Smart CFD-Simulation Techniques for Thermal Management of Digital Light, LiDAR & Sensors

数字照明、激光雷达和传感器的热管理智能模 拟技术

Thomas Schultz

Realize innovation.

Agenda

Smart CFD- Simulation Techniques 更机智的CFD仿真技术

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Trends, Challenges & Implications 趋势，挑战，影响

A Voice From The Industry 来自工业界的声音

Simulation&Test 仿真与测试

Technology & Automation 技术与自动化

Summary

- Styling / Corporate Identity 造型/品牌识别
- LEDs for the Mass-Market 大众市场的LED
- **Integrated ADAS/LiDAR for AV** 入到自动驾驶 **ADAS/LiDAR**
- **Full Digitalization of Lighting Systems** 数字化照明系统
- Glare-Free Lighting 防眩目灯光
- OLED / Laserlight OLED/激光射灯
- Regulations 规范

植 全

MAJOR CAUSES OF ELECTRONICS FAILURE
Dust, 6%
Humidity

Driver role

Vehicle role

SAE Level 0 / 1 / 2 / 3 / 4 / 5
No Automation / Driver assistance / Partial automation / Conditional automation / High automation / Full automation

Source: US DoD

More innovative and better-performing products
表现更优的产品

Accelerate product development
加速研发流程

Development cost reduction
降低研发成本

Bottleneck in development process
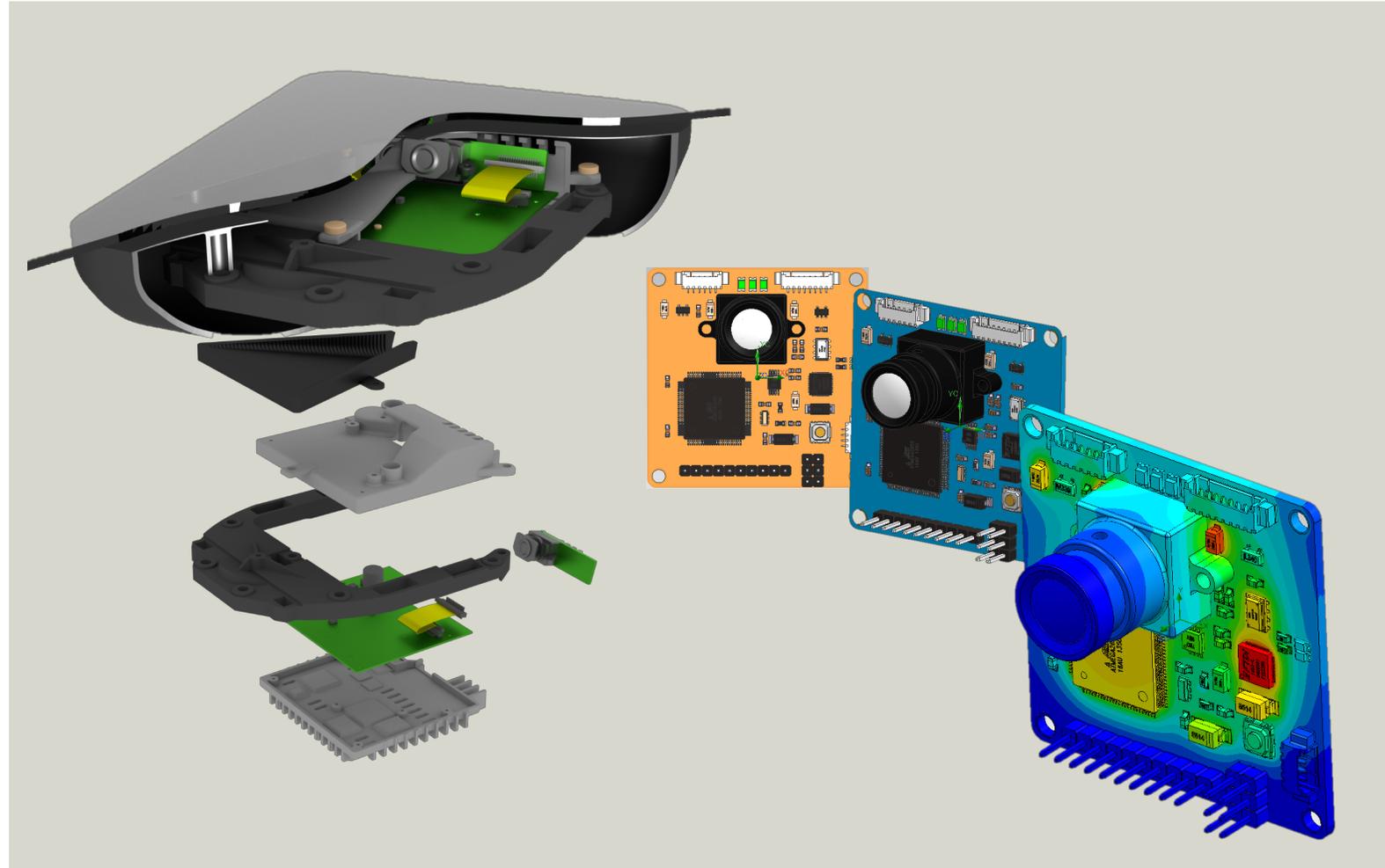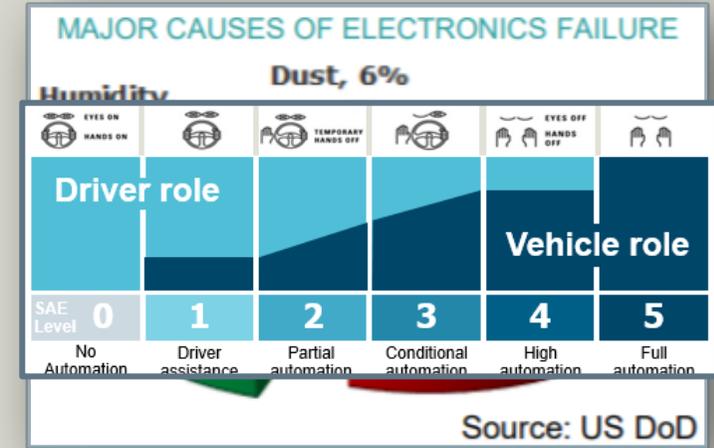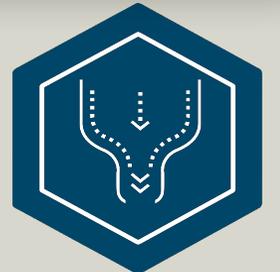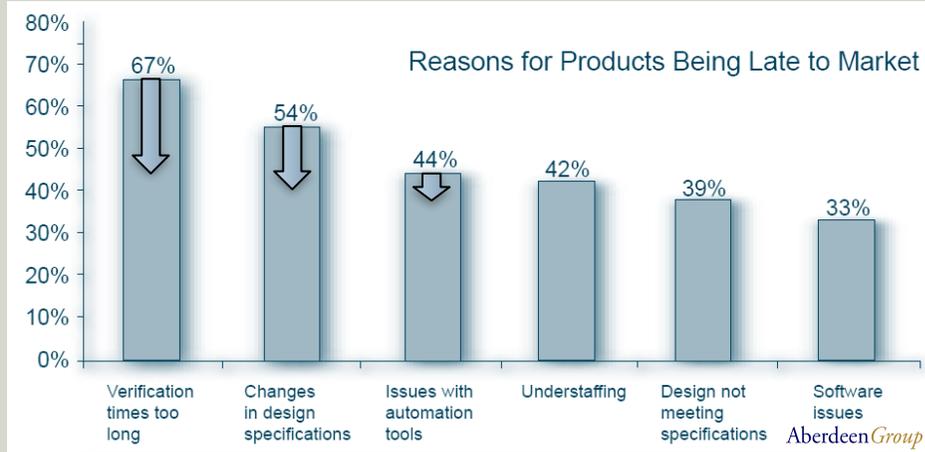突破研发瓶颈

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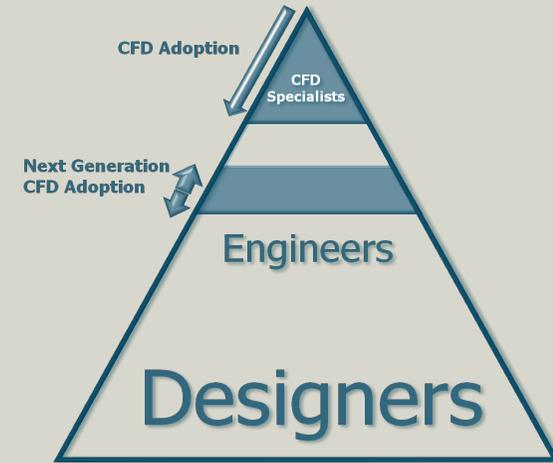**A Voice From The Industry** 来自工业界的声音

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Summary

Reasons for Products Being Late to Market

- 67% Verification times too long
- 54% Changes in design specifications
- 44% Issues with automation tools
- 42% Understaffing
- 39% Design not meeting specifications
- 33% Software issues

Aberdeen Group

CFD Adoption
CFD Specialists
Next Generation CFD Adoption
Engineers
Designers

Longer time spent getting design closure causes product to be late to market 过长的研发时间影响推向市场

Verification usually starts too late within the development process. Fast decision making? 研发过程进入验证阶段太迟，如何快速决定？

Ratio / # of CAx users

CAD = 100   FEA = 10   CFD = 2

Wider adoption of users

更广泛的用户

Frees up in-house CFD-experts

Increases productivity

Accelerates Decision Making

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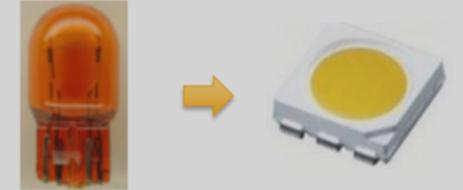**Simulation&Test**
仿真与测试

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Summary

Design trends and technological evolution impact condensation:

Replacement of bulbs with LEDs 用LED替换传统灯泡
→ lesser heat produced inside lamp
→ reduced ability to clear condensation

Increase in design complexity 提高设计复杂性
→ smaller air gaps between internal components
→ reduced ability to clear condensation

Increased focus from OEMs
→ It can be or can be perceived as a quality problem

Source: Maurizio Di Pierro, Automotive Lighting NA, at Siemens Simcenter Conference 2018 Detroit, "Defogging simulation of an automotive rear lamp using CAD embedded Flow and Thermal Solutions"

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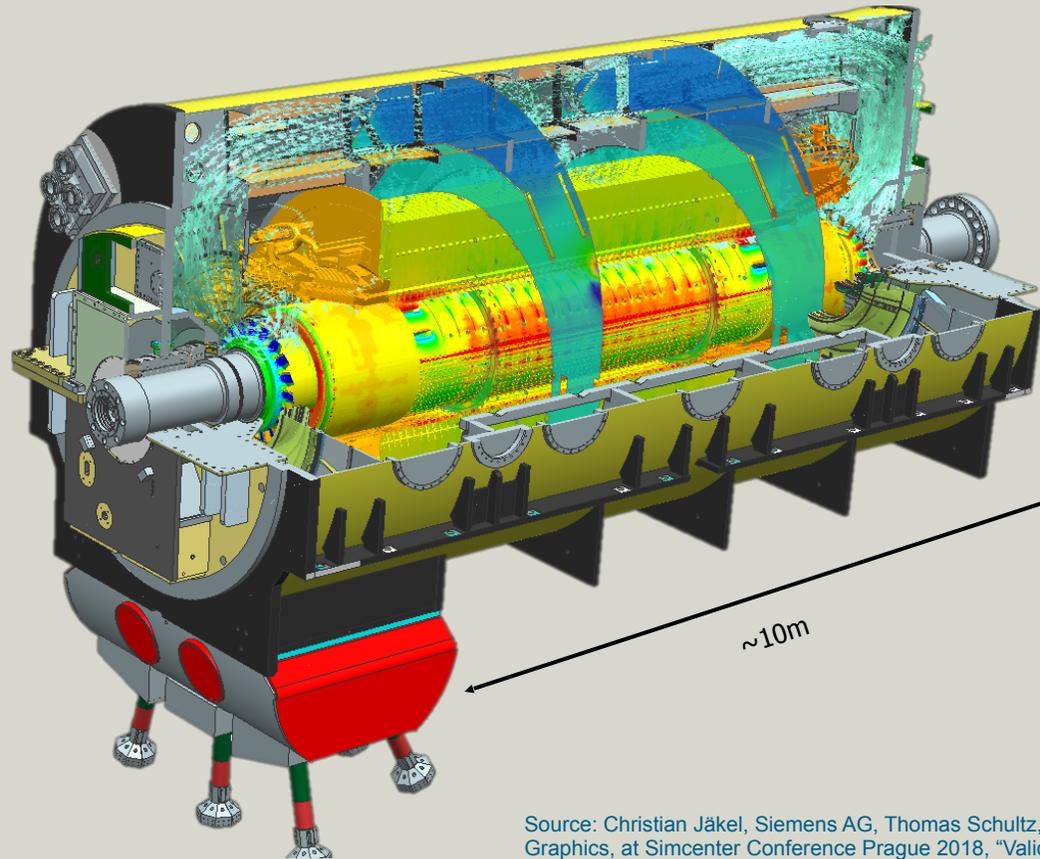
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So what is possible in terms of CAx complexitiy? 遇到复杂的设计模型是否可能？

Full-scale 全模型 turbogenerator (850MVA)

~3000 CAD components (no simplifications) 无需简化

Simulated in CAD-embedded CFD (Simcenter FLOEFD™) 嵌入到CAD中的CFD

Impossible to calculate with conventional CFD-Methods

But how do we get there? What is important?

~10m

Source: Christian Jäkel, Siemens AG, Thomas Schultz, Mentor Graphics, Tatiana Trebunskikh, Mentor Graphics, at Simcenter Conference Prague 2018, "Validation of a Full-Scale Turbogenerator Model"

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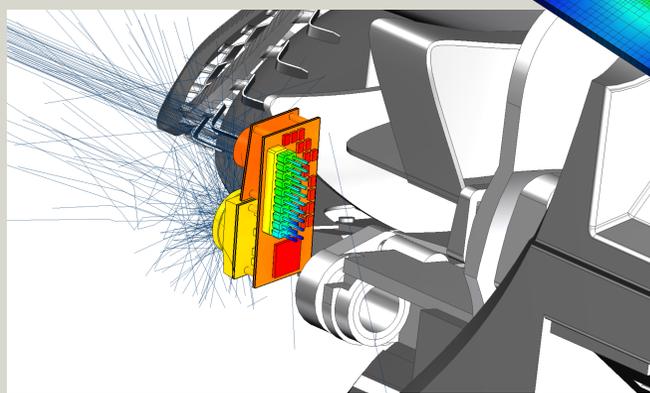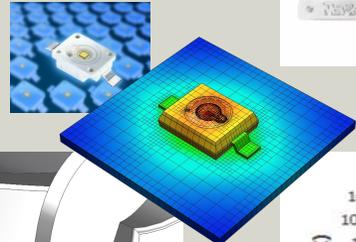Key Requirement #1 – Reliable Physical Input Parameters
#1：可靠的参数输入

关键

Golden rule: Garbage in = garbage out!

Test data supports all simulation activity, from model inputs to results verification.

Thermal accuracies up to 99.9%

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On Monday, shares were down more than 3 per cent in late-afternoon trading.

HOME NEWS

Explosions reported as fire rips through Tesla showroom

SQUAWK BOX
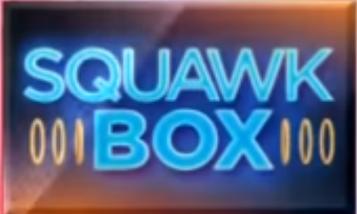
TESLA INVESTIGATING APPARENT MODEL S EXPLOSION IN CHINA

Sources: CNBC, The Independent, www.smh.com

CNBC

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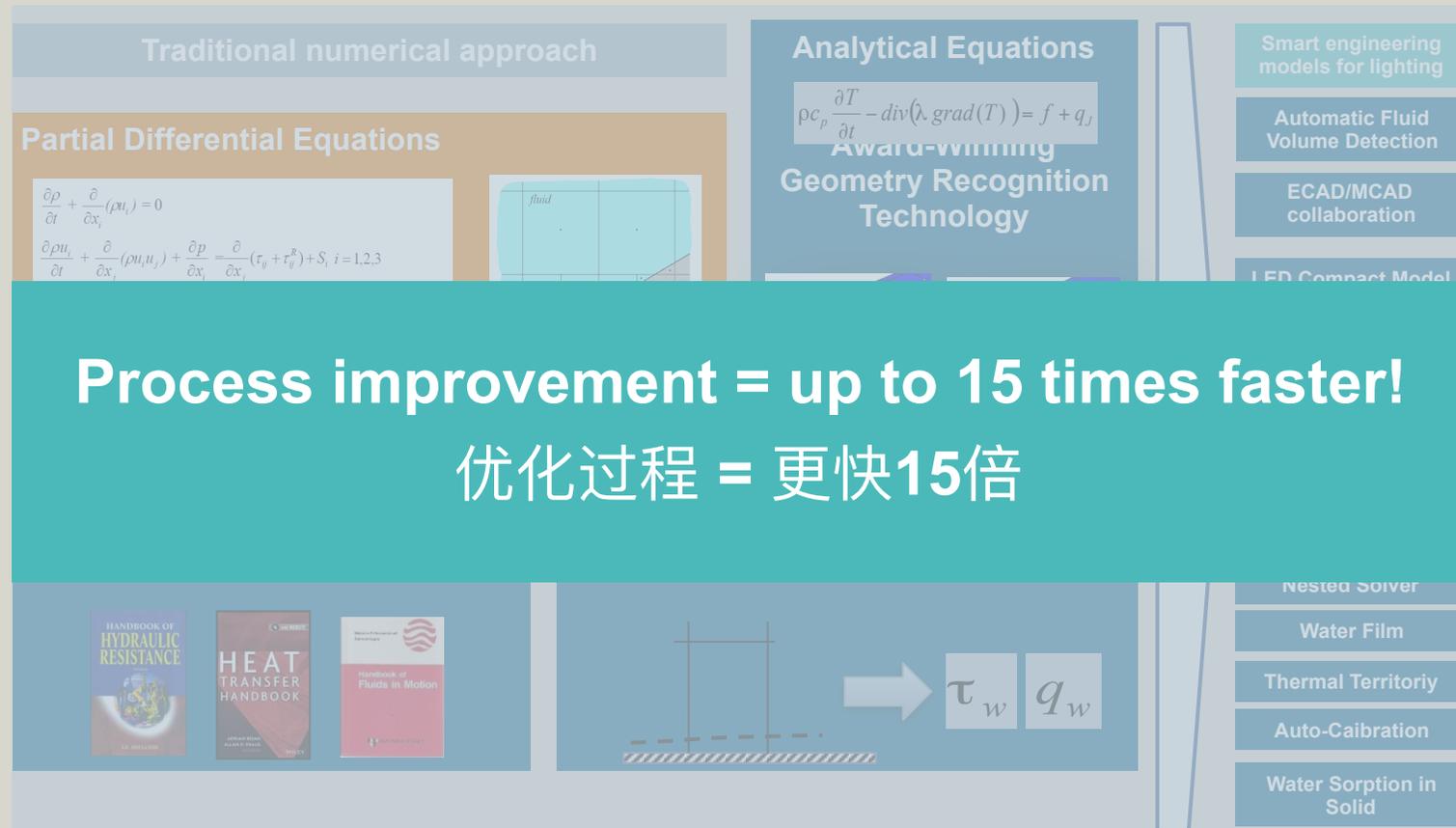
Summary

Key Requirement #2 – Evolving CFD- Simulation Technology 仿真技术CFD的革新

Traditional numerical approach

Partial Differential Equations

$$\frac{\partial \rho}{\partial t} + \frac{\partial}{\partial x_i}(\rho u_i) = 0$$

$$\frac{\partial \rho u_i}{\partial t} + \frac{\partial}{\partial x_j}(\rho u_i u_j) + \frac{\partial p}{\partial x_i} = \frac{\partial}{\partial x_i}(\tau_{ij} + \tau_{ij}^R) + S_i \ i = 1,2,3$$

fluid

Analytical Equations

$$\rho c_p \frac{\partial T}{\partial t} - div(\lambda \, grad(T)) = f + q_J$$

Award-winning Geometry Recognition Technology

Smart engineering models for lighting

Automatic Fluid Volume Detection

ECAD/MCAD collaboration

LED Compact Model

Process improvement = up to 15 times faster!

优化过程 = 更快15倍

Nested Solver

Water Film

Thermal Territoriy

Auto-Caibration

Water Sorption in Solid

τ_w q_w

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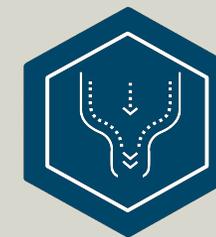## Technology & Automation Example 技术及自动化

Traditional simulation approach

Efforts dominate benefits
Bottlenecks
CAD-Complexity
Boolean Operations
Disconnectivity

Native CAD Environment

Smart CFD-Modeling Techniques

Benefits dominate efforts
Advantages
Fully CAD-Embedded
Synchronous Geometry Changes
Automatic Fluid Volume Detection

Bottleneck瓶颈 → **Accelerated product development** 加快研发速度

Siemens PLM Software

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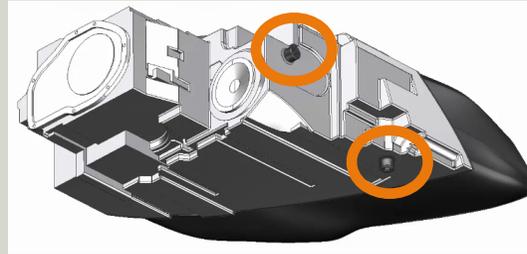
Trends, Challenges & Implications 趋势，挑战，影响
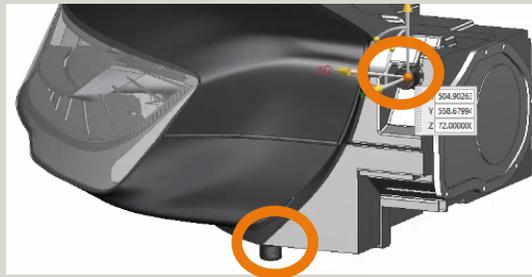
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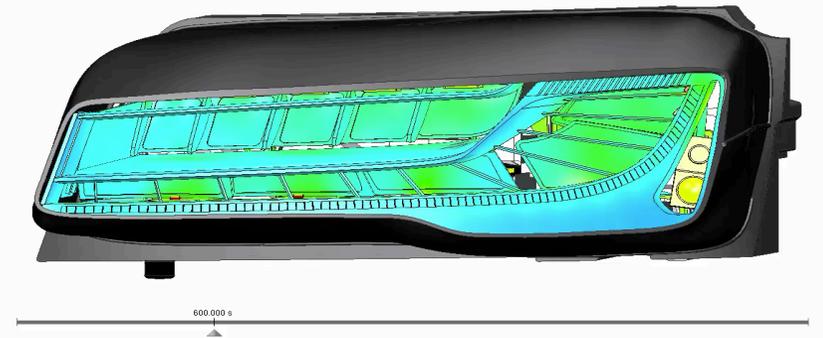仿真与测试

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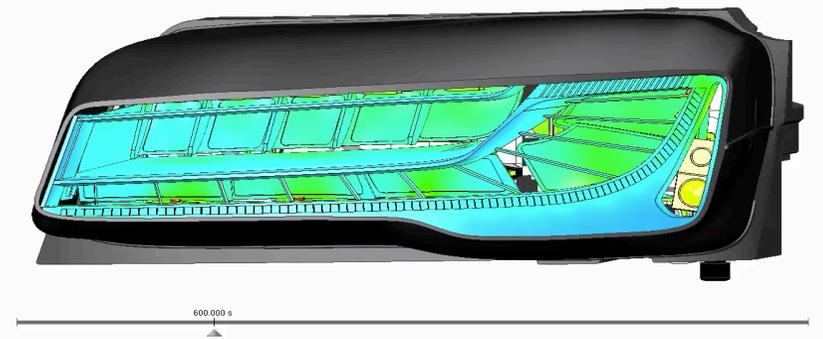**Initial vent position** 初始方案位置
No full clearance after 40min

Condensate Film Thickness vs Physical Time

600.000 s

Optimized vent position 优化后
Full clearance after 30min

Condensate Film Thickness vs Physical Time

600.000 s

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Smart CFD-Simulation Techniques Help to Overcome Engineering Challenges
更聪明的CFD仿真技术帮助克服工程挑战

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Frontloaded Simulation Allows Access to a Wider Audience of Engineers
仿真提前允许更多的工程师参与

Simulation&Test 仿真与测试

Reliable Electronics Thermal & Optical Performance Are Crucial For Safety!
可靠的电子热学&光学性能是安全保证的关键

Technology & Automation 技术与自动化

Faster Decision Making, Cost Reduction, Improved Quality
更快市场决定，降低成本，提高质量

Summary

Supporting the Digitalization Paradigm Shift!
支持数字化范式的转变

Thank you.
Please visit us at the booth!

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