Optimization As Driver For
Innovative Lightweight Solutions

Kaustubh LIMAYE
SIMULIA Senior Solution Consultant
Dassault Systèmes

NAFEMS Engineering Analysis & Simulation in the Automotive Industry: Electrification & Advanced Lightweighting Techniques
Troy, MI, April 27, 2017
Product Innovation Challenges

Performance Requirements

- Stopping power
- Brake fade
- Disc warping
- Dynamics
- Vibrations

Aesthetics

- Cost
- Manufacturability
- Warranty
- Brake squeal
- Corrosion
Optimization Driven Design Evolution

Motorcycle Brake Rotor

Efficient cooling
Less weight
Higher stiffness
Improved durability
Process to Accelerate Innovation

- Ensured reliability
- **Durability Analysis**

- Improved structural integrity
- **Shape Optimization**

- Conceptual lightweight design
- **Topology Optimization**

- Exploration of design alternatives
- **Parametric Optimization**

- Understand physical behavior
- **Structural & Thermal Analysis**
Parametric Optimization of the Disc for Efficient Cooling

- Avoid brake fade – efficient cooling
- Automatic generation and evaluation
- Best from hundreds of designs

Maximum temperature of the disc was reduced by 30°C, while leaving sufficient surface area for efficient braking.
Topology Optimization of Carrier for Weight Reduction

Lightweight Conceptual Design

- Better performance at high speed
- Sustaining severe brake loads
- Stiff but lightweight design
- Large scale modifications
- Insured manufacturability
- Non-linear modelling, contact

Weight of the carrier was reduced by 30%, while stiffness was doubled
From Conceptual Design to Detailed Design

Design Space

Design Concept
light & stiff

Detailed Design
durable
Shape Optimization of Carrier for Improved Durability

- Insure longer product life
- Minimal design changes
- Precise surface shape
- Direct input from fatigue analysis

Life of carrier was increased more than 3 times
Process to Accelerate Innovation

Consistent use of optimization enables design innovation from concept till detail

All simulation technologies used in this workflow are available in SIMULIA Portfolio
Leverage the potential of optimization to accelerate innovation!