Ansys HFSS Getting Started LE1

Module 1: Introductions

Release 2020 R2

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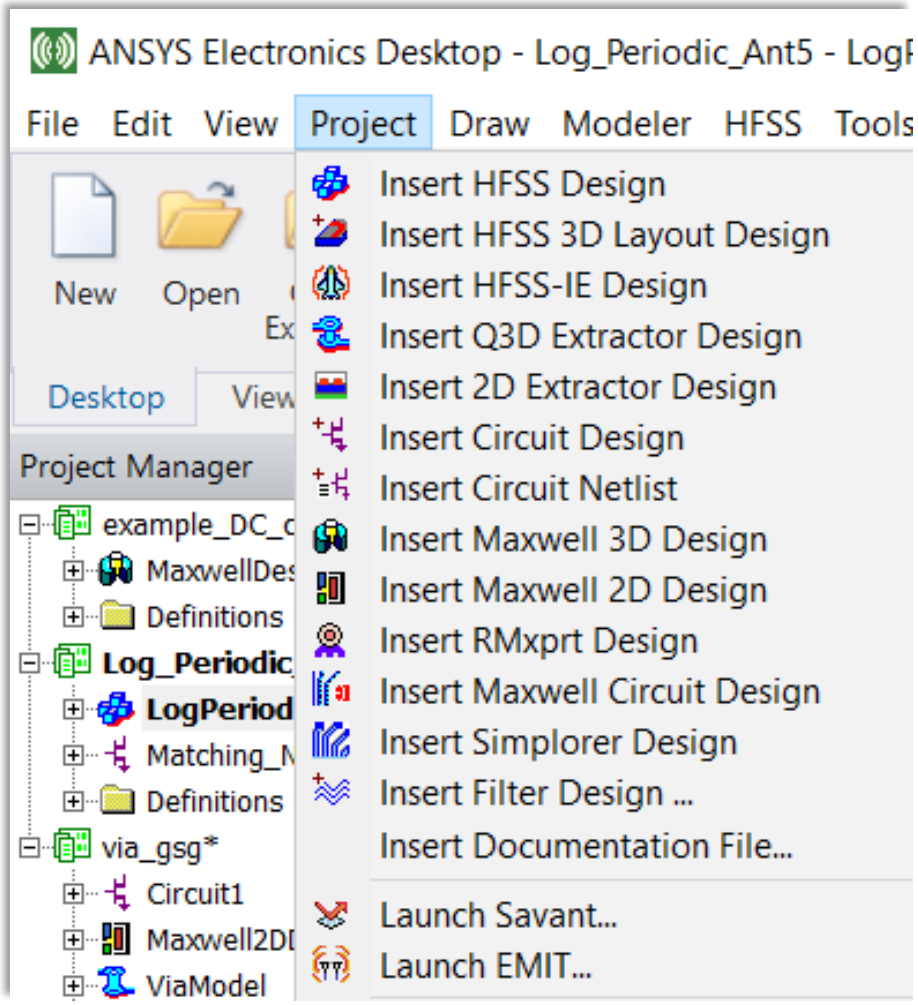
Outline - Introductions - ANSYS, Inc. - AEDT - HFSS

- **ANSYS Introduction**
  - Multiple Disciplines and Multiphysics Simulation Software
  - Publicly Traded: ANSS
  - Worldwide Headquarters in Canonsburg, PA USA
  - www.ansys.com
- **AEDT Introduction - ANSYS Electronic Desktop**
  - Common Graphical User Interface for Multiple Products
  - Common File Extension *.aedt and *.aedtz for Zip Archive
  - Multiple Projects and Different Simulators Can Be Open
- **HFSS Finite Element Method (FEM)**
  - HFSS Includes Several Different Electromagnetic Simulation Solvers.
  - HFSS Finite Element Method (FEM) is the Subject of this Course
  - Two Different Approaches and GUI Feature Sets:
    - HFSS MCAD - Fully Arbitrary 3D - ***This course***
    - HFSS 3D Layout - Layered Structures



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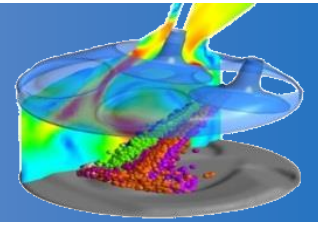
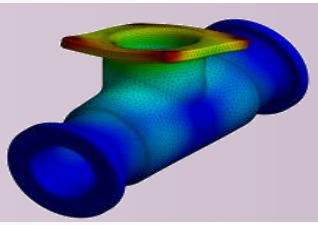
Breadth of Technologies

Fluid Mechanics:
From Single-Phase Flows

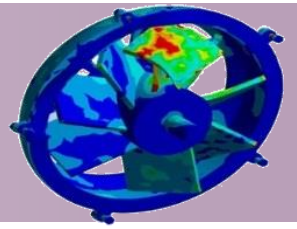
To Multiphase
Combustion

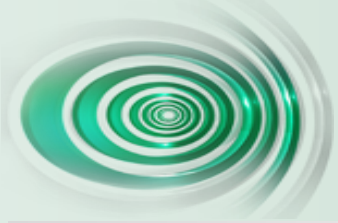


Structural Mechanics:
From Linear Statics

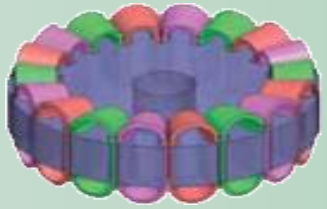


To High-Speed Impact

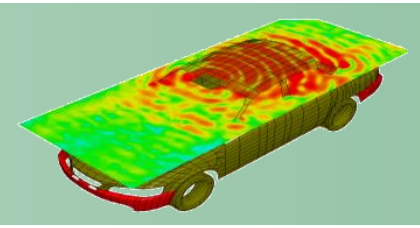




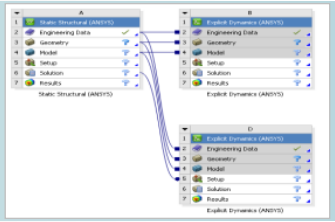
Electromagnetics: From
Low-Frequency Windings



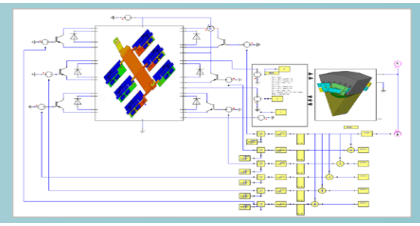
To High-Frequency
Field Analysis



Systems:
From Data Sharing



To Multi-Domain
System Analysis



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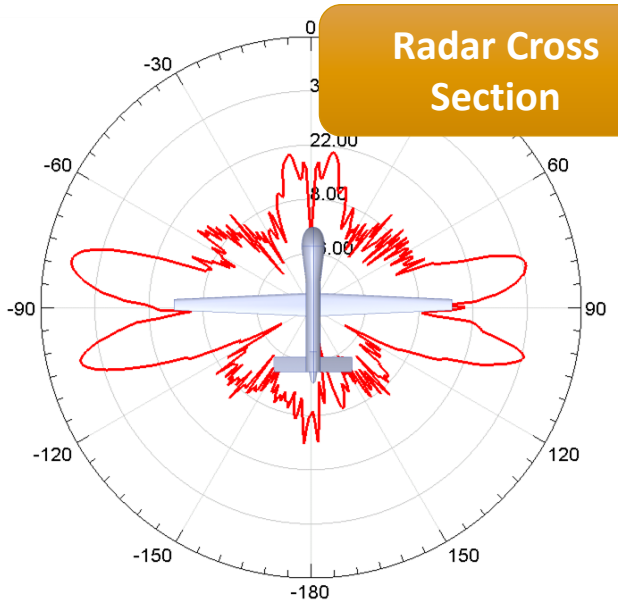
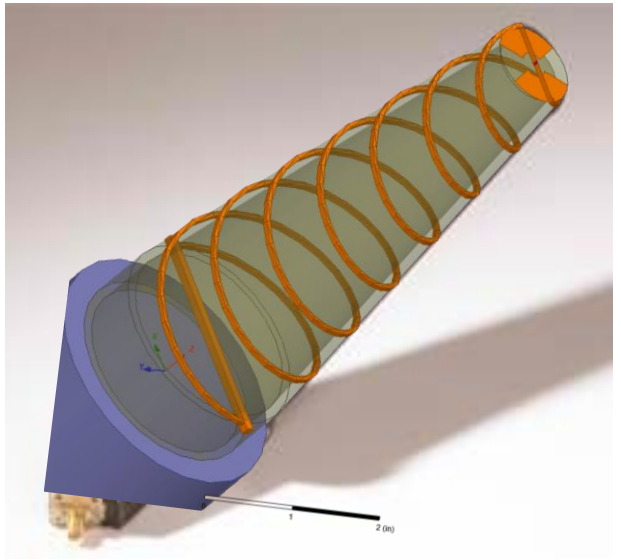
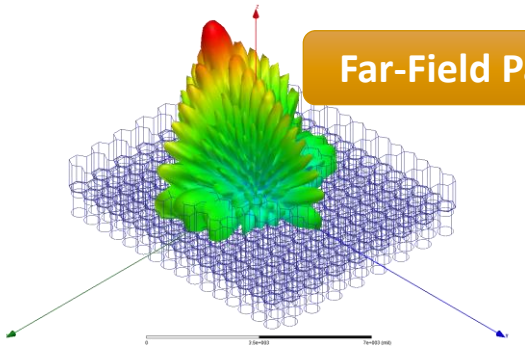
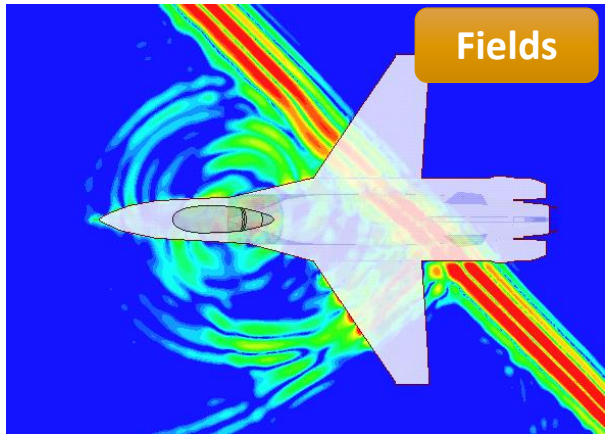
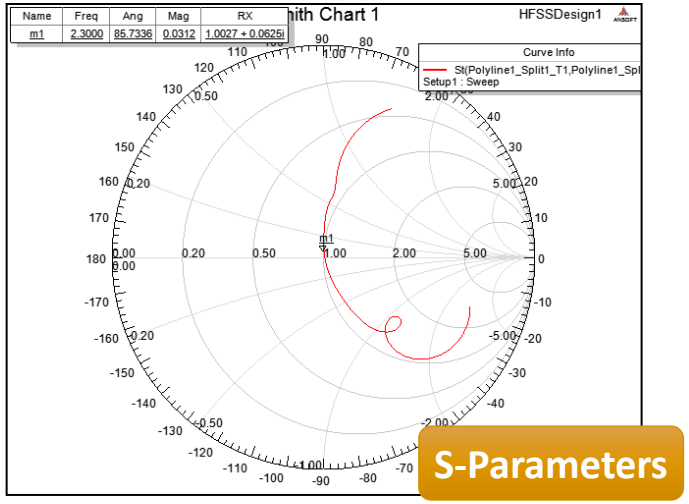
Virtual Prototypes





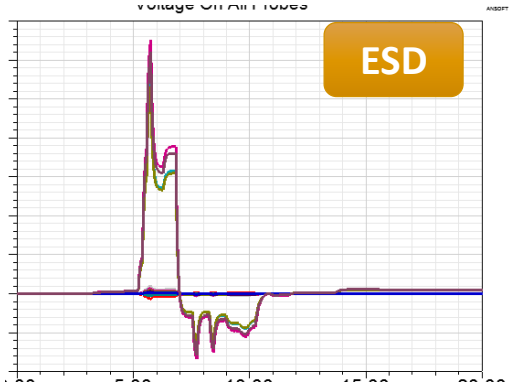






HFSS Virtual Prototype

Virtual Compliance



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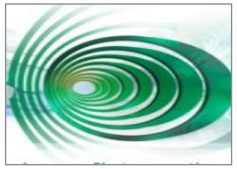
Multi-Physics for Electronics

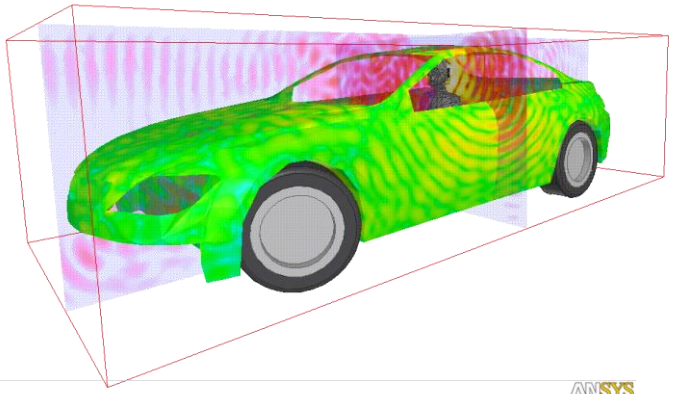
Electromagnetics
(HFSS, SIwave, Savant, Q3D Extractor, Maxwell, Designer, EMIT, Simplorer)



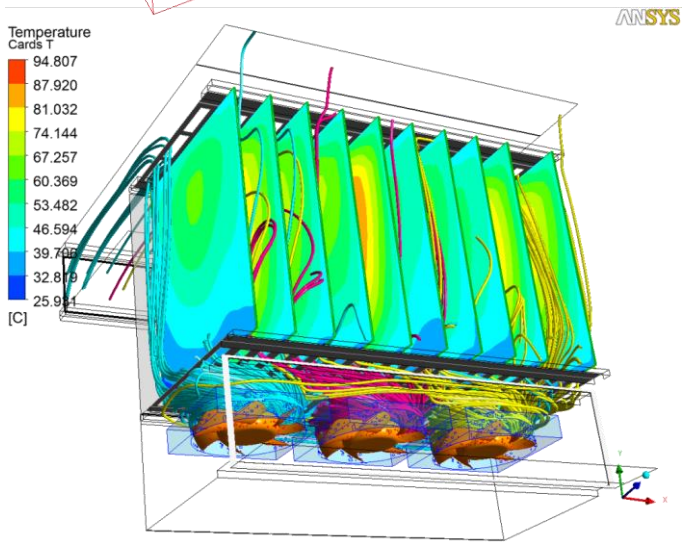
Thermal
(ANSYS Mechanical, Icepak)

Structural
(ANSYS Mechanical)

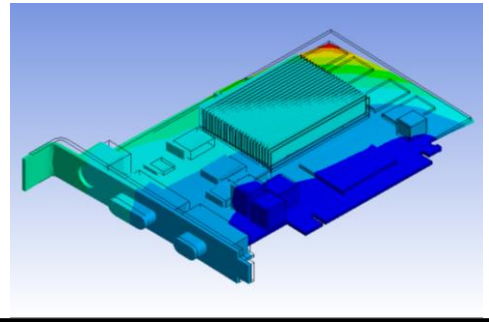
EM Fields
(HFSS)



Air Flow
(Icepak)



Stress
(Mechanical)



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Multi-Domain: Multiple Physics - Icepak for Thermal with HFSS

EM Fields
(HFSS)

Thermal
(ANSYS Mechanical)

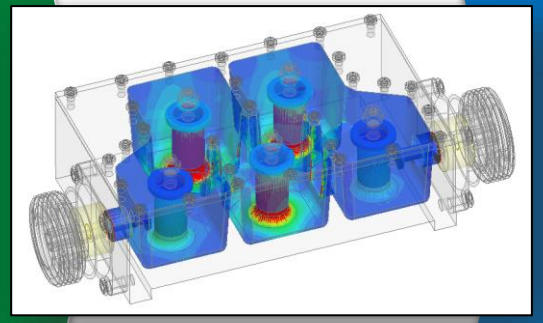
Stress
(ANSYS Mechanical)

HFSS

Adaptive Meshing

Temperature Dependent Materials

Full-Wave Finite-Element Method



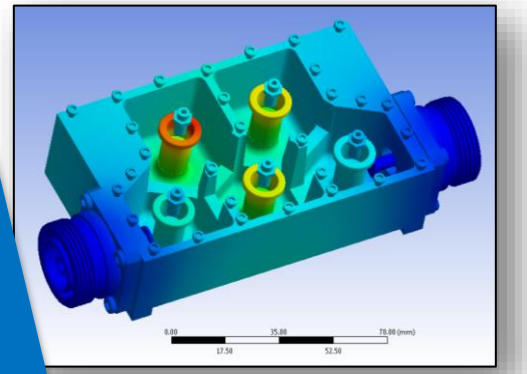
Power Loss Density as Thermal Source

Mechanical

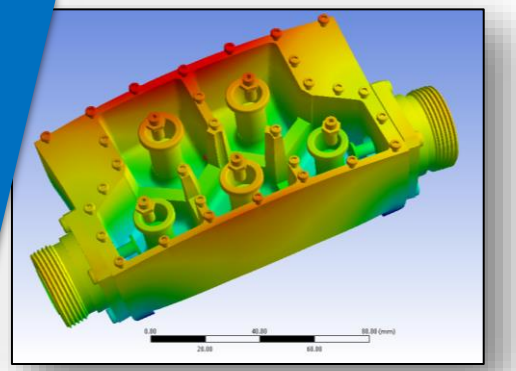
Common Geometry Interface

Conformal Mesh

Transient and Steady-State Thermal



Temperature



Structural

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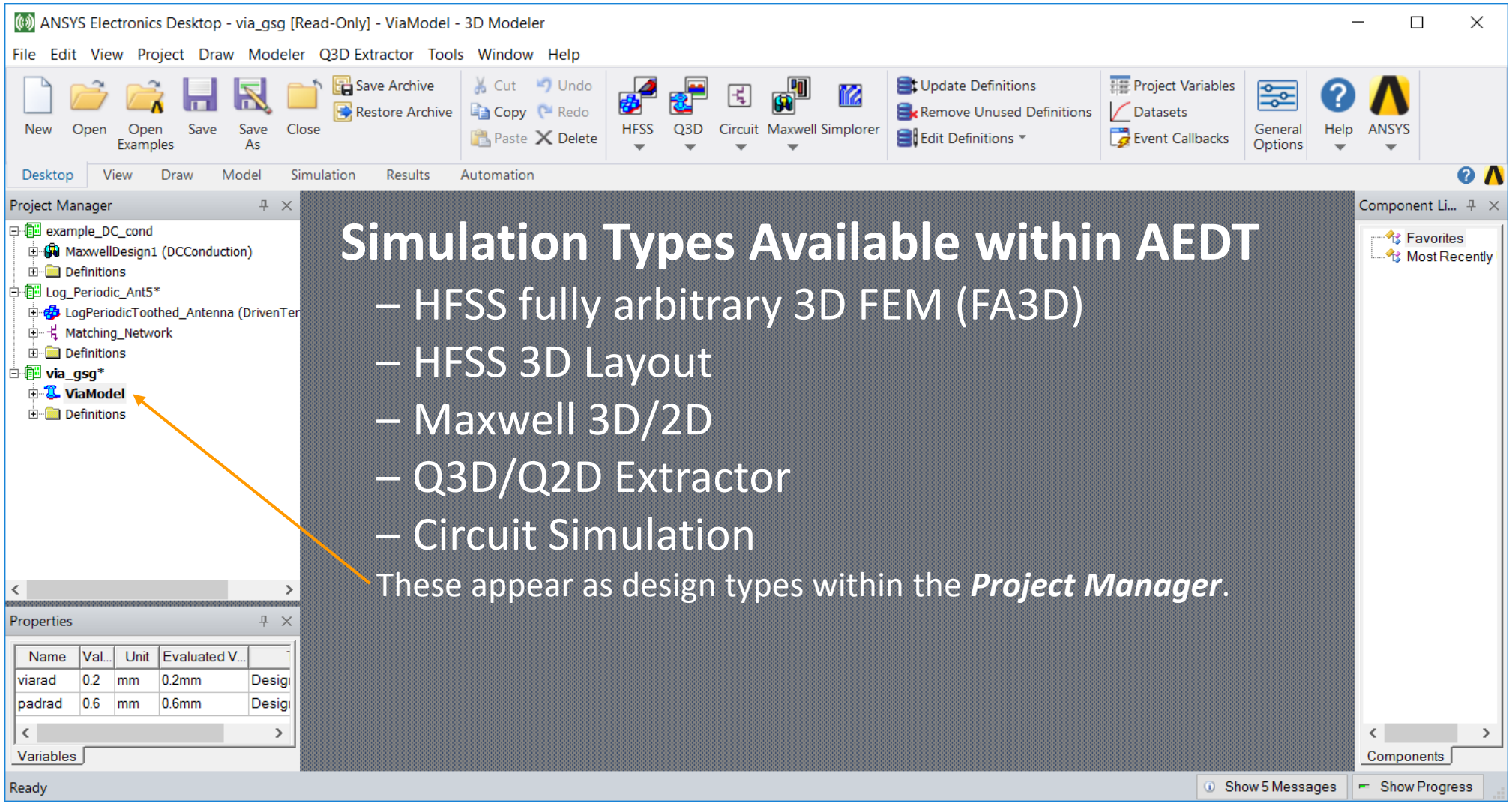
HFSS in ANSYS Electronics Desktop (AEDT)

- The ANSYS Electronic Desktop is a graphical user interface (GUI) common to many electronic simulation tools.



HFSS runs in AEDT. An HFSS project file extension is *.aedt

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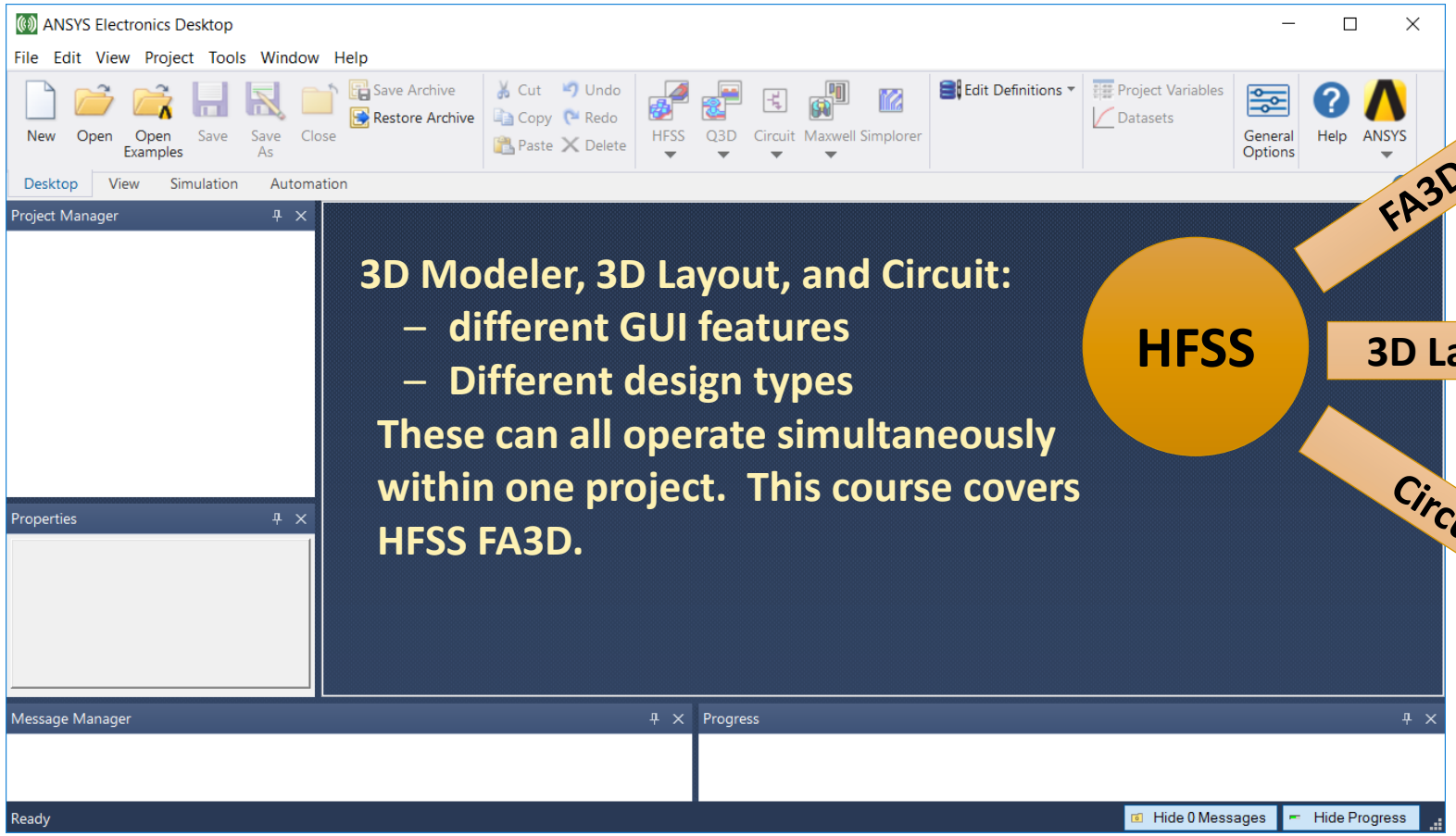
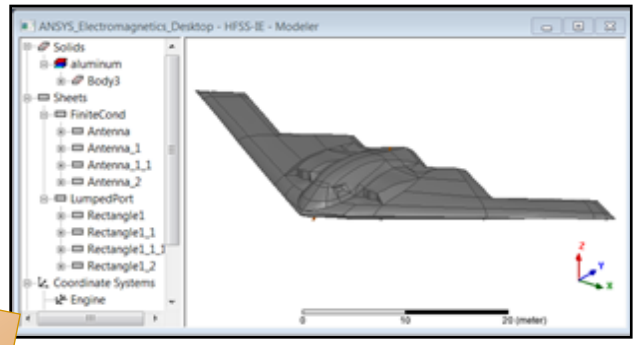
HFSS in ANSYS Electronics Desktop (AEDT)

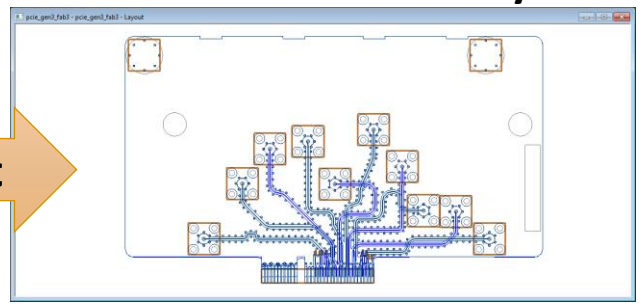
3 Basic Interfaces - 1 Desktop



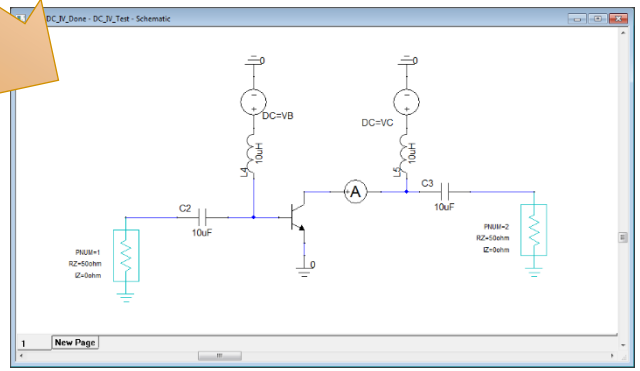
3D Modeler



3D Layout



Schematic



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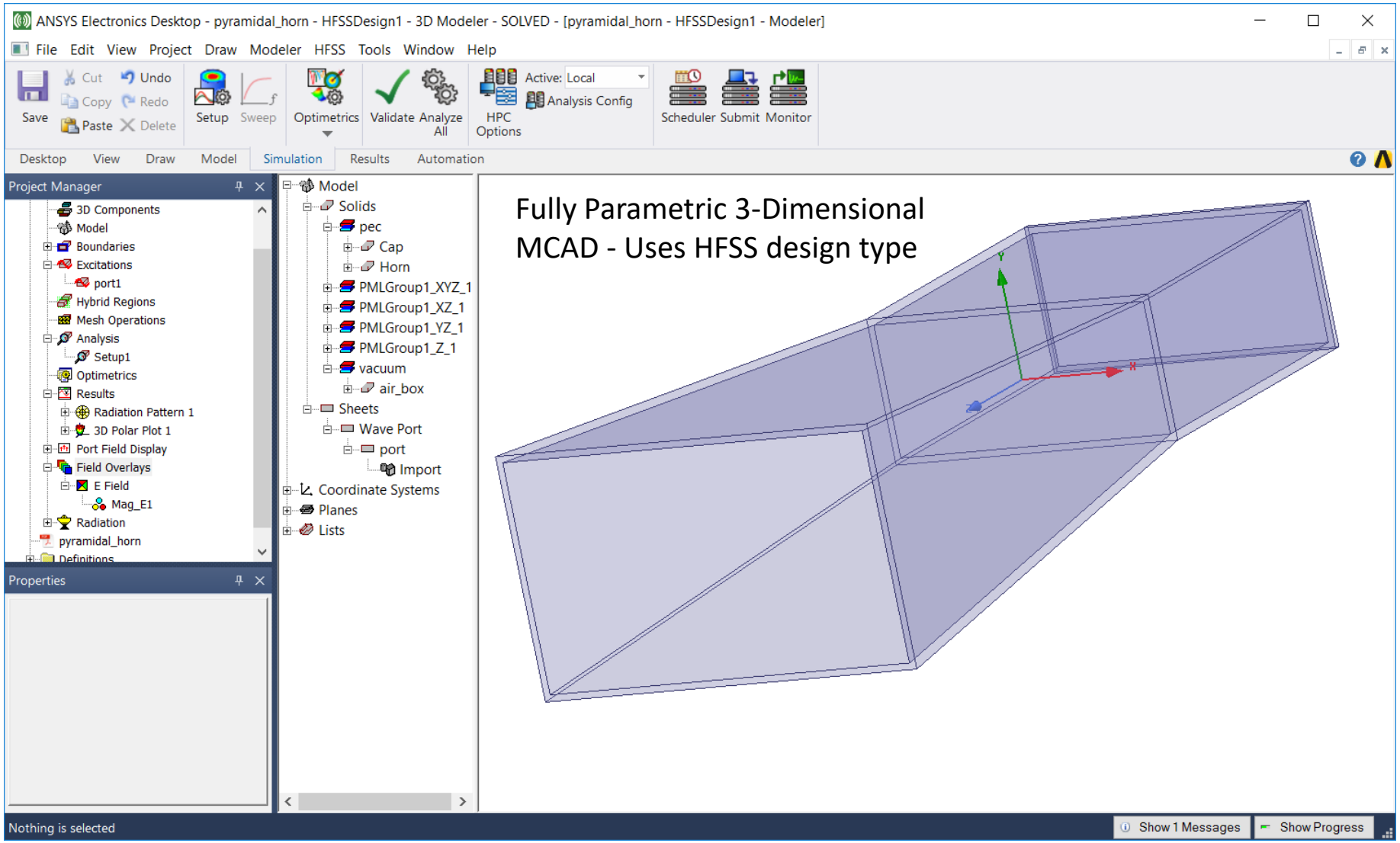
HFSS 3D: Arbitrary 3D Modeler - Mechanical CAD (MCAD)



HFSS 3D MCAD is the most general…and the subject of this course.

For additional background on the basic operations in the ANSYS electronic desktop, AEDT, including file operations, there are a number of resources that come with HFSS.

In the HFSS install directories, such as AnsysEM19.X\Win64\Help\HFSS\GSG
there is an HFSS help document "HFSS.pdf" which includes sections:

2 - Working with ANSYS Electronics Desktop Projects

including opening, closing, and saving project

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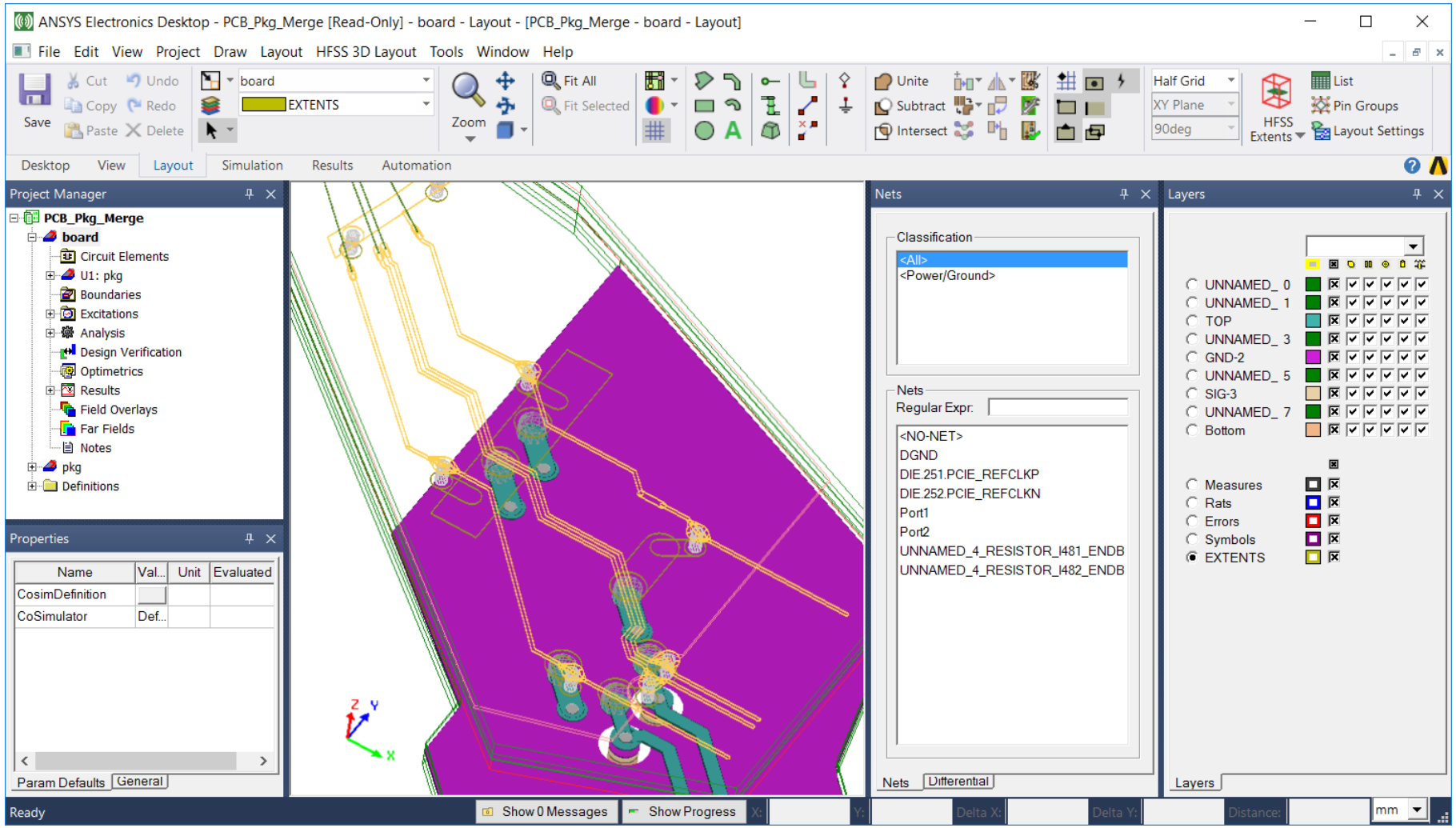
HFSS 3D Layout Editor

3-Dimensional Electrical CAD (ECAD) - Fully Parametric



There is an HFSS 3D Layout design type. The ***Layers*** and ***Nets*** functionality is available in HFSS 3D Layout.

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HFSS 3D Layout Editor

HFSS 3D Layout Integration (ANSYS Designer)

- Native Layout Editor for 3D HFSS simulations
  - Cadence, Mentor, Zuken, Altium, DXF, GDSII

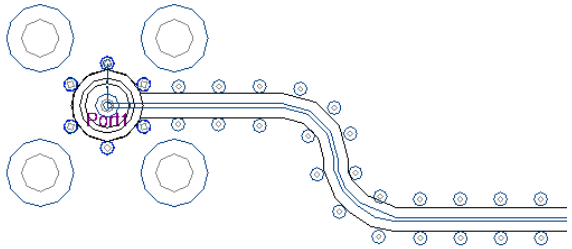
Layout Generated in ECAD System

- Cadence
- Synopsys
- Zuken
- Mentor Graphics
- Altium

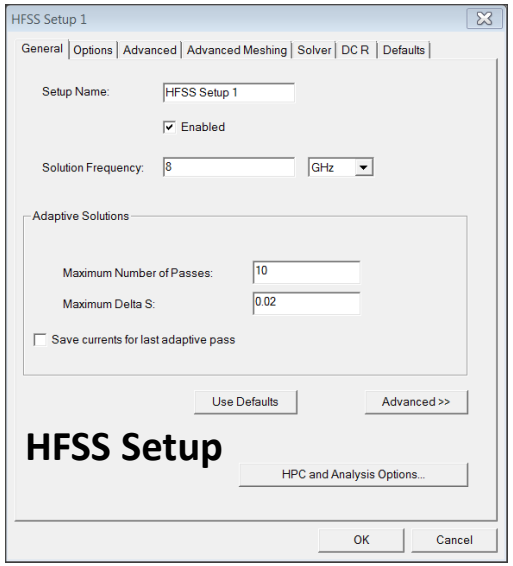
HFSS 3D Layout Editor → **HFSS Solver**

3rd Party Layout Translation

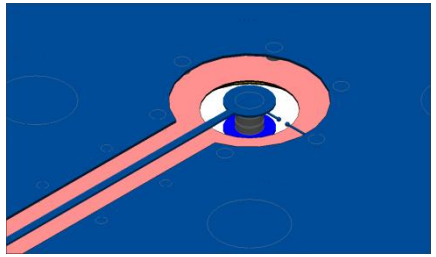
Alinks for EDA



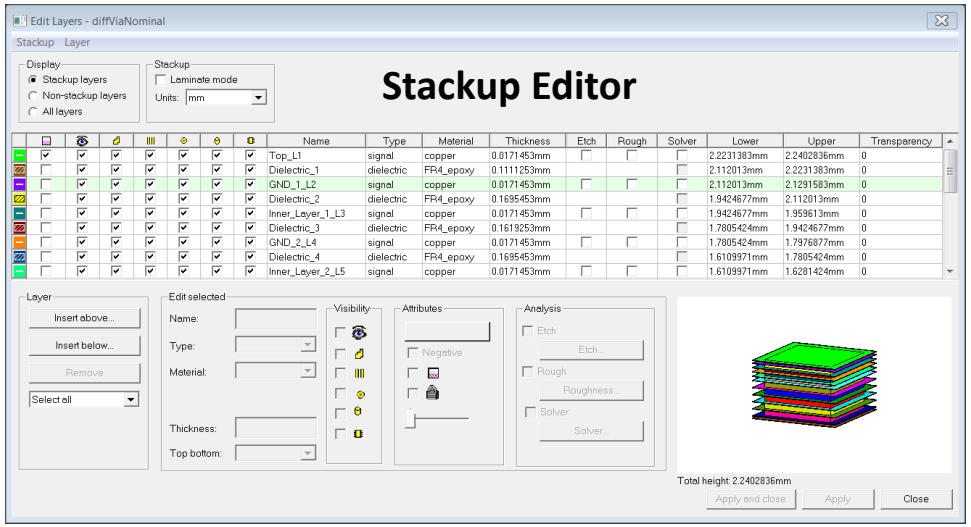
Native Layout Editor



HFSS Setup



HFSS Circuit Port



Stackup Editor

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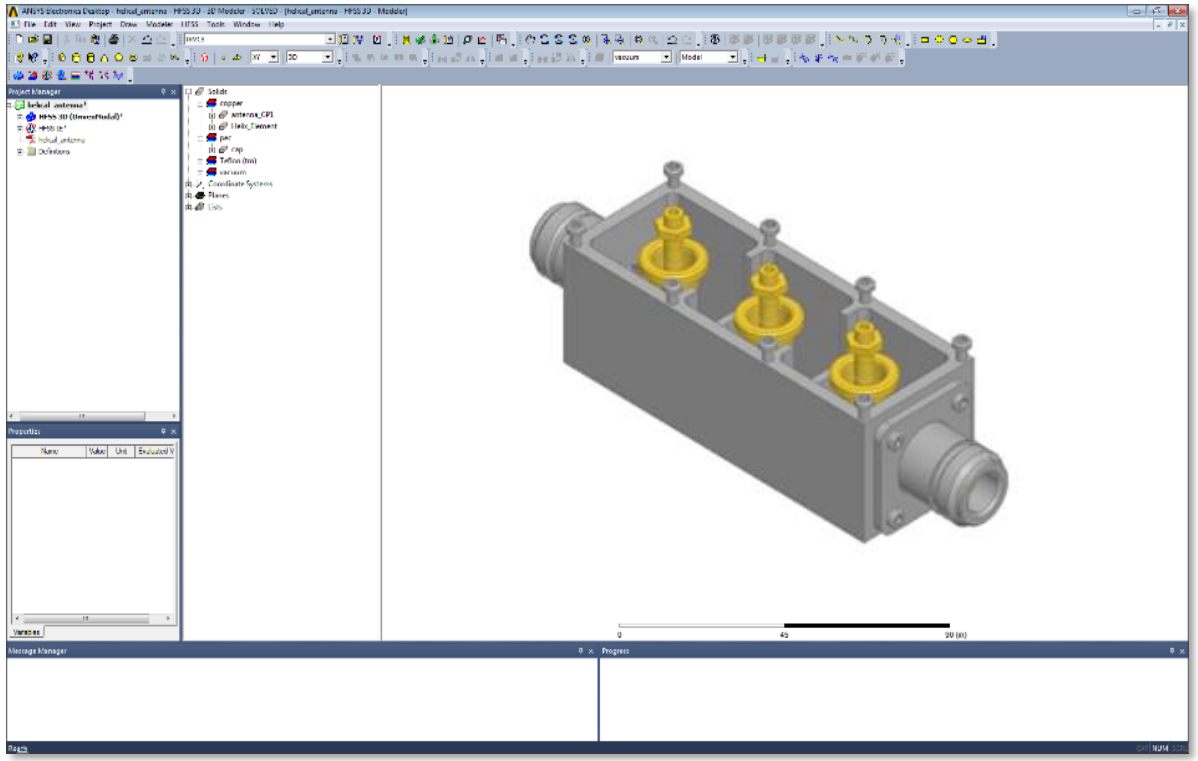
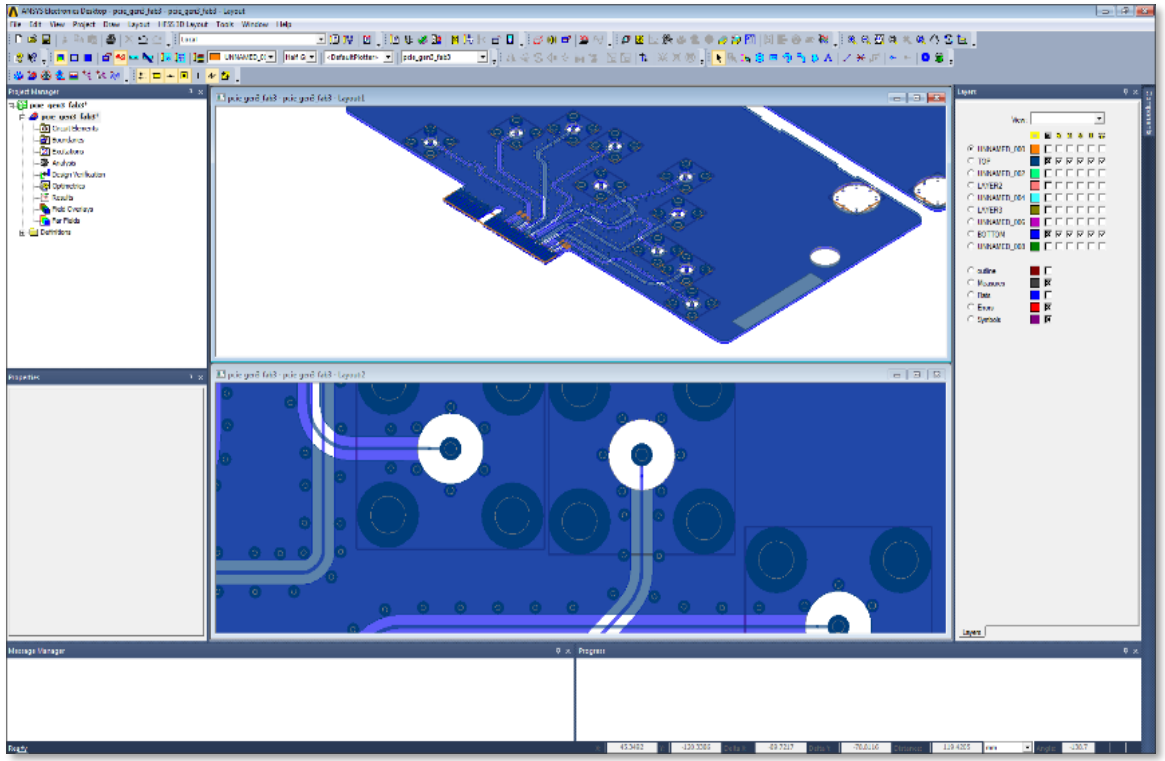
Different Interfaces – Same HFSS FEM Solver





Regardless of which User Interface is used, engineers have access to:

- full parametric modeling to aid in design space exploration
- the same Finite Element Method (HFSS-FEM) field solver
- HFSS's Automatic Adaptive Meshing Process for unparalleled accuracy

The document "***An Introduction to HFSS***", Chapter 1 ***"Fundamentals of HFSS"*** section ***"Mathematical Method Used in HFSS"*** gives a good technical description of the HFSS finite element solution process touching Green's functions and Maxwell's equations.

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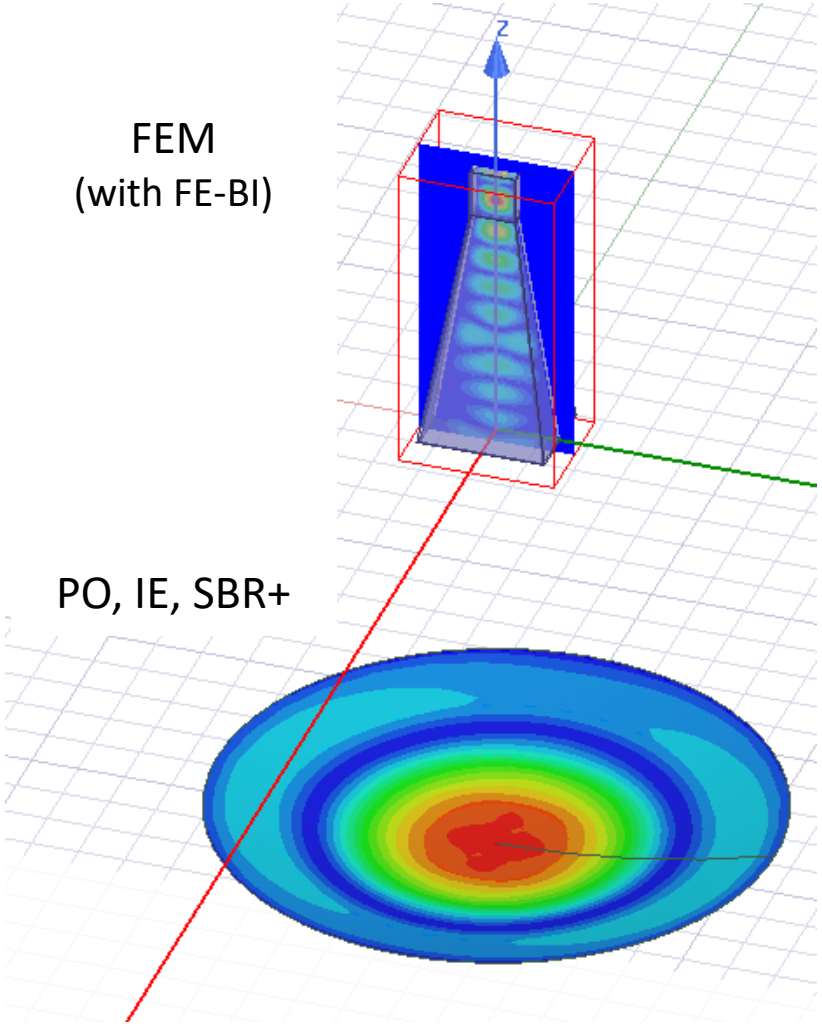
HFSS Includes Multiple EM Solvers

- **HFSS FEM (Finite Element Method)**
  - Fully arbitrary 3D - the whole simulation space gets meshed
  - Used for microwave, antenna, and PCB signal integrity applications
  - HFSS is also a “design type” within the HFSS product.
- **HFSS IE (Integral Equation) Solver**
  - 3D surface meshing – but only meshes surfaces
  - Commonly used for antenna applications
  - Available within the HFSS design type
- **HFSS PO (Physical Optics) and SBR+ (Shooting Bouncing Ray) Solvers**
  - Approaches wave propagation in terms of rays
  - Commonly used for antenna applications
  - Available within the HFSS design type
- **HFSS Transient Solver**
  - Time domain formulation that can employ pulsed excitations
  - Commonly used for applications such as EMI (electromagnetic interference)
- **HFSS Eigenmode Solver**
  - Used to obtain fields in cavities and periodic structures along with the associated dispersion curves
  - No excitation needed - not a driven solution

FEM
(with FE-BI)



PO, IE, SBR+

HFSS FEM is the subject of this course.

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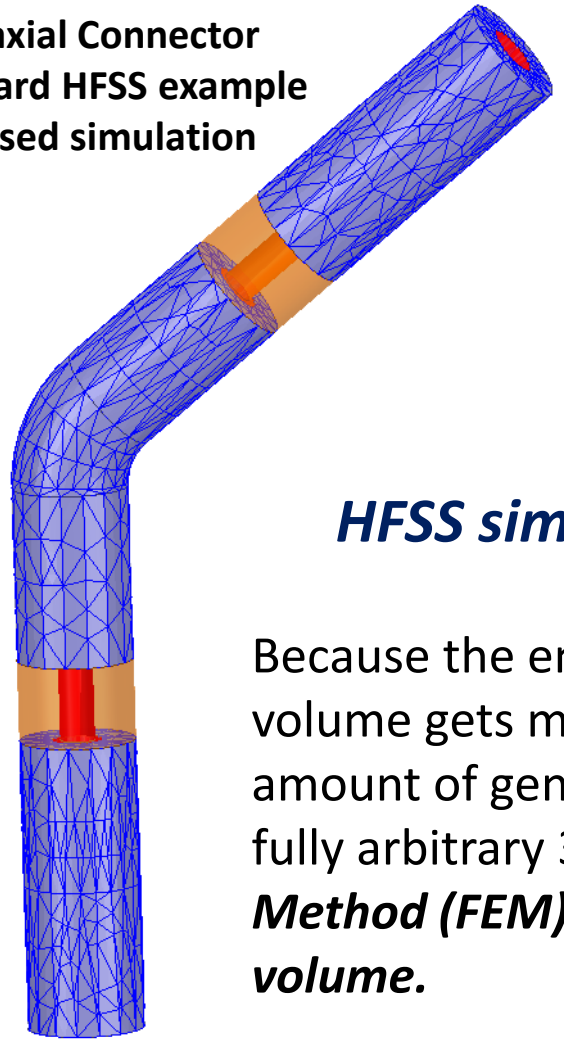
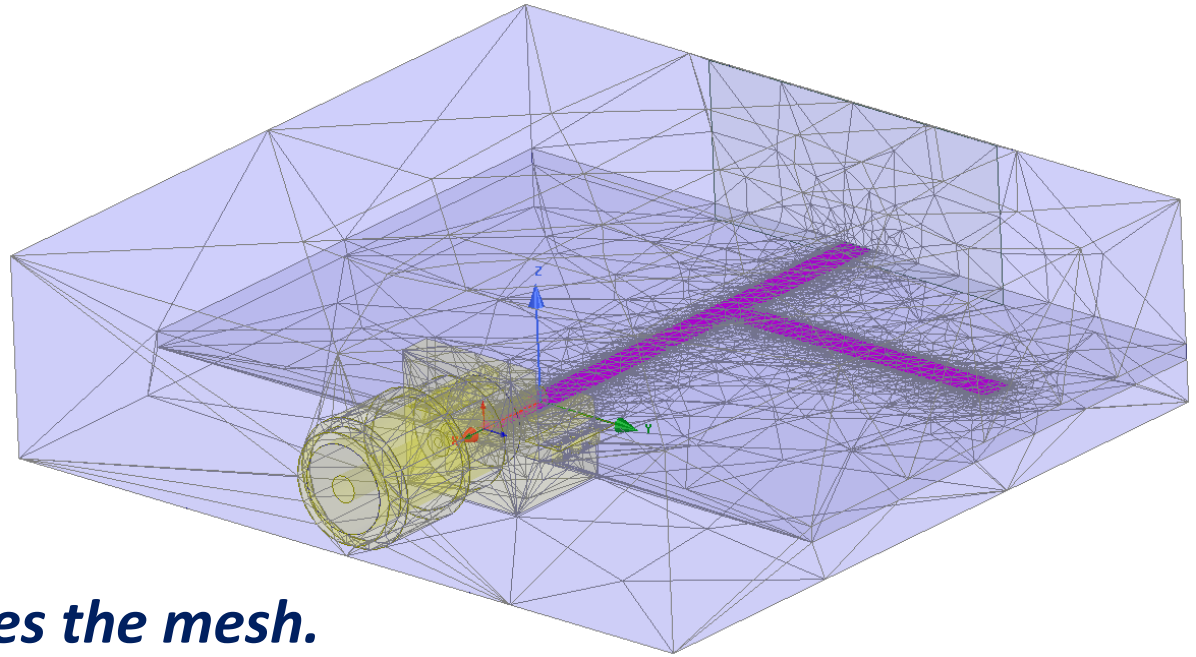
HFSS Fully Arbitrary 3D FEM Meshes the Entire Simulation Space

Coaxial Connector
Standard HFSS example
Closed simulation





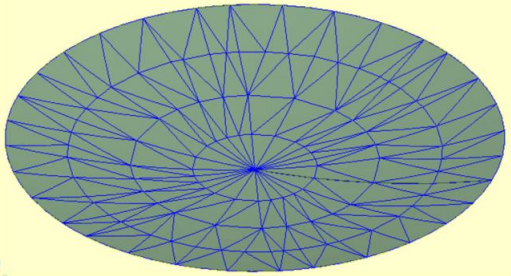
SMA coaxial to microstrip transition
Open simulation

HFSS simulates the mesh.

Because the entire computational volume gets meshed, the greatest amount of generality is available – fully arbitrary 3D. ***Finite Element Method (FEM) solves for fields in a volume.***

What else is there…besides fully arbitrary 3D?

For comparison, the HFSS IE solver meshes surfaces and simulates fields at a distance away from that structure. IE reflector antenna shown here.



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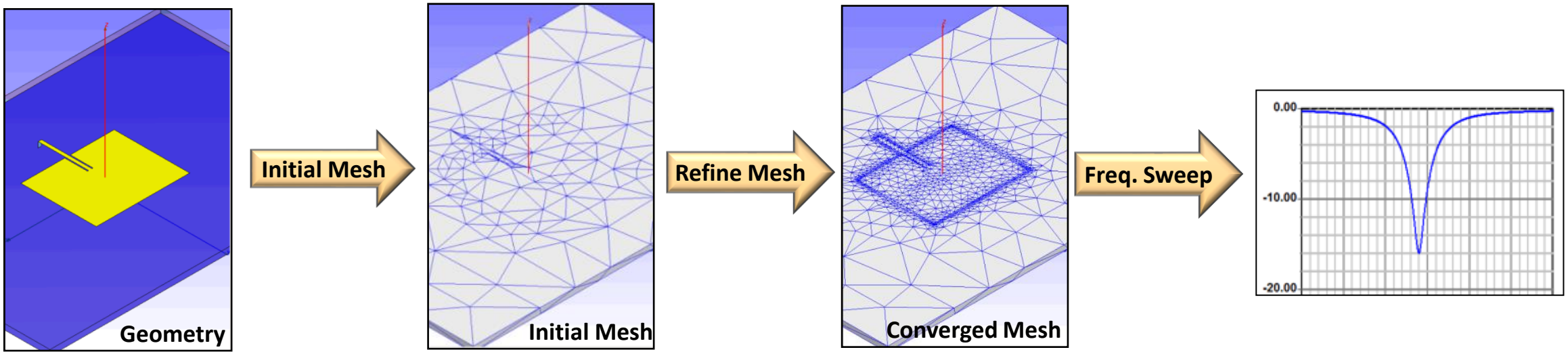
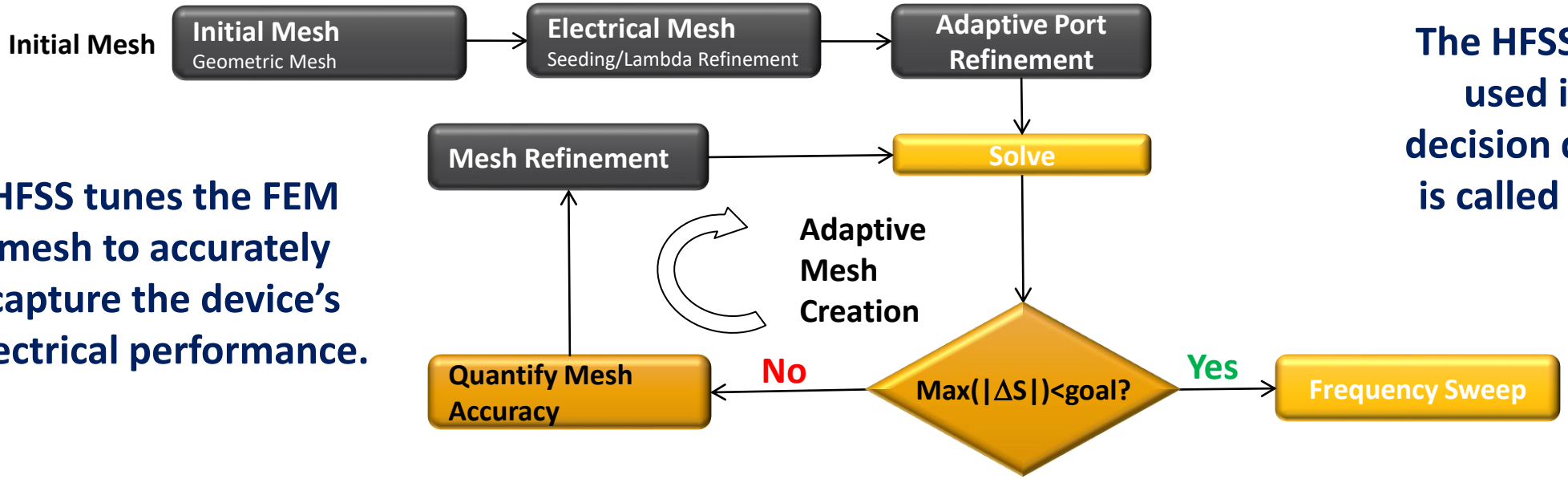
HFSS FEM Automated Solution Adaptive Meshing Process





HFSS tunes the FEM mesh to accurately capture the device's electrical performance.

The HFSS setting used in the decision diamond is called *Delta S.*

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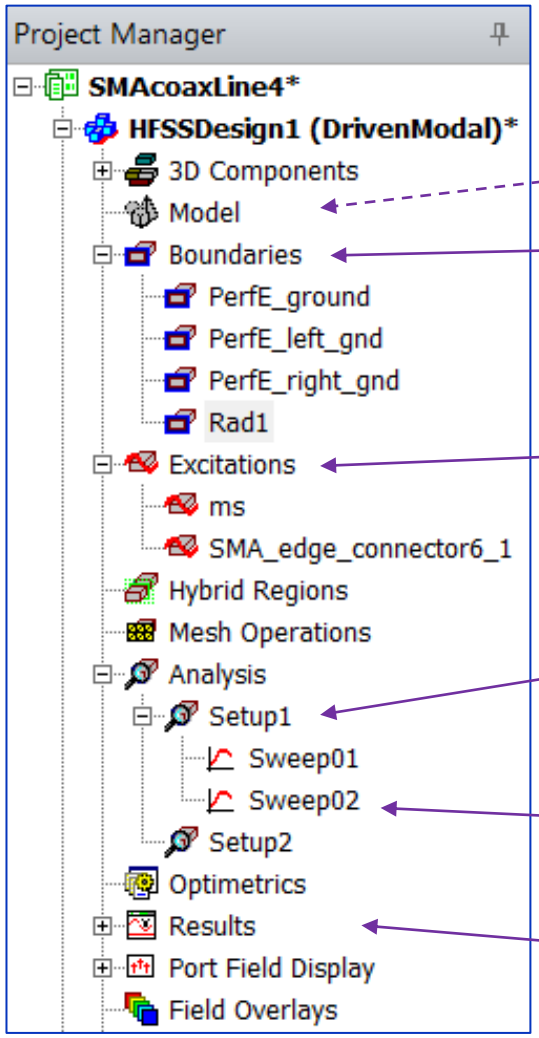
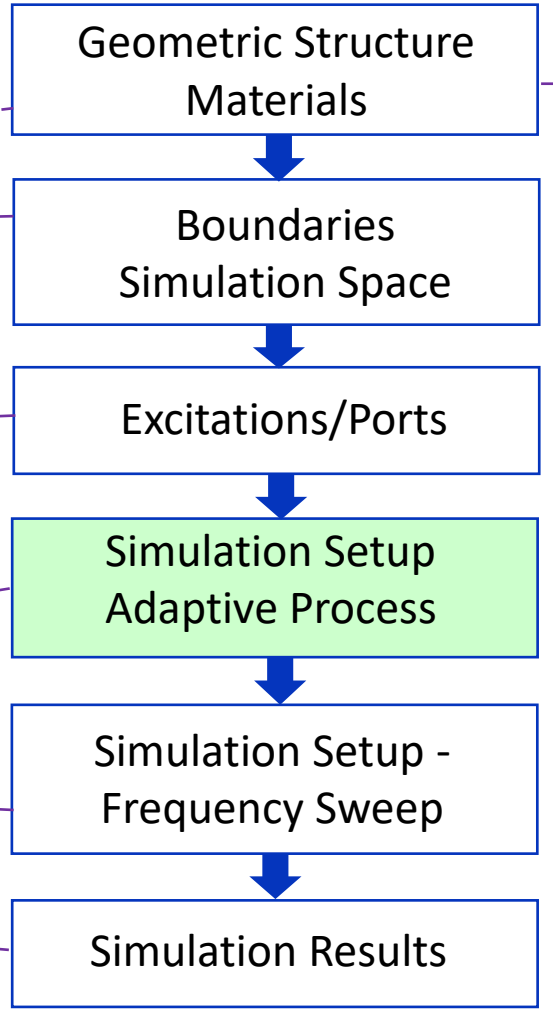
The HFSS Project Manager Reflects EM Simulation Workflow





Primarily addressed in the ***3D Modeler Tree***

HFSS FEM is the subject of this course. While HFSS represents and includes a collection of solvers, we're focusing on the finite element method solver only.

The document "***An Introduction to HFSS***", Chapter 5 ***"HFSS Modeling GUI Basics"*** section ***"Modeling Practice in HFSS"*** with an HFSS workflow.

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End of Presentation