

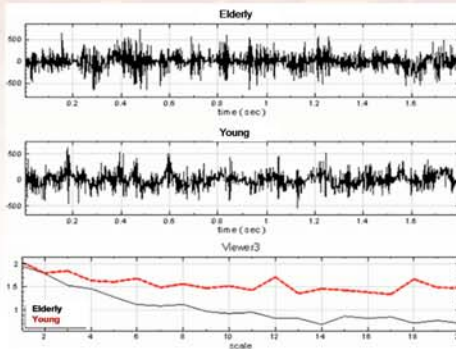
DynaDx® DataDemon

DataDemon is a commercial data analysis package specially designed for healthcare community and biomedical researchers. DataDemon has a graphical user-interface. With several simple mouse clicks, the user can build the data analysis diagram, view the results and create a final report. DataDemon is also the ONLY data analysis package with Hilbert-Huang Transform (HHT) technology licensed from NASA. In addition to the HHT, DataDemon also includes tools for data filtering, math calculation, statistics, matrix operation, data transformation and other popular time-frequency analysis (TFA) methods, such as short-term Fourier transform, (Enhanced) Morlet wavelet, and Hilbert transform. DataDemon is a tool that can help researchers enhance productivity and obtain better results.



Hilbert-Huang Transform

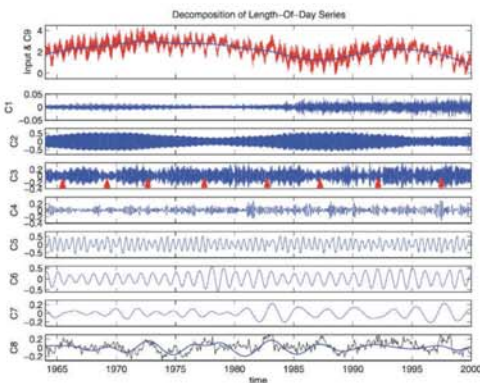
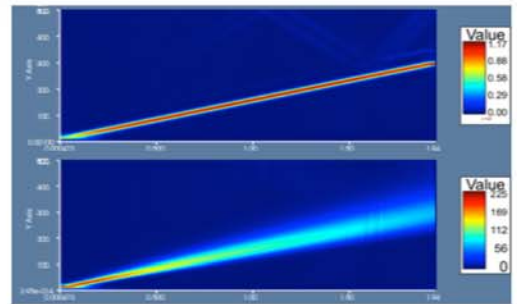
Hilbert-Huang Transform (HHT) was invented by Dr. Norden E Huang, a chief scientist and mathematician at NASA Goddard Space Flight Center. In contrast to the Fourier Transform, HHT is designed specifically for nonlinear and nonstationary signals. HHT can be used to analyze data in a wide variety of applications, including medical, acoustic, noise, vibration, environmental, industrial, structure and civil engineering, and financial applications. The invention of HHT led to a Federal Laboratory Consortium "Technology Leadership Award" for the HHT method in 2000, as well as recognition as one of R&D magazine's "R&D 100" (a list of the top 100 inventions of the year) in 2001, and the "NASA Government Invention of the Year" in 2003.



Complexity, Multi-Scale Entropy (MSE)

Multi-Scale Entropy (MSE) method was proposed by Professor Chung-Kang Peng at Harvard Medical School. MSE is a numerical method which analyzes the complexity of a time series on different time and space scales. The complexity represents the ability of the system to adapt to the pressures of its environment. MSE has been successfully applied to the study of physiology, pathology, and drug discovery. (The graphs above show MSE analysis of stability recordings between elderly and young individuals.)

The bottom graph below shows the time-frequency analysis of a chirping sound. The frequency increases over time and shows a straight line which blurs at higher frequencies. The top graph shows the results of the Enhanced Morlet Transform which combines the strengths of both the Short-Term Fourier Transform and Morlet Transform, and improves the resolution at high frequency.



DynaDx Corporation obtained the exclusive rights for HHT technology and its related applications from NASA, and DataDemon software implements the latest HHT codes from Dr. Huang and NASA. (The above figure is the HHT analysis of the length of day during 40 year span. Data is provided by NASA.)

Time-Frequency Analysis: Short-Term Fourier Transform, Wavelet Transform, and Enhanced Wavelet Transform

Time-Frequency Analysis allows the user to see the changes in frequency versus time. DataDemon supports all three types: Short-Time Fourier Transform, Wavelet Transform and Enhanced Wavelet Transform.

Why DataDemon

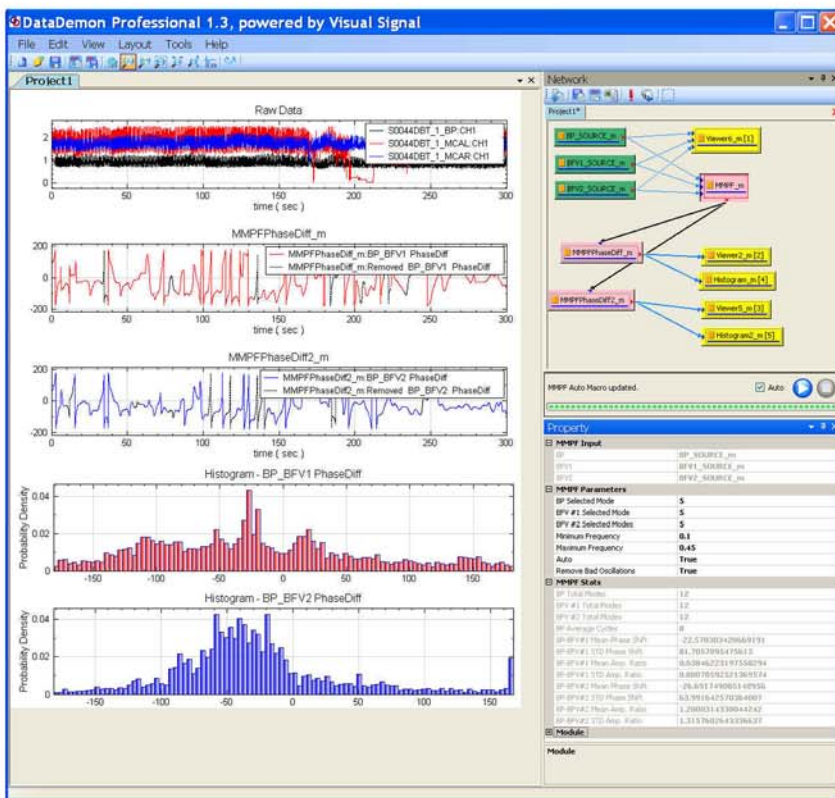
- **Easy to use, no programming skill needed:** with graphical block diagrams, data analysis can be done with several mouse clicks
- **Exclusively licensed HHT technology from NASA:** the most advanced and the only adaptive technology for analyzing nonlinear and nonstationary signals
- **Advanced and complete tool sets:** wide range of features for time-frequency analysis, matrix, filtering, statistics, transformations ... all included in one package
- **Efficient and fast:** optimized algorithm, efficient memory management, and Intel native compiler to make it run more than 300 times faster than Matlab
- **Publication quality graphics:** graphics are configurable and ready for paper publication and presentation



DataDemon

Graphical Data Analysis with No Programming

To create the data analysis diagram, the user simply connects the Signal Flow Objects (SFOs) and sets the desired properties. DataDemon will automatically do the computation and show the results.



Supported File Formats

- Input/Output file format: ASCII, tfa, csv, wav, mp3, MIT WFDB, Matlab, Excel, sac...
- Image output file format: png, bmp, tif, jpg, wmf
- Clipboard supports bitmap and vector wmf

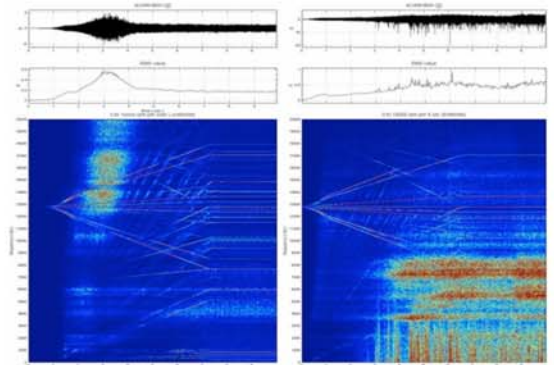
Matlab Interface

DataDemon is fully integrated with Matlab software. The data can be passed to a Matlab engine from DataDemon, and existing Matlab routines can become graphic SFOs in DataDemon.

Batch Run

If a saved project needs to be applied to various data files with the same diagram flow, or to be computed with different parameters, Batch Run can be deployed.

Real Case Studies



The figures above show the time-frequency analysis for good and bad spindles tested at varying rotational speeds. The red areas indicate larger oscillations. If the primary frequency is too strong, horizontal red stripes appear which indicate there are defects in the primary spindle. Vertical red stripes indicate a fault in the assembly.

The left-side figure above shows an example of a well-built spindle. The right-side figure above shows an example of a spindle that does not pass the quality assessment test. When the rotational speed reaches certain values, time-frequency analysis shows many horizontal and vertical red stripes. This result shows that the vibration is caused by faults in the assembly of the spindle.

Using time-frequency analysis, rotating machinery components can be tested for defects and abnormal vibration to detect faults before the component fails.



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