency exhibiting it: amplitude, flattening, orientation and direction of rotation.

Representation

A request for a speed vs. time representation will display the window shown below:

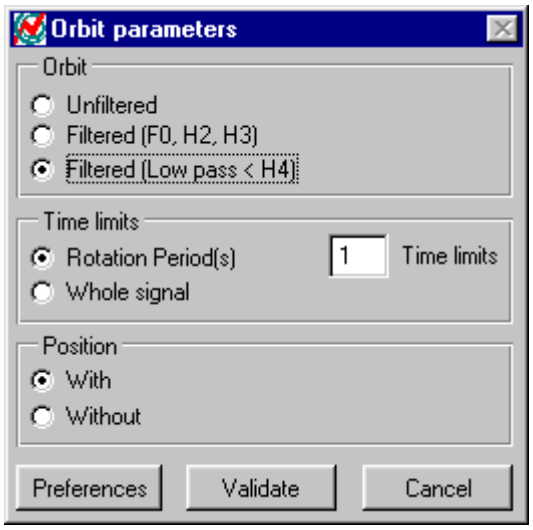


Using one or several single cursors and clicking on  will display the *Ellipse Spectrum* representations corresponding to the cursor speeds.

Using one double cursor and clicking on  will display spectra between the cursor positions in *Emax Waterfall* mode.

Use one or several single cursors and click on  to display the orbit plot corresponding to the time signals.

The following dialog box will be displayed:

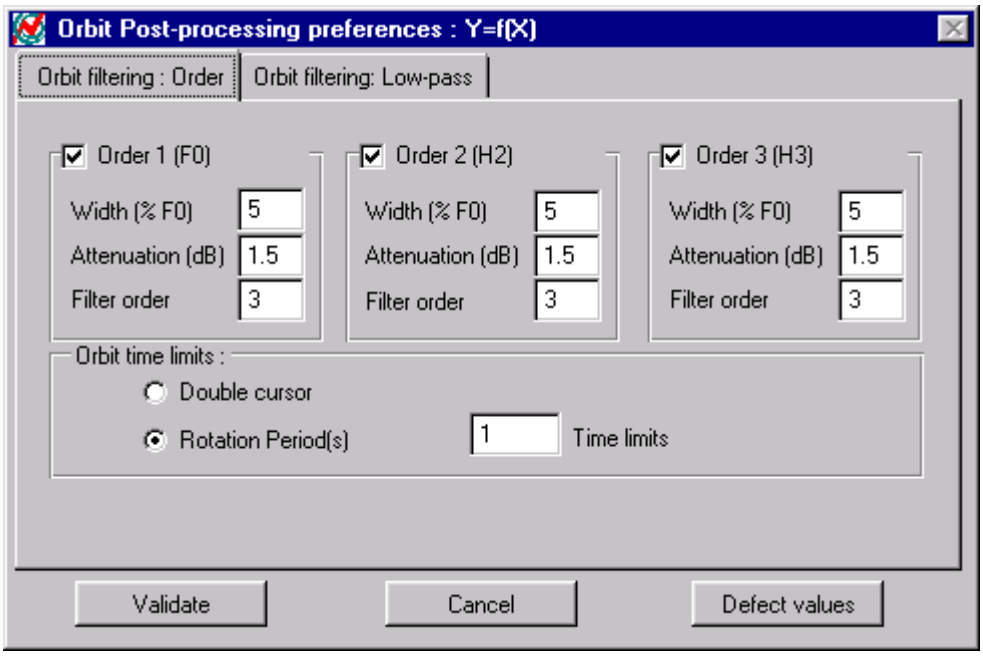


In this dialog box, the user can:

- Select the type of filtering to apply to the time signals before displaying the orbit:
  - *Unfiltered*: No filtering is applied to time signals
  - *Filtered (F0, H2, H3)*: Vib-Graph displays requested orbits (see. Dialog box for post-processing preferences) in the same graphics window. For each plot, a pass-band filter is applied to the time signals (filter parameters are defined in the Post-processing Preferences dialog box).
  - *Filtered (Low pass < H4)*: Vib-Graph applies a low pass filtering to the 2 time signals (filter parameters are defined in the Post-Processing Preferences).
- Define orbit duration:
  - *Rotation period(s)*: The orbit duration will depend on the rotation period.
  - *Whole signal*: The orbit duration depends on the duration of the time signal periods generated by the processing. Their duration depends on the spectral resolution (duration = 1/dF with dF = bandwidth/number of lines)
- Select the Position:
  - *With*: the continuous component is kept and corrected by the offset value defined in the additional information section. The shape of the orbit, as well as its position inside the bearing can thus be viewed.
  - *Without*: the continuous component is cancelled and the orbit is centred on the origin.

The 

button is used to access the Preferences dialog box for the Orbit analysis.



For more information on this dialog box, see the section on Orbit post-processing above.

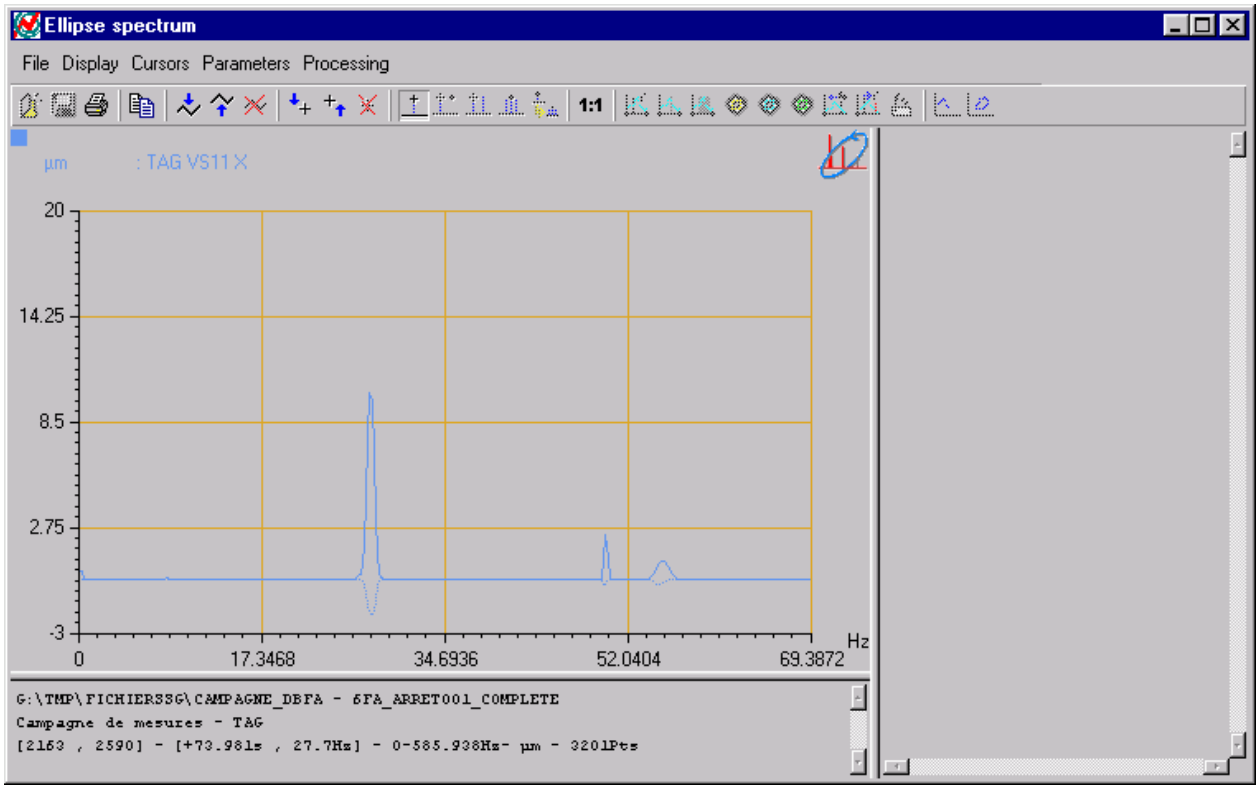
Plot of Ellipse spectrum

Purpose

This type of representation aims at displaying the Ellipse spectrum (which is a superposition of Smax and Smin) for a given speed.

Representation

The following graphics window is displayed:



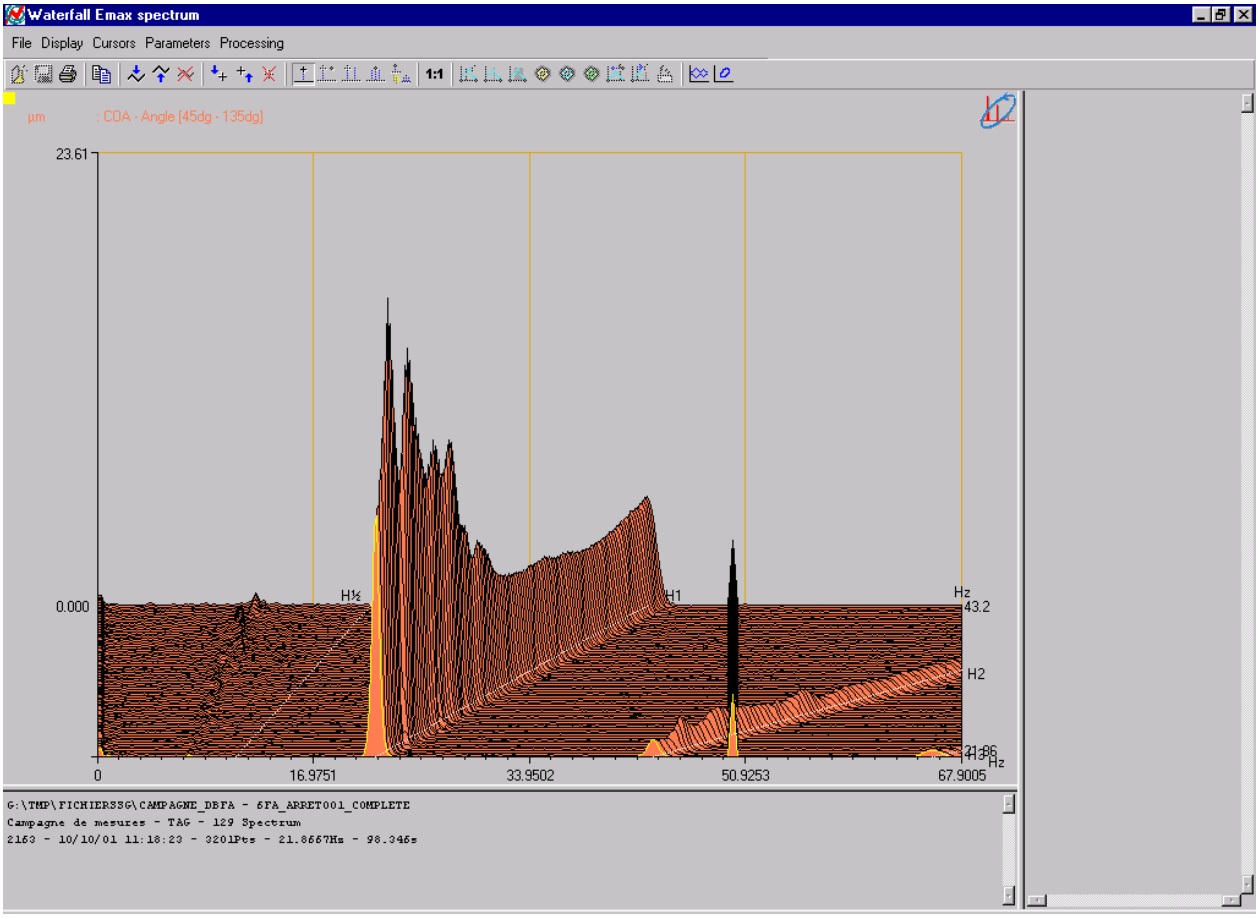
Emax waterfall plot

Purpose

This type of representation aims at displaying the list of Smax spectra between two speeds.

Representation

The following graphics window is then displayed:



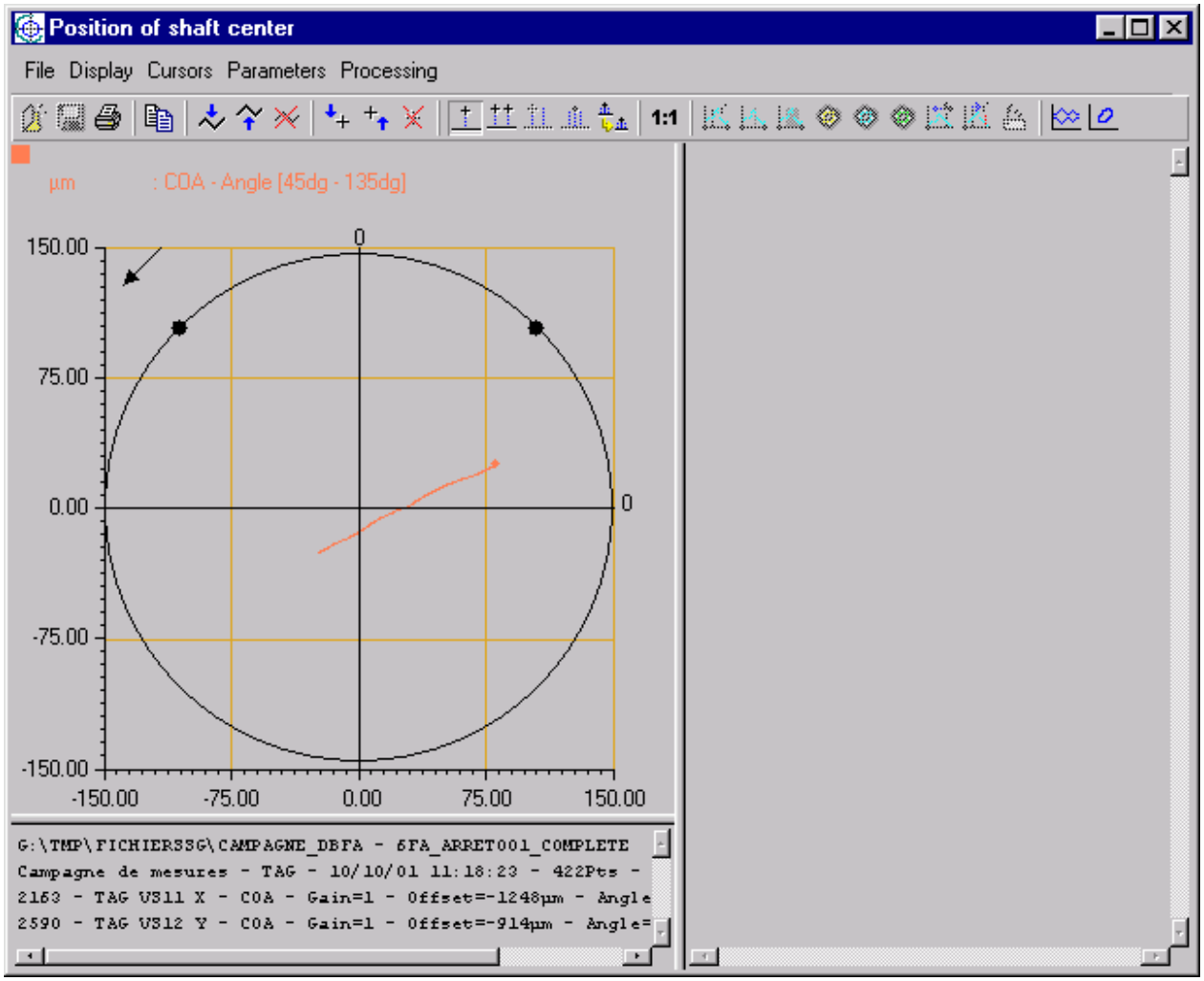
Position plot

Purpose

This type of plot aims at representing in a polar diagram the average position of the shaft in the bearing for the different speeds of the transient mode.

Representation

The graphics window shown below will be displayed:



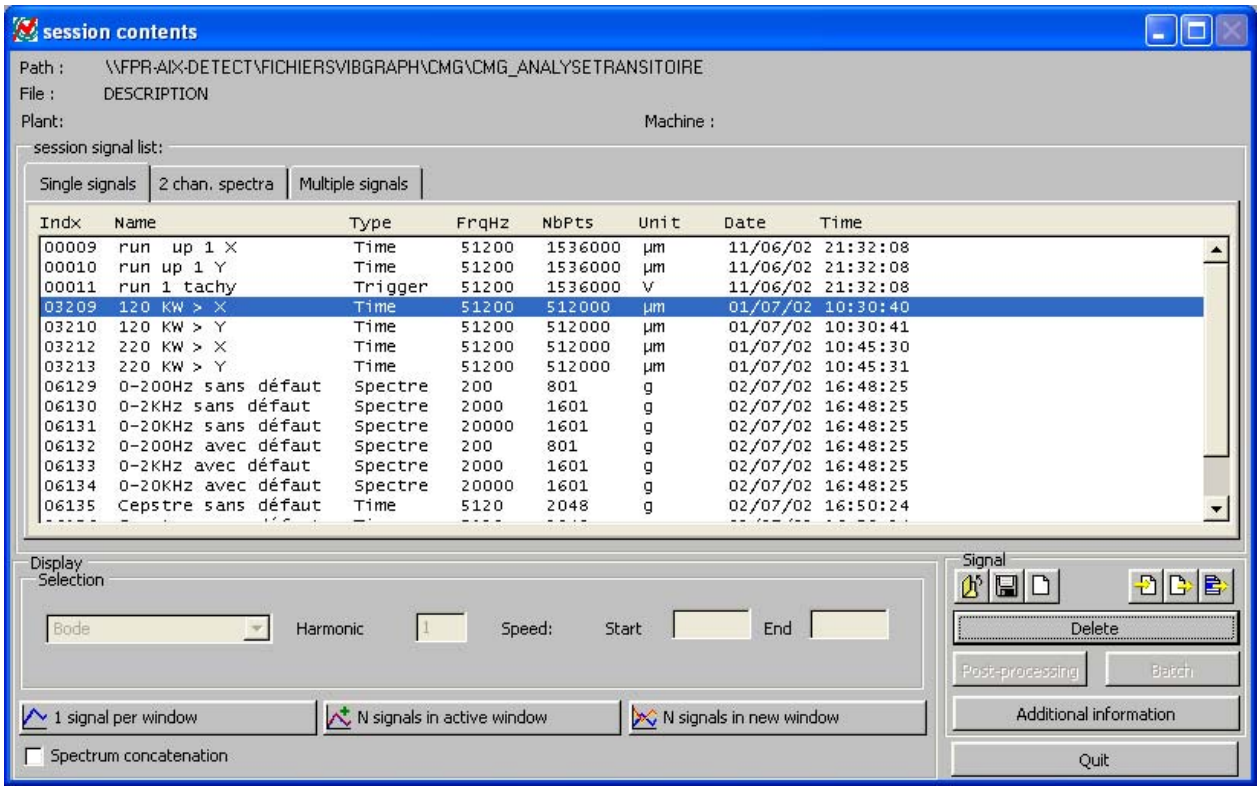
5. POST-PROCESSING

5.1. *.CMG File

Data, acquired with **Movipack (Analyzer mode) and transferred with 01dB's software LINK**, are stored in a file called **measurement session** (*.CMG extension). The processing selected by the user (i.e., calculation of a narrow band spectrum from an audio recording) is applied to this file.

Results tables and graphics can be printed from measurement sessions. Data can also be copied to a word-processing or spreadsheet software.

A *.CMG data file can contains several Mbytes of data.



Data are displayed as a database on the measurement session window.

Each row corresponds to a type of results and each column corresponds to information on the type of data.

Signals are sorted into 3 families:

- Simple signals (time or spectrum),
- Two-channel spectra measured with Movipack,
- Multiple signals (multispectra)

Click on the corresponding tab to list all signals belonging to a specific family.

5.2. View a signal

Click on the signal(s) to plot and press the adequate button :

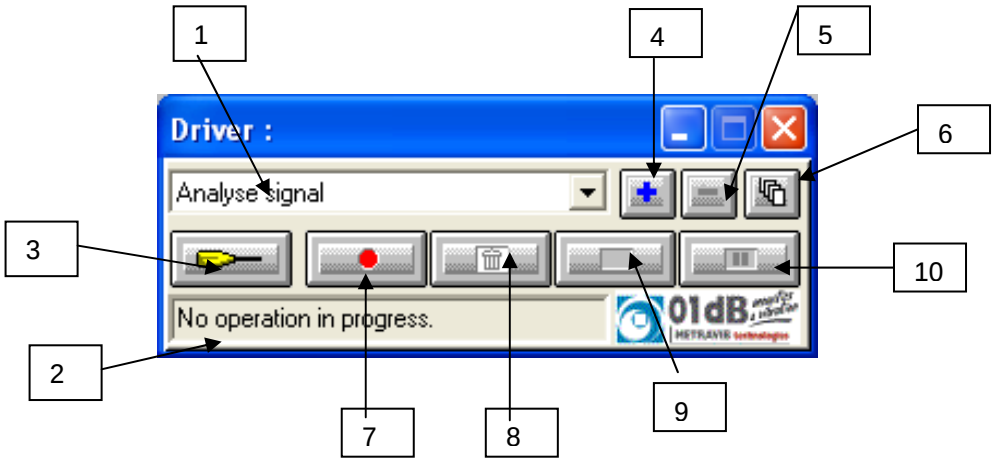
- 1 signal per window
- N signals per window
- N signals in a new window

5.3. "Single signals" tab

The "Postprocessing" button on the right is active in this tab and can be used to perform post-processing operations on time signals

5.3.1. Introduction

This new layout includes each processing as a script. A script is actually a black box with one or more input and one output, which all correspond to elements of a measurement session. Each script has its own configuration dialogue box that is used to define analysis parameters (e.g., number of lines in a narrow-band analysis, etc.), the operator's name, as well as the progress status of calculations.



1. List of scripts: this list shows all analysis scripts that are compatible with the data items selected in the measurement session datafile. According to the status of the calculation server (analysis in progress, waiting, and pause) and the user actions (stop analysis, activate an analysis), these scripts are accessible for edition and configuration.

2. Status bar: this zone shows, when a script is being executed, the name of the active operator as well as the ID of the data item currently being analysed.

3. Configuration of a script: click on this key to display the script configuration dialog box.

4. Duplication: click on this key to duplicate a default script of the application software in order to rename it, to select different operators or to change analysis parameters.
For example, the application software may offer only one script for audio data analysis. If the user wishes to keep this script with the current settings, he (or she) can duplicate the script and define different analysis types and analysis parameters. The default and user-defined scripts are automatically saved for any subsequent analysis.

5. Cancellation: click on this key to delete a user-defined script (obtained after duplication) from the calculation server. Default scripts cannot be deleted.

6. Access all scripts: click on this key to display and access all the analysis scripts contained in the calculation server, and not only the scripts compatible with the data items selected in the measurement session. In this mode, no analysis can be performed. Click again on the same key to unlock the calculation server and perform an analysis.
This mode is also used to assign operator scripts to shortcut buttons in the session toolbar. See the section on shortcuts for operator scripts.

7. Click on this key to **launch** the analysis process according to the selected script and for the selected data items.

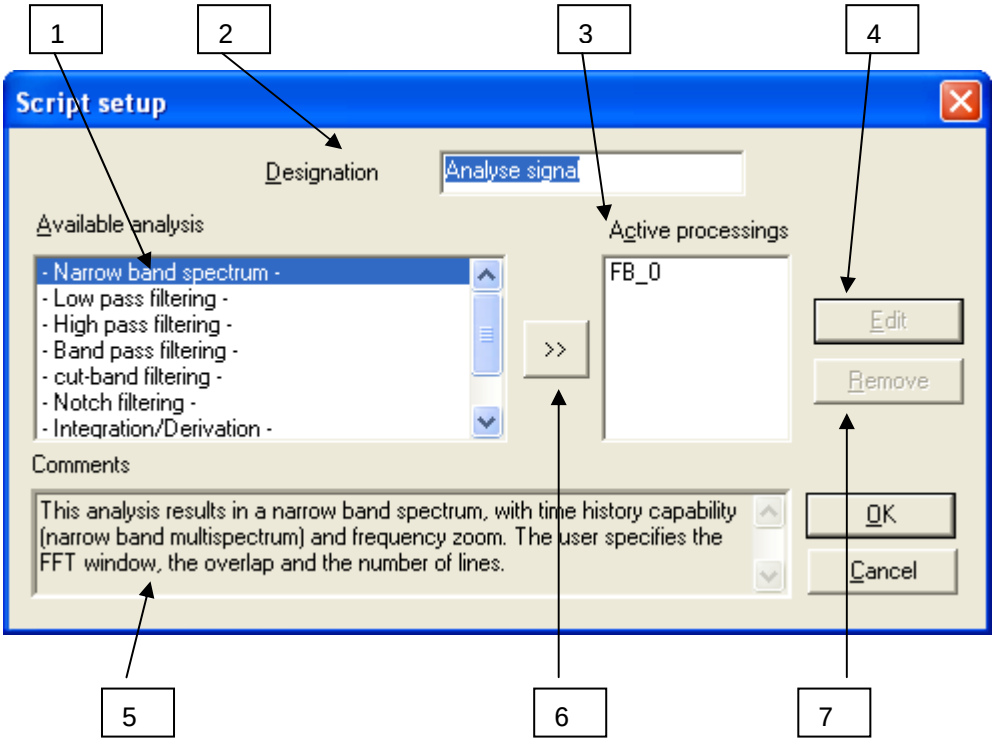
8. Abort: the script currently being executed is stopped. The analysis is thereby aborted. No result is saved in the measurement session datafile.

9. Interrupt: click on this key to interrupt the analysis process. The partial results are saved into the active measurement session datafile.

10. Pause: click on this key to temporarily stop the analysis process. The analysis will be carried out again when this key is pressed again.

5.3.2. Overview and configuration of analysis scripts

Click on icon  to access to the script configuration dialog box shown below. This dialog box is used to select and configure each single operator of the script.



1. List of **available processings**: it shows all the types of processings compatible with the active script. The same operator can be used several times with different parameters to process the same items.

2. Designation: give a name to the script. A user-defined name can be specified.

3. Set of **active processings** currently part of the script. These operators will be activated to analyse independently the same set of items when running the script.

4. Edit the parameters of the selected operator (in the list of available processings). Each operator shows its own configuration dialog box.

5. Comments describing the operator selected in the available processings' list. If an operator from the active processings' list is selected, the comment field shows the type of the operator.

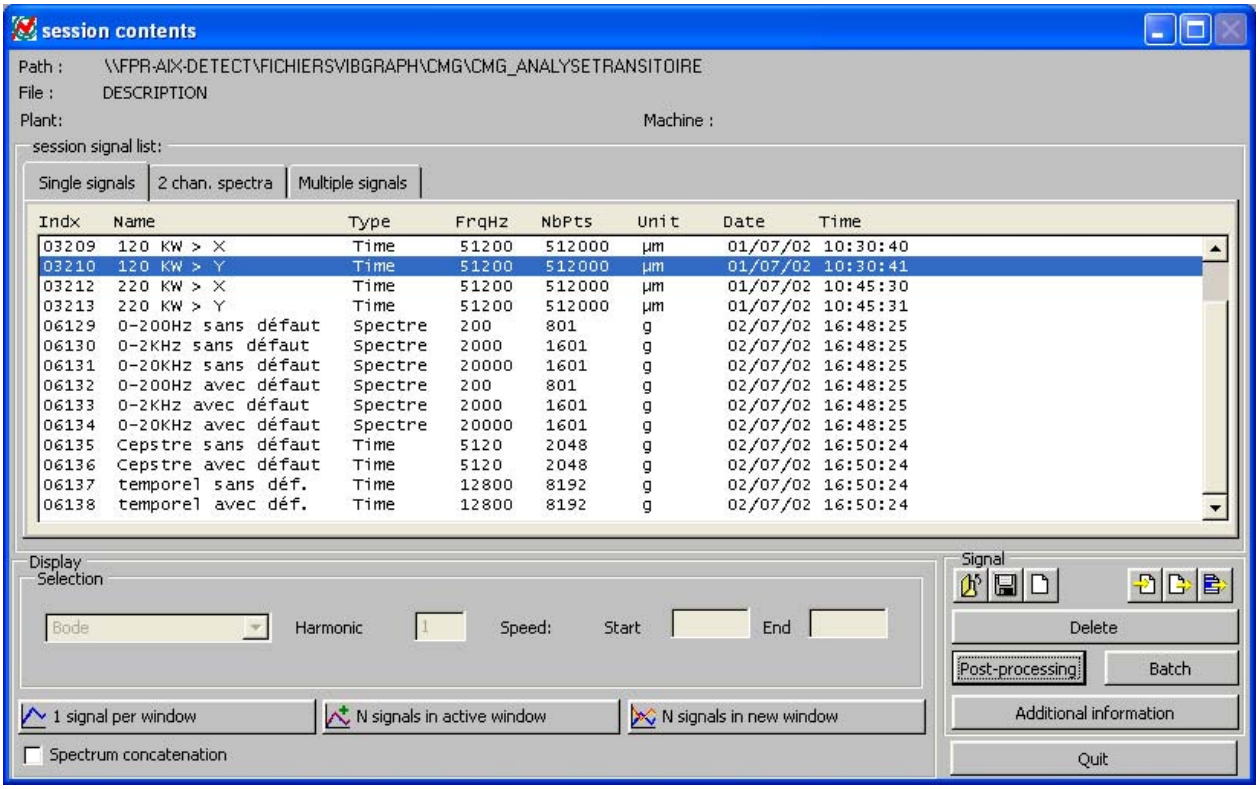
6. Key that allows adding an operator into the active processings' list. Different operators of the same type may be added (the user may for example define a multispectrum analysis in third octave band with different time steps in the same script). A generic name for each operator is given by default.

7. The key **remove** allows the user to remove an operator from the list of the active processings.

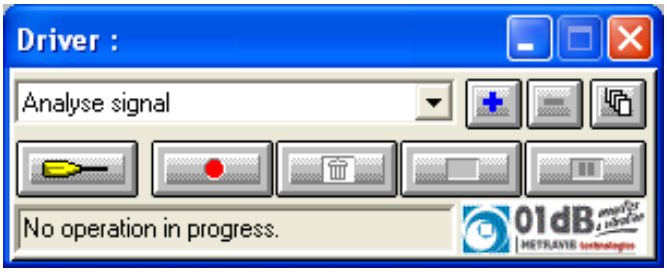
Once the list of active processings has been defined, **edit** each one of them to define the calculation parameters. To do so, select the adequate operator in the list and press the **Edit** key.

5.3.3. Operating mode

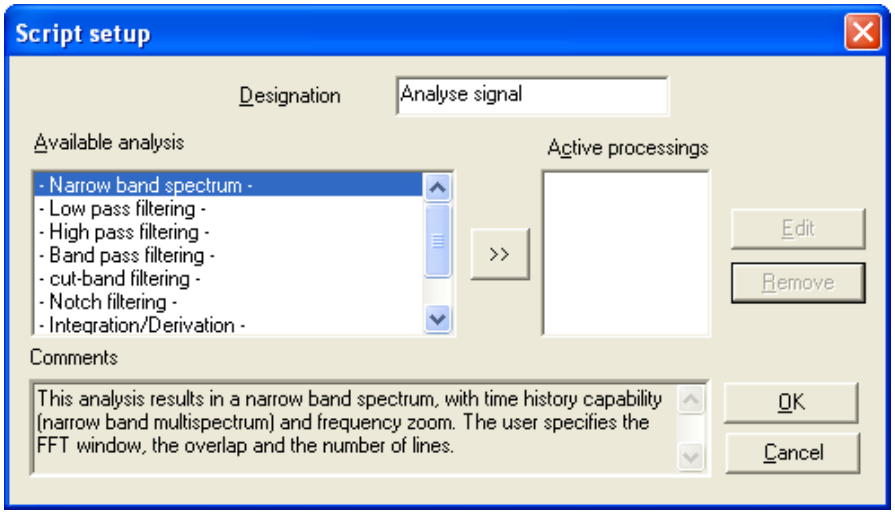
1 – Select the signal and click on the « Post-processing » button to launch the calculation driver that will define the processing.



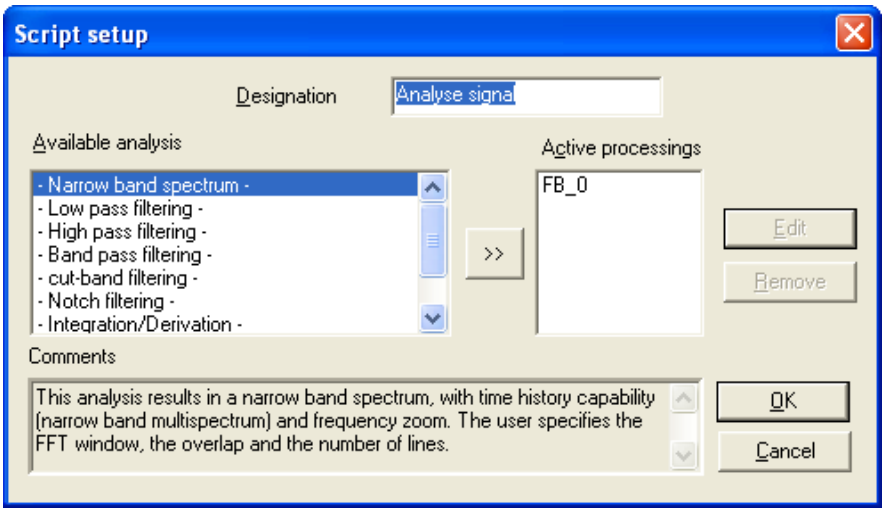
2 – Select the appropriate processing in the list and click on  :



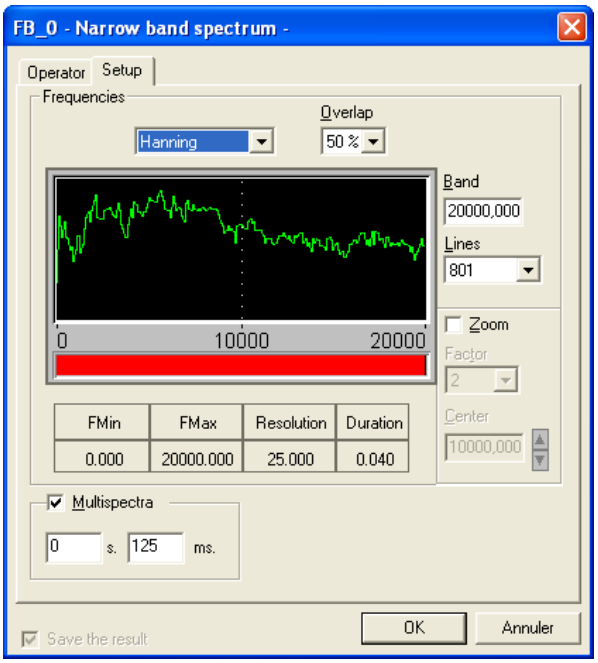
3 – Select a processing from the list and add it to the list of active processings by clicking on the double arrow:



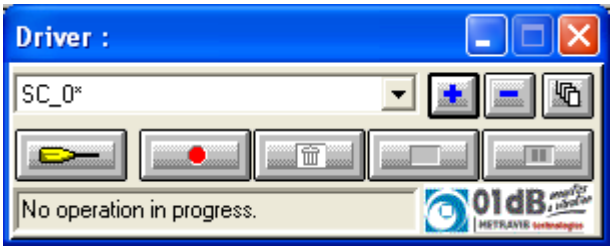
4 – Click on the active processing and then on the Edit button to change or view its settings :



5 – In the case of a narrow-band spectrum, the “Configuration” tab gives access to the processing parameters.



6 – Validate parameters and click on the red button to start calculations. A new item is added to the session list. IN the present example, it will be displayed in the “Multiple signals” tab, since the “Multispectra” options has previously been selected.



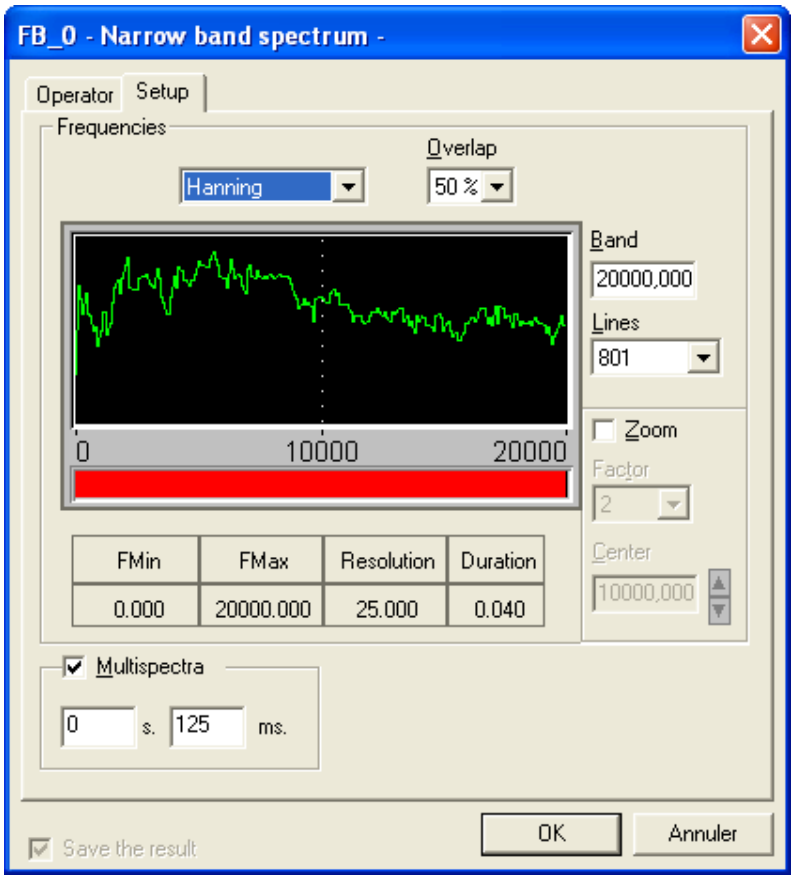
5.4. List of associated processings

Here is a summary of all scripts contained in the calculation server, with the list of associated operators and the type of data to which they pertain.

Script	Operator [Default name]	Description / Results	Active for
Tachometry	Order and phase extraction [OAF_0]	This processing performs order extraction (modulus and phase) from a tachometric channel and a measurement channel.	**1 signal and 1 speed profile**
Operations on spectra	Narrow band spectra [FB_0]	Narrow-band spectrum with possible timing (multispectrum) and frequency zoom. User-selected weighting window, overlap and number of lines.	**Signal**
	Low-pass filtering [LOW_0]	Low-pass filtered time signal (Butterworth, even order from 2 to 30).	
	High-pass filtering [HIGH_0]	High-pass filtered time signal (Butterworth, even order from 2 to 30).	
	Band-pass filtering [PASS_0]	Band-pass filtered time signal (Butterworth, even order from 2 to 30).	
	Cut-band filtering [CUT_0]	Cut-band filtered time signal (Butterworth, even order from 2 to 30).	
	Notch filtering [NOTCH_0]	This processing yields a notch-filtered time signal. The user selects the filter selectivity by setting the S factor. The -3 dB bandwidth is then fs / (PI * S) for order 2. By increasing the order, the attenuation increased to the detriment of the selectivity.	
	Integration / Derivation [DIN_0]	Signal Integration / Derivation	
	Envelope [ENV_0]	Calculation of either the signal envelope or its Hilbert transform.	
Transfer functions	MATLAB transfer [MATLAB_0]	Export all data in the MATLAB format (*.mat file) in physical units. This file can be directly processed in MATLAB using the "Load" function.	Signal
	01dB WAV [WAV01DB_0]	Export all input data in 01dB WAV format (*.WAV file, Windows compatible).	
	MP3 export [MP301DB_0]	Export input data in MPEG Layer III format (mp3). The exported signal must be sampled at 32 kHz or 44.1 kHz.	

5.4.1. Narrow-band spectrum Operator

Use this operator to obtain a narrow-band spectrum, with possible timing and frequency zoom. The dialogue box below is displayed.



In the **Configuration** tab, the following analysis parameters may be defined:

FFT Window: Choose the FFT window for the analysis. The following windows are available: Rectangular, Hanning, Hamming, Kaiser-Bessel, and Flat Top.

Overlap: Choose the overlap factor for the analysis amongst the following quantities: 0, 25%, 50% and 75%. During a FFT analysis, the overlap factor represents the percentage of samples that are used simultaneously in two adjacent data blocks.

Max. frequency: Select the maximum frequency of the analysis. bandwidth defines the maximum frequency of the analysis. A scrolling list indicates the available maximum frequencies.

Lines: Select the number of lines for the FFT analysis amongst the values displayed in the list: 101, 201, 401, 801, 1601 or 3201. The higher the number of lines the higher the frequency resolution.

Multispectra: if this option is activated, the user obtains the time history of the spectrum over the item duration. The time step may vary from 1 ms to 999 seconds.

vibGraph calculates a spectrum over each time interval and superimposed then to produce a waterfall spectrum.

The curve is a graphic representation of the analysis parameters. Maximum and minimum frequencies, resolution (Hz) and duration (in seconds) of the analysis, as well as the centre frequency Fc when using the **zoom** function, are represented.

The red information bar (lower part) indicates the analysis frequency range while the spectrum indicates the chosen frequency resolution.

To modify the centre frequency or the minimum frequency (when the **Zoom** option is activated) of analysis, move the cursors respectively to the right and to the left. The user can also modify the zoom parameters by setting the **zoom factor** and the **centre frequency** in the right part of the dialogue box.

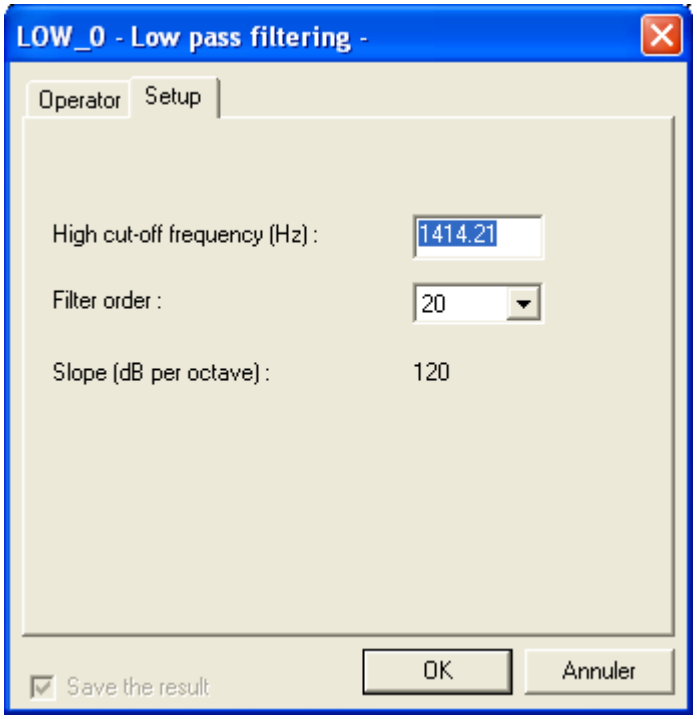
....

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator. The **Notification** tab is used to parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	FB_0
Active for	Signal, Impulse response
Restrictions	Only apply for one item. The length of a time block must smaller than that of the signal.
Family of results	Autospectrum

5.4.2. Low-pass filtering Operator [LOW]

This analysis results in a low-pass filtered time signal (Butterworth, even order from 2 to 30). The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

High cut-off frequency: define the cut-off frequency in Hz.

Filter order. Select the Butterworth filter order between the following values: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30.

The filter order defines the octave fall-off rate (dB / octave) and therefore the effectiveness of the filter. The greater the filter order, the greater the attenuation of high-frequency bands.
Low-pass filters remove components with a frequency higher than the specified cut-off frequency with an octave fall-off rate (dB / octave) depending on the filter order.

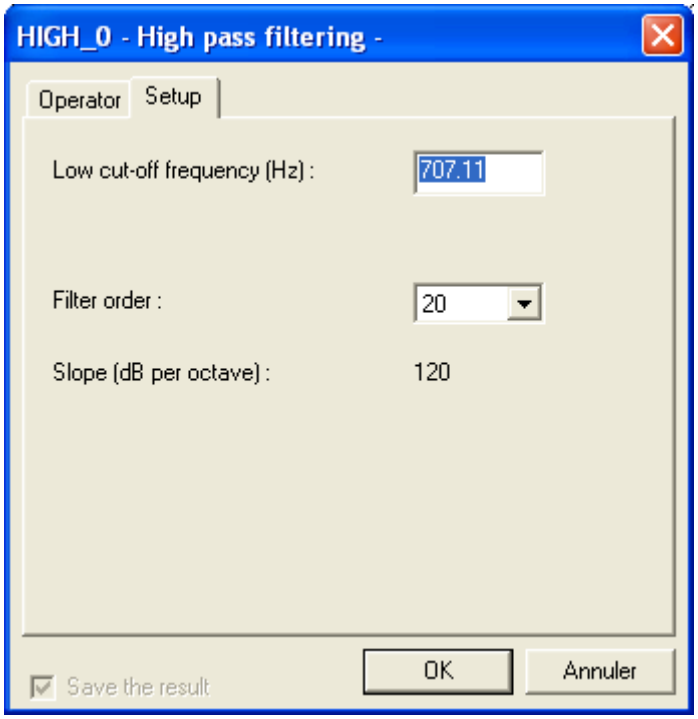
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	LOW_0
Active for	Signal, Impulse response
Restrictions	Only apply for one item.
Family of results	Signal, Impulse response

5.4.3. High-pass filtering Operator [HIGH]

This analysis results in a high-pass filtered time signal (Butterworth, even order from 2 to 30). The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

Low cut-off frequency: define the cut-off frequency in Hz.

Filter order: select the Butterworth filter order between the following values: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30.

The filter order defines the octave fall-off rate (dB / octave) and therefore the effectiveness of the filter. The greater the filter order, the greater the attenuation of low-frequency bands.

Low-pass filters remove components with a frequency lower than the specified cut-off frequency with an octave fall
off rate (dB / octave) that depends on the filter order.

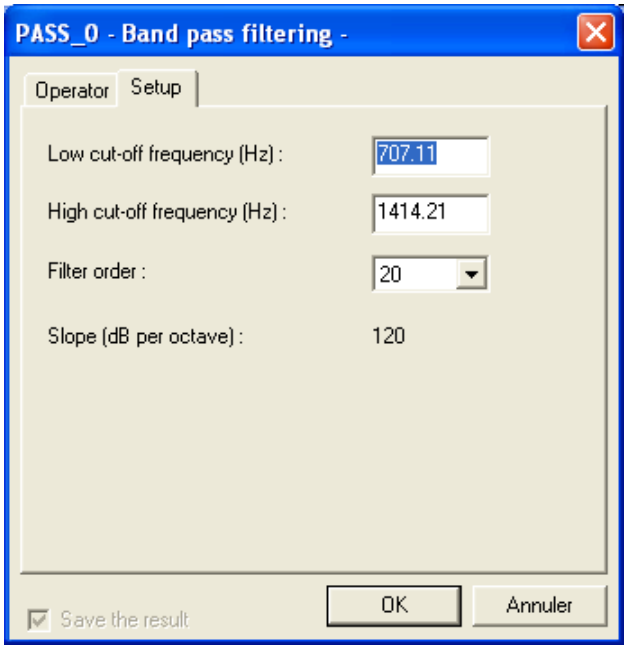
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	HIGH_0
Active for	Signal, Impulse response
Restrictions	Only apply for one item.
Family of results	Signal, Impulse response

5.4.4. Band-pass filtering Operator [PASS]

This analysis results in a band-pass-filtered time signal (Butterworth, even order from 2 to 30). The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

Low cut-off frequency: define the low cut-off frequency in Hz.

High cut-off frequency: define the high cut-off frequency in Hz.

Filter order. Select the Butterworth filter order between the following values: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30.

The filter order defines the octave fall-off rate (dB / octave) and therefore the effectiveness of the filter. The greater the filter order, the greater the attenuation of low and high-frequency bands.

Band-pass filters remove components whose frequency is lower than the specified low cut-off frequency and greater than the high cut-off frequency with an octave fall off rate (dB / octave) depending on the filter order. It corresponds to a low-pass filter and a high-pass filter simultaneously.

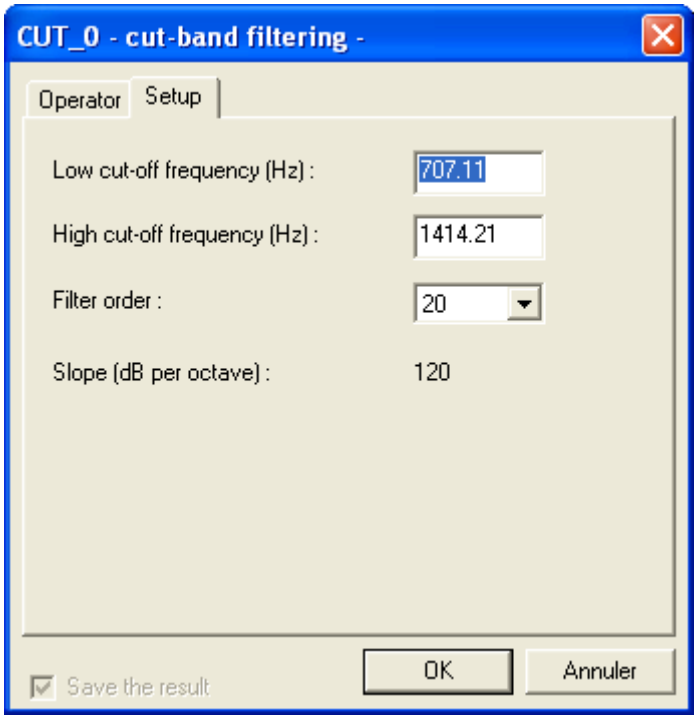
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	PASS_0
Active for	Signal, Impulse response
Restrictions	Only apply for one item.
Family of results	Signal, Impulse response

5.4.5. Cut-band filtering Operator [CUT]

This analysis results in a band-stop filtered time signal (Butterworth, even order from 2 to 30). The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

Low cut-off frequency: define the low cut-off frequency in Hz.

High cut-off frequency: define the high cut-off frequency in Hz.

Filter order. Select the Butterworth filter order between the following values: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30.

The filter order defines the octave fall-off rate (dB / octave) and therefore the effectiveness of the filter. The greater the filter order, the greater the attenuation of low and high frequency bands.

Cut-band filters remove components whose frequency lies in the range between the low cut-off frequency and the high cut-off frequency with an octave fall-off rate (dB / octave) depending on the filter order.

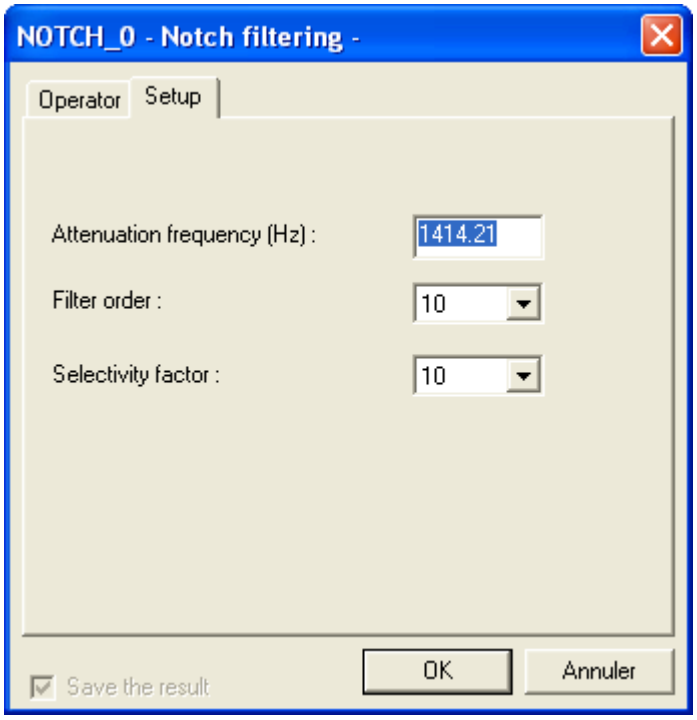
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	CUT_0
Active for	Signal, Impulse response
Restrictions	Only apply for one item.
Family of results	Signal, Impulse response

5.4.6. Notch filtering Operator [NOTCH]

This analysis results in a notch-filtered time signal. The following dialog box appears on-screen.



In the **Configuration** tab, the following analysis parameters may be defined:

Attenuation frequency Fa: define the rejection frequency in Hz.

Filter order. Select the Butterworth filter order between the following values: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30.

Selectivity factor S. Define the selectivity parameter: 10, 20, 40 or 80. The user defines the filter selectivity (S factor). The frequency range at -3 dB is then of fs / (PI * S) for an order 2. By increasing the order number, attenuation is emphasised at the expense of selectivity.

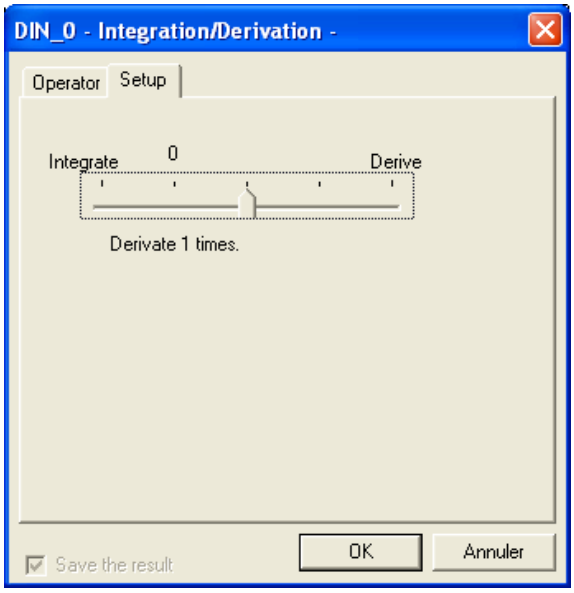
The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

Default script	Signal analysis
Default name	NOTCH_0
Active for	Signal, Impulse response
Restrictions	Only apply for one item.
Family of results	Signal, Impulse response

5.4.7. Integration / Derivation Operator [DIN]

This processing allows for the integration or the derivation of an acceleration, speed or displacement signal. The dialog box shown below is displayed.



In the **Configuration** tab, the following analysis parameters may be defined:

Integration / Derivation: Use this field to integrate/derive signals.

Move the cursor to the left to integrate the signal once (first tick), twice (second tick) or three times (third tick).

Move the cursor to the right to derive the signal once (first tick), twice (second tick) or three times (third tick).

The table below summarises the different integration/derivation options depending on the type of signal.

	Integration			derivation		
	1	2	3	1	2	3
m/s²	**m/s**	m	.	**m/s³**	.	.
m/s	**m**	.	.	**m/s²**	**m/s³**	.
M	.	.	.	**m/s**	**m/s²**	**m/s³**

Jerk: **m/s³** Acceleration: m/s²

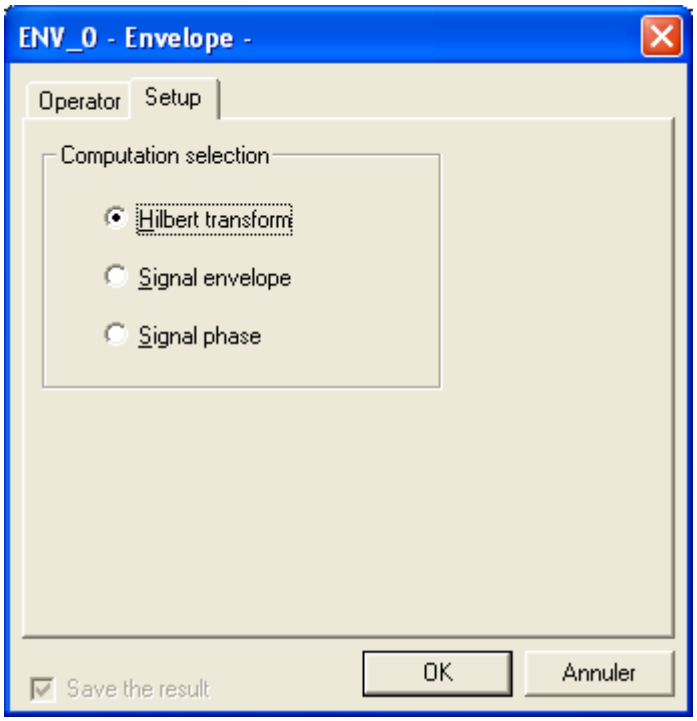
Velocity : m/s Displacement : m

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

Default script	Signal analysis
Default name	DIN_0
Active for	Acceleration, velocity, displacement signal
Restrictions	Only apply for one item. The number of derivations or integrations must be compatible with units
Family of results	Jerk, Acceleration, Velocity, Displacement signal

5.4.8. Envelope Operator

This processing calculates either the signal envelope or the analytical signal phase, or its Hilbert transform.



In the **Configuration** tab, the following analysis parameters may be defined:

Hilbert transform: The Hilbert transform of the spectrum signal X(f) consists in building the spectrum signal X'(f) with: X'(f)=-j*sgn(f).

Performing a FFT on the original signal, then this operation and then a reverse FFT, yields a time signal, which is the Hilbert transform of the original signal. The resulting signal is sometimes called a phase quadrature signal, as applying a Hilbert transform is equivalent to adding $\pi/2$ to the phase for positive frequencies and subtracting $\pi/2$ for negative frequencies.
Thus, the transform of $\cos(2\pi \times f0 \times t)$ is $\sin(2\pi \times f0 \times t)$.

Analytical signal:
Signal envelope and analytical signal phase: The analytical signal of a time signal x(t) is a complex signal, the real part of which is x(t) and the imaginary part is the Hilbert transform of x(t). The envelope x(t) is obtained by taking into account the module of this signal.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

The **Notification** tab is used to define parameters related to notification of the user of the computation progress.

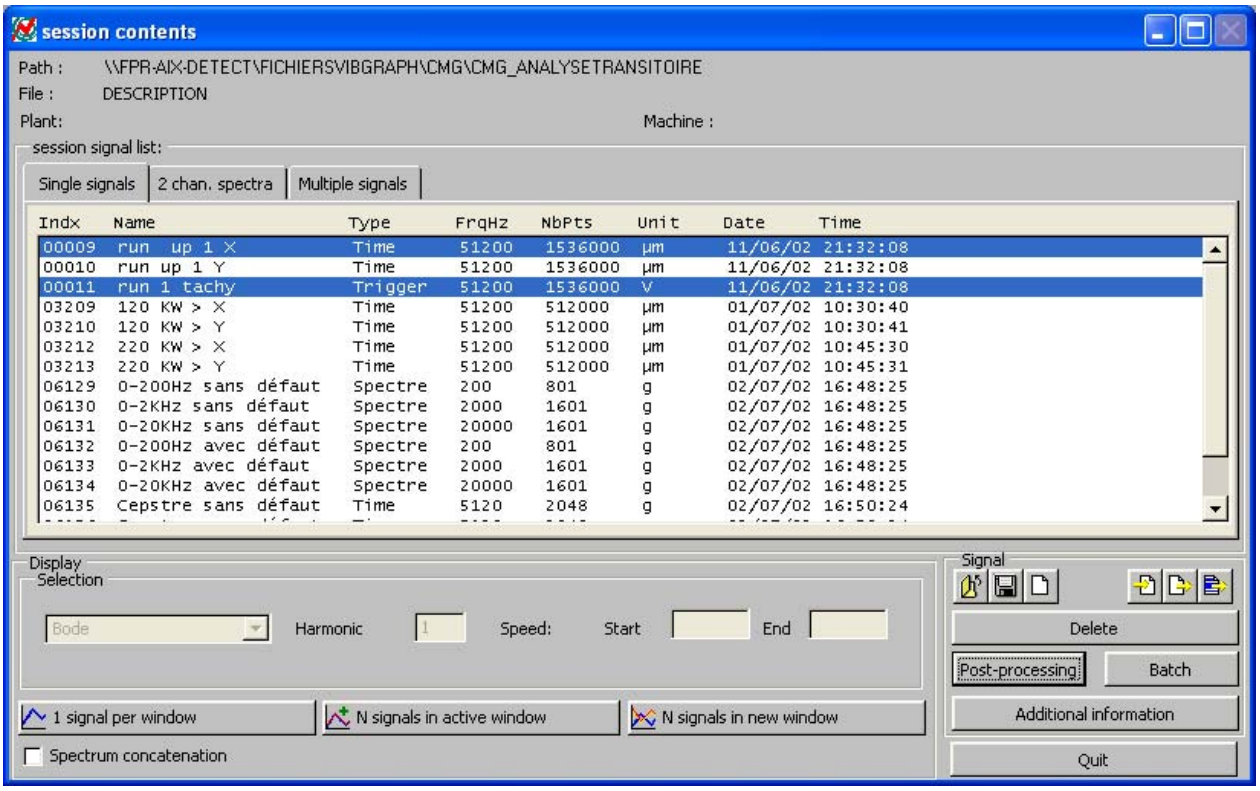
Default script	Signal analysis
Default name	ENV_0
Active for	Signal
Restrictions	Only apply for one item.
Family of results	Signal

5.4.9. Order/Phase extraction Operator [OAF]

Order analysis relies on the frequency analysis of a system's noise or vibration emission, related to its rotation speed and to the harmonics of the rotating parts (orders).

This measurement method is mainly used for fixed and/or variable-speed **rotating machines**. It gives information on effects induced by rotating elements and their amplification by the structure resonances.

One or several noise or vibration measurement channels are simultaneously recorded with a tachometric signal.

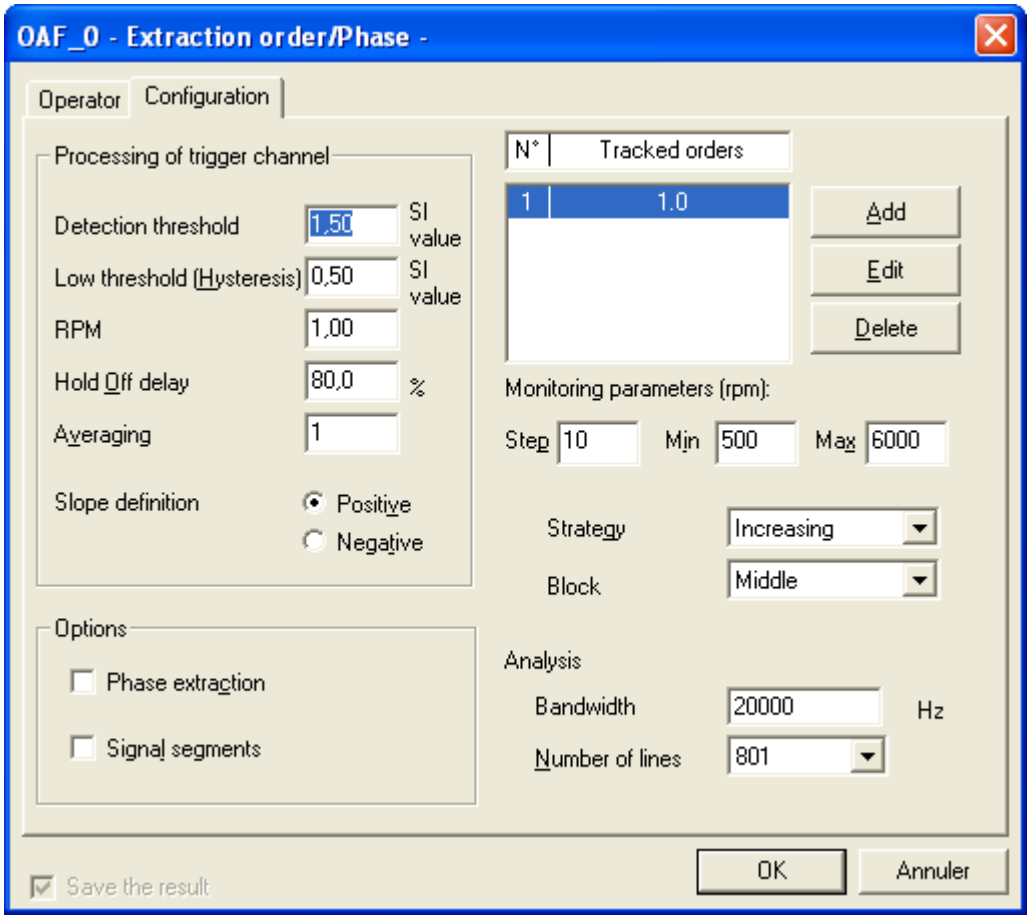


This processing performs, from a Signal item and a Trigger Input item (resulting from the recording of a tachometric transducer on a dynamic channel), an order extraction and yields:

A multispectrum versus speed containing phase information,

An overall level per order versus speed,

An item containing phase information per extracted order.



In the **Configuration** tab, the following analysis parameters may be defined:

Management of the trigger input channel

Detection threshold: Define the threshold value for impulse detection.

Lower threshold (Hysteresis): Define the lower threshold that the signal must pass to reactivate the trigger for impulse detection (case of a poor-quality tachometric signal).

Number of impulse / revolution: Indicate the number of impulse per revolution.

Hold Off delay: Definition of a time period during which the trigger is deactivated, as a percent of the time between the two previous triggerings (case of a poor-quality tachometric signal).

Averaging: Define the number of elements to average before speed calculation.

Slope definition: Define the signal slope for impulse detection.

Options

Phase extraction: compulsory option to get phase.

Segments of signal: compulsory option to memorise time blocks for a given speed, to view signals and to calculate orbits

Tracked orders: Use this table to add, delete or modify orders to extract. Orders may be non-integers. DO NOT CHANGE THIS TABLE.

Tracking parameters (rpm):

Step: time between two acquisitions of time blocks and spectra

Min: initial speed

Max: maximum speed

Strategy: Indicate whether it is a run up (**Increasing**) or a run down (**Decreasing**).

Block Synchro: Indicate if the speed used to date the spectrum is at the beginning, in the middle or at the end of the analysis time block.

Analysis:

Bandwidth: maximum spectrum frequency used to get vibration amplitudes for different vibration components of the rotation speed.

Number of lines: number of line sin spectrum. Resolution (distance between 2 lines) is the ration of the bandwidth to the number of lines.

Default script	Transient analysis
Default name	OAF_0
Active for	Signal + Trigger input Signal
Restrictions	Items must belong to the same measurement
Family of results	Complex spectrum; Overall/RPM; Measurement/RPM; Signal

Options “Phase extraction” and “Signal segments” do not need to be checked.

The **Operator** tab gives an overview of this type of processing function and allows the user to modify the default name of the operator.

View: click on the “Multiple signals” tab: by default, the resulting signal is a multiple signal of the waterfall type.

5.5. "2-channel spectra" tab

5.5.1. Introduction

This chapter will describe how to view measurements performed with Movipack in Analyzer mode.

This new function is available in Basic mode and in Expert mode in vib-Graph.

5.5.2. Data

Data are transferred from Movipack using a downloading tool of the Movipack-Link type. This program is used to transfer:

- Analyzer data: *.CMG file
- Order analyses: *.CMG file
- Balancing reports: *.RTF file

In Movipack, data are stored based on a 2-level tree structure in File\Test.

Upon downloading data, and after selection of files (machines) to download, a *.CMG file is created, which contains measurement data.

The following data types are handled by the software:

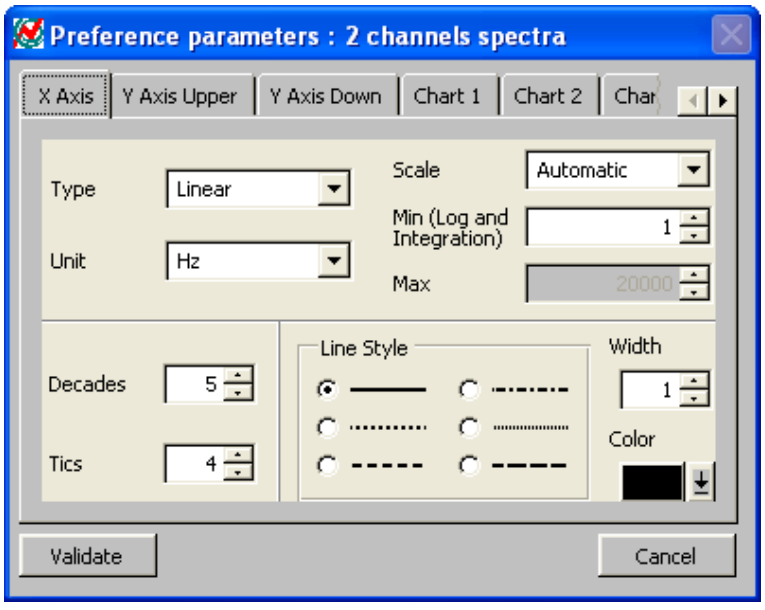
- Single-channel time signals
- Two-channels time signals
- Two-channel time signals + tachometric signal
- Single-channel RMS spectra
- Two-channel spectral measurements (2 power autospectra + cross-spectrum)

Note:

In the case of two-channel measurements, vib-Graph adds the channel number to the signal names.

5.5.3. Two-channel display preferences

Main menu of vib-Graph : Preferences / Type of chart / 2-channel spectra.



This dialogue box is similar to that used to define the simple spectrum, except for an additional tab to manage Y axes of both plots.

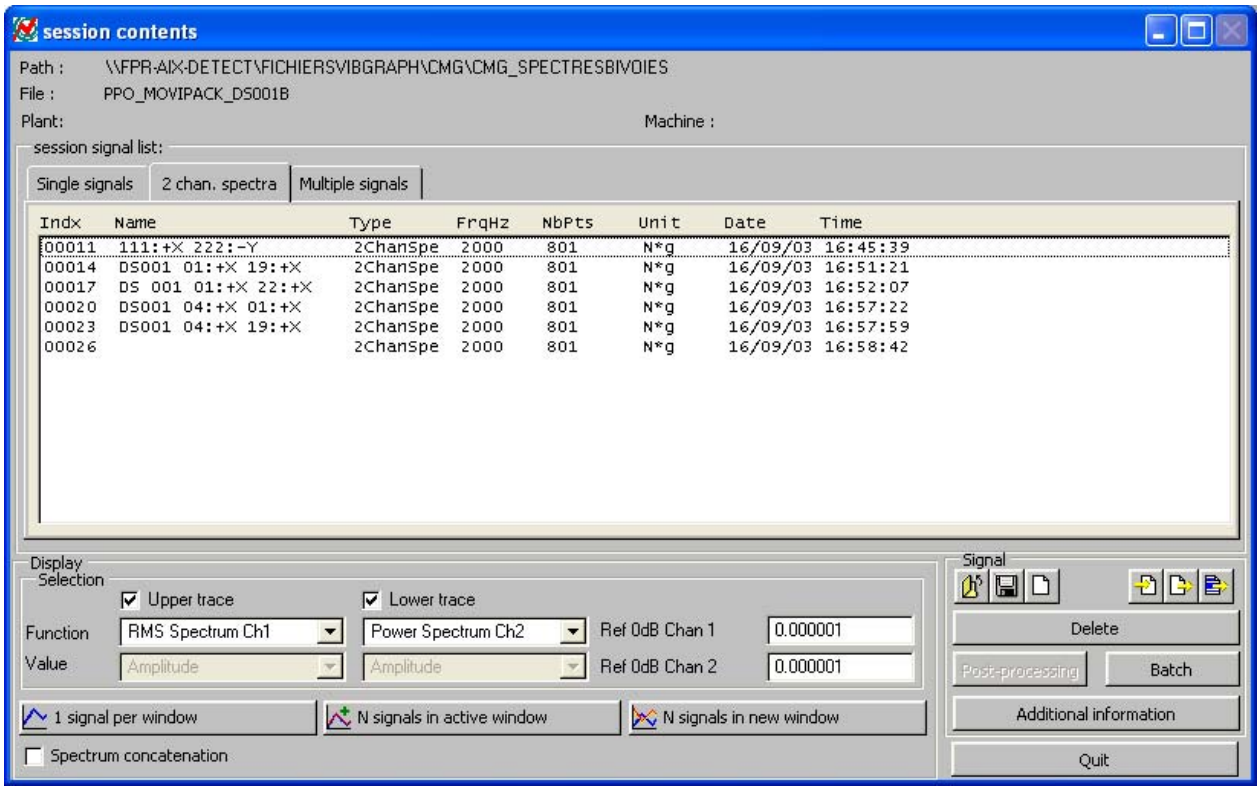
- Top Y axis for the plot on the upper part of the window

- Bottom Y axis for the plot in the lower part of the window.

The “0dB” reference is no longer part of the preferences but of the display parameters selected in the “session content” window.

Also, the type of representation is selected in the said “session content” window.

“Session content” window:



Display:			
	☑ Upper trace	☑ Lower trace	
Function:	Transfer function ½ ↓	Transfer function ½ ↓	Ref 0dB Channel 1: xxxxxxxx
Value:	Amplitude ↓	Phase ↓	Ref 0dB Channel 2: xxxxxxxx

Note :

Only one plot can be selected using the checkboxes ☑ Upper trace and ☑ Lower trace.

Available functions:

- Channel 1 RMS spectrum
- Channel 2 RMS spectrum
- Channel 1 power spectrum
- Channel 2 power spectrum
- Cross spectrum
- Transfer function 1/2
- Transfer function 2/1
- Transmissibility 1/2
- Transmissibility 2/1
- Coherence

Available values (selection of the value to represent for complex functions)

- Amplitude
- Phase
- Real part
- Imaginary part

Data stored for each “2-channel spectrum” item / unit

- Channel 1 power spectrum: S11 $U1^2$ (stored U1)
- Channel 2 power spectrum: S22 $U2^2$ (stored U2)
- Cross spectrum (complex): S12 U1*U2

Note: * = conjugated,

Calculation formulae:

- Channel 1 RMS spectrum: √S11 U1
- Channel 2 RMS spectrum: √S22 U2
- Transfer function 1/2: S12*/S22 U1/U2
- Transfer function 2/1: S12/S11 U2/U1
- Transmissibility 1/2: √(S11/S22) U1/U2
- Transmissibility 2/1: √(S22/S11) U2/U1
- Coherence: (S12.S12*)/(S11.S22) none

Calculation of values in dB: Ref = reference 0dB

Power spectrum	**10** Log ($S11/Ref1^2$)
Cross spectrum	**10** Log (|S12| /Ref1xRef2)
Averaged RMS spectrum	20 Log (√S11/Ref1)
Transfer function	20 Log (|S12/S11|).(Ref1/Ref2))
Transmissibility	20 Log ($\sqrt{(S22/S11_r)}$.(Ref1/Ref2))

Preferences can be selected according to the type of signal:

Signal	Value	Unit	Type	UP/PSD	Scale
RMS spectrum	Amplitude	☑	☑	☑	☑
Power spectrum	Amplitude	☑	☑	☑	☑
Cross spectrum	☑		☑ if value =amplitude else lin	☑	☑ -200 to +200 if value = phase
Transfer function	☑		☑ if value =amplitude else lin		☑ -200 to +200 if value = phase
Transmissibility	Amplitude		☑		☑
Coherence	Amplitude		lin		from 0 to 1

Reminder:

Unit = initial, g, m/s2, mm/s...

Type = log, lin, dB

UP/PSD: switching to power spectral density is achieved by dividing the RMS spectrum by $dF^{1/2}$ and by dividing the power spectrum and the cross spectrum by dF.

5.5.4. Plot

The window shows one or two curves depending on the preference settings.

Cursors

All types of cursors are available.

The cursor is the same for zone A and zone B (same as for Bode diagram).

Zoom

X zooms are the same for both (same as for Bode diagram).

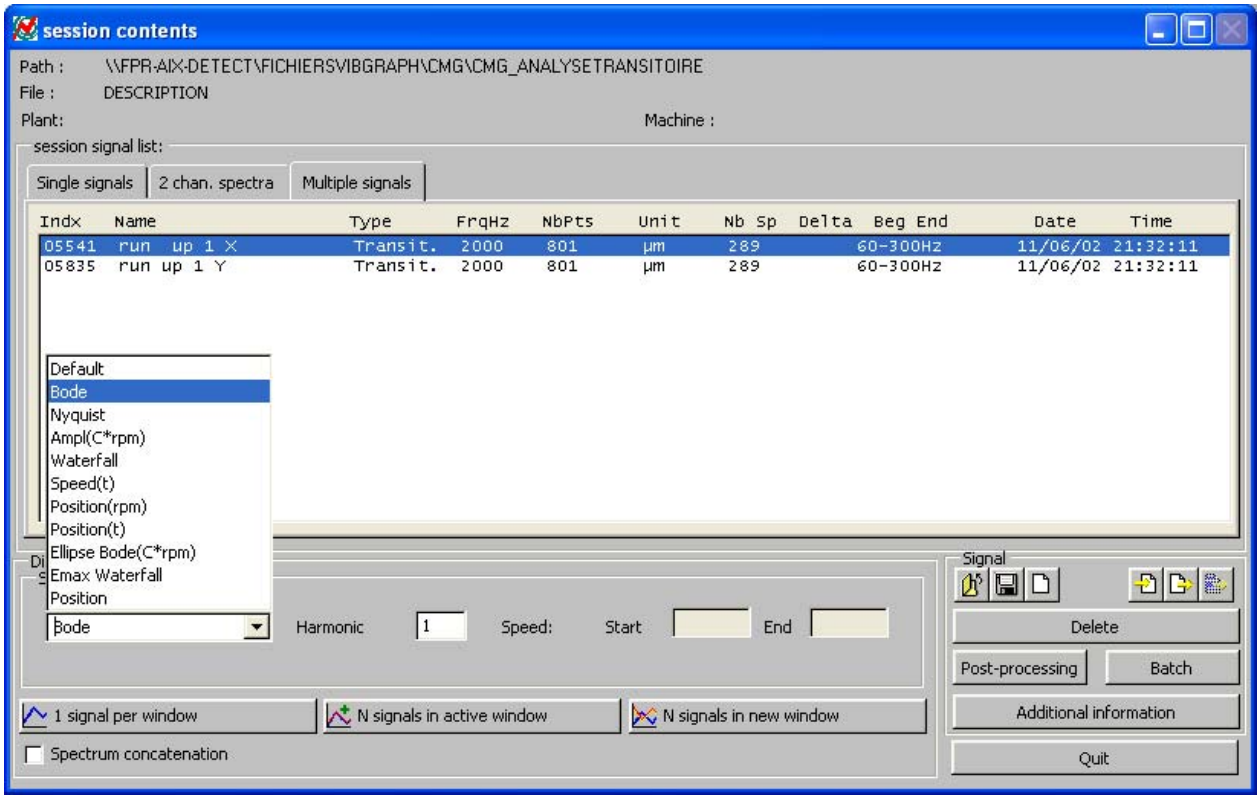
Superposition

Multiple selection allows to superimpose several signals either in a new window or in the active window. In the latter case, compatibility is checked: phase with phase, lin with lin, log with log.

5.6. "Multiple signals" tab

Different types of representations are available. Select first a signal and then, for instance, **Bode** in the *representations* pull-down. The appropriate harmonic (from 1 to 10) can then be selected, the default value of 1 being that of the rotation frequency.

The plot is achieved after the representation mode has been selected, e.g., click on the **one signal per window** button.

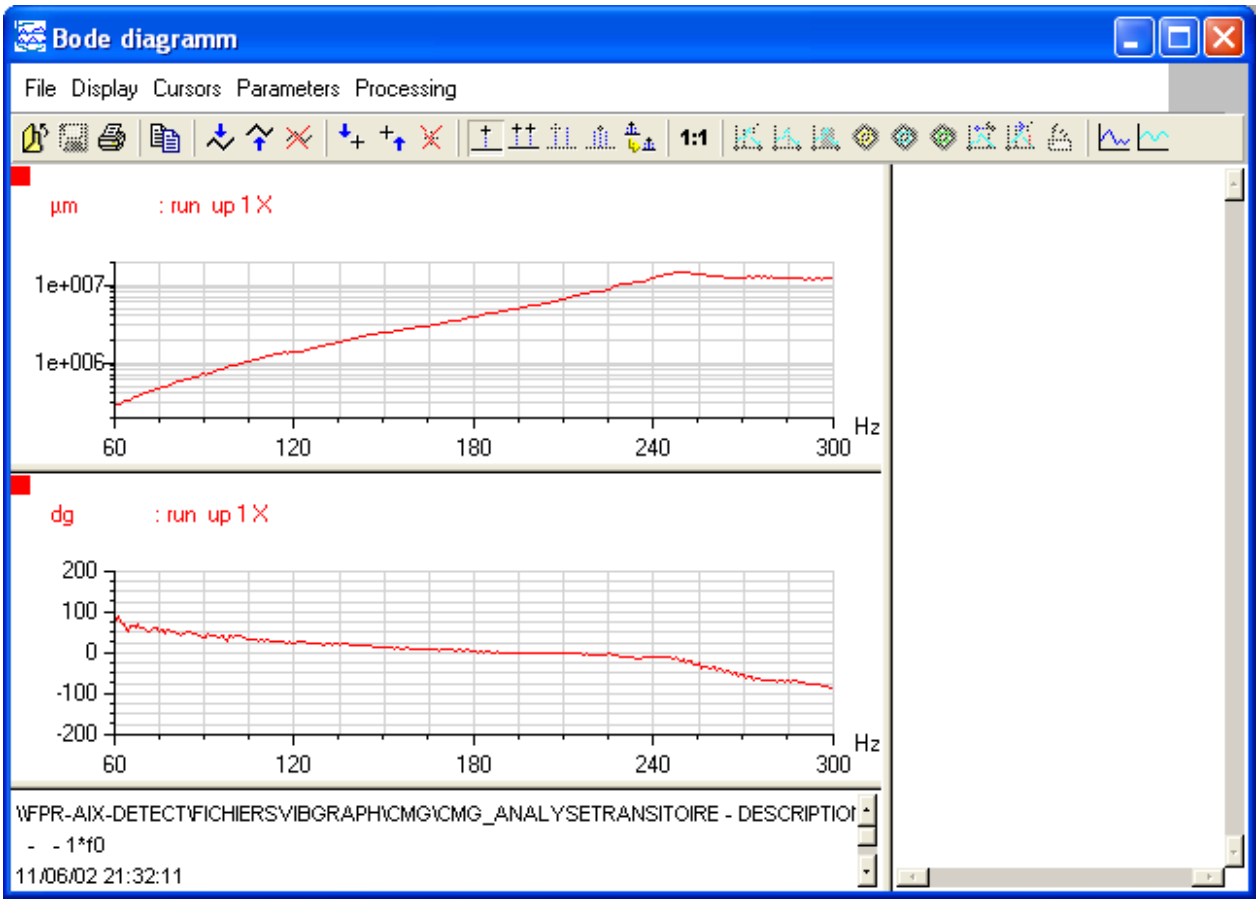


5.6.1. Bode diagram:

Select a signal and then "Bode" in the pull-down list and finally click on the type of plot.

A new window opens up that contains two curves. The first curve represents displacement versus frequency, the second phase versus frequency.

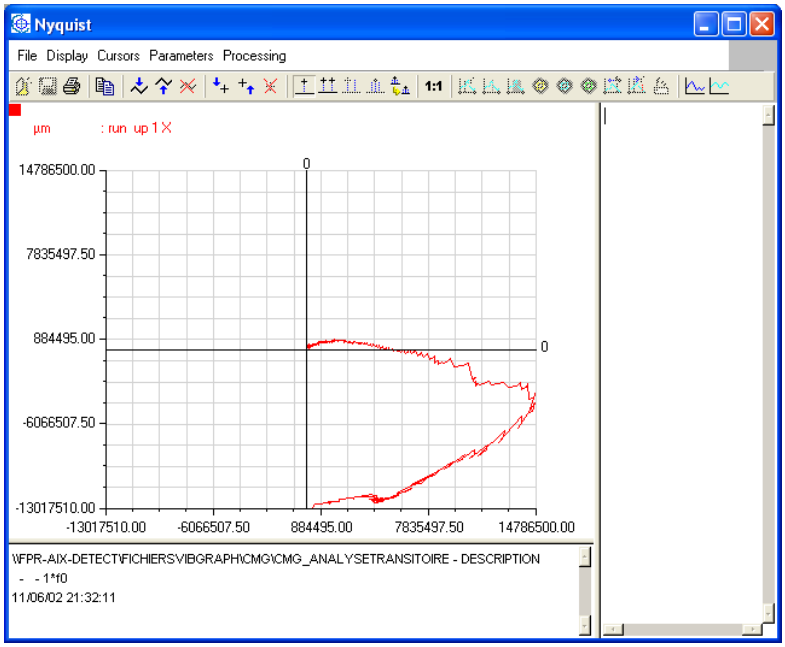
The Bode diagram represents the amplitude and phase of a component of a vibration signal (1X, 2X or 3X) versus rotation speed. It can be used to analyse critical speeds of a rotating machine and requires a phase reference. It can also be used to determine the amplification factor characteristic of the line-of-shafting (bearing + rotor) tendency to unbalance around critical speeds.



On a Bode diagram, a critical speed can be detected by a local amplitude maximum or by an inverse phase inflection.

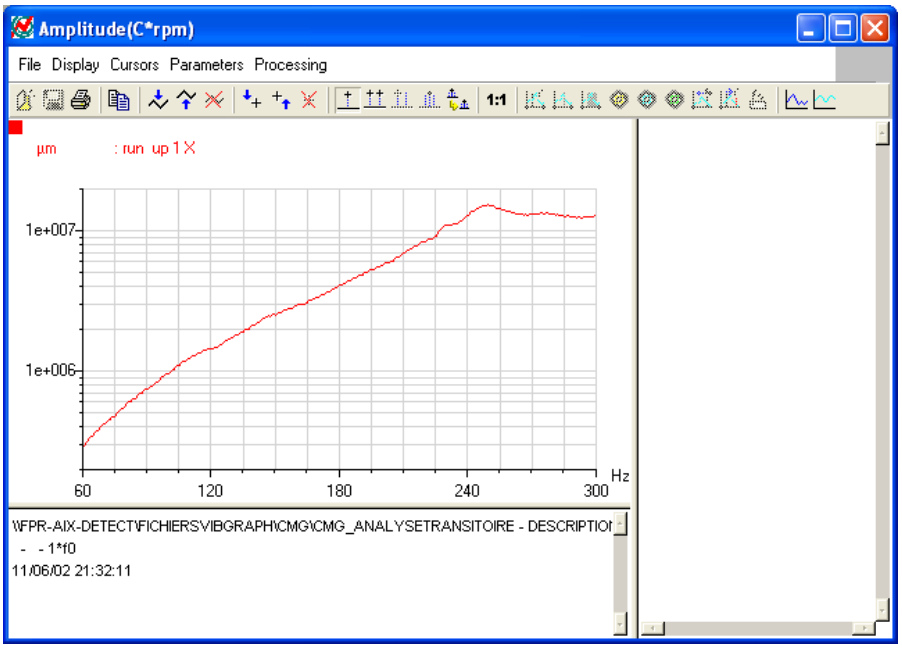
5.6.2. Nyquist diagram:

The Nyquist representation is a Real Part = f (Imaginary Part of signal) representation. It presents the same advantages as the Bode diagram.



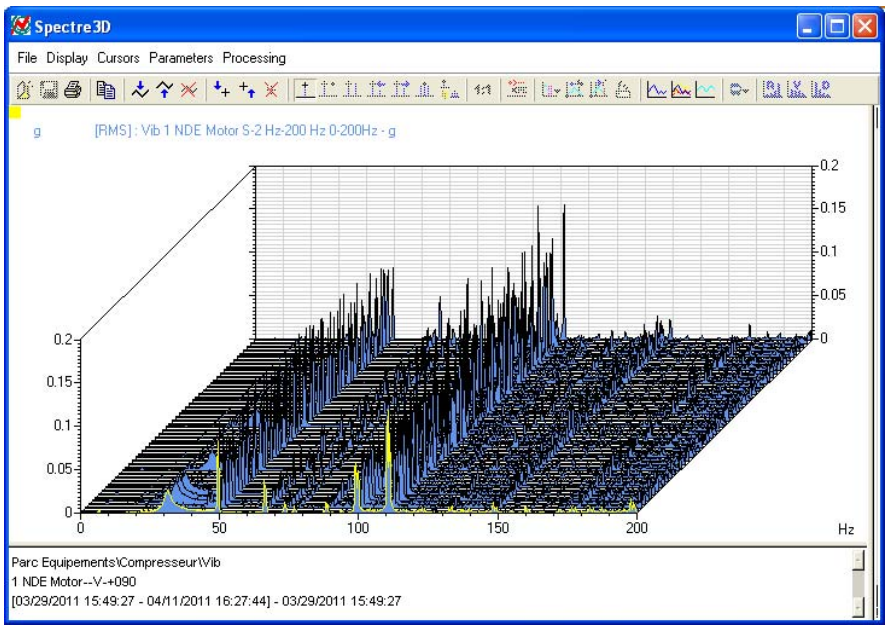
5.6.3. Ampl(C*rpm) representation:

The Ampl (C*rpm) representation corresponds to the top part of the Bode diagram, i.e., amplitude versus rotation speed, for a given harmonic.

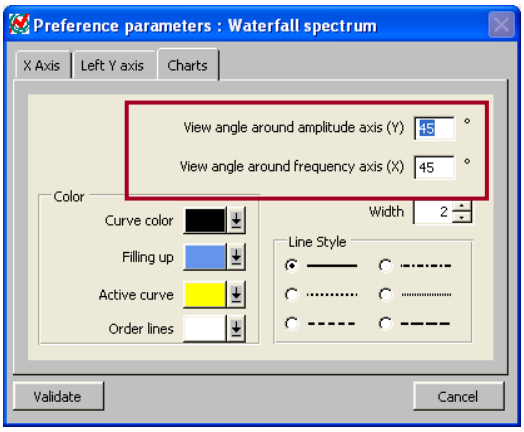


5.6.4. Waterfall representation:

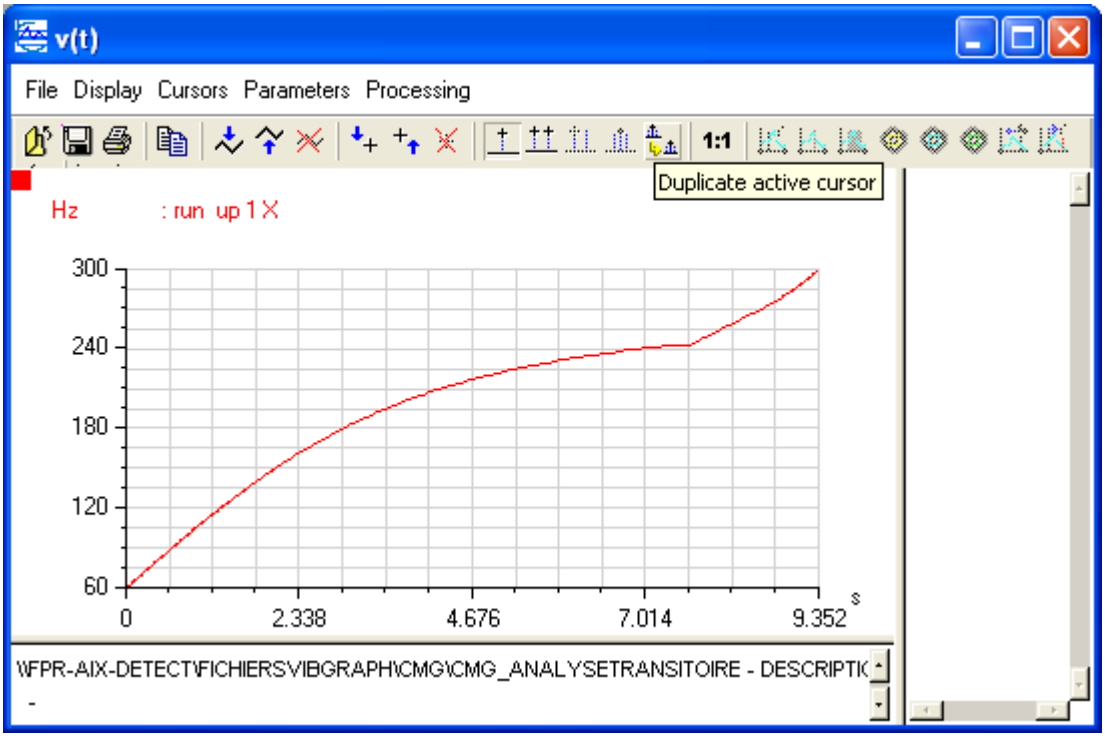
The Waterfall representation is the 3D graphic superimposition of n autospectra acquired at different instants allowing to evidence the time history of the different frequencies.



Note: the visual angle can be set from the Display Preferences of the waterfall spectrum.

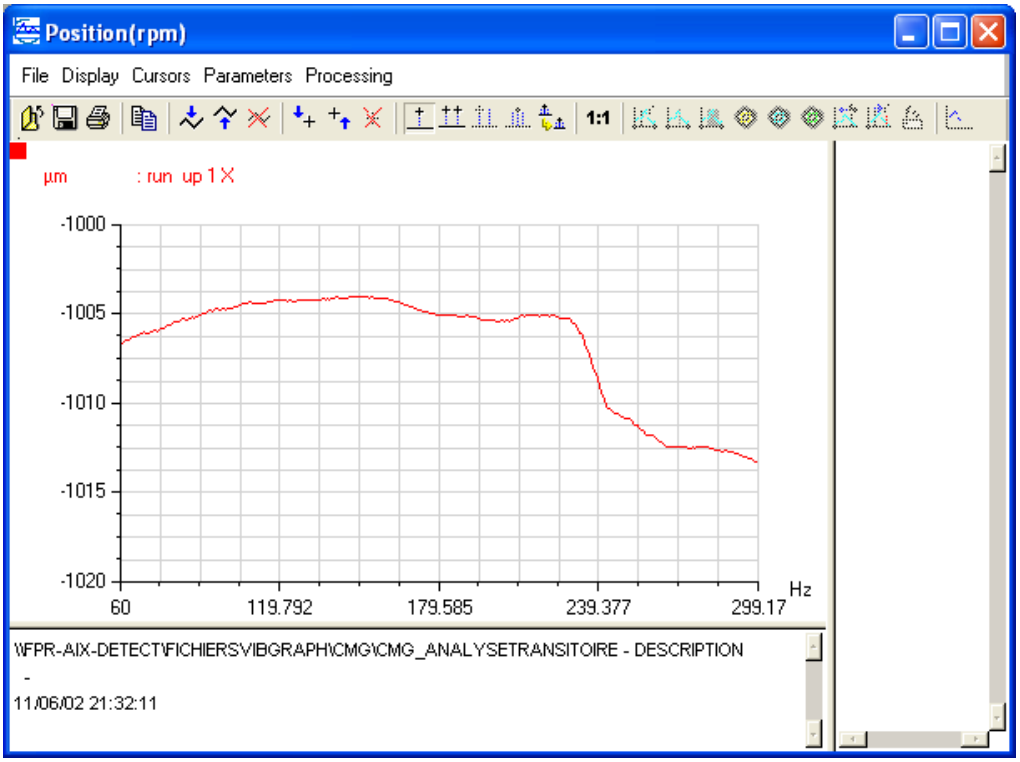


5.6.5. Speed(t) representation:



The Speed(t) representation is the plot of rotation speed during a run-up/coast-down phase versus time. It is used to assess a machine's deceleration times, these being characteristic of inner friction.

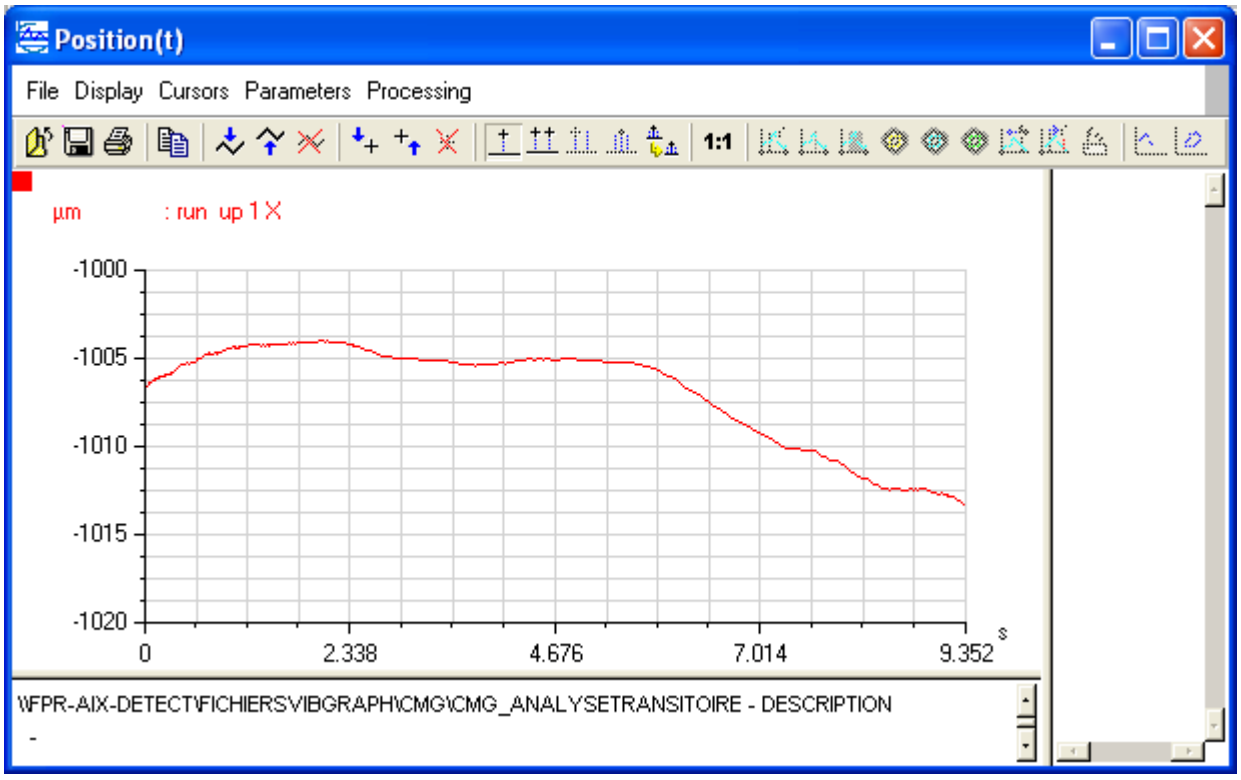
5.6.6. Position(rpm) representation:



The Position(rpm) representation describes the shaft position in the X or Y measurement plane versus rotation speed.

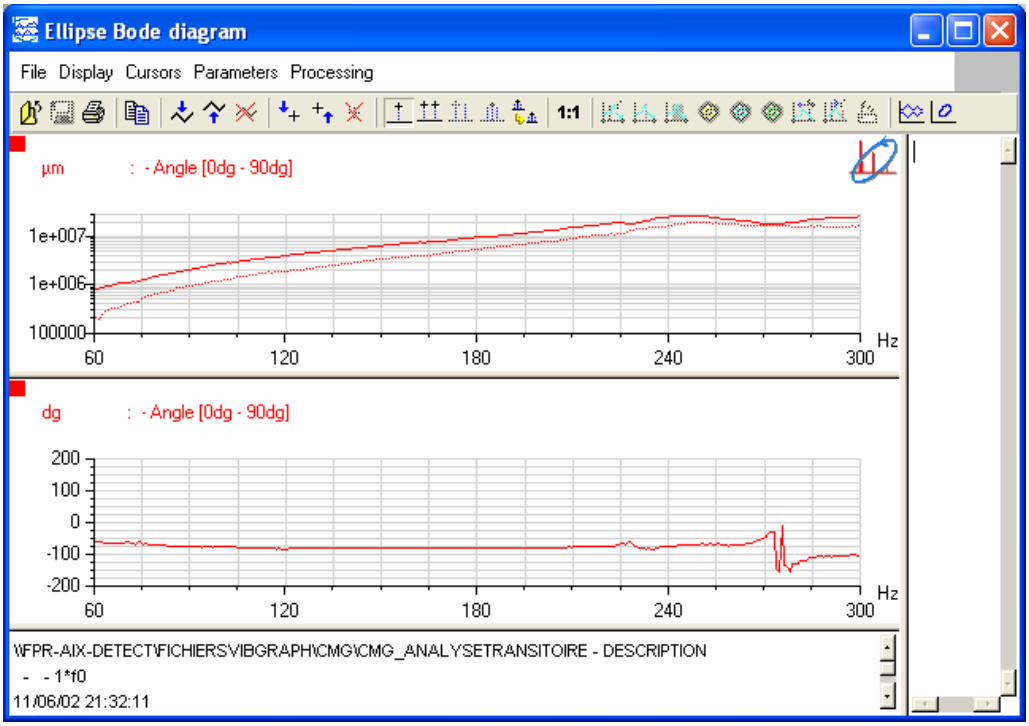
5.6.7. Position(t) representation:

The Position(rpm) describes the shaft position in the X or Y measurement plane versus time.



5.6.8. Bode Ellipse(C*rpm) representation:

Select first two multiple signals before selecting “Bode” in the pull-down list.



The above Bode Ellipse representation shows:

- For amplitudes (µm): Emax values (thick line) and Emin (dashed line) corresponding to the maximum radius and minimum radius, respectively, of the 1X-filtered orbit (1X = fundamental component of the rotation speed)
- for phases (°): orientation of 1X orbit with respect to a fixed coordinate system (measurement plane)

This representation has several advantages among which providing the maximum motions at critical speeds. These are independent of the measurement direction. Comparing Emax and Emin values gives information of the flattening of the 1X-filtered orbit.

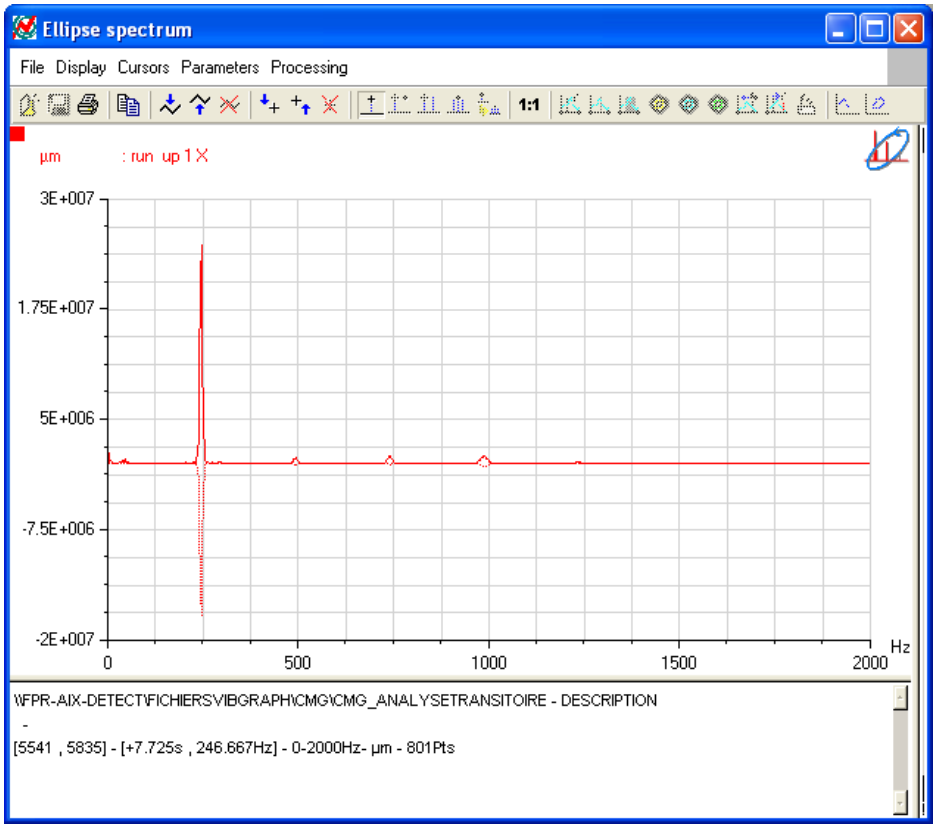
On this Bode Ellipse diagram one can very distinctly see:

- a first critical speed at 13420 RPM
- A second (more important) one at 14670 RPM
- Most likely, a third one around 18000 RPM

5.6.9. Ellipse spectrum representation:

From the previous Bode diagram, select a speed using the single cursor (icon with cross). Select, for instance, the most critical speed. Then click on icon **show ellipse spectrum(a)** on the right of the task bar.

This representation is used to view the spectral decay of Emax and Emin values.



5.6.10. Emax waterfall representation:

Select first two multiple signals before selecting “Emax waterfall” in the pull-down list. Select then the initial and final rotation speed. The default values are those previously entered.

The waterfall representation is used to analyse the evolution of the Emax spectrum versus rotation speed.