Wave export in ArtemiS SUITE

ArtemiS SUITE[1] offers the possibility to export sound files stored in HDF format to WAV format. This function allows the user to make recordings available to customers or coworkers who are unable to process, e.g., play back HDF files. Furthermore, WAV files can be embedded, for example, in a PowerPoint[2] file and played during the presentation in order to demonstrate the sound characteristics directly and not just by showing diagrams.

In order to create WAV files in ArtemiS SUITE you can use the wave export function. One way to use this export is right-clicking on a file selected in the HEAD Navigator and selecting the command **Export** -> **Export to Wav** in the file's context menu. The other way is using the wave export in the Destination Pool of different projects:

- in a Pool Project via the Destination Pool
- in a Calculation Project via the Destination Pool
- in an Automation Project using a sequence containing a **Wave** process
- in a Standard Test Project using a sequence containing a **Wave** process

Executing a wave export by means of a project allows you to export several recordings at one click.

ArtemiS SUITE is also capable of exporting multi-channel files to the WAV format. However, before exporting extensive amounts of data, you should verify that the target software is capable of handling multi-channel WAV files.

The wave export function of ArtemiS SUITE supports various settings for adapting the export parameters to different requirements. Use the software options to configure the wave export in the HEAD Navigator. The configuration of a wave export in a project takes place in the Properties window of the pool element. The first chapter of this Application Note describes possible settings for the wave export element in the Pool Project. The settings made for the wave export in other projects are basically the same and only differ in small details. In the chapter "Settings for wave export via the HEAD Navigator", the special features of the wave export via the HEAD Navigator are explained. The last chapter concerns some general information you should take into account when exporting your files to the Wav format.

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[1] The descriptions in this Application Note refer to version 9.0 of ArtemiS SUITE. The general proceeding also applies to other versions. However, the scope of functions and the user interface may differ.

[2] PowerPoint is a registered trademark of the Microsoft Corporation.

Wave export in a Pool Project

First, open your Pool Project and select the desired time domain signals and channels in the Source Pool. If you want to filter the time domain signals before exporting them, enable the desired filters in the Filter Pool. Make sure that no analysis is active, as only time domain signals can be converted to the WAV format; no analysis data. Then insert a wave export element via the context menu of the Destination Pool (**Insert** -> **Other Files** -> **Wave**) and open the Properties window to configure the export settings (see figure 1).
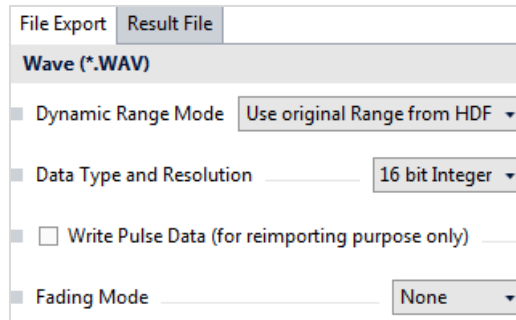

Figure 1:   Properties window of the wave export element

Dynamic Range

On the **File Export** tab of this Properties window, you can first set the **Dynamic Range Mode** of the WAV file to be created. Three options are available: **Use original Range from HDF**, **Full Dynamic (Autorange)** and **Manually**, see figure 2).
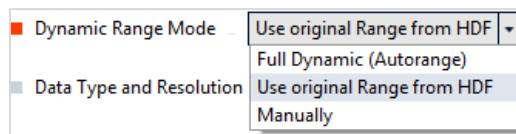

Figure 2:   Selecting the dynamic range mode

The setting **Use original Range from HDF** retains the relative signal level of the original file for the WAV file. This means that, for example, an original signal using 50 % of the measurement range will also use 50 % of the available range of the WAV file.

With the setting **Full Dynamic (Autorange)**, the WAV file is scaled so that the highest signal level occurring in the original file uses the maximum available dynamic range in the WAV file. Where this value occurs, the WAV file reaches but does not exceed its clipping limit.

The setting **Manually** allows a new dynamic range to be specified for the WAV file. The values of the original file are rescaled so that they fit the new dynamic range of the WAV file. The dynamic range you specify determines the signal level that is equivalent to 50 % of the WAV signal range.

The following table schematically shows the effect of the different settings.
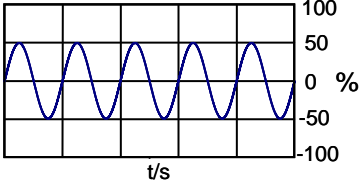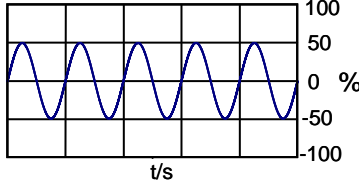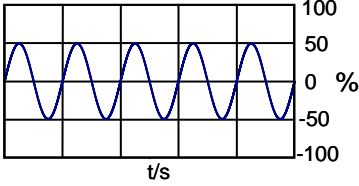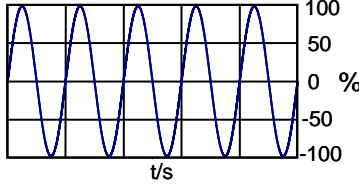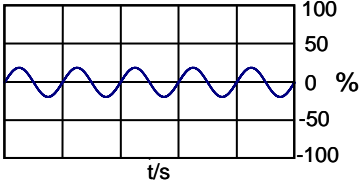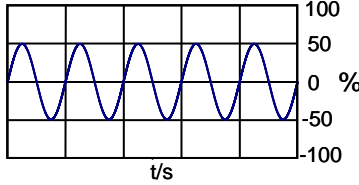
Setting	Signal level of original file	Signal level of WAV file
Use original Range from HDF		
Full Dynamic (Autorange)		
Manually	Original dynamic range: 94 dB	User-defined (new) dynamic range: 84 dB

Table 1:   Effect of dynamic range settings

These different settings are useful for different applications. For example, an application may require that data with different dynamic ranges are to be converted into WAV files that should have similar volume levels when auditioned. For example, if two original files have dynamic ranges of 94 dB and 104 dB, respectively, the setting *Use original Range from HDF* would cause the played volume of the WAV file generated from the 104 dB original to be too low compared to the 94 dB file. This can be avoided by selecting the option *Manually* and entering a level of *104 dB*. That way, both files are scaled to the same dynamic range, resulting in a consistent level of the two WAV files relative to each other. Note that in order to prevent clipping, the highest of the original dynamic ranges (numerical value) must be selected. However, if the original signals are badly adjusted so they do not utilize their entire dynamic range, it is also possible to scale to a lower range in order to raise the level of the Wave file and improve the dynamic range. On the other hand, the amplification should not be too high, as the background noise of the signal might be increased significantly.

In commercial digital audio recordings, care is always taken to put the highest level at or near 100%. Media players and computer playback features, such as from PowerPoint, are designed with this expectation. On the other hand, wave files made from data acquisitions for technical, analytic purposes may have maximum levels appreciably below 100% and therefore elicit complaints that the computer playback is too quiet. Suitable settings of the dynamic range for the wave export in ArtemiS SUITE allow you to avoid this phenomenon.

Another use of the manual adjustment of the dynamic range is to produce wave files with identical calibrations from file to file and channel to channel. If an HDF file contains channels of different ranges due to the typical slight differences in sensitivities of the microphones, this differences will be eliminated during the wave conversion. All channels will receive the same range and effectively all channels become comparable.

If a playback system from HEAD acoustics, such as a *lab*P2, is used for playing the WAV files, the device can be adjusted to the dynamic range of the original file or to the newly selected dynamic range, thus ensuring accurate playback levels. For exported artificial head recordings, the appropriate

equalization[3] can also be applied on the *lab*P2, allowing an aurally accurate playback. A file with a dynamic range of 94 dB exported with the setting *Use original Range from HDF* can thus be played back with the correct level by a *lab*P2, provided that the device is set to 94 dB and the correct equalization is used.

Data type and resolution

The *Data Type and Resolution* of the WAV file can be set to either *16 bit Integer*, *24 bit Integer* or *32 bit IEEE Float* (see figure 3).
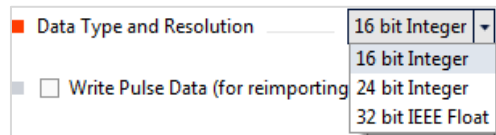
Figure 3:   *Data Type* and *Resolution* area of the wave export

Generally, a higher resolution is to be preferred to a lower one. However, the following should be considered when choosing the resolution:

- A resolution of 24 bit or 32 bit significantly increases the memory requirements compared to a 16-bit file.
- If the original file has a resolution of 16 bit only, the resolution is not be improved by choosing the 24-bit setting – this will only lead to a bigger file size.
- Not all software that is suitable for playing back WAV files is capable of handling 24-bit files.

Exporting Pulse Information

With the option *Write Pulse Data*, the wave export can be configured so that any pulse information encoded in the original file is stored in the lowest bit of a channel of the WAV file.

Pulse data is only exported if an integer format has been selected as the *Data Type*. Furthermore, only up to two pulse channels can be exported to a WAV file. The first pulse channel is written to the lowest bit of the first WAV channel, and the second pulse channel is written to the lowest bit of the second WAV channel. The option *Write Pulse Data* should only be enabled if the pulse data are actually needed and can be read later, as the assignment of the lowest bit to the pulse information reduces the dynamic range.

If files in WAV format with embedded pulse information are to be exchanged, it is advisable to create a test file first in order to verify that the target software is able to read the WAV files and to import both the audio channels and the pulse information correctly.

Fading mode

To prevent transient noise at the beginning or end of WAV files during playback due to sudden level jumps, the Properties window offers the possibility to fade the signals in and out. Two options are available: *In Out* and *Cross* (see figure 4).
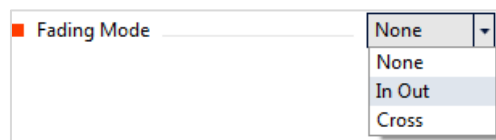
Figure 4:   Fading area of the wave export Properties window

The option *In Out* is used if a single file is to be played only once. It causes the file to be faded in and out in the time specified in the *Fading Duration* field (in milliseconds). The *Cross* option alters the file so that no interruption occurs when playing the file repeatedly in an endless loop. This is achieved by

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[3] You can find additional information about the equalization of binaural recording in the application note "Binaural Measurement, Analysis and Playback". Please download this document from our Download Center:
   http://head-acoustics.de/de/nvh_application_notes_use_of_systems.htm

moving the last part of the file to the beginning and merging it with the fade-in section, resulting in a smooth transition between the end and the beginning of the file. Since the option **Cross** overlays the beginning and the end of the file for the specified period of time, the total length of the resulting file is reduced by that period. In the case of the option **In Out**, the specified period of time refers to both the beginning and the end of the file. The total length of the file is not reduced. The **Fading Duration** field is only enabled if either the option **In Out** or **Cross** is selected. If the fading mode is set to **None**, the field is not displayed.

Whether fading is required, and how long the fading period should be, cannot be stated generally. It widely depends on the signal length and the signal characteristics. A long signal can be faded in over a longer period of time without causing an unnatural impression, whereas this is not possible with a short signal. If the signal has been recorded so that its level is low at the beginning and increases afterwards, additional fading may not be required at all. For a recording that has been cut previously in ArtemiS SUITE, so that it starts suddenly with a high level, it is highly recommended to choose a sufficient fading period. For a very short, stationary signal, it is advisable to play it in an endless loop and therefore to choose the option **Cross**. The continuous, uninterrupted playback allows the listener to evaluate the sound, whereas a repeated playback of short, non-stationary signals is quickly perceived as unpleasant by listeners.

Result file

In the **Result File** tab, you can specify the location and the name of the WAV file to be exported (see figure 5).
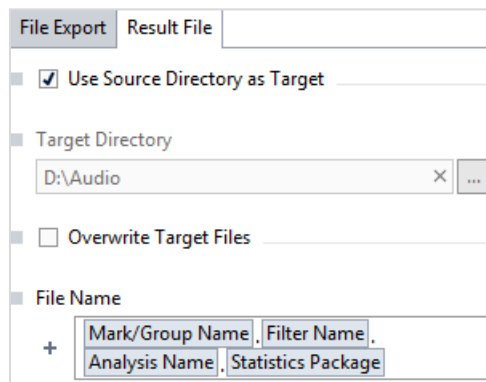

Figure 5: *Result File* tab of the wave export

Here you can first specify the path where the WAV file is to be saved. If the option **Use Source Directory as Target** is enabled, the wav file is written to the same folder where the original file is located. Deactivating this option enables the selection box **Target Directory**. Clicking on the ⋯ button opens a file browser, where you can select a different path for the target file.

The option **Overwrite Target Files** allows you to overwrite existing versions of the target file if you export the file several times with the same name. Otherwise, a consecutive number will be automatically appended to the name of each new file.

In the *File Name* section, you can specify the name for the WAV file. Clicking on the ⊞ button opens a selection menu that provides access to a number of variables. Use these variables to compile the desired file name. Moreover, you can also add freely editable text directly into the textbox. You can easily change the order of the elements via copy & paste. Clicking on the **Del** key removes the currently selected element.

If you separate individual elements in this list by a text element containing a backslash "\", the file name elements separated this way are interpreted as subfolders for the path name. So this list not only allows you to specify the file name, but also to create a folder structure for your result files.

Settings for wave export via the HEAD Navigator

To configure the wave export via the HEAD Navigator, first open the general export settings (*Tools -> Options -> Export (HEAD Navigator)* -> tab *Common*, see figure 6).
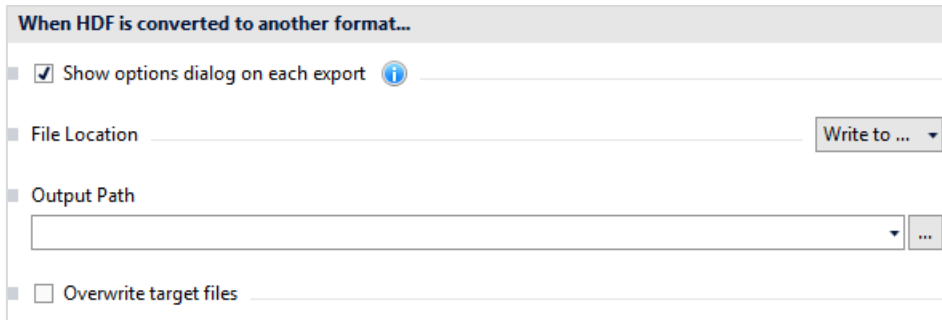

Figure 6:   General export settings for the HEAD Navigator

Checking the first checkbox in this window causes the export settings dialog to be displayed for each export. Furthermore, you can specify the *Out Path* for the target file and the behavior for overwriting files.

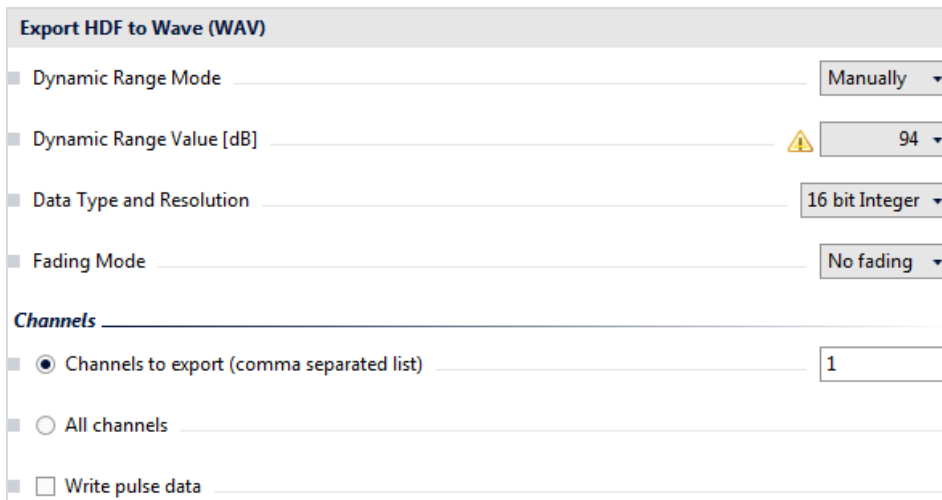The settings specific to wave export can be opened by clicking on the *Wave* tab (see figure 7).

Figure 7:   Wave format specific export settings

The settings of the first four selection boxes as well as the *Write Pulse Data* option are identical to those already described above for the wave export by means of a Pool Project.
Moreover, you can select the channels to be exported to the WAV file by entering the channel numbers (separated by commas) in the *Channels* section. If you want to export all channels activate the *All Channels* option.

General notes on wave export

Most sound cards and programs for the playback of WAV files can only play files with standard sampling rates (e.g., 44.1 kHz). Files with other sampling rates are converted to one of the standard sampling rates prior to playback. Since some playback programs and sound card drivers are unable to perform such a conversion in high quality, it is recommended to first resample original files of non-standard sampling rates in ArtemiS SUITE. ArtemiS SUITE provides algorithms ensuring high precision of the resampling process. To use this function, select the *Resampling* item in the Filter Pool. In the Properties window of this element, the option *Auto Select Audio Sampling Frequency* must be checked. With this function, ArtemiS SUITE performs a conversion from the original sampling rate to the nearest standard sampling rate.

Do you have any questions or remarks?
Please write to: imke.hauswirth@head-acoustics.de
We look forward to receiving your response!