EXPLORING THE POWER OF SIMULATION

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cadmicro

AGENDA

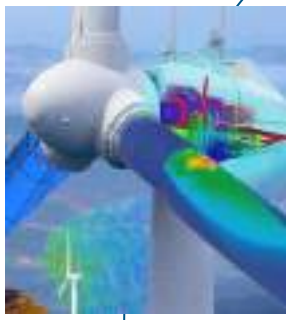
Why Use Simulation

Case Studies

Simulation Domains

Simulation Domains

Electromagnetics

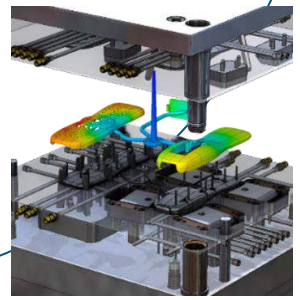


Structures

Kinematic motion

Collaboration

Fluids



Manufacturing process

WHY USE SIMULATION

Make innovative products before your competitors

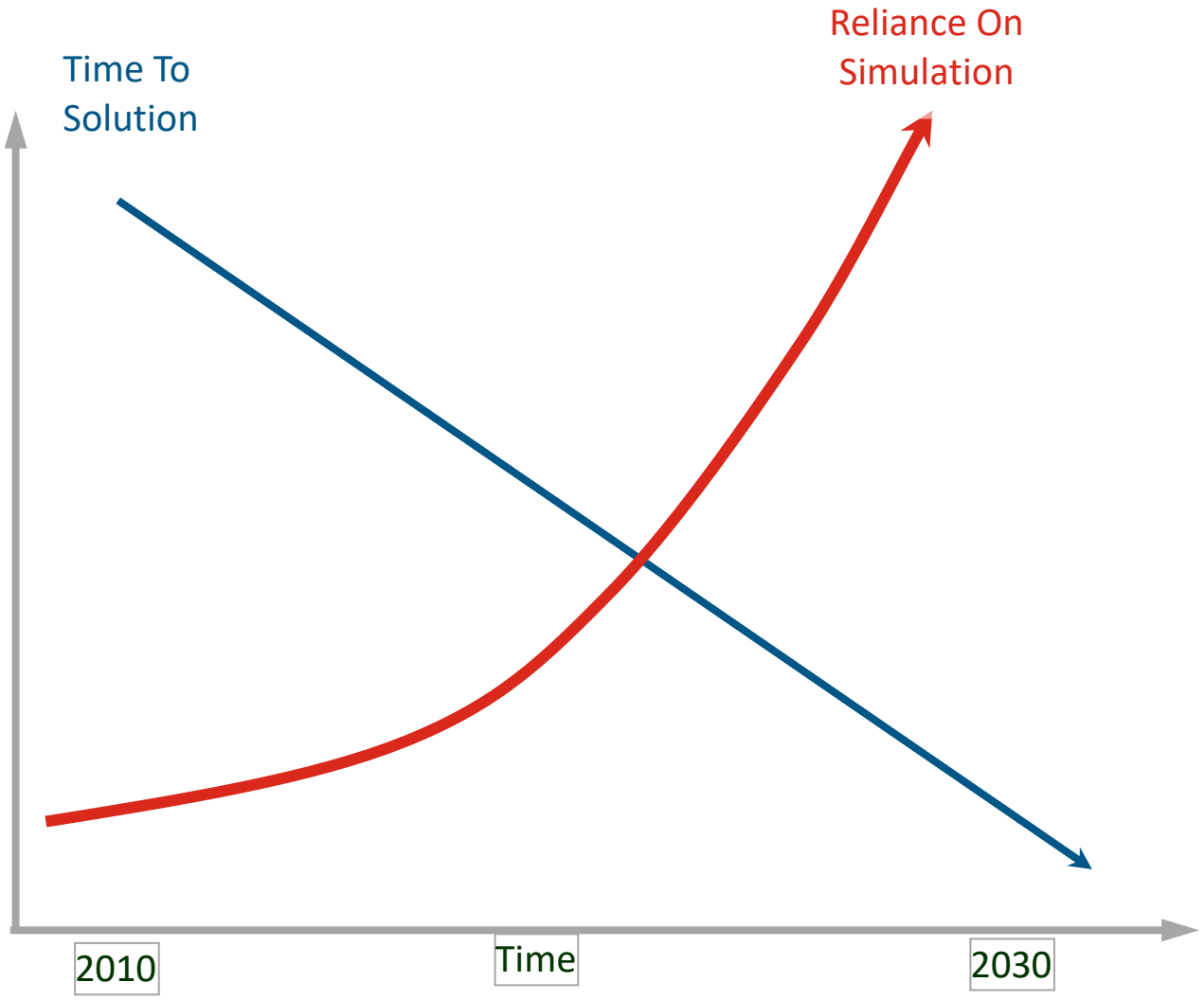
Reduce cost and time of physical prototyping – Do Virtual Testing !

Accelerate product development

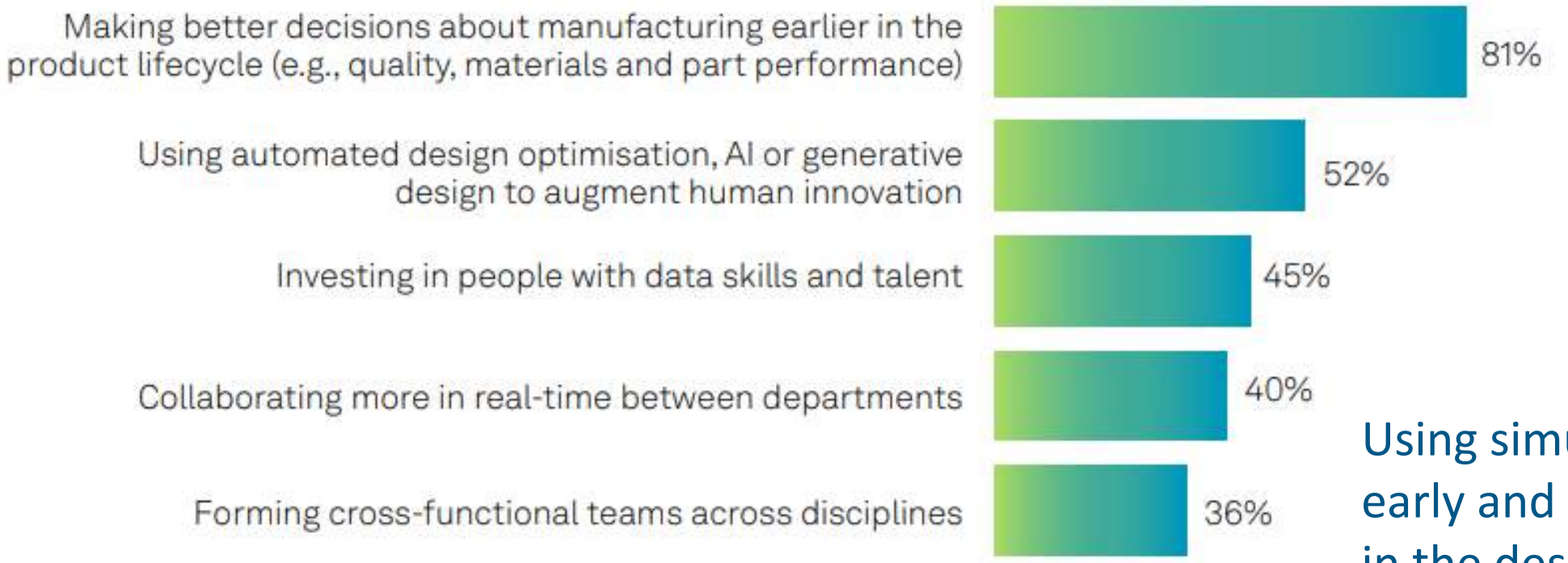
Improve product quality

Make informed decisions

Tool to Design Better Products



MOVING LEFT

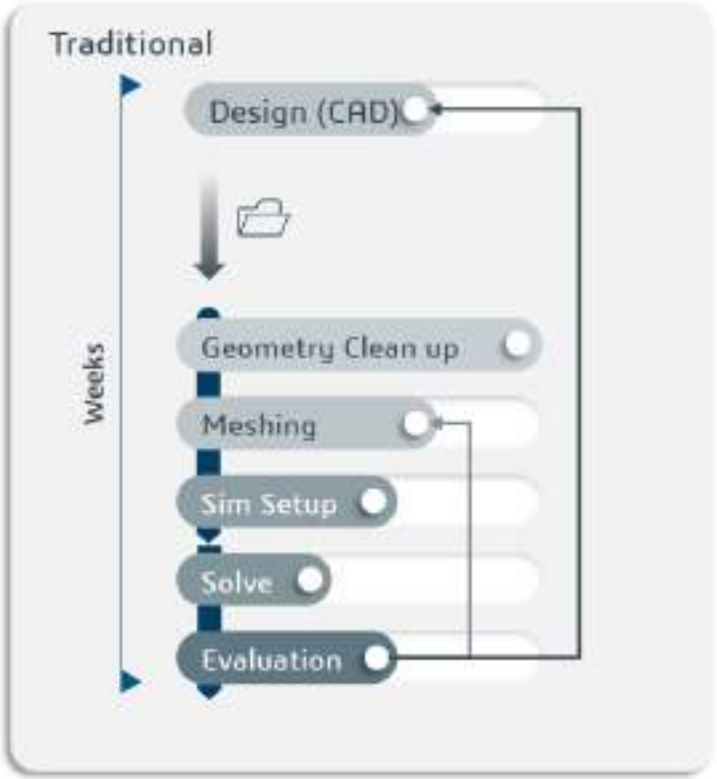


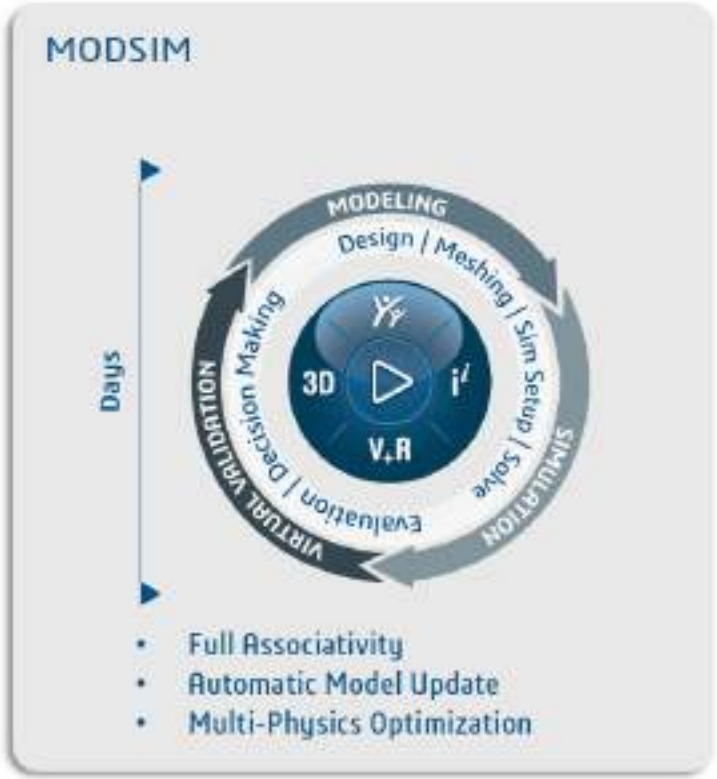
Using simulation early and frequently in the design process

85% Increased Lead Time

METHODS OF IMPLEMENTATION

- Simulation can be accomplished through a MODSIM method and specialized Analysts
- Traditionally an analyst devoted to simulation uses a model dedicated to simulation
- MODSIM uses the same model for development as for analysis

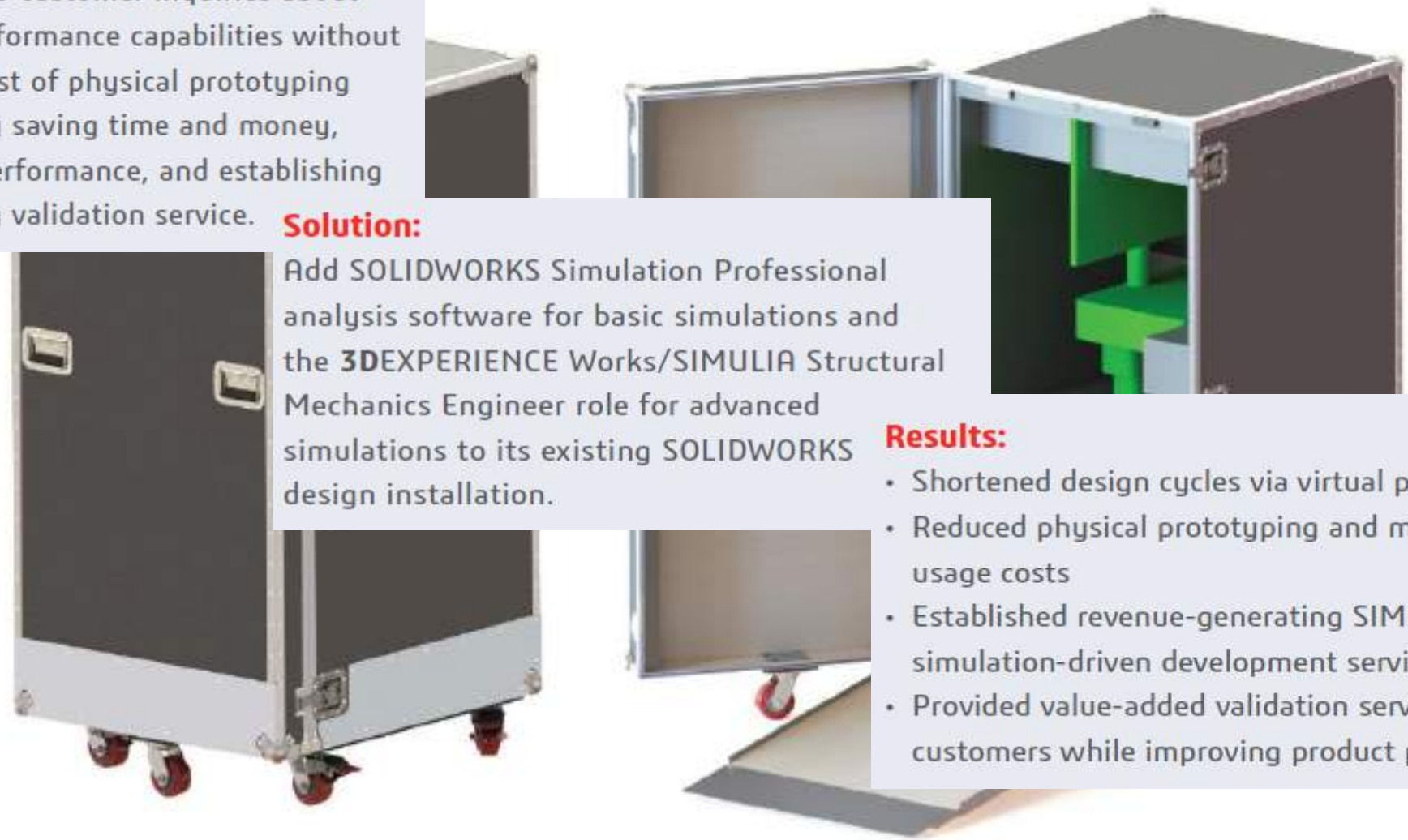




CASE STUDY: WILSON CASE

Challenge:

Accurately respond to customer inquiries about product load and performance capabilities without incurring the high cost of physical prototyping while simultaneously saving time and money, improving product performance, and establishing a revenue-generating validation service.



Solution:

Add SOLIDWORKS Simulation Professional analysis software for basic simulations and the **3D**EXPERIENCE Works/SIMULIA Structural Mechanics Engineer role for advanced simulations to its existing SOLIDWORKS design installation.

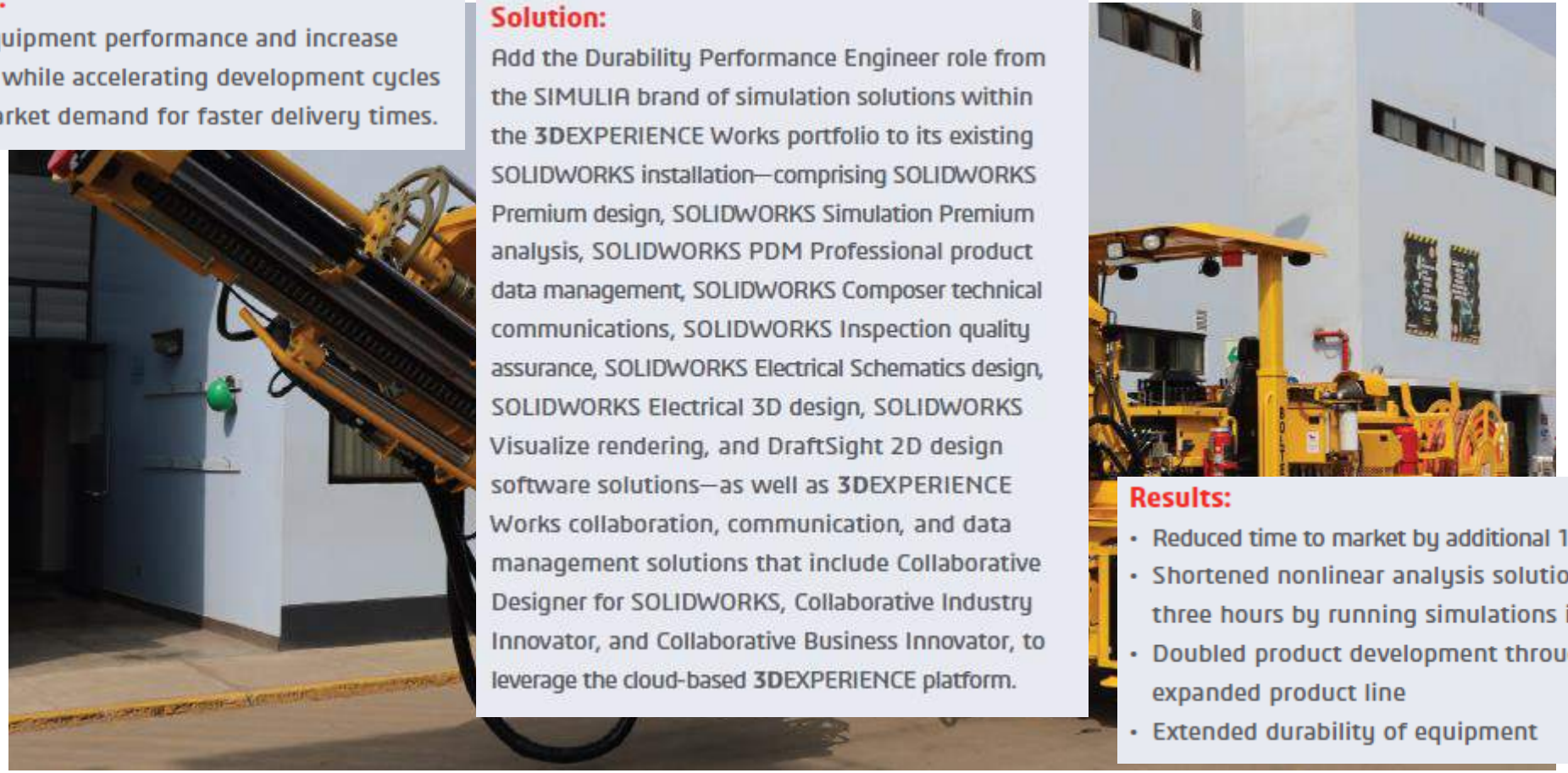
Results:

- Shortened design cycles via virtual prototyping
- Reduced physical prototyping and material usage costs
- Established revenue-generating SIMLab-WCi simulation-driven development service
- Provided value-added validation service to customers while improving product performance

CASE STUDY: RESEMIN

Challenge:

Improve equipment performance and increase innovation while accelerating development cycles to meet market demand for faster delivery times.



Solution:

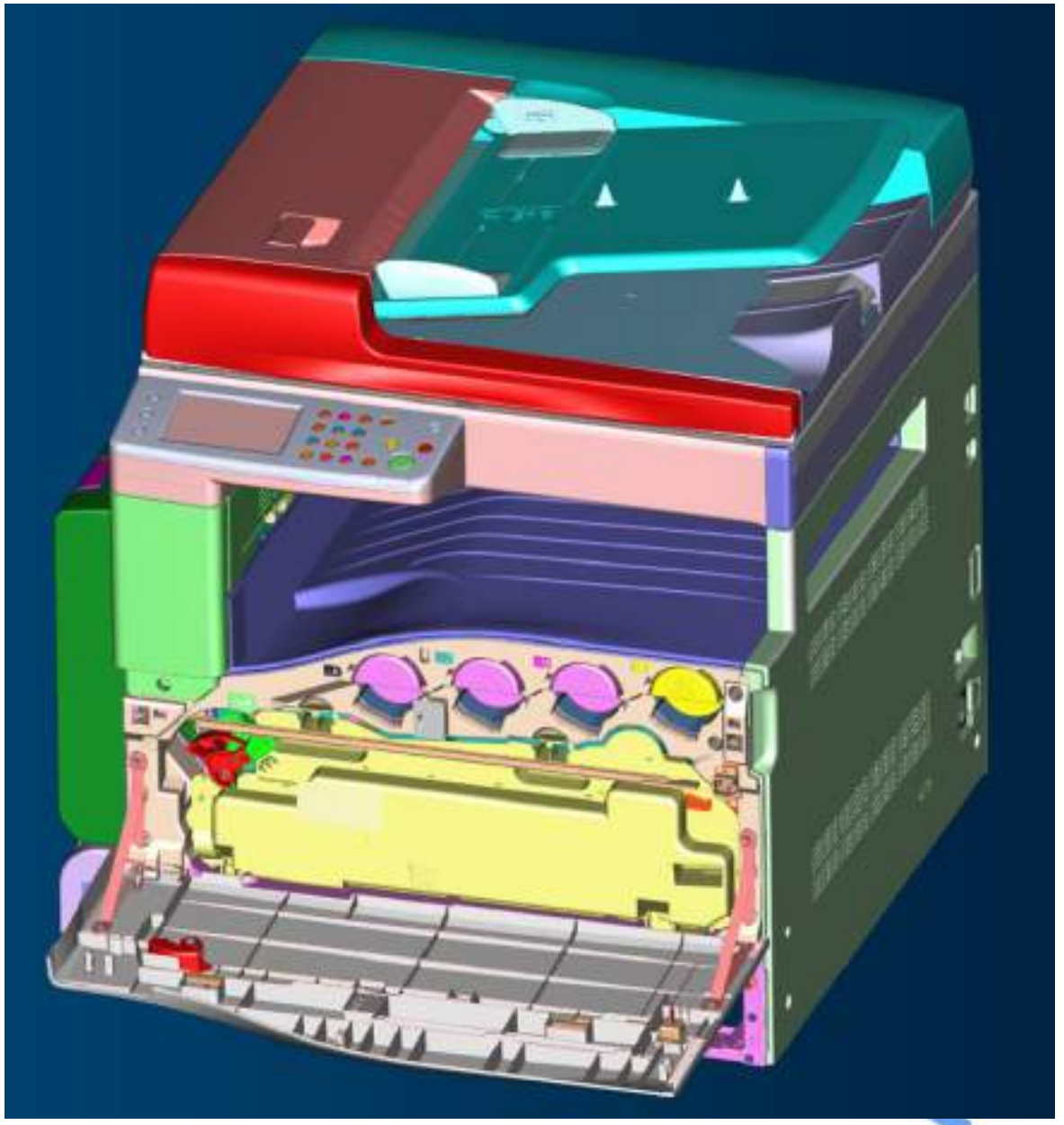
Add the Durability Performance Engineer role from the SIMULIA brand of simulation solutions within the **3D**EXPERIENCE Works portfolio to its existing SOLIDWORKS installation—comprising SOLIDWORKS Premium design, SOLIDWORKS Simulation Premium analysis, SOLIDWORKS PDM Professional product data management, SOLIDWORKS Composer technical communications, SOLIDWORKS Inspection quality assurance, SOLIDWORKS Electrical Schematics design, SOLIDWORKS Electrical 3D design, SOLIDWORKS Visualize rendering, and DraftSight 2D design software solutions—as well as **3D**EXPERIENCE Works collaboration, communication, and data management solutions that include Collaborative Designer for SOLIDWORKS, Collaborative Industry Innovator, and Collaborative Business Innovator, to leverage the cloud-based **3D**EXPERIENCE platform.

Results:

- Reduced time to market by additional 10 percent
- Shortened nonlinear analysis solution time by three hours by running simulations in cloud
- Doubled product development throughput and expanded product line
- Extended durability of equipment

FUJI XEROX
CASE STUDY

Fuji Xerox uses CST Studio Suite's Electromagnetic Simulation Platform for an EMC-compliant Printer Design

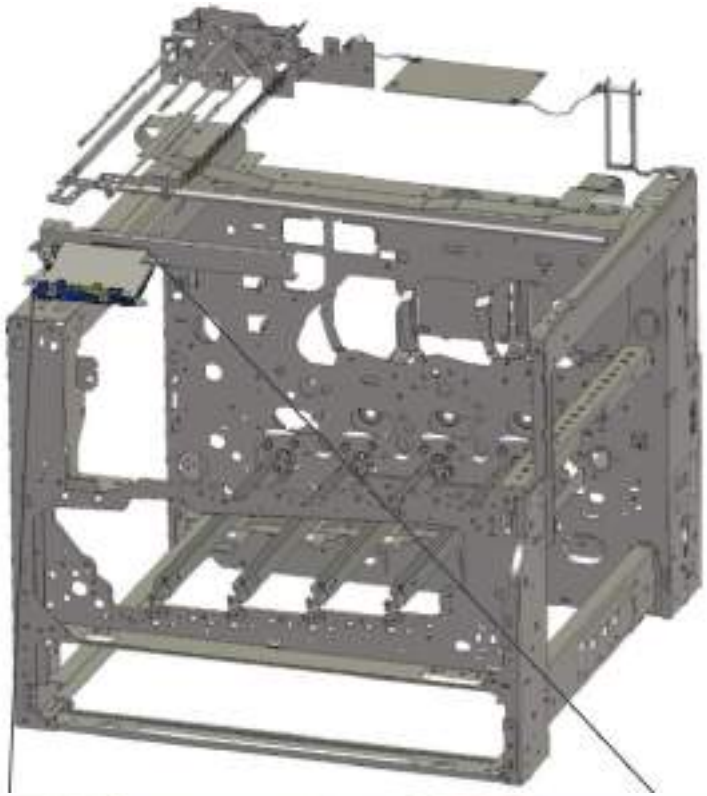


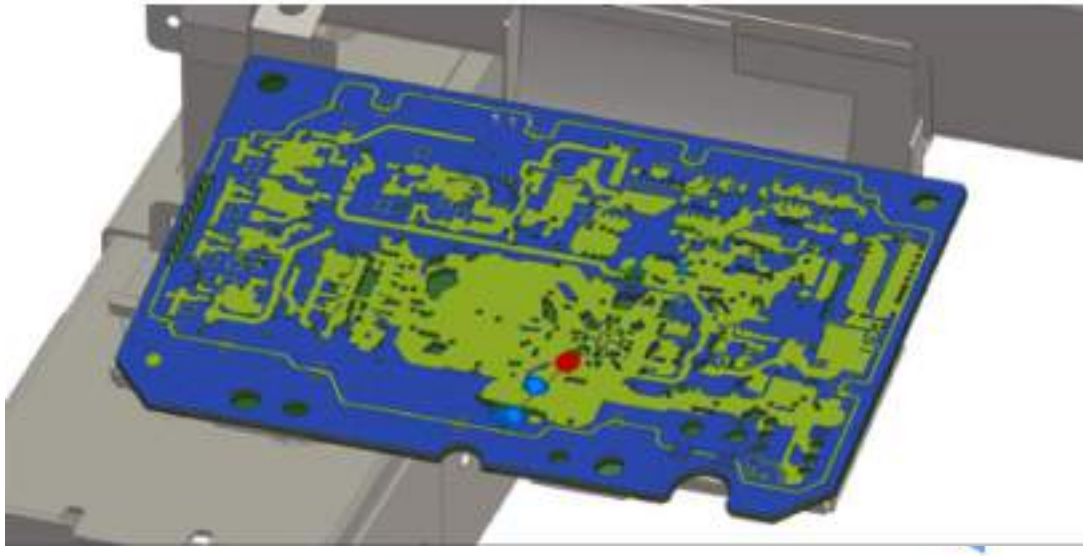
Challenge:

Modern multi-function printers include many electronic components - often modular to ensure commonality - and these can interfere with each other causing electromagnetic compatibility (EMC) issues. In addition, electrostatic discharge (ESD) can affect the performance of individual components. Where EMC issues arise during testing, it is not always clear what the cause is.

Dassault Systèmes Response:

In order to better understand the mechanisms behind these and to find effective mitigation techniques, Fuji Xerox decided to use electromagnetic simulation with CST Studio Suite. The variation in scale between the UI PCB and the frame of the printer meant that simulating them both together was a challenging task. Thanks to the high-performance computing (HPC) capabilities of CST Studio Suite, the entire model could be simulated within a workday.





CST Studio Suite reduced the number of physical prototypes needed.

Results:

By allowing some measurements to be replaced by simulation, CST Studio Suite reduced the number of physical prototypes needed, shortening the design process. With simulation, Fuji Xerox engineers were able to predict EMC problems before constructing the prototype and identify the mechanism behind any that did arise, making them easier to mitigate.

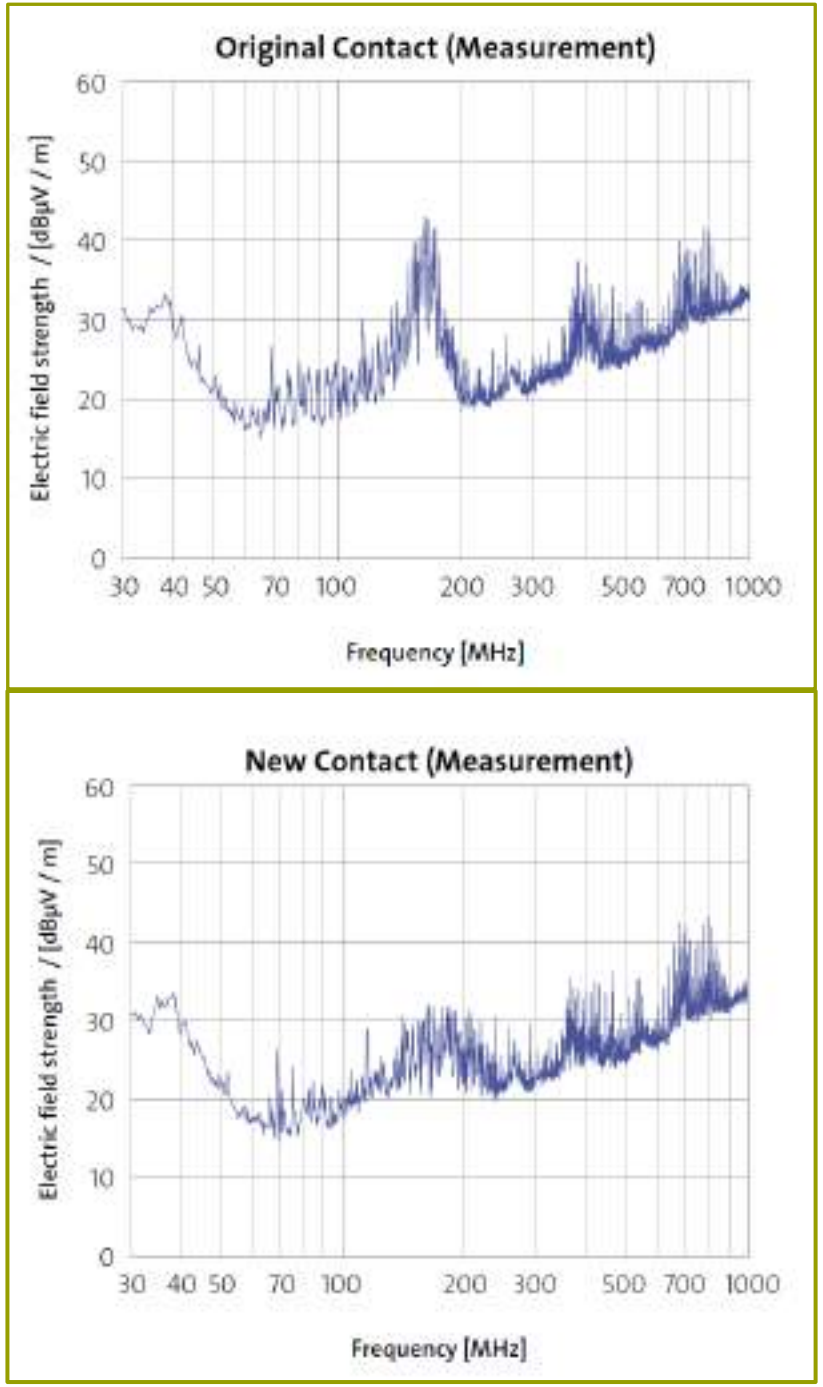
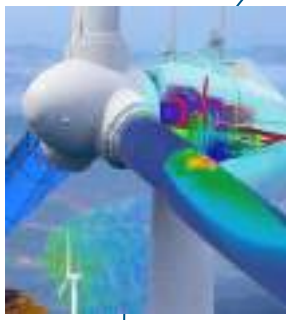


Fig. EMI spectrum at 3 m, with the old and new contact designs, comparing simulation and measurements.

Simulation Domains

Electromagnetics

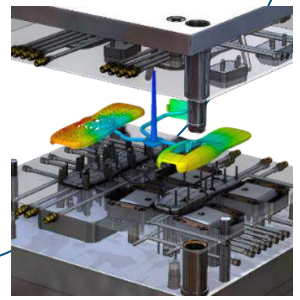


Structures

Collaboration

Kinematic motion

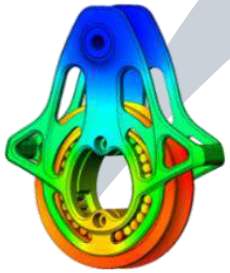
Fluids

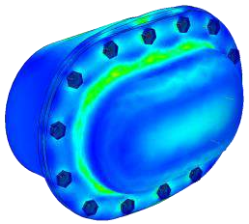


Manufacturing process

Structural Simulation

Initial

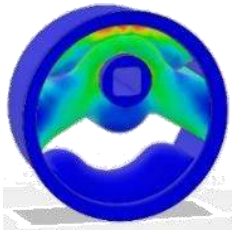




Linear Static
Thermal
Frequency

Intermediate

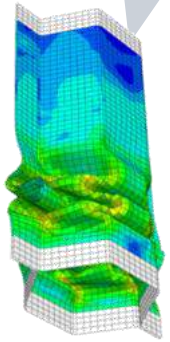
Complex Contacts
Large Deformation
Plasticity

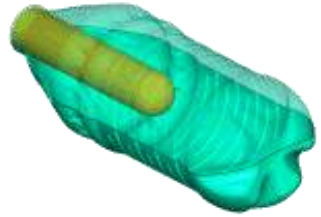


Linear Static
Non-linear
Quasi-Static
Linear Dynamic
Implicit Solver

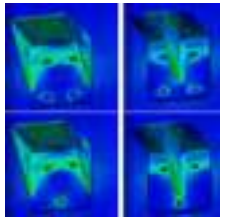
In-depth

Drop Test
Impacts
Crash Test
Snap Fits





Linear Static
Non-linear
Quasi-Static
Linear Dynamic
Non-Linear Dynamic
Implicit Solver
Explicit Solver

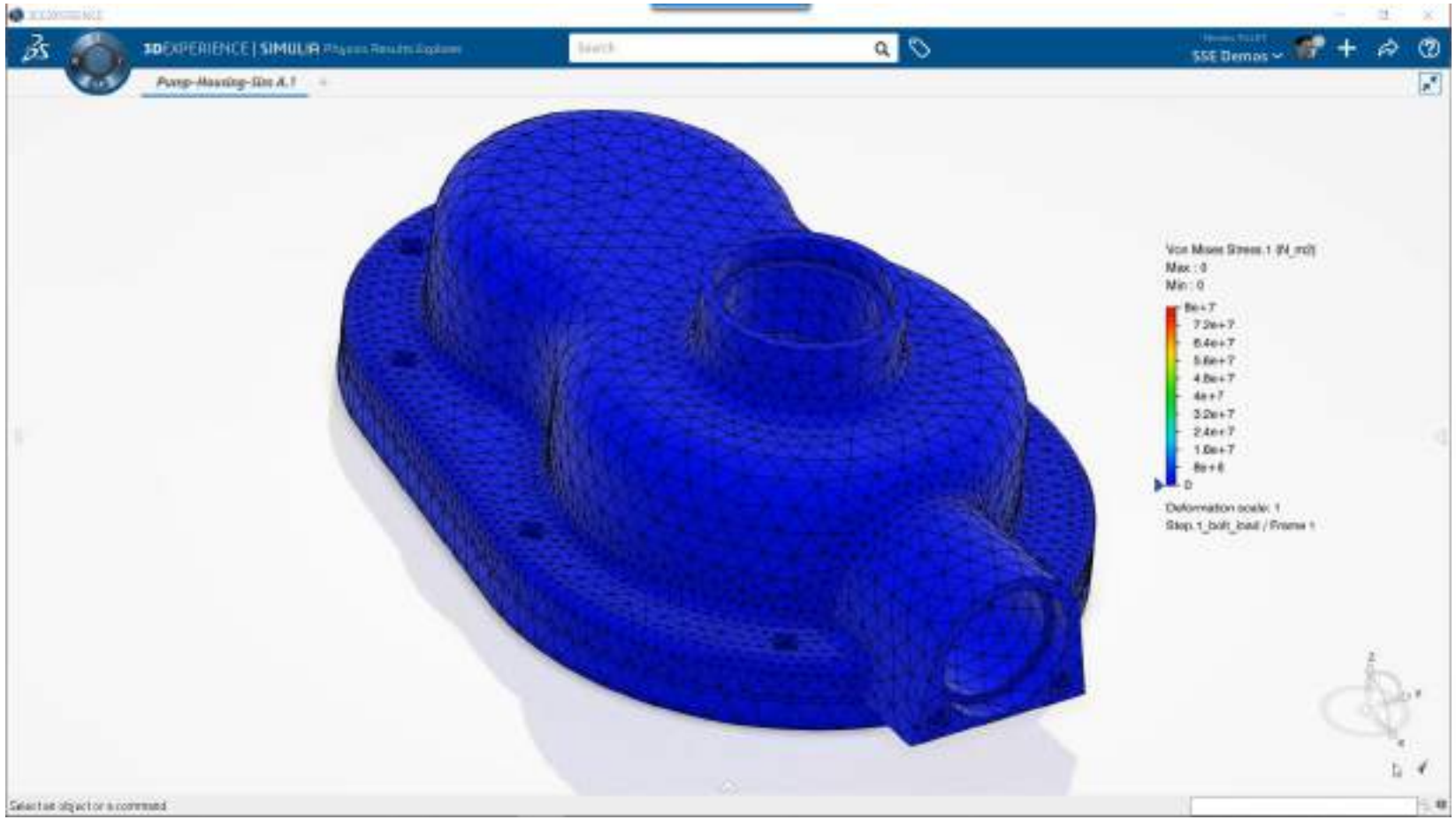


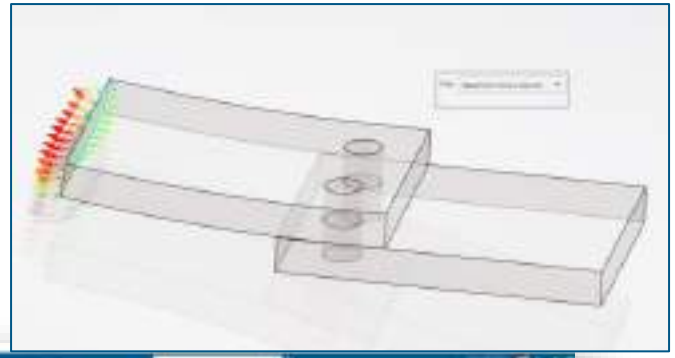
Review
Compare

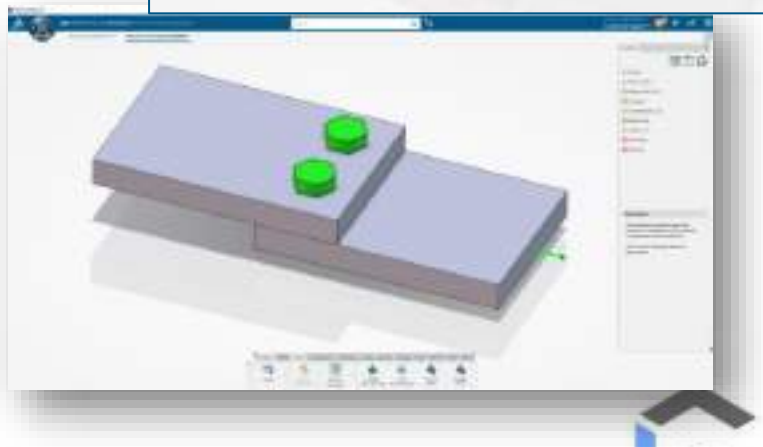
Collaboration

INITIAL

Linear Static
Factor of Safety
Deformation

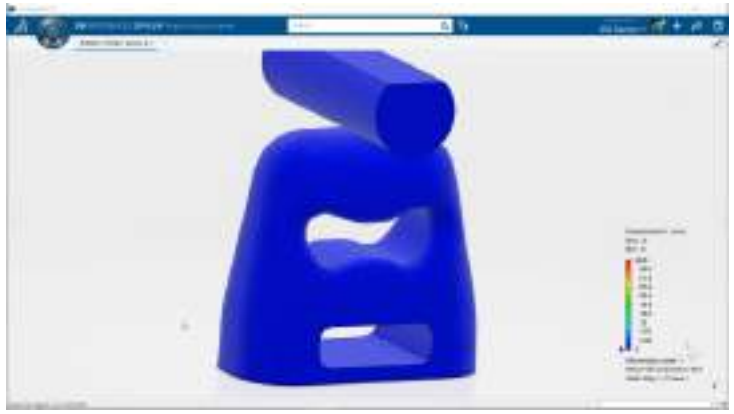


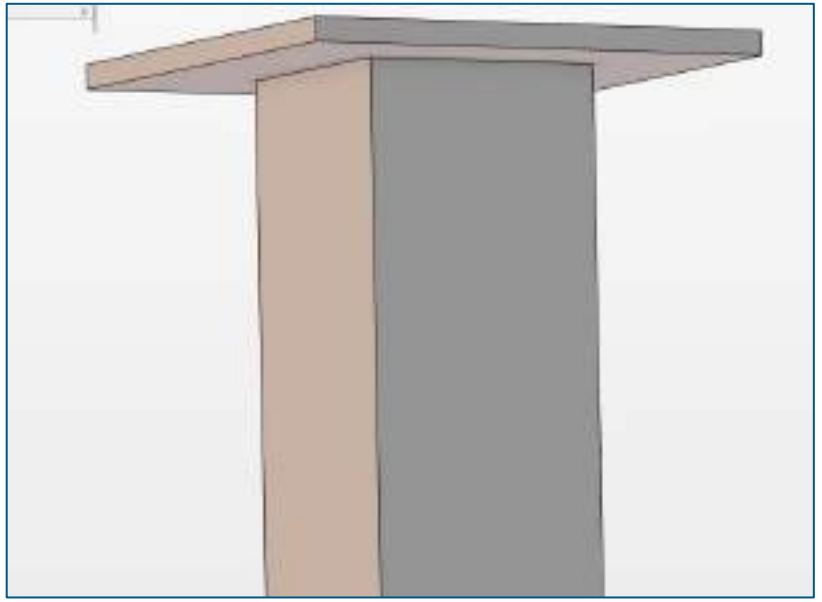


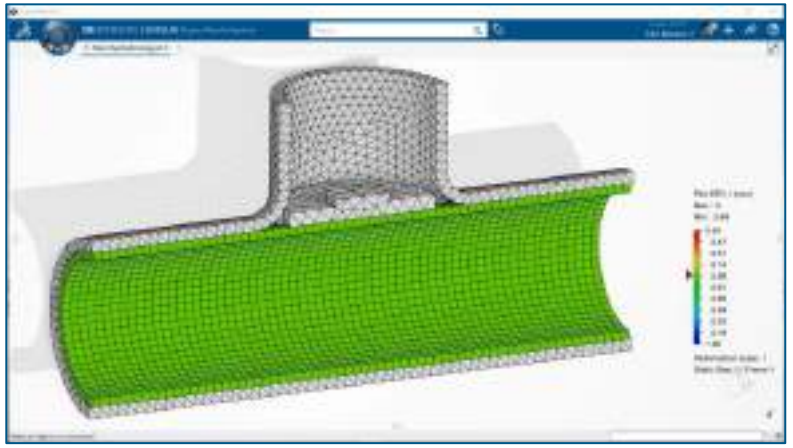


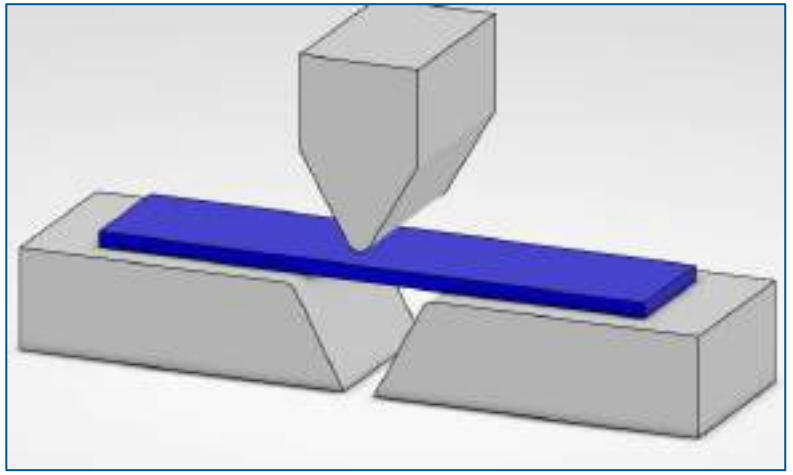
INTERMEDIATE

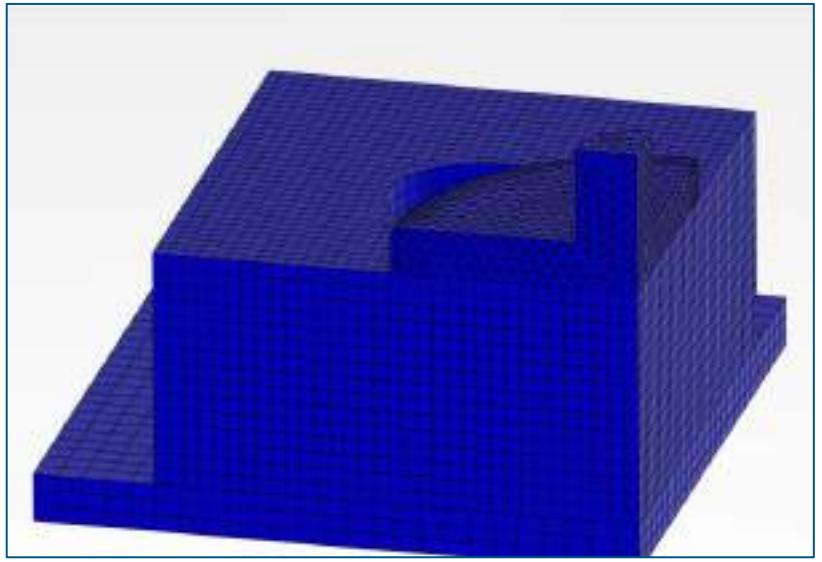
Non-Linear
Complex Contacts
Large Deformation
Plasticity





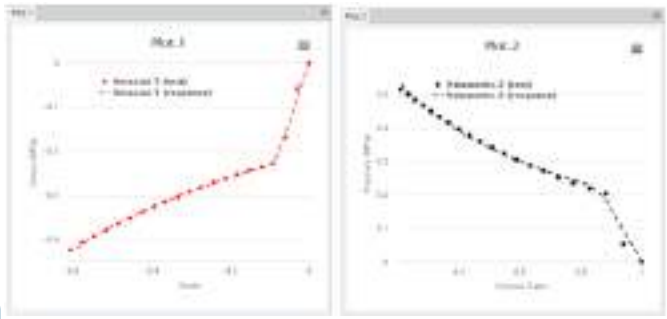


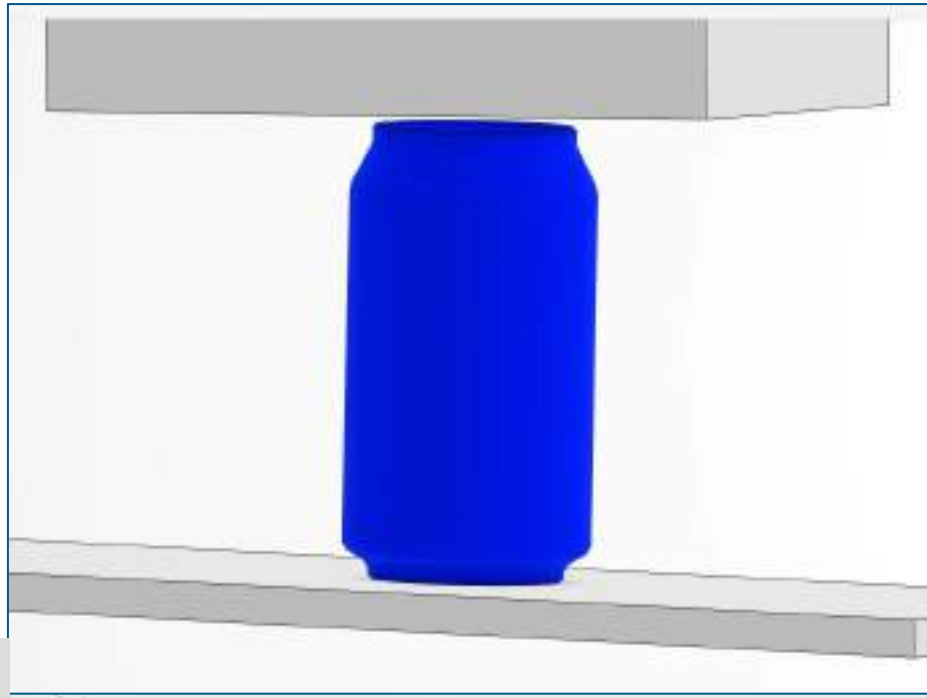


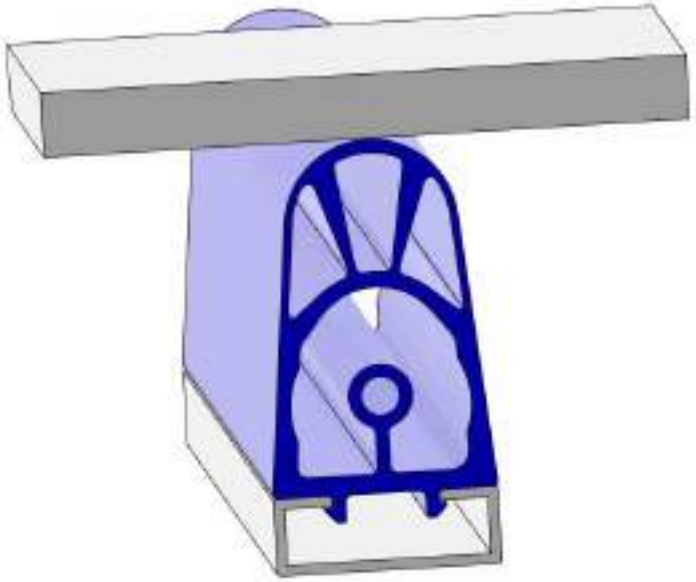


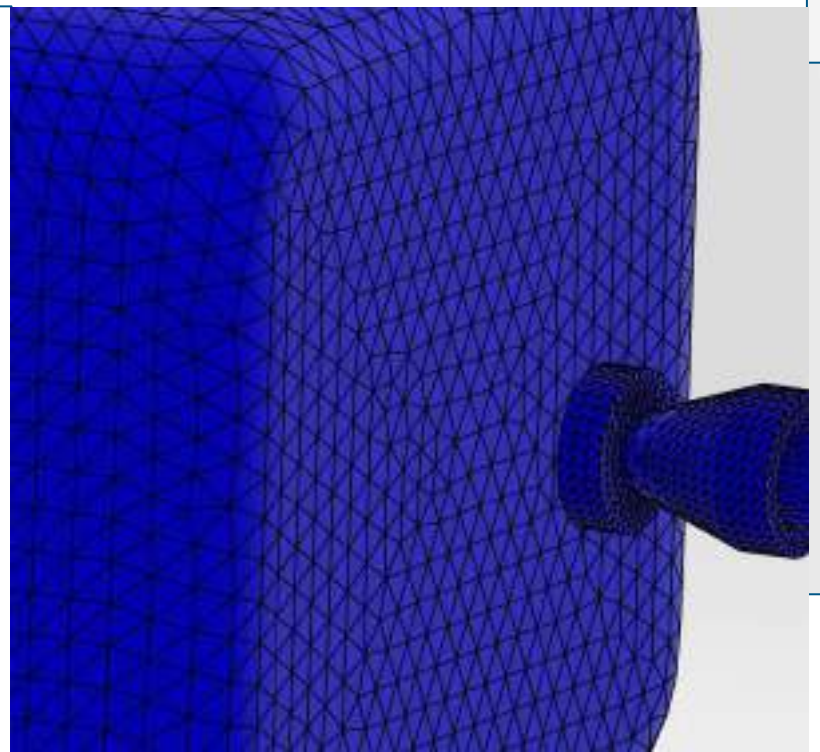
IN-DEPTH

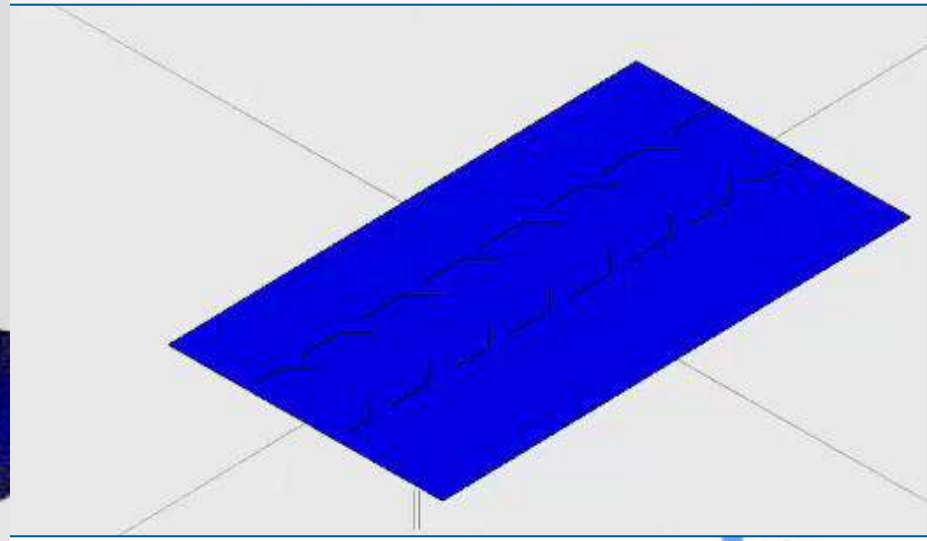
Non-Linear
Advanced Physics
Impacts
Material Calibration



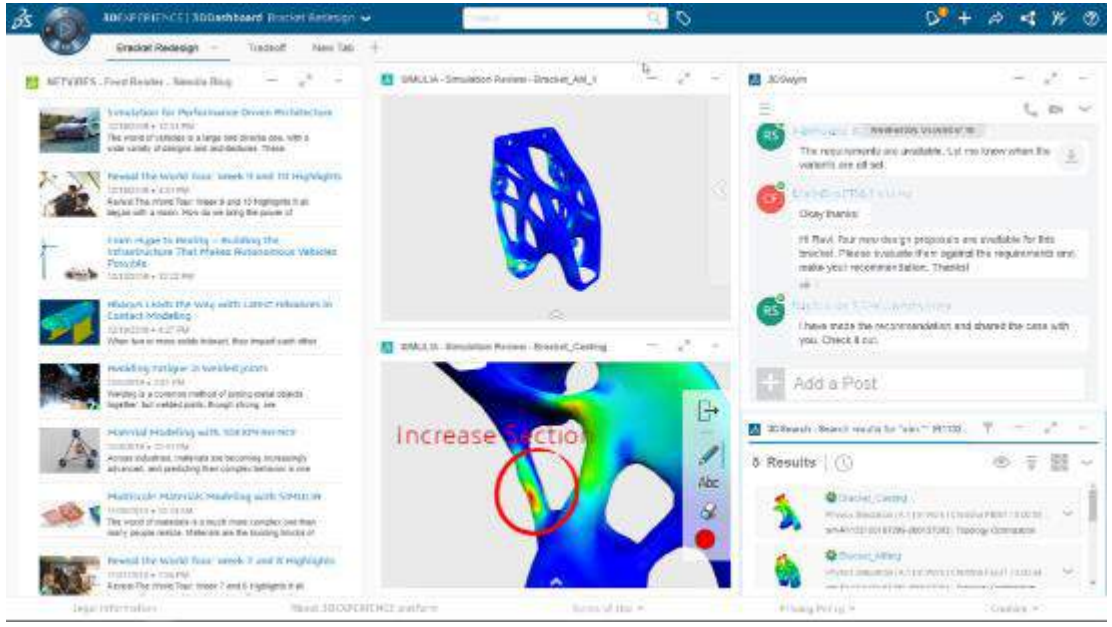


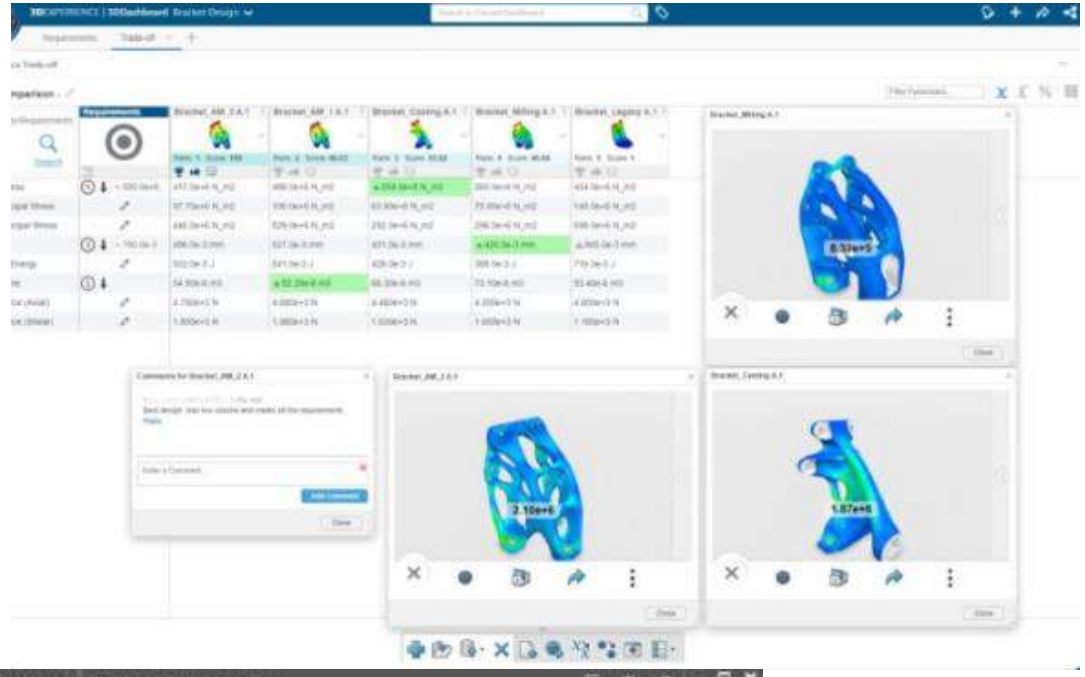


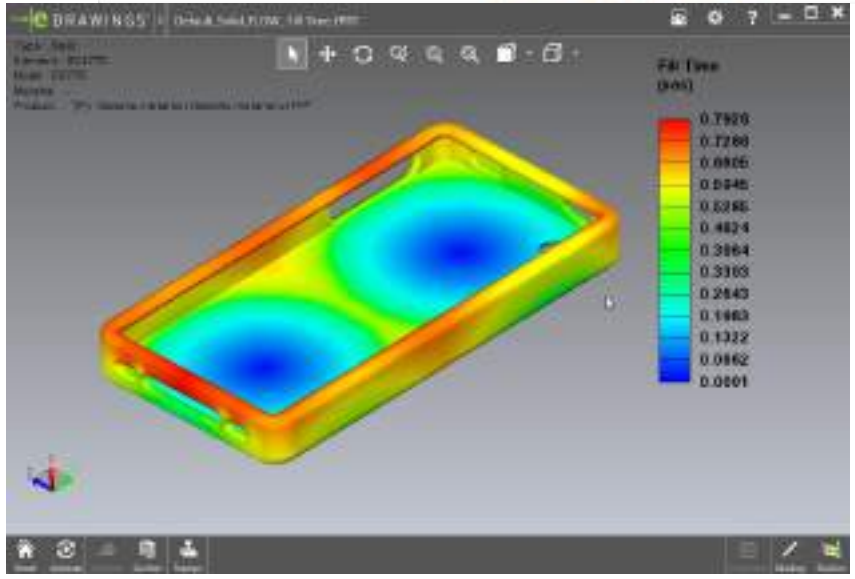




REVIEW AND COLLABORATE



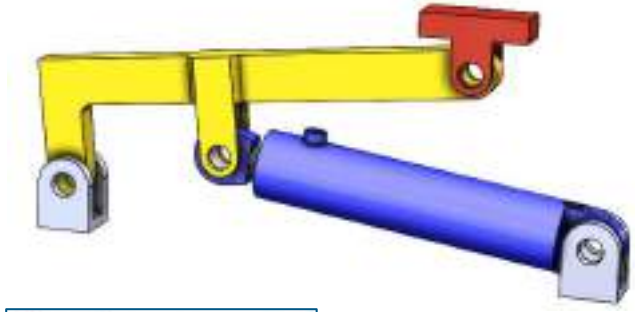


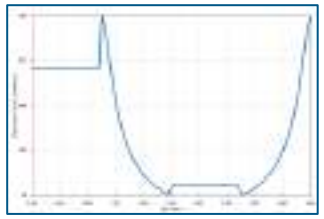


Kinematic Motion Simulation

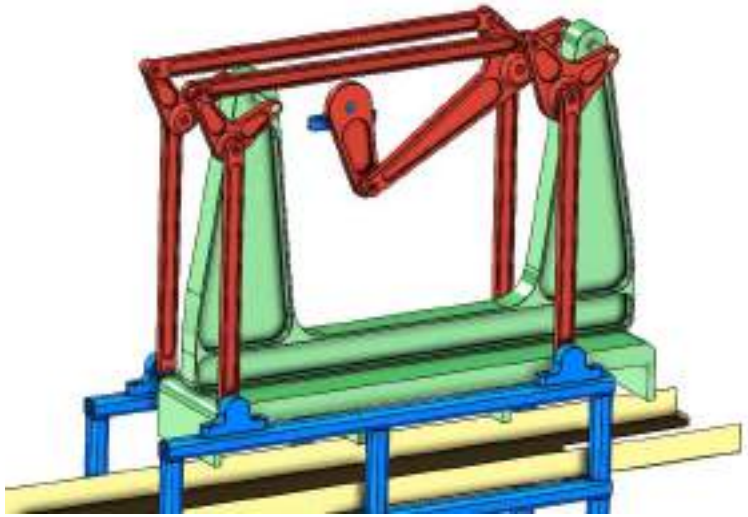
- Force generated between moving parts
- Power requirements
- Interaction between components

Cylinder & Motors



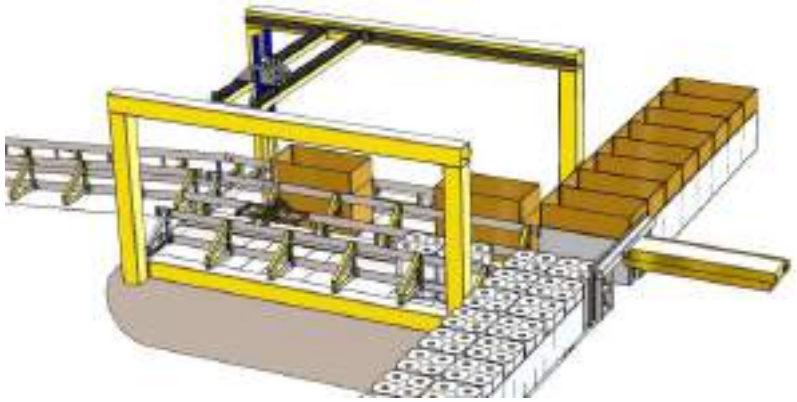


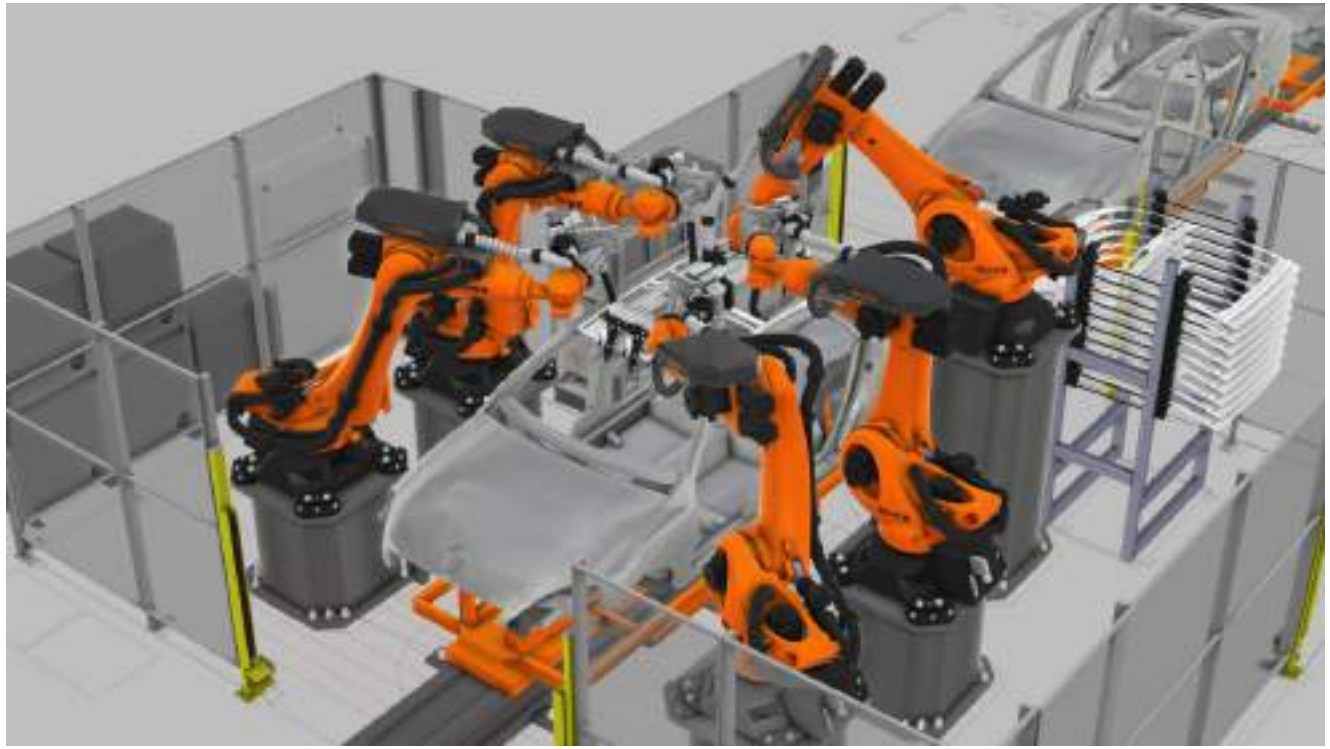
Mechanims



Collision & Friction

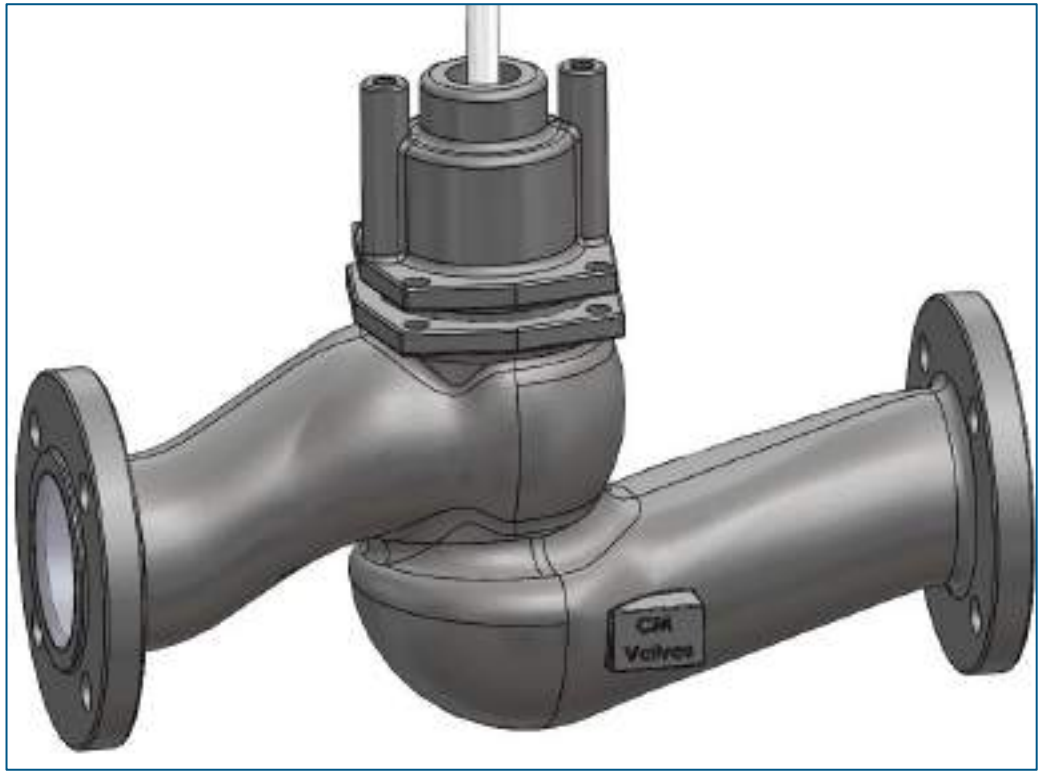
FACTORY SIMULATION

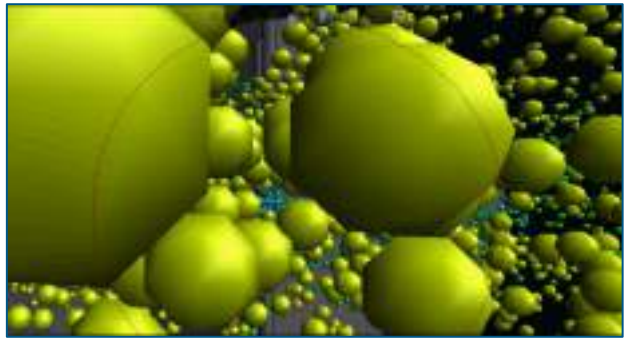


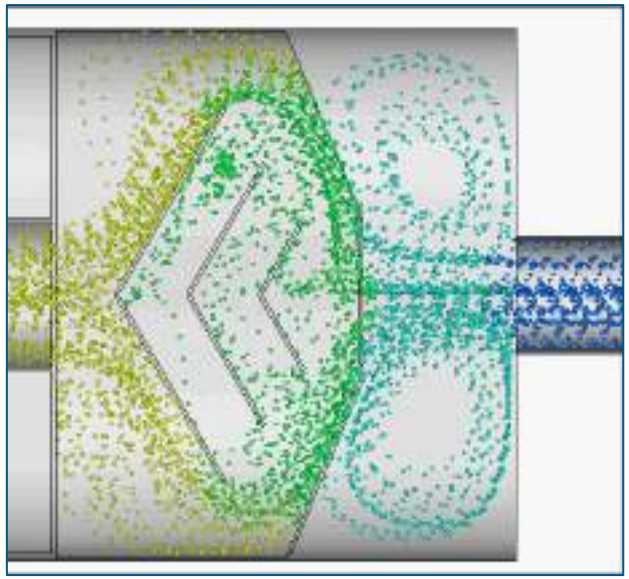


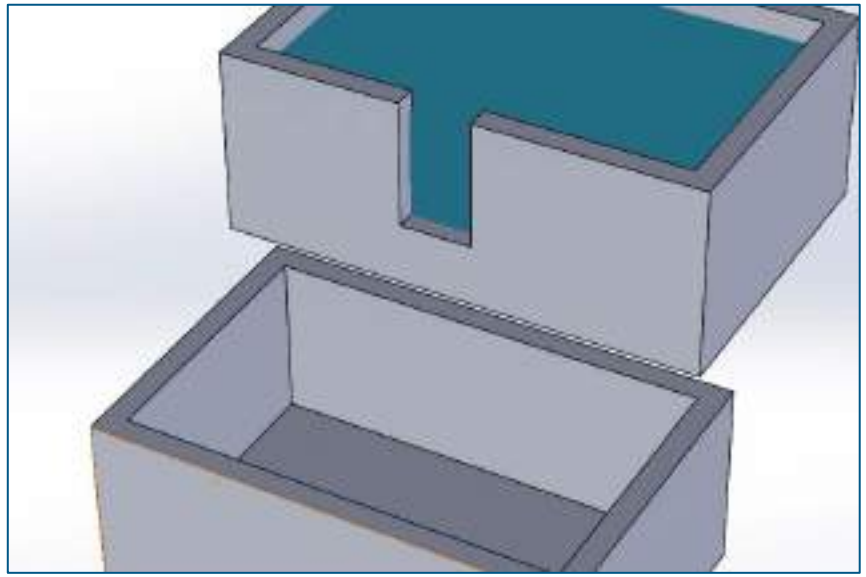
Fluid Mechanics Simulation

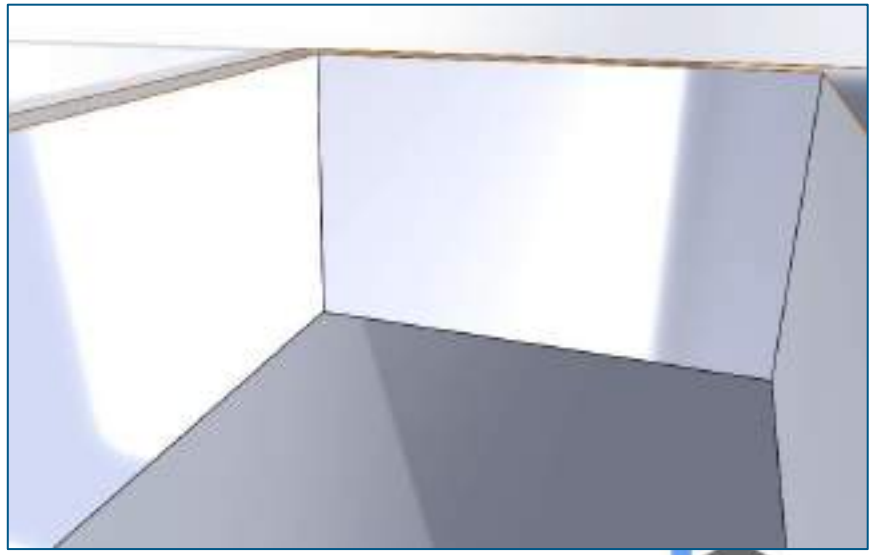
- Predict flow inside and around a design







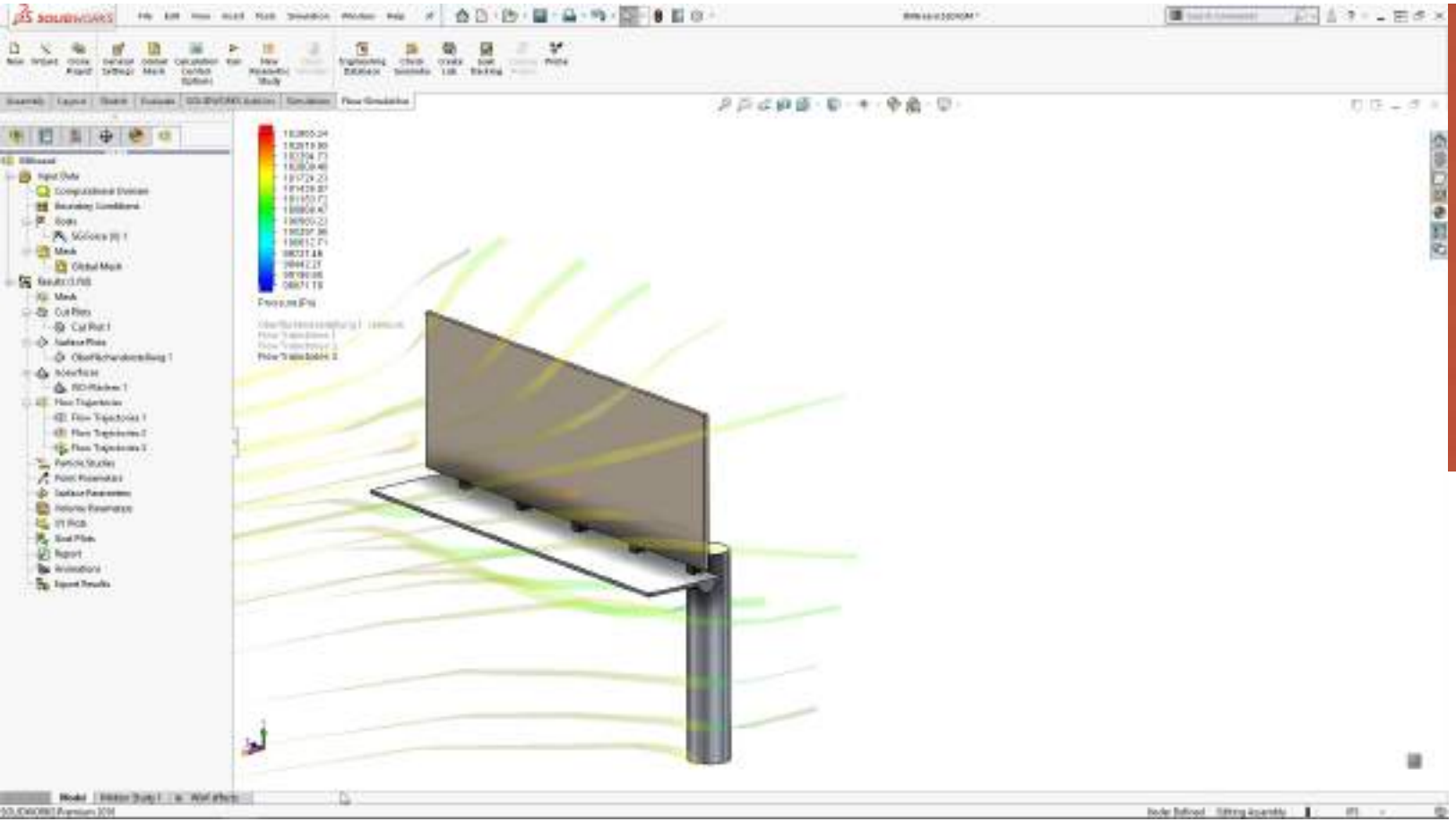


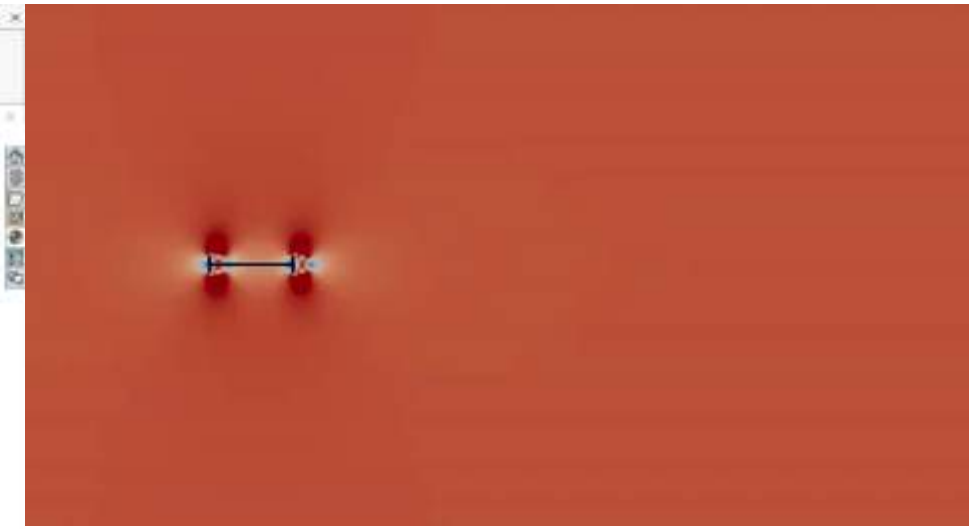


Back

Fluid Mechanics Simulation

- Forces generated on structures
- Turbulence effects

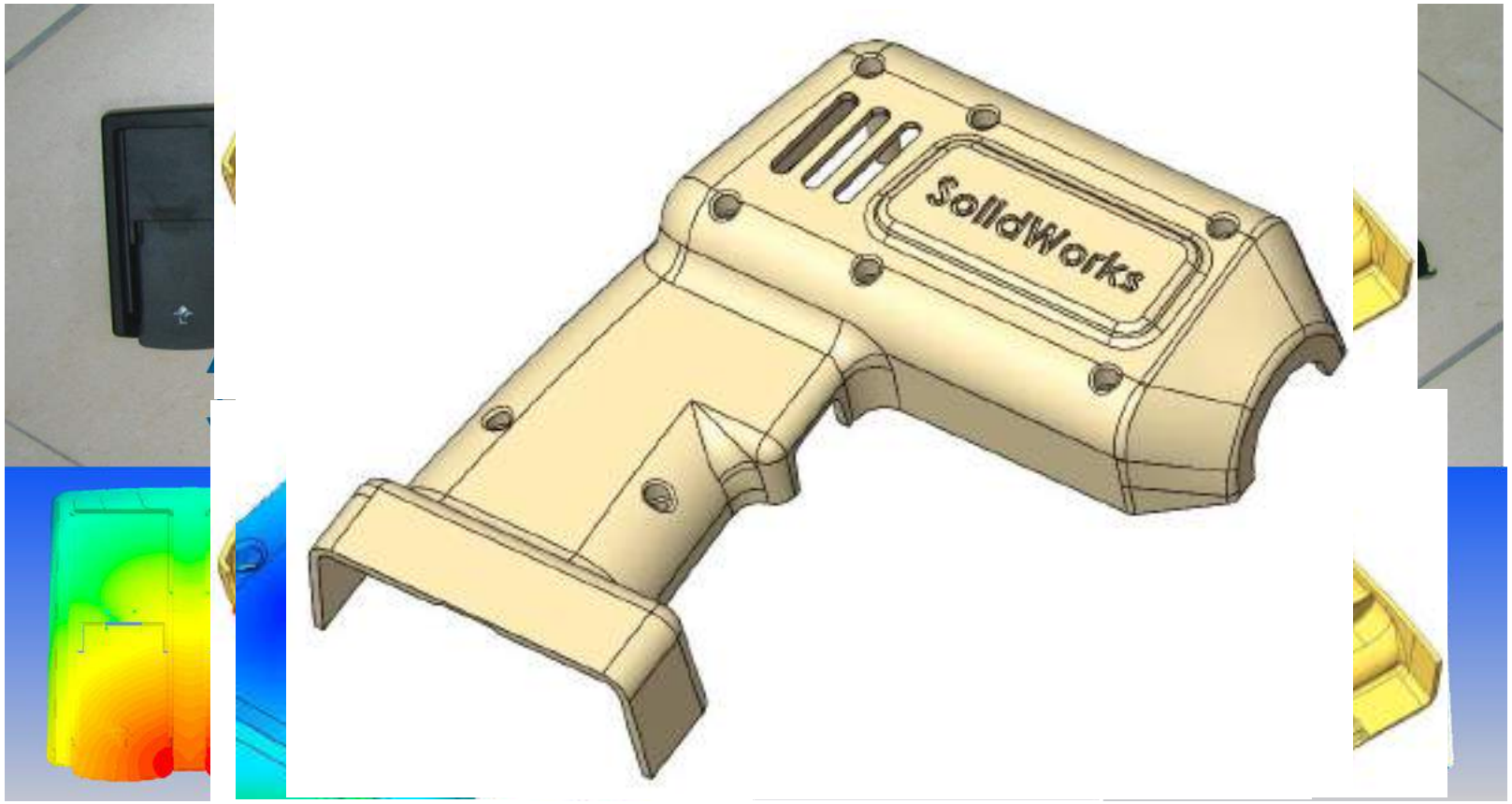




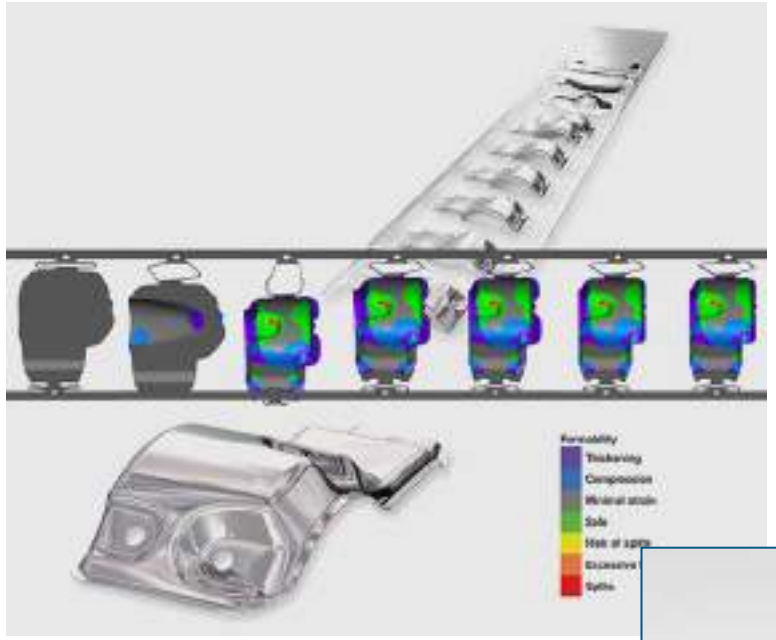
Back

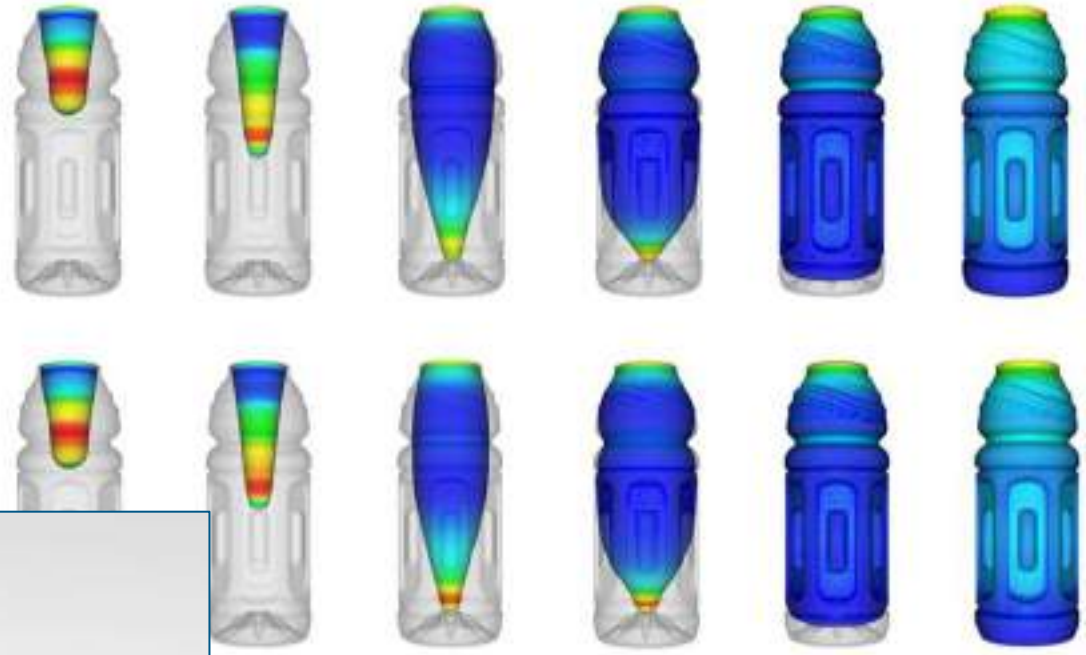
Injection Molding

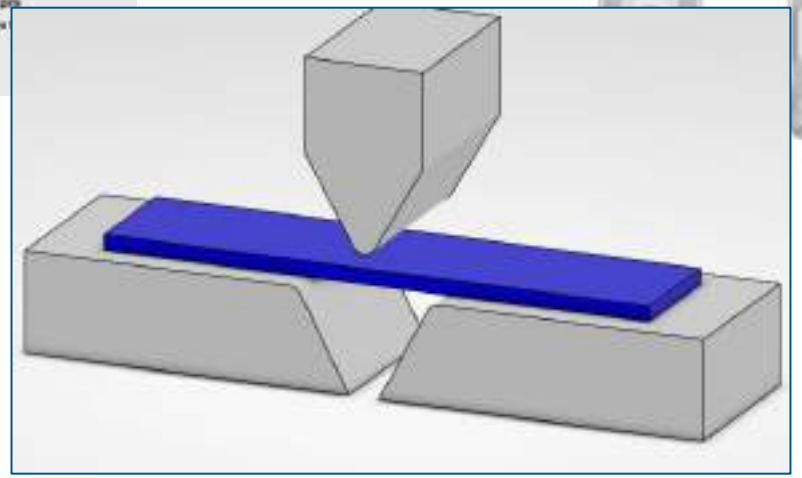
- Moldability
- Air traps, weld lines and sink marks
- Flow front uniformity
- Runner system
- Cycle Time
- Warpage



PROGRESSIVE DIE, SHEET METAL, AND BLOW MOLDING



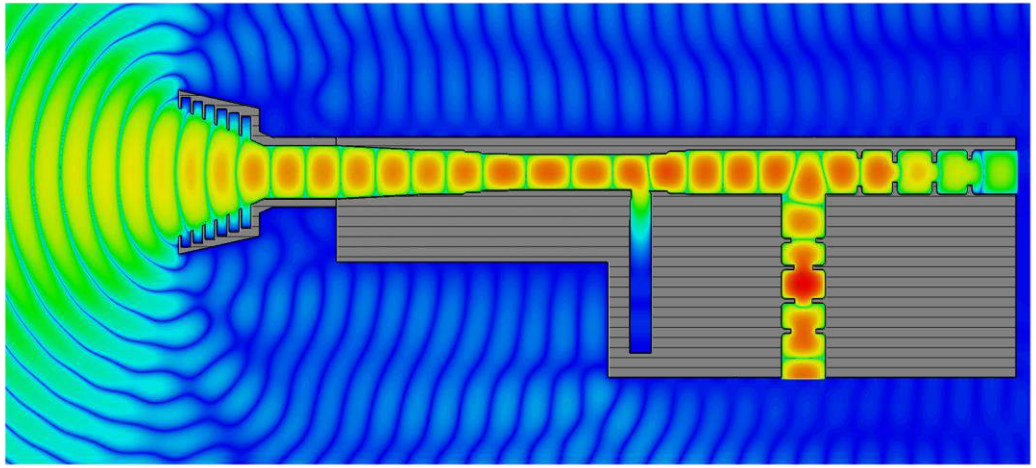




3 COMMON REASONS TO PERFORM EM SIMULATION

- **High Speed PCB/Electronics:**

Artificial Intelligence (AI), Machine Learning (ML), Big Data, LIDAR, Self-Driving Cars



- **Wireless Connectivity:**

Wi-Fi, Bluetooth, Zigbee etc. Antenna Design

- **EMC/EMI Compliance:**

Government electromagnetic emission standards.

TYPES OF ELECTRICAL SIMULATIONS

- **SPICE Simulation:** Voltage and Current calculations in 2D Schematics of Circuits. Can be time varying or just constant. Can include Signal and Power Integrity.

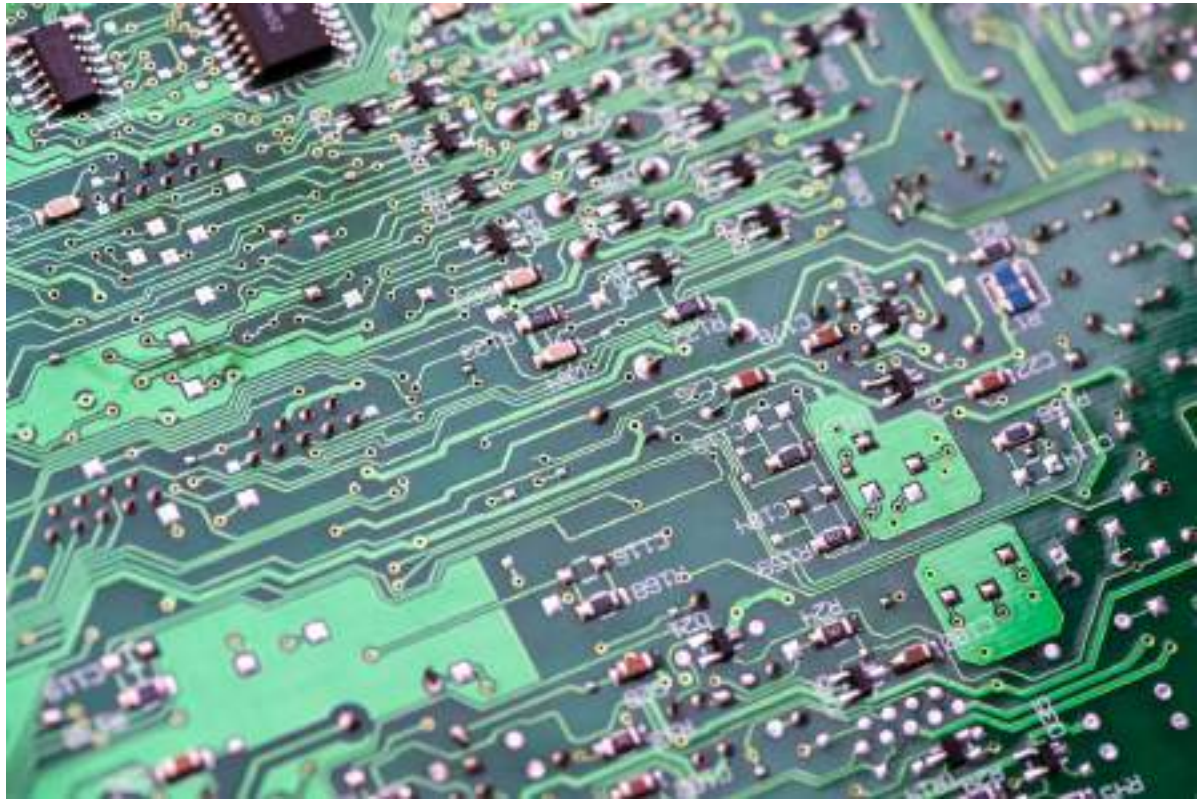
- **Electromagnetic Simulation:** Full 3D Model of device. Meshed in various ways. Single Frequency or Time Domain (frequency range). Can include 3D emissions, absorption and transmission of EM waves. Can include Singal and Power integrity.

- **Multi-Physics:** Can be combined with Electromagnetic Simulation to include Thermal and Fluid simulations to see heating and cooling effects in Electrical Devices.

HIGH SPEED PCB / ELECTRONICS

AI, ML, BIG DATA, LIDAR & AUTOMATION

- Complex PCB Design
- High Data Processing
- Multiple CPU & Memory
- Intensive Calculations
- High Data Transfer Rates

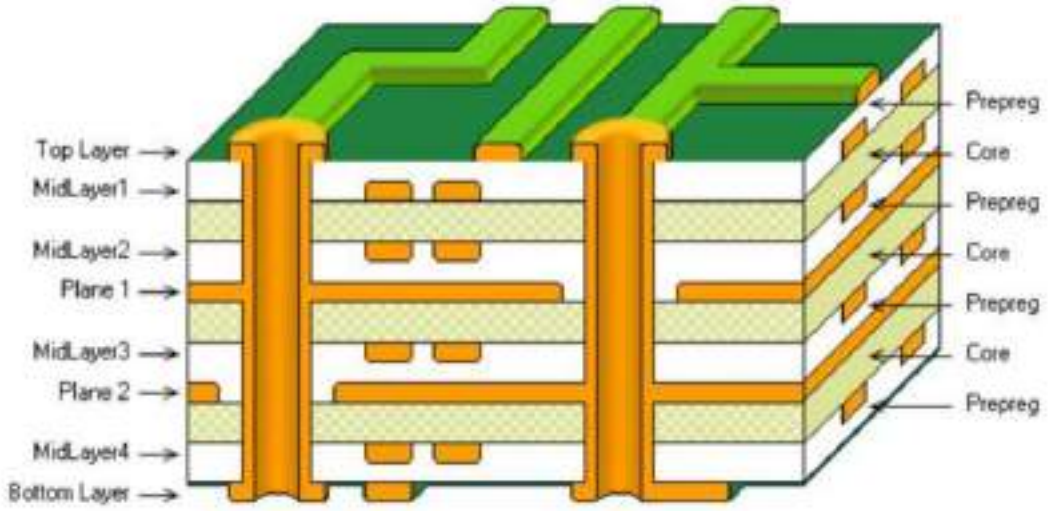


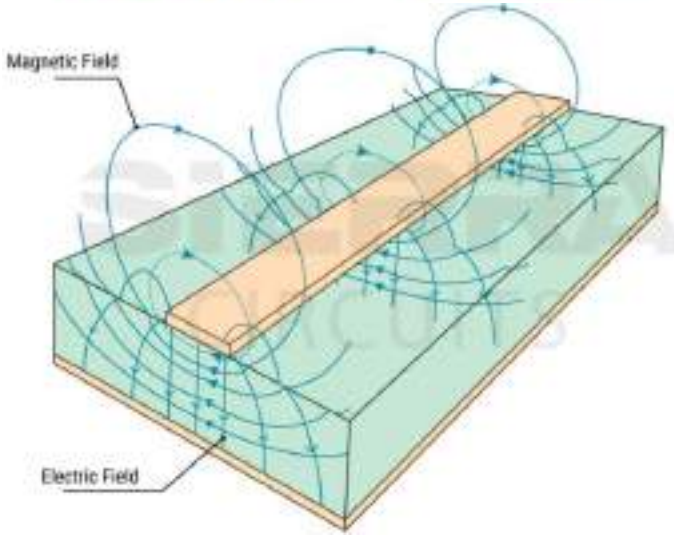
HIGH SPEED PCB / ELECTRONICS

AI, ML, BIG DATA, LIDAR & AUTOMATION

- Multilayer PCB
- Signal Quality will depend on

i. Trace Width
ii. Copper Thickness
iii. Copper Quality
iv. Substrate Material
v. Length of Traces

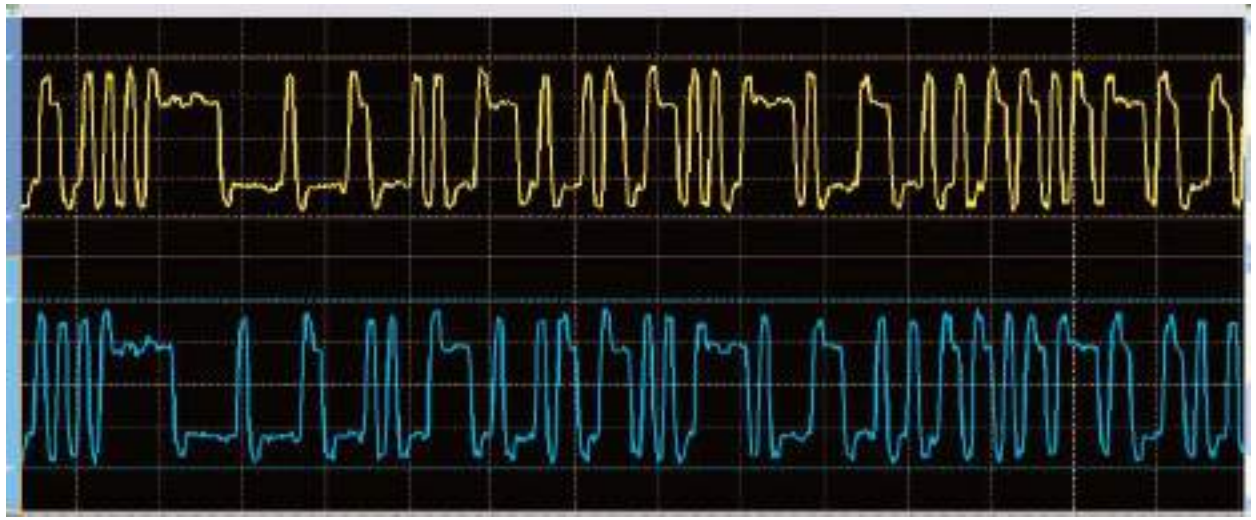


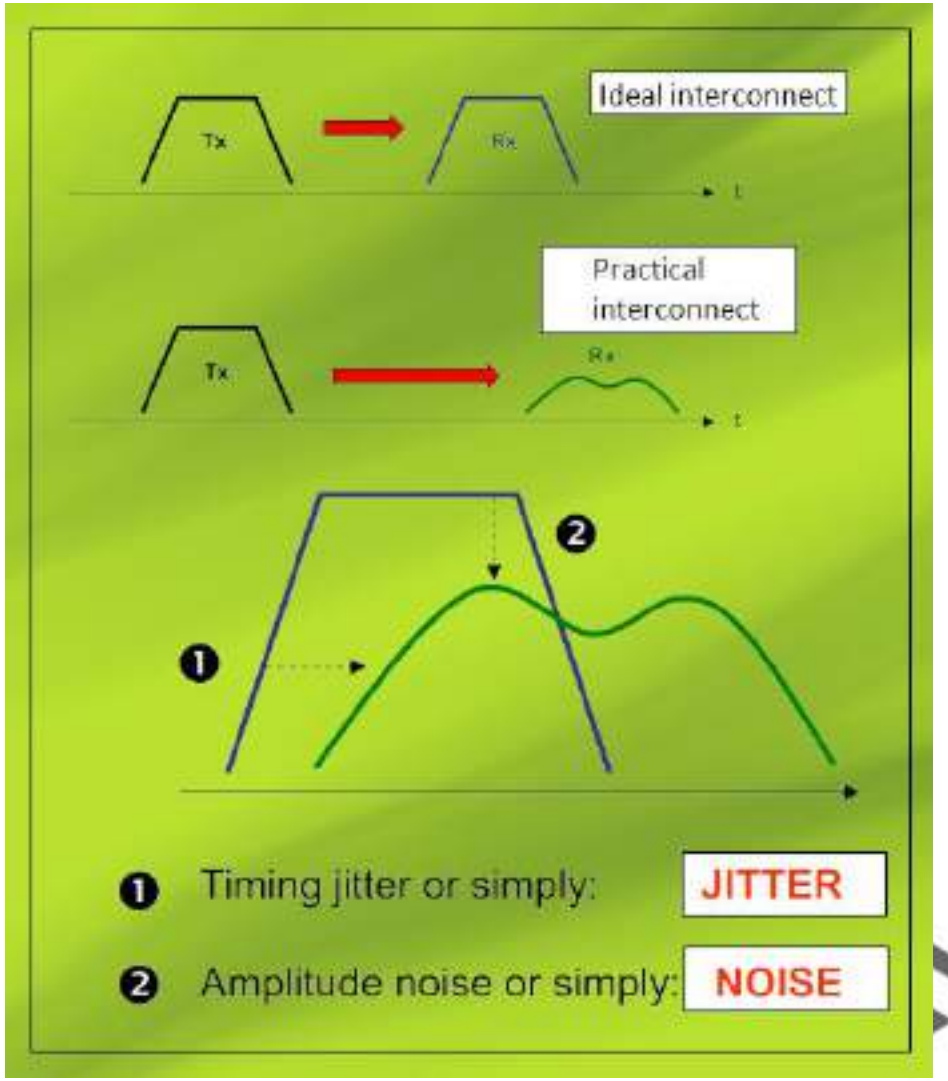


HIGH SPEED PCB / ELECTRONICS

AI, ML, BIG DATA, LIDAR & AUTOMATION

- Signal Integrity is an issue.
- Distortion of data signals.
- Manual Testing is prohibitively expensive
- Simulation gives a more complete picture than manual testing.





EMC / EMI COMPLIANCE OF GOVERNMENT REGULATIONS

- All electrical and electronic devices produce electromagnetic fields that interfere with their own workings as well as the workings of neighboring devices.

- Manufacturers of commercial, residential, and industrial electrical and electronic systems have to work to reduce electromagnetic interference (EMI) and ensure Electromagnetic Compatibility (EMC).

- For each industry sector, there are specific EMC standards to follow.

EMC / EMI COMPLIANCE OF GOVERNMENT REGULATIONS

For each industry sector, there are specific EMC standards to follow.

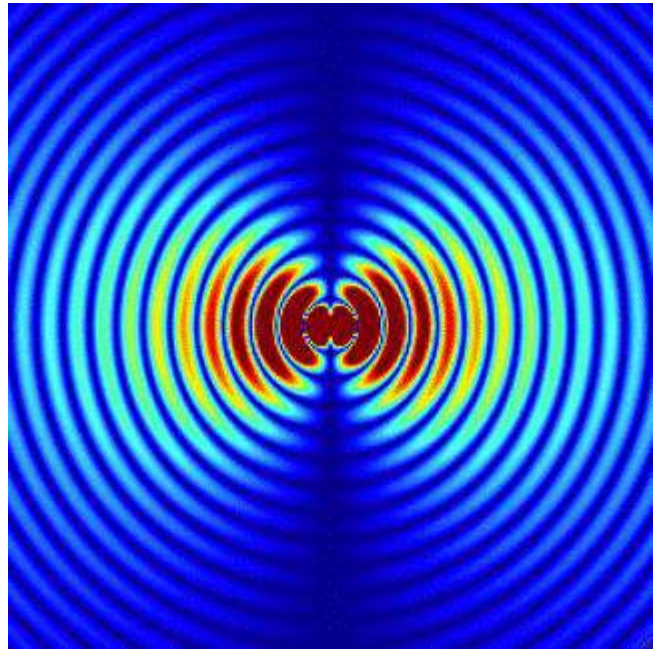
Government of Canada | Gouvernement du Canada

2020-07-23	ICES-001 — Industrial, Scientific and Medical (ISM) Equipment
2020-09-15	ICES-002 — Vehicles, Boats and Other Devices Equipped with Internal Combustion Engines, Traction Batteries or Both
2020-10-15	ICES-003 — Information Technology Equipment (including Digital Apparatus)
2022-10-28	ICES-004 — Alternating Current High Voltage Power Systems
2018-12-01	ICES-005 — Lighting Equipment
2018-07-01	ICES-006 — AC Wire Carrier Current Devices (Unintentional Radiators)
2015-06-12	ICES-008 — Cable Distribution Networks
2024-02-23	ICES-Gen — General Requirements for Compliance of Interference-Causing Equipment

EMC / EMI COMPLIANCE OF GOVERNMENT REGULATIONS

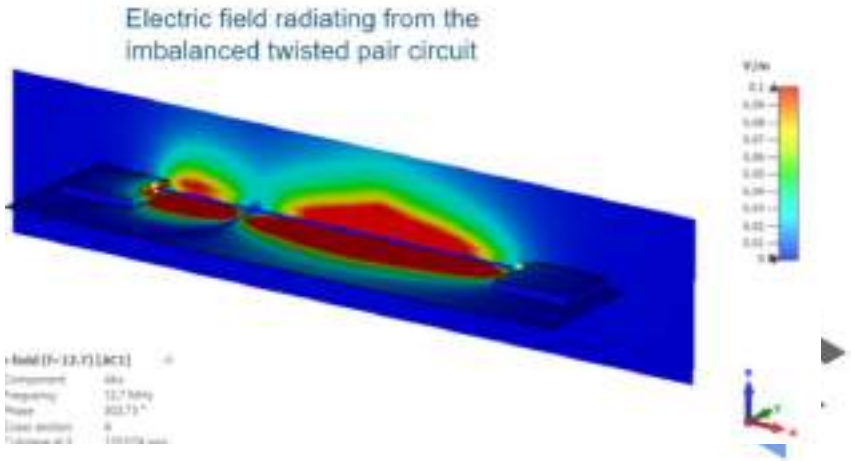
What Causes Electromagnetic Wave Generation ?

Electromagnetic waves are produced whenever electric charges are accelerated. This makes it possible to produce electromagnetic waves by letting an alternating current flow through a wire.



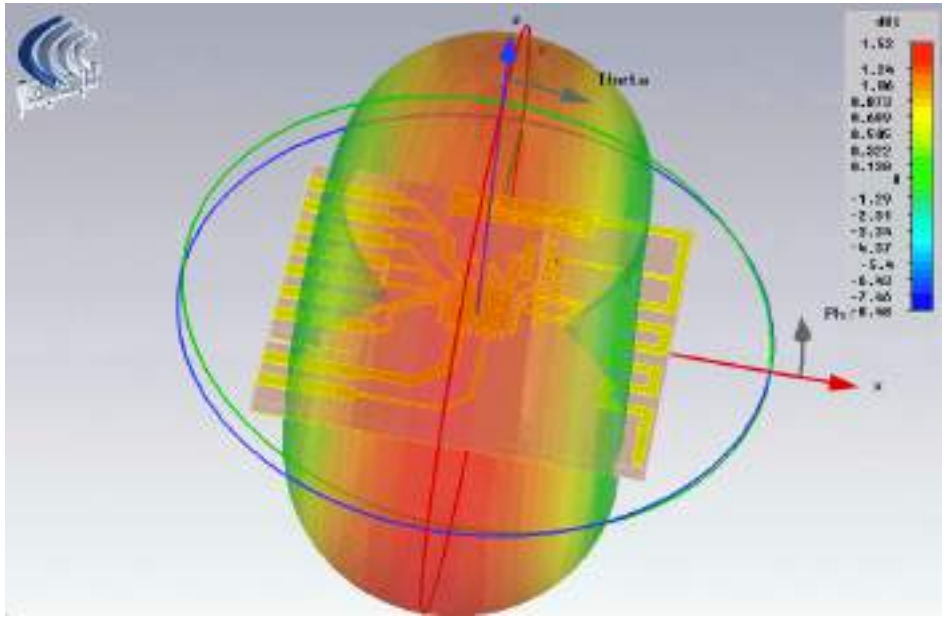
Common Sources of EMC/EMI

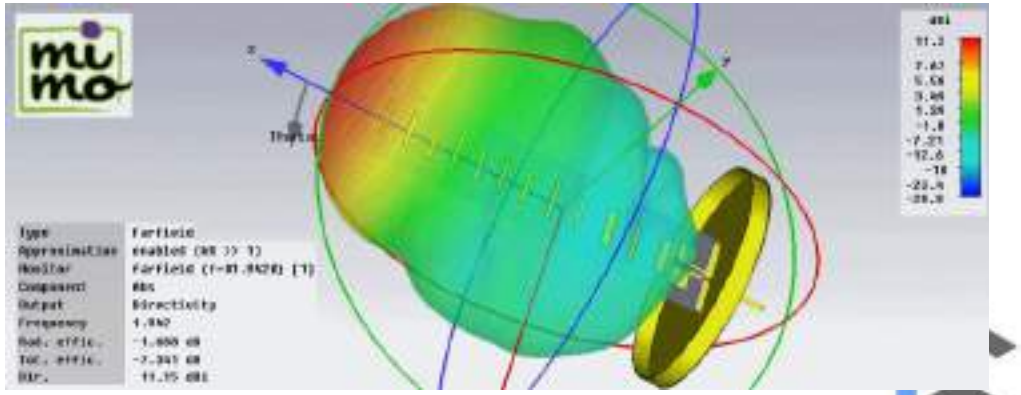
- Wires and Cables with no shielding
- Motors, Generators and Rotary Devices
- Power Supplies
- AC-DC Converters, Switch Mode Power Supplies
- PCB Traces of a high-speed signal line



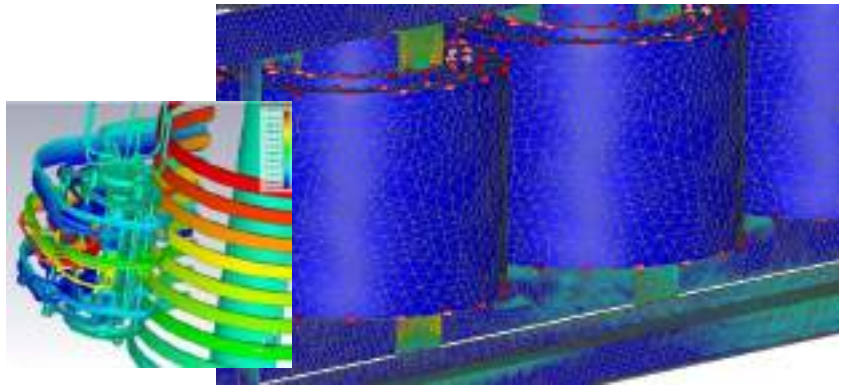
WI-FI, BLUETOOTH, ZIGBEE AND OTHER WIRELESS CONNECTIONS

- All Wireless Connections use an Antenna to send and receive data.
- Very hard to manually test and measure the complex 3D field. Simulation is the best approach.
- Any power losses will drain the battery faster.
- Usually this is a PCB based antenna
- It is very sensitive to the
  - Shape of Antenna
  - Feature Sizes and Dimensions
  - Material Properties
  - Impedance Matching Circuits
  - Surrounding Circuits.

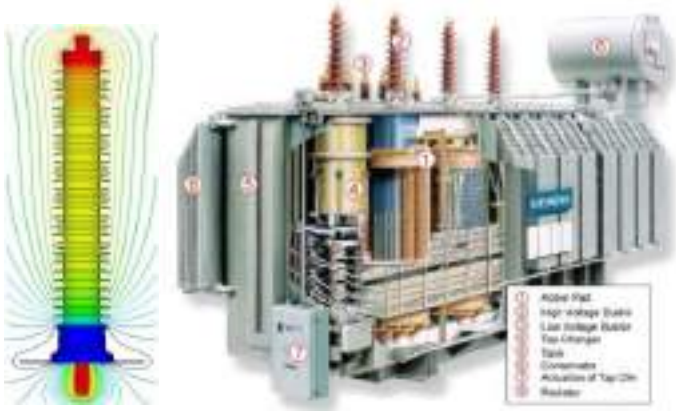




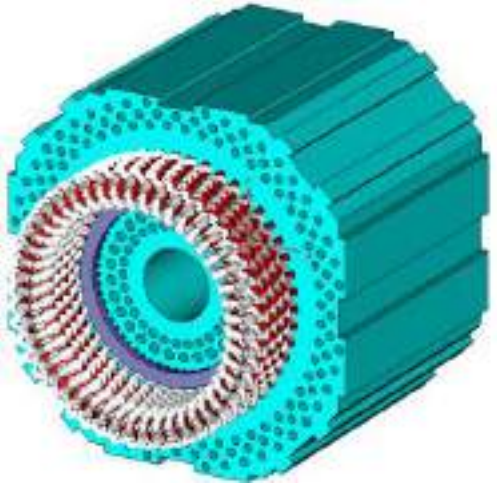
ENERGY, PROCESS AND UTILITIES



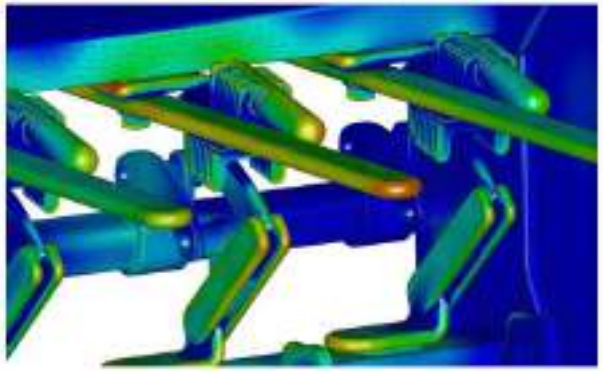
Power transformers



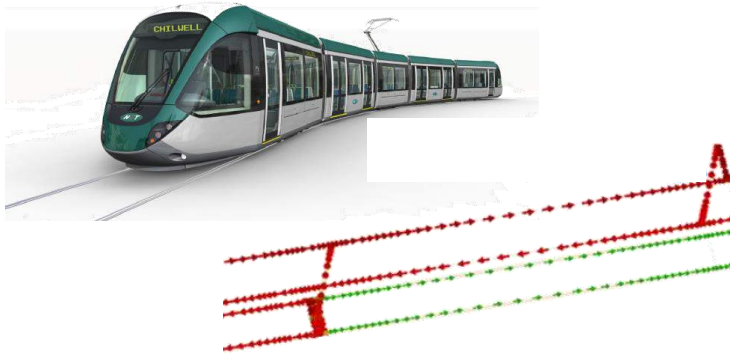
Insulators



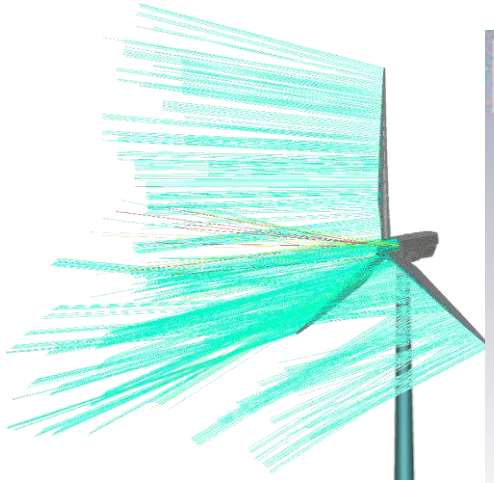
Generators

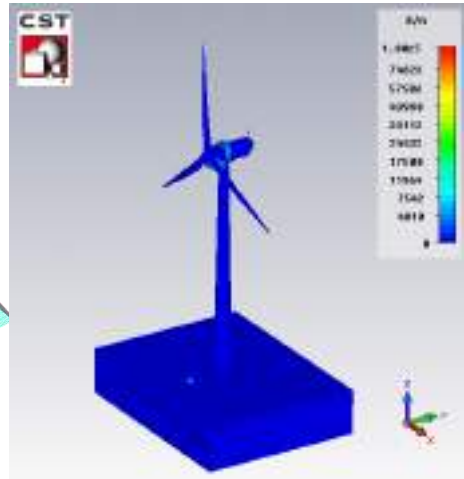


High voltage components



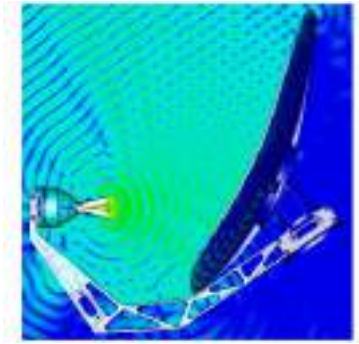
Power transmission



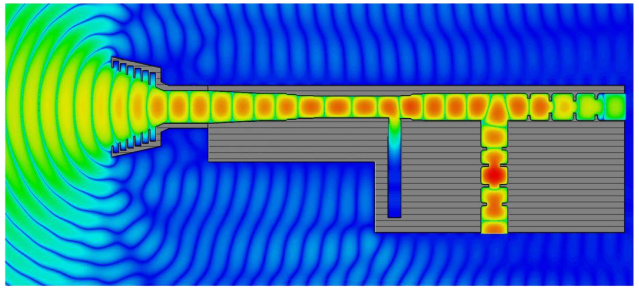


Wind turbines

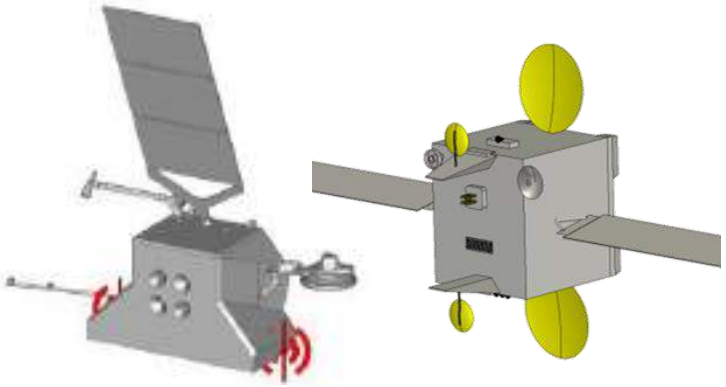
AEROSPACE & DEFENSE



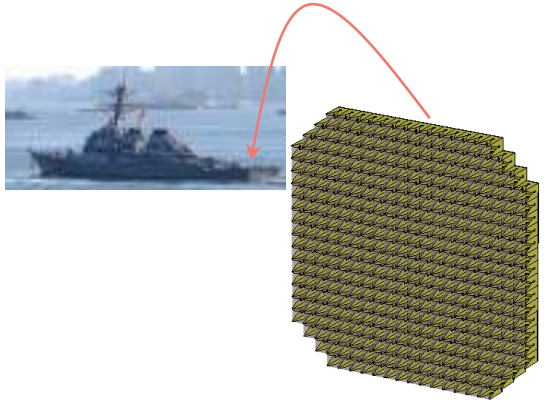
Reflector antenna



Antenna feed

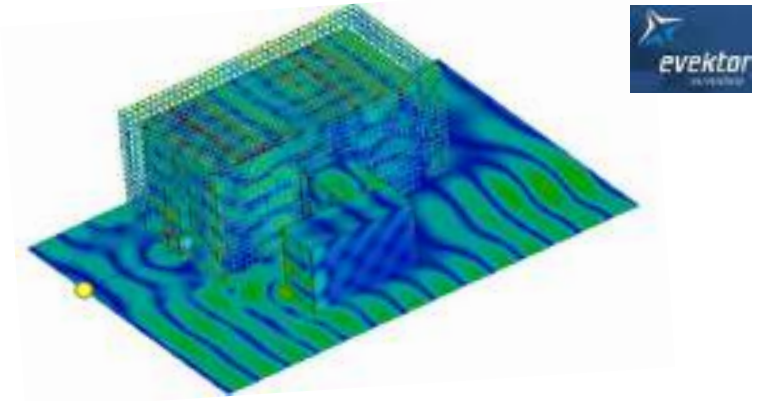


Interference analysis



Antenna arrays

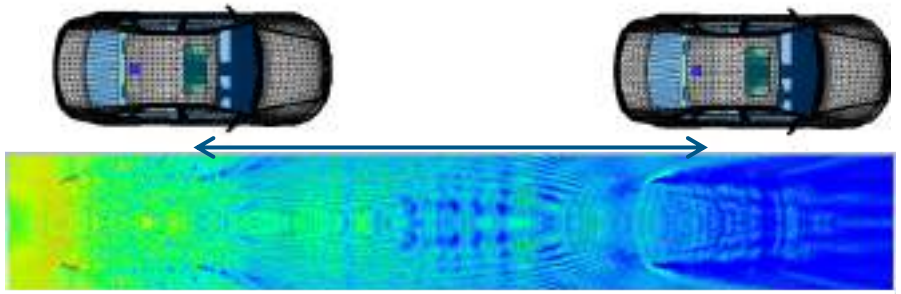
Radar Sources



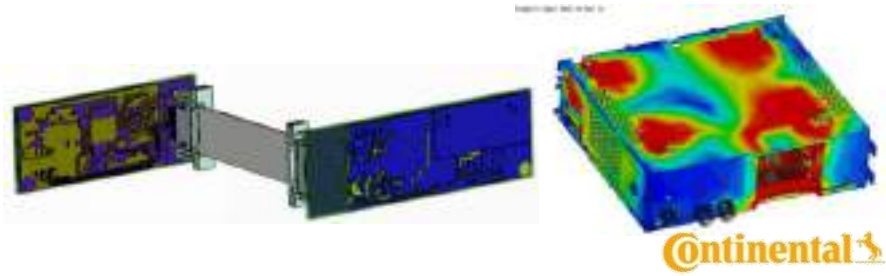
EM immunity

TRANSPORTATION & MOBILITY

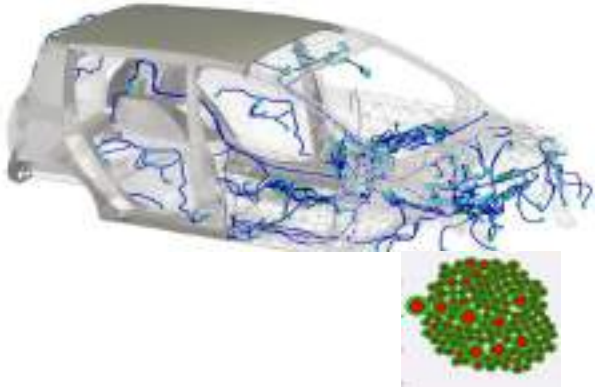
Antennas



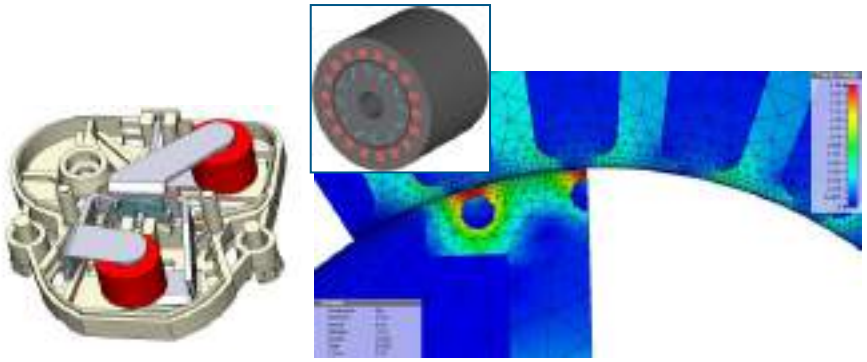
V2V Communication &
Self Driving Cars



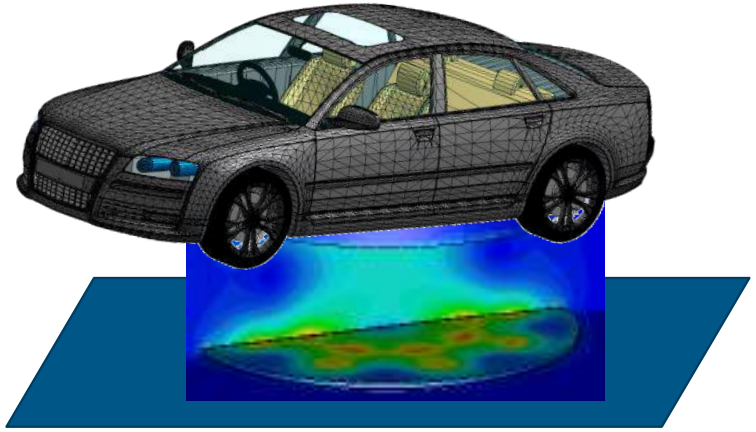
On-board electronics



Cabling EM behavior

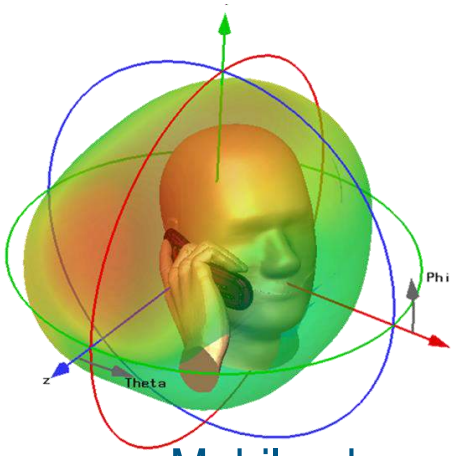


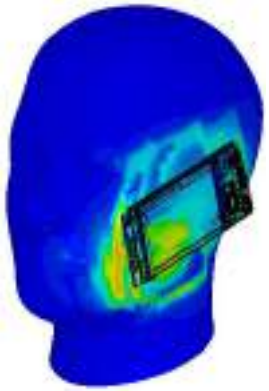
Electric motors



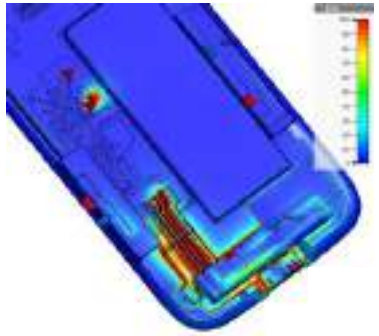
E-mobility, Wireless charging

HIGH TECH: COMMUNICATION/IOT

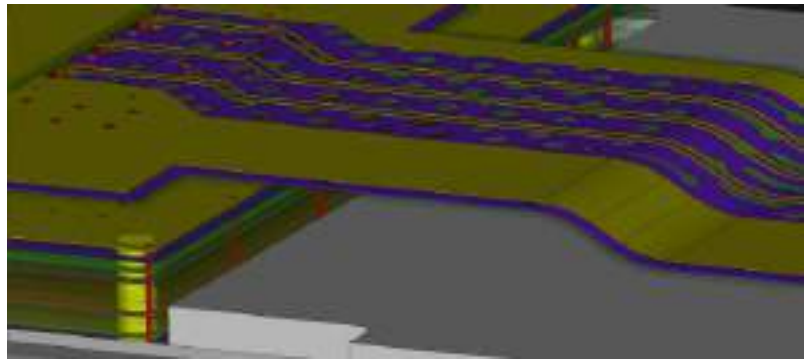




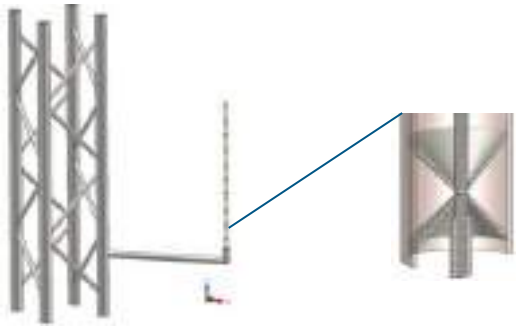
Mobile phones



Emissions and Interference

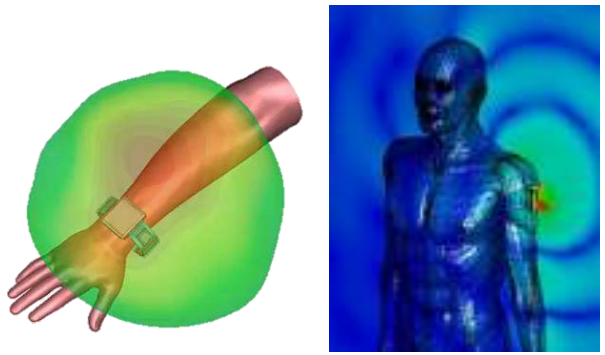


Flexible electronics



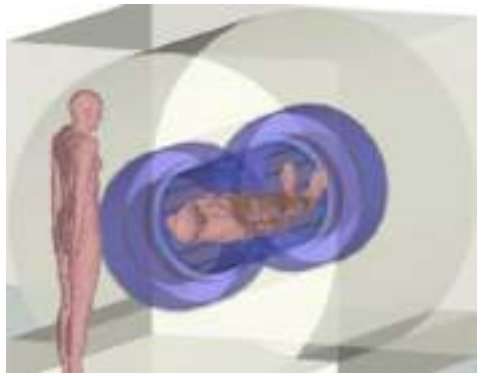
Base station

WiFi access point

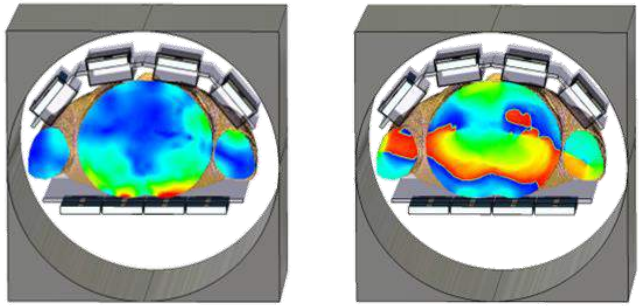


Wearable devices

LIFE SCIENCES

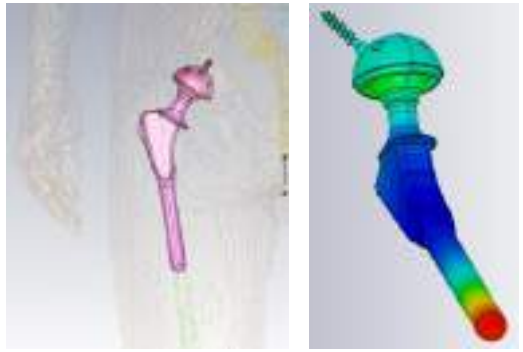


Imaging and diagnostics

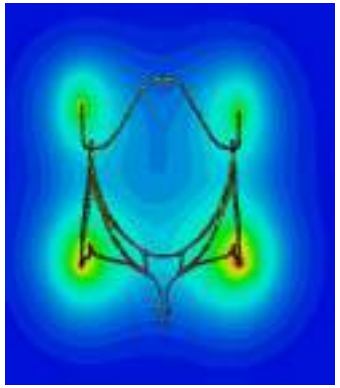


Highfield MRI

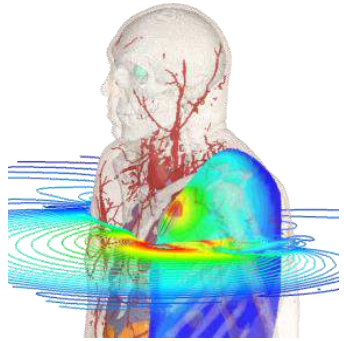
Blood Pressure and Sugar Monitors



Implant Safety



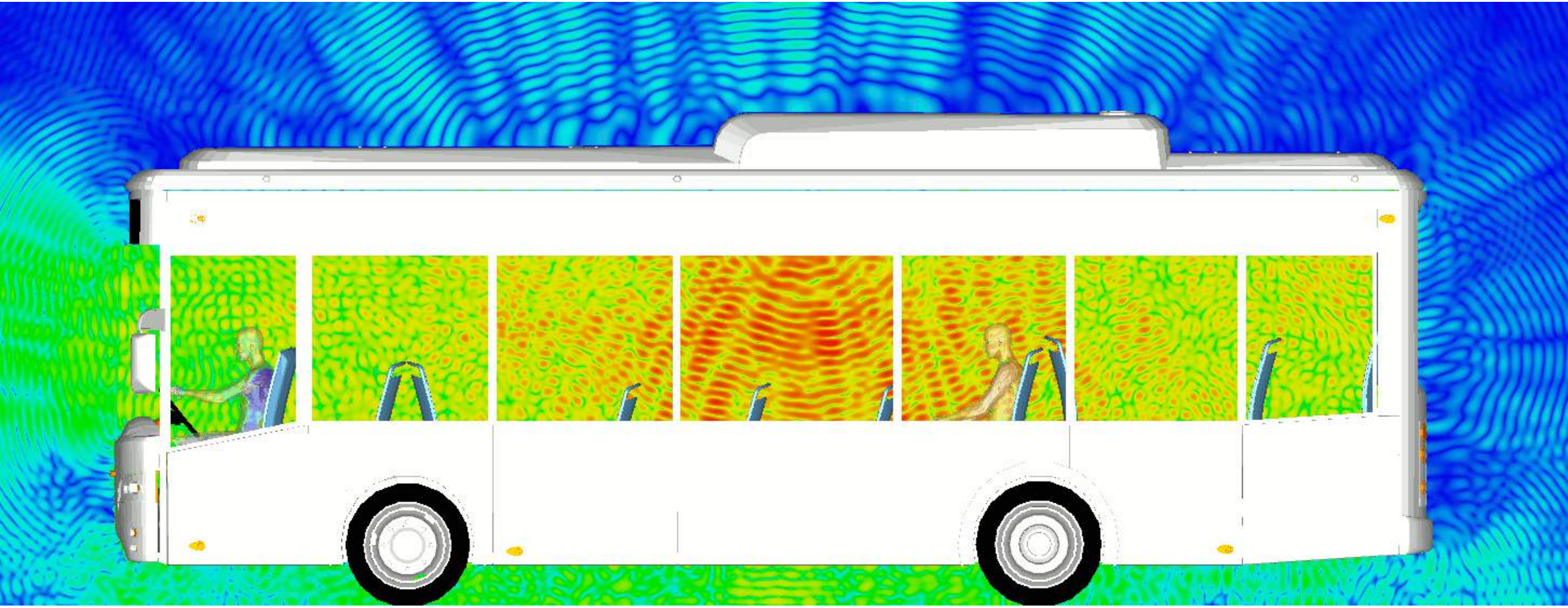
Heart Valve



Pacemaker

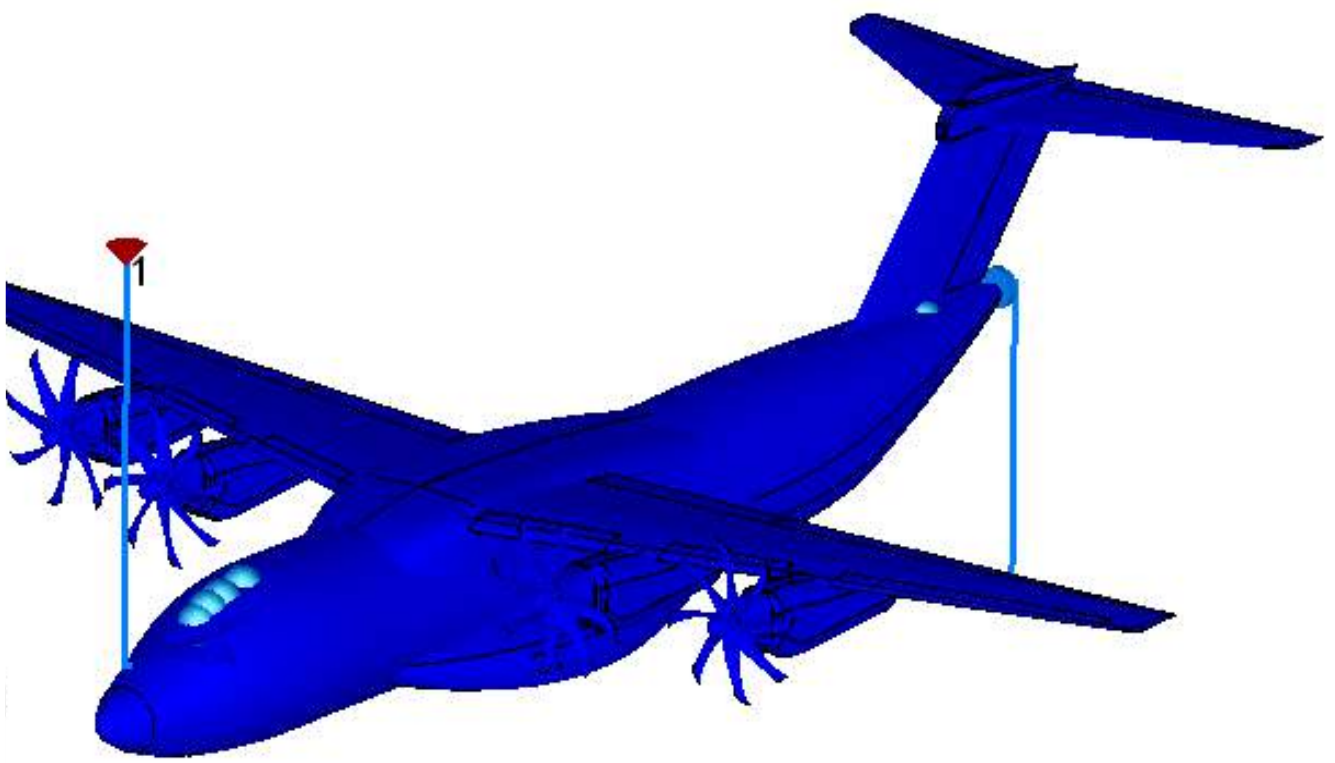
Hearing Aids

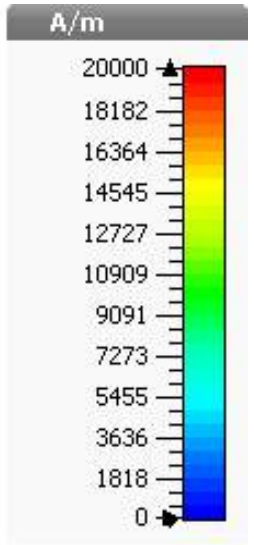
LARGE VEHICLES (BUSES, TRAINS, PLANES, ETC.)



LARGE VEHICLES (BUSES, TRAINS, PLANES, ETC.)

- Lightning Strike (Fast Transient EM Fields)
- High Voltage/Current
- Large Physical Size to Mesh
- Various Wavelengths (Wideband)





CST

Q&A / Open Discussion