



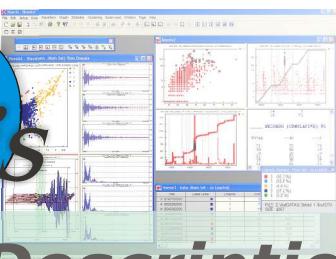
# Advanced Data Analysis Pattern Recognition & Neural Networks Software for Acoustic Emission Applications

## Software Description

### Noesis Architecture

Noesis uses the **Noesis Document** which contains all data, information, user actions, graphs, PR algorithms etc. The user starts with a New Document. This New Document needs some data (AE or other) and the user will be prompted to select the data files from standard Windows dialogs. Data can be added (or removed) to a document at any time during the analysis. Having loaded the data, the user can now create pages and graphs to view the data, apply filtering actions, use Pattern Recognition etc.

Nearly the same process applies to real-time classification and data processing. The user creates a new **Live-SPR document**, sets a few parameters and can then work with the data as with a normal Noesis document.



### Noesis Data Clustering

Noesis provides the user with a unique capability: Grouping data. This is done **by selecting some data (hits), and creating a cluster**. In this way the user can 'mark' data, for example to be filtered out, without having to delete them.

Creating data clusters also enhances drastically the way the user can view data. Different clusters can have different color and symbol so that they can easily be distinguished in any graph. The terms '**cluster**' and '**class**' are used to denote a group of data. The user can create clusters manually or using Pattern Recognition. In PR clusters are automatically created using mathematical algorithms, which group data according to their similarity.

When loading multiple data files Noesis will automatically create one cluster for the data in each file so that the user can distinguish between the data files. This grouping (clustering) can be undone at any time and different clusters be created.

### Noesis Functions Description

- \* Noesis can import any number of DTA, TDA, WFS or ASCII data files in a single document (data file merging).
- \* Noesis can read data files as these are acquired, classify and allow full processing of these data during acquisition (Live-SPR).
- \* Arrange the data files in time, order the data (sort) to time or any other feature and manage Time Marks..
- \* The user can load any or all types of data found in a PAC AE file (e.g. hits, time data, waveforms, messages etc.).
- \* At any point the user can export the data in the form of AE data files (DTA) or as text (ASCII) files. If the data are separated in classes (groups) then the user can choose to save one file for each class. Various comments will be added to the DTA file depending on the processing of the data for traceability.
- \* Noesis has a smart and easy way of creating pages and in each page creating and arranging graphs (scatter/point, color-by-value, bar, cumulative etc) to view the data. The user can make any change to pages and graphs to view the data in exactly the way he wants in a very simple and easy to understand manner.
- \* Zoom / Pan on any graph for a closer / detail view of the data of interest.
- \* Background plots can be added to any graph.
- \* Apply graphical filters to each graph individually.
- \* Select data points (hits, signals etc) from graphs using the mouse. Immediately the selected data are highlighted on all graphs

### Noesis Description

**Noesis** is a modern data analysis software that specializes in Acoustic Emission data. It can import Physical Acoustics Corp. **acoustic emission data files (DTA, TDA, WFS)** from PCI-2, DiSP, MISTRAS and SPARTAN systems. Apart from these files Noesis can import any kind of data and waveforms that are in **ASCII (text) format**. Noesis offers numerous functions to view, filter, manage and group the data. Its philosophy is to allow the user all the flexibility required to have absolute control over the data. Noesis, is also an advanced data analysis software, is also a **Pattern Recognition software**. It incorporates **statistical PR algorithms and Neural Networks** to provide the user with the latest in automatic data classification (grouping). **Noesis Enterprise can also load, extract features classify and manipulate AE data during acquisition (Live-SPR)**.

and the user can investigate their correspondence.

- \* Select data by specific criteria e.g. data from a specific file, data with waveforms, specific hits etc.
- \* Filter unwanted data. Noesis provides a number of filtering techniques starting from mouse select and delete to dedicated complex filtering dialogs. Data can be removed in the simplest manner available in AE software.
- \* View Waveforms, FFT, Power Spectrum, RMS, Autocorrelation, Segment FFT for all waveforms in the data. Waveform graphs can be manipulated and customized in a very similar manner to standard graphs. They can be zoomed, panned etc. Graphical filters can also be applied.
- \* Apply DSP filters and Windowing to waveforms for viewing or for extracting features. Filtered waveforms can be saved to AE data format files.
- \* Apply Feature Extraction for data with waveforms. Noesis offers this very powerful feature so that the user can investigate how the data change with different acquisition settings (e.g. threshold). Noesis supports features from both time and frequency domains. The new (extracted) features are added to the data without replacing the old ones, for a direct comparison. The user can continue working with both acquired and extracted features.
- \* Multi-hit extraction is also available for waveforms so that each waveform may be broken-down to many hits depending on extraction parameters.
- \* Noesis includes Calculated Features to allow the user take advantage of the existing features in the data and compute new ones. This feature includes a Feature Calculator than can use function like trigonometric or exponential.
- \* Zonal source location adds to the analysis capabilities for AE users. Noesis features an advanced zonal location technique providing the Event Sequence and Event Correspondence for each hit and a Linear 3D location that uses spatial source location between sensors.
- \* Data statistics can be viewed in Noesis. These include channel, feature statistics, feature correlation, cluster statistics and various correlation and clustering criteria.
- \* Data projections can be created to view the data in a mathematically defined space.
- \* Investigate data structures via Unsupervised Pattern Recognition. UPR is the process by which mathematical algorithms and neural networks are used to separate the data into groups (clusters) which contain similar data. The data are grouped as similar depending on their features and a number of user choices. The UPR Wizard can guide even the novice user via the various steps and actions required.
- \* Train Supervised Pattern Recognition algorithms and Neural Networks to automatically classify (group) unknown data. SPR is the process by which a data set is partitioned into various groups (clusters) using the properties of an "example" partitioning in some other data. This assumes that some data with the desired clustering has previously been achieved. The SPR algorithm is then trained, based on this known data set. Once trained, the algorithm can partition new data to clusters similar to those of the example classification. SPR functions are simplified and explained in the SPR Wizard which can guide and provide information for the whole process. SPR works also in real-time, classifying data as it is acquired.

For more information about Noesis please contact Envirocoustics SA at:

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Noesis is also available through Physical Acoustics Corp sales network. Contact PAC through [www.pacndt.com](http://www.pacndt.com).