DatapointLabs

technical center for materials

+

matereality

a DatapointLabs affiliate

EST 1995

ISO 17025 Quality

Inc. 5000 America's Fastest-Growing Private Companies

materialsphere

Materials

Testing ¤ Software ¤ Data Infrastructure

Providing an Experimental Basis in Support of FEA

Hubert Lobo

Heritage

- 1986 - Cornell Injection Molding Program (CIMP)
  - Research: Properties of molten plastics for CAE
- 1995 - Datapoint Testing Services
  - Commercialization: Properties of plastics for molding CAE
- 1998 - TestPaks Alliance Program
  - Partnerships with FEA companies – properties & modeling for FEA
- 2000 - Company rebranded as DatapointLabs
  - Supporting 8 simulation codes for plastics
- 2002 - Matereality started
  - R&D to create multivariate material database for plastics
- 2014 - Today
  - Testing any materials any properties, supporting 34 CAE codes
  - Super-database+software to analyze and transform material data

Trends

- CAE and the single physical prototype
- New, lighter materials replacing metals
  - Non-linear, multivariate behavior
  - Effect of processing and environment not considered
- Test data are part of Enterprise PLM core
  - Engineering knowledge is captured by the system
  - Globally accessible

Single Physical Prototype Concept

- Adopt CAE
- Use accurate material representations
- Verify & Validate
  - Baseline correlation
- Perform upfront iterative virtual design
  - Simulate process
  - Simulate use
- Build and test single prototype

Today's Materials Landscape

- Metals
- Plastics
- Rubber
- Foam
- Composite
- Paper

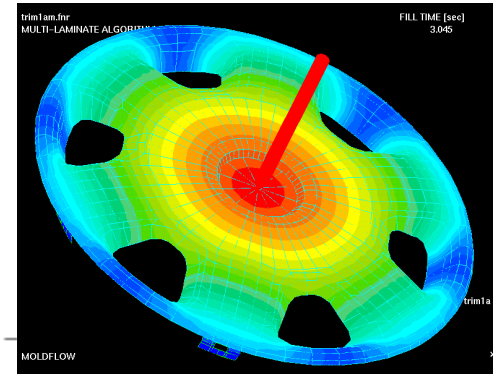
–Aerospace
–Automotive
–Appliance
–Biomedical
–Consumer products
–Electronics
–Industrial Goods
–Materials
–Petroleum
–Packaging

Plastics FEA

plastics

testing

CAE conversion



Your CAE

- Plastics testing and CAE material parameter conversion
  - Elastic, MISO, viscoelastic, creep, fatigue
  - High strain rate data for crash
  - Thermoforming/blowmolding properties
  - Injection-molding CAE data
  - DIGIMAT MX - directional properties for mold analysis to FEA

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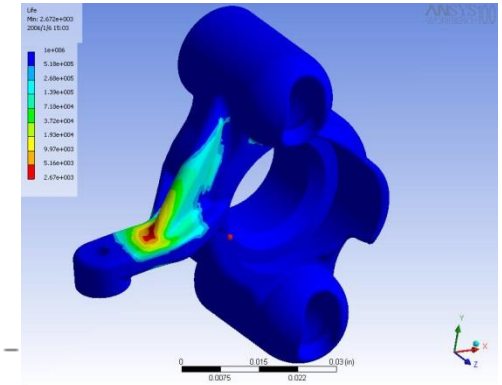
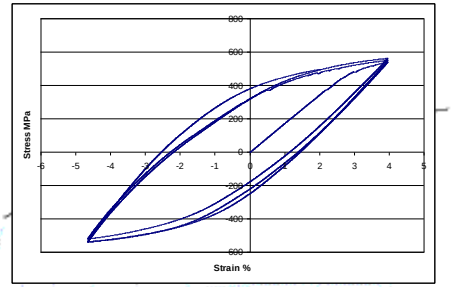
Metals FEA

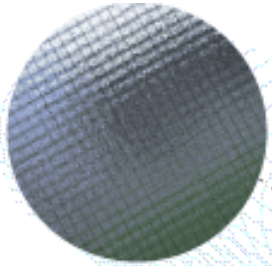


Your CAE



CAE conversion

testing



metals

- Metal testing and CAE material parameter conversion
  - Elastic, elasto-plasticity, Chaboche (cyclic)
  - Lankford parameters
  - High strain rate data for crash

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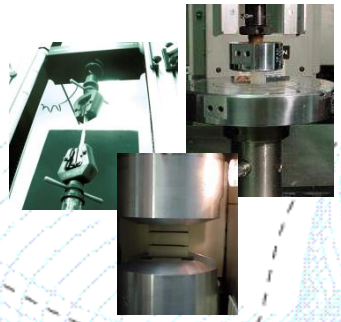
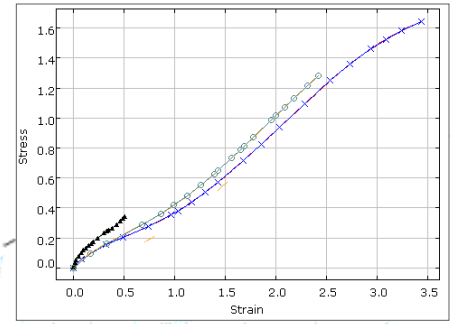
Rubber FEA

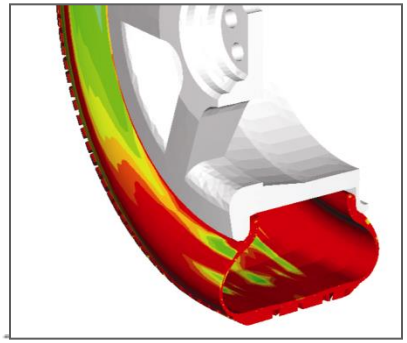
rubber



test



conversion



Your CAE

- Rubber testing and CAE material parameter conversion
  - Hyperelastic, viscoelastic, Ogden foam
  - High strain rate data for impact
  - -40C to 150C

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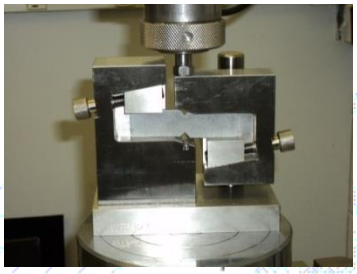
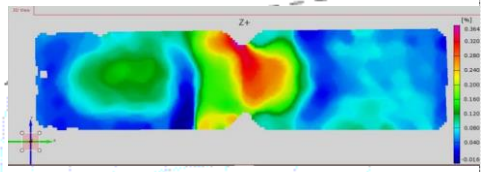
Composites FEA

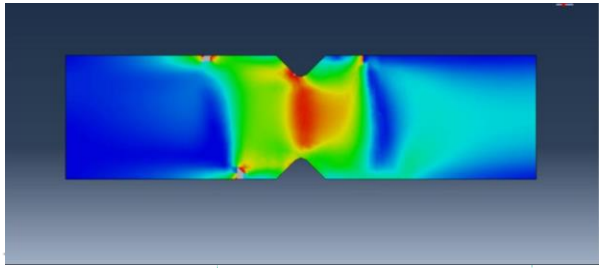
composite



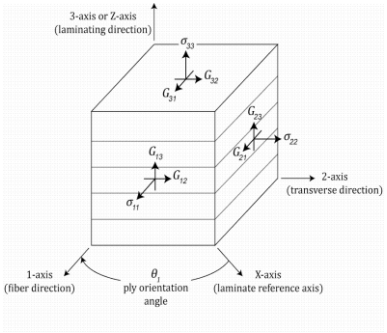
testing



DIC conversion



Your CAE



- Composite testing and CAE material parameter conversion
  - Directional shear moduli and failure
  - Directional elastic moduli

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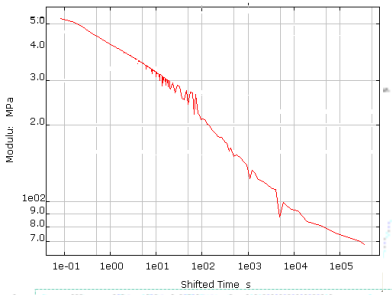
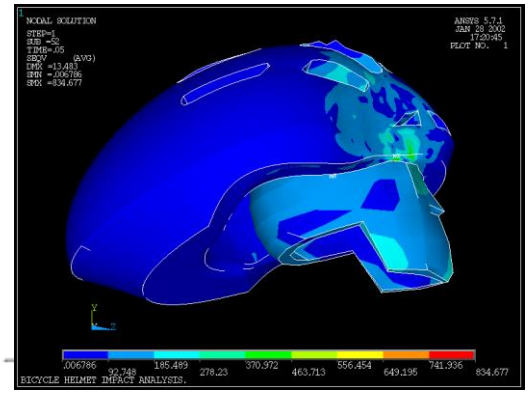
Foams FEA

foams

testing



conversion



Your CAE

- Foam testing and CAE material parameter conversion
  - Ogden foam, anisotropic foam, viscoelasticity
  - High strain rate compression for crash

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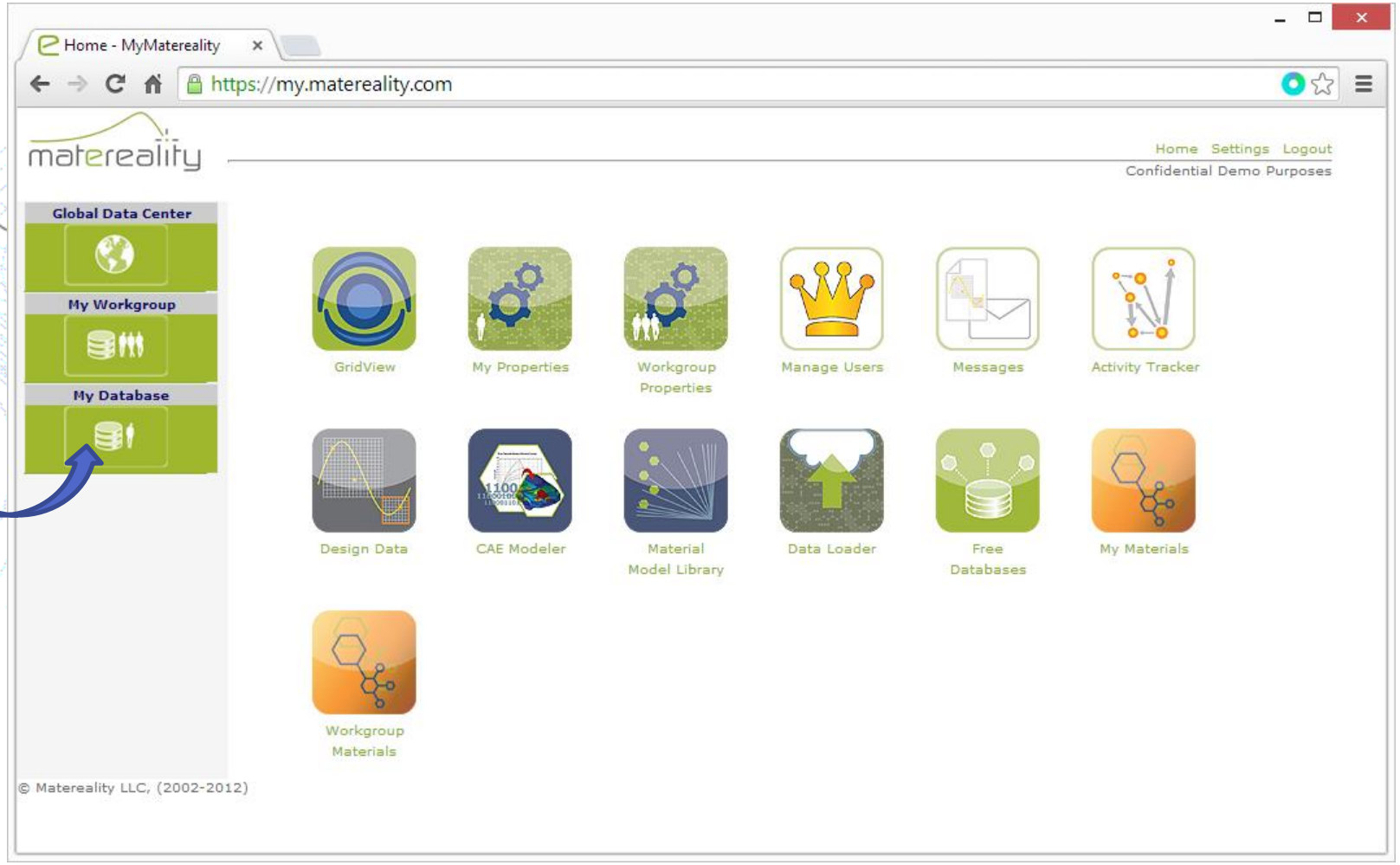
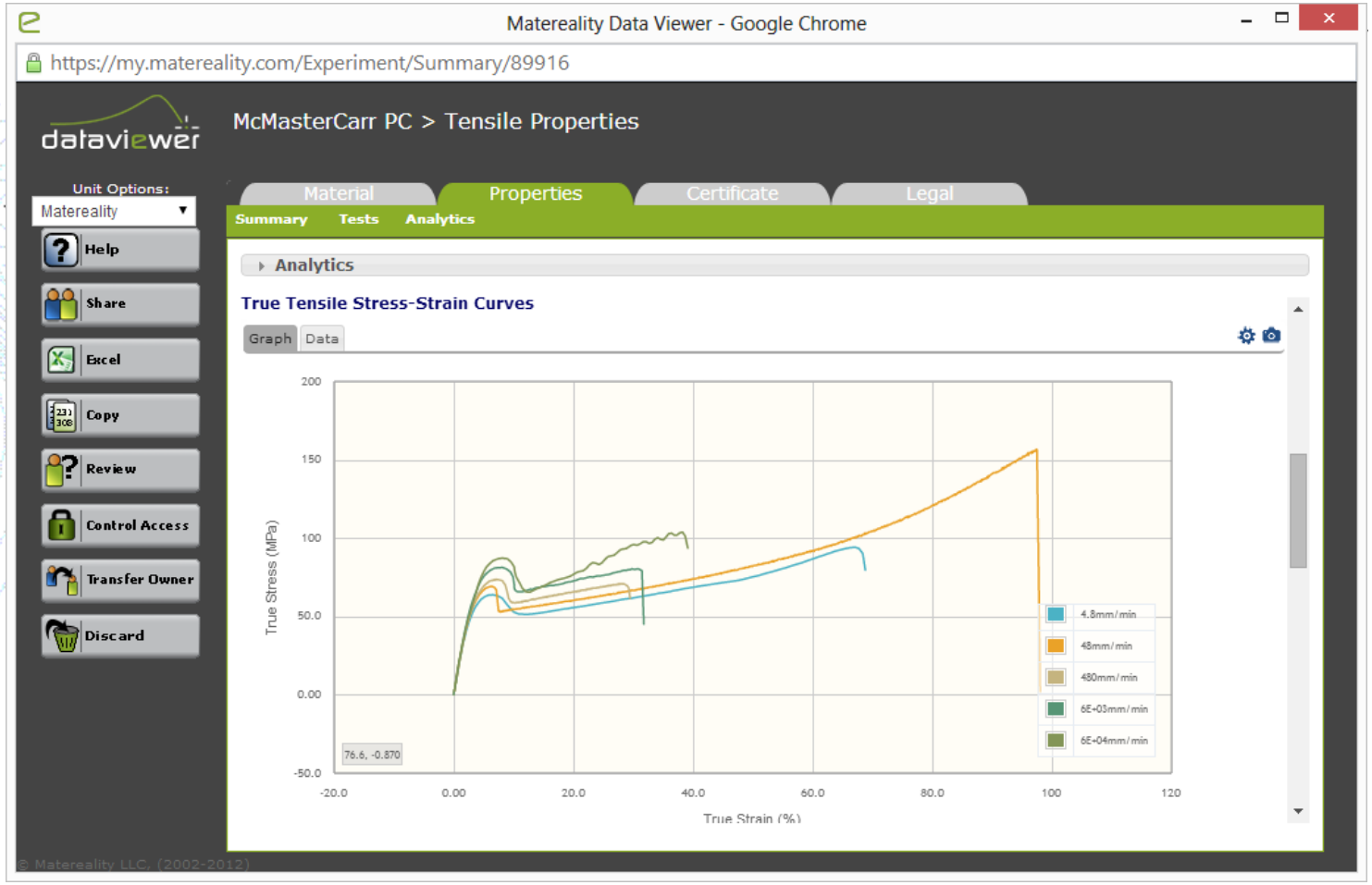
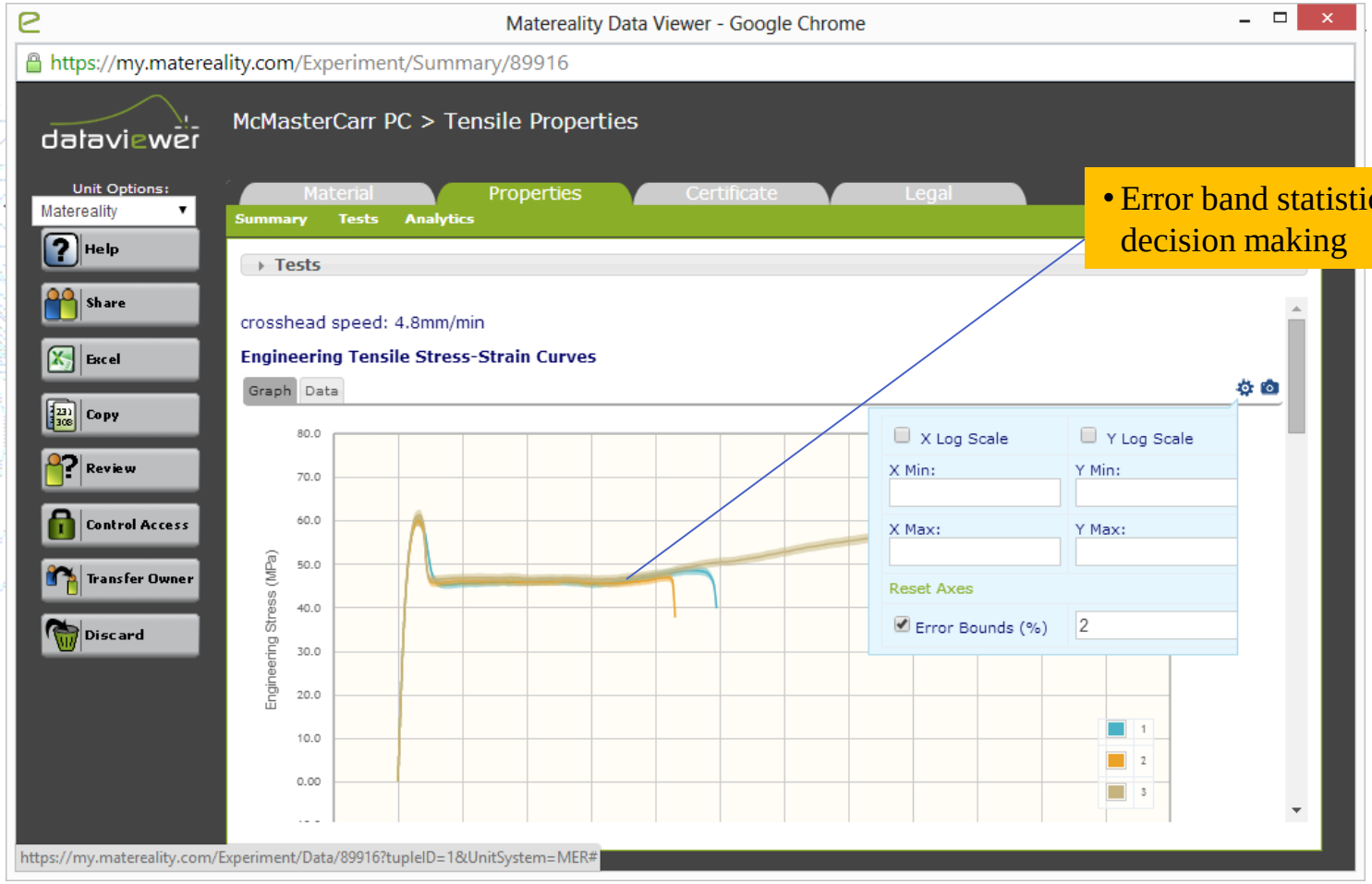
We Upload Your Data



Automated Analytics

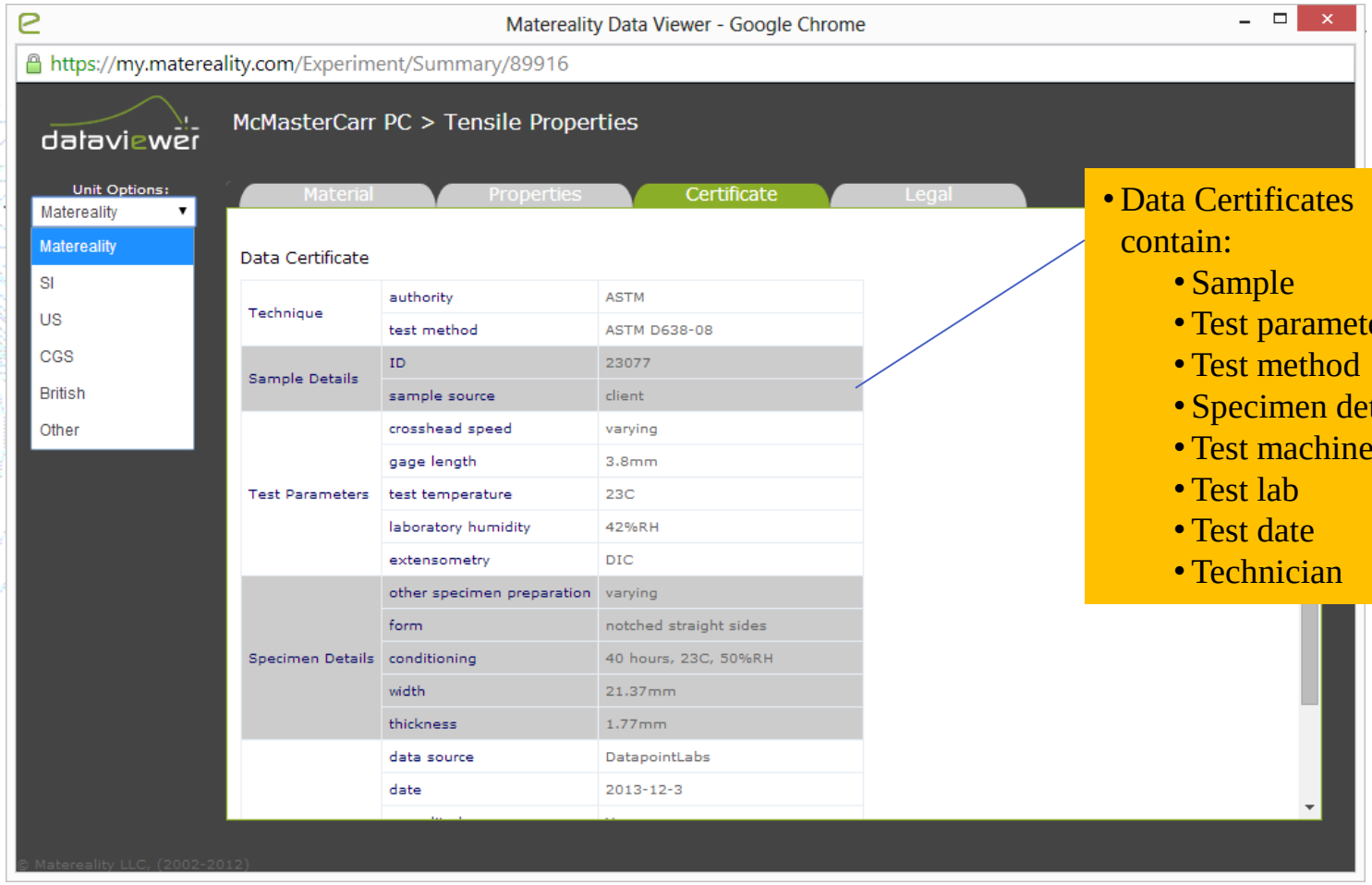


Variability Analysis



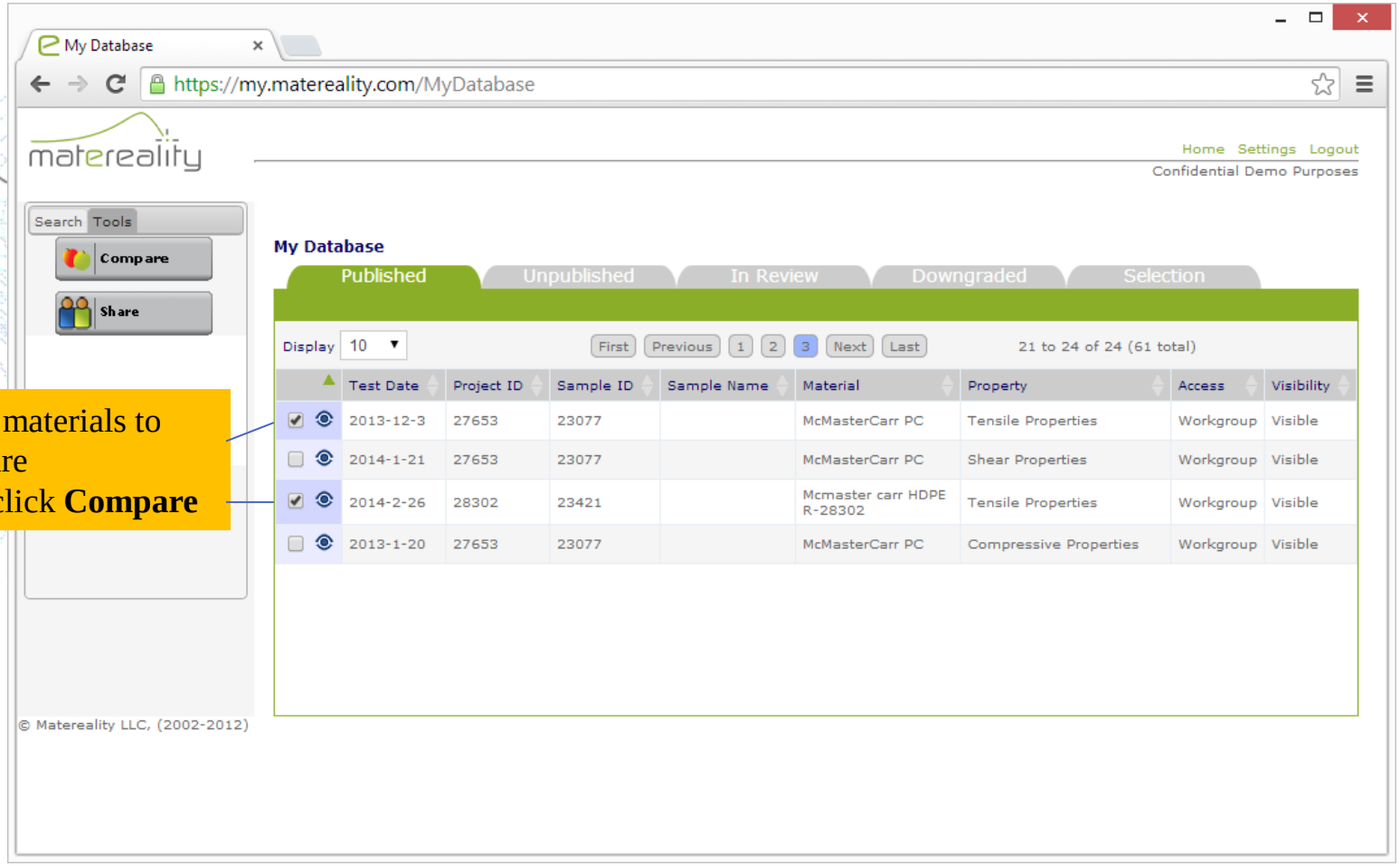
- Error band statistics aid decision making

ISO 17025 Compliant Traceability



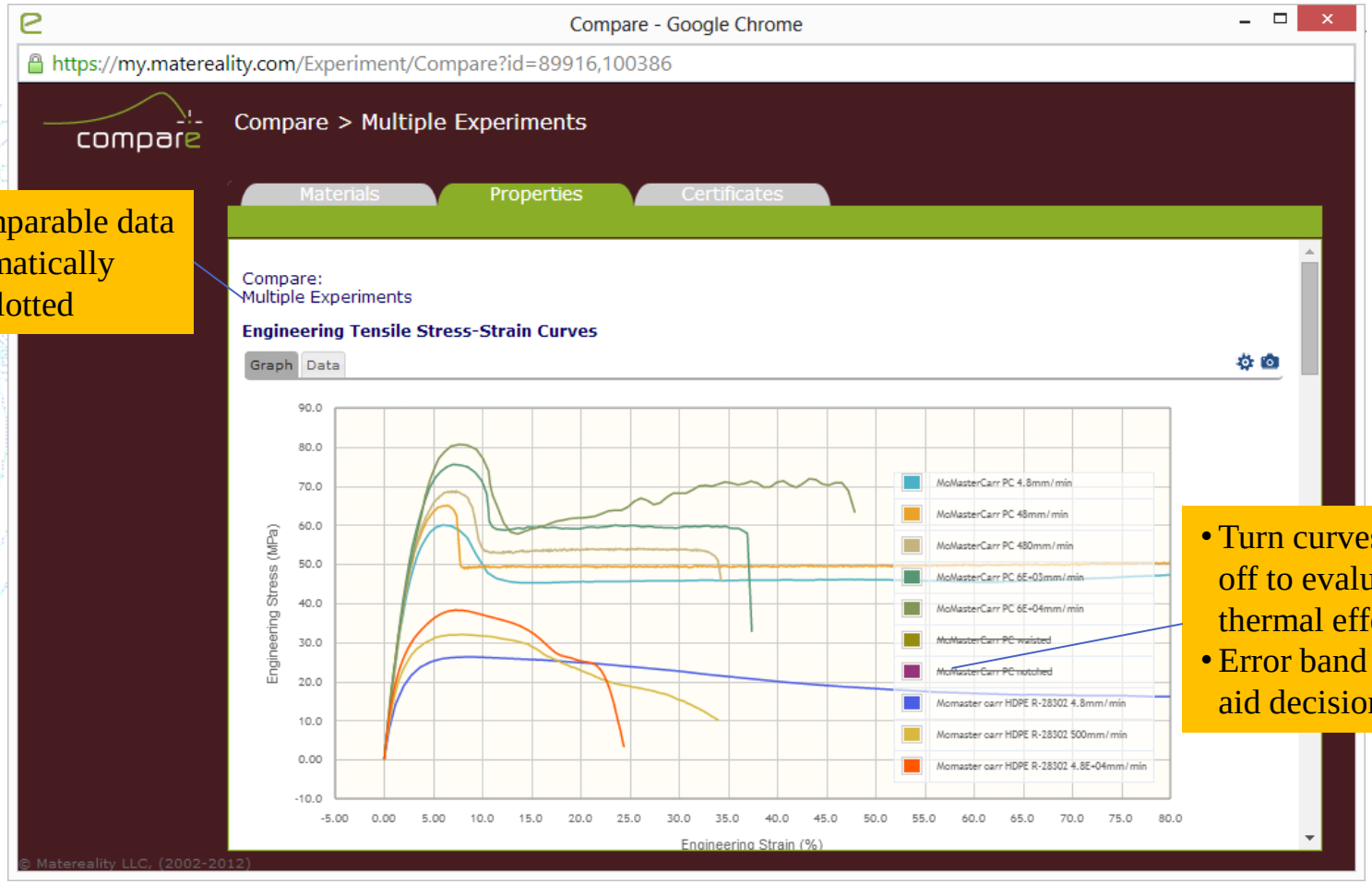
- Data Certificates contain:
  - Sample
  - Test parameters
  - Test method
  - Specimen details
  - Test machine
  - Test lab
  - Test date
  - Technician

Using **Compare** Analytics



- Select materials to compare
- Then click **Compare**

Rate Dependency of PC & HDPE

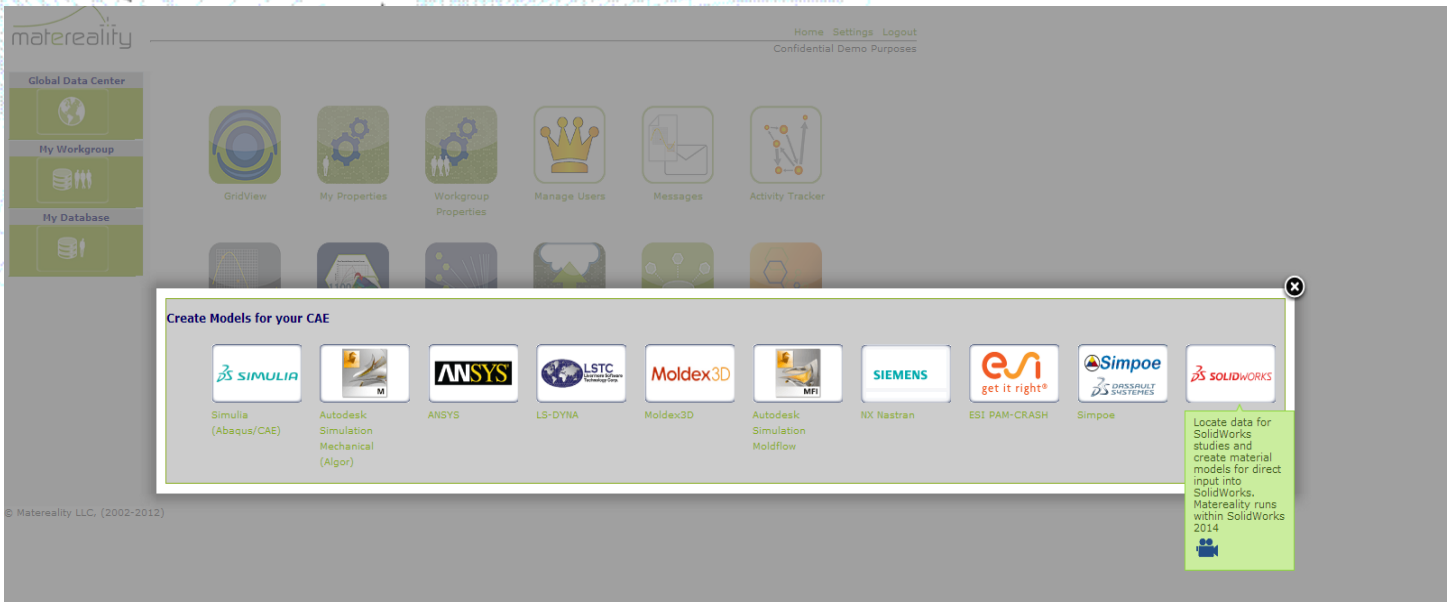


- All comparable data is automatically cross-plotted

- Turn curves on and off to evaluate thermal effects
- Error band statistics aid decision making

Sending Data to Simulation

- CAE Modeler slices multivariate data into CAE-consumable slices
  - Rate dependency for LS-DYNA, PAMCRASH, ANSYS, ABAQUS…
  - Temperature dependency for ABAQUS, ANSYS, NASTRAN…
  - Flow/thermal/PVT/shrinkage data for Moldflow, Moldex3D, Simpoe…
- Converts material data to model parameters
- Writes files to **Material Model Library**



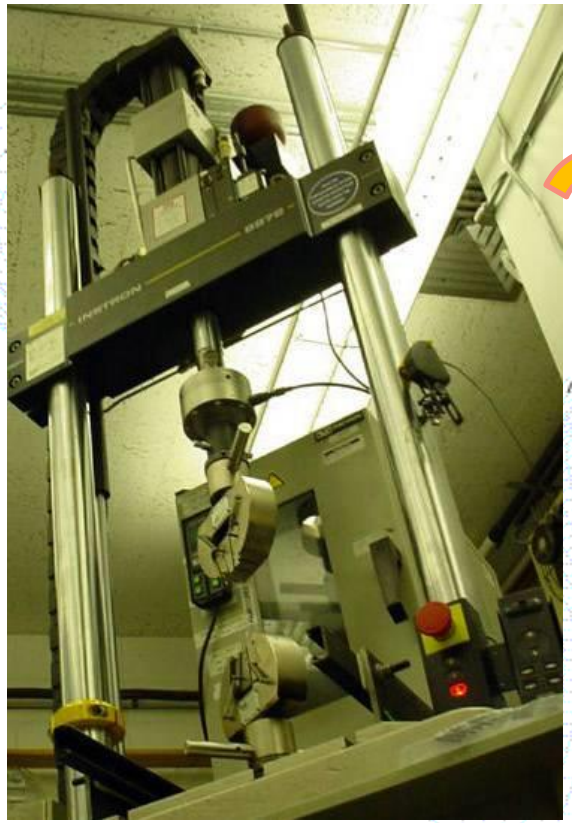
Convert Raw Data to Hyperelastic

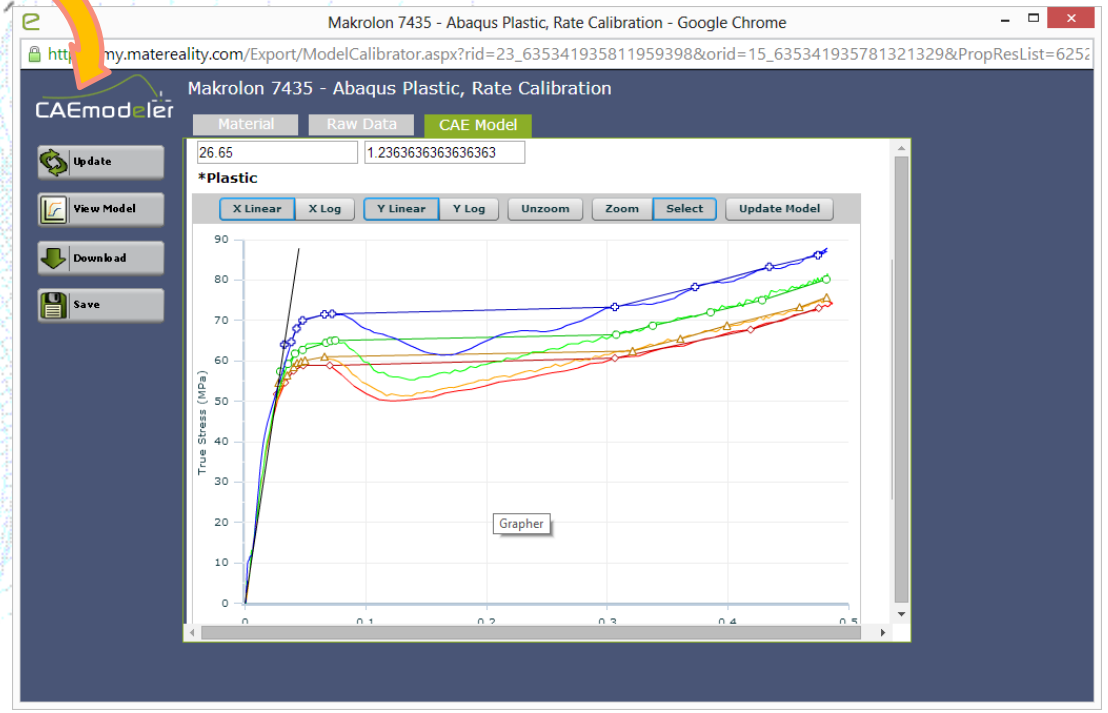
- Discretize, trim, extrapolate raw data
- Then write CAE-ready material card

Verification & Validation

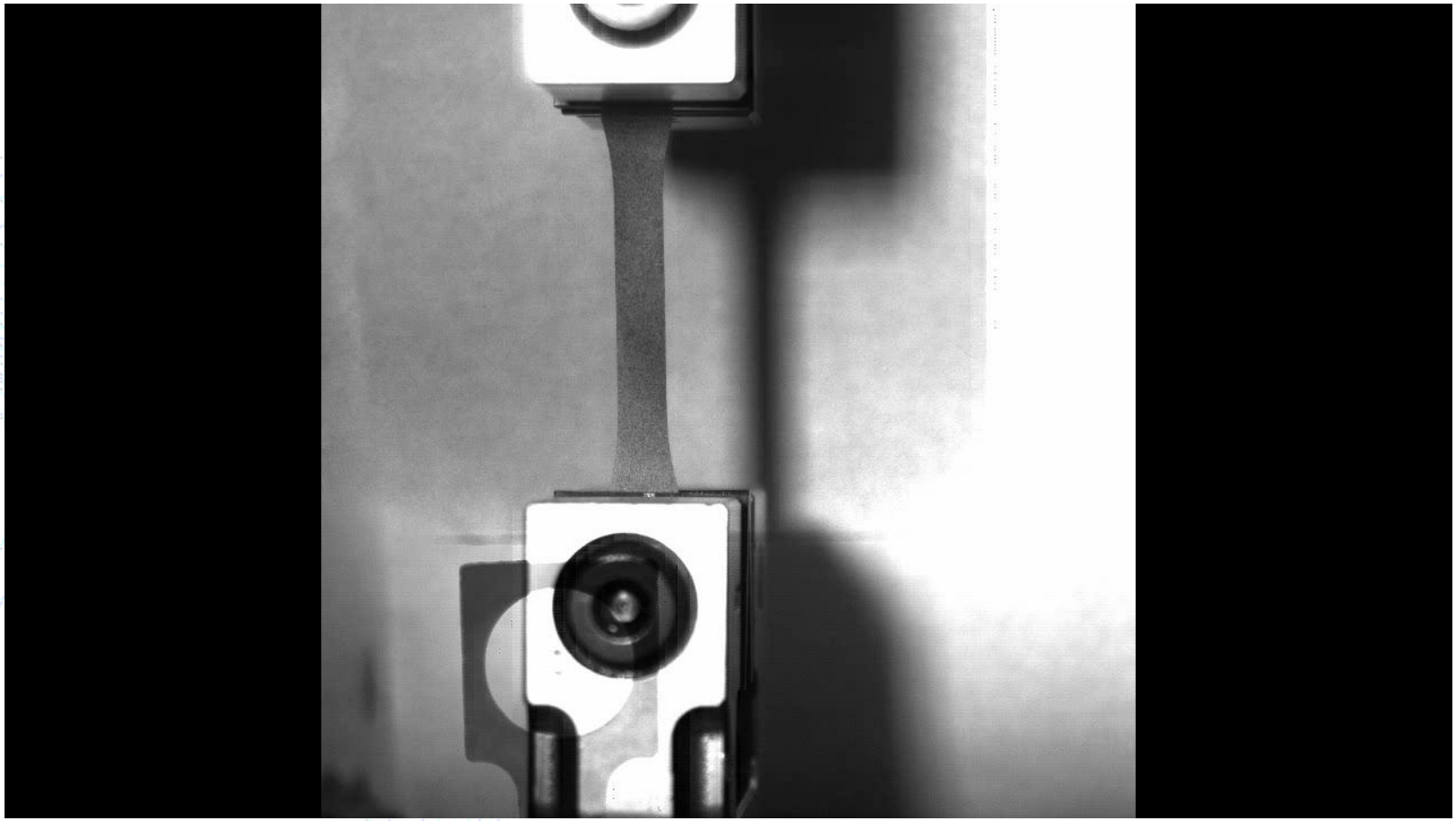
- Unit Element Test (easy)
  - Can be performed by analyst
  - Simple check on whether the model is sensible
- Closed Loop Validation (moderately difficult)
  - Check if FEA returns the original material data
- Open Loop Validation (difficult)
  - Comparison to alternate or multi-mode experiment

Closed Loop Validation

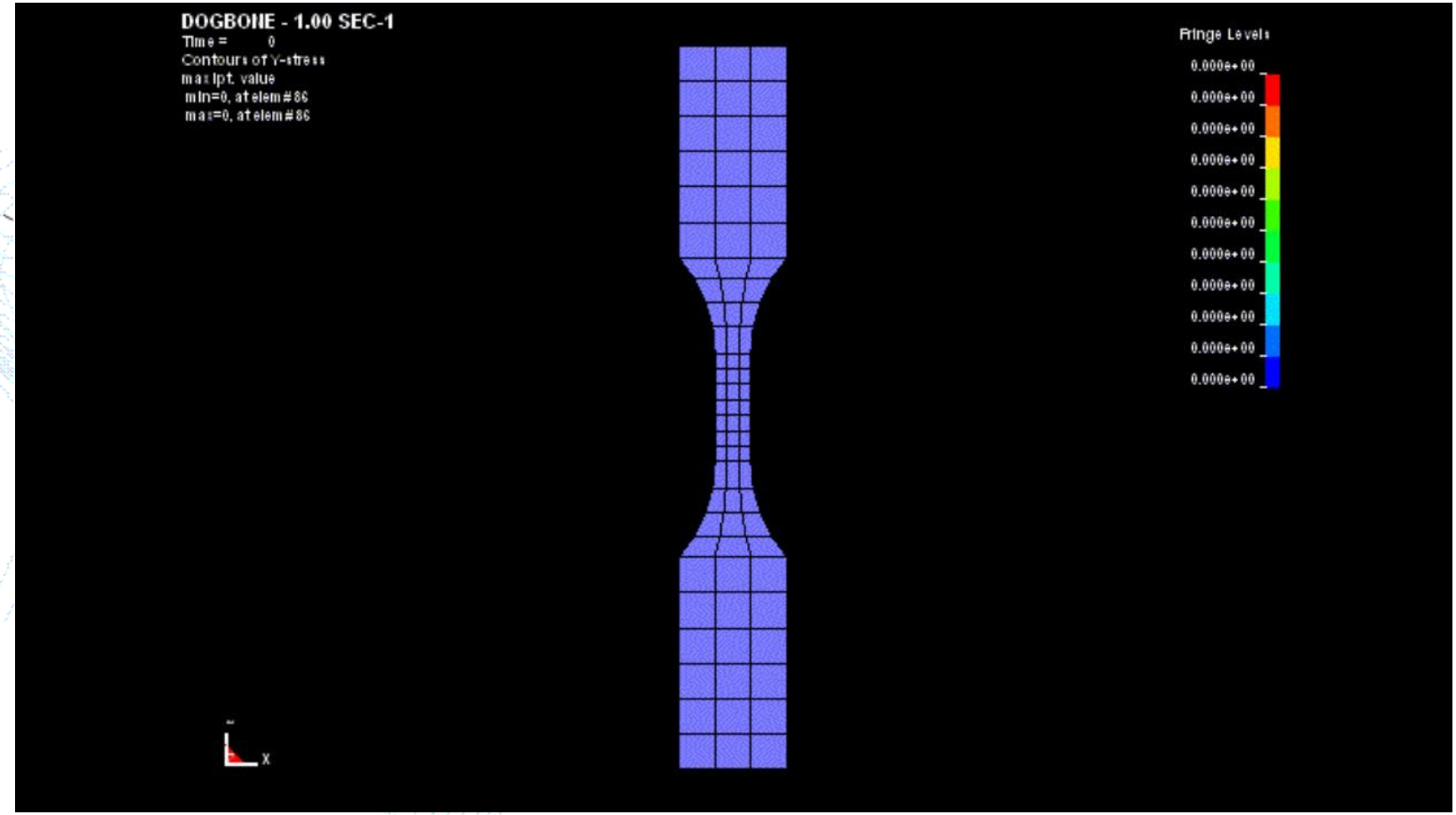




High-speed Video

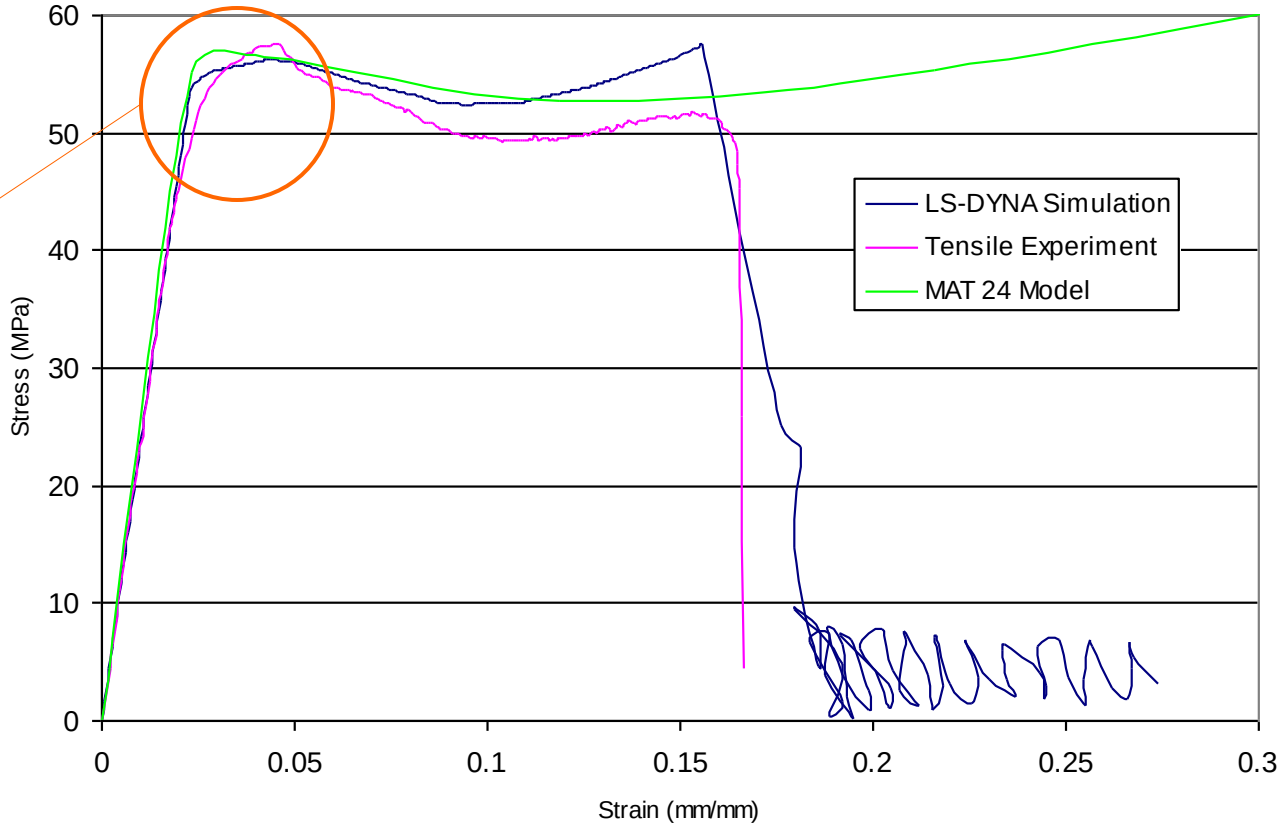


Simulation


DOGBONE - 1.00 SEC-1
Time = 0
Contours of Y-stress
max ipt. value
min=0, at elem#86
max=0, at elem#86
Fringe Levels
0.000e+00
0.000e+00
0.000e+00
0.000e+00
0.000e+00
0.000e+00
0.000e+00
0.000e+00
0.000e+00
0.000e+00
Y
X

Comparison to Experiment

limitation

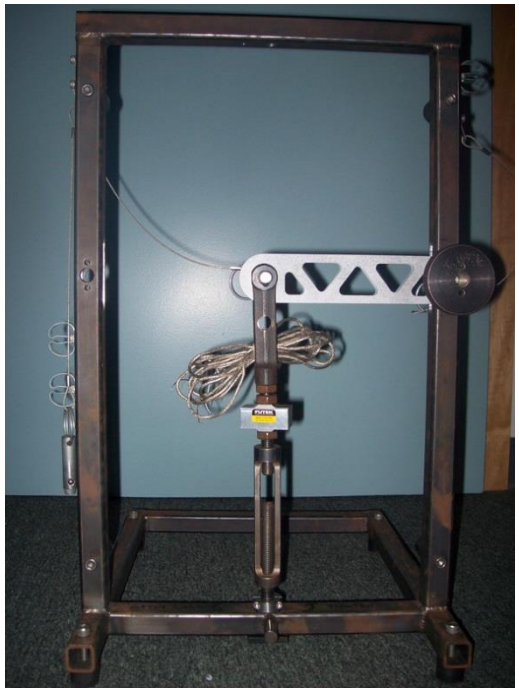


What is CAE TestBench™

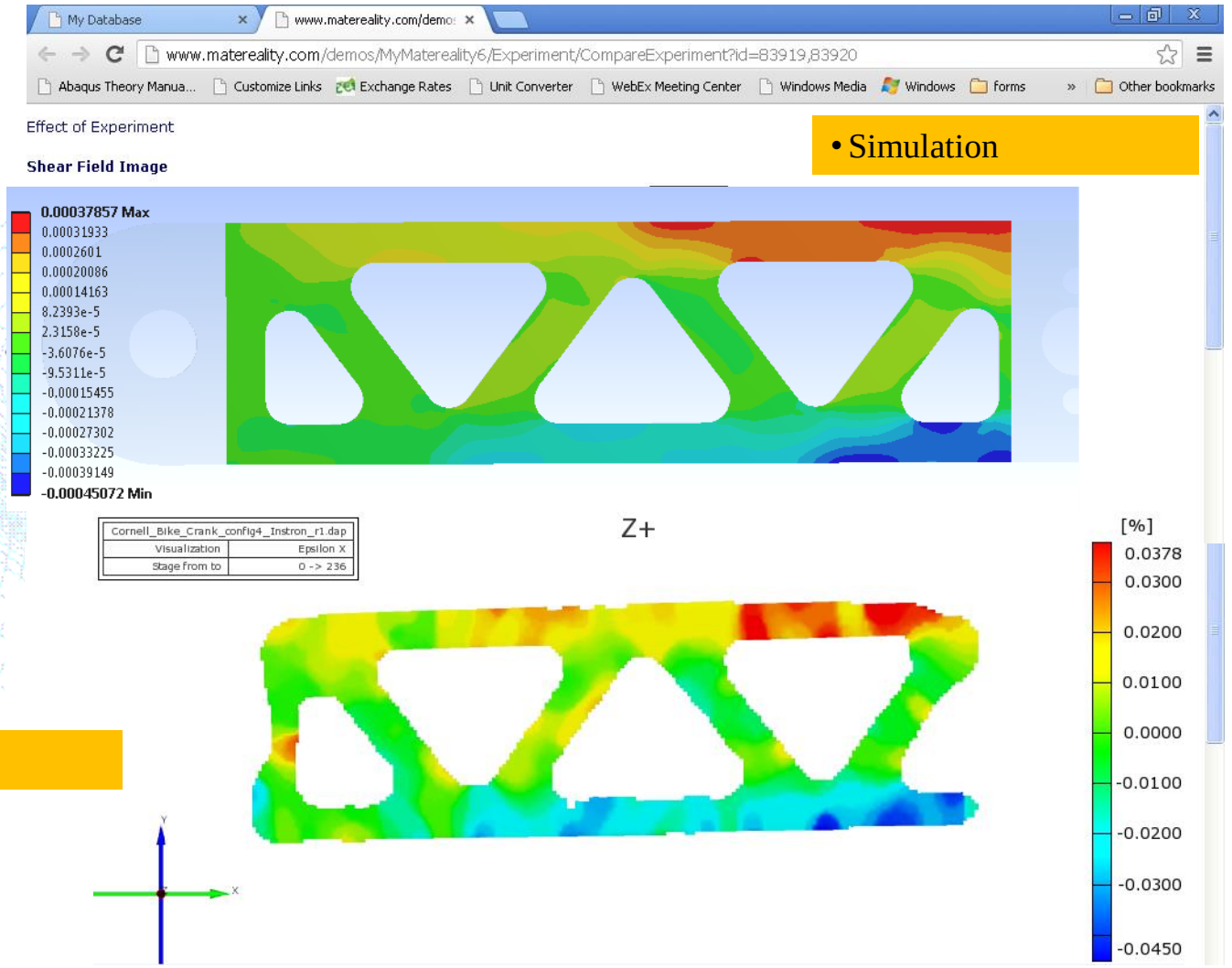
- Open Loop Validation
  - Carefully designed Benchmark models
  - Not real-life component
  - Simple multi-mode case
  - Well defined boundary conditions
  - Load cases reproducible in virtual and real life

Static FEA TestBench Model

- Cornell Bike Crank Study
  - Static loading
  - Complex geometry
  - Analytical solution exists
  - Well defined load case



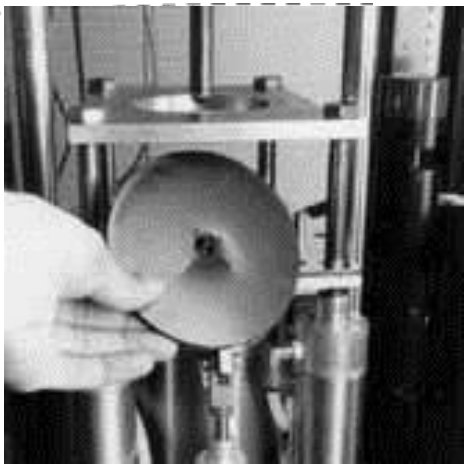
Comparing Simulation and Test



Confidence!

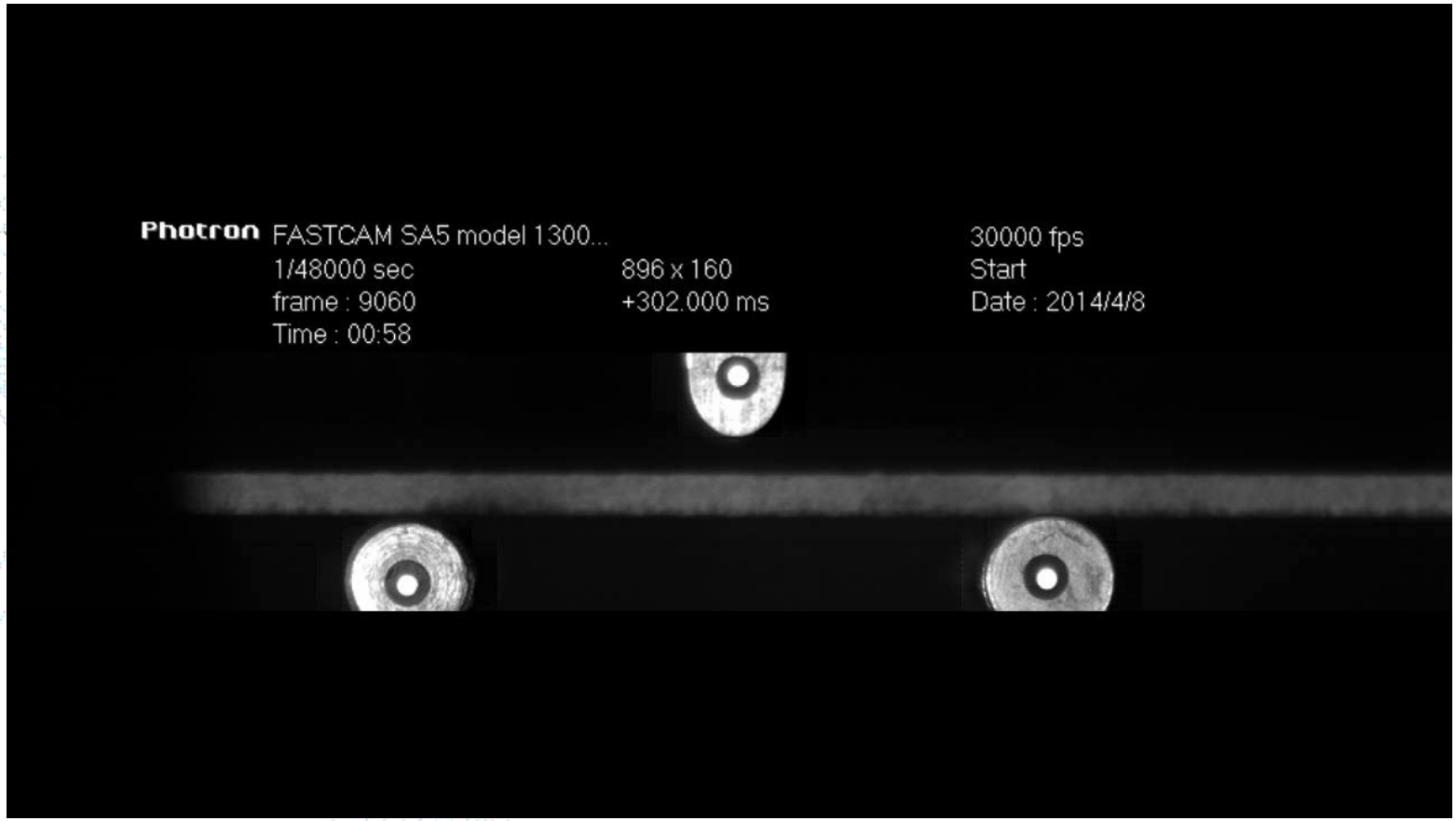
Dynamic FEA TestBench Model

- Falling Dart Impact
- Dynamic test
- Multi-axial loading
- Well defined boundary conditions



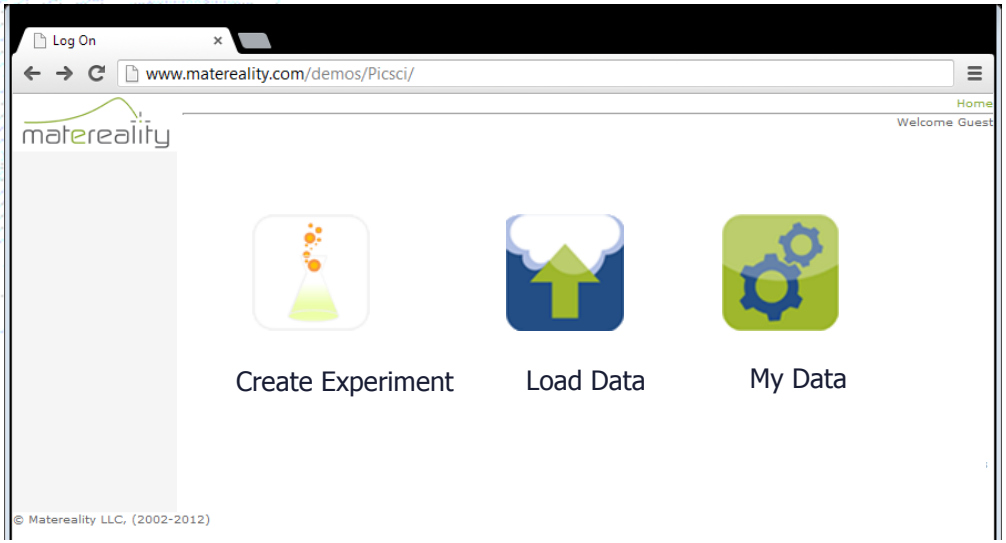
Simulation of Falling Dart Test

High-speed Composite 3 Point Bend



Software for TestBench

- Project PICSCI (a Matereality product)
  - Create experiment
  - Load test data
  - Load simulation data
  - Compare
    - apples to apples



*NAFEMS World Conference, Salzburg, Austria (2013)

Goal of CAE TestBench

- Create a library of benchmark models
- Validate for different aspects of CAE
  - Non-linear
  - Dynamic
  - Creep
  - Viscoelastic
  - Hyperelastic
  - Hyperelastic rate dependent
- Validate for different CAE codes