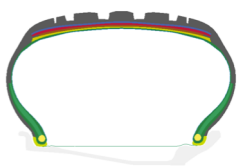
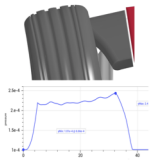
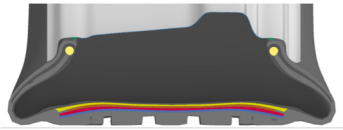






Joint Development of LS-DYNA® Tire model for Crashworthiness Applications

FCA
FIAT CHRYSLER AUTOMOBILES

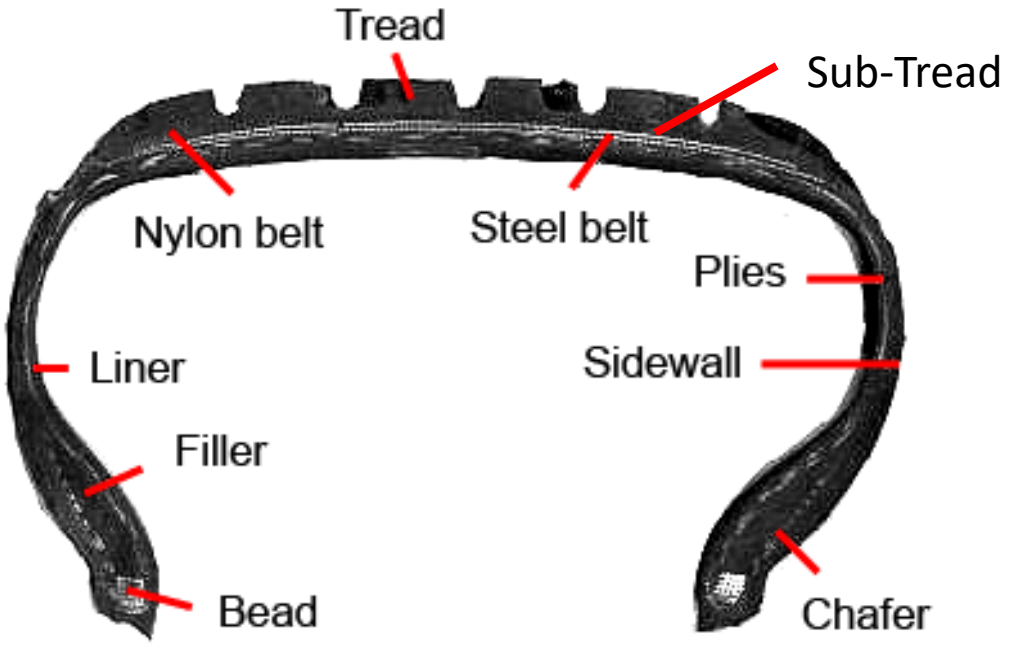
LSTC
Livermore Software Technology Corp.

Motivation

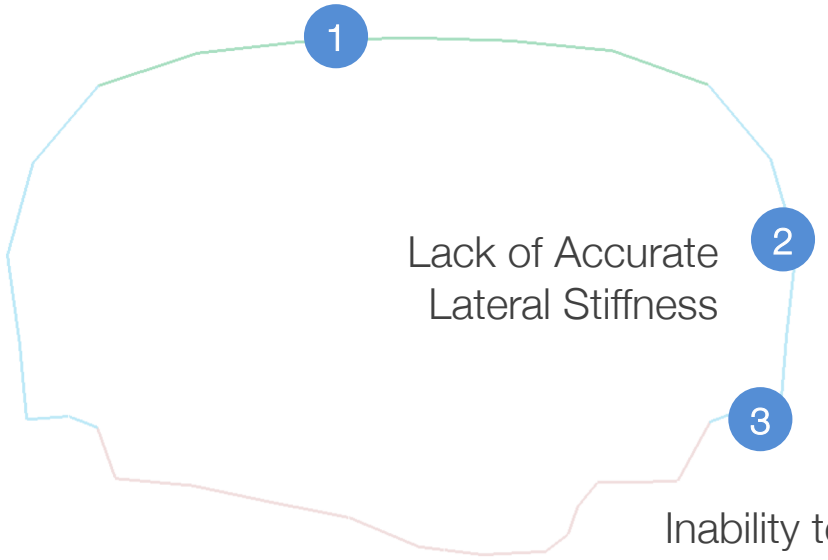
Develop state-of-art Tire Model for all load-cases with emphasis on SORB

INITIAL COMPRESSION AIR-LOSS POST-AIRLOSS INTERACTION

Tire Section and Shell Based Tire



Absence of True Thickness

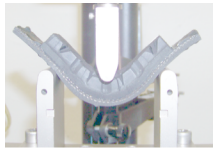


Test Plan

Material tests

In this, we determine bulk material property under various loading conditions using material samples in both static and dynamic speeds.

Verification tests



This category of tests include Tire laminates under Tension and Three Point Bending to verify the material characterization parameters

Component Tests

This category of tests involve the testing of Tire under various static and dynamic loads to verify the component behavior and stability of the FEA Tire model

Tire Fillet

ELASTOMERS

Tread
Sidewall
Bead-Filler
Inner Liner
Sub-Tread

PLIES

Body Ply
Wire-Belt
Belt Overlay

Material Tests

Elastomers

The materials under this group are
Tread, Sidewall, Sub Tread,
Bead Filler

These are modeled using
*MAT_SIMPLIFIED_RUBBER

Tests Include

Static and Dynamic Uni-Axial Tension until failure

Static and Dynamic Uni-Axial Compression

Static Bulk-Modulus Test

Static Pure-Shear until Failure

Static Uniform Bi-Axial until Failure

Plies

The materials under this group are
Belt Overlay, Wirebelts and Body Ply

These were modeled using
*MAT_ORTHOTROPIC_ELASTIC

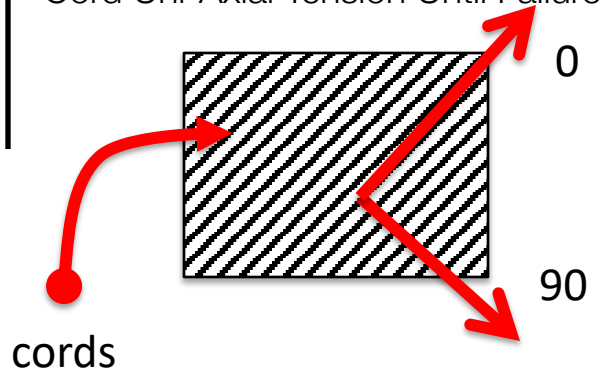
Tests Include

Static Uni-Axial Tension along 0 deg

Static Uni-Axial Tension along 90 deg

Static Shear Test

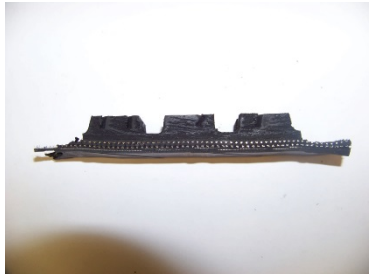
Cord Uni-Axial Tension Until Failure

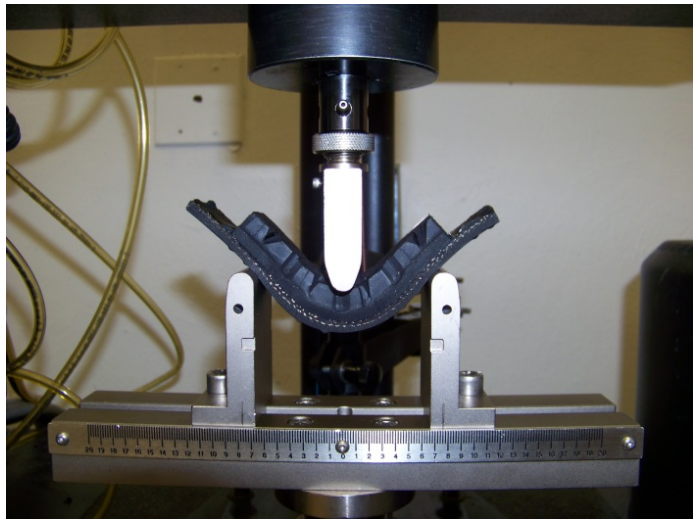


Material Verification Tests

- Tread Laminate
  - 0 and 90 deg
  - Uni-Axial Tension
  - Three-point Bending

- Sidewall Laminate
  - 0 and 90 deg
  - Uni-Axial Tension
  - Three-point Bending

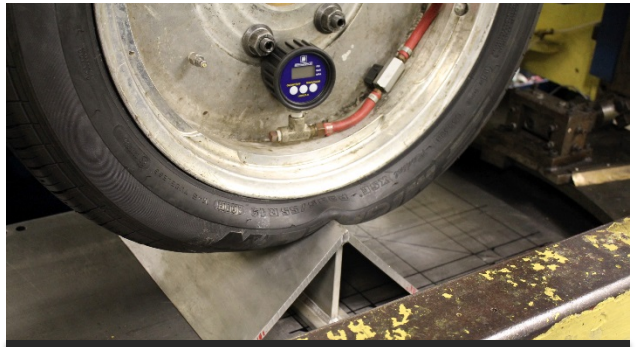




Static and Dynamic Component Tests

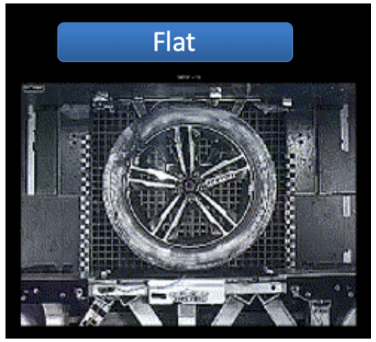
Flat Cleat

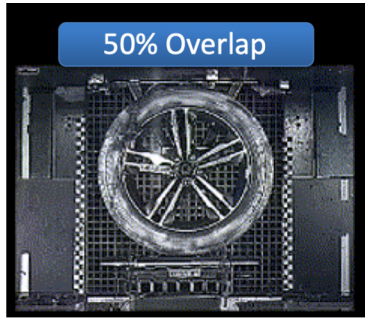
Step Cleat



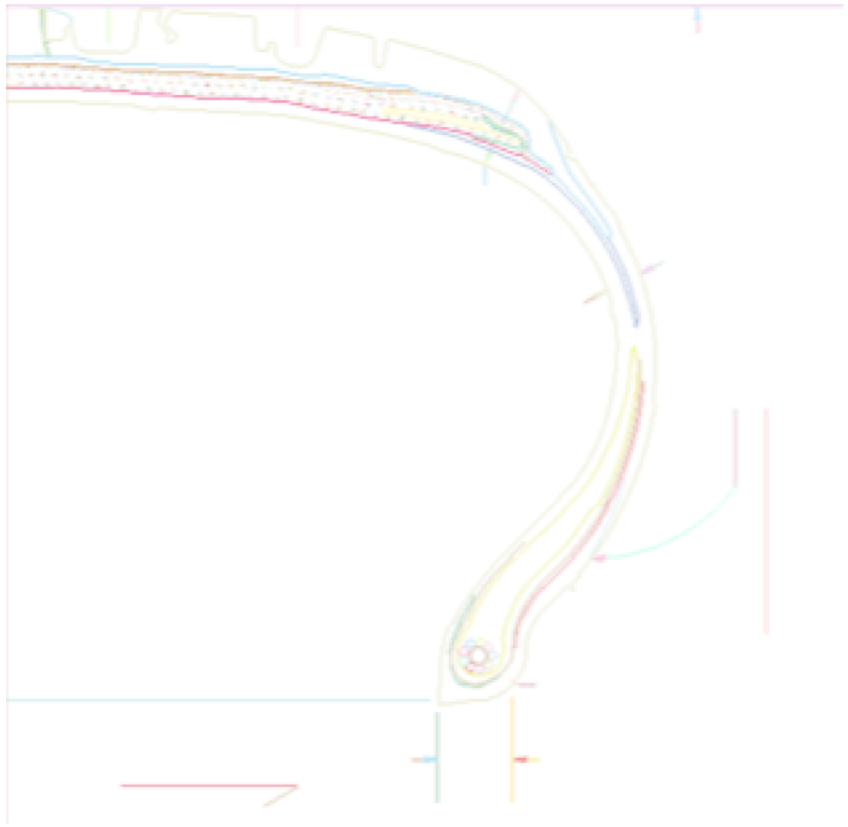
Triangle Cleat

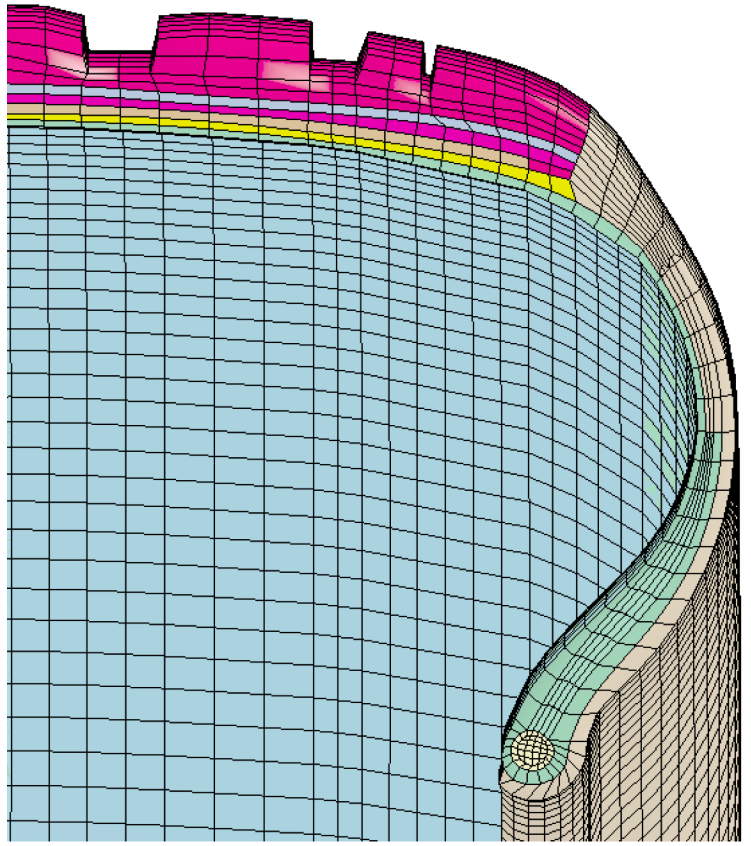
Triangle Cleat at 45 deg



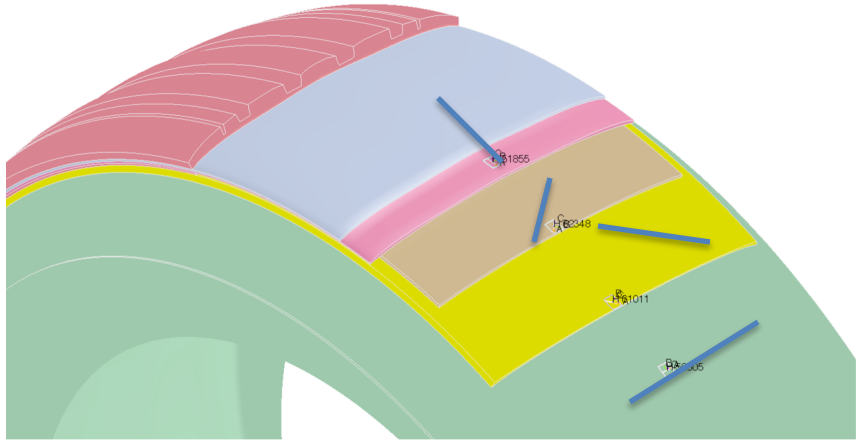


IGES to Mesh Generation



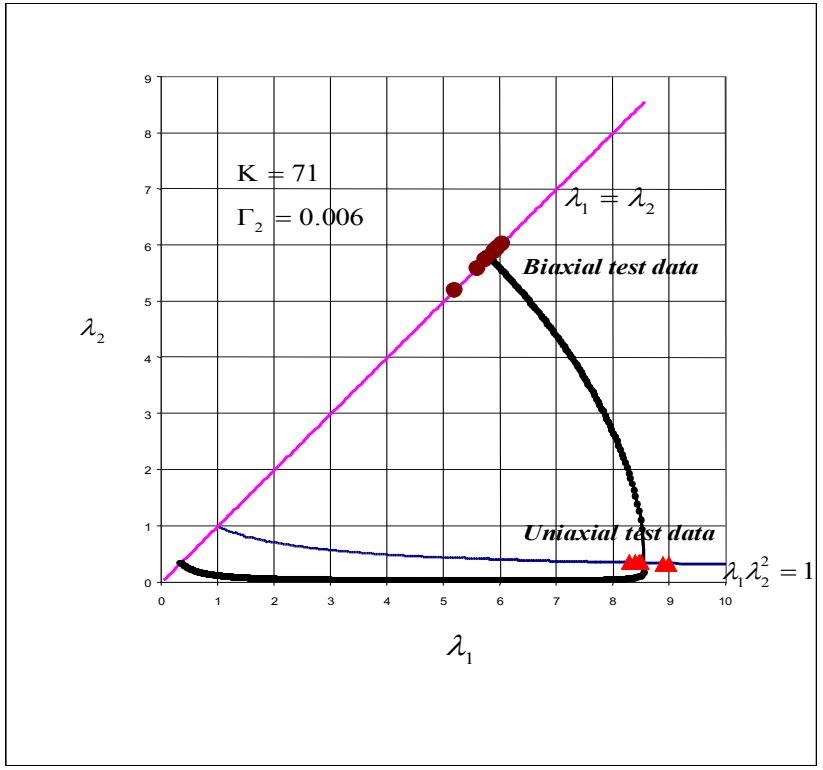


Fillet Comparison between FEA and Test



Elastomeric Failure Capabilities in LS-DYNA

- *MAT_SIMPLIFIED_RUBBER offers an option _WITH_FAILURE that allows the input of failure surface volume and failure surface shape. These constants are based on a failure stretch ratios obtained from a minimum 3 tests

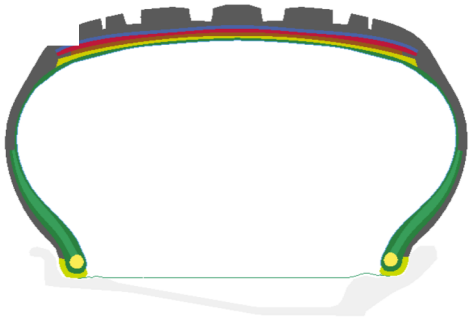


Sensors Definitions, Switches and Controls

- To model air-loss, three sensors are defined to track
  - Tire pressure,
  - Contact Force between Tire and Wheel (1 deg increments)
  - Number of elements eroded in the wheel (R10).

- When any ONE of the conditions are met, the leakage based on porosity and venting is activated in *AIRBAG_HYBRID

Model Information



265,000 elements – mostly 8-noded hexahedron elements
13 parts
MAT_181, MAT_002, with ADD_EROSION
1 Single Surface Eroding Contact
1 Surface to Surface Contact with Vehicle
Force Transducers
*AIRBAG_HYBRID for inflation
*SENSORS

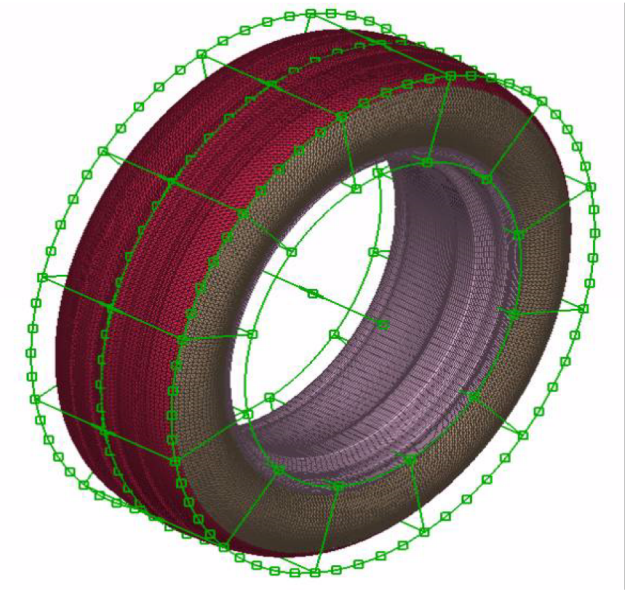
Smallest TimeStep

0.15 microsecond in some transition locations

Tire Morphing

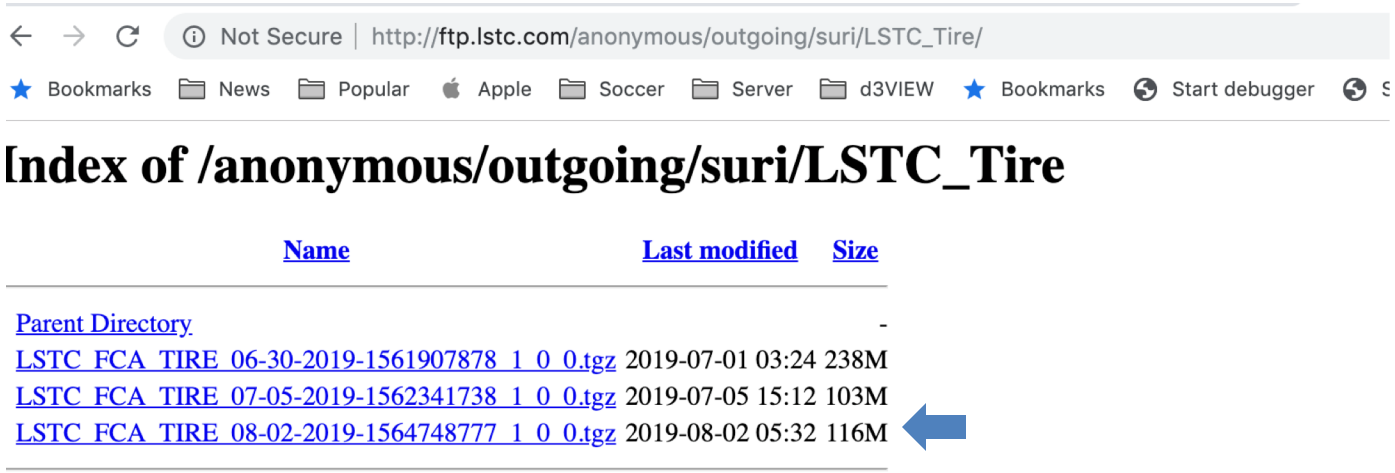
Validated Tire Model

Morpher
Ansa



Morphed Tire for Library

Where to download the current release



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