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

www.cnantennas.com
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

shared by: www.cnantennas.com
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

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

shared by: www.cnantennas.com
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)
Design Ready for Automated Optimization

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

shared by: www.cnantennas.com
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

shared by: www.cnantennas.com
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