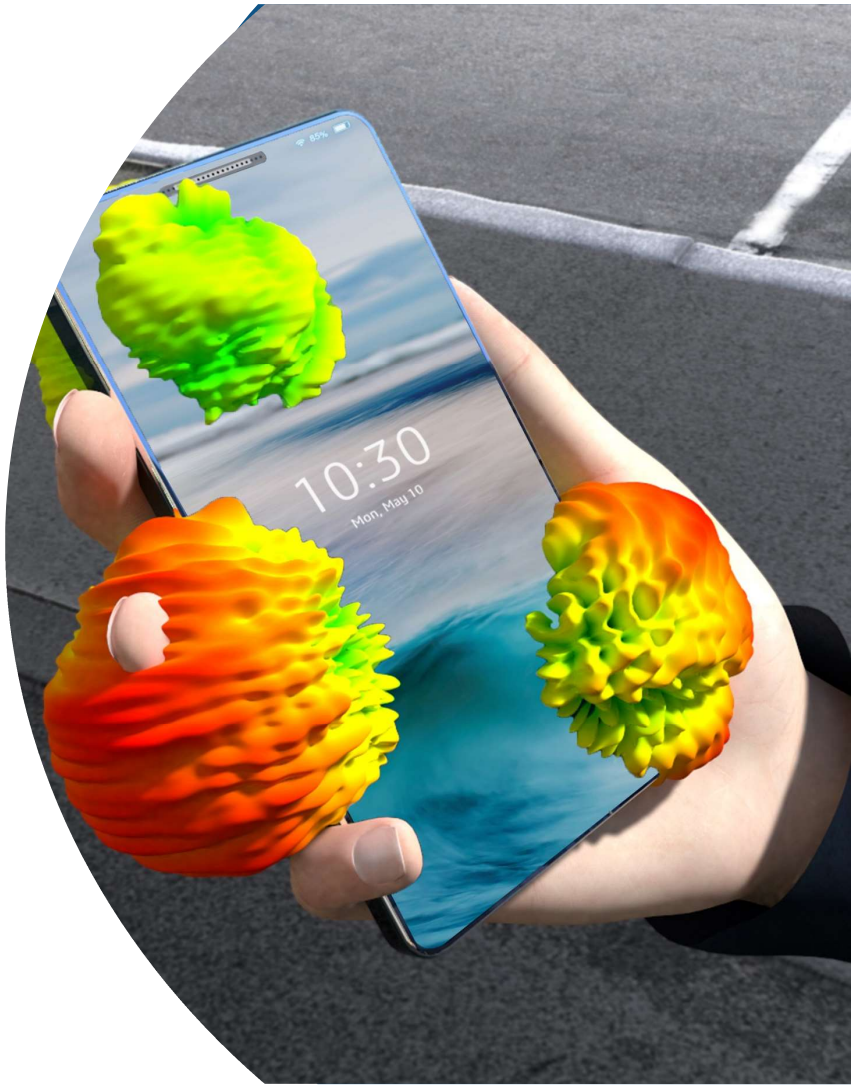
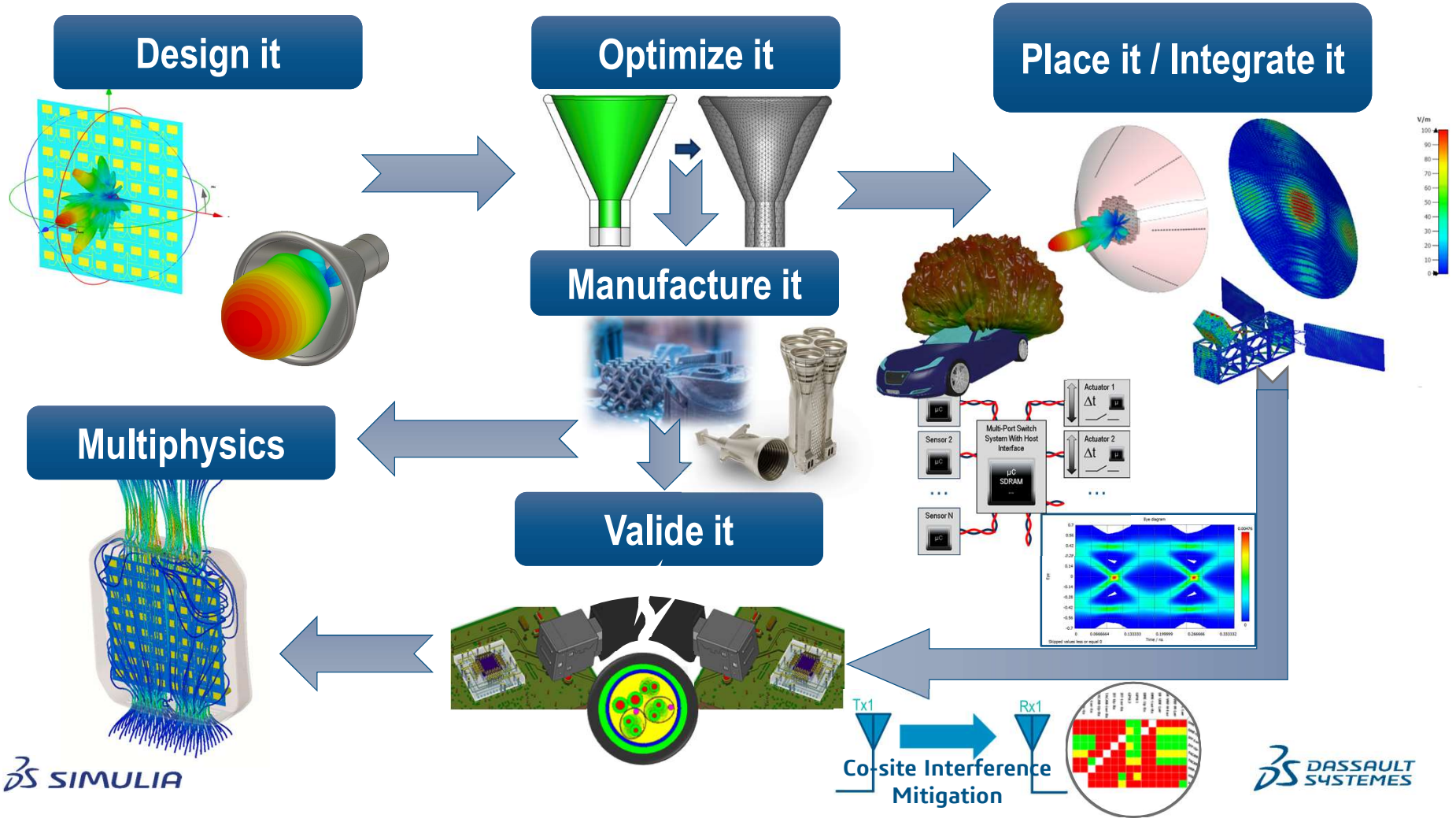
SIMULIA CST NEWS





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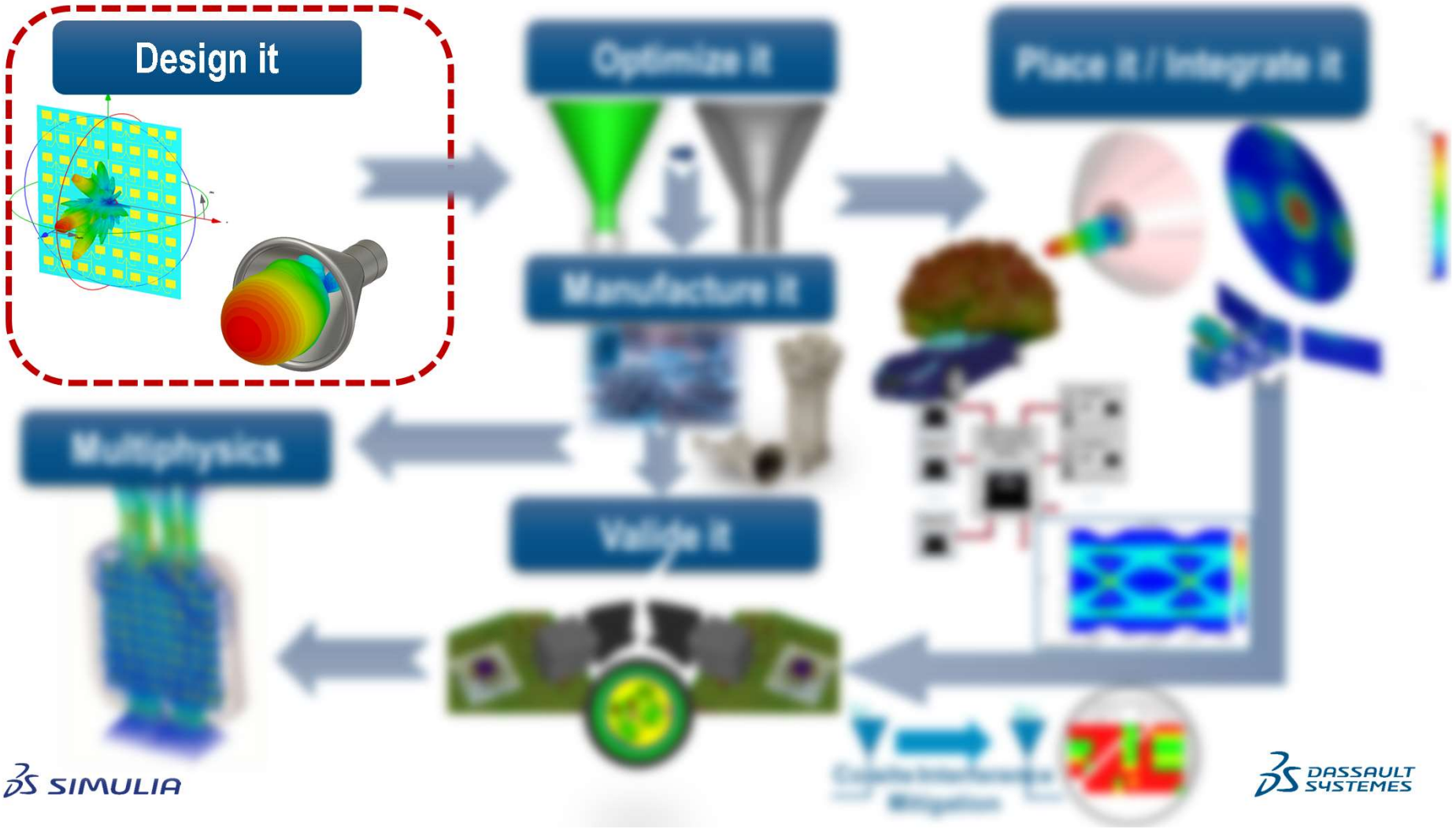
DASSAULT SYSTEMES



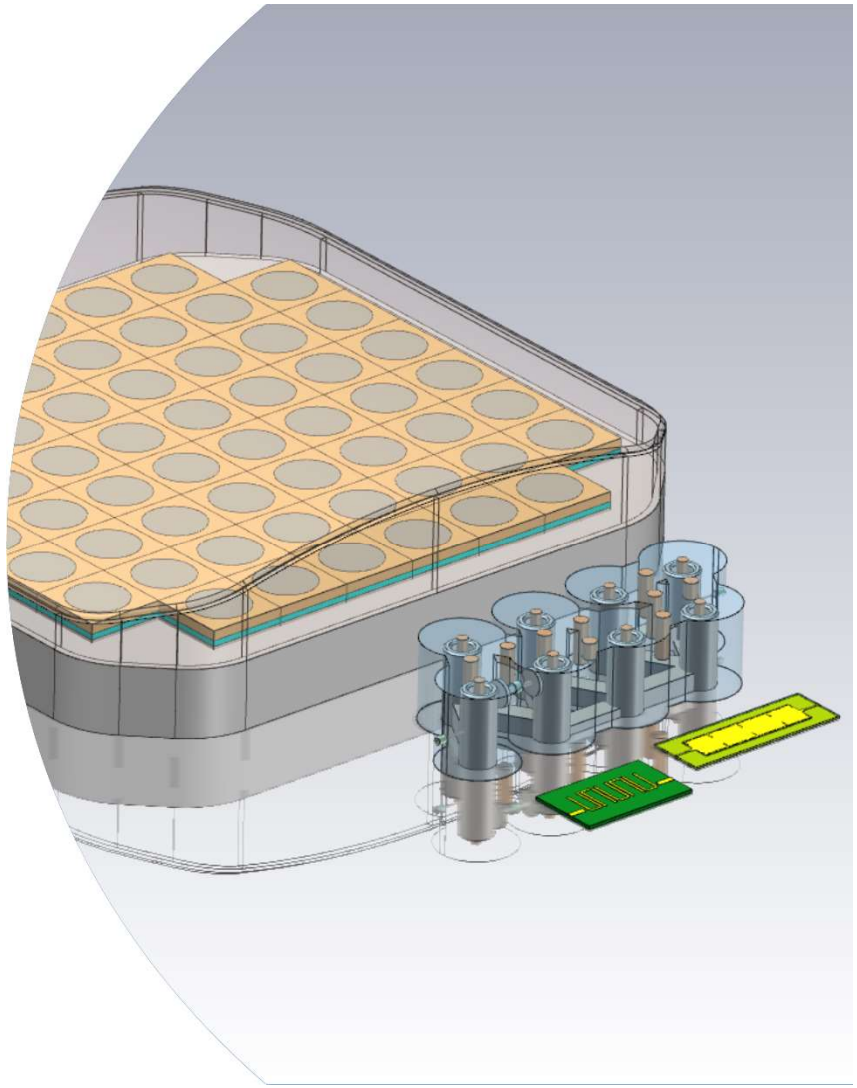
SIMULIA

DASSAULT SYSTEMES

3DEXPERIENCE®

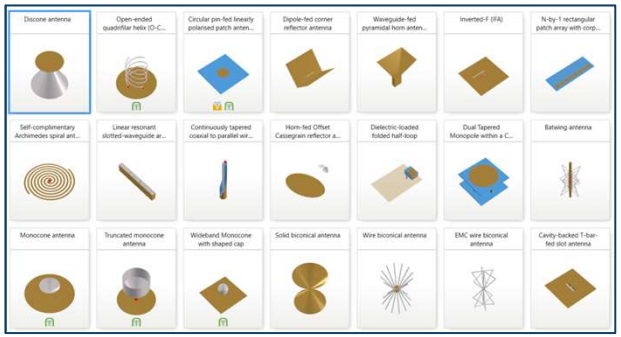
DESIGN IT

DASSAULT SYSTEMES | The 3DEXPERIENCE® Company

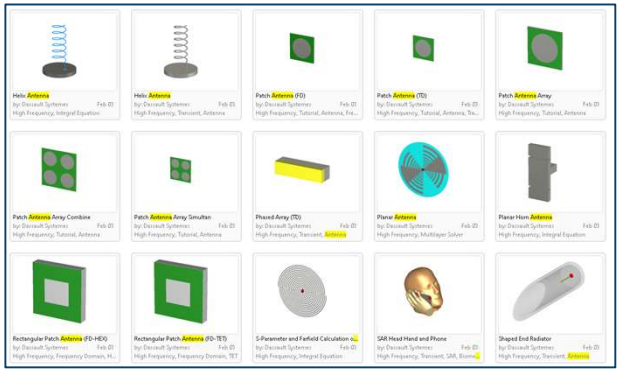


ANTENNA DESIGN CAPABILITIES

AntennaMagus



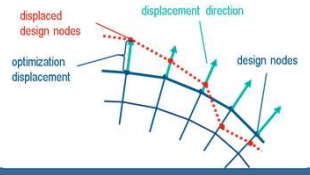
Component Library



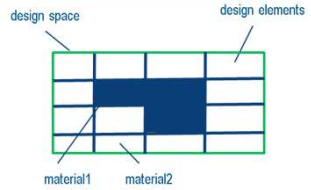
Trust Region Framework
Trust Region Framework
Nelder Mead Simplex Algorithm
CMA Evolution Strategy
Genetic Algorithm
Particle Swarm Optimization
Interpolated Quasi Newton
Classic Powell

Parameteric optimizers

Shape Optimization



Topology Optimization



Non-parameteric optimizers

SIMULIA Tosca Structure

T TLM F I MoM

Powerfull solvers with dedicated templates

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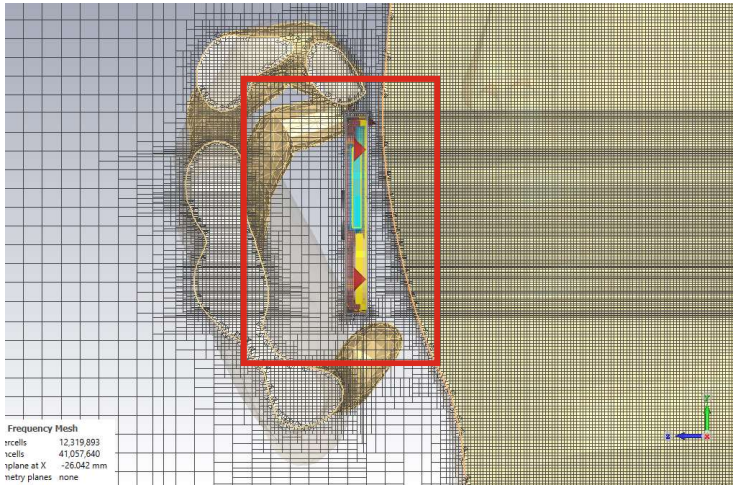
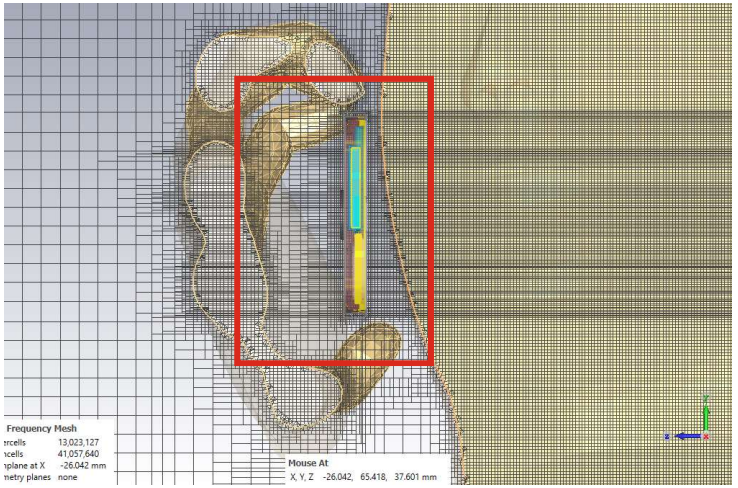
HEXAHEDRAL TLM MESH ENHANCEMENTS

- Improved Mesh Settings
  - Face Refinement removed
  - Define Absolute Value for Edge Refinement instead of “Edge Ratio”
  - Choose between Global or Local Snapping
  - Set Limit for Lumped (Octree) Cell size



Without Local Octree Limit

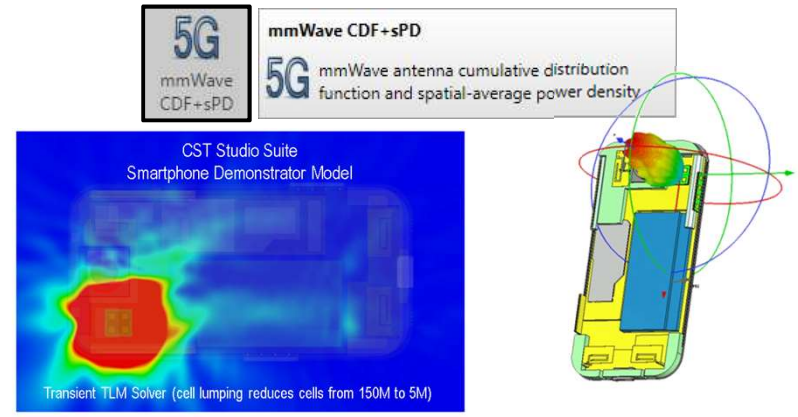


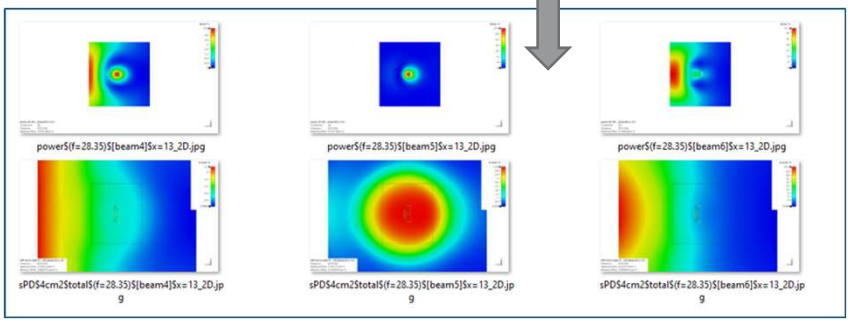
With Local Octree Limit

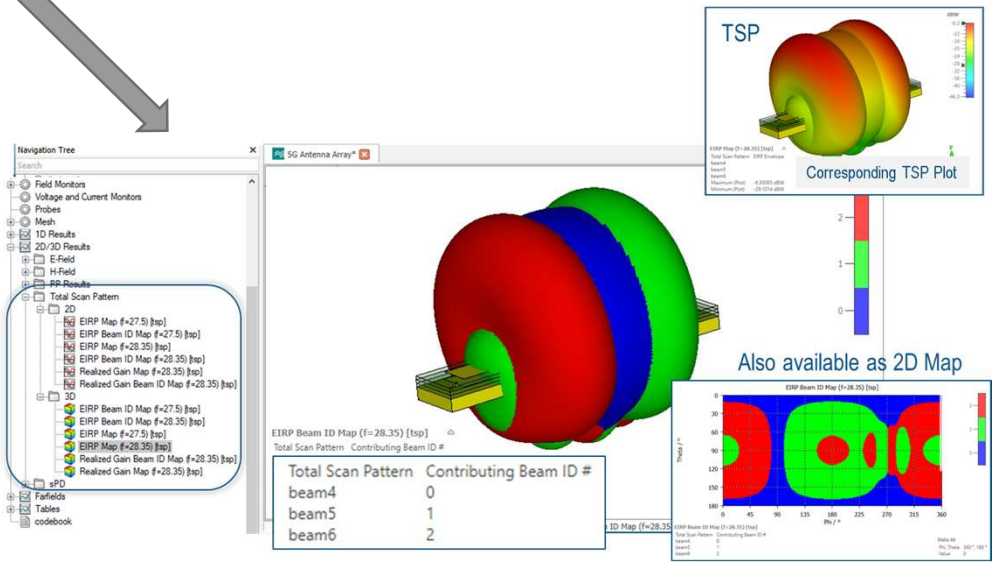
5G ANTENNA POST-PROCESSING

- 5G wizard and post processing enhancements
- New Beam ID Maps and TSP Plots under 2D/3D Results (beam signal vs direction)
- Improved reporting and summary information

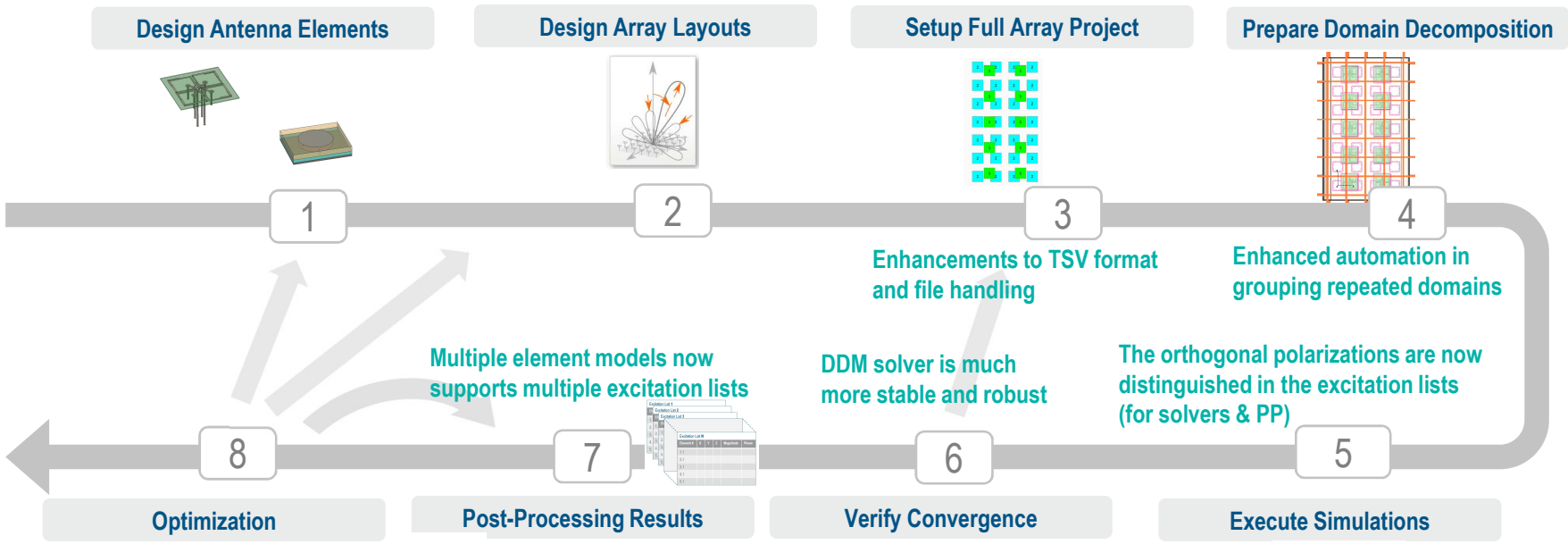
  For each frequency and monitor plane,
  power density and sPD (spatially averaged PD)
  is recorded for every beam.







WORKFLOW | MIMO ANTENNA ARRAY DESIGN FOR BASE STATIONS NEW



- Optimization routine can include:
  - Step 1: antenna geometry
  - Step 2: array element spacing / relative overlapping
  - Step 7: excitation strategies related to beamforming and electronics

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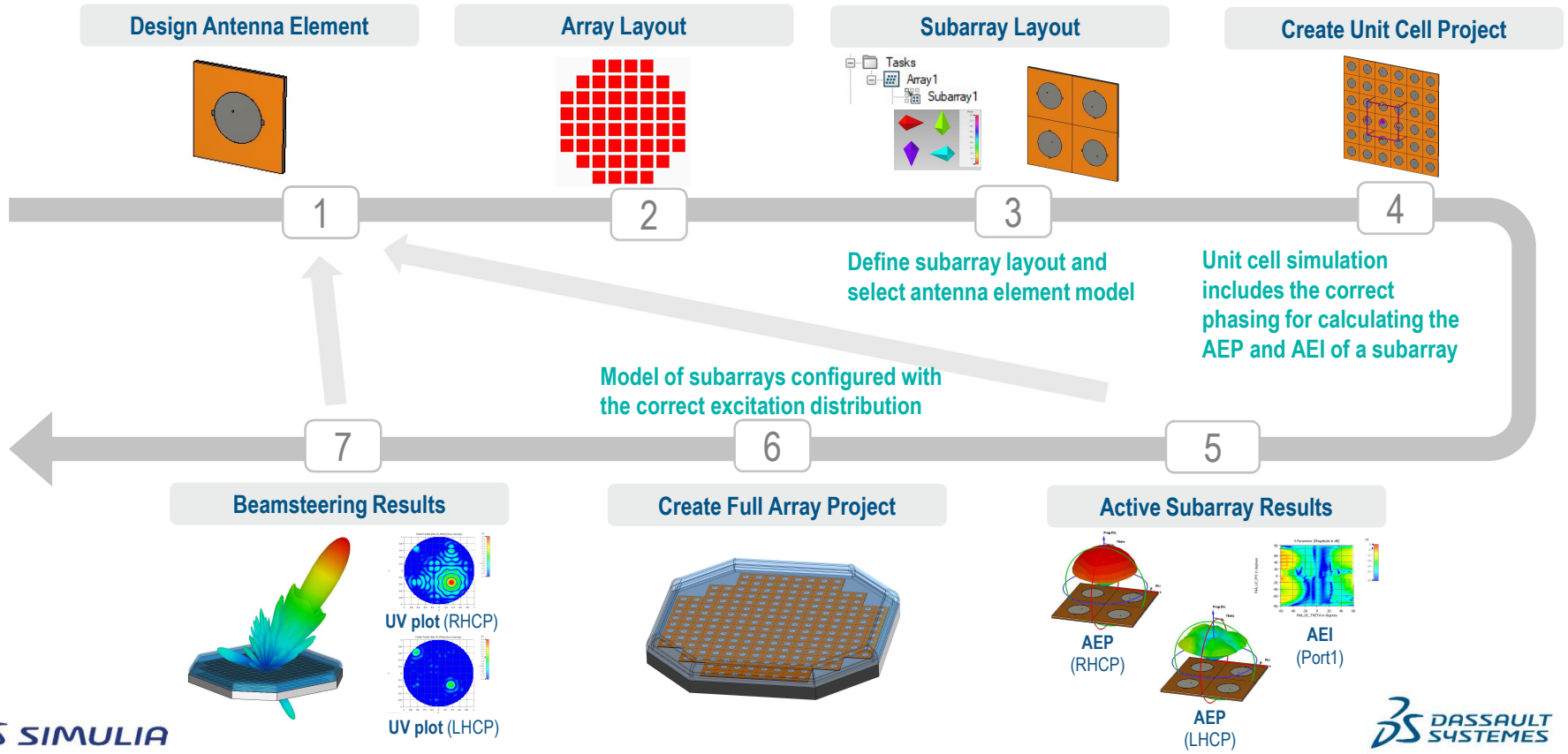
WORKFLOW | PHASED ANTENNA ARRAY DESIGN FOR SATCOM NEW



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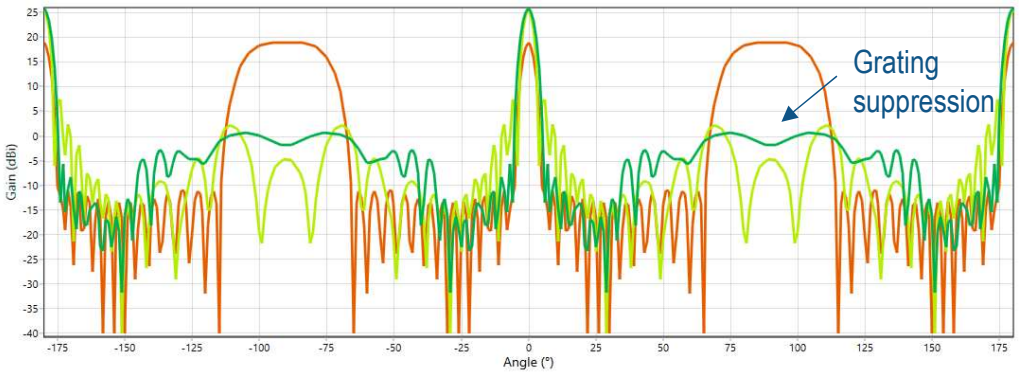
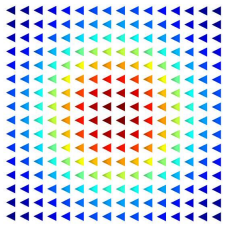
SPIRAL ARRAY SYNTHESIS

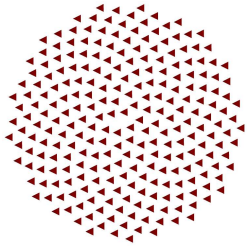
Antenna Magus

- Using the golden angle in a Fermat spiral leads to a non-periodic layout that has a sunflower pattern.
- Benefits of these non-periodic layouts:
  - The aperiodicity suppresses grating lobes found in an equivalent periodic layout.
  - The spatial Taylor distribution can reduce the sidelobe level without amplitude tapering.
  - A sparse layout (>1λ spacing) can be used to ease the feed network integration at mmWave as well as the thermal management of RFFE electronics.

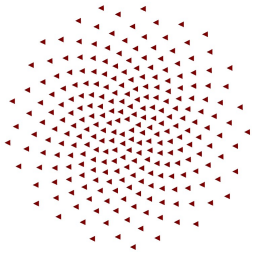




Rectangular with Taylor Excitation



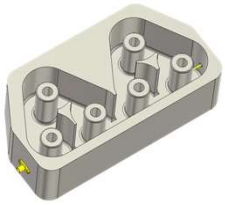
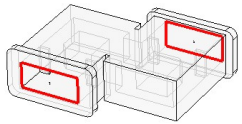
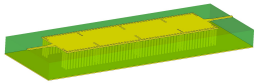
Sunflower



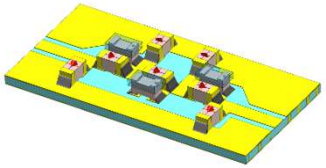
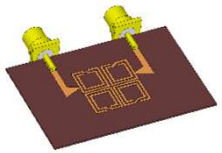
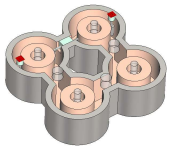
Sunflower with Spatial Taylor Distribution

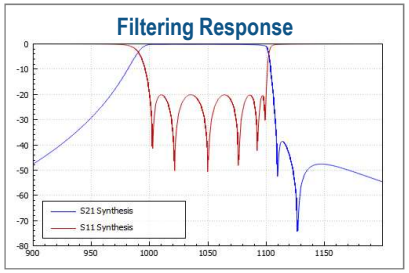
BANDPASS FILTER SYNTHESIS

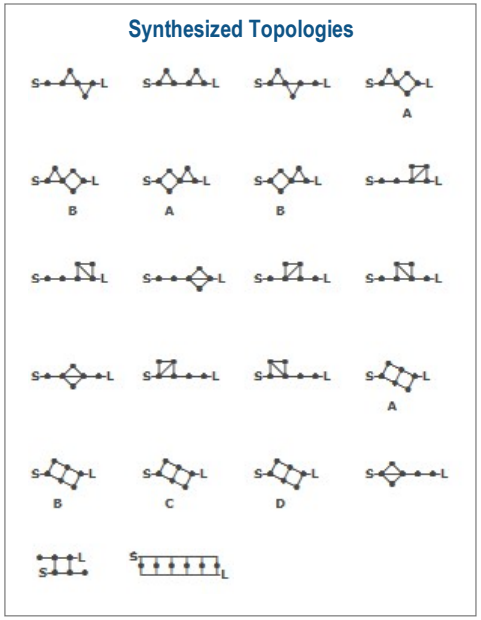
Filter Designer 3D produces realistic & efficient coupled-resonator topologies

Realisable in different guided-wave technologies!





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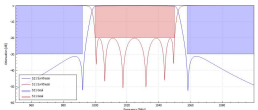
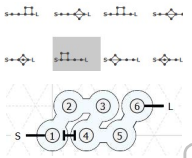
COMPLETE WORKFLOW WITH FILTER DESIGNER 3D

1 Filtering Specifications

Specify a filtering transfer function

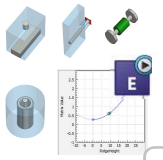


2 Topology & Layout



- Select from available topologies
- Arrange 2D layout representation

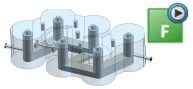
3 Design Equivalent Components



- Select components from the customizable library
- Execute the eigenmode analyses

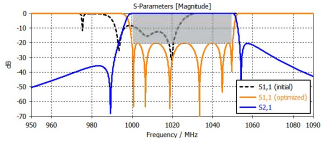
4 Execute 3D Model Built

The 3D components are automatically assembled based on the 2D layout, resulting in a complete simulation model.



5 Optimize 3D Model

Execute space-mapping or general optimizer



6 Assistive Hardware Tuning

Manufactured product is tuned on the bench using the equivalent extracted parameters

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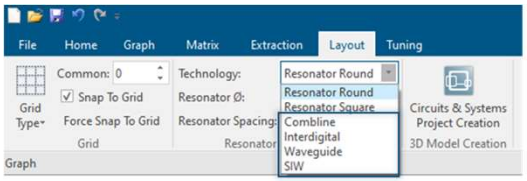
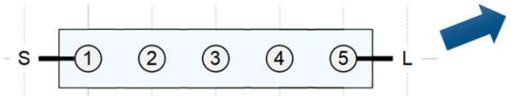
DASSAULT SYSTEMES

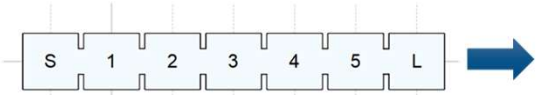
NEW FILTERS TECHNOLOGIES

Technologies added (V2021)

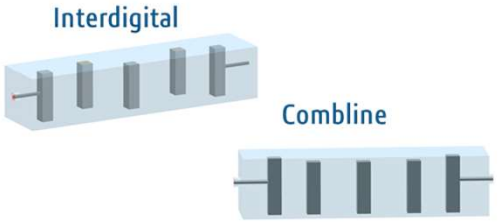


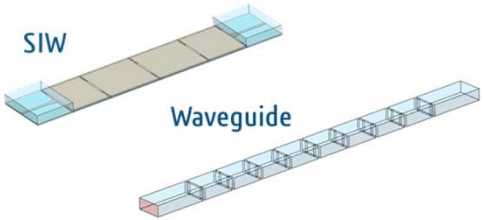


→ Modelling strategy using resonator spacing

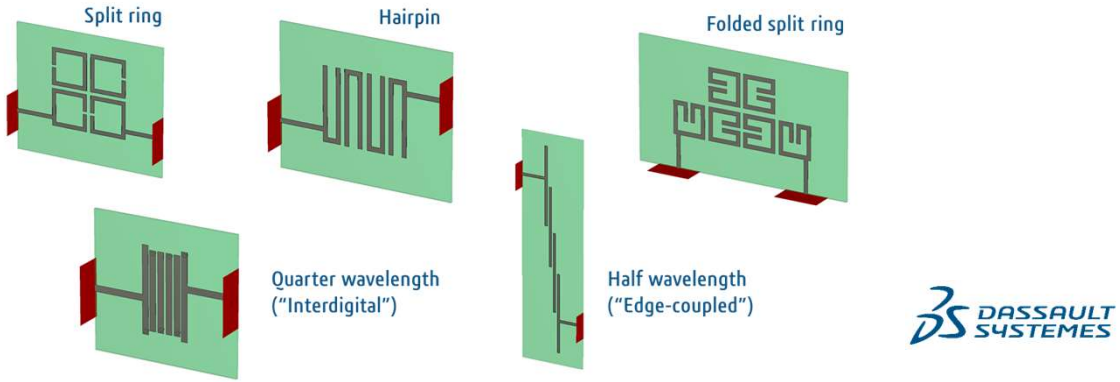


→ Modelling strategy using cascaded components





Planar Filters Added (V2022)



NEW SPECIFICATIONS & SYNTHESIS IN VERSION 2023

Filter Types:

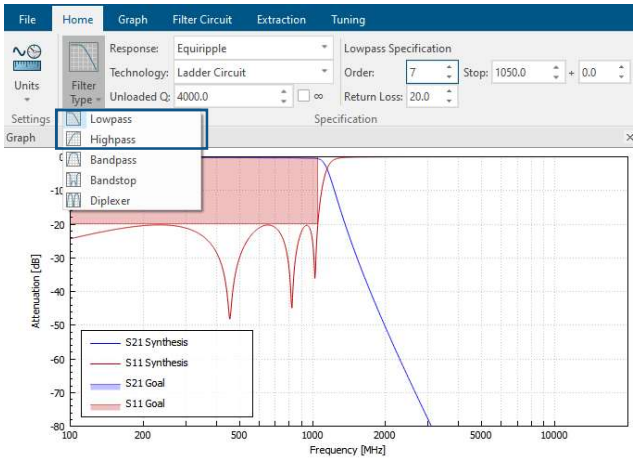
- Lowpass
- Highpass

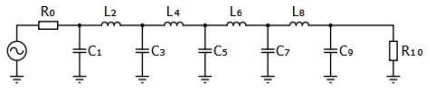
Filter Responses:

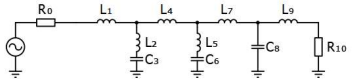
- Butterworth
- Bessel
- Chebyshev I
- Chebyshev II
- Elliptic

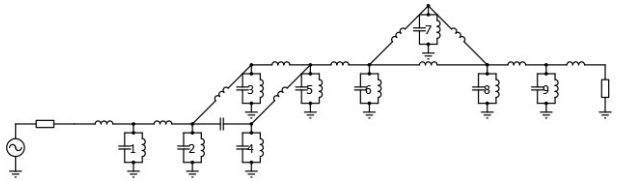
Technologies:

- Ladder Circuit
- Coupled Resonator Circuit



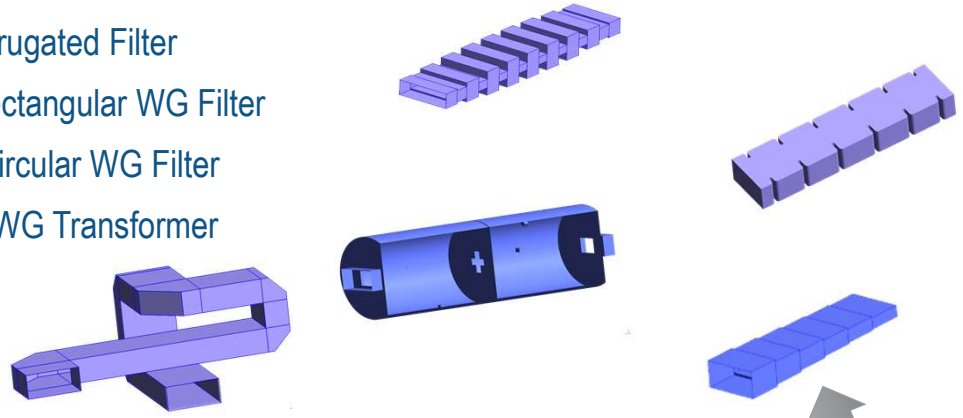






WAVEGUIDE SYNTHESIS CAPABILITY

- Lowpass Corrugated Filter
- Bandpass Rectangular WG Filter
- Dual-mode Circular WG Filter
- Rectangular WG Transformer

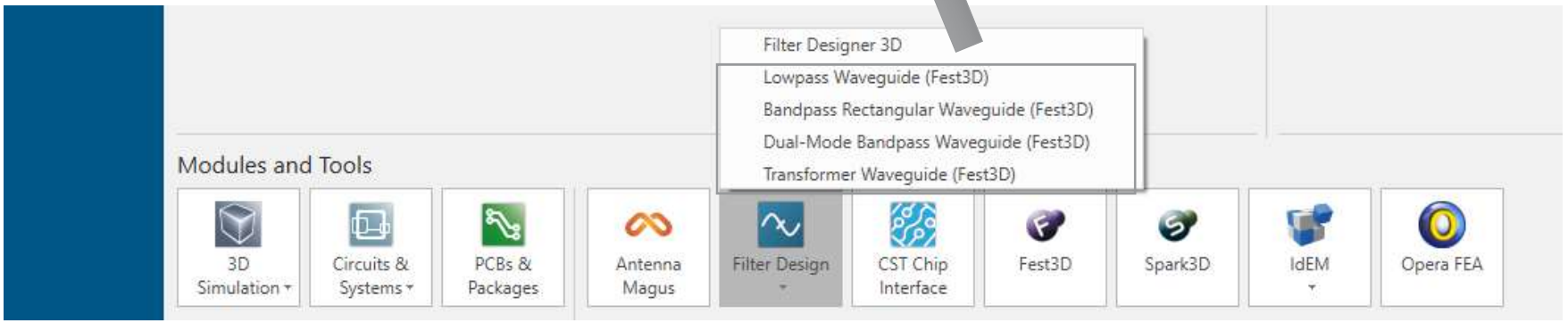


EM solver based on:

Integral equation + Method of Moments + Network Theory

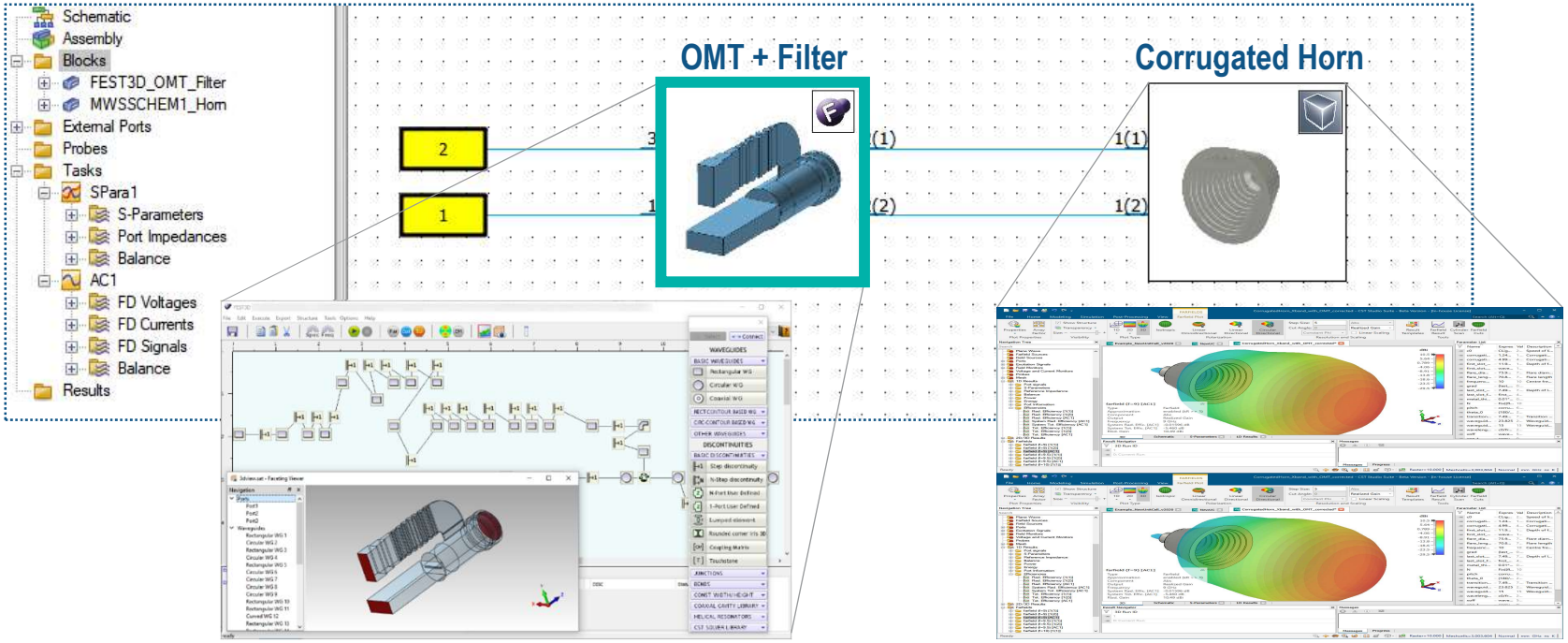
BI-RME Method, Cavity Theory...

Fast and accurate analysis of waveguide technologies:



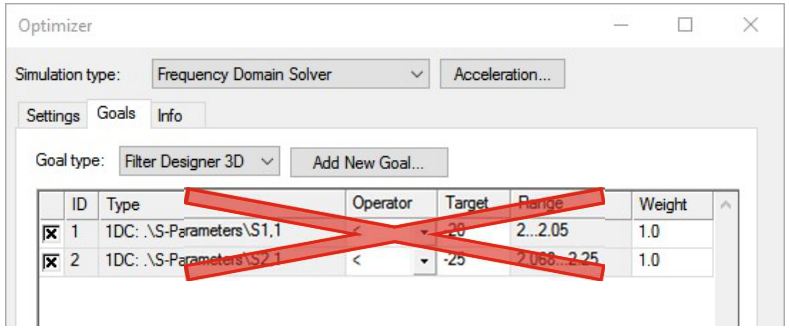
FEST3D BLOCK IN THE SCHEMATIC

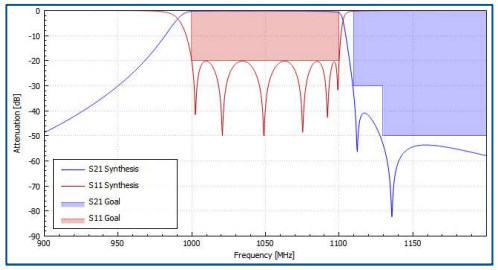
- Waveguide Feed Chain Example



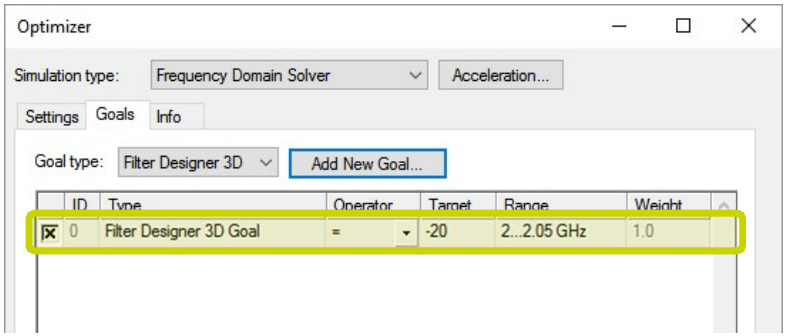
OPTIMIZATION GOALS

Classical approach: S-parameter masks





Efficient approach: Extracted coupling matrix

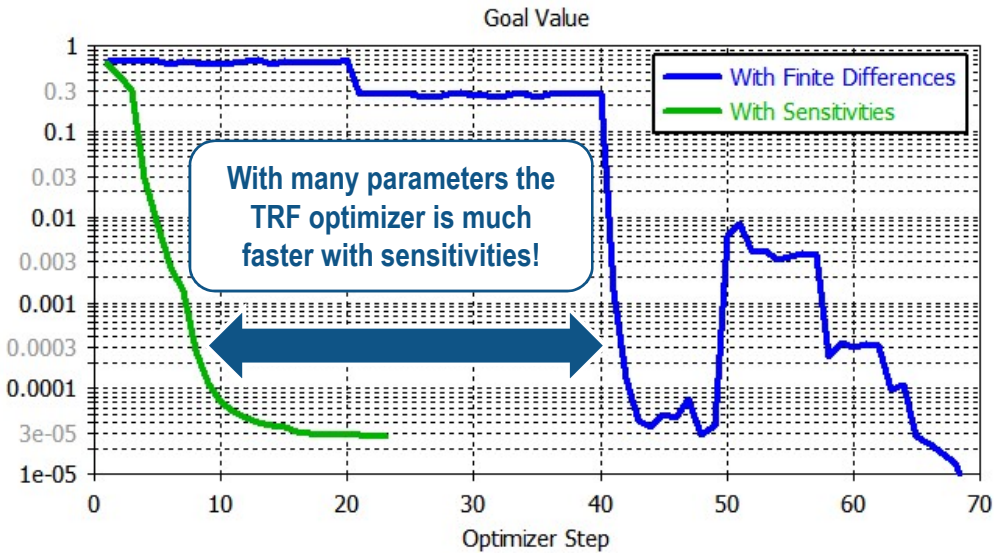


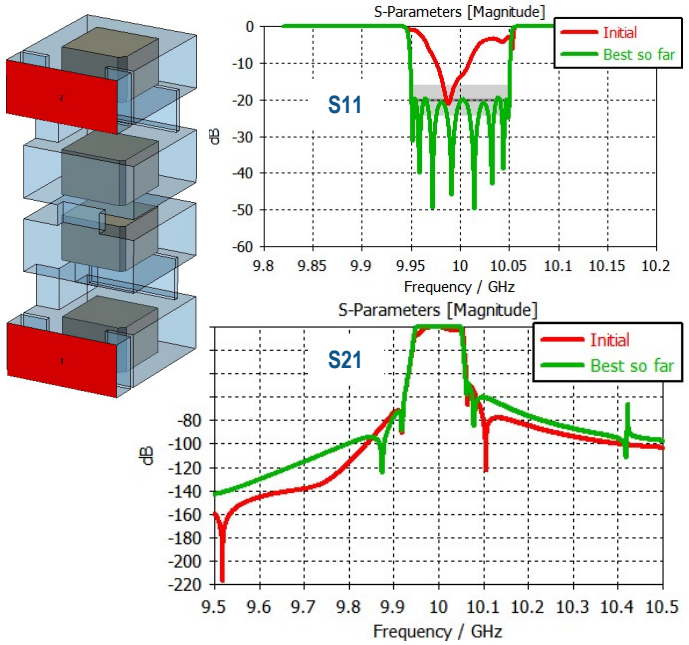
	S	1	2	3	4	5	6	L
S	0.0	1.0469 +4.5%	0.0	0.0	0.0	0.0	0.0	0.0
1	1.0469 +4.5%	-3.5645 +179.2%	0.78265 -1.9%	0.26822 -2.2%	0.0	0.0	0.0	0.0
2	0.0	0.78265 -1.9%	-1.732 +68.1%	0.50769 -10.2%	0.0	0.0	0.0	0.0
3	0.0	0.26822 -2.2%	0.50769 -10.2%	-1.2801 +67.7%	0.51784 -11.3%	0.0	0.0	0.0
4	0.0	0.0	0.0	0.51784 -11.3%	-1.2971 +68.2%	0.50977 -12.7%	0.23859 +13.5%	0.0
5	0.0	0.0	0.0	0.0	0.50977 -12.7%	-1.7259 +72.3%	0.78478 -3.9%	0.0
6	0.0	0.0	0.0	0.0	0.23859 +13.5%	0.78478 -3.9%	-3.5856 +180.2%	1.0472 +4.5%
L	0.0	0.0	0.0	0.0	0.0	0.0	1.0472 +4.5%	0.0

The goal is to minimize the sum of all errors

GEOMETRICAL PARAMETER SENSITIVITIES

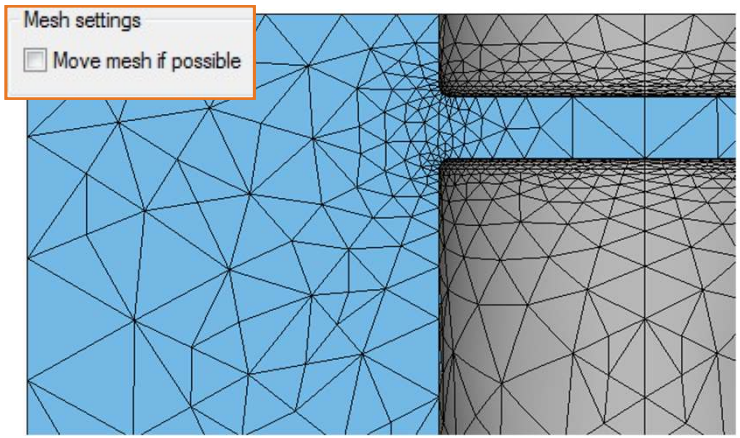
- The Trust Region Framework optimizer with FD3D goal, automatically utilizes sensitivity results to greatly speed-up the optimization.
- Here is an example of a multimode filter with 1% FBW.

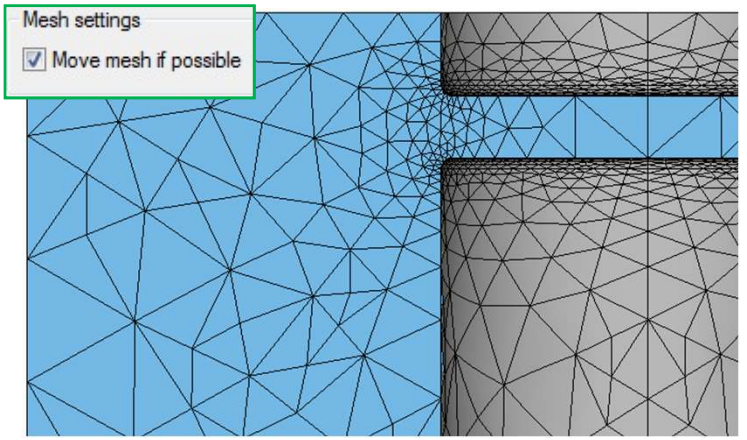


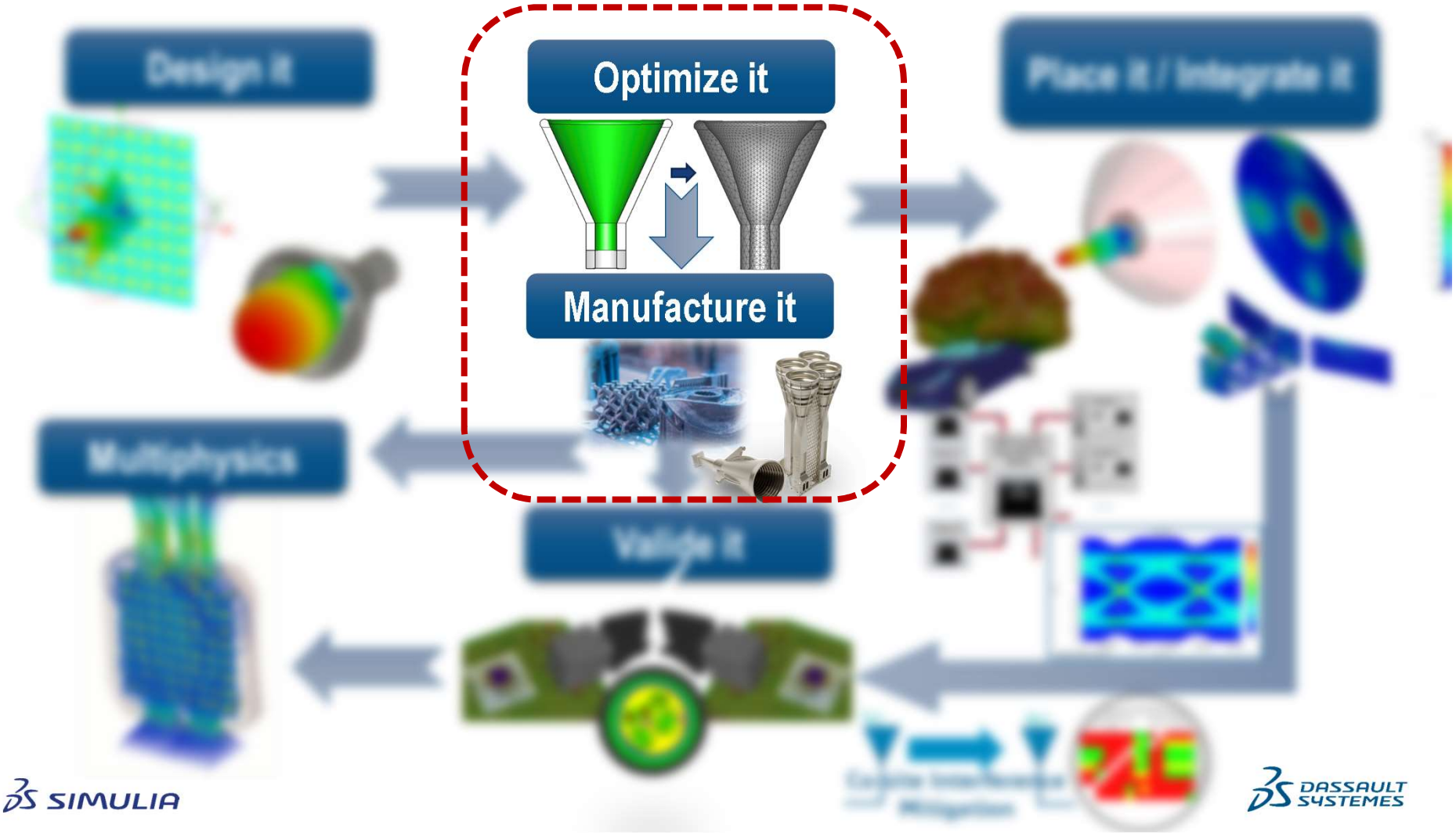


MOVING MESH

- Traditionally, all changes in a structure require re-meshing
- Mesh may change → Simulation results change → “Mesh noise”
- Moving mesh: no re-meshing for small geometric changes







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OPTIMIZE IT
MANUFACTURE IT

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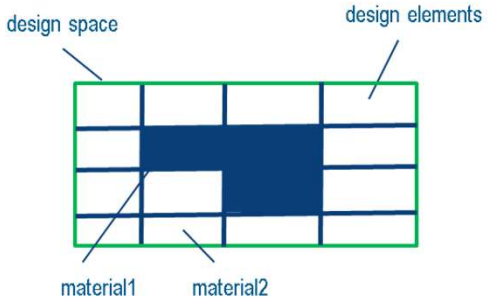
NON-PARAMETRIC SHAPE OPTIMIZATION

Tosca & CST Studio Suite

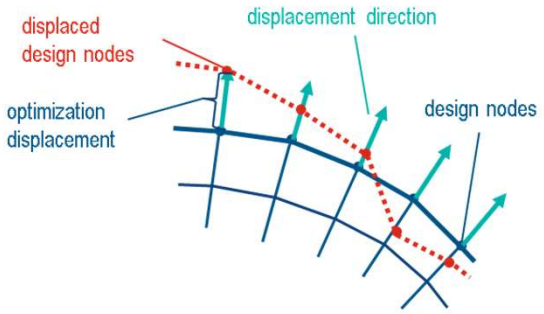
- **Non-parametric shape optimization** enables engineers to create designs not limited by conventional and parametric shapes.
- This workflow is intended for the **expert user** as it is

  not yet a push-button generative design feature.
  - A good initial antenna/component design is essential for this optimization strategy.
- Companies working with **additive manufacturing** can benefit the most from this new technology.

Topology Optimization



Shape Optimization

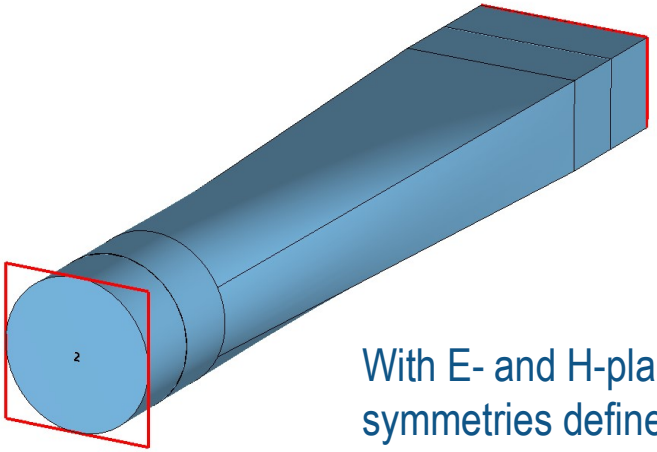


TAPERED WAVEGUIDE

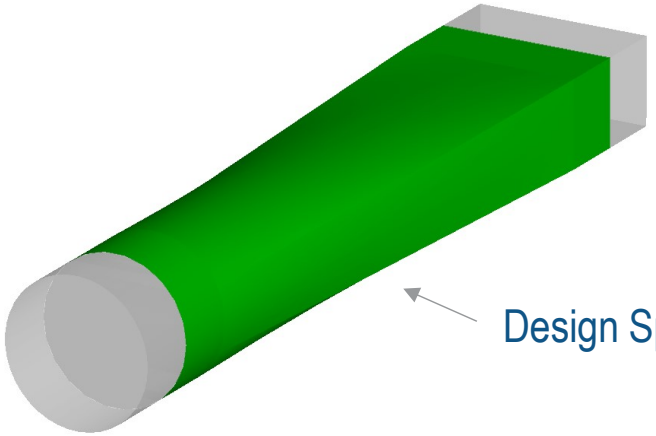
Specifications

Return loss: |S11| → minimized

Frequency range: 17.3 – 22 GHz (incl. reserves)



With E- and H-plane symmetries defined



Design Space

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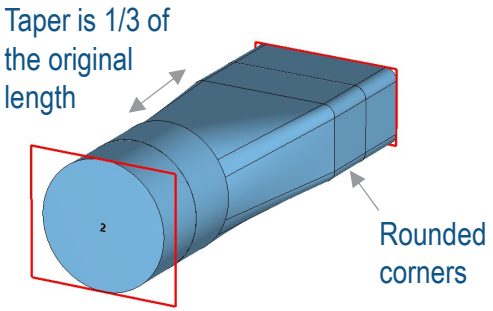
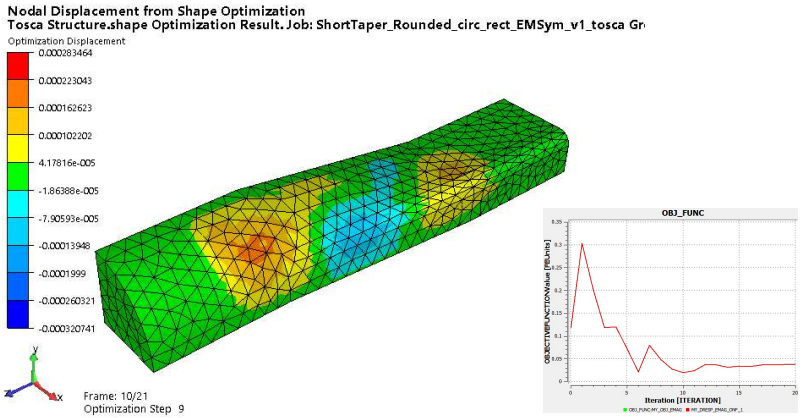
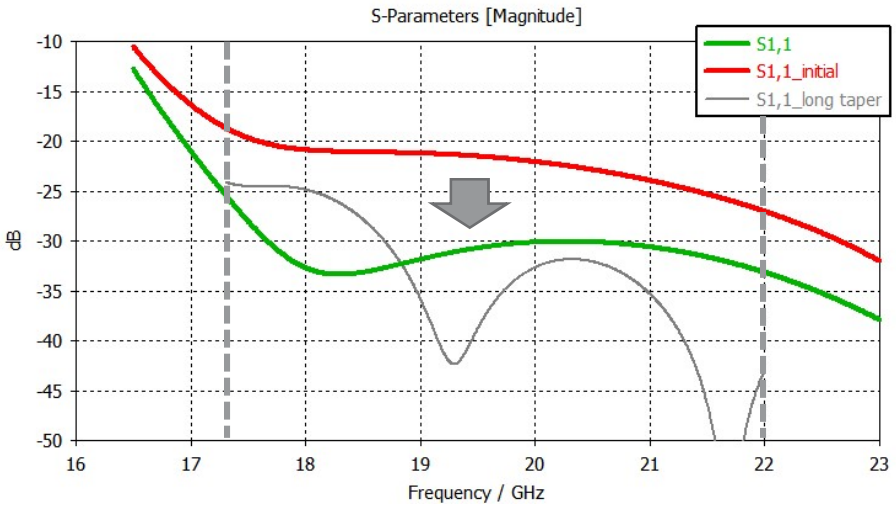
SHORT TAPERED WAVEGUIDE – OPTIMIZATION II







→ **Achieves the same return loss level compared to the original long taper**

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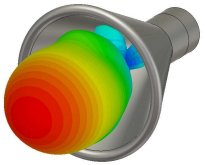
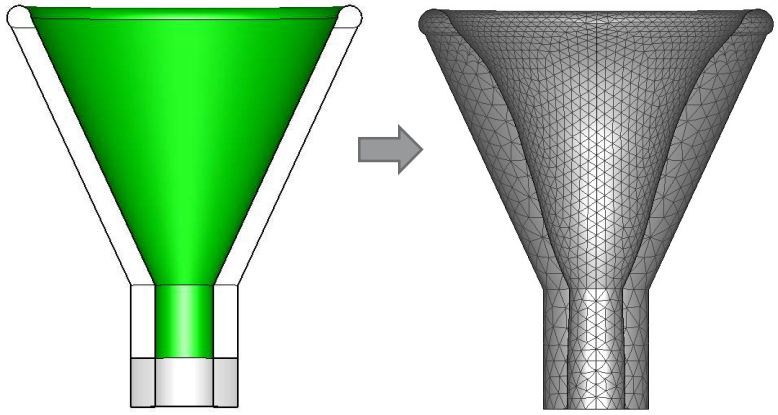
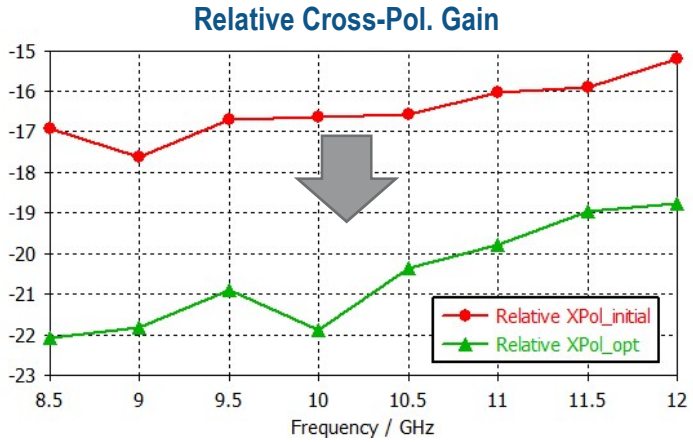
NON-PARAMETRIC SHAPE OPTIMIZATION

Horn Antenna Example



- Profiled smooth-wall horn antennas are light-weight and easier to manufacture than corrugated horns.
- By profiling the inner wall, certain farfield properties can be achieved and is then an ideal problem for non-parametric optimization.
- Example of lowering the cross-polarized gain:





→ Note that the result is comparable to an elliptical taper, which is many times used. However, the new approach allows targeting more specific properties than what a conventional taper function offers.

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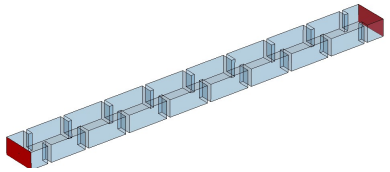
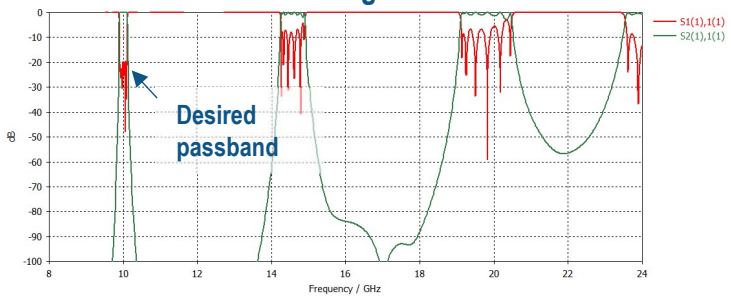
NON-PARAMETRIC SHAPE OPTIMIZATION

Waveguide Cavity Filter Example

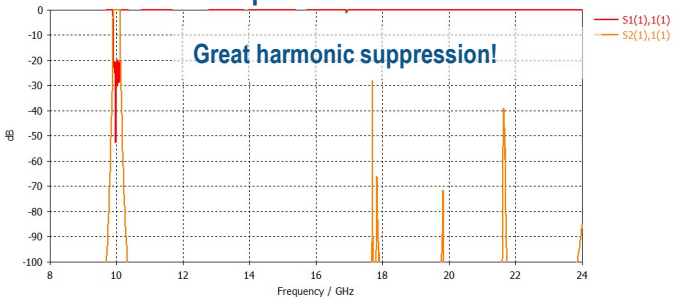
- Start with a spherical cavity and push out the higher-order modes.
- Optimization details:
  - Objective: Maximize the ratio between the fundamental and first higher-order mode
  - Constraint: Keep Q-factor of the fundamental mode above 3000
- Here's an example of the optimized cavity resonator shape with good higher-order mode performance, incorporated into a filter design:



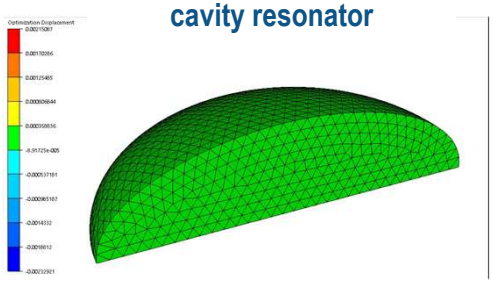
Classic waveguide filter

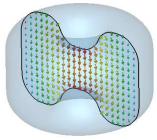


New shaped resonator filter

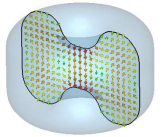


Optimization lapse of cavity resonator





10 GHz



24.6 GHz

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MANUFACTURING PROCESS

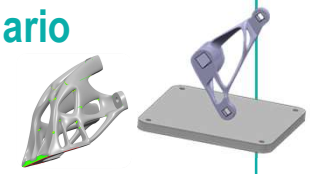
Geometry preparation for simulation

Adjustment of lattices to avoid interpenetration of material between the lattices and the cornet
Partitions for an easier meshing

CATIA Part Design Essentials

CATIA Simulation Model Prep

Additive Manufacturing Scenario



Definition of the printing process (machine, printing strategy, parts positioning…)
Printing simulation + results

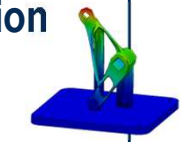
DELMIA Additive Part Preparation

DELMIA Powder Bed Fabrication

SIMULIA Additive Mfg Scenario

SIMULIA Physics Results

Reverse Engineering for printing optimization



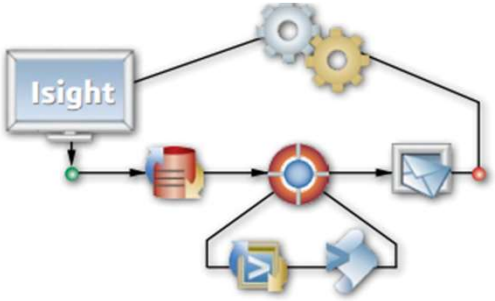
Use the simulation results to print the "wrong" part in order to get it right after the printing phase
Iterate to find the right parameters

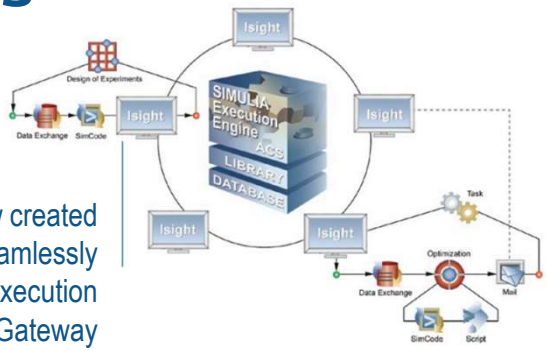
SIMULIA Physics Results

CATIA Virtual to Real Shape Morph.

CATIA Digitized Shape Preparation

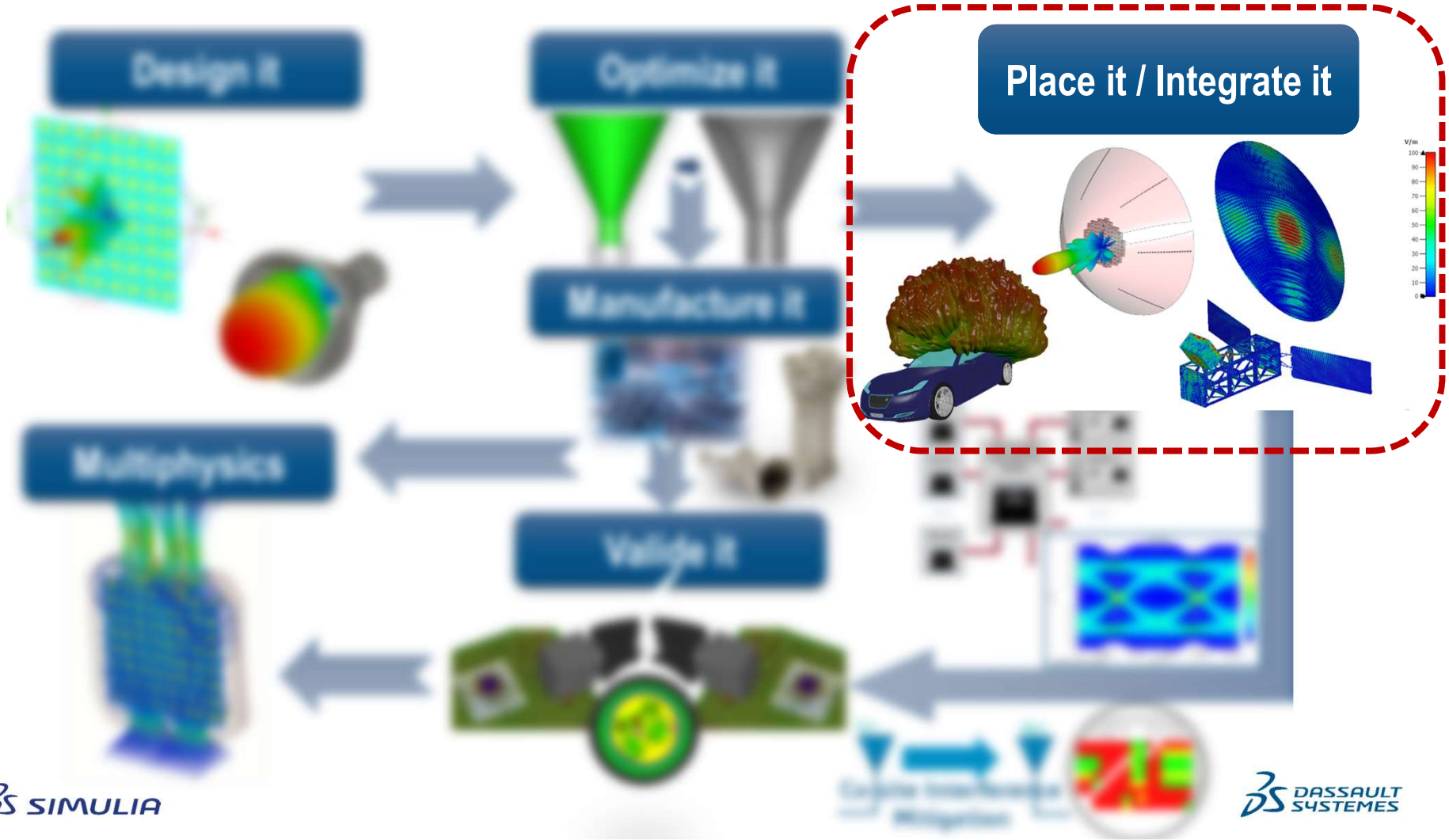
DESIGN OF EXPIREMENTS CAPABILITIES





Any simulation process flow created with Isight can be seamlessly executed on the SIMULIA Execution Engine from the Runtime Gateway

- Design of Experiments
- Optimization
- Data Matching
- Approximations and the Visual Design Driver
- Quality Methods



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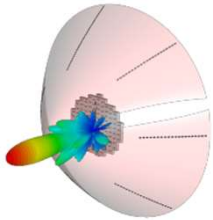
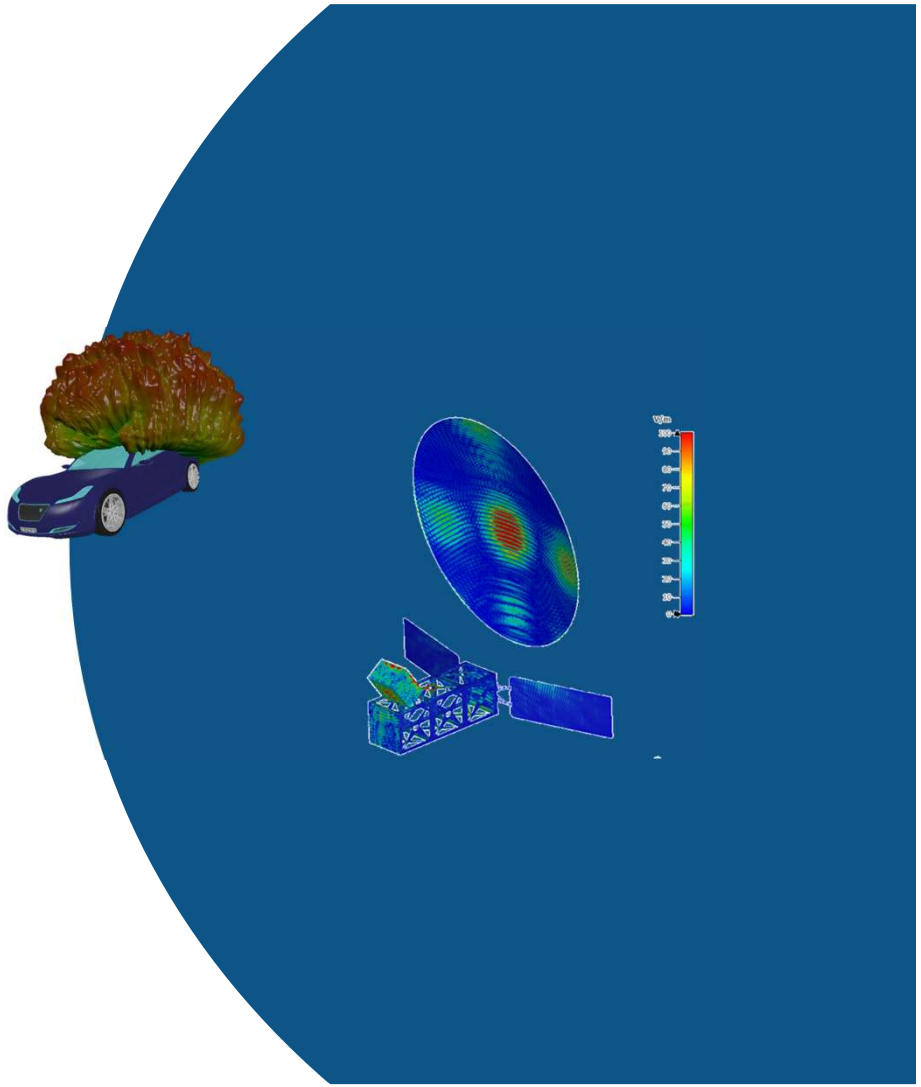
PLACE IT
INTEGRATE IT





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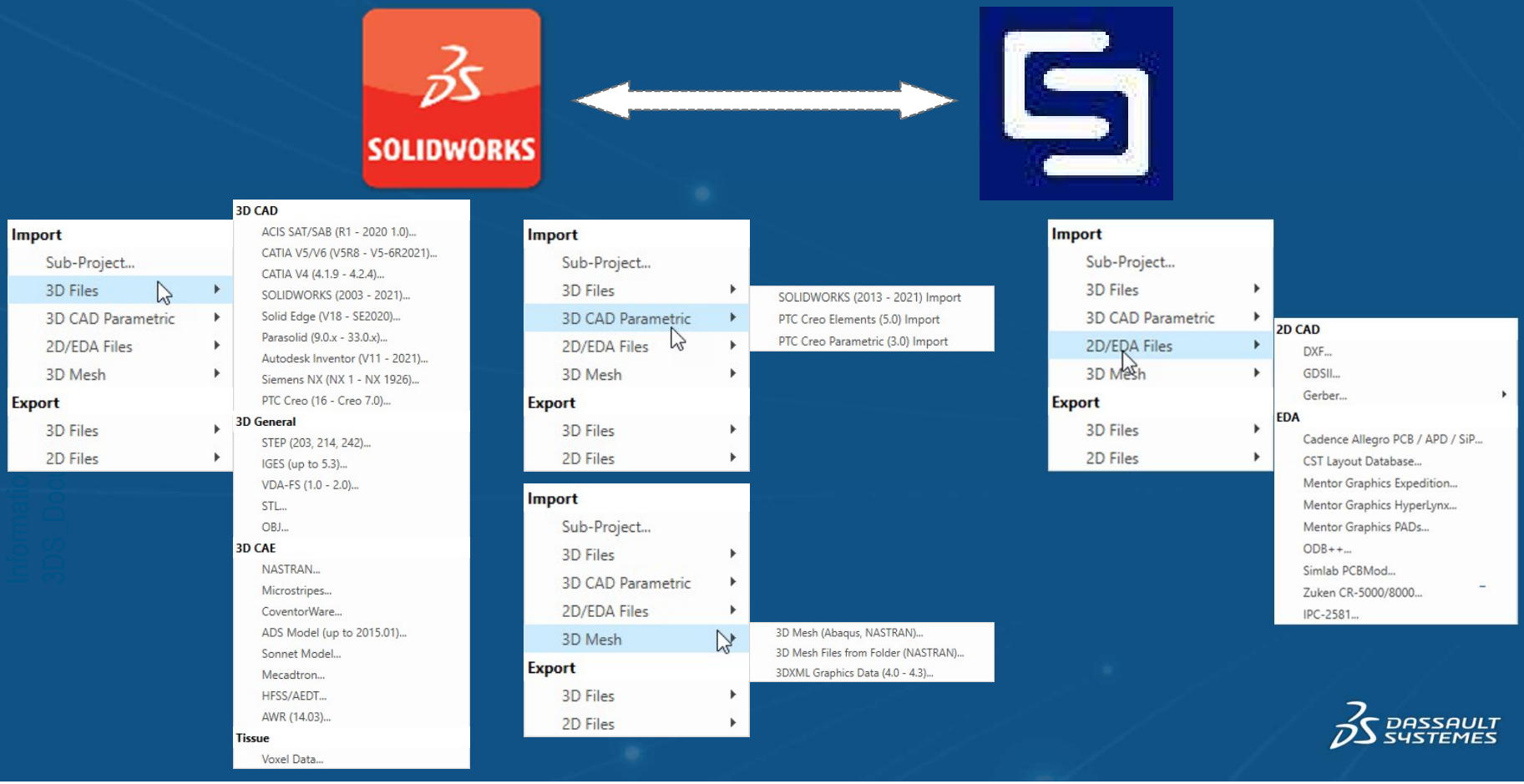
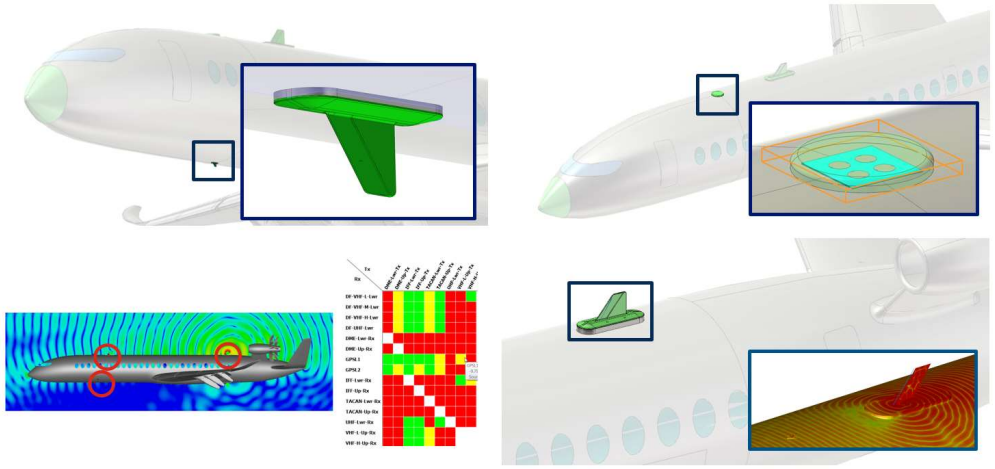
LINK BETWEEN MCAD/ECAD AND EMC-OC



DASSAULT SYSTEMES

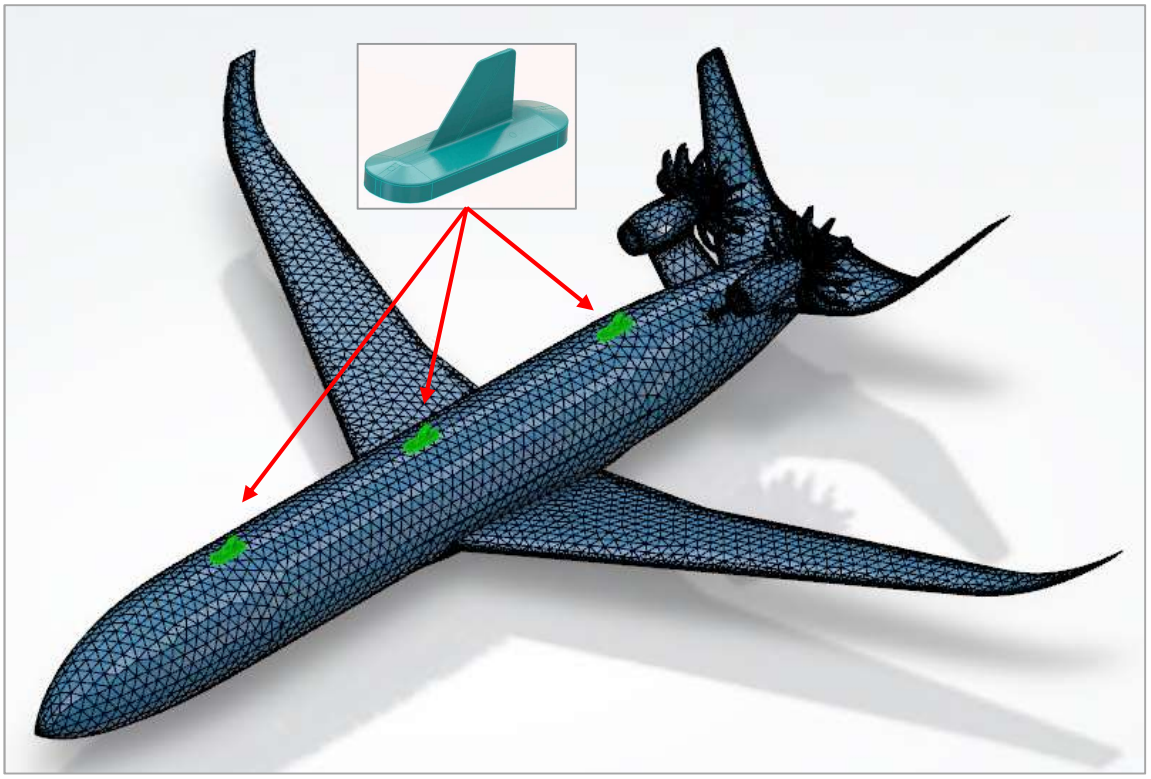
ANTENNA PLACEMENT APP

- Assess and validate installed antenna performance
- Direct link to CAD-model
- Integration to 3DEXPERIENCE



MESH AS PLATFORM

Use orphan mesh as platform instead of CAD



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Antenna Placement Simulation
with Mesh as a Platform

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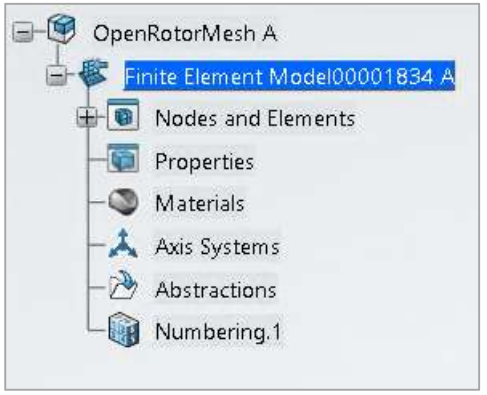
Physical product containing only mesh is considered orphan



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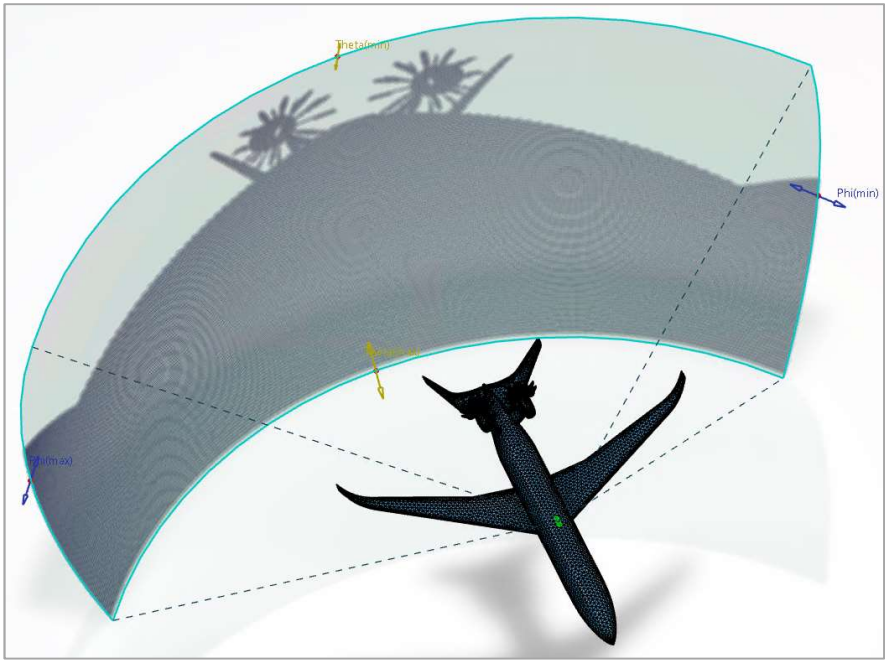
OBSCURATION IN 3D

View how the platform structure obscures the area of evaluation of a placement candidate



The angular range defines the area of evaluation

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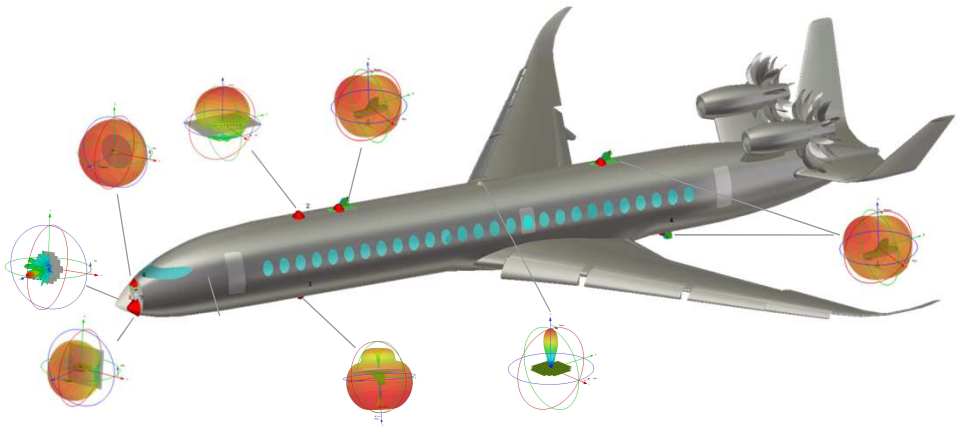
HYBRID SOLVER

Combine advantages of multiple solver technologies

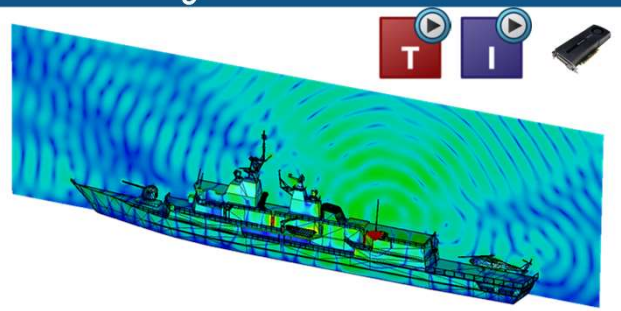
Hybrid solution to efficiently handle electrically large simulations

Uni- and bi-directional solutions

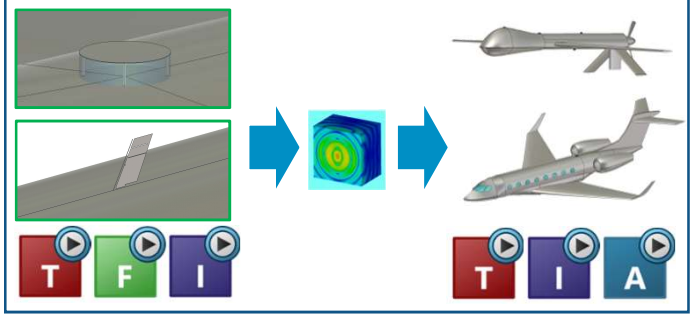


ANTENNA PLACEMENT – SIMULATION OPTIONS

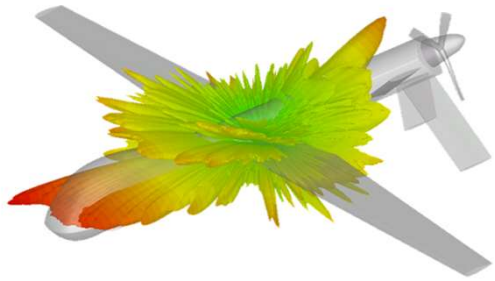
Full-wave single solver simulation



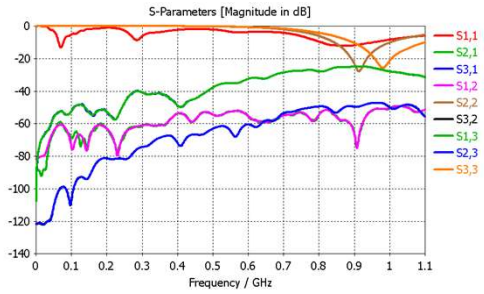
Multiple solver hybrid simulation



Antenna Placement (AP)

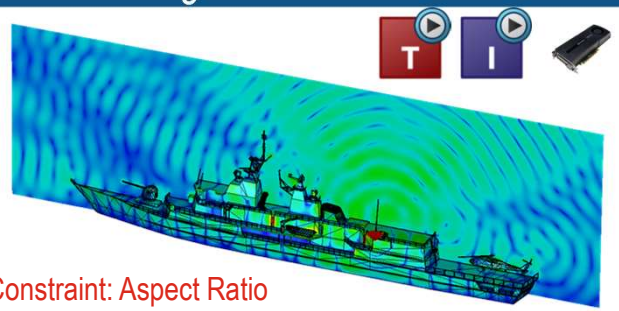


Antenna to Antenna (ATA) Coupling



SINGLE SOLVER APPROACH

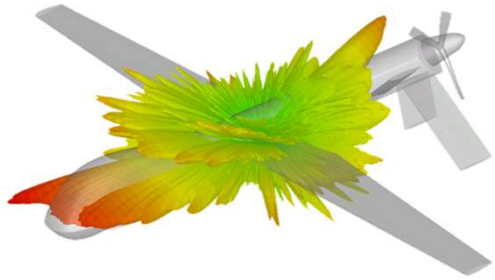
Full-wave single solver simulation



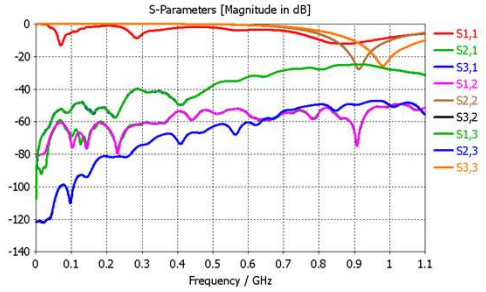
Constraint: Aspect Ratio

Multiple solver hybrid simulation

Antenna Placement (AP)



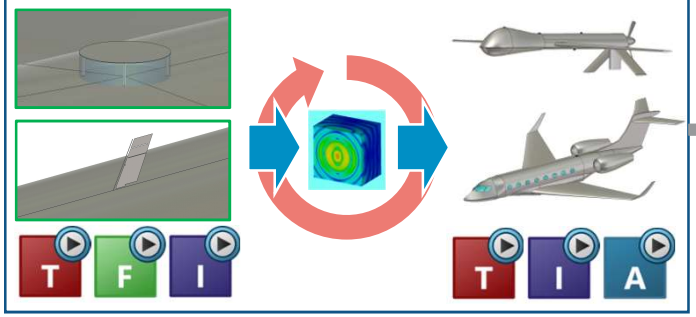
Antenna to Antenna (ATA) Coupling



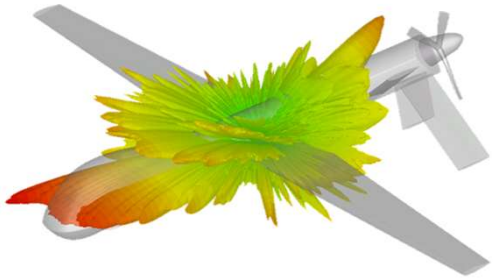
HYBRID SOLVER APPROACH

Full-wave single solver simulation

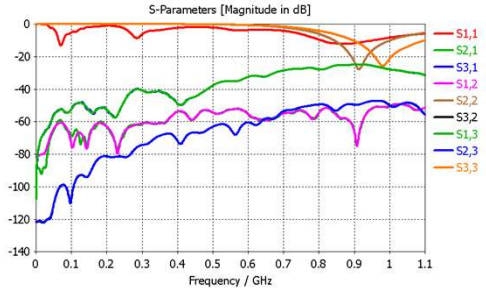
Multiple solver hybrid simulation



Antenna Placement (AP)



Antenna to Antenna (ATA) Coupling



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HYBRID SOLVER COUPLING TYPES

Uni-directional

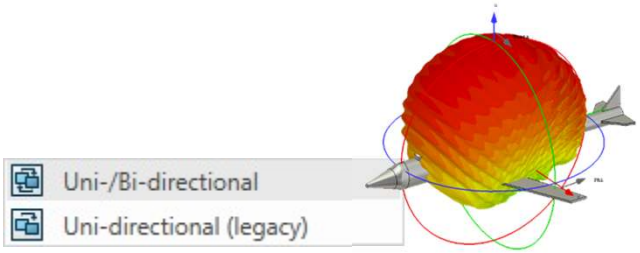
- When to use?
  - Loosely coupled antennas
  - Fast design exploration
    - Moderate accuracy
- Provided KPIs
  - **$S_{i,j}$ via Reaction Integral** (only I, A)
    - $S_{i,i}$ not corrected
  - Accurate farfield (if loosely couled)

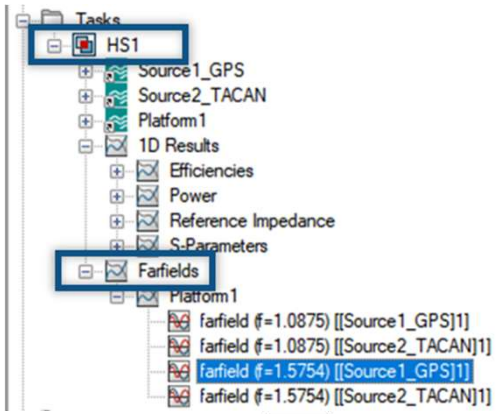
Bi-directional

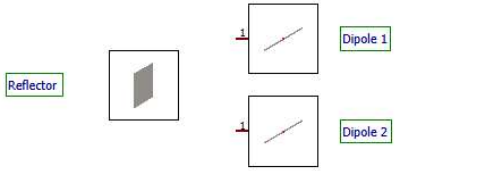
- When to use?
  - Tightly coupled antennas
  - More accurate analysis
    - Longer simulation time
- Provided KPIs
  - **Accurate full S-Matrix & installed Farfield** thanks to Iterative Krylov Solver

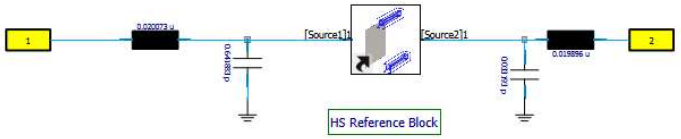
NEWS FROM HYBRID SOLVERS SIDE

- Hybrid solver task with unidirectional coupling (platform domain must be simulated with I- or A-solver).
- Use HS reference block in the schematic for quick optimization at schematic level, provide S-parameters results to interference task, etc.
- Field source can be now recorded at arbitrary frequency points (not necessarily equidistantly spaced)
- Save simulation time/disk occupation for antenna to antenna coupling or installed farfield analysis over a large frequency range
- More solvers support for Platform domain (TLM, I, A)
- Combine Near and Far Fields from HS task for source and platform
- New workflow for antenna matching for placement with parametric excitations and combine results





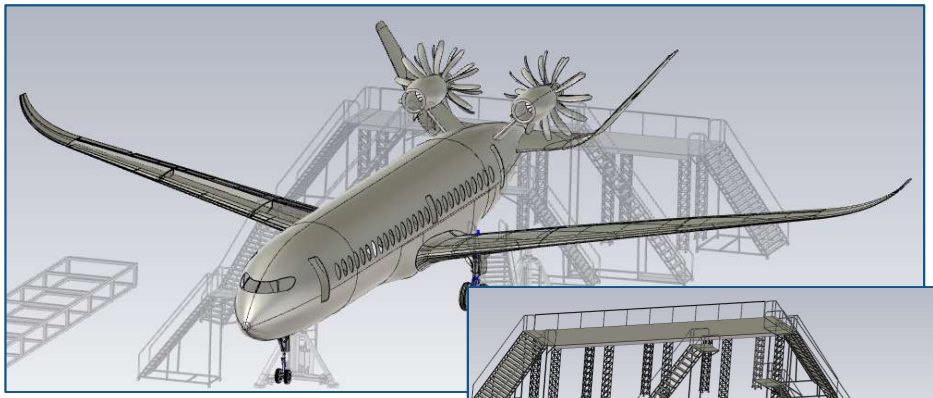


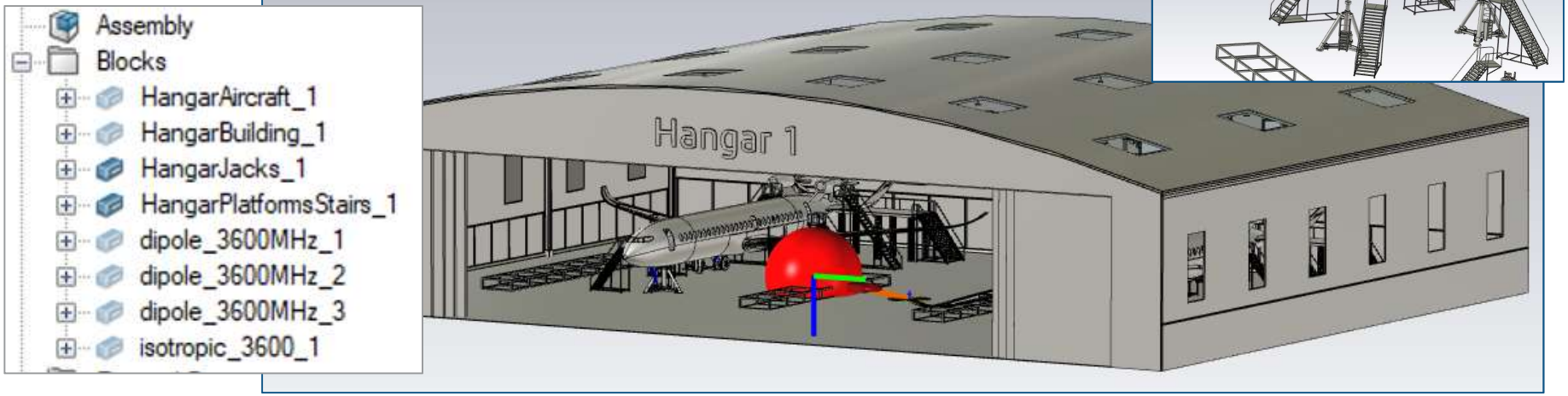


ASSEMBLY MODELING

Guideline to assemble multiple complex components

- Keep individual component history isolated and assemble through anchor points
- Use Assembly parameters in addition
- Copy and position farfield sources





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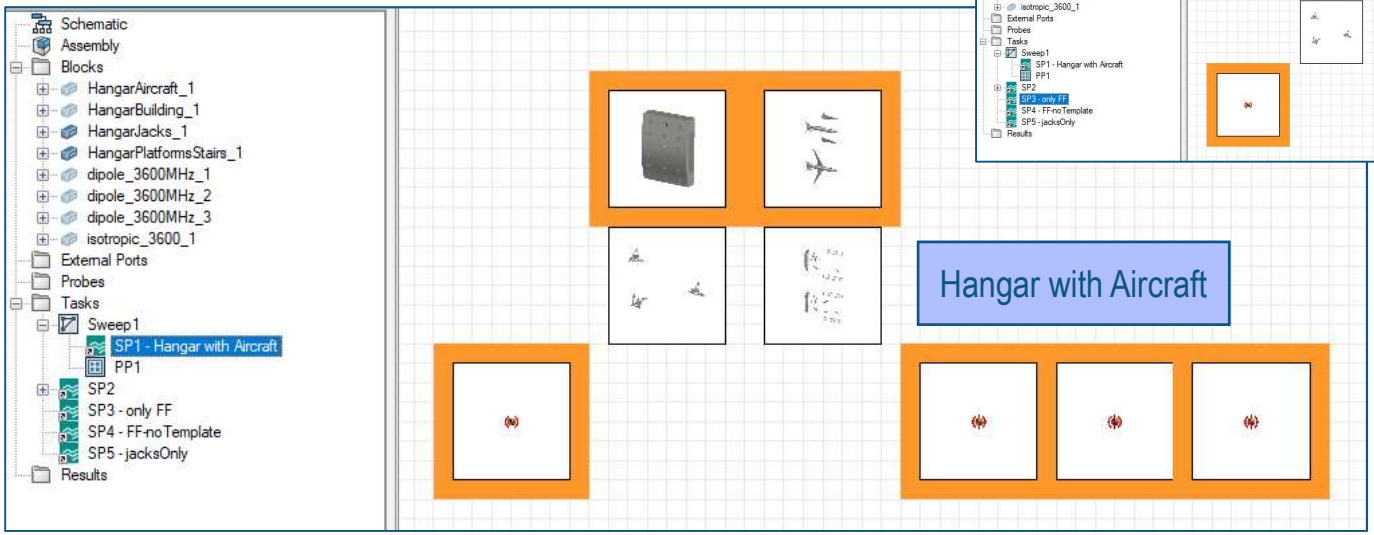
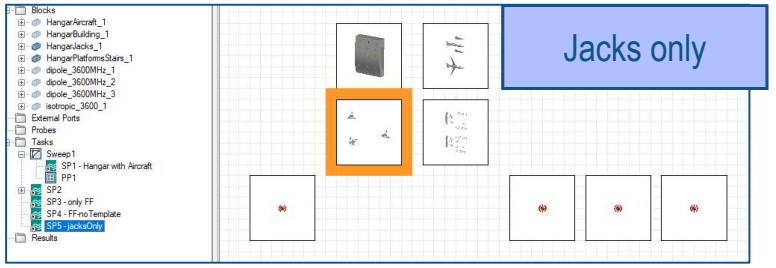
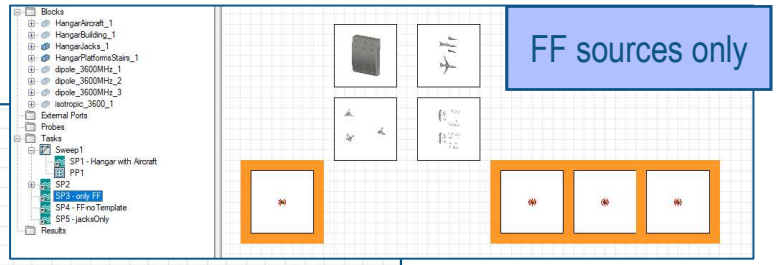
SIMULATION SCENARIOS

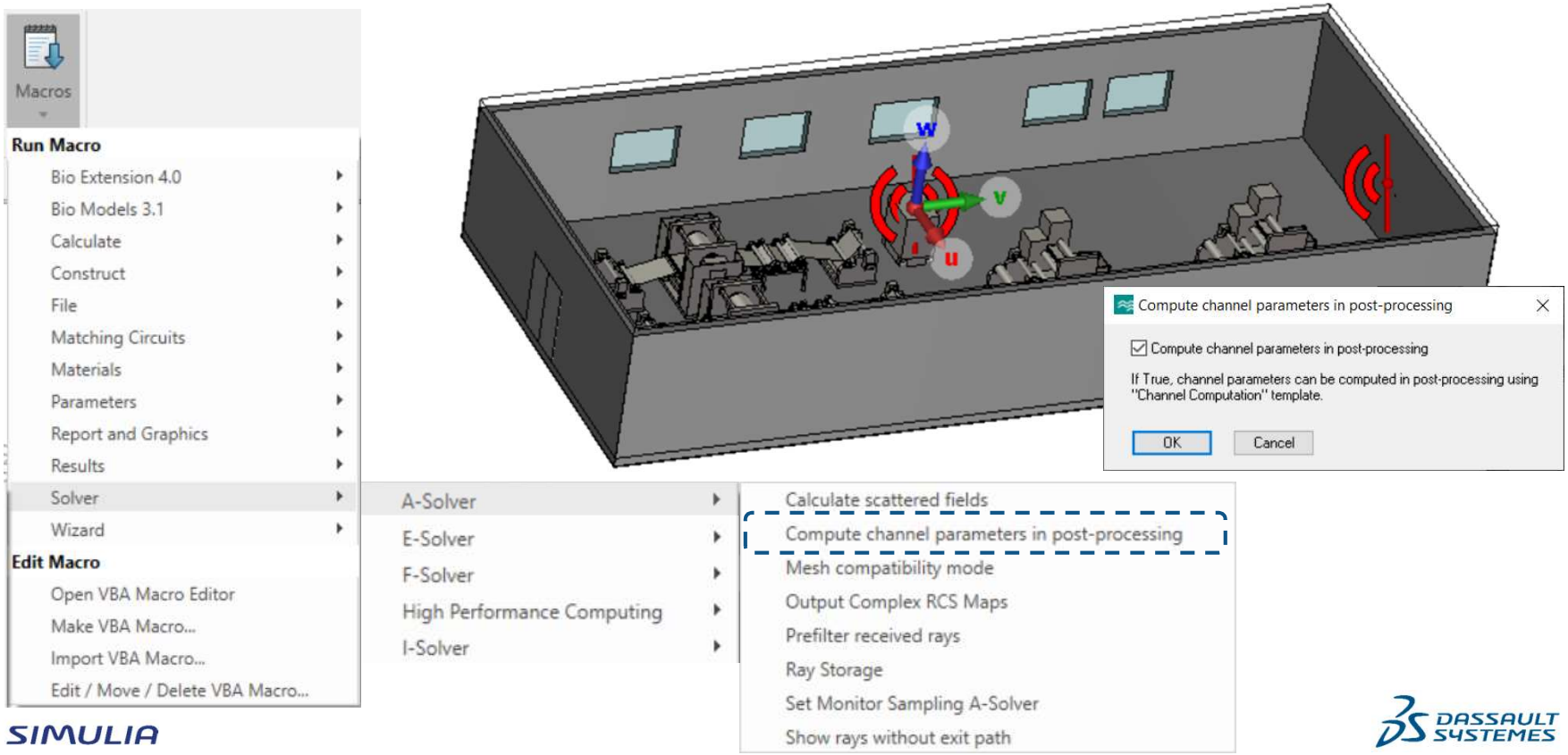
- From one master model multiple scenarios can be derived
  - Study the influence of components
  - Different sources, different positioning
  - components present or not
  - housing on / off, different housing, etc



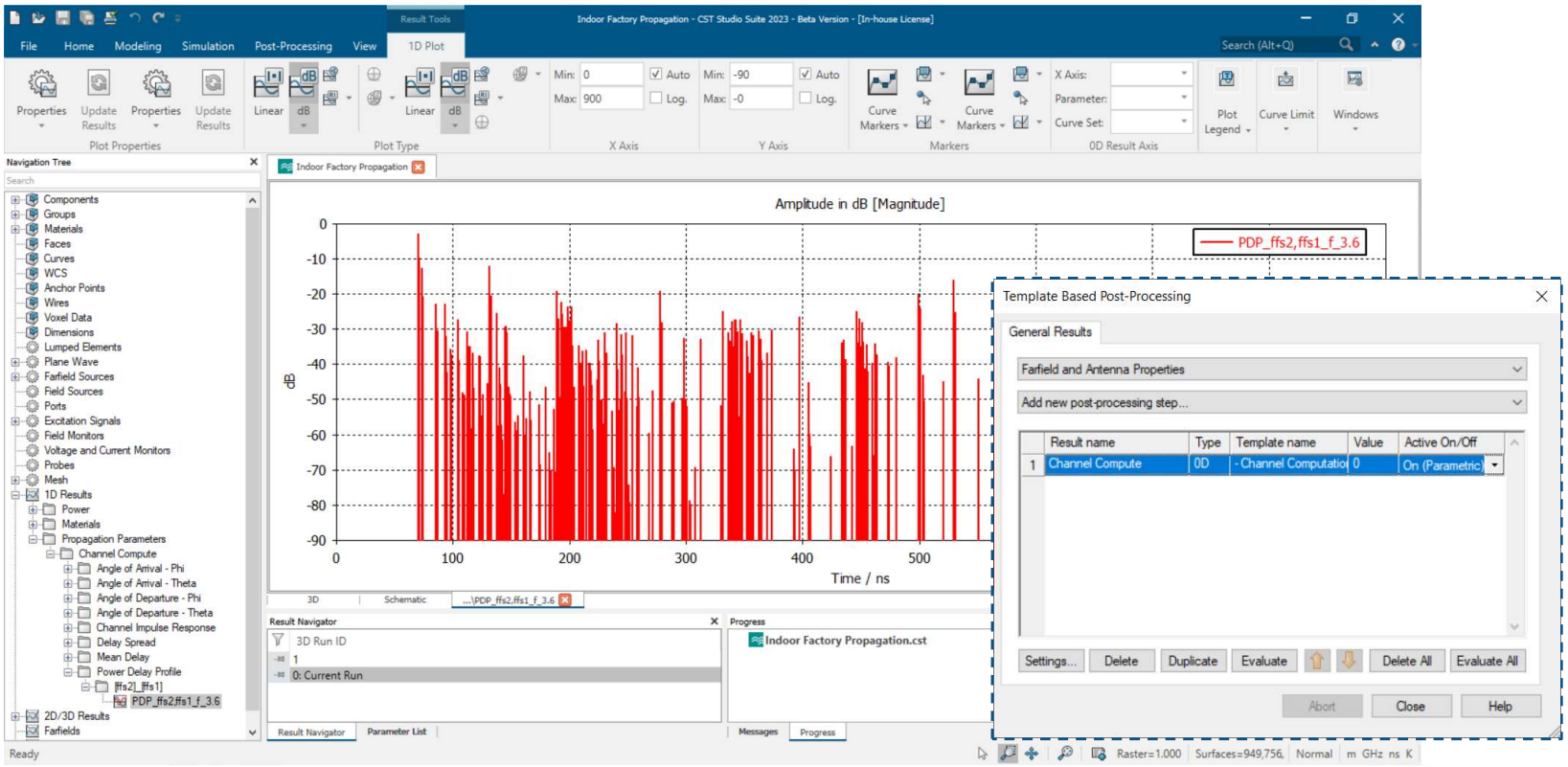




A-SOLVER: NEW CIR WORKFLOW IN POST-PROCESSING

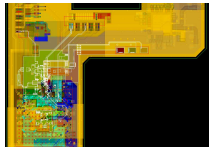


A-SOLVER: NEW CIR WORKFLOW IN POST-PROCESSING

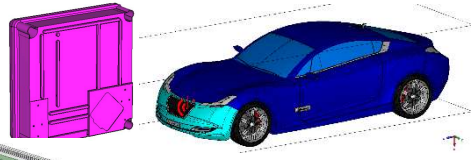


VIRTUAL TESTING OF INTEGRATED SENSOR

ECAD/Layout import

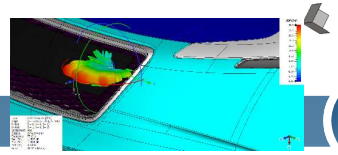


CAD Import & Simplification

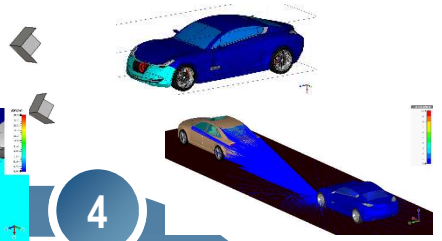


Sensor Simulation Setup

Can be re-used from previous workflow



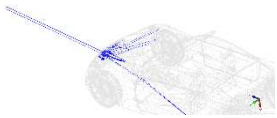
Sensor Integration Simulation Setup



Execute Hybrid Simulation

Typically 3-28 excitations

Positions sweep (movement)



Results

F-parameters

Farfields

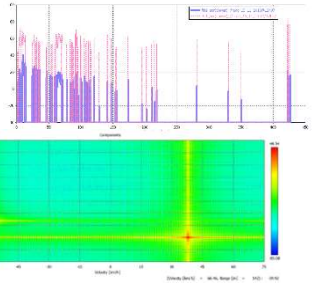
Rays

Postprocessing to obtain KPIs

Monopulse phase curves

FMCW range / velocity maps

Ray histogram



External Postprocessing with custom Signal Processing

Perform DOE / Optimization

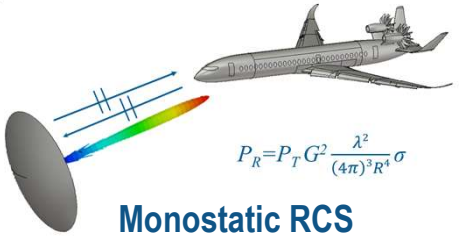
1 2 3 4 5 6 7 8 9

SIMULIA

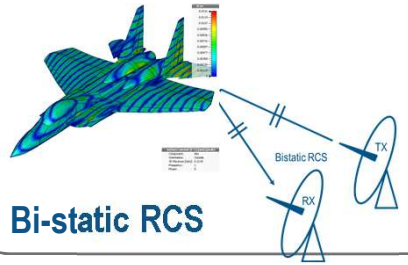
DASSAULT SYSTEMES

ANNEX TO ANTENNA PLACEMENT

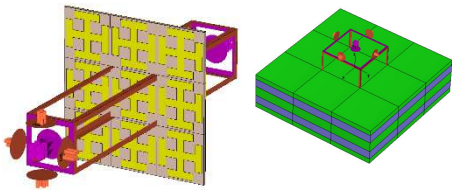
RCS FEATURES



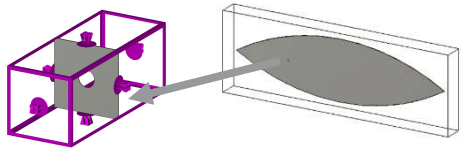
Monostatic RCS



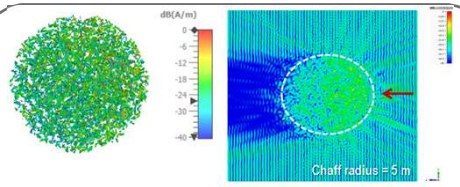
Bi-static RCS



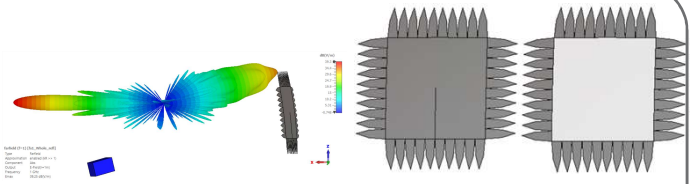
RCS reduction: RAM and FSS



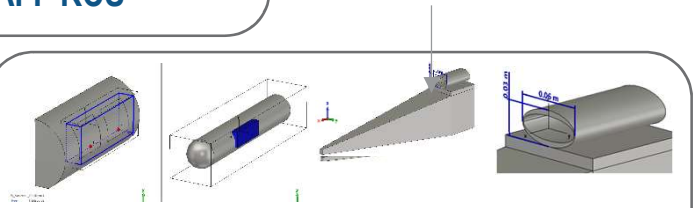
Small details RCS on large objects



CHAFF RCS

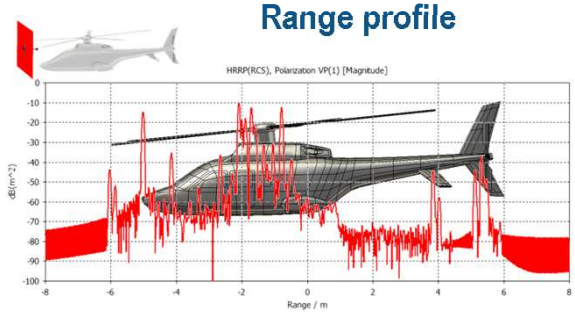


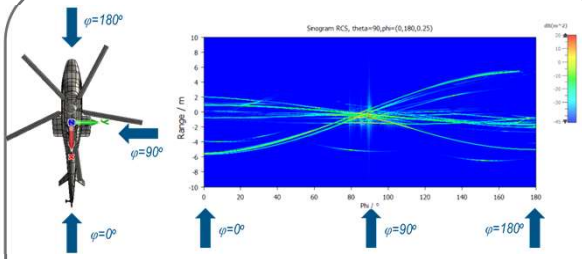
Sub-groups RCS



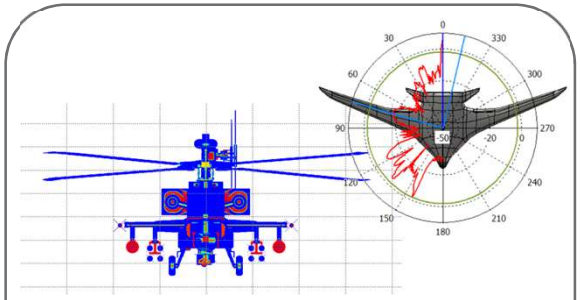
Active RCS: Antenna or resonant structure

ADVANCED ANALYSIS

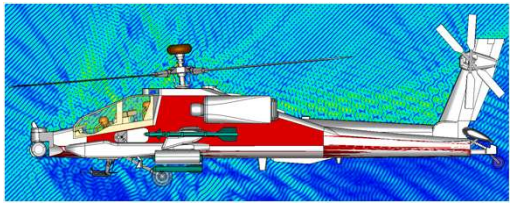




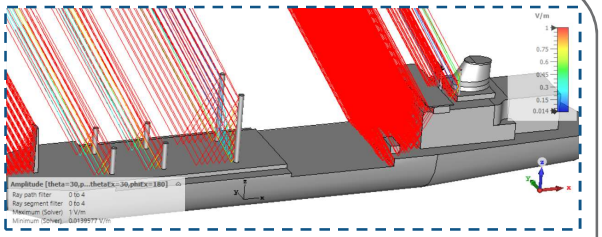
Sinogram 2D RCS



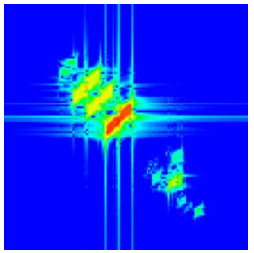
Hotspot RCS

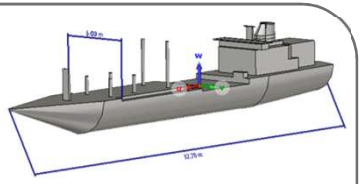


Near field and current distribution



Ray visualization





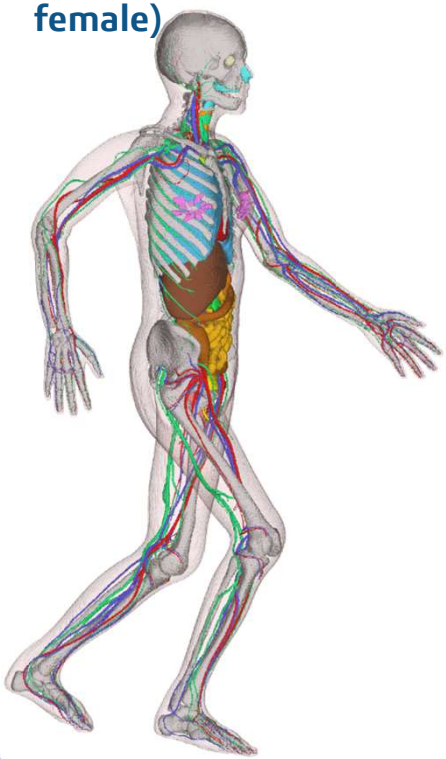
ISAR analysis

SIMULIA

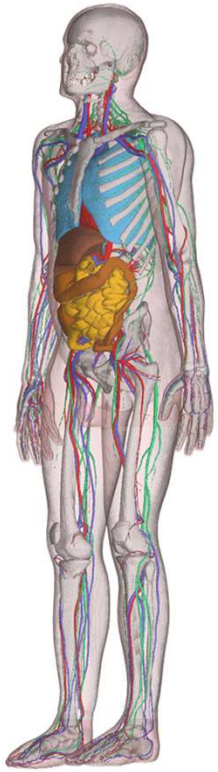
DASSAULT SYSTEMES

BioExtension 4.3 Added Male/Female Child & Baby

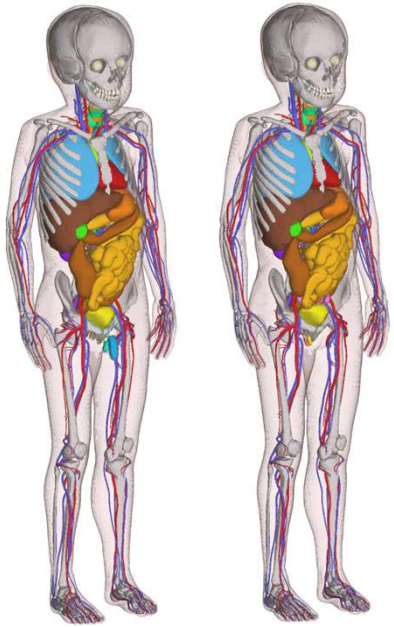
Rosalind (standard female)



Fred (standard male)

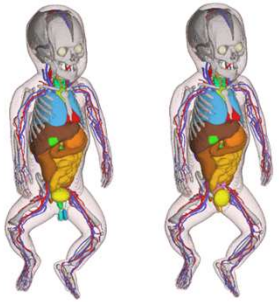


Children, 7 years



Male Female

Babies, 8 weeks



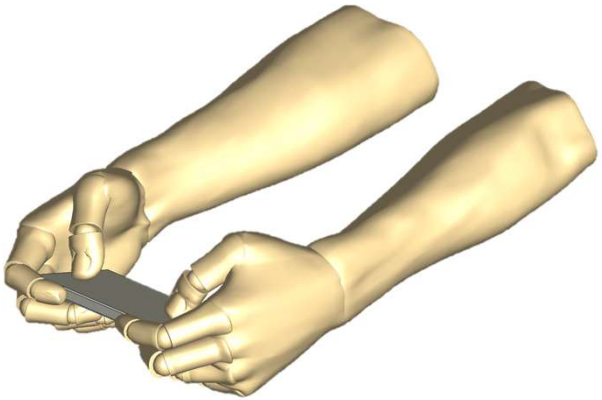
Boy Girl

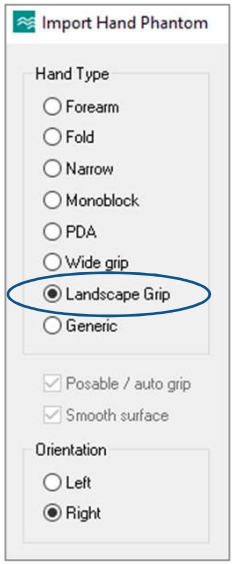
SIMULIA

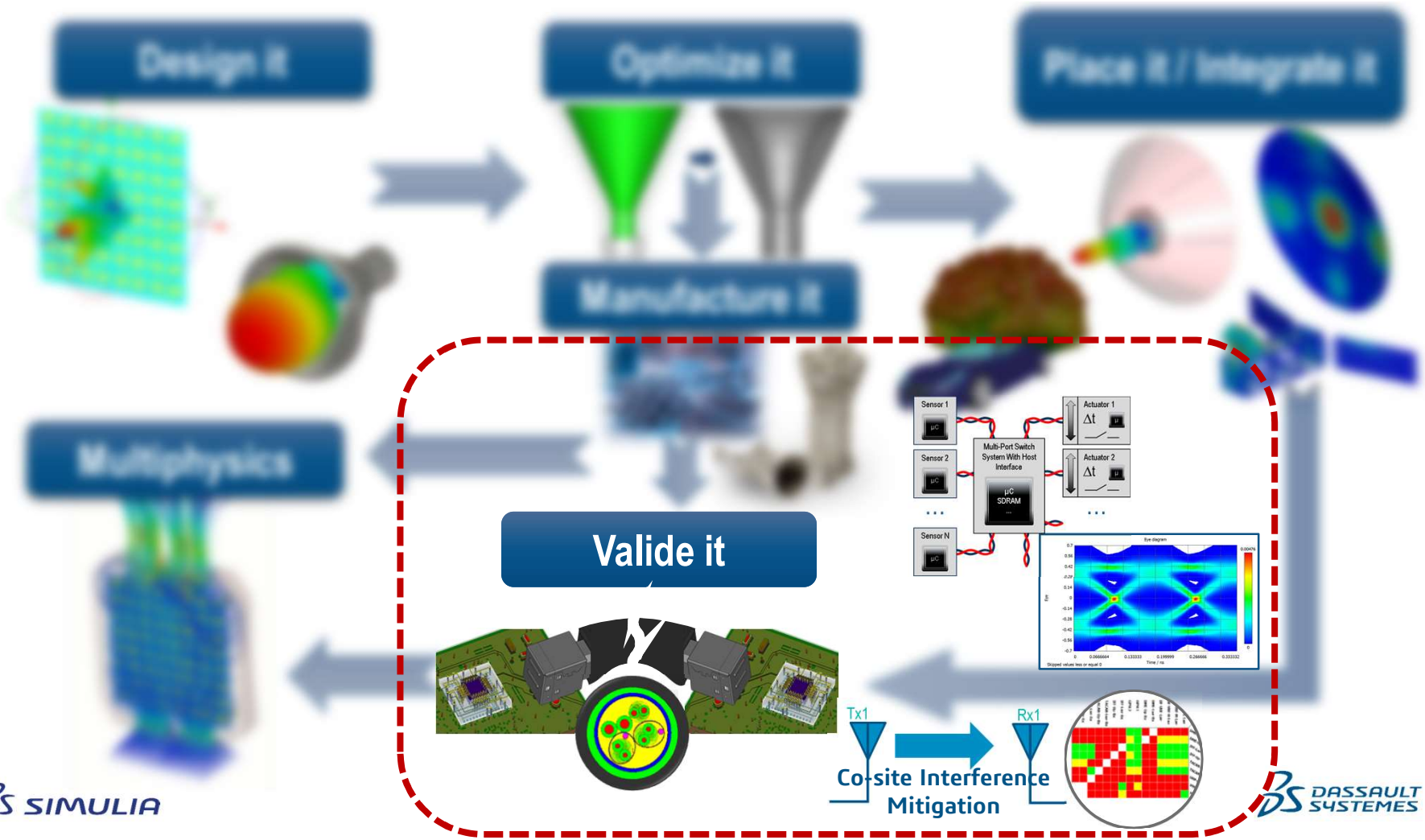
DASSAULT SYSTEMES

BioLib 4.3

- Extremity Assignment According to Upcoming IEC Standard
  - Ears, Hands and arms can be defined separately
  - For separate evaluation of **exposure in limbs**, where higher **SAR value** is allowed
- New Landscape Grip (Game Mode) Hand Phantom







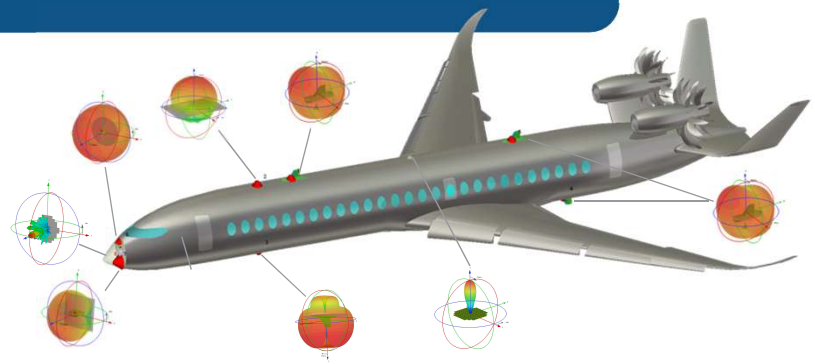
SIMULIA

DASSAULT SYSTEMES

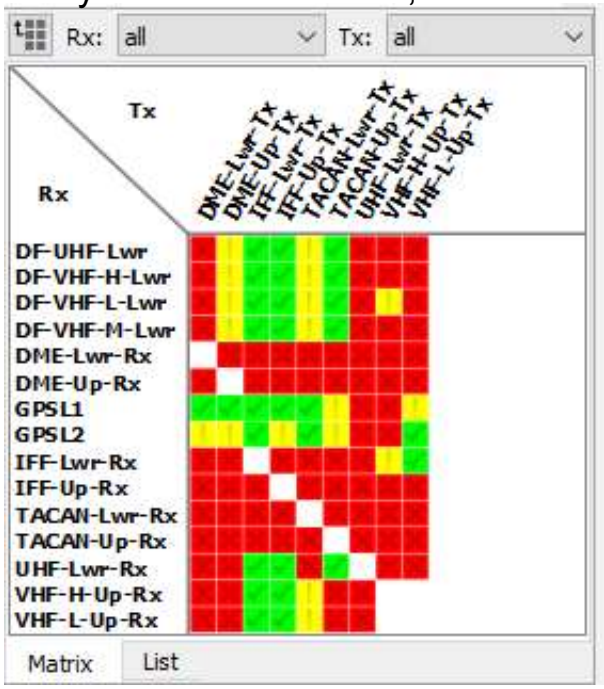
INTERFERENCE TASK

RF system interference calculation

1-to-1 and N-to-1 interference

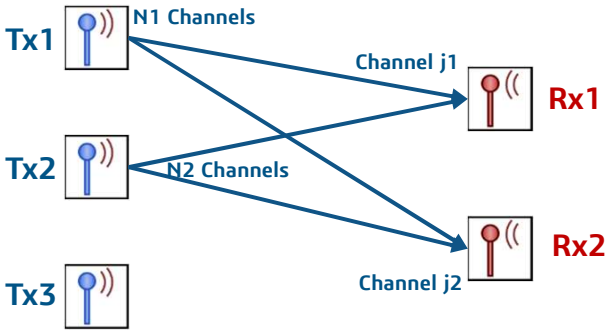


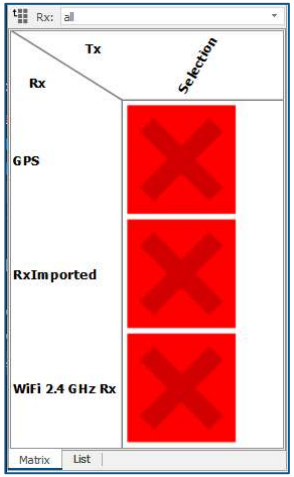
The *Interference Tool* calculates the EMI-Margin of all Transmitter/Receiver pairs, and shows the result in the form of a Violation Matrix, with a colored box for each combination. If a violation is produced for a certain combination, a red or yellow box is shown, otherwise the box is green

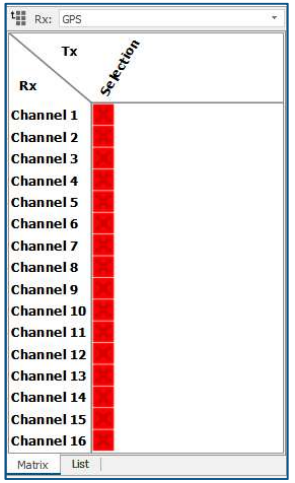


INTERFERENCE TASK MAIN NEW FEATURES

v2022 N-to-1 task detects interference events only for the selected channels and simultaneously.







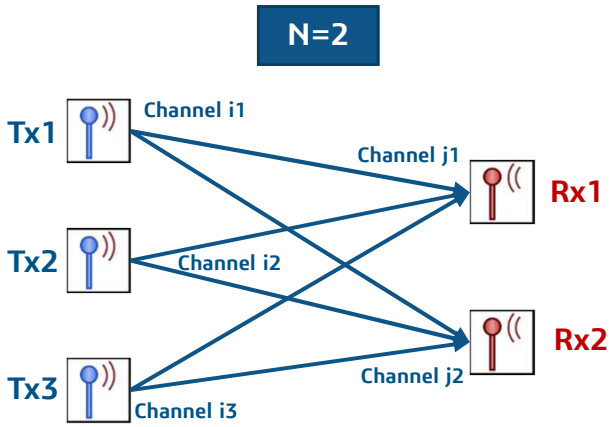
Name	Expression
RF System 4:Radio4:Band5:GSM Tx	none
GSM Tx:bb	noise floor
GSM Tx:1	1
GSM Tx:2	1.2
GSM Tx:3	1.4
GSM Tx:4	1.6
GSM Tx:5	1.8
GSM Tx:6	2
RF System 4:Radio4:Band6:UMTS Tx	custom
UMTS Tx:bb	noise floor
UMTS Tx:1	1
UMTS Tx:2	1.3
UMTS Tx:3	1.6
UMTS Tx:4	1.9
RF System 2:MixedRadio:BandIMPORTED_BB2:Tx_Im...	none

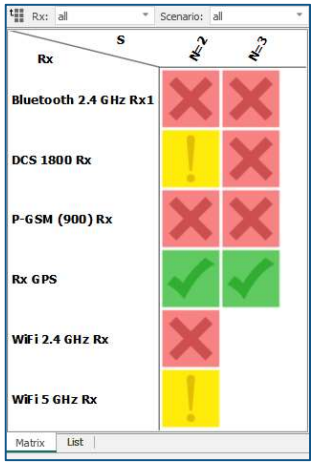
INTERFERENCE TASK MAIN NEW FEATURES

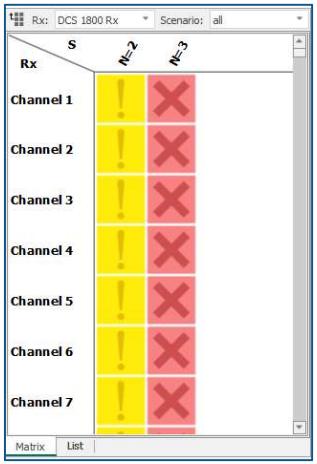
NEW N-to-1 task (v2023):

The N-to-1 task runs the interference analysis for **all possible combinations with N transmitters**.

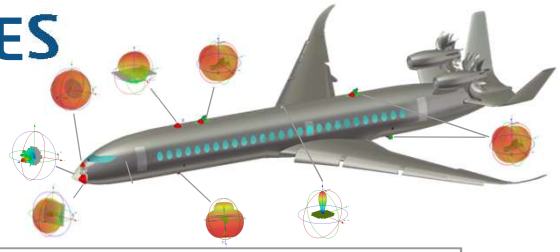
For each case, the interference is checked for **all possible channel combinations**, considering only **one channel per transmitter**.







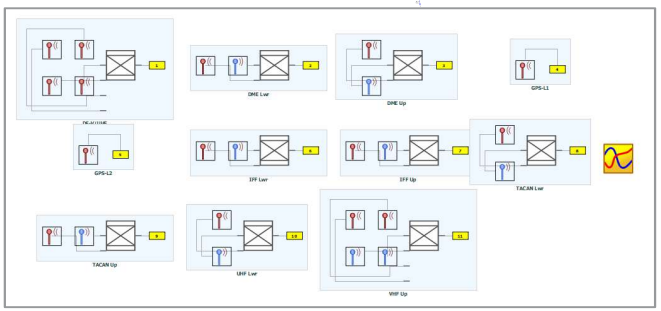
INTERFERENCE TASK MAIN NEW FEATURES



RAM memory savings: Benchmark example

Realistic scenario (Aircraft)

- TX: 9 bands, 832 channels
- RX: 15 bands, 1698 channels



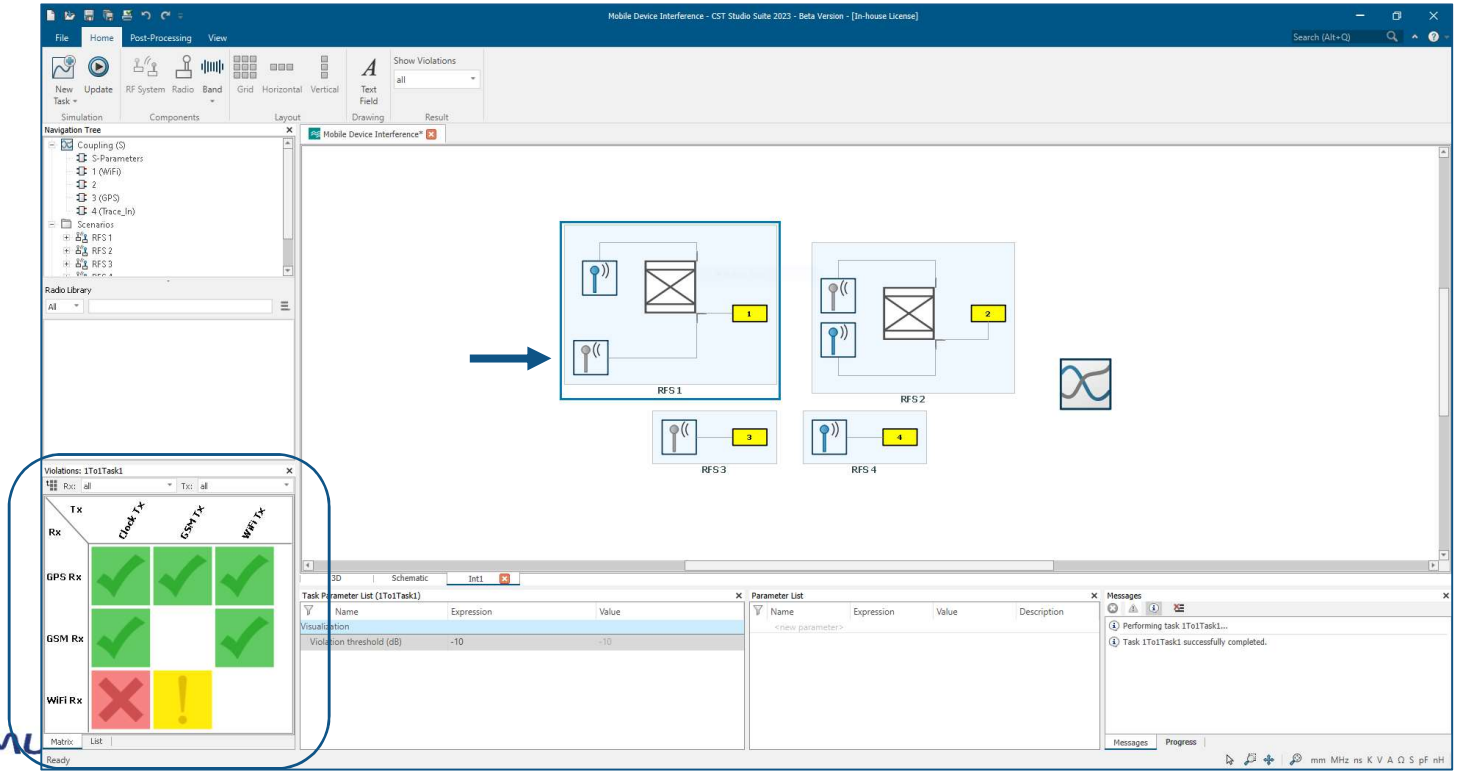
Simulation Time	Analysis time	
	1to1 task	Nto1 task
R2020	302 s	45 s
R2021	55 s	16 s
R2022	31 s	6.5 s
R2023	23 s	n/a

RAM Memory 1to1Task	GUI	Solver
R2022	1.2 GB	260 MB
R2023	1 GB	102 MB

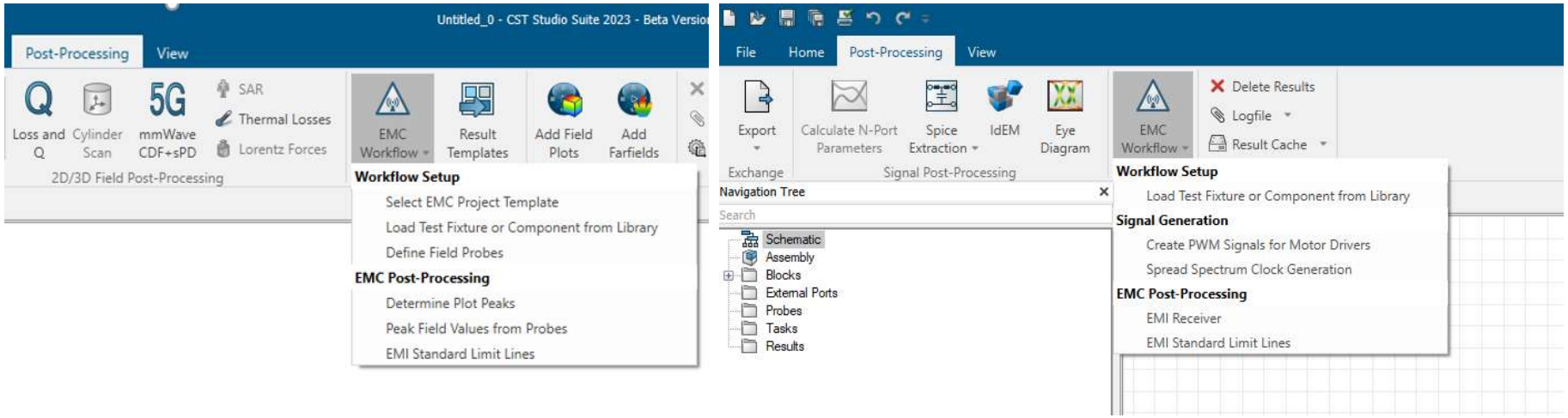
INTERFERENCE TASK MAIN NEW FEATURES

Tx/Rx Import Band improved

Look & feel: Matrix violation colors & 3DX style icons

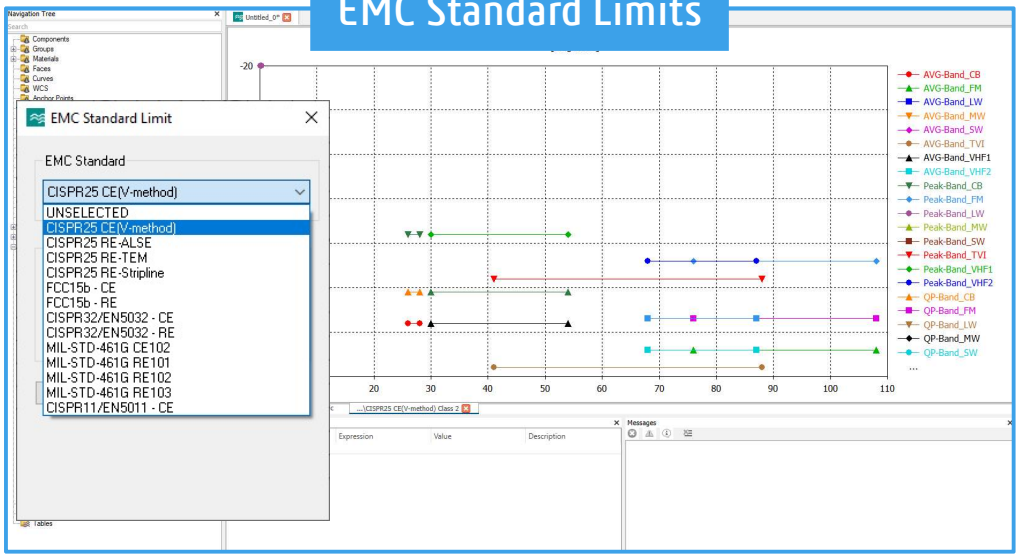


THE EMC BUTTON IN 3D MODELER AND DESIGN STUDIO

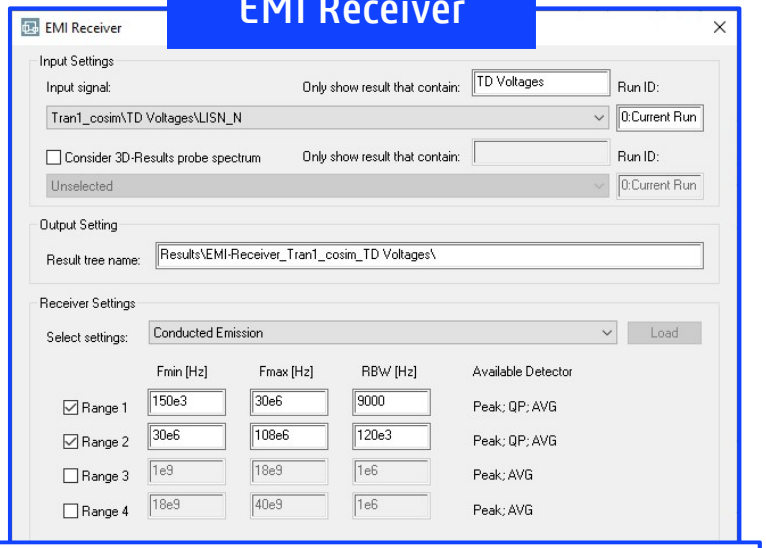


DASSAULT SYSTEMES

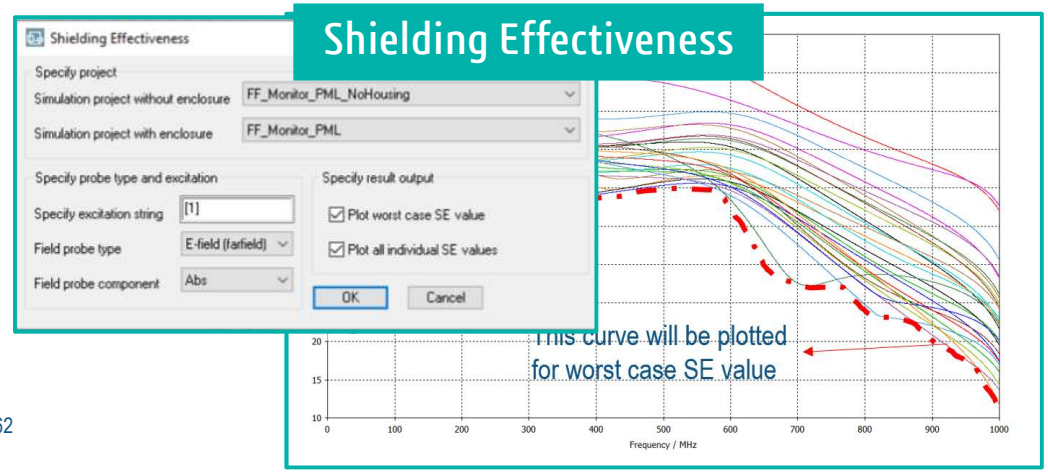
EMC Standard Limits

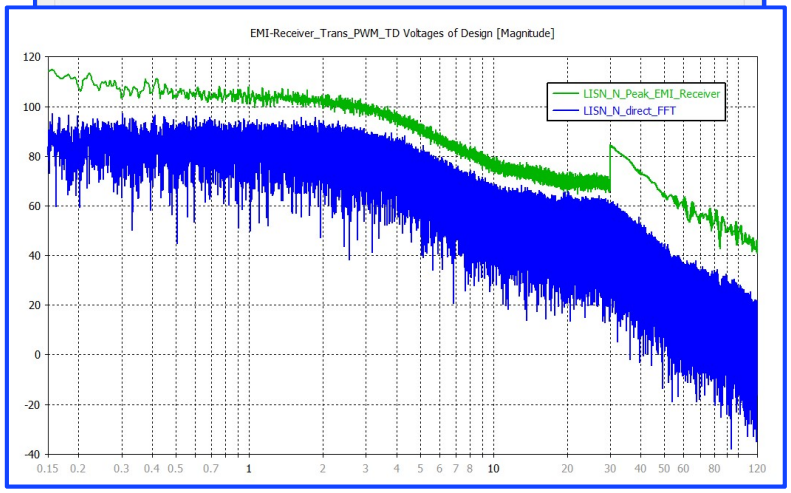


EMI Receiver

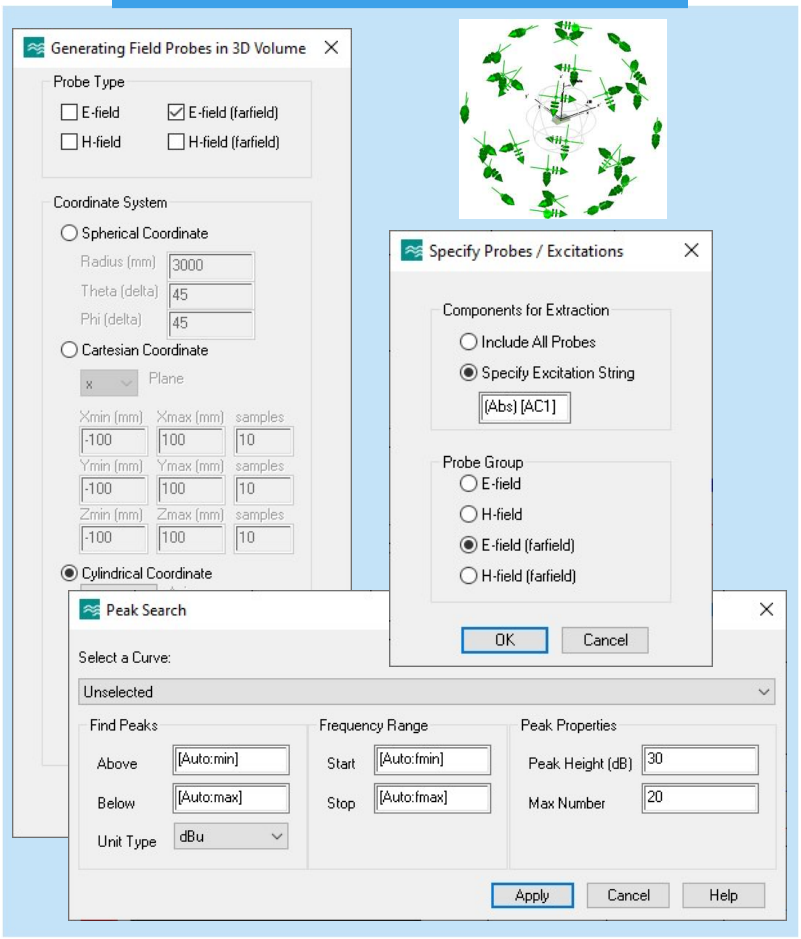


Shielding Effectiveness

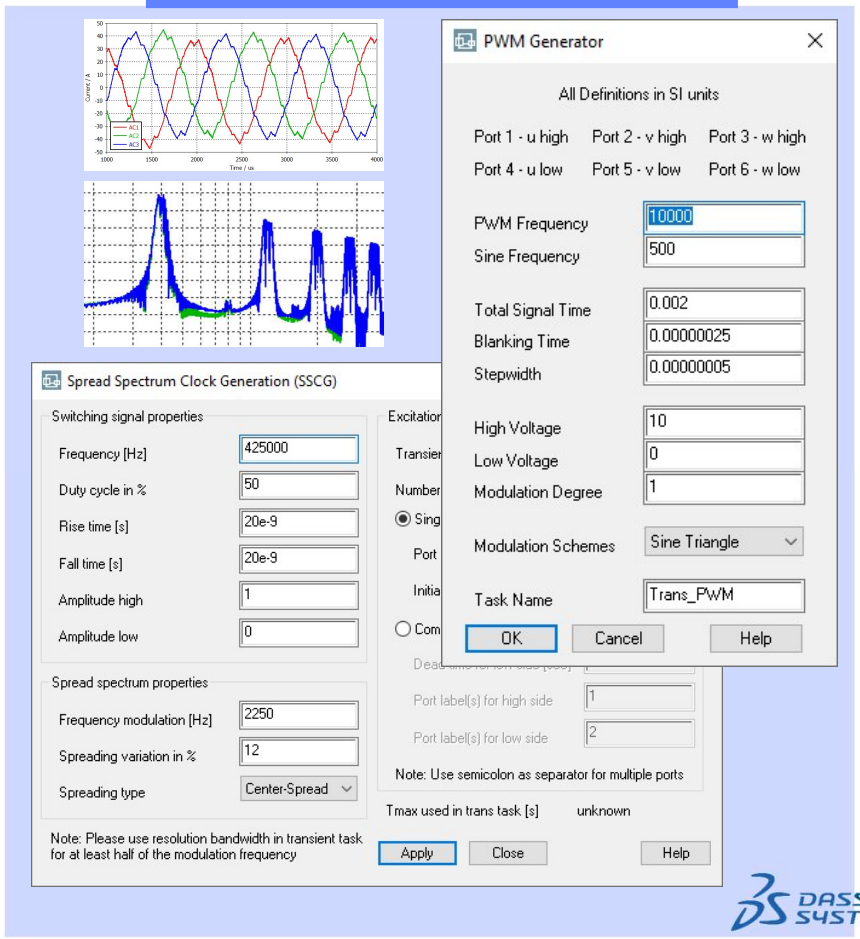




E-, H- field 1D probe features

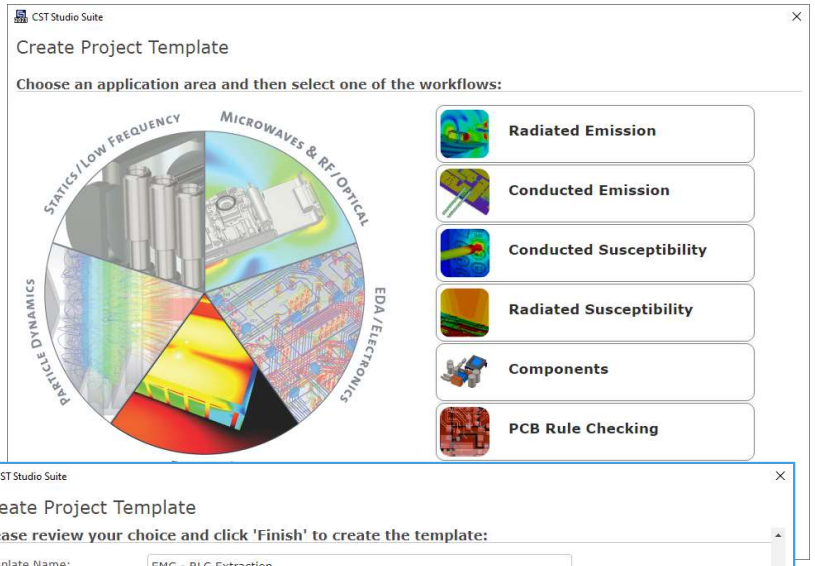


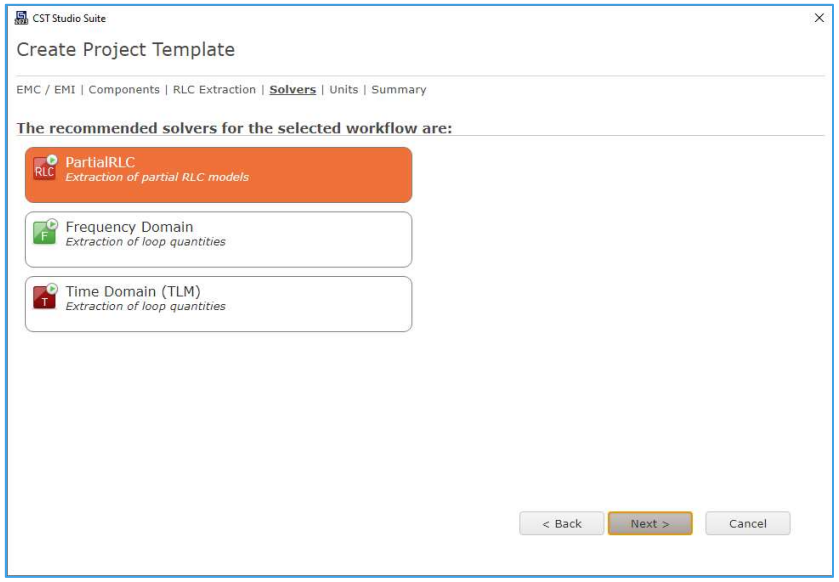
Definition of circuit excitations

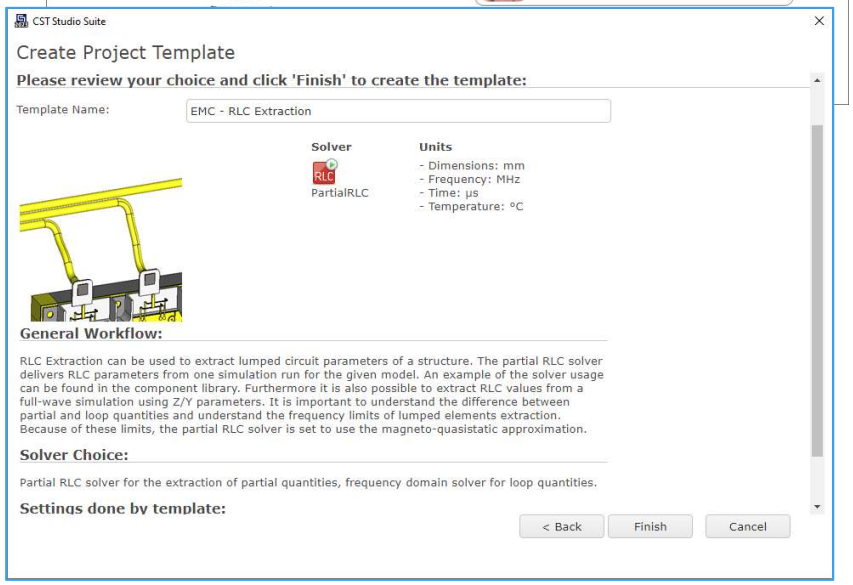


PROJECT TEMPLATE SELECTION

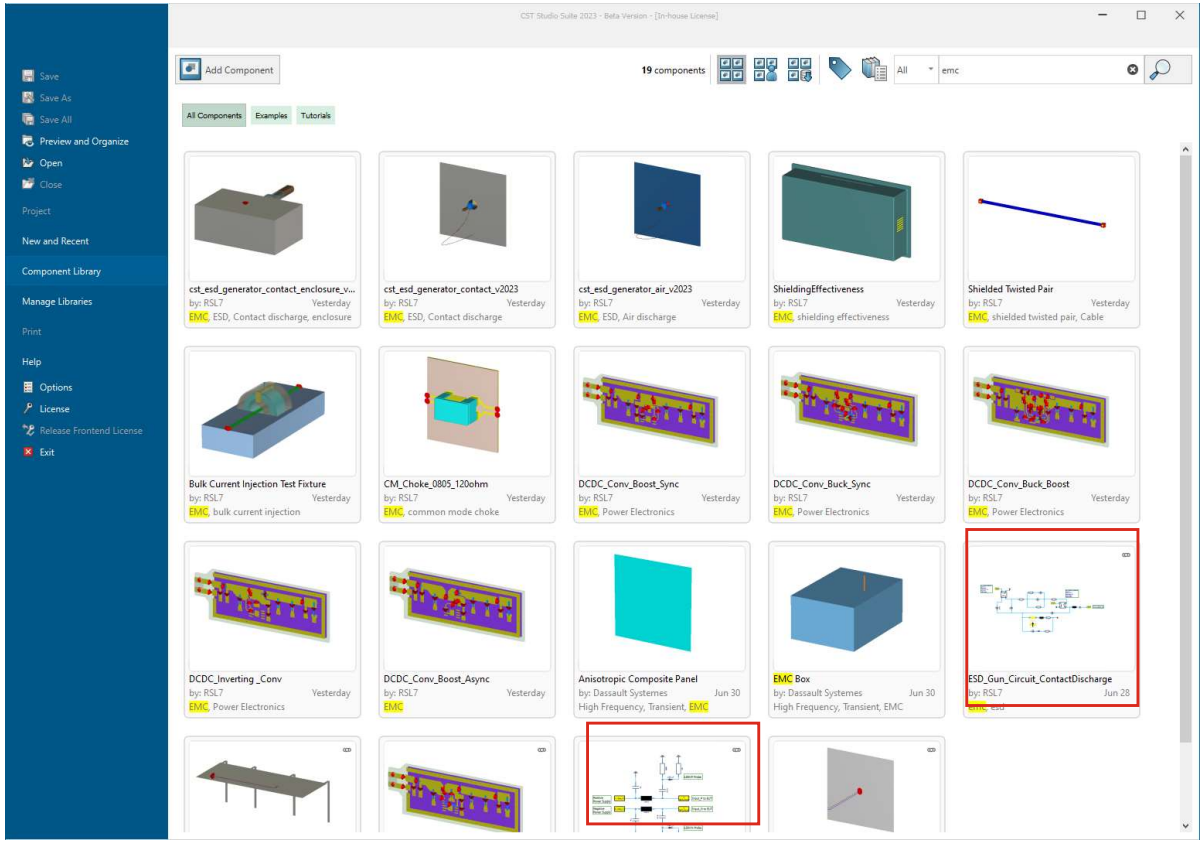
- Highly recommended to use them also in current release
  - Propose best solver,
  - Set up units, boundary conditions, mesh settings, solver settings, monitors, probes
- A major update of EMC project templates in CST Studio Suite ® 2023.







LOAD TEST FIXTURE OR COMPONENT FROM LIBRARY

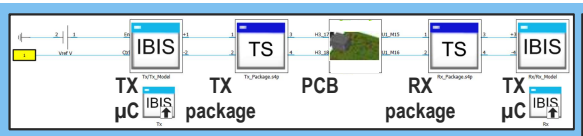


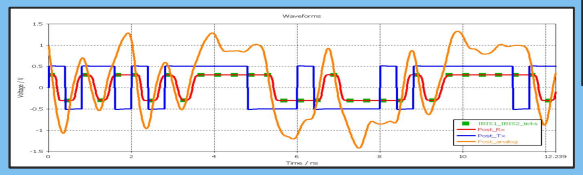
Many more models to come

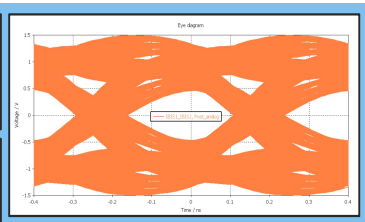
EMAG workflow: From PCB to EMC

Signal Integrity Issues

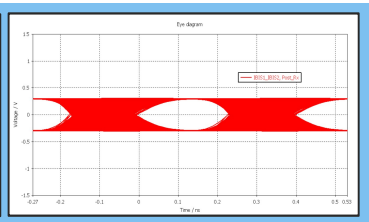
- Ringing
- Crosstalk
- Distortion
- Signal loss
- Power supply noise



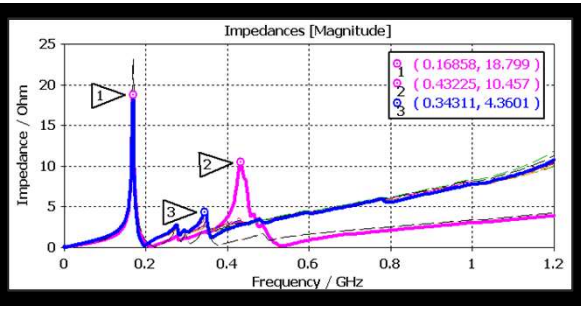


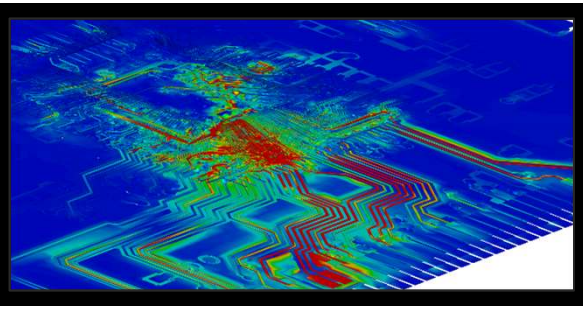


Eye Diagram
Before
Equalization & Clock Recovery



Eye Diagram
After
Equalization & Clock Recovery



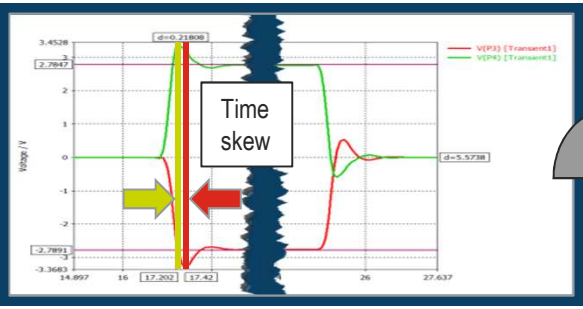


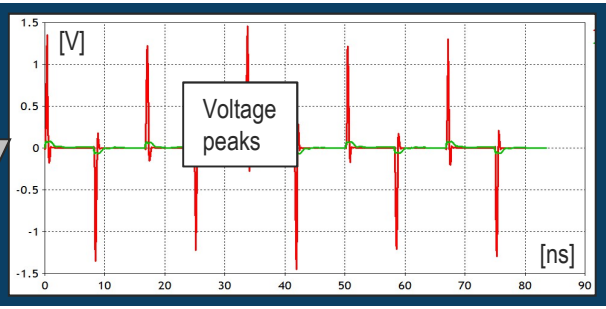
Power Integrity Issues

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

EMC Issues

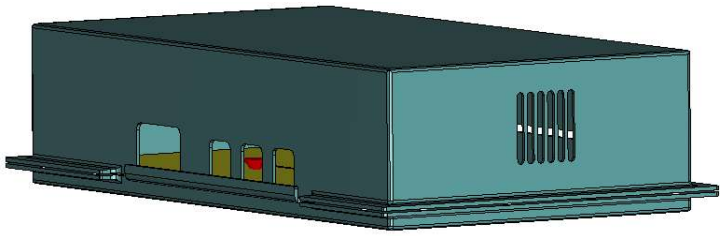
- Imbalances
- Time skew
- Common mode currents
- Conducted emissions
- Radiated emissions

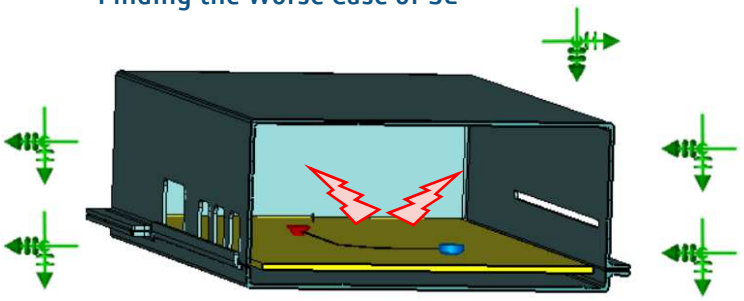


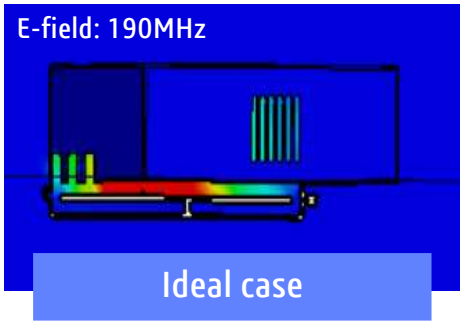


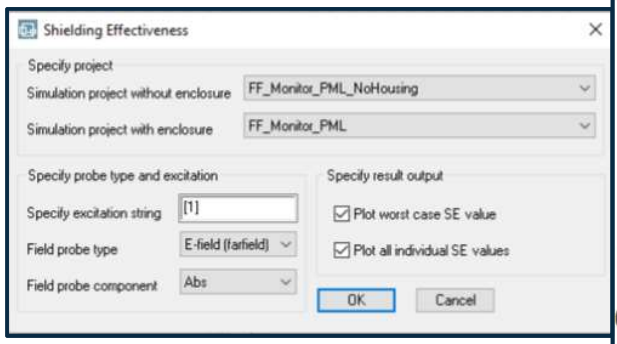
SHIELDING EFFECTIVENESS (SE)

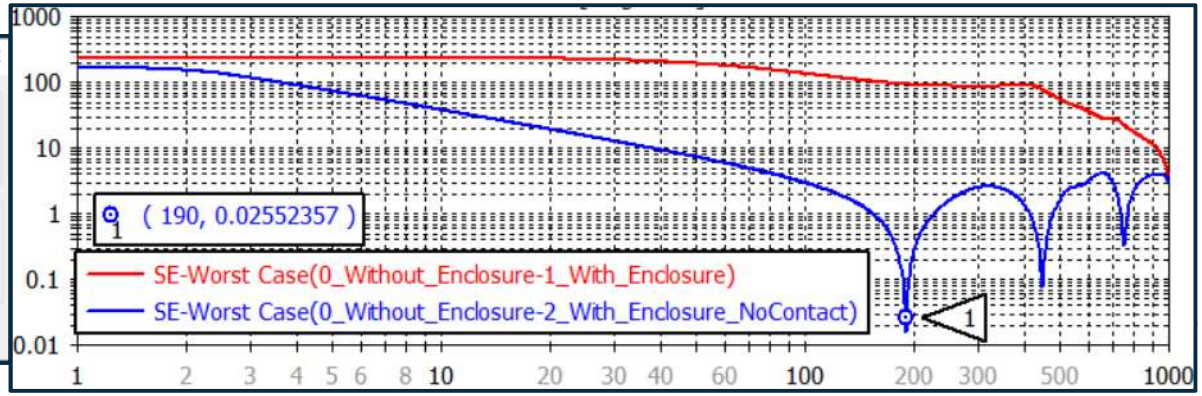
- Model in CST component library
- Frequency Domain Solver
- System Assembly Modeling
- Finding the Worse Case of SE





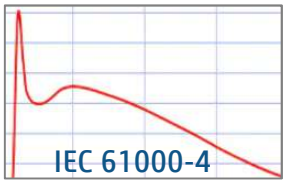


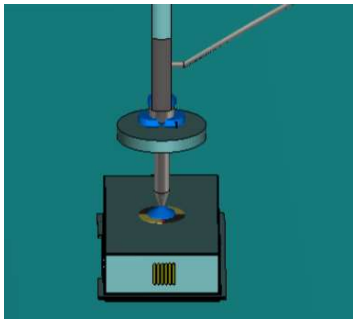


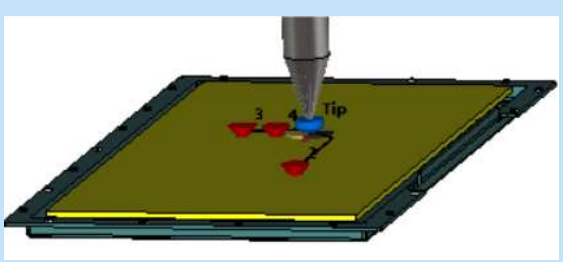


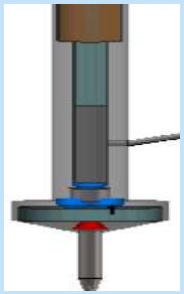
ELECTROSTATIC DISCHARGE (ESD)

- ESD gun model in CST component library
- Time Domain Solver TLM or FIT
- Details of Gun Model
- True Transient Co-Simulation
- Discharge Current Path Visualization

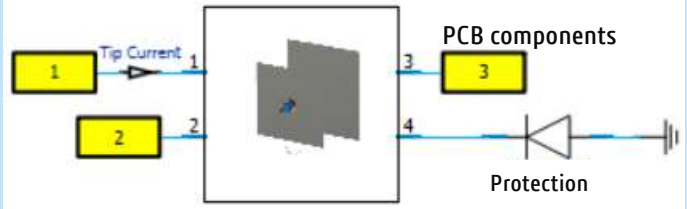


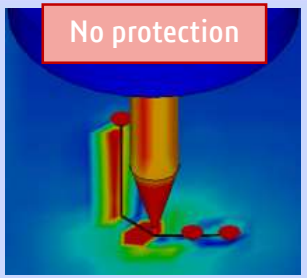


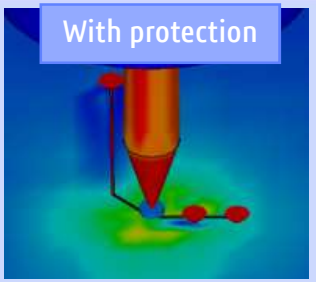


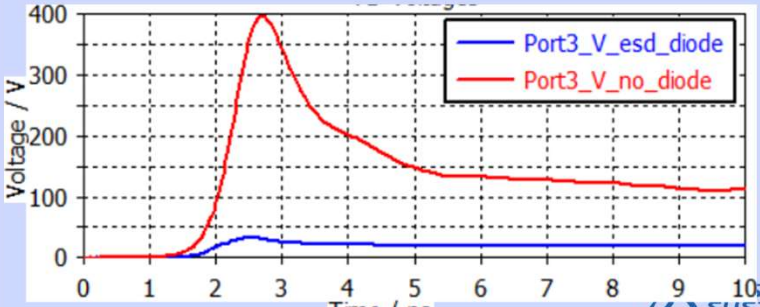


Input



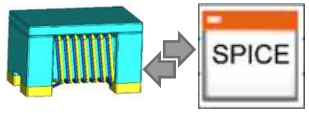


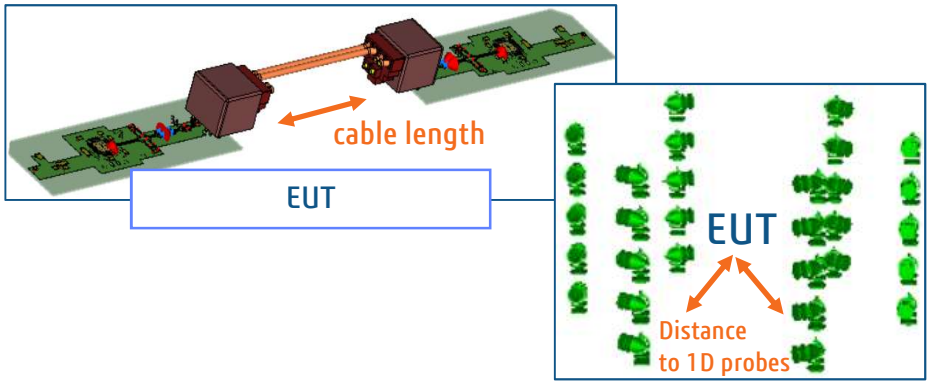


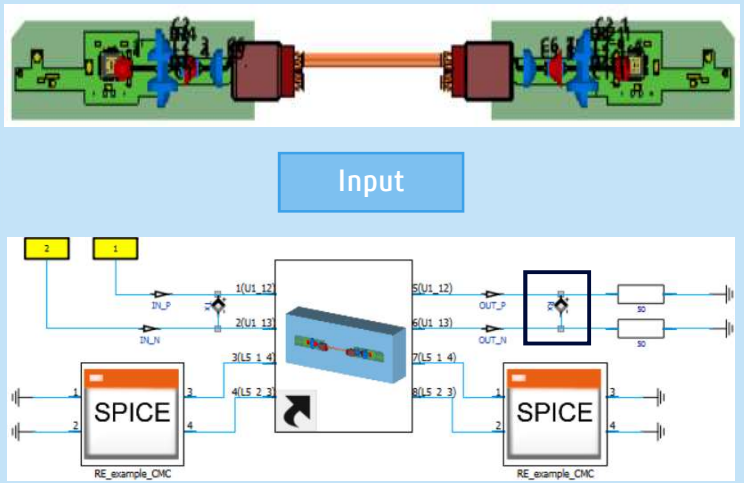


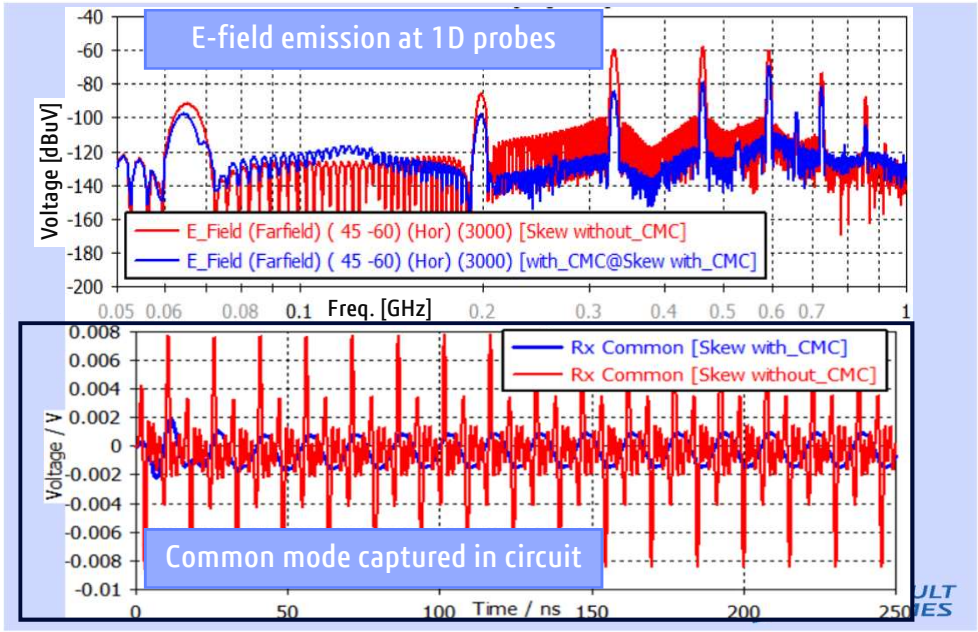
RADIATED EMISSION (RE)

- Frequency Domain Solver
- 3D and Circuit Co-Simulation
- EDA Layout Import
- Common Mode Filtering





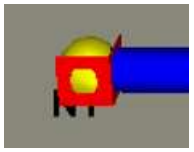




CABLE STUDIO

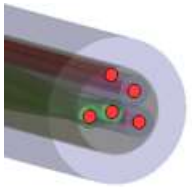
- 2DTL Solver and Time Domain Solver TLM
- Cable Modelling, Impedance Calculator
- Crosstalk Simulation in Shielded Cables
- EM Susceptibility – Field Coupling into Cables

Cable Ports



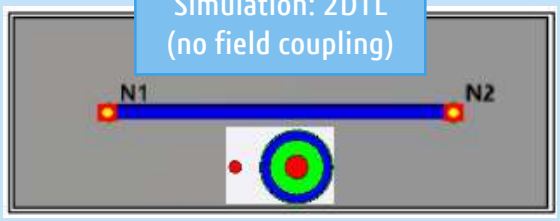
- No more pins in DES
- Sim. can run in MWS only
- 3D Combined Model, MPI, DC

Cable to 3D

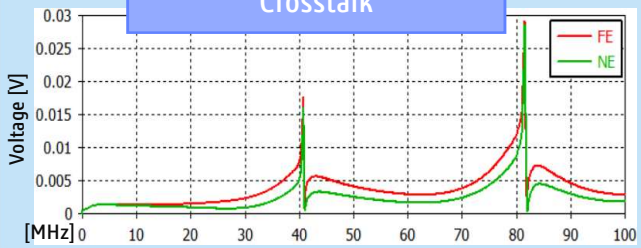


- „In case of doubts, run 3D only“

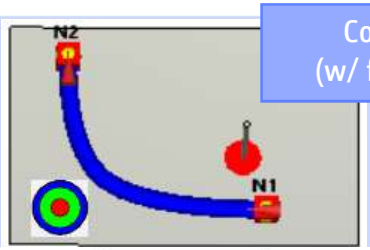
Simulation: 2DTL (no field coupling)

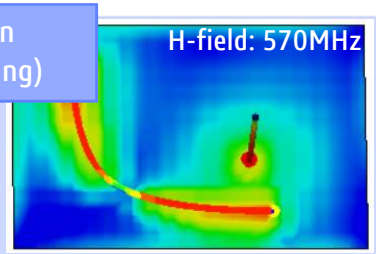


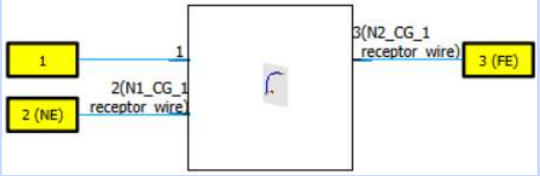
Crosstalk



Co-simulation (w/ field coupling)

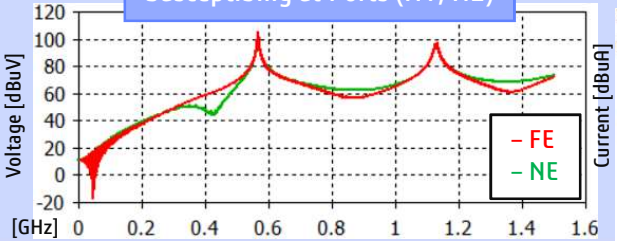




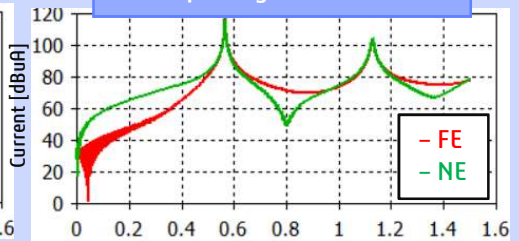


- Standard/Dispersive Model
- 3D Combined Model

Susceptibiliy at Ports (N1, N2)

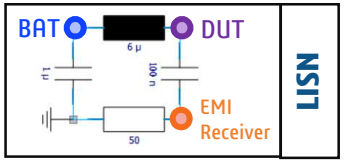


Susceptibiliy at Cable Shield

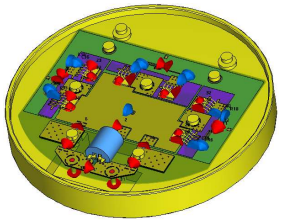


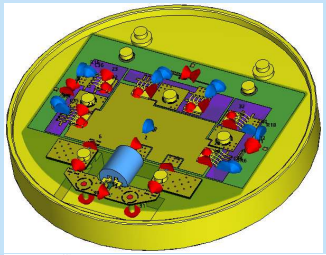
CONDUCTED EMISSIONS (CE): 3-PHASE INVERTER

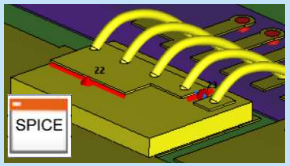
- Frequency Domain Solver
- 3D and Circuit Co-Simulation
- EDA Layout Import
- PWM inverter Control Setup

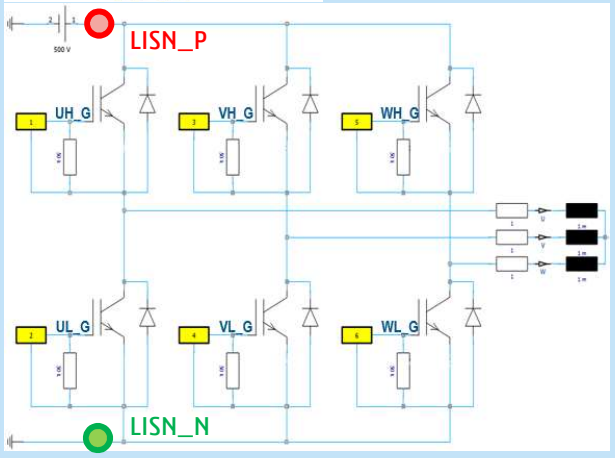


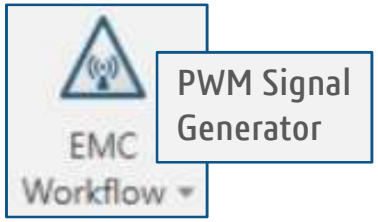
Available in CST component library

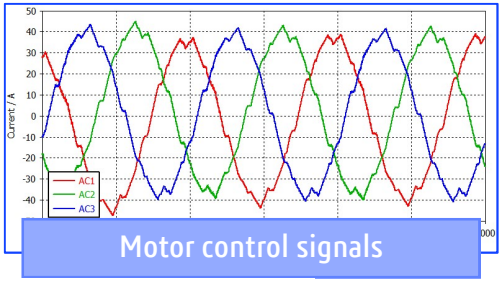


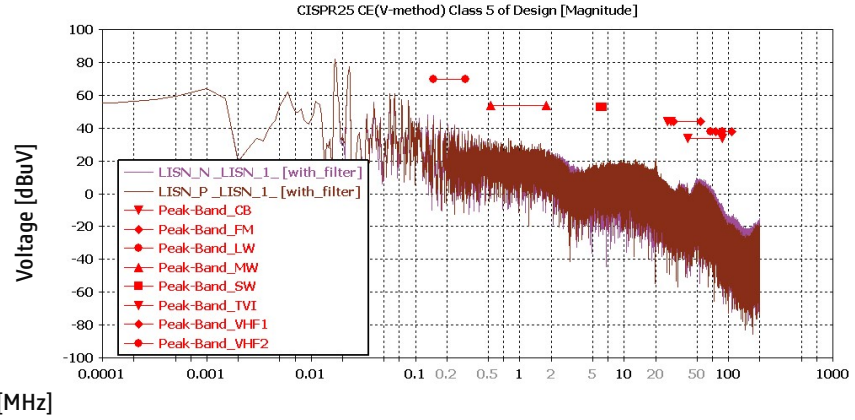






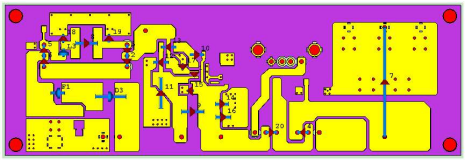


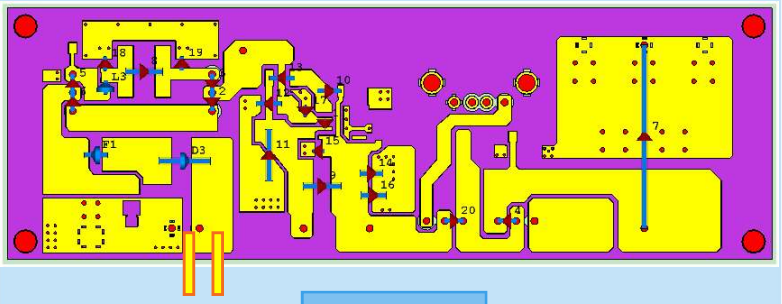




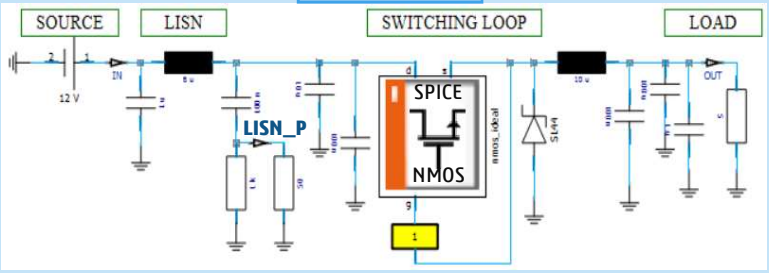
CONDUCTED EMISSIONS (CE): DC/DC CONVERTER

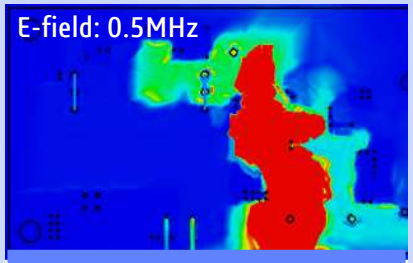
- Frequency Domain Solver
- 3D and Circuit Co-Simulation
- EDA Layout Import
- PWM inverter Control Setup



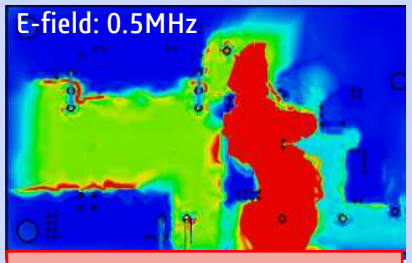


Input

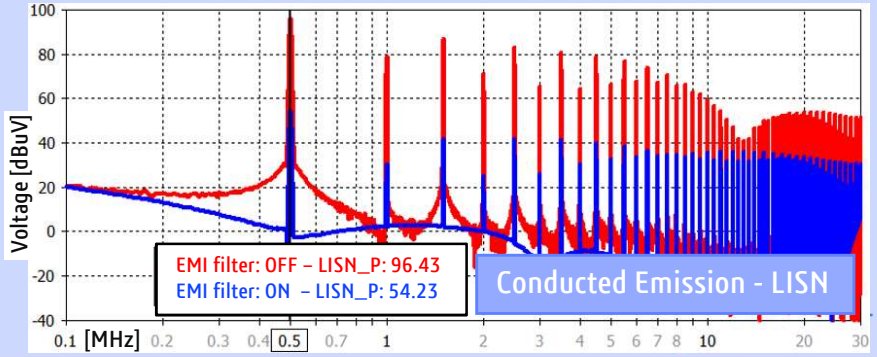


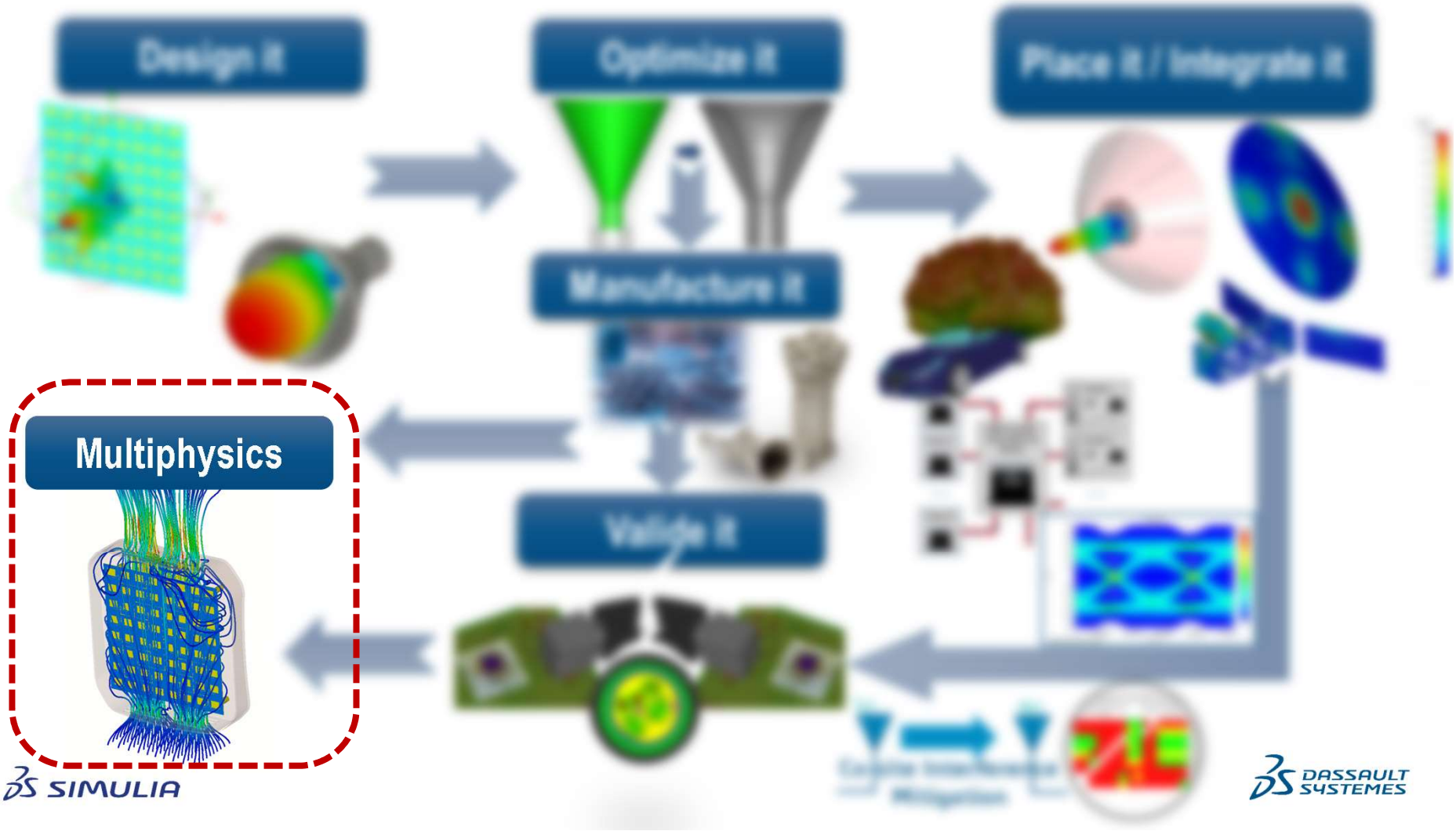


EMI filter: ON



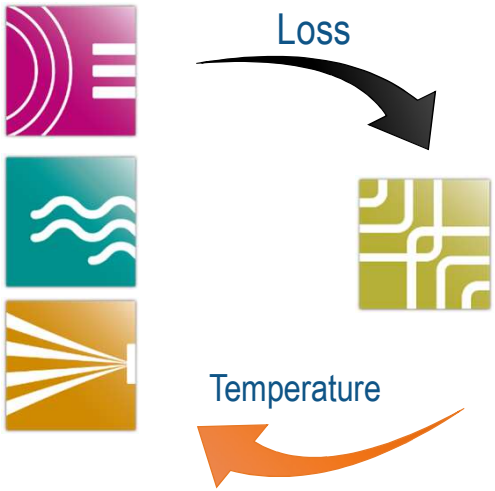
EMI filter: OFF





CST MPHYSICS STUDIO®

Shared GUI
Seamless EM-MPS link



Classic Thermal

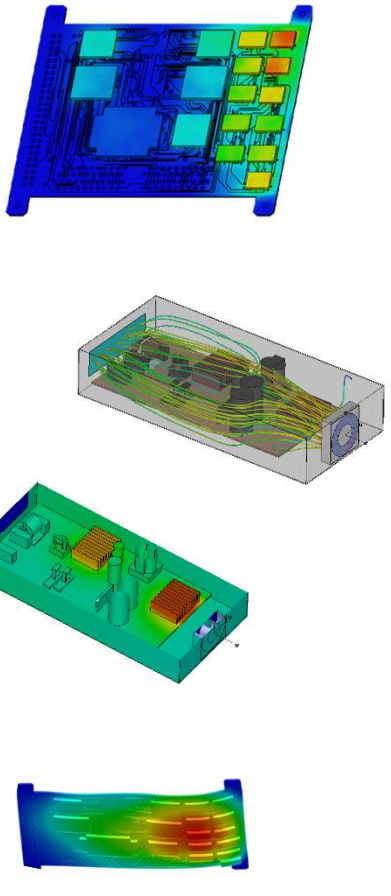
- Steady State and Transient
- Tet and Hex Meshes
- Moving Media
- Bio-heat transfer

Conjugate Heat Transfer

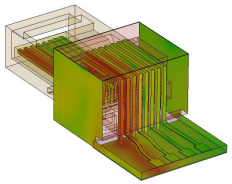
- Solve thermal conduction, convection and radiation using CFD
- Laminar and turbulent flow
- Octree meshing, GPU support
- Fan, flow resistance, compact IC model, automatic altitude correction

Structural Mechanics

- Tet mesh, displacement, force b.c.
- Thermal stress from temp distribution

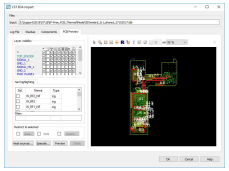


EXISTING ELECTRONICS COOLING FEATURES



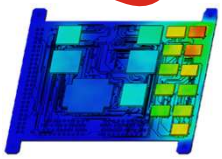
EMag-Thermal Link
(Including IR-Drop)

GPU

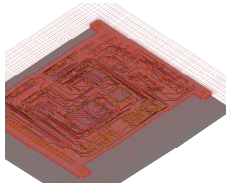


EDA Import

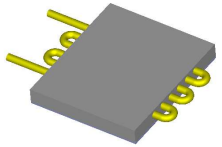
2022



Simulate PCB
with Full Details

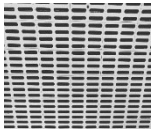


Meshing

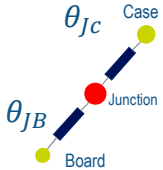


Multi-fluid

Fan



Flow
Resistance



2-R Model

TIM

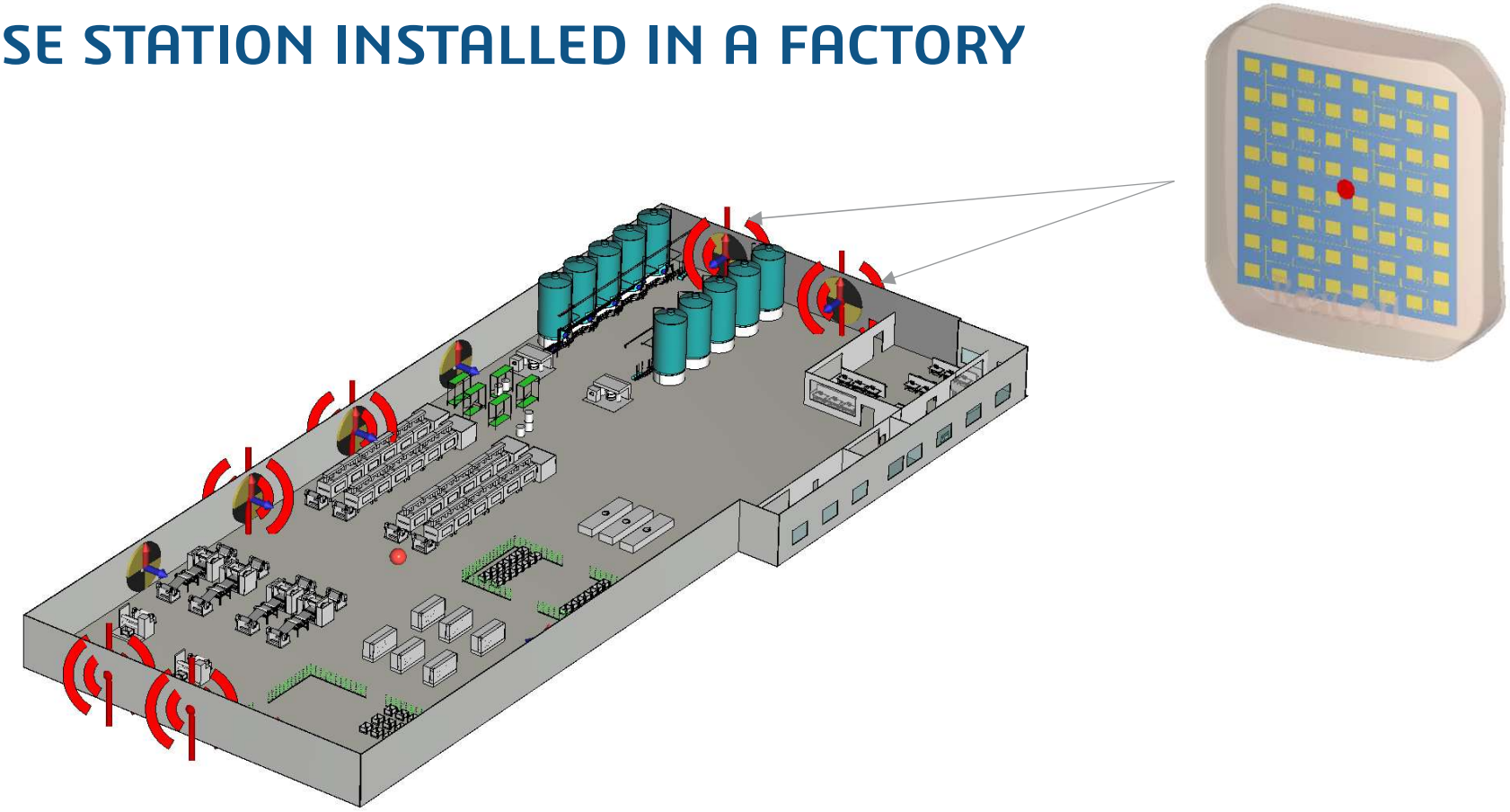
2022

Heat Pipe

2022

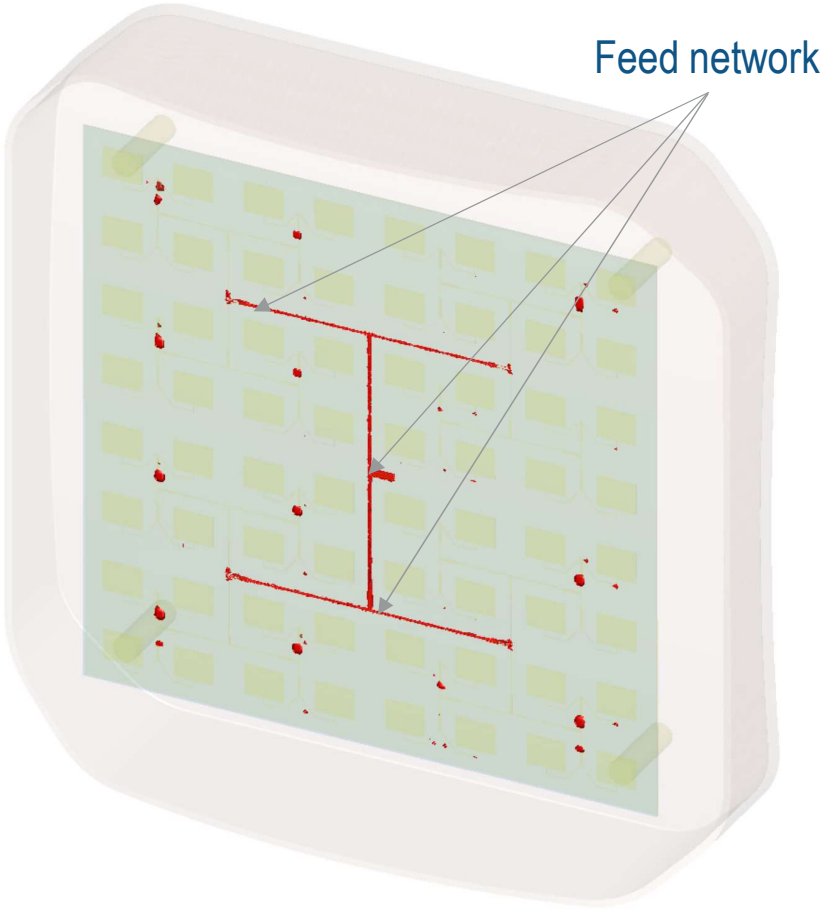
Thermal
Electric Cooler

BASE STATION INSTALLED IN A FACTORY



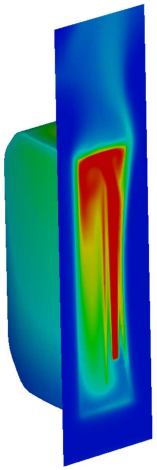
‘Hot’ Spots

- Antenna elements may not be the problem
- However, the first part of the feed network, before signal splits, because of the relatively high power, has significant loss close to the input
- This section of the network may be sensitive to heating, we will take a closer look in this area

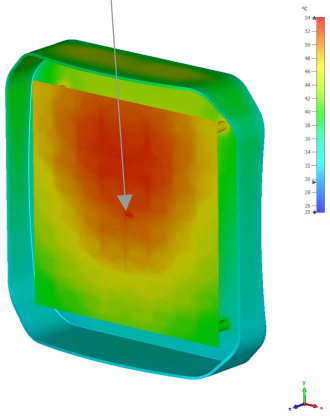


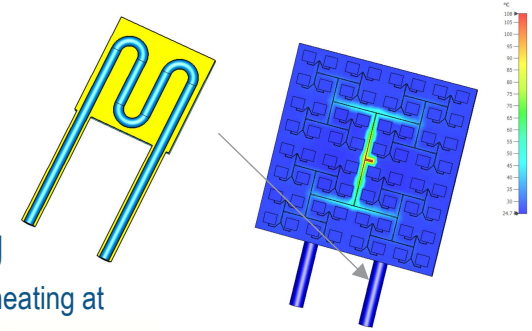
Loss (heat) Map

COOLING SOLUTIONS



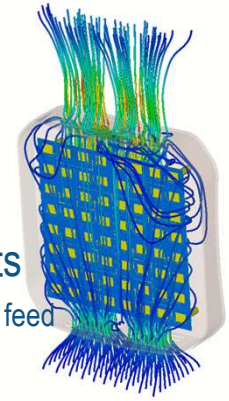
Temperature reached 53°C
on the main antenna feed

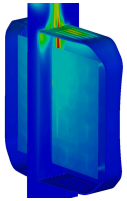


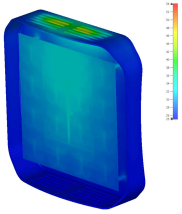


Heat pipes/liquid cooling

- Effective but expensive (local heating at feeder point)

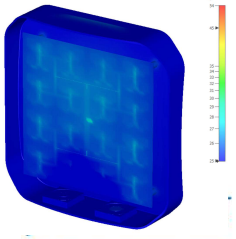






Passive cooling using slots

- Temperature at the main antenna feed reduced by 18°C, at ~35°C



Active cooling using fans

- ~ 27°C Temperature Reduction!

THERMAL-RELATED FILTER DETUNING WORKFLOW

Automated simulation projects within the Circuits & Systems environment