DIGITAL INDUSTRIES SOFTWARE

Using Simcenter physical testing to streamline durability testing

Understanding road load data to optimize strength and fatigue

Solution benefits

Increase testing productivity with an end-to-end hardware and software solution dedicated to road and lab testing

Acquire realistic vehicle road load data as input for virtual and physical validation

Set realistic durability vehicle targets by incorporating local road profiles, driving habits and vehicle loading

Combine simulation with integrated test hardware and software platforms to create a comprehensive digital twin

Increasing product durability is a challenge engineers face when combined with the pressure to make products lighter to be more energy efficient. Reducing mass and material often leads to weaker, less durable designs, which can create customer dissatisfaction. Balancing the tradeoffs between durability and energy efficiency can be tricky, but you do not necessarily need to sacrifice durability. How can you understand the durability performance of multiple design variants under increasingly shorter development cycles?

Using Simcenter™ software can help you streamline your entire end-to-end durability testing process by integrating rugged and reliable data acquisition hardware with comprehensive processing software features. Using Siemens Digital Industries Software solutions covers every step of a typical test campaign, from channel setup and measurements to validation, consolidation, analysis and reporting. Simcenter is part of the Siemens Xcelerator business platform of software, hardware and services.

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Using Simcenter physical testing to streamline durability testing

Understanding smart load data acquisition in all environmental conditions

A durable engineering process starts with gaining a precise understanding of the loads that products undergo during their anticipated lifetime. To achieve this, it is crucial to have a state-of-the-art data acquisition system. Engineers can use Simcenter SCADAS™ hardware to measure realistic data on public roads, proving grounds and off-road under extreme conditions such as those found in heavy equipment and transportation industries.

Streamline delivery of critical durability insights

Adopting an innovative load and fatigue analysis solution is crucial for speeding up time-consuming tasks such as load data classification, damage potential analysis and experimental fatigue analysis. Quickly deliver critical insights when preparing for test rig campaigns and reliable simulations with our load and fatigue analysis solution that integrates instant visualization tools with interactive or automated analysis, performant processing and active reporting.

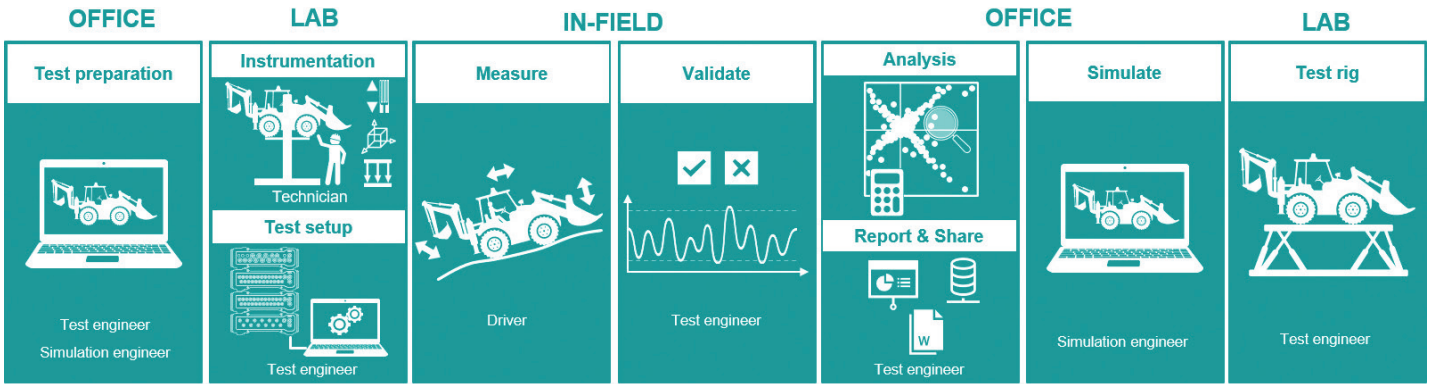
Set realistic vehicle durability targets that match your customer usage profile

Once you analyze durability-specific characteristics and set durability targets to match the target customer usage profile, it is crucial to employ realistic, customer-correlated and accelerated test schedules to avoid overtesting. Using Simcenter Testlab™ software offers tools that can help you create damage-equivalent accelerated profiles as input for shakers or computer-aided engineering (CAE)-based fatigue life predictions.

Optimize design with test simulation integration

Many see physical testing and simulation as separate functions, but there are many benefits to combining simulation with testing. You can leverage Simcenter to uniquely integrate physical testing and simulation so you can pass test data, correlate your simulation models and use simulation for pretest planning.

For example, you can gather measurements from a physical vehicle on a test track and feed that into your vehicle simulation to perform load prediction in hours instead of days. Engineers can use test data as input in Simcenter 3D™ software and build a virtual test rig to excite a model, perform load prediction without characterizing tires and roads, employ an iterative process for early access to vehicle loads and optimize and validate the design by balancing weight, strength and durability.



Industry applications

Automotive and transportation

Almost all parts of a vehicle, including electronics, are engineered for durability. Automotive original equipment manufacturers (OEMs), suppliers and those in the transport industry are using Simcenter testing solutions to access real-life, accurate vehicle loads that impact the durability of a product. With our solution suite, engineers can collect data while driving the vehicle on the proving ground or the test field and make in-depth durability analyses with load and fatigue analysis tools to gain insights into the damage potential. Moreover, customers can process data to make accelerated test schedules they can use as input for simulation or test benches.

Heavy equipment

Companies in agriculture, construction and mining share many of the same needs as the automotive and transportation industries. As such, manufacturers need to engineer almost all heavy machinery components for durability and should operate under harsh environments. Engineers can use Simcenter testing solutions that offer tools to measure real-life loads, perform load data analysis and create accelerated test cycles. Using our rugged and connected data acquisition hardware helps you collect precise multiphysics measurements under extreme conditions. Thanks to our data acquisition and analysis software, engineers can make in-depth durability analyses to gain insights into the damage potential of heavy equipment.

Aerospace and defense

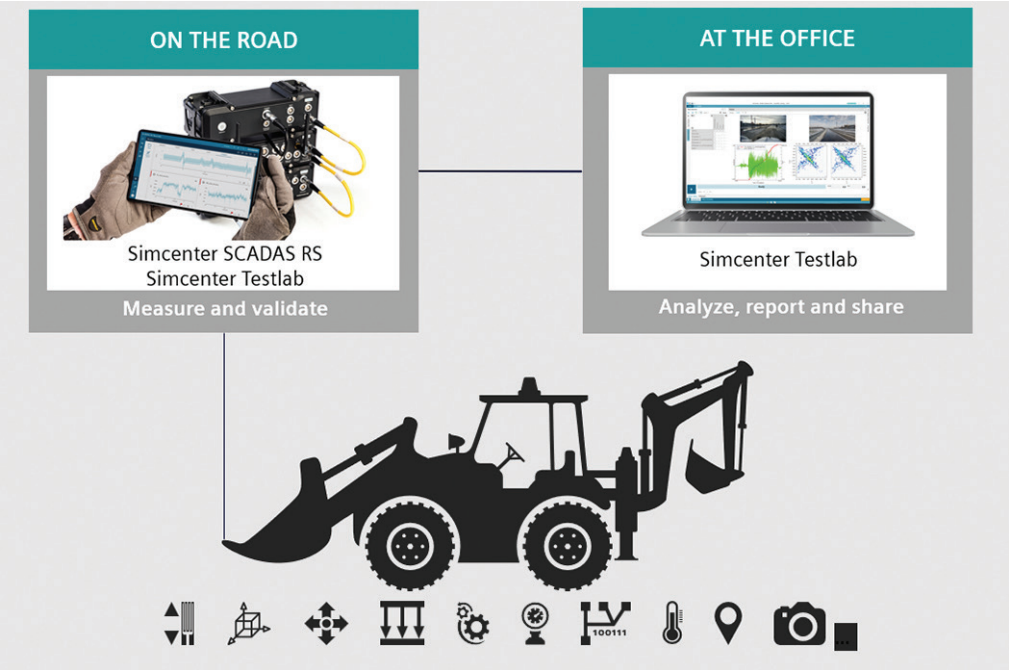
Armored military vehicles contain electronic units that need to survive a certain level of vibration according to military standards. Simcenter testing solutions provide engineers with the tools to collect vibration data and create accelerated testing profiles they can use in environmental testing labs.

Electronics and semiconductors

Many products nowadays contain sensitive electronic components that need to survive the vibrations experienced during the lifecycle of the product. Using Simcenter, electronics manufacturers can define an accelerated test that accurately represents the vibrations these products undergo in real life and make sure they are durable enough.

Energy and utilities

Wind turbines must perform as efficiently and as long as possible without breaking or causing trouble. This requires expert design early in the development process to achieve proper durability. Using Simcenter provides you with the tools for load data collection on blades, shafts, gearboxes, bearings and towers via strain gauges and force cells to determine critical spots during operation. Engineers can use measured data for fatigue life prediction and as input for realistic finite element models (FEMs).



Simcenter capabilities for durability testing

Road load data acquisition

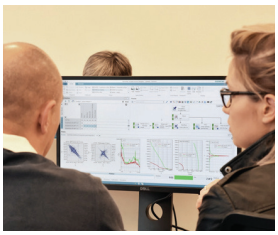
Rely on a vast amount of high-quality data. Precision and realism of load data collected on proving grounds or public roads are essential for virtual and physical product validation and verification. Using our end-to-end road load data acquisition solution allows you to seamlessly integrate test instrumentation, setup, acquisition, validation and reporting to accelerate delivering high-quality data.

Rugged data acquisition

Test faster and more cost-effectively in harsh environments. Real-world load data collected on agricultural, construction and mining equipment is essential for virtual and physical machine performance validation and verification. Using our rugged data acquisition system, deploy precise multiphysics measurements anytime and anywhere.

Load and fatigue analysis

You can accelerate delivering critical durability insights when preparing for test rig campaigns or reliable simulations. To speed up time-consuming tasks such as load data consolidation, accurate rainflow counting and experimental fatigue analysis, our load and fatigue analysis solution integrates instant visualization tools with interactive or automated analysis, performant processing and active reporting.



Accelerated life testing

Minimize the time and money spent on validating your product's durability performance based on field tests. Leveraging our accelerated life testing solution helps you design shorter and damage-equivalent test schedules for validation on single and multiaxis durability test rigs.

Optimized test schedules

Solve the riddle of mapping your product's real use to a condensed durability test schedule. Using our solution allows you to define tailored test schedules by synthesizing customer-correlated loading targets. It derives the optimal mix of test track sections to emulate the roads of the target market.

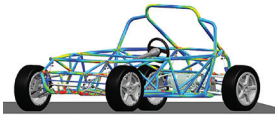
Laboratory testing

Today's market trend is to use real-time field buses to share measured data, for instance, with testbench controllers. EtherCAT is an industry standard for this.

Thanks to the Simcenter SCADAS RS EtherCAT unit, you can make a real-time connection to the test rig controller and replay durability loads in the lab.

Durability simulation

You can use simulation to evaluate and further refine the durability performance. The durability modules within Simcenter 3D give you access to state-of-the-art analysis methods, enabling engineers to interactively assign loads to a model. The solution permits efficient analysis of seam and spot welds as well as new methodologies for composite materials.



Road load data acquisition

Rely on a vast amount of high-quality data. Precision and realism of load data collected on proving grounds or public roads are essential for virtual and physical product validation and verification. Using our end-to-end road load data acquisition solution allows you to seamlessly integrate test instrumentation, setup, acquisition, validation and reporting to accelerate delivering high-quality data.

Challenges

- Provide accurate data to CAE and test rigs
- Deliver high-quality data as fast as possible
- Avoid costly test reruns

Solutions

- Compact and simplified hardware
- Remote monitoring and data download
- Advanced and on-the-spot data validation
- Unattended and fully automated measurement campaigns

Results

- Maximize testing productivity
- Up to 50 percent faster road load data acquisition (RLDA) campaigns
- Higher measurement flexibility
- Perform test campaigns with complete confidence

Road load data acquisition for auto OEMs and suppliers

Hardware and software configuration enabling durability data collection and validation on the road.

Key features

- Suitable for small setups up to large 500-plus channel measurement campaigns
- Supports various sensors, including accelerometers, strain gauges, bridge-based sensors (force, torque, pressure, etc.), potentiometers, linear variable differential transformers (LVDTs), tachometers and thermocouples
- Sensor conditioning such as voltage with optional supply, integrated circuit piezoelectric (ICP), transducer electronic datasheet (TEDS) support, Wheatstone bridge completion, pulse counters, choice between direct current (DC) or alternating current (AC) supply and 4 to 20 milliamp (mA) transmitter support
- Wired or wireless (Wi-Fi or cellular) system access via any device (personal computer (PC), tablet and phone) and any operating system (Windows, Android and iOS)
- Digital bus support, including controller area network (CAN), CAN-FD and OBD2, FlexRay, and acquiring raw bus information and decoded signals
- Synchronized measuring of global navigation satellite systems (GNSS) data using embedded chip and video data (via universal serial bus (USB)-based cameras)
- Multiple user access from any device for setup, verification, sensor calibration, measurement and data validation
- Stable and uninterruptable power supply (UPS) and buffer mechanism for reliable multiphysics measurements
- Operates in various temperatures (from -40 to +65° C or from -40 to +149° F), humidity, shock and vibration levels
- Web-based application allowing you to quickly and easily configure, take, visualize, analyze and upload measurements
- Centralized or distributed configurations (over distances up to 50 meters thanks to single cabled-daisy chaining)
- Sampling rates per channel up to 48 kilohertz (kHz) for noise, vibration and harshness (NVH) applications

Base configuration
Hardware configuration
Simcenter SCADAS RS Recorder unit (includes embedded web-based application)
Simcenter SCADAS RS UPS unit
Simcenter SCADAS RS 24-channel bridge unit (120 or 350 Ohm)
Simcenter SCADAS RS 24-channel sensor unit
Data streaming directly to PC
Simcenter Testlab Desktop Neo software
Simcenter Testlab Time Data Acquisition
Autonomous recording on Simcenter SCADAS RS
Simcenter Testlab Recording Workbook

Recommended options
Simcenter SCADAS conditioning units
Simcenter SCADAS RS Digital pulse and CAN unit
Simcenter SCADAS RS 20-channel thermocouple unit
Simcenter SCADAS RS 12-channel universal unit
Simcenter SCADAS RS 12-channel universal unit extended bandwidth
Simcenter SCADAS RS 12-channel sensor unit extended bandwidth
USB Rugged Camera for SCADAS RS
Remote monitoring and measurement control
SCALANCE Modem and Sinema RC Server
Track-side postprocessing with Simcenter Testlab Desktop Neo
Simcenter Testlab Process Designer
Simcenter Testlab Track-side Validation
Simcenter Testlab Interactive Analysis
Simcenter Testlab Anomaly Library

Road load data acquisition for trucks and buses

Hardware and software configuration including embedded web apps for flexible rugged data acquisition.

Key features

- Suitable for small setups up to large 500-plus channel measurement campaigns
- Supports various sensors, including accelerometers, strain gauges, bridge-based sensors (force, torque, pressure, etc.,), potentiometers, LVDTs, tachometers and thermocouples
- Sensor conditioning such as voltage with optional supply, ICP, Wheatstone bridge completion, pulse counters, choice between DC or AC supply and 4 to 20 mA transmitter support
- Wired or wireless (Wi-Fi or cellular) system access via any device (PC, tablet and phone) and any operating system (Windows, Android and iOS)
- Digital bus support, including CAN, CAN-FD, J1939 and OBD2, and acquiring raw bus information and decoded signals
- Synchronized measuring of GNSS data using embedded chip and video data (via USB-based cameras)
- Multiple user access from any device for setup, verification, sensor calibration, measurement and data validation
- Stable and UPS and buffer mechanism for reliable multiphysics measurements
- Operates in various temperatures (from -40 to +65° C or from -40 to +149° F), humidity, shock and vibration levels
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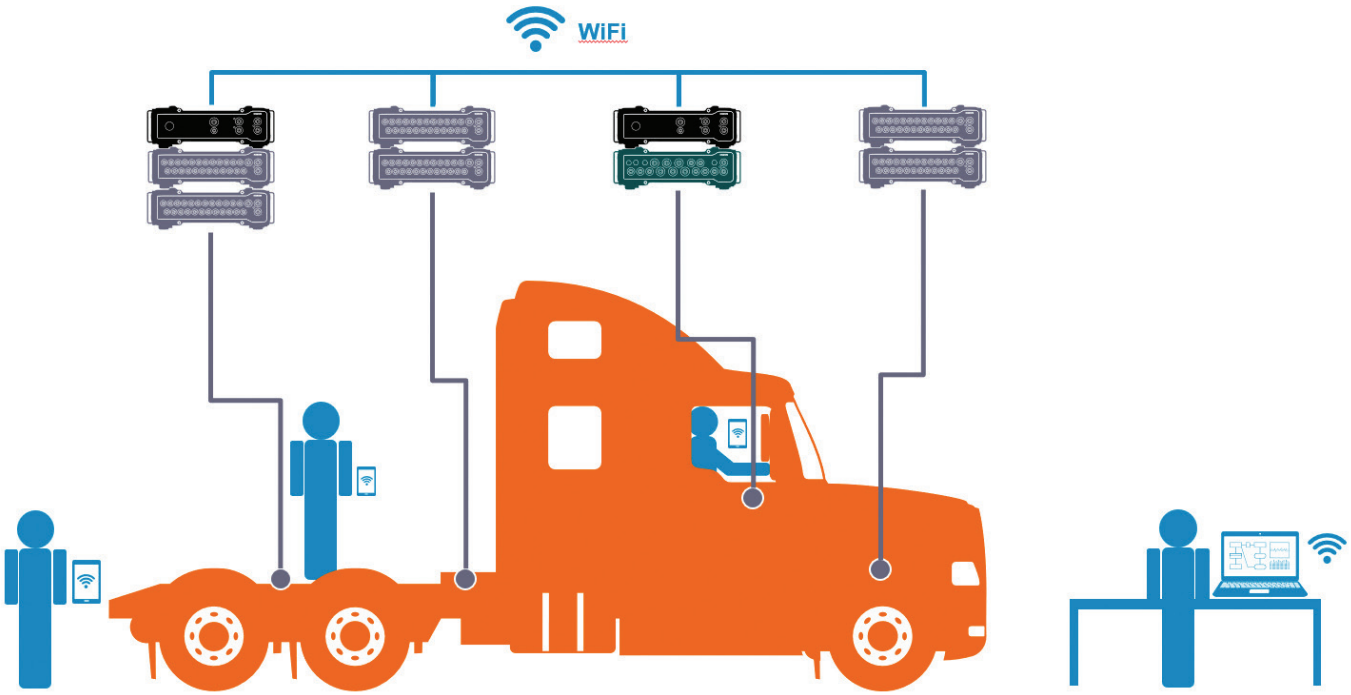

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Rugged data acquisition

Test faster and more cost-effectively in harsh environments. Real-world load data collected on agricultural, construction and mining equipment is essential for virtual and physical machine performance validation and verification. Using our rugged data acquisition system, deploy precise multiphysics measurements anytime and anywhere.

Challenges

- Harsh environments and demanding test conditions
- Speed up test campaigns by optimizing operational processes from start to finish
- Test in remote areas offering monitoring from a distance
- Meet scalability needs in terms of channel count and measurement topology
- Testing in multiple domains such as durability and NVH acoutics

Solutions

- Requires rugged design for use in harsh environments
- Extreme flexibility to optimally match the device under test (DUT)
- Ensures performance for best possible accuracy
- Unparalleled connectivity simplifies data collection and provides access from anywhere

Results

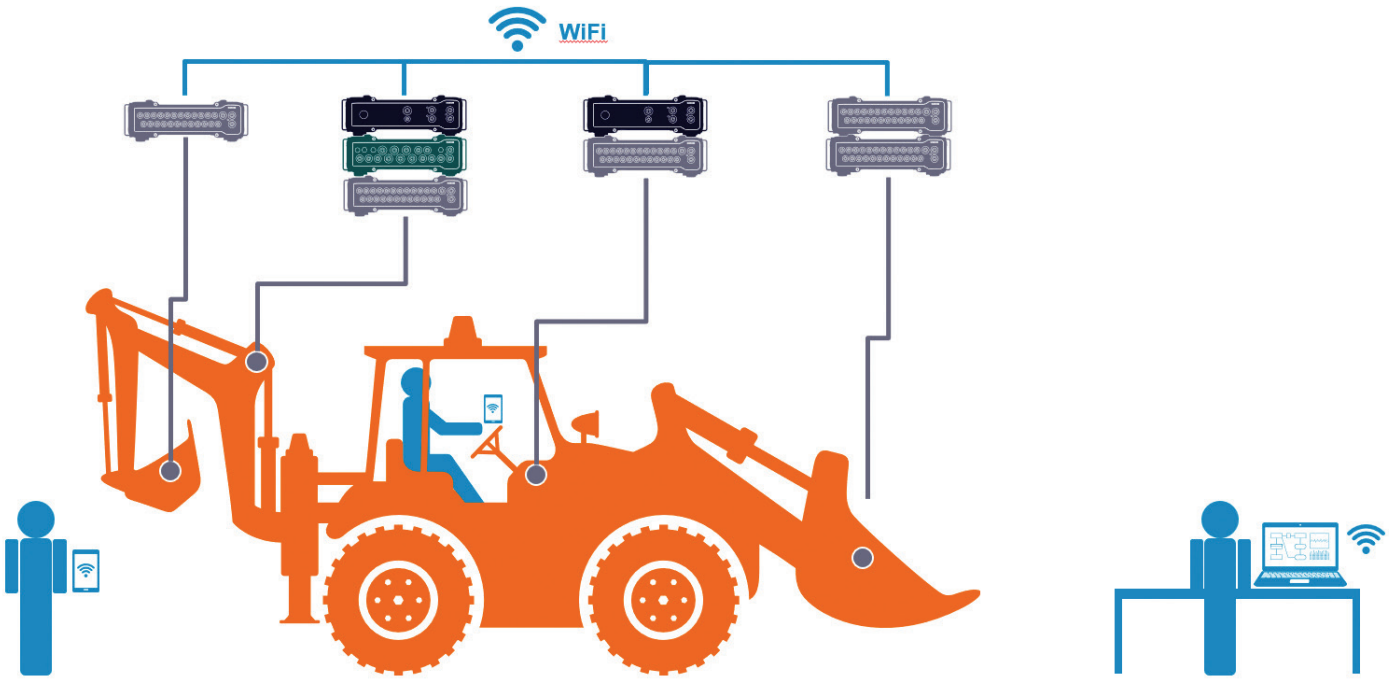
- Achieve faster and more cost-effective execution of the most demanding test campaigns
- Acquire precise multiphysics measurements anytime and anywhere
- Enable access in remote locations

Rugged data acquisition for high-channel count measurements

Hardware and software configuration, including embedded web apps for flexible rugged data acquisition.

Key features

- Suitable for small setups up to large 500-plus channel measurement campaigns
- Supports various sensors, including accelerometers, strain gauges, bridge-based sensors (force, torque, pressure, etc.,), potentiometers, LVDTs, tachometers and thermocouples
- Sensor conditioning such as voltage with optional supply, ICP, TEDS support, Wheatstone bridge completion, pulse counters, choice between DC or AC supply and 4 to 20 mA transmitter support
- Digital bus support, including CAN, CAN-FD, J1939 and OBD2, and acquiring raw bus information and decoded signals
- Synchronized measuring of GNSS data using an embedded chip and video data (via USB-based cameras)
- Multiple user access from any device for setup, verification, sensor calibration, measurement and data validation
- Stable and UPS and buffer mechanism for reliable multiphysics measurements
- Wired or wireless (Wi-Fi or cellular) system access via any device (PC, tablet and phone) and any operating system (Windows, Android and iOS)
- Operates in various temperatures (from -40 to +65° C or from -40 to +149° F), humidity, shock and vibration levels
- Web-based application, allowing you to quickly and easily configure, take, visualize, analyze and upload measurements
- Centralized or distributed configurations (over distances of up to 50 meters thanks to single cabled-daisy chaining)
- Remote connection via 4G/5G to Simcenter SCADAS RS, allowing users to access channel setup, sensor validation and calibration for test preparation
- Data streaming and download made possible from anywhere
- Sampling rates per channel up to 48 kHz for NVH applications



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Rugged data acquisition for multiphysics measurements

Hardware and software configuration, including embedded web apps for flexible rugged data acquisition

Key features

- Suitable for small setups up to large 500-plus channel measurement campaigns
- Supports various sensors, including accelerometers, strain gauges, bridge-based sensors (force, torque, pressure, etc.,), potentiometers, LVDTs, tachometers, microphones and thermocouples
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Load and fatigue analysis

Accelerate the delivery of critical durability insights when preparing for test rig campaigns or reliable simulations. To speed up time-consuming tasks such as load data consolidation, accurate rainflow counting and experimental fatigue analysis, using our load and fatigue analysis solution helps you integrate instant visualization tools with interactive or automated analysis, performant processing and active reporting.

Challenges

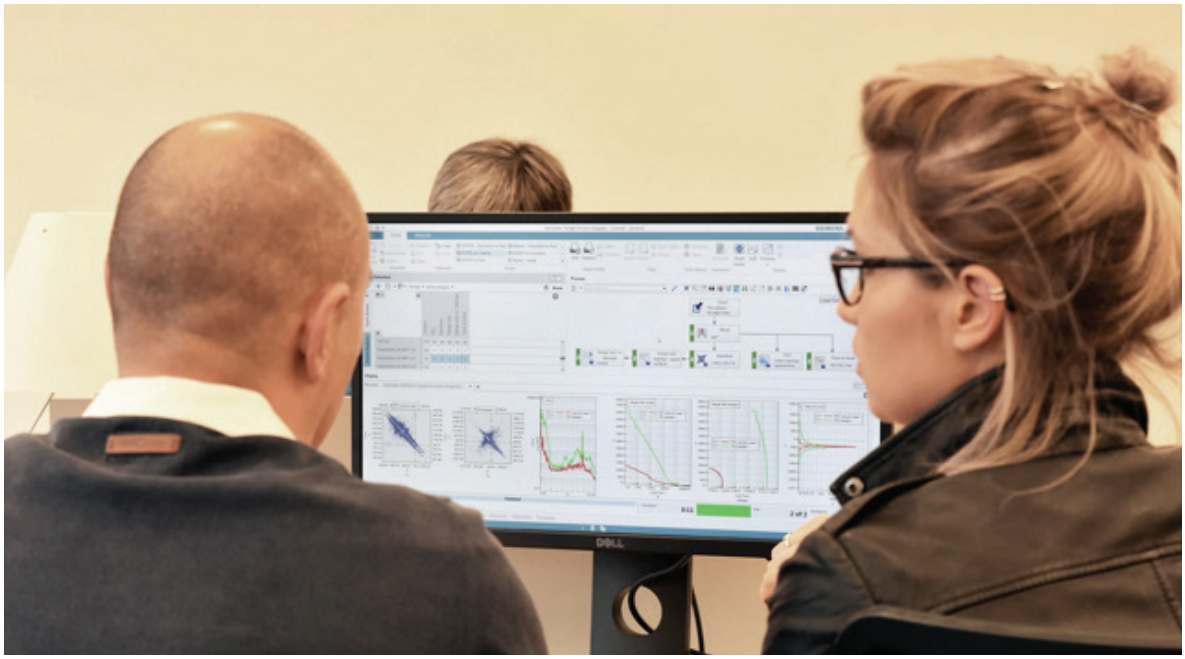
- Set accurate durability targets
- Get more insights from load measurements
- Optimize durability engineering processes

Solutions

- Use Simcenter Testlab load and fatigue analysis to rely on a wealth of analysis methods
- Use the Simcenter portfolio for data collection, analytics and modeling
- Save analysis and calculation time by using accurate, appropriate methods
- Better understanding of the fatigue content of load data, providing more insights into the behavior of the component being tested
- Streamline the test and analysis process to gain confidence in the data

Results

- Obtain valuable and precise insights to optimize the durability performance of your next design
- Improve consistency and quality with standardized processes and reports
- Automate and run analysis on large amounts of data up to 50 percent faster than traditional solutions
- Raise team effectiveness by reducing learning effort for novice and nonexpert users



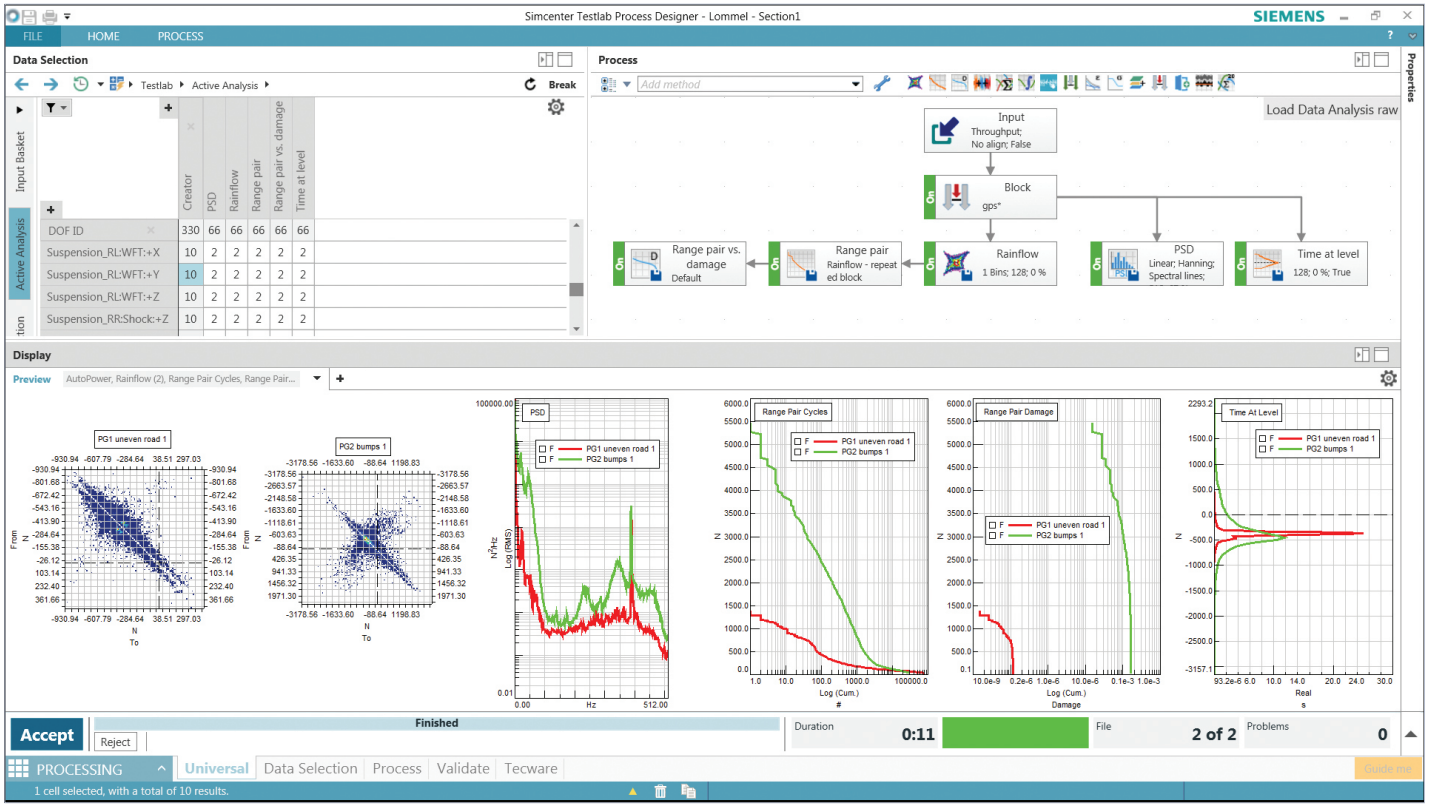
Load data analysis

Software configuration, including counting and spectral analysis methods, to perform process-driven analysis of road data.

Key features

- Intuitively create and modify processes graphically by using method boxes
- Automatic storage of process parameters for full data traceability
- Pivot table and preview picture features to easily organize and visualize multiple channels and measurements
- Data consolidation made possible via display- or process-driven interactive analysis and anomaly correction
- Counting and spectral analysis methods, including rainflow, range pair, rotating moment histograms, pseudo-damage, level crossing, peak count I and III and time at level counting, combined with power-spectral density (PSD) analysis
- Template-based Microsoft Office reports with active pictures for multiple channels and runs

Base configuration
Simcenter Testlab Desktop Neo
Simcenter Testlab Interactive Analysis
Simcenter Testlab Process Designer
Simcenter Testlab Load Data Analysis
Simcenter Testlab Anomaly Library



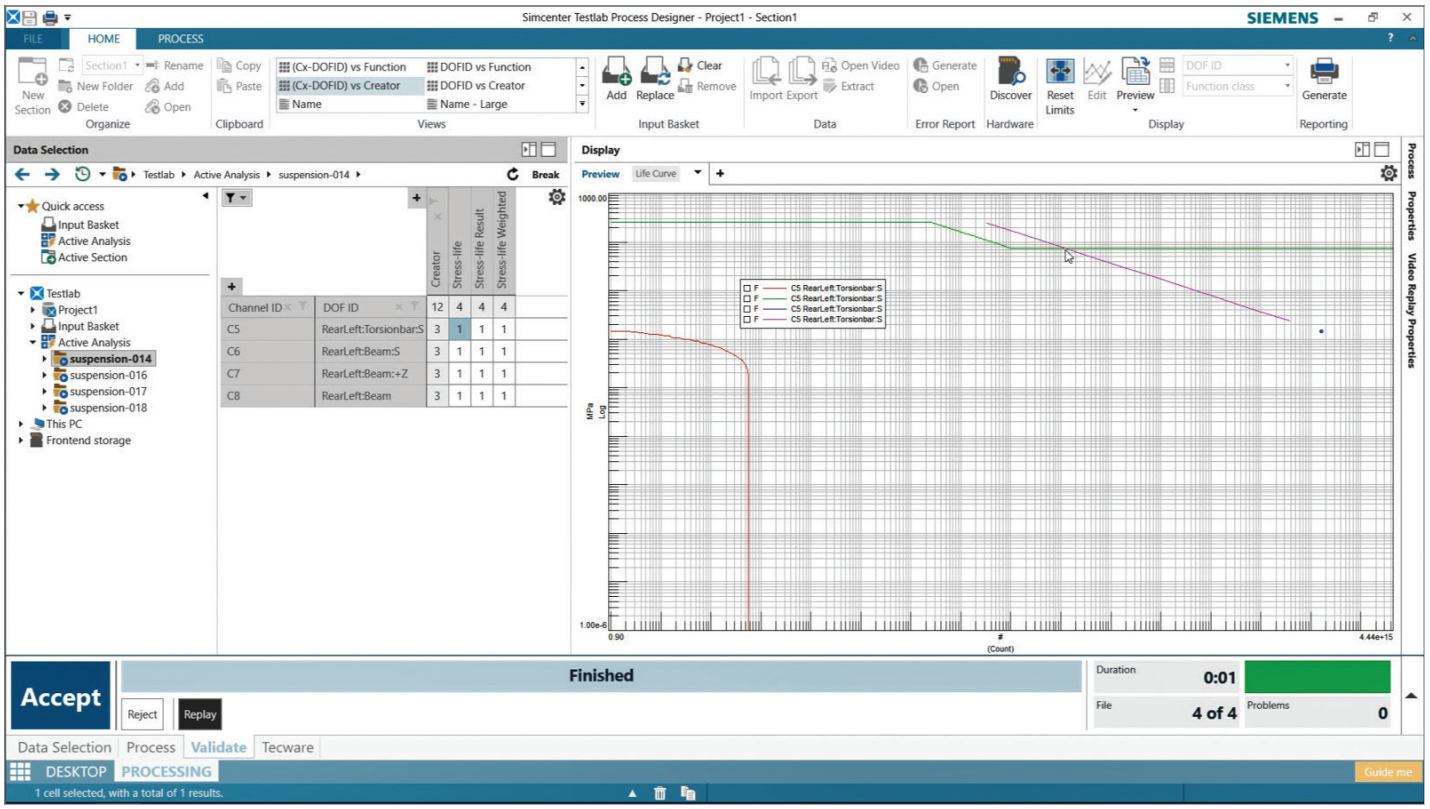
Experimental fatigue analysis

Software configuration to perform fatigue analysis based on stress-life and strain-life approaches.

Key features

- Intuitively create and modify processes graphically by using method boxes
- Pivot table and preview picture features to easily organize and visualize multiple channels and measurements
- Use the stress-life approach and strain-life approach to predict the fatigue life of a component from given load histories, material properties and stress concentration factors or from strain gauge histories and material properties
- User-extensible databases for S-N curves, materials and method parameters
- Automatic storage of process parameters for full data traceability
- Template-based Microsoft Office reports with active pictures for multiple channels and runs

Base configuration
Simcenter Testlab Desktop Neo
Simcenter Testlab Load Data Analysis
Simcenter Testlab Process Designer
Simcenter Testlab Fatigue Life Analysis



Accelerated life testing

Minimize the time and money spent on validating your product's durability performance based on field tests. Using our accelerated life testing solution helps you design shorter and damage-equivalent test schedules for validation on single- and multiaxis durability test rigs.

Challenges

- Time-consuming and costly field tests to validate the durability performance
- Risk of under- or overtesting

Solutions

- Remove nondamaging events from long-duration measurements
- Create damage-equivalent constant amplitude tests
- User-defined mix of ranges, mean values and number of repetitions from a uniaxial, variable amplitude loading

Results

- Reduce real load data to shorter time signals while ensuring the same damage potential
- Speeds up both physical testing on block cycle test machines as well as CAE-based fatigue life predictions
- Achieve realistic lifetime targets

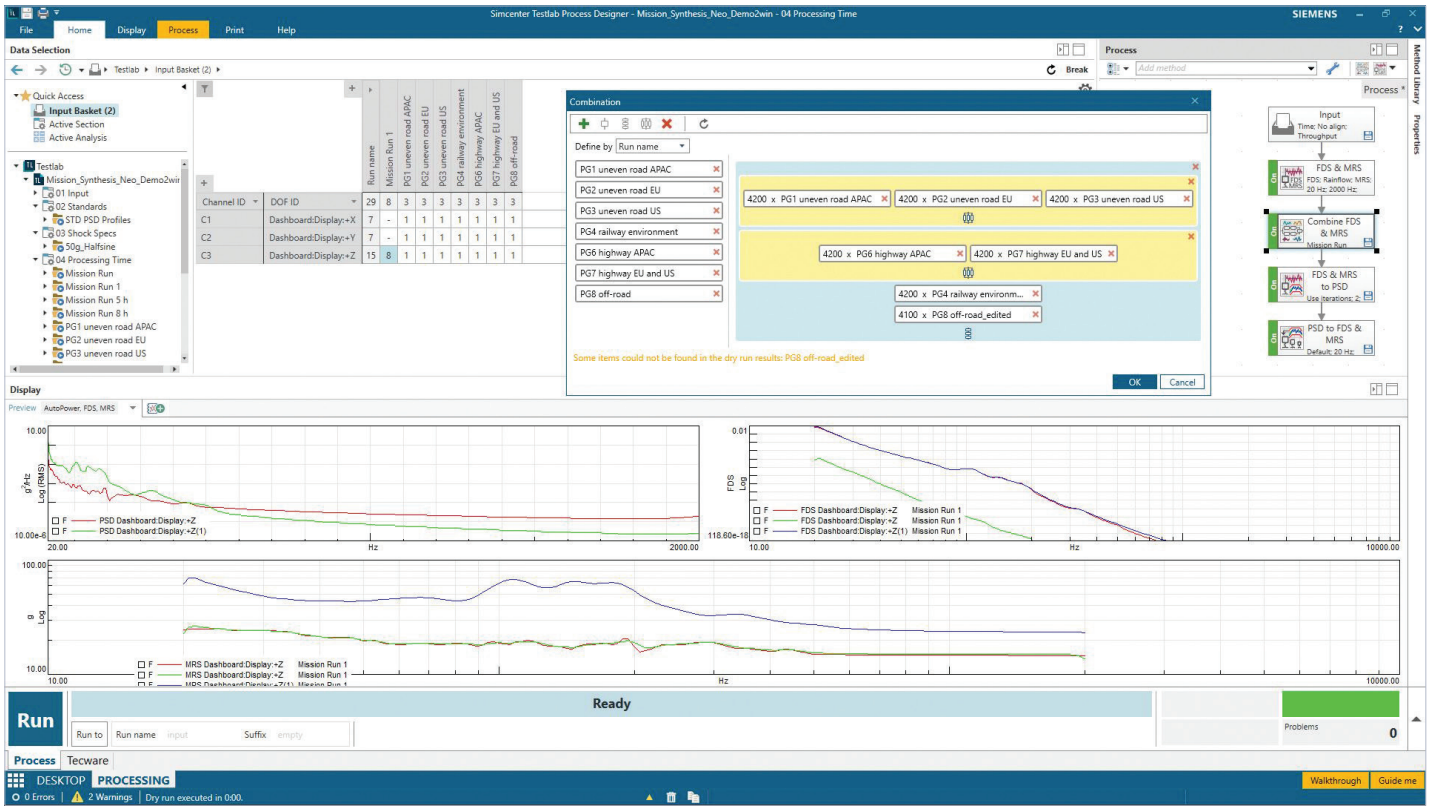
Mission synthesis

Software configuration allows users to create test specifications using fatigue damage theory and export directly random or sine profiles for laboratory shaker testing.

Key features

- Calculate the maximum response spectrum (MRS), fatigue damage spectrum (FDS) and shock response spectrum (SRS) to calculate the fatigue potential
- Define damage-equivalent test specifications for random and swept sine vibration testing from measured load data
- Use test tailoring methods as described in industry standards such as GAM EG-13, MIL-STD 810G, NATO AECTP 200, ISO 19453, ISO 16750 and ISO 12405
- Template-based Microsoft Office reports with active pictures for multiple channels and runs
- Graphical user interface (GUI) to create a break point table

Base configuration
Simcenter Testlab Desktop Neo
Simcenter Testlab Process Designer
Simcenter Testlab Mission Synthesis



Accelerated life testing

Software configuration allowing users to create damage-equivalent accelerated tests.

Key features

- Omit nondamaging events in uni- and multiaxial directions thanks to rainflow projection (RP) filtering
- Create accelerated and damage-equivalent block-cycles or constant amplitude tests
- Automatically calculate filters to keep a user-defined threshold

Base configuration
Configuration with Simcenter Testlab Neo
Simcenter Testlab Desktop Neo
Simcenter Testlab Interactive Analysis
Simcenter Testlab Process Designer
Simcenter Testlab Rainflow-based Test Definition
Configuration with Simcenter Tecware
Simcenter Tecware Load Data Processing
Simcenter Tecware Test Definition

Optimized test schedules

Solve the riddle of mapping your product's real usage to a condensed durability test schedule. Using our solution lets you define tailored test schedules by synthesizing customer-correlated loading targets. It derives the optimal mix of test track sections to emulate the roads of the target market.

Challenges

- Avoid guesswork when mapping test track data to a durability target
- Minimize the cost of field tests while replicating target use

Solutions

- Calculate the optimal mix of test track sections that match the target customer use for all considered channels

Results

- Defines an endurance test program equivalent in terms of fatigue but in less time
- Use it for the component and for full vehicle testing
- Improve the correlation between testing on the track and testing on the rig

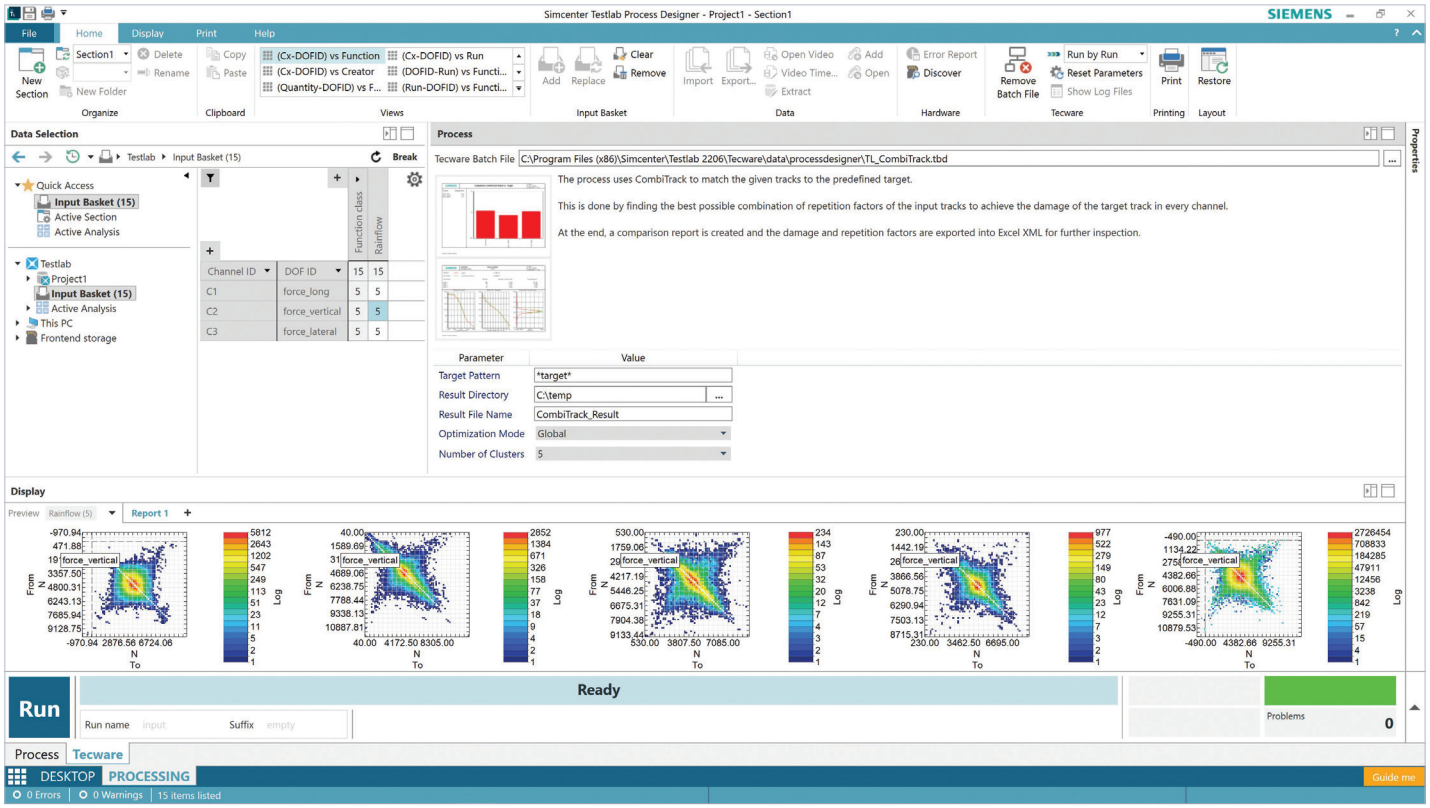
Optimized test schedules

Software configuration allowing to calculate via an optimization procedure the optimal mix of test track sections that match the target customer usage.

Key features

- Applicable to uni- and multiaxial rainflow matrices and rotating moment histograms
- Allows you to take additional PSDs into account in the optimization
- Perform optimization in terms of total test time or pseudo-damage optimization (global- or partial-based)

Base configuration
Simcenter Tecware Load Data Processing
Simcenter Tecware Test Definition



Laboratory testing

Today's market trend is to use real-time field buses to share measured data, for instance, with test bench controllers. EtherCAT has mainly become an industry standard for this.

Thanks to the Simcenter SCADAS RS EtherCAT unit, you can make a real-time connection to the test rig controller and replay durability loads in the lab.

Challenges

- Re-instrumentation of vehicles subassemblies when moving from the field onto the test rig

Solutions

- Use Simcenter SCADAS RS EtherCAT unit or SCADAS SCM/LAB ESO64 module to establish a real-time connection with any test bench controller

Results

- Maximize testing productivity by avoiding sensor rewiring

Laboratory durability testing with Simcenter SCADAS RS

Hardware configuration, including Simcenter SCADAS RS EtherCAT unit for real-time test rig connection.

Key features

- Plug-and-play: limited configuration required in software
- Up to 96 channels per EtherCAT unit – connectors UNIT1, UNIT2, UNIT3 and UNIT4
- Connection to the EtherCAT bus – connectors IN and OUT
- Real-time end-to-end latency <100 microseconds (µs) and real-time bus sample rate of up to 10 kHz
- Setup transferred via CANopen

Base configuration
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Europe
00 800 70002222

Asia-Pacific
001 800 03061910

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