

Automation functions and their licensing

ArtemiS SUITE is a multi-functional software application supporting you efficiently and comprehensively in many areas of sound and vibration analysis. As a complete solution, ArtemiS SUITE offers you tools for multi-channel recording, easy documentation of measurement data, extensive analysis, aurally accurate playback, and powerful reporting.

Furthermore, introduced with version 6.0, ArtemiS SUITE provides automation functions supporting you in performing repetitive tasks.

This functionality particularly addresses users:

- whose tasks require linear processing chains, but not the cross-product logic of a Pool Project¹.
- who have previously used the COM interface (ATP13) or the Flow Control functionality of ArtemiS Classic.
- who wish to use the Flow Control functionality of the HEAD Recorder along with functions of ArtemiS SUITE not covered by a Pool Project.

The automation steps are specified in an Automation Project, and can then be executed automatically with a single click. Besides the calculation of analyses, these steps can also include, for example, the automated creation of marks (cut based on time or RPM). The advantage of using an Automation Project is that you need to specify the processing steps only once, and you can re-use them for all further measurements. Unlike a Pool Project, which is optimized for interactive working, an Automation Project saves you a lot of time in the case of repetitive tasks, since it frees you from the need to manually repeat the necessary processing steps (such as cutting marks).

Based on an application example, this Application Note² explains several basic functions and their licensing:

Description of the example task	2
Creating an Automation Project	2
Using a report template in an Automation Project	6
Executing an Automation Project in the HEAD Navigator	8
Licensing of automation functions	8

The automation functionality of ArtemiS SUITE can be used in many ways, and provides a broad range of functions. The example task described in the following is just one of many possibilities to use automation in ArtemiS SUITE. Many other possibilities are available. Your HEAD acoustics representative will gladly assist you in evaluating the specific needs of your company or department.

¹ The cross-product logic of the Pool Project initiates that each input signal is analyzed with each filter and each analysis. By means of linear sequences, specifically configured analyses can be applied to specific input signals, whereas for other input data further analyses are used.

² The descriptions in this Application Note are based on version 9.0 of ArtemiS SUITE. The general procedure also applies to other versions. However, there may be differences in the scope of functions and in the user interface.

Description of the example task

The following example is based on a fictitious project, where the sound quality of various vehicles is to be determined. For this purpose, signals from an artificial head and an acceleration sensor in the vehicle cabin are recorded during different driving situations. The data set for a vehicle consists of two measurements with three operating states (engine run-up and run-down in one measurement, engine idle in a second measurement). The measurements for a vehicle are jointly saved to a folder (e.g., *Car 01 Initial State*), and the naming of the measurement data files always follows the same scheme: *Run up-down.hdf* and *Idle.hdf* (see figure 1).

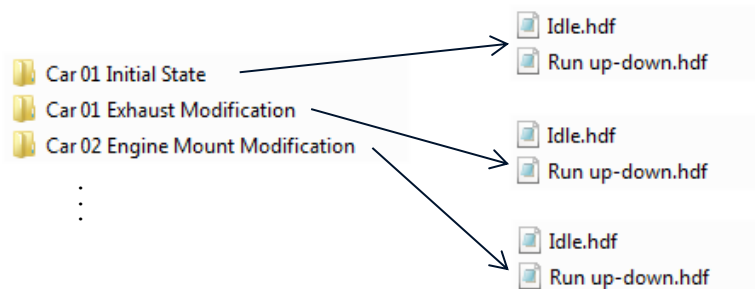


Figure 1: File structure of the example data

The run-up and the run-down (acoustic data channels) are to be examined with an RPM-dependent FFT analysis, the idle measurement (accelerometer data channel) with an averaged FFT analysis. The airborne sound channels from the artificial head generate comparable results; therefore, the analysis results of these channels can be averaged. Prior to the analysis, these channels are A-weighted. The acceleration channel is to be integrated prior to the analysis.

During the course of the project, a growing number of vehicles are examined. In order to evaluate the sound quality, the representation of the analysis results from the different vehicles must be comparable (i.e., by means of identical axis limits in the diagram).

Creating an Automation Project

Via **Start -> New -> Automation Project** you can create an empty project, in which you can specify the processing steps described above. Figure 2 shows an empty Automation Project³.

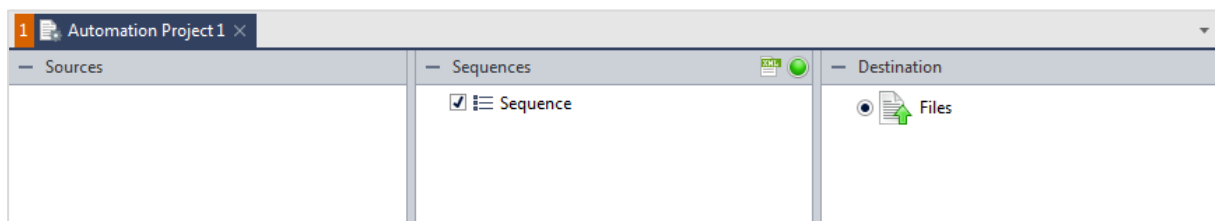


Figure 2: Empty Automation Project

An Automation Project contains three pools:

- In the first pool, you place the files or folders you want to process together.
- In the second pool, you specify the sequences, i.e., what should happen to the input data. For example, you can cut certain marks out of a file and perform various analyses.
- In the third pool, you specify the destination for the generated data (saving as a new file, or displaying in a Data Viewer or a report).

³ You can also use an existing Pool Project as the basis for creating an Automation Project, e.g., in order to transfer analysis functions you have already configured, into an Automation Project.

First, add one or several files or a folder with files to the first pool. These files must be comparable to those to which the automation is to be applied later. In our example, we use a folder containing two measurements: the folder *Car 01 Initial State* with the time-domain signals *Run up-down.hdf* and *Idle.hdf* (see figure 3).

Then specify the workflow steps as sequences in the second pool. In an Automation Project you can specify multiple sequences, e.g., for different operating states, such as run-up, run-down, and idle. A sequence in turn can contain various processes, such as file selection, mark cutting, filtering, analysis, or import/export. If you are familiar with a Pool Project in ArtemiS SUITE, you already know many of the elements. However, these elements are not structured from the left to the right in the Filter, Analysis and Statistic Pool, as this is the case in the Pool Project. In the Automation Project, the various elements are listed one below the other in a sequence in the middle pool (see figure 3).

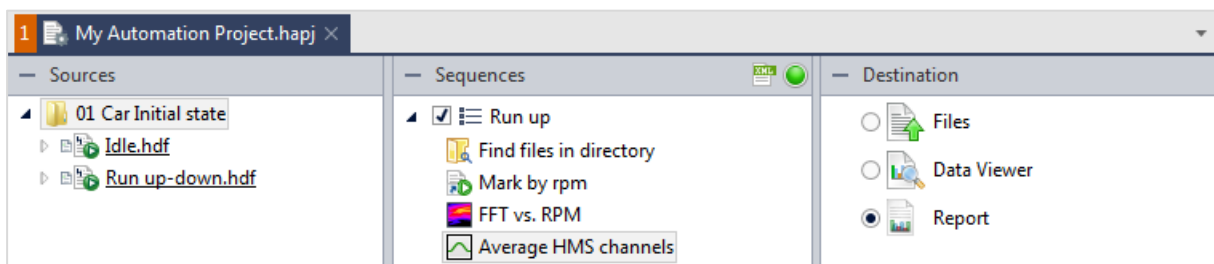


Figure 3: Automation Project with a sequences containing four processes

Sequences are created via the context menu in the second pool: Use the command **Insert Sequence** to add a new sequence and the command **Insert Process** to add a new process element within a sequence.

The first sequence in our example is supposed to find the run-up measurements, select the first two channels containing the artificial head signals, and extract a mark between 1500 and 4500 rpm. This is followed by an rpm-dependent analysis with A-weighting and averaging of the two airborne sound channels.

For a better overview, first change the name of the sequence from *Sequence* to *Run up*. Then add the process **Find files in directory** to the sequence. To do so, click on the **Insert Process** command in the context menu of the sequence. The required process element can be found on the **Find and Select** tab. After adding the process, locate the field **Search pattern** in its Properties window and enter **Run up*.hdf* to find all files whose name contains *Run up* (see figure 4).

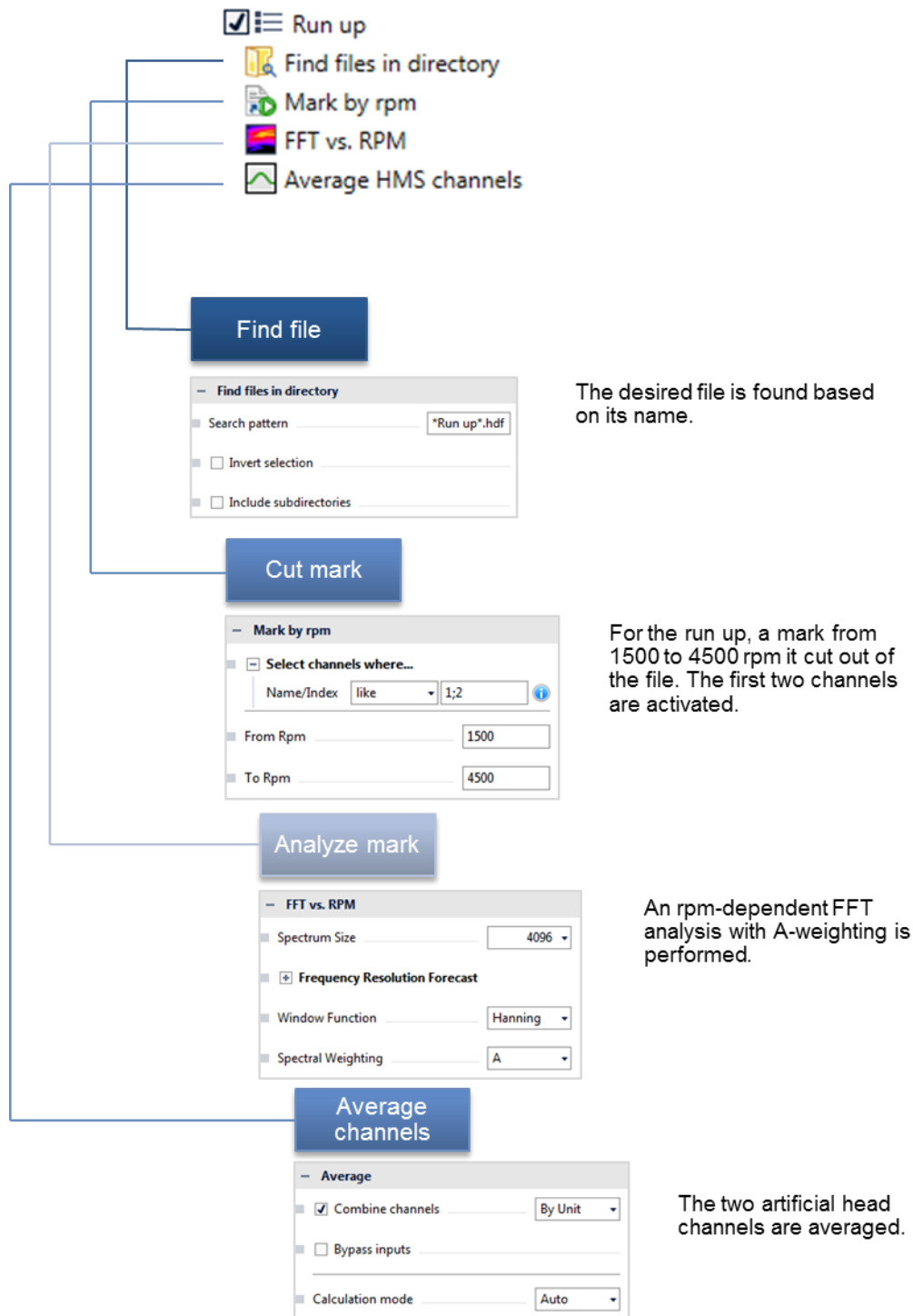


Figure 4: Example of a sequence

In the next step, add the process **Mark by rpm** (*Insert Process -> Mark Creation -> Mark by rpm*). In the Properties window of this process, specify an rpm slope using the fields **From Rpm** and **To Rpm**, based on which the file is to be cut (e.g., 1500-4500 rpm). Furthermore, you can select the desired channels for further processing in the **Name/Index** field. You can enter either the channel name or the channel number. When entering several channels, you can either separate them with semicolons or enter a range (e.g., 1;2 or 2-5).

The third process element required for our example is the analysis process **FFT vs. RPM**, which calculates an FFT analysis with the parameters specified in the Properties window (e.g., with the desired A-weighting).

Furthermore, a statistics process is used for averaging the analysis results: **Insert Process** -> **Statistics** -> **Average**. After adding this process as the fourth element of the sequence, enable the function **Combine channels** in the Properties window in order to average the two channels activated by the second process element.

You can copy and paste an entire sequence. In our example this is useful for creating the second sequence for analyzing the run-down. Only a few adaptations are required: After copying the first sequence you created, first change the name of the copy, e.g., to *Coast down*, in order to distinguish the two sequences. Then change the search pattern in the Properties window of the first process element to **down*.hdf*, and in the Properties window of the second element, change the mark range to 4500-1500 rpm. The channel selection does not need to be changed. In the Properties window of the analysis, it may be necessary to change the **Slope Detection** from **Rising Slope** to **Falling Slope**. The statistics process can be left unchanged.

For the third sequence (*Idle*), you need the following processes: **Find files in directory**, **Mark by time**, **Integrate**, **FFT (average)**. In the Properties window of the **Find files in directory** process, enter the search pattern **idle*.hdf*.

By means of the next process element you can set the mark limits to 3-8 s and activate the third channel. In the Properties window of the third process (**Integrate**) and the analysis process, you can leave the default settings unchanged.

Figure 5 shows all three sequences with their processes.

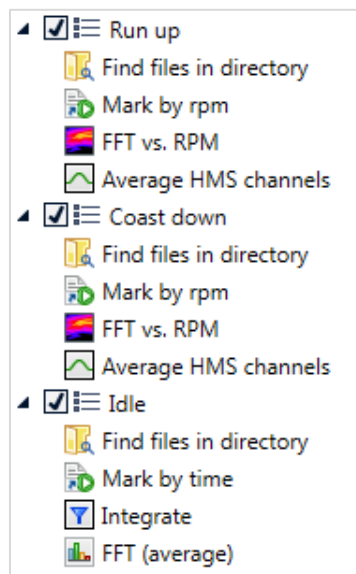


Figure 5: Three sequences

In order to check whether the results fulfill the requirements, it is advisable to test each sequence separately. An easy way to do this is to display the results in a Data Viewer. To do so, add suitable example files (or a folder with such files) to the Source Pool. Then insert a Data Viewer element in the Destination Pool and enable it. After a click on the  button, you can check the calculated results and make adjustments to the sequences if necessary. You can ,e.g., easily change the order of the processes within a sequence via drag and drop.

The creation and configuration of the sequences is now complete, and the Automation Project can be saved. The results can be viewed and evaluated in a Data Viewer. In our example, however, we also want to make sure that the diagrams are always displayed in the same way in order to ensure the comparability of the results. Furthermore, for a better understanding and valid interpretation of the

results, we want some information on the vehicle to be available. Additionally, the analysis results as well as the vehicle information should be archived, i.e., saved under a predefined path, for later comparisons. This can be achieved most easily by presenting the analysis results, combined with user documentation, in a report.

Using a report template in an Automation Project

A report template, into which the analysis results of new files are inserted, provides you with documents containing comparable text elements and diagrams (e.g., with identical axis settings) at the click of a button. The following is a brief description of how to create and use a new report template. A detailed description of this function and the use of user documentation can be found in the Help System of ArtemiS SUITE and in the Application Notes on this subject.⁴

After making sure that the sequences work correctly by displaying the results in a Data Viewer, you can add a report element to the Destination Pool of your Automation Project. In the Properties window of this element, you can enable the option **Create new** (the default for a newly-inserted report), if you want to create a new report template, or you can select an existing report template (*.hrpx), if you already have one. With the default setting of a new report element, a click on the  button creates a new report with empty diagrams, into which the calculation results can be embedded. Figure 6 shows such an empty report.

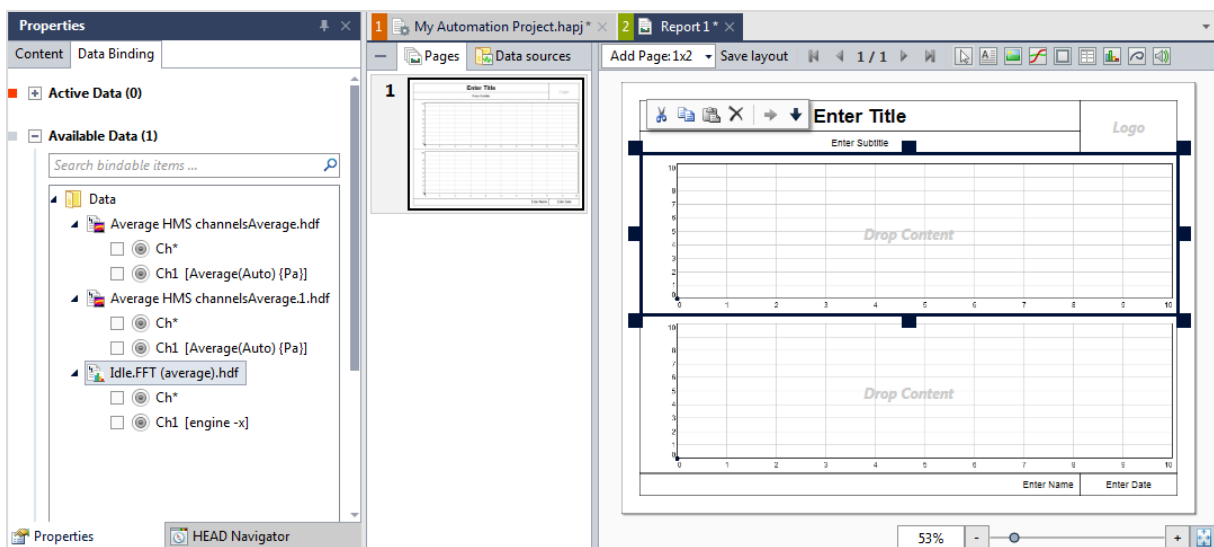


Figure 6: Newly-created default report with empty diagrams

With the tools described in the Application Notes mentioned above, the report can now be adapted for our example application: The report should show a page with three diagrams with the results of the three sequences. Furthermore, the user documentation of the measurements can be included in the report. If the user documentation of each measurement contains a description of the vehicle (e.g., manufacturer, model, vehicle status), this information can be included in the headline or other places in the report. Moreover, you can include a target curve in your report that further facilitates the interpretation of the results. Figure 7 shows an example of a complete report.

⁴ You can download the Application Notes from the following web page:
http://www.head-acoustics.de/eng/nvh_application_notes_reporting.htm

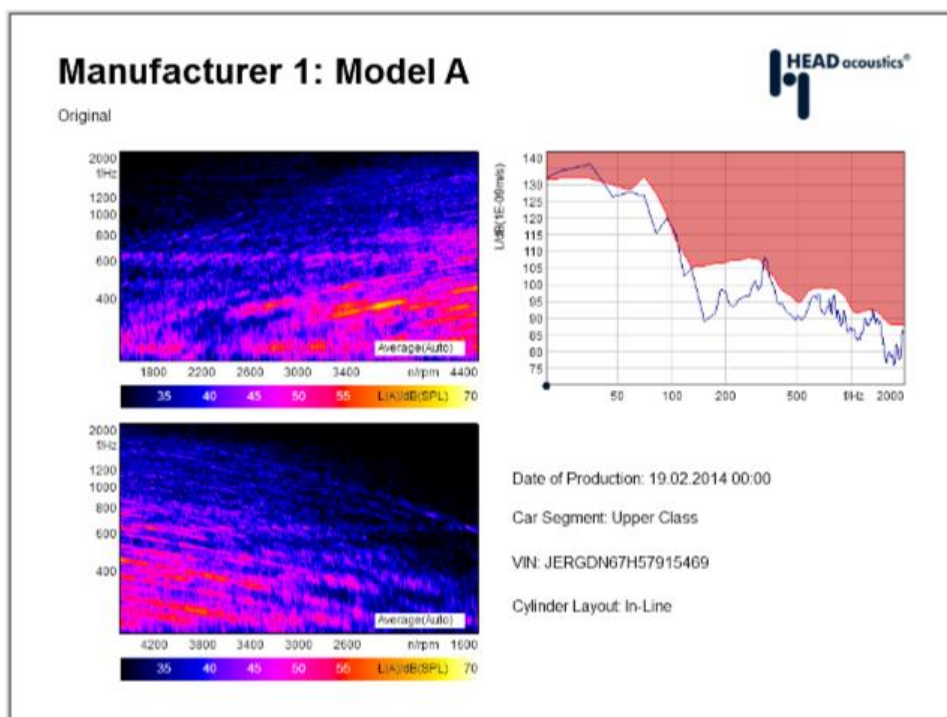


Figure 7: Example report with user documentation

The finished report template can now be saved, and you can configure the report element in your Automation Project to use this saved report as a template rather than creating a new one. To do so, enable the option **From existing report** in the Properties window of the report element, and select the desired report after clicking on the  button.

Using a report template when calculating your Automation Project with different input data provides you with a new report with a comparable representation of the new analysis results at the click of a button.⁵ Thus, there is no need to manually bring the new results into a comparable form, saving you a lot of time.

The completed Automation Project can now be used as follows:

Drag and drop a folder with new measurements of a vehicle into the Source Pool of your Automation Project.⁶ Then click on the  button.

As soon as the calculation is finished, ArtemiS SUITE displays the finished report. After reviewing the report, you can export it to the desired format by clicking on the  button, so you can save or print it with the corresponding application.

If you do not need to check the finished report, you can activate the option **Export directly** in the Properties window of the report element. This way the report will not be display, but directly saved to the desired format.

⁵ It is important to make sure that the number of measurement results fits the report template, i.e., the number of sequences and their names must not be changed, as otherwise the assignment to the diagrams of the report template would no longer work. Of course, other representations are possible, but they require the report template or the Automation Project to be redesigned.

⁶ In our example, the project was configured for the evaluation of data from a vehicle stored in a separate folder. Therefore, it must be made sure that the Source Pool always contains only the current folder with the two time-domain signals of one vehicle. Of course, other configurations are possible.

Executing an Automation Project in the HEAD Navigator

Another possibility to execute a saved Automation Project directly in ArtemiS SUITE is provided by the HEAD Navigator: Using the context menu of a file or a folder in the HEAD Navigator allows you to activate the requested Automation Project and to automatically execute the sequences included in the project. It is not necessary to open the Automation Project for this way of execution. Please ensure, however, that the Automation Project has been saved with an empty Source Pool before, since otherwise all processing steps are executed for both the new data and the data already included in the Source Pool.

To execute the project created in the above example in the HEAD Navigator, right-click on a folder with suitable data (in this case a folder containing benchmark recordings with the names *Run up-down.hdf* and *Idle.hdf*) to open its context menu. In this menu, select the command **Process with Automation Project**. This opens a selection window, where you can select the desired Automation Project from a drop-down menu. ArtemiS SUITE now generates a new report with the results of the new measurements, which can be saved directly or exported to the desired format.

Licensing of automation functions

The modular design of ArtemiS SUITE allows you to compose your own custom analysis software exactly for your specific task. The following ArtemiS SUITE Modules (ASM) are available for the functions described above:

- **ASM 00**, Basic Framework:
This module is the basis of ArtemiS SUITE and is required for all other modules.
- **ASM 01**, Basic Analysis:
For the creation and interactive execution of an Automation Project as described in the section “Creating an Automation Project”, you need ASM 01.
- **ASM 02**, Basic Report:
This module is required for representing the results in a report as described in the section “Using a report template in an Automation Project”.
- **ASM 05**, Automation API:
If you want to execute a saved Automation Project without user interaction via the HEAD Navigator, you need ASM 05. Furthermore, ASM 05 provides a possibility to use signal processing functions of ArtemiS SUITE in your own software solutions. ASM 05 includes four analysis functions: FFT (averaged), 3rd octave analysis (averaged), FFT vs. time, and Level vs. time. ASM 05, which is more favorable in comparison to ASM 01, is e.g. suitable for quality tests, so-called end of line tests. This application exclusively refers to an already existing Automation Project, which is to be executed in order to test and record a component's compliance with specified acoustic parameters, for instance. There is no need to edit the Automation Project in the context of this application.
- **ASM 06**, Automation Basic Analysis:
This ASM is a low-cost alternative to ASM 01 and serves as a supplement to ASM 05 for application cases where only the analysis functions of ASM 01 are required, but not their interactive user interface.
- If your Automation Project requires analyses or other functions exceeding the scope of ASM 01, you need the corresponding ASM (e.g., ASM 12 if you need a sharpness analysis for a sequence).
- Integrating an Automation Project into the Flow Control functionality of the HEAD Recorder (ArtemiS SUITE Data Acquisition Module) allows you to further accelerate the evaluation of your recordings. Version 4.0 or later of the HEAD Recorder provides several Flow Control blocks for this purpose. With these blocks, you can launch a saved Automation Project and apply it to your current measurement interactively or without user interaction, respectively. A general description of how to use Flow Control can be found in the online help of the HEAD Recorder

and in the Application Note on this subject.⁷ To make a recording with the HEAD Recorder, you need ASM 00 and ASM 04. To execute and interactively work with an Automation Project while recording, you also need ASM 01. To execute an Automation Project without user interaction, you need ASM 05 instead.

The diagram on the next page provides an overview of the various ArtemiS SUITE Modules, their scope of functions and their application possibilities.

Please contact your HEAD acoustics representative to determine the application possibilities and the best possible license combination for your purposes. We look forward to your response and will gladly assist you!

⁷ You can download the Application Note from the following web page:
http://www.head-acoustics.de/eng/nvh_application_notes_acquisition_data_processing.htm

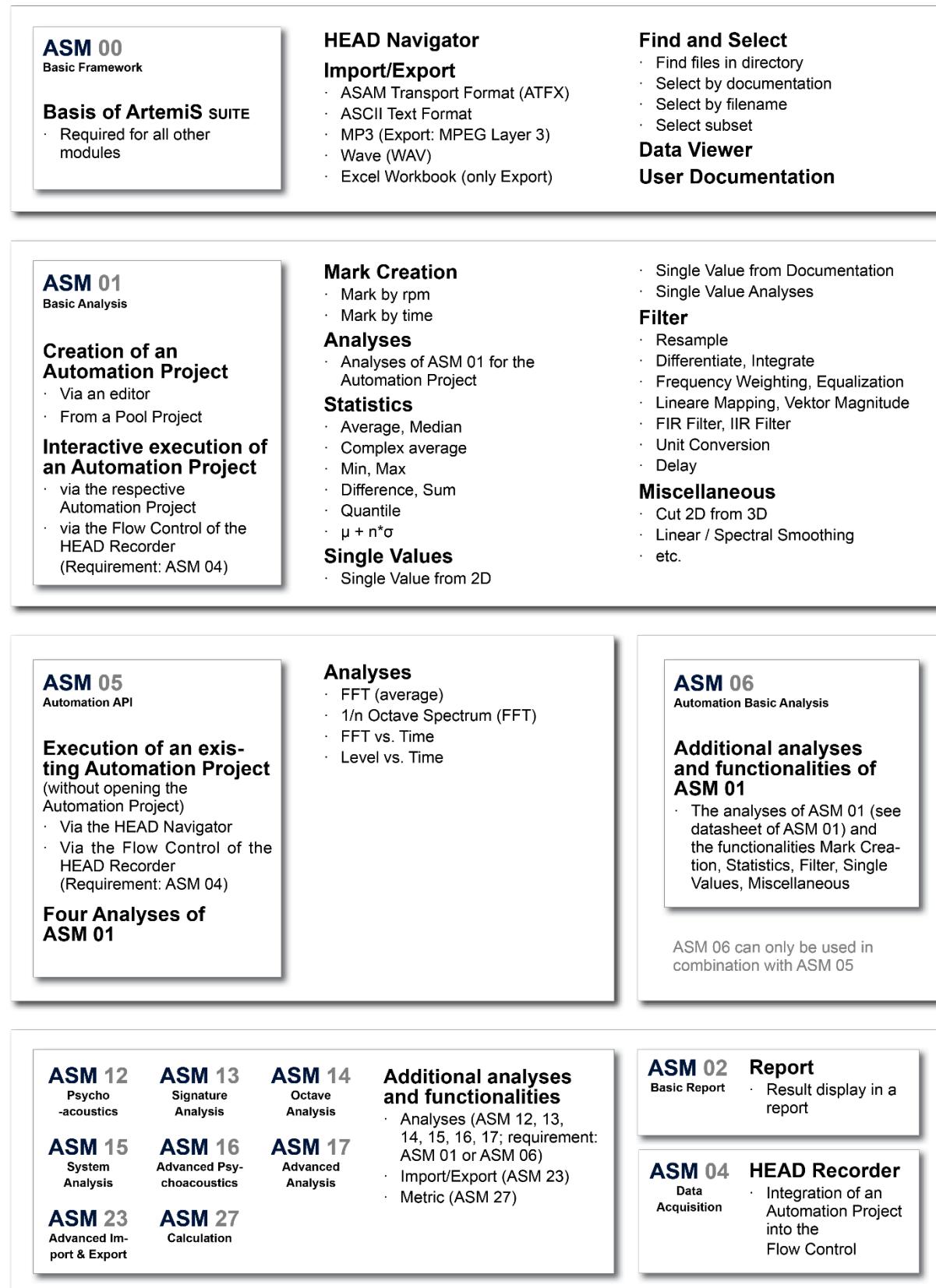


Figure 8: Licensing and functionality of the ASM modules relevant for automation