

# ANSA Plugin of Virtual Strain Gauge Utilities for FEMFAT

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## ANSA Plugin of Virtual Strain Gauge Utilities for FEMFAT

- Overview of Multidisciplinary Fatigue Analysis by FEMFAT
- Development of the plugin - How it started?
- The functionalities of the plugin
- Use case
- Conclusions

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# Multidisciplinary Fatigue Analysis FEMFAT

Comprehensive modules solve any tasks

# FEMFAT (Finite Element Method FATigue)

Multidisciplinary Fatigue Analysis – comprehensive modules solve any tasks



## Benefits

- Fatigue life, damage, and safety factors for all types of loading
- Compatible to all common FE-codes
- More than 500 material datasets and Material Generator
- Full choice of influence parameters on fatigue analysis
- Integration into automatic optimization workflows
- Combines engineering know how and standards
- Open SPOT and WELD database

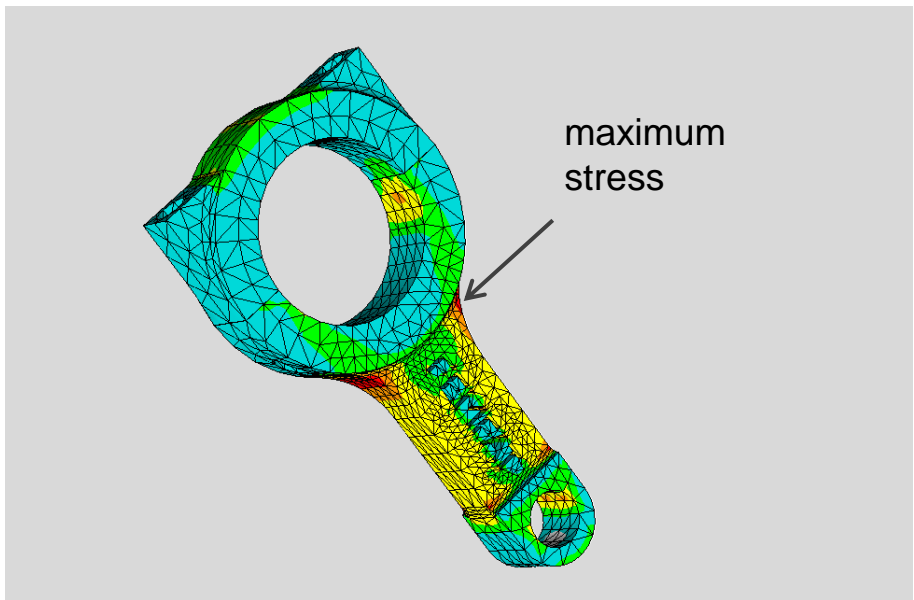
## Applications

- Unique & patented multi-axial fatigue hypotheses
- Multi-axial fatigue analysis of stochastically excited systems in the frequency domain
- Analysis of metals, composites, rubber and fiber reinforced plastics
- Assessment of point connections (SPOT welds, rivets, FDS...) and line connections (seam welds, adhesive bonding)

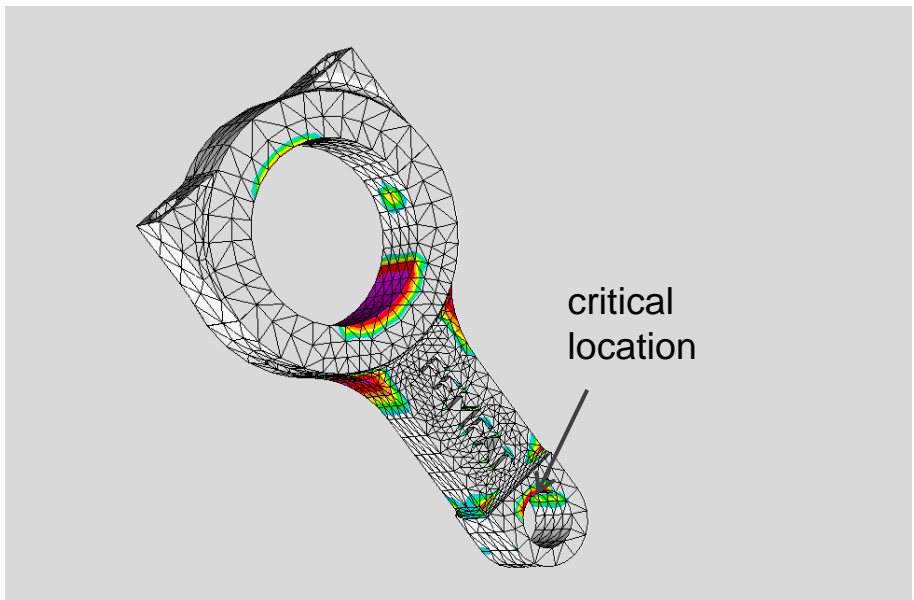
The exclusive analysis of stress in a traditional way doesn't often reveal damage occurrence at the right point




### Traditional view



### Modern life-cycle stress analysis



 Only modern fatigue analysis tools are capable of predicting critical crack locations and the number of load cycles until failure

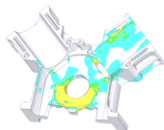
Depending on the stress state, joining technique or analysis target different FEMFAT modules are used for analysis



# FEMFAT modules

**FEMFAT** basic

plast  
break



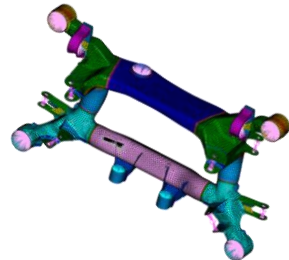
**MEHD**

**FEDIS**

**MNOISE**

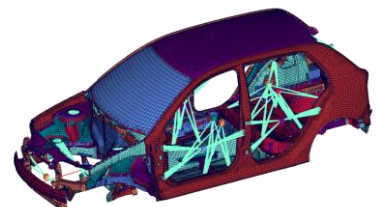
**MAMBA**

**FEMFAT** weld

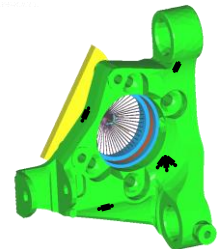


**FEMFAT** spot

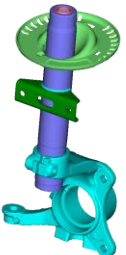
**MAMBA**



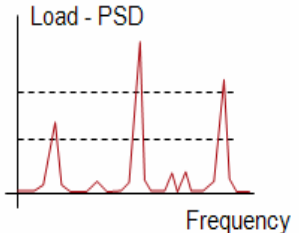
**FEMFAT** strain



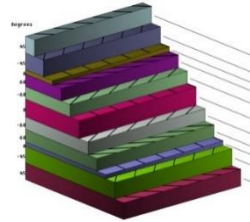
**FEMFAT** max



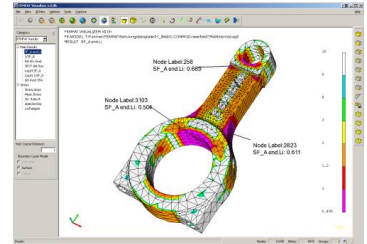
**FEMFAT** spectral



**FEMFAT** laminate parallel



**FEMFAT** visualizer



Depending on the stress state, joining technique or analysis target different FEMFAT modules are used for analysis

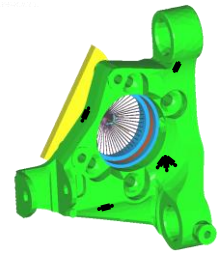


**FEMFAT strain** is an extension module for processing fatigue strength analysis using time history data from strain gages attached to components, and for checking the correlation between measured and calculated stress and strain.

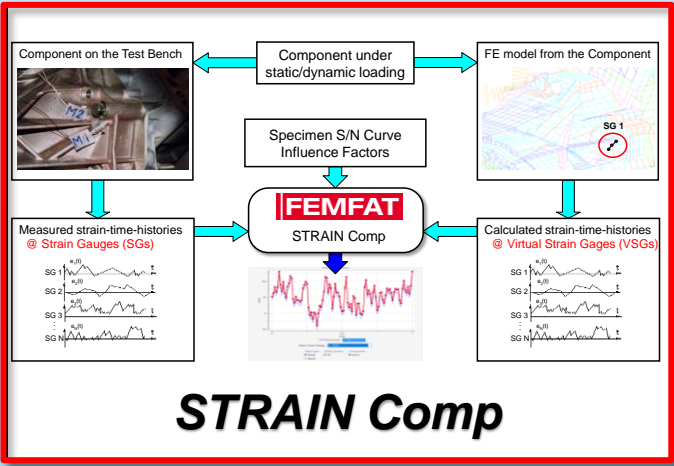
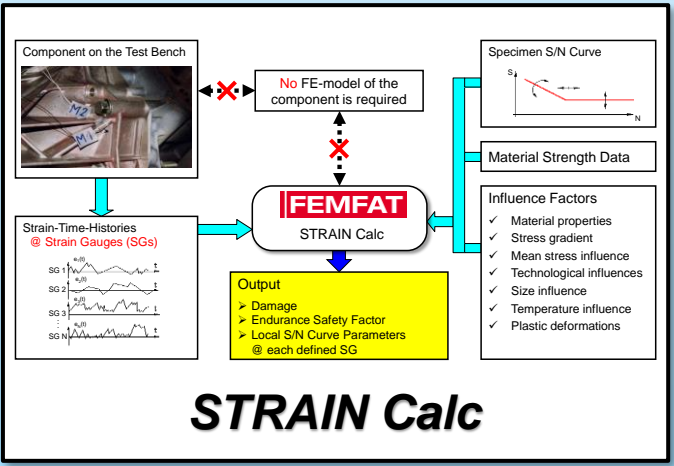
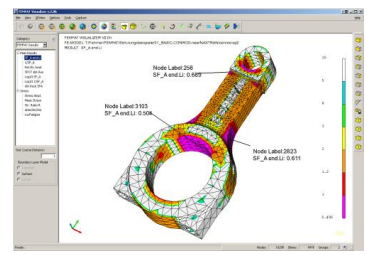
◆ **STRAIN Calc:**  
Processing measured strains directly without FE model for durability and strength analyses

◆ **STRAIN Comp:**  
Checking the correlation between measured and calculated stresses and strains using virtual strain gages at FE model

**FEMFAT** strain



**FEMFAT** visualizer

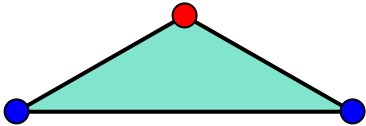
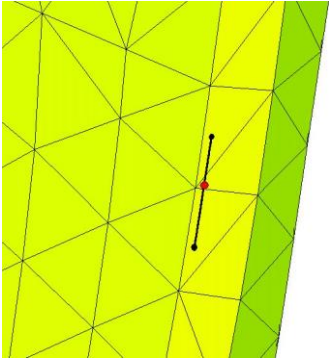




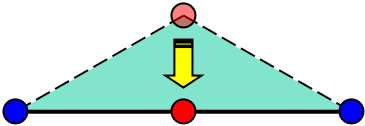
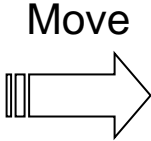
# Virtual Strain Gauge model (1/2)

- Definition

- Measurement Grid Node
- Direction grid Node



Three-node shell element



Virtual strain gauge model

# Virtual Strain Gauge model (2/2)

- Virtual Strain Gauge: Modeling guideline

- Predefined triangular model

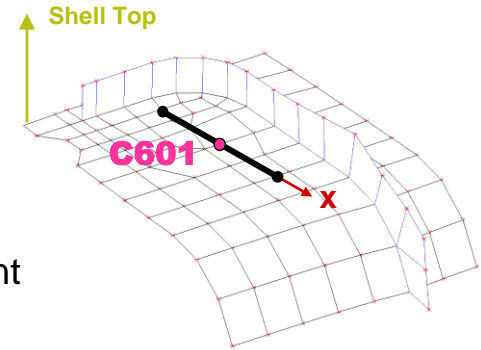
- Using three-node linear shell element
- Node color (CID) is defined according to gauge type
- Material label (MAT ID) is defined for three-node shell element

- Attribute-free triangular model

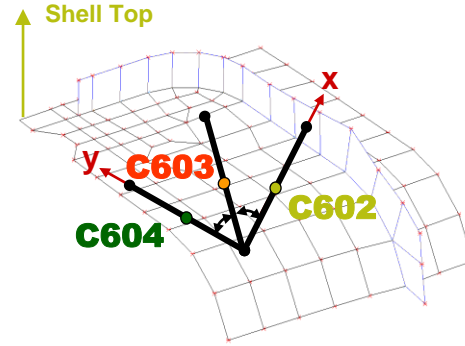
- Using three-node linear shell element
- Strain gauge is defined by GUI using EIDs

- Node to Node

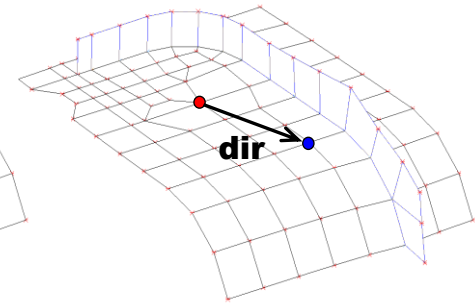
- Two nodes of NID is defined by GUI



Linear strain gauge modeling



Rosette strain gauge modeling



"Node-to-node" modeling

## ANSA Plugin of Virtual Strain Gauge Utilities for FEMFAT

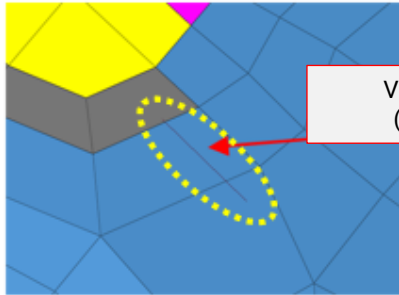
- Overview of Multidisciplinary Fatigue Analysis by FEMFAT
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## Development of the plugin - How it started?

< Current issue raised by TOYOTA >

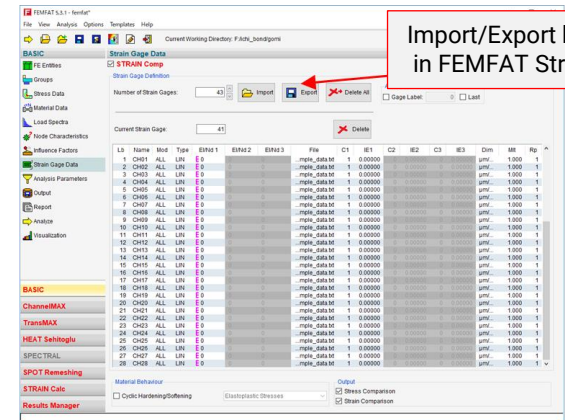
### • Creation/Handling of Virtual Strain Gauges for FEMFAT Strain is COMBERSOME!

- Not easy to create/handle “collapsed CTRIA”...
- Specific ID/Coord/Material settings...
- Relevant inputs required after imported to FEMFAT Strain...



Virtual Strain Gauge  
(collapsed CTRIA)

- Gauge definition is NOT compatible with FEMFAT Strain...
- It should be made in pre-processors...



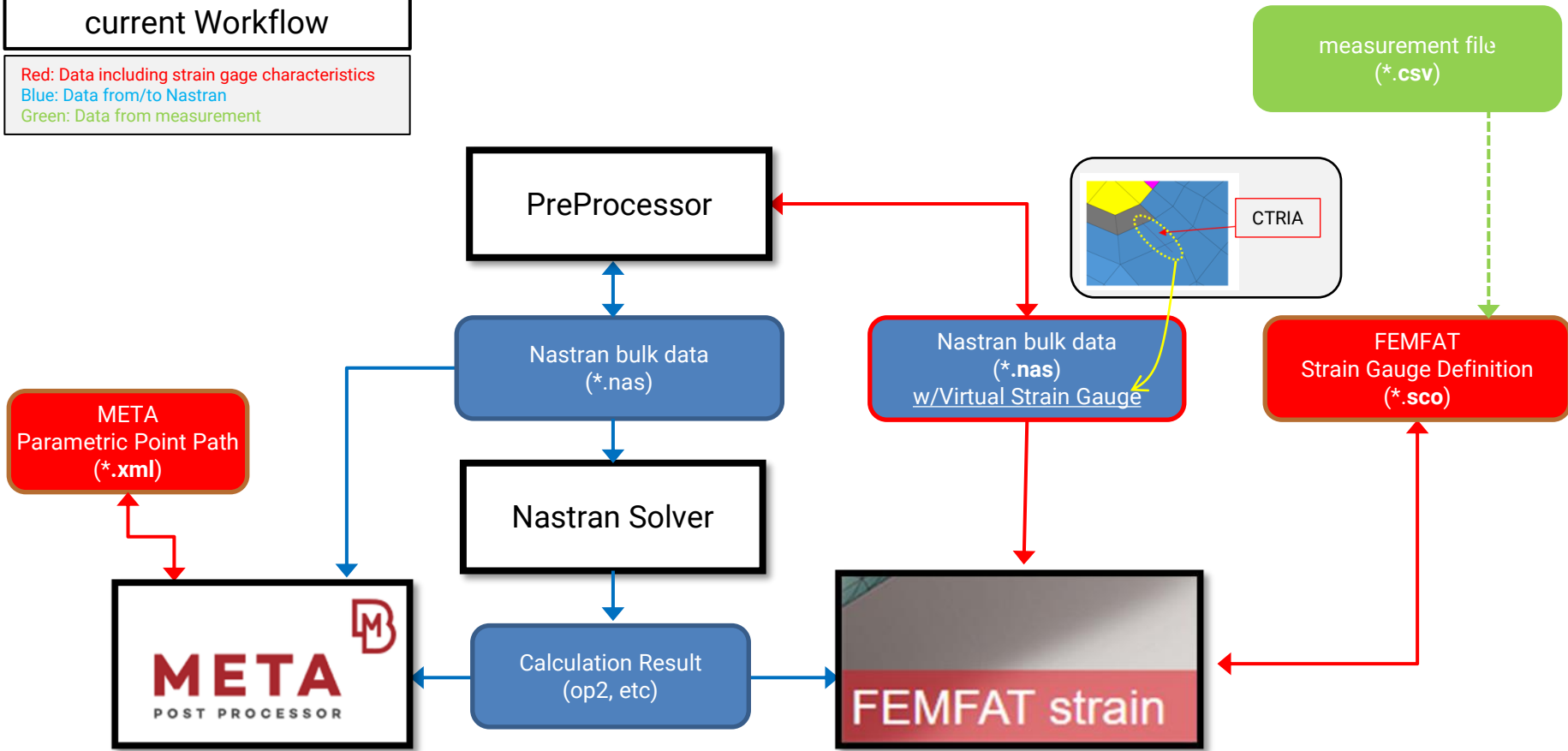
Import/Export button  
in FEMFAT Strain

< What is expected >

### • Enable ANSA to create/handle Virtual Strain Gauges, available for FEMFAT, also for META!

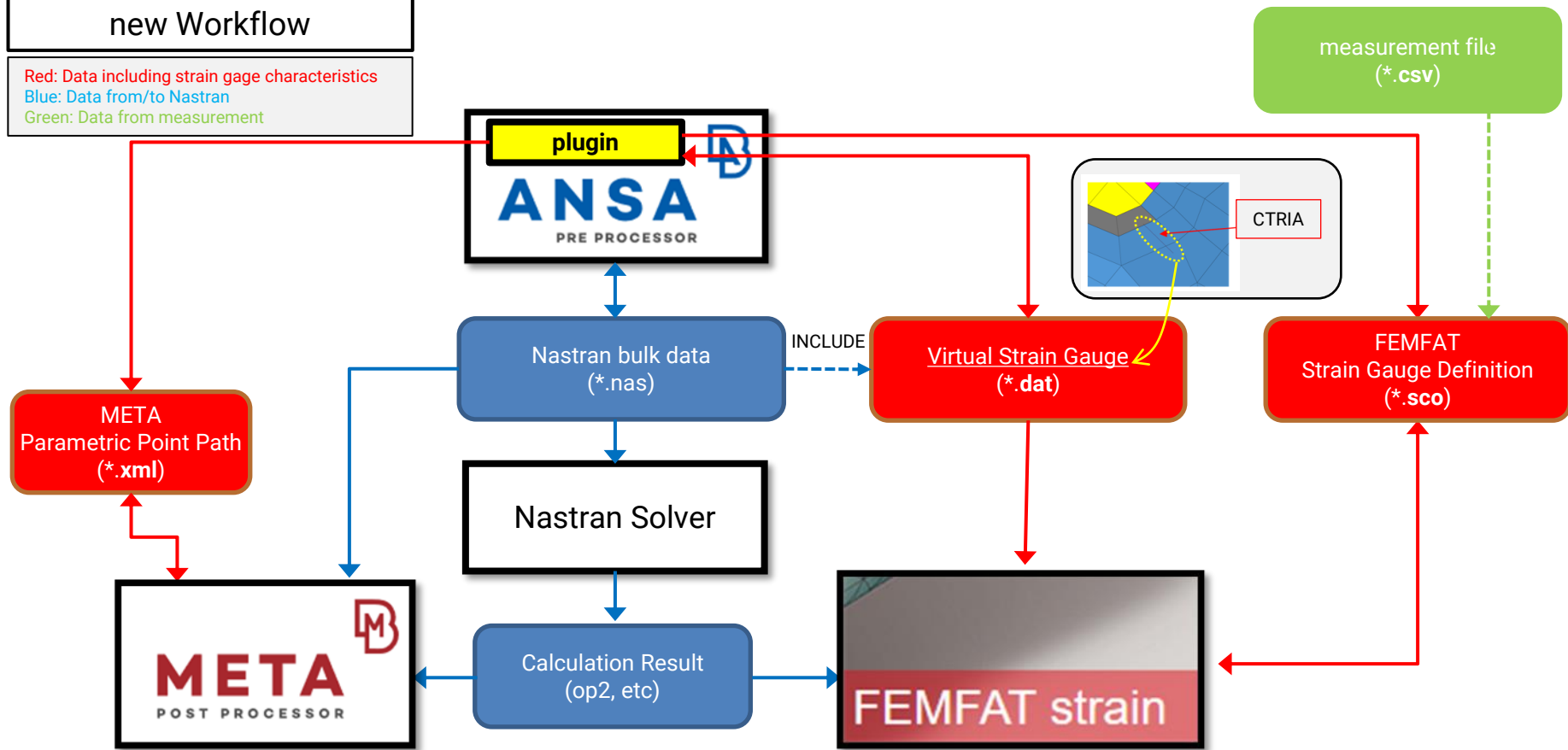
# current Workflow

Red: Data including strain gage characteristics  
Blue: Data from/to Nastran  
Green: Data from measurement



**new Workflow**

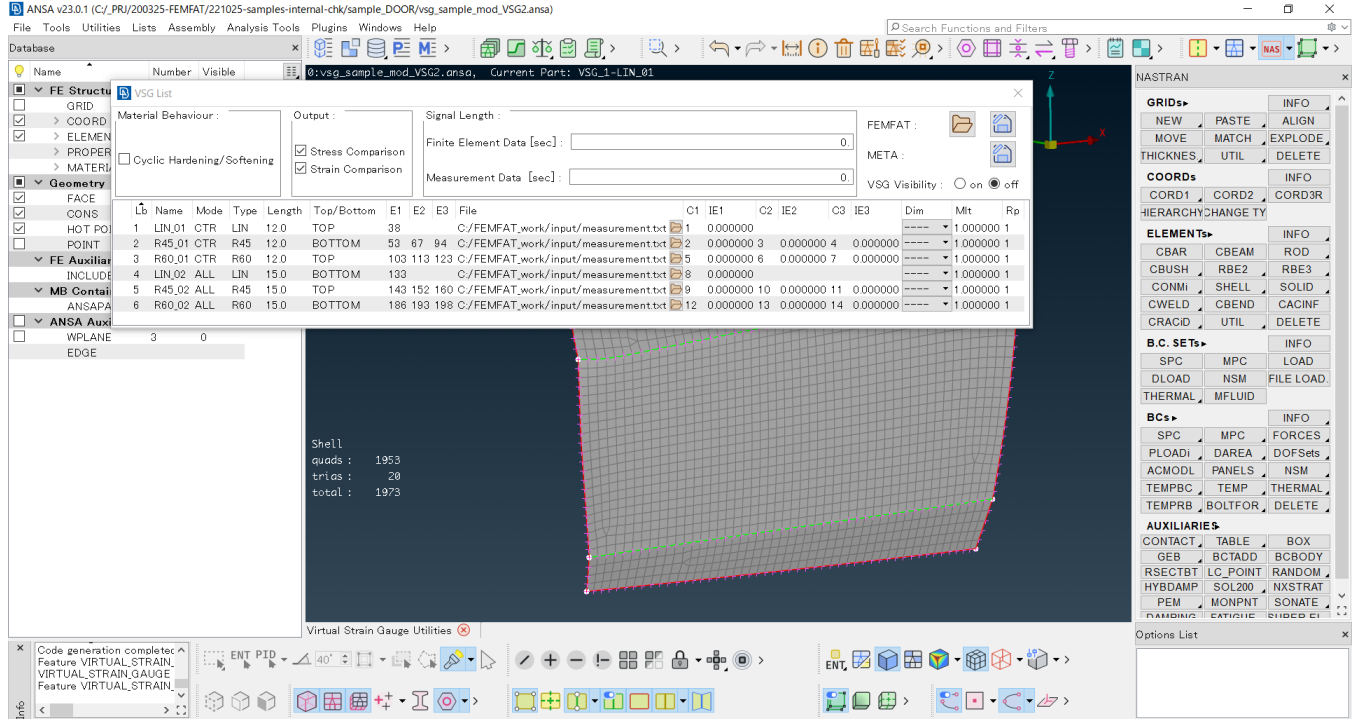
Red: Data including strain gage characteristics  
Blue: Data from/to Nastran  
Green: Data from measurement



## ANSA Plugin of Virtual Strain Gauge Utilities for FEMFAT

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# Launch the plugin



ANSYS v23.0.1 (C:/PRJ/200325-FEMFAT/221025-samples-internal-chk/sample\_DOOR/vsg\_sample\_mod\_VSG2.ans) | File Tools Utilities Lists Assembly Analysis Tools Plugins Windows Help

Database | Name | Number | Visible | @:vsg\_sample\_mod\_VSG2.ans, Current Part: VSG\_1-LIN\_01

FE Structure: VSG List

Material Behaviour: Output: Signal Length: FEMFAT: META: VSG Visibility:  on  off

Finite Element Data [sec]: 0.0  
Measurement Data [sec]: 0.0

Id	Name	Mode	Type	Length	Top/Bottom	E1	E2	E3	File	C1	IE1	C2	IE2	C3	IE3	Dim	Mit	Rp
1	LIN_01	CTR	LIN	12.0	TOP			38	C:/FEMFAT_work/input/measurement.txt	1	0.000000					----	1.000000	1
2	R45_01	CTR	R45	12.0	BOTTOM	53	67	94	C:/FEMFAT_work/input/measurement.txt	2	0.000000	3	0.000000	4	0.000000	----	1.000000	1
3	R60_01	CTR	R60	12.0	TOP	103	113	123	C:/FEMFAT_work/input/measurement.txt	5	0.000000	6	0.000000	7	0.000000	----	1.000000	1
4	LIN_02	ALL	LIN	15.0	BOTTOM			133	C:/FEMFAT_work/input/measurement.txt	8	0.000000					----	1.000000	1
5	R45_02	ALL	R45	15.0	TOP	143	152	160	C:/FEMFAT_work/input/measurement.txt	9	0.000000	10	0.000000	11	0.000000	----	1.000000	1
6	R60_02	ALL	R60	15.0	BOTTOM	186	193	198	C:/FEMFAT_work/input/measurement.txt	12	0.000000	13	0.000000	14	0.000000	----	1.000000	1

Virtual Strain Gauge Utilities

Shell:  
quads : 1953  
trias : 20  
total : 1973

NASTRAN: GRIDS, MOVE, THICKNESS, COORDS, ELEMENTS, B.C. SETS, BCs, AUXILIARIES

Code generation complete. Feature VIRTUAL\_STRAIN, VIRTUAL\_STRAIN\_GAUGE, Feature VIRTUAL\_STRAIN.



# GUI of the plugin

The screenshot shows the 'VSG List' dialog box. It has several input fields and checkboxes for configuration. Below these is a table listing 6 strain gauges with their properties and associated data points.

№	↑	Name	Mode	Type	Length	Top/Bottom	E1	E2	E3	File	C1	IE1	C2	IE2	C3	IE3	Dim	Mlt	Rp
1		LIN_01	CTR	LIN	12.0	TOP	38			C:/FEMFAT_work/input/measurement.txt	1	0.000000					----	1.000000	1
2		R45_01	CTR	R45	12.0	BOTTOM	53	67	94	C:/FEMFAT_work/input/measurement.txt	2	0.000000	3	0.000000	4	0.000000	----	1.000000	1
3		R60_01	CTR	R60	12.0	TOP	103	113	123	C:/FEMFAT_work/input/measurement.txt	5	0.000000	6	0.000000	7	0.000000	----	1.000000	1
4		LIN_02	ALL	LIN	15.0	BOTTOM	133			C:/FEMFAT_work/input/measurement.txt	8	0.000000					----	1.000000	1
5		R45_02	ALL	R45	15.0	TOP	143	152	160	C:/FEMFAT_work/input/measurement.txt	9	0.000000	10	0.000000	11	0.000000	----	1.000000	1
6		R60_02	ALL	R60	15.0	BOTTOM	186	193	198	C:/FEMFAT_work/input/measurement.txt	12	0.000000	13	0.000000	14	0.000000	----	1.000000	1

## ◇ Common Settings

- Material Behaviour, Output, Signal Length

## ◇ FEMFAT File Input/Output

- [Output] ... VSG Model File (\*.dat) , Definition File (\*.sco)
- [Input] ... VSG Model File (\*.dat)

## ◇ Strain Gauge List View

- Creation and list up of gauges
- edit settings (measurement file, etc)

## ◇ META File Output

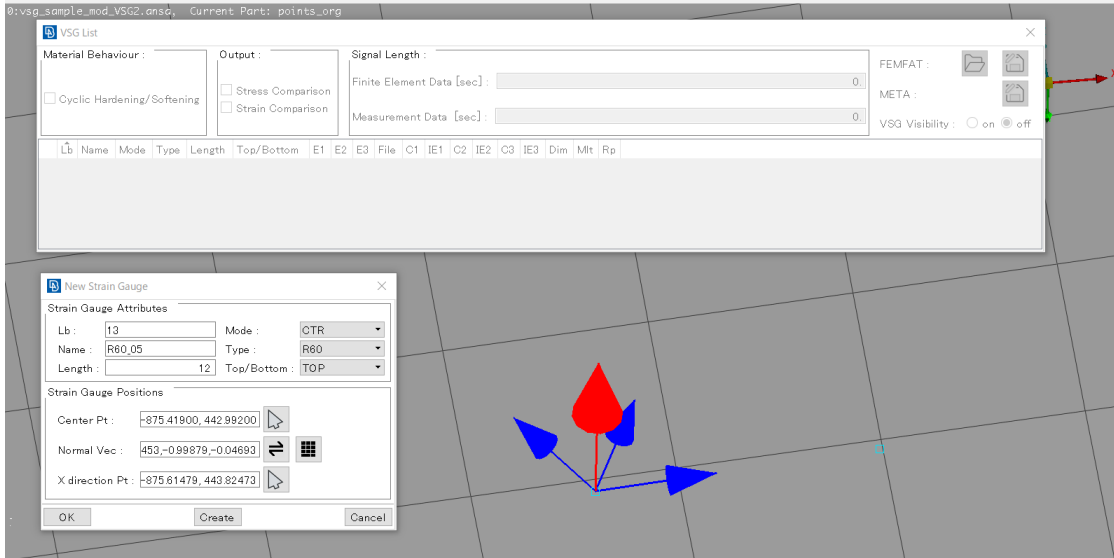
- Parametric Point Path File (\*.xml)

## ◇ VSG Visibility

- visualize gauges defined on current model

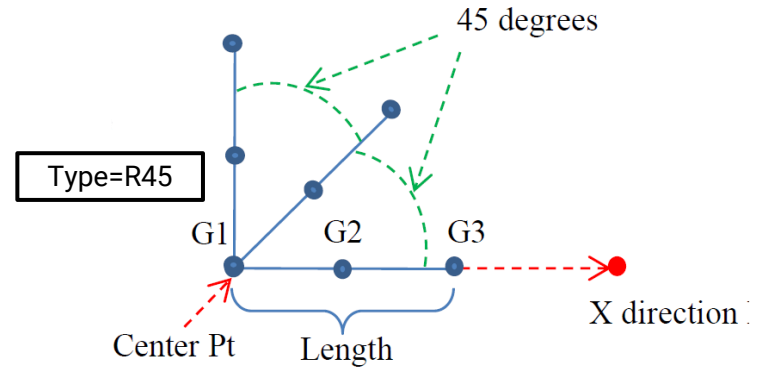
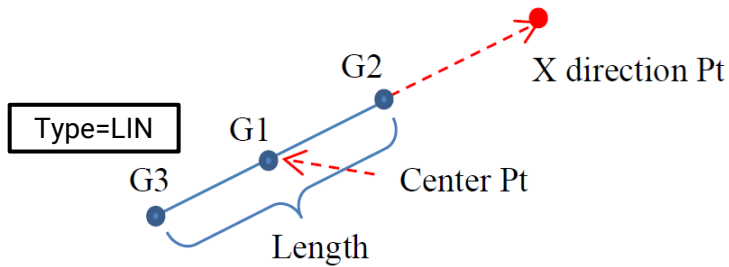
## Creation of Virtual Strain Gauges

- RMB>Add Gauge on the list view
- Input/select each field (Lb, Name, Length, Mode, Type, Top/Bottom)
- specify Center Pt on the model
- confirm Normal Vec. preview (invert/arbitrary direction is also available)
- specify X direction Pt
- confirm Virtual Strain Gauge preview
- press Create/OK button



## Definition of Virtual Strain Gauge

- Nastran CTRIA is created according to the input.
- In case of Type=R45/R60, 3 CTRIAs are aligned to counter-clockwise around Normal Vec.
- CD is set for the node lying at the middle of each CTRIA.



Type	GRID	TOP/BOTTOM	CORD_R ID
LIN	G1	TOP	601
	G1	BOTTOM	701
R45, R60	G2	TOP	602, 603, 604
	G2	BOTTOM	702, 703, 704

## Interface with FEMFAT Strain



“FEMFAT File Output” exports 2 following files :

◇ VSG Model File (\*.dat)

- NASTRAN CTRIAs and relevant cards
- INCLUDE statement (specifies solver input file name)

◇ Definition File (\*.sco)

- compliant to original \*.sco (meas. file, etc)



Evaluation of fatigue in FEMFAT Strain is possible by reading solver input/result(\*.nas/\*.op2) and 2 files mentioned above(\*.dat, \*.sco)

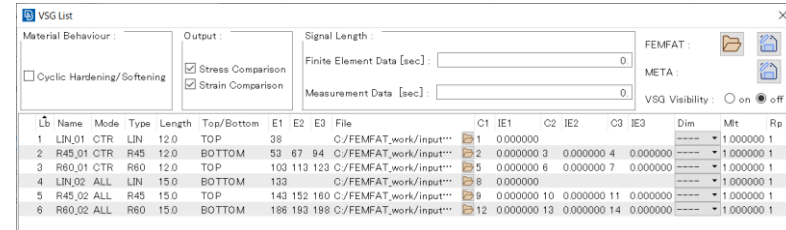
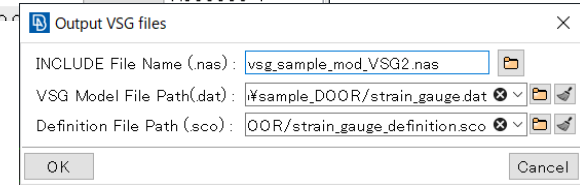
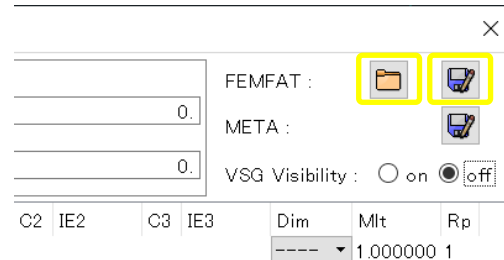


“FEMFAT File Input” imports the following file :

◇ VSG Model File (\*.dat)



Strain Gauges can be imported and applied to another model through VSG Model File (\*.dat)



# Interface with FEMFAT Strain

Virtual Strain Gauges defined in ANSA plugin

VSG List

Material Behaviour:  Cyclic Hardening/Softening

Output:  Stress Comparison  Strain Comparison

Signal Length: Finite Element Data [sec]: 1 Measurement Data [sec]: 1

FEMFAT: META: VSG Visibility:  on  off

Lb	Name	Mode	Type	Length	Top/Bottom	E1	E2	E3	File	C1	IE1	C2	IE2	C3	IE3	Dim	Mlt	Rp
1	LIN01	ALL	LIN	2.0	TOP	1			measurement.txt	0.000000						1.000000	1	
2	LIN02	CTR	LIN	2.0	BOTTOM	2			measurement.txt	0.000000						1.000000	1	
3	LIN03	CTR	LIN	2.0	TOP	3			measurement.txt	0.000000						1.000000	1	
4	LIN04	CTR	LIN	2.0	TOP	4			measurement.txt	0.000000						1.000000	1	
5	R45_01	CTR	R45	2.0	TOP	5	6	7	measurement.txt	0.000000	0.000000	0.000000				1.000000	1	
6	R45_02	CTR	R45	2.0	TOP	8	9	10	measurement.txt	0.000000	0.000000	0.000000				1.000000	1	
7	R45_03	CTR	R45	2.0	BOTTOM	11	12	13	measurement.txt	0.000000	0.000000	0.000000				1.000000	1	
8	LIN05	CTR	LIN	2.0	TOP	14			measurement.txt	0.000000						1.000000	1	
9	LIN06	ALL	LIN	2.0	TOP	15			measurement.txt	0.000000						1.000000	1	
10	R80_D1	CTR	R80	2.0	TOP	16	17	18	measurement.txt	0.000000	0.000000	0.000000				1.000000	1	
11	R80_D2	CTR	R80	2.0	TOP	19	20	21	measurement.txt	0.000000	0.000000	0.000000				1.000000	1	
12	R45_04	CTR	R45	2.0	TOP	22	23	24	measurement.txt	0.000000	0.000000	0.000000				1.000000	1	



Fatigue calculation in FEMFAT Strain

Strain Gage Data

STRAIN Comp

Strain Gage Definition

Number of Strain Gages: 12 Import Export Delete All Auto Fill Anchor Gage Label: 0 Last

Current Strain Gage: 1 Delete

Lb	Name	Mor	Typx	EI/Nd 1	EI/Nd 2	EI/Nd 3	File	C1	IE1	C2	IE2	C3	IE3	Dim	Mlt	Rp
1	LIN01	ALL	LIN	E 1			C:/FEMFAT_work/Data/test.tst	1	0.00000					1.000	1	
2	LIN02	CTR	LIN	E 2			C:/FEMFAT_work/Data/test.tst	2	0.00000	0	0.00000	0	0.00000	1.000	1	
3	LIN03	CTR	LIN	E 3			C:/FEMFAT_work/Data/test.tst	3	0.00000					1.000	1	
4	LIN04	CTR	LIN	E 4			C:/FEMFAT_work/Data/test.tst	4	0.00000	0	0.00000	0	0.00000	1.000	1	
5	R45...	CTR	R45	E 5	E 6	E 7	C:/FEMFAT_work/Data/test.tst	5	0.00000	6	0.00000	7	0.00000	1.000	1	
6	R45...	CTR	R45	E 8	E 9	E 10	C:/FEMFAT_work/Data/test.tst	8	0.00000	9	0.00000	10	0.00000	1.000	1	
7	R45...	CTR	R45	E 11	E 12	E 13	C:/FEMFAT_work/Data/test.tst	11	0.00000	12	0.00000	13	0.00000	1.000	1	
8	LIN05	CTR	LIN	E 14			C:/FEMFAT_work/Data/test.tst	14	0.00000					1.000	1	
9	LIN06	ALL	LIN	E 15			C:/FEMFAT_work/Data/test.tst	15	0.00000					1.000	1	
10	R80...	CTR	R80	E 16	E 17	E 18	C:/FEMFAT_work/Data/test.tst	16	0.00000	17	0.00000	18	0.00000	1.000	1	
11	R80...	CTR	R80	E 19	E 20	E 21	C:/FEMFAT_work/Data/test.tst	19	0.00000	20	0.00000	21	0.00000	1.000	1	
12	R45...	CTR	R45	E 22	E 23	E 24	C:/FEMFAT_work/Data/test.tst	22	0.00000	23	0.00000	24	0.00000	1.000	1	

Material Behaviour:  Cyclic Hardening/Softening Elastoplastic Stresses Output:  Stress Comparison  Strain Comparison

# Interface with META



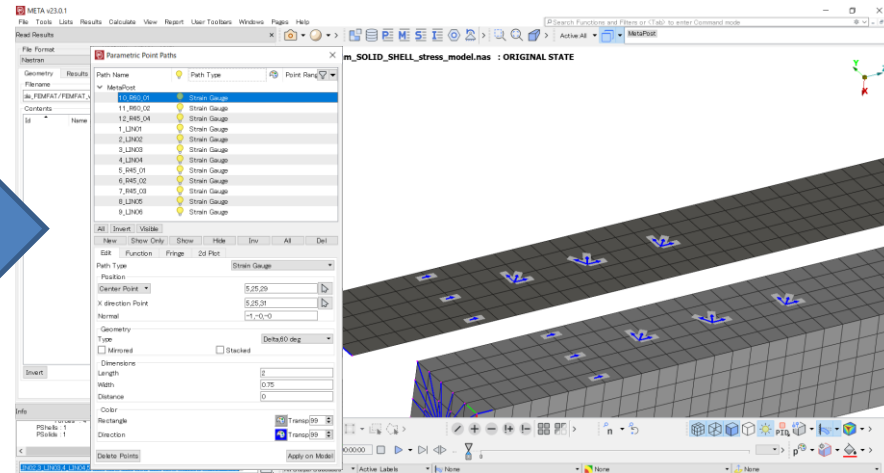
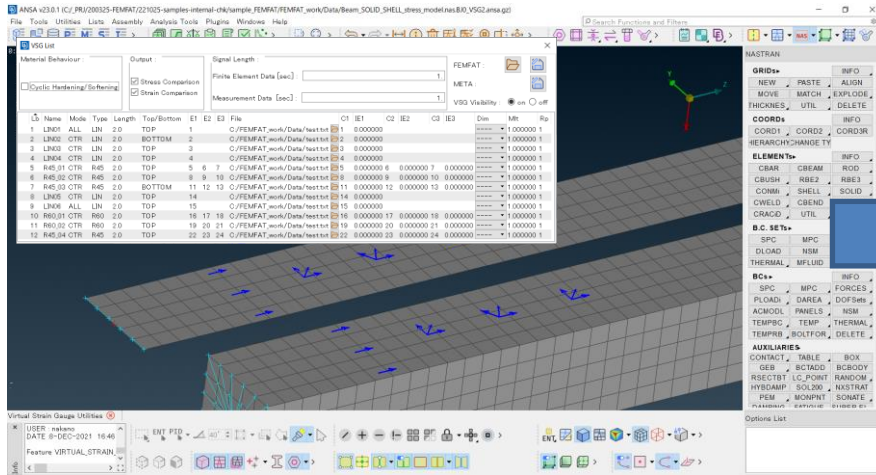
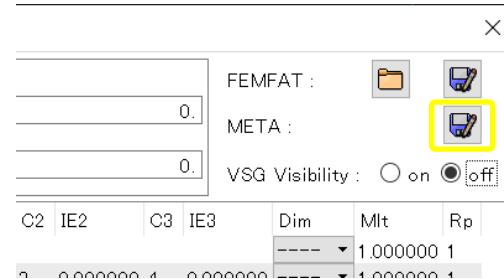
“META File Output” exports the following file:

◇ Parametric Point Path File (\*.xml)

- compatible with Strain Gauge of META



Strain Gauges defined by the plugin are available also in META



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# Problem definition

Fatigue analysis of differential cage with variable loads

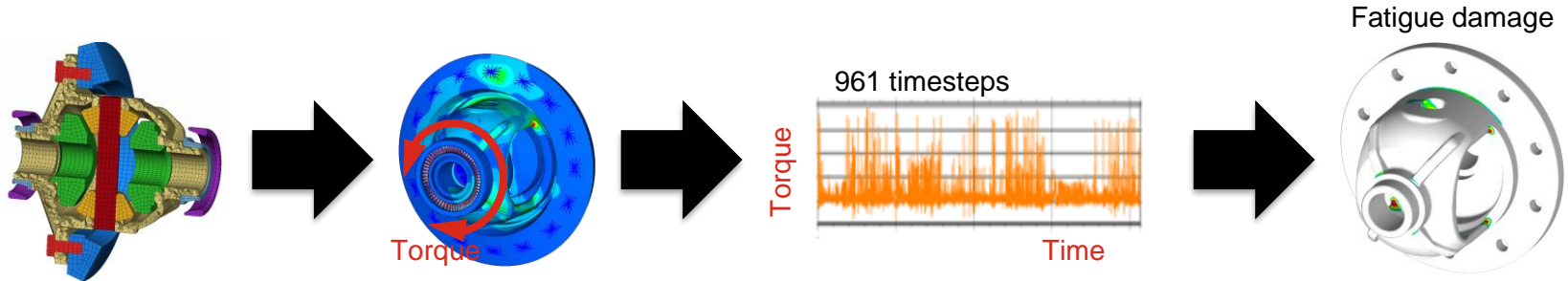
Strain gauge measurement



# Challenges

## 1. How to perform fatigue analysis for the differential cage with variable loads?

- Want to perform fatigue simulation with real vehicle condition.  
→ There are 961 timesteps (7.96sec.) of load condition.



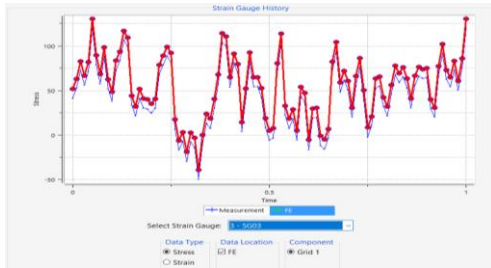
## 2. How big is the orientation sensitivity of strain gauge measurement?

- Want to compare the correlation between testing and simulation.  
→ What is the deviation coming from measurement?

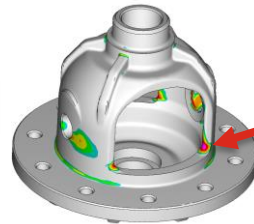
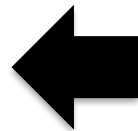


# Motivation

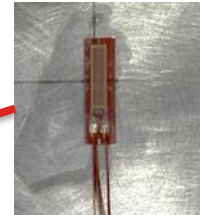
1. It is possible to detect following info from FEMFAT
  - Strain Gauge Position = **“Most critical damaged node”**
  - Strain Gauge Direction = **“Critical Cutting Plane Vector”**



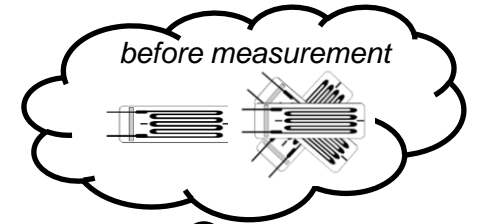
Check correlation test and simulation by FEMFAT strain



Fatigue analysis  
Damage distribution



Strain Gauge attachment



Where to be attached?  
What direction?  
What DMS type?  
How big the deviation?

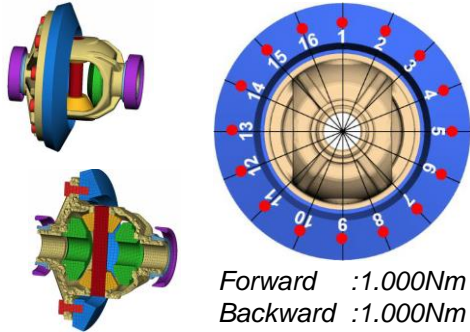
2. In general, the sensitivity of Strain Gauge orientation is very high!!
  - ➔ It is essential to find the appropriate position to be attached the Strain Gauge.
  - ➔ Measured position should be less sensitivity to the orientation.
  - ➔ Meaningful measurement to compare with FE simulation.

# Fatigue simulation procedure

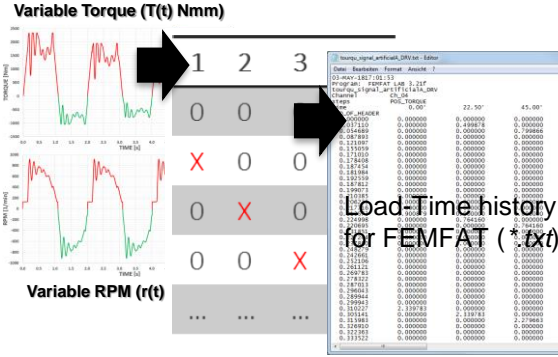
## From FE modeling till Fatigue evaluation

# Fatigue analysis procedure

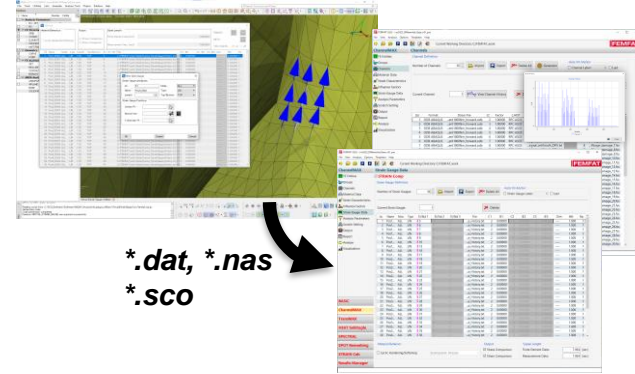
**FE model setup by ANSA**  
**FE analysis with unit load**



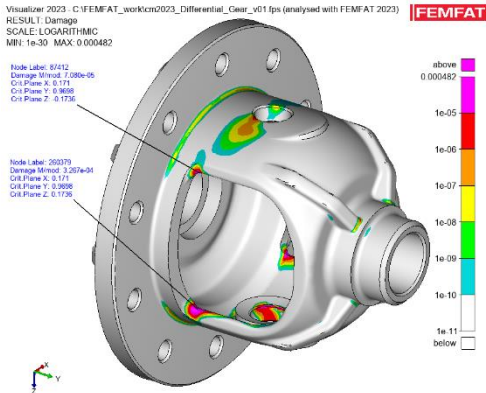
**Load-Time history conversion by FEMFAT LAB**



**Strain Gauge Definition by ANSA**  
**Fatigue analysis by FEMFAT**

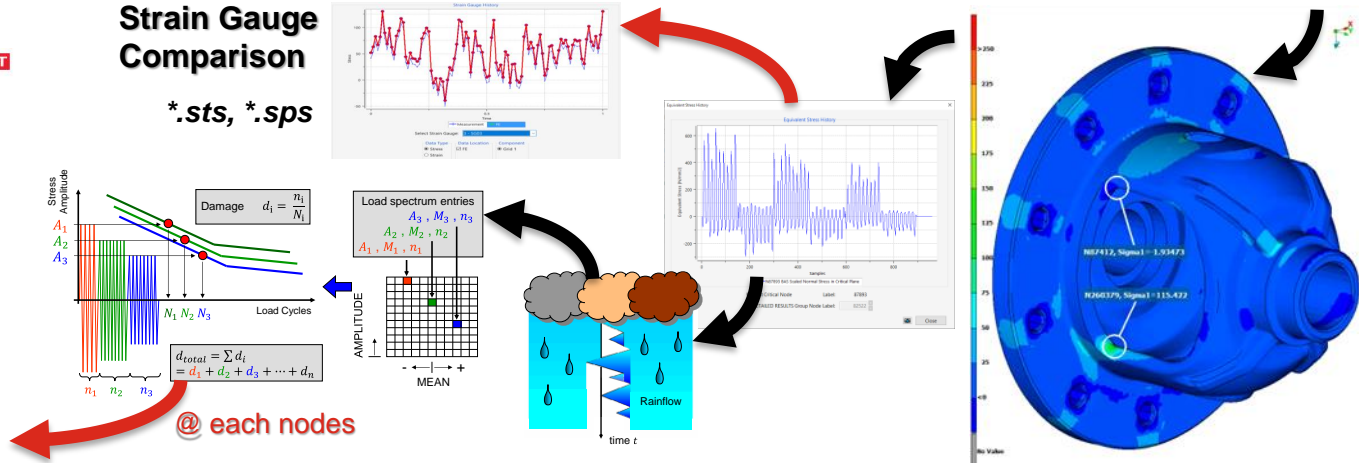


**Damage distribution**



**Strain Gauge Comparison**

\*.sts, \*.sps



# Fatigue simulation results

Detect strain gauge orientation → 4 positions

Check sensitivity of strain gauge orientation

# Detect evaluation positions

## One of the max. stress at time point Stress distribution at time point 59

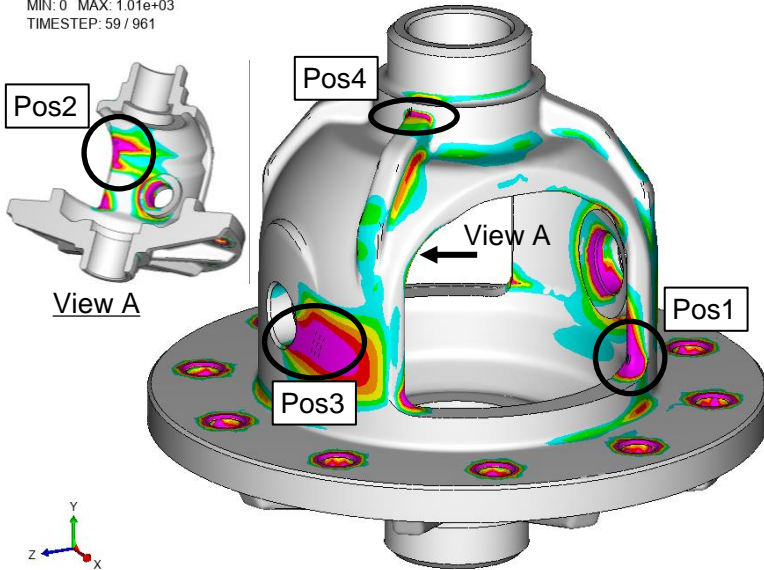
Visualizer 2023 - C:\FEMFAT\_work\cm2023\_Differential\_Gear\_v01.fps (analysed with FEMFAT 2023)  
STRESS (ChannelMAX): VON MISES - Shell: TOP - Solid: SURFACE  
SCALE: LINEAR  
MIN: 0 MAX: 1.01e+03  
TIMESTEP: 59 / 961

FEMFAT

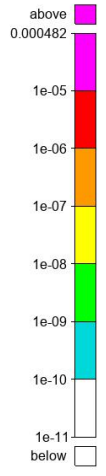
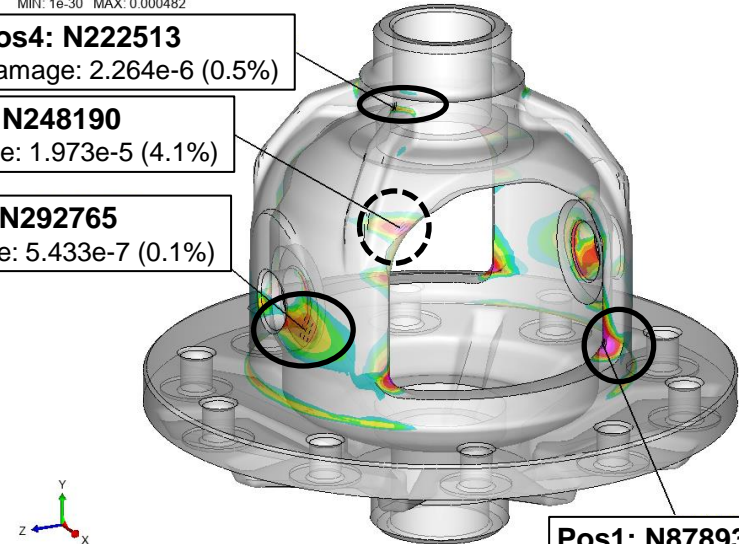
## Detect strain gauge measurement position Four positions from damage distribution

Visualizer 2023 - C:\FEMFAT\_work\cm2023\_Differential\_Gear\_v01.fps (analysed with FEMFAT 2023)  
RESULT: Damage  
SCALE: LOGARITHMIC  
MIN: 1e-30 MAX: 0.000482

FEMFAT



- Pos4: N222513**  
Damage: 2.264e-6 (0.5%)
- Pos2: N248190**  
Damage: 1.973e-5 (4.1%)
- Pos3: N292765**  
Damage: 5.433e-7 (0.1%)



- Pos1: N87893**  
Damage: 4.821e-4 (100%)

➔ Four positions were extracted from stress and damage distribution.

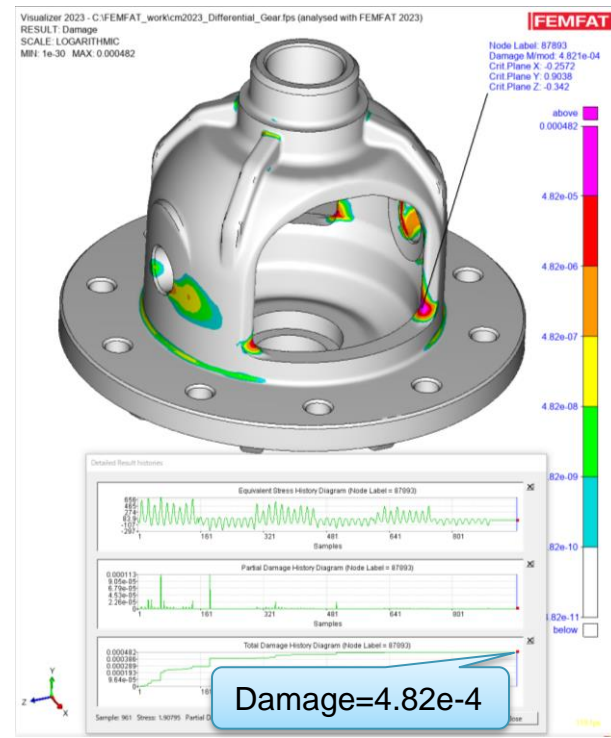
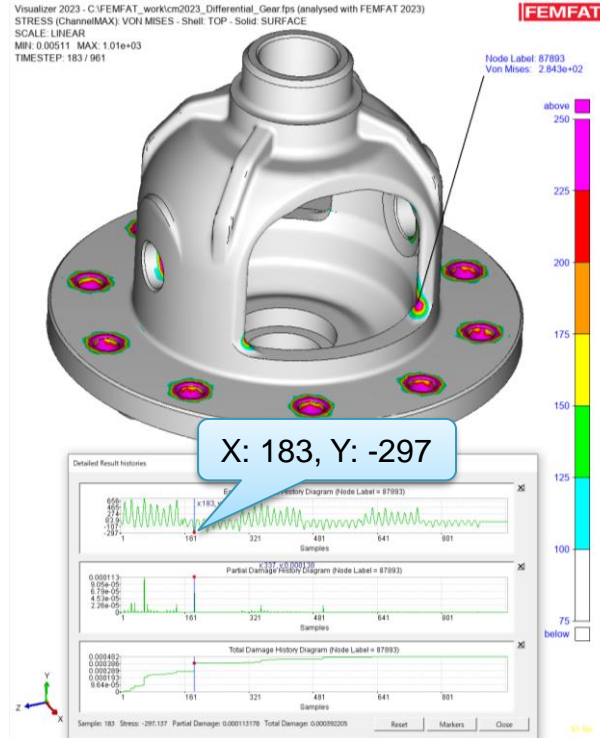
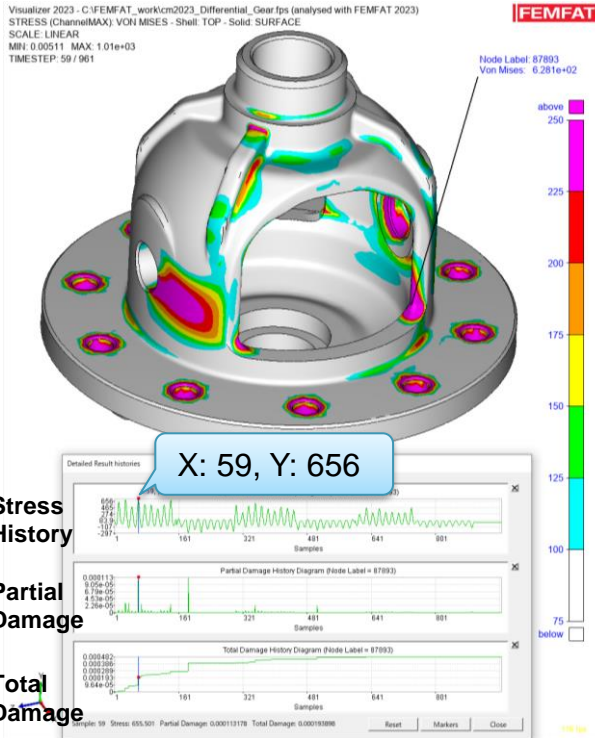
# Pos1: 100% of most critical damage at N87893



**Upper Stress: 656MPa (100%)**  
Equiv. stress @Time point = 59

**Lower Stress: -297MPa (100%)**  
Equiv. stress @Time point = 183

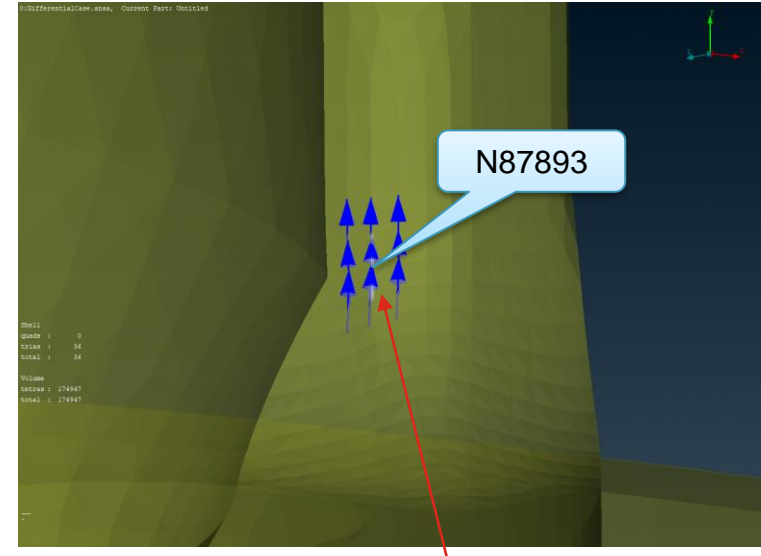
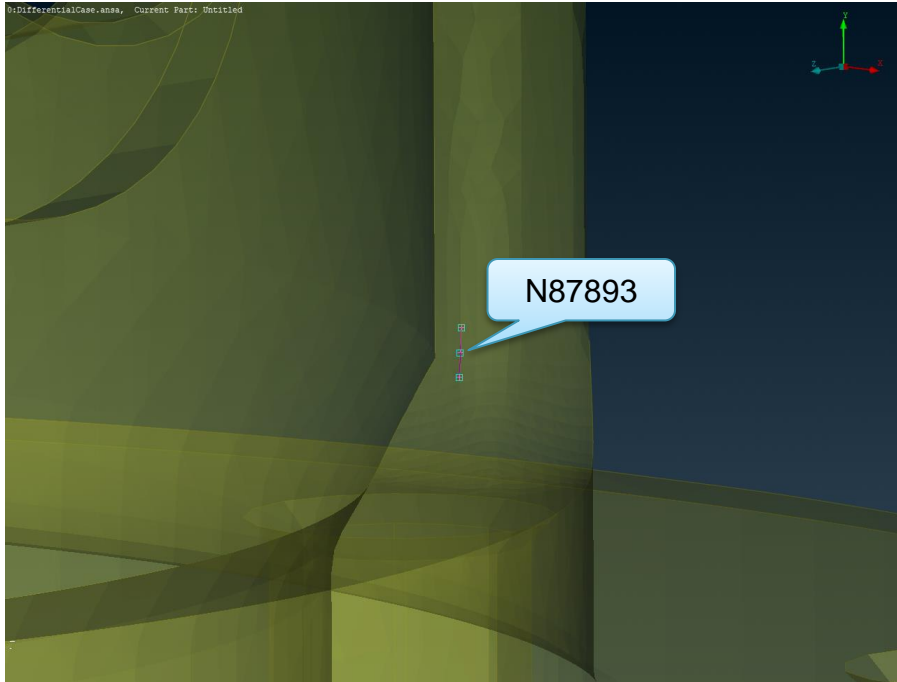
**FEMFAT: 4.281e-04 (100%)**  
Damage & Critical Cutting Plane Vector



# Pos1: Suggested strain gauge orientation by FEMFAT



- N87893 position and Critical Cutting Plane Vector & 9-gauge positions



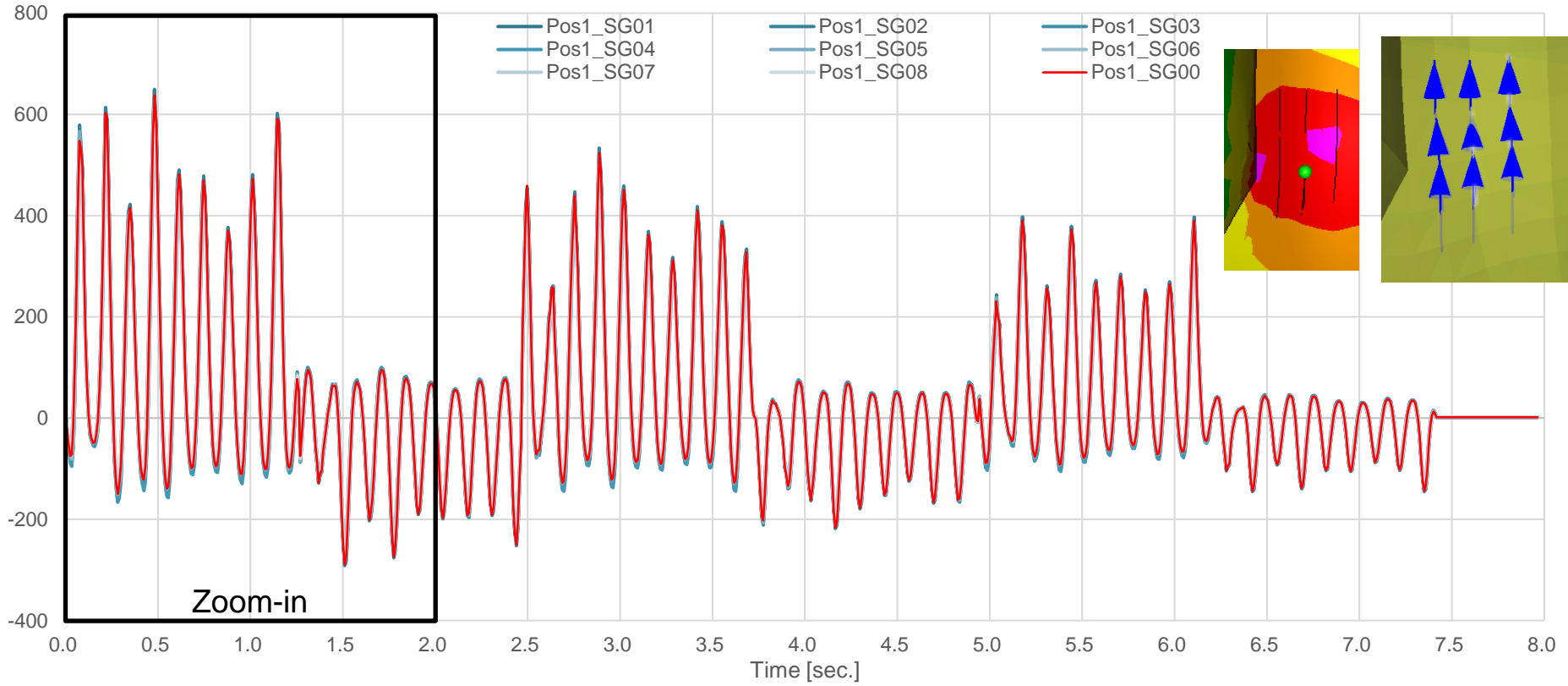
Linear Strain Gage, Length=1.52mm  
*Center arrow = Target position (white highlight)*  
*Surround eight arrows = Check sensitivity*  
*Gauge tolerance = +/-0.6mm*



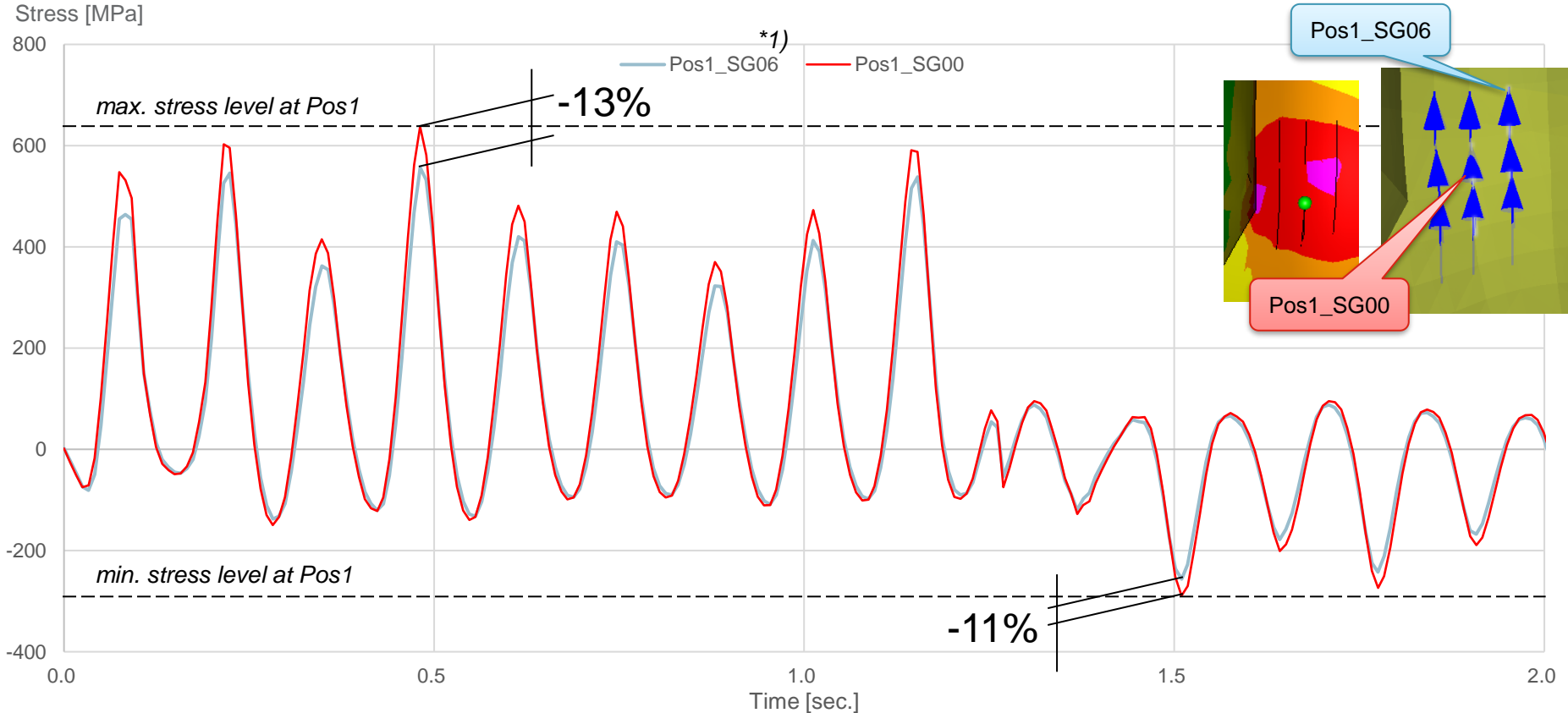
# Pos1: Sensitivity of strain gauge position / overall



Stress [MPa]



# Pos1: Sensitivity of strain gauge position / zoom-in



*\*1) It was compared the negative deviation of strain gauge position from Pos1\_SG00.*

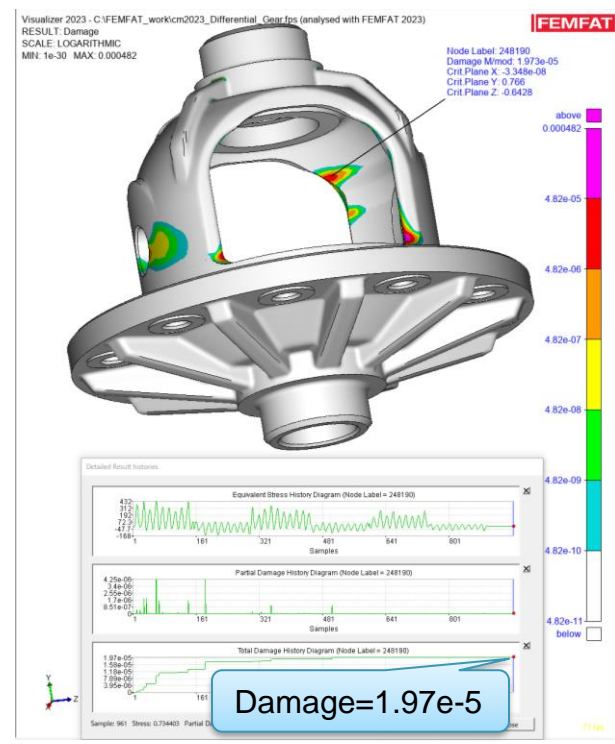
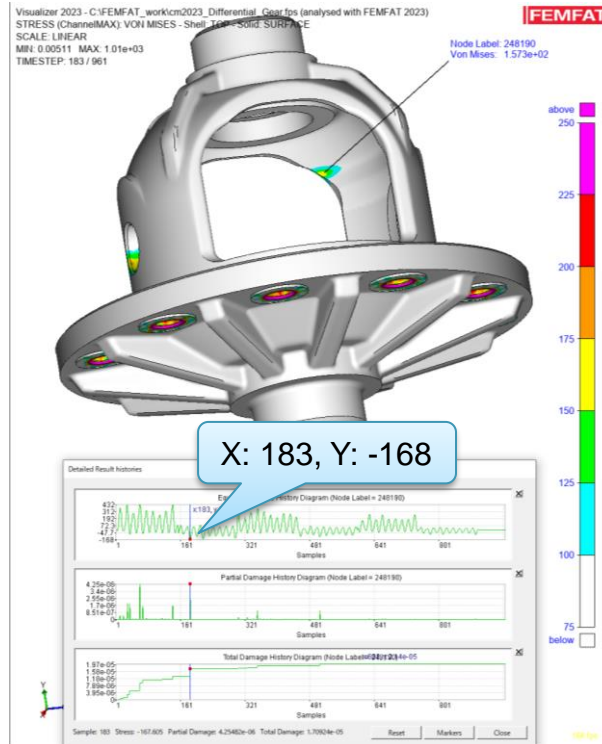
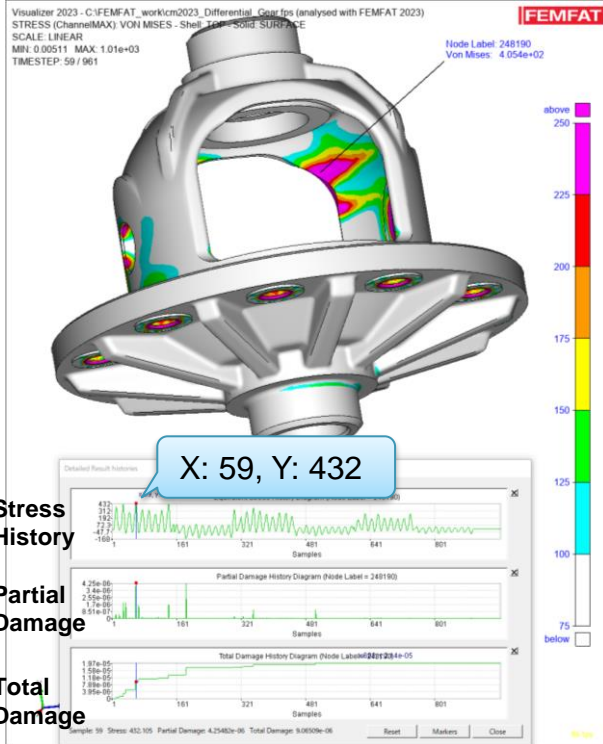
# Pos2: 4.1% of most critical damage at N248190



**Upper Stress: 432MPa (65.9%)**  
Equiv. stress @Time point = 59

**Lower Stress: -168MPa (56.6%)**  
Equiv. stress @Time point = 183

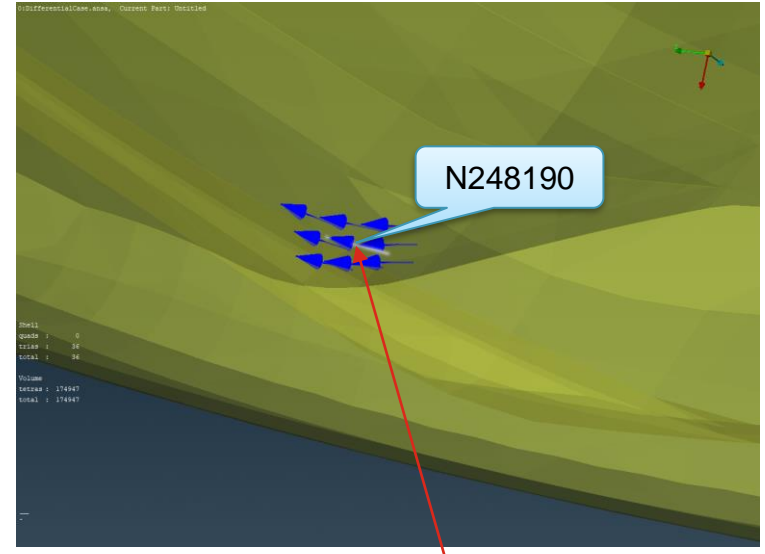
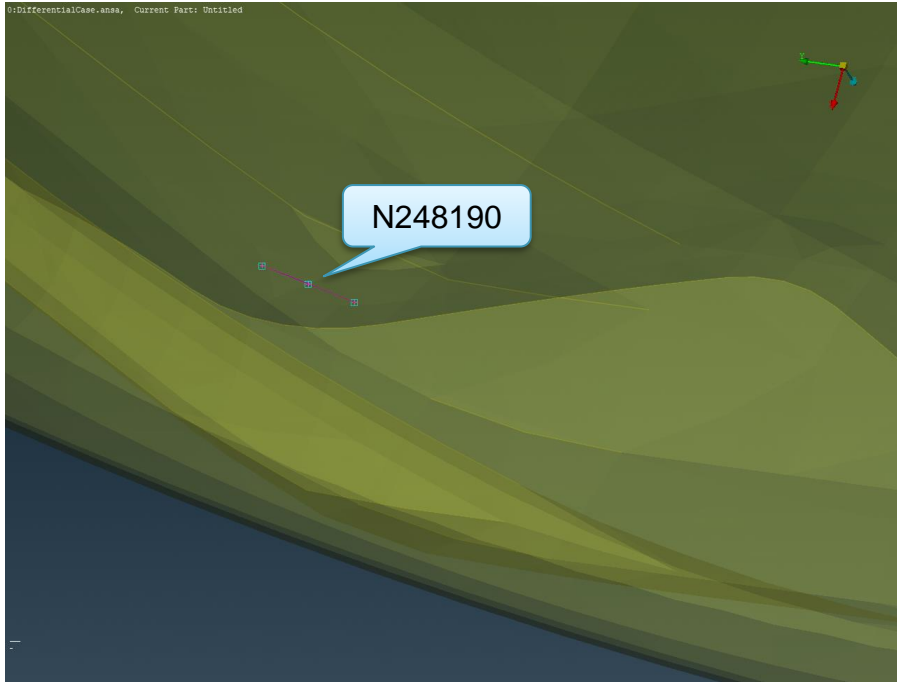
**FEMFAT: 1.973e-05 (4.1%)**  
Damage & Critical Cutting Plane Vector



# Pos2: Suggested strain gauge orientation by FEMFAT

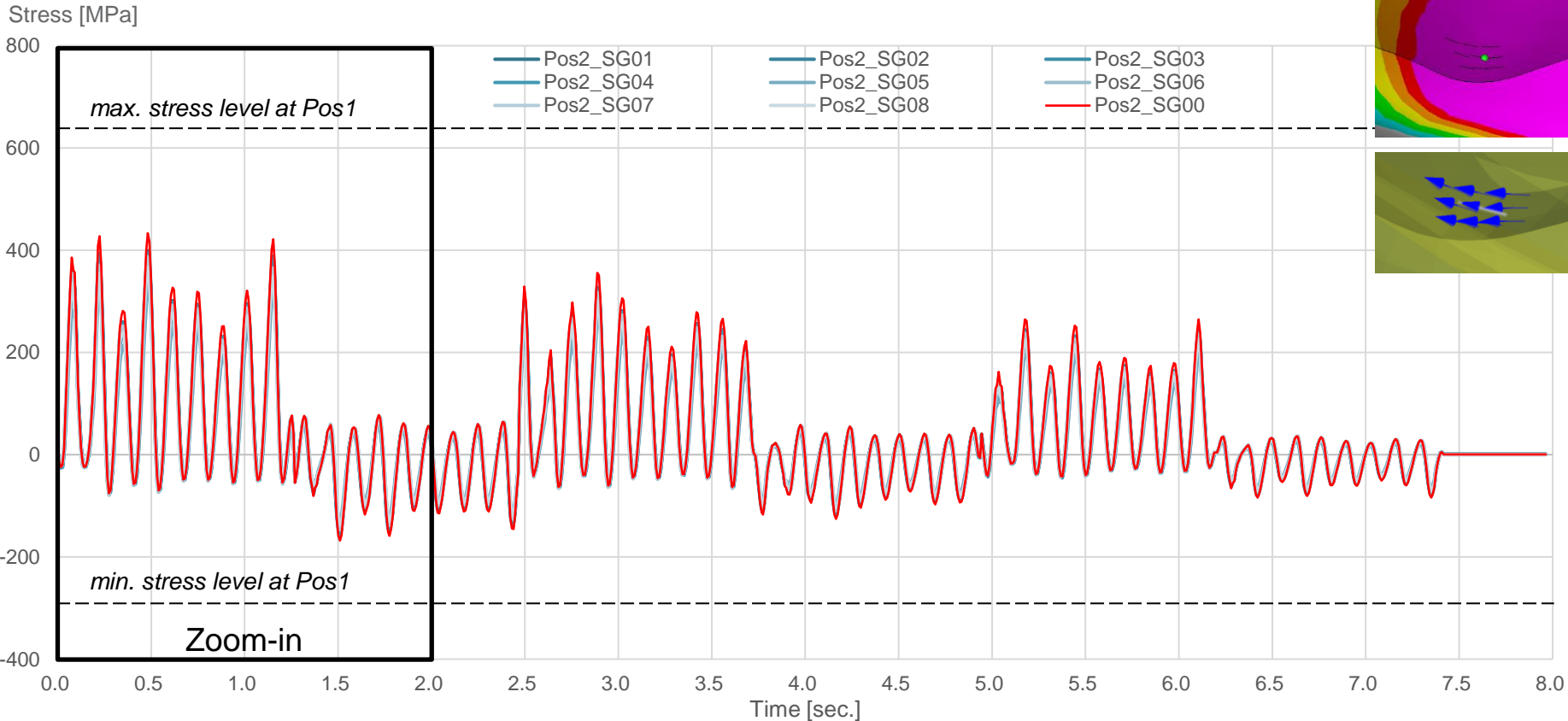


- N248190 position and Critical Cutting Plane Vector & 9-gauge positions

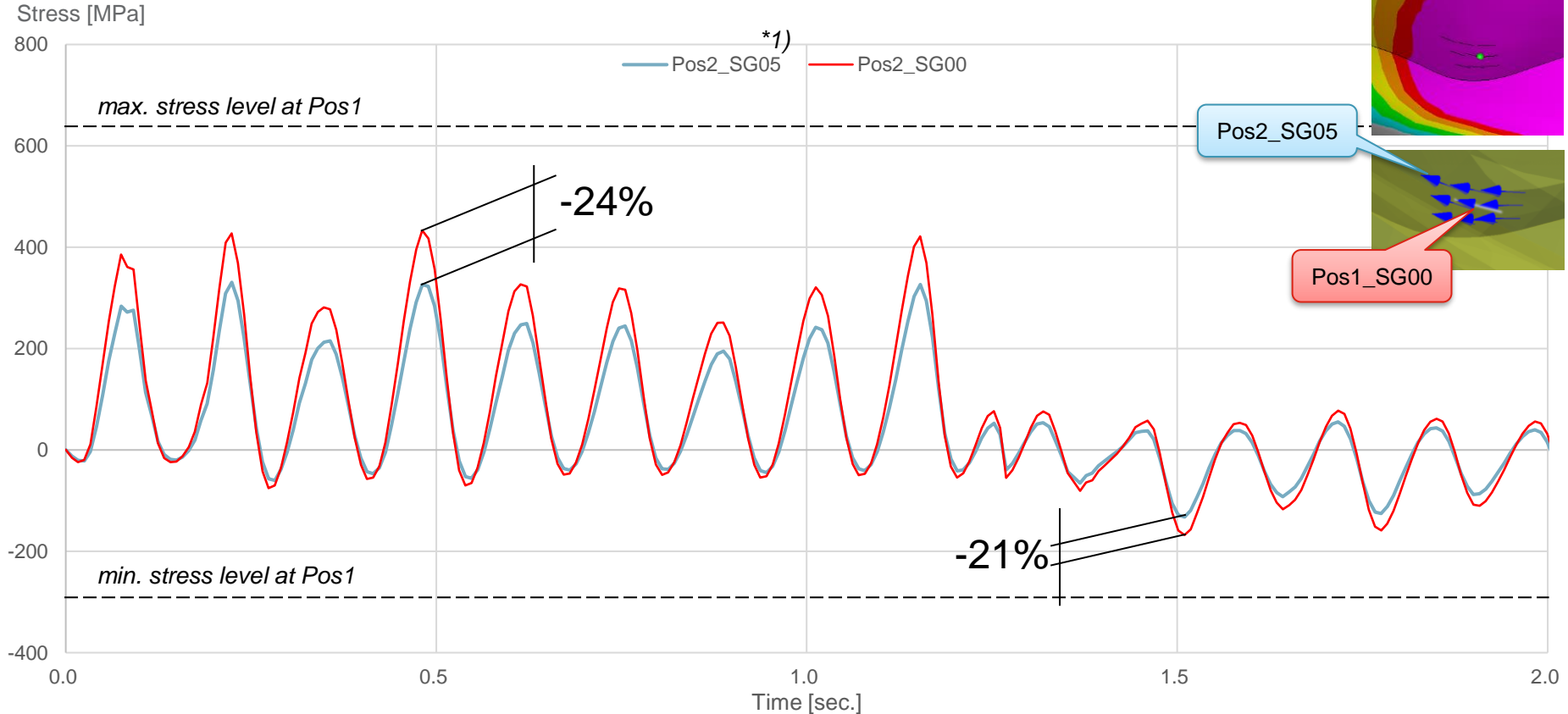


Linear Strain Gage, Length=1.52mm  
*Center arrow = Target position (white highlight)*  
*Surround eight arrows = Check sensitivity*  
*Gauge tolerance = +/-0.8mm*

# Pos2: Sensitivity of strain gauge position / overall



# Pos2: Sensitivity of strain gauge position / zoom-in



\*1) It was compared the negative deviation of strain gauge position from Pos2\_SG00.

# Pos3: 0.1% of most critical damage at N292765



**Upper Stress: 291MPa (44.3%)**

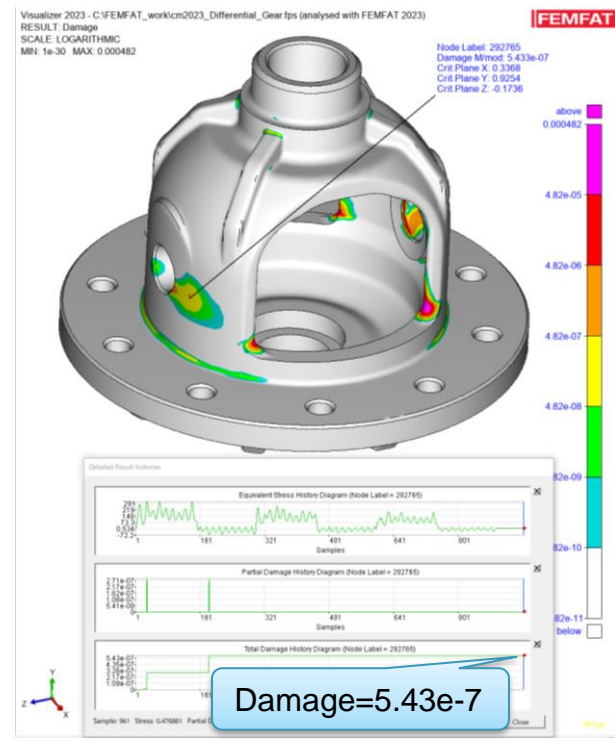
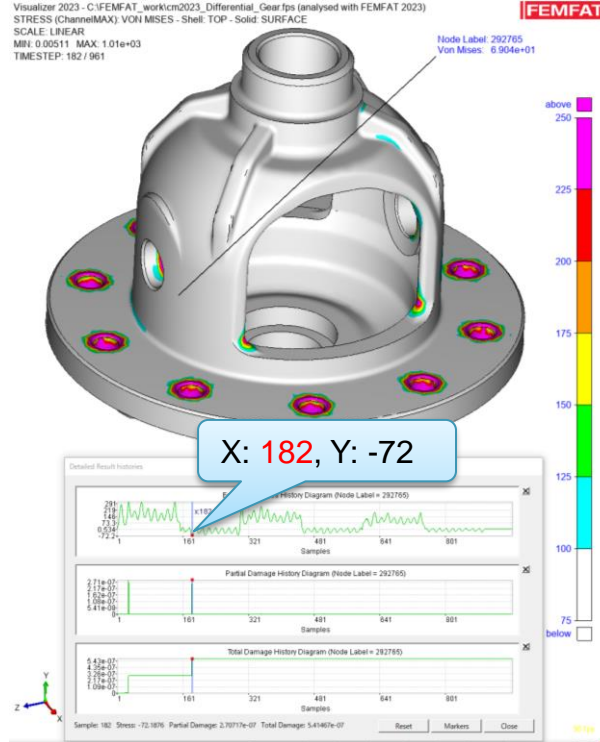
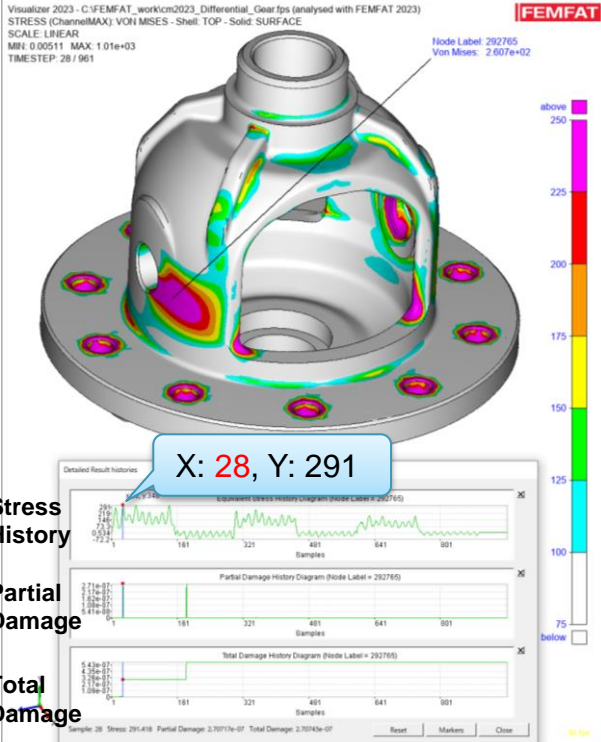
Max. VM stress @Time point = 28

**Lower Stress: -72MPa (24.2%)**

Min. VM stress @Time point = 182

**FEMFAT: 5.433e-07 (0.1%)**

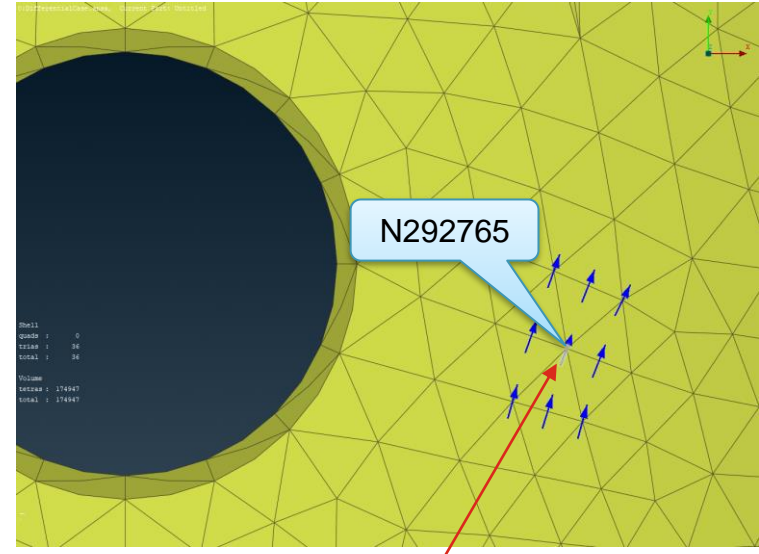
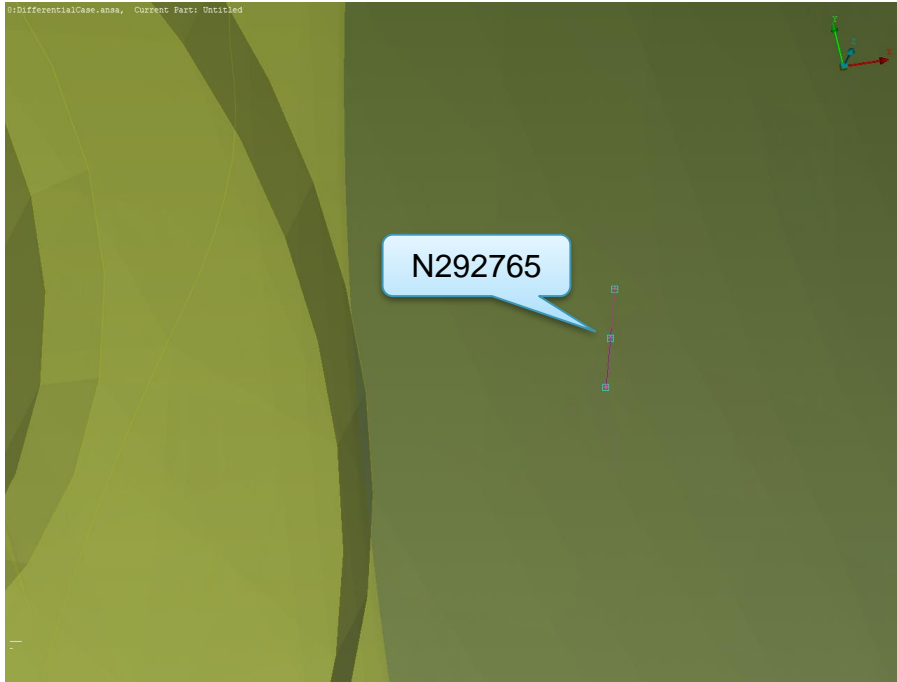
Damage & Critical Cutting Plane Vector



# Pos3: Suggested strain gauge orientation by FEMFAT



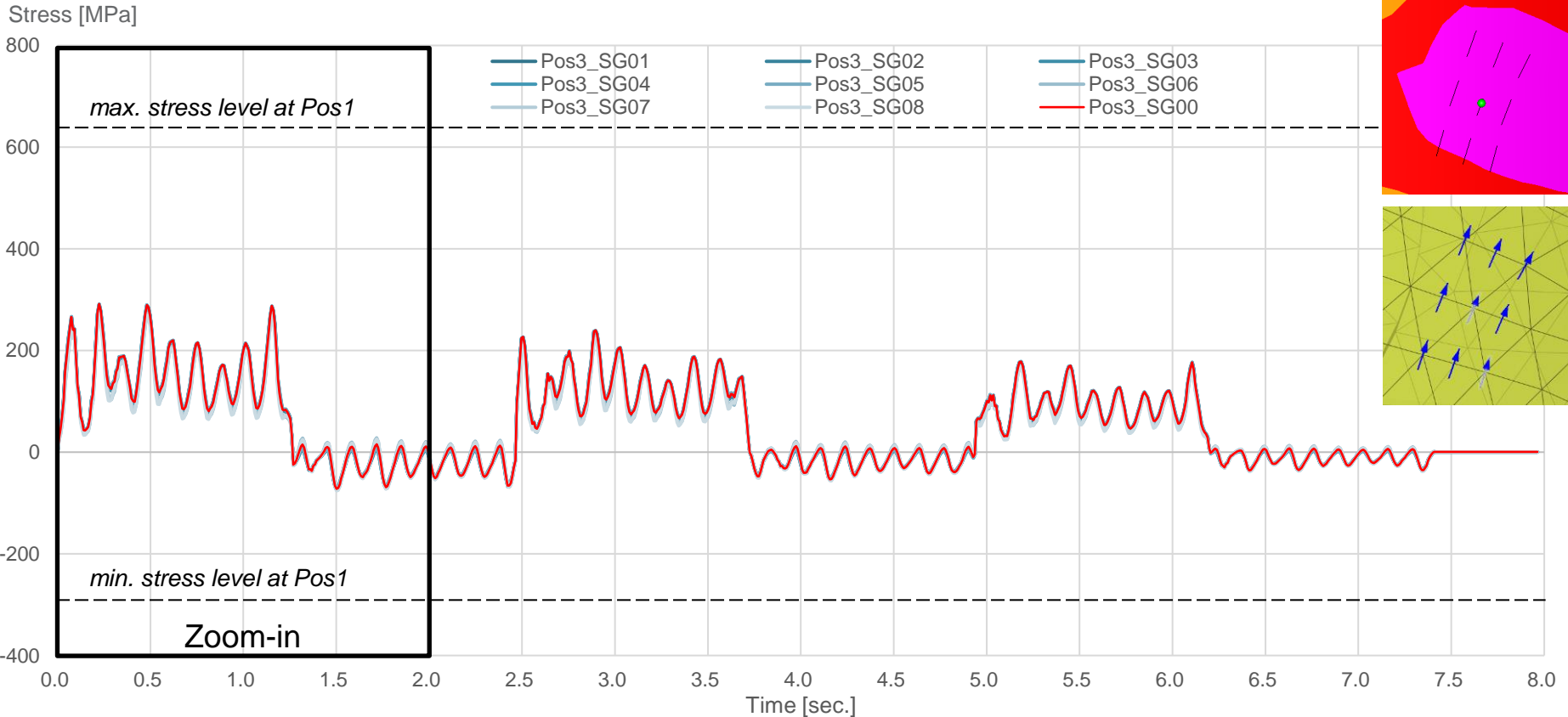
- N292765 position and Critical Cutting Plane Vector & 9-gauge positions



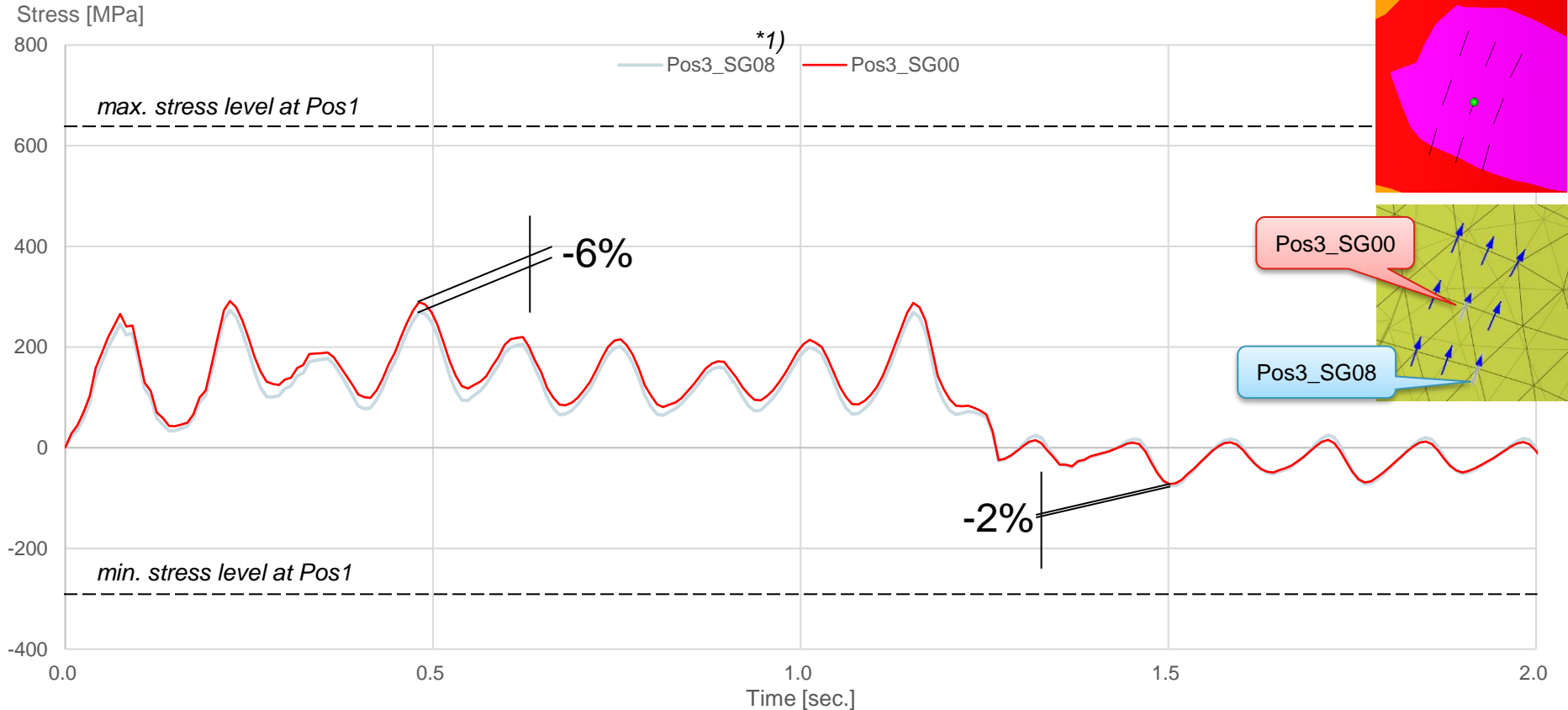
Linear Strain Gage, Length=1.52mm  
*Center arrow = Target position (white highlight)*  
*Surround eight arrows = Check sensitivity*  
*Gauge tolerance = +/-3.0mm*



# Pos3: Sensitivity of strain gauge position / overall



# Pos3: Sensitivity of strain gauge position / zoom-in



\*1) It was compared the negative deviation of strain gauge position from Pos3\_SG00.

# Pos4: 0.5% of most critical damage at N222513



**Upper Stress: 373MPa (56.9%)**

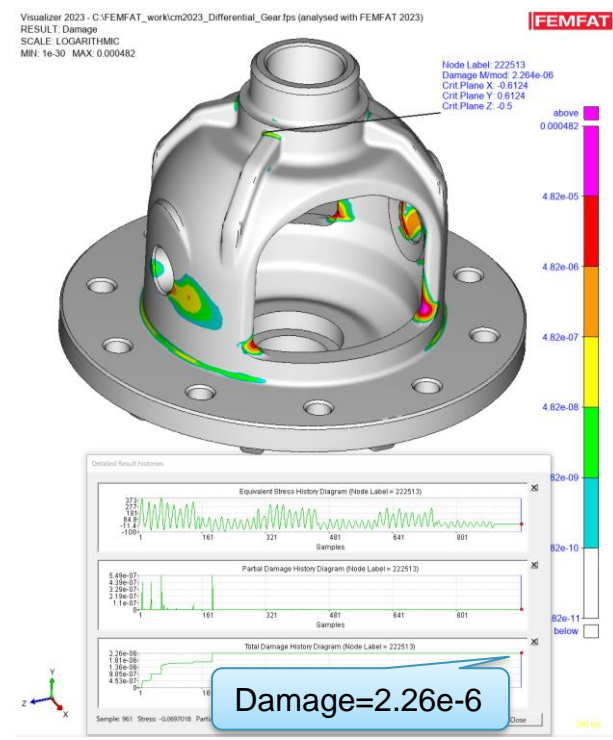
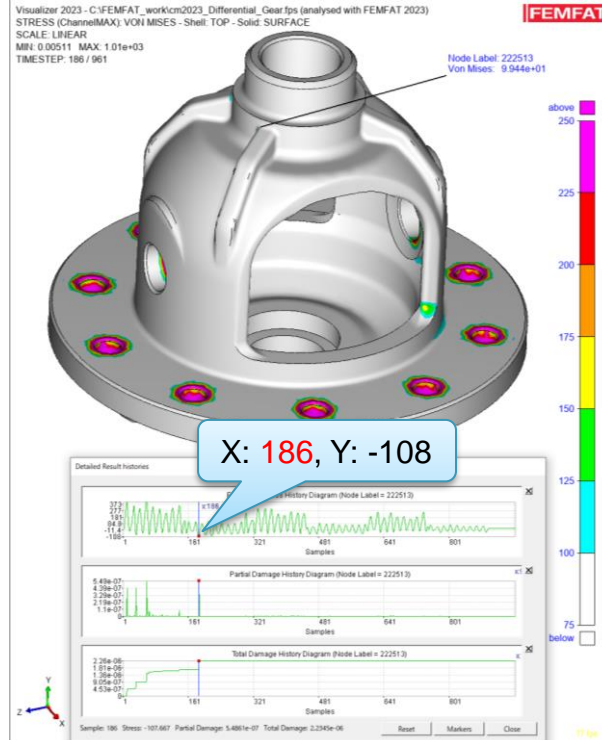
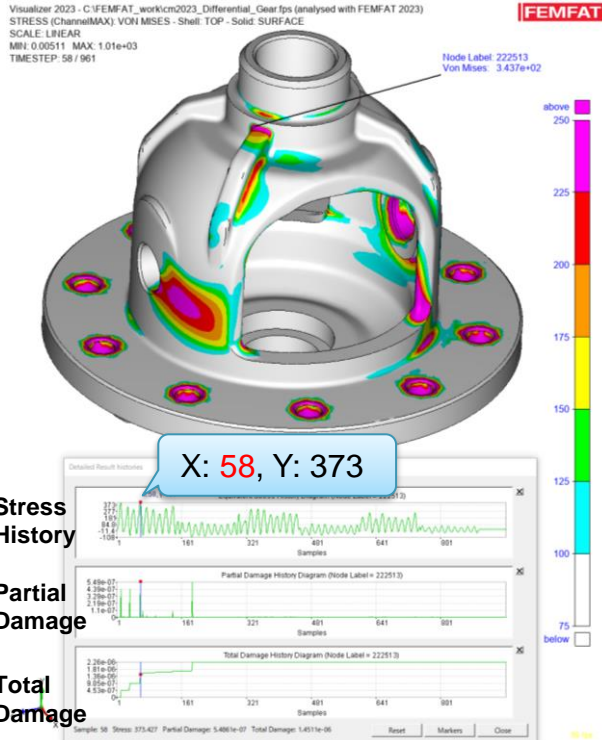
Max. VM stress @Time point = 58

**Lower Stress: -108MPa (36.4%)**

Min. VM stress @Time point = 186

**FEMFAT: 2.264e-06 (0.5%)**

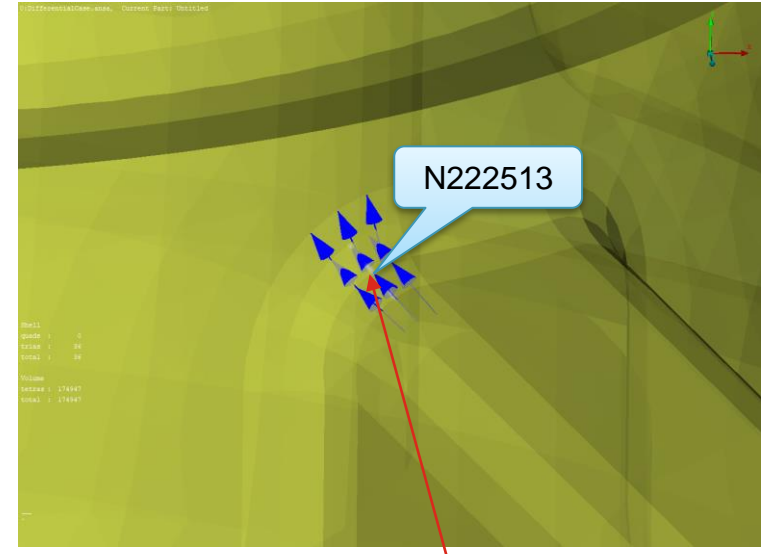
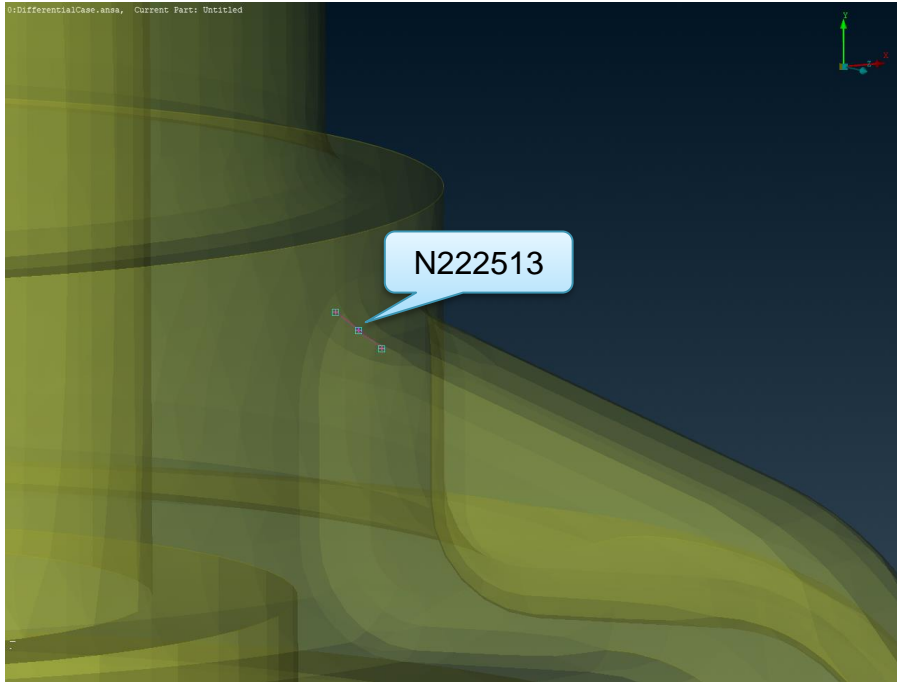
Damage & Critical Cutting Plane Vector



# Pos4: Suggested strain gauge orientation by FEMFAT

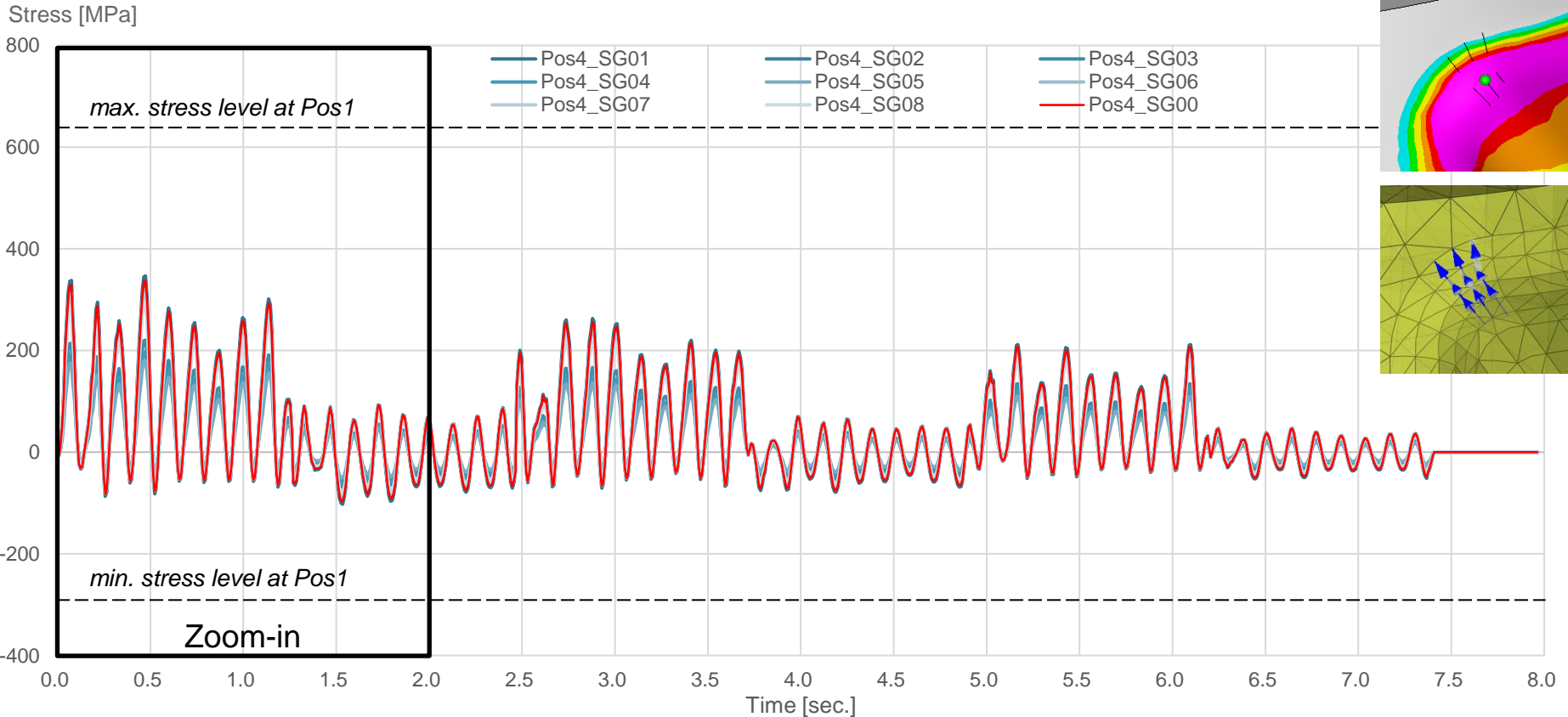


- N22513 position and Critical Cutting Plane Vector & 9-gauge positions

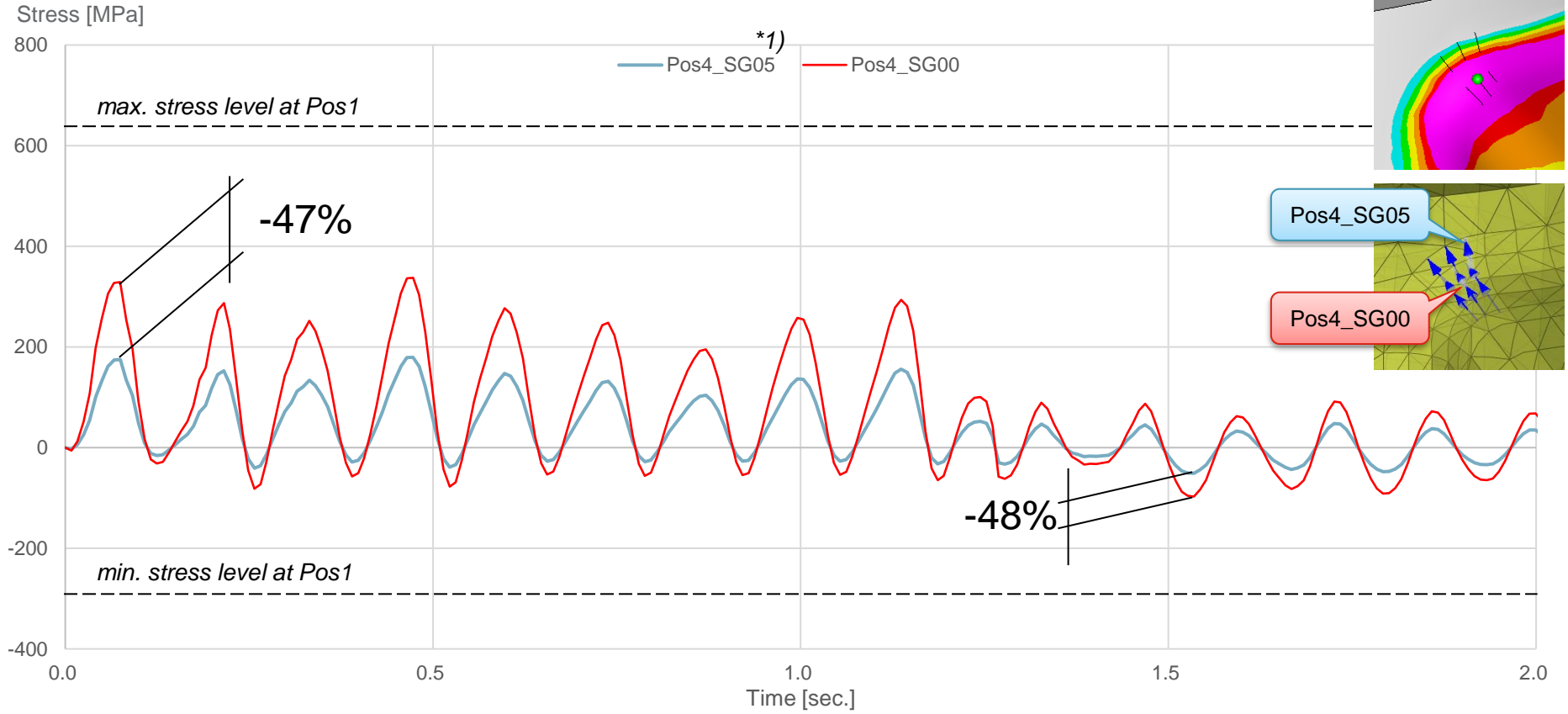


Linear Strain Gage, Length=1.52mm  
*Center arrow = Target position (white highlight)*  
*Surround eight arrows = Check sensitivity*  
*Gauge tolerance = +/-0.5mm*

# Pos4: Sensitivity of strain gauge position / overall



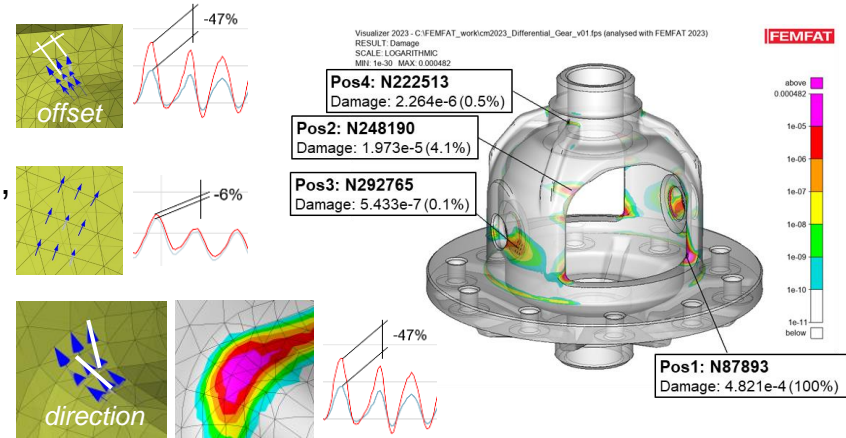
# Pos4: Sensitivity of strain gauge position / zoom-in



*\*1) It was compared the negative deviation of strain gauge position from Pos4\_SG00.*

# Summary

- When it is small radii with stress concentration area, the measured stress deviation can be high. (Pos4, ~50%)
- When it is flat area with homogeneous stress distribution, the measured stress deviation can be low. (Pos3, ~5%)
- It is not only the offset of the position (~0.5mm), but also the orientation of the direction, it is possible to have massive deviation in the stress history. (Pos4)



Position	Damage	Measured Stress (Target position)	Deviation (tolerance)	Remark
Pos1	4.821e-4 (100%)	637 / -289 MPa	-13% / -11% (+/-0.6mm)	Convex shape with small radii Equivalent fillet $R \cong 5.1$
Pos2	1.973e-5 (4.1%)	433 / -168 MPa	-24% / -21% (+/-0.8mm)	Concave shape with small radii Equivalent fillet $R \cong 5.2$
Pos3	5.433e-7 (0.1%)	292 / -72 MPa	-6% / -2% (+/-3.0mm)	Flatter shape with large radii Equivalent fillet $R \cong 15.0$
Pos4	2.264e-6 (0.5%)	338 / -97 MPa	-47% / -48% (+/-0.5mm)	Concave shape with small radii Equivalent fillet $R \cong 3.0$

## ANSA Plugin of Virtual Strain Gauge Utilities for FEMFAT

- Overview of Multidisciplinary Fatigue Analysis by FEMFAT
- Development of the plugin - How it started?
- Overview of the functionalities of the plugin
- Use case
- **Conclusions**



- ANSA-plugin and FEMFAT strain are possible to examine where is the best position (less sensitivity, meaningful position) to be attached the strain gauge before physical tests.
- It is easy to locate virtual strain gauge by ANSA, and it is easy to prepare the necessary input data for FEMFAT strain.
- The definition of virtual strain gauge is possible to be used for META, too.

NOTICE: This plugin requires a license feature, different from ANSA/META(pre-post package).

Please contact us for details via:

- Our web site : <https://beta-cae.jp/index.html>
- Technical support : [support@beta-cae.jp](mailto:support@beta-cae.jp)