SAND2017-13085C

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YEARS OF PARTNERSHIP

Sandia National Laboratories

GOODYEAR

Silent Tires for Soundless Vehicles

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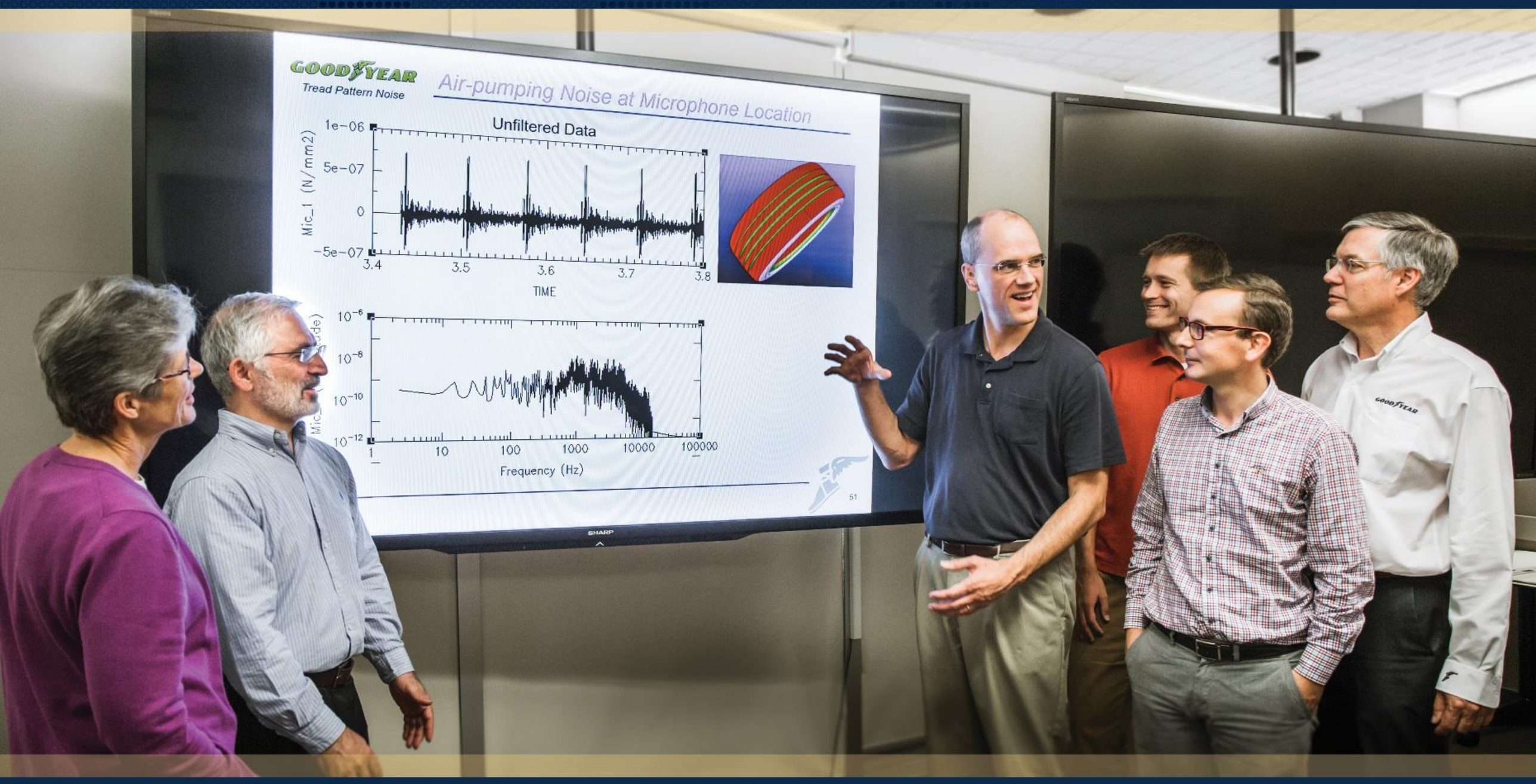
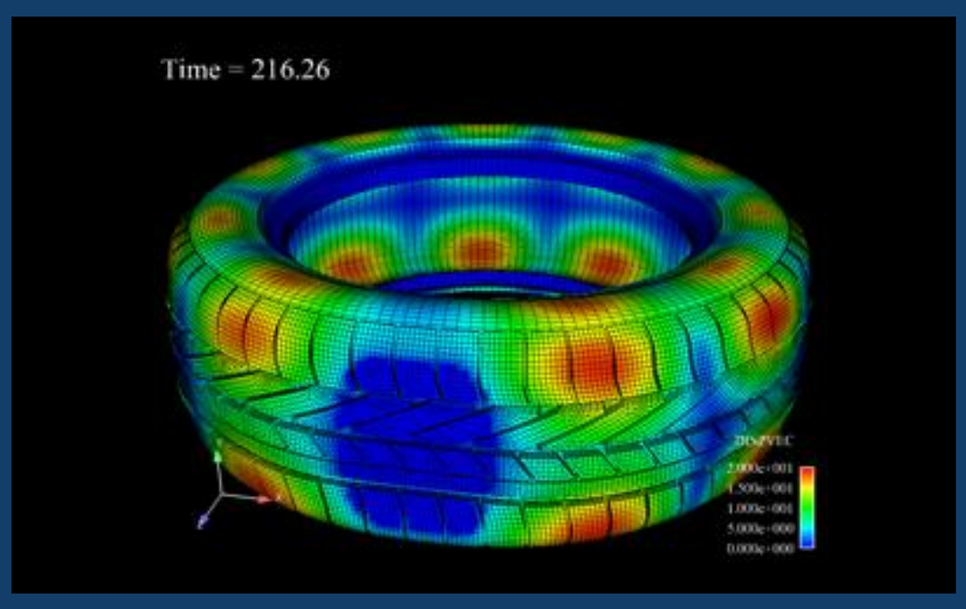
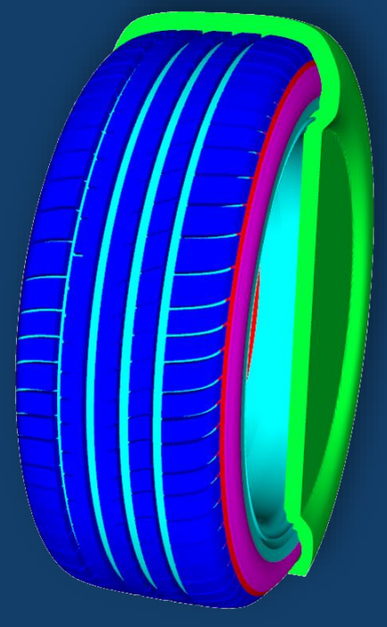


Electric vehicles are nearly soundless. Sandia and Goodyear are developing noise modeling technology to make their tires even quieter.



Motion of a tire vibrating at a natural frequency of the combined tire/enclosed air volume.



Acoustics model schematic

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Nanoscale Mechanical Testing of Rubber Compound

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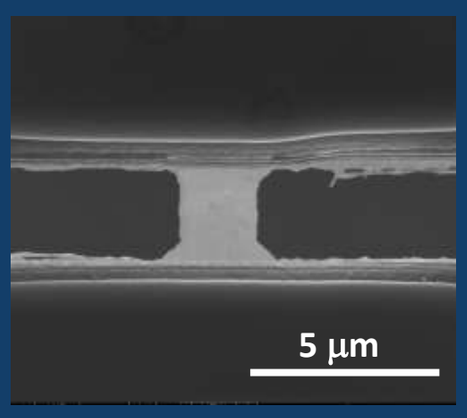
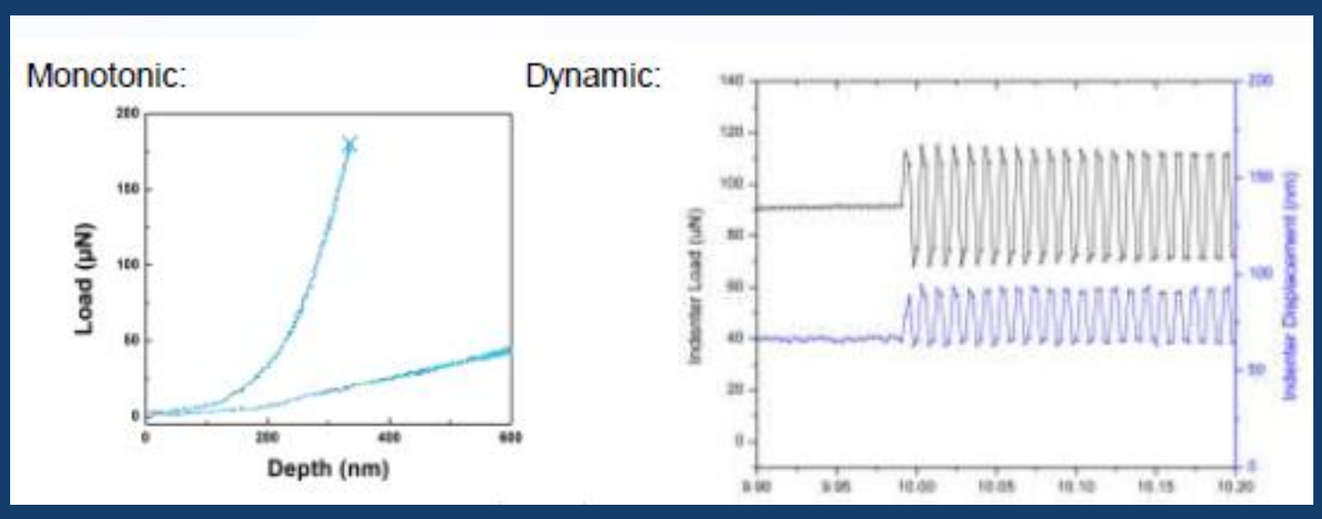
Sandia's nano-mechanics testing coupled with Transmission Electron Microscopy enables simultaneous testing of local mechanical properties of tire compounds and imaging on nanoscale.



Samples cut with Focused Ion Beam to "dog-bone" shape for micro-tensile test inside TEM

Samples mounted on PI-95 holder



Oscillatory load functionality, potential for fatigue studies and filler-rubber interactions, real-time monitoring of crack development and mechanical properties under given conditions, would be the first implementation of nano-DMA in TEM for polymers

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Nanoscale Material Models for New Tire Tread Compound Design

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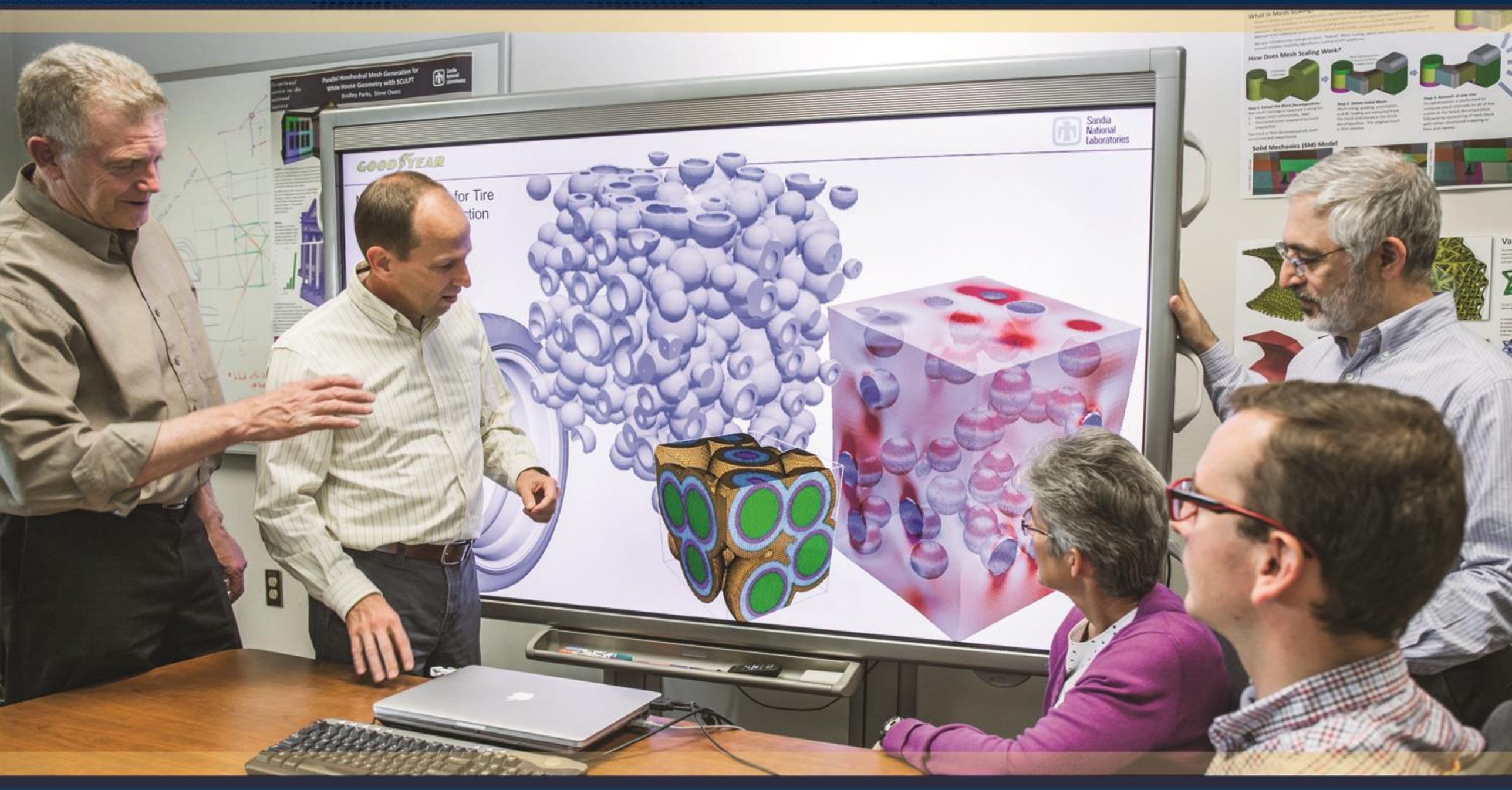
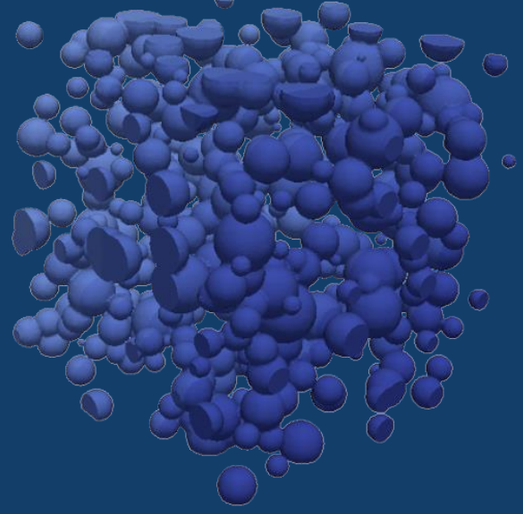
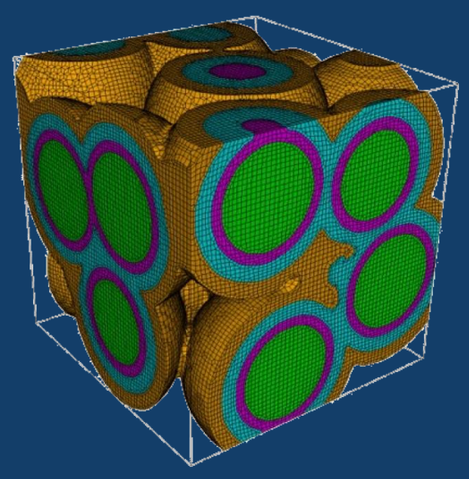


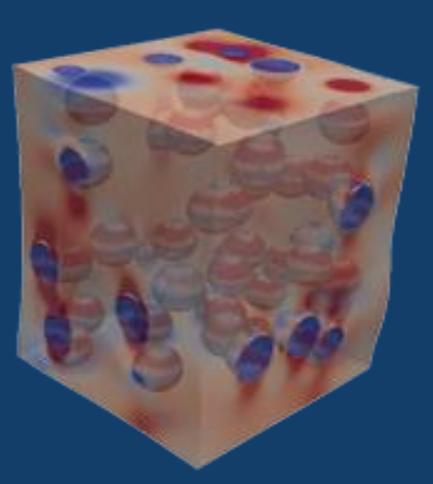
Finite element methods predict the influence of microstructures of a compound on its overall properties, providing better understanding of compound behavior, a tool for virtual compound design, and accelerated new compound development.



Microstructure of a compound: filler particles



Finite element mesh of filler particles



Representative Volume Element showing inter-particle stresses within a novel compound.

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Virtual Prototyping Replaces "Build & Test"

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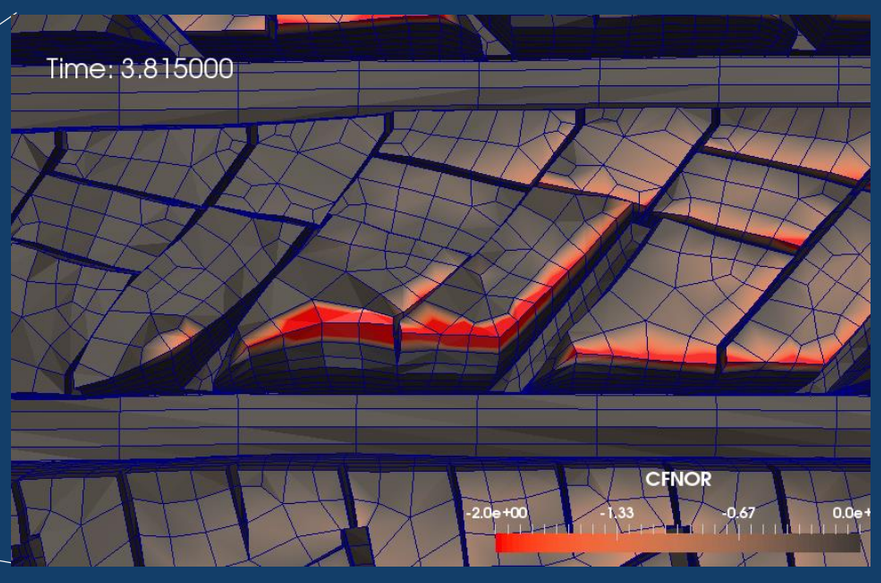
Accurate FEA simulation of tire handling is essential for Goodyear's virtual tire development process, and also for future submissions to vehicle OEMs. This technology is being developed today by Sandia & Goodyear.

Finite element model of a Goodyear high performance tire being tested in extreme cornering maneuvers.



Calculated contact pressures in the footprint showing how the tread pattern reacts instantaneously to the cornering forces.

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Optimally Assigning Tire SKU's to Manufacturing Equipment

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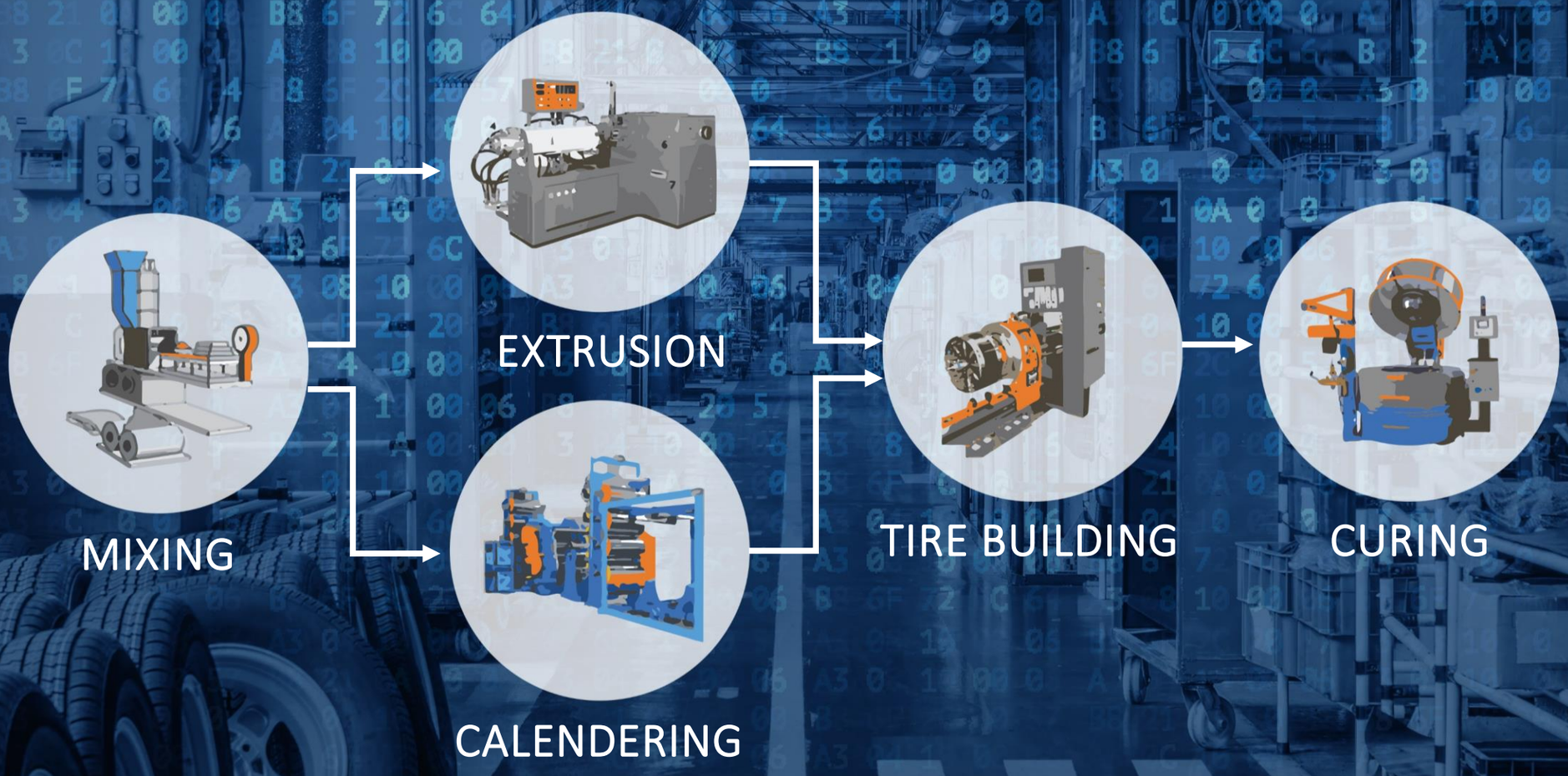
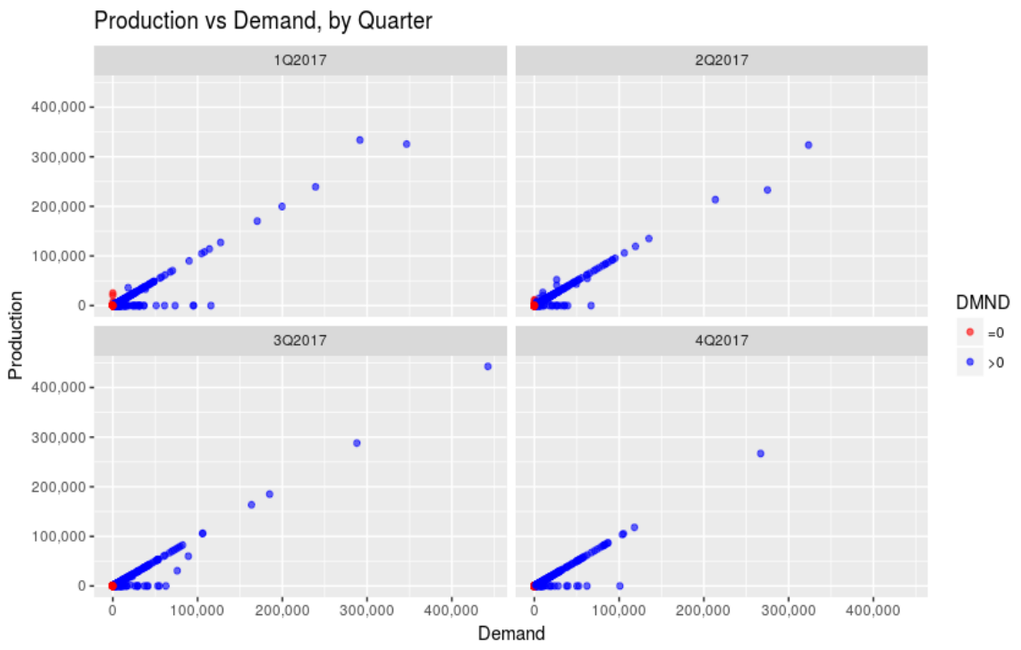
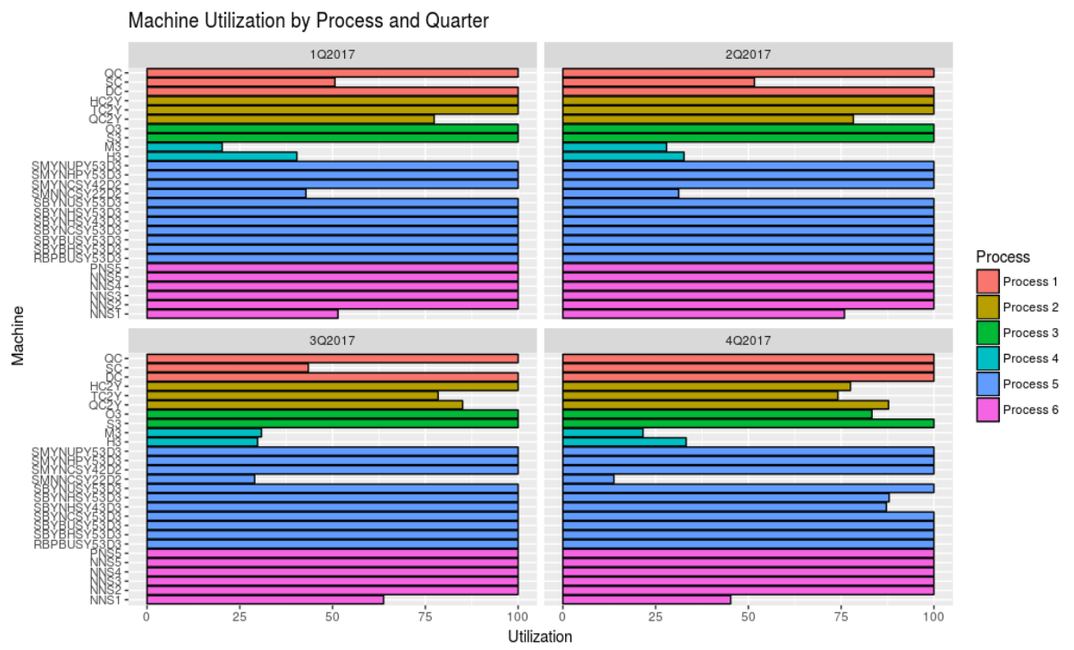
SIMPLIFIED TIRE MANUFACTURING PROCESS



Tire manufacturing is a multi-stage process, where multiple machines with different capabilities are available in each stage. Some tire SKU's may require different machine capabilities (within a stage) than others. We use mixed integer linear programming to optimally assign tire SKU's to machines at each stage.



Production vs Demand when unmet demand is minimized over 4 calendar quarters



Machine utilization for all 6 processes when unmet demand is minimized

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Optimization of Tire Manufacturing Machine and Crew Scheduling

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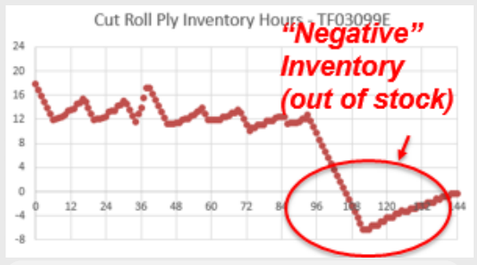


Assess Inventory "Goodness" in Hours "Safety Stock"

How Good?

Treatment Code	Treatment Type	Treatment Length	StandNr	CreelRoom
TF03214E	Fabric	3300	0	0
TF03101E	Fabric	8250	0	0
TF03213H	Fabric	8250	0	0
TF01679E	Fabric	5880	0	0
TW00082	Wire	85128	1	1
TW00059	Wire	7080	1	1
TR03099E	Fabric	6600	0	0
TF03214E	Fabric	6600	0	0
TR03501F	Fabric	8250	0	0

Genetic Optimization Tool creates New Schedule for DES, "evolving" order of codes produced and batch sizes

Validated Discrete Event Simulation Model

CUT ROLLS

Cut to width and angle

CUTTERS

"pull"

Cutters scheduled per Kanban needs of Tire Building

TIRE BUILDING

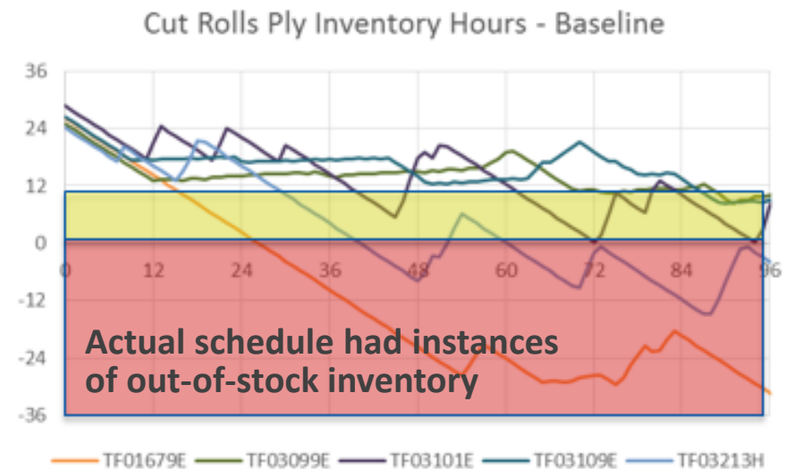
"pull"

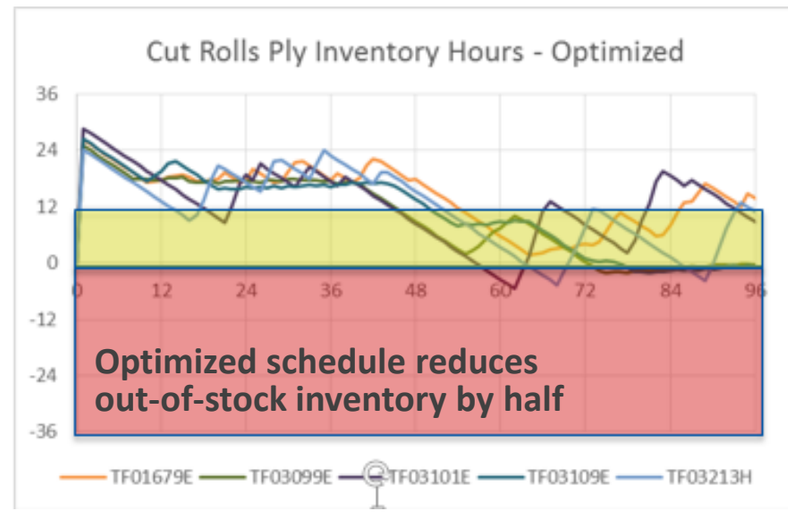
CALENDER

Calender follows schedule producing Fabric & Wire Rolls

TREATMENTS

Optimization reduces out-of-stock inventory





A novel combination of best in class Discrete Event Simulation and Optimization methods are developed jointly by Sandia National Labs and Goodyear to "evolve" superior machine and crew schedules using Genetic Optimization methods.

Method can also be applied in standalone tool for supervisors to use to assign crews.

Demonstrated to increase number of tires that can be produced by alleviating bottleneck due to crew scheduling.

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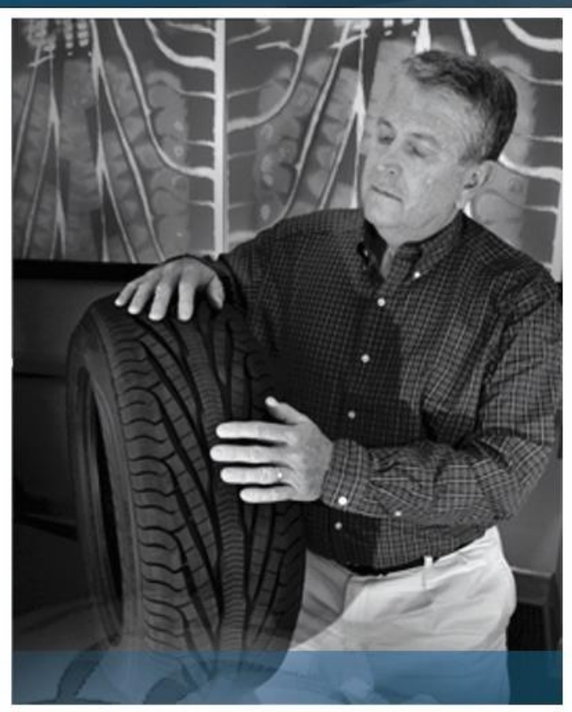

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