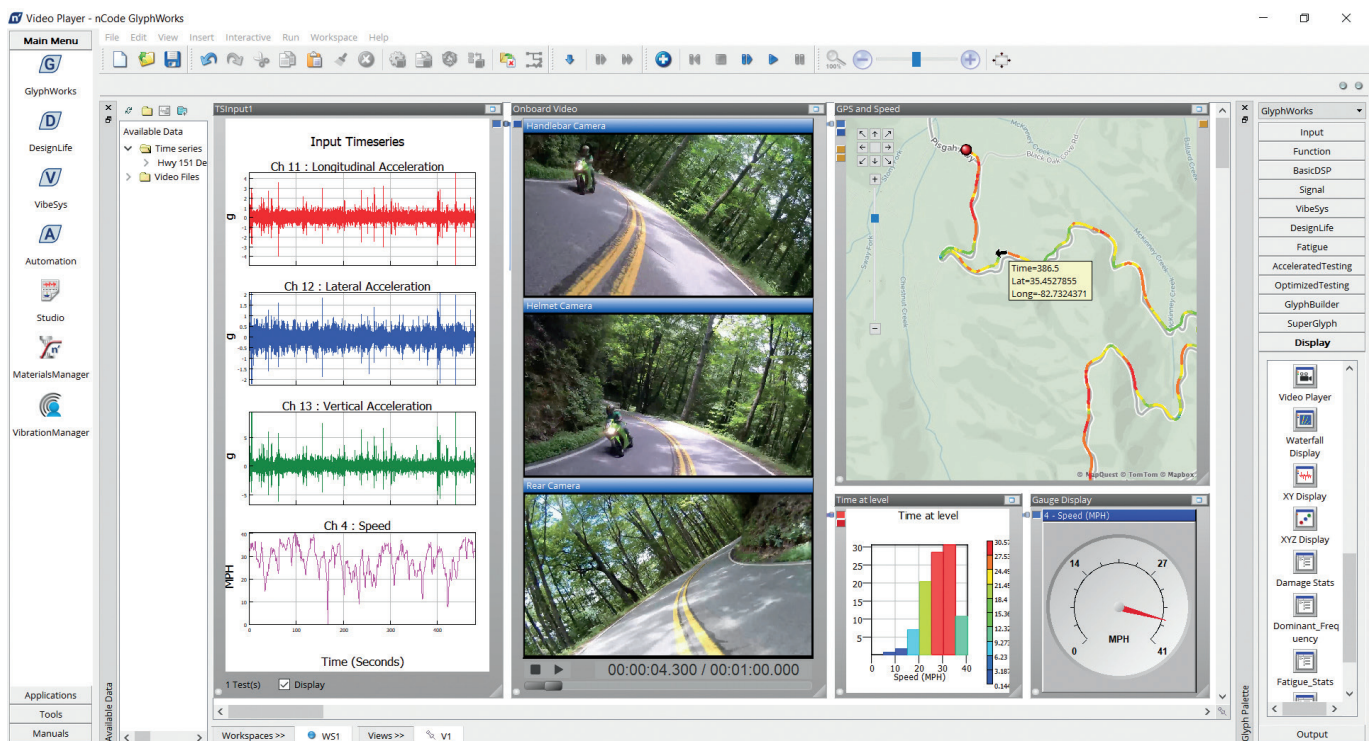


## PRODUCT DETAILS

# Signal Processing and Durability Analysis

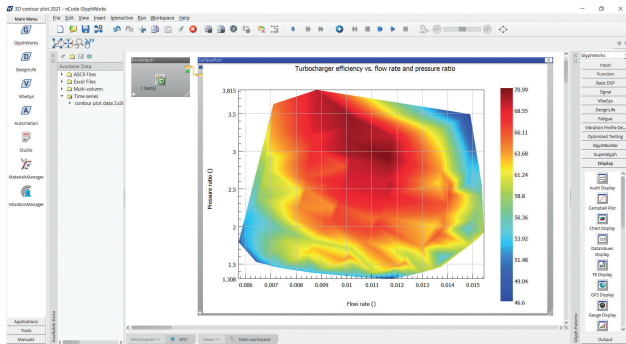
**nCode GlyphWorks** is a post-processing system that contains a comprehensive set of standard and specialized tools for analyzing measured data to increase product durability and performance.



## BENEFITS

- **Easily process** huge amounts of measured data in a wide range of 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

# Core functionality for test data analysis



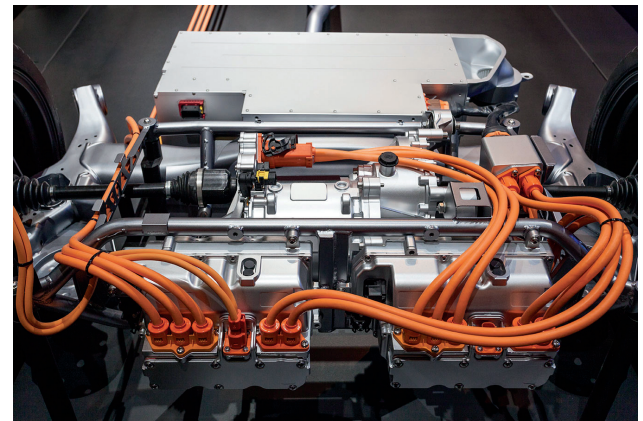
Designed to handle huge amounts of data, GlyphWorks provides comprehensive analysis through a graphical, process-oriented environment. Workflows are easily created by 'dragging and drop' analysis building blocks.

## NCODE FUNDAMENTALS

Enable correlation between test and finite element results. Gauges (single or rosette) or displacement sensors may be graphically positioned and oriented on finite models as a post-processing step. Time histories due to applied loads can be extracted for direct correlation with measured strain, displacement, acceleration and velocity data.

## NCODE FUNDAMENTALS FEATURES

- Input/output support of multiple data formats
- Channel calculator
- Filtering and resampling
- Extraction and concatenation
- Statistics and running statistics
- Unit conversion
- Frequency analysis
- Time at level analysis
- Rainflow counting
- Graphical editor
- Visualization and reporting
- Batch and interactive interfaces
- SuperGlyph to encapsulate multiple analysis functions as a single glyph
- ScheduleCreate durability duty cycle definition
- Electric power analysis to estimate the efficiency of electric powertrains from measured currents and voltages



# GlyphWorks options

## FATIGUE

GlyphWorks provides the industry-leading fatigue analysis technology necessary to calculate fatigue life from measured data. A materials database with over 450 in-house validated fatigue properties for many commonly used materials is included.

### THE FATIGUE OPTION ALLOWS YOU TO:

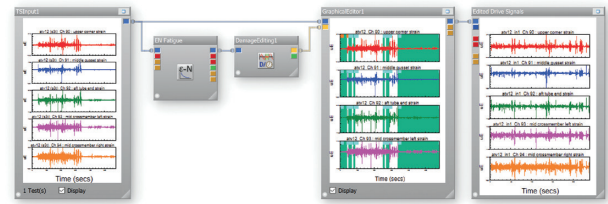
- Correct for mean stress and surface finish effects
- Back calculate from each data channel to determine a scale or fatigue concentration factor required to achieve a target life
- Review damage histograms to determine which load cycles were most damaging
- Output damage time histories to show exactly when the damage occurred
- Use material data to perform Stress-Strain conversions and plot hysteresis loops

## 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

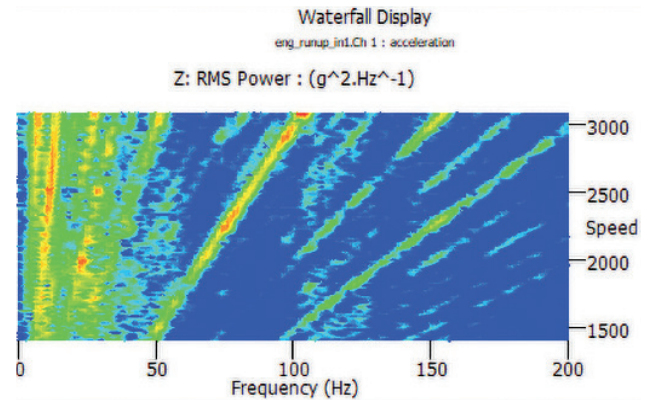
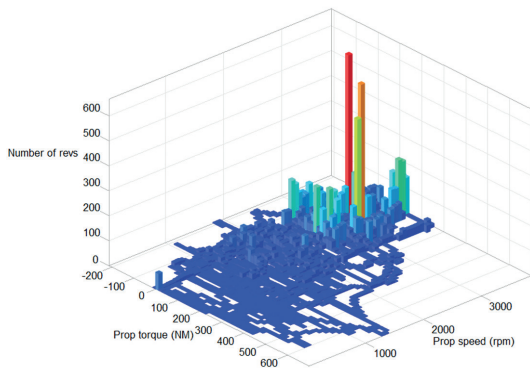
Performing durability tests, such as vehicle road simulators, can take many weeks and require huge amounts of time history data. Fatigue Editing is an option that can be used to perform damage-sensitive editing to generate shorter time series data that retain the required damage.

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

### FATIGUE EDITING ALLOWS YOU TO:

- 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
- Rainflow to time series
- 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.

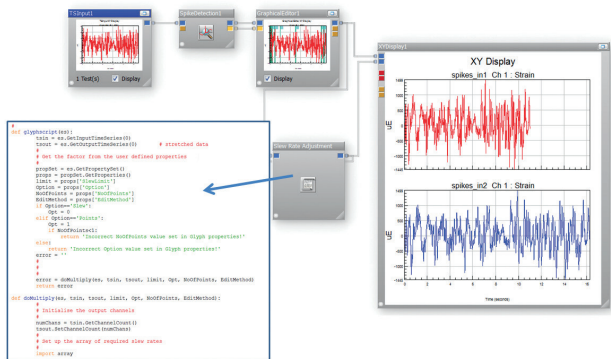
## VIBESYS FEATURES A SET OF PREDEFINED PROCESSES FOR:

- 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
- Human perception. Assess whole body comfort and health. Specific functionality includes vehicle ride quality analysis and hand-arm vibration assessment

The Modal Analysis module is a specialized product option for extracting modal parameters from test data. Synchronous animation of the simulation and test mode shapes, as well as the determination of the Modal Assurance Criterion enable correlation between test and CAE.

Additional information on VibeSys can be found at: [www.ncode.com/vibesys](http://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 OpenGlyph.

The Scripting glyph allows users to define their own processes by using either MATLAB or Python programming language.

The OpenGlyph gives direct access to external applications from a GlyphWorks process. A given command line operation is executed from 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.

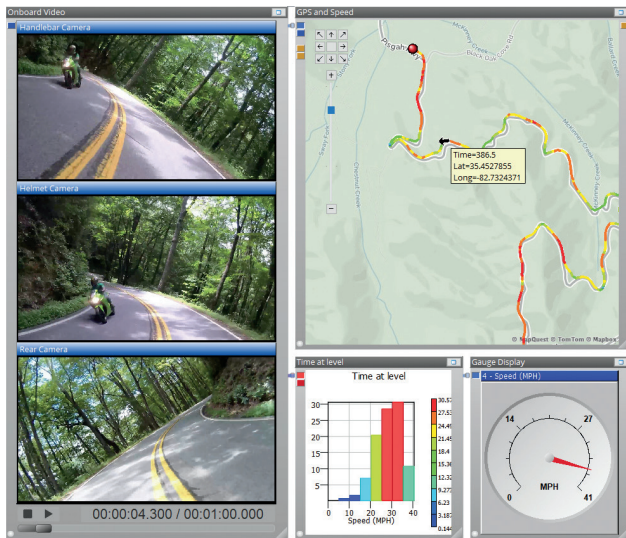
## VIBRATION PROFILE DESIGN

Vibration Profile Design (formerly 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. It allows 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.

### VIBRATION PROFILE DESIGN ALLOWS YOU TO:

- 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

# GlyphWorks product options to easily visualize measured data



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 Video Player and Media Display glyphs enable multiple synchronized videos and audio signals to be played alongside measured data. They also enable 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.

## GPS DISPLAY

The GPS Display option allows you to plot 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.

The GPS Processing glyph enables vehicle performance data to be estimated from low sample rate GPS data. Calculated channels include speed, percent gradient, yaw rate and, lateral acceleration.

## THE GPS DISPLAY OPTION ALLOWS YOU TO:

- Quickly plot thousands of data points
- Colour 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

# GlyphWorks options

## 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 libraries such as NLOpt.

## OPTIMIZED TESTING ALLOWS YOU TO:

- 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. It 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 in GlyphWorks. ASAM ATF and ATFX files are also supported and can be both imported and exported.

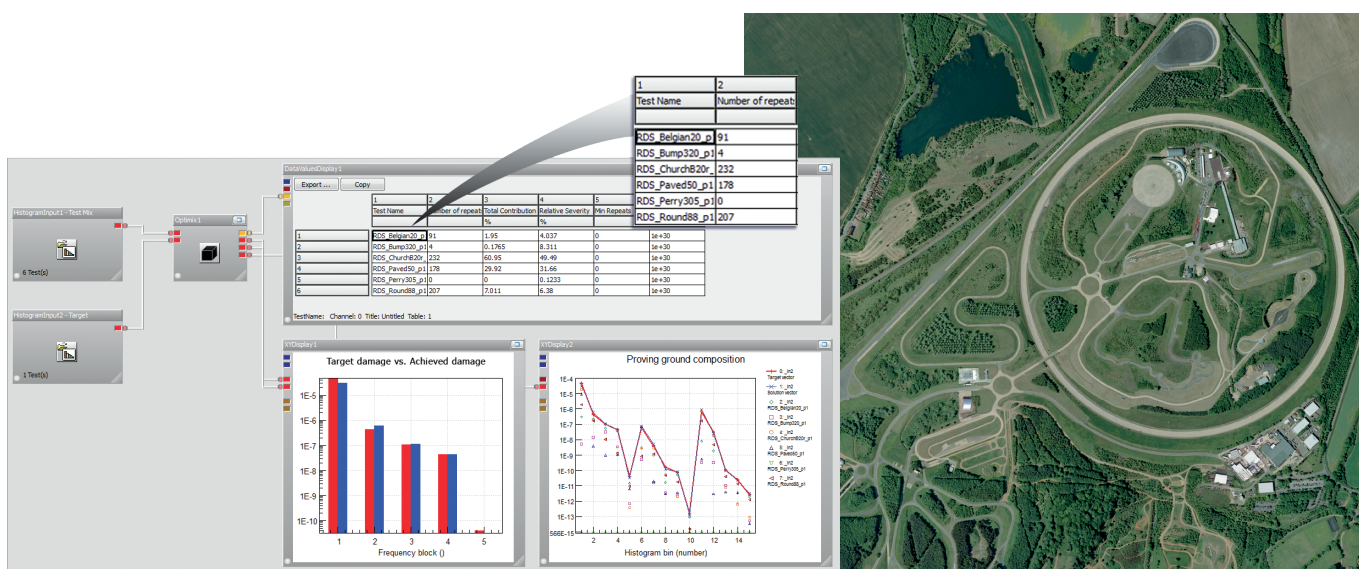


Image courtesy of Millbrook Proving Ground

## EXPLORE OTHER NCODE SOLUTIONS

### **nCode DesignLife**

CAE-based durability analysis system for fatigue life prediction and test-CAE correlation.

### **nCode VibeSys**

Data processing system for vibration analysis.

### **Aqira**

Standardize engineering processes, performstreamed data analytics, and manage data.

### **Premium Materials Database**

High-quality fatigue parameters of steels, aluminium alloys, and additive manufacturing materials.

## ABOUT US

We help engineers deliver durable and reliable products and avoid the cost of unexpected failures. Our software brands for durability and reliability, nCode and ReliaSoft, empower data-driven confidence through accurate analysis and simulation, enabling customers to achieve success through failure prediction.

For more information, please visit: [www.hbkworld.com](http://www.hbkworld.com)

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