

Using the Channel Calc Function (ATP 14) in ArtemiS

The function "Channel Calc", which can be called from within the Statistics Pool of ArtemiS, allows channel-related operations to be performed – for example, for an automated post-processing of analysis results. With a short introduction and some examples, this Application Note explains how to take advantage of this useful function.

Introduction

The Channel Calc function can be called from within the Statistics Pool of an ArtemiS project (see figure 1).

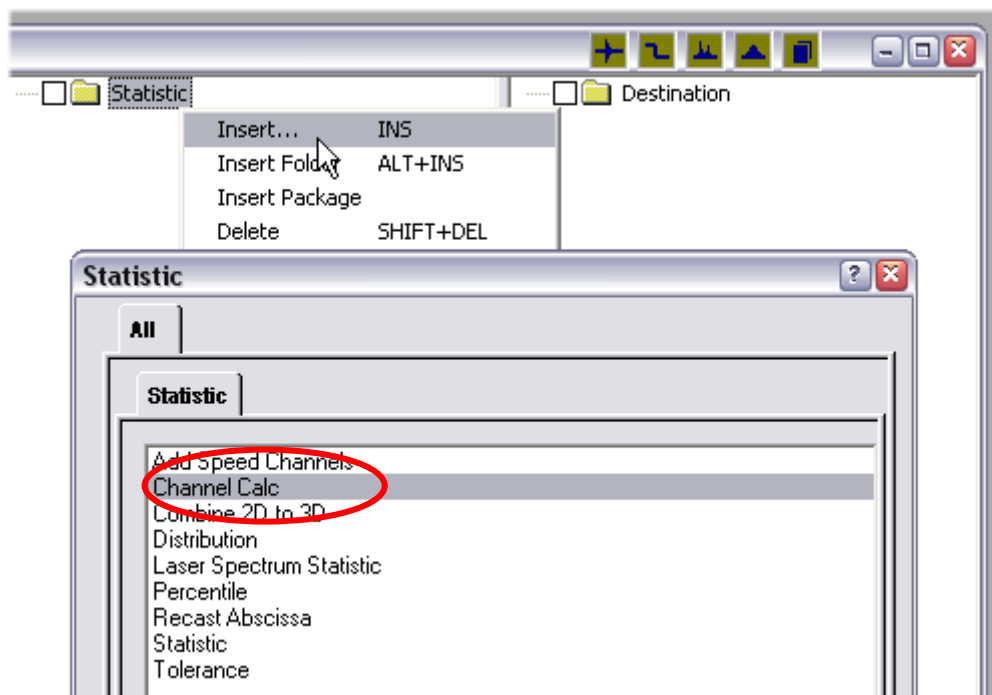


Figure 1: Calling the Channel Calc function in ArtemiS

After inserting the Channel Calc function, you can enter the calculation rules in the Properties dialog in the form of a text script. Figure 2 shows the Properties dialog of a newly inserted Channel Calc element.

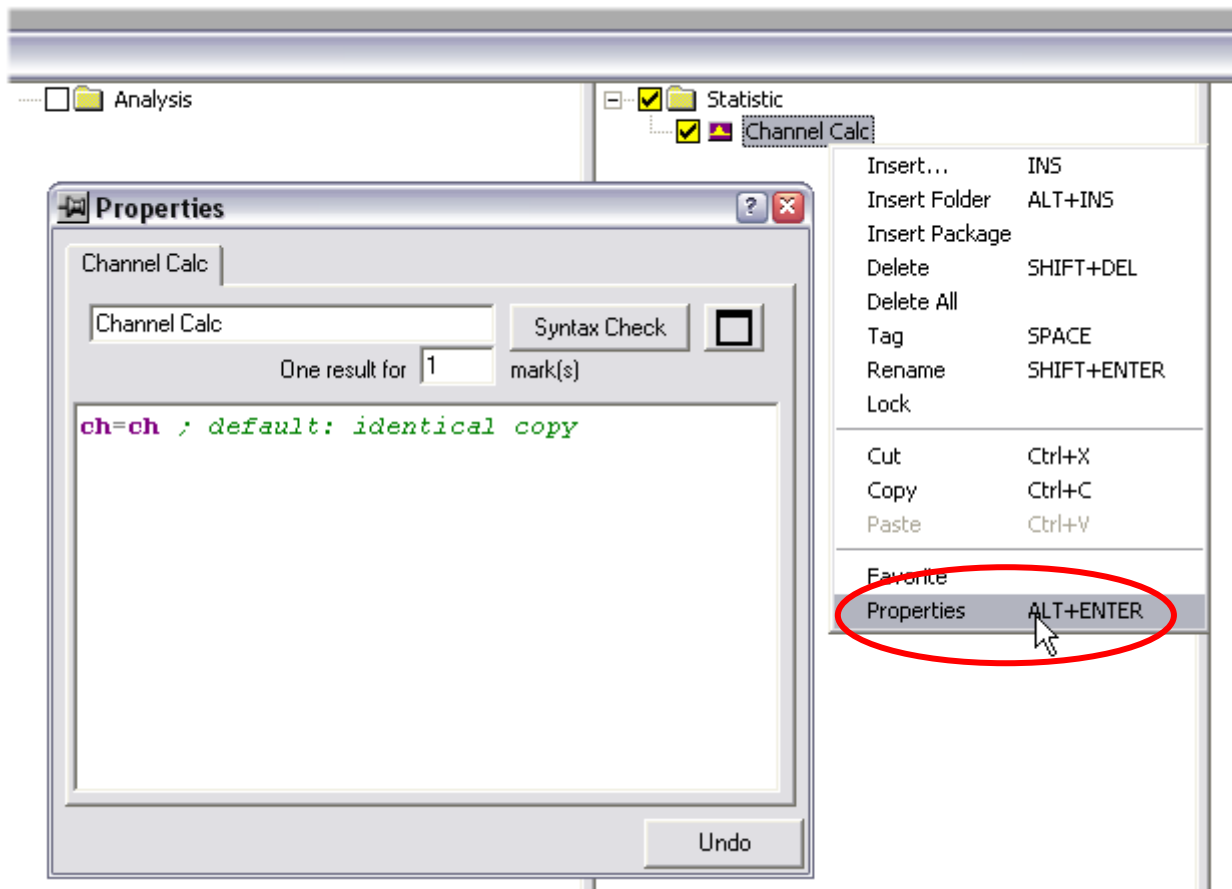


Figure 2: Properties dialog of a newly inserted Channel Calc element

The Properties dialog of the Channel Calc function contains the following areas:

- title bar with element name,
- "Syntax Check" button for checking the entered script code,
- button for maximizing the script input window,
- input field for the number of marks to be linked ("One result for x mark(s)"),
- script input field.

A newly inserted Channel Calc element always contains the formula "**ch=ch**", which causes all input channels to be copied to the output channels. The description following after that ("*; default: identical copy*") is a comment, separated from the code by a semicolon.

In the script input field, the output data are always entered on the left side of the equal sign, and on the right side the calculation rules based on the input data. The abbreviation **ch** or **ch[]** is used to refer to all channels of a signal. Using an index number, for example **ch[1]** refers to a specific channel for the calculation.

If an output channel appears several times on the left side, only the last assignment is valid. Iterations are not possible, since the formulas on the right side always refer to the original input signals. For example, the following code

```
ch[2]=ch[1]+ch[2]
ch[2]=ch[2]
```

simply causes the second input channel to be copied to the second output channel. The addition of channel 1 and channel 2 in the first line, though executed at first, is overridden by the com-

mand in the second line, because the calculations on the right side always refer to the (unchanged) input data.

The calculation rules can contain the basic arithmetic functions as well as more complex operations such as sine or logarithm. With the keyboard shortcut [Ctrl]+[Space] or via the context menu, a list of keywords showing all the possible operations can be opened (see figure 3).

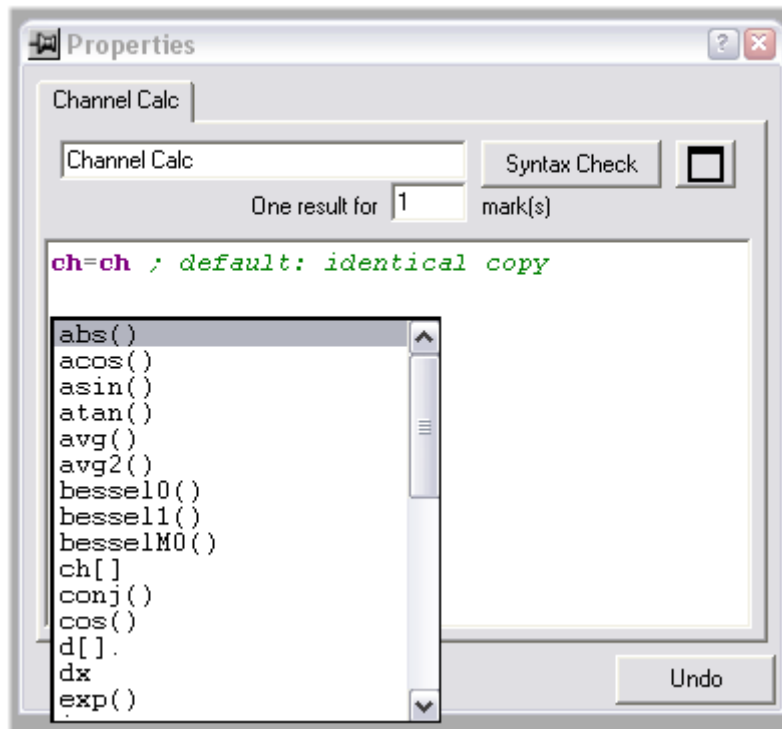


Figure 3: Keyword list for the Channel Calc function

To combine the data from several sound files, the prefix **d[]** must be used before the channel specification (e.g. **ch[2]=d[1].ch[2]** to refer to the second channel of the first data set). That way, several data sets are linked, for example, to create a four-channel file from two two-channel files. To combine two marks, enter a "2" in the field "One result for x mark(s)".

The calculation rules of the Channel Calc element are applied to all active data files in the Source Pool of the project. Also, the calculation rules are only applied to the active channels. This means that if, for example, only the first and the fourth channel of a four-channel file have been activated, the term **ch[2]** refers to the fourth channel, as it is the second active channel for this calculation. As soon as an analysis is active in the project, the calculation rules are applied to the analysis results.

With these rules, channel-related operations can be performed quickly and easily. The following application examples illustrate some of the possibilities.

Application Example 1

Task: Reduce the signal level of all channels of an audio signal by 10 dB.

Solution: First we define a constant named "amplification_dB" and set it to "-10" (see figure 4). In the next line "amplification_lin=**pow10**(amplification_dB/20)", converts the parameter into a linear value. This conversion is necessary, because the subsequent calculation formula is applied to the audio signals, which are saved as linear values as well (in Pascal). The calculation formula **ch=ch*amplification_lin** then multiplies all input channels with the linear constant. The multiplication with the linear value is equivalent to the subtraction of the level reduction value in dB.

To save this modification permanently, a File Export must be selected in the Destination Pool as the destination. With this configuration, a new file with the new, level-reduced audio signal is created.

Application: With this small script, the signal level of several audio signals can be adapted quickly and easily. This is necessary, for example, if a calibration error occurred during a recording session.

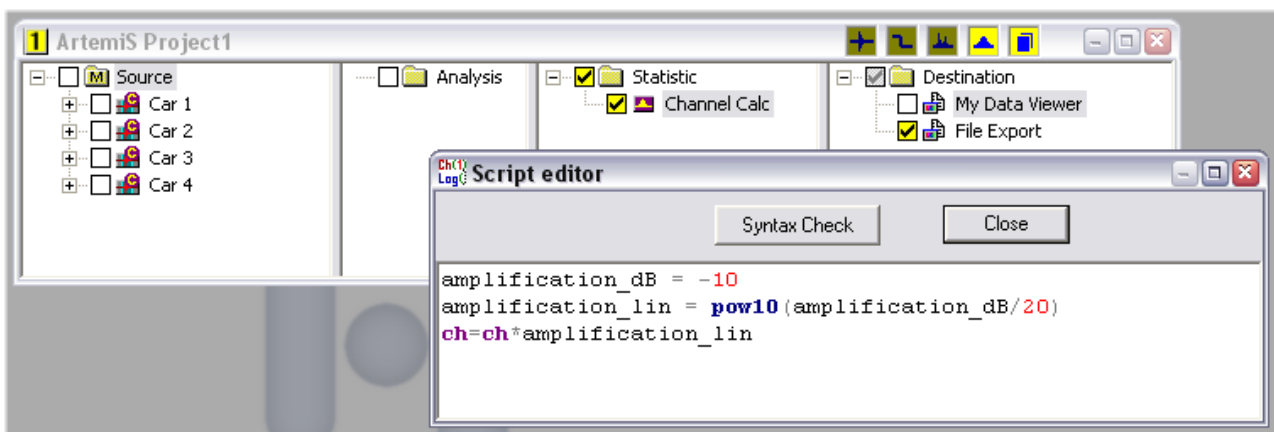


Figure 4: Project and script for application example 1

Application Example 2

Task: Normalize the analysis results of all channels of a mark using the first channel as the reference quantity.

Solution: The formula **ch=ch/ch[1]** divides all active channels of a mark by the first channel (see figure 5).

Important: In ArtemiS, analysis results are always saved as linear quantities with the corresponding unit. The Channel Calc calculation refers to these linear quantities and their units. This is the case even if the analysis results are displayed in dB in the result window. Therefore, in the following example using the "Level vs. time" analysis, the calculation rules do not refer to the values in dB, but to the values in Pascal. The division does not only affect the numerical values, but also their units. Therefore, the result of the example script shown here is dimensionless. In the result

window, this dimensionless quantity is then shown in dB. Since the quotient of the Pascal values is equivalent to the difference in dB, the result of the analysis and the Channel Calc function shown in figure 5 is the difference between channel n and channel 1 in dB.

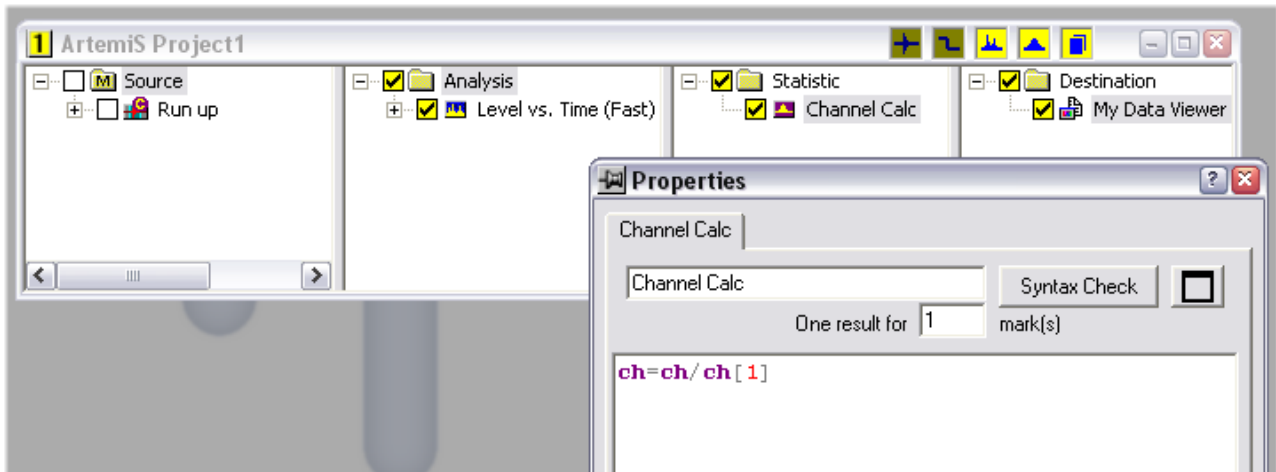


Figure 5: Project and script for application example 2

Application Example 3

Task: Determine the proportion of the second and fourth order of an engine noise signal in percent of the total signal level using a Channel Calc element and the function “Analysis Pool for Files”.

Solution: First the signal levels of the second and fourth order as well as the total signal level must be determined and saved as separate result files. This can be done with the project shown in figure 6, which includes the sound file to be analyzed, the “Order Spectrum vs. rpm” analysis and a File Export. On the second tab of the Properties dialog of the analysis, the function “Cut” can be activated. With the entry “0.”, the total signal level is determined (see figure 6). For the second order, enter a “2.” in the list and a “4.” for the fourth order. In the Destination Pool, a File Export is selected as the destination. That way, the calculation creates three new files containing the results of the analyses.

In order to further process these results with the Channel Calc element, they are inserted into the “Analysis Pool for Files” immediately after the export. For this purpose the option “Analysis results -> Analysis Pool for Files” must be selected in the selection box “Feed” on the property page of the File-Export (see figure 7). As soon as this option has been chosen and a calculation has been started the results are automatically inserted into the Analysis Pool for Files and can be used for further calculations.

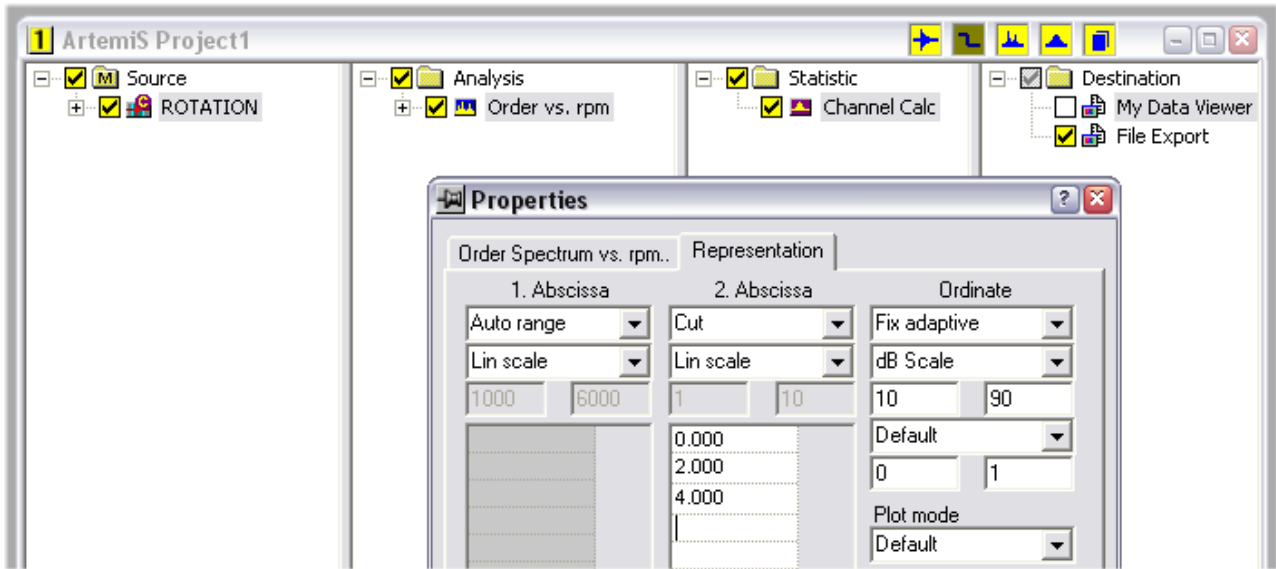


Figure 6: Properties dialog of the “Order Spectrum vs. rpm” analysis for determining the total signal level

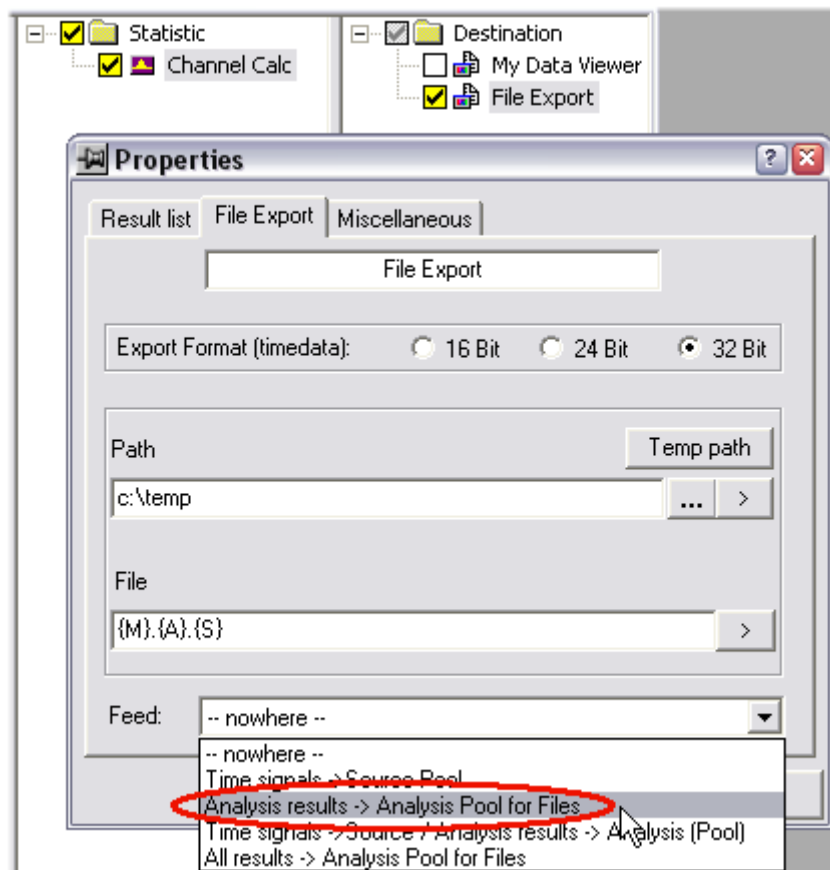


Figure 7: Property Page of the File Export

In order to see the data sets which have been inserted into the Analysis Pool for Files, the project needs to be switched to the “Analysis Pool for Files” mode. This can be done via the context menu of the Analysis Pool (see figure 8).

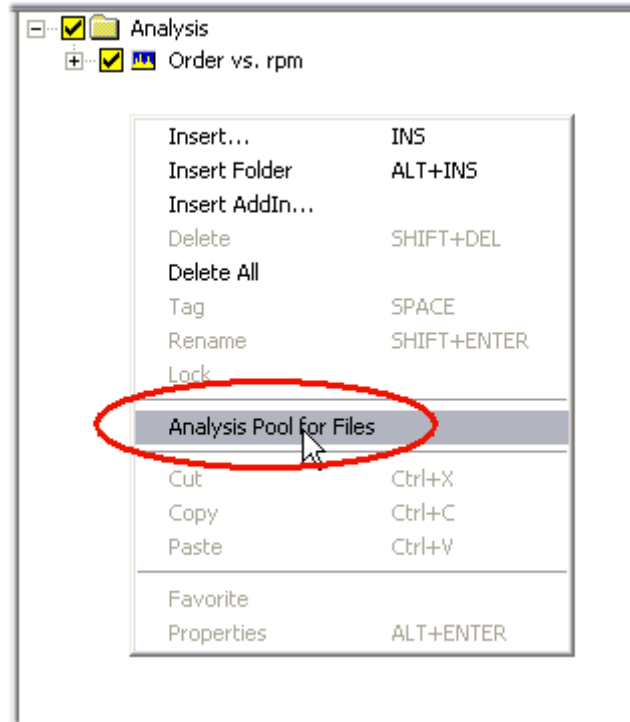


Figure 8: Context menu of the Analysis Pool

By switching to the “Analysis Pool for Files” mode, the Source Pool of the project is grayed out, and it is now possible to insert the calculated analysis results into the Analysis Pool (see figure 9).

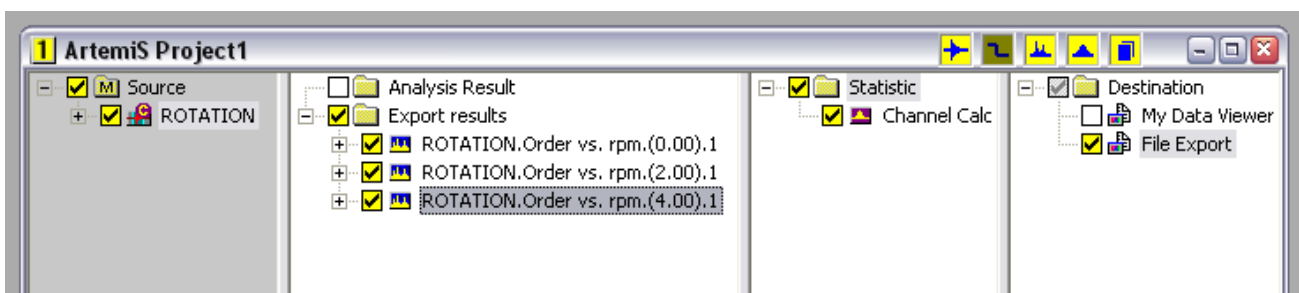


Figure 9: ArtemiS project in “Analysis Pool for Files” mode

Figure 10 shows the script for the Channel Calc element, which determines the percentage of the total signal level for the second and fourth order. Furthermore, this script changes the unit to “%” and specifies a new channel title. For a better overview, the script is shown with the script editor window maximized.

The conversion of the unit is achieved by a multiplication with the term “Unit(“%”)”. The following command changes the channel name: “ch=“channel name; abbreviation of the channel name; channel title””. The command “ch=“ch\$;ch\$;(2.Order+4.Order)/Overall”” used in the script copies the channel name and the abbreviation of the input channel and changes the channel title to “(2.Order+4.Order)/Overall”. In order for the script to work cor-

rectly, the results of the three files must be combined. To achieve this, a "3" must be entered in the "One result for x mark(s)" field.

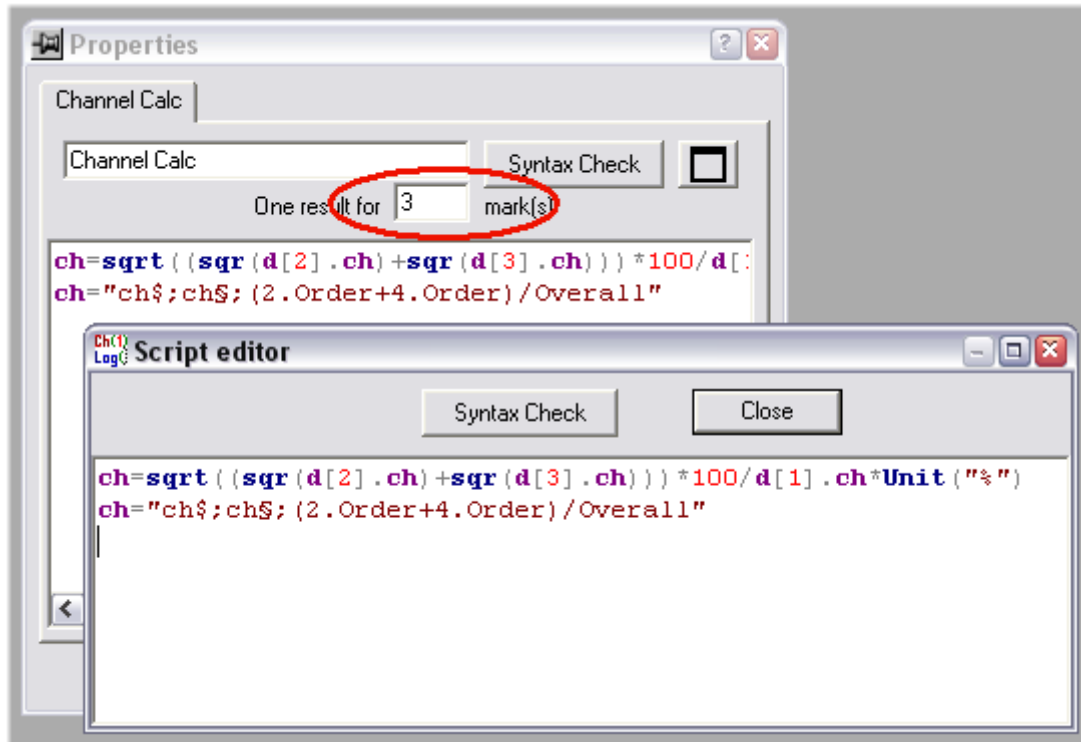


Figure 10: Script for application example 3

Important: In order for the result to be displayed correctly in "%" rather than in "dB[100%]", the output format must be changed to "Lin Scale" on the second tab of the Properties dialog of the results inserted into the "Analysis Pool for Files" (see figure 11).

In the subsequent calculation with the Channel Calc script activated, the diagram scale is displayed with the unit "%". Figure 12 shows an example created with the calculation steps described above.

The section of an engine run-up examined here shows a resonance that is especially prominent in the second and fourth order. This is illustrated very well by the percentage of the total signal level for these orders. When the resonance is passed through, the percentage of the second and fourth order increases to about 80 % of the total signal level.

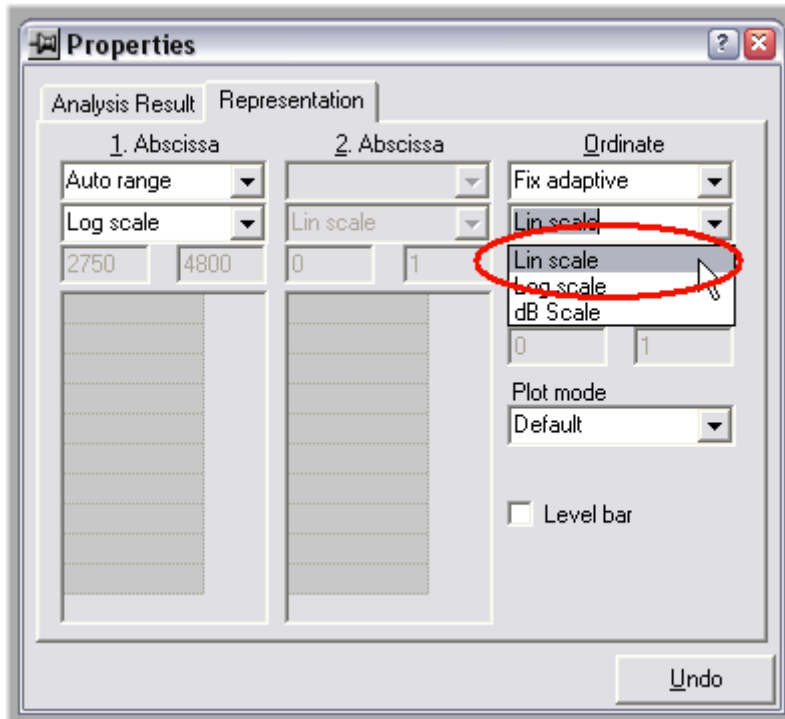


Figure 11: Properties dialog of a result inserted into the "Analysis Pool for Files"

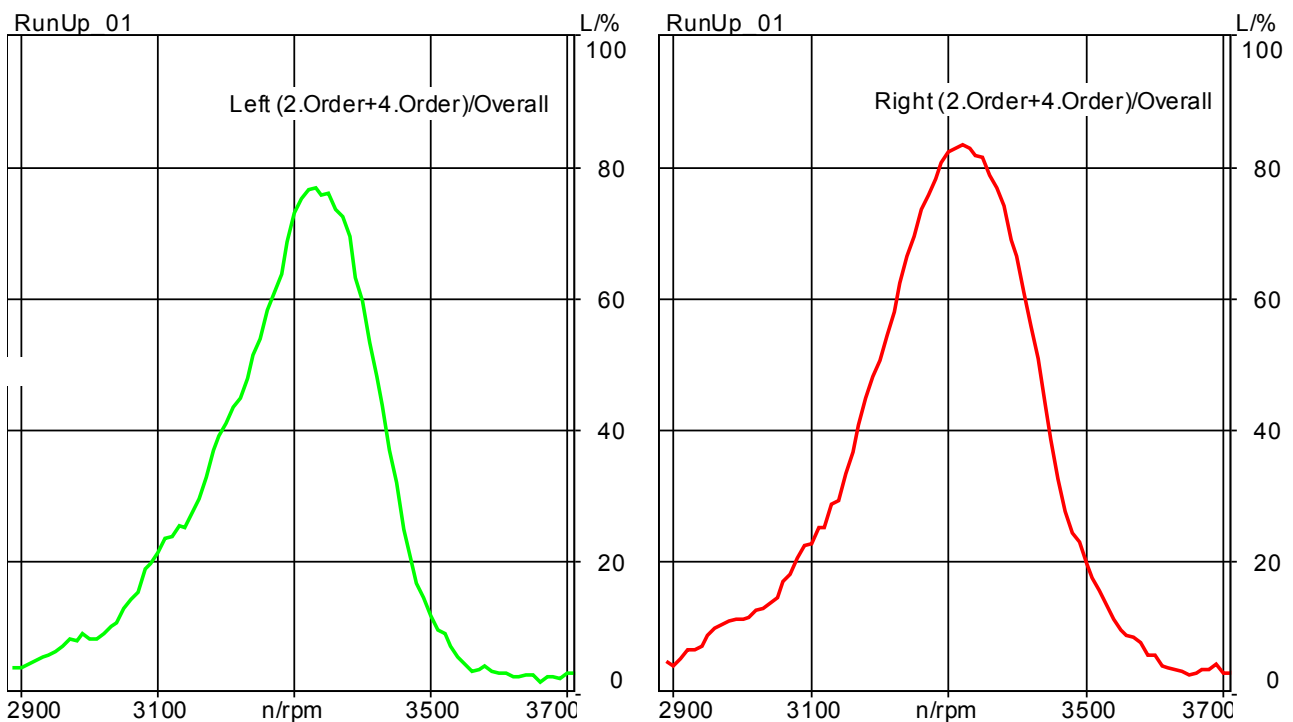


Figure 12: Percentage of the total signal level for the second and fourth order of a noise signal

A brief explanation of the script syntax as well as additional application examples can be found in the ArtemiS online help under the keyword "Channel Calc".

Notes

For the applications described in this Application Note, you need the ArtemiS base version (code 4600); the advanced report generation requires the ArtemiS Tool Pack 14 (Code 4614).

Do you have questions for the author? Contact us at imke.hauswirth@head-acoustics.de. We look forward to your feedback!