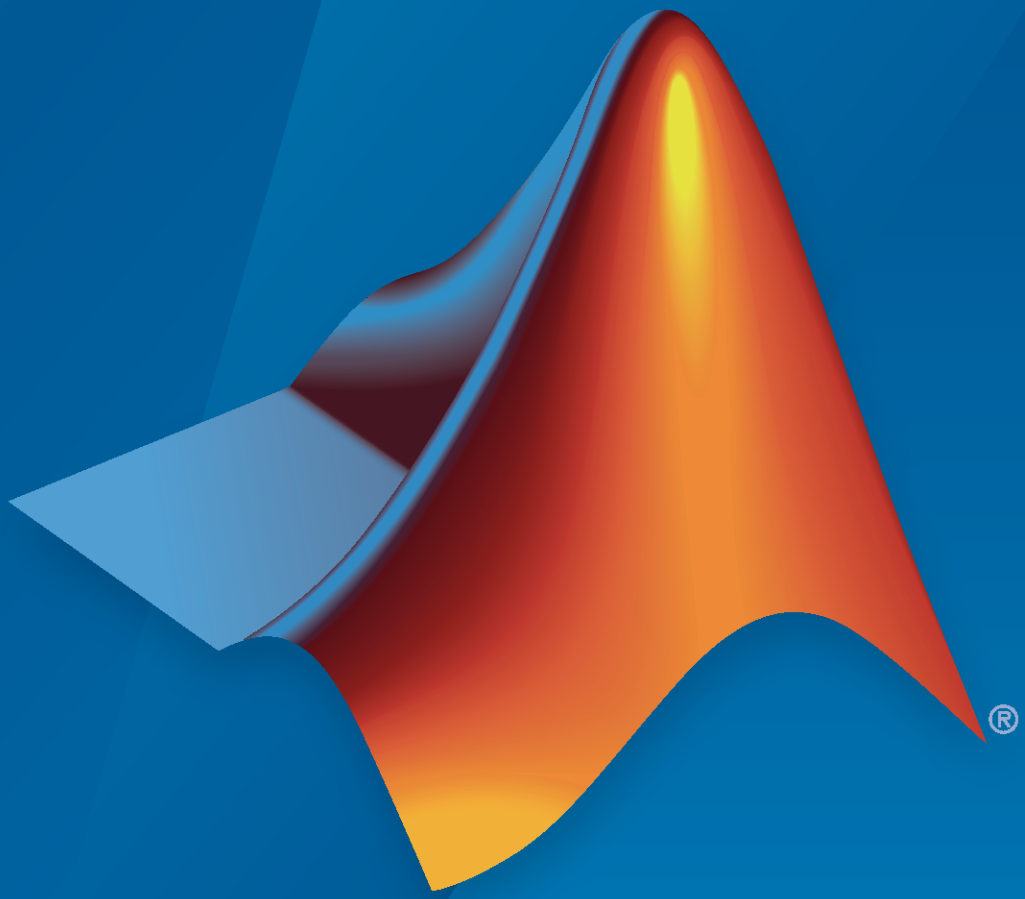
Antenna Toolbox™ Release Notes



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Antenna Toolbox™ Release Notes

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Contents

R2020b

Import Gerber Files: Import, modify, and analyze Gerber files Antenna Toolbox **1-2**

Grid, Cylindrical, and Spherical Reflectors; Bicone, Discone, and More: Design, visualize, and analyze ten new antennas including reflectors using parametrized geometry **1-2**

Cartesian Positioning for txsite and rxsite: Perform point-to-point RF propagation analysis using Cartesian coordinate system **1-2**

Ray Tracing Analysis for Cartesian Coordinates: Import STL files to describe scenarios for ray tracing analysis **1-3**

SADEA Optimization Using Command Line Interface: Optimize antennas and arrays by providing access to optimization data **1-3**

Surrogate Optimization in Antenna Designer and Array Designer: Optimize antenna and arrays using surrogate optimizer **1-3**

R2020a

SADEA Optimization in Antenna Designer and Array Designer: Optimize antennas and arrays using Antenna Toolbox **2-2**

customAntennaStl Object: Import STL file to create a custom 3D antenna **2-2**

Wire Solver: Analyze and solve dipole like antenna catalog elements . . . **2-2**

PCB Stack for Arrays: Convert arrays directly to PCB stack **2-2**

Corrugated Horn, Antipodal Vivaldi, Monocone, Elliptical Patch, Fractal Snowflake and More: Design, visualize, and analyze ten new antennas using parametrized geometry **2-2**

Ray Tracing Propagation Model: New propagation model using ray tracing method of images with material reflection loss **2-3**

Measurements Data in Site Viewer: Import and visualize measurements data in Site Viewer **2-3**

RF Propagation and Ray Tracing Enhancements: New and updated objects and functions for analysis using ray tracing **2-3**

Great Circle Path: geodesic Input changed to greatcircle input option **2-3**

R2019b

Physical Optics (PO) and Hybrid MoM: New solvers added for large structure analysis **3-2**

Radar Cross-Section (RCS) analysis: Generate and visualize RCS of platform, antenna, or array object **3-2**

Antenna Array Designer App: Interactively design, analyze, and visualize antenna arrays **3-2**

Buildings Data in Site Viewer: Import and visualize buildings in Site Viewer for point-to-point ray tracing analysis **3-2**

Cassegrain, Gregorian, Slotted Waveguide, Circular Horn, Quad Custom and More: Design, visualize, and analyze nine new antennas using parametrized geometry **3-2**

R2019a

Installed Antenna Analysis: Perform analysis of antennas installed on electrically large structures called platforms **4-2**

Data from STL Files: Import platform objects from STL files and export antenna geometry to STL files **4-2**

Polygonal Board Shape for PCB Stack: Define printed antennas on polygonal board shape **4-2**

Gerber Files for Arrays: Generate Gerber files with multiple feeds for arrays **4-3**

Improvements in Antenna Designer App: Updates to Antenna Designer app supports backing structure gallery, dielectric catalog, and better export to MATLAB scripts **4-3**

Improvements in Radiation Pattern Visualization: Plot phase in 3-D; overlay antenna, or array and its pattern on same axes **4-3**

3-D Radiation Pattern of Orthogonal Slices: Generation of 3-D radiation pattern from two orthogonal slices **4-4**

Subarrays for Conformal Arrays: Include linear, rectangular, and circular arrays as elements in conformal arrays **4-4**

Conical helix, Crossed Dipole, H-Slot Patch, Sierpinski's Carpet, and Minkowski's Loop: Design, visualize, and analyze five new antennas using parameterized geometry **4-5**

Logarithmic Current and Charge Plots: Visualize current and charge distributions on antennas in logarithmic scale **4-6**

Site Viewer Command Line Interface: Launch, configure, and close Site Viewer windows from MATLAB command line **4-6**

DTED Terrain Data: Import 3-D terrain data files for use in Site Viewer and RF propagation tools **4-7**

TIREM Propagation Model: Visualize path loss computed using TIREM propagation model **4-7**

R2018b

3-D Terrain Visualization: Stream global terrain data in Site Viewer and visualize path loss computed using the Longley-Rice propagation model **5-2**

Array Design Function: Design an array configuration with appropriate antenna spacings for a given frequency **5-2**

Array Phase Shift Function: Calculate the phase shifts of the array elements to achieve beam scanning in a particular direction **5-2**

Bifilar and Quadrafilar Helix, Koch Curve Fractal, Sierpinski’ s Gasket, Single Arm Archimedean Spiral: Design, visualize, and analyze five additional antennas with parameterized geometry **5-2**

Parabolic Reflector: Design, visualize, and analyze an antenna in the presence of a large parabolic reflector element with parameterized geometry **5-2**

R2018a

SINR Visualization: Visualize transmitter site signal-to-interference-plus-noise ratio (SINR) on a map **6-2**

Antenna Site Visualization: Visualize line-of-sight path between transmitter/receiver sites and clustering of adjacent sites **6-2**

Meshing Engine for Metal Surfaces: Improved performance for analysis of metal antennas **6-2**

E-Shaped Patch, Triangular Patch, LPDA, and J-Dipole: Design, visualize, and analyze four additional printed antennas with parameterized geometry **6-2**

Corner Reflector: Design, visualize, and analyze an antenna in the presence of an additional reflector element with parameterized geometry **6-2**

R2017b

PCB Stack Antenna: Design Custom PCB antennas with arbitrary metal-dielectric layers, solid feed/via models, and advanced meshing control **7-2**

Gerber File Generation from pcbstack: Prototype and implement antennas using customizable library of RF connectors and PCB manufacturing services **7-2**

Conversion of 2-D/2.5-D Antenna Elements to pcbStack: Design custom printed antennas using available library elements **7-2**

Inset-Fed Patch, Circular Patch, Cloverleaf, Circular Reflector, and Circular Cavity: Design, visualize, and analyze three additional antennas and two additional backing structures using parameterized geometry **7-2**

Birdcage Antenna: Design, visualize, and analyze an additional antenna, including the effects of human heads modeled with phantoms **7-3**

Visualization Within Dielectric Volume: Inspect charge and current separately in the metal and dielectric layers **7-3**

RF Propagation: Visualize transmitter/receiver sites, links, and coverage on map using outdoor and weather-based path loss models **7-3**

R2017a

Plane Wave Excitation: Compute the scattering solution of antennas and arrays when excited by plane waves **8-2**

Antenna Designer App: Interactively select and analyze antennas with desired characteristics **8-2**

Lumped RLC Load for Antenna Elements: Modify the resonant frequency using load elements at an arbitrary location on an antenna surface **8-2**

Array Factor Analysis: Compute the array pattern using pattern superposition of individual antennas **8-2**

PCB Stack Antenna: Describe custom printed antennas on multilayered substrates **8-2**

Custom Planar Array Geometry: Describe a custom array by defining its geometric boundaries **8-2**

Custom Ground Plane for Dielectric Structures: Model an infinite ground plane or no ground plane for antennas mounted on substrates **8-3**

Cycloid Dipole and Blade Dipole: Design, visualize, and analyze two additional antennas using parameterized geometry **8-3**

conformalArray: Build heterogeneous conformal antenna arrays by specifying both balanced and unbalanced antennas **8-3**

R2016b

MultiLayered Dielectric Substrate: Include multilayered and thick dielectric substrate effects in antennas and antenna arrays **9-2**

Antenna Design Function: Design the geometric properties of antennas to resonate at a particular frequency **9-2**

Custom Planar Antenna Geometry: Describe a custom antenna by defining its geometric boundaries **9-2**

Lumped RLC Components for Antenna Elements: Modify resonant frequency using load elements at the antenna feed point **9-2**

Circular Antenna Array: Position elements of an antenna array on a circle **9-2**

Custom Patch Antenna: Create a probe-fed patch antenna with arbitrary shape **9-2**

Dipole Helix, Coplanar Inverted-F, and Coplanar Inverted-L Antennas: Design, visualize, and analyze three additional antennas using parameterized geometry **9-2**

R2016a

Dielectric Modeling: Account for the effects of the substrate in antennas and finite antenna arrays **10-2**

Import Antenna Arrays as a Planar Mesh: Design antenna arrays with custom planar geometries **10-2**

Conformal Antenna Arrays: Position the antenna elements of an array at arbitrary position **10-2**

Multi-Axis Tilt Property for Antennas and Antenna Arrays: Rotate an antenna or an array around any arbitrary axis **10-2**

Polar Plot: Interactively visualize the radiation pattern and perform measurements using polarpattern **10-2**

Custom Pattern and Field: Visualize any arbitrary 3-D radiation pattern data or electric/magnetic field data using patternCustom and fieldsCustom **10-2**

Radiation Pattern Import/Export: Import and export radiation pattern data using the MSI file format with msiread and msiwrite **10-3**

Rectangular Horn and Waveguide Antennas: Design, visualize, and analyze rectangular horn and waveguide antennas with parameterized geometry **10-3**

R2015b

Infinite Array Object: Analyze a library antenna as a unit cell in an infinite array **11-2**

Custom Planar Mesh Object: Import an arbitrary 2-D mesh to describe a custom antenna **11-2**

Infinite Ground Plane Specification: Model an infinite ground plane for antennas connected to the ground **11-2**

E-H Field Visualization: Inspect the electric and magnetic fields at an arbitrary distance from the antenna **11-2**

Biquad Antenna Object: Design, visualize, and analyze biquad antennas with parameterized geometry **11-2**

Antenna library for rapid design and visualization of metal antennas using parameterized geometry **12-2**

Antenna array design using antenna elements **12-2**

Port analysis of antennas and antenna arrays **12-2**

Field analysis of antennas and antenna arrays **12-2**

Surface analysis of antennas and antenna arrays **12-2**

Antenna array analysis for the embedded element pattern and the correlation coefficient of the elements of the array **12-2**

Infinite ground plane specification for analyzing balanced antennas . . **12-2**

R2020b

Version: 4.3

New Features

Import Gerber Files: Import, modify, and analyze Gerber files Antenna Toolbox

Use the `gerberRead` function to read Gerber files or use the `PCBReader` class to:

- Create a `pcbStack` object.
- Clean up specific metal layers.
- Access objects in different shapes associated with a particular layer.
- Specify the dielectric substrate type.

Grid, Cylindrical, and Spherical Reflectors; Bicone, Discone, and More: Design, visualize, and analyze ten new antennas including reflectors using parametrized geometry

- Use the `reflectorGrid` object to create a reflector made of a grid of parallel wires or bars oriented in one direction. These reflectors can be used as high-gain antennas for point-to-point communications.
- Use the `reflectorCylindrical` object to create parabolic cylindrical reflector antennas. These reflectors are used in designing airborne navigational antennas.
- Use the `reflectorSpherical` object to create a spherical reflector antenna for wide-angle scanning. These antennas are used as multiple beam antennas in satellite communications.
- Use the `biconeStrip` object to create a stripped bicone antenna widely used in emissions testing, field monitoring, and chamber characterization.
- Use the `disconeStrip` object to model a stripped discone antenna. These antennas have low omnidirectional gain and wide to ultra-wide bandwidth and are used in UHF and microwave band applications.
- Use the `rhombic` object to create a rhombus made of parallel wires suspended above the ground to provide high forward gain and wide bandwidth. Rhombic antennas are used in long-distance communications.
- Use the `monopoleRadial` object to create a monopole antenna with the ground plane consisting of a number of radials. These antennas are widely used in cellular communications on account of their omnidirectional characteristics.
- Use the `hornRidge` object to create a horn with ridges on the inside and extending from the center to the sides. The ridges lower the cutoff frequency and increase the bandwidth. Ridged horn antennas are commonly used in electromagnetic interference and compatibility applications for generating electromagnetic fields.
- Use the `hornCorrugated` object to create a corrugated rectangular antenna mostly used in broadcasting. The corrugated horn provides beam symmetry, low side lobe level, and spillover reduction.
- Use the `monopoleCustom` object to create customized radiators on ground planes in a variety of shapes. These antennas are mostly used in airborne and ground-based communication systems.

Cartesian Positioning for txsite and rxsite: Perform point-to-point RF propagation analysis using Cartesian coordinate system

- Use the `CoordinateSystem` and `AntennaPosition` properties of the `txsite` and `rxsite` objects to support Cartesian coordinates in antenna site location.

- Use functions like `sigstrength`, `sinr`, and `pathloss` for point-to-point RF propagation analysis when using Cartesian coordinates to locate antenna sites.

Ray Tracing Analysis for Cartesian Coordinates: Import STL files to describe scenarios for ray tracing analysis

- You can use the `Map` and `propagationModel` parameters of point-to-point RF Propagation functions to support an STL file or a triangulation object. This aids ray tracing analysis in any 3-D map environment.
- New properties of the ray tracing propagation model include `CoordinateSystem`, `SurfaceMaterial`, `SurfaceMaterialPermittivity`, and `SurfaceMaterialConductivity`. You can use these properties to define surface materials for a 3-D map surface.

SADEA Optimization Using Command Line Interface: Optimize antennas and arrays by providing access to optimization data

Use the `optimize` function to optimize antennas and arrays in the command line interface. You can use the SADEA optimizer to optimize antennas and arrays with respect to various analysis parameters and the associated required constraints.

Surrogate Optimization in Antenna Designer and Array Designer: Optimize antenna and arrays using surrogate optimizer

You can now use the surrogate optimizer from Global Optimization Toolbox as an alternative to the SADEA optimizer in the **Antenna Designer** app and the **Antenna Array Designer** app.

R2020a

Version: 4.2

New Features

Bug Fixes

SADEA Optimization in Antenna Designer and Array Designer: Optimize antennas and arrays using Antenna Toolbox

Use the **Antenna Designer** App and the **Antenna Array Designer** App to optimize antennas and arrays with respect to various analysis parameters under given constraints.

customAntennaStl Object: Import STL file to create a custom 3D antenna

Use the `customAntennaStl` object to:

- Create a custom 3D antenna object.
- Create a feed for the antenna object using `createFeed` function.
- Select the feeding edge or the feeding contour.
- Run analysis on the antenna object at any desired frequency.

Wire Solver: Analyze and solve dipole like antenna catalog elements

Use the `wireStack` object to create, analyze, and solve a single or multifeed wire antenna.

PCB Stack for Arrays: Convert arrays directly to PCB stack

Use the `pcbStack` object for the conversion of antenna array catalog elements to PCB stack.

Corrugated Horn, Antipodal Vivaldi, Monocone, Elliptical Patch, Fractal Snowflake and More: Design, visualize, and analyze ten new antennas using parametrized geometry

- Use the `hornConicalCorrugated` antenna object to model a corrugated horn antenna, where the corrugations are slots or grooves covering the inner surface of the cone.
- Use the `vivaldiAntipodal` object to create an antipodal vivaldi antenna mostly used in wireless communications and radars. This antenna is a type of end fire tapered slot antenna that provides medium gain with less side lobes and wide bandwidth.
- Use the `monocone` object to create a modified monocone that consists of a merged cone and cylinder on a circular ground plane. The modified monocone as a higher bandwidth and finds uses in airborne as well as ground applications.
- Use the `patchMicrostripElliptical` object to create an elliptical shape microstrip patch antennas for uses in applications that require circular polarization.
- Use the `fractalSnowflake` object to create a snowflake fractal antenna.
- Use the `spiralRectangular` object to create a single or dual arm rectangular spiral antenna mostly used in WLAN applications.
- Use the `waveguideRidge` object to create a double ridge waveguide mostly used in ultra-wideband applications like radio astronomy.
- You can now use the `lpda` object to create a tapered log-periodic dipole antenna with a trapezoidal board shape.

Ray Tracing Propagation Model: New propagation model using ray tracing method of images with material reflection loss

Use `raytracing-image-method` parameter in `propagationModel` for ray tracing analysis to compute propagation paths and their corresponding path losses, including surface reflections losses.

Measurements Data in Site Viewer: Import and visualize measurements data in Site Viewer

Use the `propagationData` object for importing and visualizing geolocated propagation data such as measurement files, data variables in MATLAB, or the output of `coverage` or `sinr` functions.

RF Propagation and Ray Tracing Enhancements: New and updated objects and functions for analysis using ray tracing

New and updated features enable you to:

- Predict the total received power and generate coverage maps using ray tracing.
- Use the command line to access ray tracing analysis info generated by using the `raytrace` function.
- Include permittivity of building materials (`buildingMaterialPermittivity`) and earth surfaces (`earthSurfacePermittivity`) in path loss calculation of reflected waves.
- Include antenna polarization in path loss calculations.

New features include a `comm.Ray` object, `raypl`, `earthSurfacePermittivity`, `buildingMaterialPermittivity`, and `add` functions.

Updated features include `raytrace`, `coverage`, `sinr`, `sigstrength`, `link`, and `pathloss`.

Great Circle Path: geodesic Input changed to greatcircle input option

In `distance` and `angle` functions, the `geodesic` option for the `path` input parameter is changed `greatcircle` option.

R2019b

Version: 4.1

New Features

Physical Optics (PO) and Hybrid MoM: New solvers added for large structure analysis

Antenna Toolbox now has the Hybrid MOM-PO solver for modeling large structures such as parabolic antennas. The antenna element of the large structure is accurately modelled using the Method of Moments (MoM) solver and the effect of electrically large structure is considered using Physical Optics (PO).

Antenna toolbox also uses the PO solver for radar cross section (RCS) analysis. For more information, see Hybrid MoM-PO Method for Metal Antennas with Large Scatterers and Physical Optics Solver.

Radar Cross-Section (RCS) analysis: Generate and visualize RCS of platform, antenna, or array object

Use the `rcs` function to calculate and plot the monostatic or bistatic RCS of a platform, antenna, or an array.

Antenna Array Designer App: Interactively design, analyze, and visualize antenna arrays

Use the **Antenna Array Designer** app to:

- Show different array configurations and layout defining element spacing.
- Compare different array types and responses.
- Pick array configuration to meet specific peek gain, directivity, desired coverage, pattern, port parameters etc.
- Change the spacing between the elements and see the effect on the performance of the array.
- Visualize the effect of mutual coupling at the port and in the far-field.
- Calculate mutual impedance.
- Control the radiation pattern of the array in a desired direction in space.
- Calculate the scan impedance and the scan pattern for different azimuth and elevation values.
- Observe mutual coupling between elements and minimize it to achieve diversity reception.

Buildings Data in Site Viewer: Import and visualize buildings in Site Viewer for point-to-point ray tracing analysis

Use the `siteviewer` object to import and visualize buildings in Site Viewer. Use the `raytrace` function to visualize point-to-point ray tracing analysis.

Cassegrain, Gregorian, Slotted Waveguide, Circular Horn, Quad Custom and More: Design, visualize, and analyze nine new antennas using parametrized geometry

New antenna objects and enhancements to existing objects aid in design and visualization.

- You can now use the existing `biquad` antenna object to model a double biquad antenna.

- Use the `bicone` antenna object to model a bicone antenna used in applications such as Electronic Support Measurement (ESM), or electromagnetic interference (EMI) testing.
- Use the `discone` object to model a discone antenna in which one cone is replaced by a disk.
- Use the `waveguideCircular` to create a hollow tube of uniform cross section that confines electromagnetic waves.
- Use the `waveguideSlotted` to create a various types of slots on the waveguide like longitudinal, transversal, centered inclined and inclined slots cut into narrow wall.
- Use the `hornConical` to create a waveguide shaped like a cone to direct radio waves in a beam.
- Use the `cassegrain` and the `gregorian` objects to create parabolic antennas in which the feed antenna is mounted at or behind the surface of the main parabolic reflector and is aimed at the secondary reflector.
- Use the `quadCustom` object to create a Yagi-Uda custom array antenna.

R2019a

Version: 4.0

New Features

Installed Antenna Analysis: Perform analysis of antennas installed on electrically large structures called platforms

Use `installedAntenna` object to integrate the effect of large electrical structures known as platforms on antennas and arrays. Import the `platform` (ship, plane, or car) as an STL file. You can place single or multiple antennas around the platform. Calculate the S-parameters, pattern, charge, and current to see the effect of the platform on the antenna.

Data from STL Files: Import platform objects from STL files and export antenna geometry to STL files

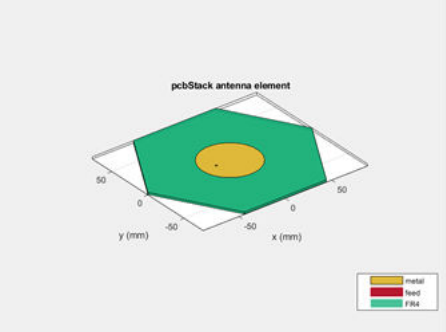
Use `platform` to import STL files as platforms for installed antenna analysis.

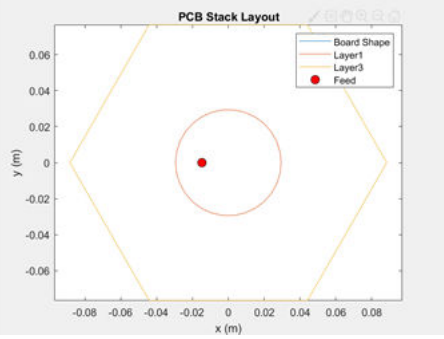
Use `stlwrite` to export an antenna or array geometry to an STL file.

Polygonal Board Shape for PCB Stack: Define printed antennas on polygonal board shape

Create printed antennas on polygonal boards and boards with holes. For example, design a circular microstrip patch on a polygonal board.

```
%% Design circular microstrip patch using FR4 substrate.
p = design(patchMicrostripCircular,3e9);
p.Substrate = dielectric('FR4');
c = antenna.Circle;
c.NumPoints = 6;
c.Radius = 3*p.Radius;
figure
show(c)
%% Create polygonal stack
v = getShapeVertices(c);
cp = antenna.Polygon('Vertices',v);
pb = pcbStack(p);
pb.Layers{3} = cp;
pb.BoardShape = cp;
% Visualize geometry
show(pb)
axis equal
% Visualize layout of board, layers, feeds, vias etc.
figure
layout(pb)
```





Gerber Files for Arrays: Generate Gerber files with multiple feeds for arrays

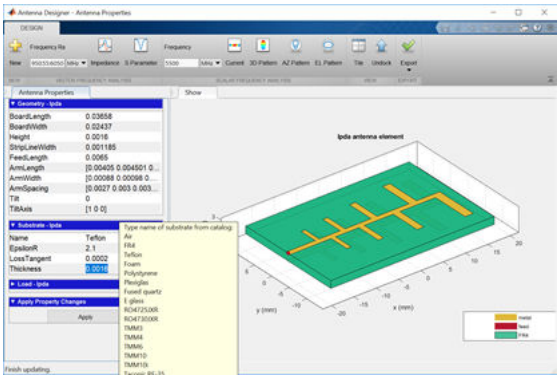
Create PCB antennas with more than one feed for a multifeed antenna or an array. Use this PCB antenna to create Gerber files for a connector and manufacturing service.

Improvements in Antenna Designer App: Updates to Antenna Designer app supports backing structure gallery, dielectric catalog, and better export to MATLAB scripts

You can now use the **Antenna Designer** app to:

- Choose backing structures such as a cavity or reflector, for an antenna.

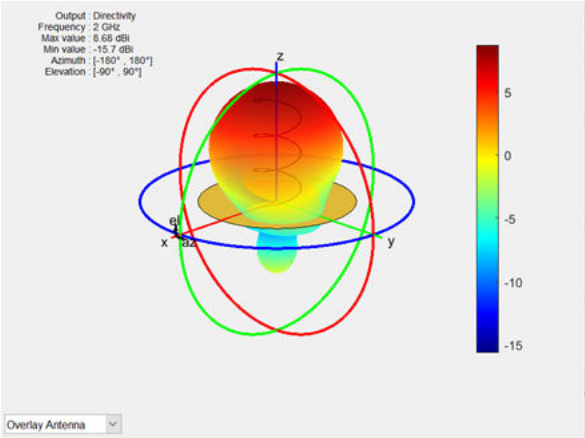
- Auto-fill the dielectric properties by typing the name of the substrate.



- Generate a consolidated MATLAB® script that walks you through all the changes made to an antenna using the application.

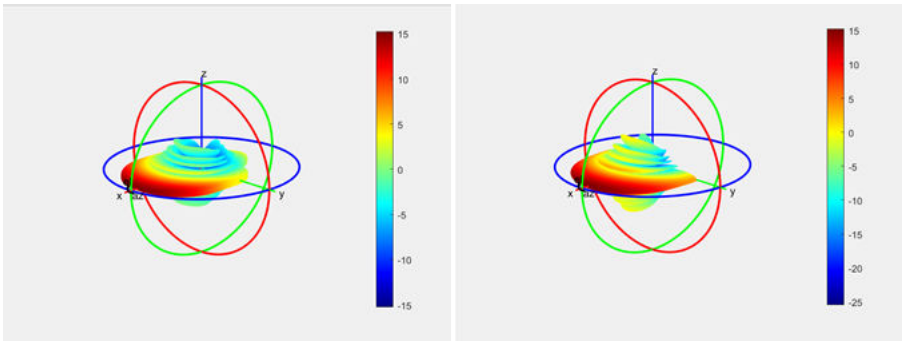
Improvements in Radiation Pattern Visualization: Plot phase in 3-D; overlay antenna, or array and its pattern on same axes

Use the `pattern` function to visualize an antenna or an array with its corresponding radiation pattern on the same axes. Now, you can also customize the radiation pattern.



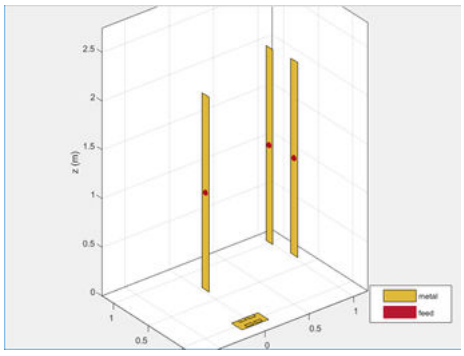
3-D Radiation Pattern of Orthogonal Slices: Generation of 3-D radiation pattern from two orthogonal slices

Use the `patternFromSlices` function to reconstruct a 3-D radiation pattern from azimuth and elevation slices.



Subarrays for Conformal Arrays: Include linear, rectangular, and circular arrays as elements in conformal arrays

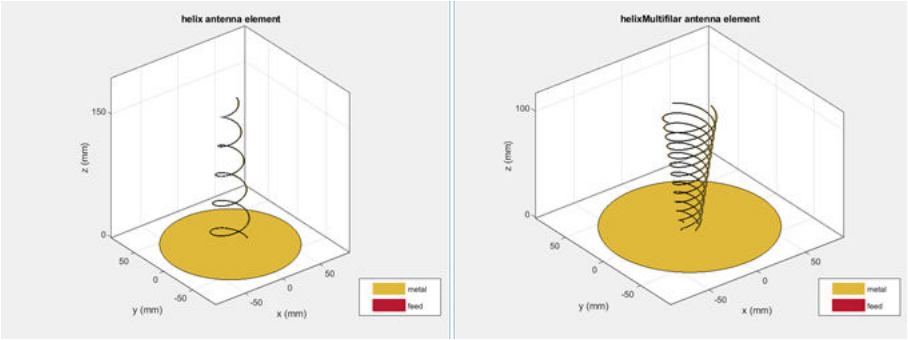
You can now include linear, rectangular, and circular arrays as elements in a `conformalArray` object. You can also modify the conformal array properties, such as `AmplitudeTaper` and `PhaseShift`.



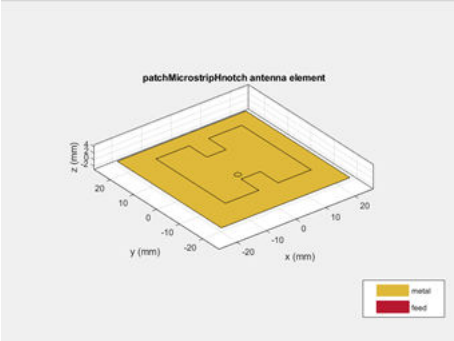
Conical helix, Crossed Dipole, H-Slot Patch, Sierpinski's Carpet, and Minkowski's Loop: Design, visualize, and analyze five new antennas using parameterized geometry

New antenna objects and enhancements to existing objects aid in design and visualization.

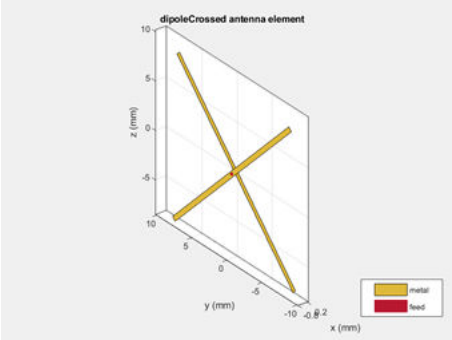
- You can now use the existing `helix` and `helixMultifilar` objects to model helix antennas of increasing or decreasing radius.



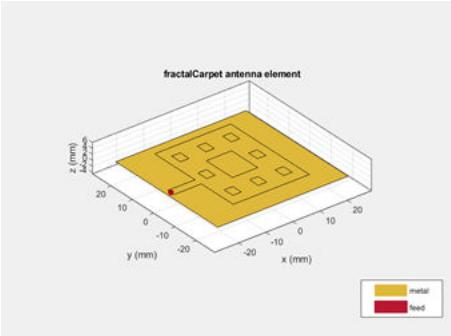
- Use the `patchMicrostripHnotch` object to model a probe-fed H-shaped microstrip patch antenna.



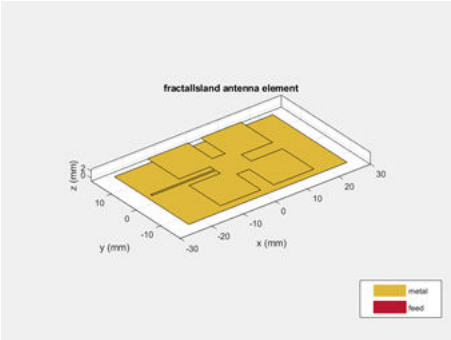
- Use the `dipoleCrossed` object to model a crossed dipole antenna.



- Use the `fractalCarpet` object to model a Sierpinski's carpet fractal.



- Use the `fractalIsland` object to model a Minkowski's loop.



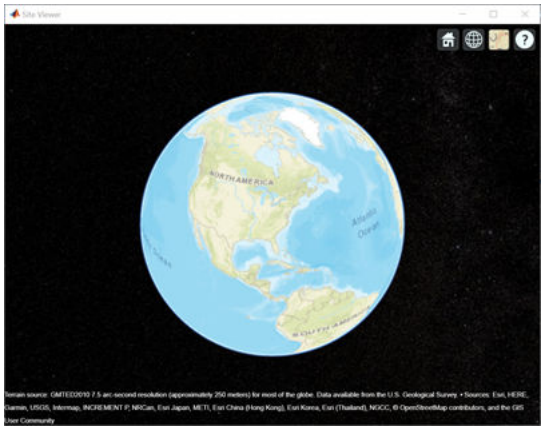
Use the `show` function to view the structures of these antennas.

Logarithmic Current and Charge Plots: Visualize current and charge distributions on antennas in logarithmic scale

Use the existing `current` and `charge` functions to visualize current and charge distributions of antennas in a logarithmic scale.

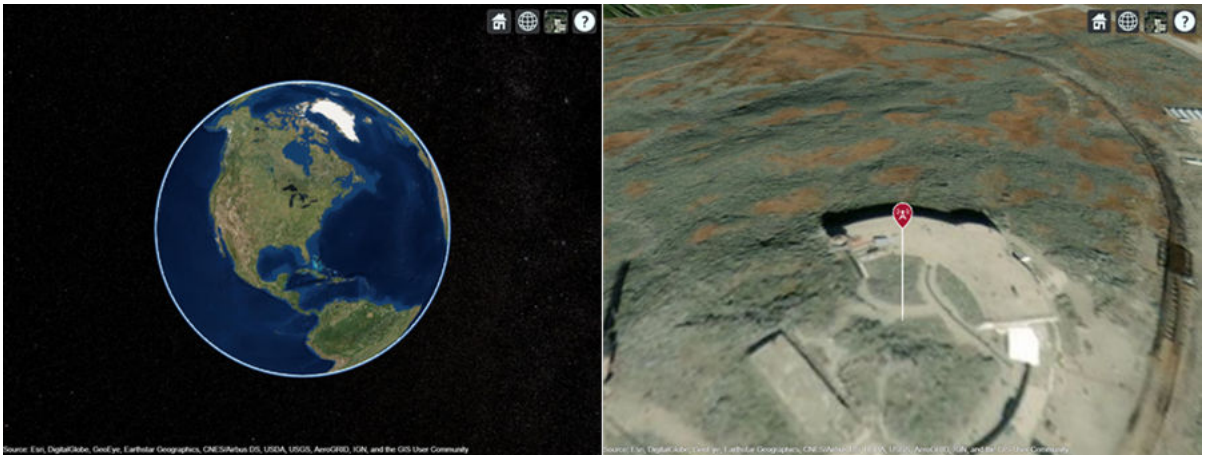
Site Viewer Command Line Interface: Launch, configure, and close Site Viewer windows from MATLAB command line

Use the `siteviewer` function to launch and configure Site Viewer windows. You can create multiple Site Viewer windows to compare visualizations as well as configure basemaps and terrain information.



DTED Terrain Data: Import 3-D terrain data files for use in Site Viewer and RF propagation tools

Use the `addCustomTerrain` function to import terrain from DTED files and specify new terrain in Site Viewer.



TIREM Propagation Model: Visualize path loss computed using TIREM propagation model

help

You can now use the `propagationModel` function to integrate the Terrain Integrated Rough Earth Model™ (TIREM™) in the Site Viewer and visualize the impact on received signal strength.

R2018b

Version: 3.2

New Features

3-D Terrain Visualization: Stream global terrain data in Site Viewer and visualize path loss computed using the Longley-Rice propagation model

You can now visualize terrain features in Site Viewer.

Use the Longley-Rice propagation model in `propagationModel` to visualize the impact of local terrain features on received signal strength.

Use the `elevation` function to calculate the ground elevation at the required site.

Use the `pattern` function to visualize antenna radiation pattern in Site Viewer.

Array Design Function: Design an array configuration with appropriate antenna spacings for a given frequency

You can now use the existing `design` function to create array configurations that operate at a specified frequency.

Array Phase Shift Function: Calculate the phase shifts of the array elements to achieve beam scanning in a particular direction

Use the `phaseShift` function to calculate a set of phase shift values that you can apply to an array operating at a specified frequency.

Bifilar and Quadrafilar Helix, Koch Curve Fractal, Sierpinski’ s Gasket, Single Arm Archimedean Spiral: Design, visualize, and analyze five additional antennas with parameterized geometry

The new objects aid in the design and visualization of new antennas:

- Use the `helixMultifilar` object to model a bifilar or quadrafilar helix antenna on a ground plane.
- Use the `dipolehelixMultifilar` object to model a bifilar or quadrafilar helix dipole antenna.
- Use `fractalKoch` object to model a Koch curve fractal antenna in an X-Y plane.
- Use `fractalGasket` object to model a Sierpinski's gasket on the X-Y plane.
- Use the existing `spiralArchimedean` object to model a single arm Archimedean spiral antenna.

Use the `show` function to view the structures of these antennas.

Parabolic Reflector: Design, visualize, and analyze an antenna in the presence of a large parabolic reflector element with parameterized geometry

Use the `reflectorParabolic` object to model a parabolic reflecting backing structure for antenna elements. Parabolic reflectors are large antennas of at least 10 wavelengths in diameter.

R2018a

Version: 3.1

New Features

Compatibility Considerations

SINR Visualization: Visualize transmitter site signal-to-interference-plus-noise ratio (SINR) on a map

Use the `sinr` function to measure the signal-to-interference-plus-noise ratio (SINR) of a receiver and display a map visualization. The SINR value is an important measure of receiver quality.

Antenna Site Visualization: Visualize line-of-sight path between transmitter/receiver sites and clustering of adjacent sites

Use the `los` function to plot the line-of-sight visibility between two sites on a map.

Meshing Engine for Metal Surfaces: Improved performance for analysis of metal antennas

The mesh generator, `mesh`, now uses new algorithms for 2-D geometries of metal antennas.

Compatibility Considerations

Resulting meshes can differ from meshes generated in previous releases. For example, meshes generated with default size controls might have fewer elements than before.

E-Shaped Patch, Triangular Patch, LPDA, and J-Dipole: Design, visualize, and analyze four additional printed antennas with parameterized geometry

The new objects aid in the design and visualization of new antennas:

- Use the `patchMicrostripEnotch`, `patchMicrostripTriangular`, and `lpda` objects to create PCB antennas.
- Use the `dipoleJ` object to model a J-pole antenna that finds applications in ham radio.

Corner Reflector: Design, visualize, and analyze an antenna in the presence of an additional reflector element with parameterized geometry

Use the `reflectorCorner` object to create a corner reflecting backing structure for antenna elements. Antennas using corner reflectors are mostly used in radar and wireless communications systems.

R2017b

Version: 3.0

New Features

PCB Stack Antenna: Design Custom PCB antennas with arbitrary metal-dielectric layers, solid feed/via models, and advanced meshing control

Use the `pcbStack` object to build custom multi-layer metal-dielectric PCB antennas. You can use this object for practical antenna designs such as cell phones, RFID, IoT applications.

Gerber File Generation from pcbstack: Prototype and implement antennas using customizable library of RF connectors and PCB manufacturing services

Printed Circuit Board (PCB) antennas are described by a set of manufacturing files collectively known as `'Gerber files'`.

Use the `PCBWriter` object or the `gerberWrite` function with the `pcbStack` object to generate Gerber files. Optionally, you can choose the RF connector for the PCB board and PCB viewer or manufacturing service.

Conversion of 2-D/2.5-D Antenna Elements to pcbStack: Design custom printed antennas using available library elements

Use `pcbStack` to convert antenna library elements for PCB-based custom printed antennas. You can now customize antenna elements by:

- Adding one or more feed points and control the excitation amplitude, phase.
- Defining one or more vias between different layers.

Inset-Fed Patch, Circular Patch, Cloverleaf, Circular Reflector, and Circular Cavity: Design, visualize, and analyze three additional antennas and two additional backing structures using parameterized geometry

The new objects aid in the design and visualization of new antennas:

- Use the `patchMicrostripInsetfed` object to feed a rectangular patch antenna using inset-feed.
- Use the `patchMicrostripCircular` object to model a circular patch antenna.
- Use `cloverleaf` object to model a wideband circularly polarized cloverleaf antenna.
- Use `sectorInvertedAmos` object to model a sector antenna the pattern of which illuminates a sector.
- Use the `cavityCircular` and `reflectorCircular` objects as backing structures for other antenna elements.

Use the `show` function to view the structures of these antennas.

Birdcage Antenna: Design, visualize, and analyze an additional antenna, including the effects of human heads modeled with phantoms

Use the `birdcage` antenna object to design, analyze, and visualize a birdcage antenna. You can use this antenna to model an MRI coil and study the performance for a loaded and unloaded MRI coil. Use the `show` function to view the structures of these antennas.

Visualization Within Dielectric Volume: Inspect charge and current separately in the metal and dielectric layers

You can now use the `charge` and `current` functions to visualize charge and current separately in metal and dielectric layers.

RF Propagation: Visualize transmitter/receiver sites, links, and coverage on map using outdoor and weather-based path loss models

Use Antenna Toolbox `txsite` and `rxsite` objects to compute and visualize antenna sites and RF propagation on a virtual globe. Computation and Visualization options include:

- Signal strength computation using free-space propagation or your choice of propagation model to include effects due to weather.
- Map-based visualization of sites and signal strength, including links for point-to-point communication and contour maps for area coverage
- High-quality map for visualizations including 3-D virtual globe.

R2017a

Version: 2.2

New Features

Plane Wave Excitation: Compute the scattering solution of antennas and arrays when excited by plane waves

Use the `planeWaveExcitation` object to excite any antenna or array from the library using a plane wave. Plane waves in Antenna Toolbox are specified using a direction vector and a polarization vector.

Antenna Designer App: Interactively select and analyze antennas with desired characteristics

Use the **Antenna Designer** app to interactively explore, design, and analyze antennas in the library. You can also select multiple antennas and compare the analysis of these antennas. Antennas designed using the app can be exported as a variable in the MATLAB workspace, as a live script, or as a function.

Lumped RLC Load for Antenna Elements: Modify the resonant frequency using load elements at an arbitrary location on an antenna surface

You can now use the `lumpedElement` function to modify the resonant frequency of an antenna by adding the load at an arbitrary location.

Array Factor Analysis: Compute the array pattern using pattern superposition of individual antennas

Use `arrayFactor` and `patternMultiply` to calculate the array factor and the full array pattern of an antenna array. `arrayFactor` and `patternMultiply` do not consider the effect of mutual coupling between different elements in an array.

PCB Stack Antenna: Describe custom printed antennas on multilayered substrates

Use the `pcbStack` object to create structures used in the PCB-based design of antennas. Using this object, you can define:

- Multiple metal layers
- Dielectric substrate
- One or more feed points and control excitation amplitude or phase
- Any number of vias between different layers.

Custom Planar Array Geometry: Describe a custom array by defining its geometric boundaries

Use the `customArrayGeometry` function to create an array represented by 2-D custom geometry. Use the `layout` and `show` functions to view the layout and structure of the array.

Custom Ground Plane for Dielectric Structures: Model an infinite ground plane or no ground plane for antennas mounted on substrates

You can now add infinite ground plane or no ground plane to design and analyze antenna structures with dielectric such as `patch`, `cavity`, and `reflector`.

Cycloid Dipole and Blade Dipole: Design, visualize, and analyze two additional antennas using parameterized geometry

Use the `dipoleCycloid` and `dipoleBlade` antenna objects to design and analyze cycloid dipole and blade dipole antennas, respectively. Use the `show` function to view the structures of these antennas.

conformalArray: Build heterogeneous conformal antenna arrays by specifying both balanced and unbalanced antennas

You can now use the `conformalArray` object to design and analyze heterogeneous conformal arrays using balanced and unbalanced antennas. Use the `layout` and `show` function to view the layout and structures of these arrays.

R2016b

Version: 2.1

New Features

MultiLayered Dielectric Substrate: Include multilayered and thick dielectric substrate effects in antennas and antenna arrays

Use the `dielectric` function to design and analyze `patch`, `cavity`, and `reflector` antennas or array structures that have multi-layered or thick dielectric substrates.

Antenna Design Function: Design the geometric properties of antennas to resonate at a particular frequency

Use the `design` function to create an antenna object that operates at a specified frequency.

Custom Planar Antenna Geometry: Describe a custom antenna by defining its geometric boundaries

Use the `customAntennaGeometry` class to define geometric boundaries for custom antenna shapes. Use the antenna analysis functions to analyze the custom antenna geometry for its port, surface, and field characteristics. You can also use this custom antenna geometry in finite and infinite arrays.

Lumped RLC Components for Antenna Elements: Modify resonant frequency using load elements at the antenna feed point

Use the `lumpedElement` function to change the electric properties of the antenna. For example, you can increase the antenna bandwidth without changing the dimensions using RLC components.

Circular Antenna Array: Position elements of an antenna array on a circle

Use the antenna elements library to design `circularArray`. Use the `layout` function to view the placement of the different antenna elements.

Custom Patch Antenna: Create a probe-fed patch antenna with arbitrary shape

Use Double slot cavity patch on TMM10 substrate example to learn how to create an antenna using `customAntennaGeometry`. This example also shows you how to manipulate properties of an antenna using `lumpedElement` and multi-layered dielectric substrates.

Dipole Helix, Coplanar Inverted-F, and Coplanar Inverted-L Antennas: Design, visualize, and analyze three additional antennas using parameterized geometry

Use the `dipoleHelix`, `invertedFcoplanar`, and `invertedLcoplanar` antenna objects to design and analyze helix dipole, coplanar inverted-F, and coplanar inverted-L antennas, respectively. Use the `show` function to view the structures of these antennas.

R2016a

Version: 2.0

New Features

Dielectric Modeling: Account for the effects of the substrate in antennas and finite antenna arrays

Design and analyze `patch`, `cavity`, and `reflector` antenna or array structures by using dielectric material as substrates. Characterize dielectric substrates using the `dielectric` utility function and the constants and properties listed in `DielectricCatalog`.

Import Antenna Arrays as a Planar Mesh: Design antenna arrays with custom planar geometries

Use the `customArrayMesh` class to design a planar array object. Analyze the custom mesh array for its port, surface, and field characteristics using array analysis functions.

Conformal Antenna Arrays: Position the antenna elements of an array at arbitrary position

Design conformal antenna arrays using any antenna elements from Antenna Toolbox as unit cells. You can also specify an array of any shape and antenna arrangements. Analyze unit cells of the array and extract the embedded pattern using array analysis functions.

Multi-Axis Tilt Property for Antennas and Antenna Arrays: Rotate an antenna or an array around any arbitrary axis

Use the `TiltAxis` property to a rotate the antenna and array elements around any arbitrary axis.

Polar Plot: Interactively visualize the radiation pattern and perform measurements using polarpattern

Use the `polarpattern` function to plot antenna and array characteristics in polar coordinates. In the polar plot, you can:

- Use markers to enable measurements of the plotted data
- Visualize *N*-dB beamwidth
- Change the orientation of the data

Custom Pattern and Field: Visualize any arbitrary 3-D radiation pattern data or electric/magnetic field data using patternCustom and fieldsCustom

Use the `patternCustom` function to plot and visualize 2-D or 3-D radiation patterns from user specified or lab-measured antenna data recorded in CSV, text, or MAT files.

Use the `fieldsCustom` function to plot and visualize electric or magnetic fields from user specified or lab-measured antenna data recorded in CSV, text, or MAT files.

Radiation Pattern Import/Export: Import and export radiation pattern data using the MSI file format with msiread and msiwrite

Use the `msiread` function to read data from MSI files that have `.msi` or `.pln` extensions. Use the `msiwrite` function to write data into MSI files that have `.pln` extension.

Rectangular Horn and Waveguide Antennas: Design, visualize, and analyze rectangular horn and waveguide antennas with parameterized geometry

Use the `horn` and `waveguide` antennas class to design and analyze a rectangular horn and waveguide antennas, respectively. To view the structure of horn or waveguide metal antennas, use the `show` function.

R2015b

Version: 1.1

New Features

Infinite Array Object: Analyze a library antenna as a unit cell in an infinite array

Design infinite antenna arrays using antenna elements from Antenna Toolbox as unit cells. Use array analysis functions to analyze unit cells of the array and extract the embedded pattern.

Custom Planar Mesh Object: Import an arbitrary 2-D mesh to describe a custom antenna

Use the `customAntennaMesh` class to design a planar antenna object. Use the antenna analysis functions to analyze the custom mesh antenna for its port, surface, and field characteristics.

Infinite Ground Plane Specification: Model an infinite ground plane for antennas connected to the ground

Analyze and visualize properties of antenna connected to the ground plane, such as patch, monopole, and pifa in the presence of an infinite ground plane.

E-H Field Visualization: Inspect the electric and magnetic fields at an arbitrary distance from the antenna

Use `EHfields` to visualize the electric and magnetic fields of an antenna element in Antenna Toolbox.

Biquad Antenna Object: Design, visualize, and analyze biquad antennas with parameterized geometry

Use the `biquad` antenna class to design and analyze a biquad metal antenna. Use the `show` function to view the structure of the biquad metal antenna.

R2015a

Version: 1.0

New Features

Antenna library for rapid design and visualization of metal antennas using parameterized geometry

Design and analyze the structure of 22 metal antennas including dipoles, monopoles, spirals, and patches. Use the `show` function to view the structure of the metal antennas.

Antenna array design using antenna elements

Use the Antenna Toolbox library of antenna elements to design `linear` and `rectangular` antenna arrays. Use the `layout` function to view the placement of the different antenna elements in the array.

Port analysis of antennas and antenna arrays

Analyze the ports of different antennas and antenna arrays using `impedance`, `returnLoss`, and `sparameters` functions.

Field analysis of antennas and antenna arrays

Analyze and visualize the radiation pattern, E-H fields and beamwidth of different antennas and antenna arrays using `pattern`, `EHfields`, `patternAzimuth`, `patternElevation` and `beamwidth` functions.

Surface analysis of antennas and antenna arrays

Determine, visualize and analyze the surface charge and current of different antennas and antenna arrays using `charge`, and `current` functions.

Antenna array analysis for the embedded element pattern and the correlation coefficient of the elements of the array

Determine, analyze, and visualize the embedded element pattern and the correlation coefficient of elements in an array using `pattern`, and `correlation` functions.

Infinite ground plane specification for analyzing balanced antennas

Analyze and visualize balanced antenna properties, such as, dipoles and bowties in the presence of an infinite ground plane.