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

Software Overview

Data Analysis Using Noesis

The complexity of Acoustic Emission (AE) (and in fact of any data) can, at times, be **overwhelming**, if the **appropriate tools are not available** to the analyst. The main tool used for AE data analysis has traditionally been feature correlation graphs. These have allowed experienced users to investigate the data structure, decide on the origin of the data, apply appropriate filters and investigate the validity of the result. Noesis, is an Advanced Data Analysis software featuring Pattern Recognition and Neural Networks, with powerful tools to aid and improve data analysis, ranging from drastically improved graphics with numerous options to view the data in new and different ways, to mathematical algorithms for signal/data discrimination and **data classification and manipulation during acquisition**.

Advanced Data Viewing

Noesis uses an advanced page creation and graph arranging method. Each page can support **graphs** (scatter, density, bar, cumulative, line, 3D etc) with **unique customization options**. In addition **statistics, data tables, waveforms, FFT, RMS, Autocorrelation and many more data views** can be on screen simultaneously. The **graphs and other views are active** in the sense that the user can **zoom and pan** to closely view the data, apply **graphical filtering** to each graph individually, **select data** with the mouse or user defined functions and view the selection in all other graphs (hit correspondence) and do much more. These functions alone render Noesis a superior analysis tool as the user gets a new and deeper look into the data. The simplicity and user friendliness that such complex data viewing is achieved can be compared to typing a text document!

Data Grouping & Multi-Dimensional Sorting

A **Cluster or Class** is **a group of signals/data**, which can be selected and defined by the user, according to their similarity or correspondence to physical phenomena, so as to distinguish from other data. Creating data clusters drastically enhances the way the user can view the data. Different clusters can have different color and symbol so that they can easily be distinguished in any graph or other view (tables, waveforms etc). The user can **get separate statistics for each cluster (class), compare clusters, view cluster comparative and evolution statistics etc**. The user can simply drag the mouse over a plot and select some data from multiple plots with logical AND/OR operations, or apply advanced multi-dimensional filtering. As data are usually grouped according to their similarity **Noesis offers much more than manual, user defined, selections and clustering** (which are limited to the user's observation capabilities in 2D or 3D space), although these tools alone can provide great power, ease, confidence and speed in data analysis.

Other Tools

Data viewing is only the beginning in Noesis. The data structure can be investigated using **advanced statistics** (e.g. feature discriminant, class dsciminant etc), **feature correlation matrices and dendrograms** (to investigate feature correlation), **principal component analysis and data projections** (to investigate the data in a mathematically defined space), **feature extraction** from waveforms (to get new unique signal features and use them in the analysis), **calculated features** (to get computed features from the existing ones) and other small functions that will make data analysis a new process.

Interactive Advanced Data Clustering

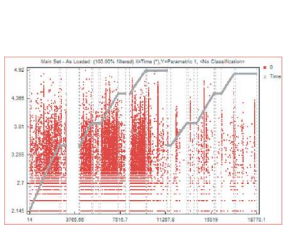
Apart from manual clustering Noesis offers a number of algorithms to automatically classify data. The Interactive Advanced Data Clustering is known as **Unsupervised Pattern Recognition (UPR)** and incorporates **mathematical algorithms and Neural Networks**. As its name suggests this process investigates the data to find and Recognize Patterns in the data and group them accordingly. **These algorithms provide the user with an interactive way to classify data according to their similarity**. Traditional analysis of 2D or 3D graphs has limited analysts. Unsupervised Pattern Recognition **lets the user set a limited number of parameters** and **get an automatic classification based on these parameters**. The results of the classification will depend on user input (e.g. features to be used, desired clusters, algorithm used etc) but most importantly they will depend on the quality of the data. Thus, **Noesis allows signal/data similarity to be compared on Multi-Dimensional space** (can be 10D or 20D even) that an analysts could not even begin to imagine due to the complexity of the problem. The results **of any classification of data will be immediately visible on all graphs and views** as different colors for each class (group of data) are automatically assigned. The data structure can then be further investigated using graphs, tables, statistics, correlation plots and all the tools available in Noesis.

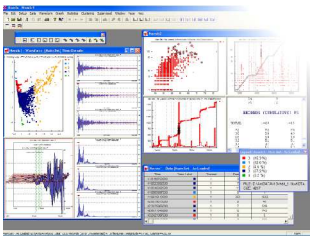
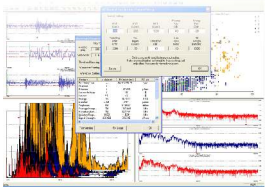
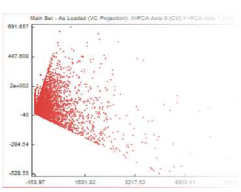
Fully Automated Advanced Data Classification

Unsupervised Pattern Recognition is a process requiring some user input to allow data grouping in some unknown data. The Fully Automated Data Classification functions, known as **Supervised Pattern Recognition (SPR)**, incorporates **mathematical algorithms and Neural Networks** that can be trained from known data or data clustered by UPR (see Interactive Advanced Data Clustering) and then automatically **classify similar unknown data, even during acquisition!** The user needs some data and decide on their classification (data groups). Once this is finalized **an SPR algorithm can be trained to recognize the defined patterns in the data**. The algorithm can then be applied to unknown data and it will classify the signals into the predefined groups (classes).

Noesis For the Analysis of Data other than AE

All Noesis functions are available for the analysis of any kind of data. The ASCII data and waveform file import feature allows the user to acquire data trough any equipment (even manually), arrange them in simple tab delimited columnar ASCII file(s) and import them in Noesis. All viewing and analysis capabilities are available.



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Envirocoustics Non Destructive Testing

Noesis is also available through Physical Acoustics Corp sales network. Contact PAC through www.pacndt.com .