VIAS EM Capabilities – General Overview

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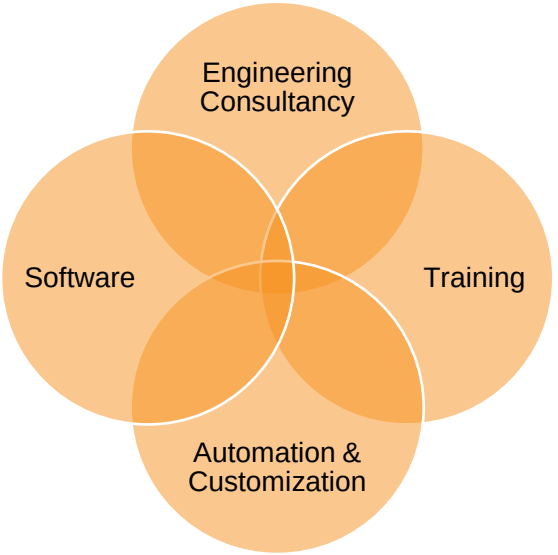
Who We Are

- Multiple Industry Experience – Hi-Tech, CPG, Oil & Gas, Petrochemical & Process, Nuclear, Aerospace, Medical Devices, Machinery & Equipment, Manufacturing and Automotive
- Global Presence: USA, CANADA..
- Team consists of +50 employees with 7 PhD's and 7 MSc/MTech's in Design, Manufacturing, Structural Mechanics, Fluid Mechanics, Electromagnetics, Optimization & Reliability, Data Analytics, System and Hardware Architecture
- Dassault Systèmes Platinum Partner
- Provide Engineering and PLM Consultancy, Training, Software Sales and Support, Automation and Customization



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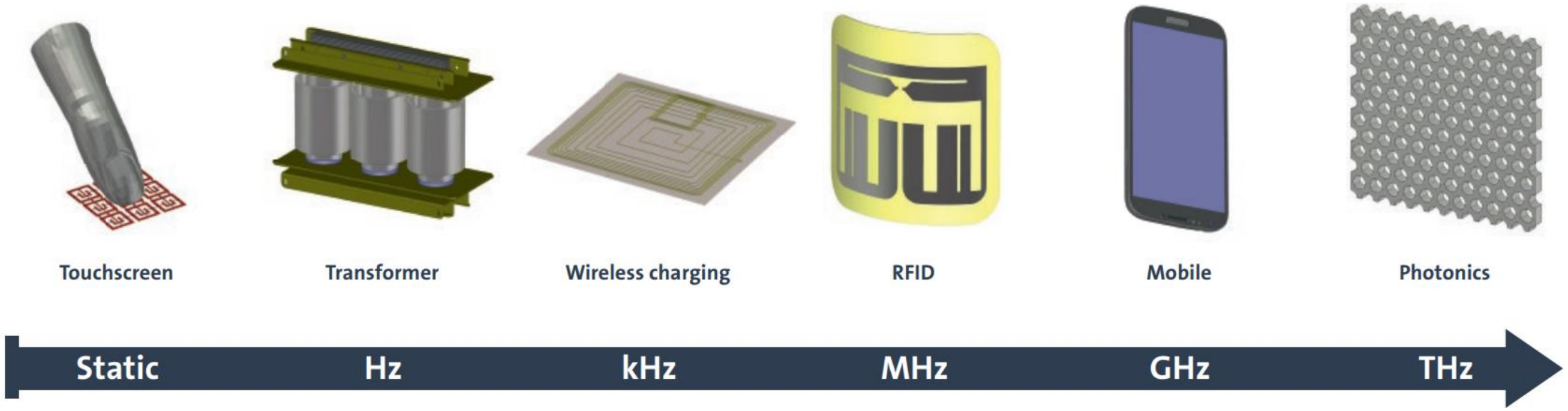
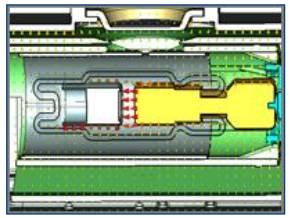
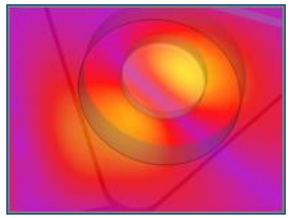
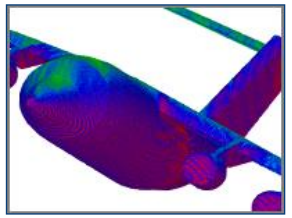
What is EM Simulation?

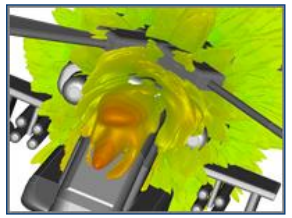
- EM simulation deals with all kinds of electromagnetic phenomena
- We can categorize EM simulation by frequency or application
- Frequency: DC (static) to AC (kHz, MHz, GHz) to visible light (THz)

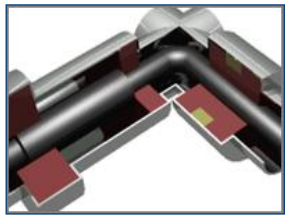


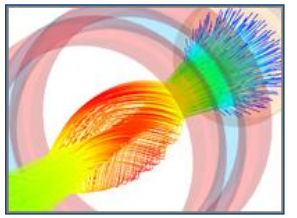


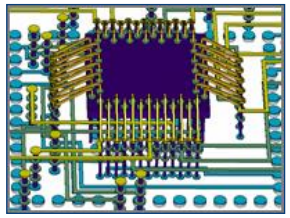


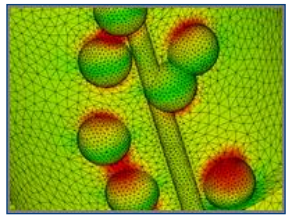


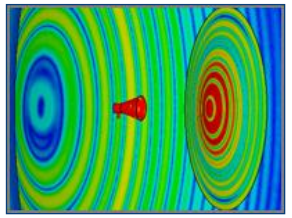


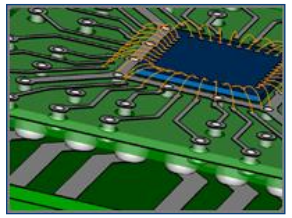


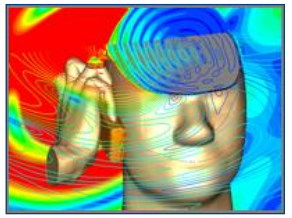


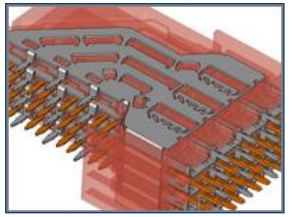




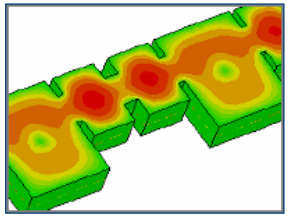


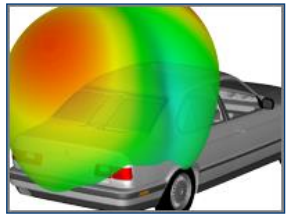


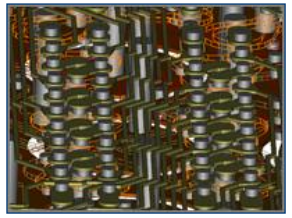


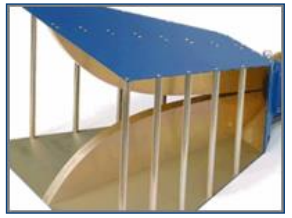


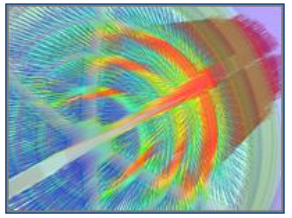
CST offers the most appropriate simulation techniques for each type of EM phenomena

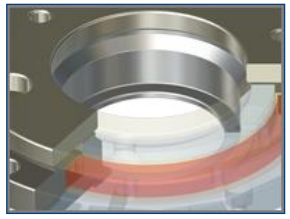


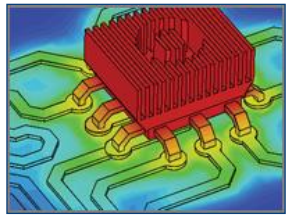


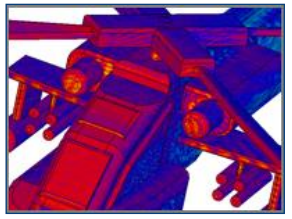


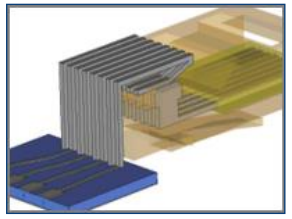


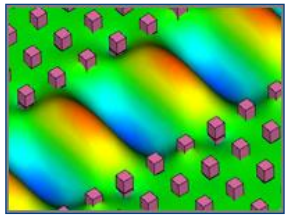


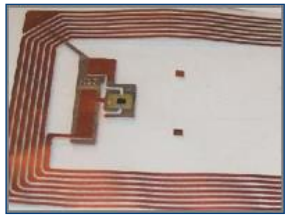












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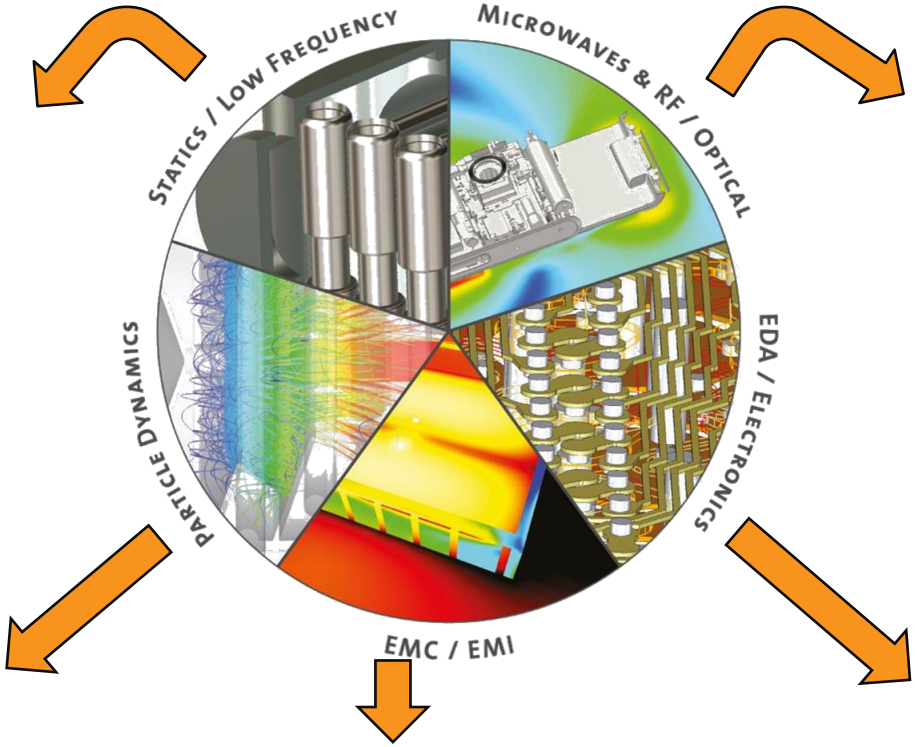
EM Applications

- Electromechanical Devices
- High Voltage / Heavy Current
- Magnet Design
- Sensors
- EMC / Shielding
- Power Electronics



- Antennas
- Circuit & Components
- Radar Cross Section
- Biomedical, Exposure, SAR
- Optical Applications
- Periodic Structures

- Accelerator Components
- Vacuum Electronic Devices
- Space Applications
- Beam Optics

- Radiated Emission
- Conducted Emission
- Conducted Susceptibility
- Radiated Susceptibility
- Components
- PCB Rule Checking

- Signal Integrity Analysis
- Power Integrity Analysis
- SI-PI Co-simulation
- Broadband Model Extraction
- Narrowband Model Extraction
- Design Rule Check (DRC)

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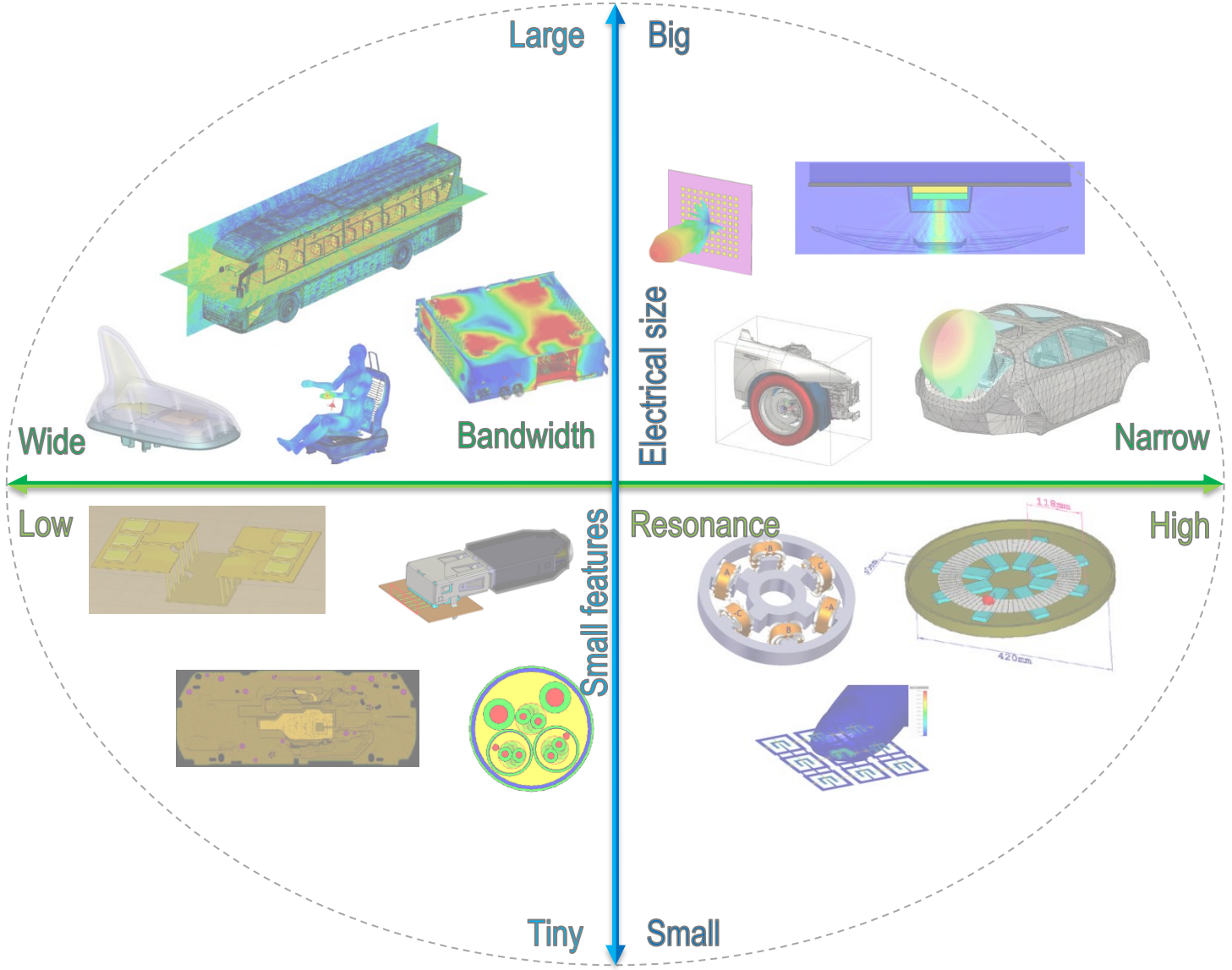
Complete Technology for EM Simulations



The Right Solver for the Job

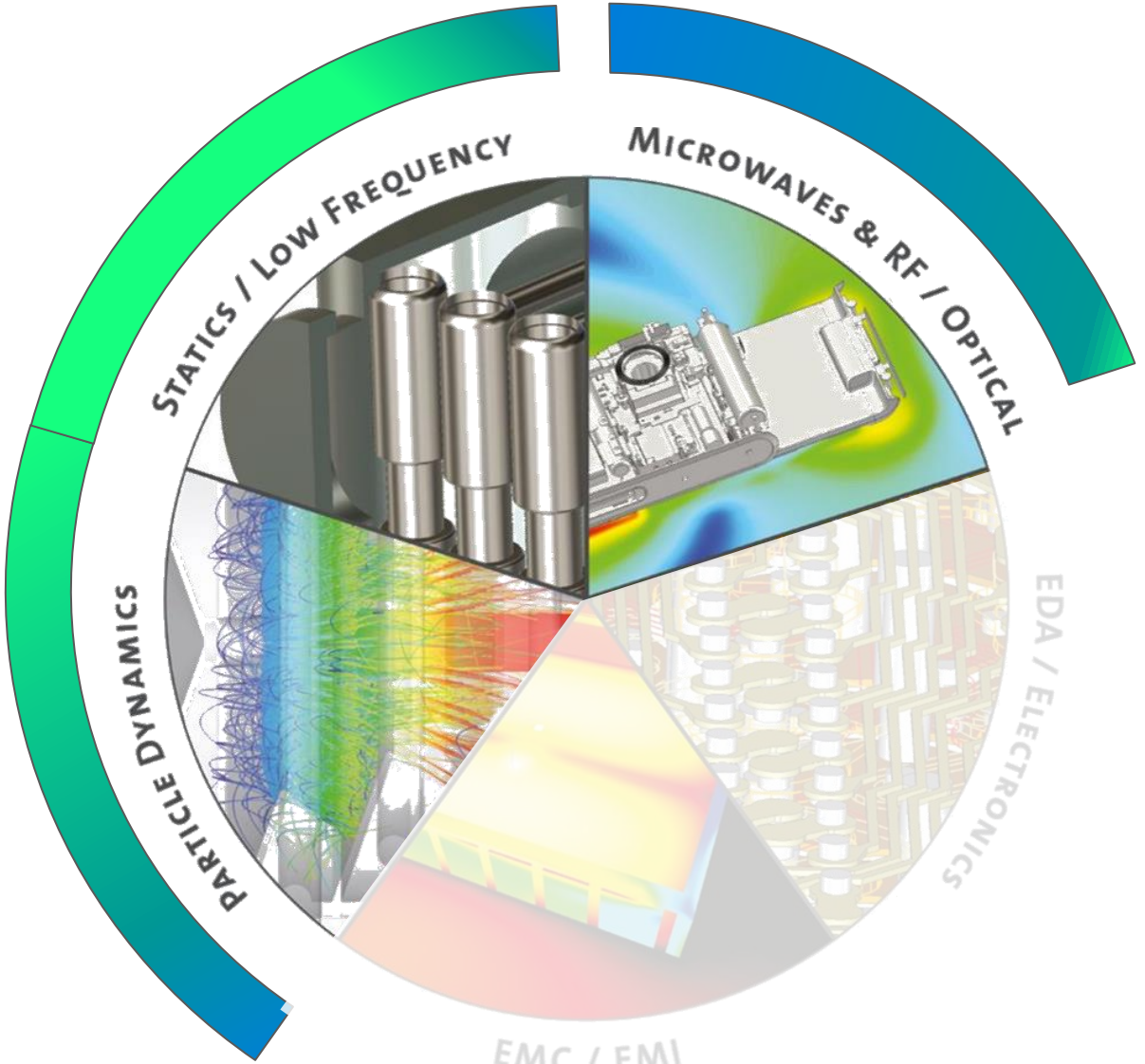
We offer the appropriate simulation techniques for a very wide range of applications.

- ▷ 4 general purpose solvers +20 application-specific solvers
- ▷ Covering EM + circuit + multiphysics
- ▷ Seamlessly integrated in the same intuitive user interface
- ▷ High performance computing features

- Time Domain Solver
- Frequency Domain Solver
- Integral Equation Solver
- Asymptotic Solver
- Eigenmode Solver
- Multilayer Solver
- E-Static Solver
- M-Static Solver
- Stationary Current Solver
- LF Frequency Domain Solver
- LF Time Domain Solver

EM Applications

High Frequency

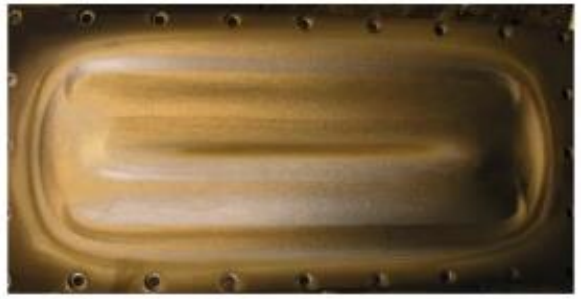


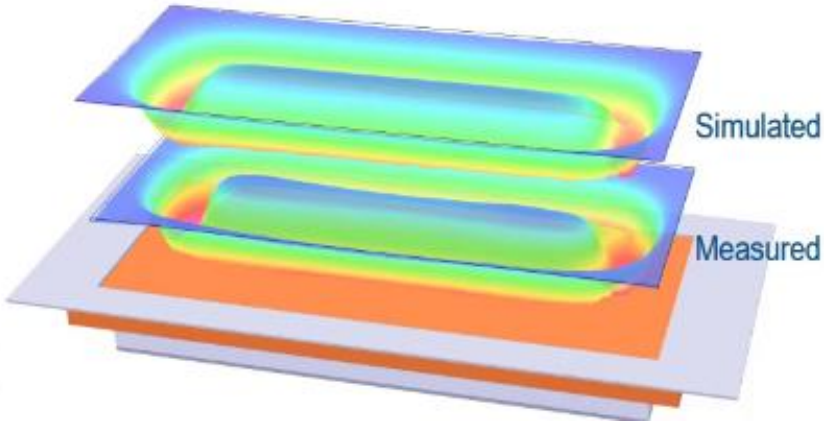
Low Frequency

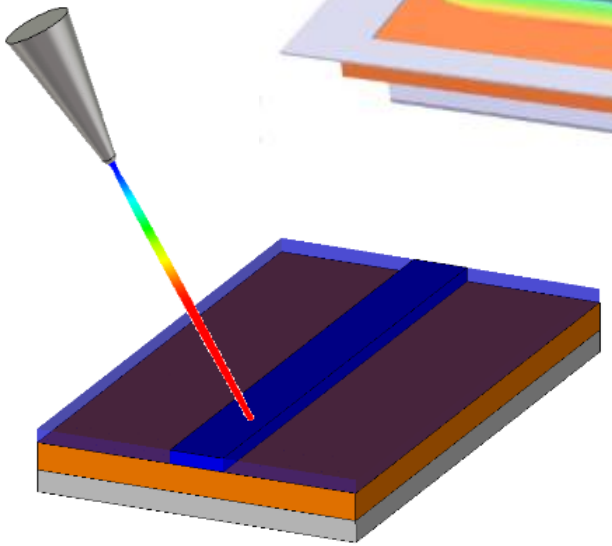
Electromagnetics - Charge Particles Interaction

Processes used in the Manufacture of Semiconductors

- Deposition
  - Sputtering
  - Chemical Vapour Deposition, Plasma Vapour Deposition and many related methods
- Etching
  - Wet Chemical Etching & Physical abrasion
  - Dry Plasma Etching
  - Ashing (Photoresist removal & Trimming)
- Doping Process
  - Ion Implantation
- Lithography
  - E-beam Lithography – to create the masks for Extreme UV photo-lithography
  - Sintering Printed Circuits for Flexible Electronics







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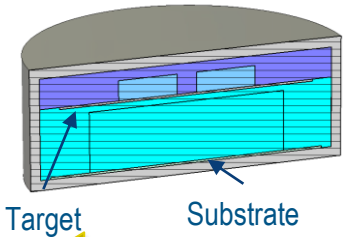
Electromagnetics-Charge Particles Interaction

- Exploring new Plasma Reactor Design
- Improving Uniformity of ion Density Profiles
- Thermal coupling analysis to prevent damage
- Exploring the effect of using different types of gases
- Pressure and External sources effects on the Plasma homogeneity
- High Fidelity modeling to predict/explain experimental results when no diagnostics are available
- Plasma modelling & Space Charge Dynamics interaction
- Transient effects

Design of the Plasma Chamber (Parameterized Geometry)

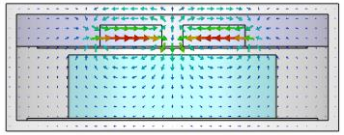
1



External Source definition

2

- Bias Voltage
- Focusing Magnets

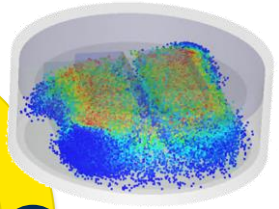


Ar-Neutral gas introduction

3

- Ionization cross-section
- Elastic/Inelastic collisions (MCC models)
- Parameterized Pressure

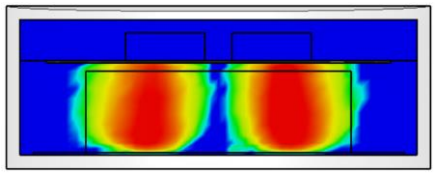
4



Plasma creation, Space Charge Dynamics

5

Ion Density Profile (Material removed from the target)



6

Plasma reactor optimization Performance

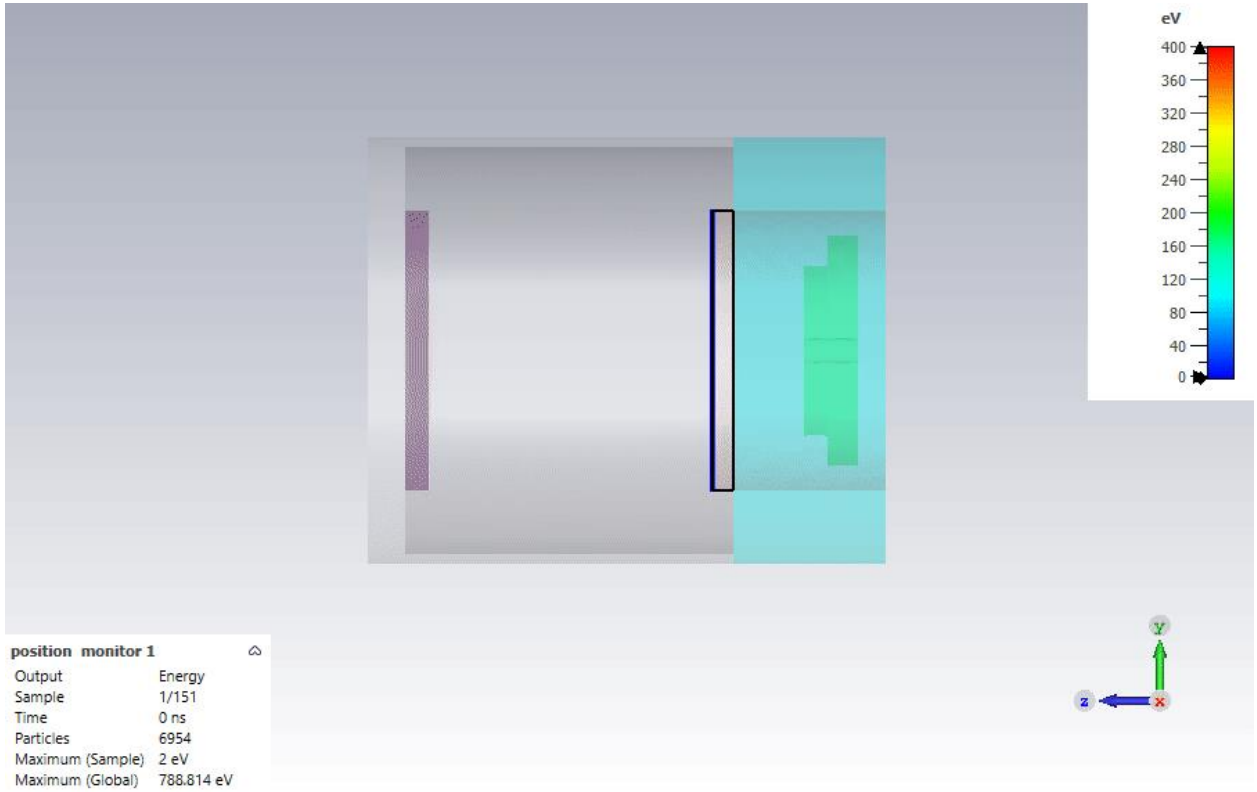
- Pressure Influence
- Plasma Uniformity

7

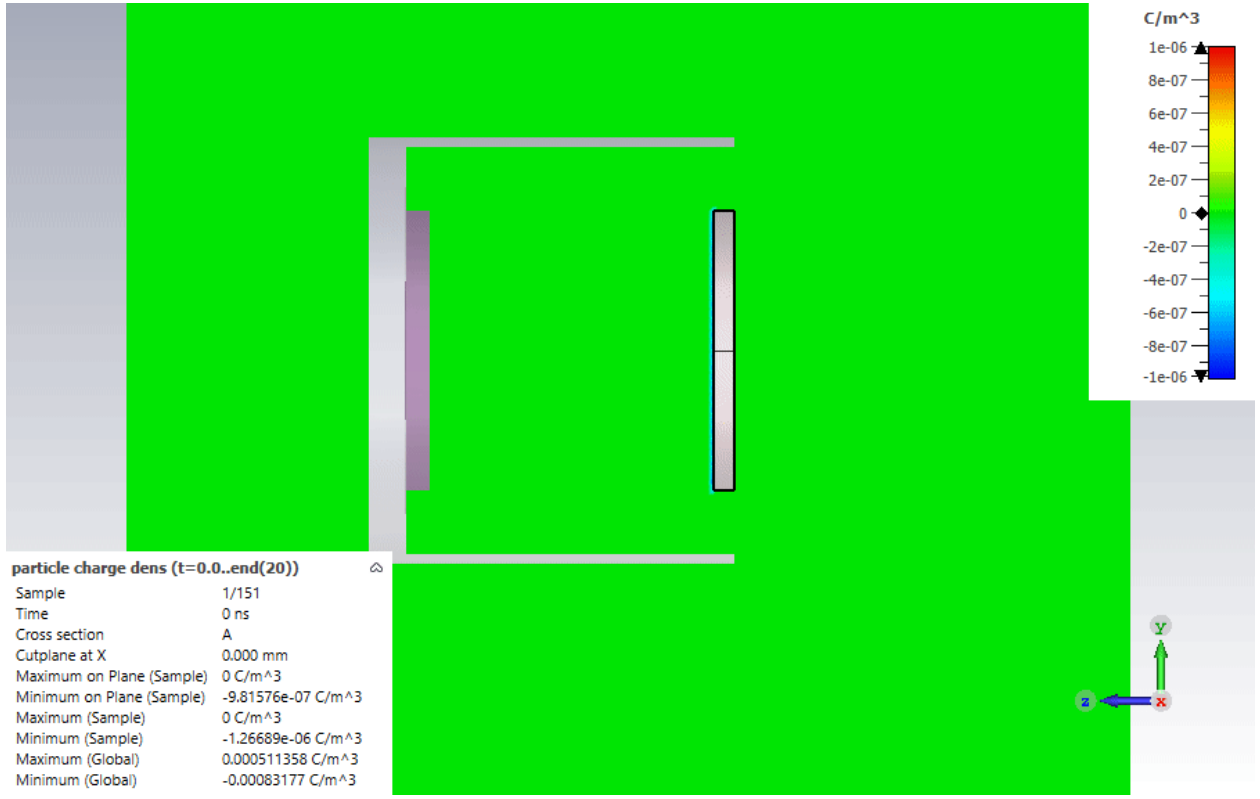
- Target Erosion Profile
- Thin Film Deposition

Electromagnetics - Charge Particles Interaction

Plasma Ignition – Transient behavior



Plasma Expansion and Particle energy concentration at the Target surface



Electron & Ion beam Profiles with evidence of Ar-Ion bombardments on the Target surface

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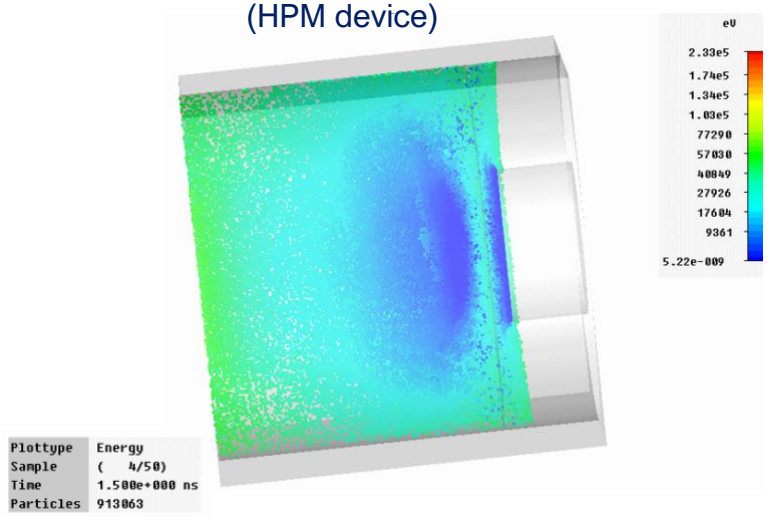
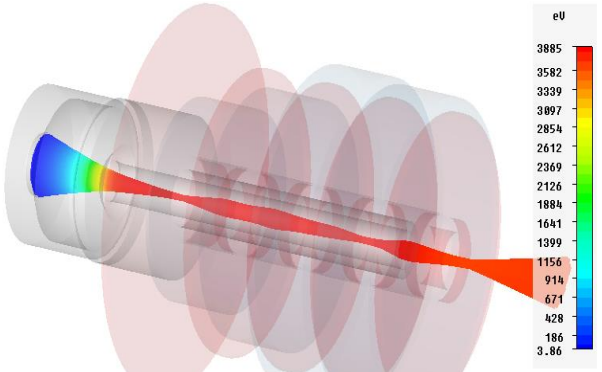
Electromagnetics - Charge Particles Interaction

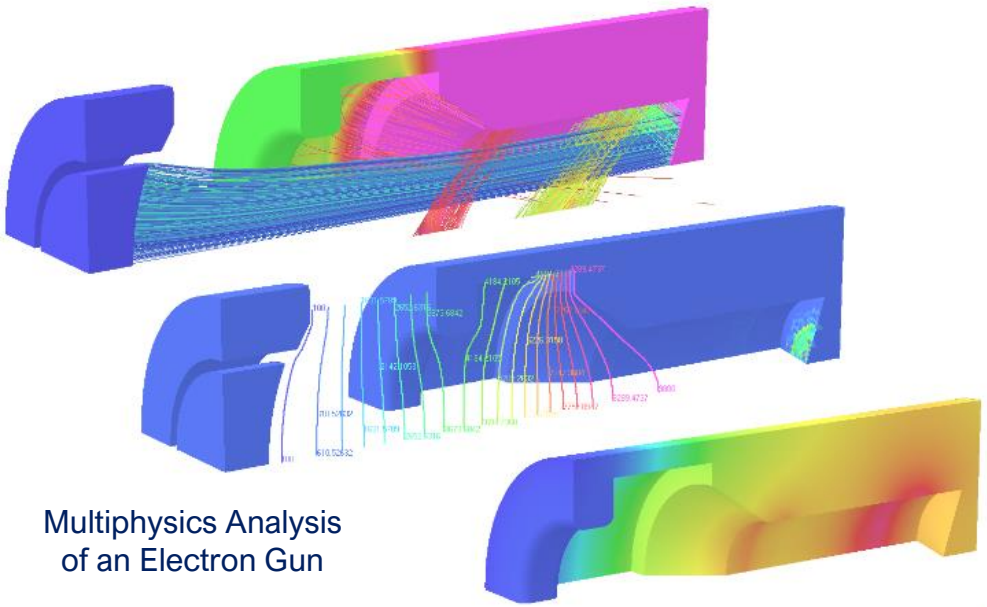
- Satellite communication
- Radar Systems
  ⇒ Vacuum electron Devices (TWT, Klystrons, etc…)
- Emission Models for Primary and Secondary particles
- High Power Microwave (HPM) generation
  ⇒ Compact Relativistic vacuum electron Devices
- Streak Cameras for night vision
  ⇒ Photon-electron conversion (Photoelectric effect)
- Manipulation of Charge particle beams with Magnets
- Multiphysics – beam-heating-deformation

VIRCATOR design
(HPM device)

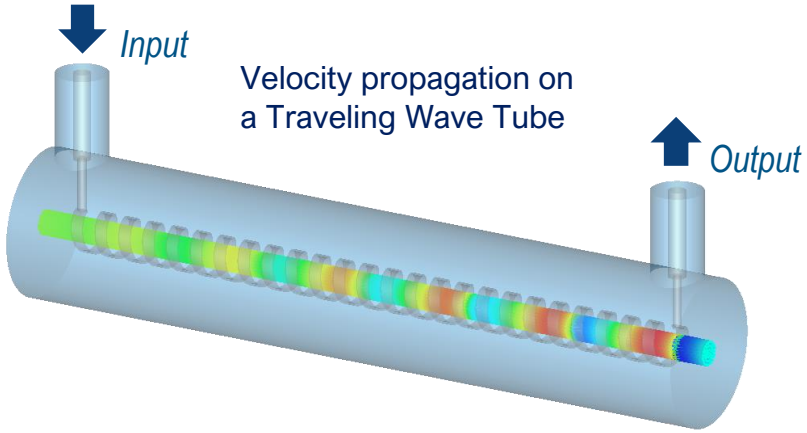


Electron Gun and output
signals versus time (below)

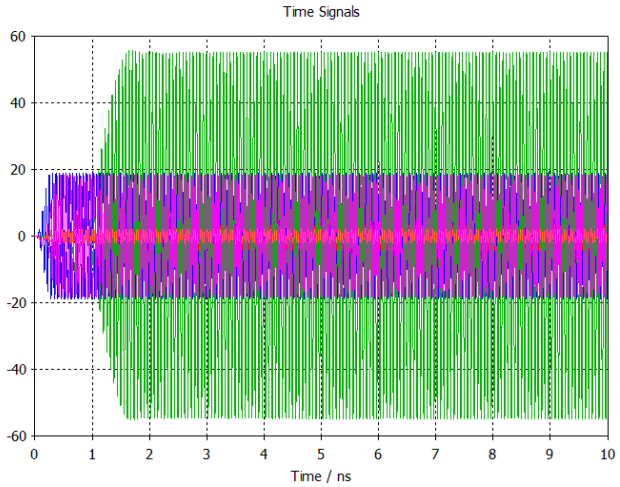




Multiphysics Analysis
of an Electron Gun

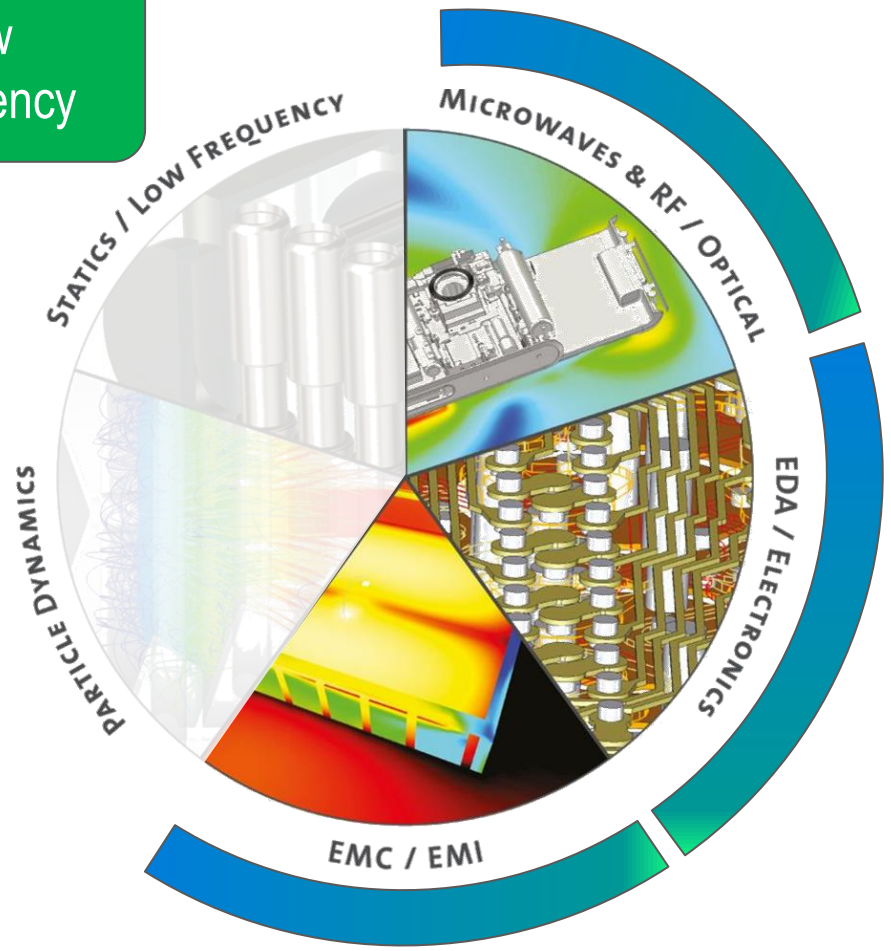


Velocity propagation on
a Traveling Wave Tube



EM Applications

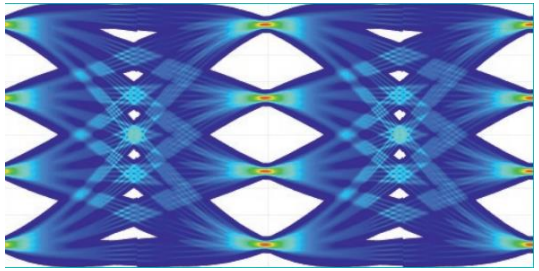
Low Frequency



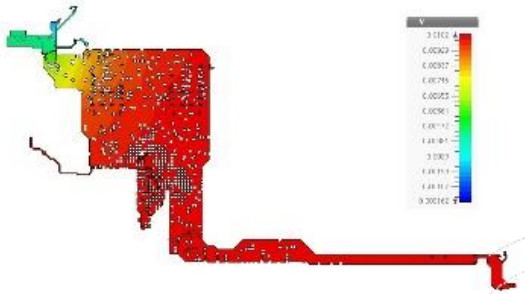
High Frequency

EDA / Electronics and EMC

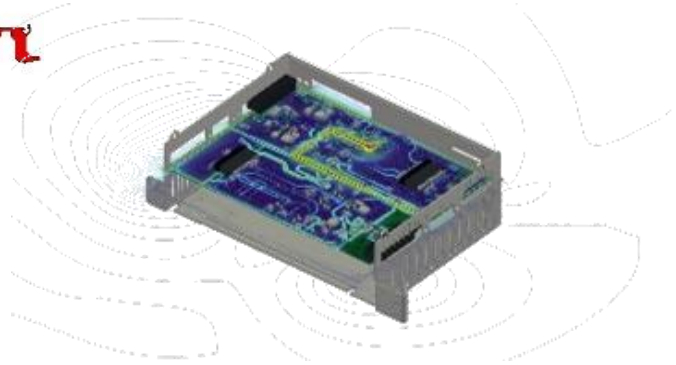
Signal Integrity



Power Integrity



EMC



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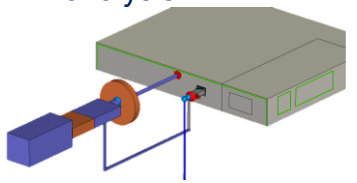
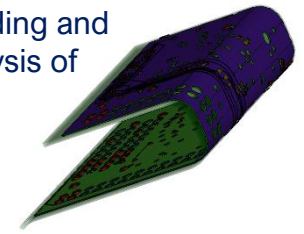
Electronics Design Analysis

- Time-Domain Refractory (TDR) analysis.
- Visualization of Electromagnetics (EM) fields and losses.
- Analysis of Signal and Power Integrity of PCBs.
- EM compatibility and interference compliance check.
- Electrostatic Discharge (ESD), Lightning and EMP analysis.
- Radiated and Conducted emission, Electromagnetic Immunity analysis on complex cable structures and connectors.

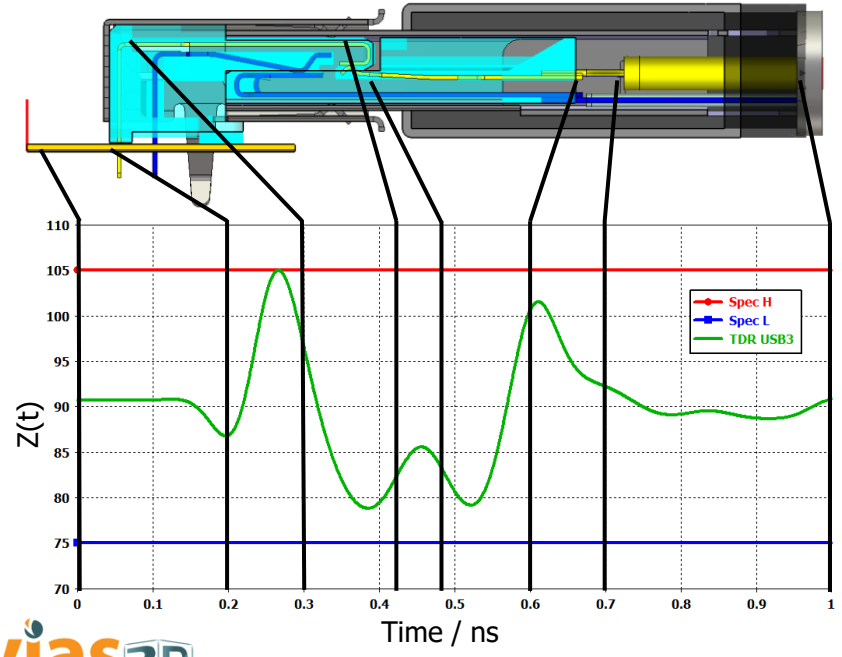
Model for ESD analysis



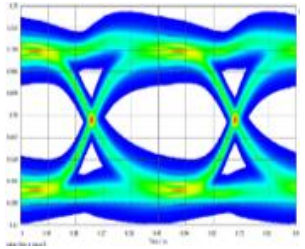
Bending and analysis of PCB



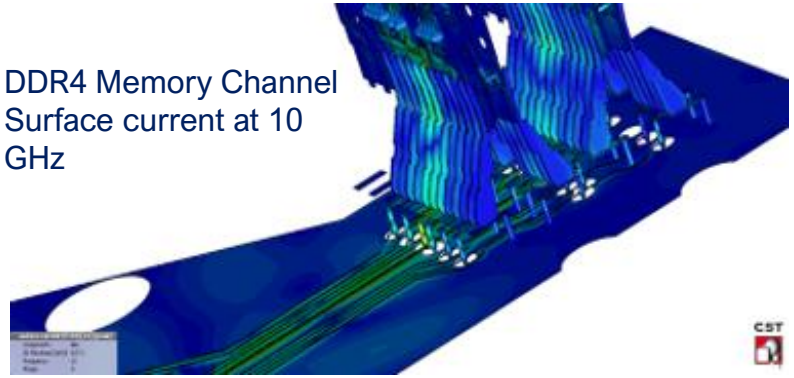
Impedance profile versus time on connectors and lines



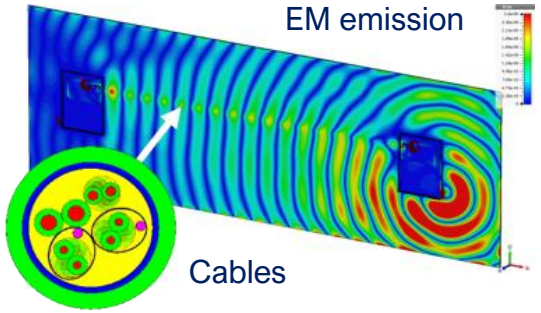
Eye Diagram



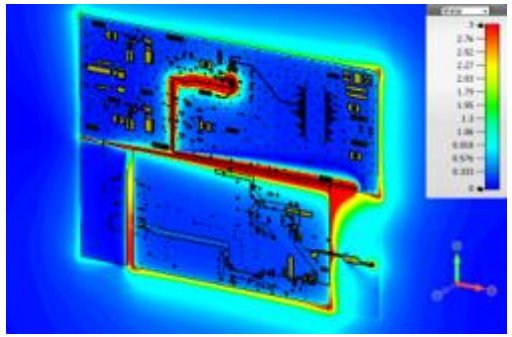
DDR4 Memory Channel Surface current at 10 GHz



EM emission



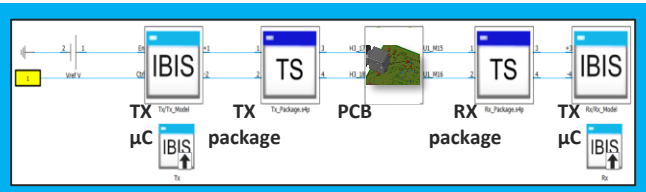
EM PCB Losses

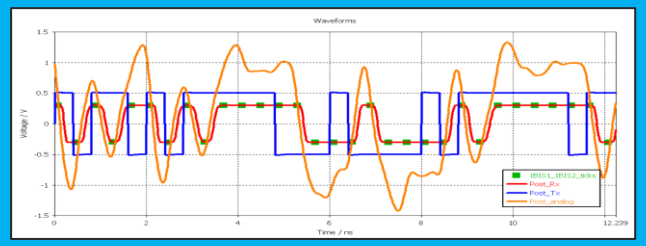


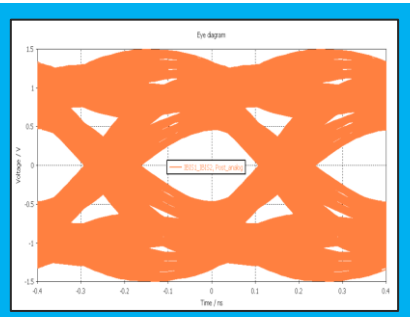
Signal Integrity, Power Integrity and EMC

Signal Integrity Issues

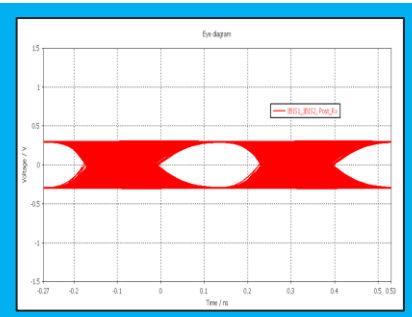
- Ringing
- Crosstalk
- Distortion
- Signal loss
- Power supply noise



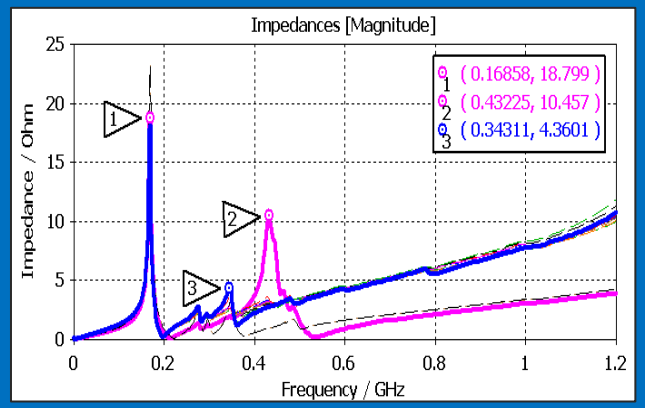


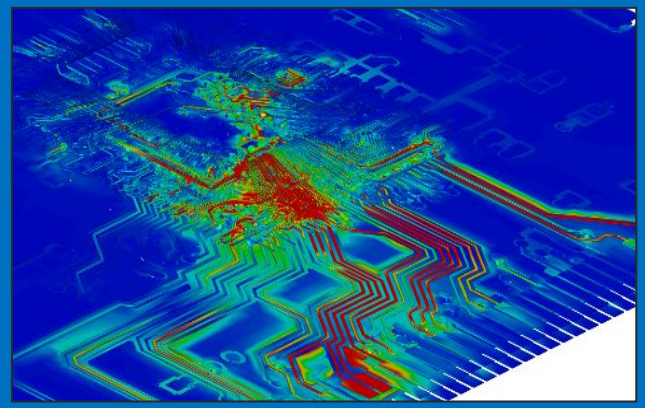


Eye Diagram
Before
Equalization & Clock Recovery



Eye Diagram
After
Equalization & Clock Recovery



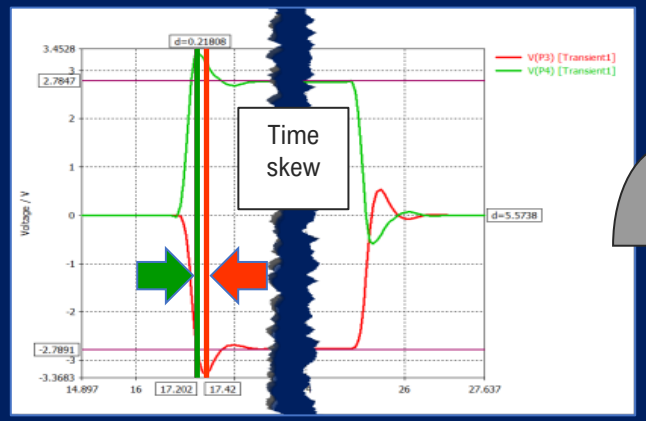


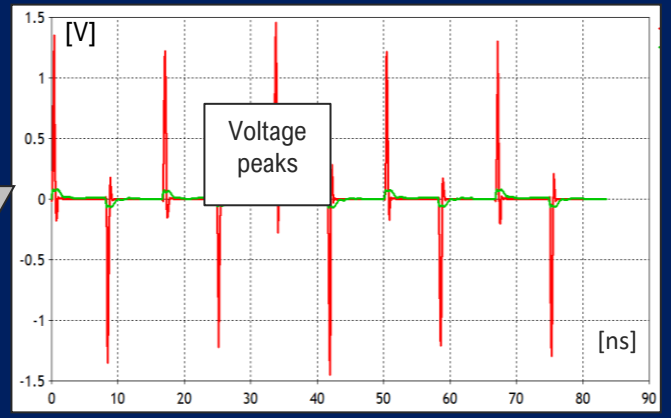
Power Integrity Issues

- Simultaneous switching noise
- Ground bounce
- High impedance
- Resonance

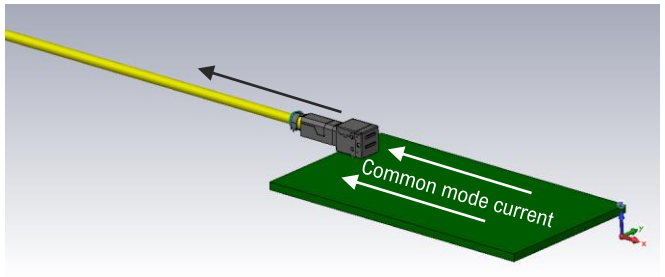
EMC Issues

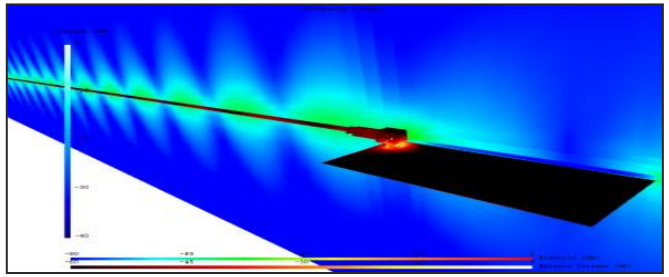
- Imbalances
- Time skew
- Common mode currents
- Conducted emissions
- Radiated emissions

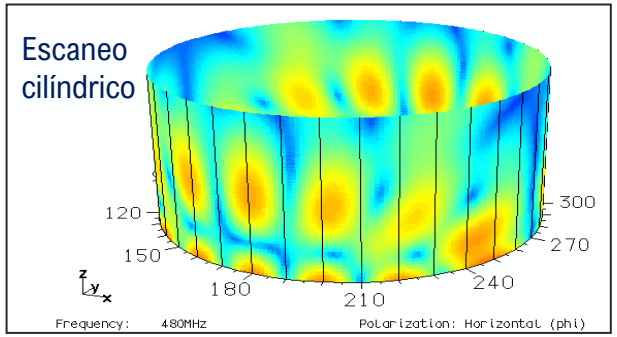


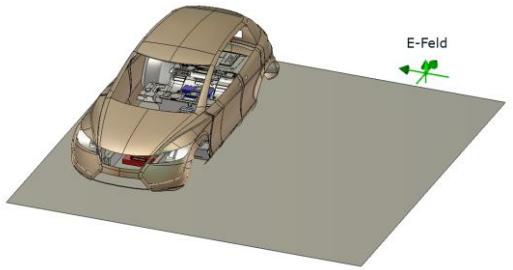


Effect of Conducted and Radiated Emissions

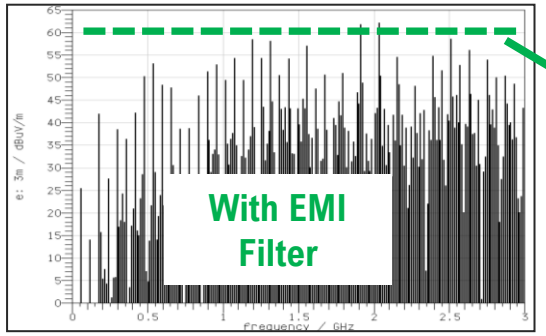


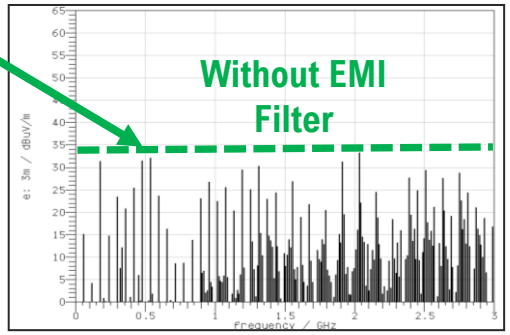


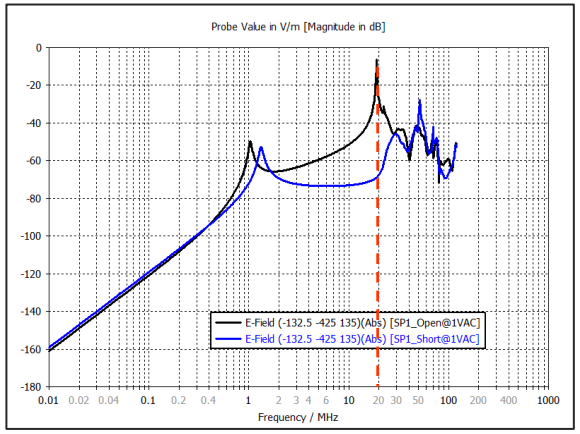


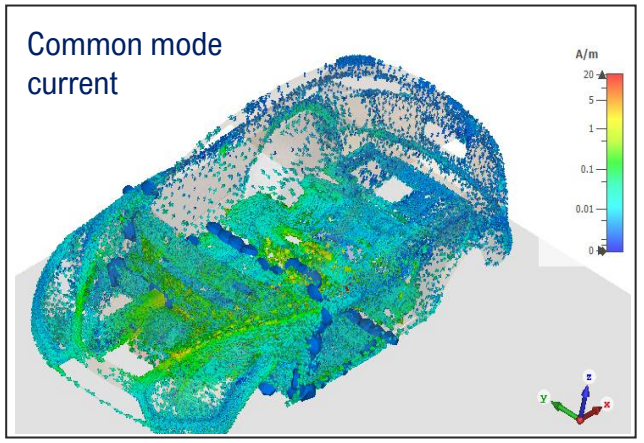


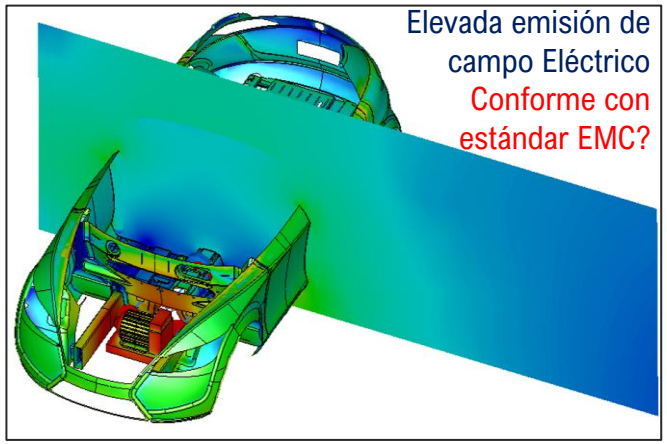
Conducted Emission Analysis







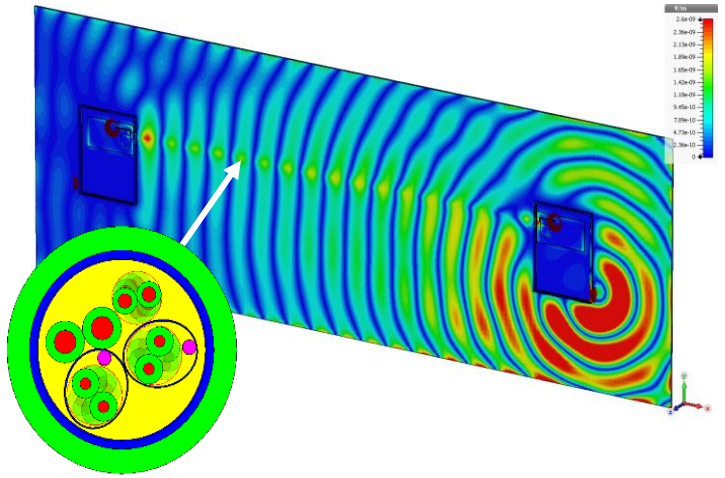


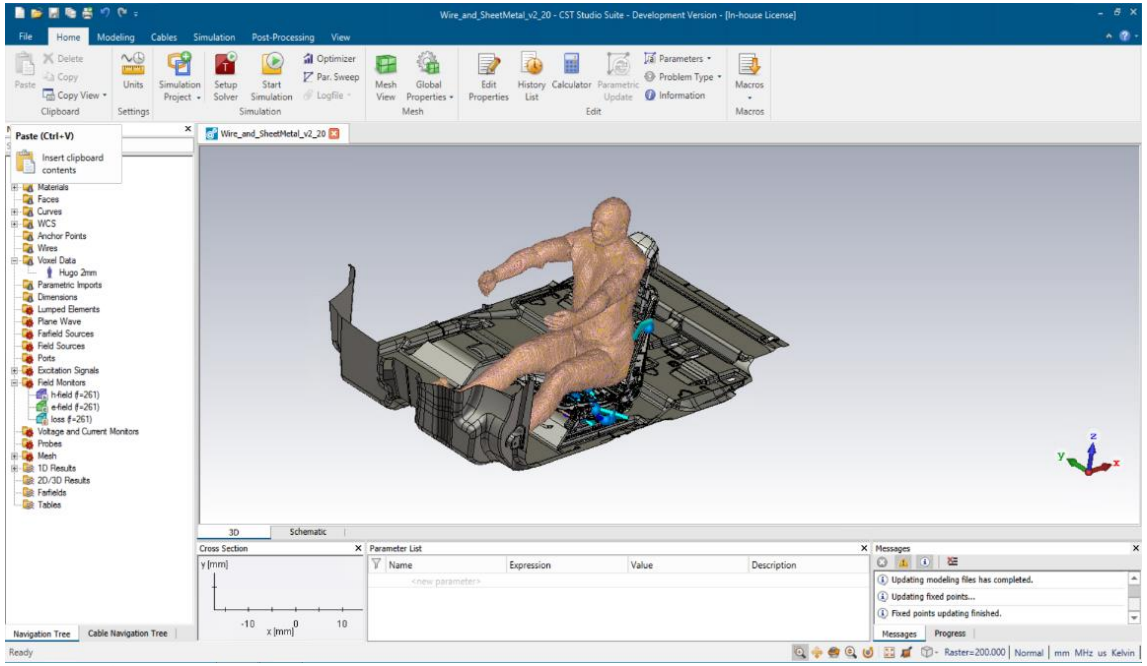


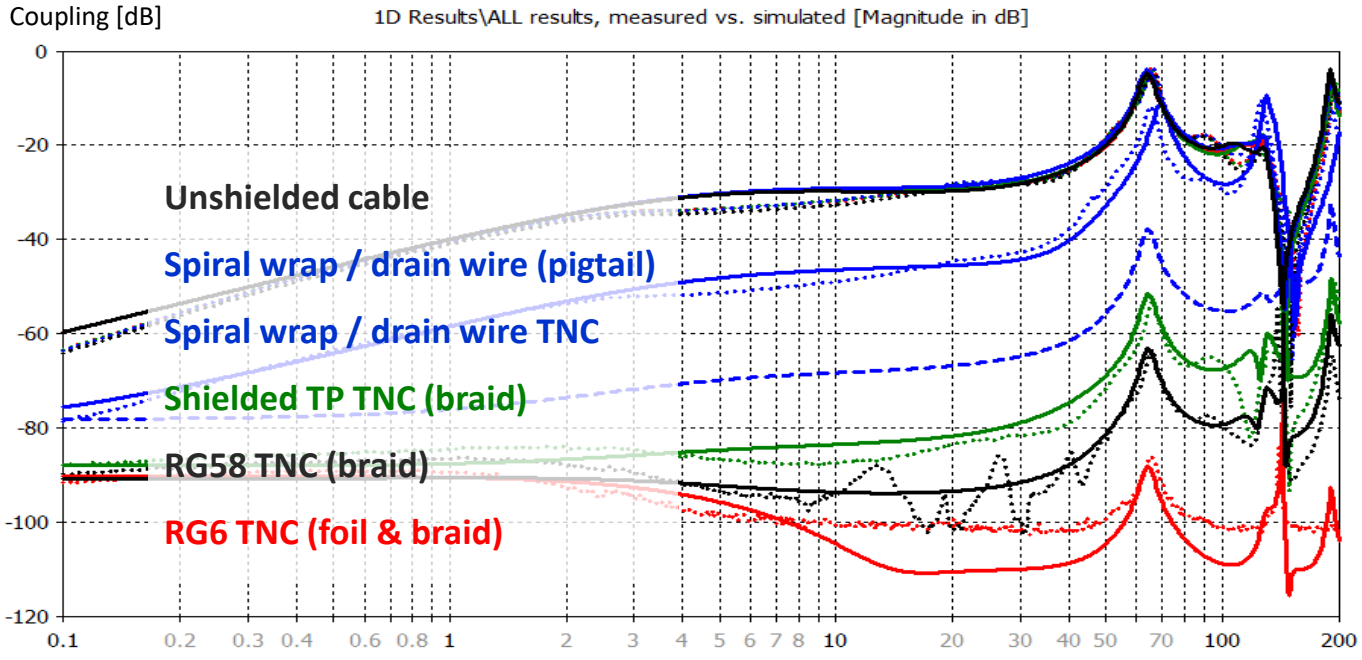
viasD

Harness & Electrical Wiring

- Component level & System level Analysis
- Interconnects and connectors modelled & simulated in full 3D
- High bandwidth, high frequency applications (Automotive Ethernet)
- Import wire harness data, complex cross section definition and Material & cable type libraries available.
- S-Parameters, propagation delay, cross talk, signal & power integrity, transfer impedance, etc…
- EMC/EMI analysis of cables.
- Full 3D shield modelling and library of shield types.
- Human Exposure Simulation, SAR calculation, Radiation Hazards.

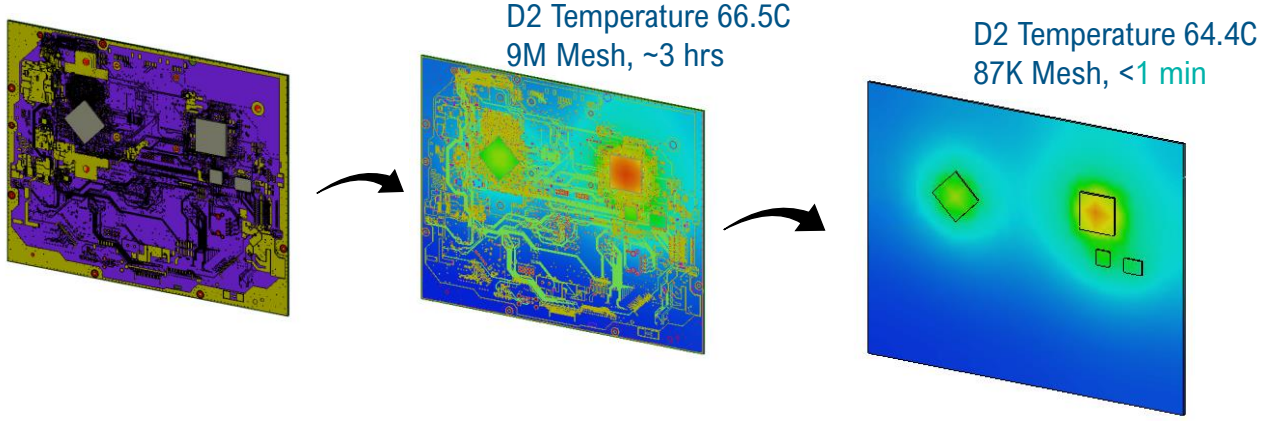




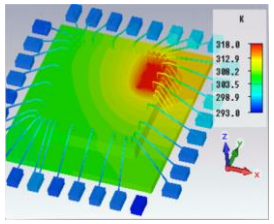


EM-Thermal and Stress Analysis

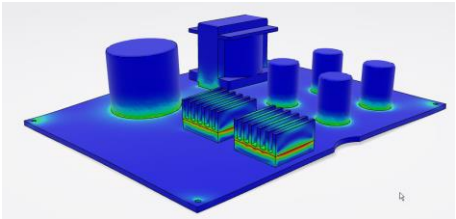
- Perform Multiphysics analyses involving EM-Thermal-Mechanical problems.
- Steady state, transient and Conjugate Heat Transfer solvers.
- Uni-directional and Bi-directional coupling.
- Automatic layer simplification (average material properties).
- Components modeling.



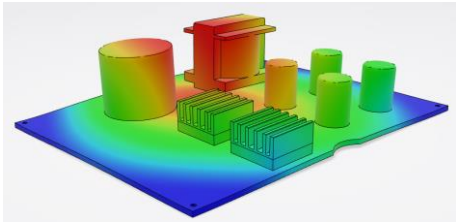
Temp. distribution on IC/Packages



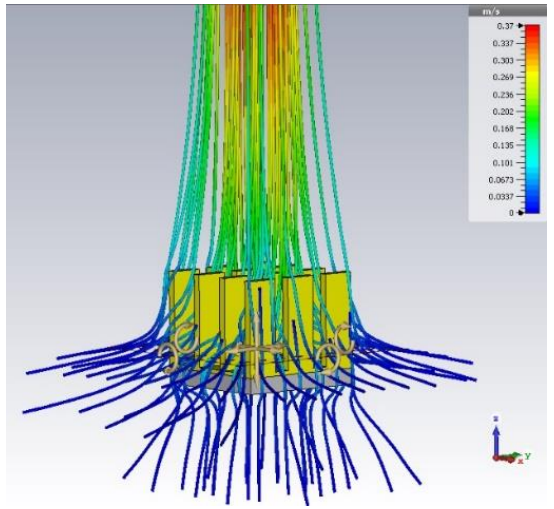
Von Mises Stress



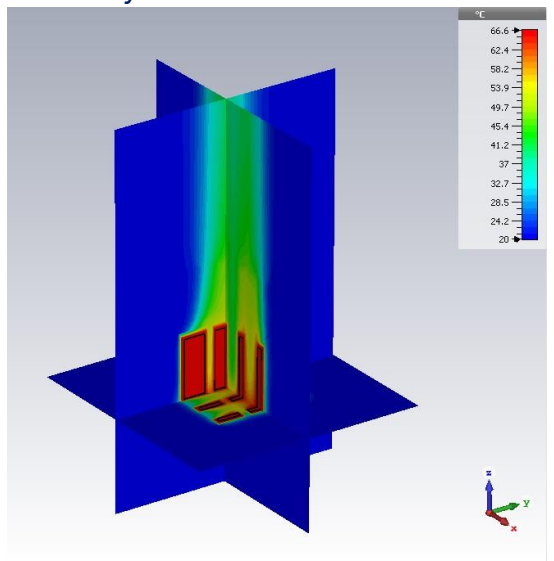
Deformation



Temperature



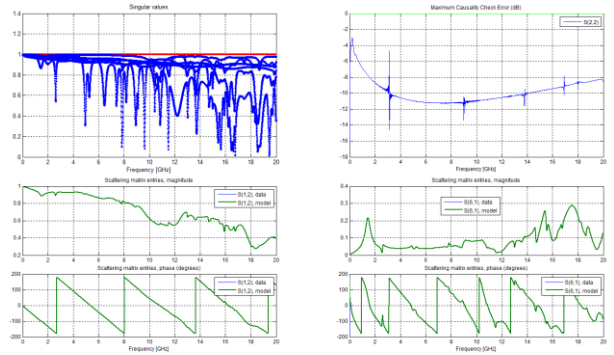
Velocity



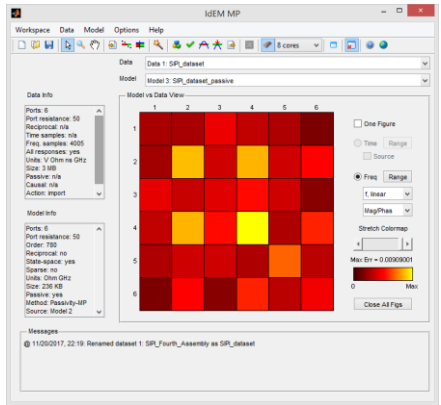
IdEM-based simulation flow

EM Simulation / Measurements

$\mathbf{S}(f)$ *Touchstone*



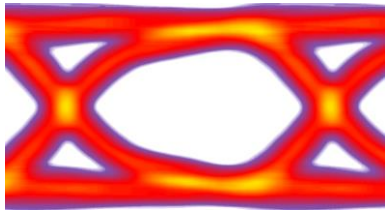
IdEM



- ✓ Data certification
- ✓ Rational approximation
- ✓ Passivity enforcement
- ✓ Synthesis

Passive and Causal Macromodel

SI/PI analysis

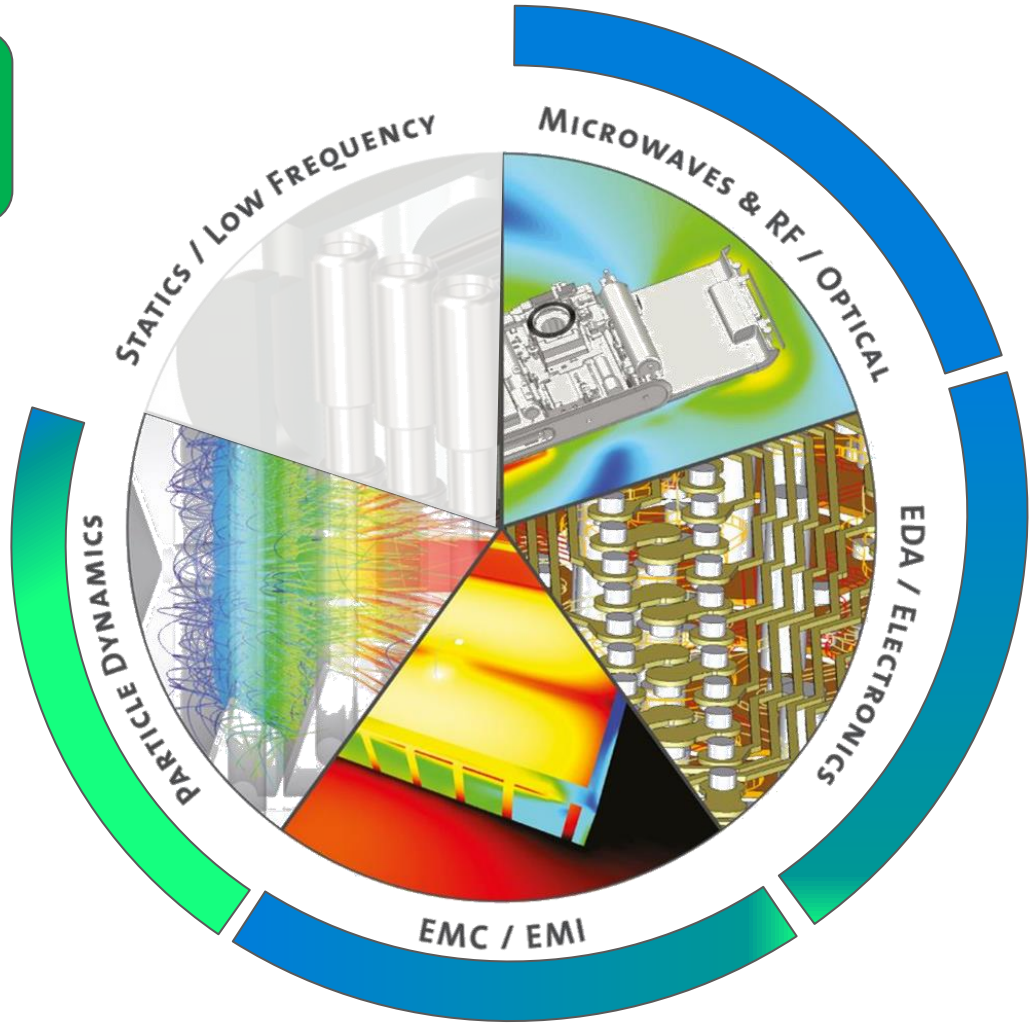


Circuit solver

Time domain simulation

EM Applications

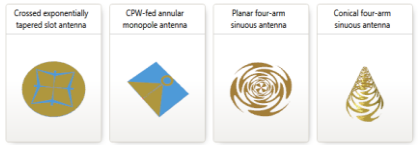
Low Frequency



High Frequency

Antenna engineering & certification

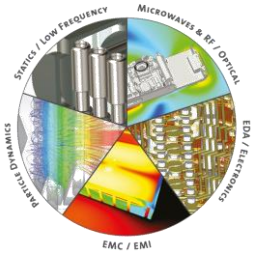
AntennaMagus
Explore.Design.Deliver.



CST Studio Suite 2021

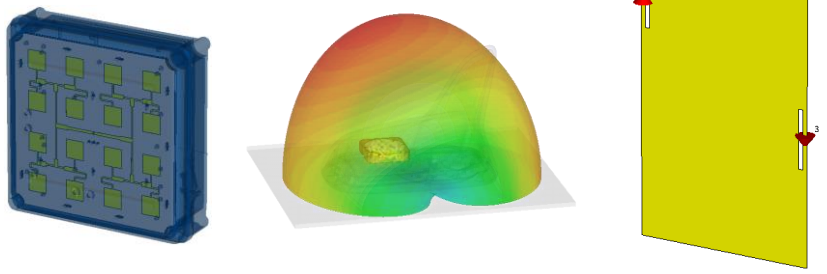
SIMULIA

DASSAULT SYSTEMES | The 3DEXPERIENCE Company

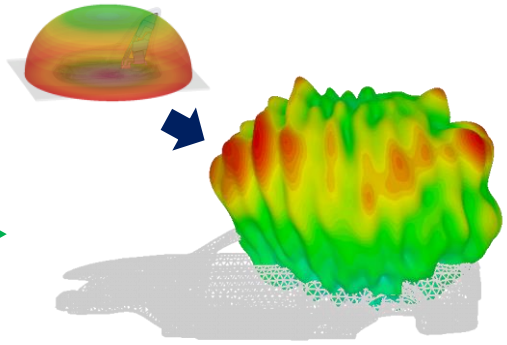


Waveguide (Horn, Cone, etc.)	Planar (Patch, Slot, etc.)
Wire	Phased Array, Unit Cell
Mobile Phone, Integrated	Reflector
Dielectric Resonator	RFID

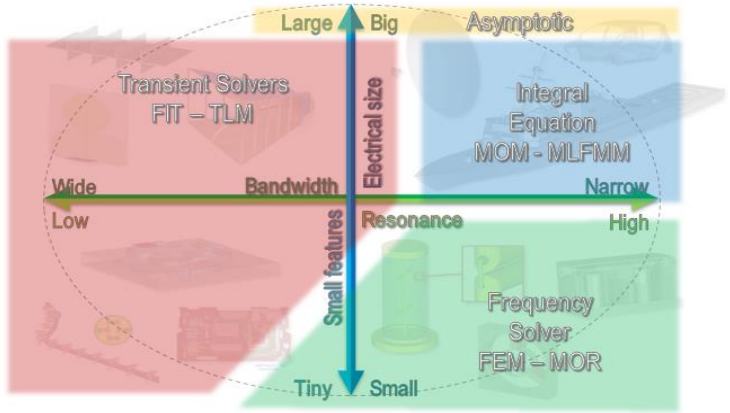
Simulation and Optimization. 3D Model Completely Parametrized.

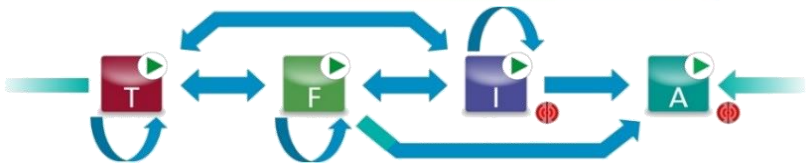


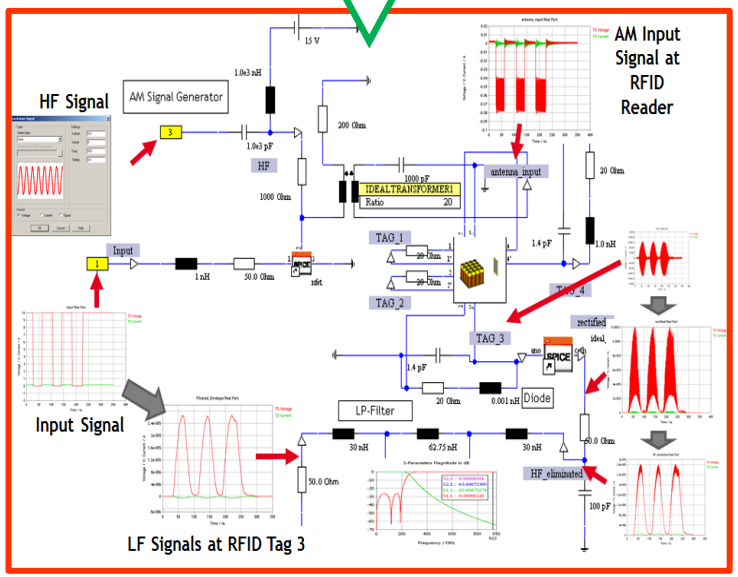
Installed Antenna Performance



Complete Technology for solving EM problems, hybrid simulation, all included in one GUI.





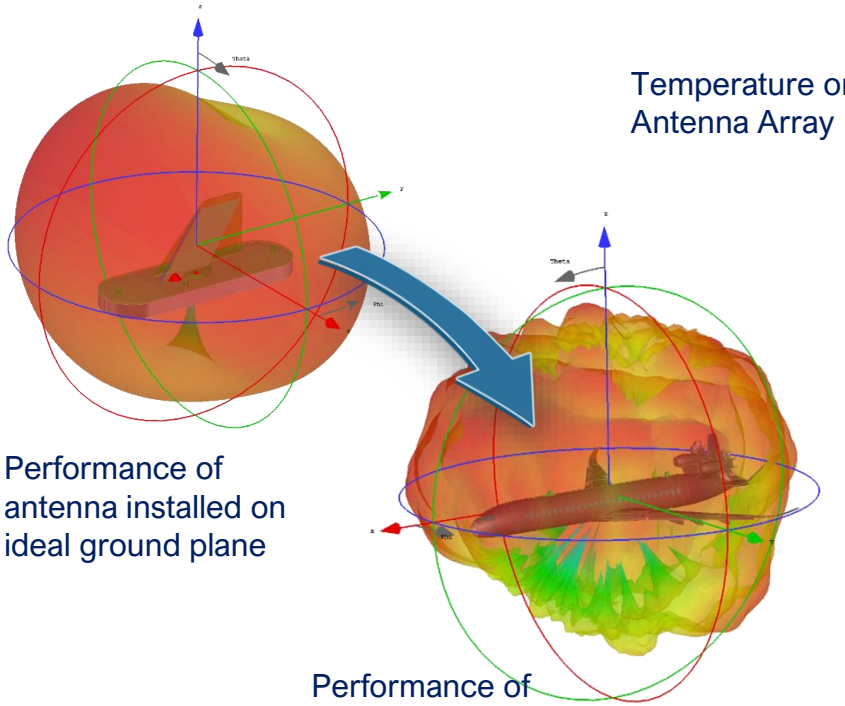


Circuit and System Simulation

viasD

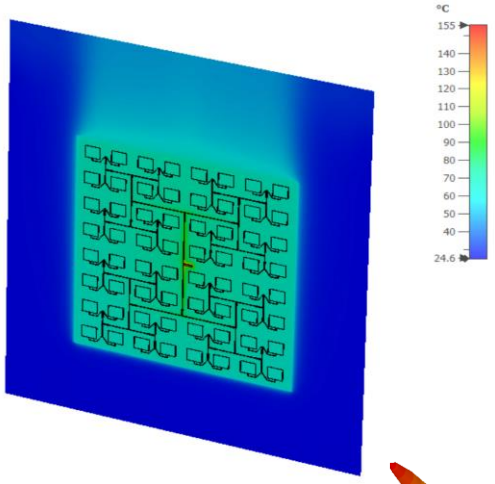
Antenna engineering & certification

- Find, design/tweak, evaluate and export validated simulation-ready antenna design models.
- Synthesized and analyze antenna arrays.
- Evaluate installed performance and optimize antenna placement.
- Antenna radome analysis.
- Mitigate co-site interference.
- Perform Multiphysics analysis.

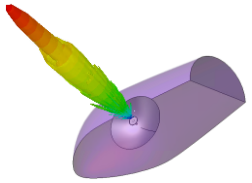


Performance of antenna installed on ideal ground plane

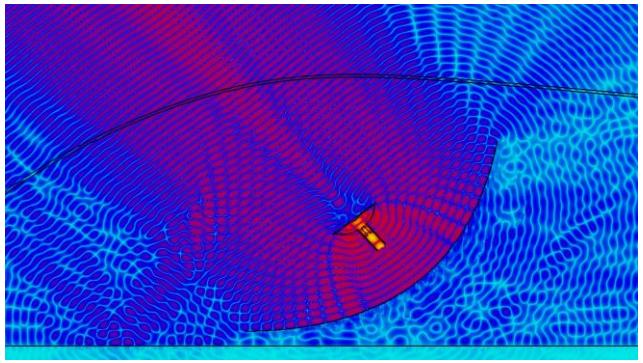
Performance of antenna installed on open rotor aircraft

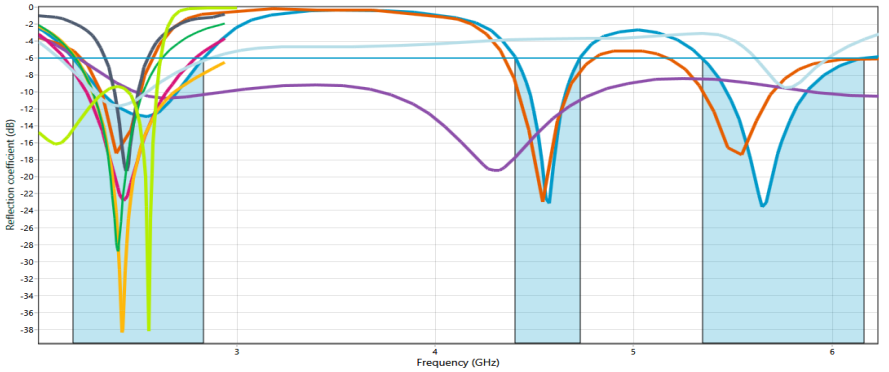


Temperature on an Antenna Array

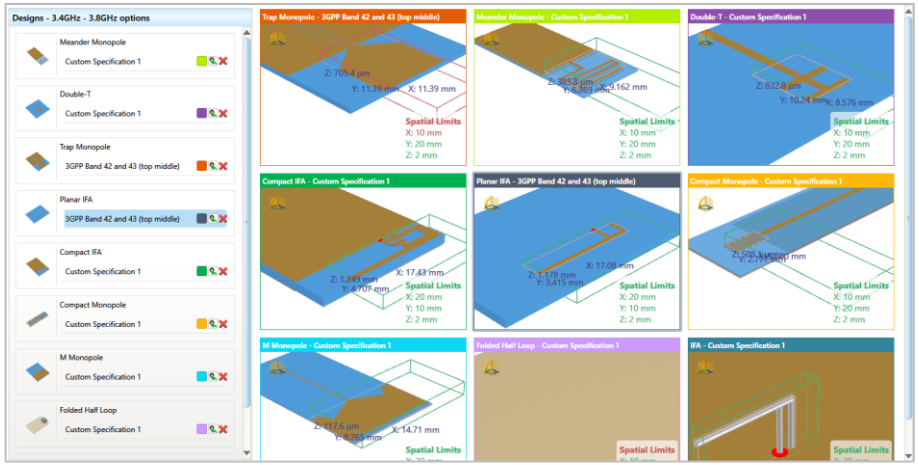


Reflector antenna placed inside a radome





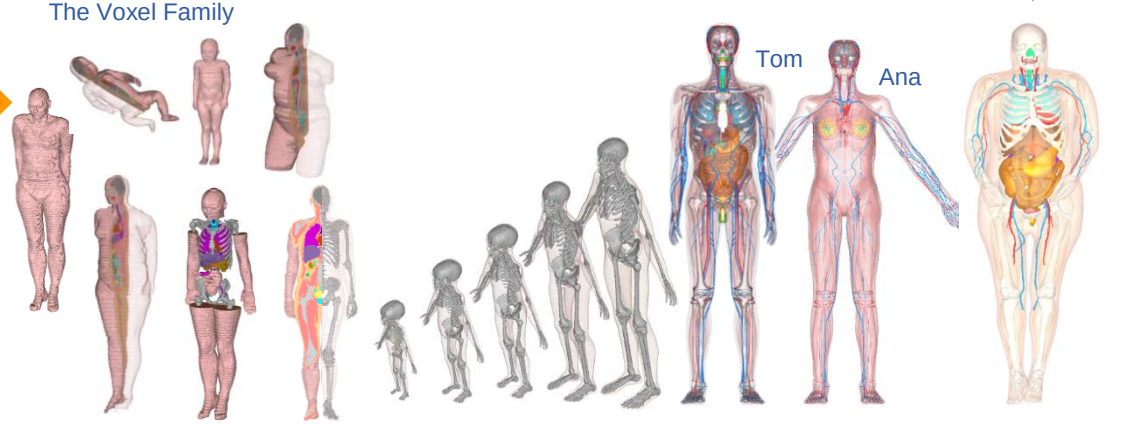
	Port 1	Port 1	Port 1	Port 1	Port 1	Port 1	Port 1	Port 1
Bandwidth (below the -6.0 dB level)	654.9 MHz	362.9 MHz	7.401 GHz	213.6 MHz	663.8 MHz	749.6 MHz	438.4 MHz	756.1 MHz
Bandwidth (%)	26.14 %	15.14 %	4.366	8.734 %	26.95 %	29.22 %	18.21 %	30.40 %
Bandwidth (below the -6.0 dB level)	325.6 MHz	457.7 MHz	-	-	-	-	-	368.6 MHz
Bandwidth (%)	7.128 %	9.998 %	-	-	-	-	-	6.357 %
Bandwidth (below the -6.0 dB level)	814.5 MHz	10.48 GHz	-	-	-	-	-	-
Bandwidth (%)	14.15 %	3.027	-	-	-	-	-	-



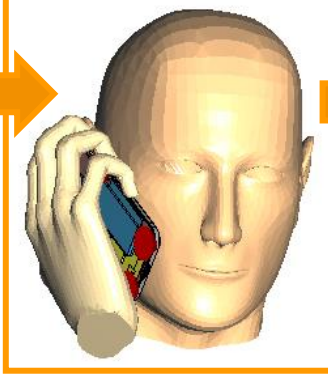
Compare set of parametric antenna prototypes and performance comparison (top)

Compliance - Human Exposure & SAR

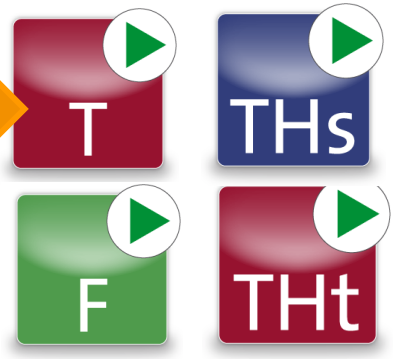
Phone

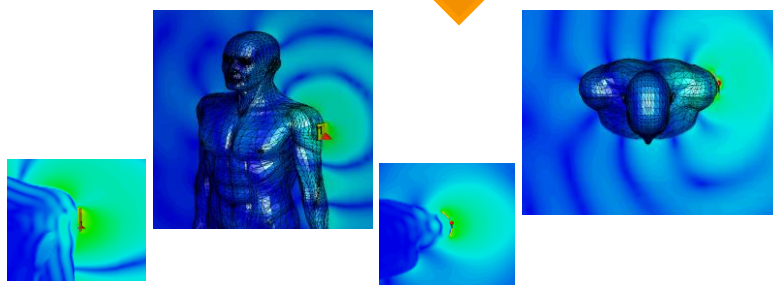


CST Voxel family

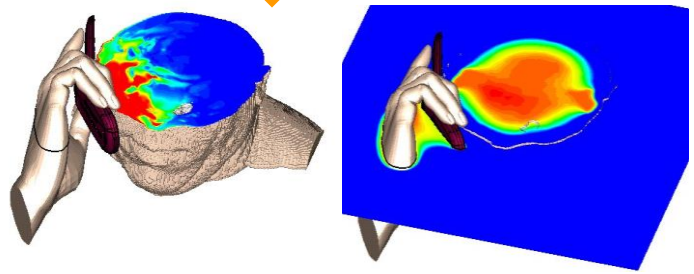


Phone with head

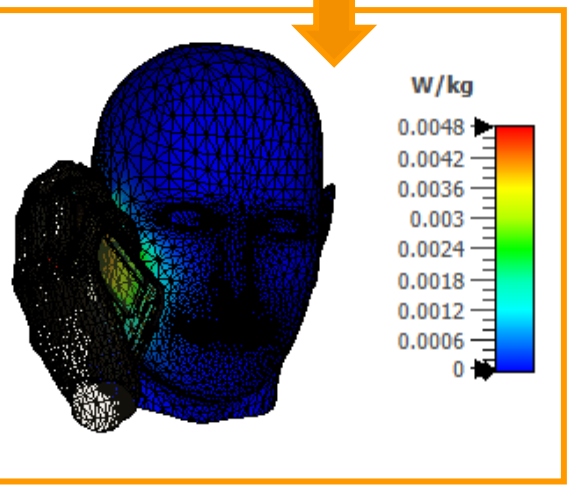




Body Sensors



Temperature distribution

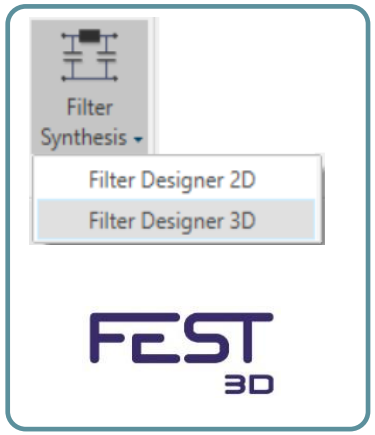


SAR

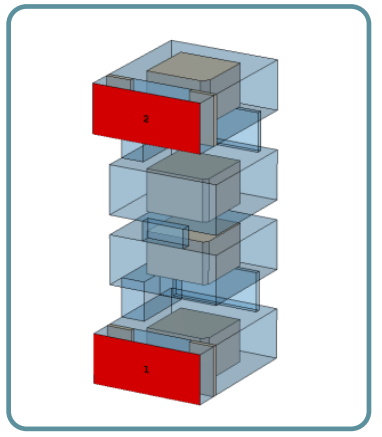
Microwave & RF Passive Components - Synthesis and Analysis

- Synthesized and design passive components based on waveguide technology.
- Synthesis tool for bandpass and diplexer filter design supporting cross coupling and advanced topologies.
- Filter optimization/tunning via coupling matrix extraction from simulated and measured scattering parameters.
- Analysis of Multipaction and Corona (arcing) for estimation of the power handling capability.
- Thermal-related, structural breakdown and cooling analysis.
- System level analysis.

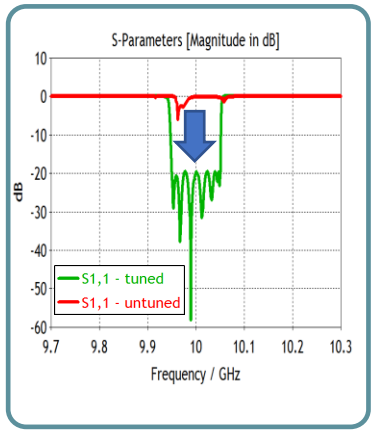
Synthesis



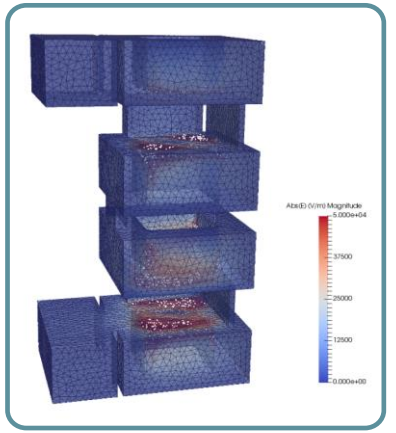
Model Creation



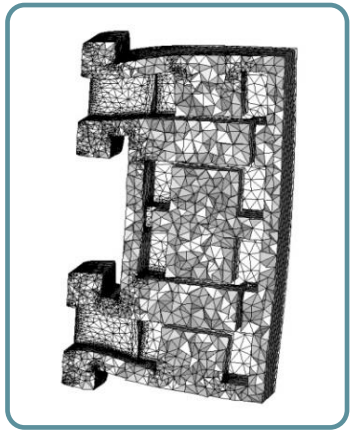
Optimization



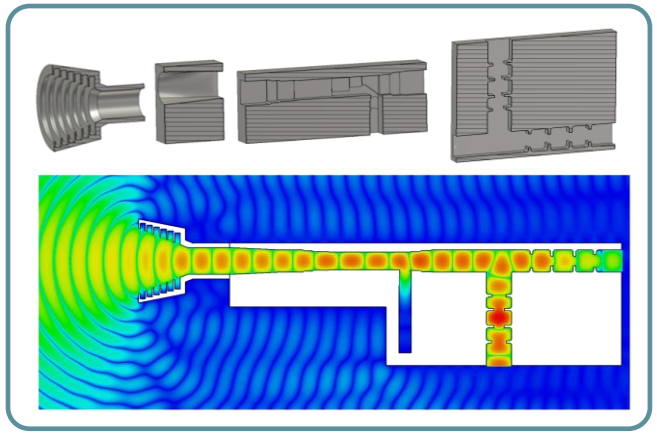
Power Handling



Multiphysics



Assembly



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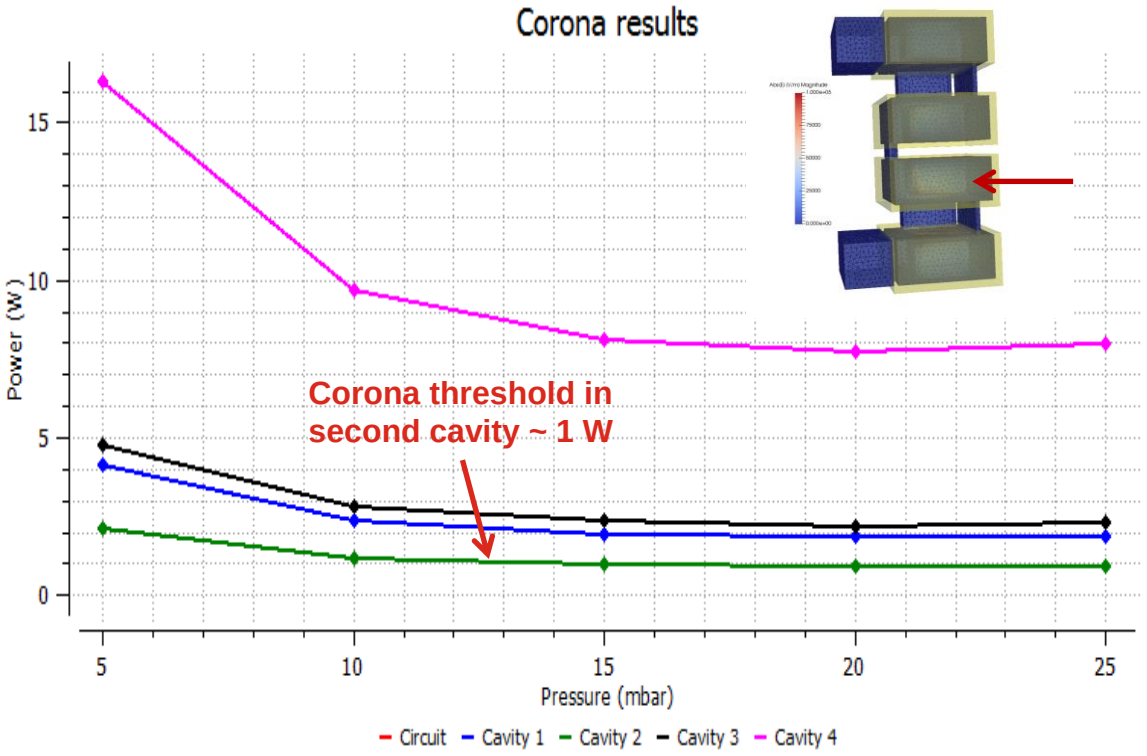
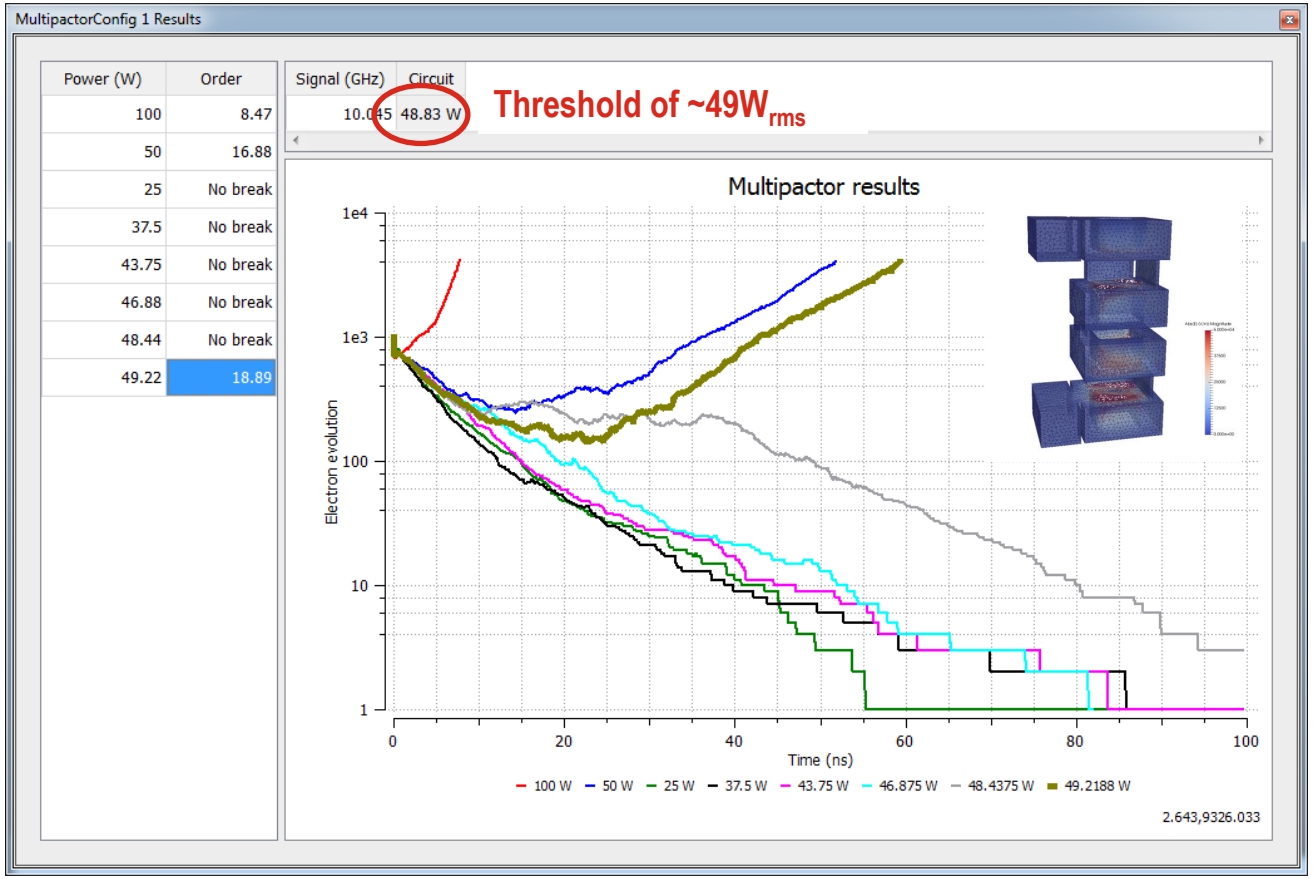
Microwave & RF Passive Components - Multipaction - Corona

- Perform Radio Frequency (RF) breakdown analysis in complicated structures.
- Furman, Vaughan and model based on imported secondary electron yield (Import) for characterization of materials.
- Multipaction analysis with single-carrier and multi-carrier simulations with arbitrary number of carriers and phase schemes.
- Possibility to add external uniform DC magnetic and/or electric field.
- Corona discharge with one or more CW signals and pulsed signals.
- Possibility of using several filling gases.

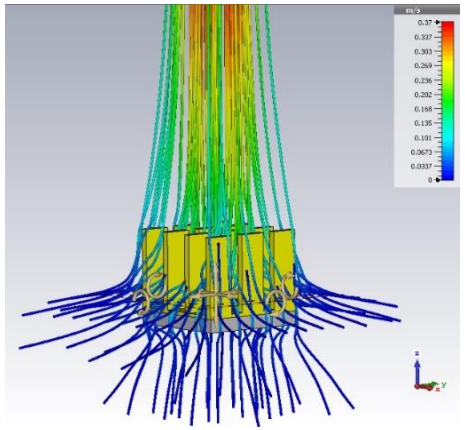




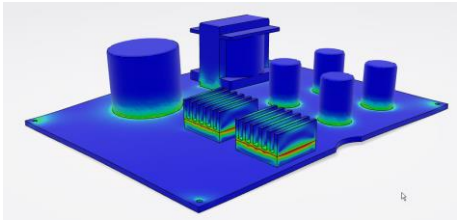
Microwave Passive Components - Multiphysics Analysis

- Perform Multiphysics analyses involving EM-Thermal-Mechanical problems.
- Steady state, transient and Conjugate Heat Transfer solvers.
- Uni-directional and Bi-directional coupling.
- Evaluate EM performance using the deformed structures from mechanical analysis and predict the detuning effect.
- Components modeling.

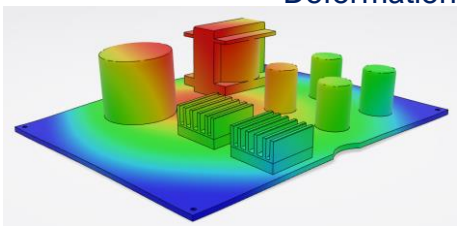
Temperature



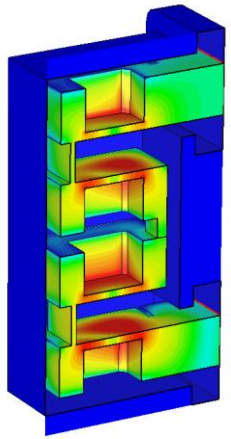
Von Mises Stress

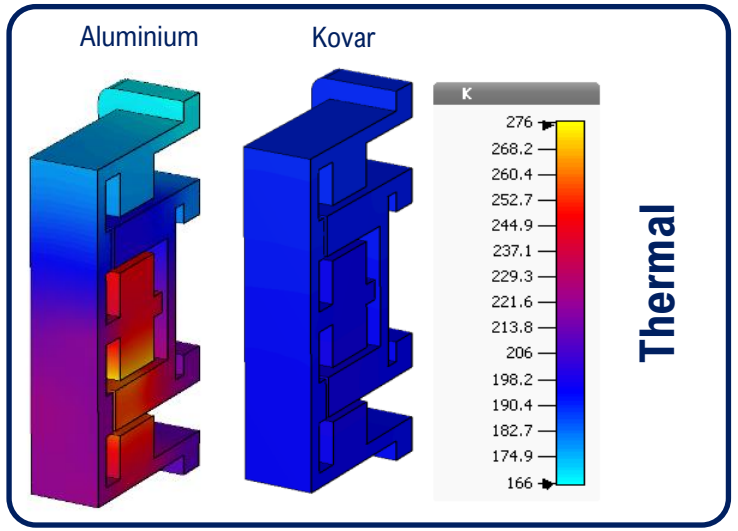


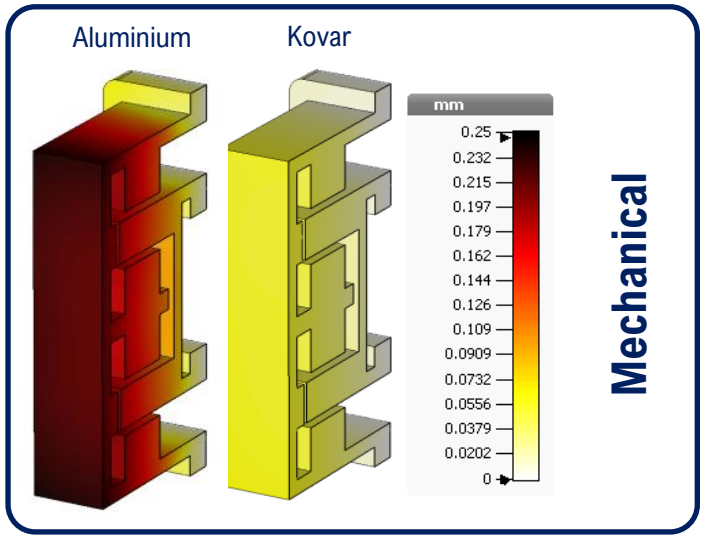
Deformation

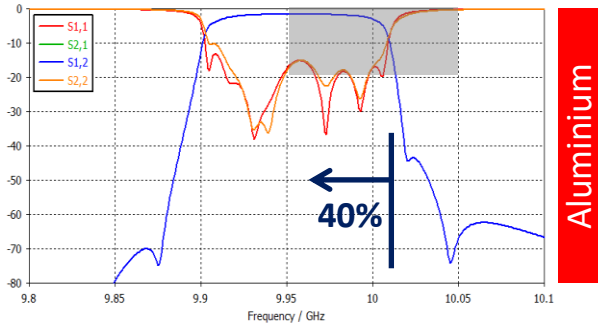


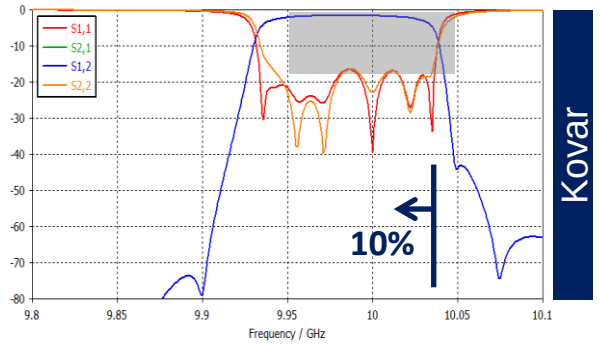
Volume and Surface losses



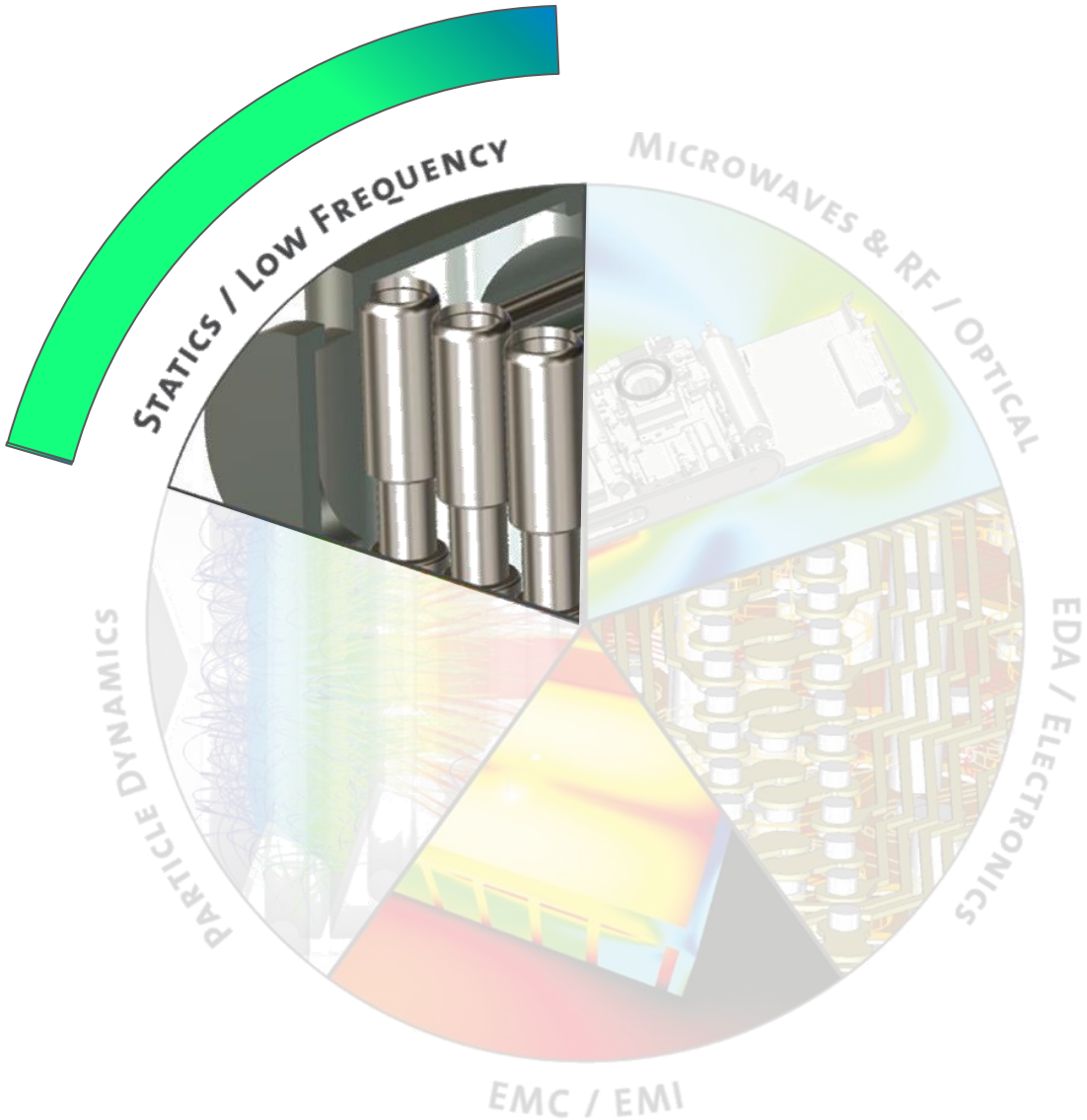








EM Applications

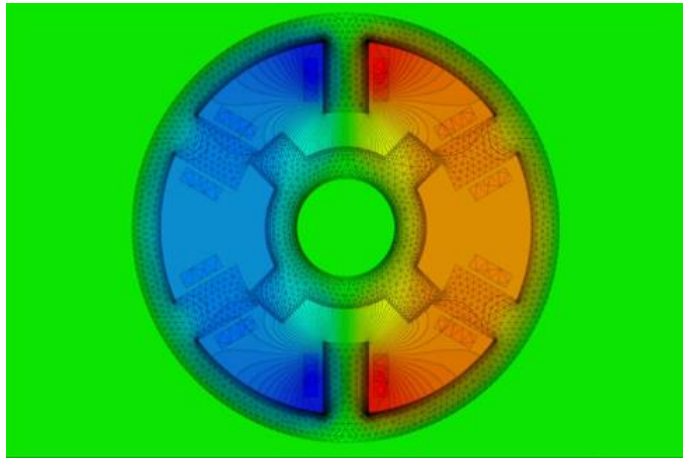


Low Frequency

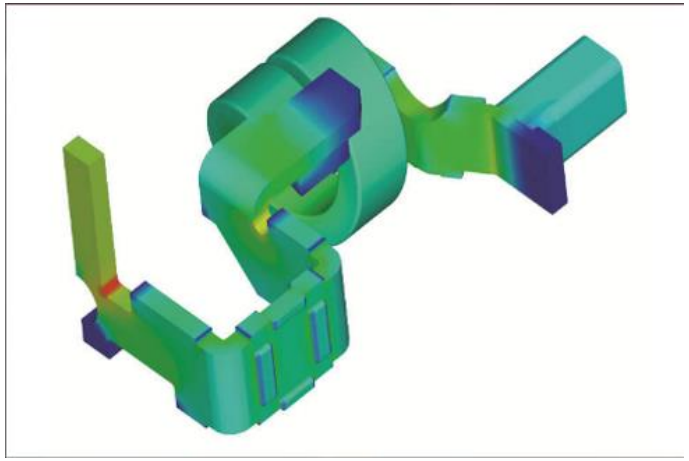
High Frequency

Statics/Low Frequency

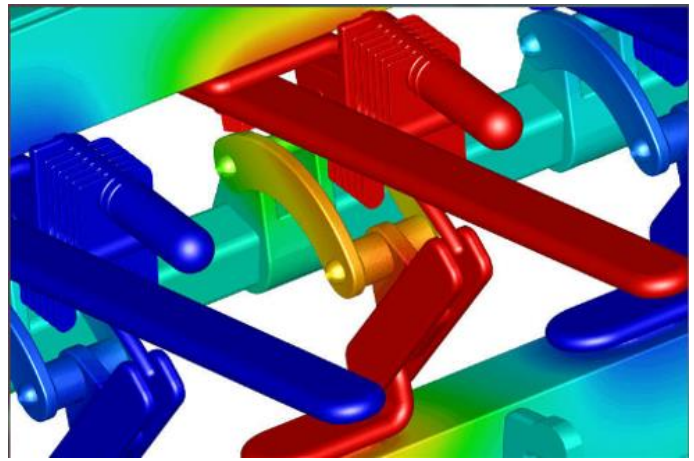
Electrical Machines



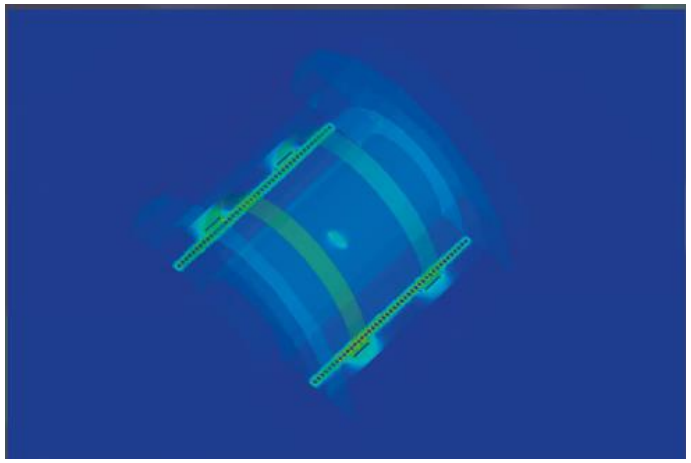
Electromechanical



Power Engineering

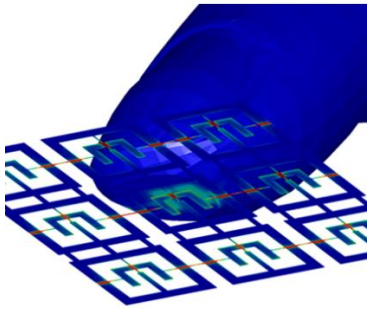


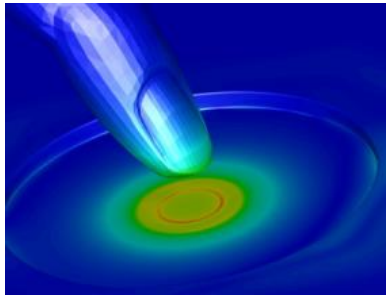
Sensors



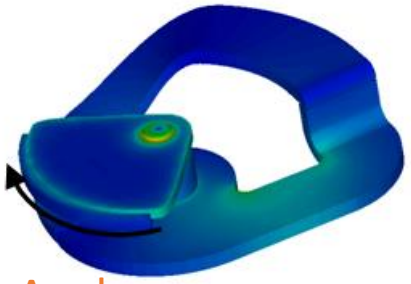
Sensors Design

Capacitive Touchscreen

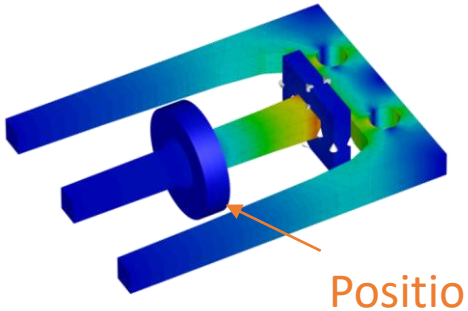




Inductive Position Sensors

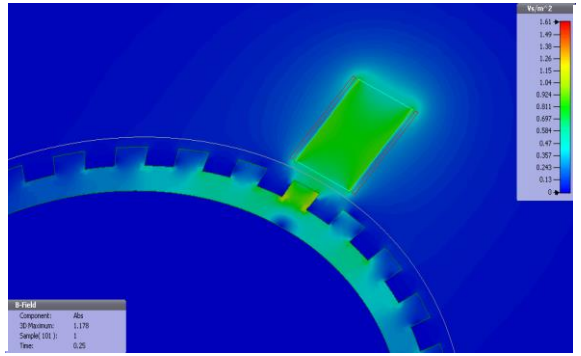


Angle

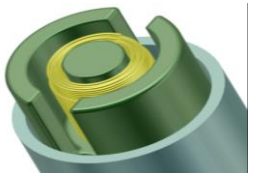


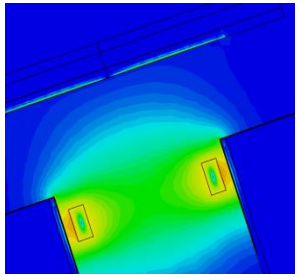
Position

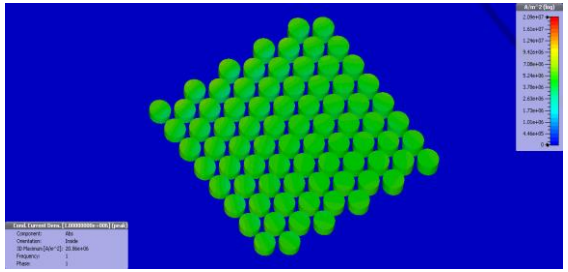
Speed Sensors



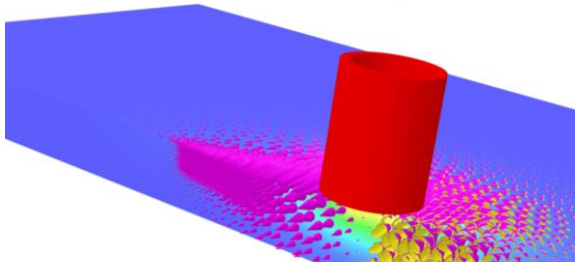
Inductive Proximity Sensors

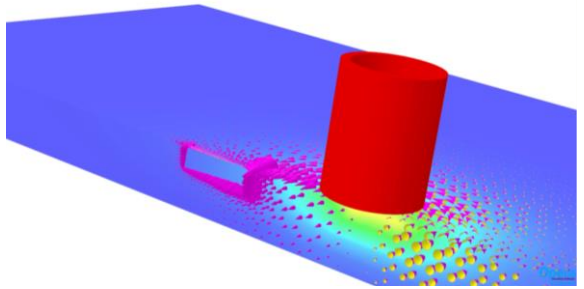






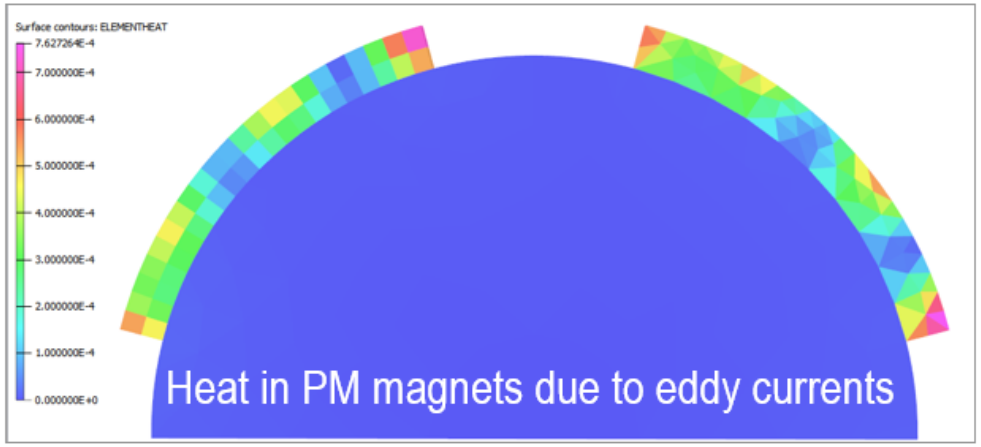
Eddy Current Non-Destructive Testing

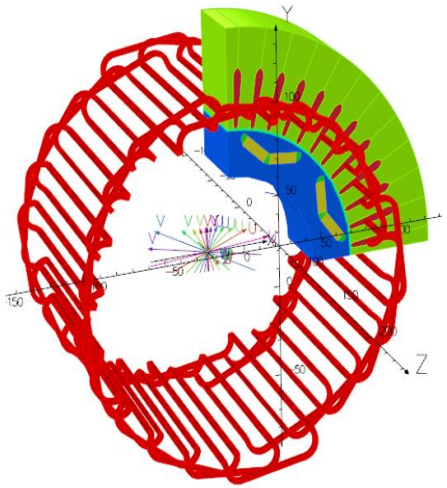


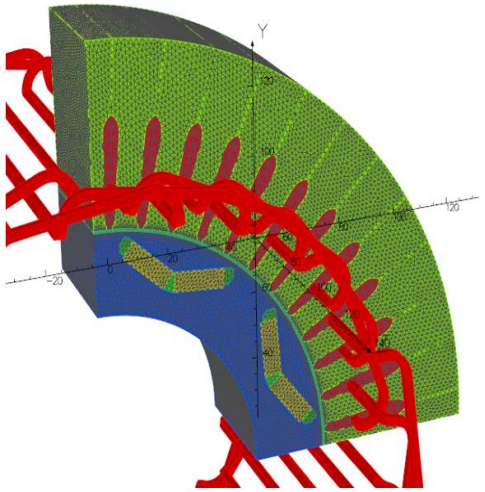


Electrical Machines: Motors & Generators

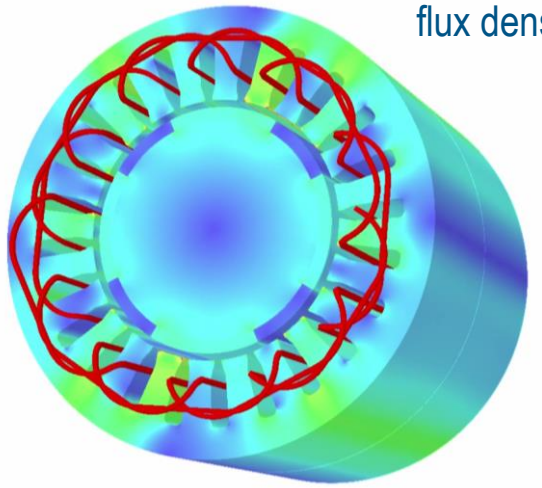
- Setup Using ‘Machine Environment’ and ‘Winding Tool’
- Automatic Model Creation and Meshing



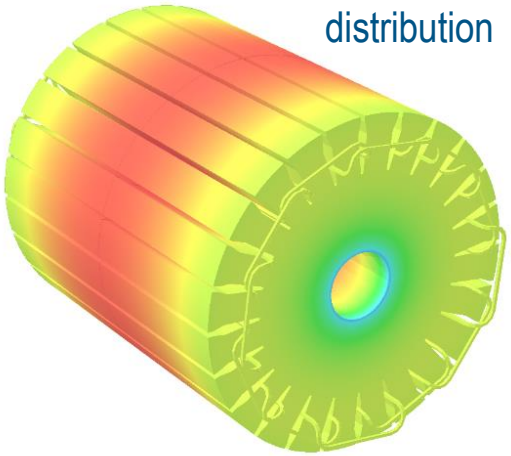




Magnetic flux density



Temperature distribution



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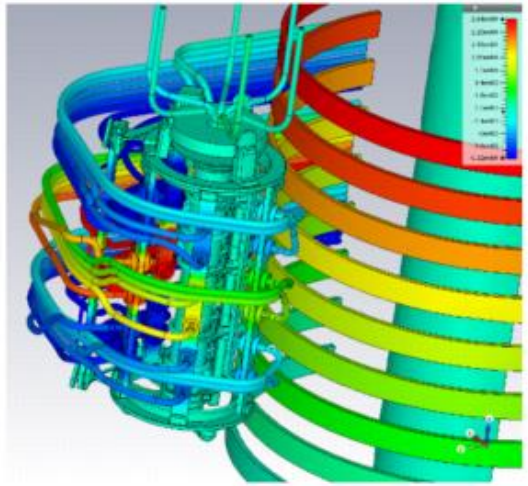
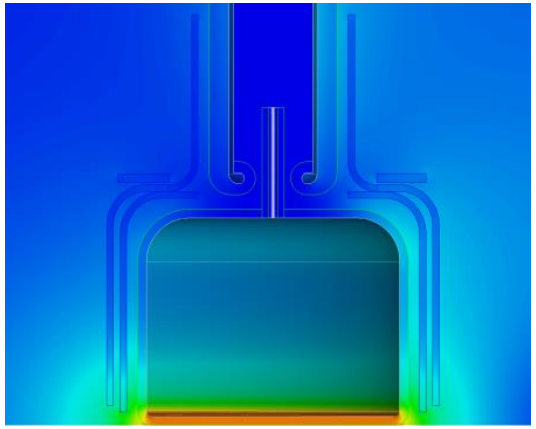
Power Engineering: Transformers





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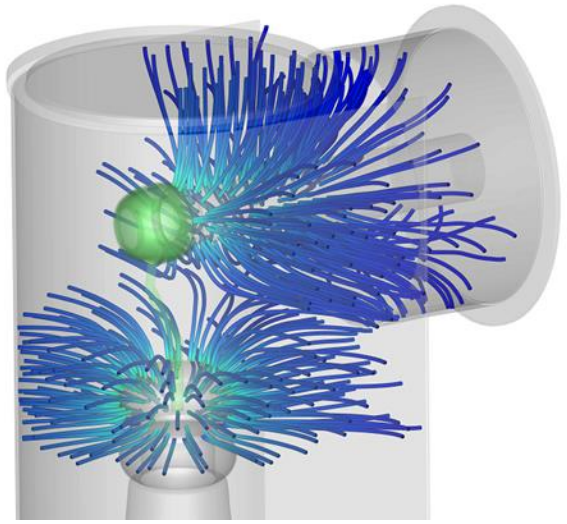

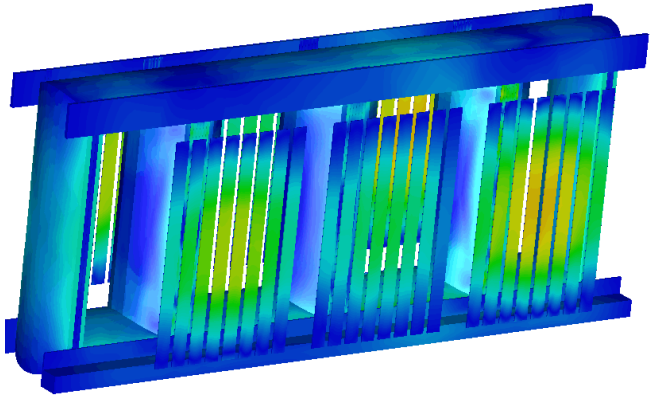

Why VIAS?

- Prompt and complete technical solutions
- Experts with knowledge of industry applications and software solutions
- Rich technical consulting experience & Software Agnostic
- Knowledge transfer through training services
- Adherence to strict quality control (ISO 9001: 2015 Compliant)
- Flexible pricing / startup discounts
- One Stop Shop – CAD / FEA / CFD / EMAG / GUI / Root-Cause / Optimization

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Thank You