Nonlinear, Transient Dynamic Analysis

LS-DYNA – Engineering Services, Sales and Training

At Predictive Engineering, we pride ourselves for our ability to idealized complex structures and systems into accurate numerical models. When it comes to nonlinear, transient dynamic analysis, we are experts in getting LS-DYNA to do the near impossible.

We have direct validated experience in:
- Drop-test analysis per 49 CFR 173 or MIL-STD-810E
- Airplane seat analysis per TSO-C127a / SAE AS8049A / 14 CFR Part 25.562 for the 16g sled test
- Blast analysis for protective design per PDC-TR 06-08 and CSA S850-12
- Nonlinear material modeling of plastic, elastomeric and foam modeling for the sporting goods industry
- Simulation of medical equipment from orthopedic screws, endoscopic tools (cables and tubes), syringes, cardiac tools and dental equipment
- Extensive experience in nonlinear analysis of plastics from multi-shot assemblies, thread designs and even drink cups
- Impact analysis of a broad range of systems from composite structures, structural steel frames, engine stands, mining digger teeth, cameras and locomotive fuel tanks
- Burst containment analysis of high-speed rotating turbines and medical equipment (x-ray scanning equipment)
- Fracture simulation in glass and ceramic composites
- Pyro-shock analysis of military devices
- Hyperelastic seal design (e.g., O-rings) for medical devices, truck components and coffee cups
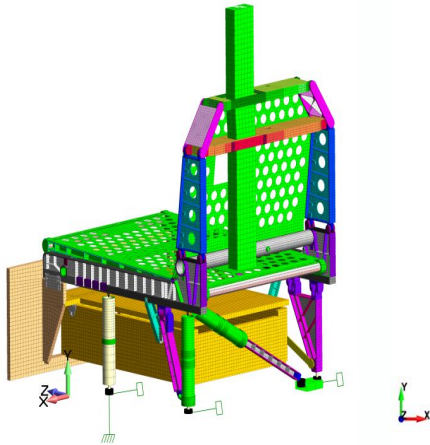
Our hard-fought experience comes from over 20 years of continuous use of LS-DYNA in solving some of the toughest nonlinear static and dynamic analysis problems. If you would like to know more, please feel free to contact us.

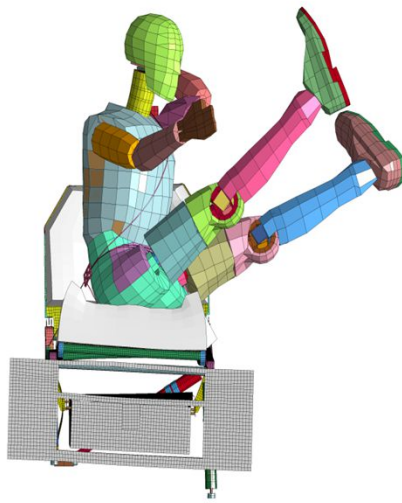FINITE ELEMENT ANALYSIS
PredictiveEngineering
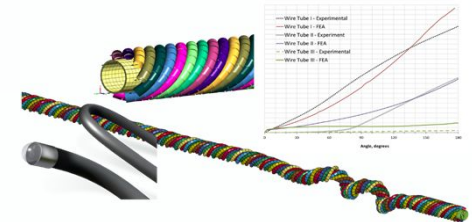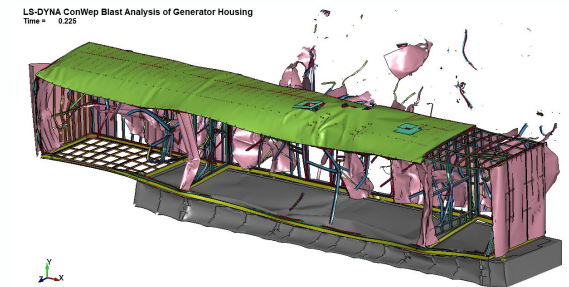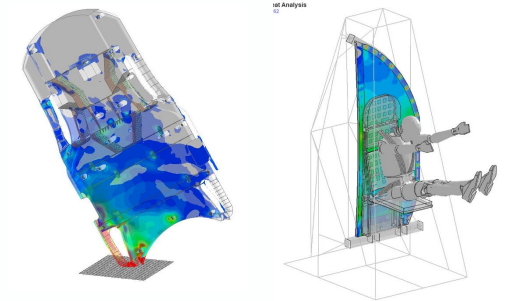
16g Seat Crash Test
TSO-C127a / SAE AS8049A / 14 CFR Part 25.562

Bus Seat Durability Simulation and FMVSS 210

FEA Model

FEA + LS-DYNA Model

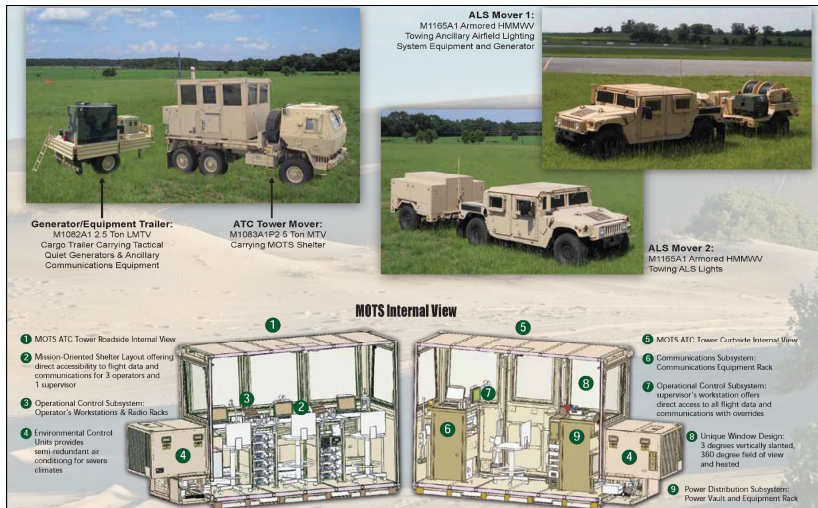**Validation is Gold**
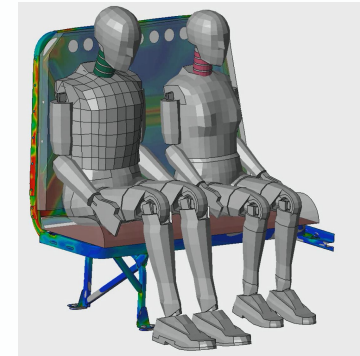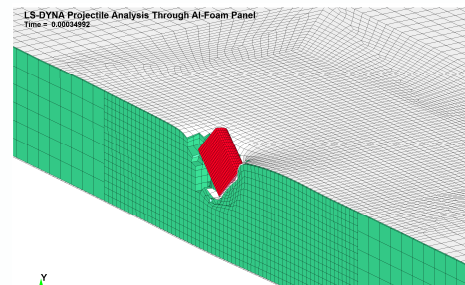

Aviation Attendants Seat – 16g
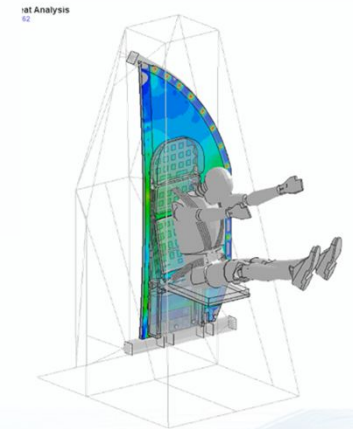
Passing the FAA 16g sled test is no trivial matter for highly optimized aluminum and composite airplane seats. The objective of this LS-DYNA study was to ensure that the client's seat could be validated against the test sled results and that subsequent seat versions would pass "the first time".
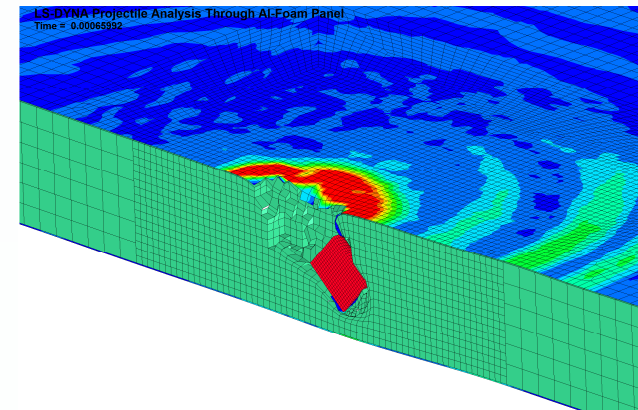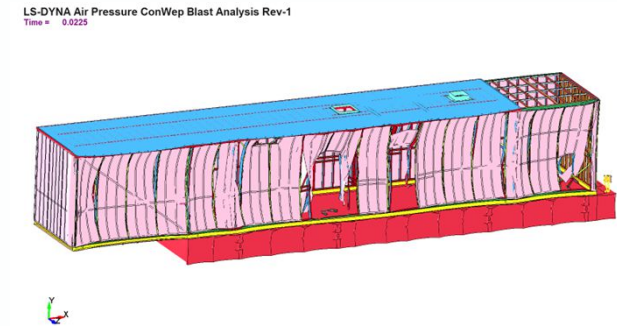
Projectile Penetration and Blast Survivability Analysis
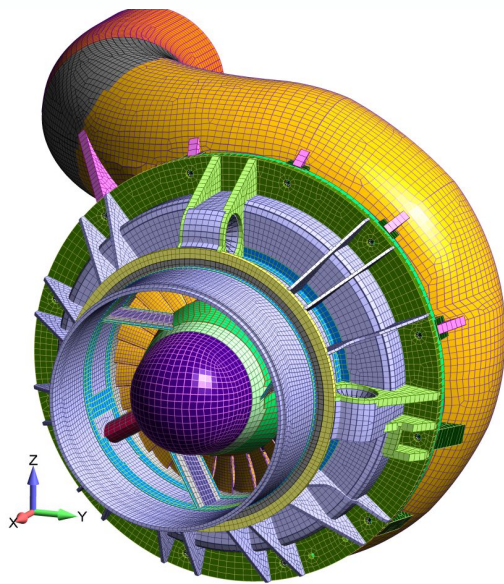

Ballistic Analysis of Composite Panels

LS-DYNA Projectile Analysis Through Al-Foam Panel
Time = 0.00034992

CONWEP Blast Survivability

LS-DYNA Air Pressure ConWep Blast Analysis Rev-1
Time = 0.0225

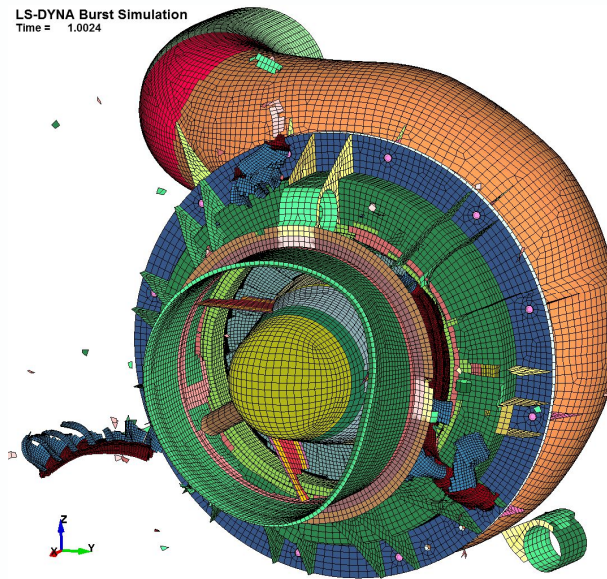LS-DYNA Projectile Analysis Through Al-Foam Panel
Time = 0.00065992

A projectile penetration study was conducted to assess the protective capabilities of a standard aluminum skinned foam sandwich panel. These types of panels are commonly used to create lightweight truck-mounted mobile shelters. For this analysis work, a section of the panel was idealized into a shell and brick FEA model. The panel was subjected to a secondary ballistic impact penetration of a grenade fragment falling at terminal velocity. The results allowed the client to meet their design requirements without experimental testing.
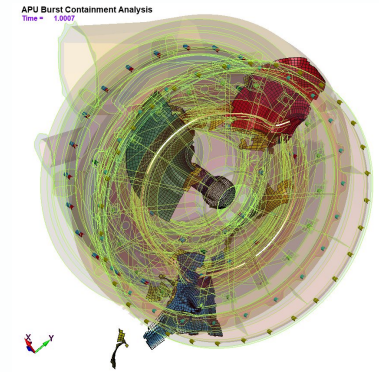
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Turbine Blade-Out and Rotor Burst Simulations
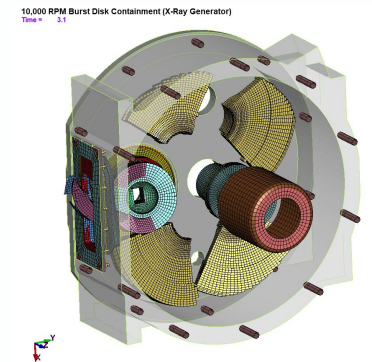

LS-DYNA Burst Simulation
Time =   1.0024

APU Blade-Out Containment

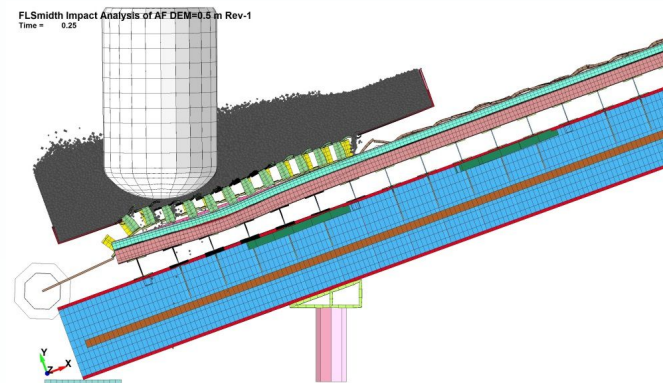APU Burst Containment Analysis
Time =   1.0007

Tri-Burst Rotor Containment
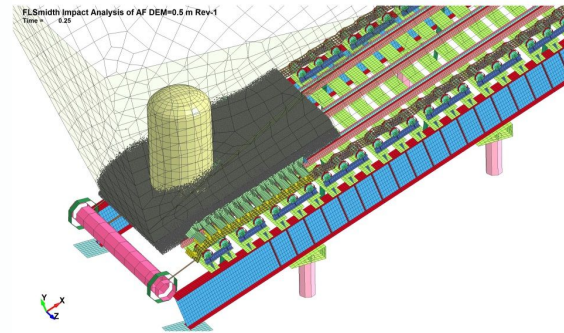
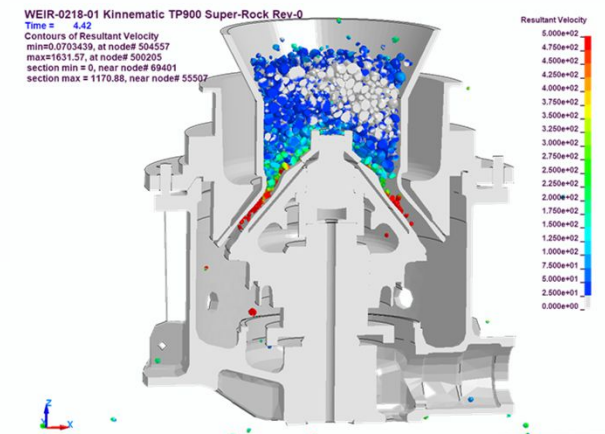10,000 RPM Burst Disk Containment (X-Ray Generator)
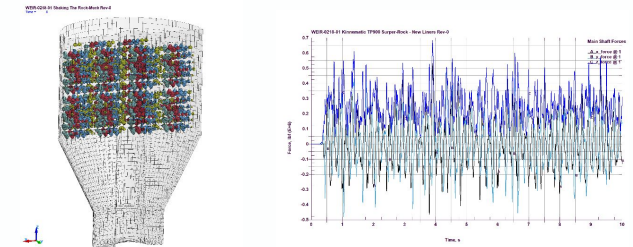Time =   3.1

LS-DYNA turbine burst simulation of an air drive power turbine.   Analysis work led to significant costs and schedule savings; e.g., each simulation was approximately $5k and four days as compared to the burst tests at over $100k and 30 days.

Mining and Mineral Comminution Simulations

FLSmidth Impact Analysis of AF DEM=0.5 m Rev-1
Time = 0.25

Dynamic simulation of high-speed cone crusher to extract loads for fatigue analysis
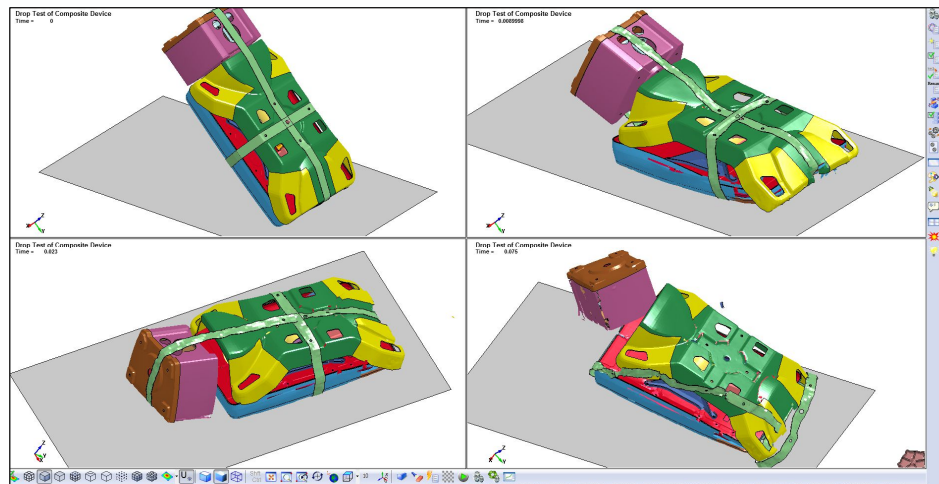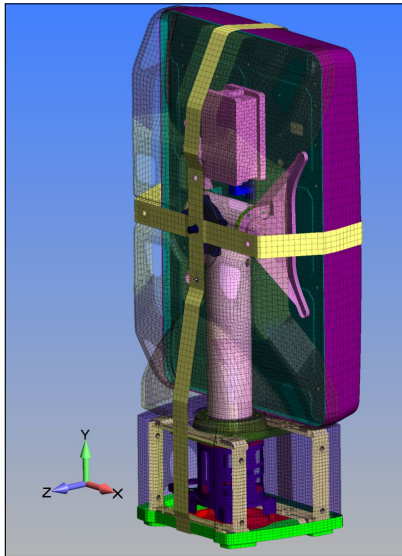

LS-DYNA was used in a combined structural / DEM model for the simulation of a large rock-drop on an apron feeder (AF) commonly used within the mining industry. Results show that if the AF is kept full of material, damage from the impact of large rocks is almost completely mitigated.

FLSmidth Impact Analysis of AF DEM=0.5 m Rev-1
Time = 0.25

WEIR-0218-01 Kinnematic TP900 Super-Rock Rev-0
Time = 4.42
Contours of Resultant Velocity
min=0.0703439, at node# 504557
max=1631.57, at node# 500205
section min = 0, near node# 69401
section max = 1170.88, near node# 55507

Virtual Drop Test of Electronics, Composites and Containers

Nuclear Waste Containers

Hand-Held Electronics

An ultra light-weight carbon fiber composite electronic device was drop tested through a range of 26 positions (MIL-STD 810e). The shell of the unit was a blend of carbon and Kevlar layers for increased impact resistance. The finite element model was used to document experimental drop test failures and then to implement solutions. The modeling results were reviewed by a team of external experts and accepted for production.
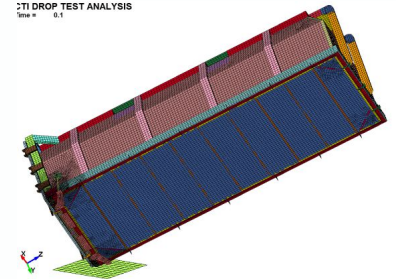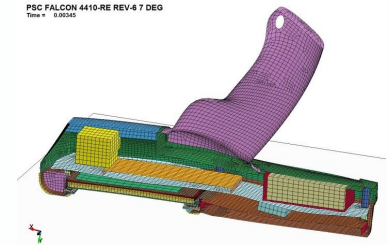
Large Composite Aerospace Structures

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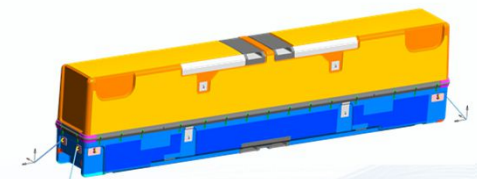
Medical Simulations – Endoscopic, Orthopedic, Syringes,
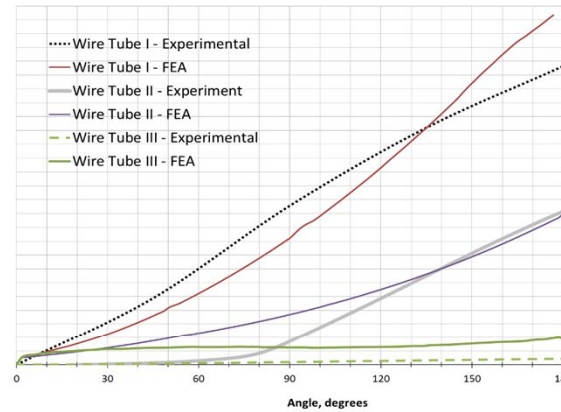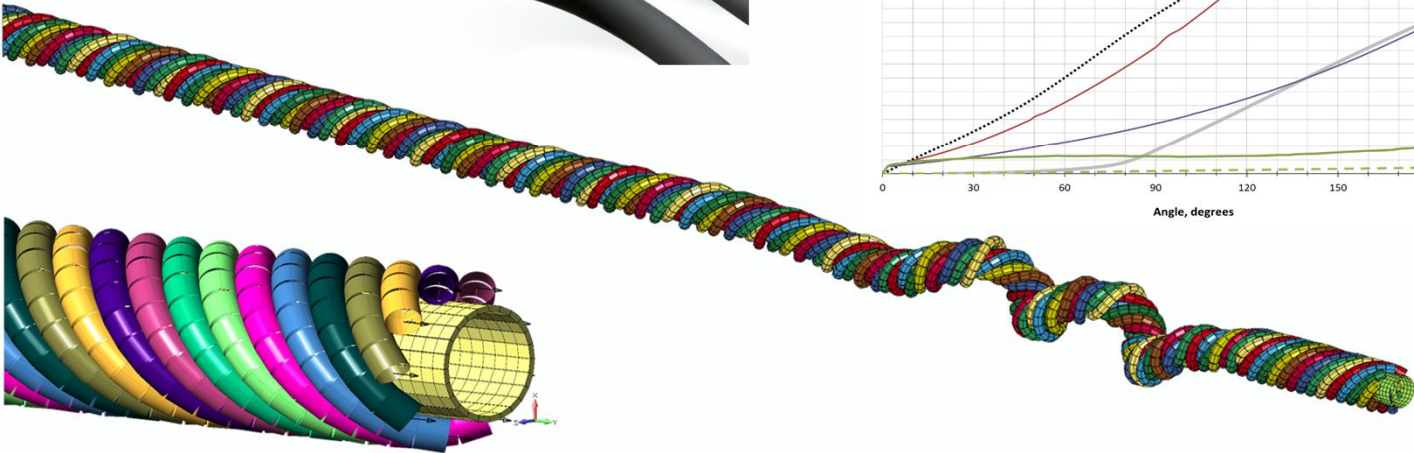
All-Plastic Snap-Fit Syringe
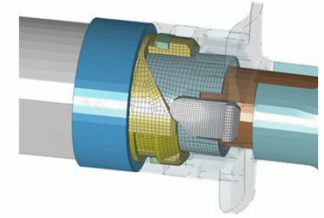
Titanium Ceramic Spine Screw
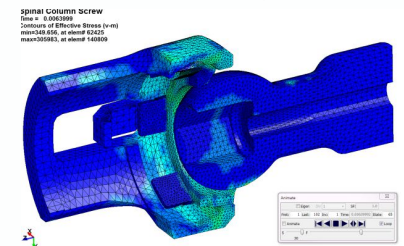

Human Biometrics Fit and Function
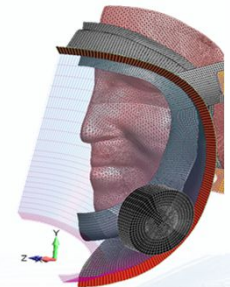
Robotic endoscopic surgery requires the use of highly engineered steel micro-cables and helical hollow strand (HHS) tubes. The wire tube shown above is the main structural component that allows endoscopic probes to navigate through arterial systems. It must be flexible yet capable of sustaining high torque loads without buckling. An LS-DYNA model was constructed and correlated to one set of experiment data. Based on these results, two other HHS models were created and shown to correlate directly to the experimental results. This out-of-the-gate correlation demonstrates that FEA modeling can be a predictive tool for the development of the next generation of these tools.

Crash Simulations (Std and Composites) and MASH 2016 TL-3

MASH 2016 TL-3 25 Degree Barrier Crash

Large Vehicle Crash Simulations
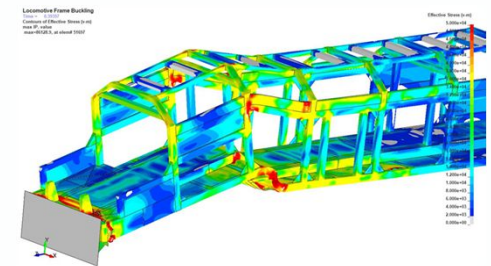

ASME RT-2-2014 – Rail Crash Stability
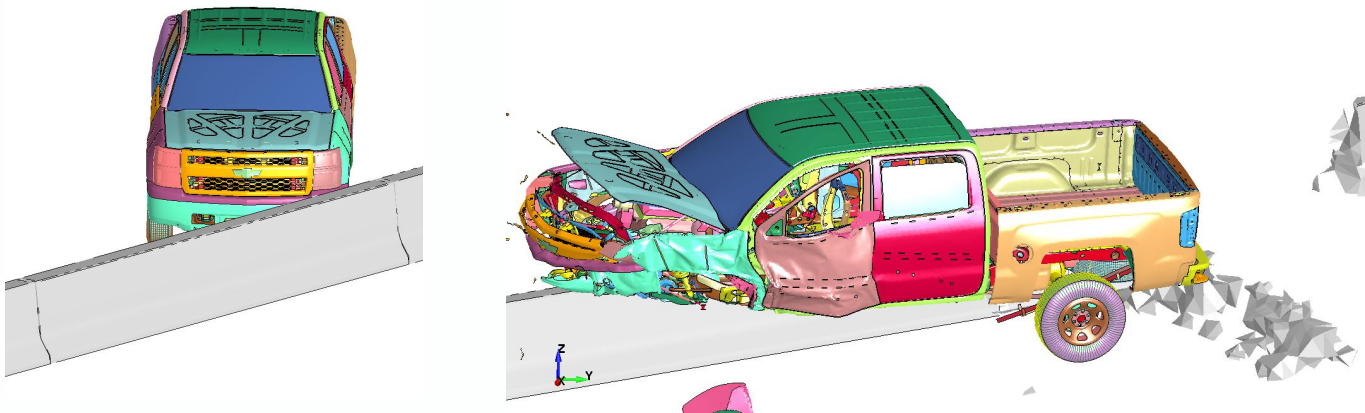
Crash simulations represent the combination of extensive material modeling expertise with core LS-DYNA experience. Predictive Engineering has experience in crash simulations across various industries outside of the standard automotive business. Our understanding of barrier materials, from concrete to steel, is derived from our engineering team's background in material science and we specialize in the construction of complicated simulations, whether for MASH 2016, large-vehicle crash simulations or composite "crash" simulations.

**ITAR Composite "Crash"
{That we can't talk about...}**

Purchase LS-DYNA Software from Predictive Engineering – Dedicated Technical Support and Training

LS-DYNA® from <u>ANSYS-LST</u> is the world's most advanced general-purpose nonlinear finite element program. At Predictive Engineering, we are longtime experts in LS-DYNA software and can help you buy LS-DYNA and then guide you through the acquisition, licensing, installation, support and <u>in-depth LS-DYNA training</u>. We like to say that we don't sell LS-DYNA but we advocate LS-DYNA to clients where it will make them money.