

Using different reference quantities in ArtemiS SUITE

ArtemiS SUITE allows you to perform sound analyses versus a number of different reference quantities. Many analyses are calculated and displayed versus time, such as **Level vs. Time**, **FFT vs. Time**, etc. For other application cases, however, it can be important to evaluate the changes of a signal depending on other quantities. Most commonly used – besides the calculation versus time – are analyses versus revolution speed (revolutions per minute, rpm). However, ArtemiS SUITE also allows you to calculate an analysis referenced to any other quantity. For example, you can visualize the dependency of a signal level on a force.

The data you can use as a reference quantity in ArtemiS SUITE can be stored in the file in a number of ways. For example, the information representing the reference quantity can be in the form of pulses in a digital or analog channel. ArtemiS SUITE can then calculate a revolution speed curve from this pulse signal. On the other hand, any analog channel of a file can be chosen directly as the reference quantity. If the reference quantity is stored in the form of pulses, it may be necessary to decode the pulse signal first. Comprehensive information on this can be found in the Application Note “Pre-processing of revolution speed data in ArtemiS SUITE”.

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Analysis versus a reference quantity

ArtemiS SUITE provides a wide range of analysis functions. Analyses calculated and displayed as a function of time can be recognized by **... vs. Time** in their names. Analyses named **... vs. RPM** are displayed as a function of whatever reference quantity is specified in the Properties window of the mark. This can be a revolution speed channel (as suggested by “RPM”), but it can also be any other quantity you recorded along with your signal. Thus using the analysis **Level vs. RPM** not only allows to display the rpm-depending level curve, but also, e.g., a pressure-depending level curve, if a corresponding channel is available.

In the Properties window of these analyses, you can configure the step size for the calculation points. Depending on your reference quantity, this value then does not refer to **RPM**, but, for example, to a force. The step size should have a reasonable proportion to the relevant value range of the reference quantity. The default step size of 50 in the properties for analyses vs. RPM, expecting rotational speed, is often too large a value for other reference quantities and if not recognized and changed, can lead to “mysteriously uninformative” results. An appropriate step size for an analysis versus revolution speed with a value range from 1000 to 6000 rpm can be considerably higher than the appropriate step size for an analysis against force with a range from 300 to 800 Newton, or speed with a span of 50 to 200 km/h.

¹ The descriptions in this Application Note refer to version 8.3 of ArtemiS SUITE. The general proceeding also applies to other versions. However, the scope of functions and the user interface may differ.

Selecting the reference quantity for the result display

Pool project

The reference quantity for displaying analysis results is selected via the Source Pool of the Pool Project, in the Properties dialog of an individual mark² or a folder. Moreover, after a multiple selection you can edit the reference quantity for all selected marks at once. Figure 1 shows the relevant section of such a Properties window.

The image shows a 'Mark' properties dialog box. It contains several input fields: 'Name' with the value 'WOT_03', 'Event Name' (empty), 'Time [s]' with a range '0 - 43,104', and 'Duration [s]' with the value '43,104'. There is a checkbox labeled 'Absolute Date/Time'. Below these is an 'Open with' button labeled 'Mark Editor'. At the bottom, there are two dropdown menus: 'Reference quantity' and 'Order calculation'. Both are currently set to '13 - Engine Speed (rpm, 12kHz)'. The 'Reference quantity' dropdown is highlighted with a red rectangular box.

Figure 1: Properties window for selecting the **Reference quantity**

After clicking on the arrow in the select box **Reference quantity** you can select a channel from the file's channel list as the reference quantity. In figure 1 the engine speed  was selected, which is stored in the 13th signal channel in the present example. Reference quantities recorded as pulse signals are labeled with  (pulse channel) or  (trigger channel) in addition to the unit icon. The differences between these two data formats as well as the required pre-processing steps are described in the Application Note "Pre-processing of revolution speed data in ArtemiS SUITE".

Automation Project and Standardized Test Project

In an Automation Project or a Standardized Test Project, you can specify the reference quantity for displaying analysis results via the processes **Mark by time** and **Mark by rpm**. To do so, go to the Properties window of the respective process and specify in the select box **Reference Channel** whether it is a pulse signal in a **Pulse Channel** or a **Signal Channel**, i.e., a reference quantity in an analog channel. Then specify the channel either via the channel name or by entering the channel number. The latter always refers to the selected channel type, which means that **1** either selects the first signal channel or the first pulse channel. Figure 2 shows the relevant section of such a Properties window.

The image shows a section of a properties dialog with two rows. The first row is labeled 'Reference Channel' and has a dropdown menu currently showing 'Pulse Ch.' and an adjacent input box containing the number '1'. The second row is labeled 'Order Channel' and has a dropdown menu currently showing 'Signal Ch.' and an adjacent input box containing the number '1'.

Figure 2: Properties window for selecting the reference quantity for the process **Mark by time**

Compact Analysis Project

When using a Compact Analysis Project for your analyses, the desired reference variable can be selected after having clicked the  button.

After clicking, you will see all input data currently being available in the Compact Analysis Project. Please click on the arrow icon next to the checkbox **Control Channel** and select the desired channel as reference quantity from the channel list.

² The Source Pool works with marks, which are pointers (references) to the actual time domain signal files. For example, if you perform an analysis or filtering, the original time domain signal data are not modified.

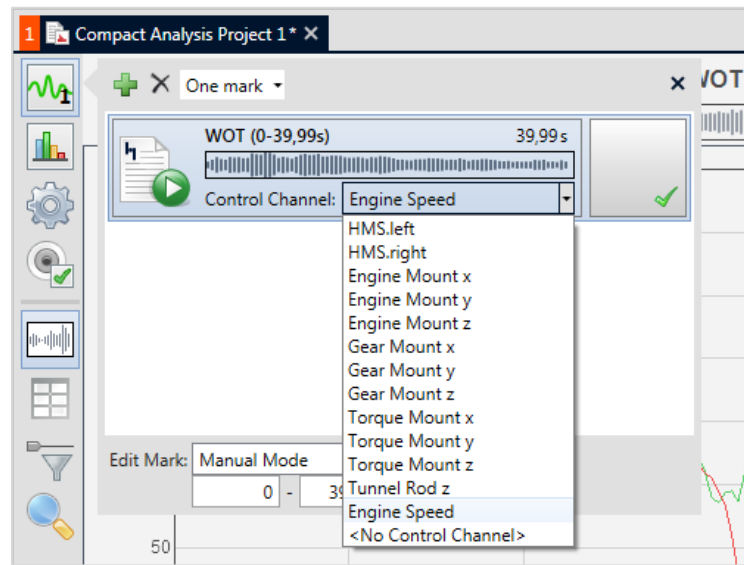


Figure 3: Compact Analysis Project with **Control Channel** selection

Using different reference quantities for the order calculation and the result display

Using a Pool Project, an Automation Project or a Standardized Test Project ArtemiS SUITE allows you to perform an order calculation against revolution speed and to display the analysis results against a different reference quantity.

In order to perform such a calculation in a Pool Project, the quantity for the order calculation must be specified in the Properties window of the mark in the **Order calculation** field. For this field, only channels containing revolution speed information  can be used. The quantity specified in the **Reference quantity** field, on the other hand, is used for *displaying* the analysis results. As described above, here you can select any of the channels contained in your mark.

Figures 4 and 5 show for example two order spectra displayed with different reference quantities. In the upper diagram, the orders have been determined based on the revolution speed of an engine (**Engine speed**) and are displayed versus this revolution speed. In the lower diagram, the analysis has also been calculated based on the engine speed, but is now displayed versus the **Drive shaft** speed.

With an Automation Project or a Standardized Test Project, the channel for the order calculation can be specified via the processes **Mark by time** or **Mark by rpm** respectively. For this purpose please use the field **Order Channel** in the Properties window of these processes to select the signal type first and the channel name or channel number afterwards. As with the Pool Project, the channel for the order calculation may differ from the channel for the reference quantity. In order to calculate the order spectrum correctly, a channel with an rpm signal has to be selected for the order calculation here, too.

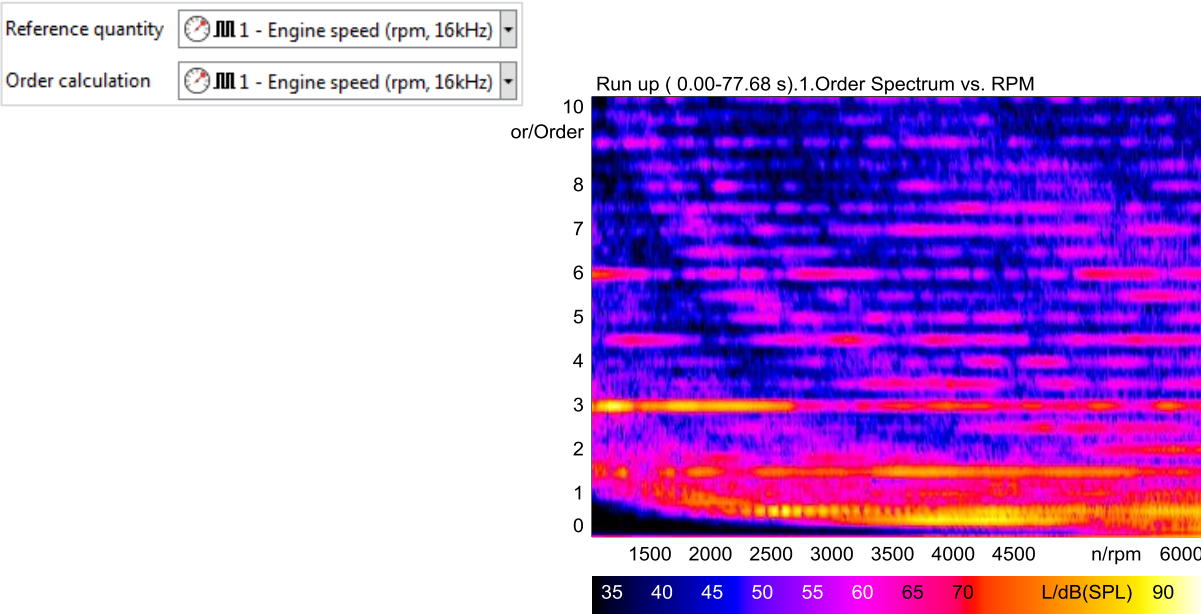


Figure 4: Order analysis calculated and displayed versus engine speed

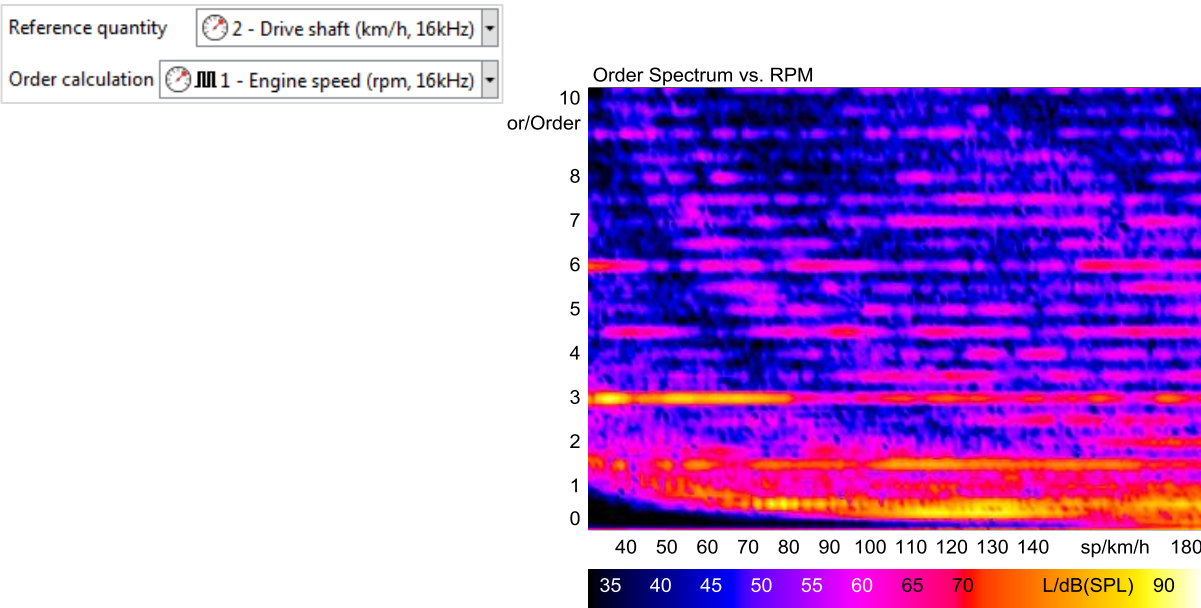


Figure 5: Order analysis calculated against engine speed and displayed versus vehicle speed

Converting pulse signals into an analog channel

Reference quantities that are to be examined with statistical operations in ArtemiS SUITE, e.g., in order to determine the difference between the left and the right wheel revolution speed, must be stored in analog channels. A reference quantity stored as a pulse signal must therefore first be converted into an analog channel. This applies to pulse signals stored in digital pulse channels as well as to pulse signals in an analog channel (trigger channel).

To convert a pulse signal into an analog channel, use a Decoder Project with a pulse decoder. To open a new Decoder Project³, click on **Start** → **New** → **Decoder Project**. A decoder project has three pools similar to those of a normal Pool Project (see figure 6).

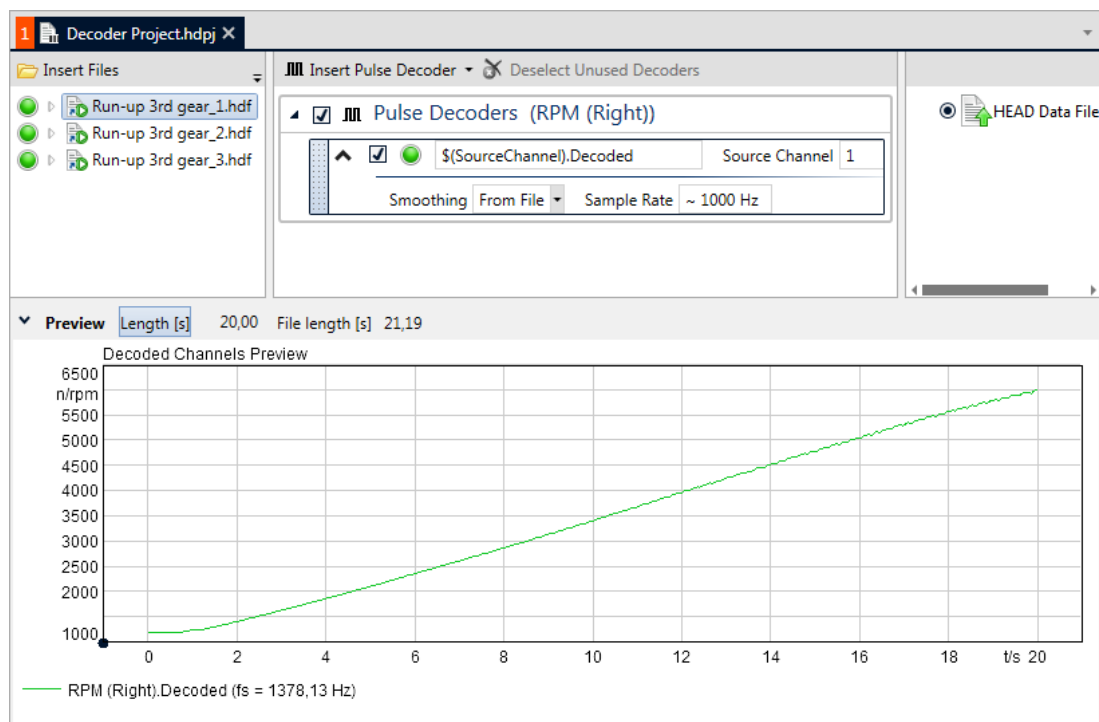


Figure 6: Decoder Project

Use the Source Pool on the left to insert the time domain signal(s) containing a pulse signal you want to convert into an analog channel. In the center pool, similar to the Analysis Pool of a normal Pool Project, insert a decoder. ArtemiS SUITE uses the decoder to calculate an additional analog channel containing the decoded revolution speed information. Depending on whether you want to convert a pulse channel or a trigger channel click on **Insert Decoder** → **Pulse** or **Trigger** in the context menu of the center pool.

In the preview window of the Decoder Project displayed below the pools (see figure 6), you can inspect the calculated revolution speed curve in advance.

In the right pool of the Decoder Project, you can specify the format for the new file. After opening a new Decoder Project the HDF format is activated by default. You can use this format if you want to further analyze the file in ArtemiS SUITE, because the file can be inserted directly e.g. into a Pool Project. For analyzing the file with other software applications a file export to ATFX and UFF format is available⁴.

Exporting the file to a third-party format is useful if you want to further process the data with software applications that cannot interpret pulse information. The procedure described above converts the pulse information to a form that can be evaluated by third-party software products.

³ A Decoder Project can only be opened if your ArtemiS SUITE license includes the Data Preparation Module (ASM 24).

⁴ UFF export can only be used if your ArtemiS SUITE license includes the Advanced Import & Export Module (ASM 23).

In a Decoder Project, all input signals are always active, allowing you to apply the conversion of revolution speed data to multiple files at once.

Clicking on the abacus icon  starts the conversion. Afterwards, you can insert the newly created files, e.g, into a Pool Project for further analysis. A particularly convenient way to do this is by using the **Recent Results** list of the HEAD Navigator. The results calculated most recently can be found at the top of this list, and can simply be dragged and dropped to the required place.

Do you have questions or suggestions?

Please do not hesitate to contact us at imke.hauswirth@head-acoustics.de.

We look forward to your feedback!