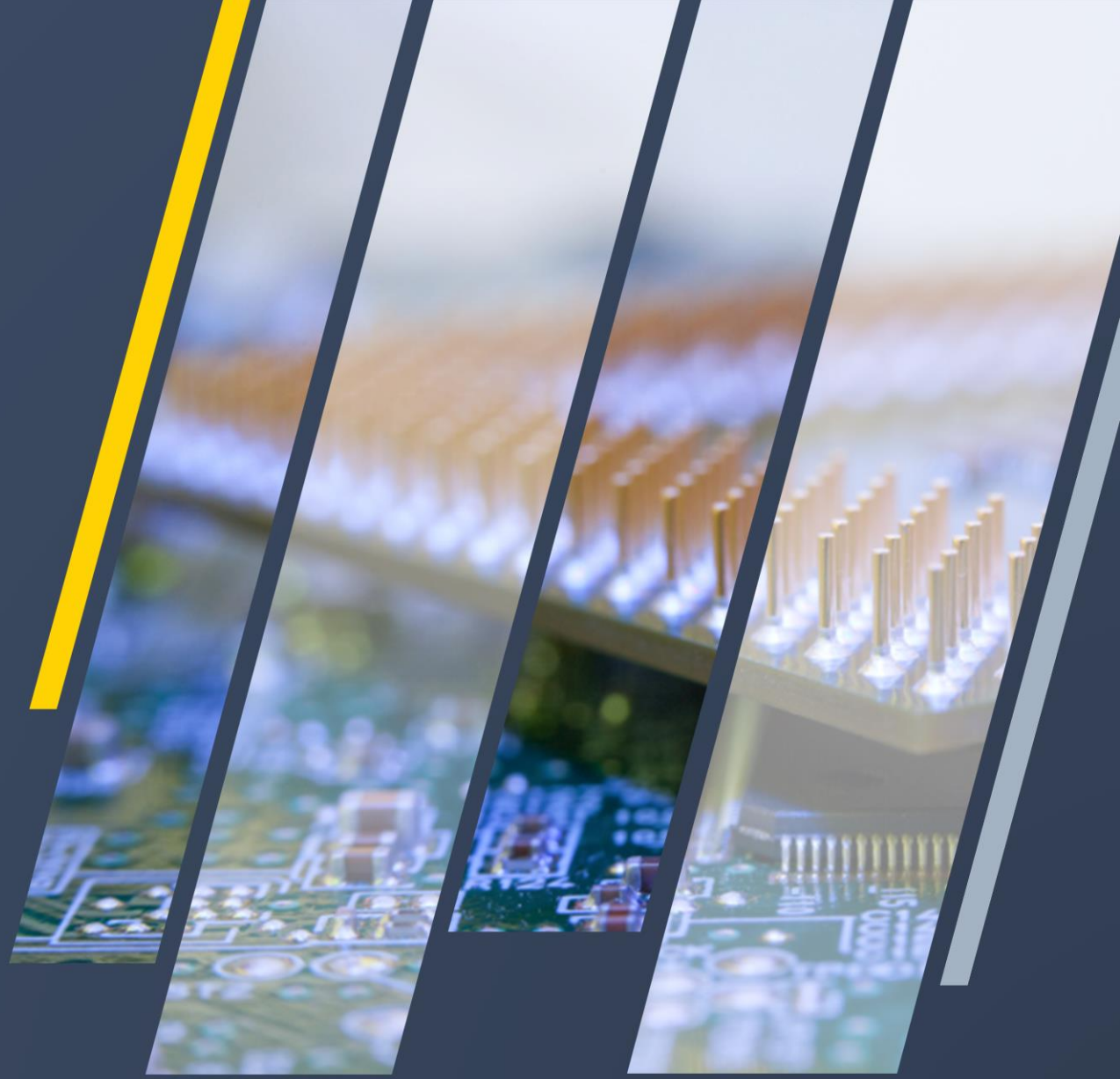
ANSYS®

2019 R2 Highlights High Frequency Electromagnetics



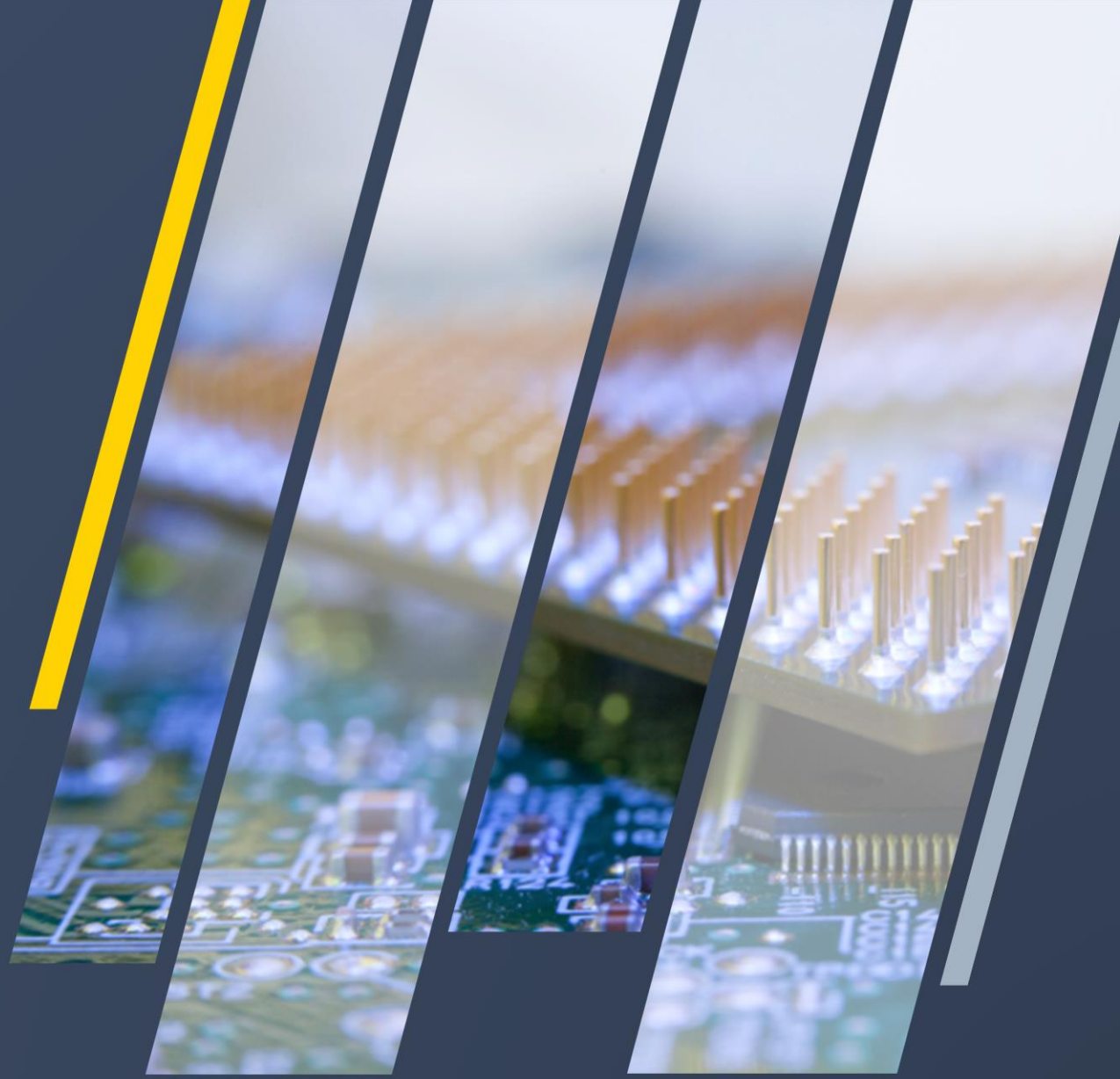
What's New for High Frequency in ANSYS 2019 R2

- Auto-solution setup with ***Fast*** HFSS Solve Mode
- Faster HFSS field recovery process
- Save fields with HFSS 3D interpolating sweep
- Circuit port in HFSS 3D
- Fast ADAS simulation with *Accelerated Doppler Processing*
- SBR+ current source conformance and efficiency option
- SBR+ gain, S-parameter data with linked HFSS 3D designs
- HFSS 3D Layout improved mesh feedback
- HFSS 3D Layout new HFSS-PI solver
- Modelithics 3D Component library installed
- SBR+ Creeping Wave physics for RCS modeling (beta)
- Multi-paction Analysis (beta)
- Support for IEC 62704-4 FEM SAR certification (beta)

© 2019 ANSYS, Inc.

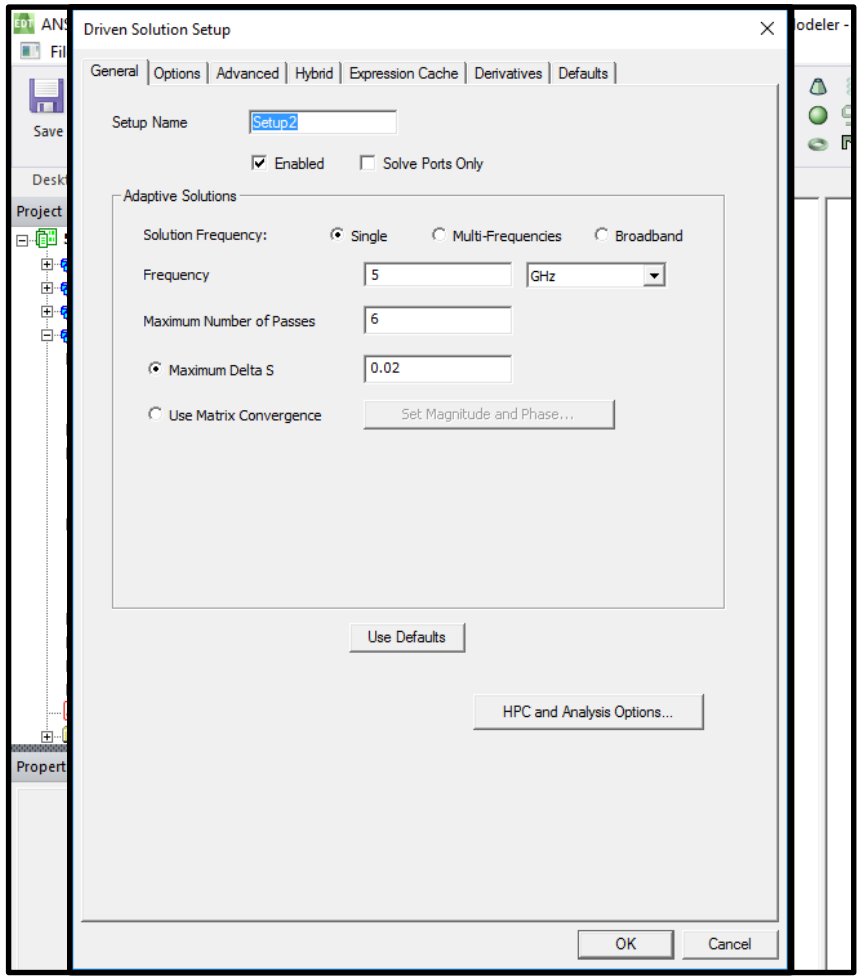
ANSYS®

HFSS



New HFSS Auto Solution Setup with Fast Solver Mode

- Auto… Minimal user input for solve setup
  - Use ANSYS expertise to automatically determine best meshing strategy
- Inputs
  - Frequency sweep
  - *Higher Speed – Balanced – Higher Accuracy* slider bar selection
- Higher Speed optimized for fast results with reasonable accuracy
  - Strategy for earlier design cycle runs requiring rapid iterations
- Higher Accuracy setting for most reliable results
  - Strategy for design sign-off
- Advanced… The “traditional” user setup
  - Provides user with more detailed control of mesh and solver settings



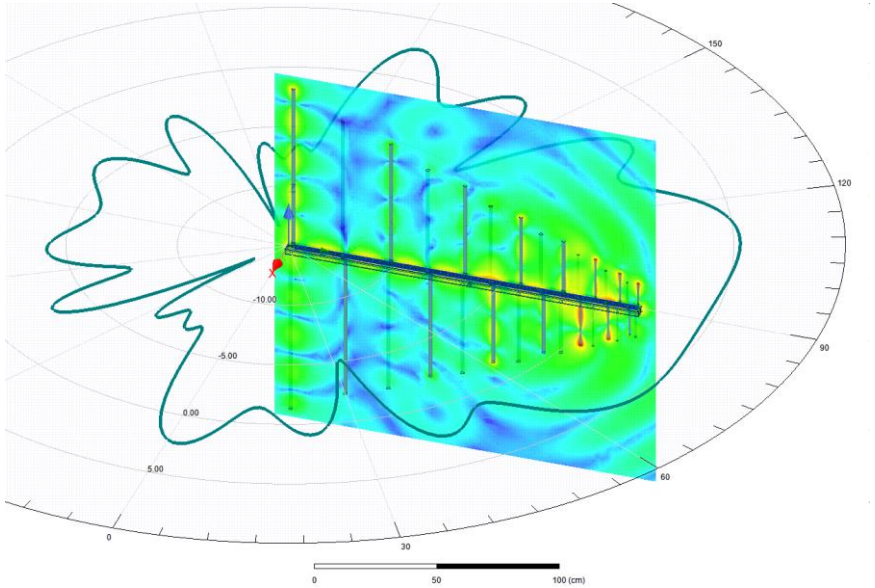
© 2019 ANSYS, Inc.
ANSYS Confidential

Auto: A New HFSS Paradigm

	2019 R1	2019 R2
User Responsibility	Problem Setup Geometry, materials, BCs, Ports	Problem Setup Geometry, materials, BCs, Ports
	Mesh Setup Accuracy	Frequency Sweep Accuracy
	Frequency Sweep	**Mesh Setup**
ANSYS Responsibility	**Matrix Assembly**	**Matrix Assembly**
	Matrix Solve	**Matrix Solve**
	Adapt	**Adapt**
	Post-process	Post-process

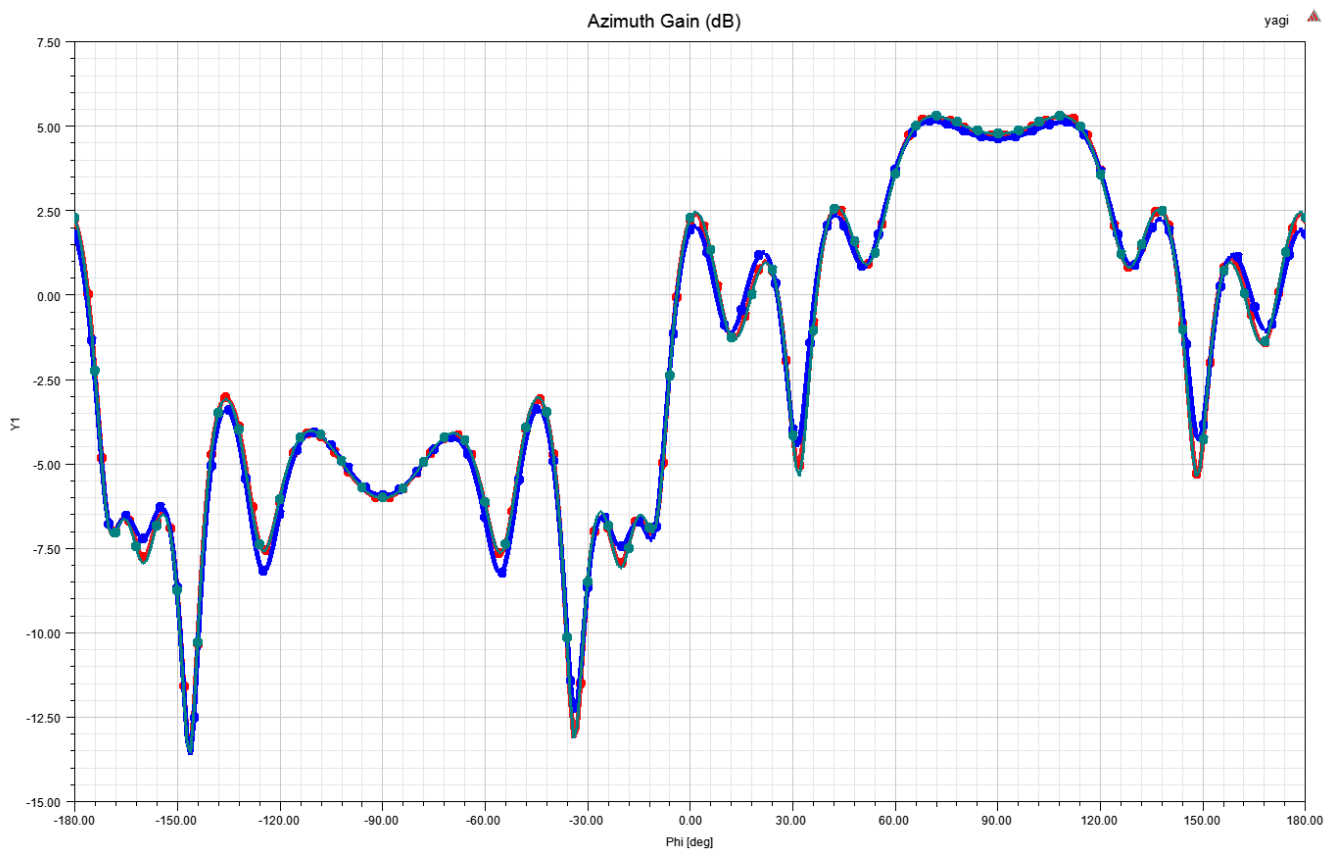
© 2019 ANSYS, Inc.

Auto Solution Setup Results: Yagi Antenna



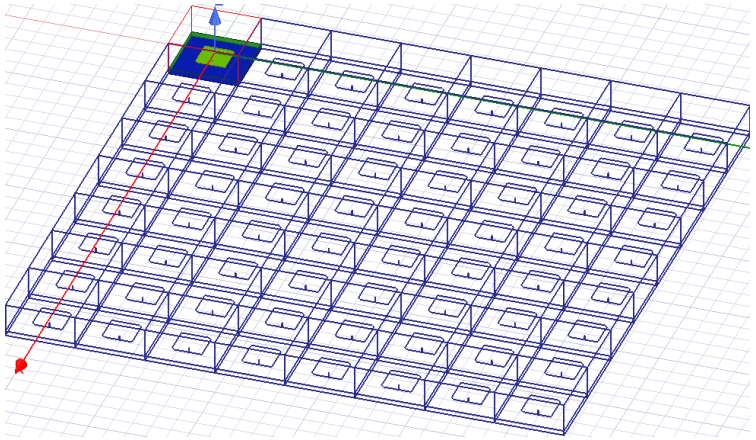
	Fast	Balanced	Accurate
Time	00:05:53	00:08:45	00:29:09
Memory	4.89 GB	7.4 GB	42.13 GB

- Yagi antenna @ 850 MHz
- Trade off memory and time for reasonable accuracy
- Allow for rapid early design iteration

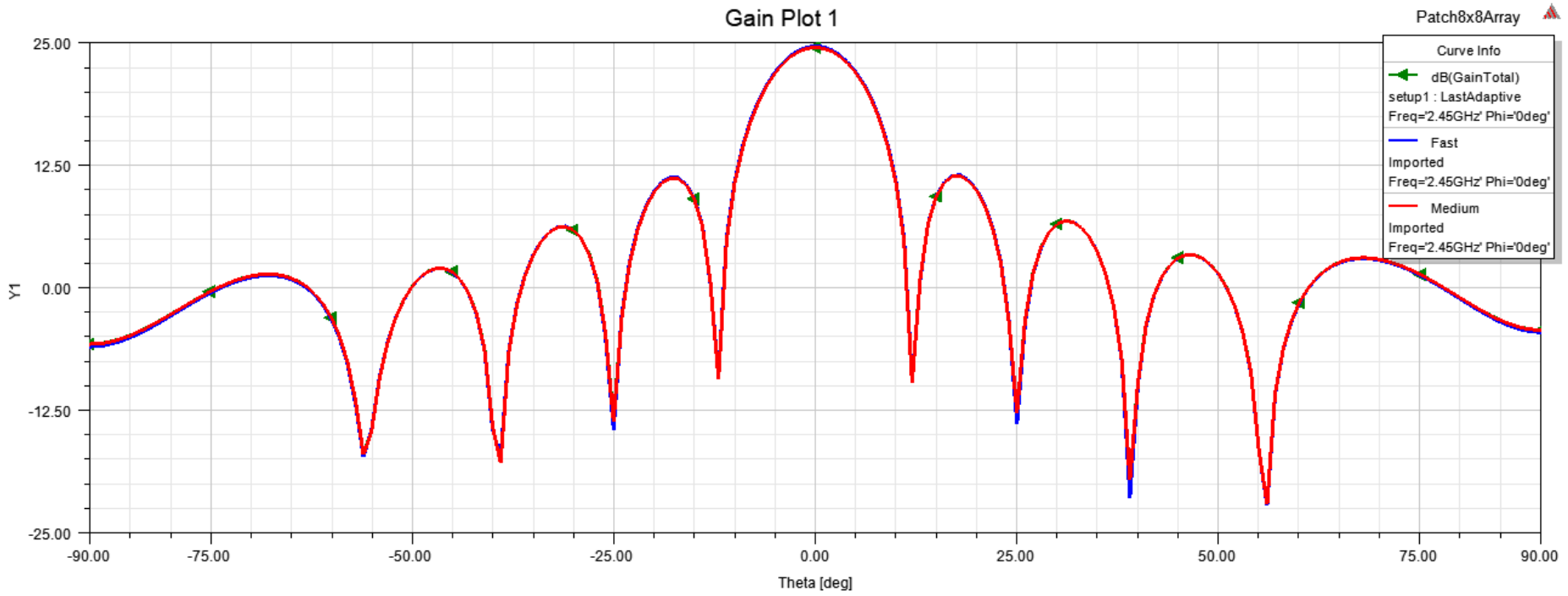


© 2019 ANSYS, Inc.

Auto Solution Setup Results: Antenna Array



	Fast	Medium	Accurate
Time	00:16:41	00:46:54	00:59:42
Memory	2.7 GB	6.63 GB	6.2 GB



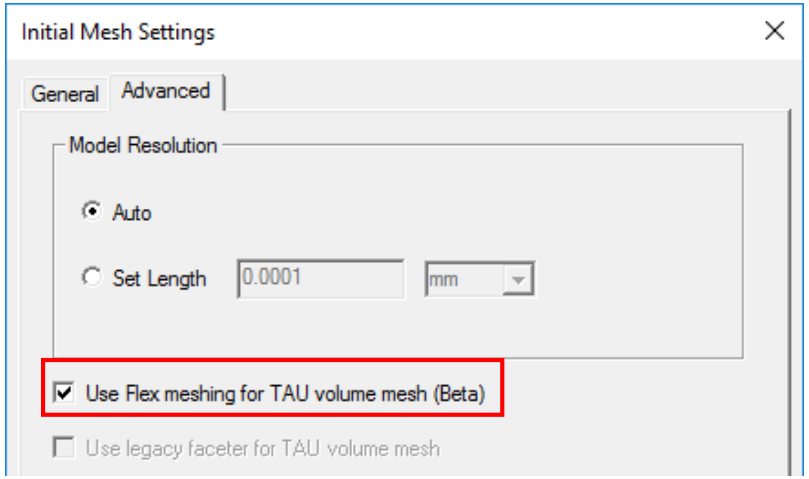
© 2019 ANSYS, Inc.

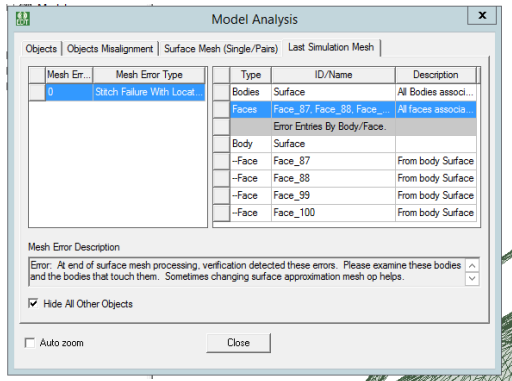
New Tolerant Option for TAU Mesher (Beta)

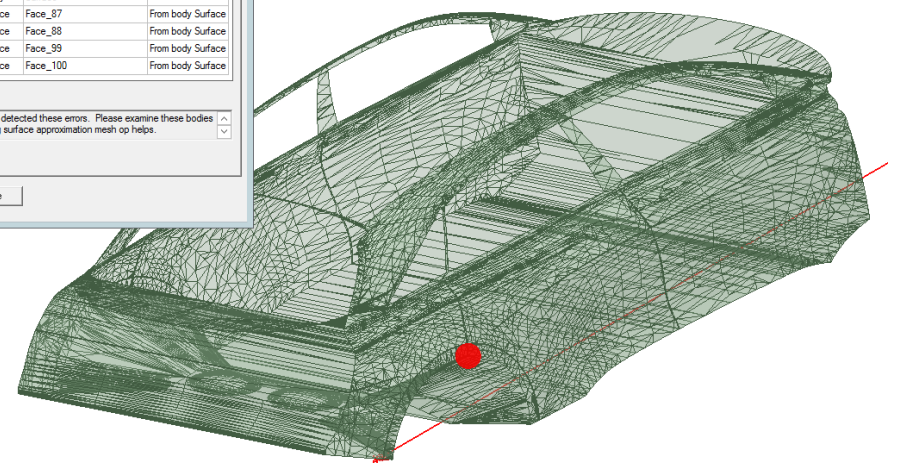
- **Geometry meshing challenge**
  - With the rigorous and reliable approach of FEM everything is included in the simulation
  - Geometry is not always “clean”: Bad translation, poor CAD modeling

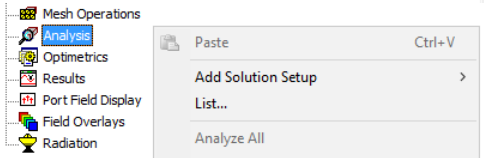
- **New meshing technic to handle complex and “dirty” geometries**
  - Deliver full fidelity mesh in priority regions
  - Relax the requirements in user defined non-critical regions

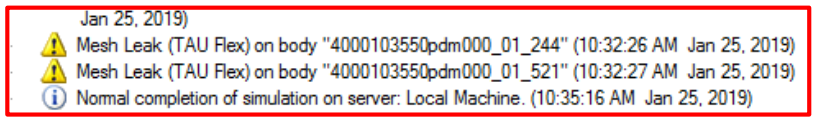
- **Provide feedback to the user regarding the initial mesh**
  - Make aware of problem regions and help making further decisions
  - Highlight the regions where geometry is modified
  - Review errors and warnings to validate the mesh







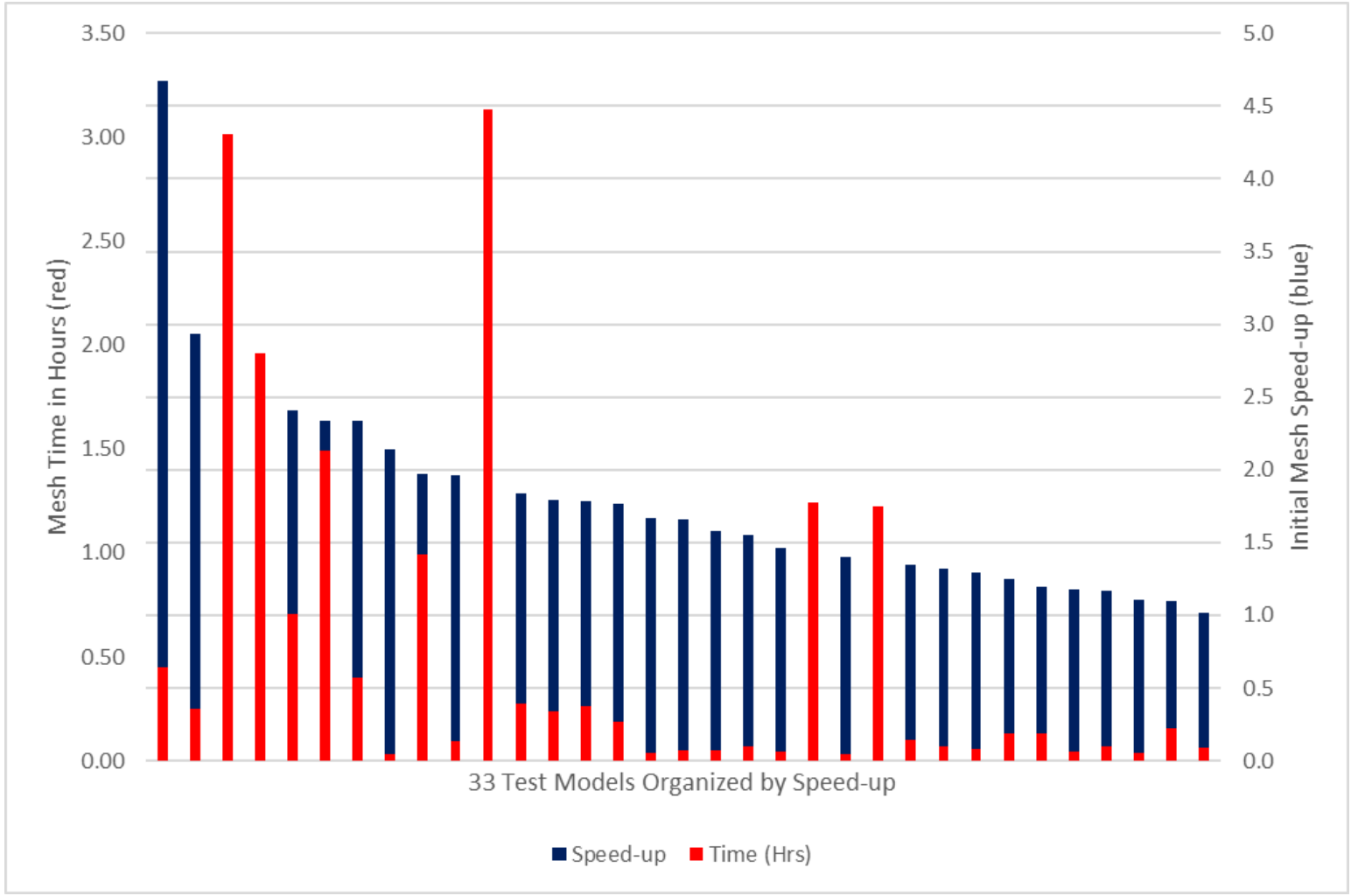




© 2019 ANSYS, Inc.
ANSYS Confidential

TAU Flex Meshing (Beta)

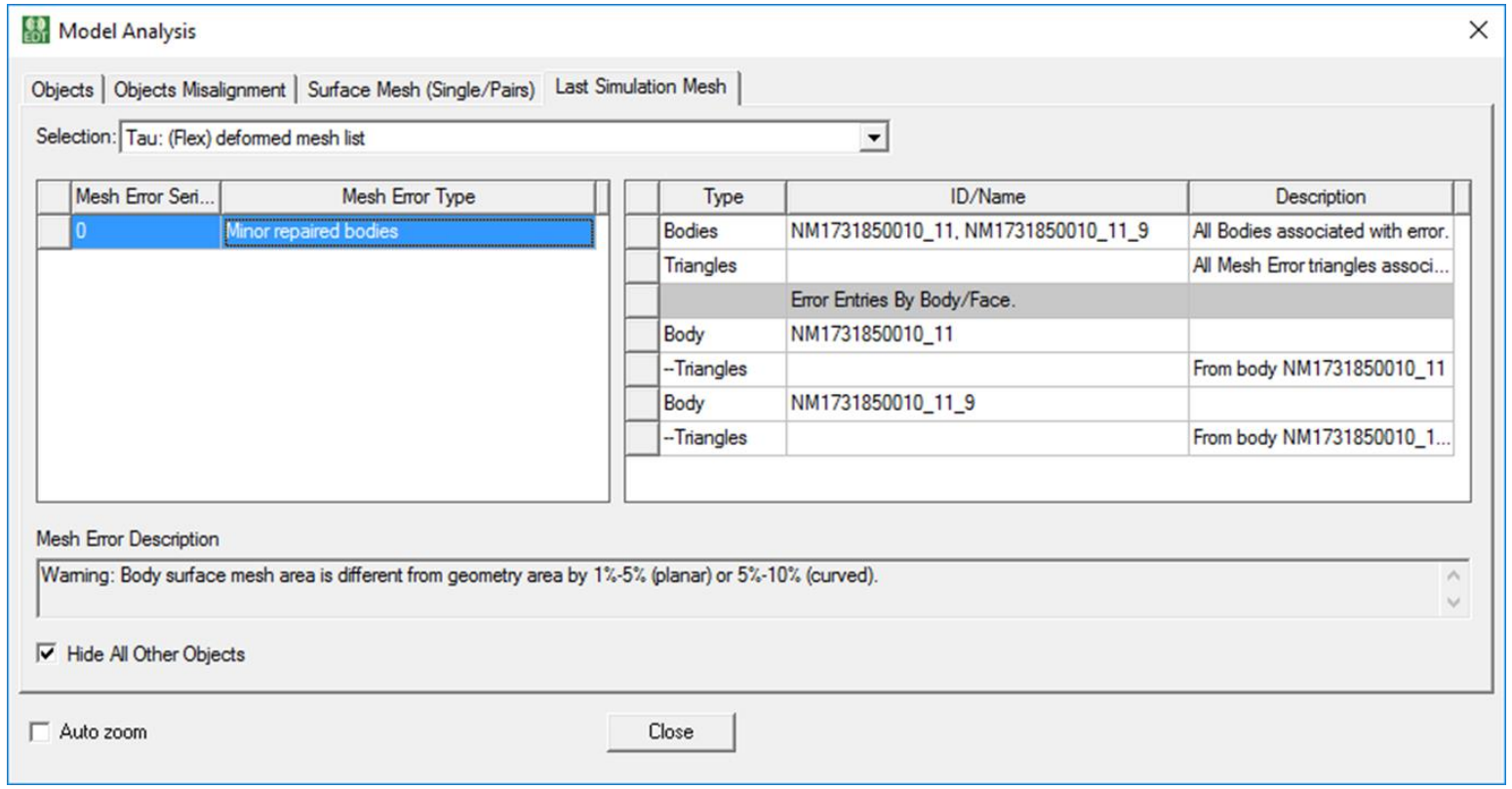
- **New meshing technology introduced in 2019 R2**
  - More robust, faster
- **33 example connectors tested**
  - Average speed up: 1.8
  - Average time saving 0.5 hrs
- **Detailed feedback when meshing fails**

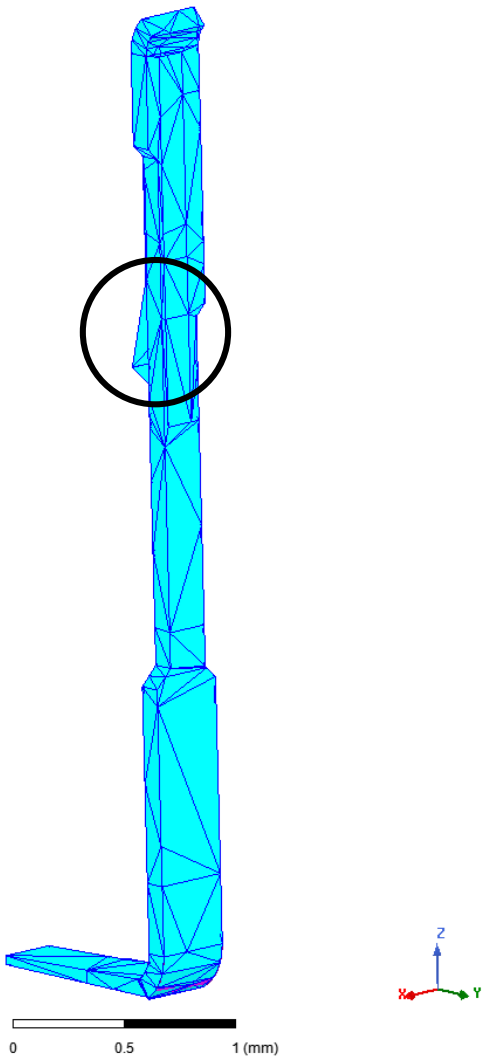


© 2019 ANSYS, Inc.

Feedback Example: Connector on PCB Model

- Feedback identified parts with mesh issue
  - Selected. Plotted mesh. Observed ‘leak’. Easy to fix.
    - Overly aggressive mesh op to minimize initial mesh size
    - Reverted to defaults for mesh and returned clean mesh in 1/5 time of TAU

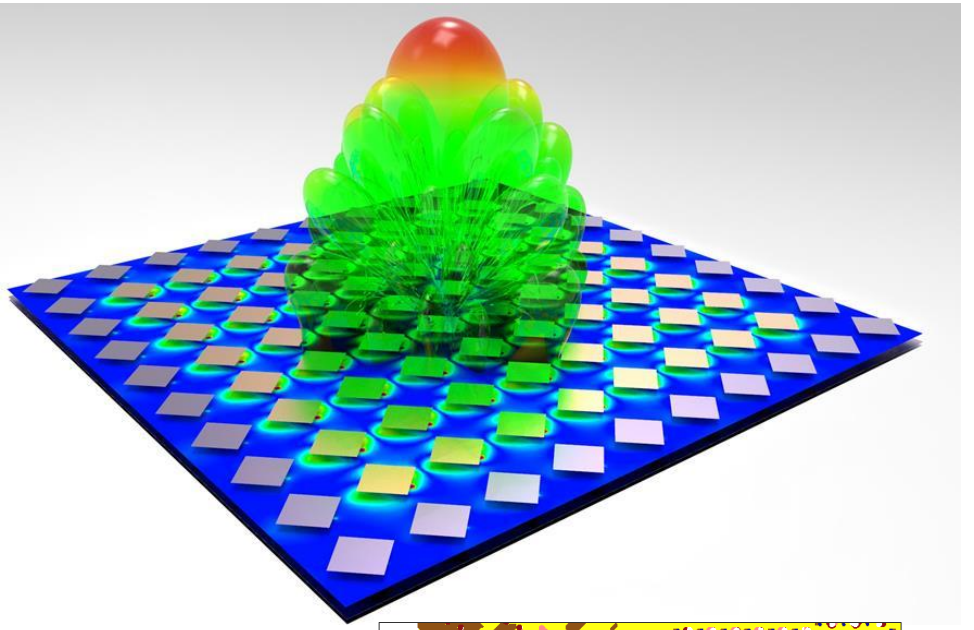




© 2019 ANSYS, Inc.

Speed up of Field Recovery Computation

- **Field recovery can be significant for designs with large port counts**
- **Performed software optimization to improve the performance**

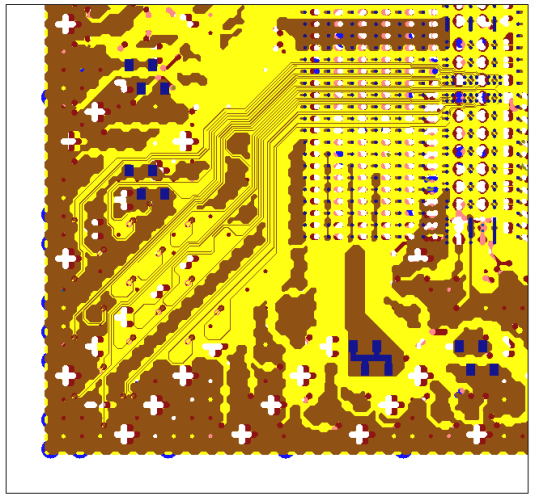


Adaptive Meshing Fr...				
Simulation Setup	00:06:25	00:06:15	5.87 G	Disk = 0 Bytes
Matrix Assembly	00:29:31	00:35:53	65.6 G	Disk = 28.5 MBytes, 2823153 tetrahedra, 904 lumped port(s)
Solver DCS32	03:07:54	78:18:21	749 G	Disk = 715 Bytes, matrix size 19707498 , matrix bandwidth 24.3
Field Recovery	02:39:41	77:58:28	749 G	Disk = 95.4 MBytes, 904 excitations
Data Transfer	00:00:00	00:00:00	5.21 G	Adaptive Pass 1
				Adaptive Passes did not converge
Adaptive Meshing				Elapsed time: 06:29:35

2019 R1

Adaptive Meshing Fr...				
Simulation Setup	00:06:29	00:06:19	5.99 G	Disk = 0 Bytes
Matrix Assembly	00:30:50	00:36:59	65.7 G	Disk = 28.5 MBytes, 2823153 tetrahedra, 904 lumped port(s)
Solver DCS32	03:09:25	79:51:00	750 G	Disk = 715 Bytes, matrix size 19707498 , matrix bandwidth 24.3
Field Recovery	00:47:51	22:58:09	750 G	Disk = 95.4 MBytes, 904 excitations
Data Transfer	00:00:00	00:00:00	5.19 G	Adaptive Pass 1
				Adaptive Passes did not converge
Adaptive Meshing				Elapsed time: 04:37:12

2019 R2



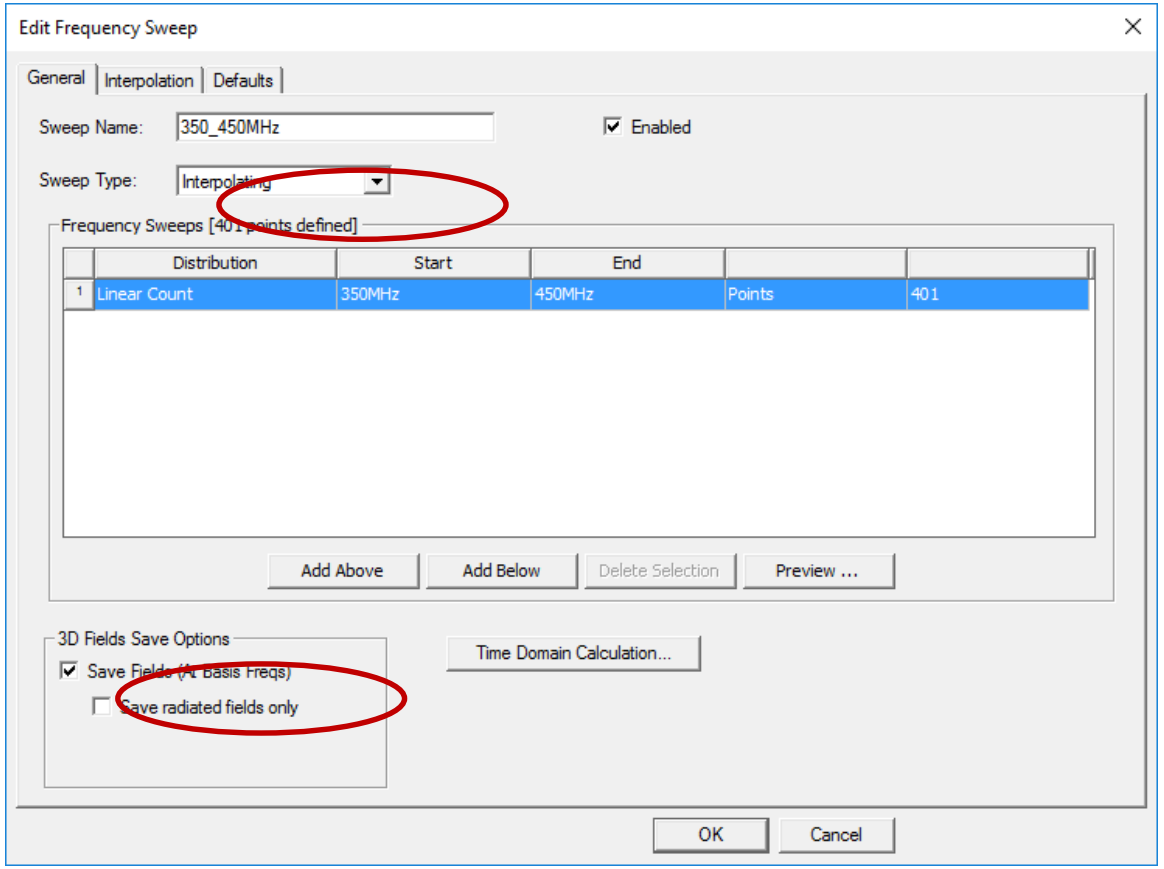
3.4X faster!

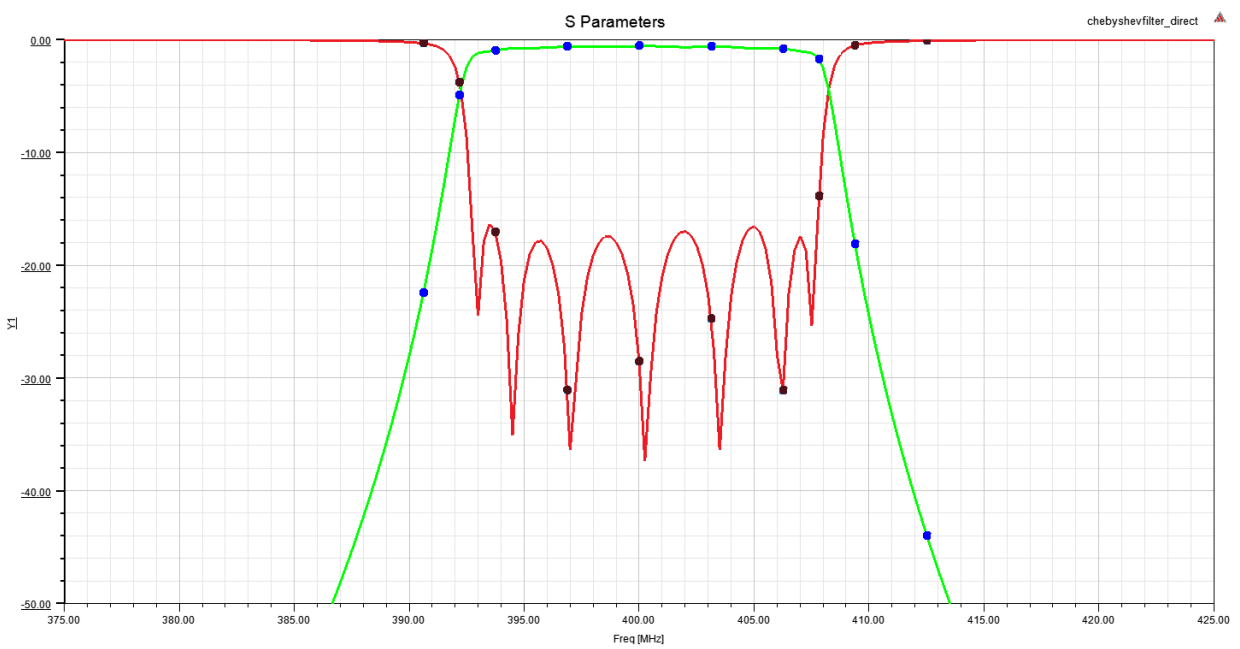
1 hr 50 min time savings!

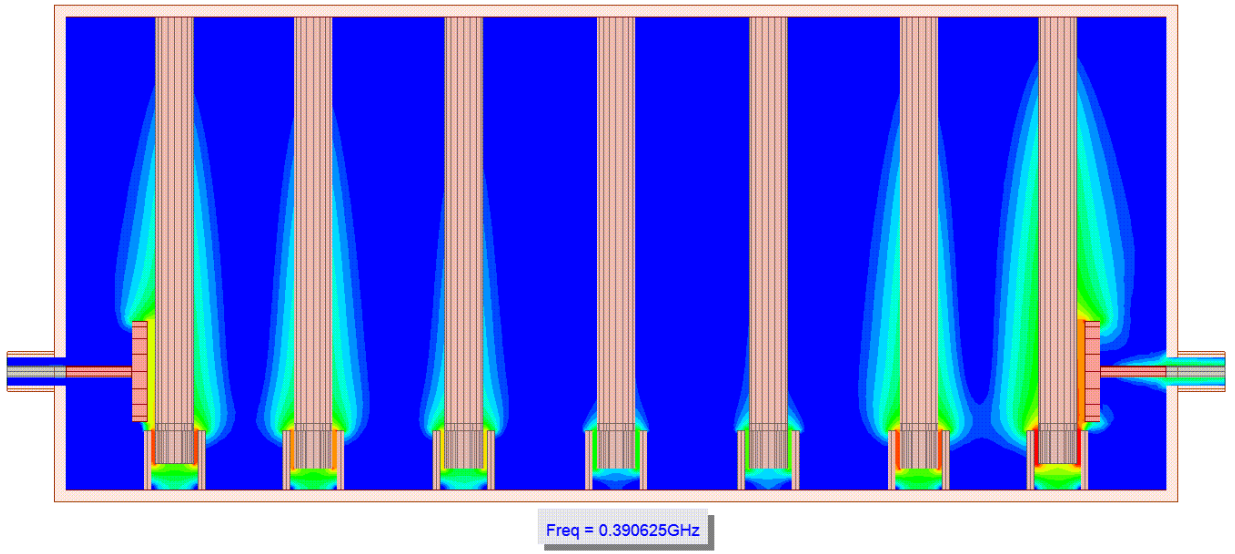
© 2019 ANSYS, Inc.

Interpolating Sweep Save Fields

- **Save Fields at Basis Points**
  - View fields at critical frequency points
  - Basis points capture resonate phenomenon



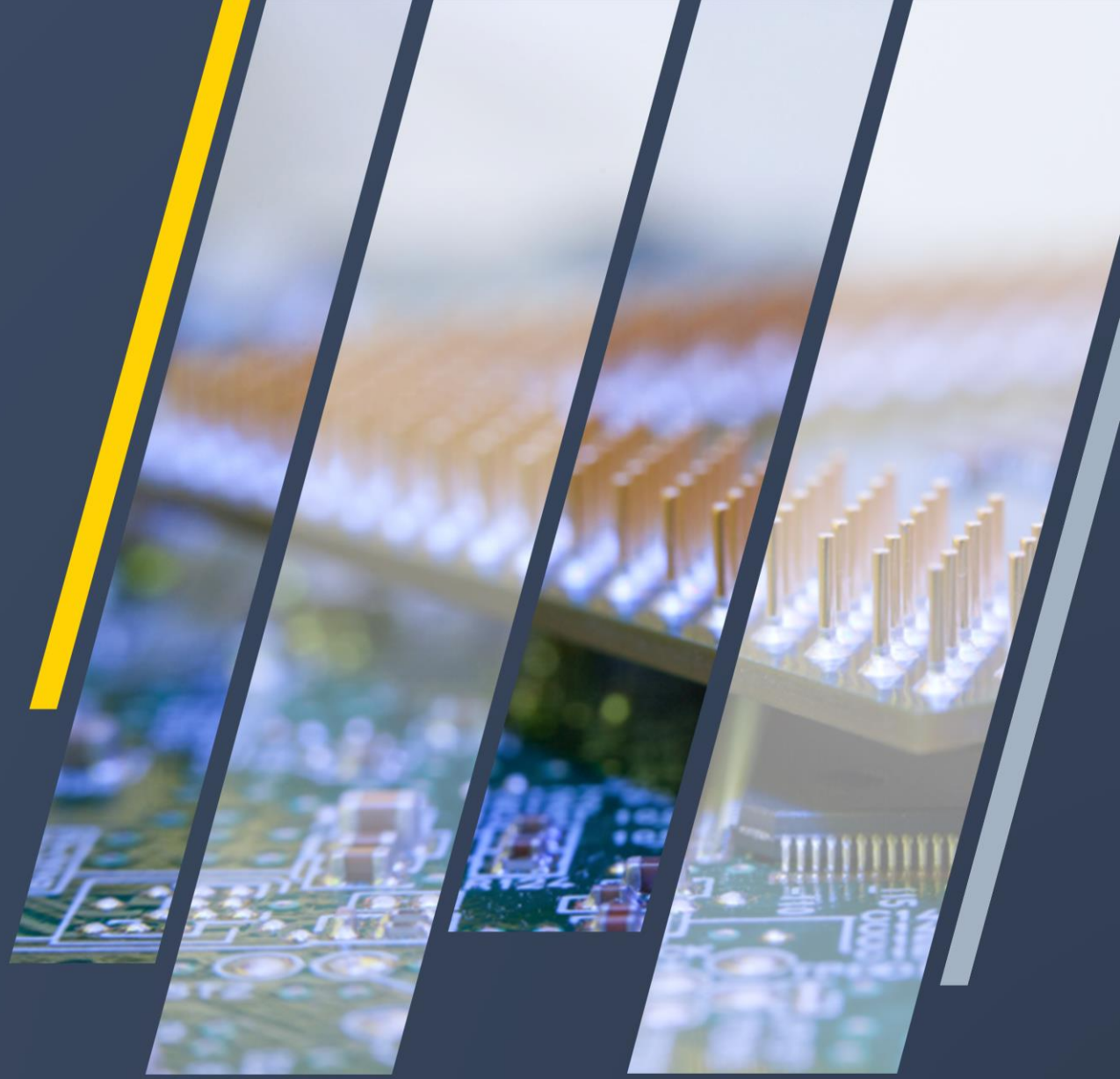




© 2019 ANSYS, Inc.
ANSYS Confidential

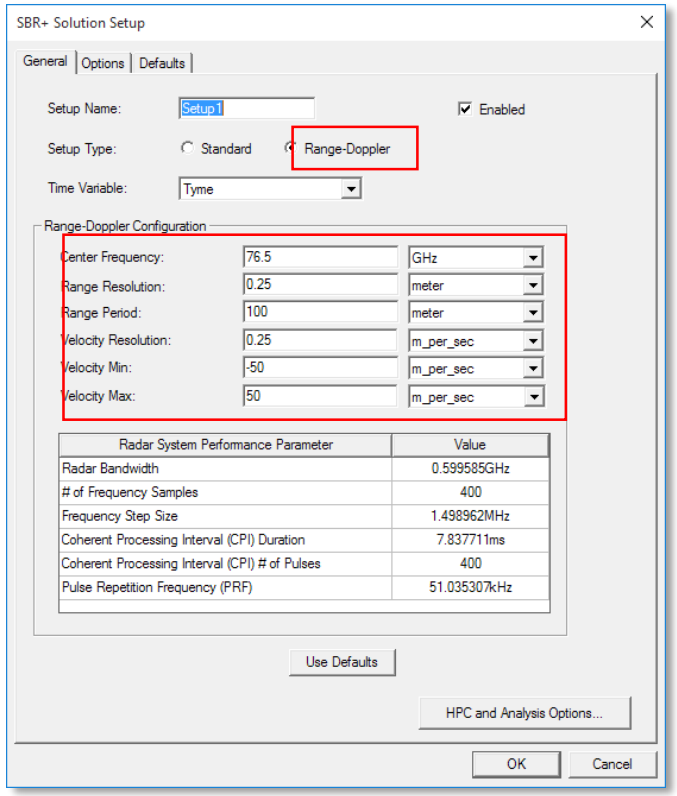
ANSYS®

HFSS SBR+ and EMIT for ADAS, RCS, and Desense



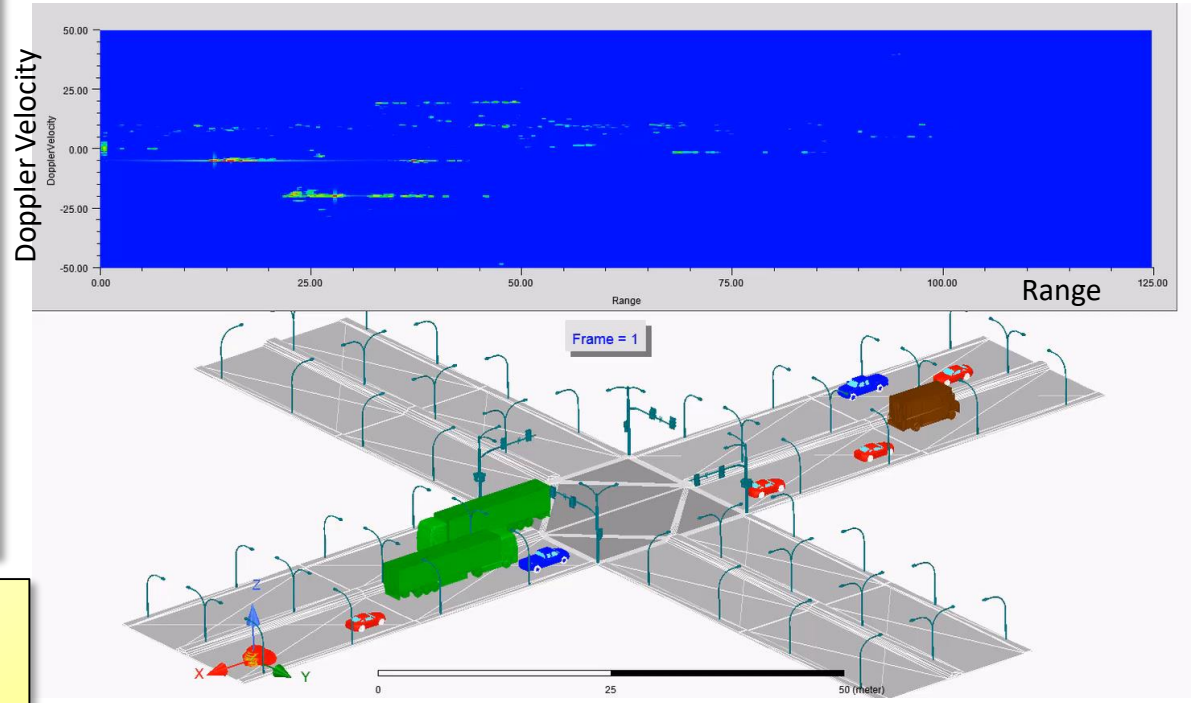
Accelerated Doppler Processing for HFSS SBR+

- Dramatic acceleration for ADAS & NF radar sims
  - Chirp-sequence
  - FMCW
  - Pulse-Doppler MIMO
- Setup based on system performance specifications
- Process and animate Range-Doppler maps
- Requires HFSS and SBR+ Solver licenses



- Direct entry of radar performance specs
- Automatic sim settings for…
  - frequency sweep
  - coherent processing interval

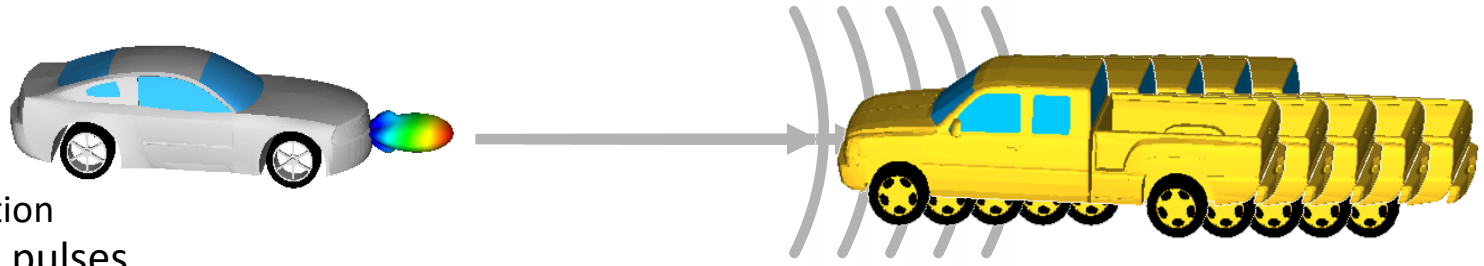
Accelerated Doppler Processing provides **100x - 300x faster** radar frame simulations



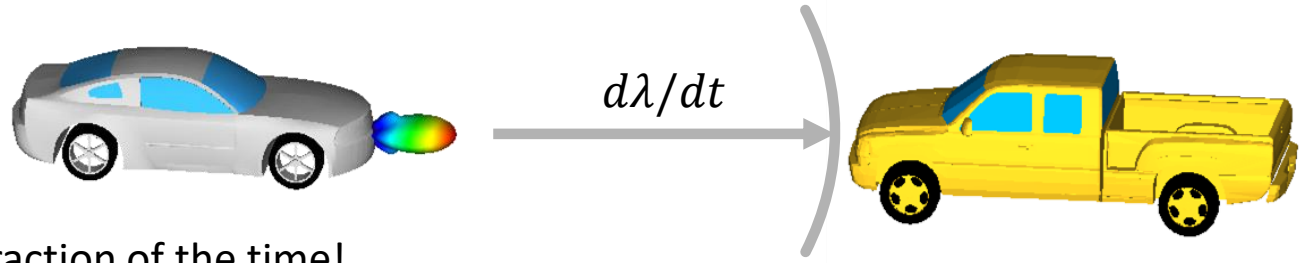
© 2019 ANSYS, Inc.
ANSYS Confidential

ADAS: Accelerated Doppler Processing (ADP)

- **Direct simulation**
  - 100s of doppler pulses/frame
    - ➢ Individual doppler pulses provide velocity resolution
  - Artifacts due to loss of ray coherence between pulses

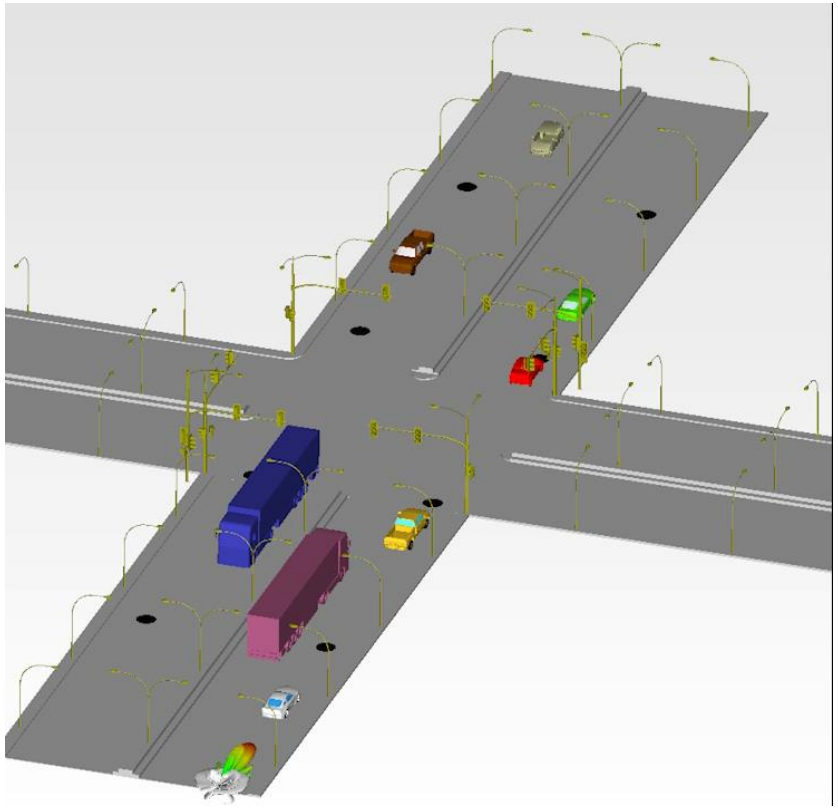


- **ADP simulation**
  - One doppler pulse/frame
  - Extrapolating the rays to obtain one frame
  - Higher quality images with less clutter in a fraction of the time!
    - ➢ **Speed up over 100x over direct simulation!**

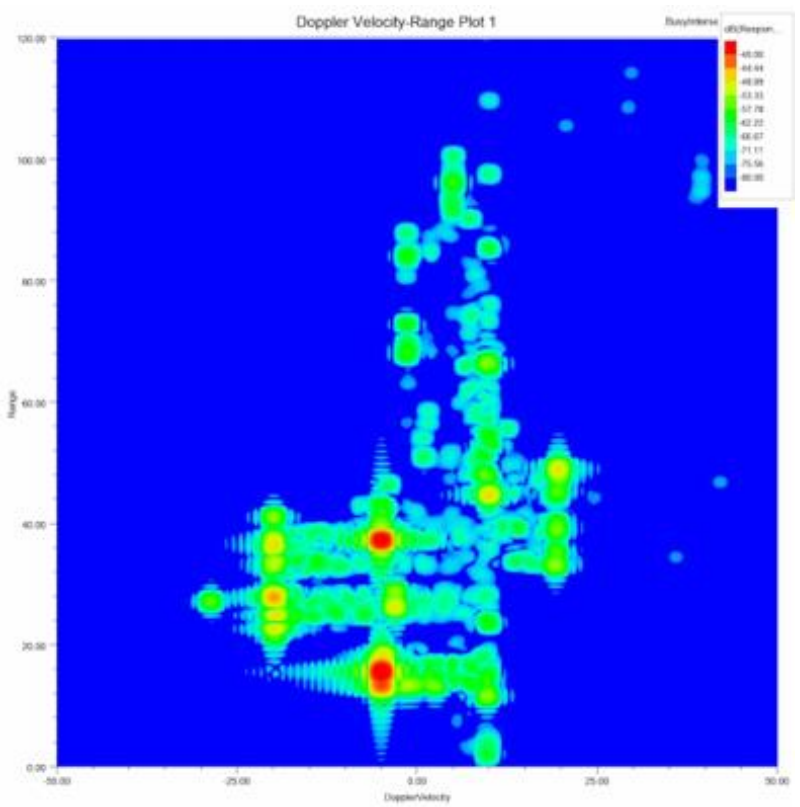


© 2019 ANSYS, Inc.
ANSYS Confidential

Busy Intersection ADP Speed

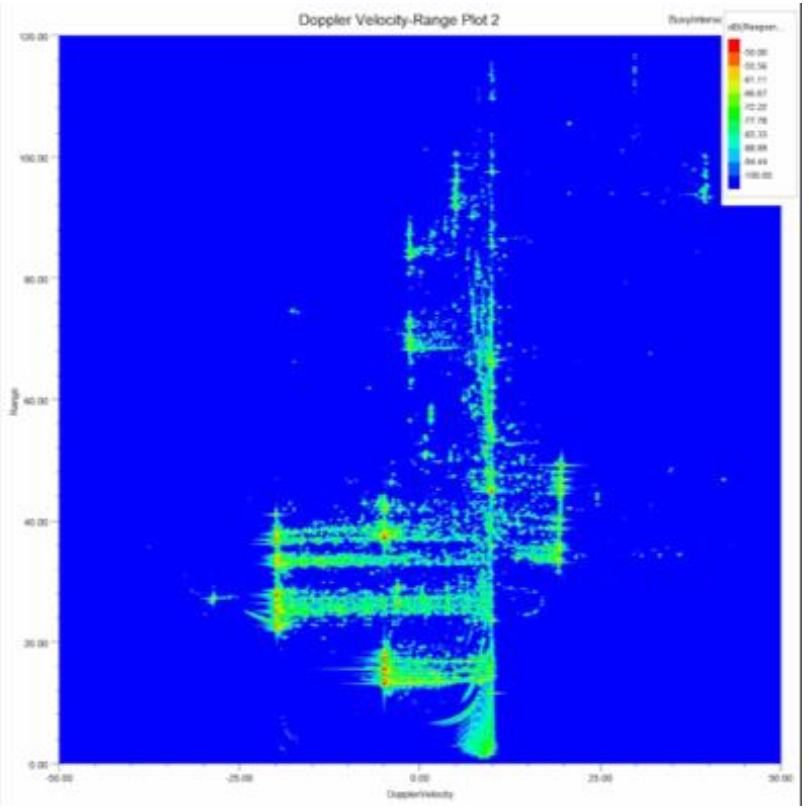


Rres = 1.0 m
Vres = 1.0 m/s
92x FASTER



- 2,400 Freq Sweeps of 120 frequencies
- 288,000 total
- 20 mins on laptop with ADP

Rres = 0.125 m
Vres = 0.125 m/s
~800x FASTER

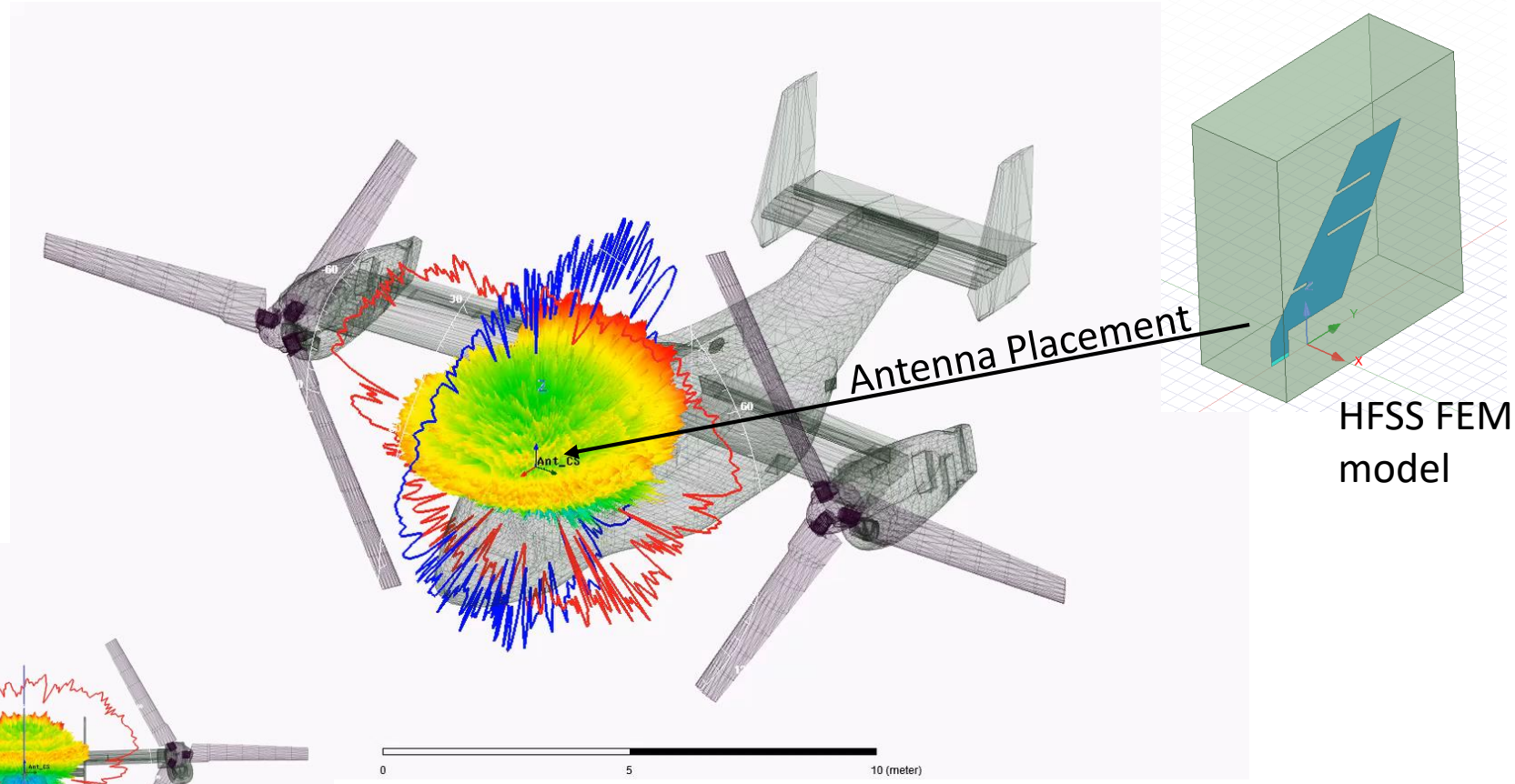


- 19,200 Freq Sweeps of 1200 frequencies
- 23,040,000 total
- 2 hours on laptop with ADP

© 2019 ANSYS, Inc.
ANSYS Confidential

Gain and Self-coupling for N-port Linked HFSS Antenna Models

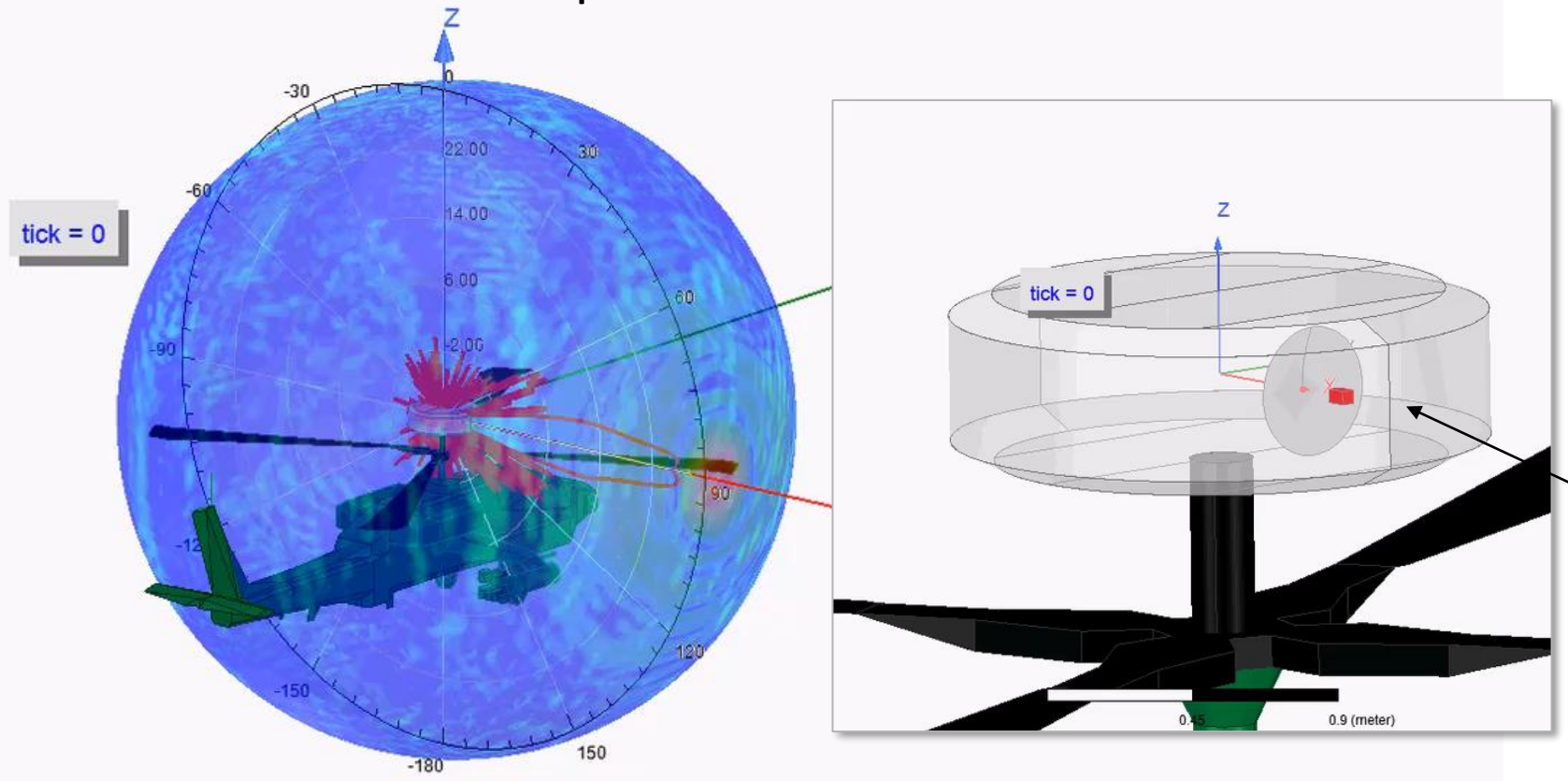
- Supports installed antenna workflow
- Leverage pre-existing HFSS antenna designs to drive SBR+ analysis
- Gain enables SBR+ antenna placement and coupling simulations
- Enable self-coupling for duplex antennas (e.g. radar)



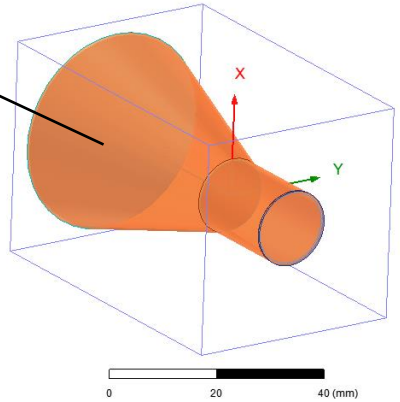
© 2019 ANSYS, Inc.
ANSYS Confidential

Gain and Self-coupling for N-port Linked HFSS Antenna Models

15 GHz direct-fed parabolic reflector under radome



LHCP feedhorn
HFSS Modal Solution

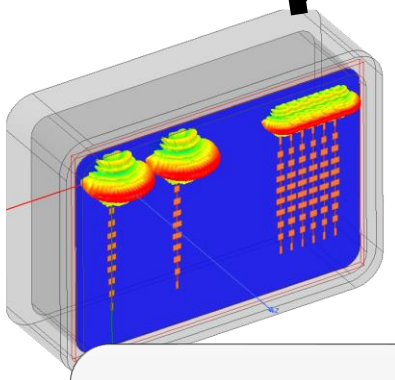


© 2019 ANSYS, Inc.
ANSYS Confidential

ADAS—The ANSYS Simulation Flow for Automotive Radar

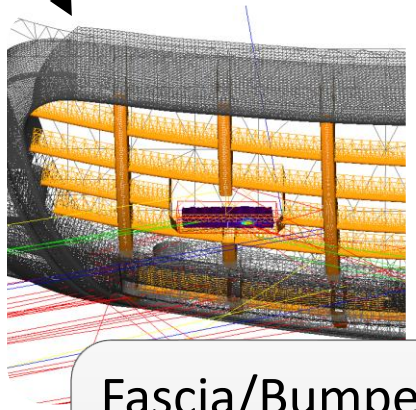
Multi-Port Linked NF Source

Multi-Port Linked FF Source, Interpolating Sweep



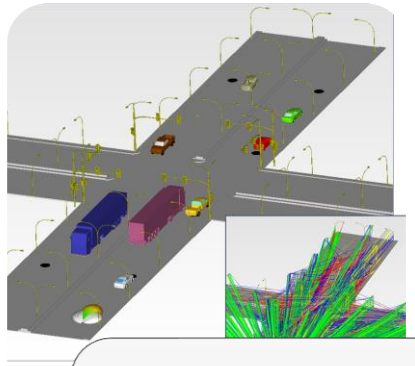
Radar Module Design

- Modal Solution
- Discrete and Interpolated Sweep



Fascia/Bumper Interaction

- Hybrid Sim or SBR+ Solution
- Must be NF coupled



ADAS/Radar

- SBR+ Solution
- Linked NF Source, Interpolated FF

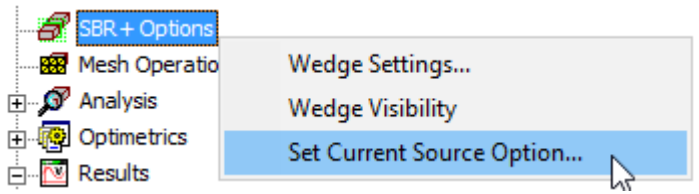
Multi-Port Linked FF Source, Interpolating Sweep

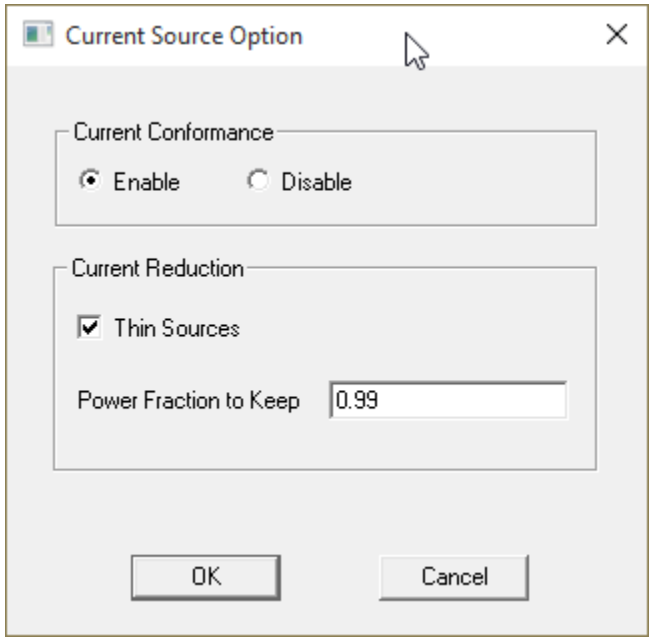
© 2019 ANSYS, Inc.
ANSYS Confidential

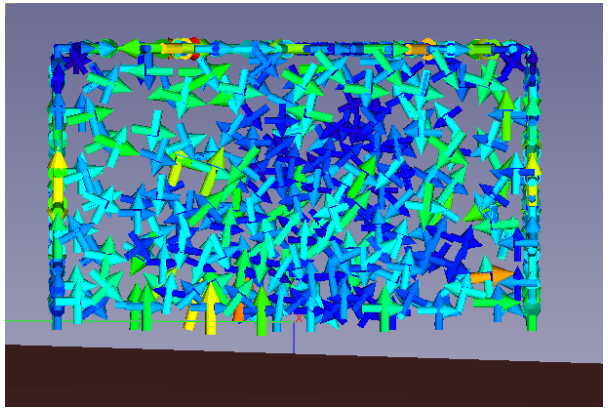
HFSS SBR+ Current Source Conformance and Reduction

- Enables easy antenna locating for installed performance modeling
- Conforms HFSS near-field antenna models to complex host CAD shapes
- Accelerates installed performance modeling of large and phased array antennas
- Accelerates hybrid FEM/IE+/SBR+ simulation by skipping weakest current sources

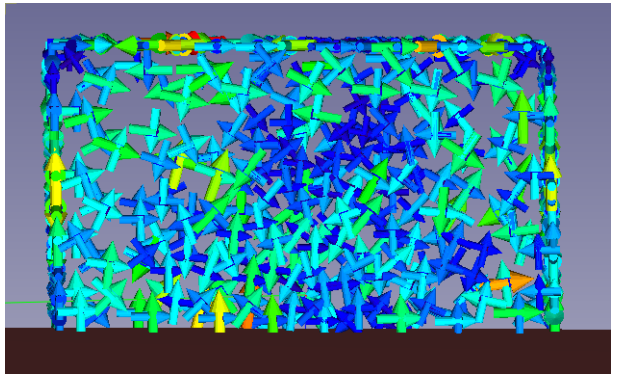
Linked NF antenna model automatically conforms to host CAD surface







Conformance Off

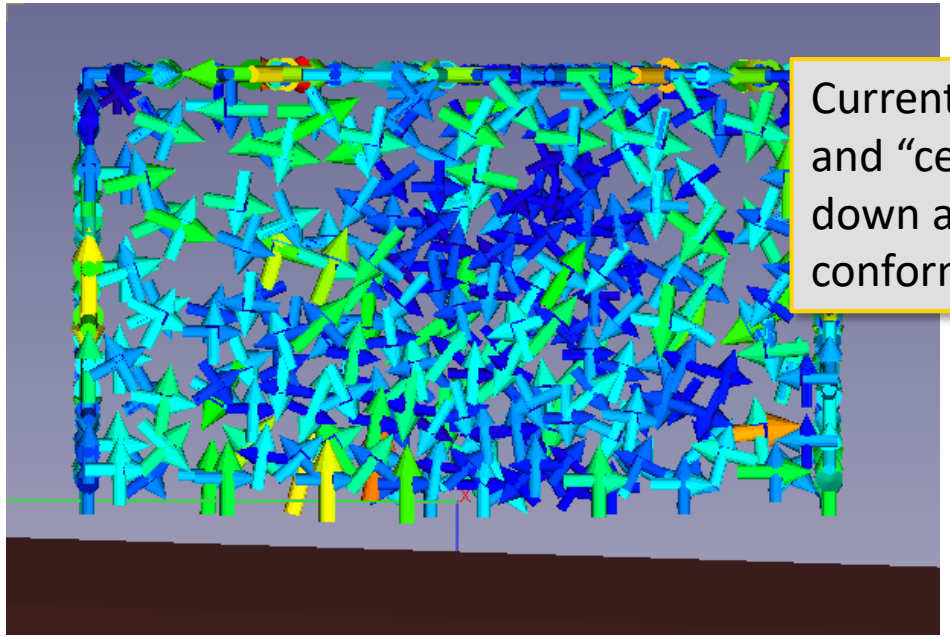


Conformance On

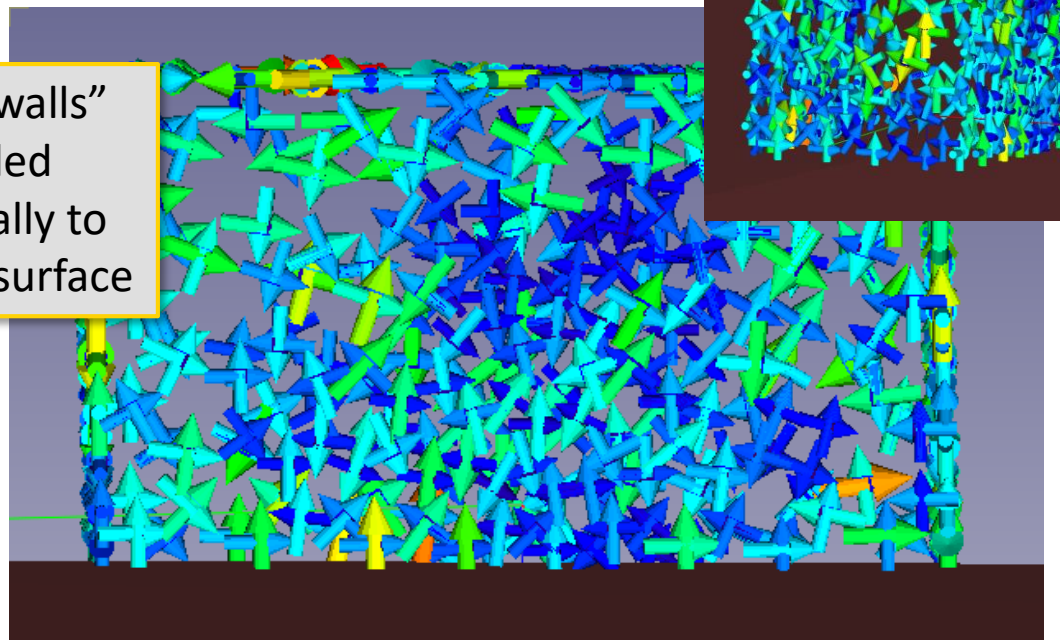
© 2019 ANSYS, Inc.
ANSYS Confidential

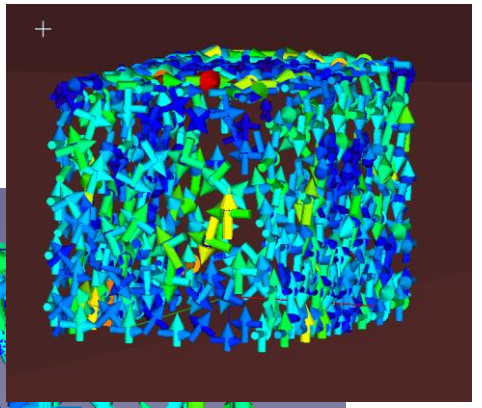
Setting Conformance for Sources in SBR+

Underlying SBR+ Sources of antenna on vehicle roof
HFSS SBR+ Current Sources shown



Current source “walls” and “ceiling” pulled down automatically to conform to CAD surface





Conformance Off

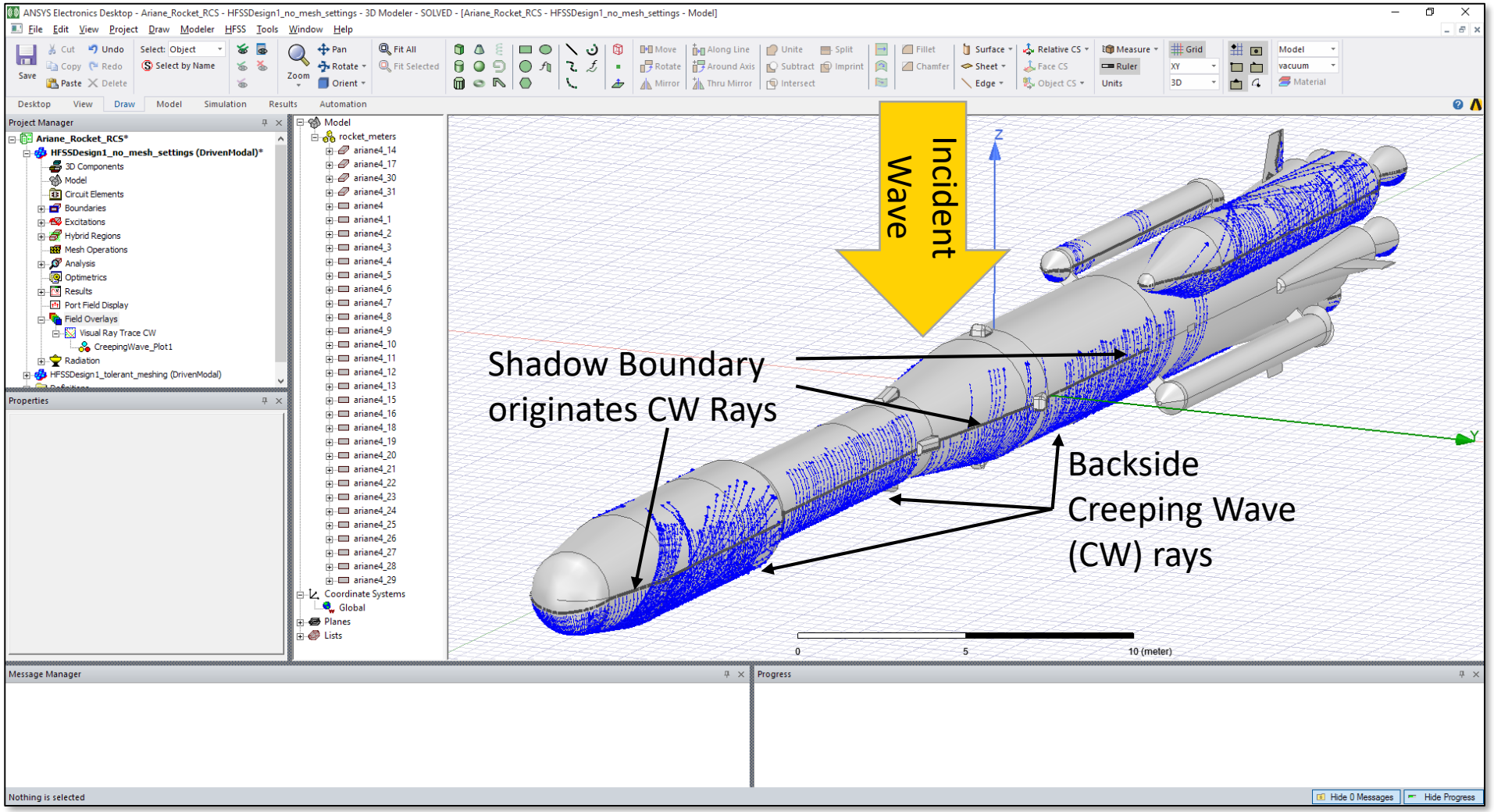
Conformance On

Recommend using Conformance for antennas using host as ground plane

© 2019 ANSYS, Inc.
ANSYS Confidential

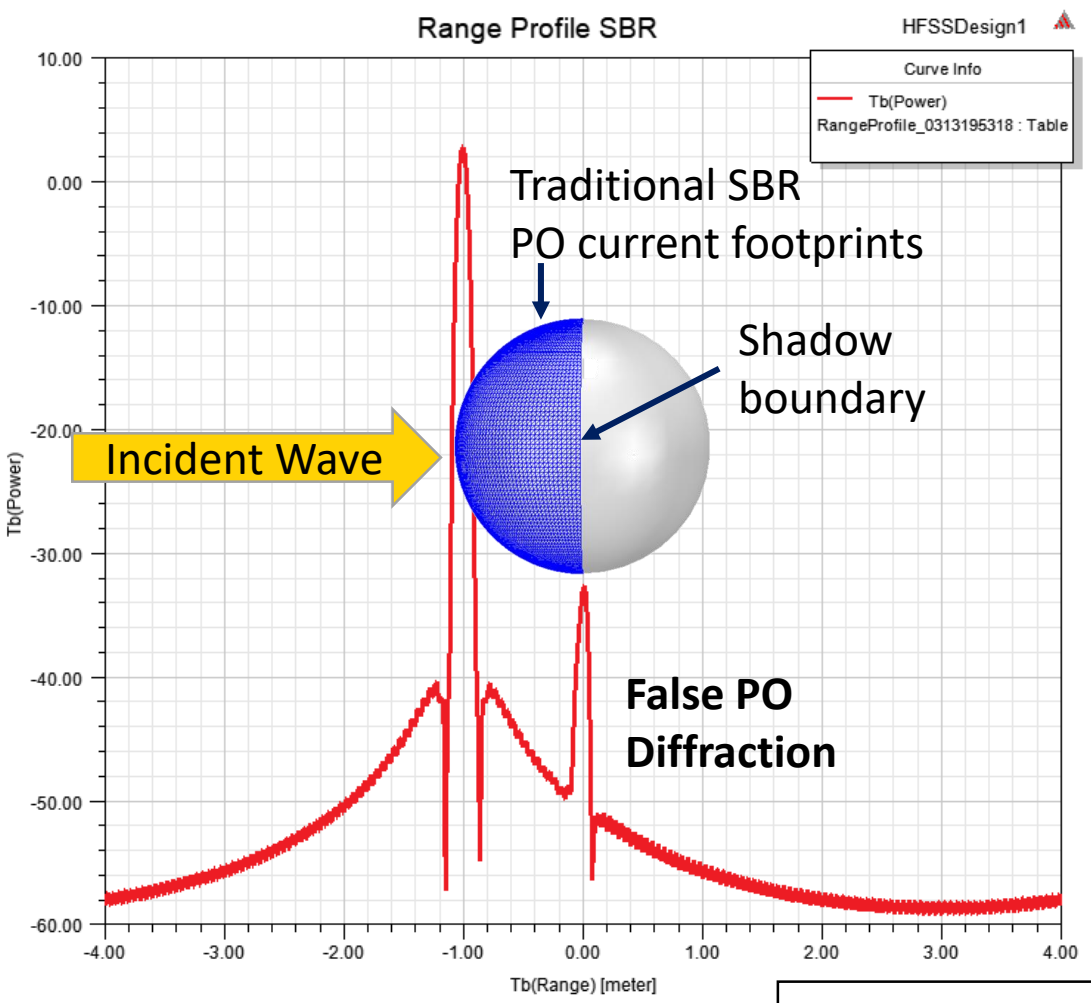
HFSS SBR+ Creeping Wave (CW) Physics for RCS & Radar Signatures

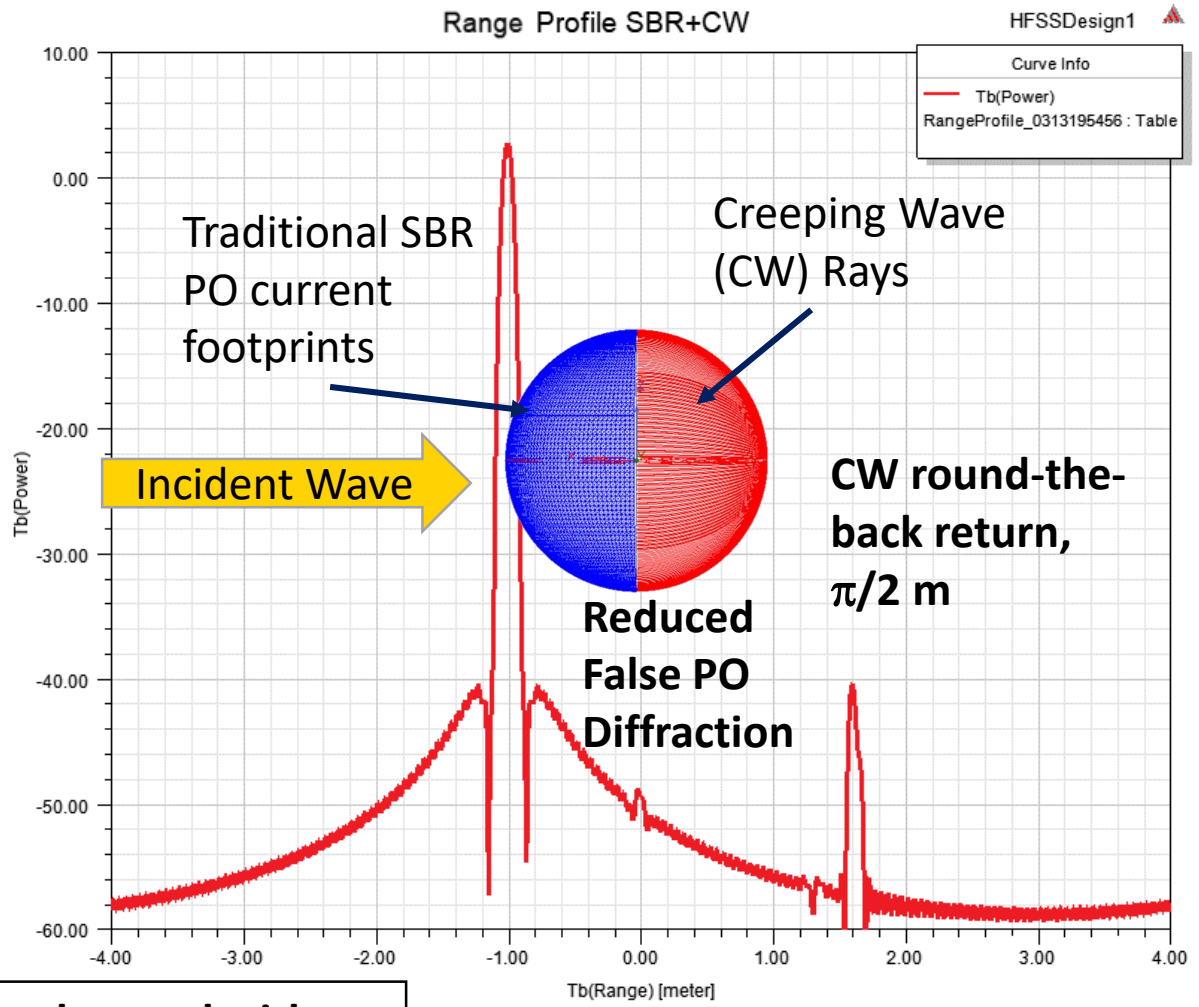
- Increases fidelity for RCS involving curved surfaces
- Extends currents to back side of target
- Removes diffraction @ illumination cut-off
- Industry-first Creeping Waves for RCS modeling



© 2019 ANSYS, Inc.
ANSYS Confidential

SBR+ Creeping Wave Rays: Smooth Shadow Boundary Diffraction Effects from RCS



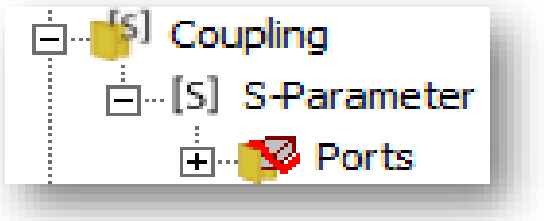


Correct reflection observed with Creeping Waves

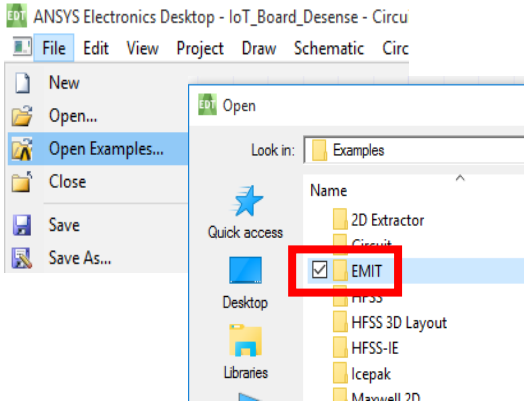
© 2019 ANSYS, Inc.
ANSYS Confidential

New in EMIT

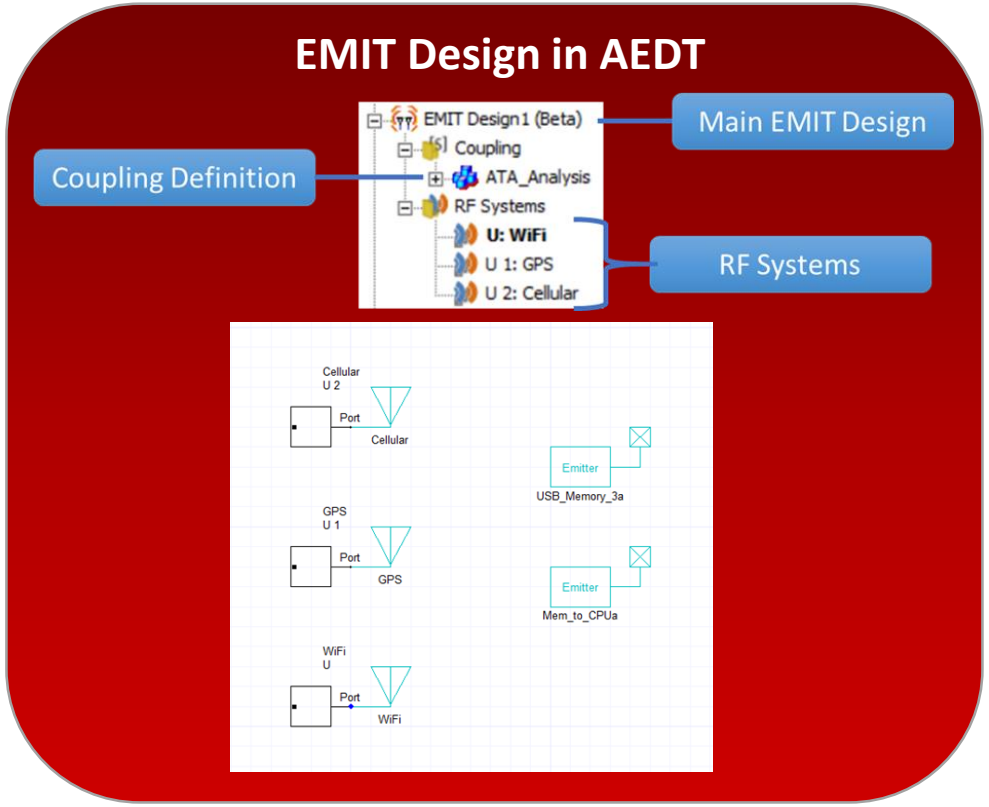
- **Support for adding coupling data from external Touchstone files**



- **Example EMIT projects included**
  - Detailed PDF documentation/tutorial



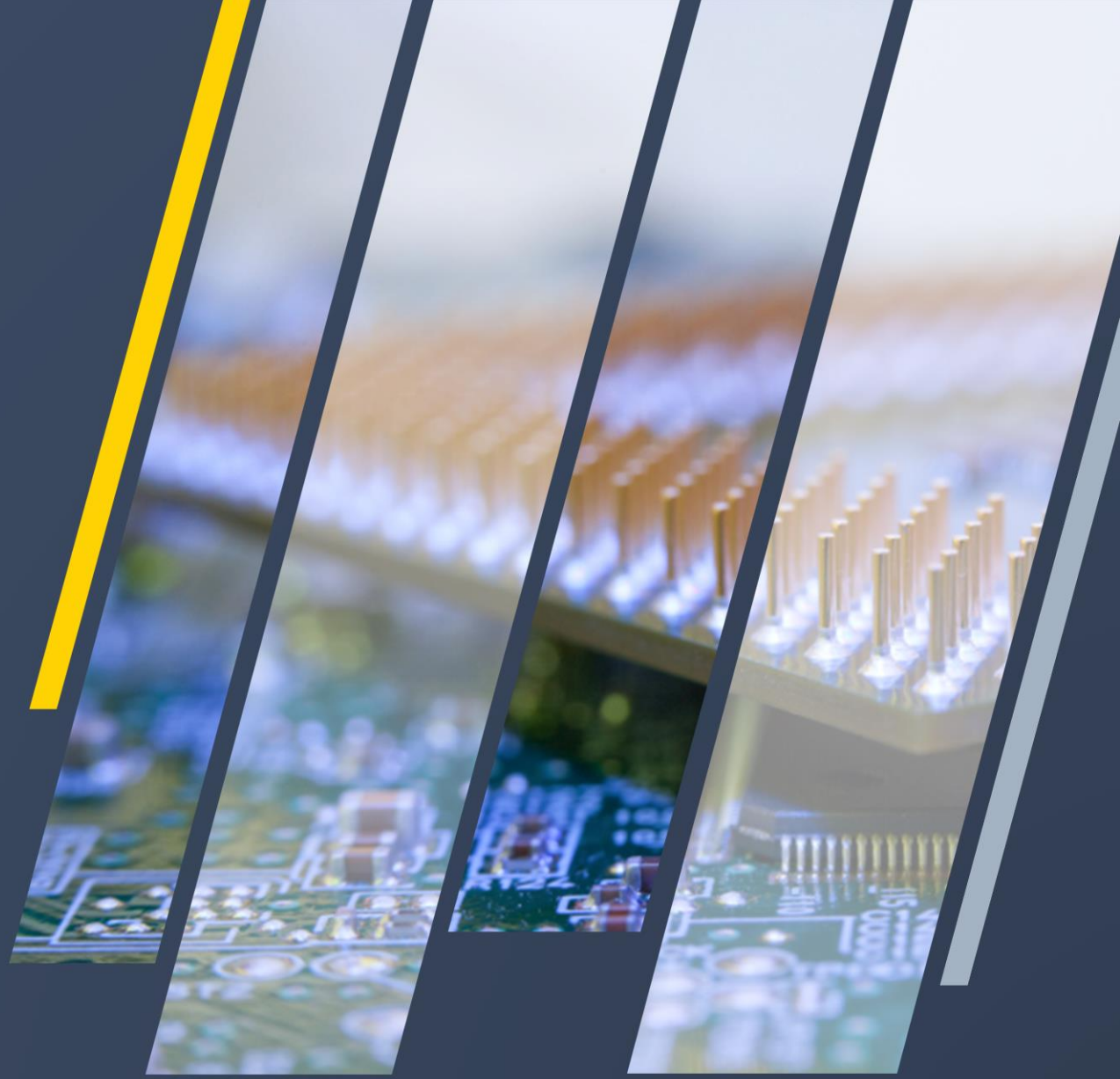
- **User experience enhancements including:**
  - Settings from Analysis & Results window are saved on exit
  - Improved default appearance of component configuration dialog
  - And more!



 © 2019 ANSYS, Inc.
ANSYS Confidential

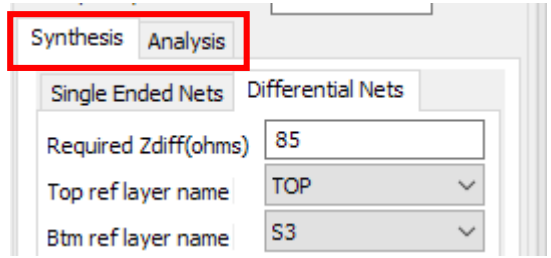
ANSYS®

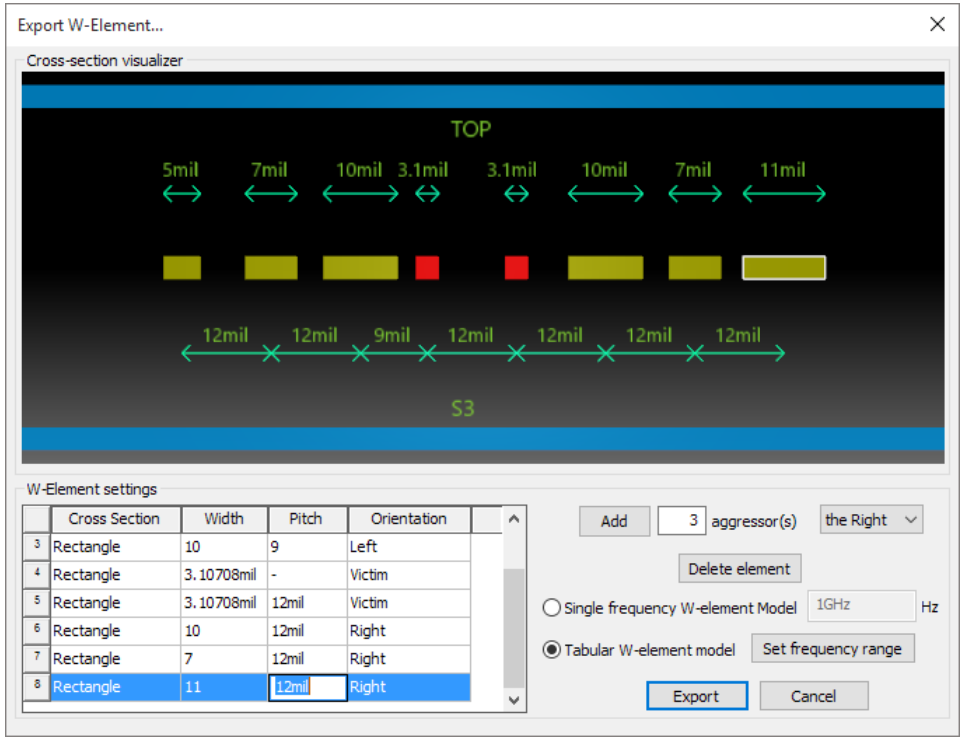
HFSS 3D Layout

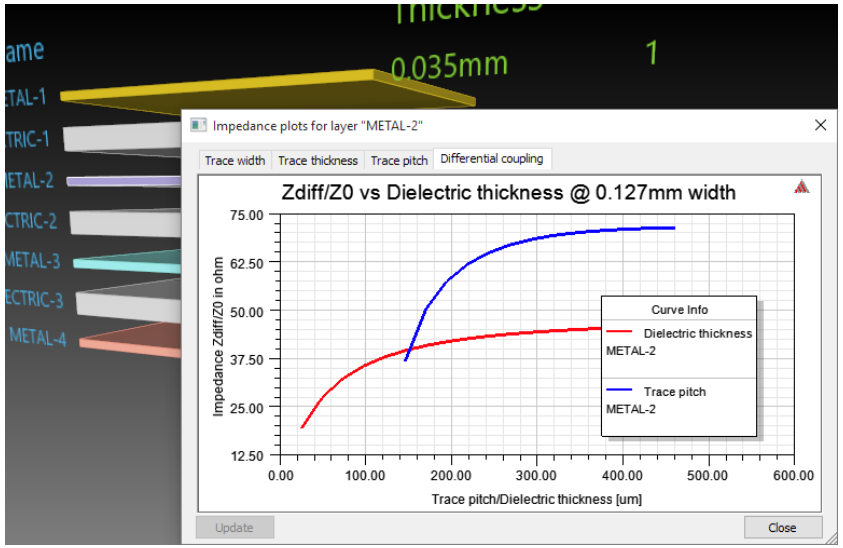


Stackup Wizard Enhancements

- **Improved UI with separate “Analysis” and “Synthesis” tabs**
- **Plots of impedance vs trace width, thickness, diff trace separation and diff decoupling**
- **Export stackup in IPC2581 rev B format**
- **Specify aggressor/victim traces in W-element export**
- **Tabular W-element model export**





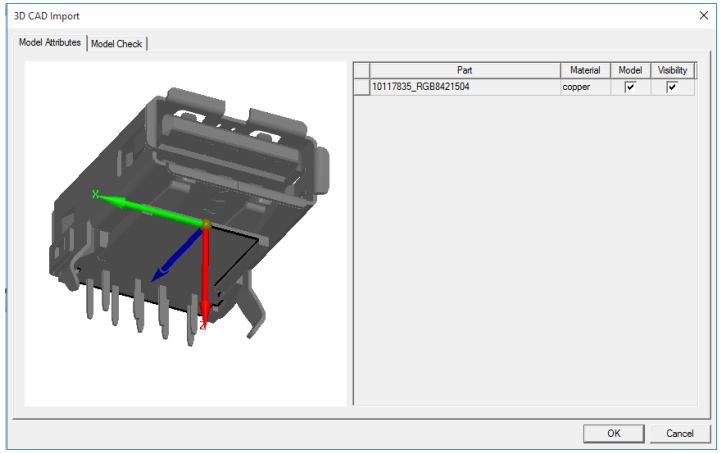


Available in HFSS 3D Layout and SIwave

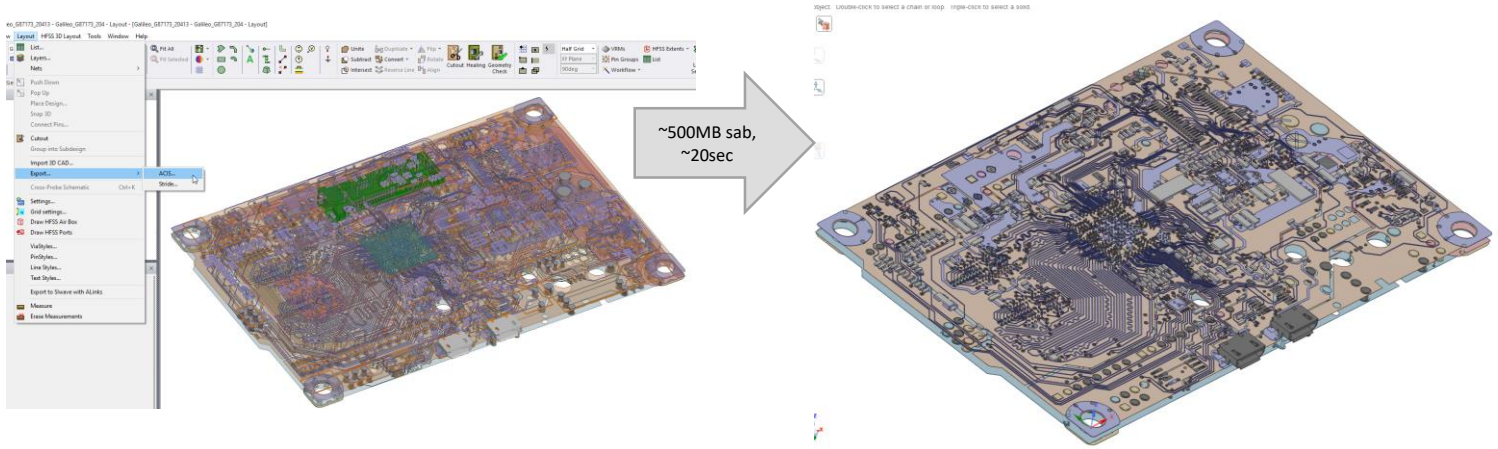
© 2019 ANSYS, Inc.
ANSYS Confidential

Lightweight MCAD in Layout

- **Lightweight 3D Geometry**
  - Import sat, sab, step, iges, etc… directly to Layout
  - Place, assign materials, filter bodies, solve
  - Improved UI performance
  - Improved placement operations



- **Export full assembly to sat, sab, stride**
  - *Fast* ACIS model generation from ECAD

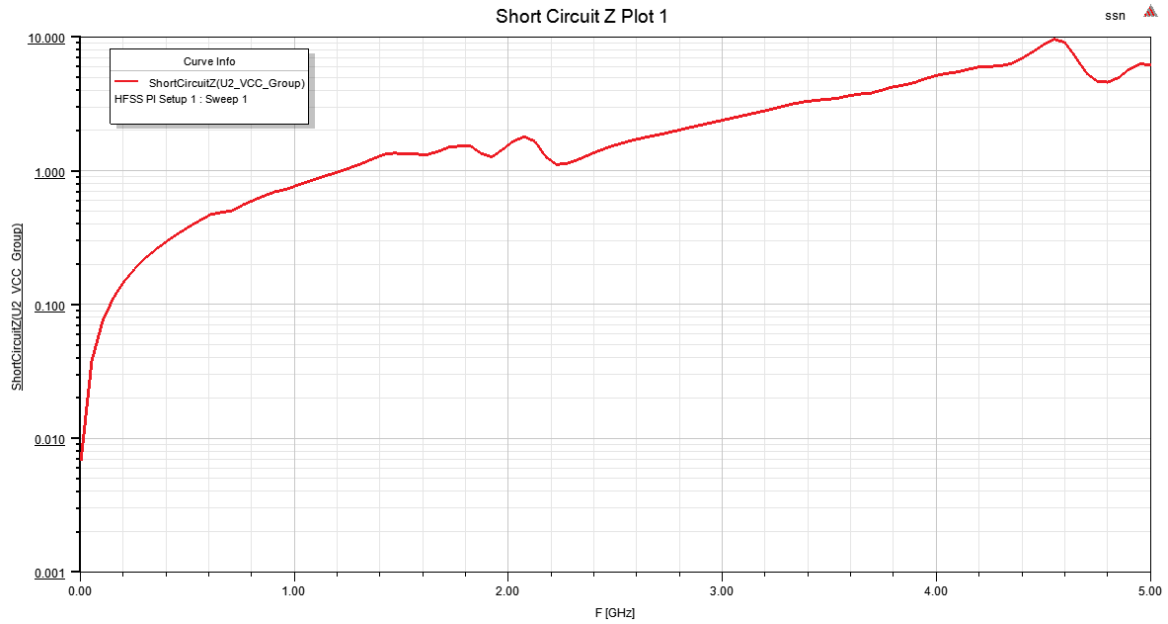


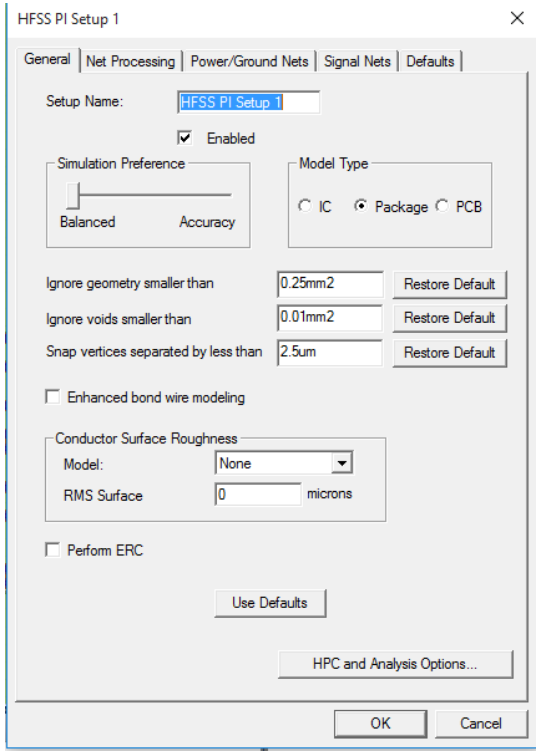
© 2019 ANSYS, Inc.
ANSYS Confidential

HFSS-PI (BETA)

- **New simulation type for power integrity, PI, focused SYZ extraction**

- **PI-specific output quantities**
  - Short Circuit Z, Loop Inductance, Loop Resistance, Capacitance

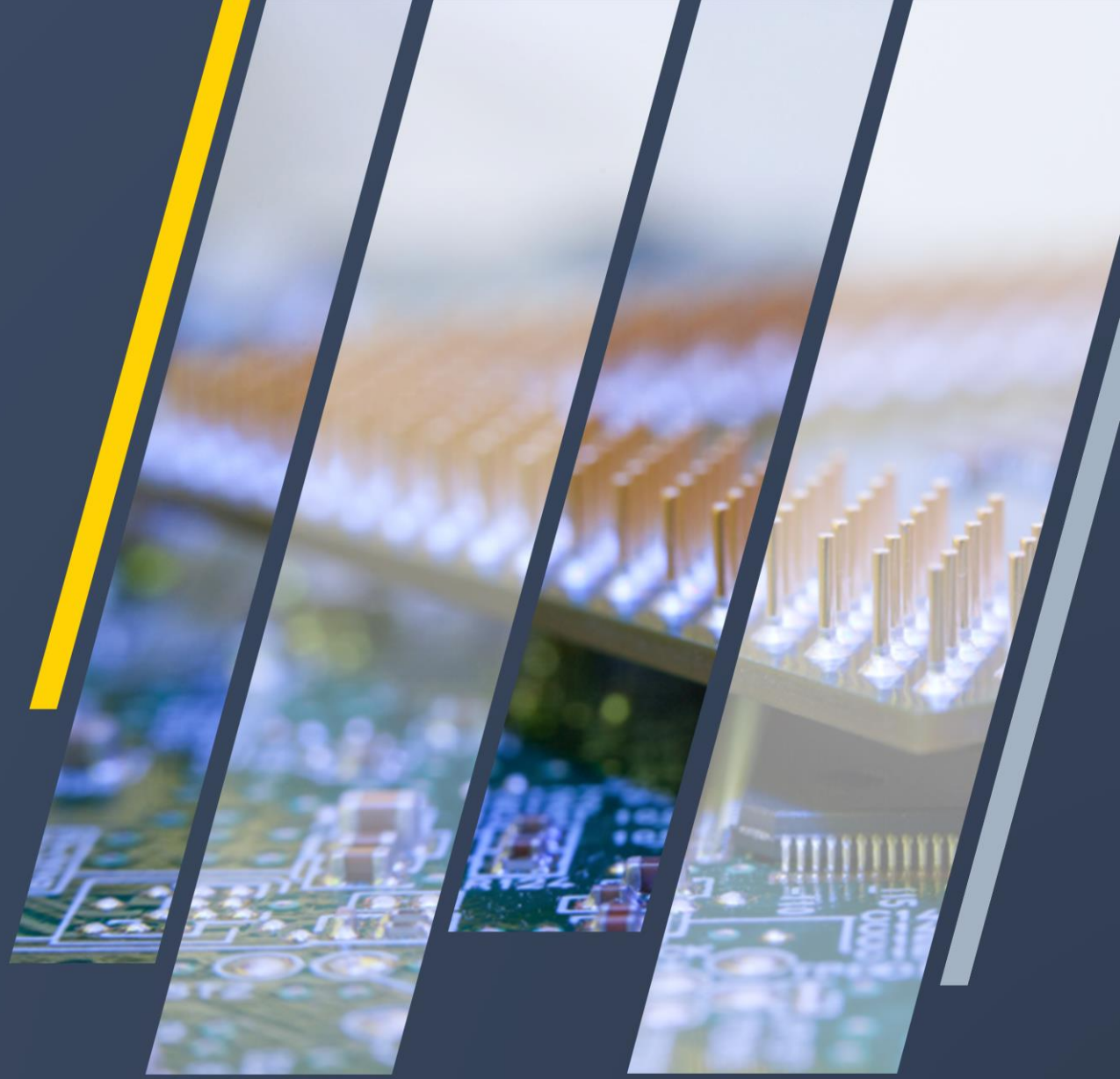




 © 2019 ANSYS, Inc.
ANSYS Confidential

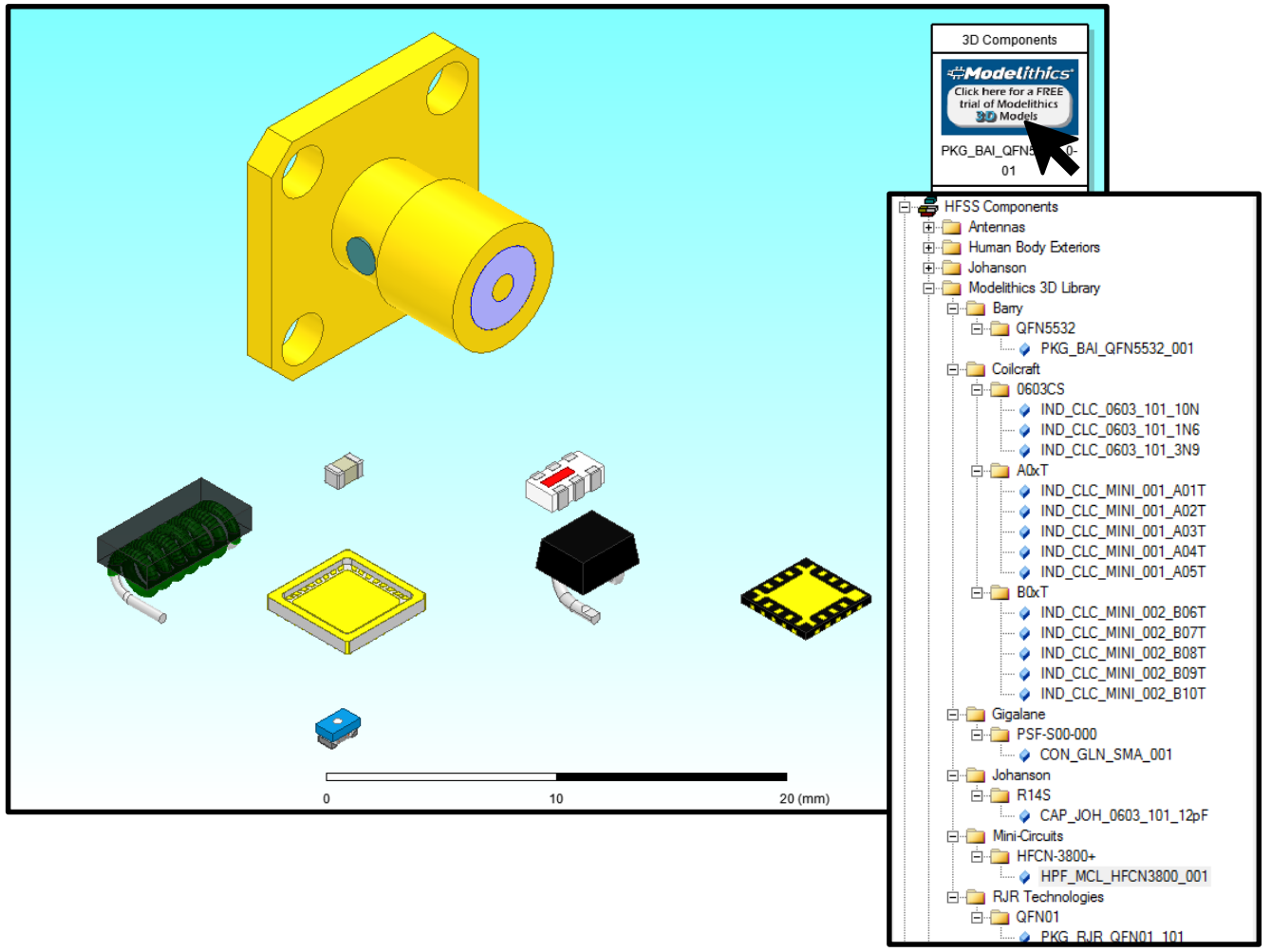
ANSYS®

Applications



Modelithics 3D Component Library

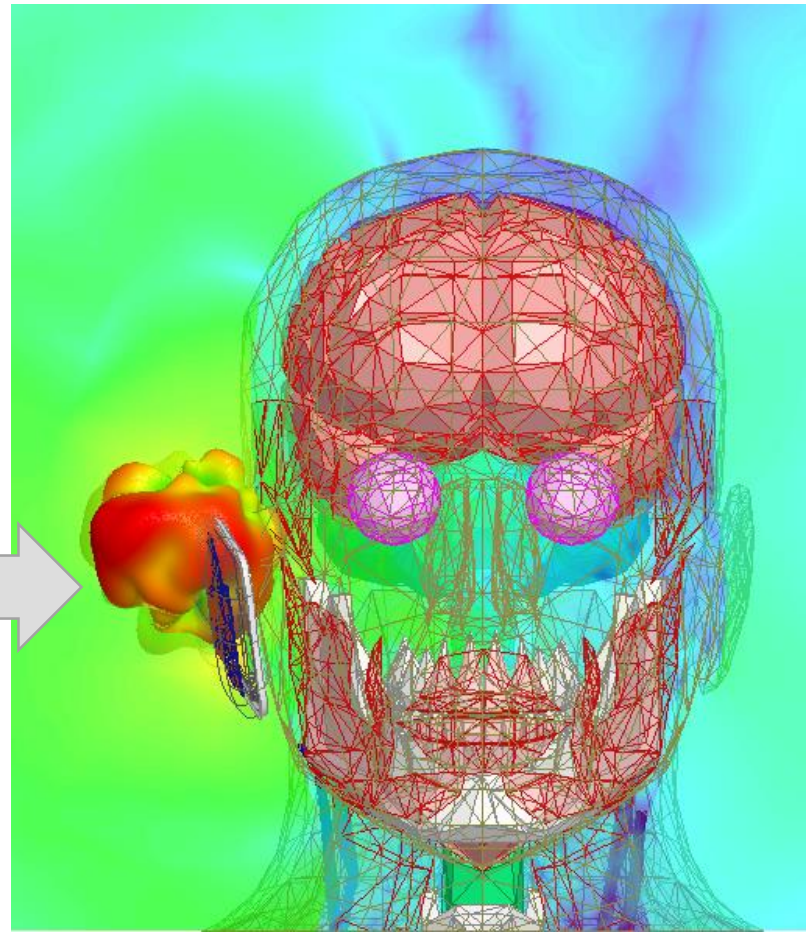
- 18 New 3D Components from Modelithics
  - https://www.modelithics.com/
- Free Trial Licenses for Modelithics 3D Components @
  - https://www.modelithics.com/mvp/hfss
  - Click on component logo in 3D modeler to launch website

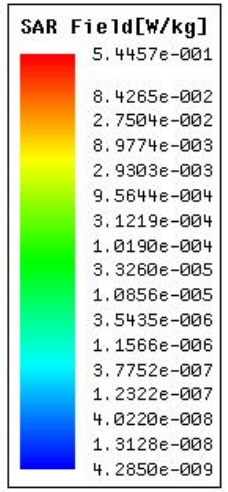


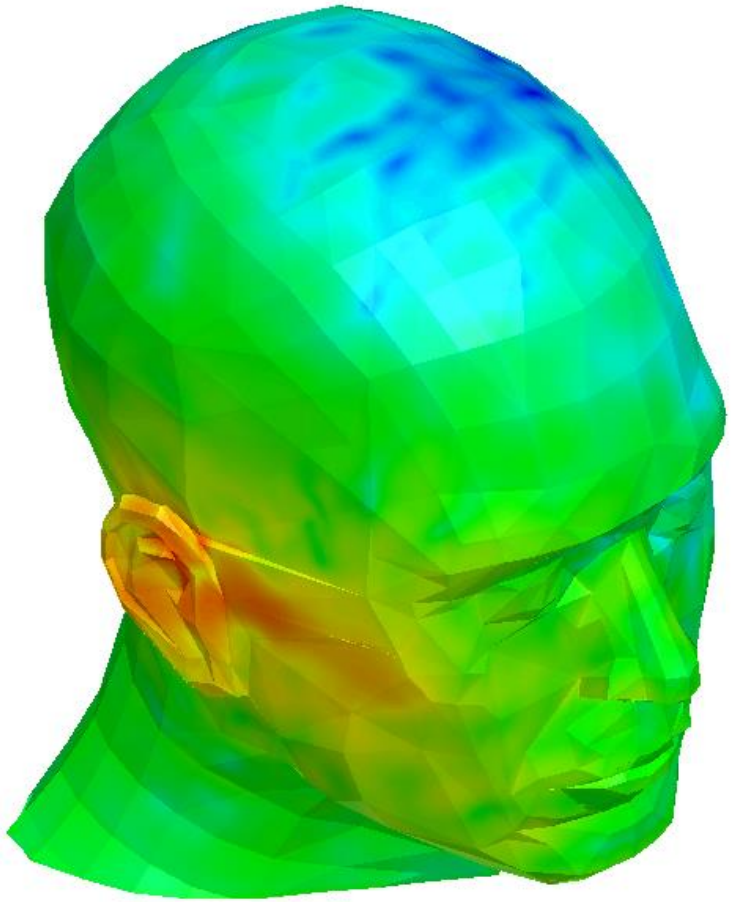
 © 2019 ANSYS, Inc.
ANSYS Confidential

IEC62704 FEM Standard for SAR Certification (Beta)

- **Implementation of IEC62704 -4 standard for Specific Absorption Rate**



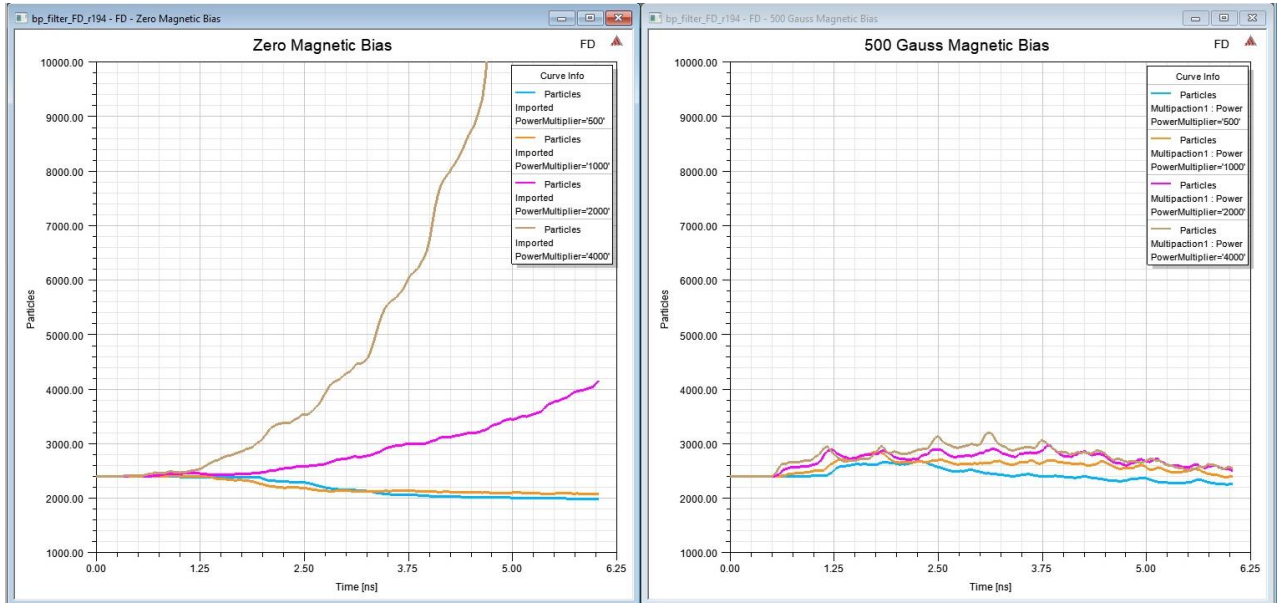


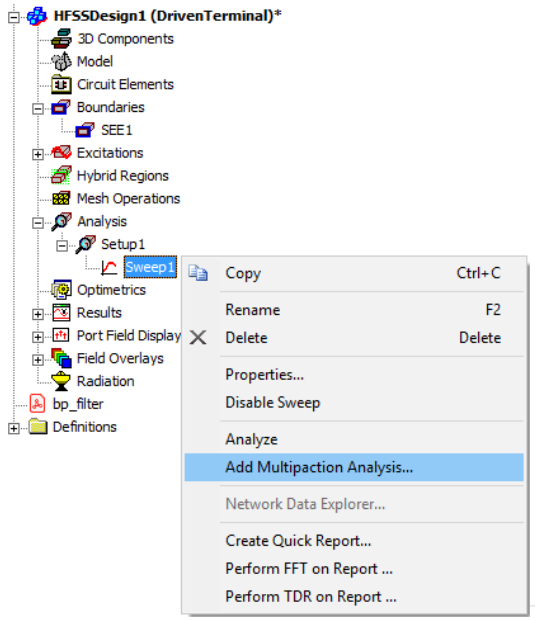


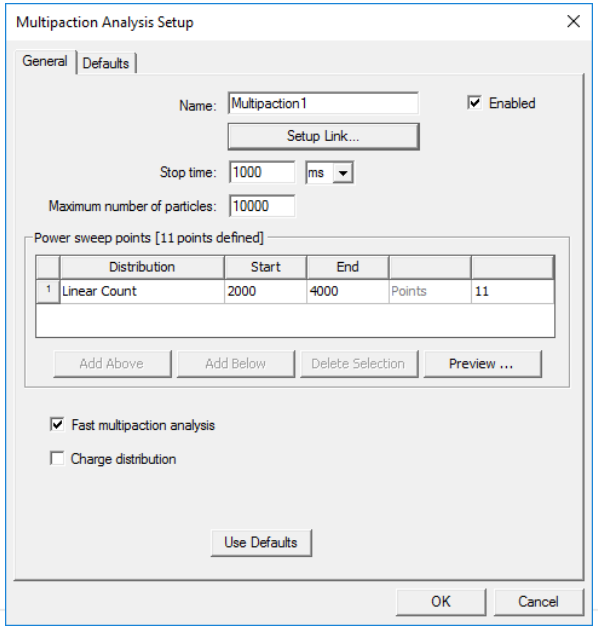
© 2019 ANSYS, Inc.

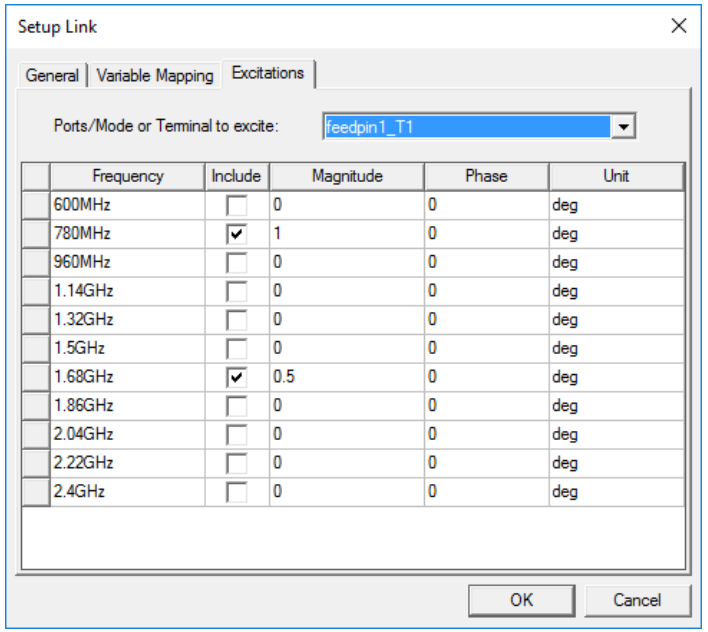
Multipaction Solver (Beta)

- **Advanced FEM charged particle tracking solver**
- **Easy to setup; similar to post processing**
  - Add charge region
  - Add SEE (secondary electron emission) boundary
  - Add solution setup linked to discrete sweep
- **Add Maxwell DC bias links**
  - Explore means to suppress multi-paction





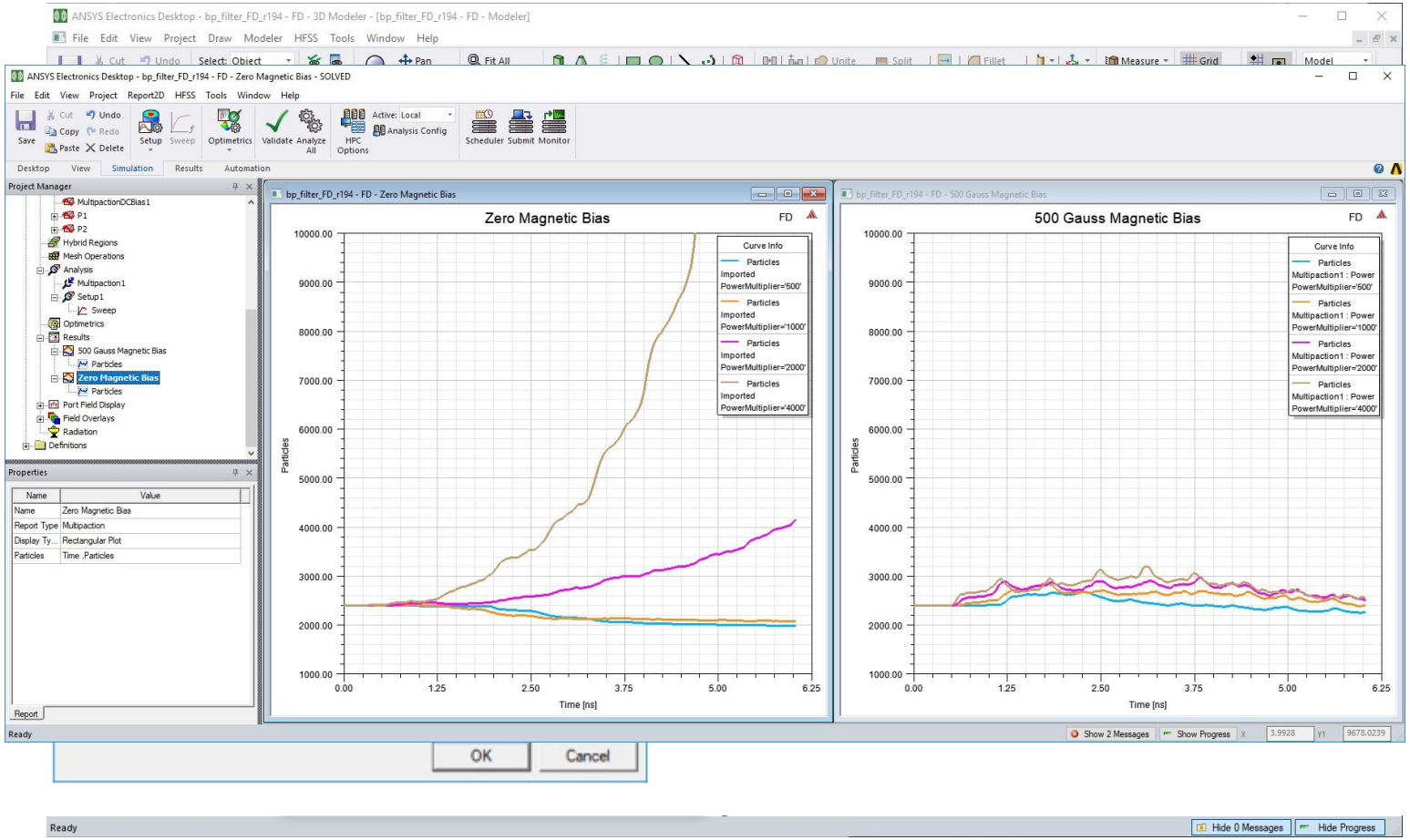




 © 2019 ANSYS, Inc.
ANSYS Confidential

Multi-paction Setup

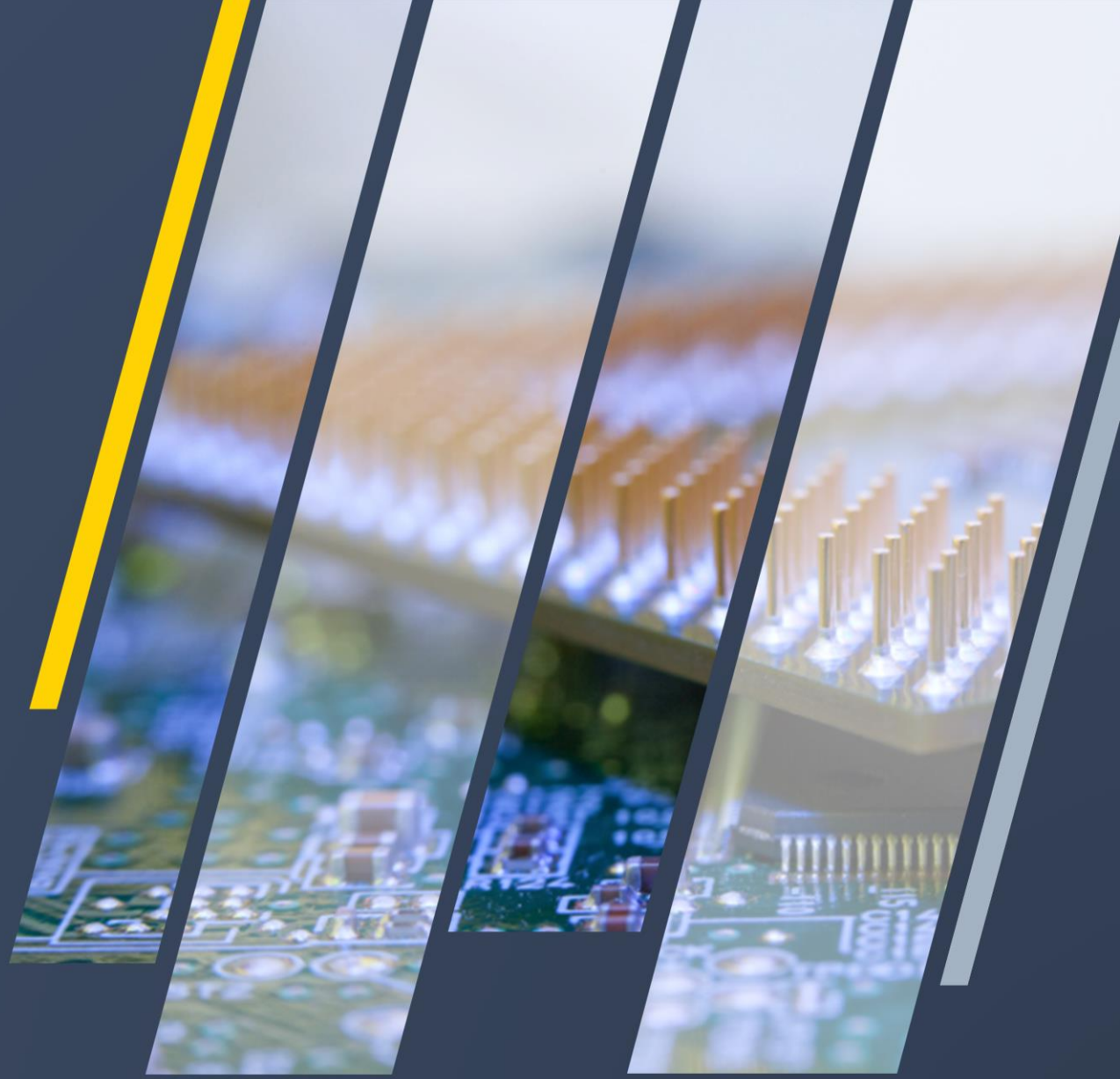
- Define charge regions
- Specify SEE boundaries
- Define multicarrier setup (optional)
- Apply DC Biasing fields (optional)
- Run multi-paction analysis
- Post process results



© 2019 ANSYS, Inc.

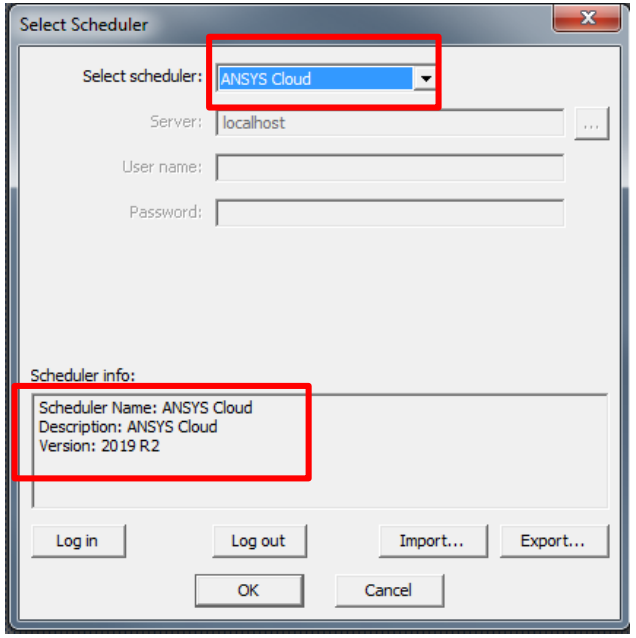
ANSYS®

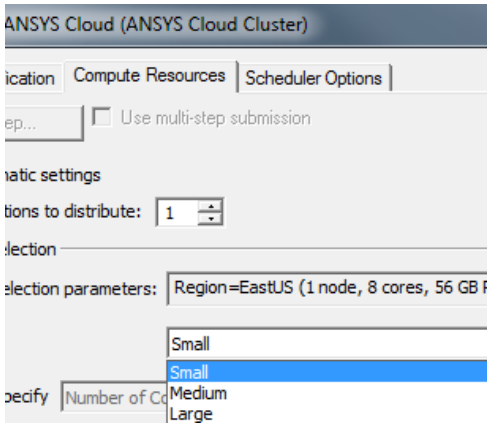
Electronics Desktop

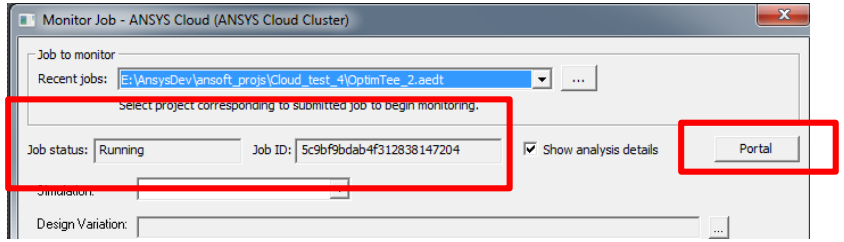


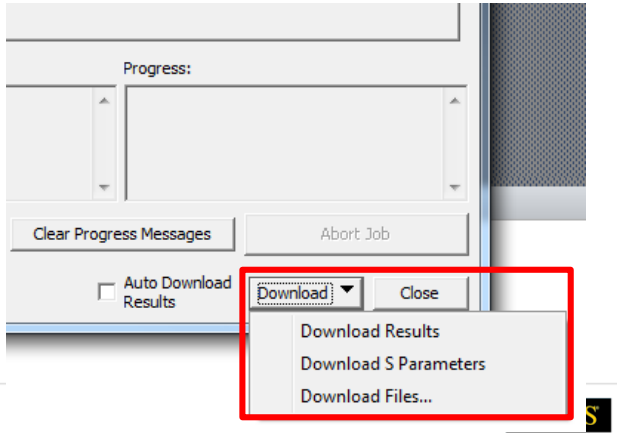
HFSS on the ANSYS Cloud!

- **Available for HFSS 3D and 3D Layout**
  - Builds on cluster submission workflow
- **Three pre-defined machine configurations**
  - Small: 8 cores, 56 GB node
  - Medium: 16 cores, 224 GB node
  - Large: 32 cores, 448 GBs, two nodes
- **Job status available in Desktop Job monitor**
  - Desktop Job Monitor
  - Web based Cloud portal
- **Results Download Options**
  - SYZ-parameters
  - Solution monitor files, e.g. profile, convergence
  - Full results



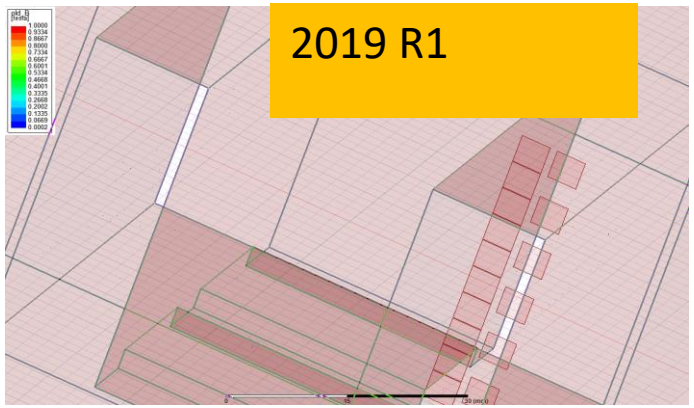


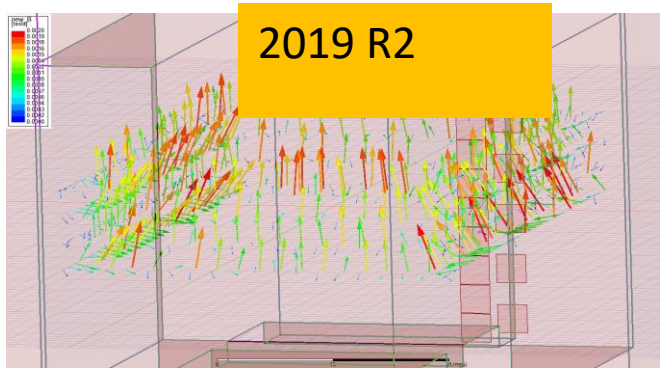


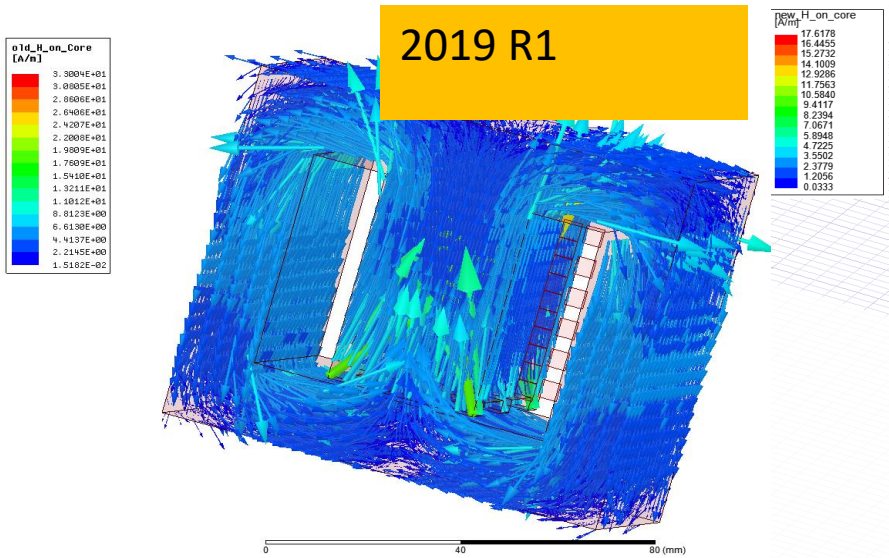


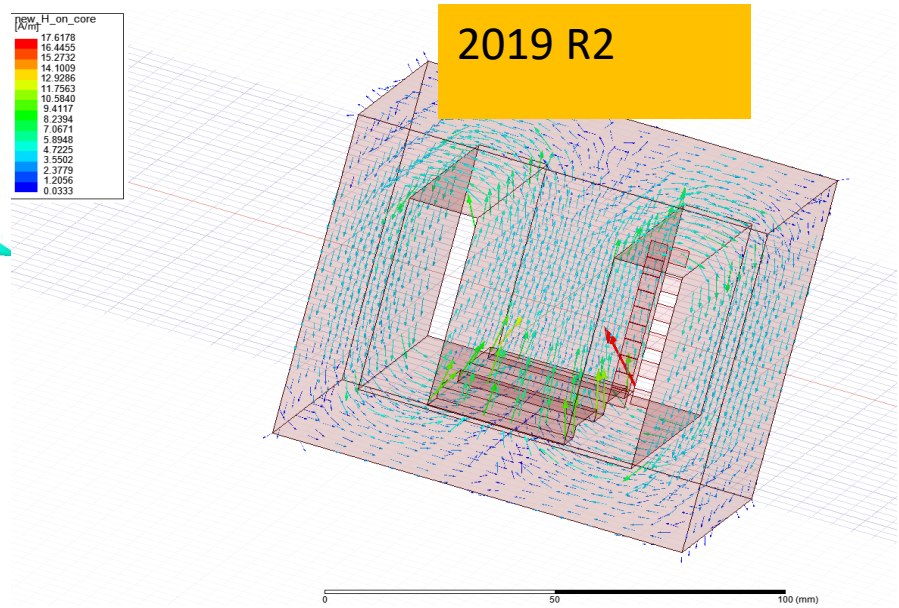
© 2019 ANSYS, Inc.

Improved Vector Field Post processing









 © 2019 ANSYS, Inc.

ANSYS Confidential