

VIEW2002: Data analysis software for the MR2002

VIEW2002 is the data analysis software specifically developed for the MR2002 Strong Motion Recorder. VIEW2002 is the tool to view and process signals recorded with the MR2002 and to carry out a large number of evaluations like integration, frequency analysis or calculation of damping. A year ago, at the 5. *Symposium of Structural Dynamics and vibration measurement* when the new version of VIEW2002 has been introduced, a detailed description of the program has been given. In the meantime many minor deficiencies have been eliminated and a few new features have been added to the program.

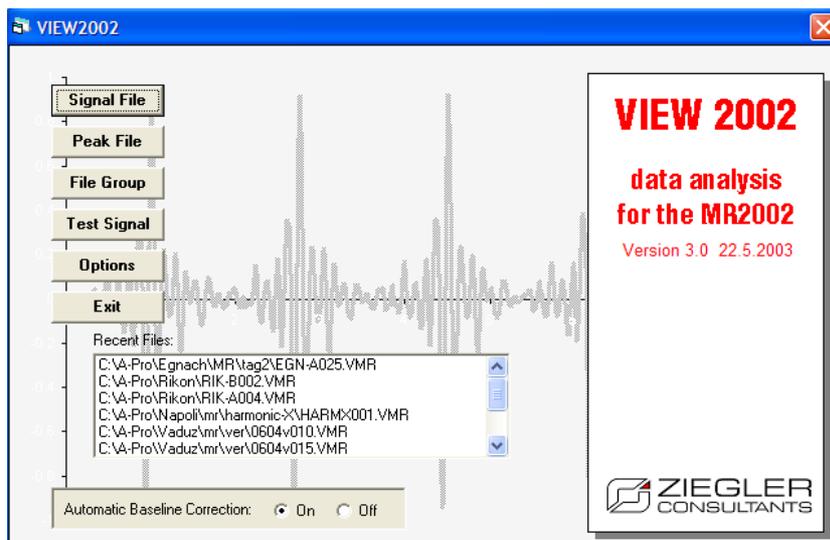
In this report we will:

- Present an overview of all options in VIEW2002
- Explain some of the less obvious features in VIEW2002 and
- Introduce the new features added to VIEW2002

1 Overview of VIEW2002

VIEW2002 is divided in five main groups:

- Signal file processing
- Peak file processing
- File group processing
- Test signal
- Options



In the table below an overview of all features in VIEW2002 is presented.

Signal File	File	Open File	Opens a velocity or acceleration file for display	
		Print	Opens the page preview and allows printing	
	View	Channel i	Frequency domain	Amplitude spectrum
				Power spectrum
			Response spectrum	Use only for acc. Signals!
		Header Info	Displays all important information about the signal	
		List	Displays a list with numerical values of signal. Useful for export into other programs	
	Time domain	Baseline correction	Baseline correction by subtracting mean value	
		Vector sum	$R_i = \sqrt{X_i^2 + Y_i^2 + Z_i^2}$	
		Displacement	Direct	Numerical integration
			w. high pass filter	Eliminates baseline errors
		Acceleration	Direct	Numerical differentiation
			w. low pass filter	Eliminates spikes
		Moving average	Rectangular window	
			Exponential window	
		Channel sum	Adds or subtracts individual channels	Frequency domain
				Response spectrum
	Frequency domain	Amplitude spectrum	Square root of power spectrum (see below)	
		Power spectrum	Sum of $(Re)^2$ and $(Im)^2$ from FFT	
		Third octave avg.	Values averaged over entire signal	
		Third octave max.	Each band represents its maximum value	
	Filter	Butterworth	Low pass	1. and 2. order
			High pass	1. and 2. order
		FFT-Filter	Band pass filter using forward and backward FFT	
	National Codes	DIN 4150/2	Moving average and KB according DIN 4150/2	
		Weighted signal (F)	weighted according to the "Arrêté relatif aux exploitations de carriers .. 22.9.1994"	

		ÖNORM S9010	Moving average and K according ÖNORM S9010
	Concatenate	Append	Appends the signal to an internal buffer
		Display	Displays all signals appended to the buffer
		Clear	Empties the buffer
	Extras	Resonance plot	Calculates resonance curve from combined acceleration and velocity signals obtained during harmonic excitation.
Peak files	File	Open File	Opens a peak file for display
		Print	Opens the page preview and allows printing
	View	Header Info	Displays all important information about the signal
		List	Displays a list with numerical values of peak file. Useful for export into other programs
	Concatenate	Append	Appends the peak file to an internal buffer
		Display	Displays all peak files appended to the buffer
		Clear	Empties the buffer
File Group	Peak	Calculates peak values for all files and evaluates statistic; displays plot	
	RMS	Calculates RMS values for all files and evaluates statistic; displays plot	
	Peak vs. Freq	Calculates peak values and dominant frequencies for all files and evaluates statistic; displays peak vs. frequency plot; shows national code limits.	
	Process Data	User specified data processing	
	DIN 4150/2	Calculates KB values for all files and evaluates KB_{Ftm} ; displays plot	
	ÖNORM S9010	Calculates K values for all files and evaluates statistic; displays plot	
	Weighted (F)	Calculates peak values for all frequency weighted files and evaluates statistic; displays plot	
	Avg. Amp. Spect.	Calculates average amplitude spectrum	
	Avg. Third Oct.	Calculates average third octave spectrum	
Test signal	Create Test signal	Sinusoidal test signal with different parameters	
	Import signal	Import signal from ASCII-files	
Options	Company logo	For print output	
	National Codes	Input data for national code limits used in peak vs. frequency plot	
	Print mode; Peak draw mode; X-axis draw mode		

2 Some less obvious features in VIEW2002

From the questions we receive, we see that some features in VIEW2002 are not as obvious as we thought they are. The examples below show the use of some of these features.

2.1 Copying files to MS-Word

Copying files from VIEW2002 to MS-Word follows the standard procedure of MS-Window and not anymore the procedure we used in earlier version of VIEW2002. To copy a signal into a word document follow the steps explained below.

1. Mark the signal you want to copy by clicking on it with the mouse. The blue line indicates the active signal (see Fig. 2.1).
2. Press Ctrl+C; the signal (only one signal) is copied to the windows buffer as meta file.
3. Put the cursor at the appropriate location in your word document and press Ctrl+V or use the specific commands to insert objects from the buffer.

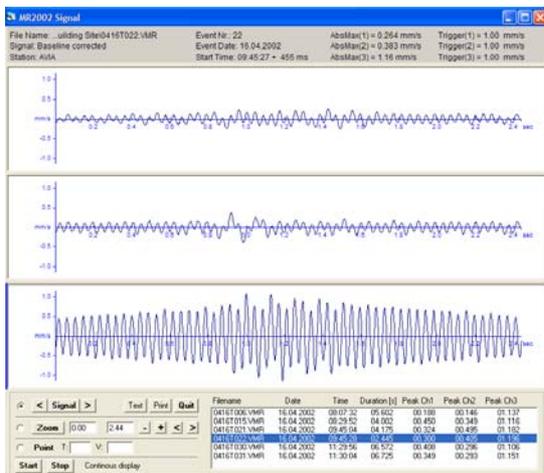


Fig. 2.1

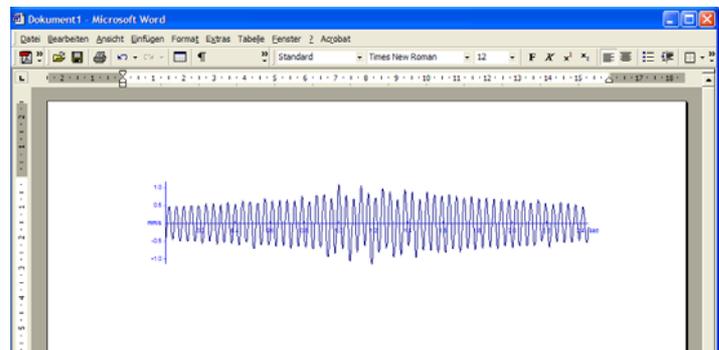


Fig. 2.2

2.2 Labelling VIEW2002 plots

VIEW2002 has a neat way to label plots. Follow the procedure described below:

1. Open a signal
2. Double click on the desired channel
3. Select *Frequency Domain* and then *Amplitude Spectrum*
4. Enable *Point*, mark the peak of interest with a mouse click and click on *Label*.

The result - as shown in Fig. 2.3a - helps to make your reports more readable.

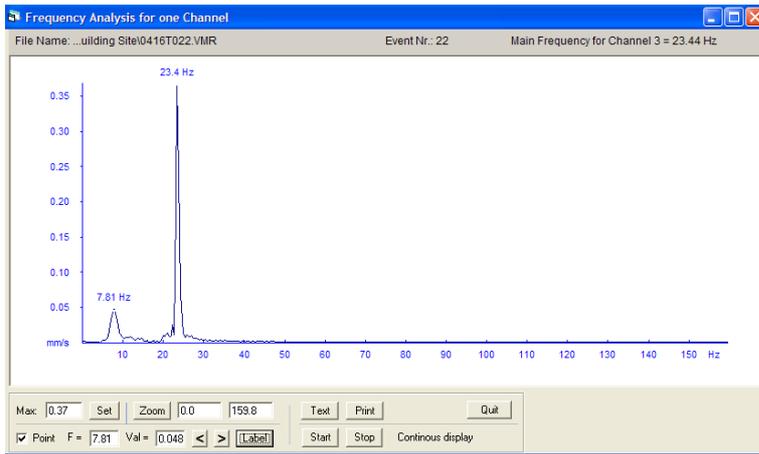


Fig. 2.3a

Similarly the plots from peak files or from file groups can be enhanced with comment as shown in Fig. 2.3b and c.

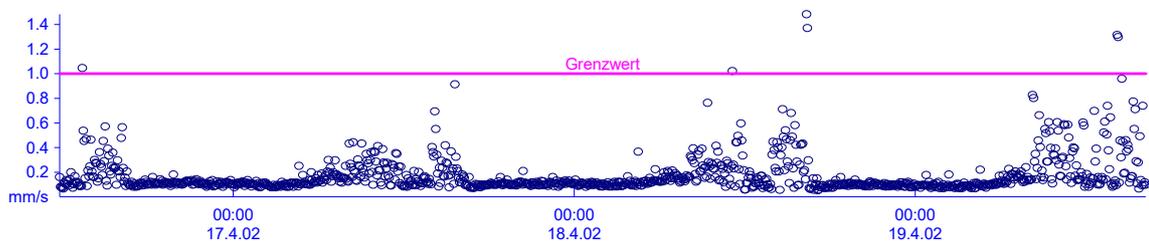


Fig. 2.3b

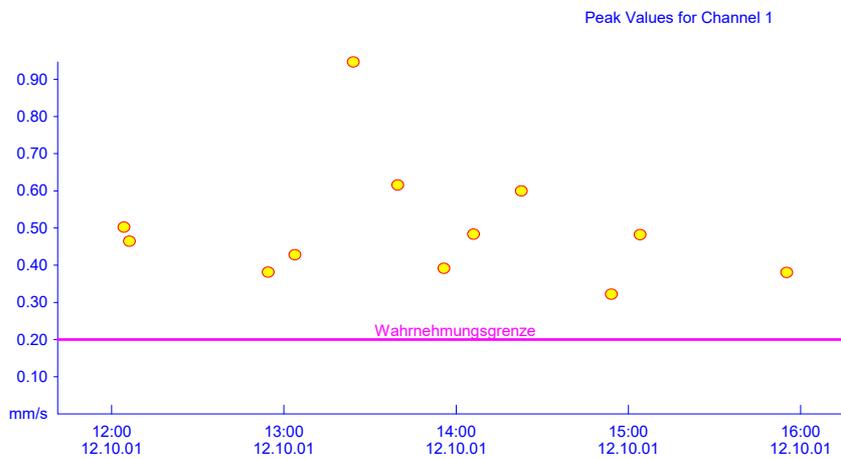


Fig. 2.3c

2.3 Concatenating Peak files

Peak files i.e. files with the extension .vmx are very useful for long term vibration monitoring. They are created by the MR2002 in the background monitoring mode. If the MR2002 has created several short peak files instead of one long peak file, you can concatenate these files easily with VIEW2002. To concatenate peak files follow the procedure shown below:

1. Open the first peak file
2. Select *Concatenate, Append*
3. Open the next peak file and select *Concatenate, Append*
4. Repeat step 3 for all peak files you want to include
5. Select *Concatenate, Display*

Fig. 2.4 shows an example of a concatenated peak file consisting of 5 separate peak files.

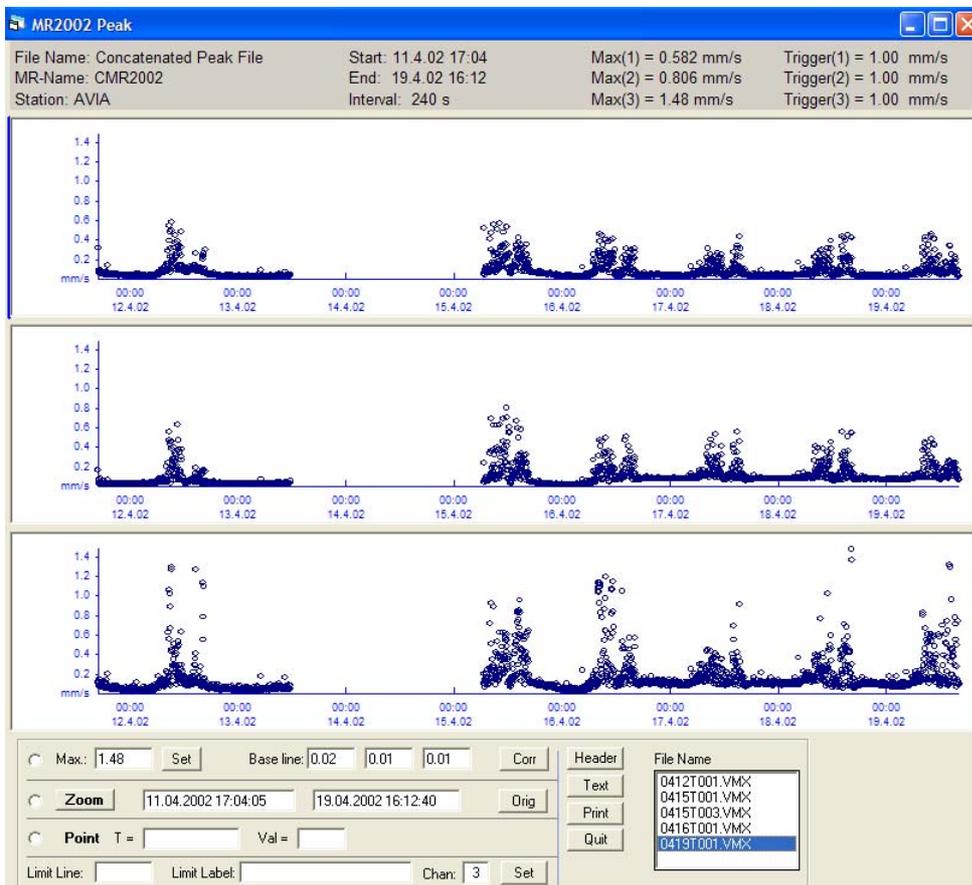


Fig. 2.4

2.4 Evaluation according to DIN 4150/2

For train induced vibrations DIN 4150/2 requires the determination of the KB_{FTm} and KB_{Fmax} values. With VIEW2002 this can be done with the menu *File Group*. Make sure that all files

are in the same directory. In the form *Evaluation of File Groups* select DIN 4150/2. The dialog box “Time Interval for DIN 4150/2” shows the *start* and *end time* as given by the first and last signal file. Overwrite these values if you want different start and end times. To bring back the original start and end times press *Set* in the dialog box. Press OK to start DIN 4150/2 calculation. The result is shown in Fig. 2.6.

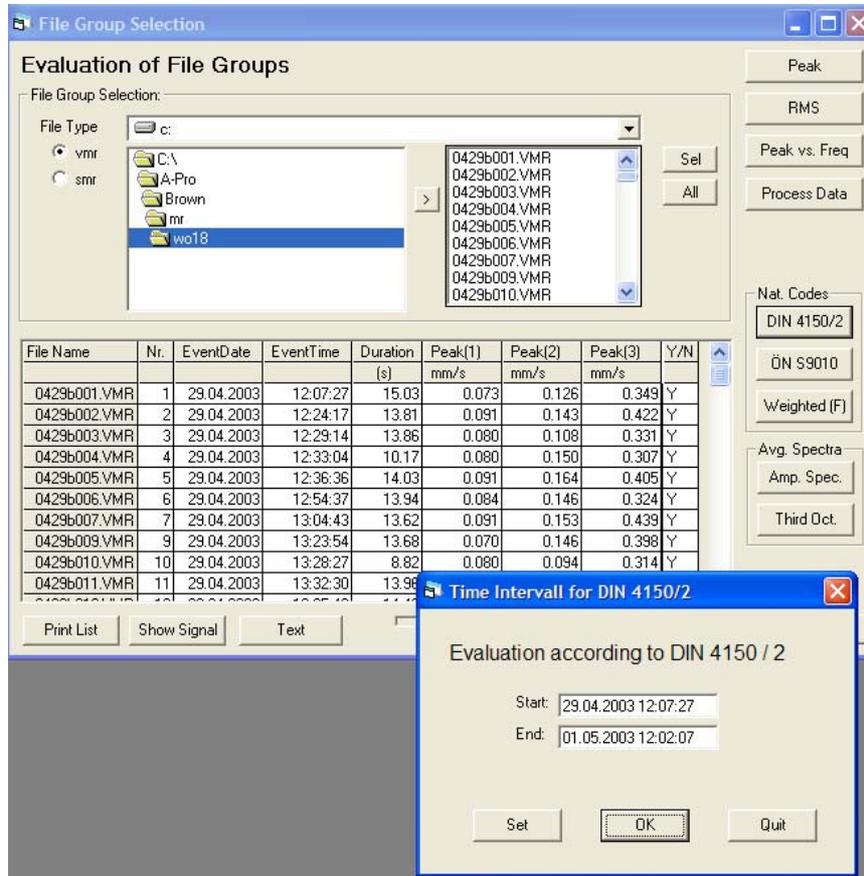


Fig. 2.5

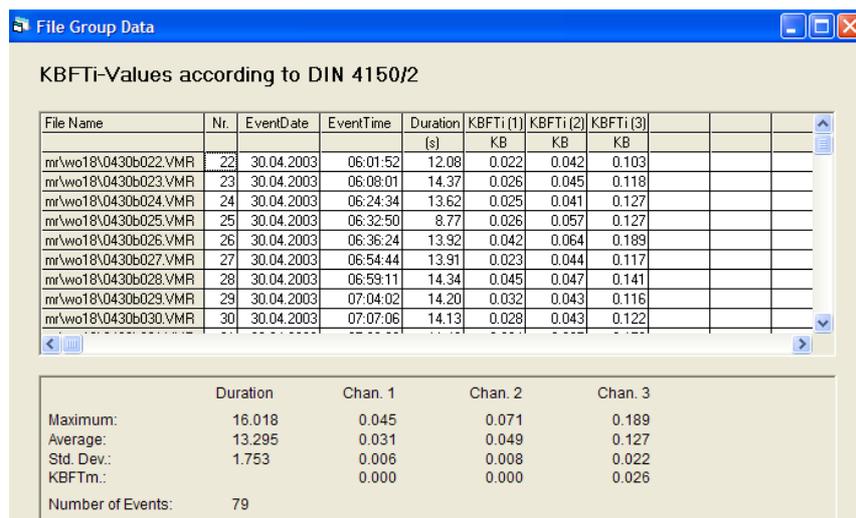


Fig. 2.6

3 New features in VIEW2002

VIEW2002 has among several minor improvements three new features:

- Continuous display

- Resonance plot
- Response spectra

3.1 Continuous display

Continuous display uses the MR2002's new ability to automatically upload signal files. These files are continually stored in the directory "C:\Program Files\Syscom\Instant" under the name *insta001.vmr*, *insta002.vmr* and so on. If you select one of these files with VIEW2002, you can display continuously all oncoming files as soon as they become available. To start *Continuous display* you click *Start* in the lower left corner of the signal window (see Fig. 3.1). VIEW2002 will automatically display the signals and wait for the next file if no file is available yet.

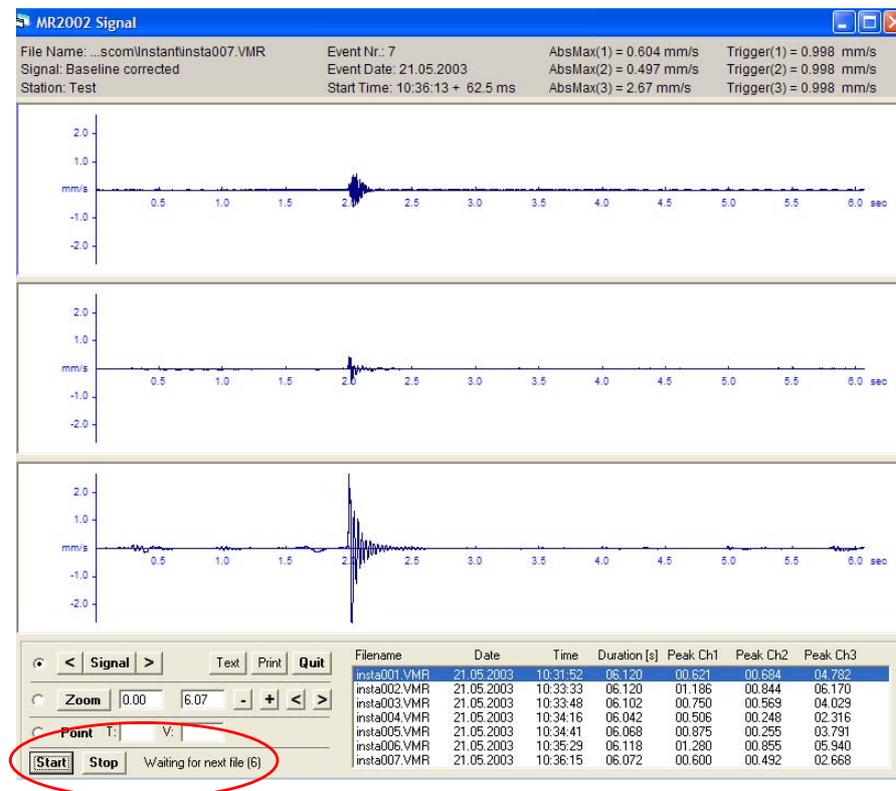


Fig. 3.1

Continuous display is available in the following windows:

- Signal window (as shown in Fig. 3.1)
- Amplitude spectrum window for 3 channels
- Amplitude spectrum window for 1 channel

In the signal window the user gets automatically the latest signal displayed. In the window for amplitude spectra (1 or 3 channels) the average of the spectra is displayed. The user can observe – almost in real time - how the shape of the spectrum improves with increasing number

of measurements. This feature is especially useful when using the spectral ratio calculation according to Nakamura as shown in Fig. 3.2.

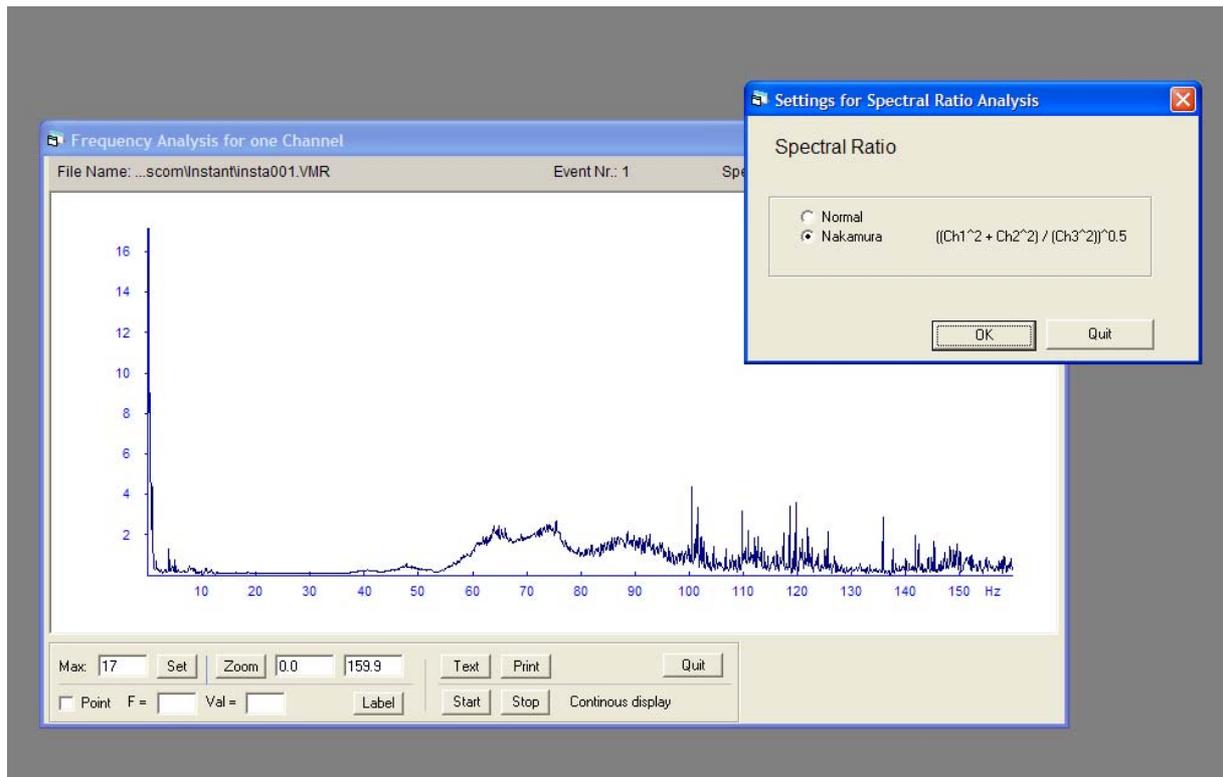


Fig. 3.2

3.2 Resonance Plot

With the new feature “Resonance Plot” the MR2002 can be used - in combination with a shaker (harmonic excitator) - to determine the dynamic stiffness of a structure. An uni-axial acceleration sensor is placed on the excitator mass and an uni-axial velocity sensor on the structure itself as shown in Fig. 3.3. Note that the MR2002 can be used with acceleration and velocity sensors at the same time but you must take care of the amplification factors. The acceleration and velocity signals are continuously recorded and the frequency of excitation is slowly increased.

Once the signals are recorded the evaluation with VIEW2002 can start: VIEW2002 takes the first section of the signal (with length = window size) to get the force and the displacement and calculates the ratio of the two. Then it takes the next section (also with length = window size) and so on. If a value for overlap is entered the new section contains part of the former section. The ratio of the two values plotted against frequency yields the resonance curve as shown in Fig. 3.4.



Fig. 3.3

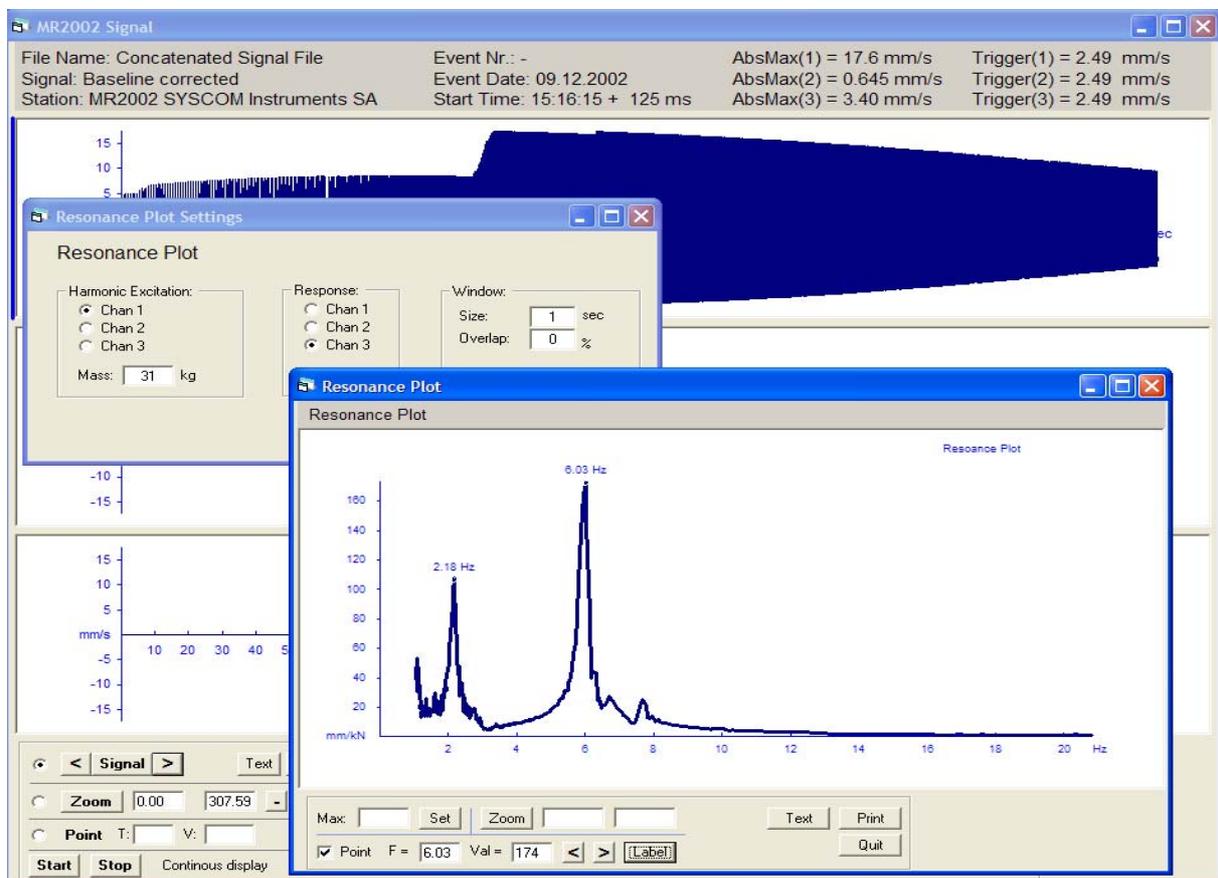


Fig. 3.4

3.3 Response Spectra

Response spectra are a convenient way to graphically display the effect of vibrations on structures. It is widely used in earthquake engineering. VIEW2002 has now incorporated the feature of calculating response spectra for vibrations measured with the MR2002. To calculate the response spectrum for a signal we proceed as follows:

1. Calculate the acceleration of the signal (in menu *Time domain*)
2. Select the desired channel
3. Select menu *Response Spectrum*
4. In the dialog box *Response Spectrum Settings* enter the damping values and press *OK*.

The response spectra for the desired damping values are displayed as shown in Fig. 3.5.

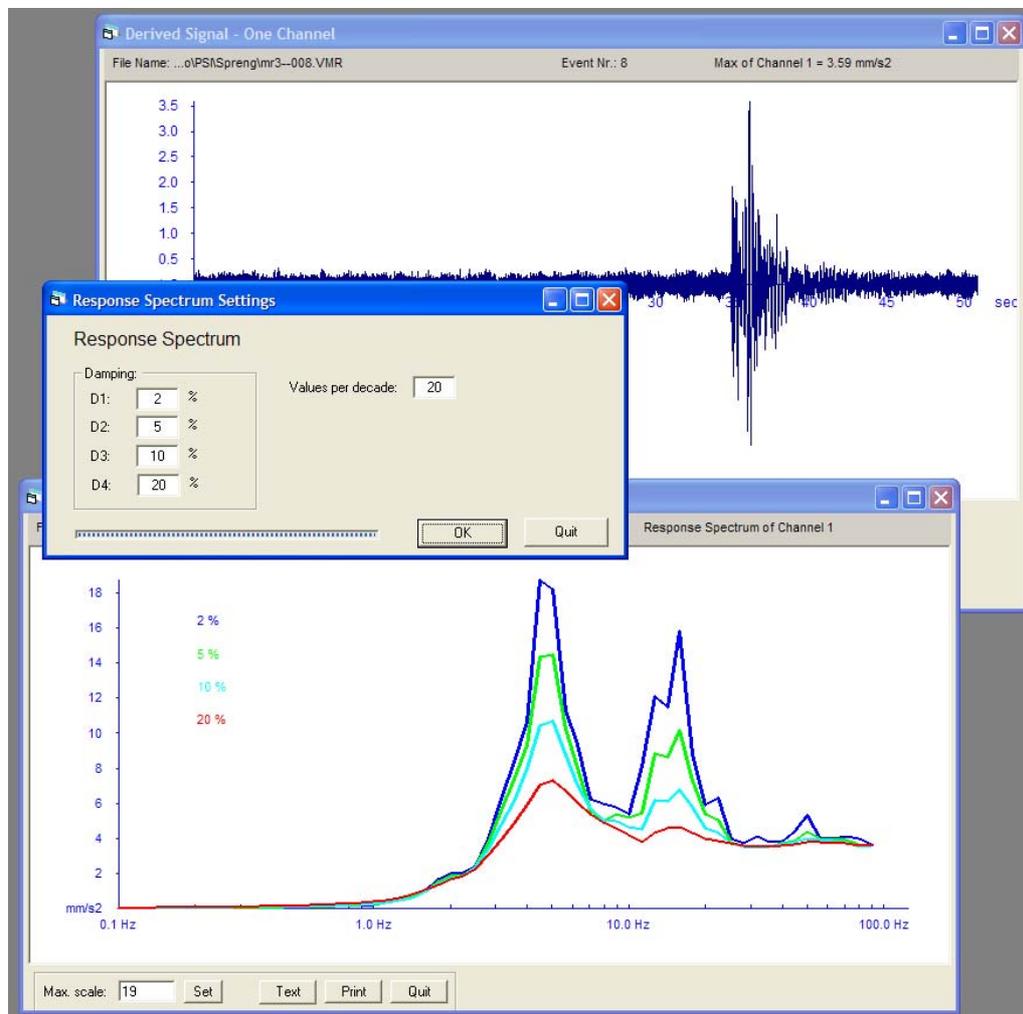


Fig. 3.5