NEVS

Siemens Simcenter Nordic Conference 2018

Agenda

In a world hurt from emissions,
we want to make a difference.

National Electric Vehicle Sweden AB

Founded	• 2012 • Acquiring the assets of Saab Automobile
Vision	• Shape mobility for a more sustainable future
Mission	• Developing Premium Electric Vehicles • Providing Mobility Services

NEVS 9-3 EV Concept

SAAB "ursaab"

NEVS InMotion Concept

Global Locations 全球坐标

Trollhättan Plant and TDC
特罗尔海坦工厂与研发中心

Tianjin Plant and R&D center
天津工厂与研发中心

Beijing office and Brand Experience Center
北京办公室与品牌体验中心

New Long Ma Motor Co. Plant and R&D center
新龙马汽车工厂与研发中心

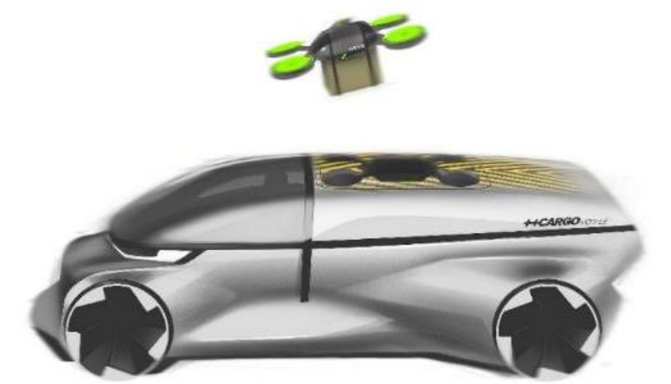
NEVS

Next generation NEVS Connected Mobility
下一代NEVS车联网出行

Sustainability awareness and enabling technologies of the connected society challenge automotive norms.可持续发展的意识以及有利于互联网社会的技术挑战着“汽车”的概念。
This allows NEVS to design innovative products and ownership models, with agility. 这使得NEVS可以更灵活地设计创新产品以及所有权模式。

Solutions for Ownership and Exclusive Sharing
为所有权以及独家共享提供的解决方案

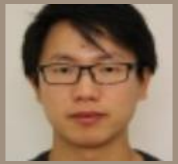
Solutions for Sharing Society
为共享社会提供的解决方案



Solutions for Goods and Services
为商品与服务提供的解决方案

CFD Department at NEVS

Mohammad El-Alti
Supervisor CFD & Aerodynamics




Kaixiang Dai | Zongyao Wan

Engineer CFD & Modelling

Battery Thermal Management
Climate comfort



Kristian Abdallah | Wenting Zhou | Jingxiang Wang

Engineer CFD & Aerodynamics

External Aerodynamics
Underhood Thermal Management

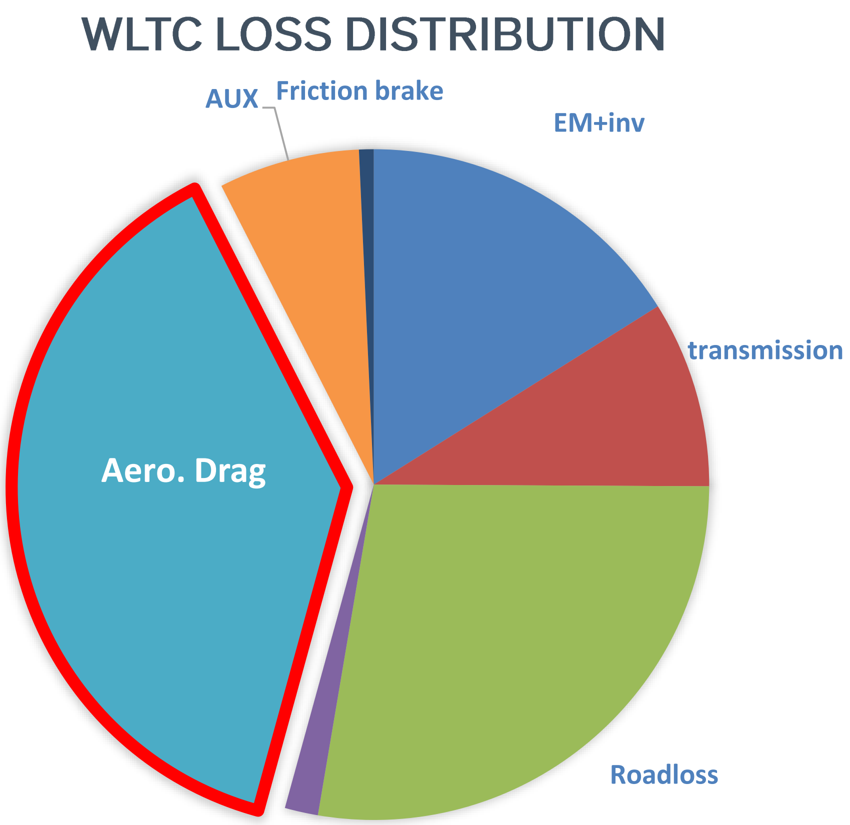

Jonas Gunnarsson | Zhenhua Kang

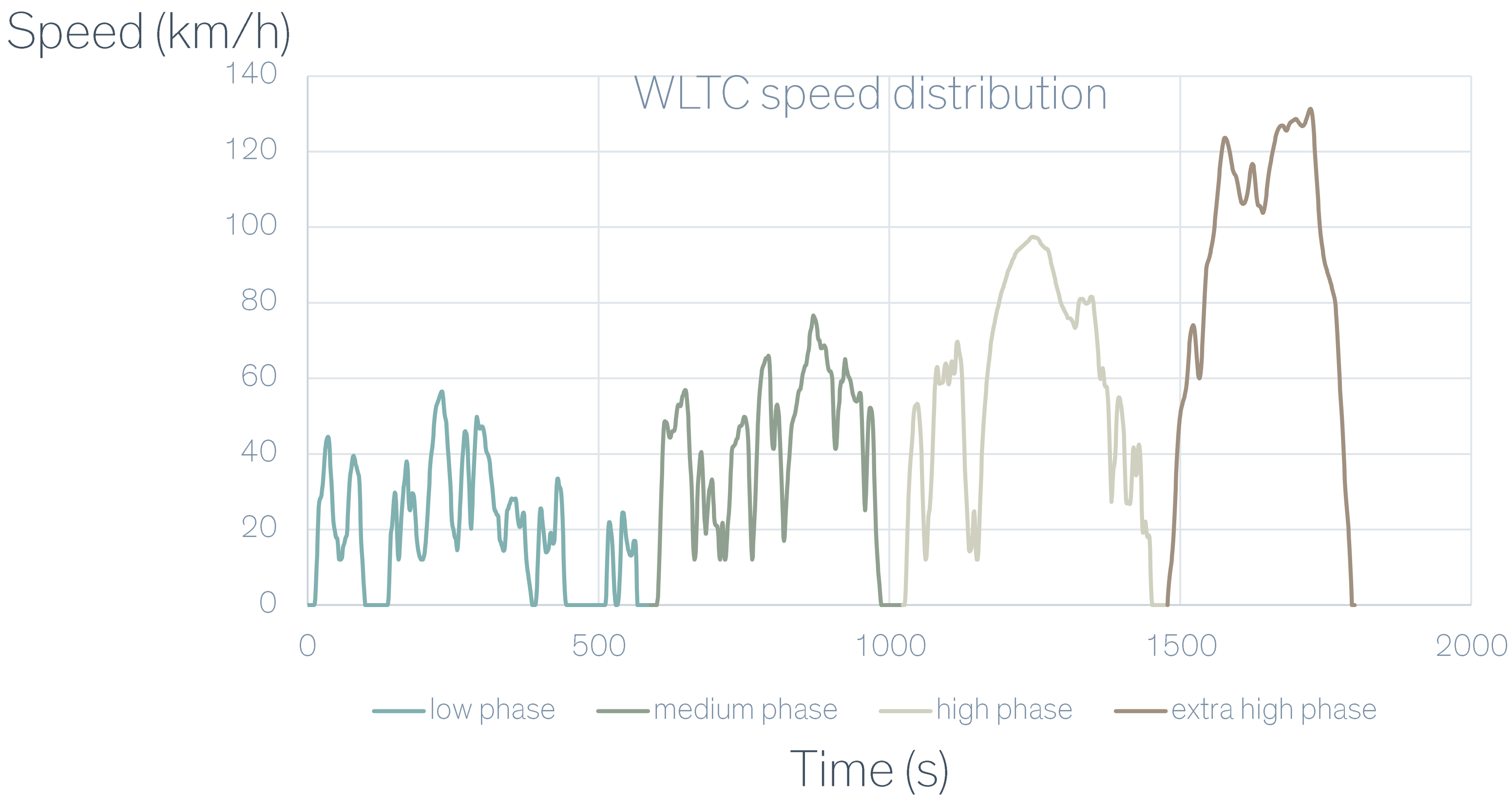
Engineer CAE Simulation

Thermal Simulations on System Level
1D CFD

Aerodynamic Simulation Process

WLTC

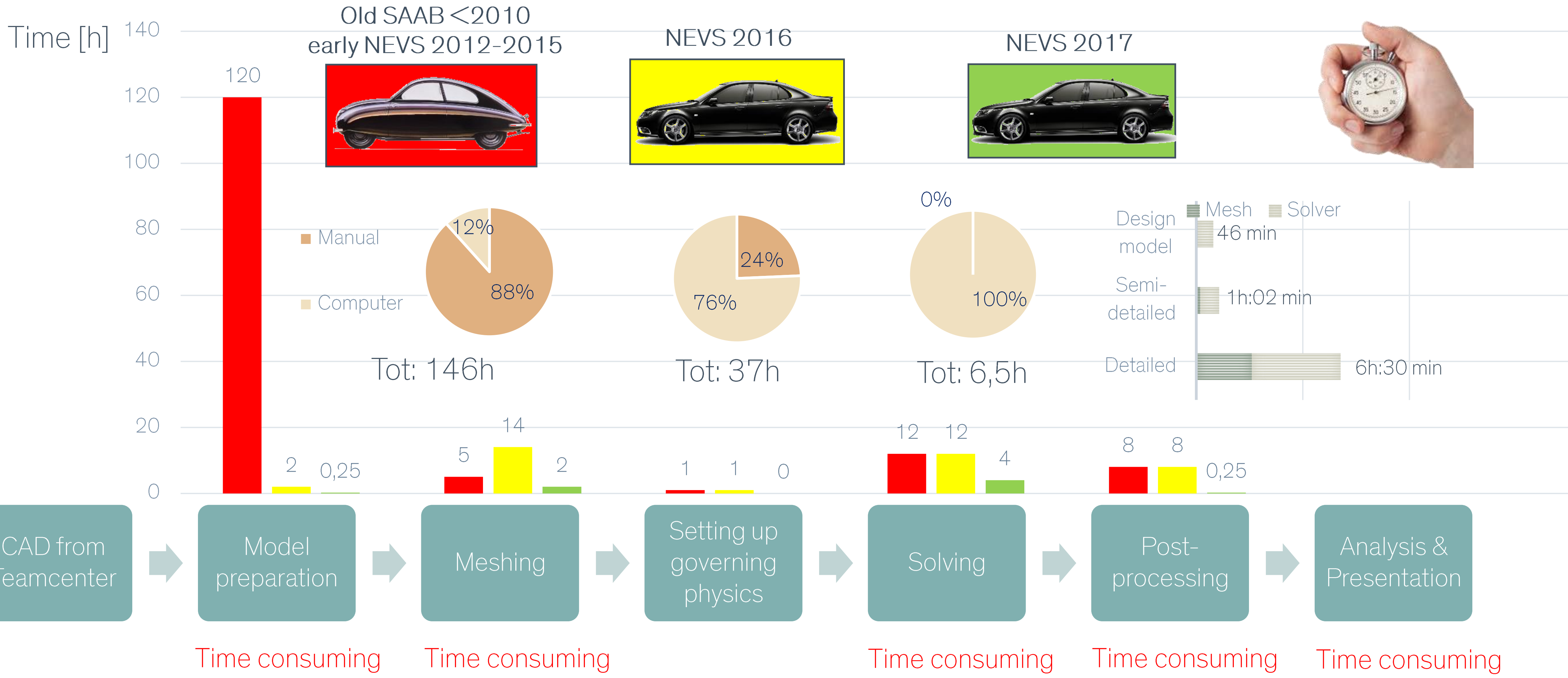




- Dynamic cycle, < 4% in constant speed
- Divided into 4 phases

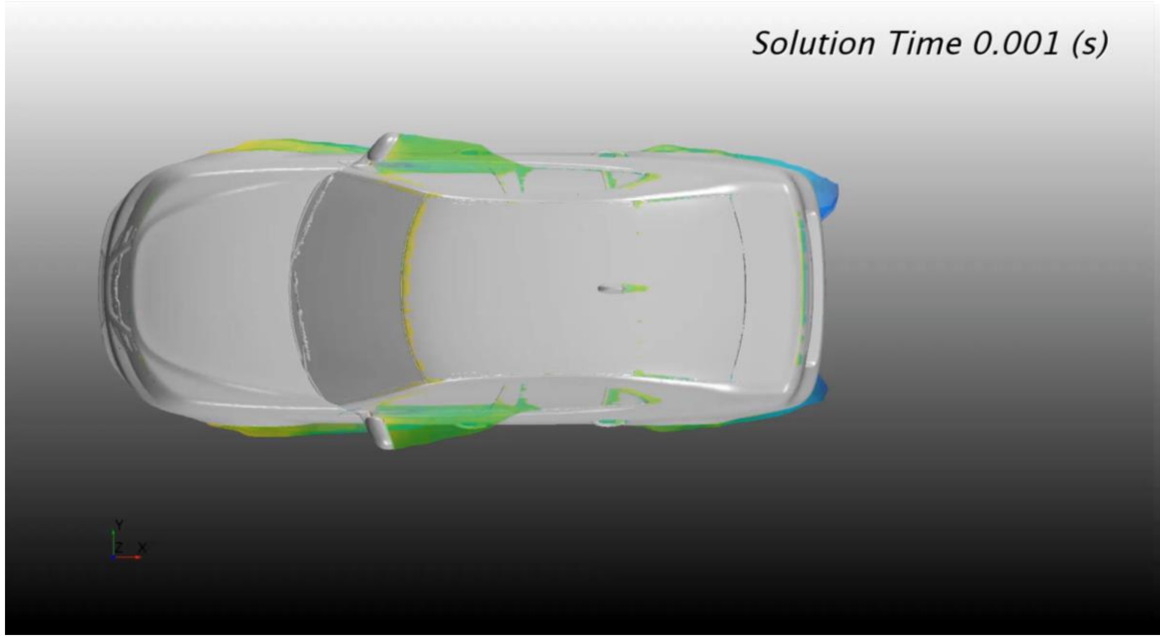
The aerodynamics and CFD Process

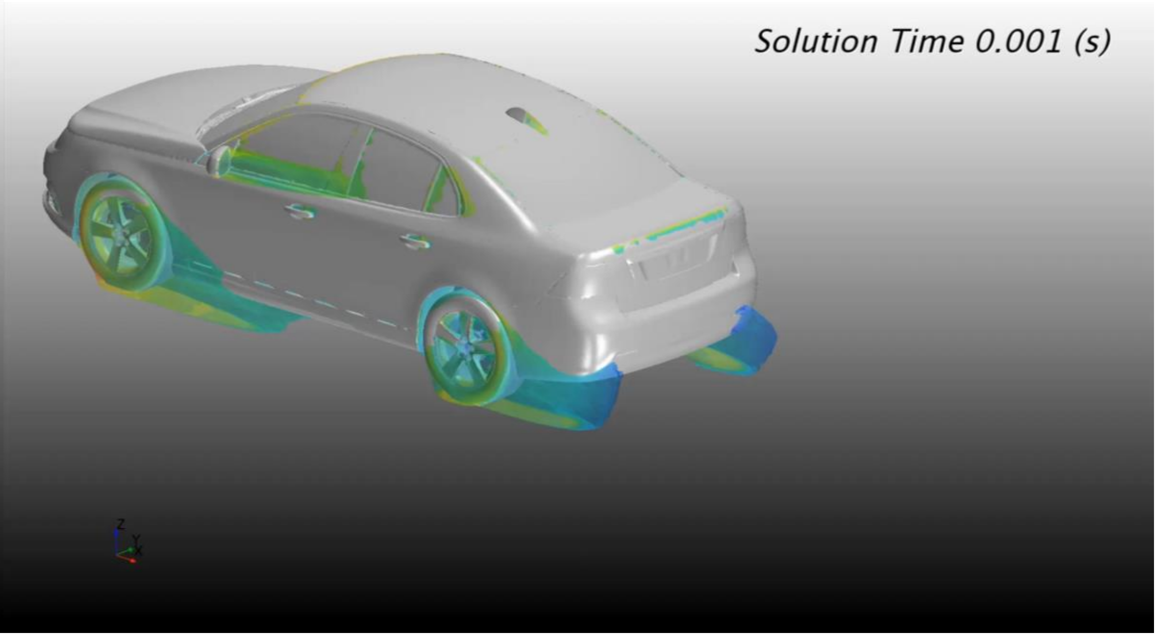
Comparison between process timings in the TS project



External Aerodynamic Simulations

– Next Step for NEVS: DES Modelling





Ongoing development: CFD process

Siemens PLM Software
SIEMENS TEAMCENTER

Microsoft Excel 2016

Java

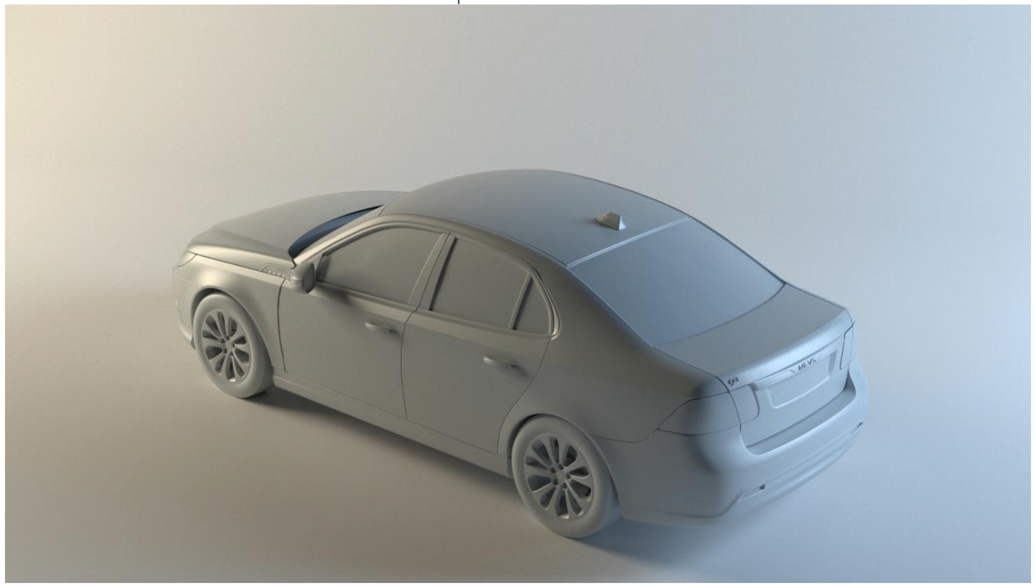
STAR-CCM+ 11

Microsoft® PowerPoint 2016

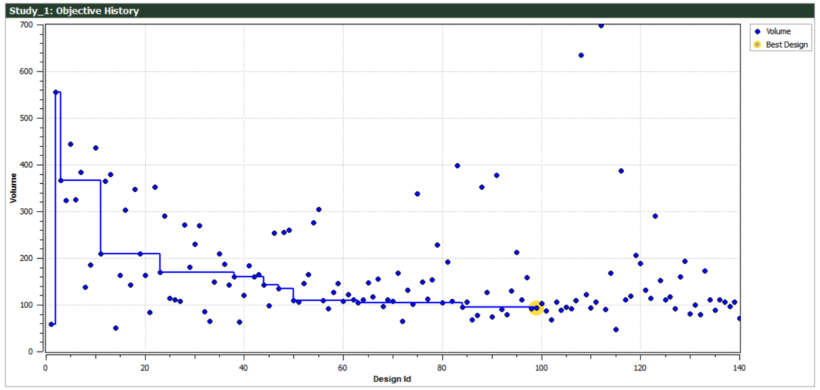
"Focus man time here to become innovative"

Parameterize the CAD and set up control point on surface

Adjoint Optimization Solver to identify potential regions

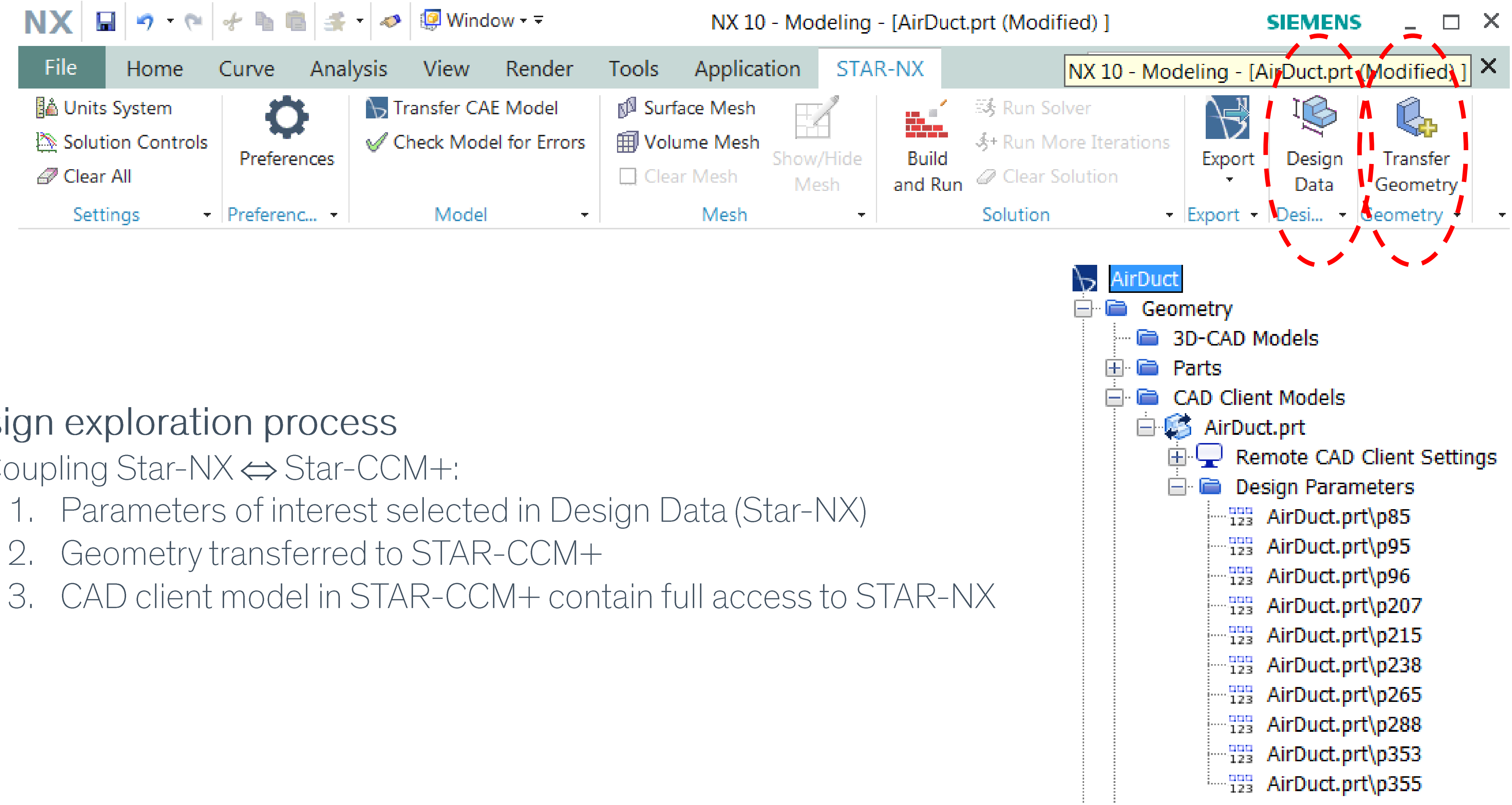


"Run CFD of hundreds of design candidates HEEDS® MDO automates the design exploration process



Design Exploration of an Air Duct

Design Exploration of an Air Duct



Design exploration process

- Coupling Star-NX ⇔ Star-CCM+:
  1. Parameters of interest selected in Design Data (Star-NX)
  2. Geometry transferred to STAR-CCM+
  3. CAD client model in STAR-CCM+ contain full access to STAR-NX

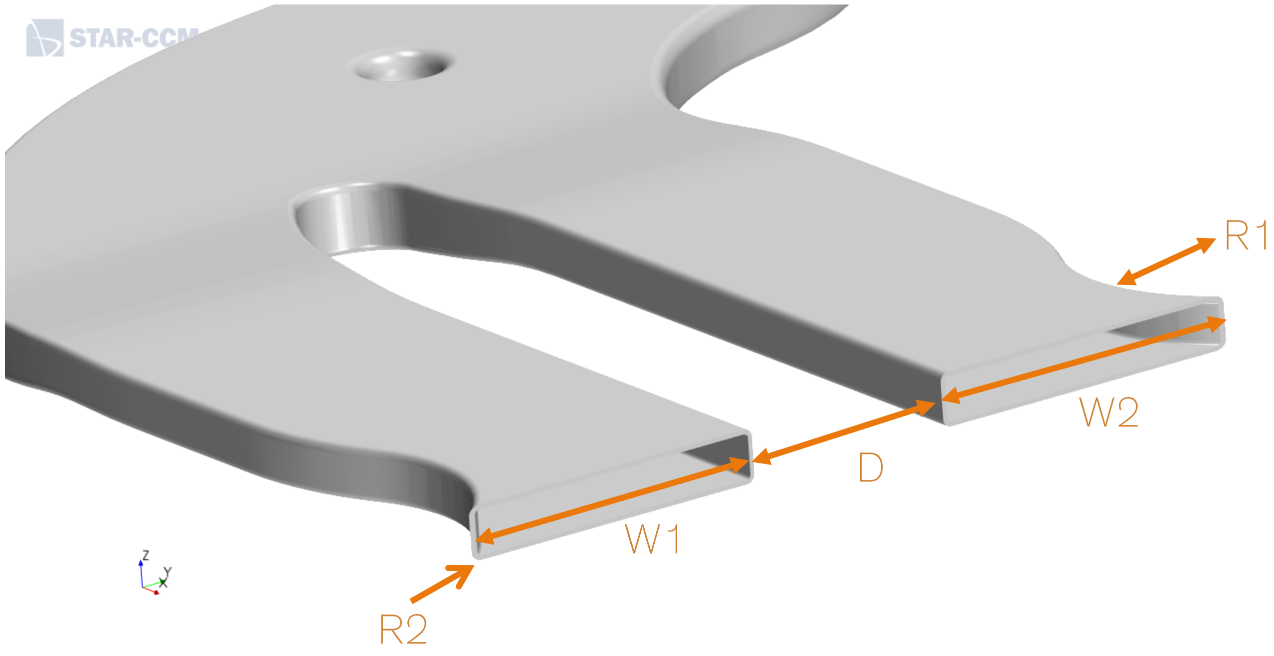
Design Exploration of an Air Duct

Purpose:

- The duct is used to guide cooling airflow from the main HVAC system to the compartment

Objectives:

- Minimize pressure drop
- Increase flow uniformity



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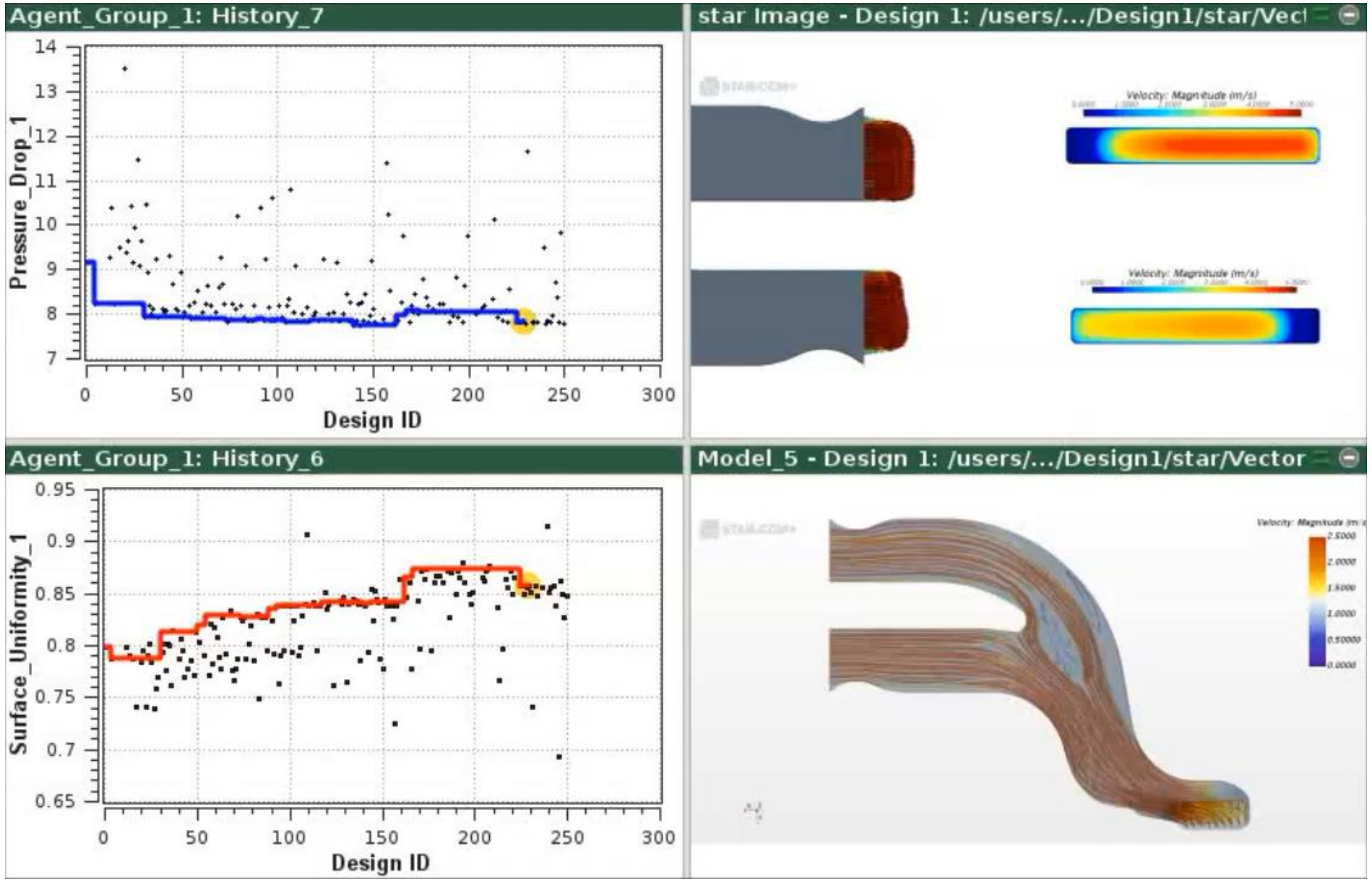
Design Exploration of an Air Duct – Results

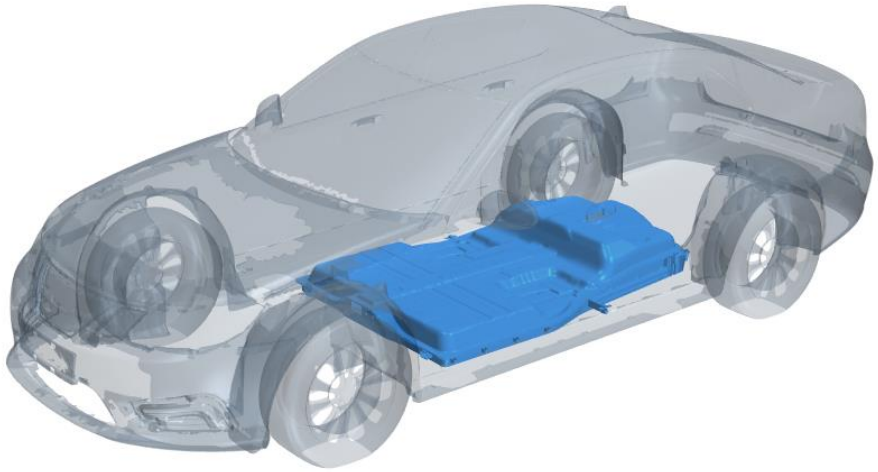
Optimization Loop

- 250 design sets in 19 hours
  - → Pressure drop reduced by **6%**
  - → Surface uniformity improved by **15.2%**



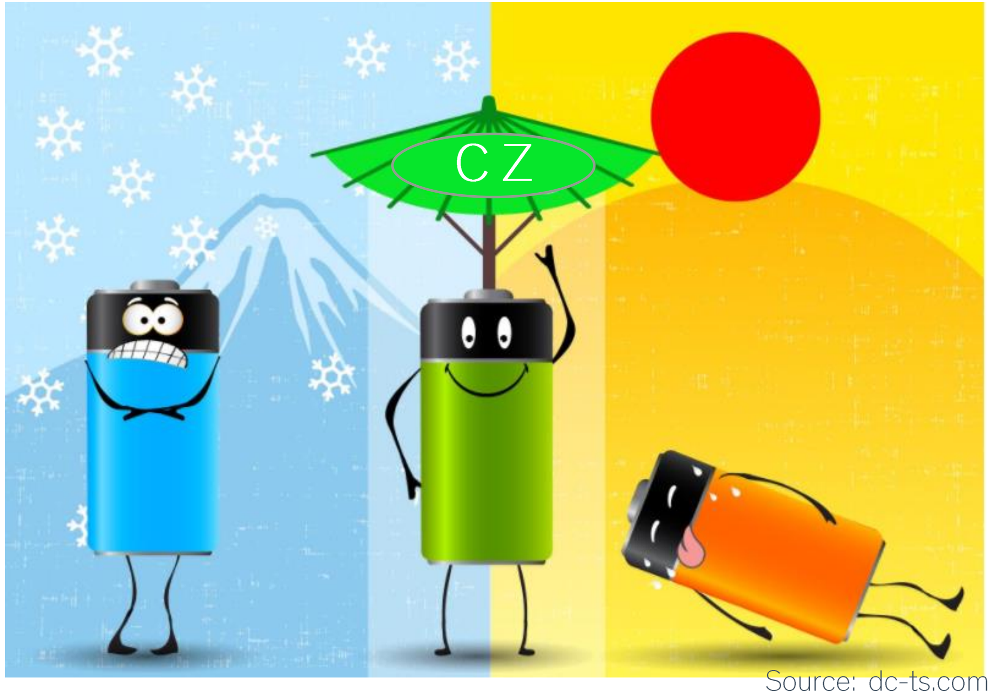
Battery Thermal Management

Battery Thermal Simulations



The battery pack is the heart of an electric vehicle

- Powers the propulsion and determines the driving range



Source: dc-ts.com

Extreme ambient temperatures

- Performance
- Safety
- Lifecycle of lithium-ion batteries (LIB).

Heating and cooling of cells

Battery Simulation Scopes

Cooling plate design

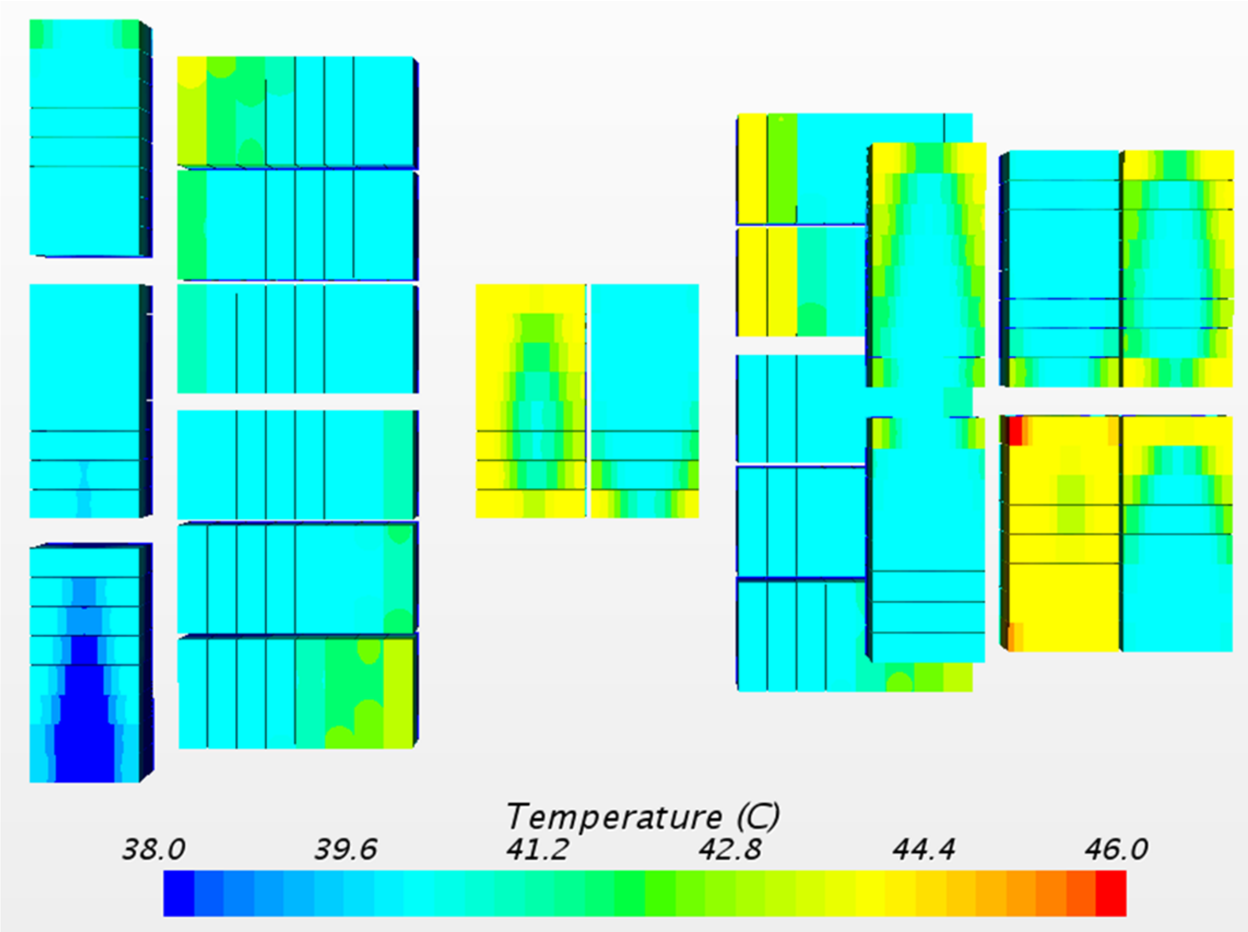
- Flow optimization and minimization of pressure drop

Analysis of temperature distribution

- Minimize the overall temperature deviation over the modules

Power input for maintaining RESS temp

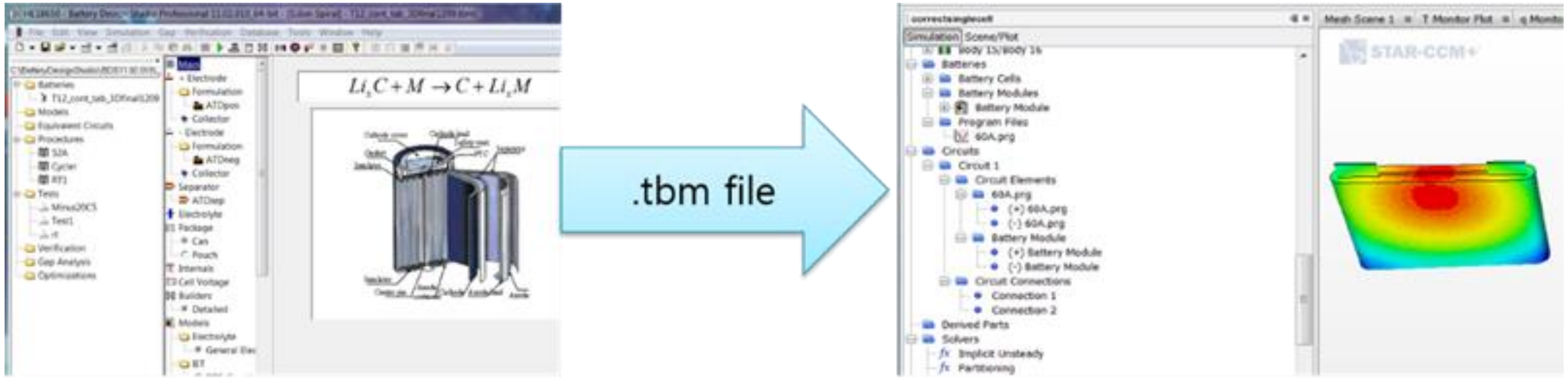
- Studying thermal insulation and minimizing loss of energy



RESS- Recyclable Energy Storage System

Battery Thermal Modelling: BDS & BSM

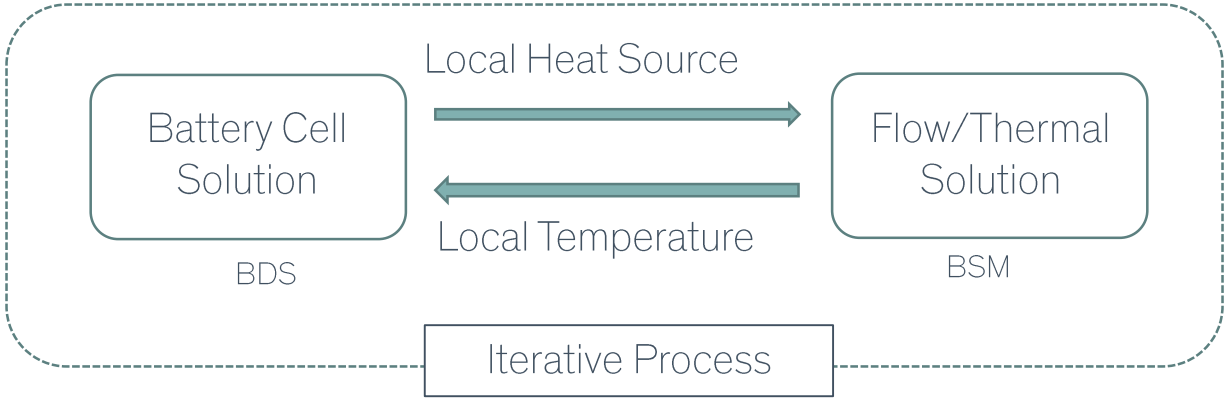
- Couple battery cell design with complete thermal simulations of the RESS Package



BDS

Export the .tbm file from BDS to BSM

BSM



Battery Thermal Modelling Process

Assessing the thermal performance of the entire system

Climate Comfort

Cabin Air Quality Levels

– Ensuring driver and passengers clean fresh air

Air pollution is a major issue in big cities as it impacts human health

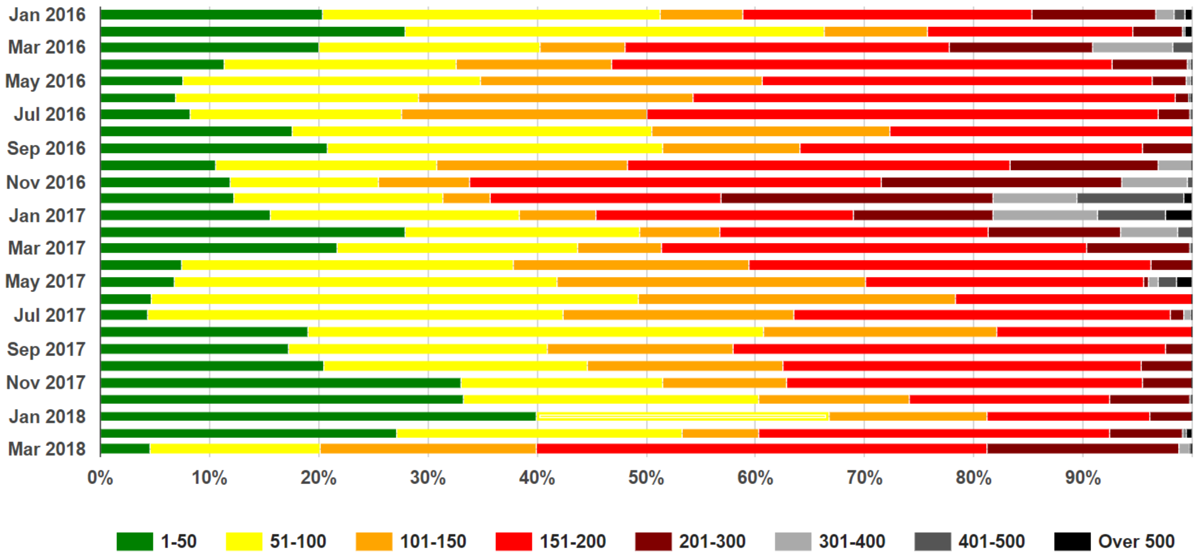
- Tiny particles, known as PM2.5, penetrates deep into the lungs and damages cells
- PM2.5 – Particulate Matter (PM) with particle diameter < 2.5 um

A cabin air filter is able to prevent the PM2.5 from entering the compartment

- Supplying clean fresh air to the driver and passengers

Regulation:
Average PM2.5 < 50 μg/m³

PM2.5 trend in Beijing from 2016-01 to 2018-04



CFD is used to evaluate the air filter performance

Source: aqicn.org

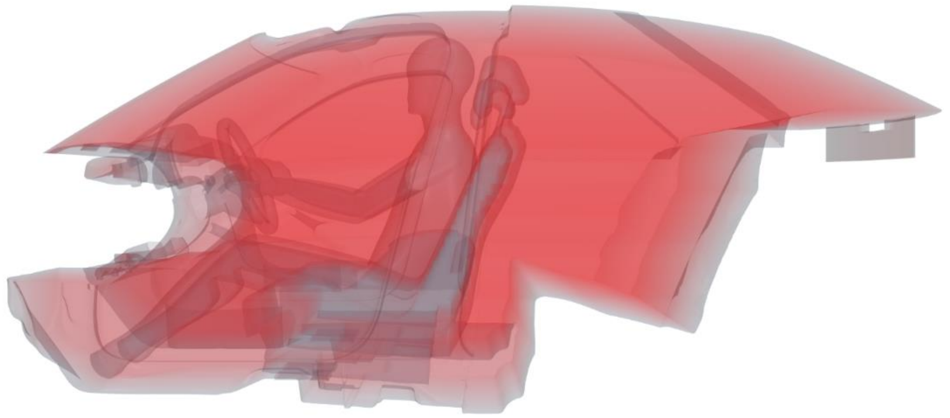
Cabin Air Quality Simulation Model

Cabin Condition

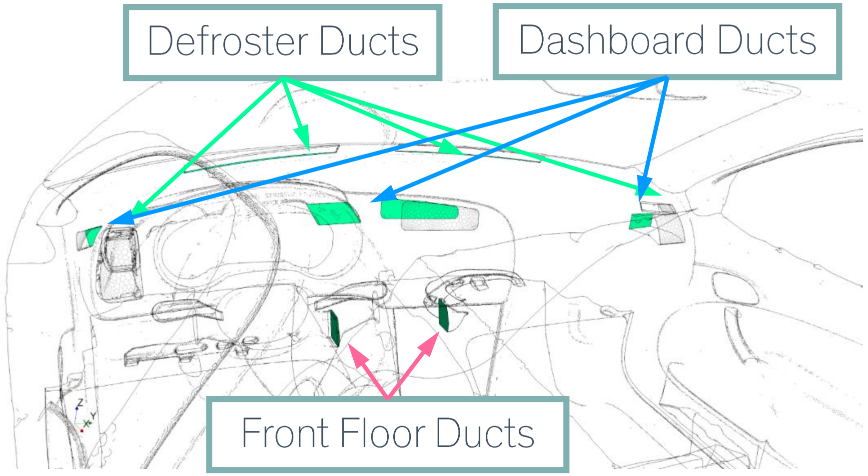
- Dirty air (PM2.5 = 800) initially in the cabin
- Fresh air (PM2.5 = 30) at HVAC ducts

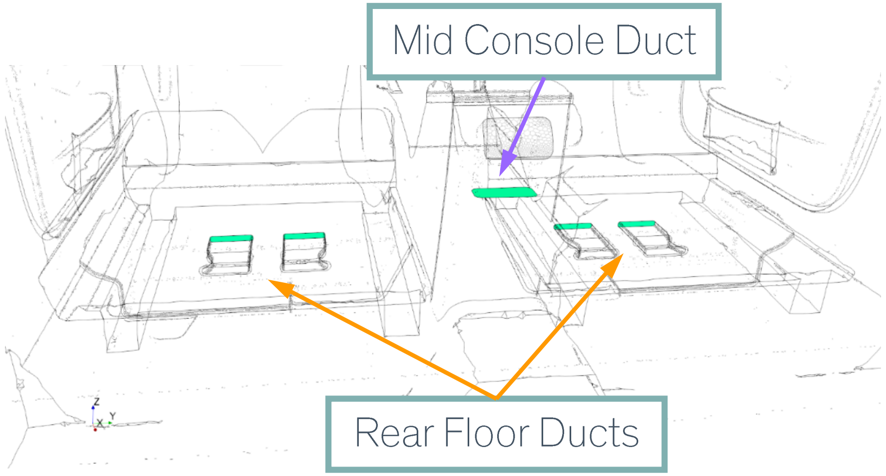
Physics

- Transient condition
- Turbulence Model: SST k-omega
- Multi-component gas

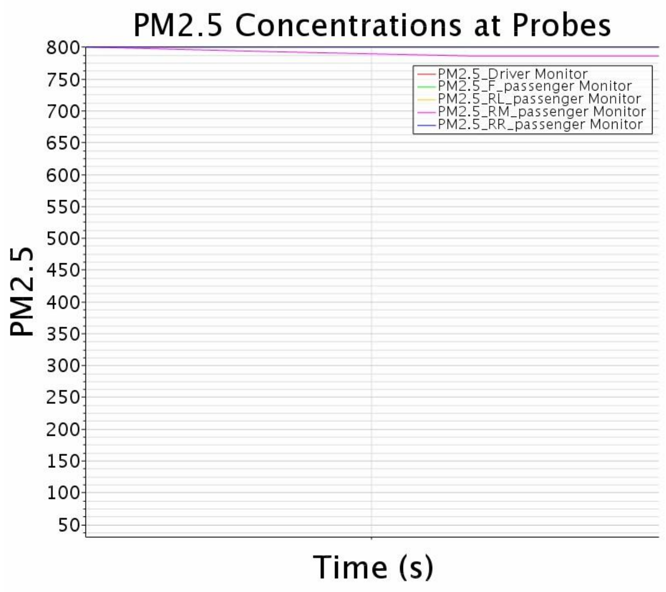


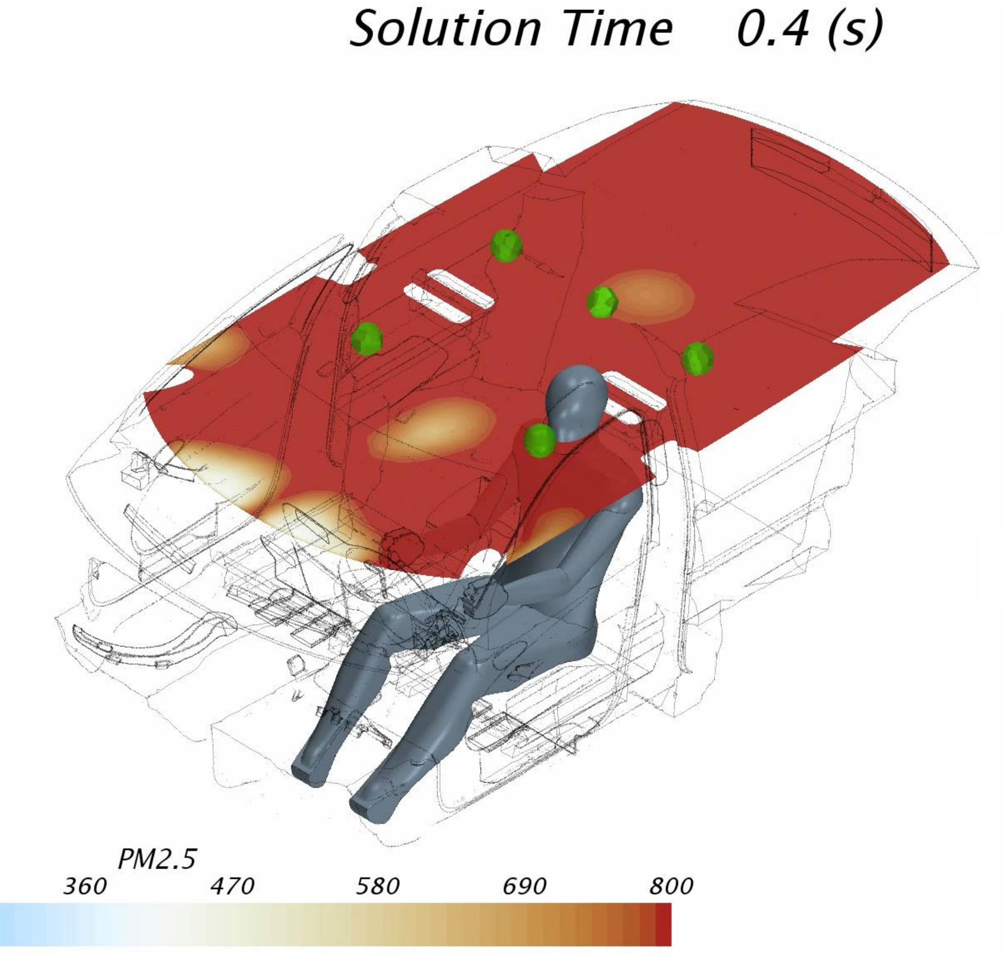
Initial dirty air quality in the cabin

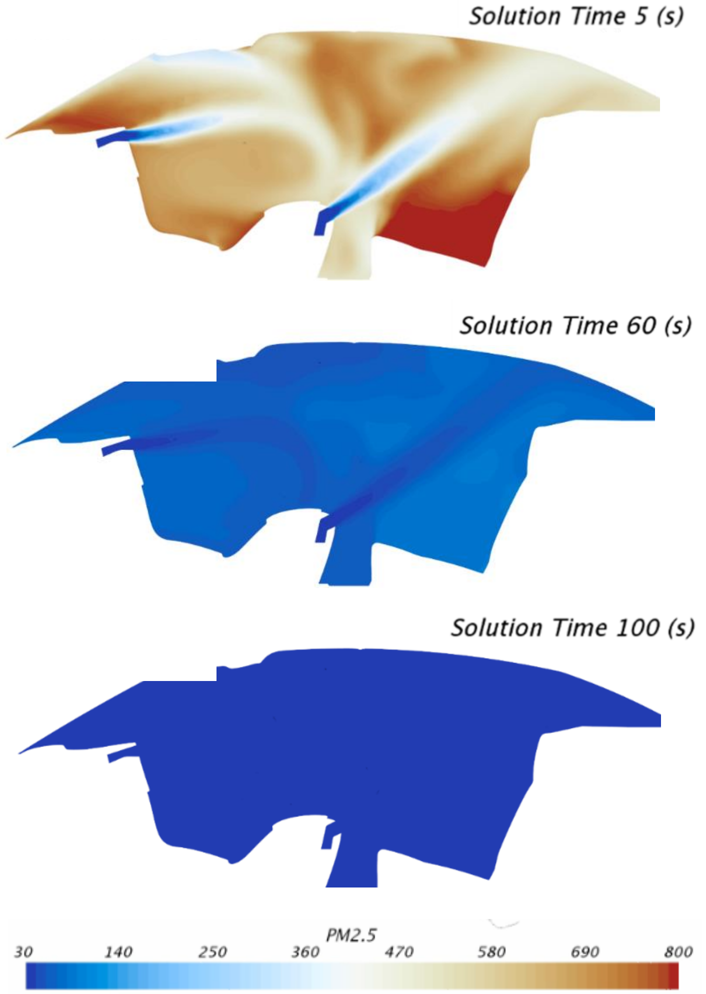




PM2.5 Concentrations Over Time

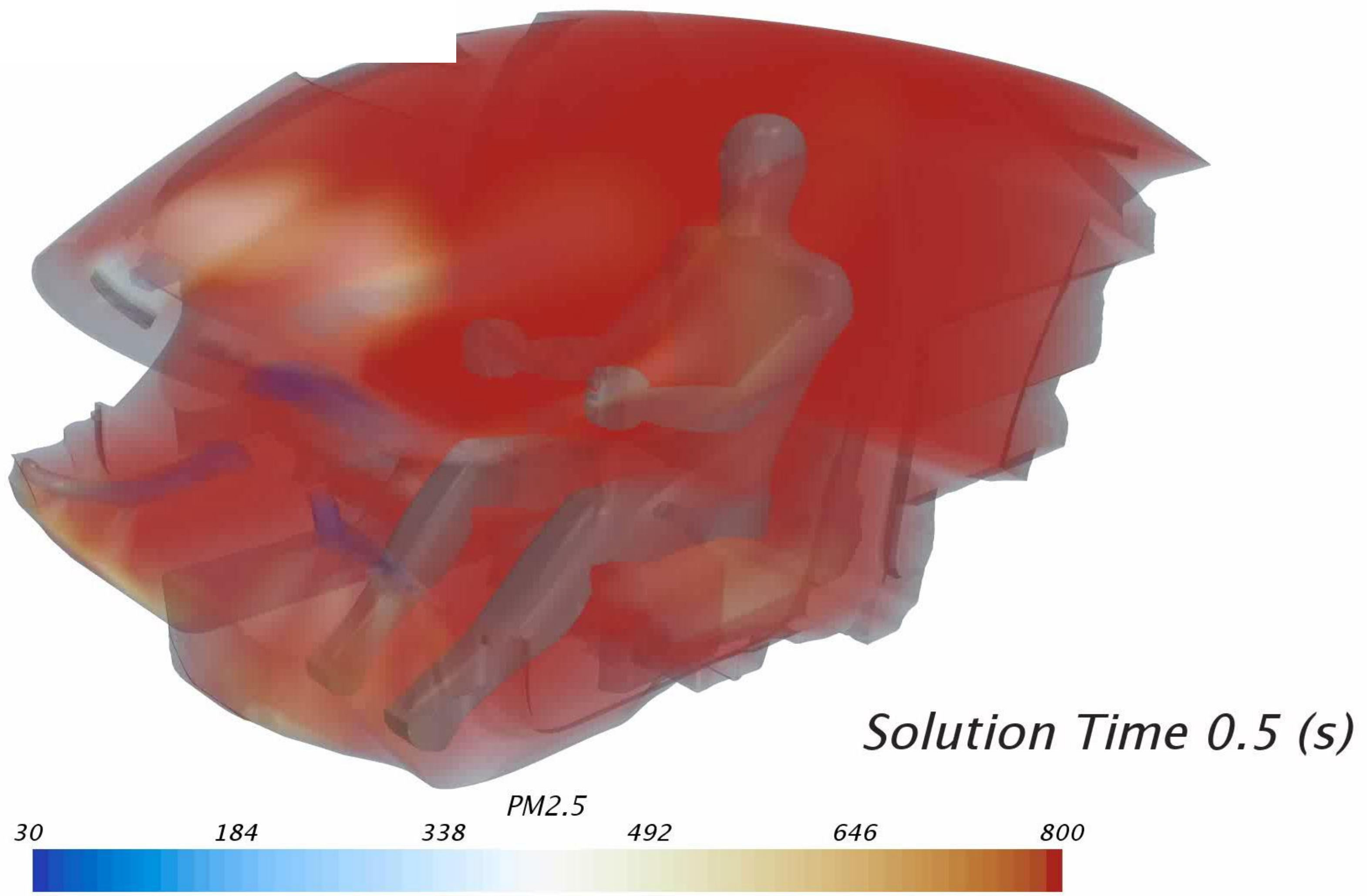




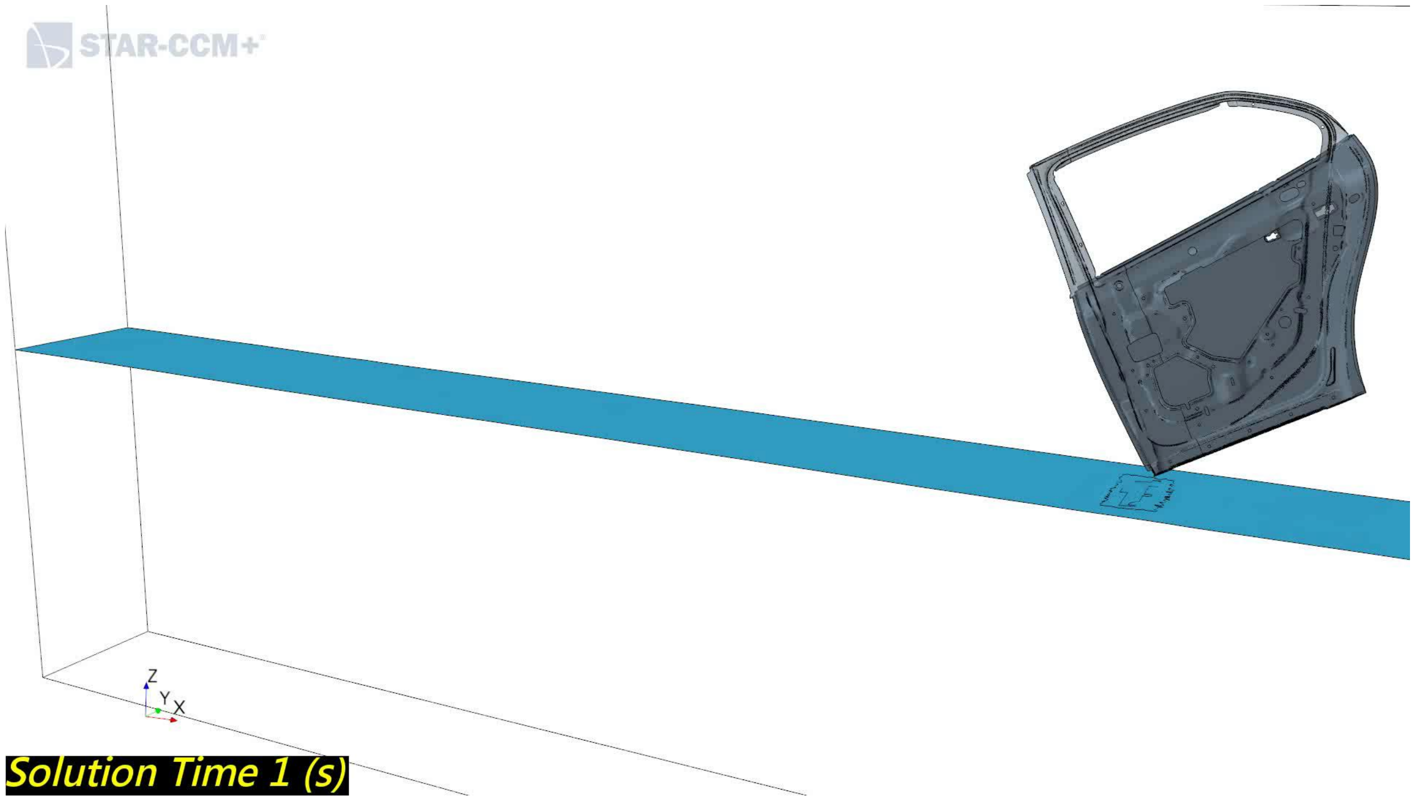


After **100 seconds**, the PM2.5 concentration reached a stabilized value of ~30 μg/m³

PM2.5 Concentrations Over Time



Electro-Deposition Coating



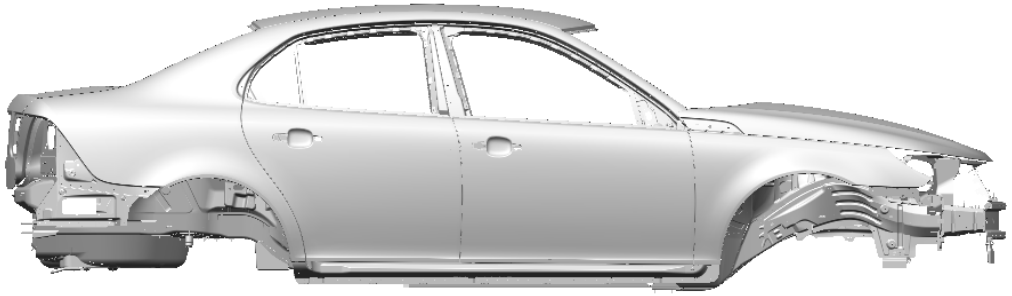
Electro-Deposition Modelling

With CFD simulations these issues can be located and solved early in the process

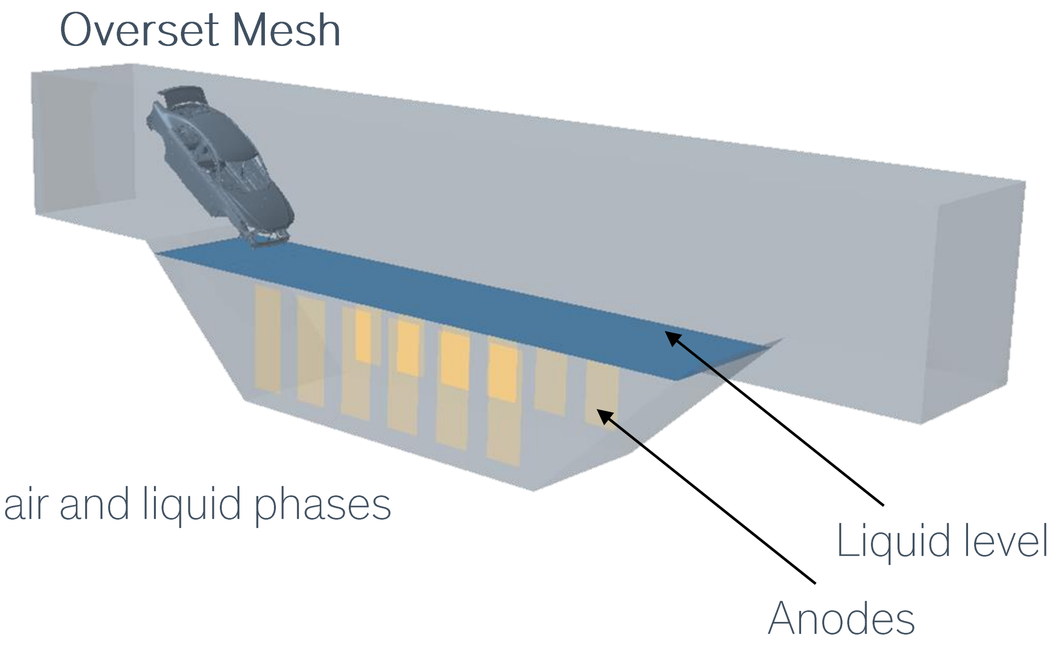
Common issues of different ED process stages:

1. Dip-In.
   - Complex geometry → Air bubbles may remain inside the bath
2. Electro-Deposition.
   - Areas with no coating due to remaining air
3. Dip-Out.
   - Excessive drainage time → Small sizes and/or bad placements of drainage holes.

ED Coating: deposition of a chemical thin film
→ to rustproof the BIW structure



Electro-Deposition Modelling

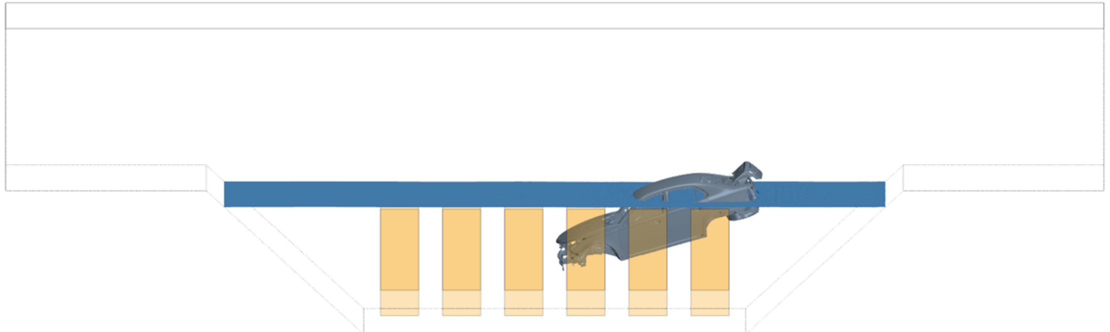


Physics Modelling

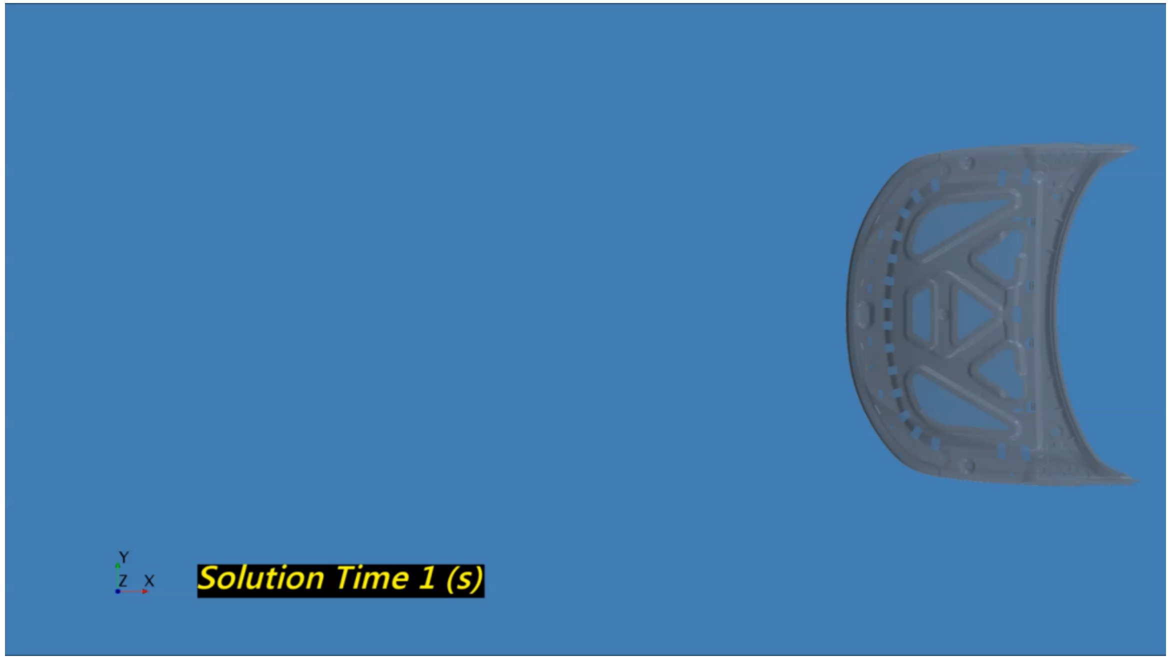
1. VOF Model → Dipping in/out stage
   - Predicts and captures the interactions and movement between air and liquid phases

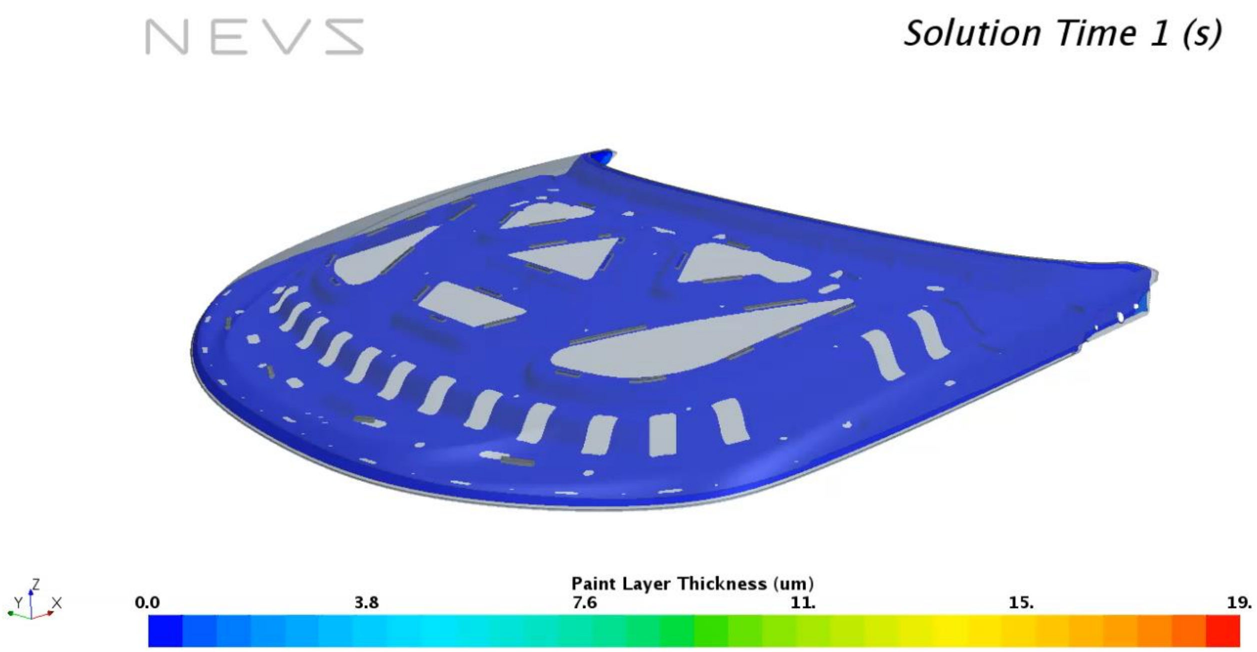
2. Electrodynamic Potential Model → Coating stage
   - Electric potential is applied to the anodes
   - User defined surface resistance is applied at the cathode (the BIW surface)

3. Electro-Deposition Coating Model → Calculates surface resistance during coating.
   - Increase of surface resistance leads to increased coat layer thickness
   - And after some time it will be saturated and reach maximum thickness.



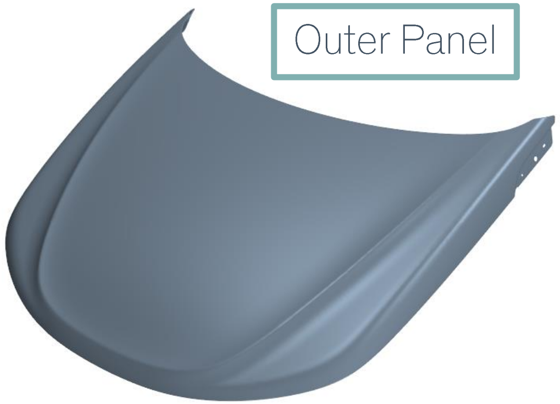
Electro-Deposition Simulation on a Hood

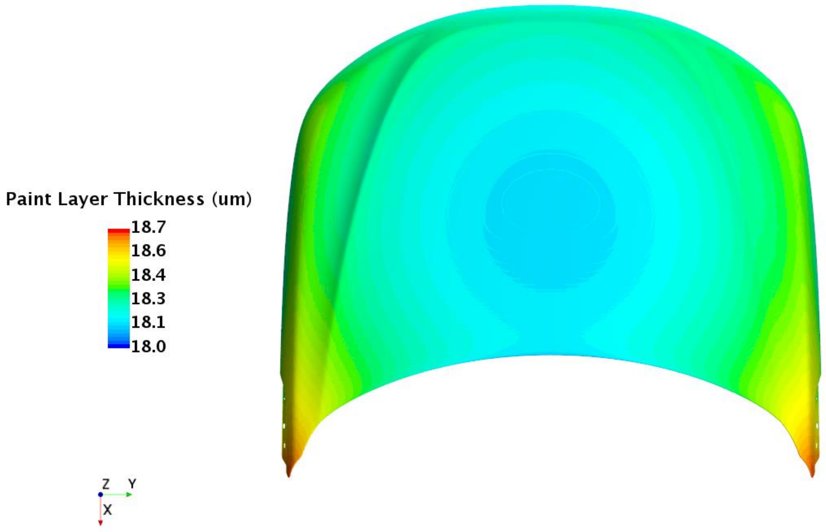




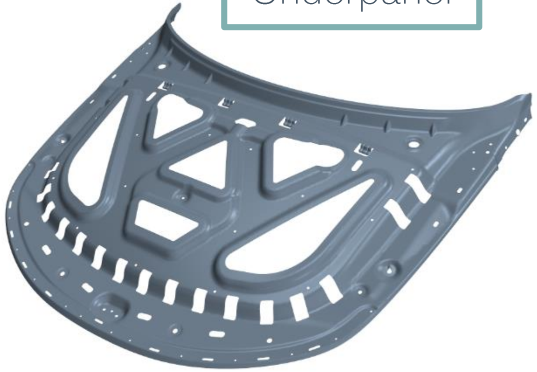
Electro-Deposition Simulation on a Hood

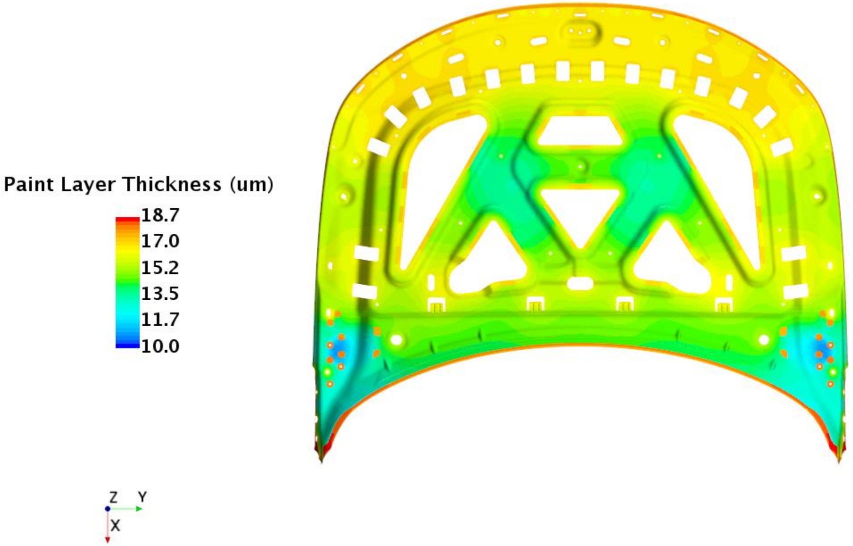
Outer Panel



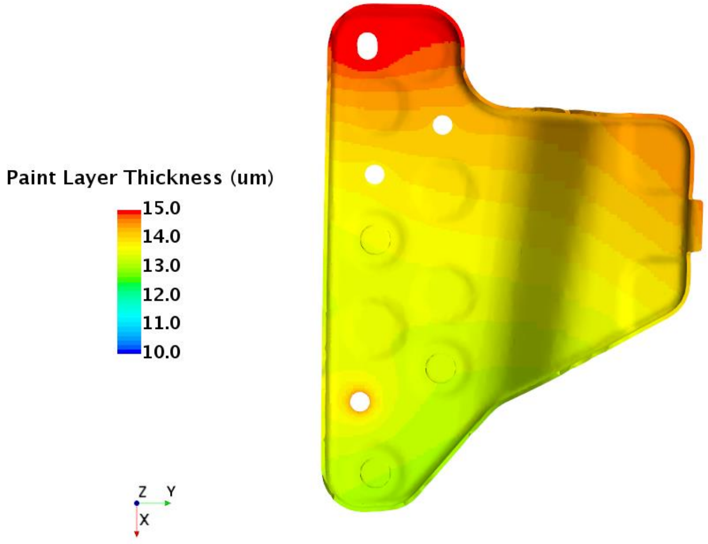


Underpanel





Reinforcements with Screws

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