



3DEXPERIENCE®

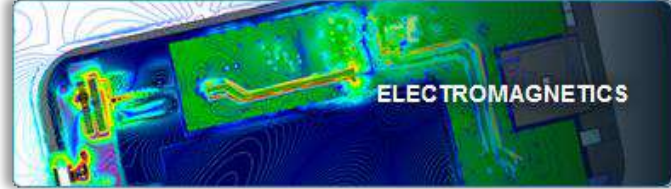
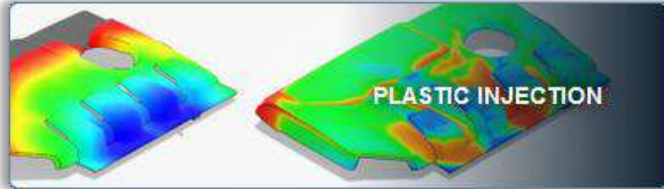
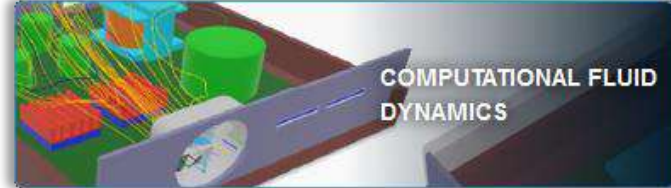
Structural Simulation with the 3DEXPERIENCE Platform

Dassault Systèmes

 **DASSAULT
SYSTEMES** | The 3DEXPERIENCE® Company



3DEXPERIENCE Simulation Domains



SIMULATION PORTFOLIO | STRUCTURES

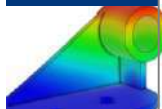
Structural Designer
(SRD)

Structural Engineer
(SLL)

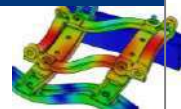
Structural Performance Engineer (SFO)
Durability Performance Engineer (FGP)*

Structural Mechanics Engineer (SSU)
Durability & Mechanics Engineer (FGM)*

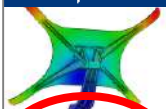
Linear
Static



Frequency



Harmonic
Response



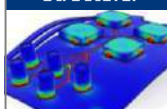
Modal
Dynamic



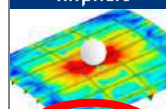
Nonlinear
Static



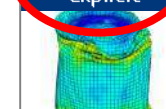
Thermal-
Structural



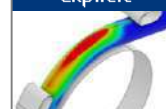
NL Dynamic
Implicit



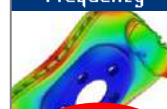
NL Dynamic
Explicit



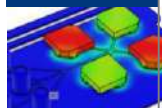
Quasi-Static
Explicit



Complex
Frequency



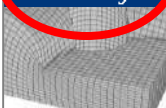
Thermal



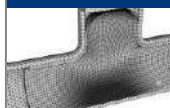
Buckling



Advanced
Meshing



Advanced
Elements



Material
Failure



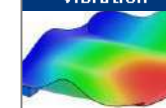
Advanced
Connectors



Advanced
Contact



Random
Vibration



Geometry
Preparation



Material
Calibration



Cloud
Computing



Assistant

- Setup
- Materials
- Connections
- Restraints

Multi-Step



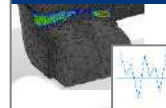
General
Contact



Advanced
Materials



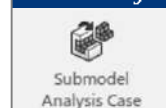
*Fatigue



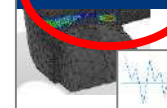
Restart



Sub-
Modelling

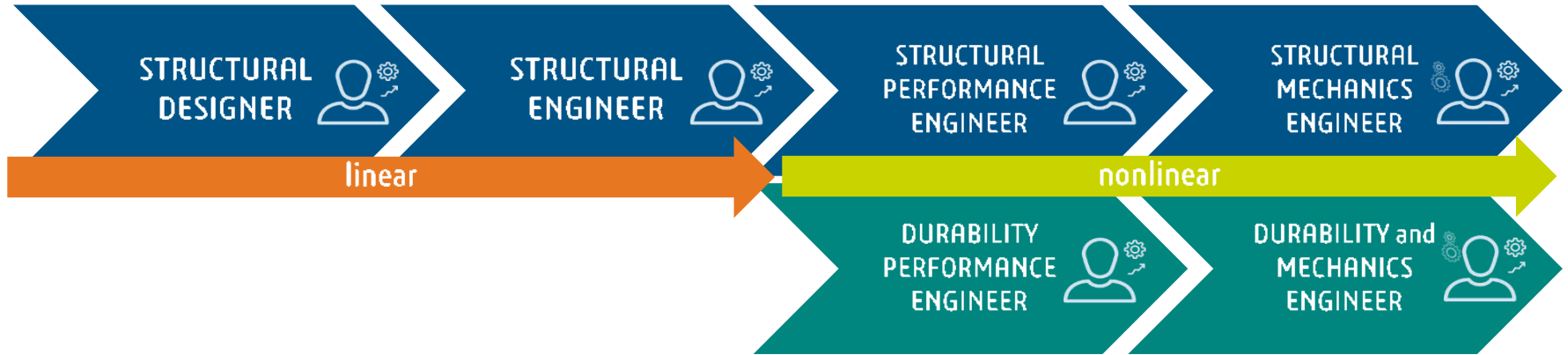


*Fatigue



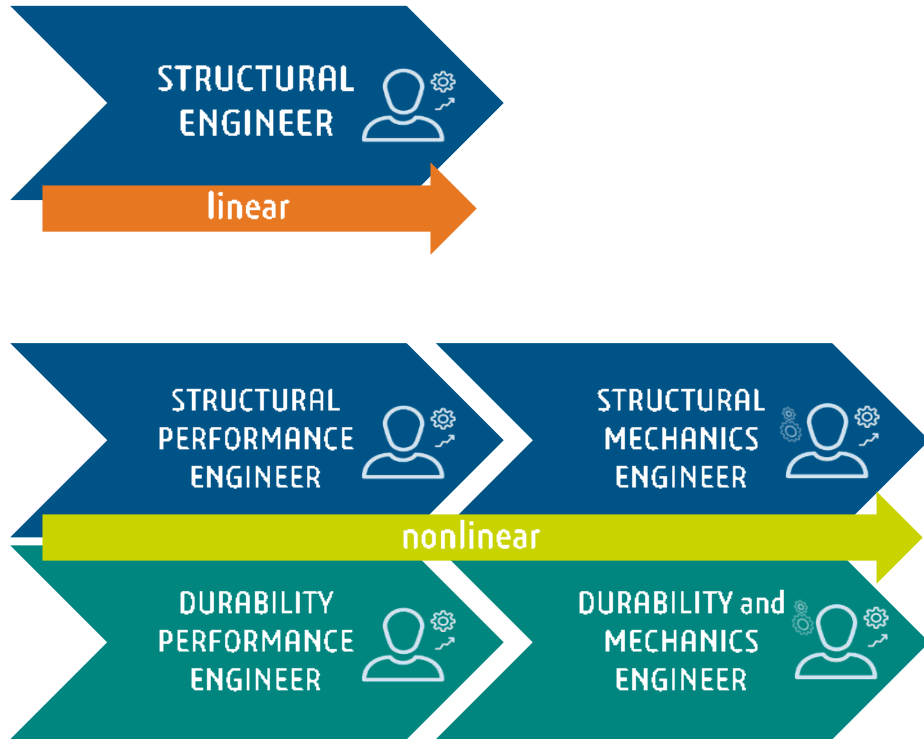
3DEXPERIENCE Structural Simulation

Simulate with increasing capability – from linear to non-linear – from static to dynamic



One App for everything

Model + Scenario + Result



Model
Scenario
Result

Workflow und Apps

Role

Model

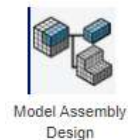
Scenario

Result

- Structural Engineer



- Structural Performance Eng.
- Durability Performance Eng.

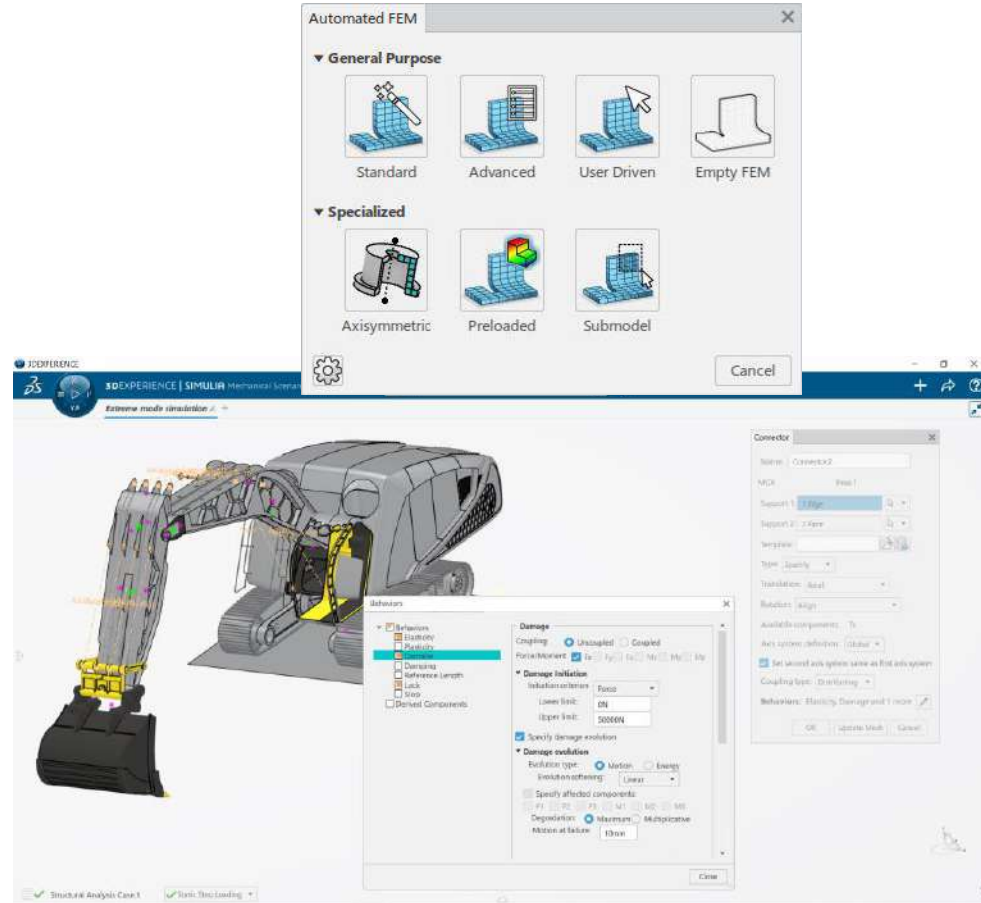


- Structural Mechanics Eng.
- Durability And Mechanics Eng.



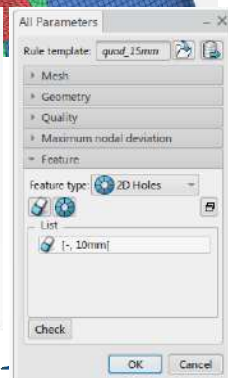
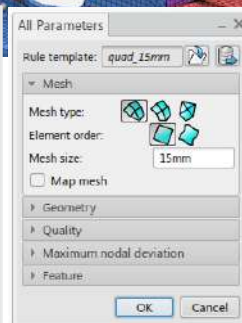
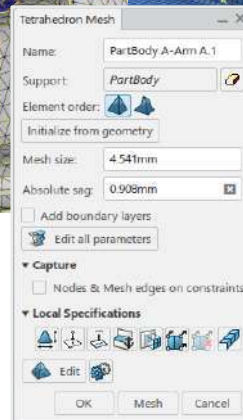
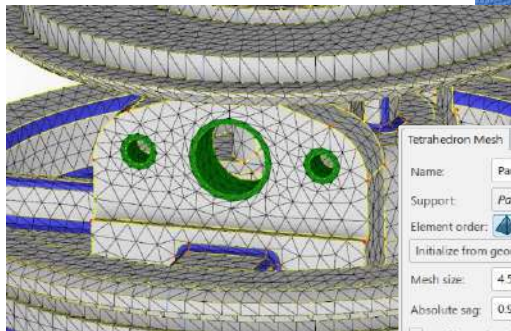
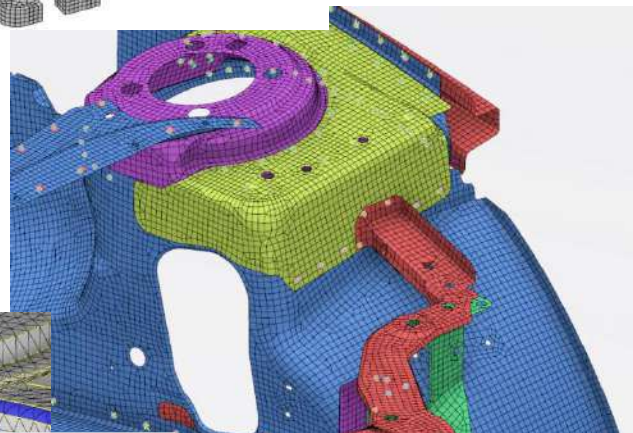
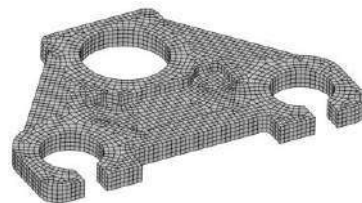
Structural Model Creation (1/2)

- **Create complete FE-Model**
- Apply material (if not yet done)
- Define section (solid, shell, beam, membrane, truss, gasket, etc.)
- Virtual or real bolt pretension section
- Define connection (tie, coupling, spring, damper, connector, fastener, rigid connection, etc.)
- Mark parts as rigid bodies
- Artificial mass and inertia
- Cyclic symmetry
- Fluid Cavity
- Model plots to check definitions



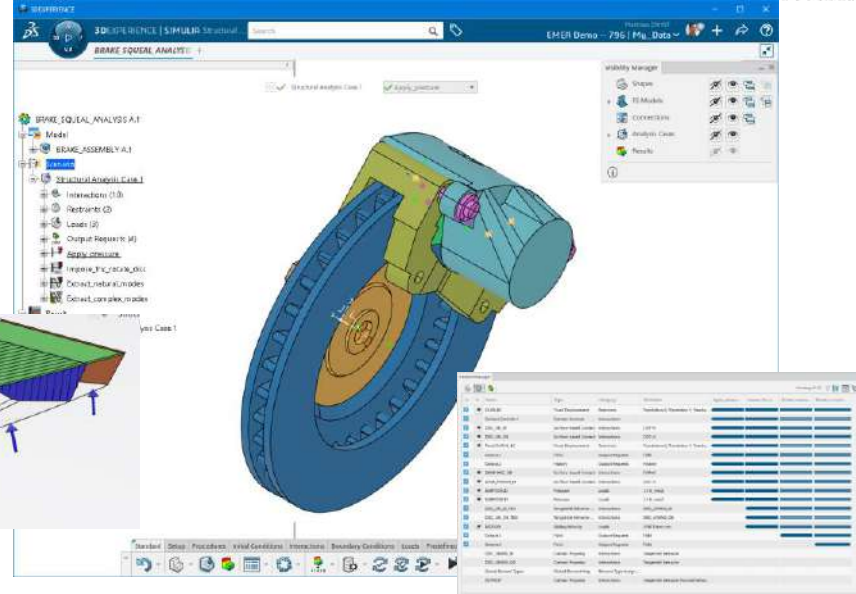
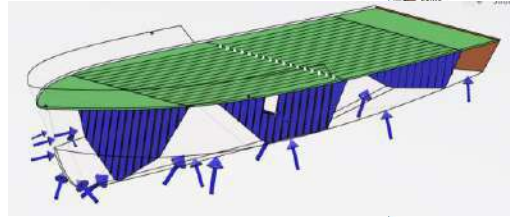
Structural Model Creation (2/2)

- **Meshing**
- Assembly or part level meshing (MoA, AoM, or both)
- Rule based meshing
- Multiple meshing techniques for solid, face and line structures with many options
- Techniques for solids:
 - Octree tet meshing
 - Tetrahedron mesher
 - Sweep hex meshing
 - Partition-based Hex-mesher
 - Hex-dominated meshing
 - Voxel meshing
- Mesh checks and statistics
- Creation of groups (nodes, elements, element faces)



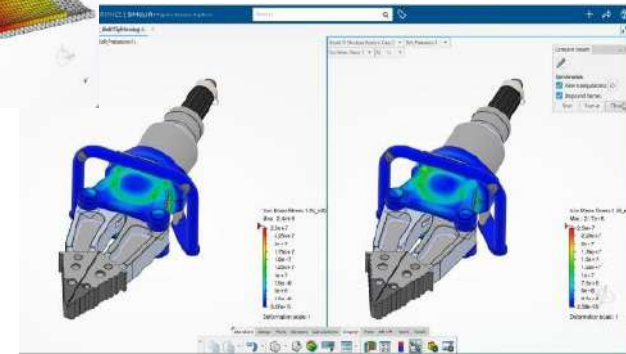
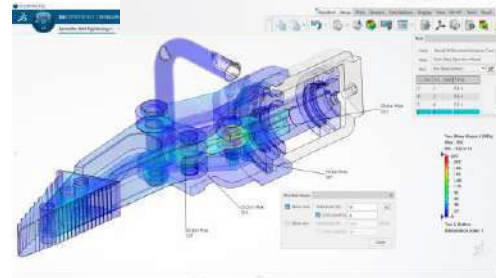
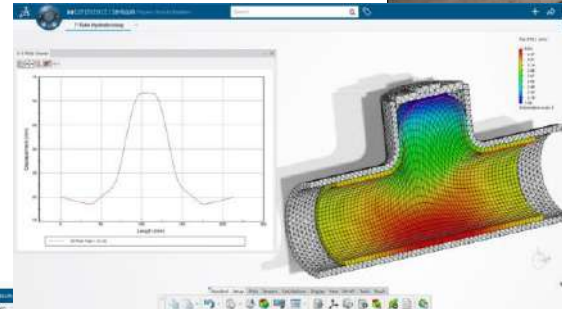
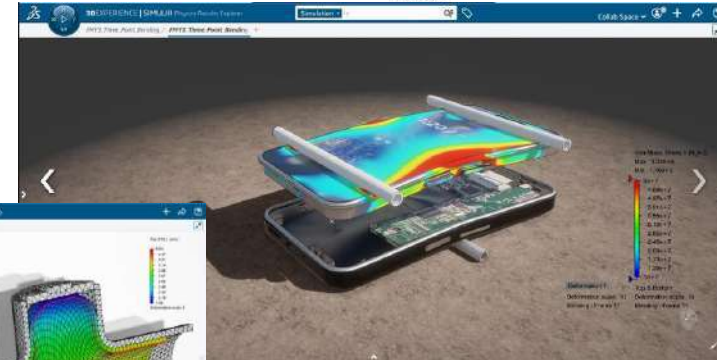
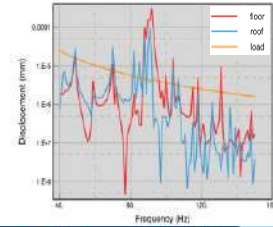
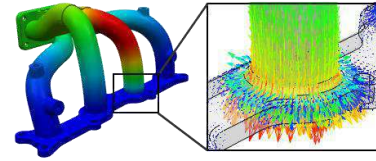
Mechanical Scenario Creation

- Selection of FE-Model
- Creation of simulation history with it's definitions
 - Linear and nonlinear step sequence
 - Loadcases and LCP contact in linear steps
 - Loads
 - Restraints
 - Contacts
 - Thermal conditions
 - Etc.
- Working with multiple Analysis Cases
- Definition of Durability Case
- Submission and monitoring of analysis

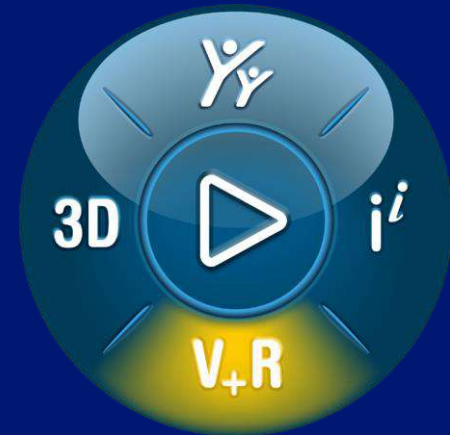


Physics Results Explorer

- High performance visualization for simulation results
- Built to handle large data sets
- State-of-the-art rendering capabilities
- Various 3D plot types
 - Contours, iso-surfaces, symbol plot, streamlines, path plot, etc.
- XY plotting with multiple options
- Animations
- Free-body cut
- Result Sensors
- Multiple viewports
- Compare results
- Report Generator



NONLINEAR ANALYSIS: FROM SOLIDWORKS TO 3DEXPERIENCE PLATFORM



Compressing a spring

Simple, but lots of nonlinearity

GEOMETRIC Nonlinearity

Large Displacement

CONTACT Nonlinearity

Contact changes as coils self-contact

MATERIAL Nonlinearity

Post-yield plastic deformation



3DEXperience workflow

Connected to SOLIDWORKS



INITIAL DESIGN

- Import design from SOLIDWORKS
- Connected to 3DEXPERIENCE Platform



SETUP ANALYSIS

- Material
- General Contact
- Loading (Displacement)
- Outputs



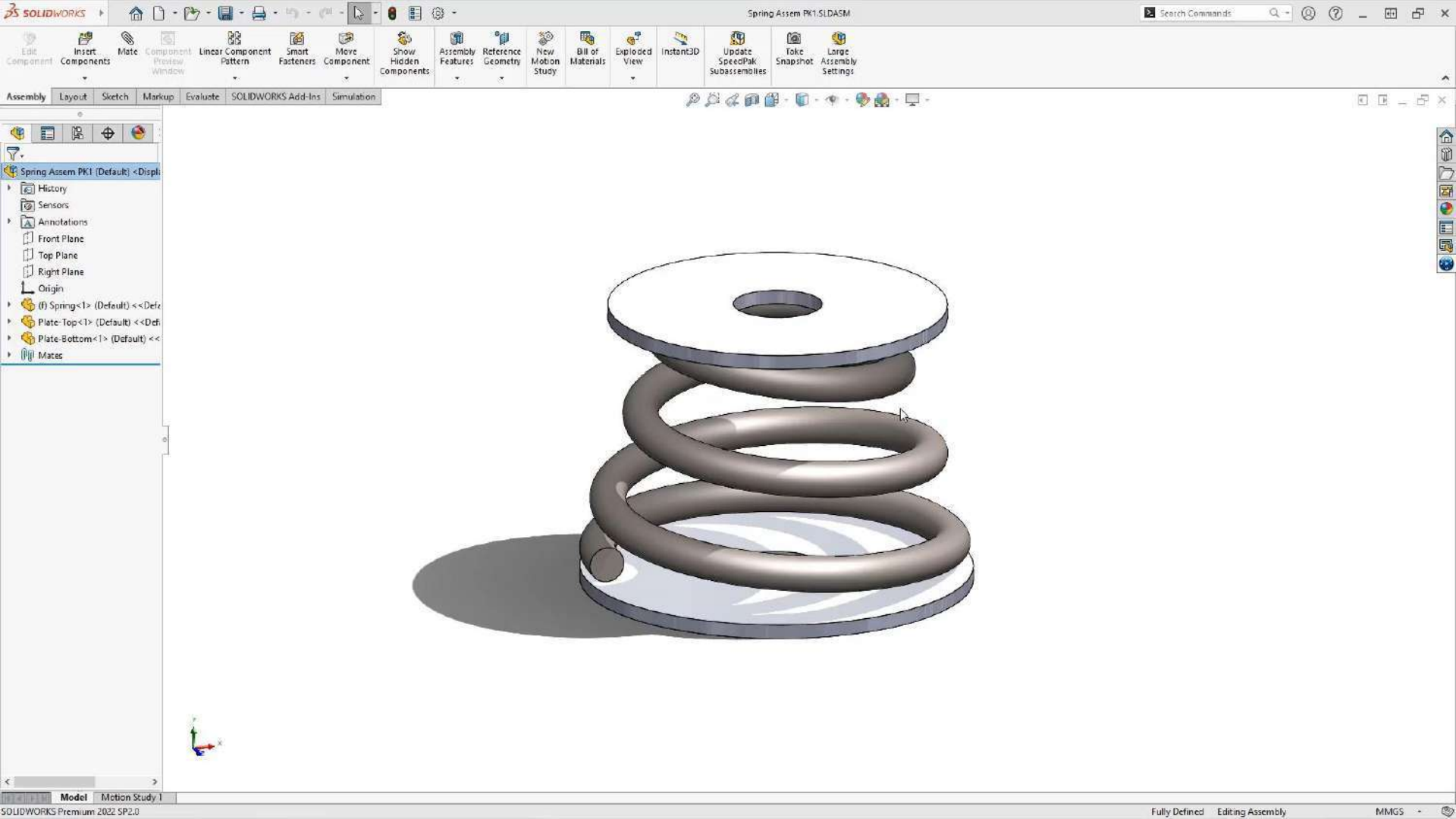
ANALYSIS RESULTS

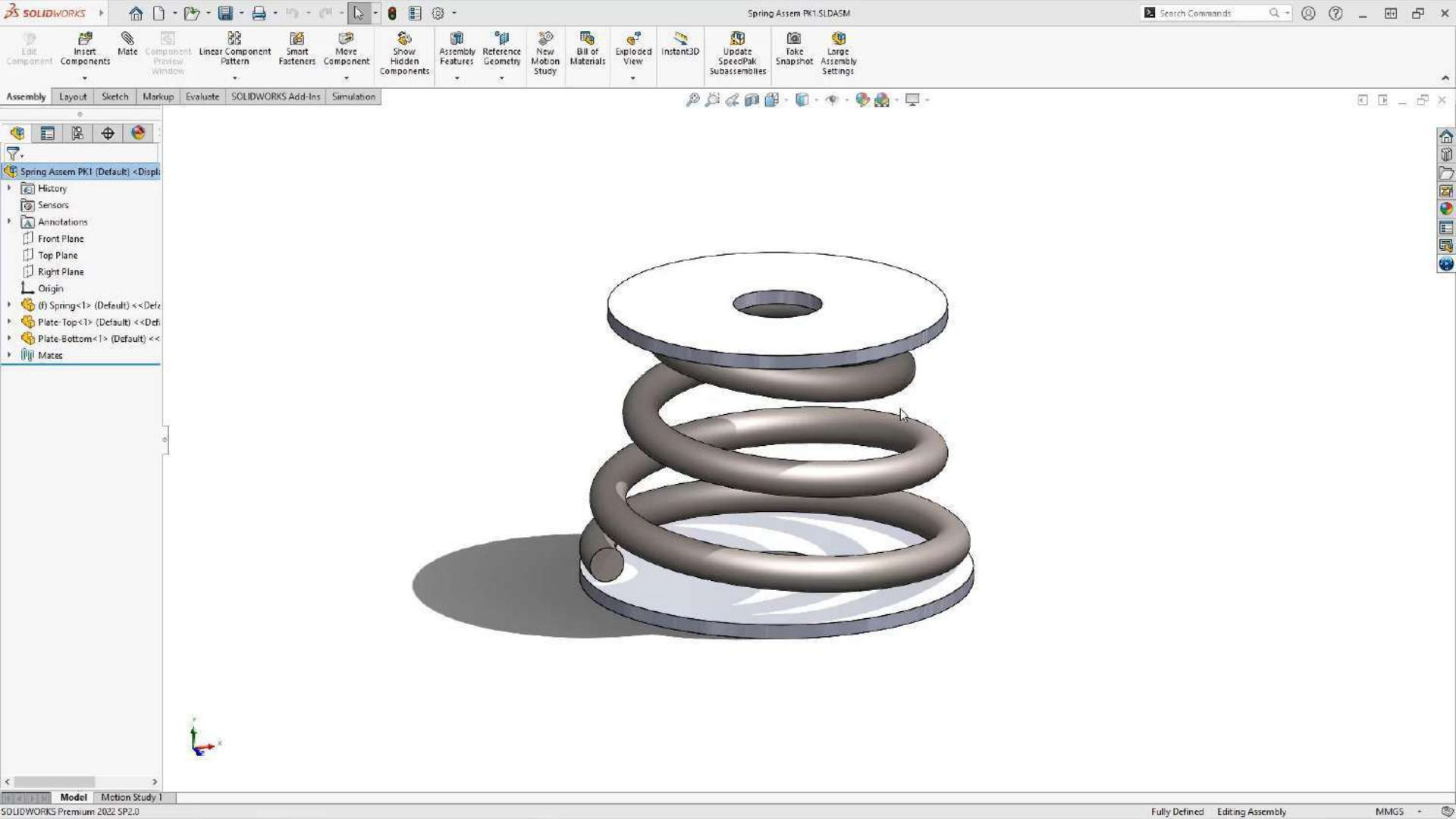
- Stresses
- Displacements
- Identify Yielding Areas
- Force vs. Displacement Curve



DESIGN CHANGE

- Design Change in SOLIDWORKS
- Connected Update on 3DEXPERIENCE Platform
- Easily Update Analysis





PK_Webinar_Spring A

- Model
 - Spring Assem PK1 A
 - PK_Webinar_Spring_FEM A
 - Nodes and Elements
 - Properties
 - Plate-Top A (Plate-Top<1> (Default))
 - Spring A (Spring<1> (Default))
 - Plate-Bottom A (Plate-Bottom<1> (Default))
 - Materials
 - Engineering Connections
- Scenario
 - PK_Webinar_Spring
 - Result

Simulation Status

✓ PK_Webinar_Spring completed

Messages Licensing Messages Plots Iterations Diagnostic files

- Errors (0)
- Warnings (72)
- Information (0)

Close Stop

Plots

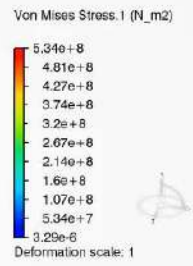
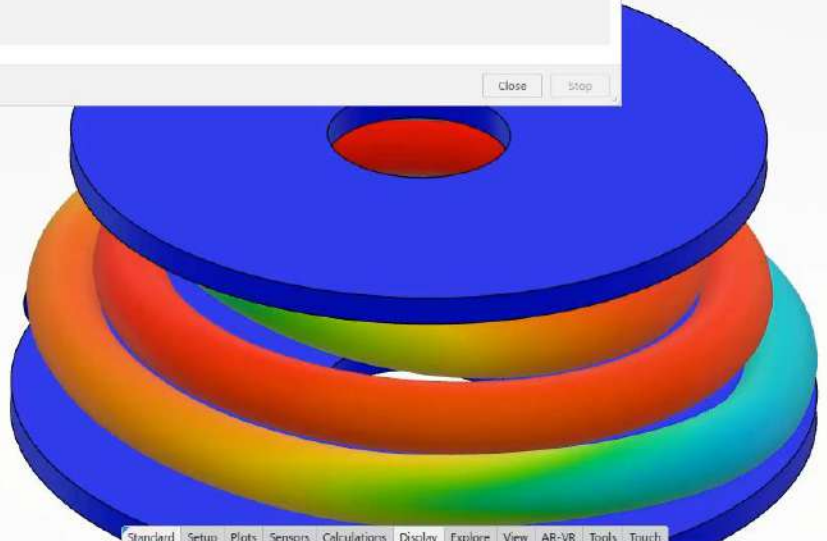
Local save successful.

Case: Result of PK_Webinar_Spring

Step: Compress -75mm

Plot: Von Mises Stress.1

Frame	Increment	Time
9	30	0.33 s
10	32	0.395 s
11	33	0.454 s
12	34	0.512 s
13	35	0.642 s
14	38	0.69 s
15	45	0.732 s
16	47	0.789 s
17	48	0.839 s
18	49	0.856 s
19	50	0.887 s
20	58	0.925 s
21	60	0.968 s
22	61	1 s



Standard Setup Plots Sensors Calculations Display Explore View AR-VR Tools Touch

Copy Paste Undo Model Scenario Results Play Animation Feature Manager Plot Sectioning Display Group Show Min/Max Val... Compare Results Camera Cameras Result Options Rendering Settings

Implicit analysis on 3dexperience

Powerful toolset for nonlinear analysis

CONNECTED TO SOLIDWORKS

Leverage Models, Revisions, etc

ADVANCED MESHING

Brick Elements, Sweep Mesh, Element Library

ABAQUS GENERAL CONTACT & SOLVERS

Simple Setup, Robust Results

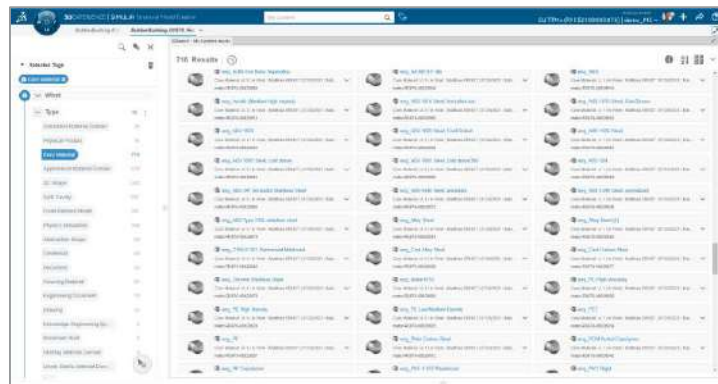


Materials and Material Calibration



Simulation Material

- Material options for all supported simulation domains
 - Structural, Durability, CFD, Plastic Injection
- Providing a large set materials
 - No guarantee that the material you need is included
- Built-in database
 - Manage the data
 - Control who can modify them
 - Track usage
- Define multiple behaviors per material
 - User selects behavior during simulation creation
 - With or without plasticity, e.g.



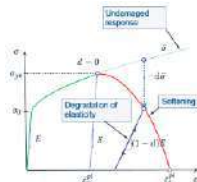
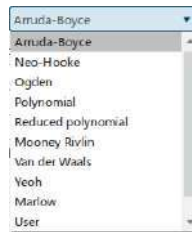
Material	Product	Revision	Material Name	Type	Simulation Size	Event	Collaboration Status	Status
Steel	Steel	1.0	Steel	Cast Steel	40.0 (2,007.0 N/mm²)	Material (2007)	Collaboration	Open
Aluminum	Aluminum	1.0	Aluminum	Extruded Aluminum	40.0 (2,007.0 N/mm²)	Material (2007)	Collaboration	Open
Carbon Fiber	Carbon Fiber	1.0	Carbon Fiber	Carbon Fiber	140.0 (7,000.0 N/mm²)	Material (2007)	Collaboration	Open
Composite	Composite	1.0	Composite	Composite	40.0 (2,007.0 N/mm²)	Material (2007)	Collaboration	Open
Concrete	Concrete	1.0	Concrete	Concrete	40.0 (2,007.0 N/mm²)	Material (2007)	Collaboration	Open
Wood	Wood	1.0	Wood	Wood	40.0 (2,007.0 N/mm²)	Material (2007)	Collaboration	Open
Plastic	Plastic	1.0	Plastic	Plastic	40.0 (2,007.0 N/mm²)	Material (2007)	Collaboration	Open
...

Material Models

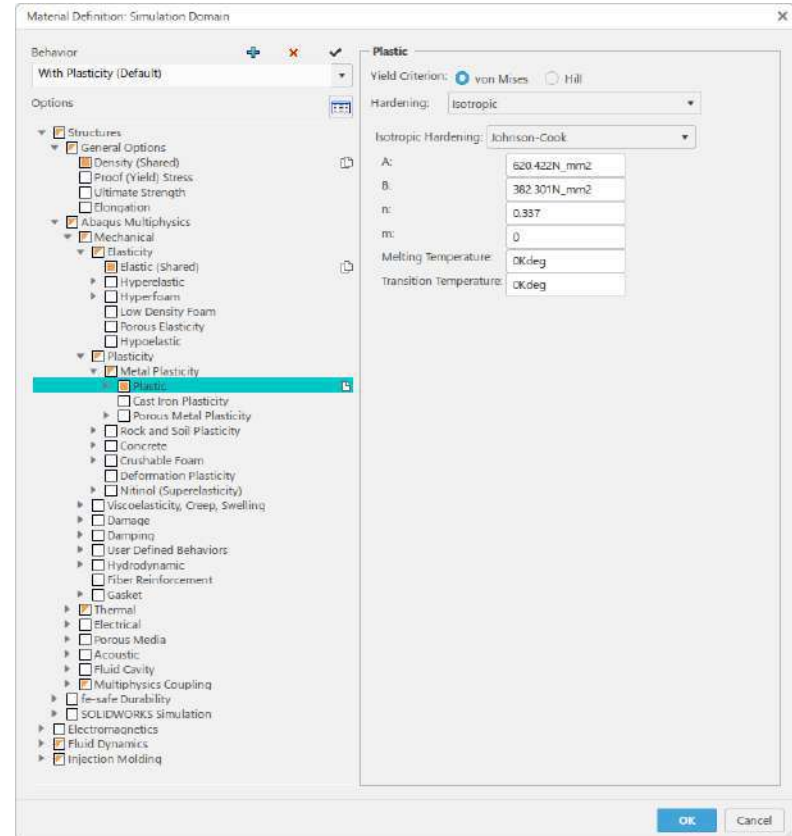
- Many material models are available
 - From basic to advanced
- Nearly all material data can be temperature dependent

Examples:

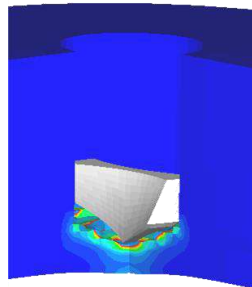
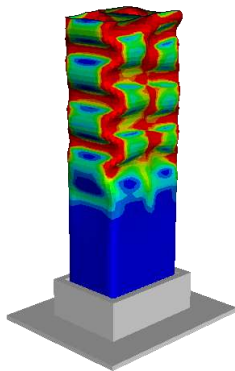
- Hyperelasticity
 - Isotropic
 - Anisotropic
- Metal Plasticity
 - Yield: Von Mises, Hill
 - Hardening: Isotropic, Kinematic, Combined
- Progressive Damage and Failure



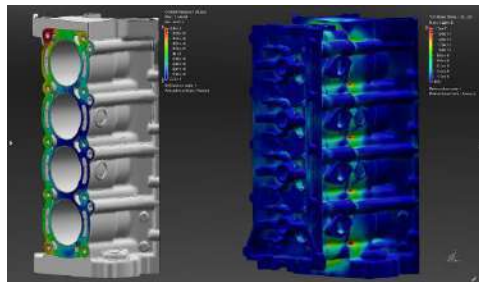
- Damage
 - Ductile Metals
 - Ductile Damage
 - FLD Damage
 - FLSL Damage
 - Johnson-Cook Damage
 - M-K Damage
 - MSFLD Damage
 - Shear Damage
 - Hosford-Coulomb Damage
 - Fiber-Reinforced Composites
 - Hashin Damage
 - LaRC05 Damage
 - Fail Strain
 - Fail Stress



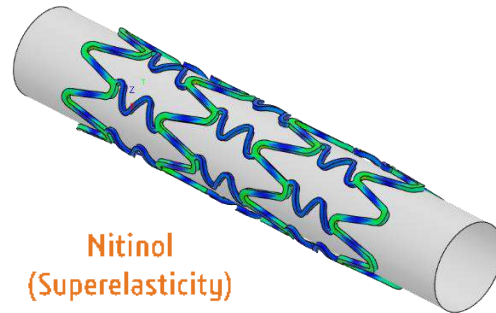
Material Models



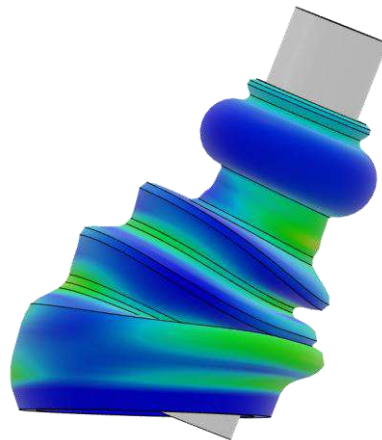
Damage and Failure



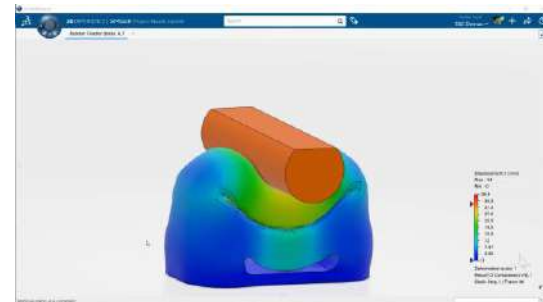
Gasket



Nitinol
(Superelasticity)



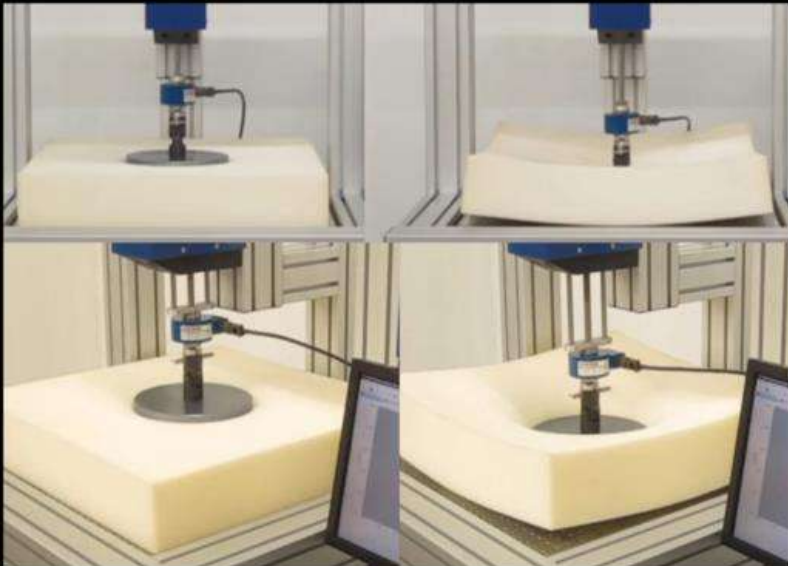
Hyperelasticity



AVAILABLE MATERIAL MODELS ON 3DEXPERIENCE

- Elasticity
 - Elastic
 - Hyperelastic
 - Hyperfoam
 - Low Density Foam
 - Porous Elasticity
 - Hypoelastic
- Plasticity
 - Metal Plasticity
 - Multiple Yield Criteria
 - Hardening – isotropic, kinematic, combined, custom
 - Rate Dependent Modeling
 - Tensile Failure
 - Cast Iron Plasticity
 - Porous Metal Plasticity
- Rock and Soil Plasticity
 - Drucker Prager
 - Mohr Coulomb
 - Cap Plasticity
 - Soft Rock Plasticity
 - Clay Tabular Plasticity
 - Clay Exponential Plasticity
- Concrete
 - Concrete Damaged Plasticity
 - Tension, Compression, Failure
 - Brittle Cracking
 - Shear, failure
- Crushable Foam
- Deformation Plasticity
- Nitinol (Superelasticity)
- Viscoelasticity
- Thermal Behavior
- Creep
- Swelling
- Composite Materials
 - Fiber Reinforcement
- Damage
 - Ductile Damage
 - FLD Damage
 - FLSD Damage
 - Johnson-Cook Damage
 - M-K Damage
 - MSFLD Damage
 - Shear Damage
 - Hosford-Coulomb Damage

SOLIDWORKS Simulation
43% of loading in
22min solver time



Structural Performance Engineer
100% of loading in
3min solver time

Model name: Foam_Example
 Study name/Type: Compression (Default)
 Part type: Surface Displacement/Displacement
 Plot step: 10 Line: 6400011 Second
 Determination scale: 1

URSE (avg)
 3.377e+0
 2.856e+0
 2.336e+0
 1.816e+0
 1.297e+0
 7.770e-0
 2.650e-0
 1.128e-0
 6.440e-0
 8.826e-0
 2.344e-0
 1.900e-0
 Local Plot Step: 10

Model: 3D View: Minimize Study | 25mm, Compression
 CAE (PWA) 2018 Premium 2018 SP10

IDEASiX | SIMUL8 | Physics Results Explorer

Foam_RT A.1

Foam_RT A.1
 Model
 Foam_Example_Default A.1
 Foam_Example A.1
 75mm_Compression A.1
 Nodes and Elements
 Properties
 Cut-Extrude1[1].Default A.1 (Cut-Extrude
 cut-hedrad[1] A.1
 Materials
 RT10Hyperfoam (Ordered Geom
 RT10 Material Simulation Dom
 Cut-Extrude1[2].Default A.1 (Cut-Extrude
 Cut-Extrude1[3].Default A.1 (Cut-Extrude
 Materials
 Scenario
 75mm_Compression
 Interactions (7)
 Restraints (3)

Case: Result of 75mm_Compression
 Step: Static Step 1
 Plot: Displacement 1

Frame	Incrumatic	Time
1	0	0 s
2	1	0.25 s
3	2	0.5 s
4	3	0.75 s
5	4	0.912 s
6	5	0.975 s
7	6	0.922 s
8	7	0.953 s

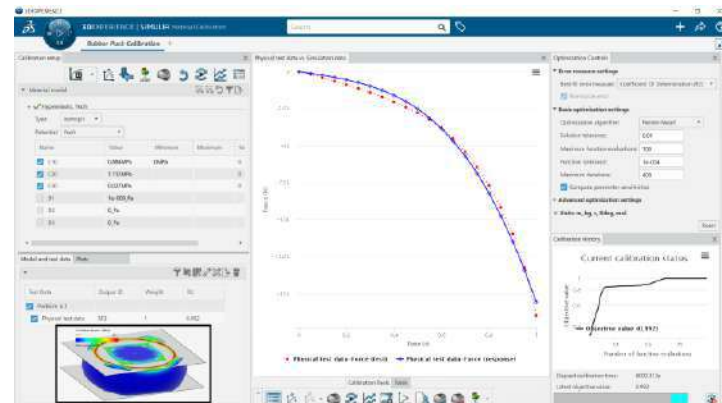
Displacement 1 (mm)
 77.8
 70
 62.2
 54.4
 46.7
 38.9
 31.1
 23.3
 15.6
 7.78
 Deformation scale: 1

Standard Setup Plots Display Sensors Calculations View All-View Tools Search
 Undo Mesh Isometric Results Plot Animation Feature Manager

Material Calibration



- We are providing a powerful Material Calibration app on the **3DEXPERIENCE Platform**
- With the Material Calibration app you can
 - **Import the test data**
 - **Modify the imported data (optional)**
 - Repair, regularize, decimate, shift, smooth
 - **Choose the desired material behavior**
 - **Adjust the calibration settings (optional)**
 - **Run the material calibration**
 - **Visualize the calibration result and check stability**
 - **Generate the material in 3DEXPERIENCE**
 - And/or export the material data
 - **Save all calibration settings and data (optional)**



Material Calibration



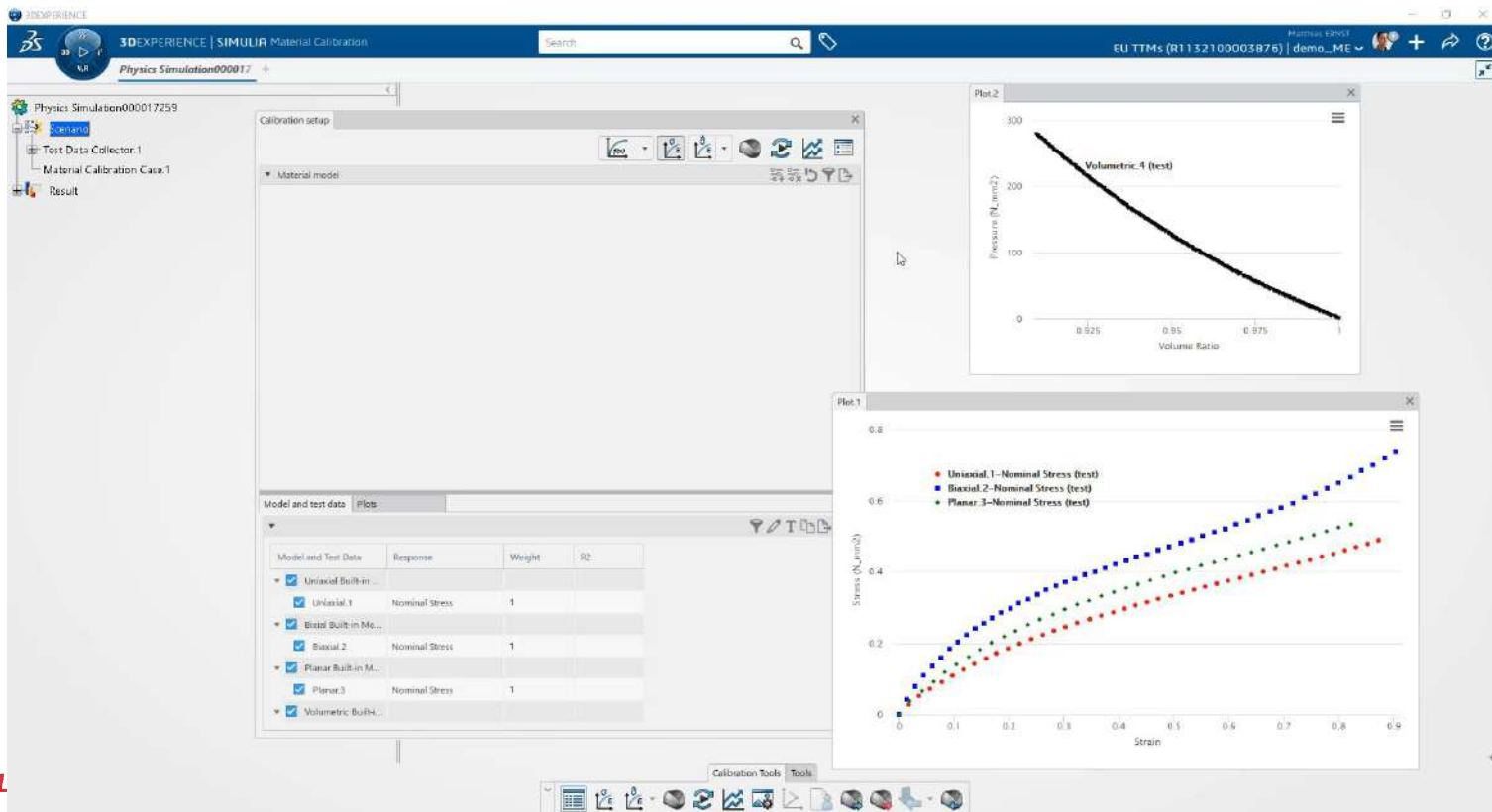
- Import test data from Excel file



Material Calibration



- Choose material behavior & model and run calibration



Steps, Procedures and Numerics

Steps, Procedures and Numerics

Simulation in **3DEXPERIENCE** (Abaqus) can consist of **multiple steps** with **linear and nonlinear procedures**.

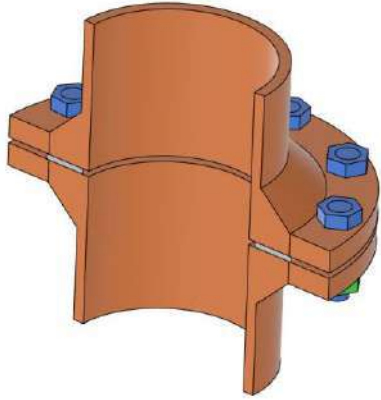
Nonlinear procedures:

- **Static**
- Static Riks
- Quasi-static
- Implicit dynamics
- Explicit dynamics
- Heat Transfer
 - Steady-state
 - Transient
- Fully coupled
 - Thermal-stress
 - Thermal-stress explicit
 - Thermal-electrical
 - Thermal-electrical-stress

Linear procedures:

- Static perturbation
- Natural frequency extraction
- Harmonic response
- Buckle
- Random vibration
- Response spectrum
- Modal dynamic
- Substructure generation
- Complex frequency extraction

Steps, Procedures and Numerics



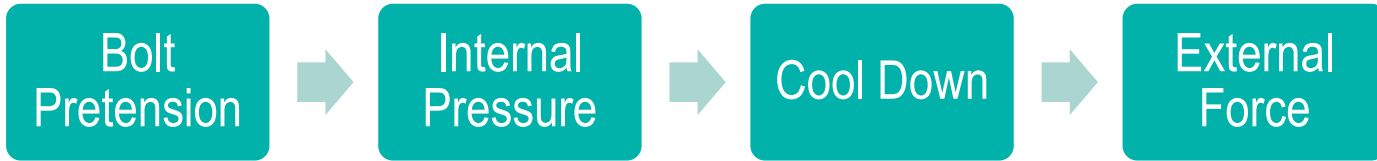
Bolted flanges with gasket



Feature Manager

Viewing all 16

W	Name	Type	Category	Definition	Bolt Pretension	Service Load	Cool Down	External Load
<input checked="" type="checkbox"/>	Bolt Force.1	Bolt Force	Loads	1500 N	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Fixed Displacement.1	Fixed Displacement	Restraints	Translation X	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	General Contact.1	General Contact	Interactions	Friction Coefficient	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Output.1	Field	Output Requests	Field	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Output.2	History	Output Requests	History	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Slider.2	Slider	Restraints		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Symmetry BC	Slider	Restraints		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Bolt Restraint.1	Bolt Restraint	Restraints		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Pressure.1	Pressure	Loads	5 N/mm2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Prescribed Temperature.1	Prescribed Temperature	Predefined Fields	253 Kdeg	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Force.1	Force	Loads	Magnitude: 1000 N	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Friction.1	Contact Property	Interactions		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Friction.2	Contact Property	Interactions		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Global Element Type Assignment.1	Global	Element Type Assign...		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Initial Temperature.1	Initial Temperature	Initial Conditions	253 Kdeg	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	Local Element Type Assignment.2	Local	Element Type Assign...		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>



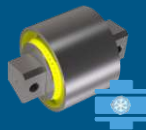
Four nonlinear static steps



Manufacturing Validation

Production Process Scenario

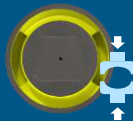
- Multi-step (Thermal stresses + Plasticization) technology allows precise replication of manufacturing workflows



Cooling

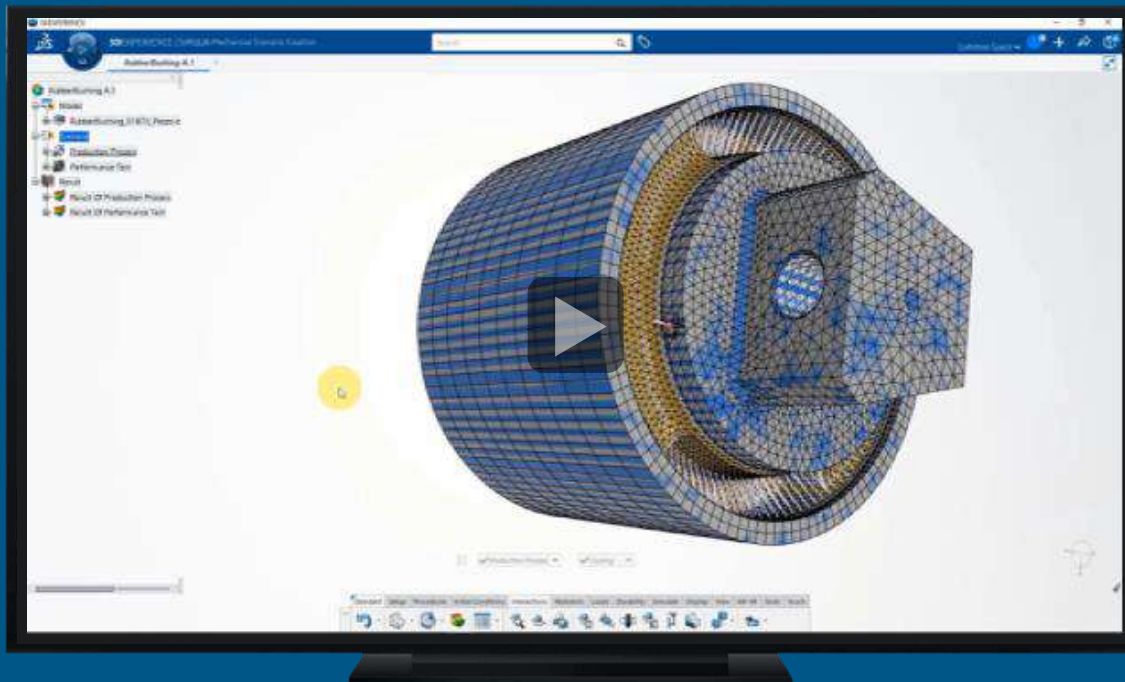
430 °K to 300 °K

Forming
2 mm radially inside displacement of the outer ring



Release

Release the radial load so that outer ring displaces due to spring back and produces plastic deformation





Manufacturing Validation

Performance Test Scenario



This scenario is comprised of **6 static steps**:

- X axis loading (70 kN) & release
- Y axis loading (35 kN) & release
- Z axis loading (70 kN) & release



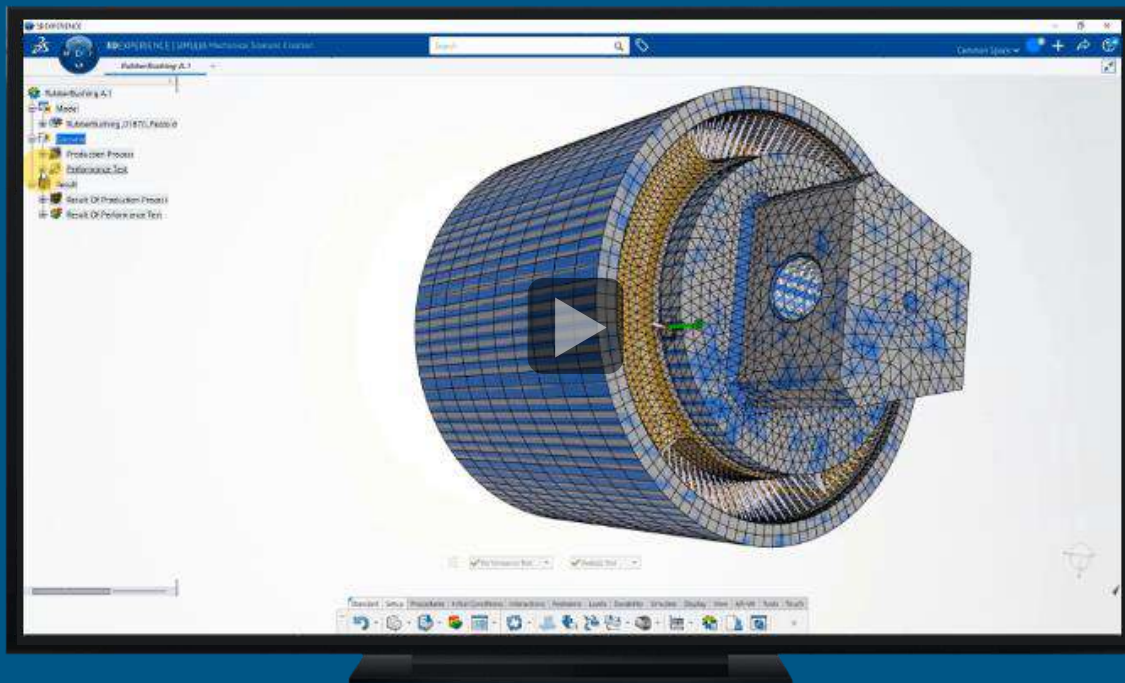
Performance test scenario will give outputs on the outer ring:

- UT, Translations
- RT, Reaction forces
- CF, Concentrated forces & moments



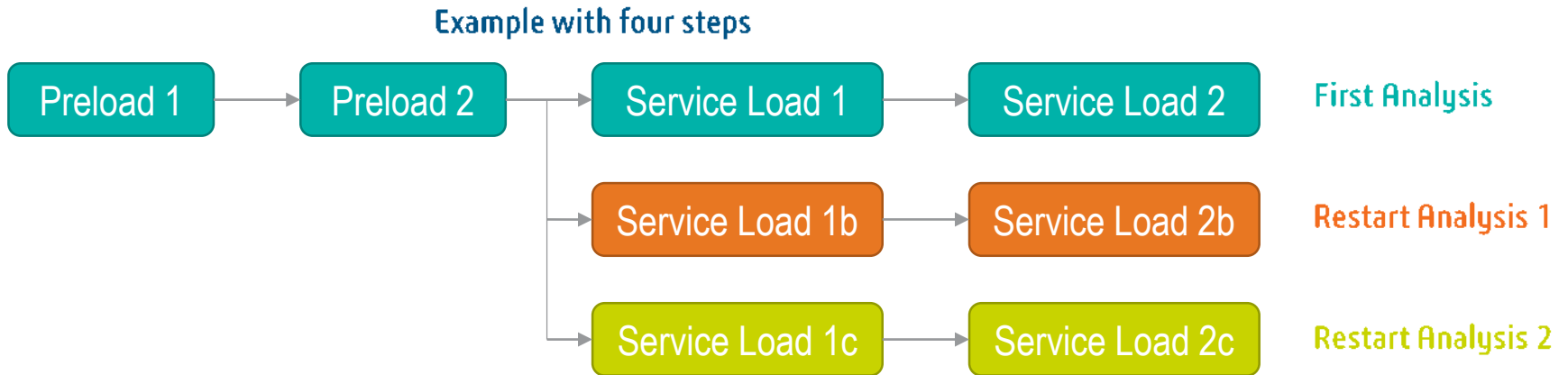
Release step, why?

To check the linear behavior of the rubber bushing in X, Y and Z direction and cumulative at the end of the analysis



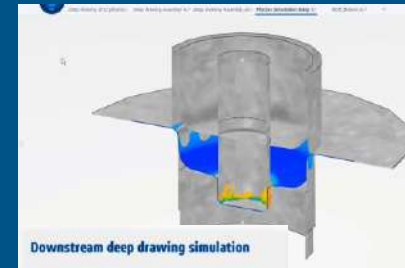
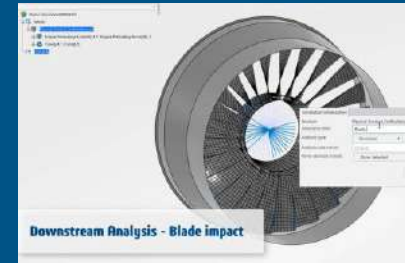
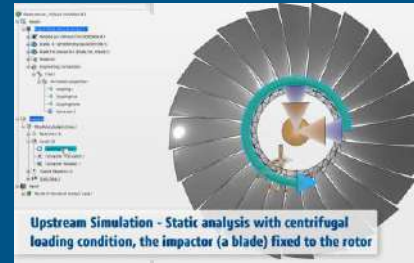
Steps, Procedures and Numerics

- Various special purpose techniques available
- Two examples:
 - Preloading – Allows to reuse parts/products incl. results from other analysis in new analysis
 - Restart Analysis – Allows to continue finished or aborted steps and analysis from any points



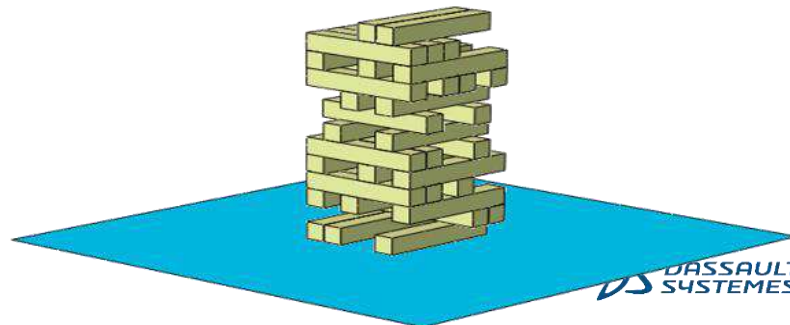
Preloaded FEMs

- Start a new analysis using the pre-deformed, pre-stressed results of a previous analysis as a starting point.
- Include stress from manufacturing processes
- Also for other sequential analyses
- New analysis has not only the deformed shape...
but is also preloaded with stresses from the previous analysis



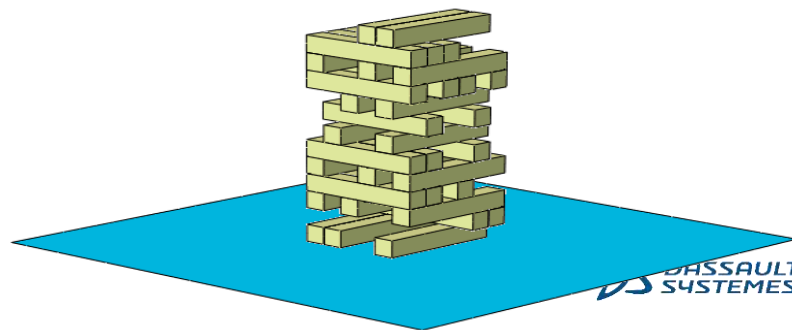
Contact

- Changing contact situations are highly nonlinear effects
- We have very powerful contact algorithms
 - **General Contact** and **Contact Pair** methods
 - Both based on custom **Surface-to-Surface** formulation
 - **Superior compared to Surface-to-Surface** formulation of other vendors
- Many other contact options and settings
 - Friction, Self contact, Geometric Correction, Contact Damping, Unsymmetric equation solver, Interference Fit, ...



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InFocus Energy Services Case Study (Downhole Drilling Tools) <http://www.solidworks.com/infocus>

Explicit Dynamics

Explicit Dynamics

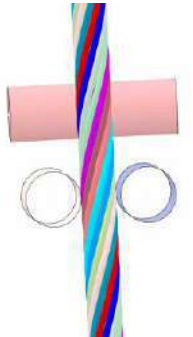
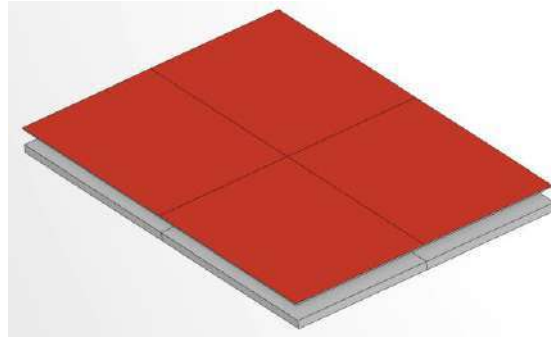
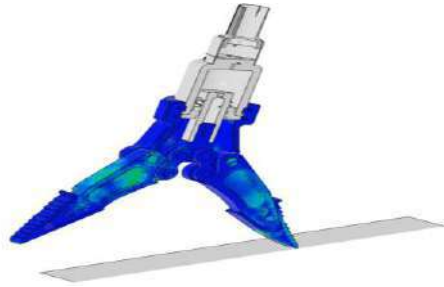
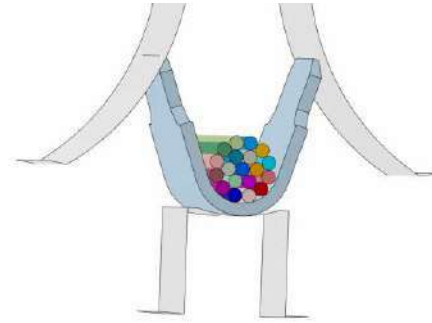
What is Abaqus/Explicit?

- A FE solver based on explicit time integration
- Intended for high-speed dynamic events
- **Also allows to solve complex static analysis efficiently**

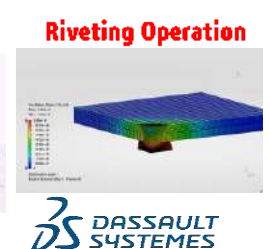
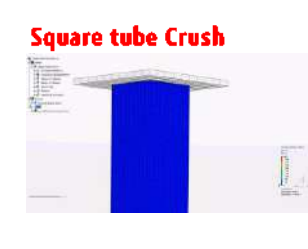
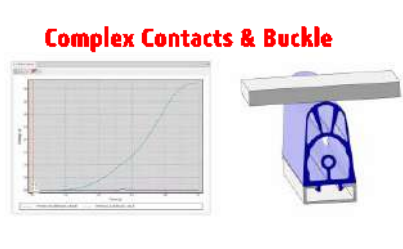
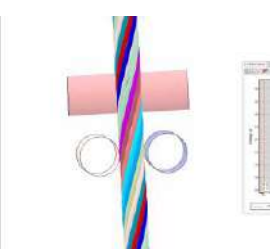
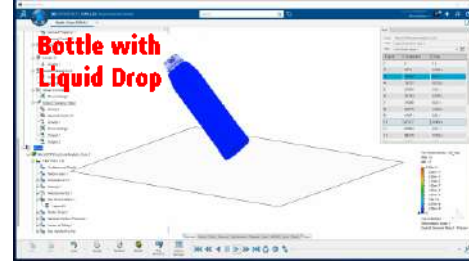
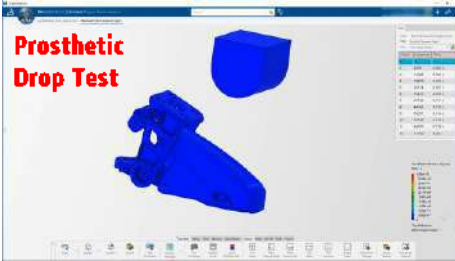
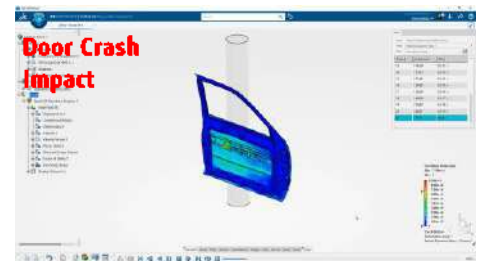
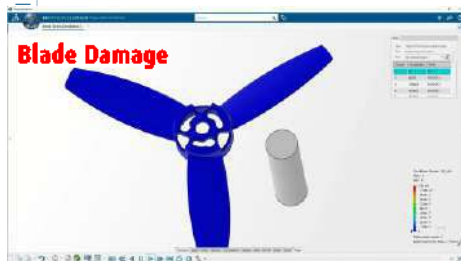
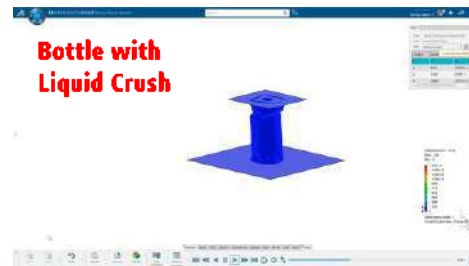
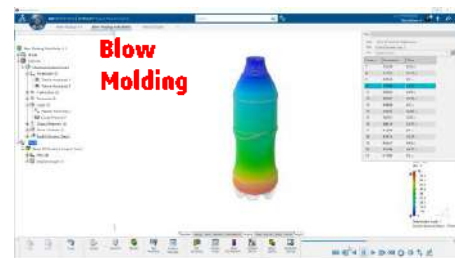
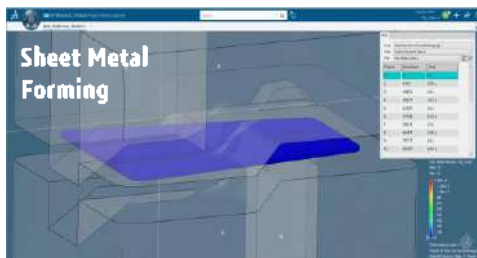
Explicit Dynamics

What is Abaqus/Explicit?

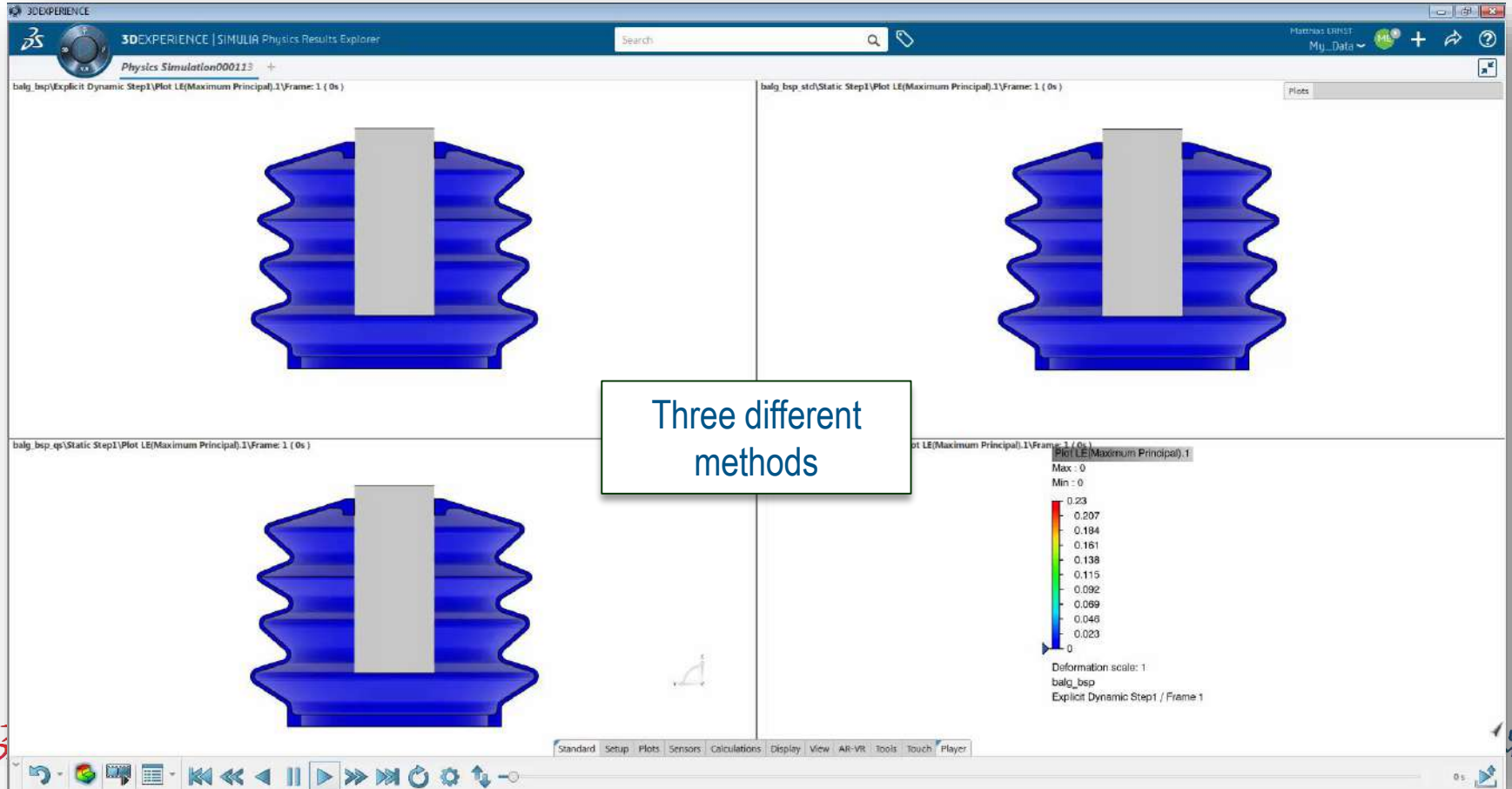
- A FE solver based on explicit time integration
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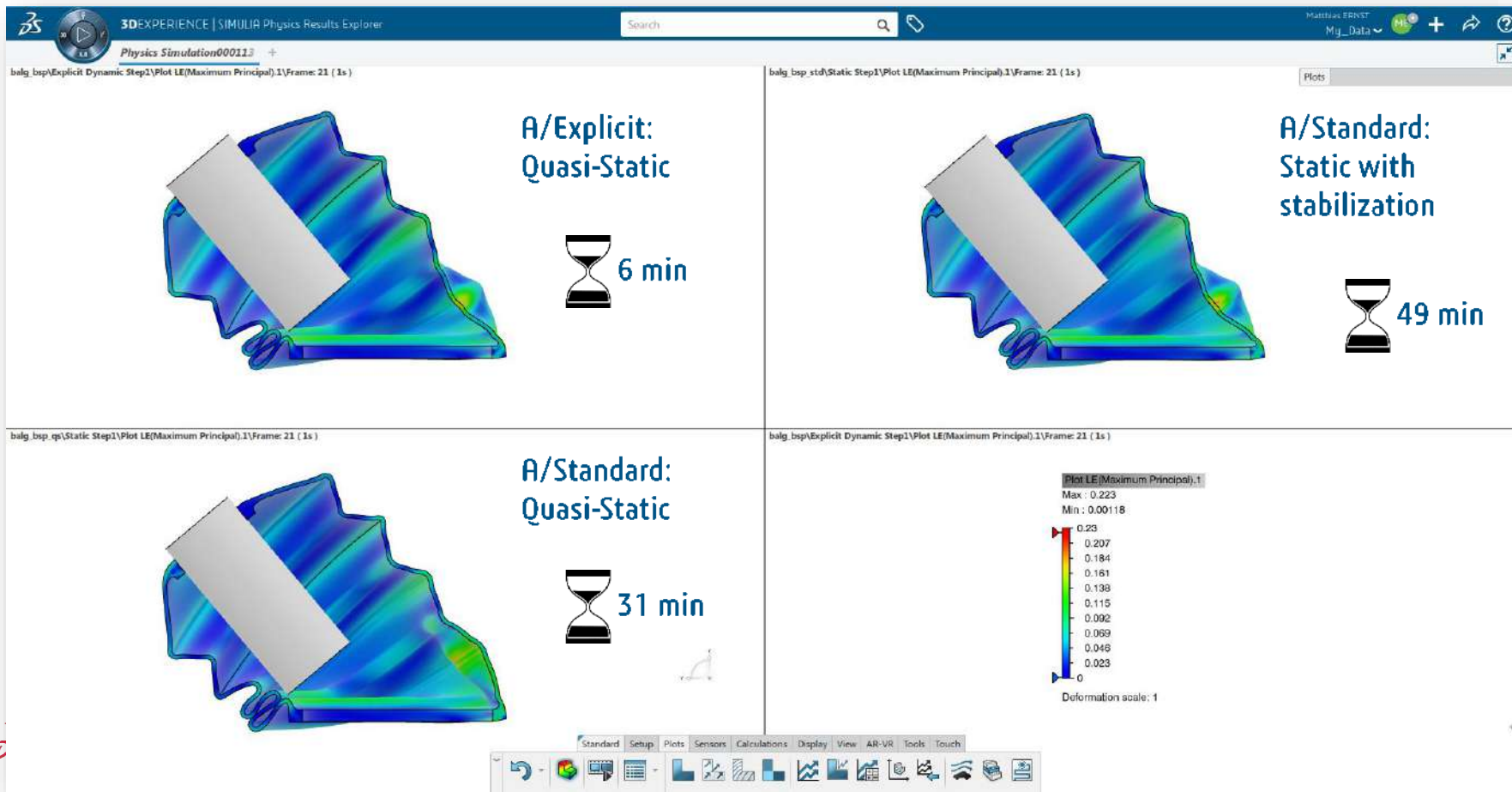
IMPACT, DAMAGE, MANUFACTURING, SPH & MUCH MORE



Bellow

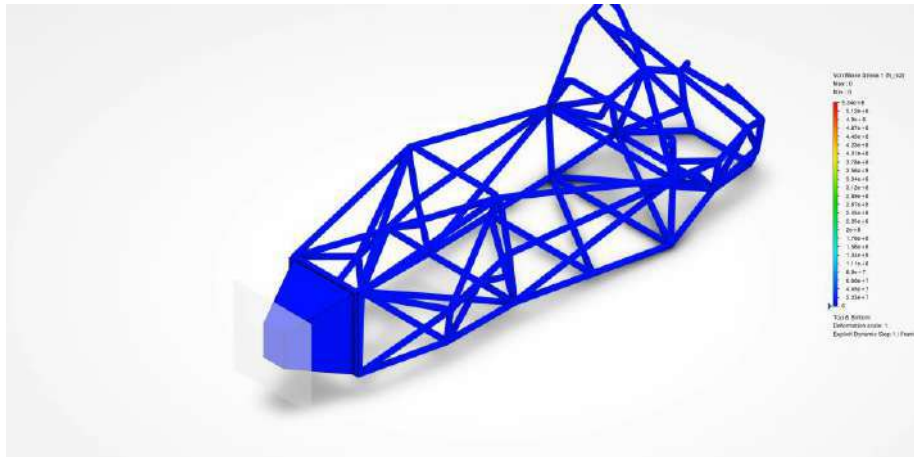


Bellow

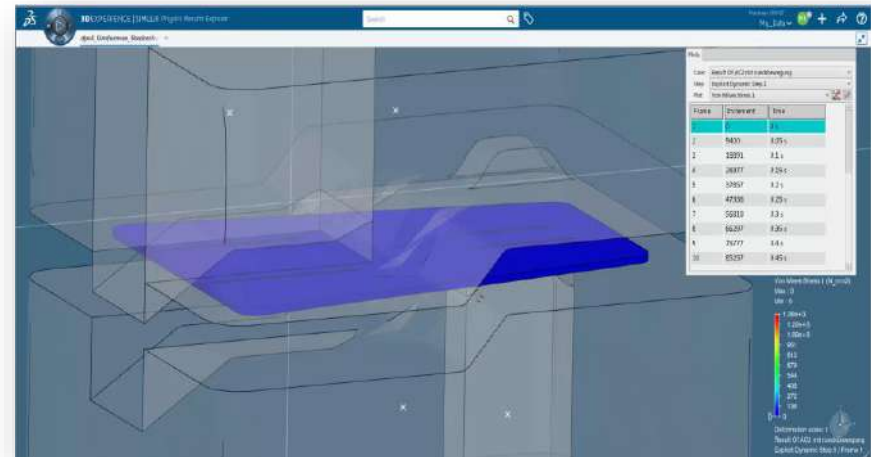


EXAMPLES OF DIFFERENT NONLINEAR RESPONSE

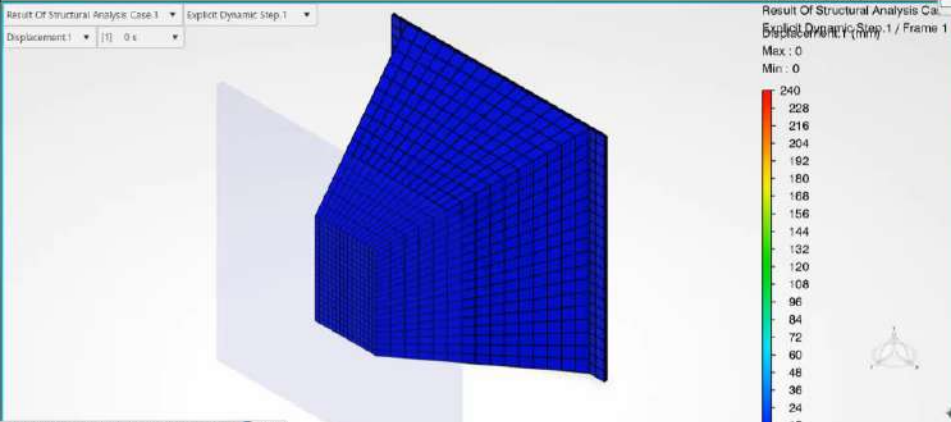
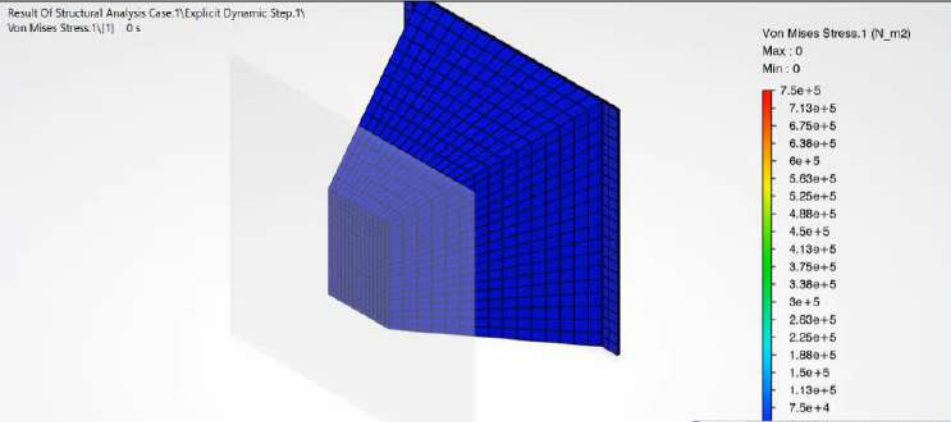
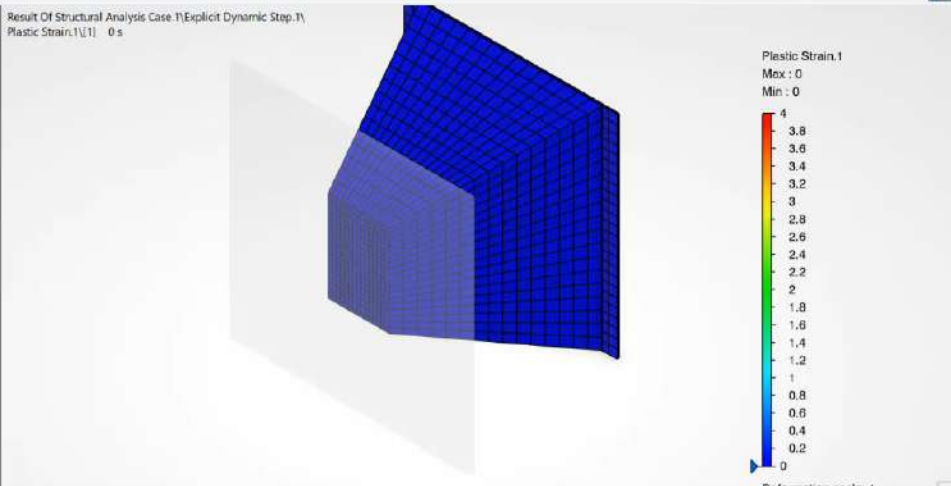
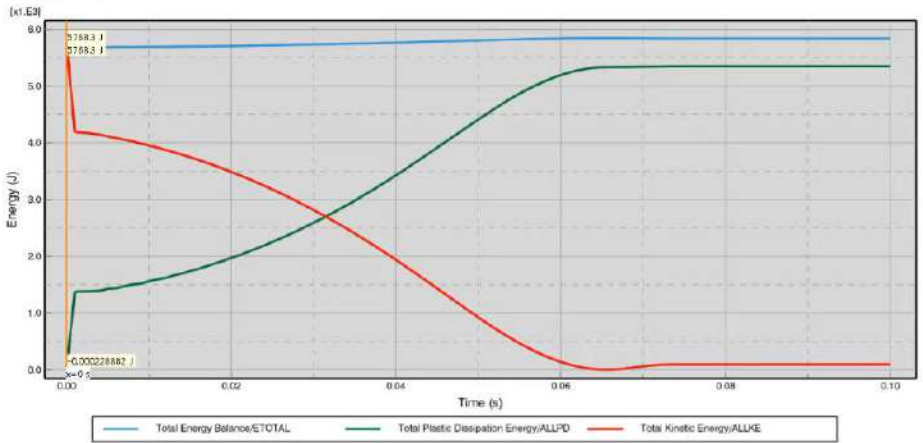
Crushable Foam



Metal Plasticity

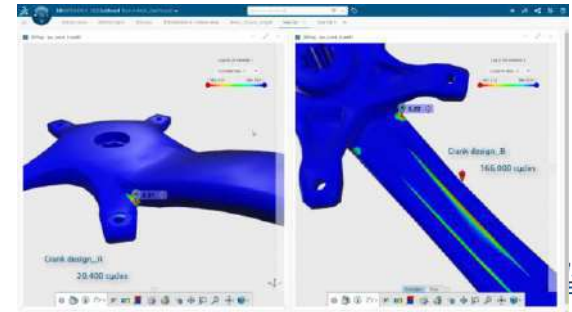
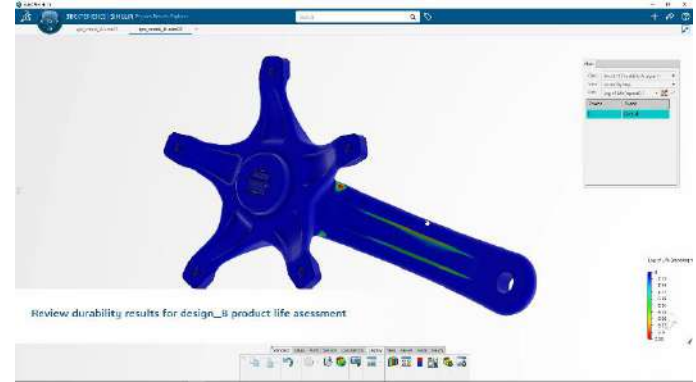
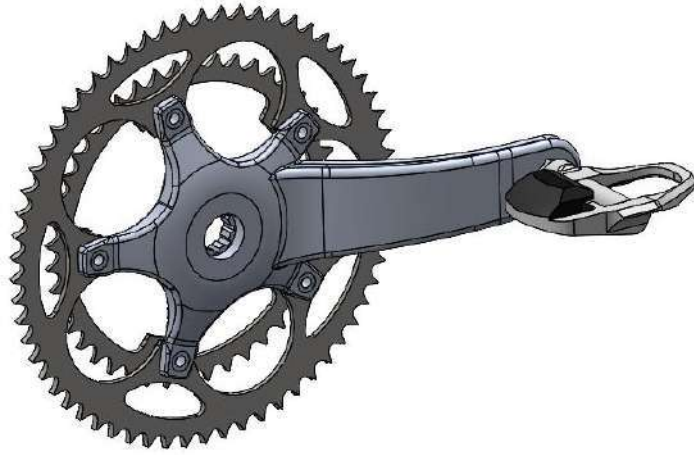


IA_std_crash A.1

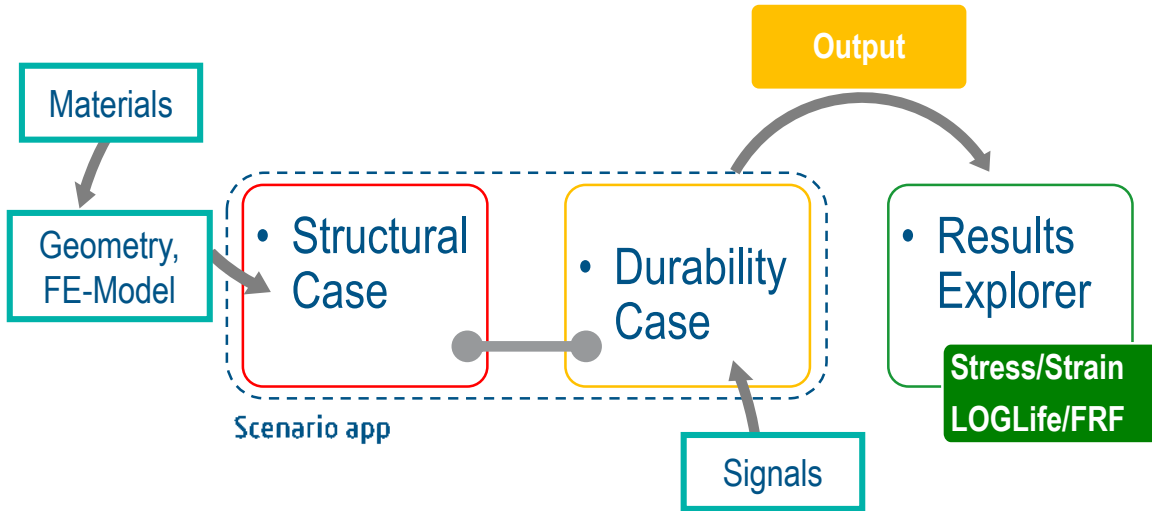


Durability

Durability



Durability Workflow



► Inputs

- ▷ Model (Geometry, Mesh, Material, etc.)
- ▷ Signals (if necessary for fatigue loading)

► Process

- ▷ Structural Analysis Case (in the scenario app)
- ▷ Durability Analysis Case (in the scenario app)
- ▷ Physics Results Explorer

► Output

- ▷ Structural and durability output
- ▷ Fatigue life, FRF or utilization
- ▷ Other durability related plots

Durability Value Proposition

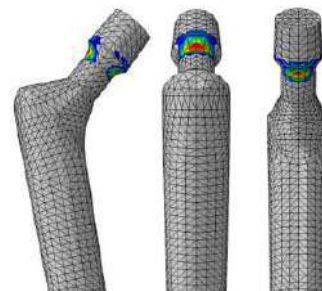
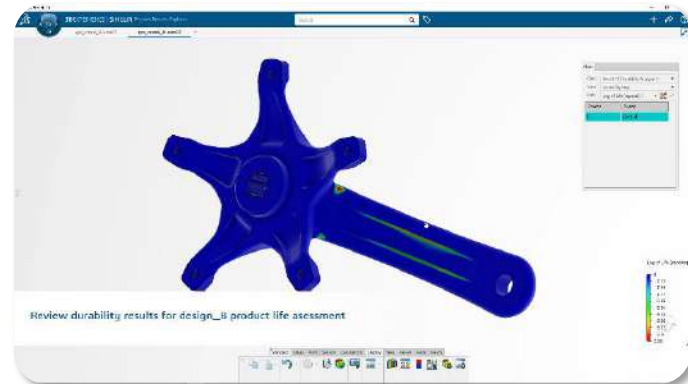


Durability
Performance
Engineer



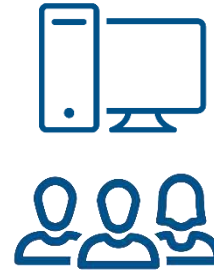
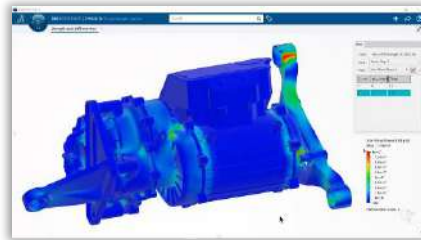
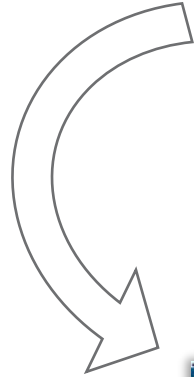
Durability and
Mechanics
Engineer

- Proven & Powerful SIMULIA fe-safe® Fatigue Technology
 - Intended for metal-like fatigue
 - Advanced techniques for **high cycle** and **low cycle** fatigue
 - Stress and **strain-based** algorithms
 - **Multi-events** and **multi-directional** loading
- Expansion of Advanced Structural Simulation
 - Automatic execution of **coupled** simulations between Abaqus and fe-safe solvers
 - Same cloud-based platform, same user interface, same data model
 - Over **370** fatigue materials included
- Connected to SOLIDWORKS
 - Same connected and **associative** workflow from SOLIDWORKS



Cloud Computing

Computing Options



Not enough
RAM for large
model

Analysis runs
too long

I have to run
multiple analysis
at the same time

On premise HPC costs



Known Costs

Hardware

Hidden Costs

Outages

UPS

Power/cooling

Maintenance

Security

Disaster Recovery

Queues

Back up

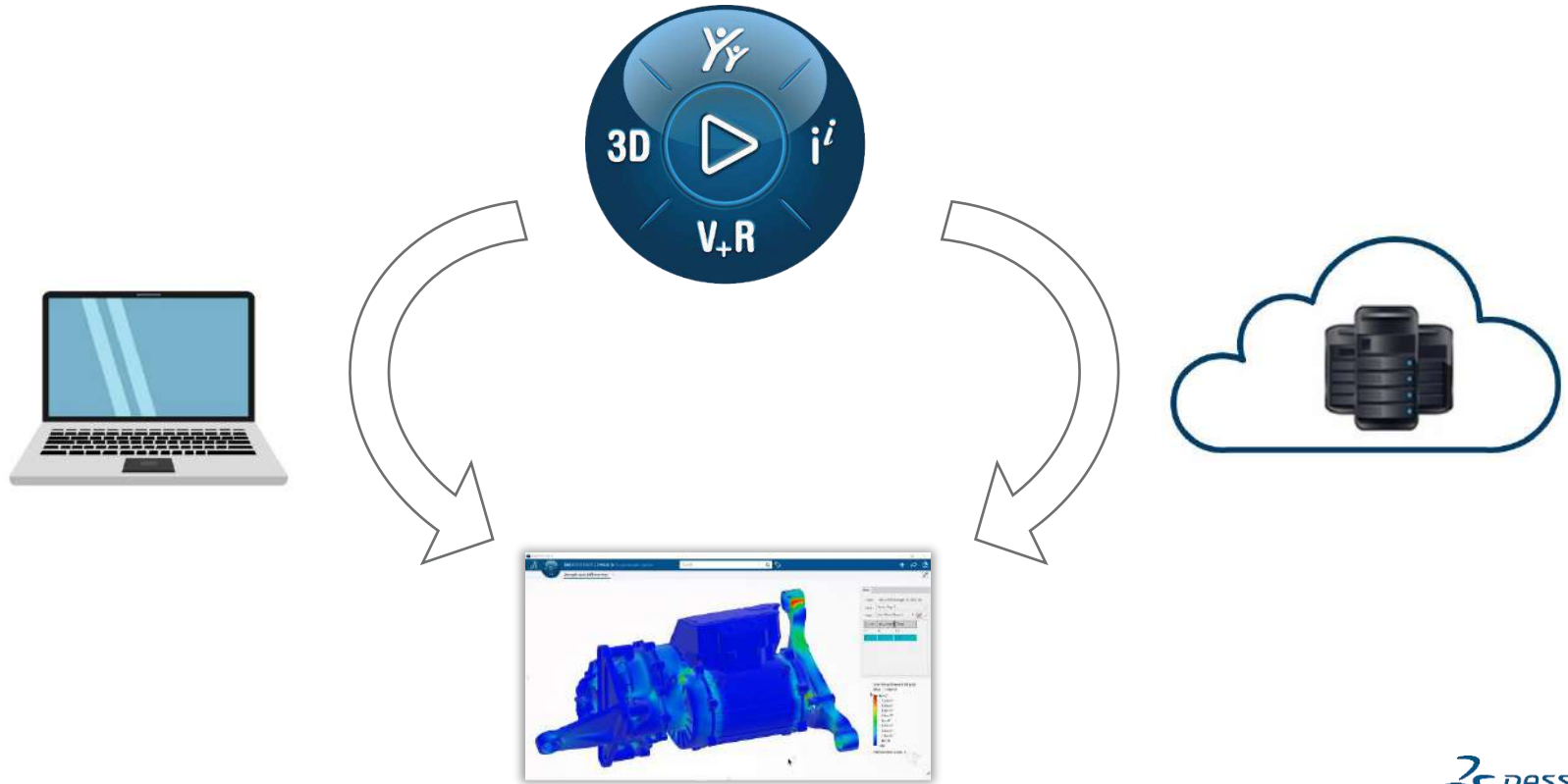
Staffing

Licenses

Depreciation

Insurance

Computing Options



Computing on Cloud



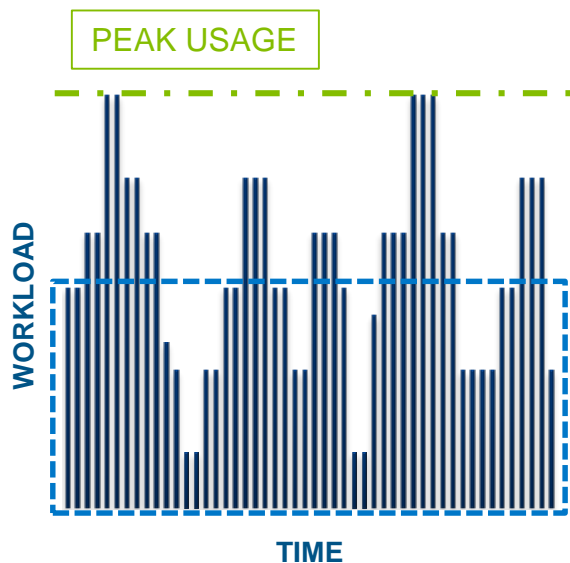
- **On-demand** cloud compute 24/7
- High performance computing (**HPC**) architecture
- Cloud Instances with **latest generation** CPU's
- Up to **144 true cores** per analysis
- Distributed computing with **low latency** networking
- **High performance** and **scalable** storage system

Included Compute Power

		Included with each role	
		local	cloud
Structures	3DEXPERIENCE Simulation		
	Structural Designer	4 cores	
	Structural Engineer		
	Structural Performance Engineer		
	Structural Mechanics Engineer	8 cores	
	Durability Performance Engineer		
	Durability & Mechanics Engineer		
EM Fluids	Fluid Dynamics Engineer	16 cores	
	Plastics Injection Engineer	8 cores	
	Electromagnetics Engineer	16 cores	

*One analysis at a time per role

Additional Compute Power



CREDITS

- ☞ Consumable compute license
- ☞ Run unlimited number of simulations concurrently
- ☞ Best for **variable compute workload** or pay-per-use
- ☞ Maximum flexibility



TOKEN

- ☞ Reusable compute license
- ☞ Run unlimited number of simulations concurrently
- ☞ Best for **regular & high compute workload**
- ☞ Maximum flexibility



EMBEDDED

- ☞ Embedded compute license
- ☞ Run one simulation at a time up to a maximum number of cores
- ☞ Suitable for **typical, routine use**
- ☞ Limited flexibility