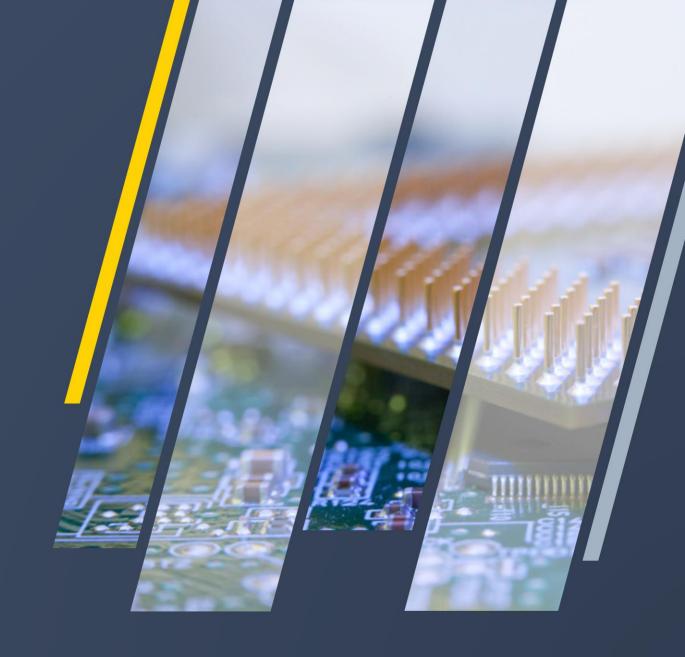


2019 R2 Highlights High Frequency Electromagnetics



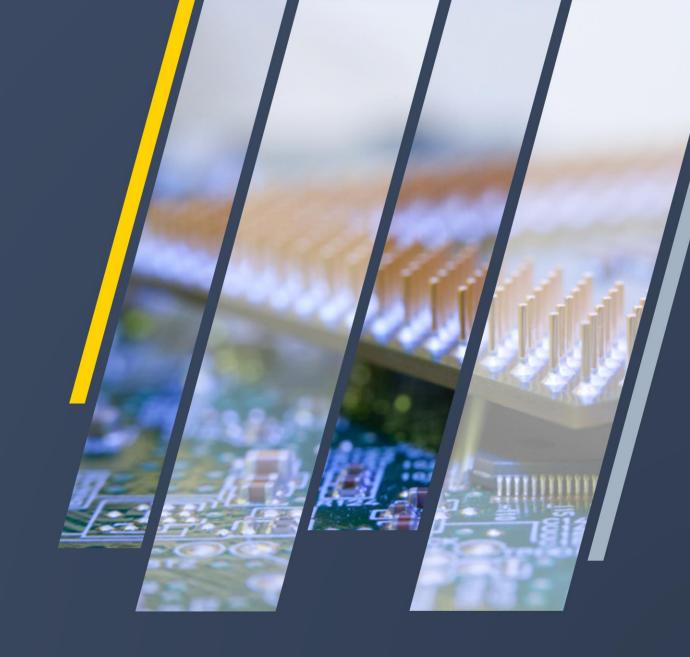
What's New for High Frequency in ANSYS 2019 R2

- 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)





HFSS



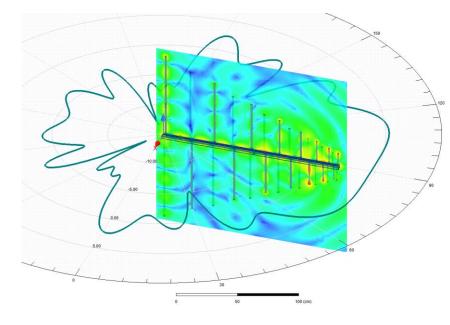
New HFSS Auto Solution Setup with Fast Solver Mode

- 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

| | Seneral Options Advanced Hybrid Expression Cache Derivatives Defaults | ۵ |
|--|---|-------|
| Save | Setup Name Setup2 | 0 |
| Deskt roject | Adaptive Solutions | |
| | Solution Frequency: O Single O Multi-Frequencies O Broadband | |
| ÷ | Frequency 5 GHz 💌 | |
| ę ę ę ę | Maximum Number of Passes 6 | |
| | Maximum Delta S 0.02 | |
| | C Use Matrix Convergence Set Magnitude and Phase | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | Use Defaults | |
| | | |
| ((| Use Defaults HPC and Analysis Options | |
| 00000000 | | |
| ropert | | |
| 000000000 | | |
| 000000000 | | |

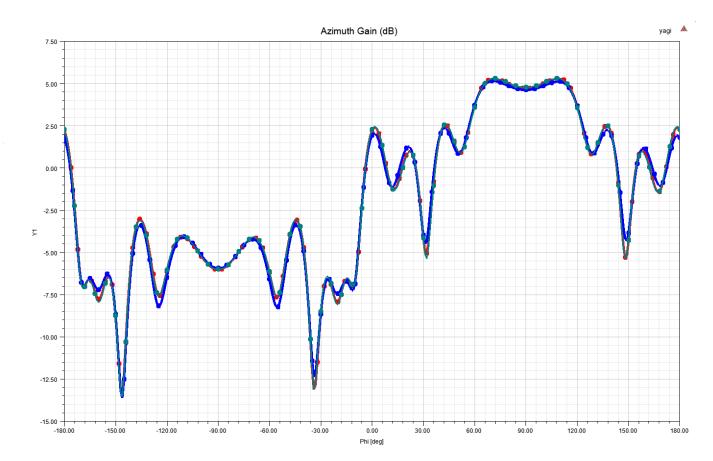
| Auto: A New | 2019 R1 | 2019 R2 |
|---|--|--|
| HFSS Paradigm | Problem Setup Geometry, materials, BCs, Ports | Problem Setup Geometry, materials, BCs, Ports |
| | Mesh Setup Accuracy | Frequency Sweep Accuracy |
| User Responsibility ANSYS Responsibility | Frequency Sweep | Mesh Setup |
| | Matrix Assembly | Matrix Assembly |
| | Matrix Solve | Matrix Solve |
| | Adapt | Adapt |
| | Post-process | Post-process |

Auto Solution Setup Results: Yagi Antenna

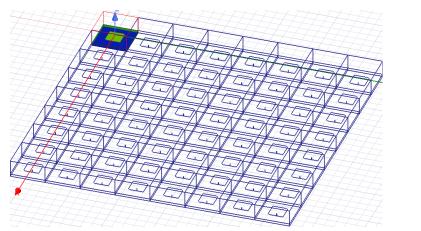


- Yagi antenna @ 850 MHz
- Trade off memory and time for reasonable accuracy
- Allow for rapid early design iteration

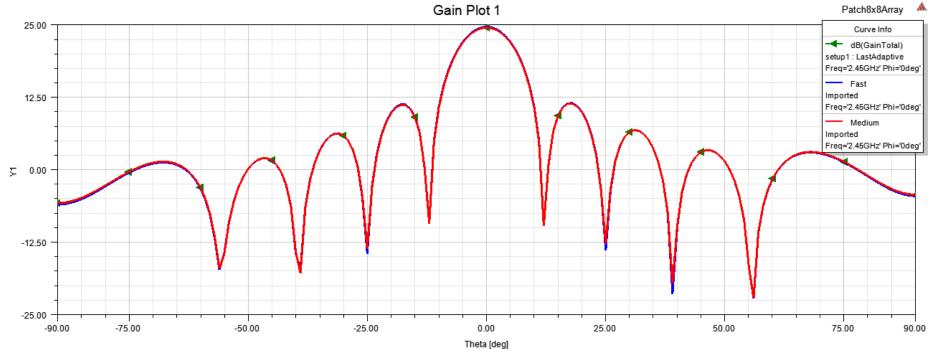
| | Fast | Balanced | Accurate |
|--------|----------|----------|----------|
| Time | 00:05:53 | 00:08:45 | 00:29:09 |
| Memory | 4.89 GB | 7.4 GB | 42.13 GB |



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 |



New Tolerant Option for TAU Mesher (Beta)

- Geometry meshing challenge
 - With the rigorous and reliable approach of FEM everything is included in the simulation

Mesh Operations

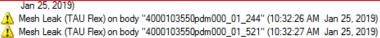
Optimetrics

Field Overlay:

Results
Port Field Display

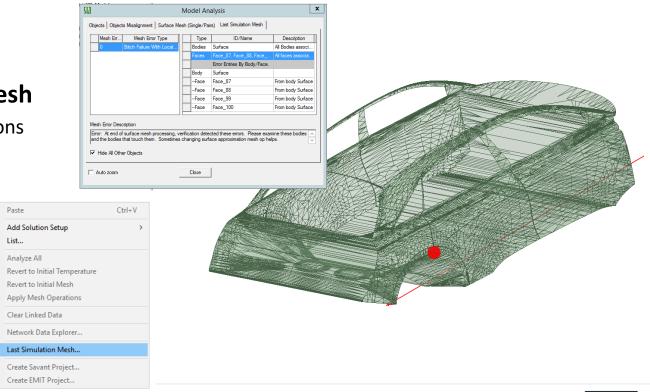
🗢 Radiatio

- 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



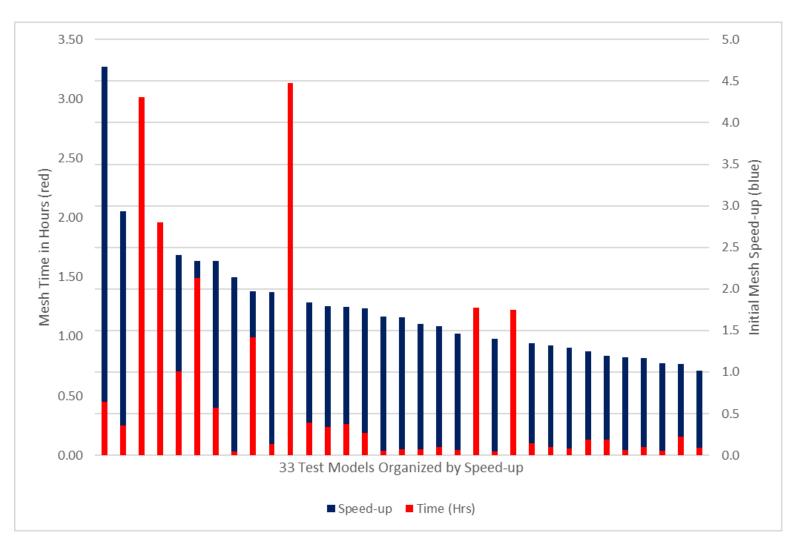
i Normal completion of simulation on server: Local Machine. (10:35:16 AM Jan 25, 2019)

| Initial Mesh Settings | × |
|---|---|
| General Advanced | |
| Model Resolution | |
| Auto | |
| O Set Length 0.0001 mm | |
| | |
| ✓ Use Flex meshing for TAU volume mesh (Beta) | |
| Use legacy faceter for TAU volume mesh | |



TAU Flex Meshing (Beta)

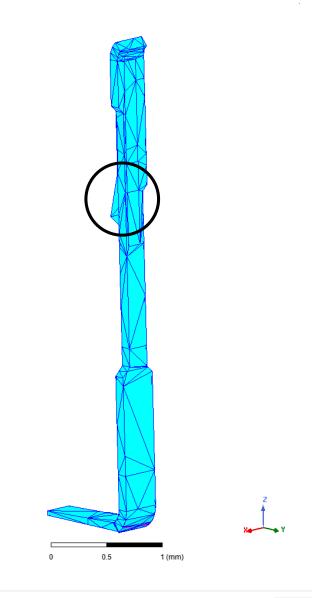
- New meshing technology introduced in 2019 R2
 - More robust, faster
- 33 example connectors tested
 - Average speed up: 1.8
 - Average time saving 0.5 hrs
- Detailed feedback when meshing fails



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

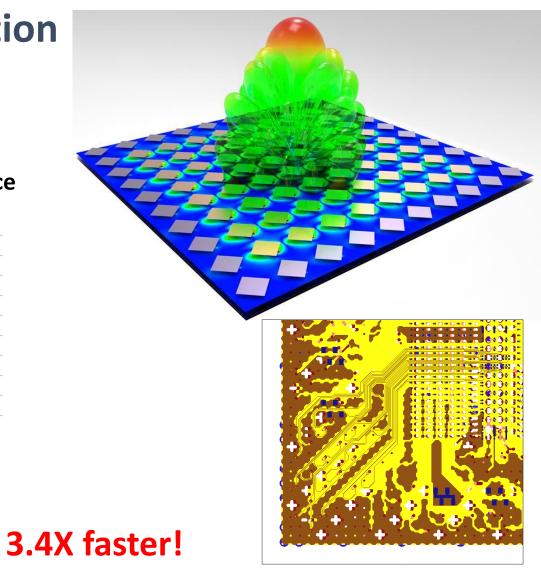
| ction: Tau: (Flex) deformed mesh list | | • | |
|---|--------------------------|------------------------------------|----------------------------------|
| Mesh Error Seri Mesh Error Type | Туре | ID/Name | Description |
| 0 Minor repaired bodies | Bodies | NM1731850010_11, NM1731850010_11_9 | All Bodies associated with erro |
| | Triangles | | All Mesh Error triangles associ. |
| | | Error Entries By Body/Face. | |
| | Body | NM1731850010_11 | |
| | Triangles | | From body NM1731850010_1 |
| | Body | NM1731850010_11_9 | |
| | Triangles | | From body NM1731850010_1 |
| h Error Description ming: Body surface mesh area is different from geometry area l Hide All Other Objects | by 1%-5% (planar) or 5%- | 10% (curved). | |



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 2019 R1 |
| | | | | Adaptive Passes did not converge |
| Adaptive Meshing | | | | Elapsed time: 06:29:35 |
| Adaptive Meshing Fr | ı | | | |
| 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 2019 R2 |
| | | | | |

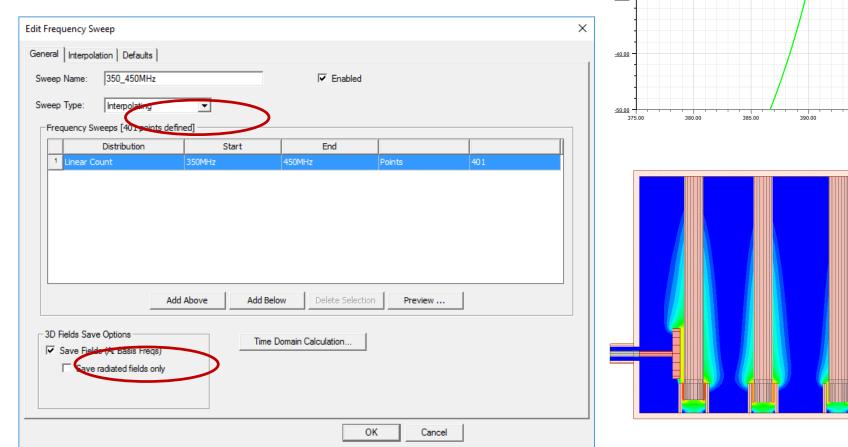


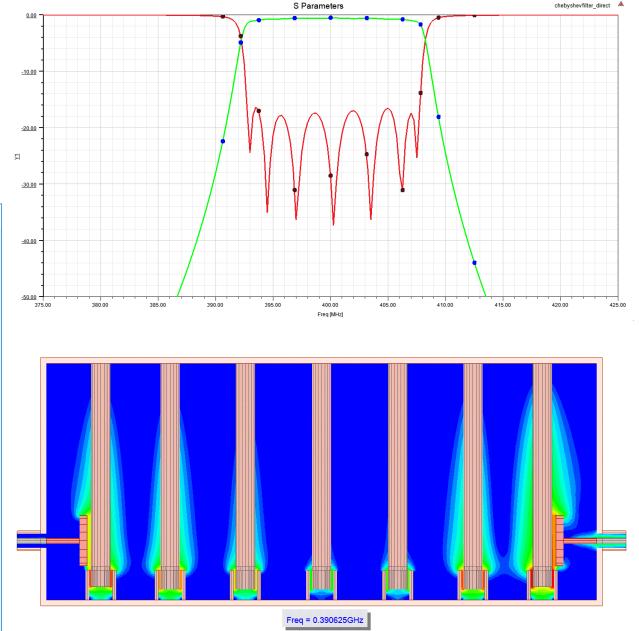
1 hr 50 min time savings!

Interpolating Sweep Save Fields

• Save Fields at Basis Points

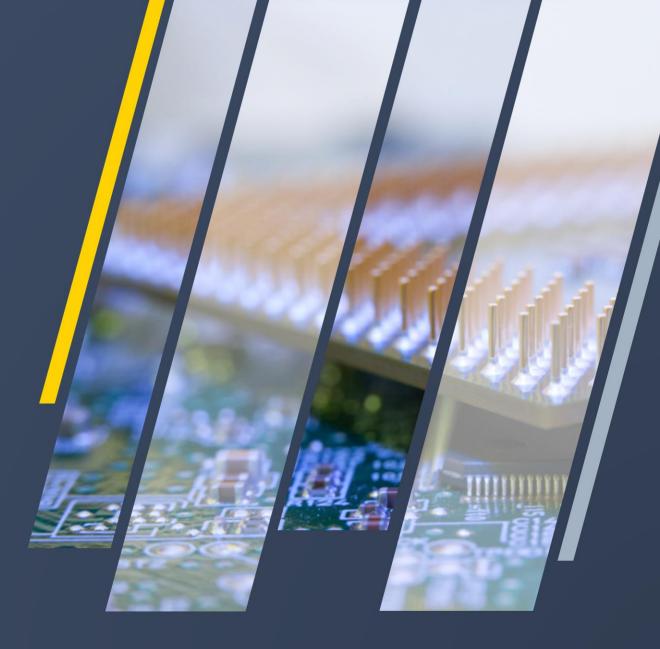
- View fields at critical frequency points
- Basis points capture resonate phenomenon







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



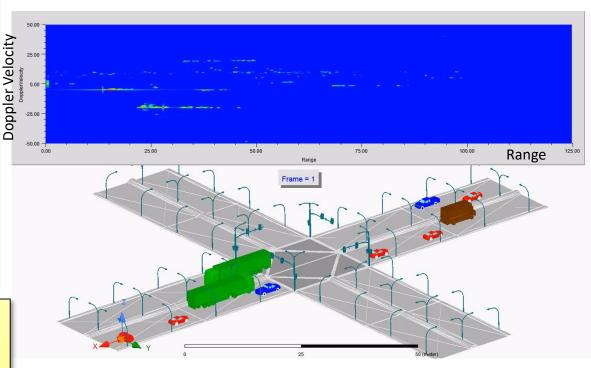
Accelerated Doppler Processing for HFSS SBR+

- 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

| SBR+ Solution Setup | | | × | | | | |
|---|-------------------------|----------------------|--------|--|--|--|--|
| General Options Defaults | | | | | | | |
| Setup Name: Setu | p1 | I Enabled | | | | | |
| Setup Type: O S | itandard 🤅 Range-Dopple | ar - | | | | | |
| Time Variable: Tym | e 🗸 | | | | | | |
| Range-Doppler Configuration | | | | | | | |
| Center Frequency: | 76.5 | GHz 💌 | | | | | |
| Range Resolution: | 0.25 | meter 💌 | | | | | |
| Range Period: | 100 | meter 💌 | | | | | |
| Velocity Resolution: | 0.25 | m_per_sec 💌 | | | | | |
| Velocity Min: | -50 | m_per_sec 💌 | | | | | |
| Velocity Max: | 50 | m_per_sec 💌 | | | | | |
| Radar System P | Performance Parameter | Value | | | | | |
| Radar Bandwidth | | 0.599585GHz | | | | | |
| # of Frequency Samples | | 400 | | | | | |
| Frequency Step Size | | 1.498962MHz | | | | | |
| Coherent Processing Inter | | 7.837711ms 400 | | | | | |
| Coherent Processing Inter Pulse Repetition Frequence | | 400 51.035307kHz | | | | | |
| | Use Defaults | | | | | | |
| | | HPC and Analysis Opt | ions | | | | |
| | | ОК | Cancel | | | | |
| [,] Direct ent | Direct entry of radar | | | | | | |
| performa | nce specs | 5 | | | | | |
| Automatio | c sim sett | ings for | | | | | |
| • frogu | | on | | | | | |

- trequency sweep
- coherent processing interval

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

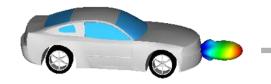


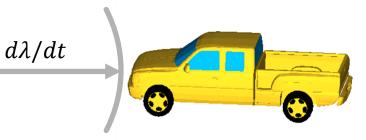
ADAS: Accelerated Doppler Processing (ADP)

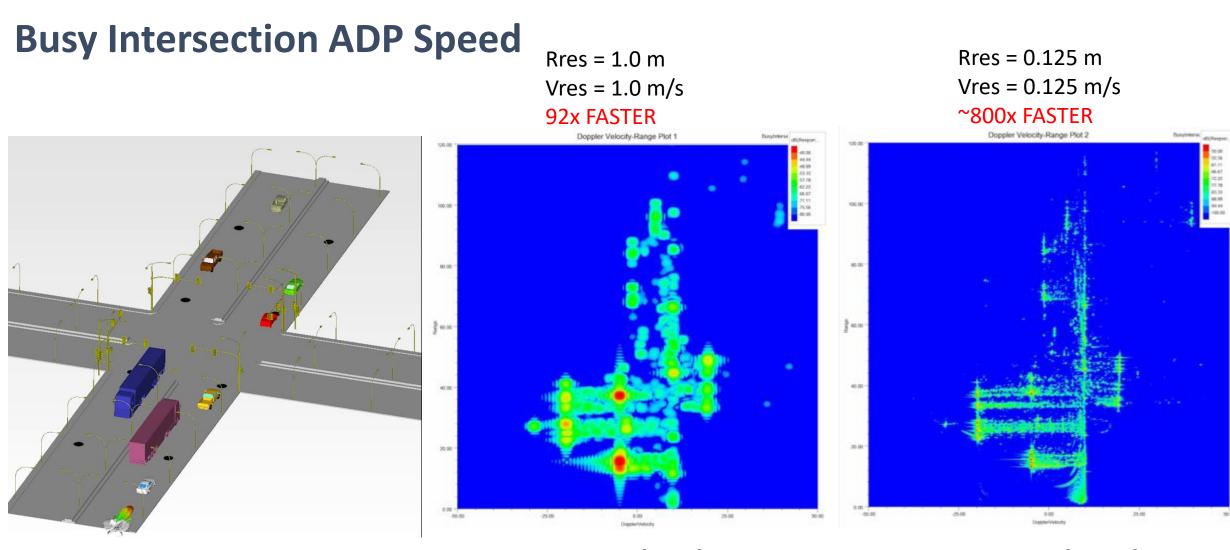
Direct simulation

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

- 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!





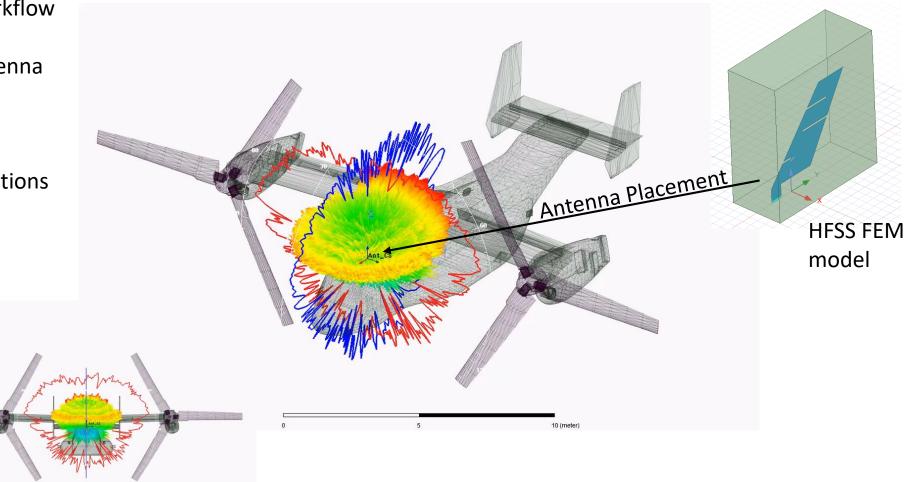


- 2,400 Freq Sweeps of 120 frequencies
- 288,000 total
- 20 mins on laptop with ADP

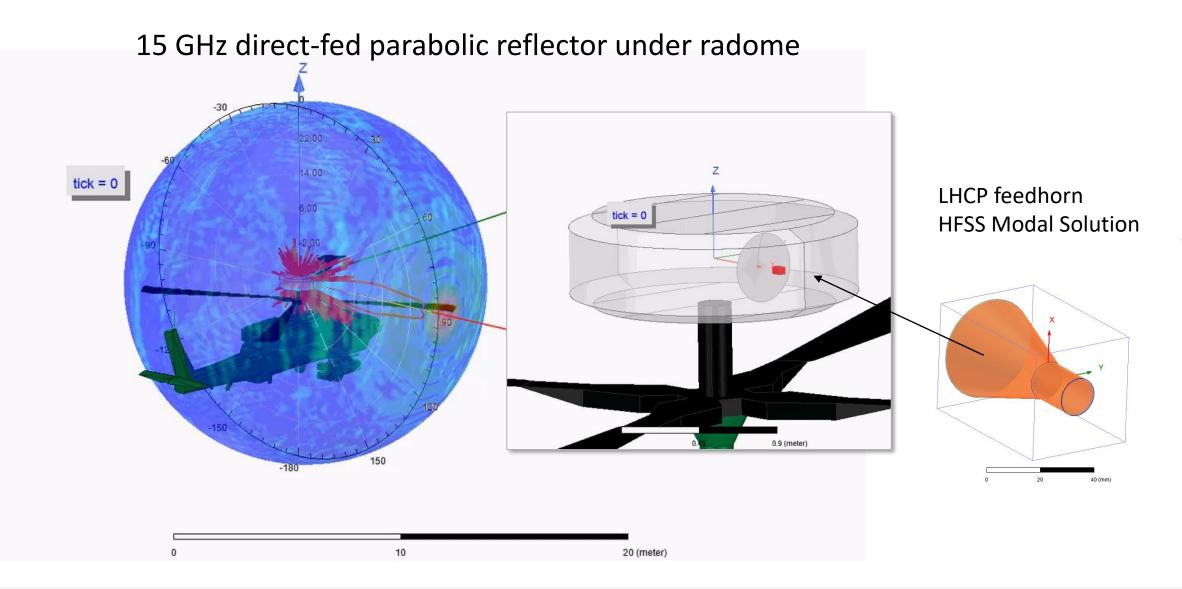
- 19,200 Freq Sweeps of 1200 frequencies
- 23,040,000 total
- 2 hours on laptop with ADP

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

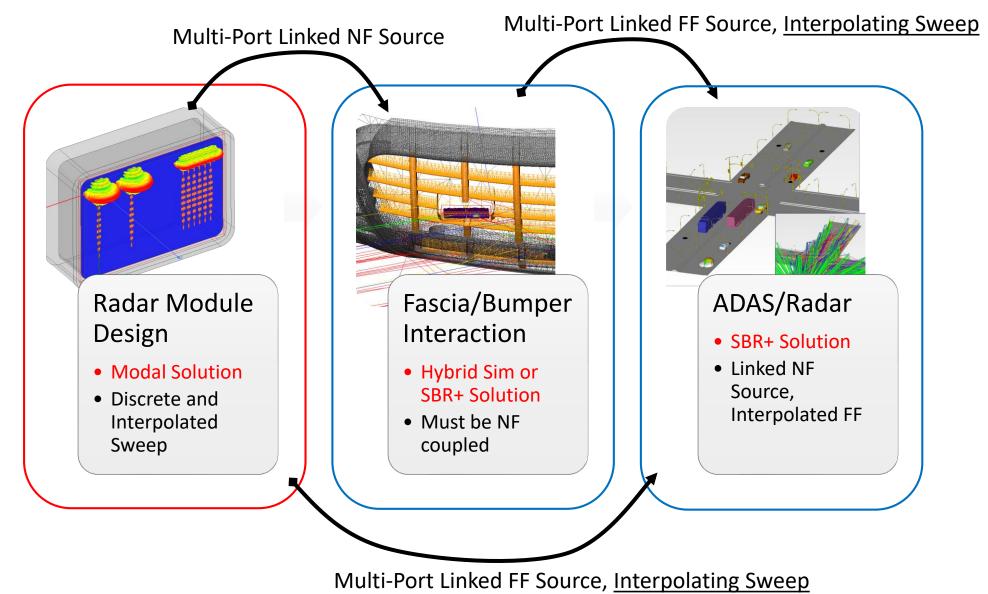
- Supports installed antenna workflow
- Leverage pre-existing HFSS antenna designs to drive SBR+ analysis
- Gain enables SBR+ antenna placement and coupling simulations
- Enable self-coupling for duplex antennas (e.g. radar)



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



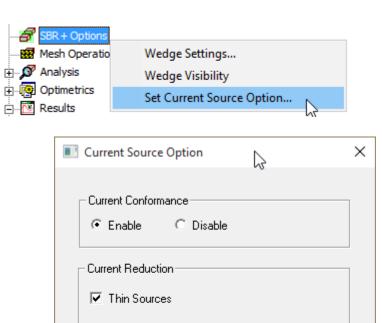
ADAS—The ANSYS Simulation Flow for Automotive Radar



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

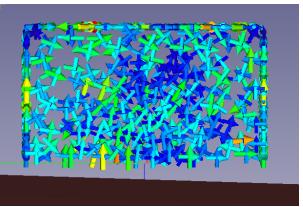


0.99

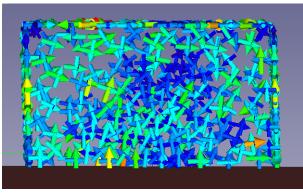
Cancel

Power Fraction to Keep

OK.



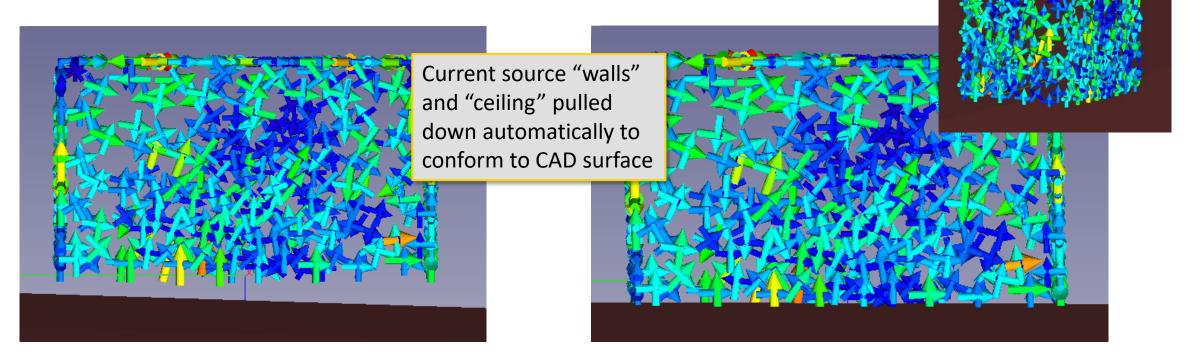
Conformance Off



Conformance On

Setting Conformance for Sources in SBR+

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



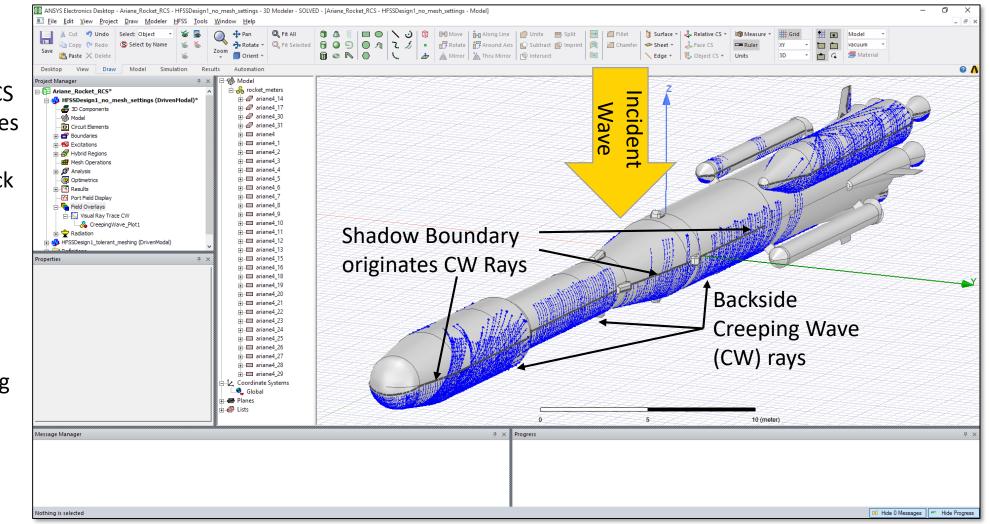
Conformance Off

Conformance On

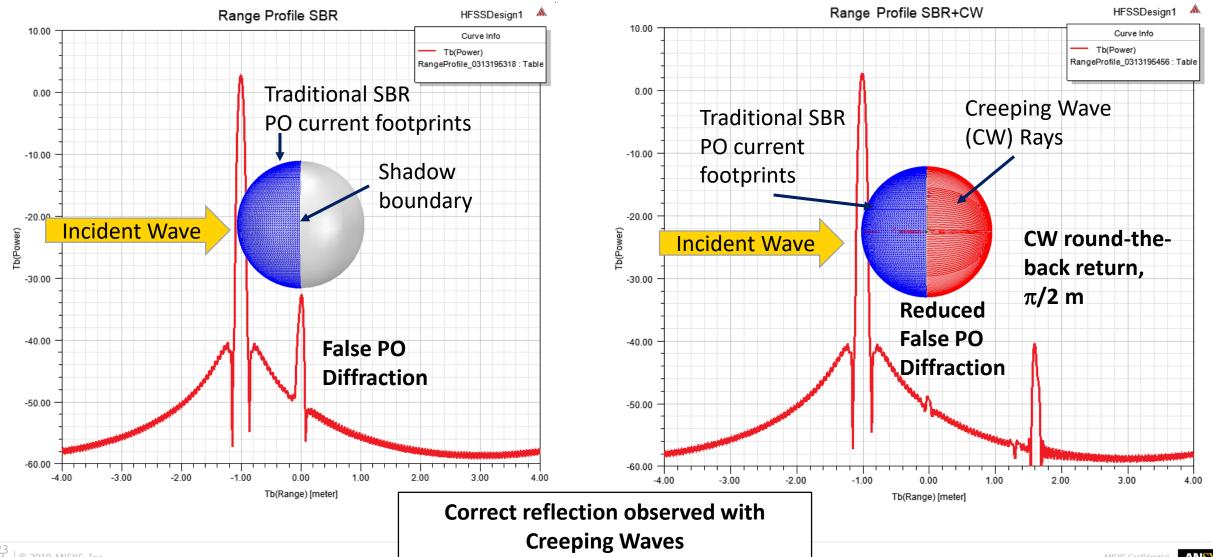
Recommend using Conformance for antennas using host as ground plane

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
- <u>Industry-first</u> Creeping Waves for RCS modeling



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



New in EMIT

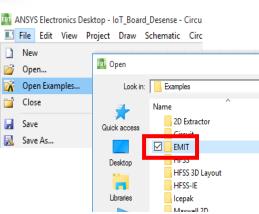
• Support for adding coupling data from external Touchstone files

🗄 🥵 Ports

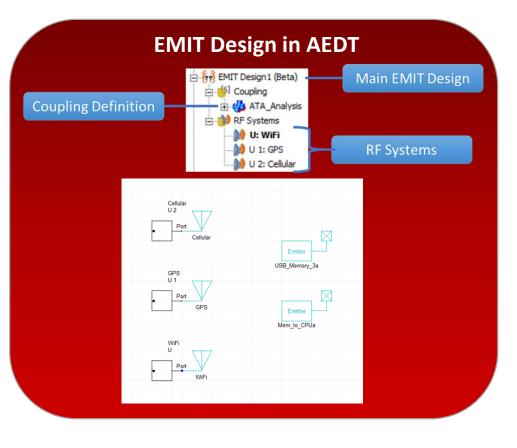
🗄 👘 Coupling



Detailed PDF documentation/tutorial

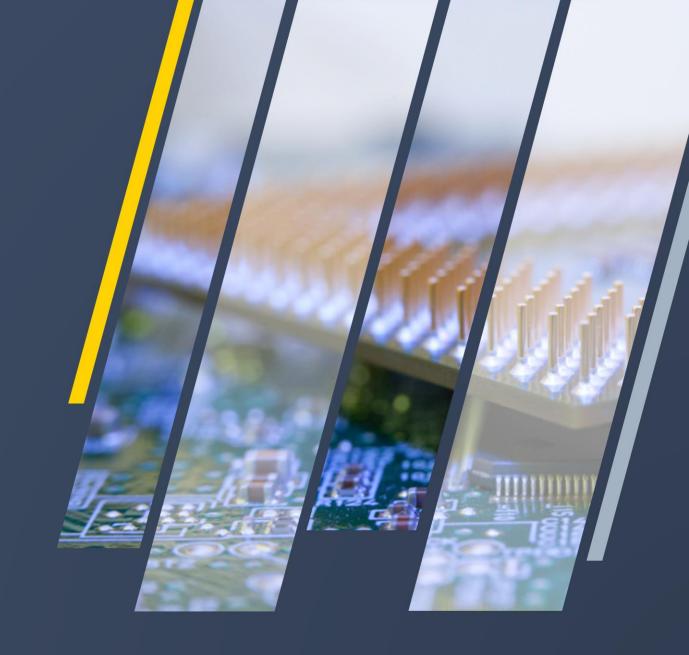


- User experience enhancements including:
 - Settings from Analysis & Results window are saved on exit
 - Improved default appearance of component configuration dialog
 - And more!



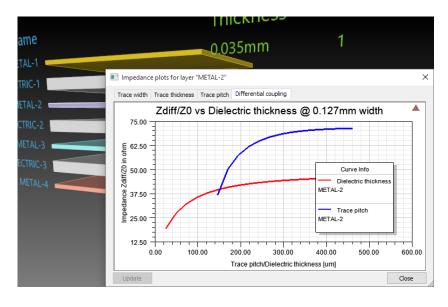


HFSS 3D Layout

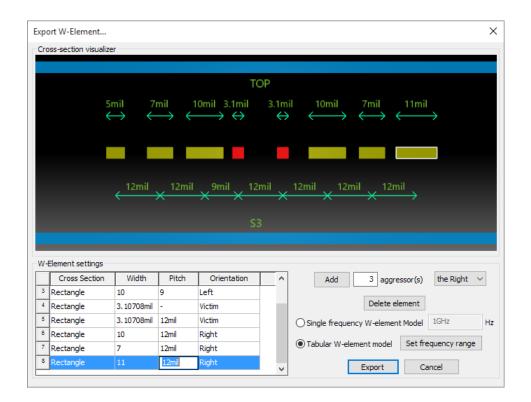


Stackup Wizard Enhancements

- 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



| Synthesis | Analysis | | |
|------------|-------------|-------------------|--------|
| Single En | ded Nets | Differential Nets | |
| Required | Zdiff(ohms) | 85 | |
| Top ref la | yer name | TOP | \sim |
| Btm ref la | yer name | S3 | \sim |

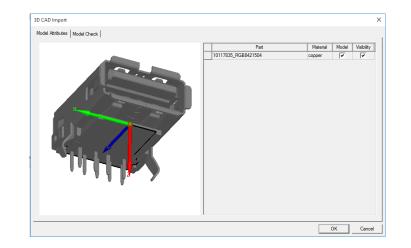


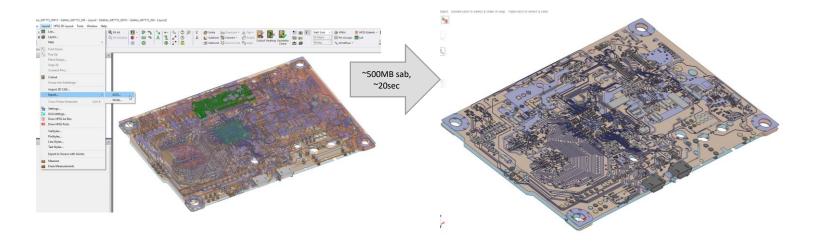
Available in HFSS 3D Layout and SIwave

Lightweight MCAD in Layout

• Lightweight 3D Geometry

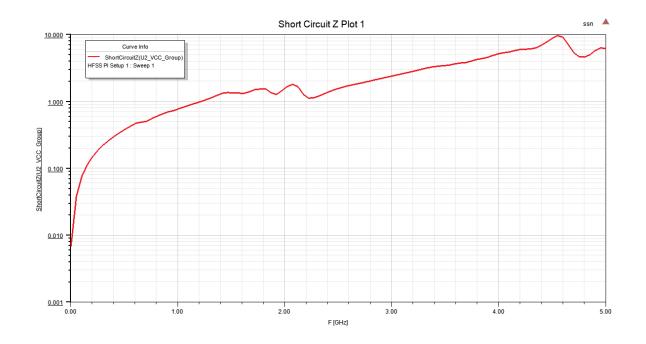
- Import sat, sab, step, iges, etc... directly to Layout
- Place, assign materials, filter bodies, solve
- Improved UI performance
- Improved placement operations
- Export full assembly to sat, sab, stride
 - Fast ACIS model generation from ECAD

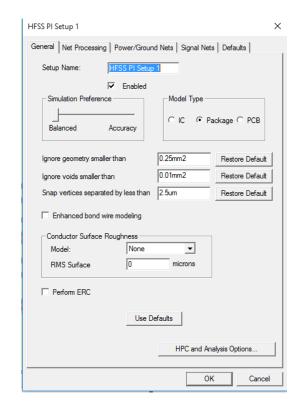




HFSS-PI (BETA)

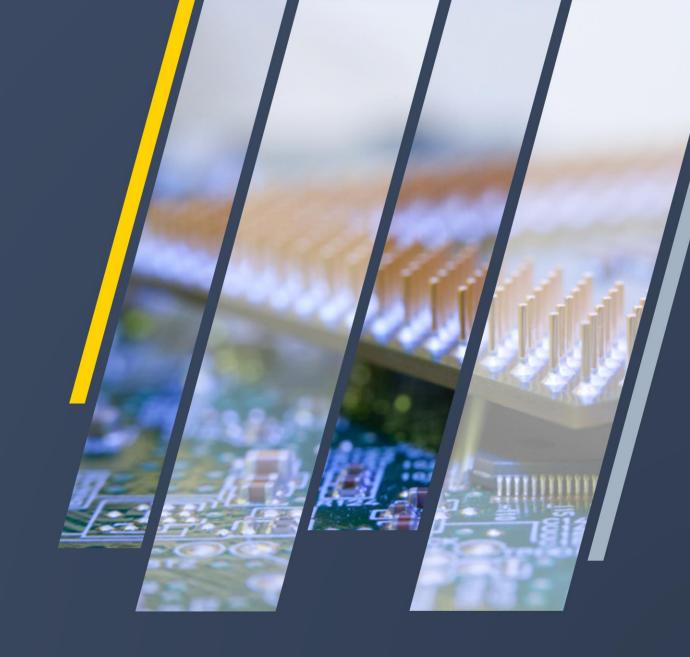
- New simulation type for power integrity, PI, focused SYZ extraction
- PI-specific output quantities
 - Short Circuit Z, Loop Inductance, Loop Resistance, Capacitance





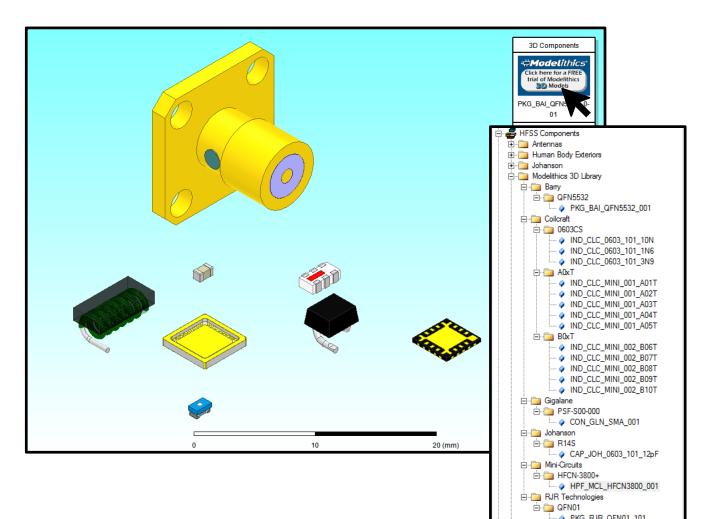


Applications



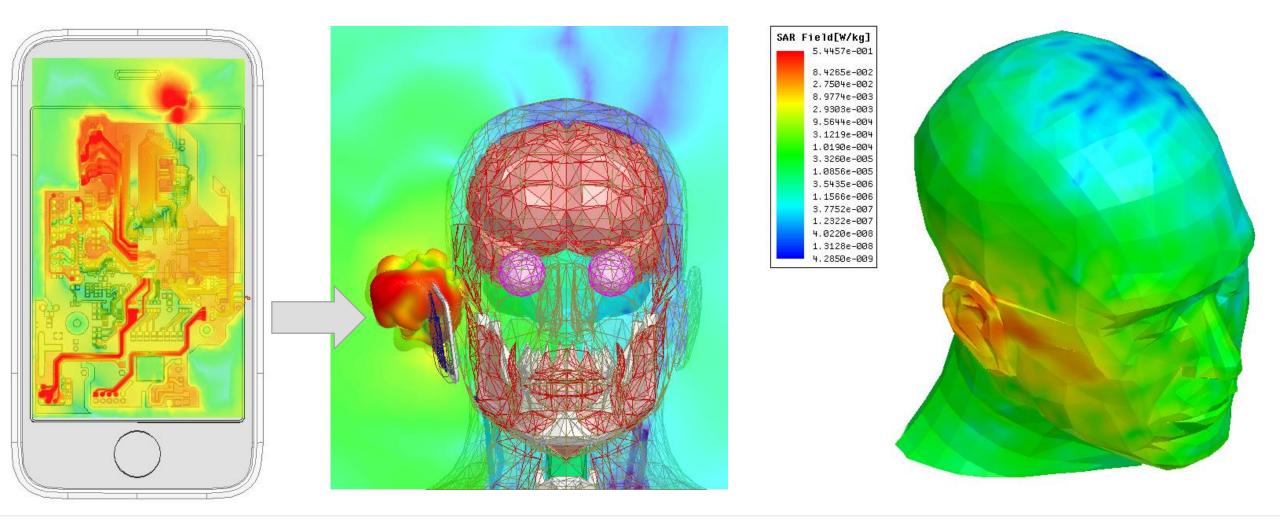
Modelithics 3D Component Library

- 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



IEC62704 FEM Standard for SAR Certification (Beta)

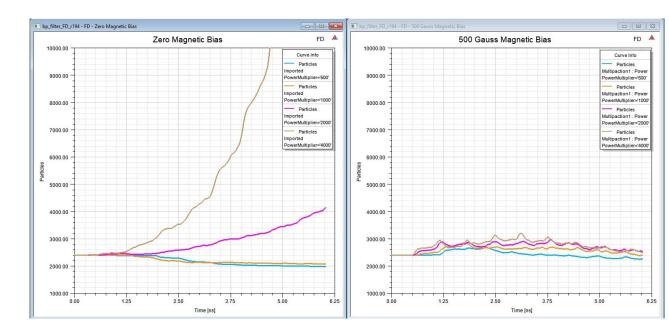
• Implementation of IEC62704 -4 standard for Specific Absorption Rate



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

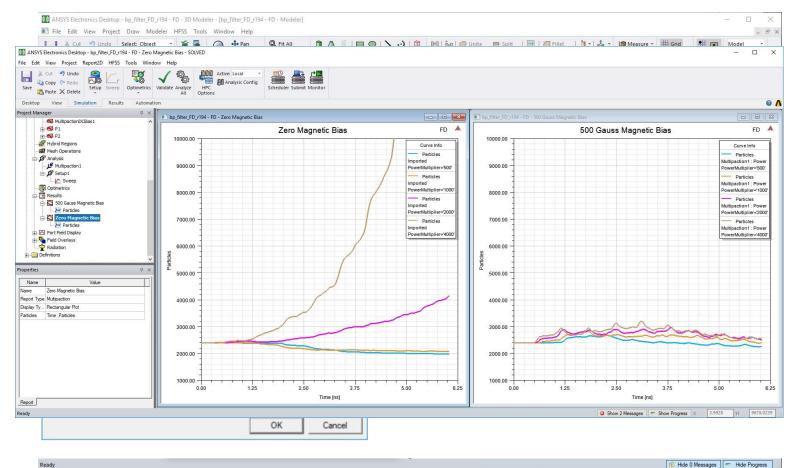
| HFSSDesign1 (DrivenTerminal)* 3D Components | | | | Mu | Multipaction Analysis Setup | | | | | > |
|---|------|---------------------------|--------|---------------------|-----------------------------|------------------------------|--------------|-------------|---------|---------|
| Model | | | | Ge | ener | al Defaults | | | | |
| Circuit Elements | | | | | | | | | | _ |
| E and aries | | | | Name: Multipaction1 | | | | | Enabled | |
| - 🗗 SEE 1 | | | | | | | Se | tup Link | | |
| Excitations | | | | | | Stop time: | 1000 | ms 💌 | | |
| Hybrid Regions | | | | | | | | | | |
| Mesh Operations | | | | | М | laximum number of particles: | 10000 | | | |
| Setup1 | | | | _ ⊢ [₽] | Pow | er sweep points [11 points d | lefined] | | | |
| | Da . | Сору | Ctrl+C | [| | Distribution | Start | End | | |
| Optimetrics | _ | Сору | Cuite | | 1 | Linear Count | 2000 | 4000 | Points | 11 |
| E Results | | Rename | F2 | | | | | | | |
| Port Field Display | | Delete | Delete | | | 1 | | | 1 | |
| Field Overlays | | Properties | | | | Add Above Ad | d Below | Delete Sele | stion F | Preview |
| bp_filter | | Disable Sweep | | | | | | | | |
| Definitions | | · · · | | | V | Fast multipaction analysis | | | | |
| _ | | Analyze | | | Г | Charge distribution | | | | |
| | | Add Multipaction Analysis | | | , | | | | | |
| | | Network Data Explorer | | | | | | | | |
| | | Create Quick Report | | | | | Use Defaults | 1 | | |
| | | Perform FFT on Report | | | | _ | | _ | | |
| | | - renomination neporem | | | _ | | | | | |



| Ports/Mode or Ter | minal to excit | e: feedpin1_T | 1 | - |
|-------------------|----------------|---------------|-------|------|
| Frequency | Include | Magnitude | Phase | Unit |
| 600MHz | | 0 | 0 | deg |
| 780MHz | ~ | 1 | 0 | deg |
| 960MHz | | 0 | 0 | deg |
| 1.14GHz | | 0 | 0 | deg |
| 1.32GHz | | 0 | 0 | deg |
| 1.5GHz | | 0 | 0 | deg |
| 1.68GHz | ~ | 0.5 | 0 | deg |
| 1.86GHz | | 0 | 0 | deg |
| 2.04GHz | | 0 | 0 | deg |
| 2.22GHz | | 0 | 0 | deg |
| 2.4GHz | | 0 | 0 | deg |

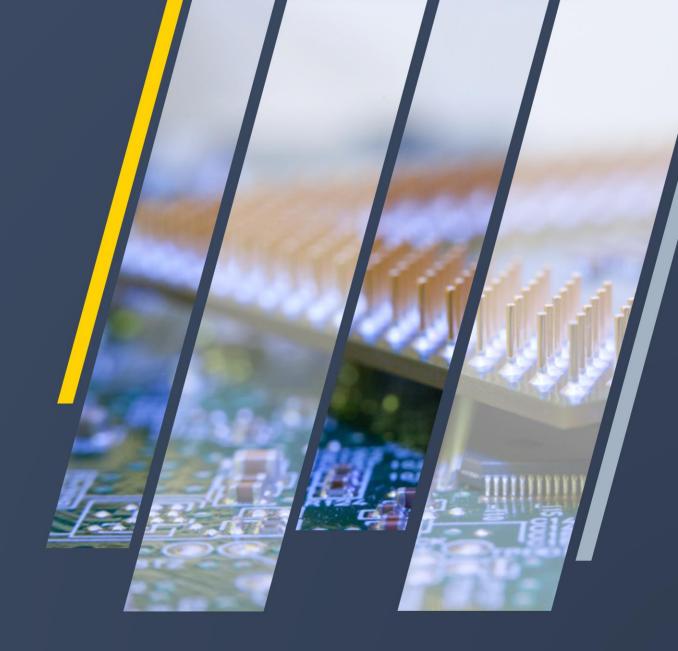
Multi-paction Setup

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





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

| Select Scheduler | X |
|--|--|
| Select scheduler: ANSYS Cloud | ANSYS Cloud (ANSYS Cloud Cluster) |
| Server: localhost | |
| User name: | ication Compute Resources Scheduler Options |
| | ep |
| Password: | natic settings |
| | tions to distribute: 1 |
| | lection |
| Scheduler info: | election parameters: Region=EastUS (1 node, 8 cores, 5 |
| Scheduler Name: ANSYS Cloud | Small |
| Description: ANSYS Cloud Version: 2019 R2 | Small Decify Number of Co |
| | Large |
| Log in Log out Import Ex | oprt |
| OK Cancel | |
| | |
| Monitor Job - ANSYS Cloud (ANSYS Cloud Cluster) | X |
| of the monitor | |
| Recent jobs: E:\AnsysDev\ansoft_projs\Cloud_test_4\OptimTee_2.aedt select project corresponding to submitted joo to begin monitoring. | |
| Job status: Running Job ID: 5c9bf9bdab4f312838147204 | ✓ Show analysis details Portal |
| | |
| Design Variation: | |
| ergence_1 Diplay At messages | |
| / Pass Number Solved Elements | |
| Kay Mag Deta 5 | Progress: |
| | |
| | |
| | * * |
| \mathcal{A} | Clear Progress Messages Abort Job |
| \vee | ☐ Auto Download Download Close |
| | Download Results |
| 10 15 20 25 20 | Download S Parameters |
| | Download Files |

Improved Vector Field Post processing

