nCode GlyphWorks is a powerful data processing system for engineering test data analysis with specific application to durability and fatigue analysis. In addition to general signal processing, GlyphWorks provides leading fatigue analysis capabilities for measured data. Unique capabilities include the ability to help specify accelerated durability tests, saving both time and money in environmental qualification and product validation.

Product benefits:
- **Easily process** huge amounts of data in a wide range of data formats
- **Save time and cost** with faster, more realistic durability tests
- **Improve consistency and quality** with standardized analysis processes
- **Increase productivity** by going straight from raw data to finished reporting
- **Comprehensive** analysis for experts but simple to use for occasional users raising team effectiveness

Product features:
- **Proven analysis methods** for durability and fatigue analysis with specialized capabilities for damage calculation and test profile generation
- **Intuitive, graphical interface** for developing analytical processes, with displays for synchronized GPS and video
- **Pre-defined processes** for performing time, frequency, and statistical analysis
- **User-defined processes** easily created with MATLAB® or Python programming language
- **Single environment for correlating** test and CAE data
Core functionality for test data analysis

nCode Fundamentals

nCode Fundamentals provides visualization and basic manipulation of data, frequency spectrum analysis, filtering capabilities, and reporting. It is included in the base package of GlyphWorks and is a prerequisite for all other product options.

nCode Fundamentals features:
- Input/output support of multiple data formats
- Channel calculator
- Channel reassignment
- Filtering
- Extraction and concatenation
- Statistics and running statistics
- Resampling
- Unit conversion
- Frequency analysis
- Time at level analysis
- Rainflow counting
- Graphical editor
- Visualization and reporting
- Batch and interactive interfaces
- Super glyph to encapsulate multiple analysis functions as a single glyph that can be saved and reused
- ScheduleCreate durability duty cycle definition

Designed to handle huge amounts of data, nCode GlyphWorks provides a graphical, process-oriented environment. Users can simply create an analysis workflow by ‘dragging and dropping’ analysis building blocks.

A wide range of data processing capabilities are available with standard and specialized options to increase product durability and performance.
Fatigue
GlyphWorks provides the industry-leading fatigue analysis technology necessary to calculate fatigue life from measured data. A materials database with commonly used fatigue data is also provided.

With the Fatigue option, you can:
- Correct for mean stress and surface finish effects
- Back calculate from each data channel to determine a scale or fatigue concentration factor required to achieve a target life
- Review damage histograms to determine which load cycles were most damaging
- Output damage time histories to show exactly when the damage occurred.

Stress-Life
Uses a nominal stress approach for high-cycle conditions or non-metallic applications. A wide range of methods is provided for defining the SN curves including the ability to interpolate multiple material data curves for mean stress effects. For ultimate flexibility, Python scripting enables the definition of custom fatigue methods and material models.

Strain-Life
Is commonly used for more severe loading conditions (low-cycle fatigue) – where local elastic-plastic strain controls the fatigue life. Supported methods include the Coffin-Manson-Basquin formula with additional mean stress corrections such as Morrow and Smith-Watson-Topper.

Crack Growth
Provides linear elastic fracture mechanics to determine how a crack will propagate after initiation. Built-in growth laws include NASGRO3, Forman, Paris, Walker, and more.

Creep Analysis
Performs creep calculation for time in hours to rupture at high temperatures. Supported methods include Larson-Miller which uses a creep curve that is either paired points X-Y curve or polynomial function and Chaboche method using a family of curves, each for a specific temperature.

Fatigue Editing
Performing durability tests, such as vehicle road simulators, can take many weeks and require huge amounts of time history data. Fatigue Editing is an option that can be used to perform damage-sensitive editing to generate shorter time series data that retain the required damage.

A highly flexible tool, Fatigue Editing uses the powerful Fatigue glyphs, enabling complete control over the parameters used in the damage calculations.

With Fatigue Editing you can:
- Shorten multi-axial durability tests while retaining damage to save time and money
- Assess the trade-off between time saved and damage retained across multiple channels
Save time and money with more efficient durability tests

**Signal**
The Signal option contains a set of glyphs often used in durability test applications to identify ‘features’ such as spikes, drift, and flat-lines within time series data. Features can be viewed and corrected automatically using other glyphs such as the Graphical Editing glyph.

**Signal option features:**
- Level crossing counting
- Joint distribution analysis
- Peak valley slice
- PSD to rainflow cycle count
- Trend removal
- Markov counting
- Relative damage calculation
- Flat-line detection
- Drift and spike detection
- Frequency-banded relative damage spectrum
- Rainflow extrapolation
- Curve fitting
- Weibull analysis

**nCode VibeSys**
VibeSys provides a set of glyphs that enable Acoustics and Vibration engineers to design a reliable product that satisfies customers’ expectations in terms of sound, comfort, and regulatory requirements. A Vibration Manager is included, providing the ability for users to enter, edit, and view vibration specification data.

**VibeSys features a set of pre-defined processes for:**
- Rotating Machinery. Detect early symptoms of noise or vibration problems in rotating machinery and identifying their root cause.
- Structural Dynamics. Characterize the dynamics of a structure in terms of its modes of vibration. Includes modal analysis, animations of mode shapes and Operating Deflection Shapes.

A specialized product option for identifying modes of vibration and extracting modal parameters is available in the Modal Analysis module.

Additional information on VibeSys can be found at www.ncode.com/vibesys.
GlyphWorks options

GlyphBuilder
The GlyphBuilder option enables users to add their own unique or proprietary methods and file formats by combining the capabilities of the Scripting and Open glyphs.

Within the Scripting glyph, users can define their own processes by using MATLAB or Python programming language. IMSL math and statistic functions can also be accessed by using the special Python-enabled PyIMSL™ functions.

The Open glyph gives direct access to external applications from within a GlyphWorks process. A given command line operation is executed from within this glyph so that external code or scripts such as Visual Basic®, Java™, nCL, C++, etc., can all be called using data from the process.

Accelerated Testing
Accelerated Testing provides the ability to create a representative PSD or swept sine shaker vibration test based on measured data. It uses the fatigue damage spectrum (FDS) approach as described in NATO STANAG 4370 (AECTP-240)/UK DefStan 00-35/Mil-Std-810G, allowing users to tailor vibration tests to a target vibration environment. Users can also compare existing test evidence against the requirements of a known test specification, enabling assessment of whether components in service will likely survive to the target service life. This known safety margin may help extend the life of parts in service or conversely avoid unexpected failures.

With Accelerated Testing you can:
- Create an accelerated shaker test and assess the impact on shock and fatigue damage
- Rapidly compare an existing test specification with service vibration data
- Extend the life of parts in-service or avoid unexpected failures
- Understand the impact of exposure time in-service and on the test rig

Image courtesy of STFC
GlyphWorks product options to easily visualize measured data

GPS Display
The GPS Display glyph plots latitude and longitude GPS data on a map or grid background. Data can be easily exported for viewing in Google Maps™ or Google Earth™. Feature lists are also supported, allowing locations of interest on the data lines to be automatically identified and marked. Regions for editing data can be defined based on geographical location.

With GPS Display you can:
- Quickly plot thousands of data points
- Color code routes based on channel data like speed, strain, or temperature
- Edit data based on defined regions or geographical location
- Easily view data in Google Maps™ or Google Earth™ using a Google KML file
- Estimate vehicle performance characteristics such as engine power and braking power

From GPS mapping and video playback to 3D data plots — nCode GlyphWorks provides a wide range of displays that reveal information important to engineers. It also directly reads many engineering and data acquisition file formats to streamline the overall process.

Media Display
The Media Display glyph enables video and audio signals to be played using Windows Media® Player embedded in the glyph. It also enables cursor synchronization with other data displays to gain insight on what was occurring in other signals. The Gauge Display glyph enables synchronized values to be displayed during playback in a variety of styles such as angular gauges or digital read-outs.
**Optimized Testing**

Physical durability testing often requires determination of the optimum, most efficient mix of events required to match an overall target. In automotive applications for example, the challenge is to obtain the best value from proving ground usage for durability schedules. Optimized Testing provides a proven approach to find the optimum solution across many channel locations.

A wide range of inputs from measured data such as rainflow cycle counts or relative damage values enables many industry applications. The optimization methods for best fit least-squares regression and constrained minimization routines employ robust algorithms from IMSL® Numerical Library.

With Optimized Testing you can:

- Significantly reduce proving ground track usage
- Optimize testing schedules and reduce testing time
- Understand how real world usage compares to track data
- Rapidly compare different proving grounds or duty cycles

**Data Cleaning**

The Data Cleaning option provides advance data cleaning techniques beyond what is possible with classical filtering techniques alone. This option includes the Wavelet Denoising glyph that enables noise to be separated out from signals by decomposing data into the combination of “wavelet levels”. It also includes the Kalman Filter glyph which accounts for noise in measured data using a physics model that predicts, given the current point, where the next point will be.

**ASAM ODS**

Gain access to search and select data from your ASAM ODS database within GlyphWorks!

The interface to the ASAM ODS data enables interactive browsing, editing of metadata, and searching based on metadata, all within GlyphWorks. ASAM ATF and ATFX files are also supported and can be both imported and exported.
About HBM Prenscia

HBM Prenscia leverages ReliaSoft and nCode software, training, and consulting to deliver solutions that empower the engineering community. We are committed to the development of innovative concepts for improving reliability, availability, maintainability, safety, and durability, while reducing risk across a broad range of applications.

For more information, visit our website at www.hbmprenscia.com