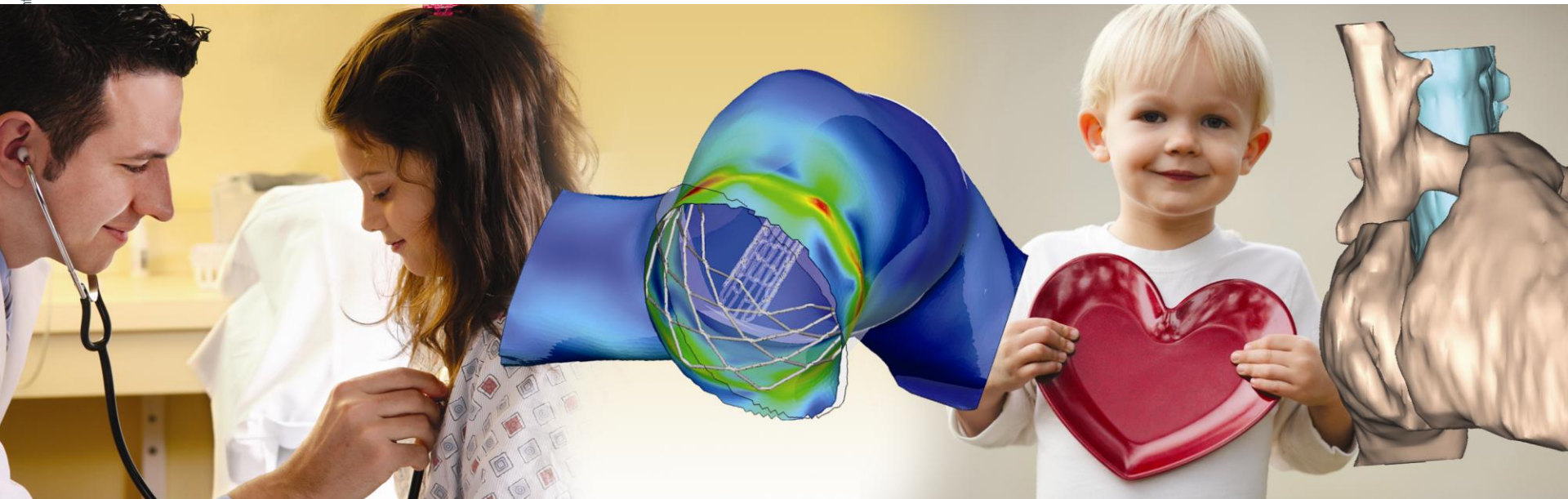


SIMULIA in Medical Devices Industry

information

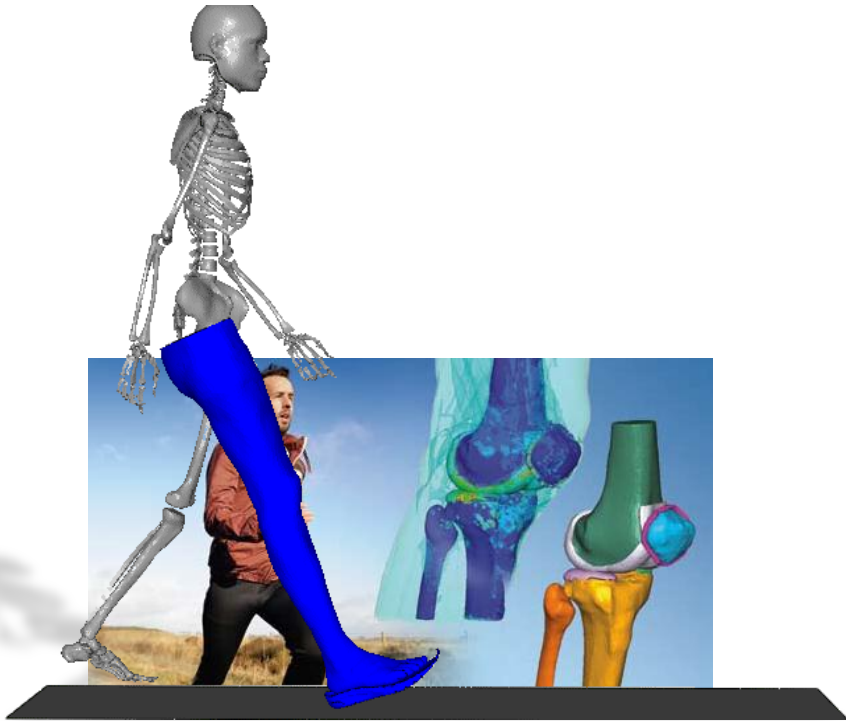


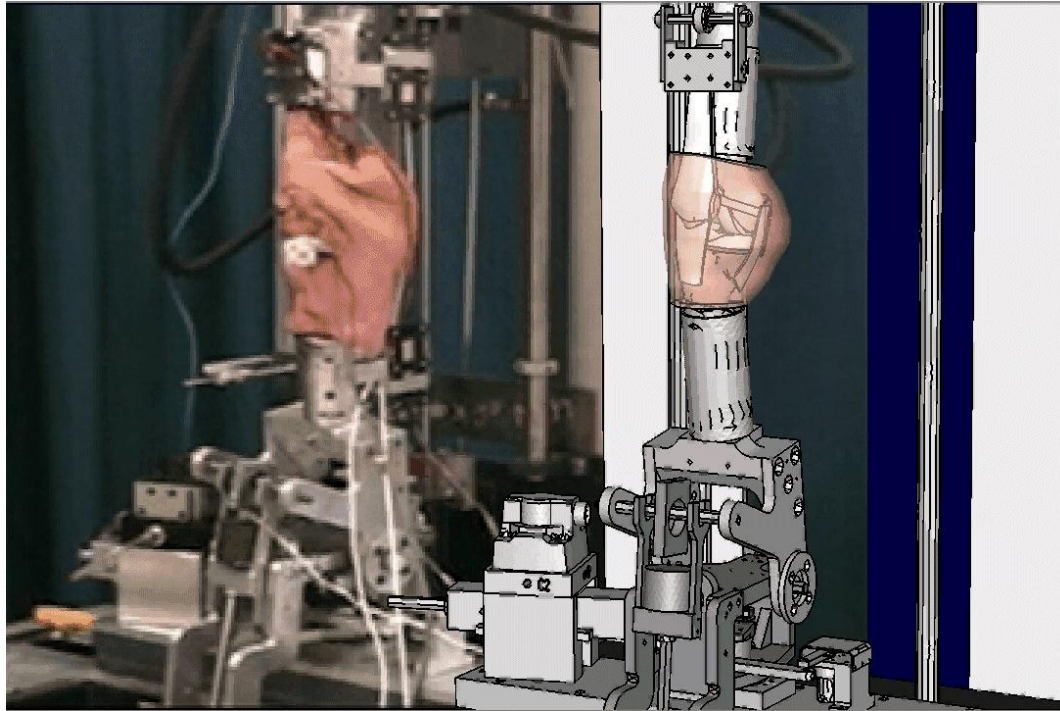
Realistic Simulation is ...

The use of Unified FEA, multiphysics and optimization technology and methods to understand and improve how products will perform in life

- **Evaluate** design alternatives
- **Reduce** physical prototypes
- **Increase** confidence in product performance
- **Accelerate** design decisions
- **Gain knowledge** of real-world behavior
- **Aid** FDA submission

... **Lifelike Experience through Simulation**

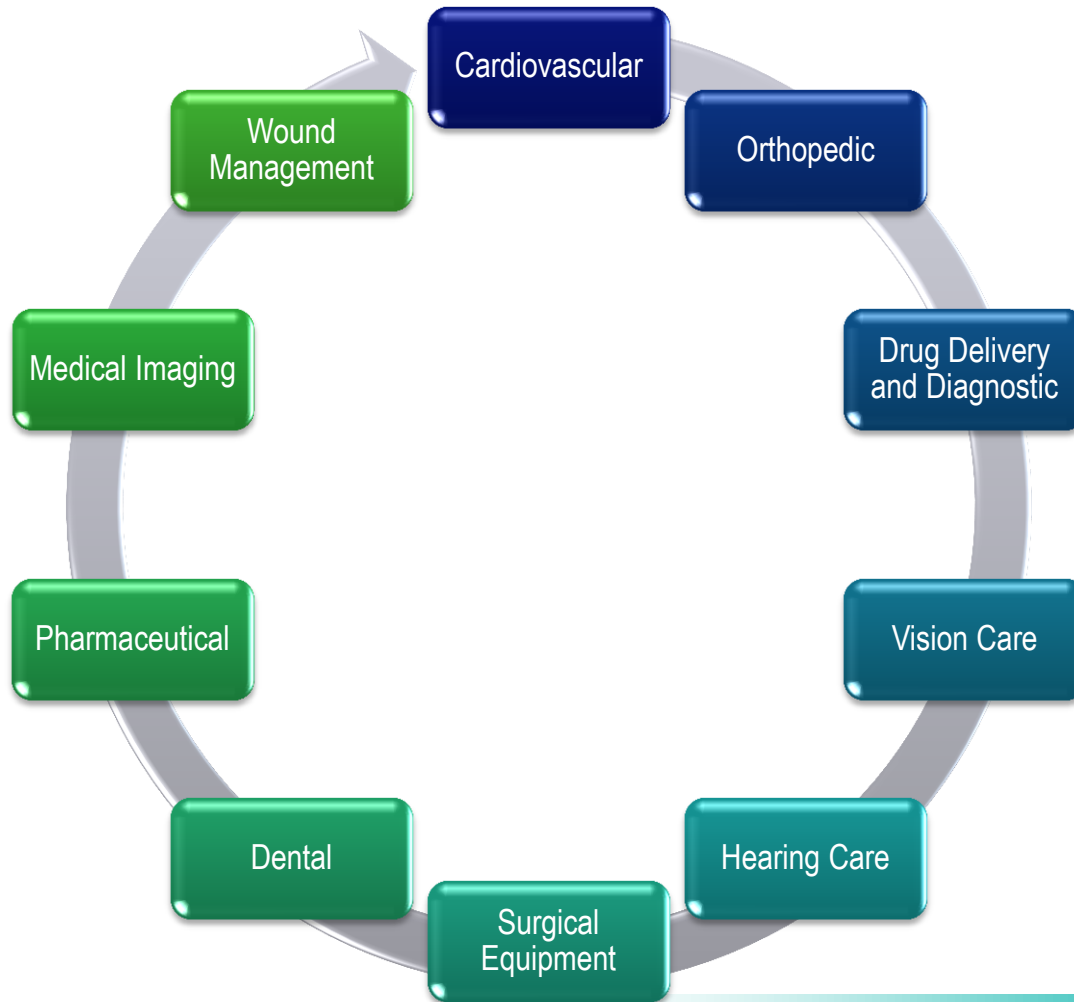




to **Reduce** Physical Testing,
Save significant
Time and **Money**

SIMULIA in Medical Devices Industry

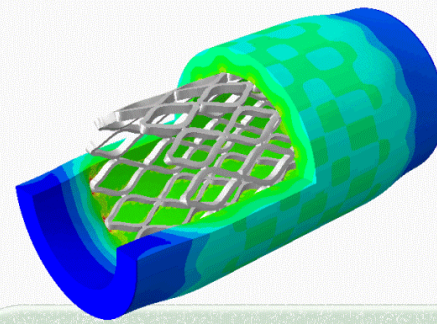
Industry Segments



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Cardiovascular Devices



Devices

Stents

IPG and Pacemakers

Heart Valves

Aneurysm Exclusion Graft

Why SIMULIA?

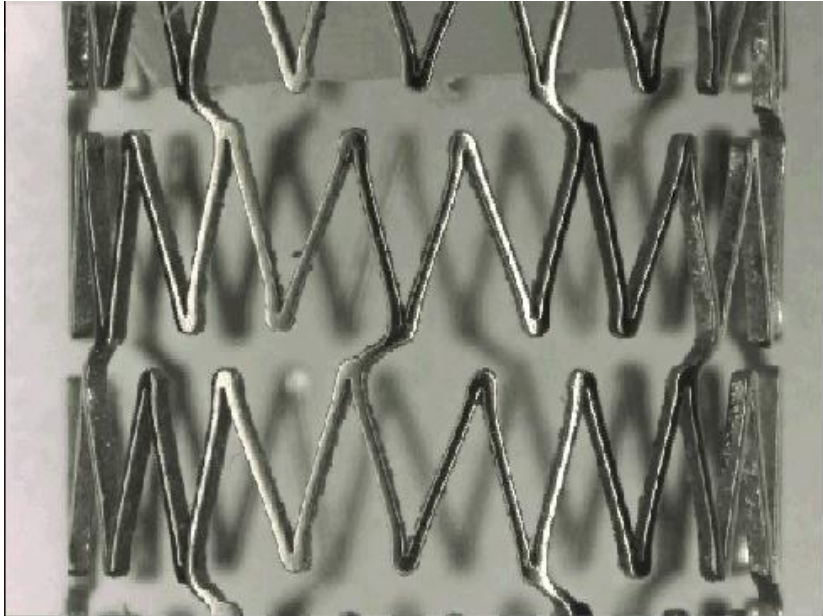
Built-in Nitinol Material

Nonlinear Large Deformation Analysis

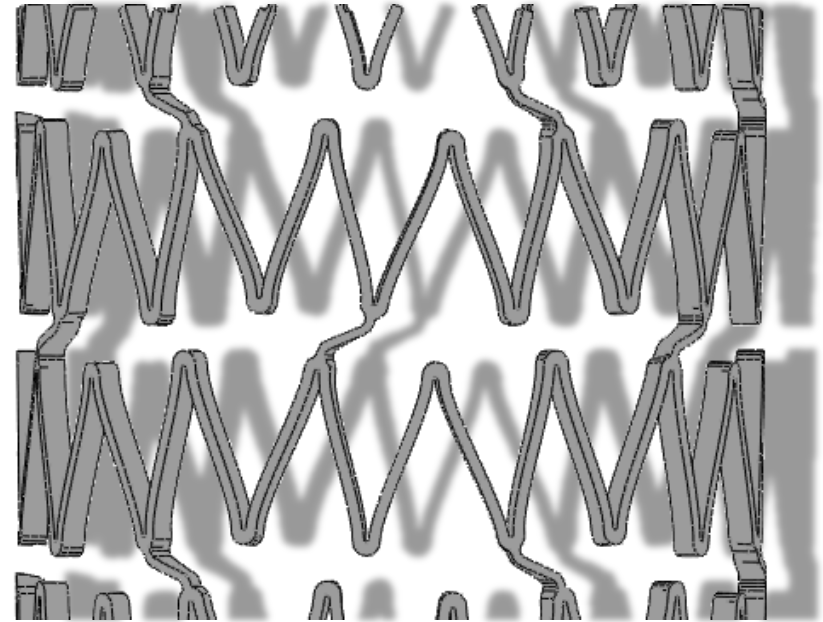
Robust Contact Algorithm

Technical Expertise

Cardiovascular Devices – Stents



Test data

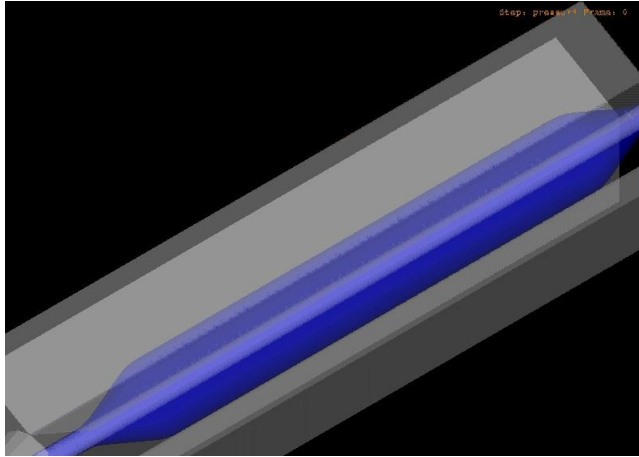


Abaqus data

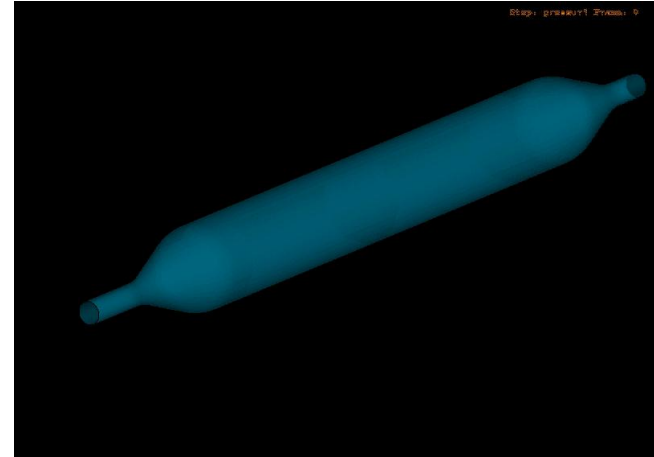
Test data courtesy SRI. Abaqus model courtesy NDC

Simulation of Bench Test to Validate FEA Solution

Cardiovascular Devices – Stents



Assembly level interactions

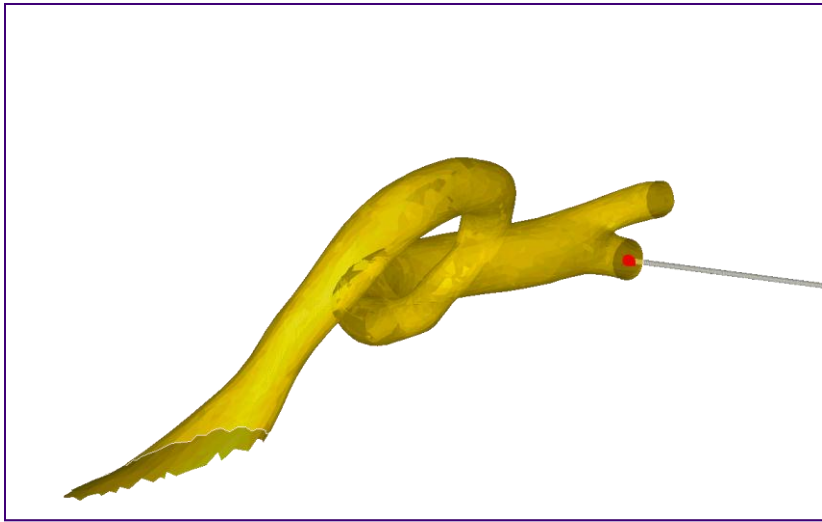


Balloon forming process

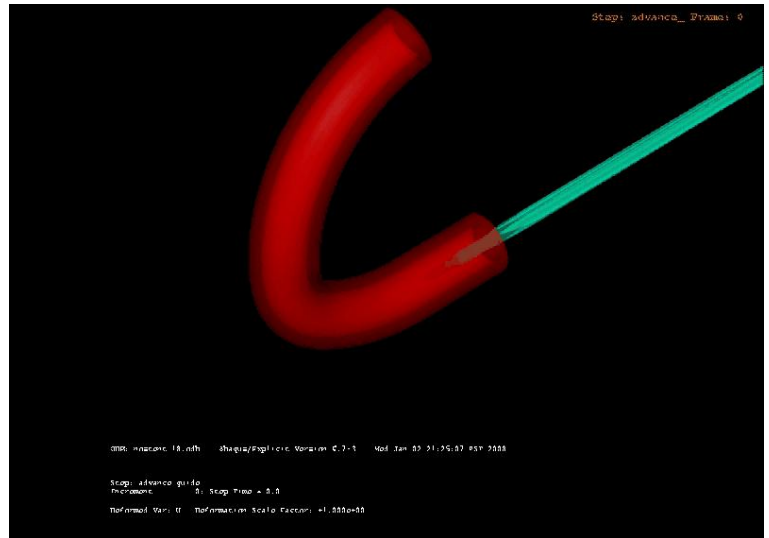
Courtesy : NDC

Angioplasty Balloon Forming

Cardiovascular Devices – Stents



Advancing a Guide Wire



Balloon Expansion

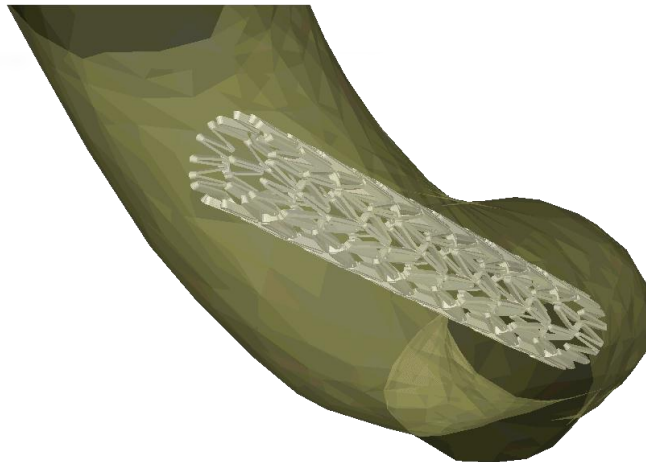
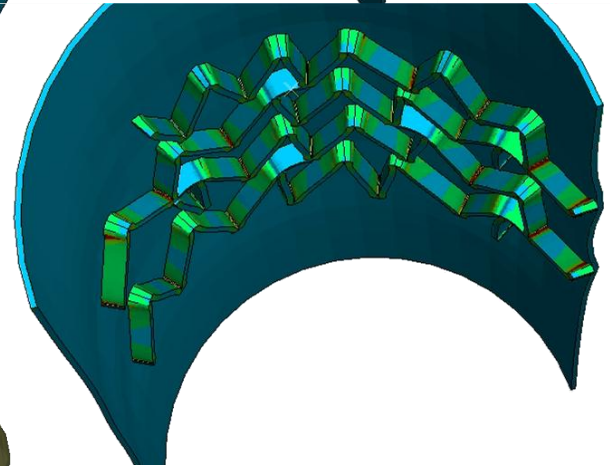
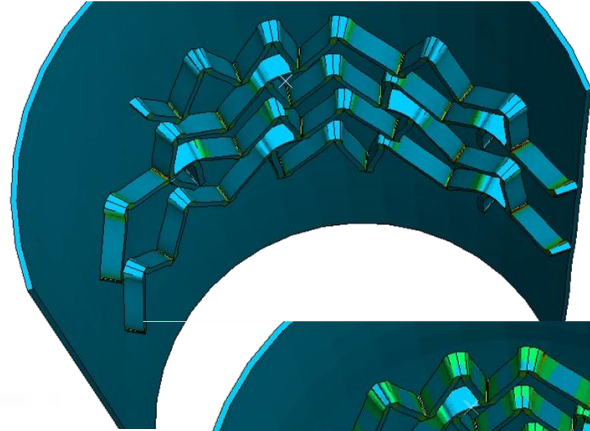
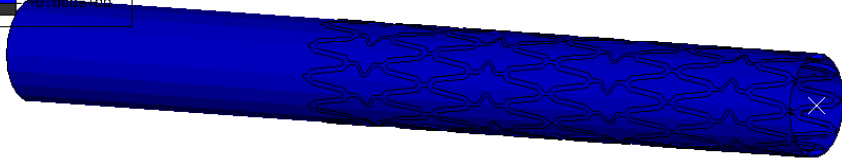
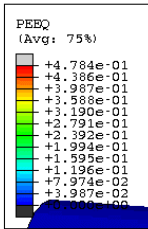
Ref: SIMULIA User's Conference, 2010, Atul Gupta, Medtronic

Courtesy : NDC

Simulation of Guide Wire and Balloon for Angioplasty and Stent Deployment

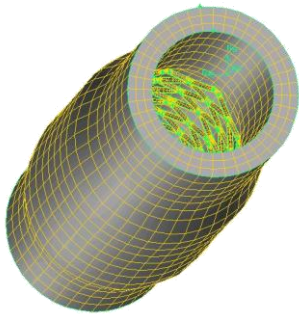


Cardiovascular Devices – Stents

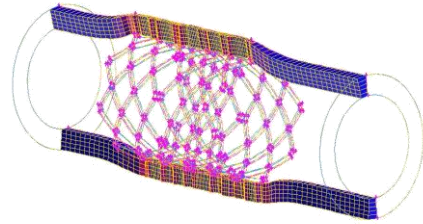


Stent Manufacturing, Deployment and Fatigue Analysis

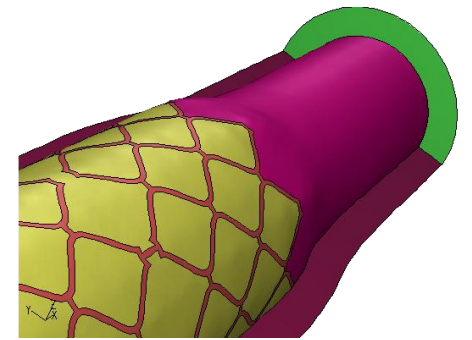
Cardiovascular Devices – Stents



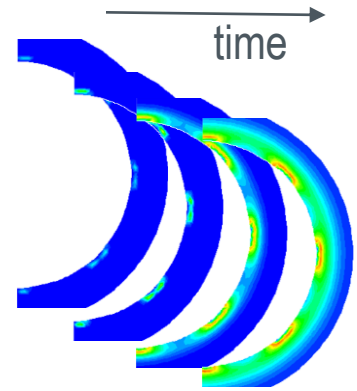
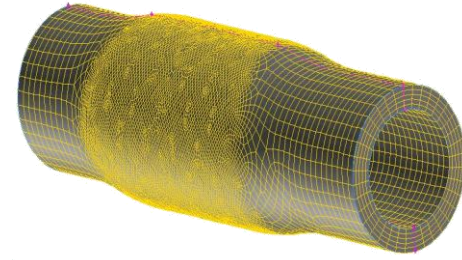
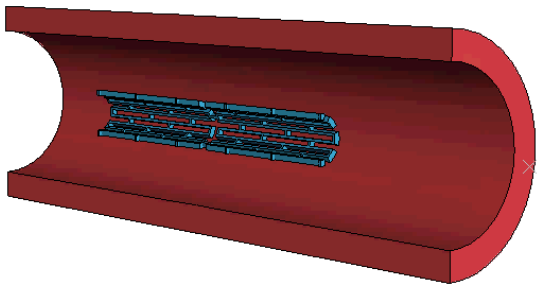
Structural deployment



CFD mesh creation from the deformed structure



Drug Delivery

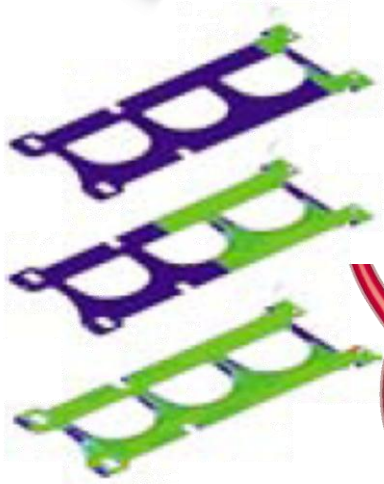


time

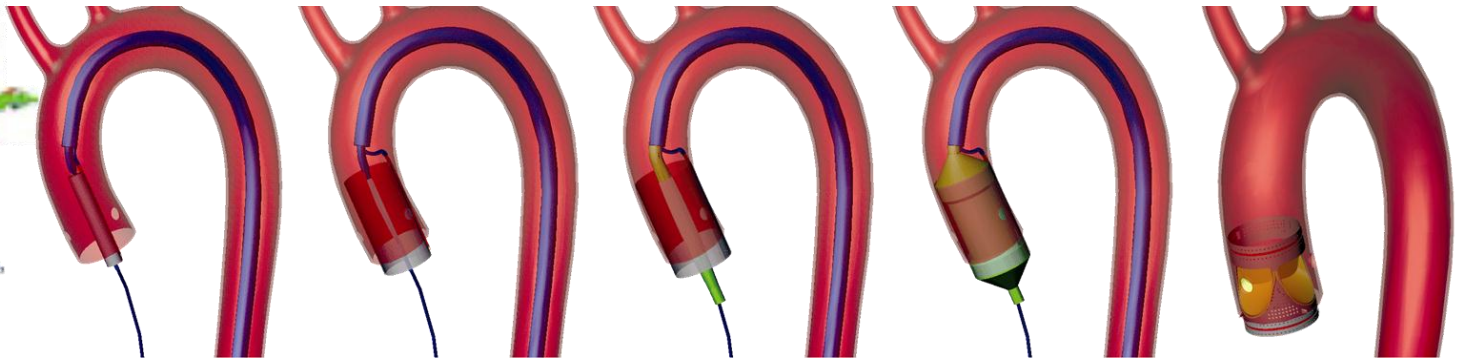
Simulation of Drug Diffusion into the Surrounding Tissue

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Cardiovascular Devices – Heart Valve



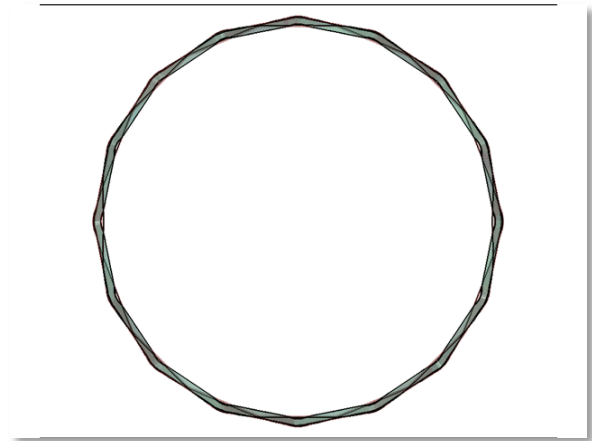
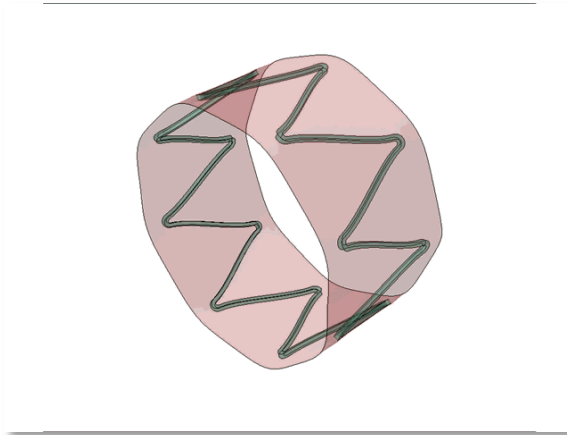
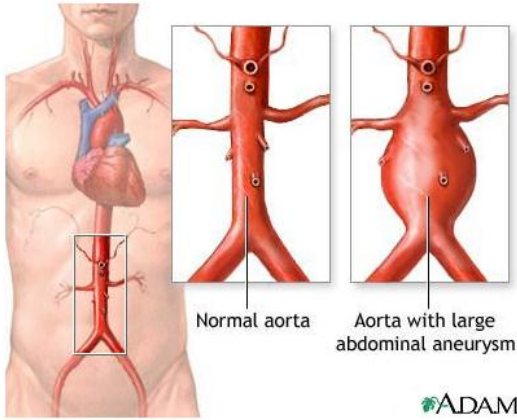
Maximum tensile strain, LEP3, (mm/mm) during flat-sheet stent roll-down, displayed on undeformed configuration.



Ref: 2004 Abaqus User's Conference, Edwards Lifesciences

Stent Mounted Heart Valves

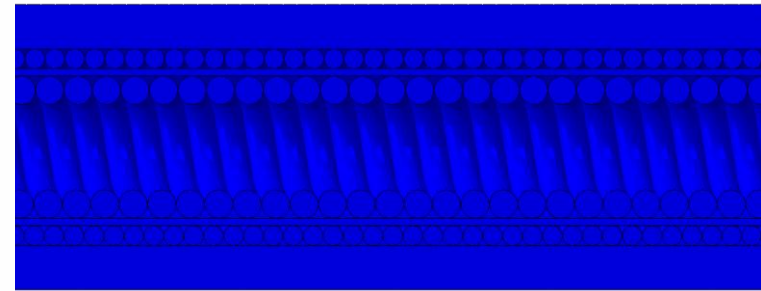
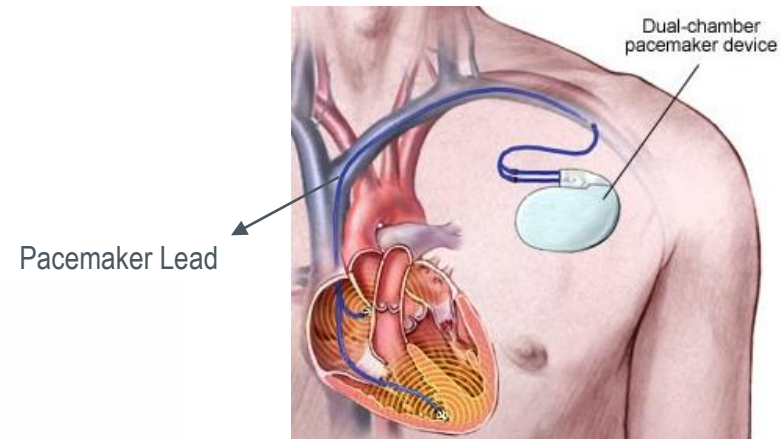
Cardiovascular Devices – Stent Graft



Stent Graft Uneven Crimping

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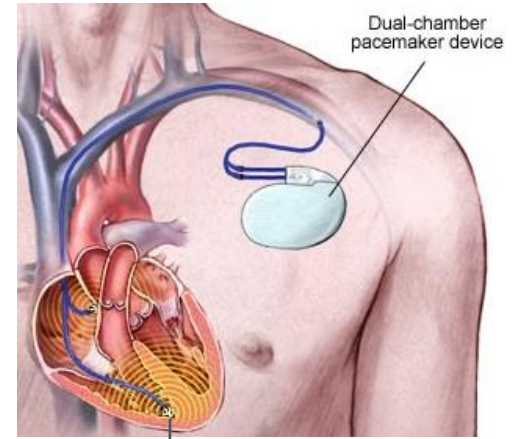
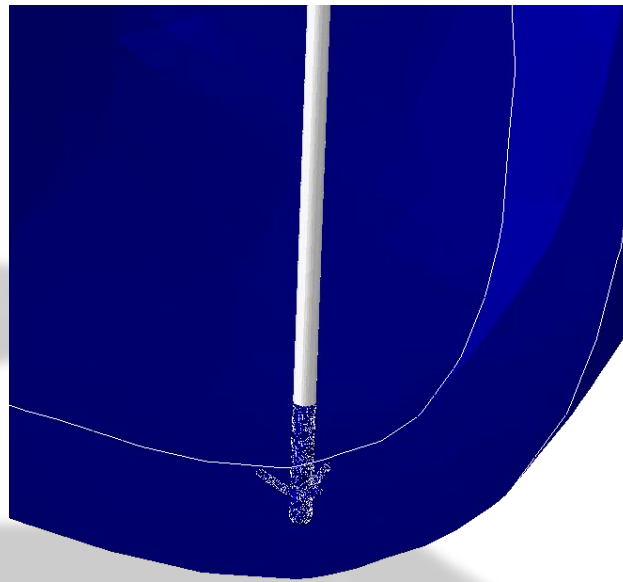
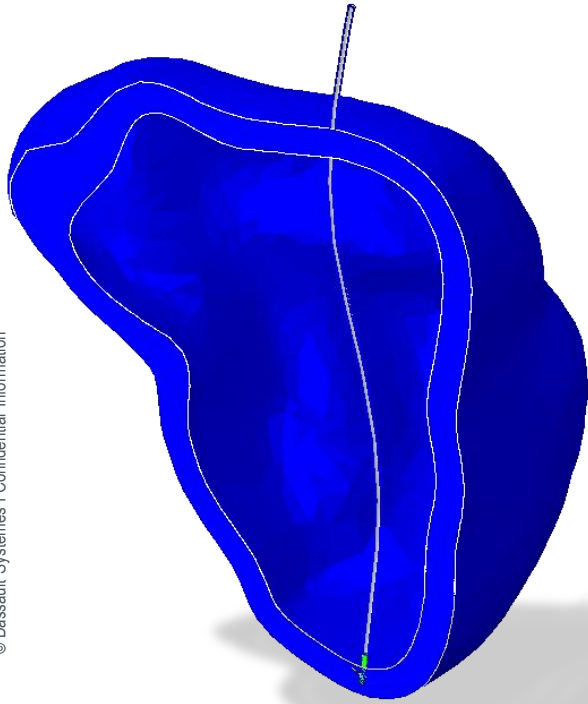
Cardiovascular Devices – Cardiac Rhythm Management



Pacemaker Lead Stress Analysis



Cardiovascular Devices – Cardiac Rhythm Management



Dual-chamber pacemaker device

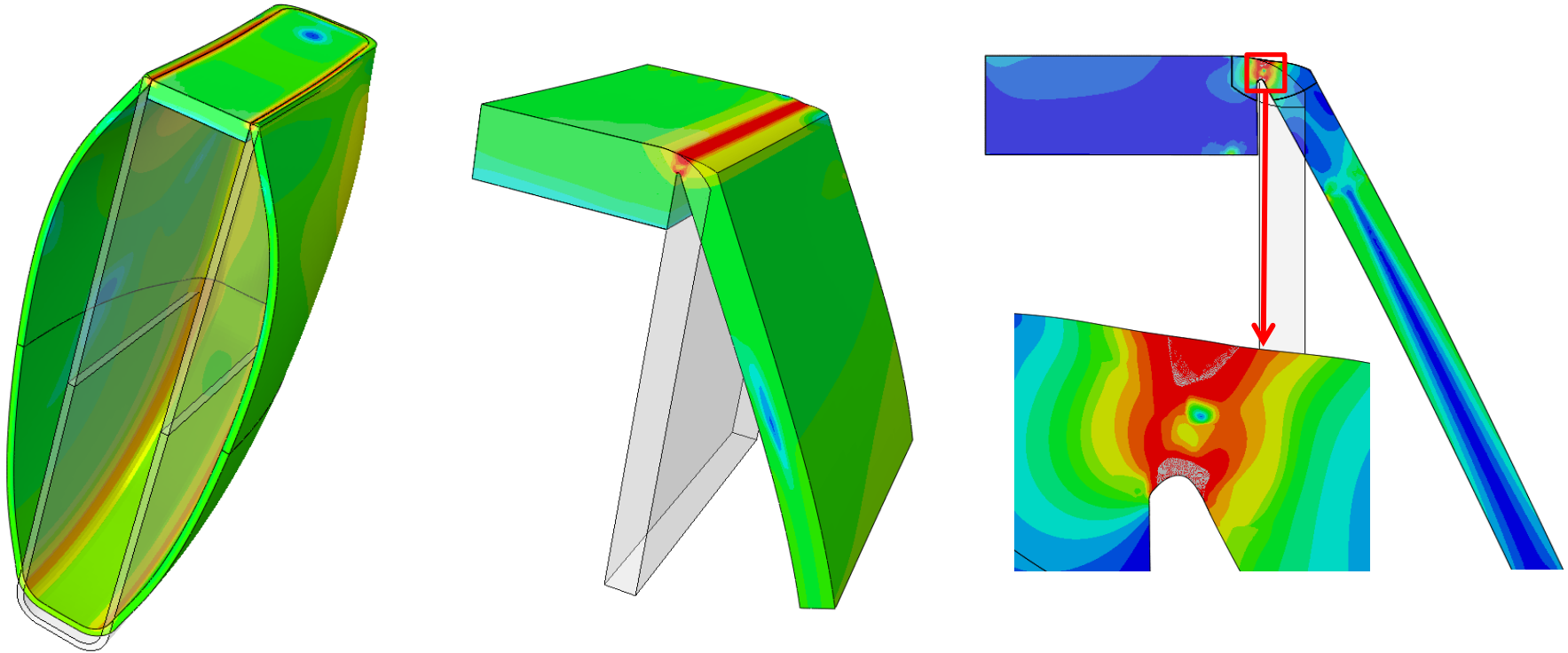
Lead Fixation

Pacemaker Lead Fixation Analysis

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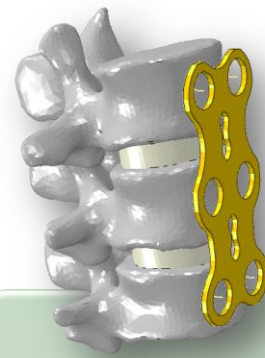
Cardiovascular Devices – Cardiac Rhythm Management



Ref: 2010 SIMULIA Customer Conference, Medtronic

Fracture Analysis of Battery Can for Implanted Pulse Generator

Orthopedics



Devices and Procedures

Joint Replacement

Surgical Planning

Body Support

Trauma Care

Why SIMULIA?

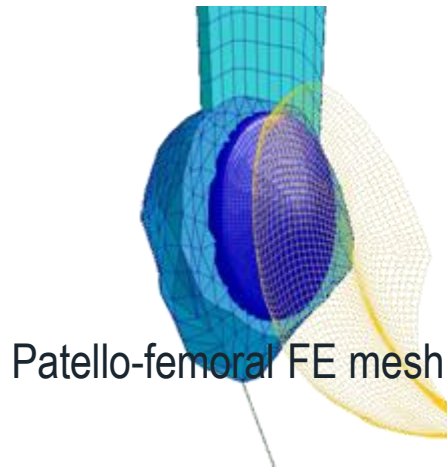
Advanced Material Models

Robust Contact and Wear Analysis

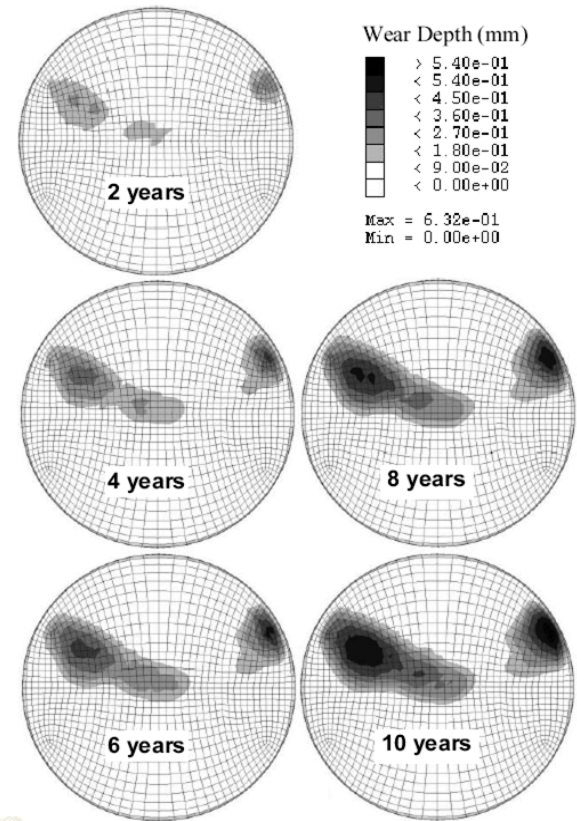
Fracture and Failure Analysis

Designer Friendly Interfaces

Orthopedics – Joint Replacements



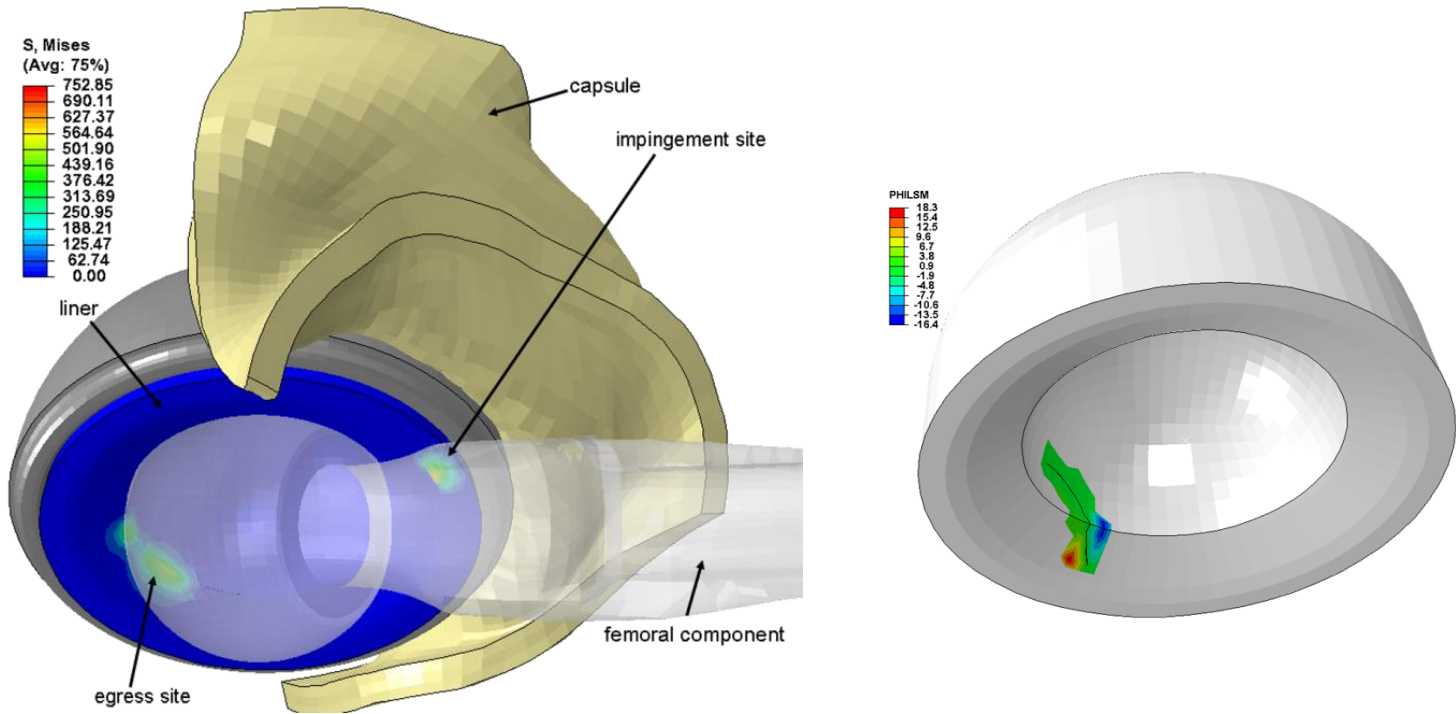
Wear depth on the patellar surface



Ref: 2002 Abaqus User's Conference, DePuy Orthopaedics

Wear Prediction

Orthopedics – Joint Replacements



Ref: 2011 SIMULIA Customer Conference, University of Iowa and SIMULIA

Ceramic Hip Socket Liner Fracture Analysis

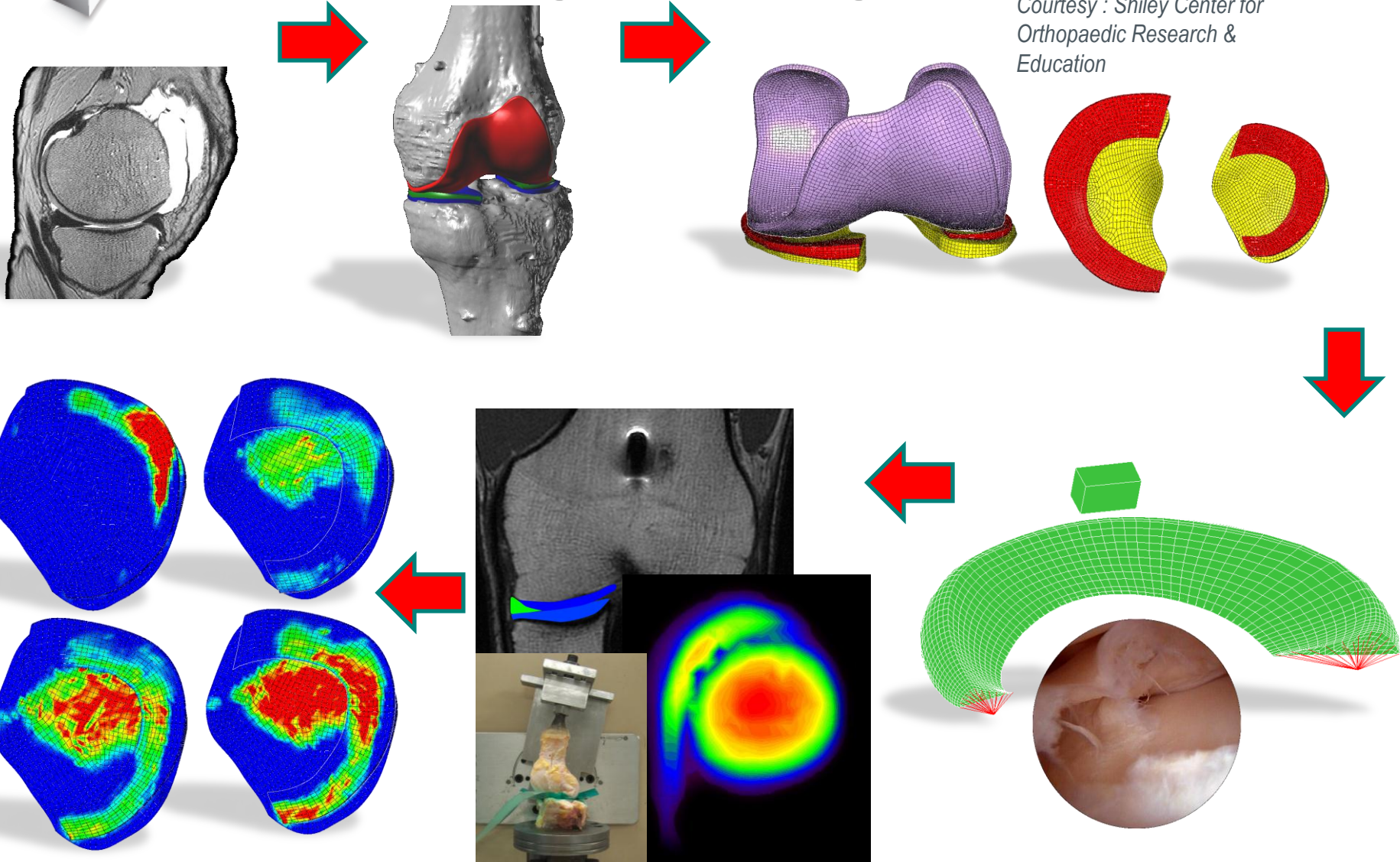
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Orthopedics – Surgical Planning

SCORE

simuleon

Courtesy : Shiley Center for Orthopaedic Research & Education



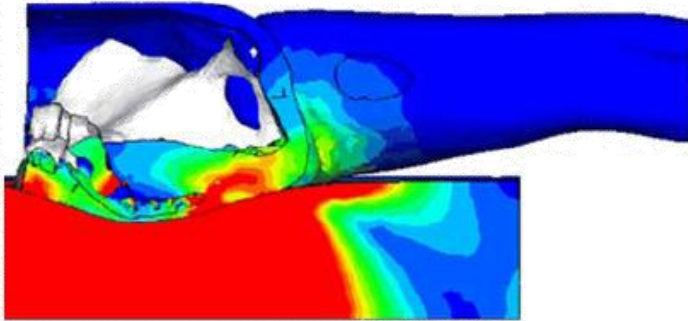
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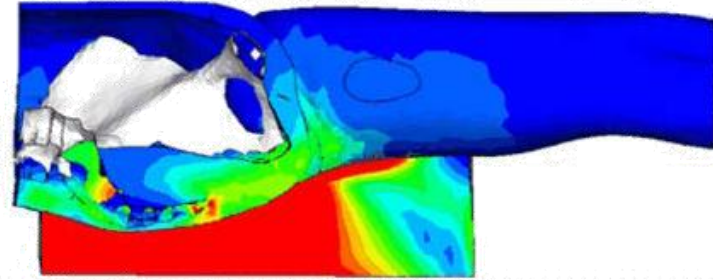
Meniscus Replacement

SIMULIA

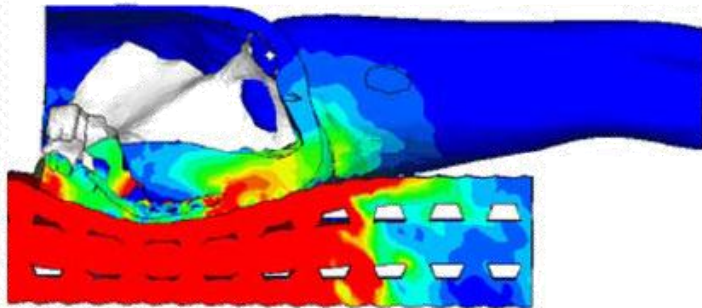
Orthopedics – Soft Tissue and Support



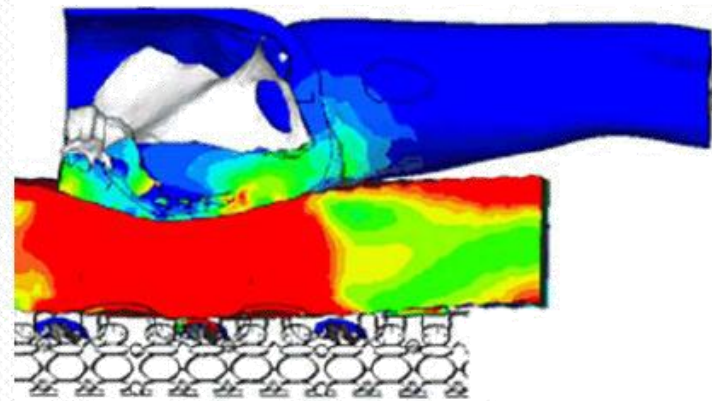
Cold-Cure Foam



Highly Viscoelastic Foam



Soft Foam Composite



Mirco-Stimulation System

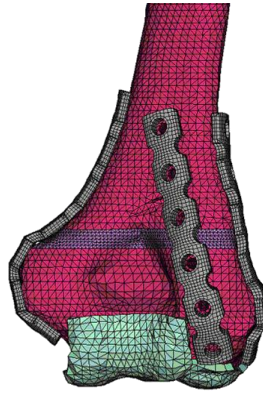
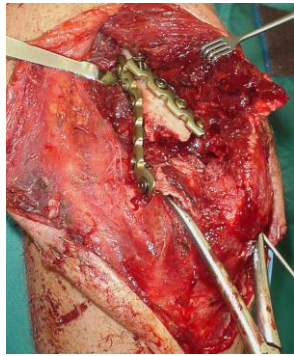
Ref: 2009 SIMULIA Customer Conference

Comparison of Body Supports to Reduce Pressure Ulcers

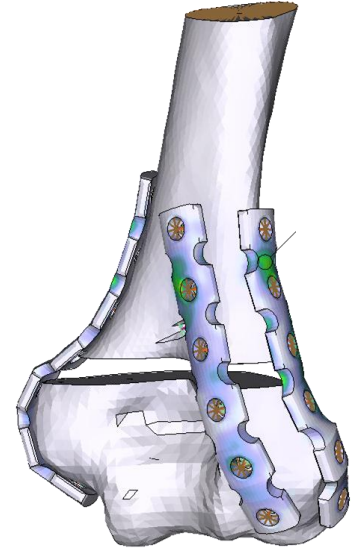
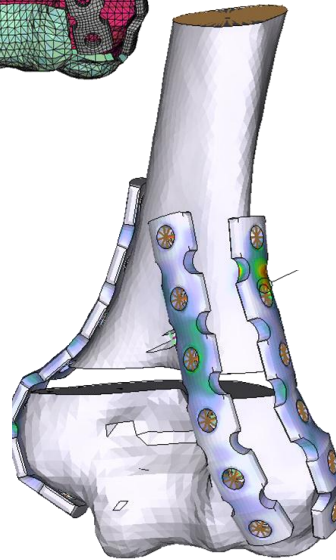
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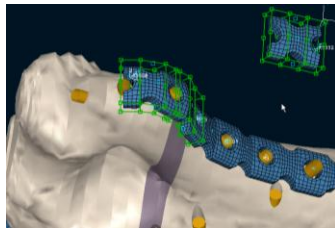
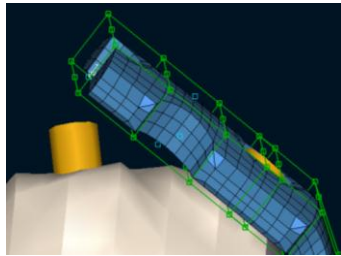
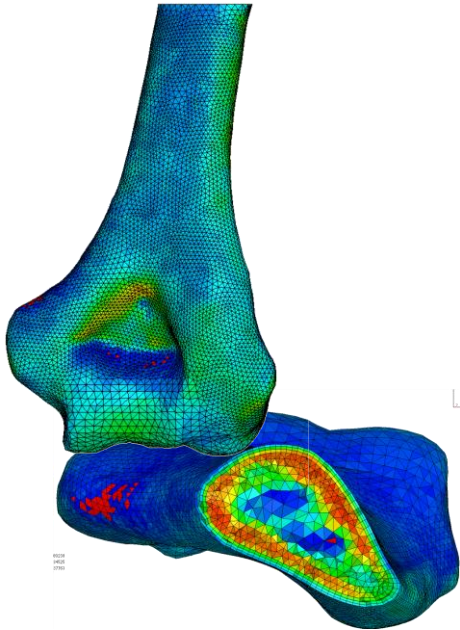
Orthopedics – Trauma Care



LASSO
Ingenieurgesellschaft mbH

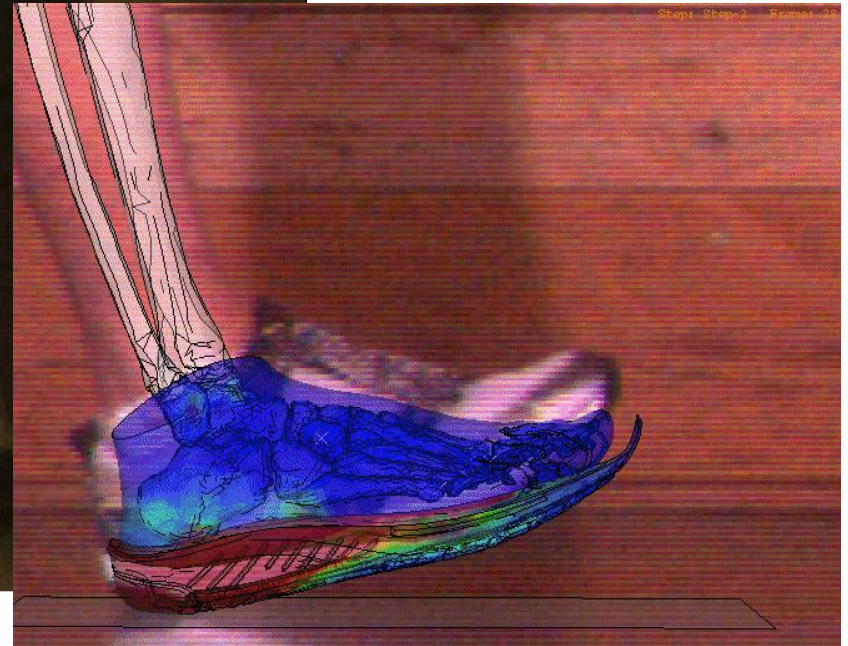


Frontal bending sagittal bending
3-PLATE configurations, stress in plates



Fixation Techniques of a Fractured Distal Humerus

Orthopedics – Biomechanics



Gait and Tissue Stress Analysis for Shoe Sole Design

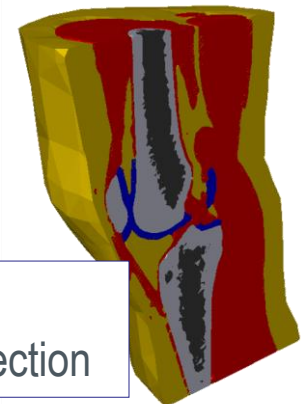
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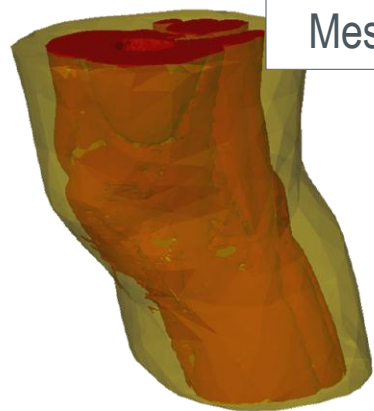
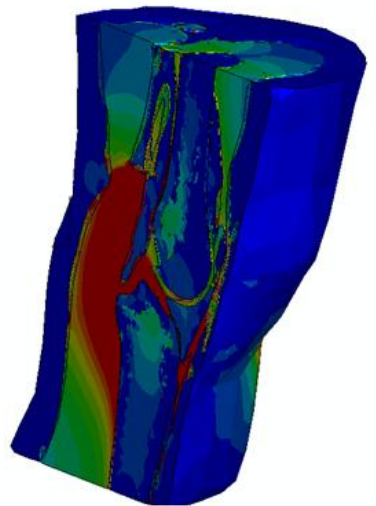
Orthopedics – Tissue Regeneration



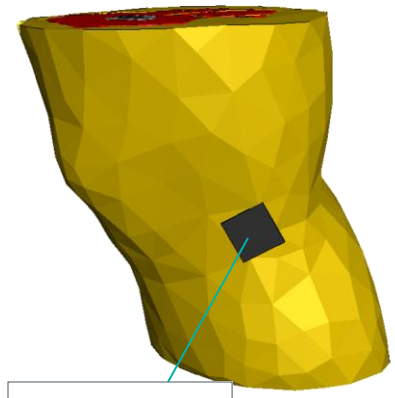
CT Scan



Model
Cross-Section



Volume
Mesh



Electrode

Optimize Electrode Location for Electrical Treatment to Regenerate Cartilage Tissue

Drug Delivery

Devices

Syringes

Automatic Injectors

Catheters and Fluid-filled
Bags

Septums

Why SIMULIA?

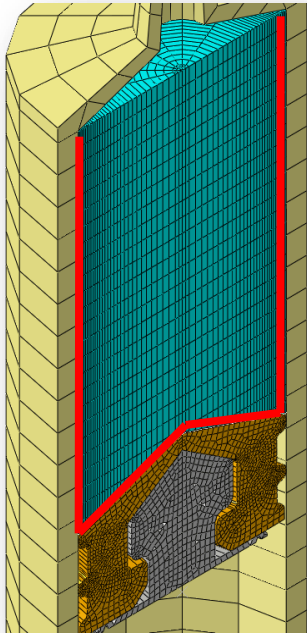
Nonlinear Large Deformation
Analysis

Robust Contact Algorithm

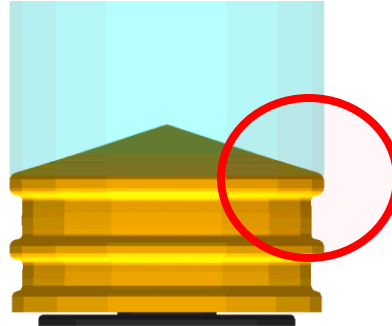
Fracture and Failure Analysis

Multiphysics Capabilities

Drug Delivery – Disposable Syringe



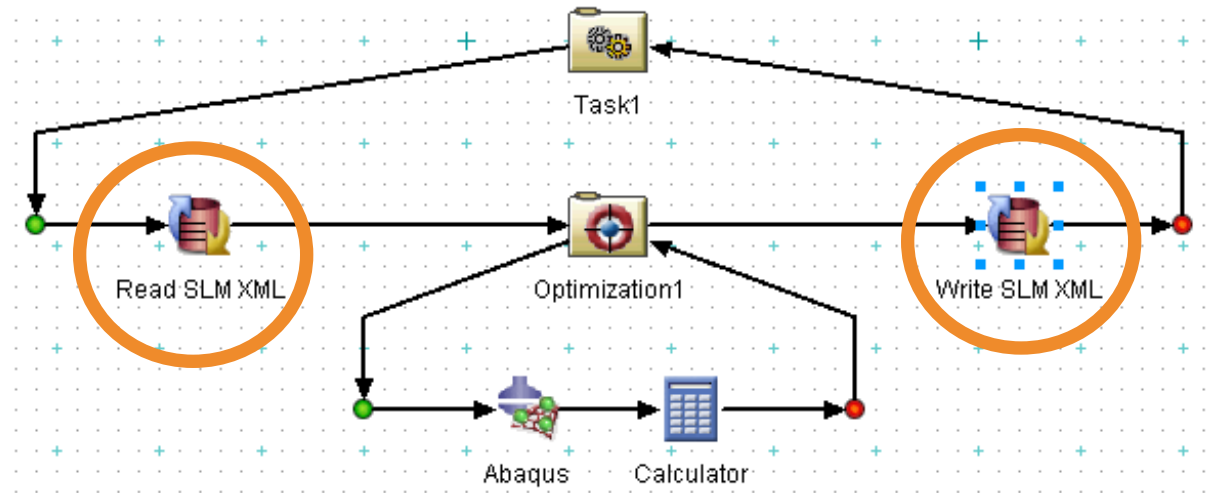
CEL Model



No side loads on plunger



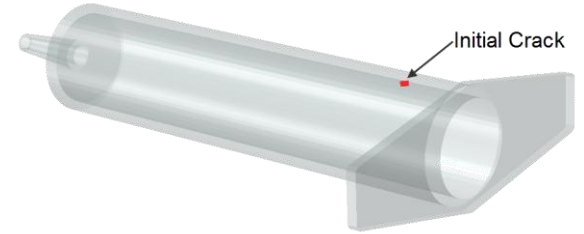
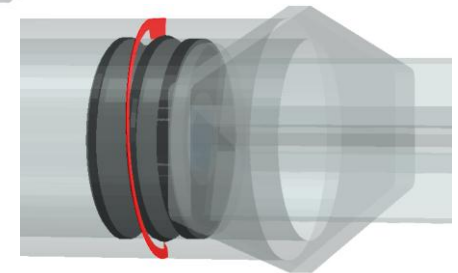
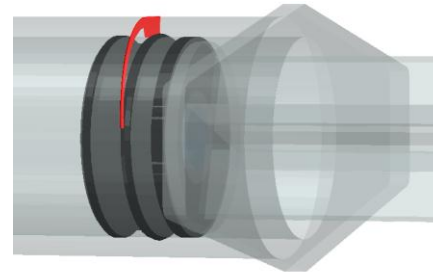
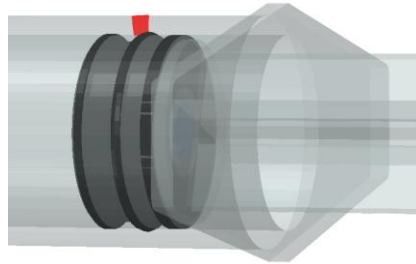
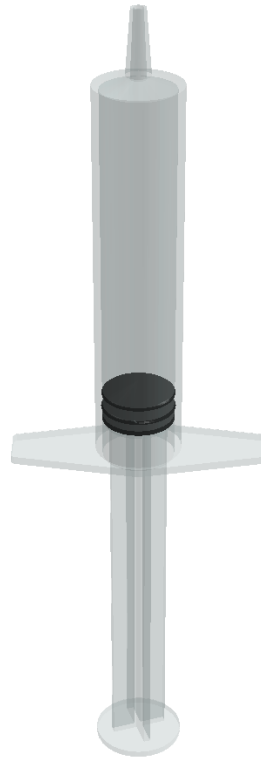
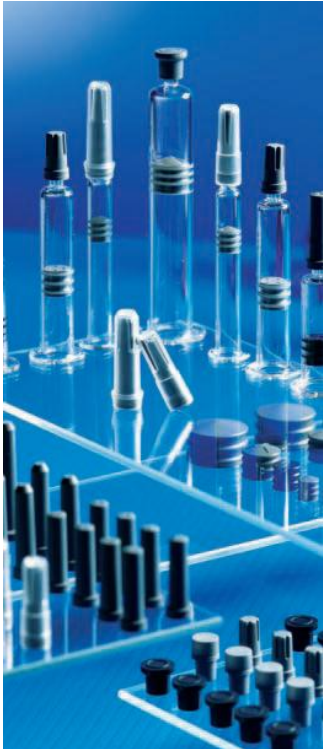
Side loads on plunger



Plunger Design Optimization Using Isight to Reduce Leakage

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Drug Delivery – Prefilled Syringe

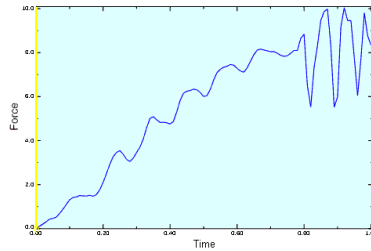


Syringe Barrel Failure Analysis

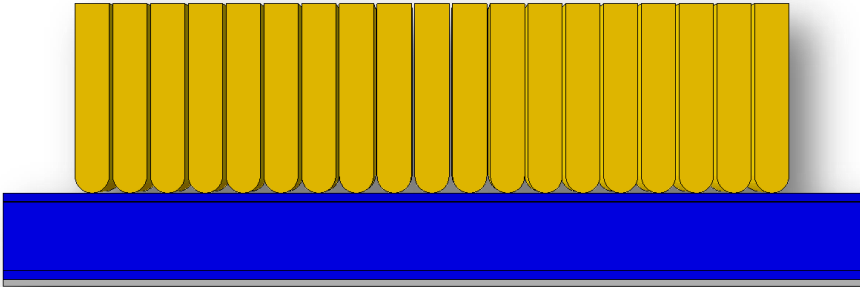
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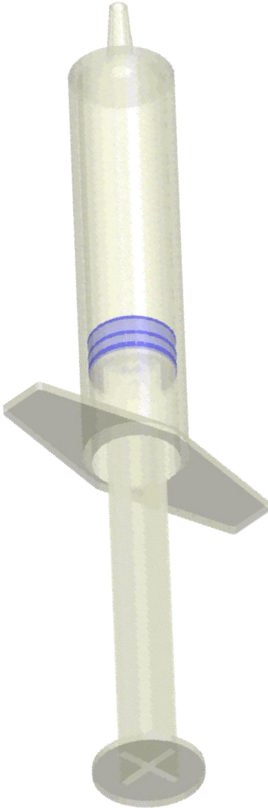
Drug Delivery



Fluid-filled catheter buckling



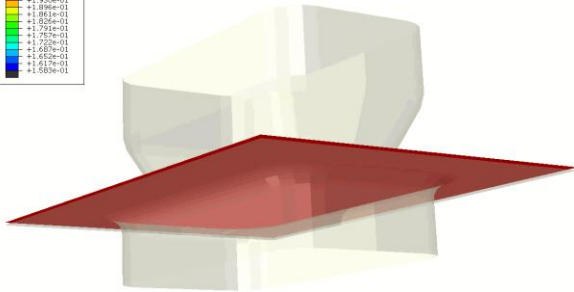
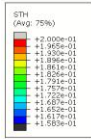
Peristaltic pump



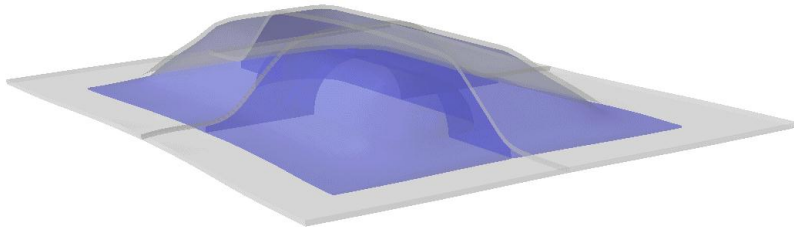
3D pressure penetration - simplified syringe leakage analysis

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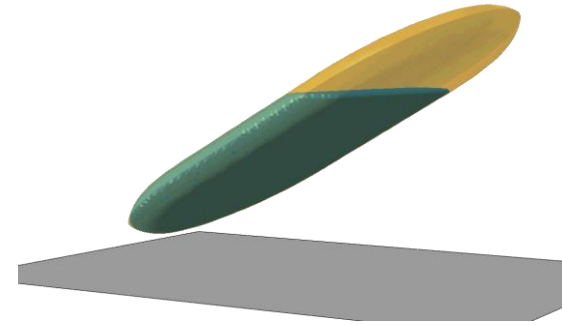
Drug Delivery – Packaging



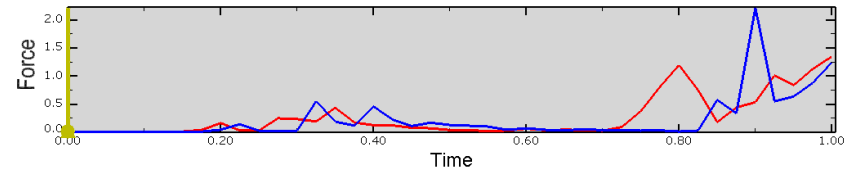
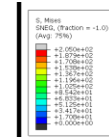
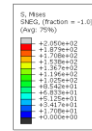
Blister pack thermoforming



Moisture/Oxygen diffusion



IV bag drop test



Peeling blister pack

Other Devices

Devices and Processes

Hearing Aids

Eye Implants

Dental Implants

Tablet Compaction

Why SIMULIA?

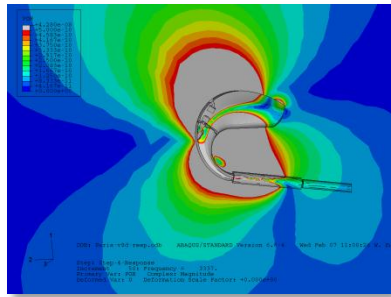
Nonlinear Large Deformation
Analysis

Robust Contact Algorithm

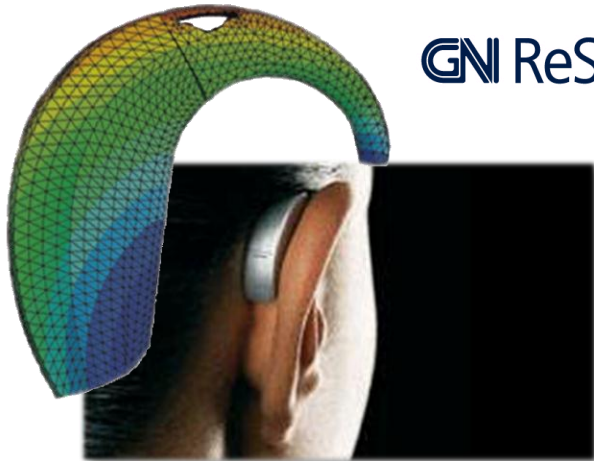
Nonlinear Material Models

Multiphysics Capabilities

Other Devices



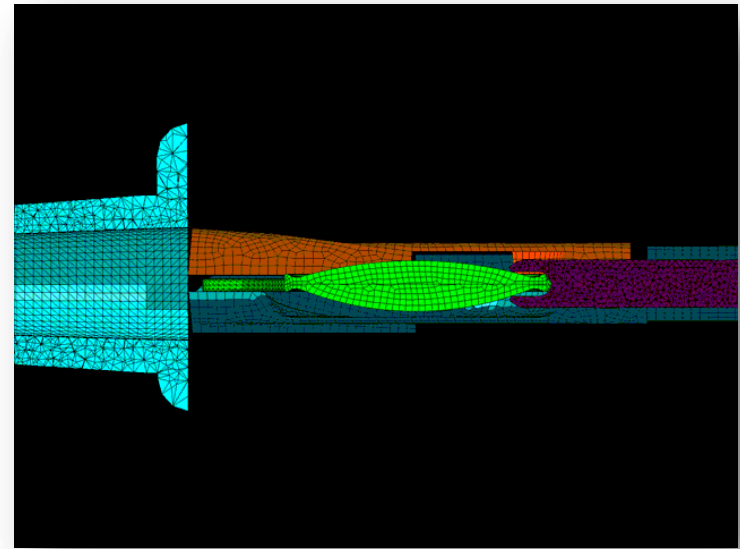
GN ReSound



Acoustic-Structural Analysis of Hearing Aid

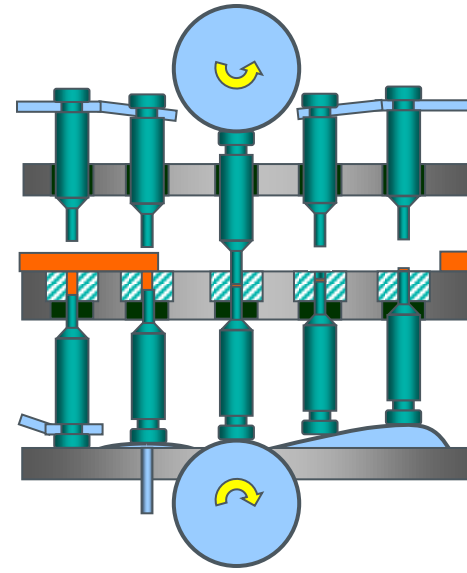
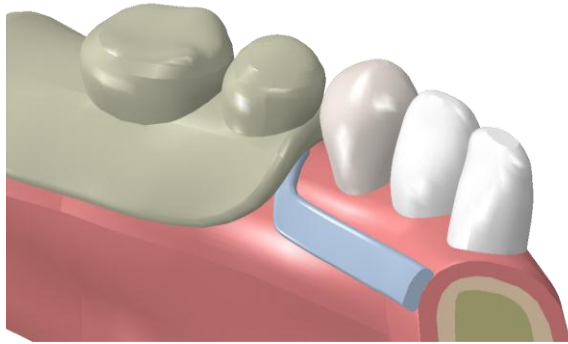


BAUSCH+LOMB

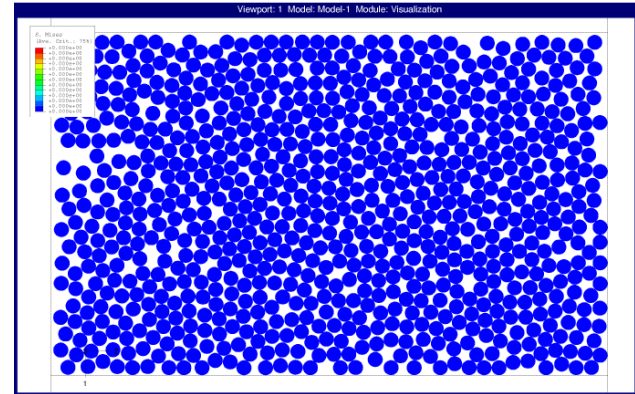
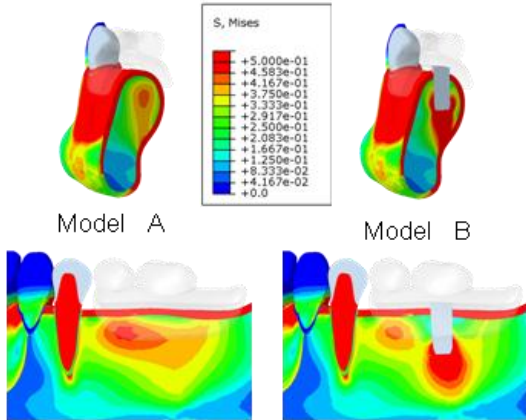


Intraocular Lens Insert

Other Devices



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Ref: 2005 Abaqus East Regional Users Meeting, Merck

2011 SIMULIA User Conference, C.M Rocha and S.M. Arndt

Tablet Compaction

Bone Remodeling Around Dental Implant






In Summary – Why SIMULIA?

Industry leading technology for materials, contact, and non-linear modeling

Leading computational mechanics researchers and material modeling developers work in SIMULIA

Our services teams have hundreds of man-years of experience in device design and assisting with submittal work

Only software company to disseminate best practices know-how to end-users



In Summary – Why SIMULIA?

Actively involved with ASME and ASTM on development of simulation guidelines for Medical Devices industry

Abaqus is the de-facto realistic simulation provider for the medical device industry

Isight has powerful tools for stochastics and probabilistic analysis and the community feels the need

We continue to push new technology areas

www.simulia.com

Public Website

- Life Sciences Solution
- Technology brief
- Knowledge database
 - Customized extensions
- Events and webinars
- Customer Conference papers
- Customer References
- Realistic Simulation News

The screenshot displays the Simulia website interface. At the top, there's a navigation bar with 'SOLUTIONS' and 'Life Sciences' highlighted. The 'Life Sciences' section features a 3D anatomical model of a human torso and text describing the challenges of simulating medical devices. Below this, there's a 'Technology Briefs' section with a list of topics like 'Abaqus FEA' and 'Aerospace'. The 'My Support / SIMULIA Online Support System (SOSS)' section shows a search interface with a search bar, filters, and a list of 7 answers available. The 'Cardiovascular Devices' section includes a 'Customer Reference' for Sunshine Heart, Inc., featuring a 3D model of a heart and a 'C-pulse heart pump's cuff' with a stress analysis visualization.

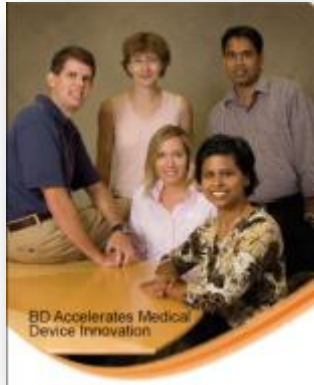
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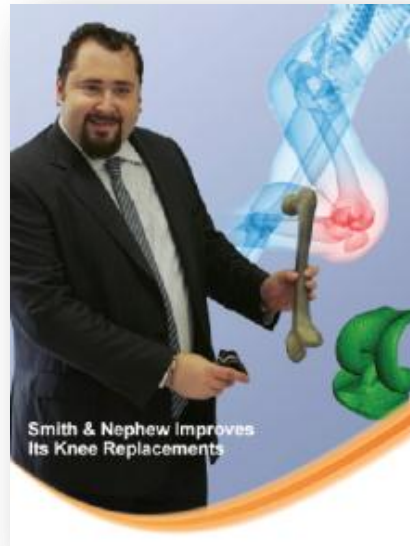
Realistic Simulation News

Recent issues

BD





Smith & Nephew



Kimberly-Clark



- 
Smith & Nephew
 - knee replacements
- 
Mobelife
 - personalized hip implants
- 
Wölfel
 - automotive seat comfort
- 
Bausch + Lomb
 - cataract lens insertion
- 
University of Denmark
 - skull fracture
- 
Haddassah University:
 - femoral fracture fixation

SIMULIA in Medical Devices Industry

