



FEMFAT LAB software
LOAD DATA ANALYSIS

Link between test track,
laboratory and CAE

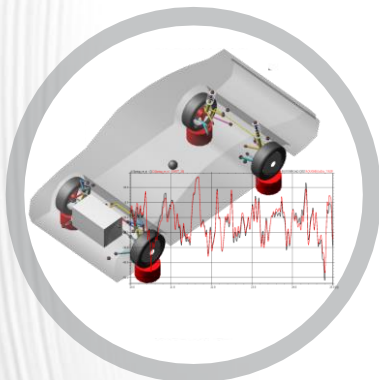
2021

FEMFAT LAB vi

LOAD DATA ANALYSIS

Virtual iteration

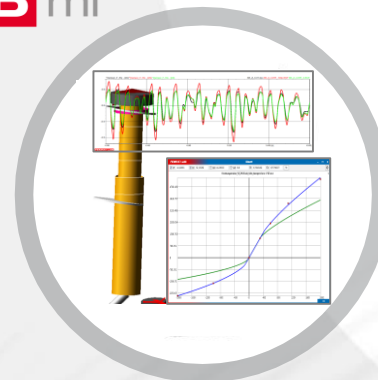
- 3D ROAD



FEMFAT LAB mi

LOAD DATA ANALYSIS

Model improvement

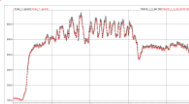


Interface to dynamic simulation

FEMFAT LAB time

LOAD DATA ANALYSIS

time based
analyzing tools



FEMFAT LAB frequency

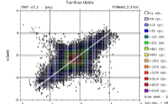
LOAD DATA ANALYSIS

frequency based
analyzing tools

FEMFAT LAB fatigue

LOAD DATA ANALYSIS

counting methods,
damage analysis,
data reduction,
mixing tracks



Load data analysis software

FEMFAT LAB vi

LOAD DATA ANALYSIS

Virtual iteration

- 3D ROAD

FEMFAT LAB mi

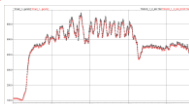
LOAD DATA ANALYSIS

Model improvement

Interface to dynamic simulation

FEMFAT LAB time

LOAD DATA ANALYSIS



time based
analyzing tools

FEMFAT LAB frequency

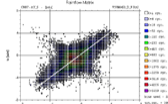
LOAD DATA ANALYSIS

frequency based
analyzing tools

FEMFAT LAB fatigue

LOAD DATA ANALYSIS

counting methods,
damage analysis,
data reduction,
mixing tracks



Load data analysis software

FEMFAT LAB vi

LOAD DATA ANALYSIS

Virtual iteration

- 3D ROAD

FEMFAT LAB mi

LOAD DATA ANALYSIS

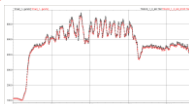
Model improvement

Interface to dynamic simulation

FEMFAT LAB time

LOAD DATA ANALYSIS

time based
analyzing tools



FEMFAT LAB frequency

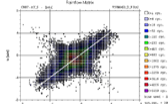
LOAD DATA ANALYSIS

frequency based
analyzing tools

FEMFAT LAB fatigue

LOAD DATA ANALYSIS

counting methods,
damage analysis,
data reduction,
mixing tracks



Load data analysis software

FEMFAT LAB vi

LOAD DATA ANALYSIS

Virtual iteration

- 3D ROAD

FEMFAT LAB mi

LOAD DATA ANALYSIS

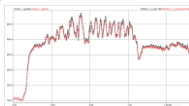
Model improvement

Interface to dynamic simulation

FEMFAT LAB time

LOAD DATA ANALYSIS

time based
analyzing tools



FEMFAT LAB frequency

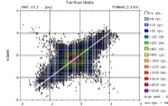
LOAD DATA ANALYSIS

frequency based
analyzing tools

FEMFAT LAB fatigue

LOAD DATA ANALYSIS

counting methods,
damage analysis,
data reduction,
mixing tracks



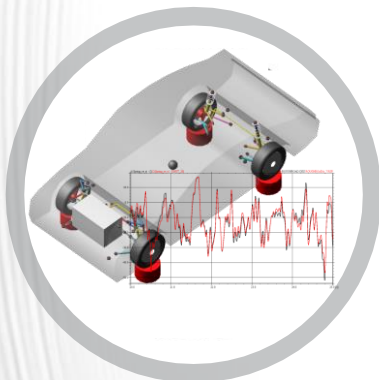
Load data analysis software

FEMFAT LAB vi

LOAD DATA ANALYSIS

Virtual iteration

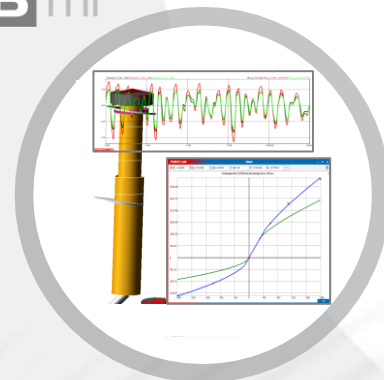
- 3D ROAD



FEMFAT LAB mi

LOAD DATA ANALYSIS

Model improvement

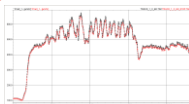


Interface to dynamic simulation

FEMFAT LAB time

LOAD DATA ANALYSIS

time based
analyzing tools



FEMFAT LAB frequency

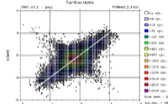
LOAD DATA ANALYSIS

frequency based
analyzing tools

FEMFAT LAB fatigue

LOAD DATA ANALYSIS

counting methods,
damage analysis,
data reduction,
mixing tracks



Load data analysis software

FEMFAT LAB vi

LOAD DATA ANALYSIS

Virtual iteration

- 3D ROAD

FEMFAT LAB mi

LOAD DATA ANALYSIS

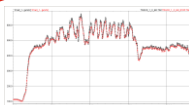
Model improvement

Interface to dynamic simulation

FEMFAT LAB time

LOAD DATA ANALYSIS

time based
analyzing tools



FEMFAT LAB frequency

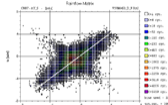
LOAD DATA ANALYSIS

frequency based
analyzing tools

FEMFAT LAB fatigue

LOAD DATA ANALYSIS

counting methods,
damage analysis,
data reduction,
mixing tracks



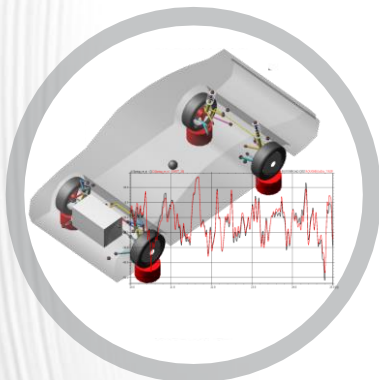
Load data analysis software

FEMFAT LAB vi

LOAD DATA ANALYSIS

Virtual iteration

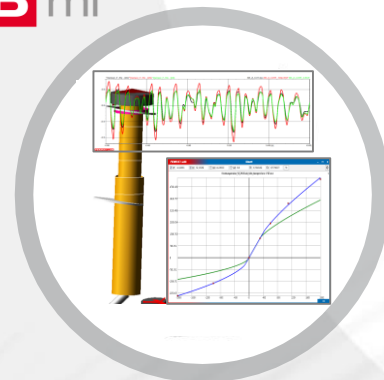
- 3D ROAD



FEMFAT LAB mi

LOAD DATA ANALYSIS

Model improvement

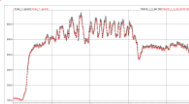


Interface to dynamic simulation

FEMFAT LAB time

LOAD DATA ANALYSIS

time based
analyzing tools



FEMFAT LAB frequency

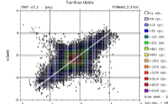
LOAD DATA ANALYSIS

frequency based
analyzing tools

FEMFAT LAB fatigue

LOAD DATA ANALYSIS

counting methods,
damage analysis,
data reduction,
mixing tracks



Load data analysis software

1986:

First Fortran Version (MESTEC)

- Statistic calculations
- Rainflow counting
- Damage calculation

Since 1992:

Permanent development

- Tools for load data analysis
- Diploma theses
- Adaption by customer and practical job requirements

Start

FEMFAT LAB mi

LOAD DATA ANALYSIS

1986

1992

2002

2015

2017

1992:

Start of the development in C++

Start

FEMFAT LAB vi

LOAD DATA ANALYSIS

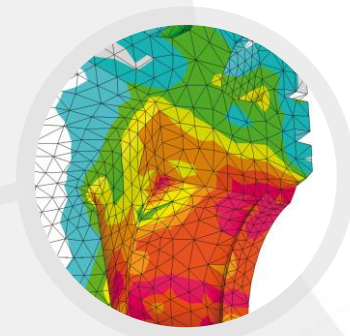
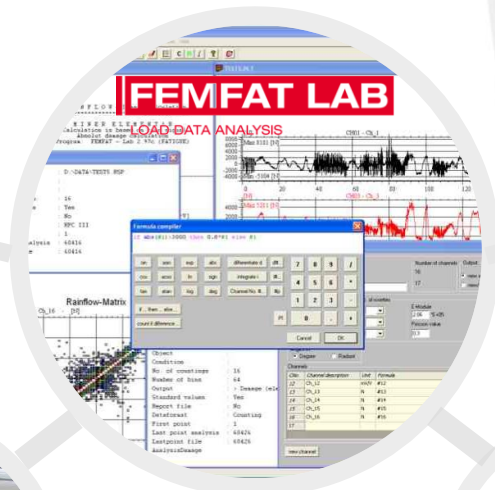
Start

FEMFAT LAB vi 3D road

LOAD DATA ANALYSIS software



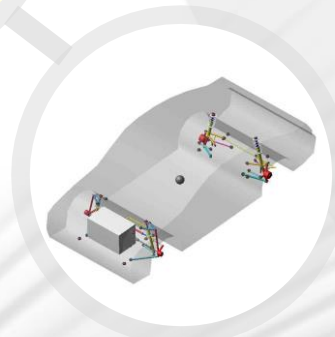
Proving ground



Fatigue simulation



Test bench



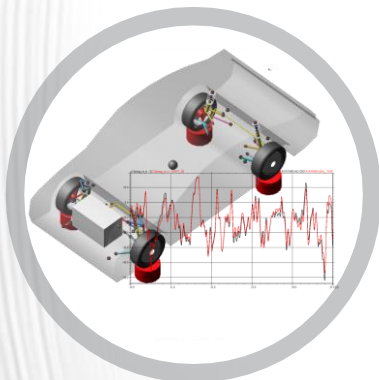
Multi-body simulation

FEMFAT LAB vi

LOAD DATA ANALYSIS

Virtual iteration

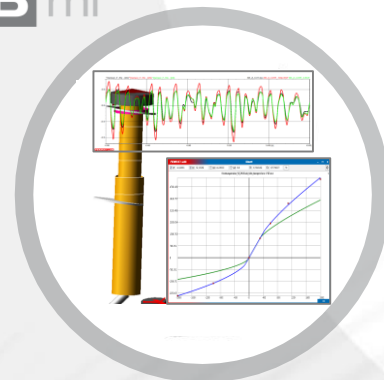
- 3D ROAD



FEMFAT LAB mi

LOAD DATA ANALYSIS

Model improvement

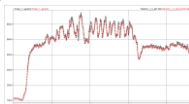


Interface to dynamic simulation

FEMFAT LAB time

LOAD DATA ANALYSIS

time based
analyzing tools



FEMFAT LAB frequency

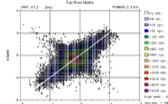
LOAD DATA ANALYSIS

frequency based
analyzing tools

FEMFAT LAB fatigue

LOAD DATA ANALYSIS

counting methods,
damage analysis,
data reduction,
mixing tracks



Load data analysis software

Key feature

Benefits

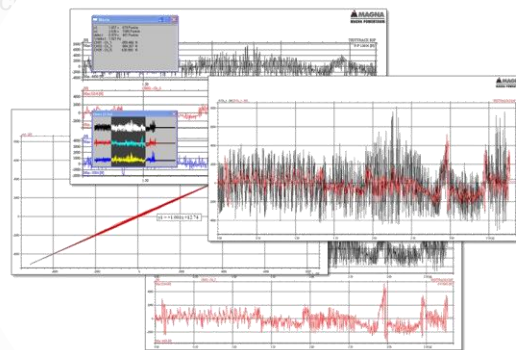
- Get forces at complex structures based on strain gauges

Reverse Calculated Forces

- Method can be used for stiff structures
- Measure forces using the original part applied with strain gauges

Standard tools

- Statistics, time-edit, formula compiler
- Plot time histories (Overlay-plot, xt-plot, xy-plot, zoom)
- Convenient data-analysis over multiple channels
- Linear approximation
- Spike detection
- Edit signal curve
- Cutting in time domain
- Arithmetic functions
- Trigonometric functions
- Logical functions
- Differentiation
- Integration
- Linear interpolation
- f-DC Conversion
- Rosette evaluation
- FFT
- FIR
- Resampling
- And many more...



FEMFAT LAB vi

LOAD DATA ANALYSIS

Virtual iteration

- 3D ROAD

FEMFAT LAB mi

LOAD DATA ANALYSIS

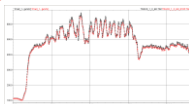
Model improvement

Interface to dynamic simulation

FEMFAT LAB time

LOAD DATA ANALYSIS

time based
analyzing tools



FEMFAT LAB frequency

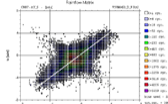
LOAD DATA ANALYSIS

frequency based
analyzing tools

FEMFAT LAB fatigue

LOAD DATA ANALYSIS

counting methods,
damage analysis,
data reduction,
mixing tracks



Load data analysis software

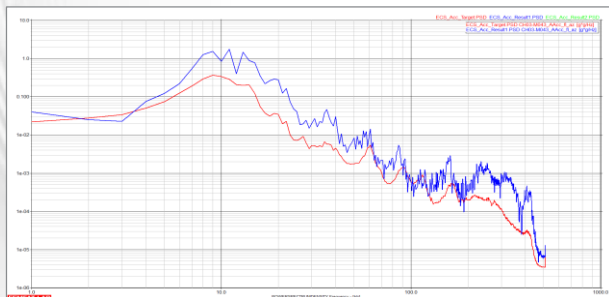
Key feature

Benefits

- Input data for fatigue analysis based on frequency domain

Link to fatigue analysis

- Power spectrum density
 - of load data for FEMFAT
 - to time conversion



Standard tools

- Spectral analysis
- Amplitude spectrum
- Power spectrum using different window types (rectangle, Hanning, Hamming, ...)
- Waterfall
- Campbell
- Ordercut (wavelet)
- Autoplot of frequency
- Generating and editing functions
- Noise generation
- PSD to time
- Edit of frequency
- Amplitude spectrum
- Power Spectrum
- Convenient use
- Different scaling types
- Assessment norms
- and many more



FEMFAT LAB vi

LOAD DATA ANALYSIS

Virtual iteration

- 3D ROAD

FEMFAT LAB mi

LOAD DATA ANALYSIS

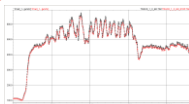
Model improvement

Interface to dynamic simulation

FEMFAT LAB time

LOAD DATA ANALYSIS

time based
analyzing tools



FEMFAT LAB frequency

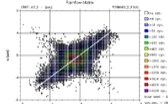
LOAD DATA ANALYSIS

frequency based
analyzing tools

FEMFAT LAB fatigue

LOAD DATA ANALYSIS

counting methods,
damage analysis,
data reduction,
mixing tracks



Load data analysis software

Key feature

Benefits

- Generate an optimized test procedure

Mixing Tracks Tool

- Correlation by means of damage comparison
- Compute repetition numbers of single tracks to reduce test or calculation time

Standard tools

- Damage calculation based on the Rainflow-matrix and the Miner-algorithm
- Multi-channel Rainflow-data reduction for FE or testing
- Graphical representation (Rainflow-time at level, level crossing, range c...)

- Fatigue-Modify

- Graphical plot

- Multi-channel testing

- Damage

- m stress

- Calcula

- with line

- Damage

- Damage

- combinati

- Information

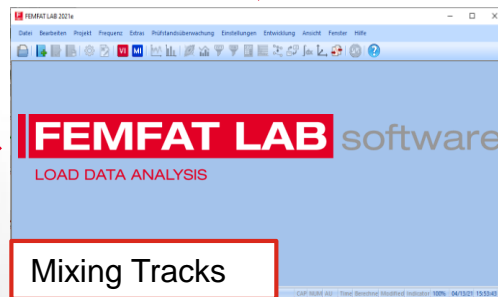
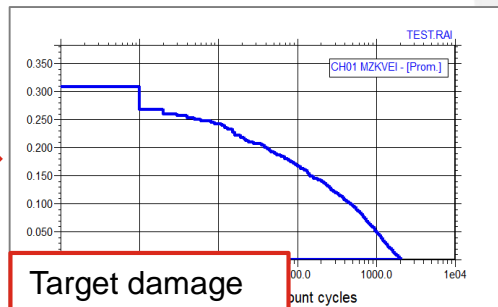
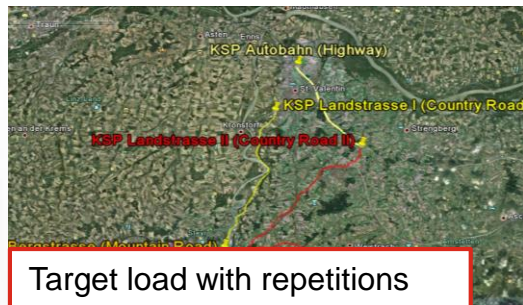
- New time histo

- Control of the resu

- And many more.....



- Creation of a testsequence using Mixing Tracks



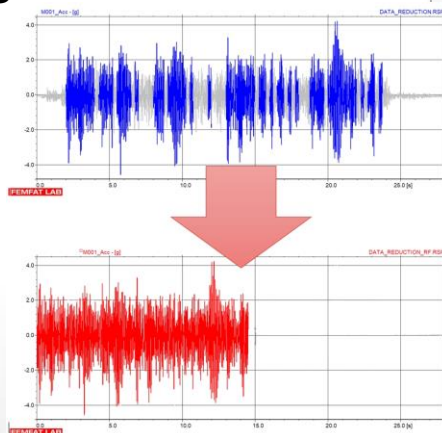
Key feature

Benefits

- Data Reduction

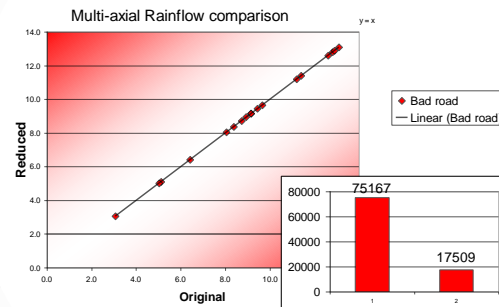
Automatic deleting of non-relevant

- time parts or
 - stress cycles
- based on damage calculation



Standard tools

- Damage calculation based on the Rainflow-matrix and the Miner-algorithm
- Multi-channel Rainflow-data reduction for FE or testing
- Graphical representation (Rainflow, time at level, level crossing, range c...)
- Fatigue-Modify
- Graphical plot
- Multi-channel testing
- Damage
- m stres
- Calcula with line
- Damage
- Damage combinati
- Information
- New time histo
- Control of the resu
- And many more.....



FEMFAT LAB vi

LOAD DATA ANALYSIS

Virtual iteration

- 3D ROAD

FEMFAT LAB mi

LOAD DATA ANALYSIS

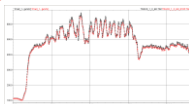
Model improvement

Interface to dynamic simulation

FEMFAT LAB time

LOAD DATA ANALYSIS

time based
analyzing tools



FEMFAT LAB frequency

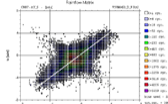
LOAD DATA ANALYSIS

frequency based
analyzing tools

FEMFAT LAB fatigue

LOAD DATA ANALYSIS

counting methods,
damage analysis,
data reduction,
mixing tracks

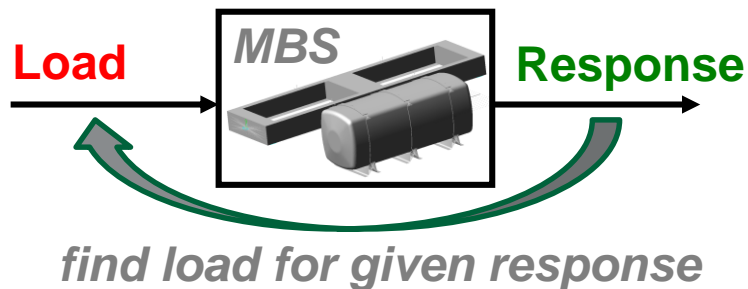


Load data analysis software

Key feature

Benefits

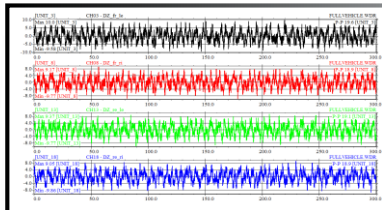
- Load data generation for simulation models based on measured responses (accelerations, relative displacements, strains,...)



Link to simulation (MBS)

- Excellent convergence between measurement and simulation
- Convenient and automated process for ADAMS, SIMPACK, MotionSolve, RecurDyn and VI-Grade



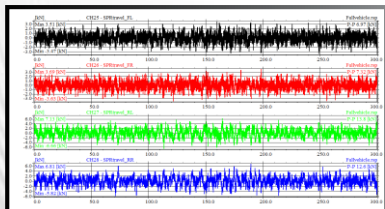
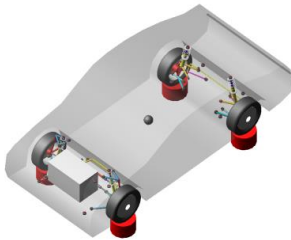


1. Noise

u_{Noise}

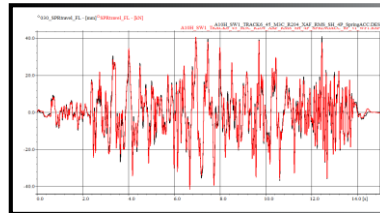
↓

y_{Noise}



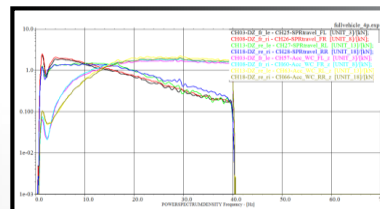
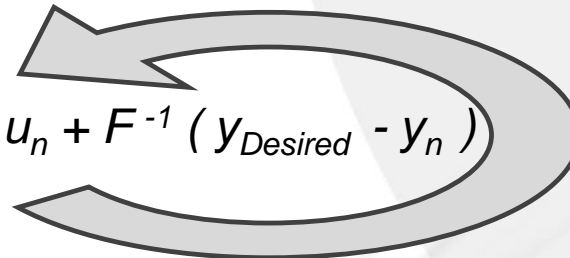
2. Response of noise

$$F = \frac{y_{Noise}}{u_{Noise}}$$



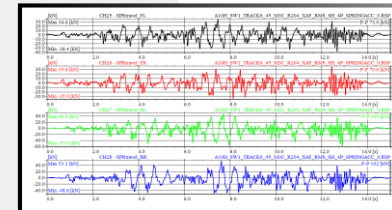
6. Response = desired

$$u_{n+1} = u_n + F^{-1} (y_{Desired} - y_n)$$

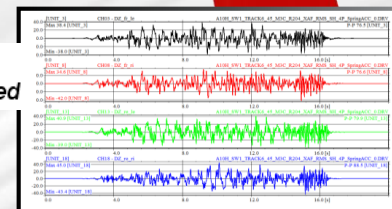
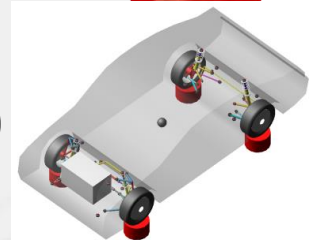


3. Transfer function

$$u_0 = F^{-1} y_{Desired}$$



5. Response



4. Drive signal

FEMFAT LAB vi

LOAD DATA ANALYSIS

Virtual iteration

- 3D ROAD

FEMFAT LAB mi

LOAD DATA ANALYSIS

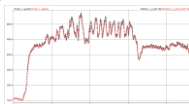
Model improvement

Interface to dynamic simulation

FEMFAT LAB time

LOAD DATA ANALYSIS

time based
analyzing tools



FEMFAT LAB frequency

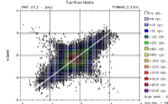
LOAD DATA ANALYSIS

frequency based
analyzing tools

FEMFAT LAB fatigue

LOAD DATA ANALYSIS

counting methods,
damage analysis,
data reduction,
mixing tracks



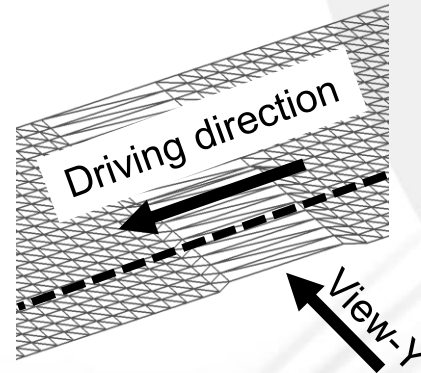
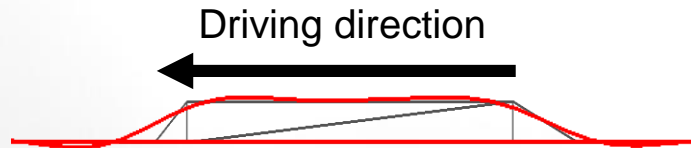
Load data analysis software

Key feature

Benefits

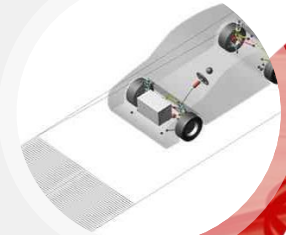
- Generation of road surface without scanning because
 - often not permitted (confidential proving grounds)
 - too expensive (customer usages)
 - not reasonable (weak, mud or wet conditions)

black...real threshold (View-Y)
red.....generated threshold



Road surface for simulation (MSC.ADAMS/Car)

- Generation of 3D road based on measured responses of a full vehicle (accelerations, relative displacements, strains,...)
- Using virtual iteration



FEMFAT LAB vi

LOAD DATA ANALYSIS

Virtual iteration

- 3D ROAD

FEMFAT LAB mi

LOAD DATA ANALYSIS

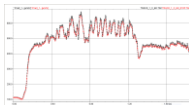
Model improvement

Interface to dynamic simulation

FEMFAT LAB time

LOAD DATA ANALYSIS

time based
analyzing tools



FEMFAT LAB frequency

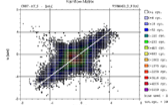
LOAD DATA ANALYSIS

frequency based
analyzing tools

FEMFAT LAB fatigue

LOAD DATA ANALYSIS

counting methods,
damage analysis,
data reduction,
mixing tracks



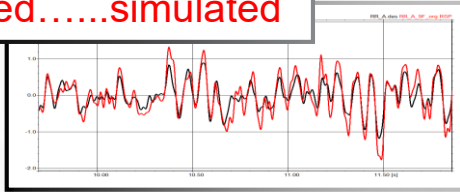
Load data analysis software

Key feature

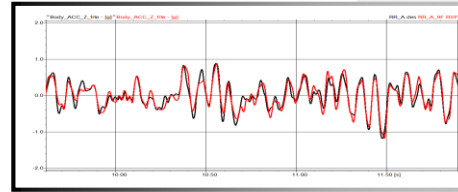
Benefits

- Optimized MSC.ADAMS model

black...measured
red.....simulated

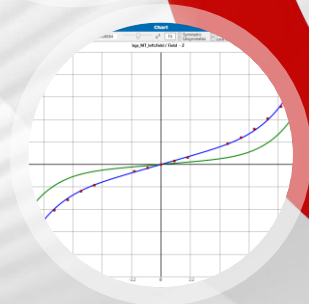
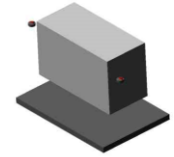


Optimized
characteristics



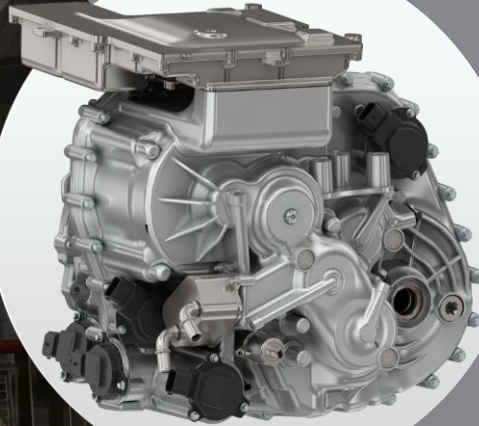
Optimization of MBS models

- Automated improvement of model quality based on measured responses (accelerations, relative displacements, strains,...)
- Linear and nonlinear parameters
- A diagnose tool assists to identify the relevant parameters
- Convenient and automated process
- Fast algorithm (less number of simulations required)





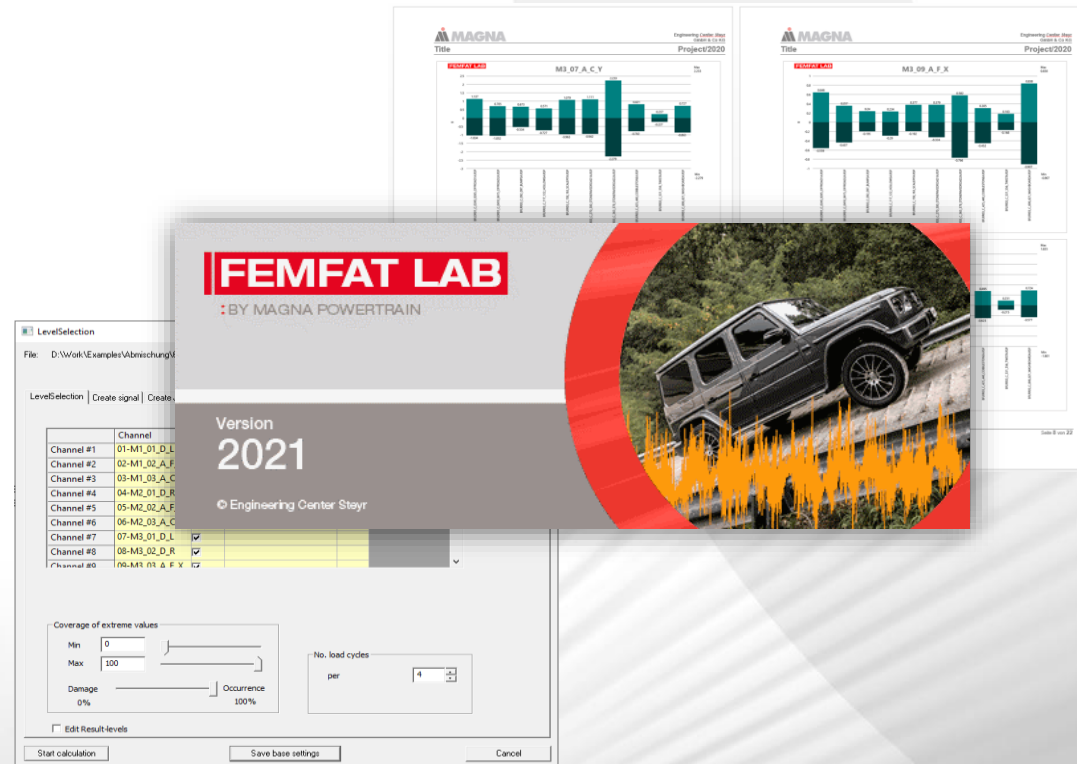
DRIVING **EXCELLENCE.**
INSPIRING **INNOVATION.**



FEMFAT LAB

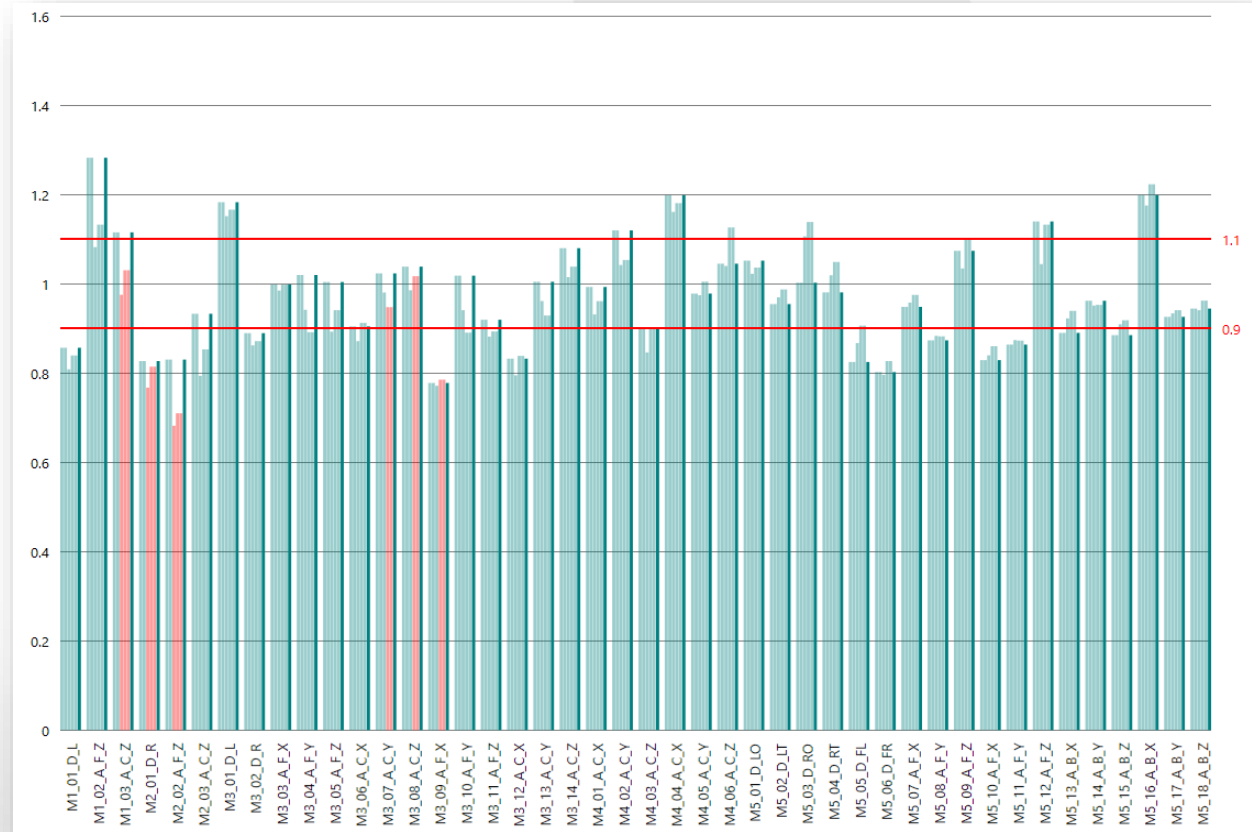
News - 2021

- Bargraph
 - Mixing tracks
 - Statistic
 - Virtual iteration
- Level selection
- GPS cut



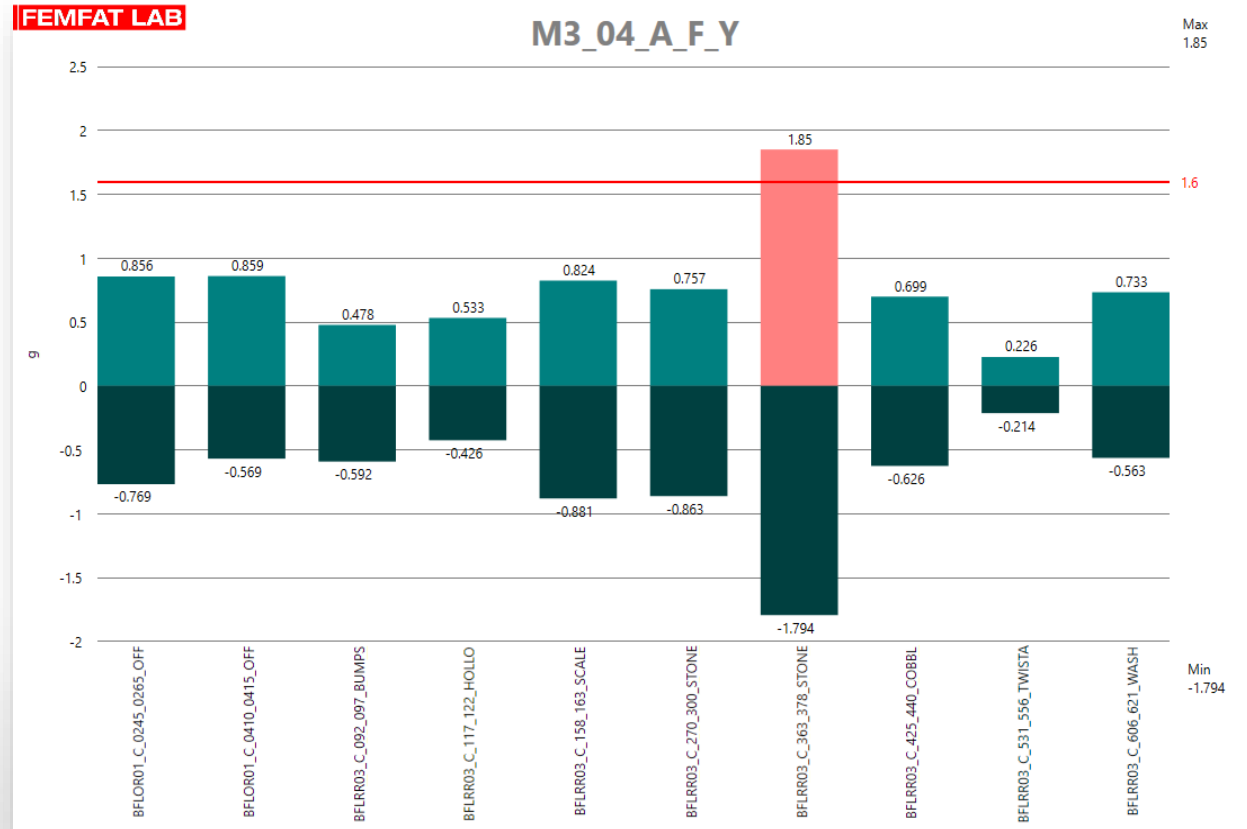
Bargraph: Mixing Tracks

- Processing history overview
- Highlighting of unused files
- Add custom limits
- Updates automatically after every calculation



Bargraph: Statistic

- Overview of project statistics
- Add custom limits
- Highlight important values
- Possible results to be displayed:
 - Extrema
 - Damage
 - RMS
 - Mean
 - CRest



Bargraph: Statistic



- Autoreport:
Export your project
statistics to a word
document

TESTPROGRAM.F90

D:\Work\Examples\Abrechnung\636_TESTPROGRAM\TESTPROGRAMA.F90

Objekt: 44

Standardwerte: Ja

Repositores: Nein

Anzahl Eingabefiler: 10

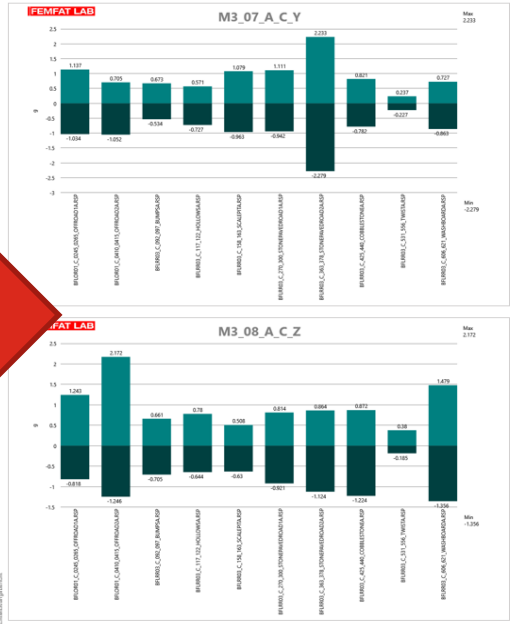
Dateien im Projekt:

Dateiname	Startpunkt	Endpunkt	MaxEndpunkt
BF1R001_C_0245_0245_OFFROADIA.RSP	1	4096	4096
BF1R001_C_0410_0415_OFFROADIA.RSP	1	1024	1024
BF1R001_C_092_097_DINIGA.RSP	1	1024	1024
BF1R001_C_117_122_DOLEWIA.RSP	1	1024	1024
BF1R001_C_150_163_SCALEPITA.RSP	1	1024	1024
BF1R001_C_270_300_OTOREPAVEDROADIA.RSP	1	6144	6144
BF1R001_C_343_379_STOREPAVEDROADIA.RSP	1	3072	3072
BF1R001_C_436_440_CORRECTIONIA.RSP	1	3072	3072
BF1R001_C_531_556_TWISTA.RSP	1	5120	5120
BF1R001_C_604_621_VASHOORDIA.RSP	1	3072	3072



Engineering Center Stg
GmbH & Co KG

Title: Project/2020



Speicherdatum: 24.06.2020
Pfad: D:\Work\Examples\Abrechnung\636_TESTPROGRAM\TESTPROGRAMA.F90

Seite 7 von 22



Engineering Center Stg
GmbH & Co KG

Title: Project/2020



Speicherdatum: 24.06.2020
Pfad: D:\Work\Examples\Abrechnung\636_TESTPROGRAM\TESTPROGRAMA.F90

Seite 8 von 22

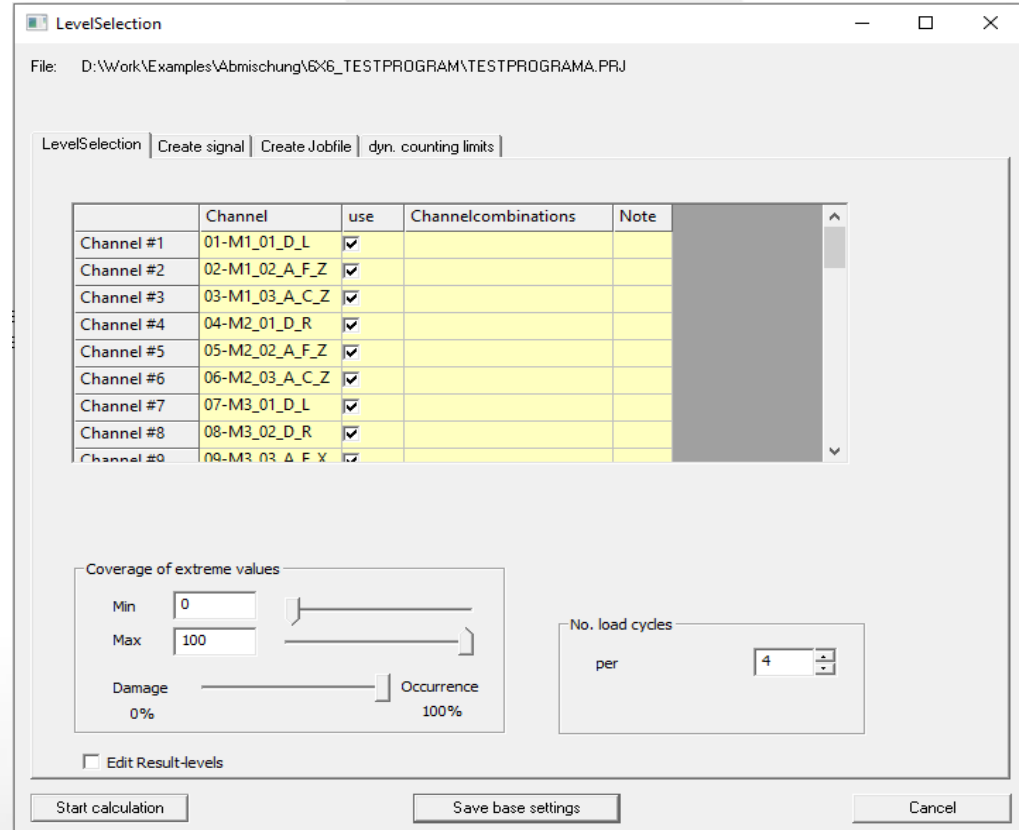
Bargraph: VI

- Iteration history overview
- Add custom limits
- Updates automatically after each iteration



Levelselection

- Searches for load changes in a time history
- based on a rainflow calculation
- Generation of a time-reduced, but damage-equivalent signal



The screenshot shows the 'LevelSelection' software window. The title bar reads 'LevelSelection'. The file path is 'D:\Work\Examples\Abmischung\6X6_TESTPROGRAM\TESTPROGRAMA.PRJ'. The window has four tabs: 'LevelSelection' (selected), 'Create signal', 'Create Jobfile', and 'dyn. counting limits'. Below the tabs is a table with columns: 'Channel', 'use', 'Channelcombinations', and 'Note'. The table lists 9 channels, each with a 'use' checkbox checked. Below the table is a section titled 'Coverage of extreme values' with sliders for 'Min' (0) and 'Max' (100), and a 'Damage' slider (0% to 100%). To the right is a 'No. load cycles' section with a value of 4. At the bottom are buttons for 'Start calculation', 'Save base settings', and 'Cancel'. There is also a checkbox for 'Edit Result-levels'.

	Channel	use	Channelcombinations	Note
Channel #1	01-M1_01_D_L	<input checked="" type="checkbox"/>		
Channel #2	02-M1_02_A_F_Z	<input checked="" type="checkbox"/>		
Channel #3	03-M1_03_A_C_Z	<input checked="" type="checkbox"/>		
Channel #4	04-M2_01_D_R	<input checked="" type="checkbox"/>		
Channel #5	05-M2_02_A_F_Z	<input checked="" type="checkbox"/>		
Channel #6	06-M2_03_A_C_Z	<input checked="" type="checkbox"/>		
Channel #7	07-M3_01_D_L	<input checked="" type="checkbox"/>		
Channel #8	08-M3_02_D_R	<input checked="" type="checkbox"/>		
Channel #9	09-M3_03_A_F_X	<input checked="" type="checkbox"/>		

Coverage of extreme values

Min: 0, Max: 100

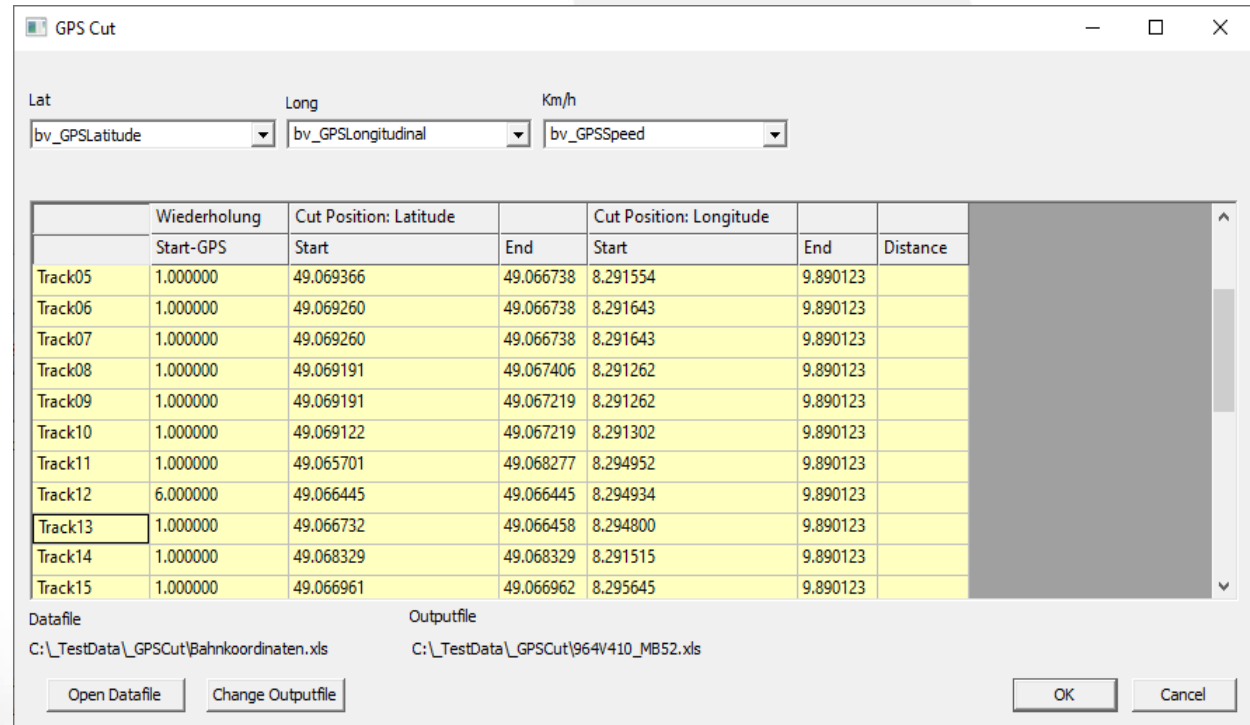
Damage: 0%, Occurrence: 100%

No. load cycles per: 4

☐ Edit Result-levels

Start calculation, Save base settings, Cancel

- Cut out parts of time signals based on user defined GPS coordinates
- Reducion of measurement data to the relevant sections



	Wiederholung	Cut Position: Latitude	End	Cut Position: Longitude	End	Distance
	Start-GPS	Start		Start		
Track05	1.000000	49.069366	49.066738	8.291554	9.890123	
Track06	1.000000	49.069260	49.066738	8.291643	9.890123	
Track07	1.000000	49.069260	49.066738	8.291643	9.890123	
Track08	1.000000	49.069191	49.067406	8.291262	9.890123	
Track09	1.000000	49.069191	49.067219	8.291262	9.890123	
Track10	1.000000	49.069122	49.067219	8.291302	9.890123	
Track11	1.000000	49.065701	49.068277	8.294952	9.890123	
Track12	6.000000	49.066445	49.066445	8.294934	9.890123	
Track13	1.000000	49.066732	49.066458	8.294800	9.890123	
Track14	1.000000	49.068329	49.068329	8.291515	9.890123	
Track15	1.000000	49.066961	49.066962	8.295645	9.890123	

Datafile: C:_TestData_GPSCut\Bahnkoordinaten.xls
Outputfile: C:_TestData_GPSCut\964V410_MB52.xls

Open Datafile Change Outputfile OK Cancel



DRIVING **EXCELLENCE.**
INSPIRING **INNOVATION.**