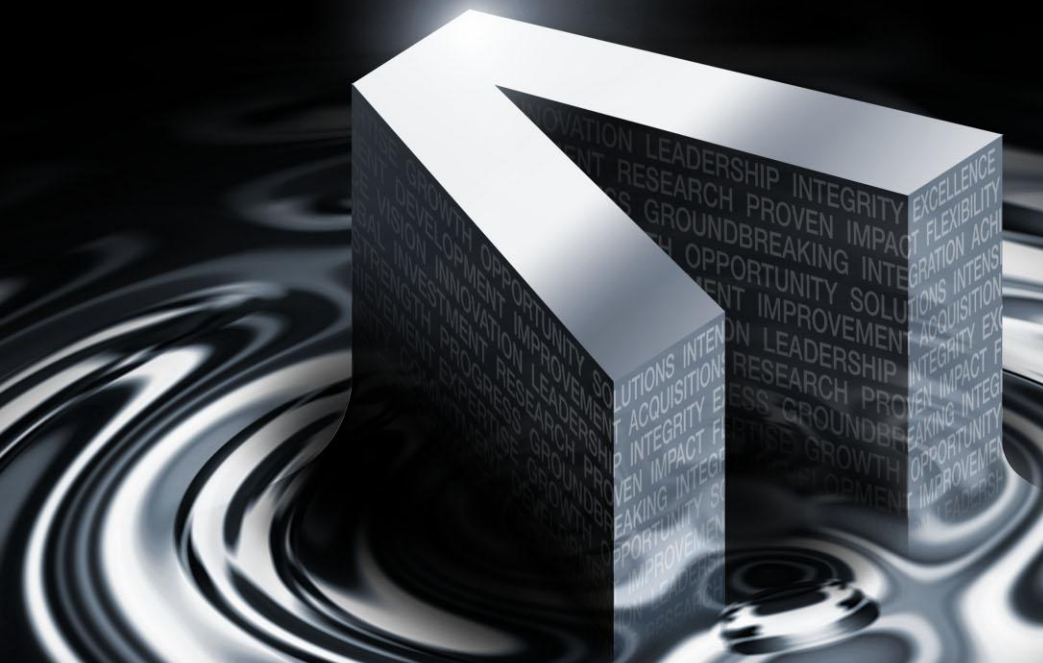
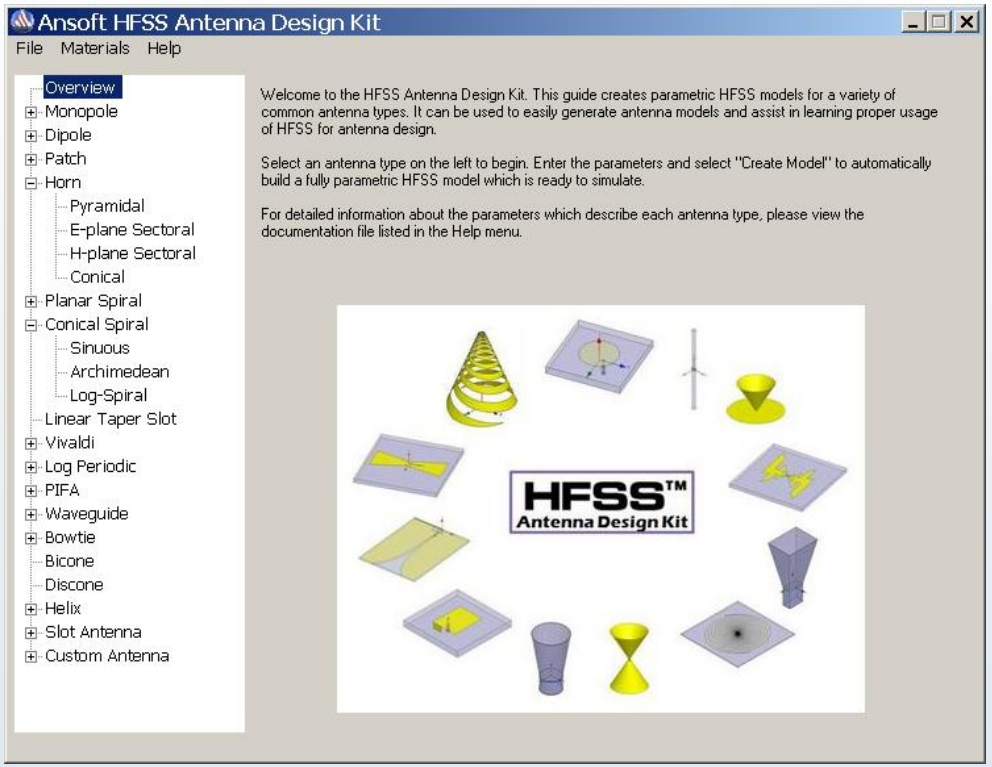
Ansoft HFSS Antenna Design Kit



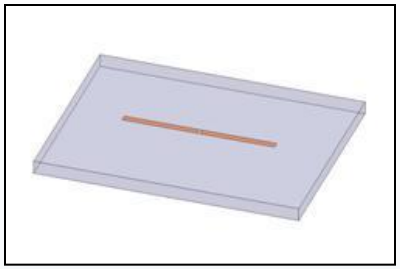
Arien Sligar

Overview of HFSS Antenna Design Kit

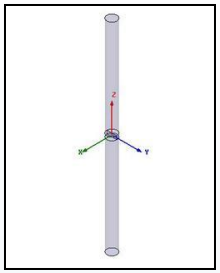
- GUI-based wizard tool
  - Automates geometry creation, solution setup, and post-processing reports for 50 common antenna elements
  - Assists in learning to use HFSS for antenna design
- Parametric antenna geometry
  - Easily modify parameters in HFSS after generating initial model
  - Facilitates parametric sweeps and optimizations
- Synthesis feature for each antenna
  - Automatically generates physical dimensions for desired frequency
  - Provides starting point for new designs



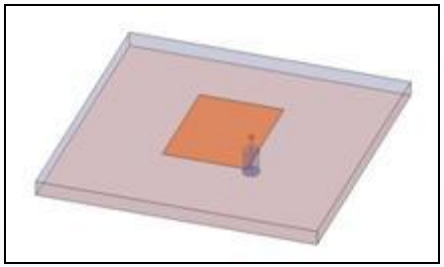
Available Antenna Types



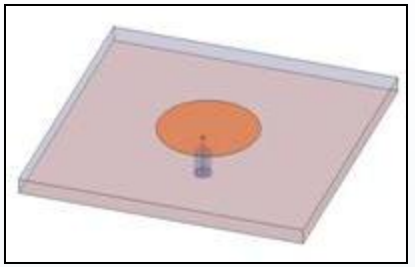
Planar Dipole



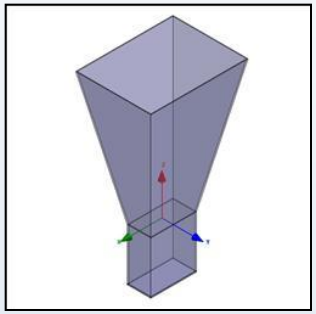
Wire Dipole



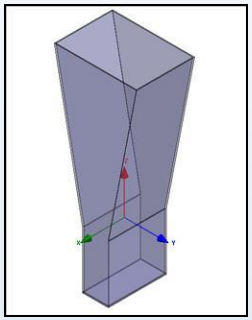
Rectangular Patch



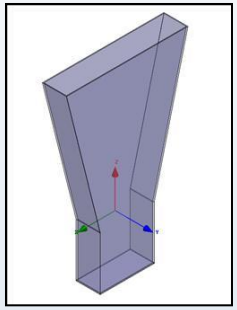
Elliptical Patch



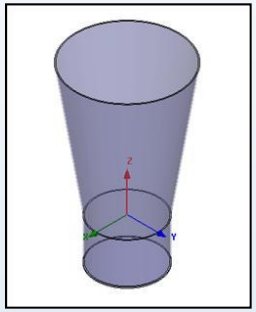
Pyramidal Horn



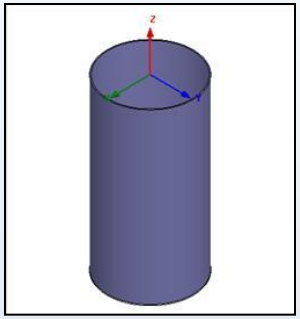
E-plane Sectoral Horn



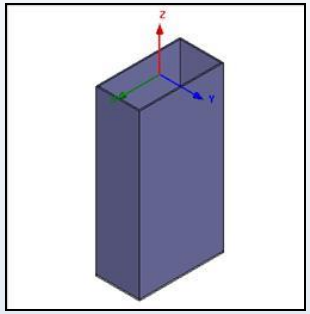
H-plane Sectoral Horn



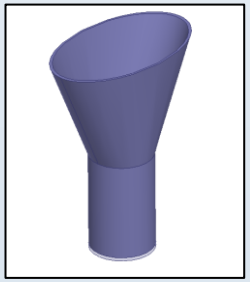
Conical Horn



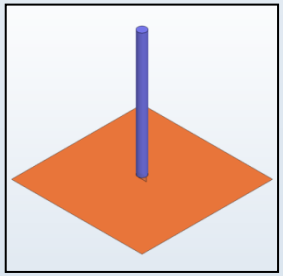
Circular Waveguide



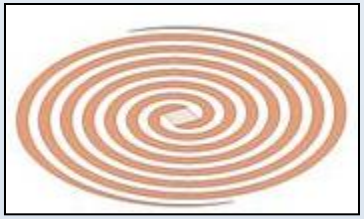
Rectangular Waveguide



Elliptical Horn

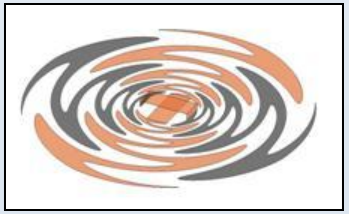


Wire Monopole



Archimedean Spiral

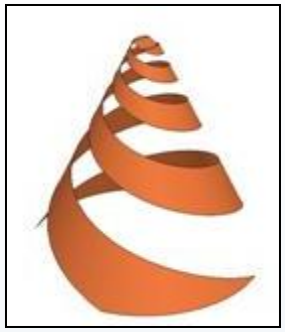
Log-Spiral



Sinuous Spiral

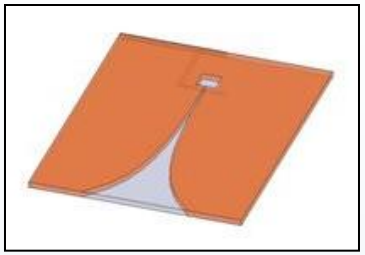
Available Antenna Types (cont)

Conical Archimedean Spiral

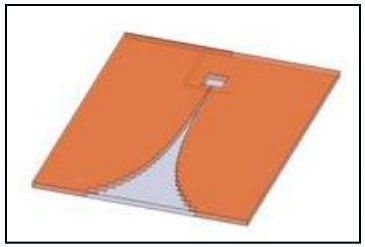


Conical Log-Spiral

Conical Sinuous Spiral

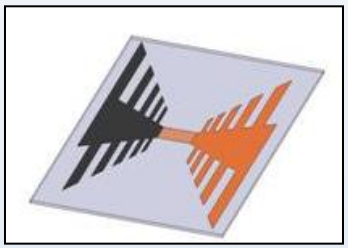


Vivaldi (Tapered Slot)

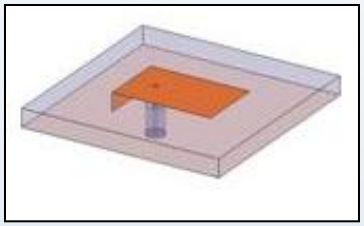


Stepped Vivaldi

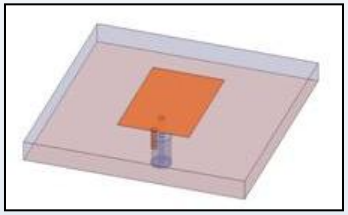
Log-Periodic Toothed



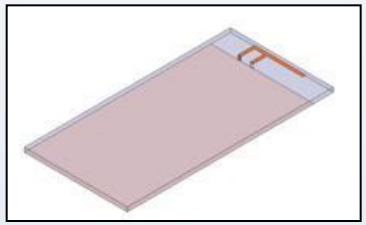
Log-Periodic Toothed Trapezoidal



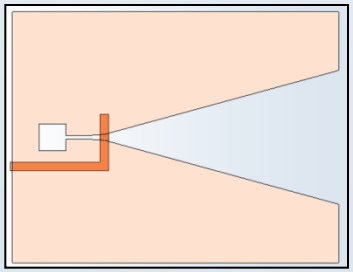
PIFA with Shorting Strip



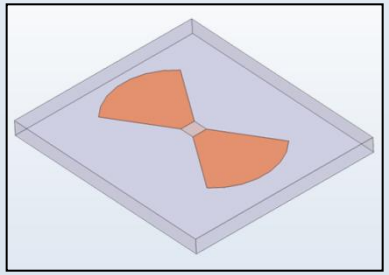
PIFA with Shorting Pin



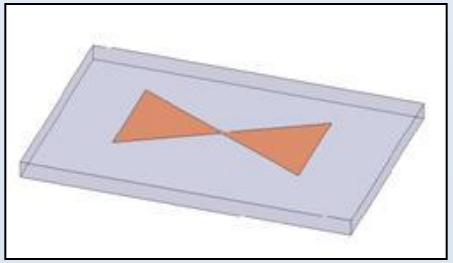
PIFA



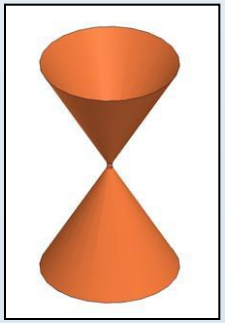
Linear Taper Slot



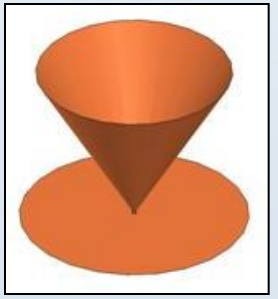
Rounded Bowtie



Bowtie

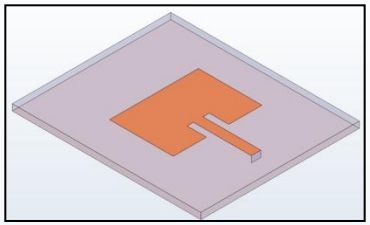


Bicone

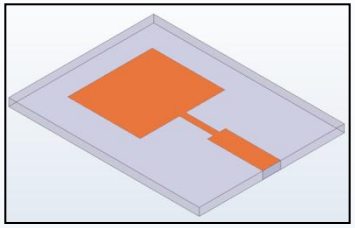


Discone

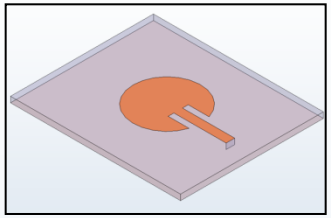
Available Antenna Types (cont)



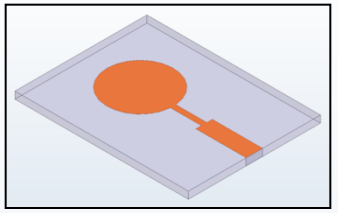
Inset Fed Microstrip Patch



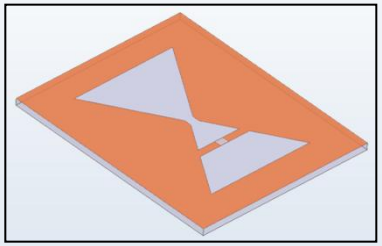
Edge Fed Microstrip Patch



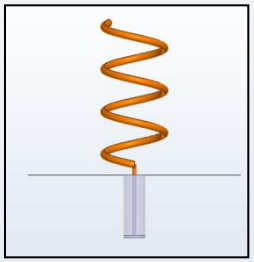
Inset Fed Elliptical Microstrip Patch



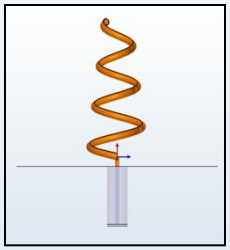
Edge Fed Elliptical Microstrip Patch



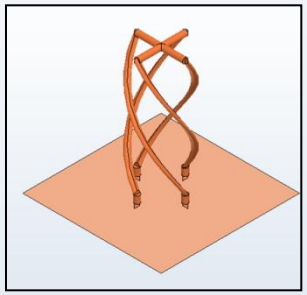
Bowtie-Slot



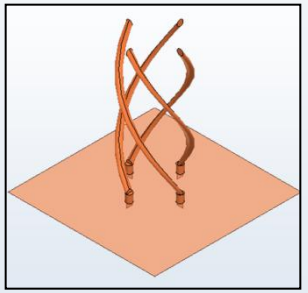
Helix – Normal and Axial Mode



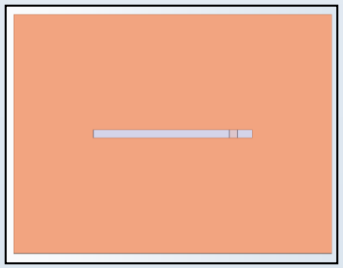
Helix -Continuous Taper Axial Mode



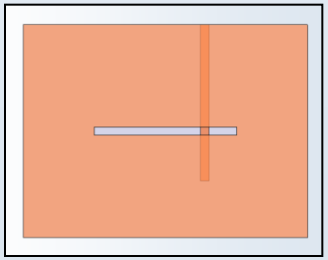
QFHA-SC



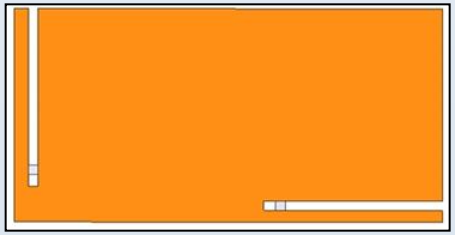
QFHA-OC



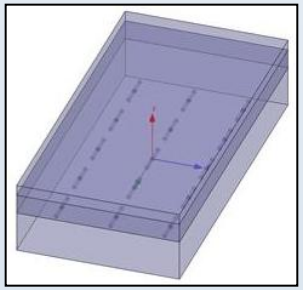
Slot – Gap Fed



Slot – Microstrip Fed

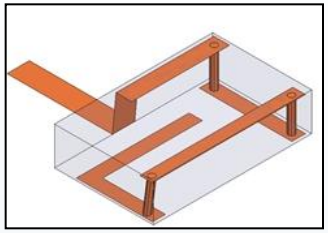


Dual Slot

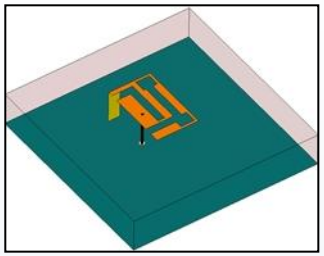


Dipole Array

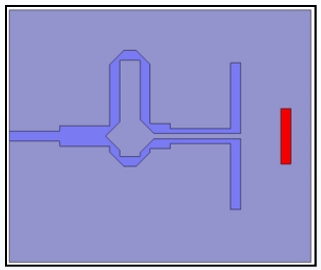
Available Antenna Types (cont)



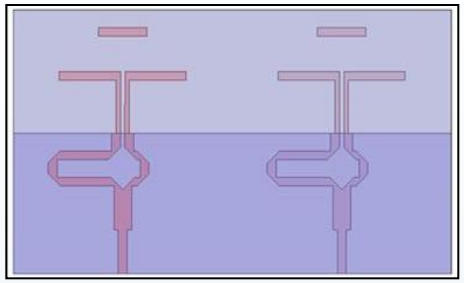
WLAN Ceramic Chip Antenna



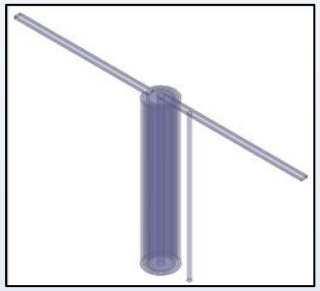
WLAN Dual Band Slot Antenna



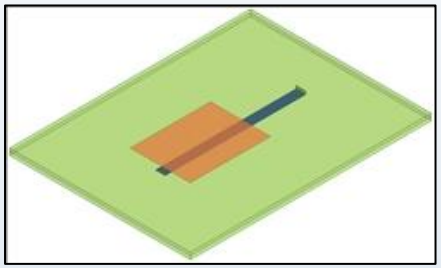
Quasi Yagi Element



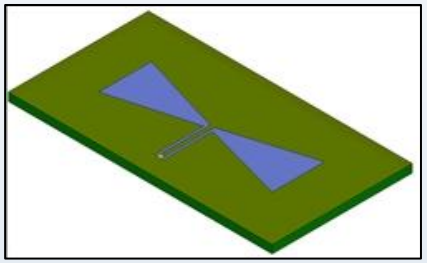
Quasi Yagi 2x1 Array



UHF Probe



Slot Feed Patch



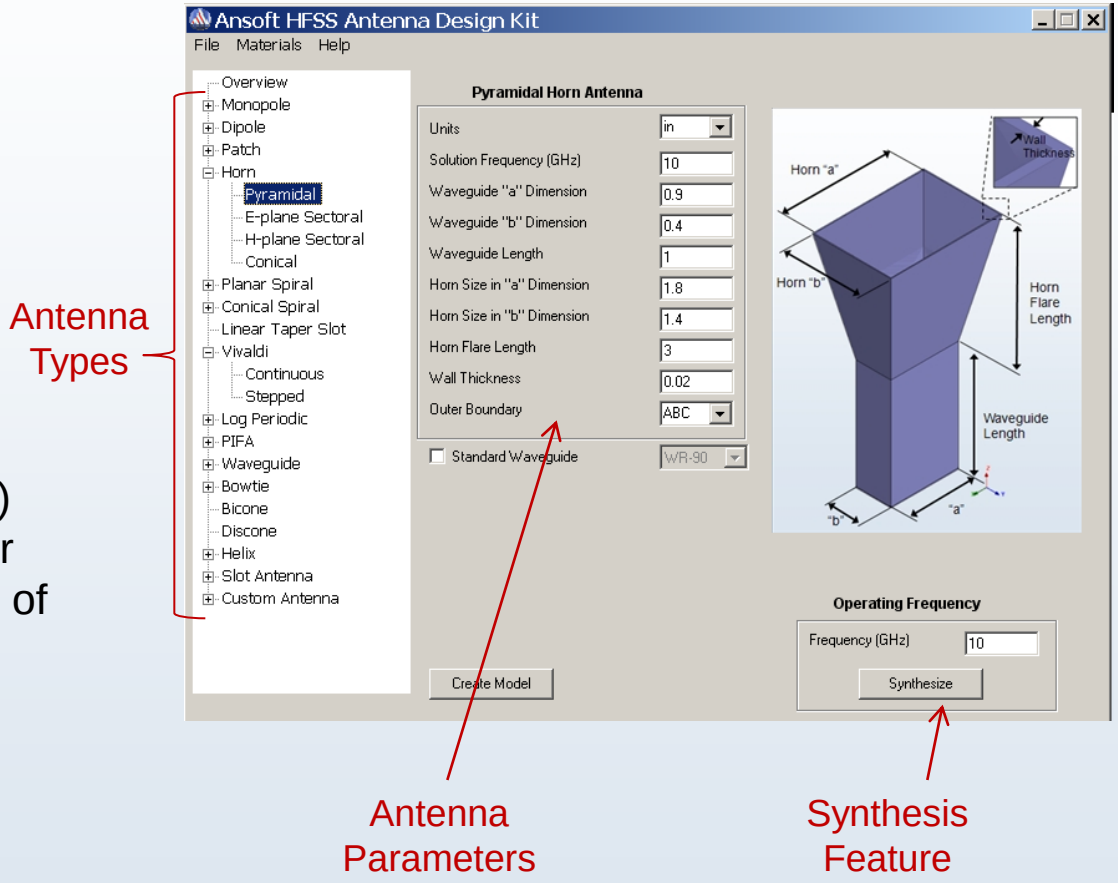
CPW Bowtie

Common Applications for Each Antenna Type

Antenna Type	Common Applications
Dipole	Communication systems, consumer electronics, WLAN, RFID, biomedical
Patch	Consumer electronics, mobile handsets, phased arrays, GPS
Horn	Reflector feeds, gain standards for antenna measurements, EMC/EMI tests, communication systems, radar, direction finding (DF), mm-wave systems
Waveguides	Phased arrays, radar, high power systems, reflector feeds, circularly polarized systems
Planar spirals	Wideband systems, multi-function apertures, electronic warfare, UWB, reflector feeds, telemetry, direction finding, missile guidance
Conical spirals	Wideband systems, circularly polarized systems, aerospace systems, EMI/EMC testing, DF systems
Vivaldi	Phased arrays, radar, wideband systems, multi-function apertures, electronic warfare, UWB
Log-periodic	Wideband systems, reflector feeds, UWB
PIFA	Consumer electronics, mobile handsets, medical devices, WLAN, Bluetooth
Bowtie	Phased arrays, radar, wideband systems, RFID, UWB, GPR
Bicone/discone	Wideband systems, electronic warfare, EMC tests, beacons, UWB

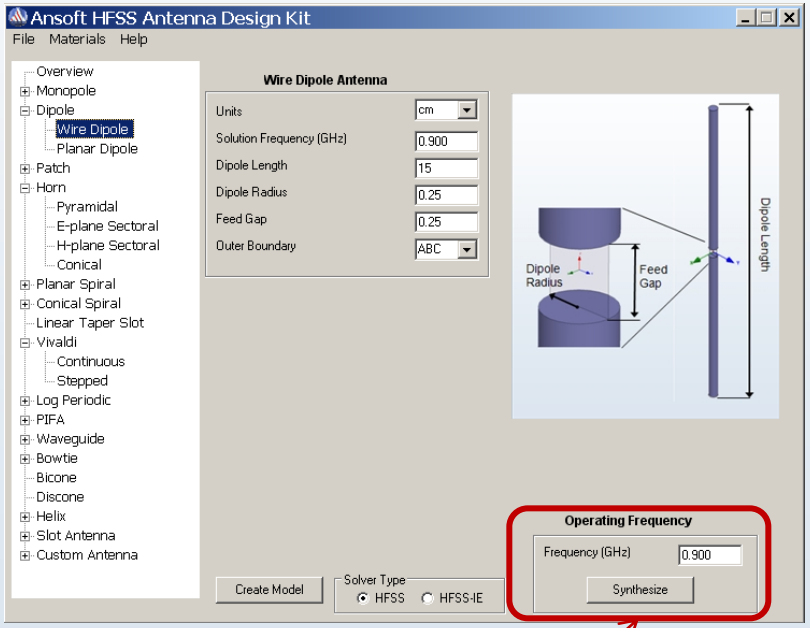
Using HFSS Antenna Design Kit

- Select desired antenna type from tree structure
- Enter necessary antenna parameters
  - Units and solution frequency
  - Physical dimensions for element and feed
  - Choice of absorbing boundary condition (ABC) or perfectly matched layer (PML) for outer boundary of HFSS model
- Alternatively, synthesize parameters from desired operating frequency
- Select Create Model to invoke HFSS

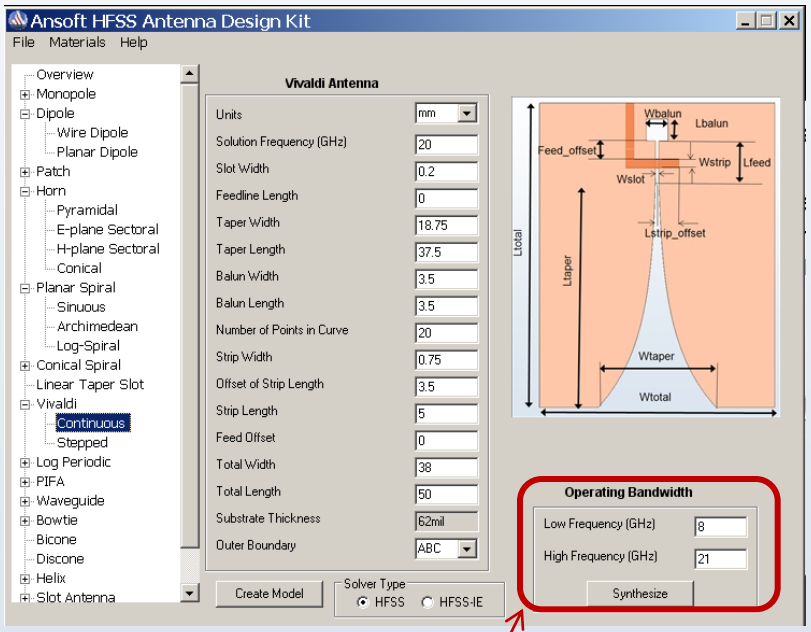


Antenna Synthesis Option

- Creates physical characteristics from desired operating frequency or operating band
  - Based on general design guidelines found in common textbooks
- It is not possible to synthesize the “best” design based on frequency alone
  - Depends upon additional parameters such as size, gain, beamwidth, bandwidth, materials, etc.
  - Synthesized antenna should be viewed as one possible starting point for actual design process
- Parameterized models allow for automated optimizations



Synthesis based on resonant frequency for narrowband antennas



Synthesis based on frequency band for wideband antennas

Example HFSS Model Created by Antenna Design Kit

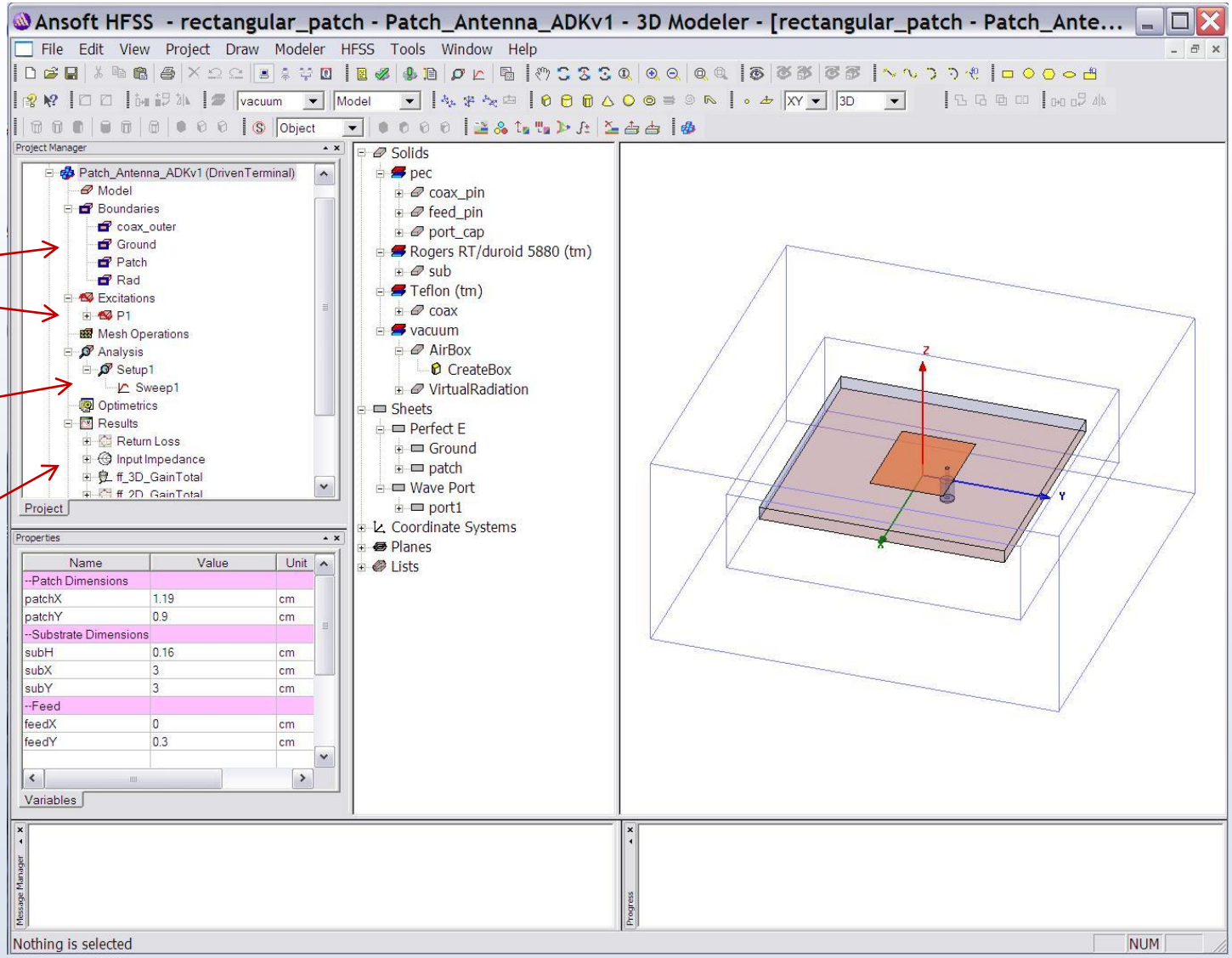
- Model ready to solve

Ports and Boundary Conditions

Solution Setup and Frequency Sweep

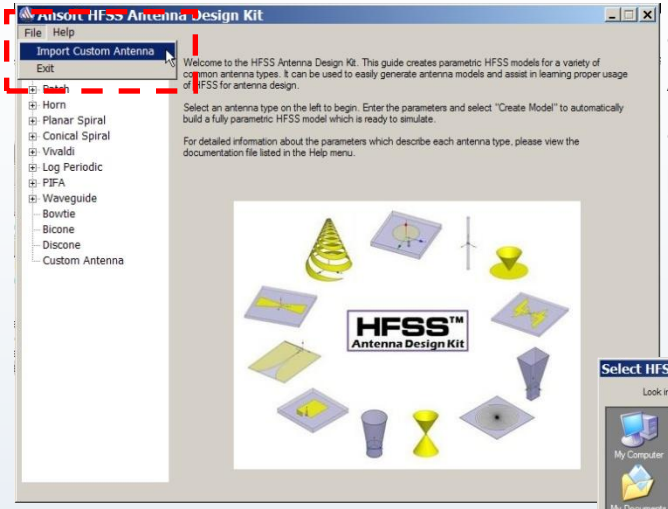
Reports for Input Impedance and Radiation Patterns

Parameters for Antenna Geometry



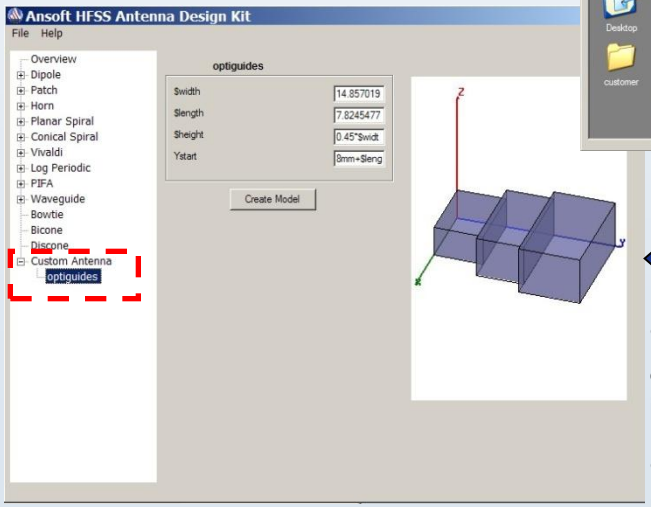
Import Custom Antennas

- **Custom Antenna can be added to ADK user interface**
- **Custom library files created in directory <ADK_InstalationDirectory>\Custom_Library**
  - *.adk - Project File
  - *.ant – Parameter File, this file contains a list of all parameters that will be shown in ADK User Interface. Lines can be removed to keep them from displaying in ADK.
  - *.jpg – Design Image, image can be replace with any custom image. Maximum resolution is 250x475 pixels
- **If multiple designs exists in project you will be prompted to choose which design you wish to include**
- **Custom library can be exported to other users by copying all files located in Custom_Library directory and pasting them into Custom_Library directory on any other machine.**



•Select **File → Import Custom Antenna**

•Browse to location of HFSS project to be included in ADK

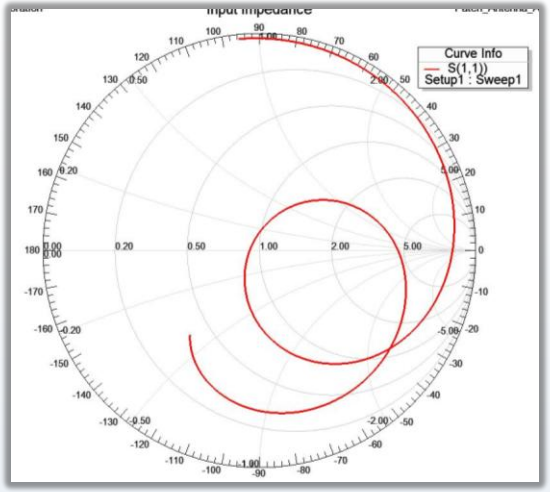


•Added antenna will now be available under Custom Antenna in ADK Tree view

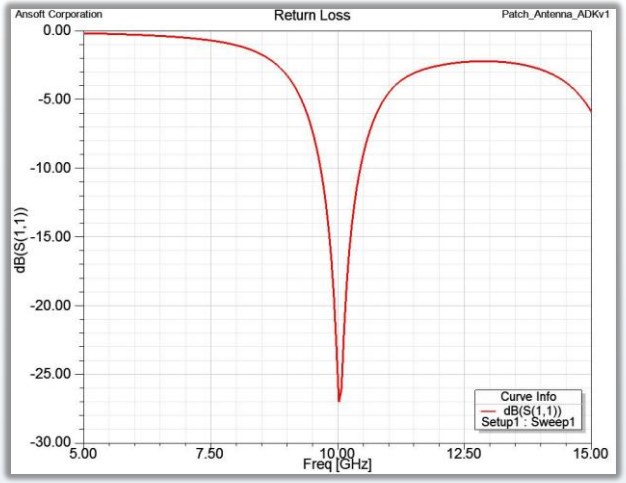
•Parameters can be entered and model created

Results of Example HFSS Model

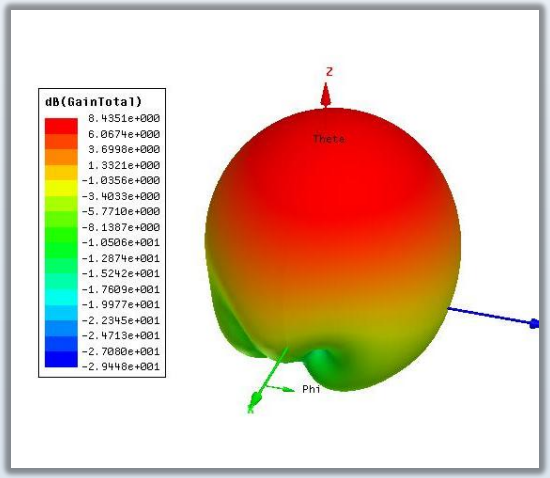
- Reports automatically generated by ADK
- Antenna performance generally evaluated using input impedance and far-field radiation patterns
  - Antenna must be well-matched to impedance of feed circuit
  - Antenna must spatially distribute input power in desired direction(s)



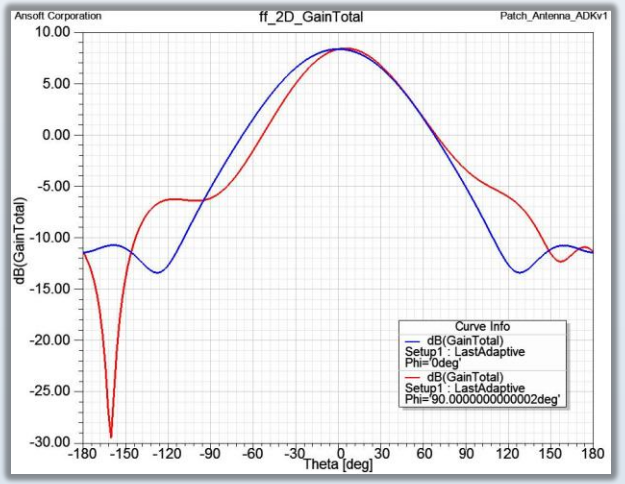
Input Impedance



Return Loss



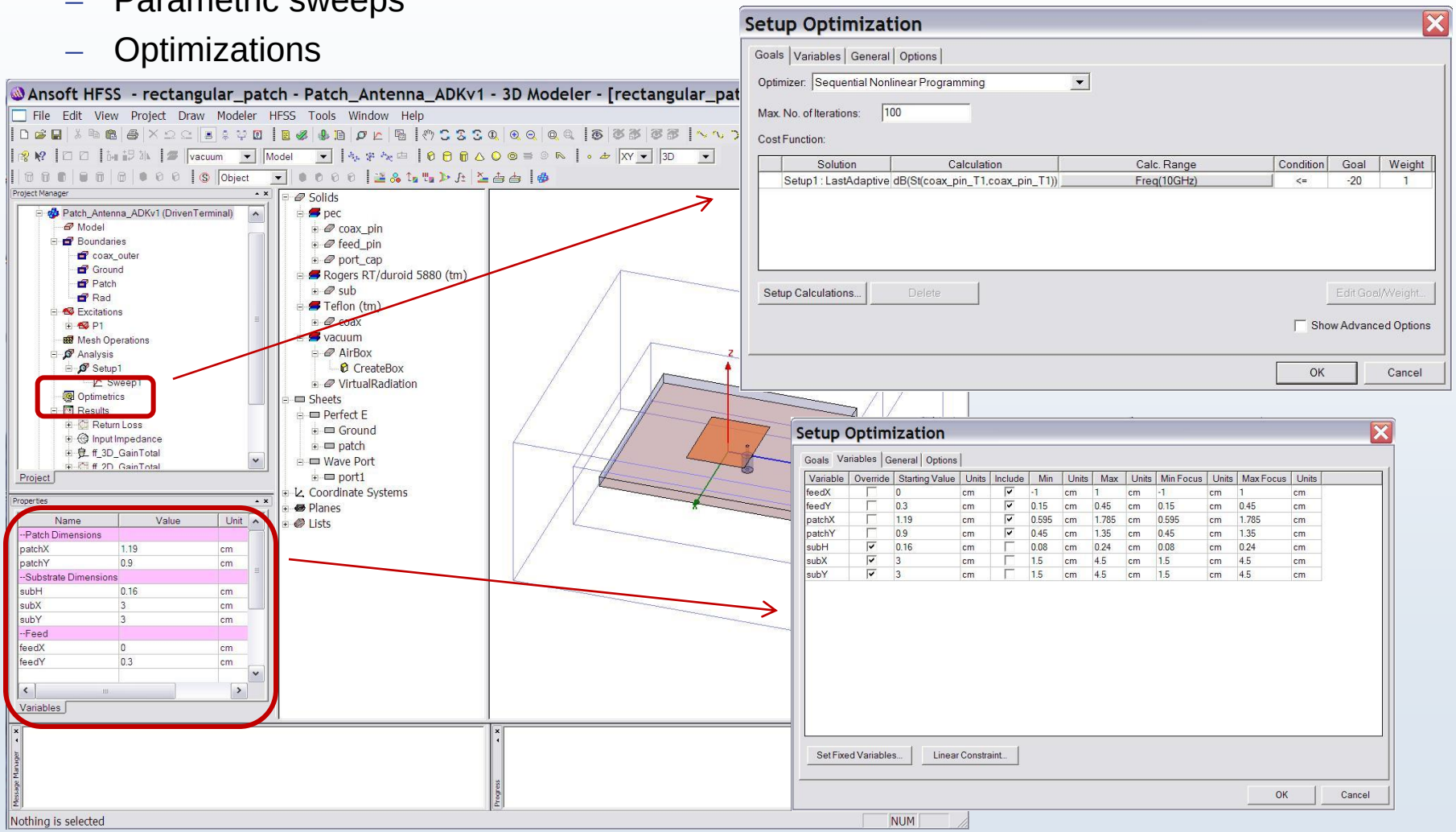
3D Radiation Pattern



2D Pattern Cuts

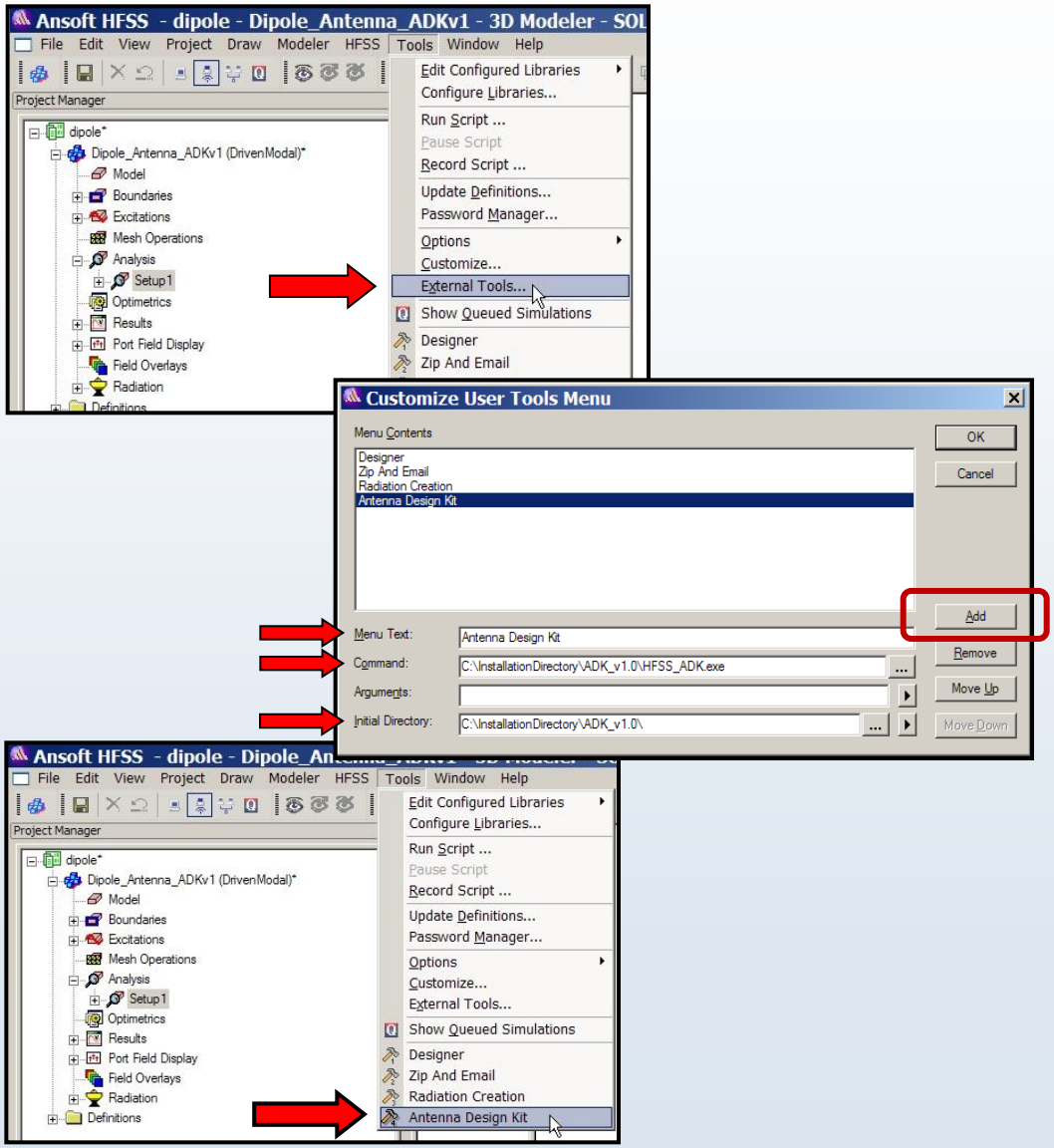
Design Ready for Automated Optimization

- All antenna parameters available for Optimetrics analysis
  - Parametric sweeps
  - Optimizations



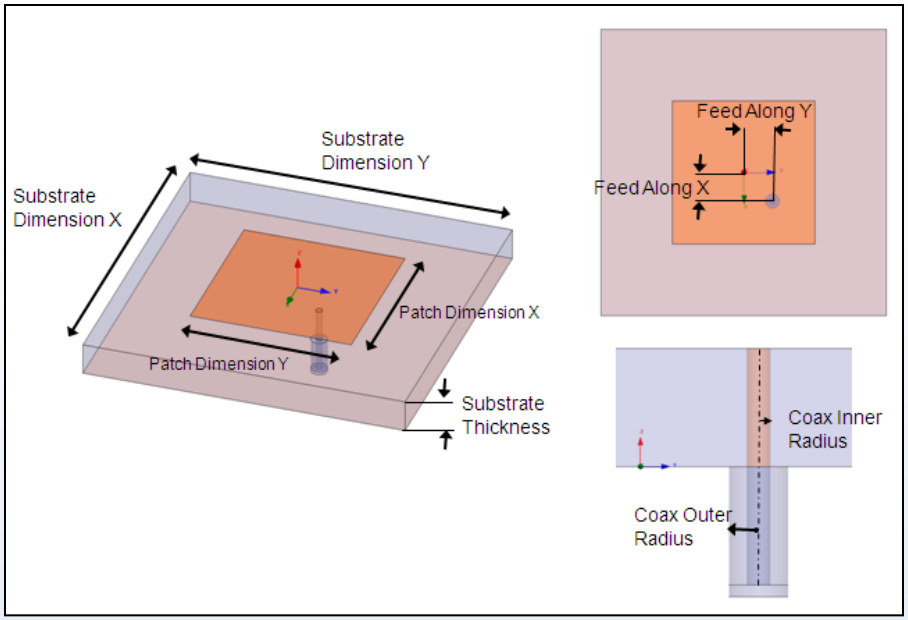
Integrate Antenna Design Kit with HFSS

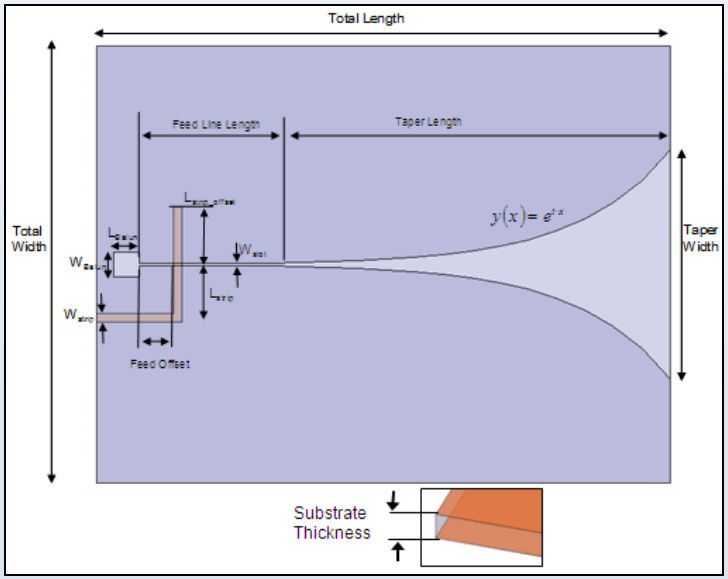
- Antenna Design Kit can be added as an external tool to be launched from within HFSS
- To add as External Tool
  - Choose the menu **Tools → External Tools**
  - Select **Add** to create a new External Tool
  - Specify **Menu Text**, **Command** and **Initial Directory** (replace *InstallationDirectory* with actual installation directory)
- Antenna Design Kit can now be run from the menu
  - **Tools → Antenna Design Kit**

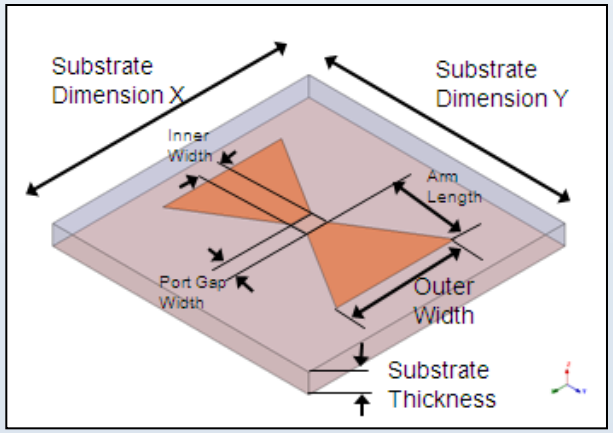


Antenna Design Kit Documentation

- Complete description of parameters necessary for each antenna
- Design references for each antenna
- HFSS results for nominal antenna parameters
  - Input impedance and far-field patterns
- Best practices for antenna design using HFSS







HFSS Antenna Design Kit Summary

- Automates model creation for variety of common antennas
  - Resonant and wideband antennas
  - 3D and planar antennas
  - Creates ready-to-solve designs!
- Synthesis feature provides example design for desired operating frequency or bandwidth
- Help documentation describes all parameters for each antenna
- Possible to include additional antennas in future versions