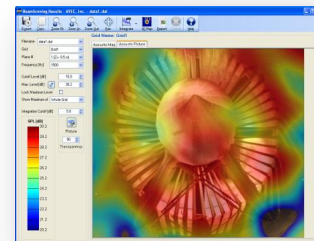
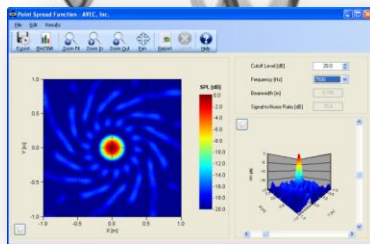
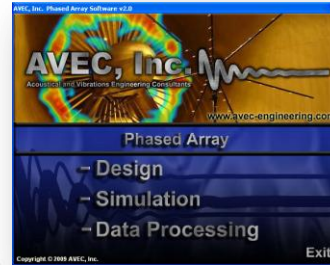
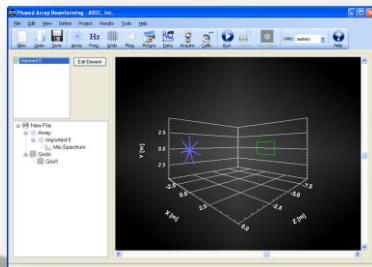


## AVEC PHASED ARRAY SOFTWARE V2.0



### FAST, SIMPLE, INTUITIVE, HELPFUL

AVEC's Phased Array Software is a complete solution for the design of microphone phased arrays, simulation of array performance, processing and analysis of experimental data collected with arrays.

The software design philosophy always had the user in mind. Being long time developers and users of phased array technologies allowed AVEC to focus on the most important aspects of array processing and analysis. The goal was to give the user a comprehensive environment to perform all the tasks involved in a typical phased array test.

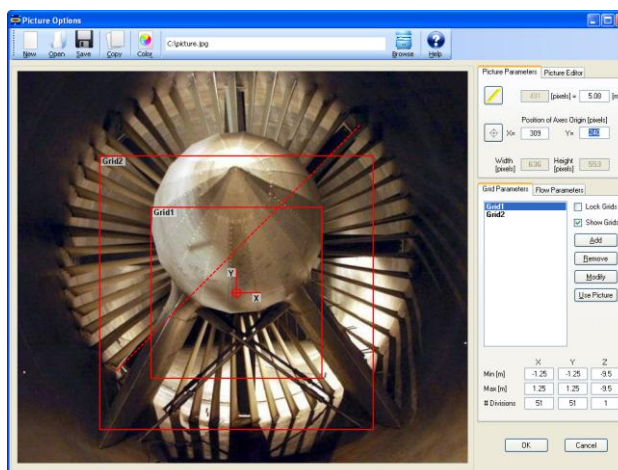
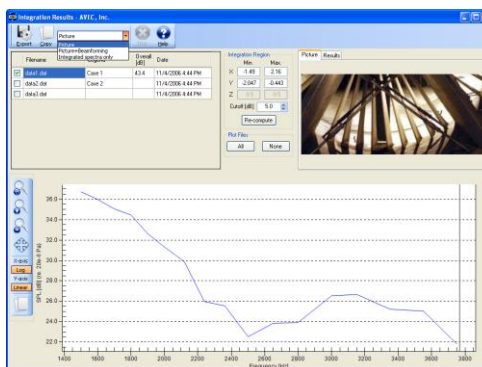
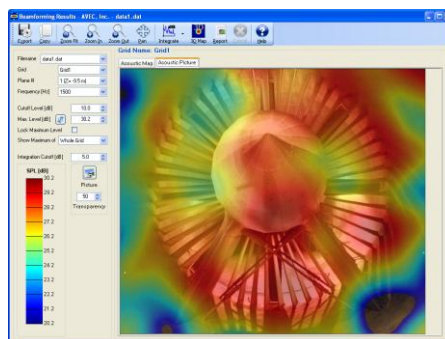
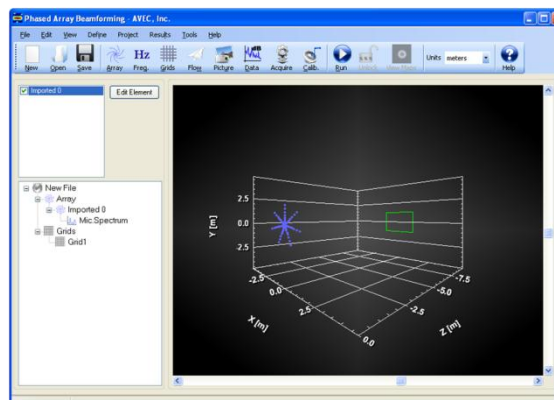
As a result, our software excels in processing speed, simplicity of setup, and intuitive access to results, among other advantages. It also provides the user with tools that help increase productivity by saving time while documenting the results, like using automatic report generation and being able to easily copy any figure with a single button. This and several other features allow the user to focus on data analysis.

# AVEC PHASED ARRAY SOFTWARE V2.0

## Data Processing Module

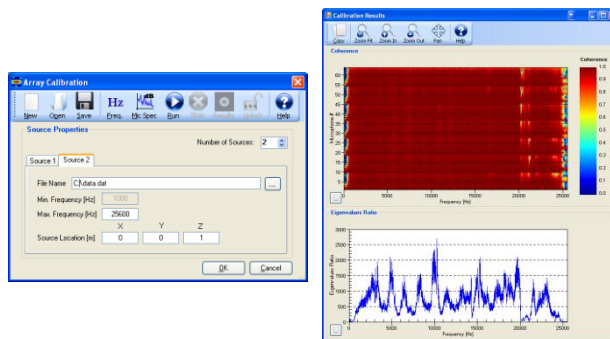
The Data Processing module allows the user to process and analyze experimental data collected using a microphone phased array. This module includes most aspects of conventional phased array analysis. Also, additional functions were added to aid in the data processing and analysis. Some of these features include:

- **Processing and analysis options:** The software includes processing options such as narrowband, octave band frequencies (1/3<sup>rd</sup>, 1/12<sup>th</sup> and 1/24<sup>th</sup>) analysis, beamforming with flow (including refraction effects), Diagonal Removing (DR) beamforming, and use of an array calibration file, among others. The software can also process multiple files and scanning grids in a single project, making it easy to access and compare results for different test configurations.
- **Acoustic maps:** The beamforming results can be visualized as conventional contour plots or overlaid with a picture/drawing to make the results easier to analyze and interpret. These maps, like most figures in the software, can be easily copied and the data can be exported to ASCII files.
- **Integrated spectra calculation:** An easy-to-use array integration module has been implemented to quantify the noise from a particular region on the maps. This feature allows the user to select a region on the map and instantly determine its spectrum. This new version also allows to compare different configurations in a single plot.
- **Automatic report generation:** This unique feature automatically generates a professional looking report with maps at the desired frequencies, figure captions and a table of contents. This increases the user productivity and allows him to spend more time analyzing data instead of copying, pasting and cropping figures.
- **Fast, easy project setup:** An intuitive interface design provides tools that allow you to setup the software and have the results available in a few minutes. One such tool allows the user to easily define the scanning grids using a picture or drawing of the test model.

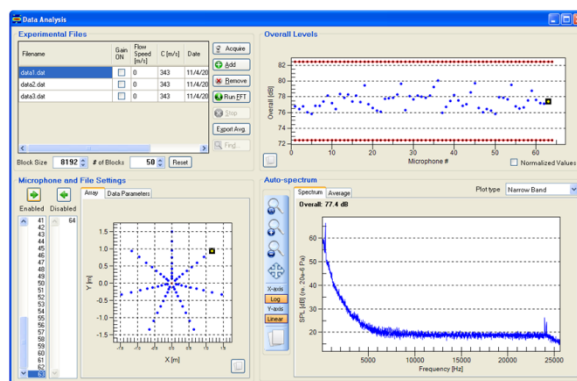


## Data Processing Module – Other Features

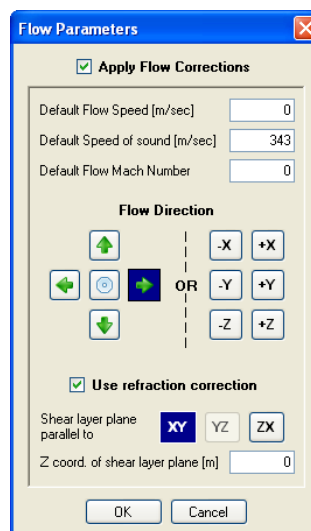
➤ **Array calibration module:** This module obtains the calibration matrices from speaker tests conducted in an anechoic chamber. It provides the capability of using different speakers for different frequency ranges to improve the calibration results. To determine the quality of the calibration data, the results are summarized in a plot showing the coherence between microphones and the eigenvalues ratio.



➤ **Microphones spectra and “self-check”:** An interface was created that allows the user to visualize and export the spectrum of each individual microphone, or the average over a subset of microphones. This module also includes a section where the overall levels for each microphone are plotted, making it easy to determine if a microphone is not working properly. Non-working microphones can also be easily discarded in the processing, to avoid “contaminating” the beamforming results.



➤ **Flow Corrections:** Wind tunnel testing is a common application of phased array technologies in which flow corrections should be accounted for. Two correction types are available in the software. The simplest one applies a constant shifting to the whole grid according to the flow speed and direction (input by the user) and the distance to the array. This correction is valid when the source and observer are immersed in a uniform flow and is typically used in hard wall wind tunnels. The second type of corrections available in the software accounts for boundary/shear layer refraction, as in the case of uniform flow with the receiver in a region at rest, i.e. open jet wind tunnel testing. Note that these corrections do not account for transmission losses.

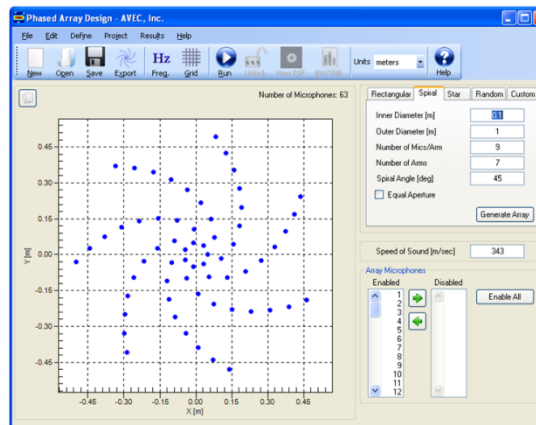


# AVEC PHASED ARRAY SOFTWARE V2.0

## Design Module

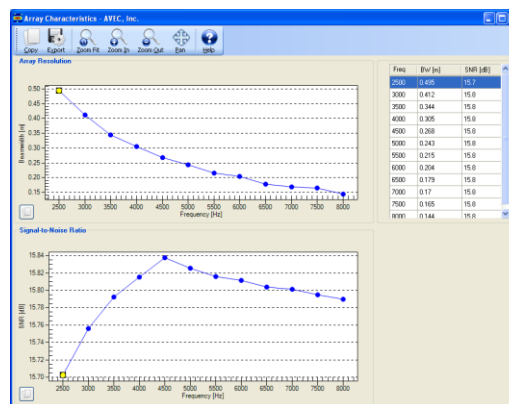
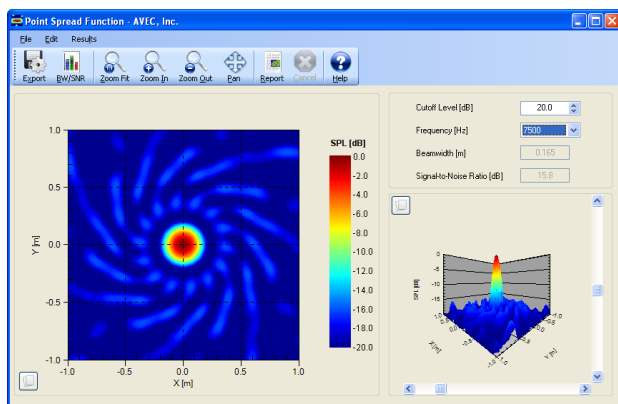
The phased array Design Module is a powerful tool to design and test different array patterns. This module can generate predefined patterns (rectangular, spiral, star, and random) or import an array from an ASCII file.

Once an array pattern is defined, the simulation settings can be defined in accordance with the actual working conditions of the array. In this way, the results are more representative of the testing conditions in terms of grid resolution, area to be scanned and distance to the source.



In addition to a beamforming map at each frequency, the simulation results provide the user with valuable information about the design: array signal-to-noise ratio (SNR) and array resolution (beamwidth). These results are also summarized in a simple SNR or resolution vs. frequency plot.

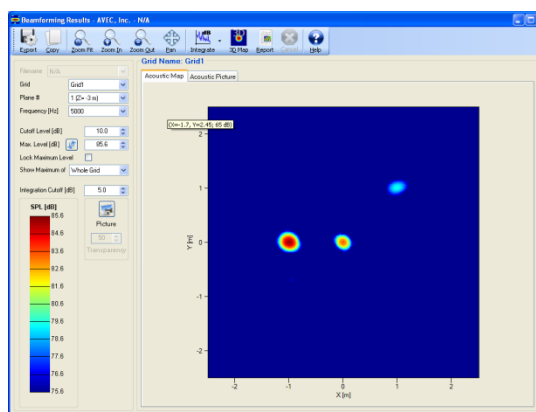
Also, this module is a helpful tool to learn about phased arrays. The simulation module can help the user understand the effects of array pattern, number of microphones, overall dimensions, etc. on the beamforming results.



## Simulation Module

The Simulation Module extends the capabilities of the Design Module. This module is intended to provide an environment to test an array under simulated working conditions. This includes multiple sources, sources with different relative levels and spectrums, beamforming in 3D grids, Diagonal Removal (DR) beamforming, etc. The simulation module is also a very useful tool for understanding array results and learning about phased arrays.

This module has been designed with the same layout as the Data Processing module to help the user in the transition from array simulation to processing actual experimental data.





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