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Overview

Electromagnetic Field Solver Based on UTD

- XGTD is a general purpose ray-based electromagnetic analysis tool for antenna radiation, antenna coupling, scattering and EMC applications
- A ray-based EM solver based on the UTD (Uniform Theory of Diffraction)
- Uses computer graphics techniques for fast ray tracing
- Evaluate E-fields using UTD with material dependent reflection, transmission and diffraction coefficients
- Combine E-fields with antenna patterns to find received power, time and frequency domain E-field, far-zone radiation patterns, path loss, etc

$B = \mu H$ $\nabla \cdot B = 0$ $\nabla \cdot D = \rho$ $D = \in E$

Electromagnetic Field Solver (2)

- Executes a full 3-D ray tracing
- Full implementation of the UTD formulation of GTD
- Includes reflections, transmissions, and edge and surface diffractions, creeping wave
- Calculate far-zone gain patterns for antennas on the surface of, or in the vicinity of, electrically large platforms (aircraft, vehicles, etc.)
- Predict fields on the surface of objects or in the space surrounding them
- Interference and coupling of antennas on large platforms

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Graphical User Interface
Overview of Features

- Import, edit and view geometrical features (3D objects, thin plates, and anechoic chambers)
- Specify electromagnetic properties of materials
- Specify antennas types and parameters
- Specify location of transmitters and receivers
- Set waveform frequency and spectral characteristics
- Set UTD parameters (number of reflections, etc.)
- Select desired output
- Plot and view output

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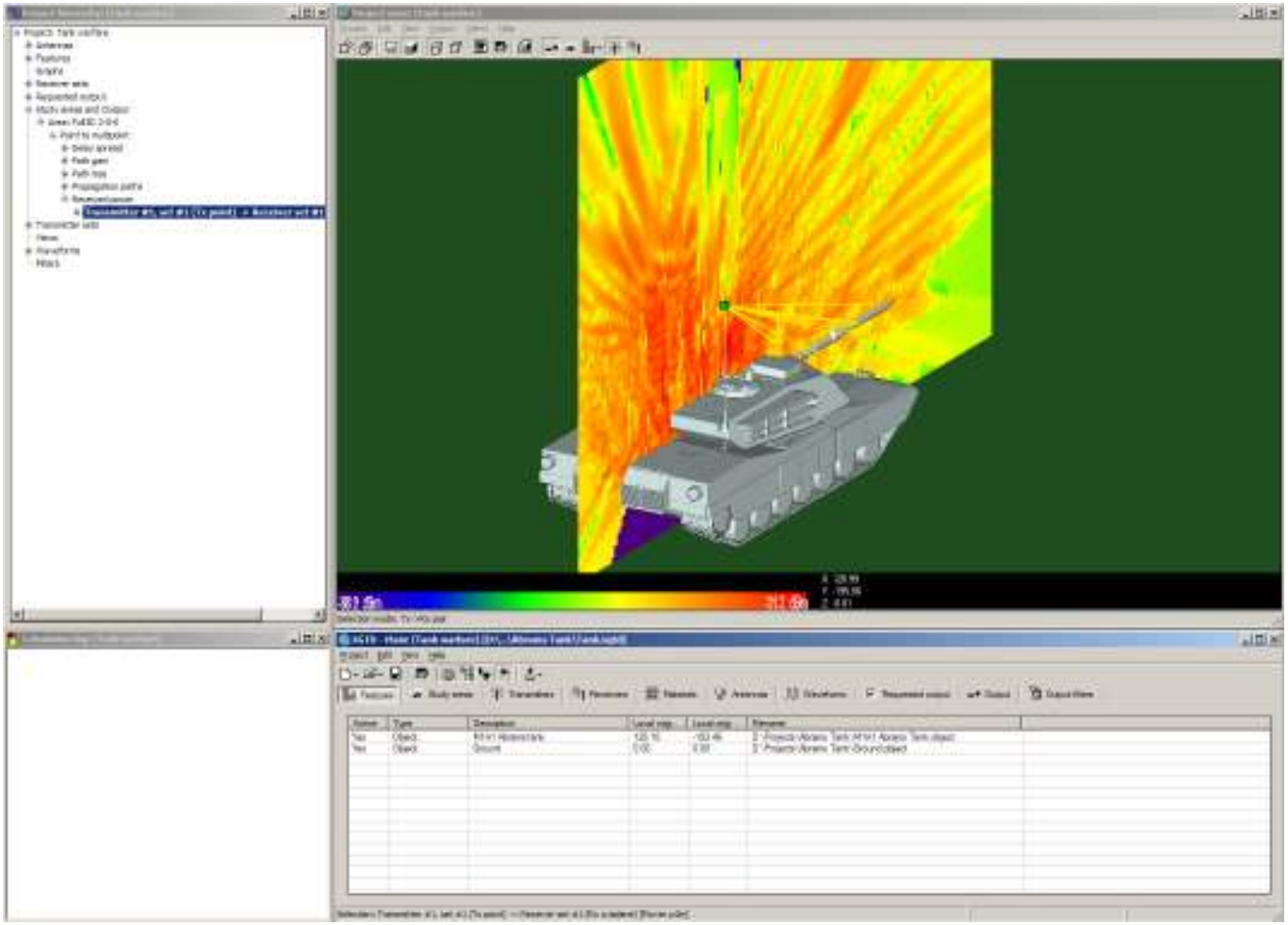
Graphical User Interface (2)

- CAD import including geometry simplification
- Databases (antenna, absorber, waveforms)
- Display of antenna patterns and antenna boresight and polarization
- Control vectors for setting and displaying orientation of any object in the chamber
- Importation of antenna patterns
- Computing far zone antenna patterns

Graphical User Interface Utilizes a Modular Design



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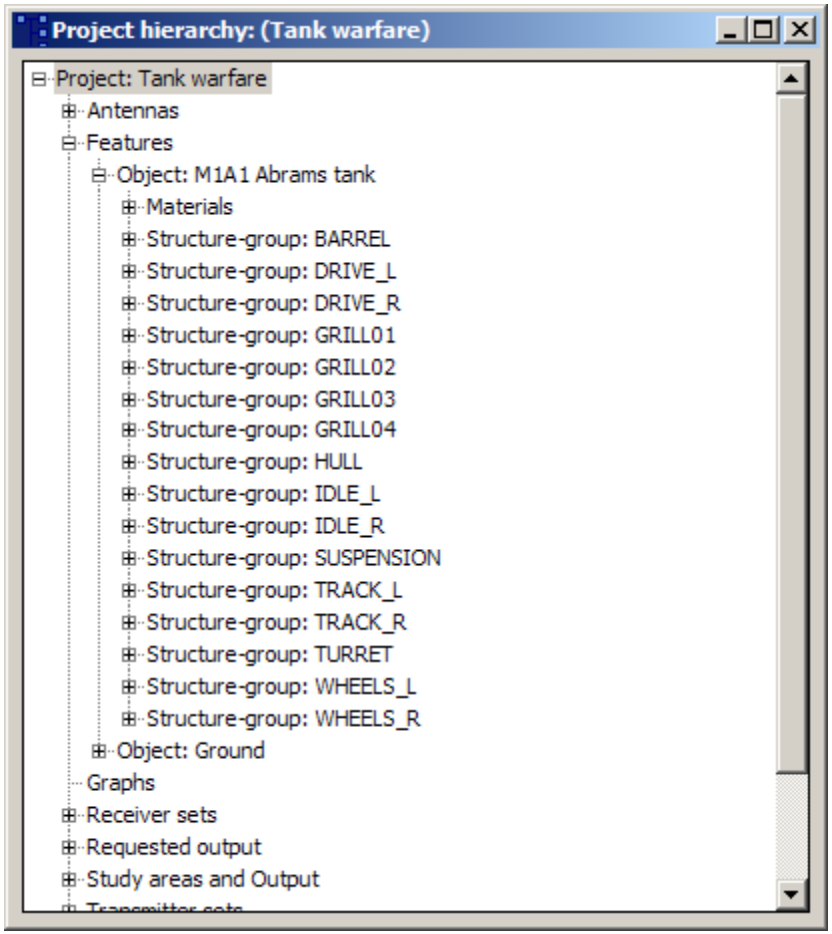
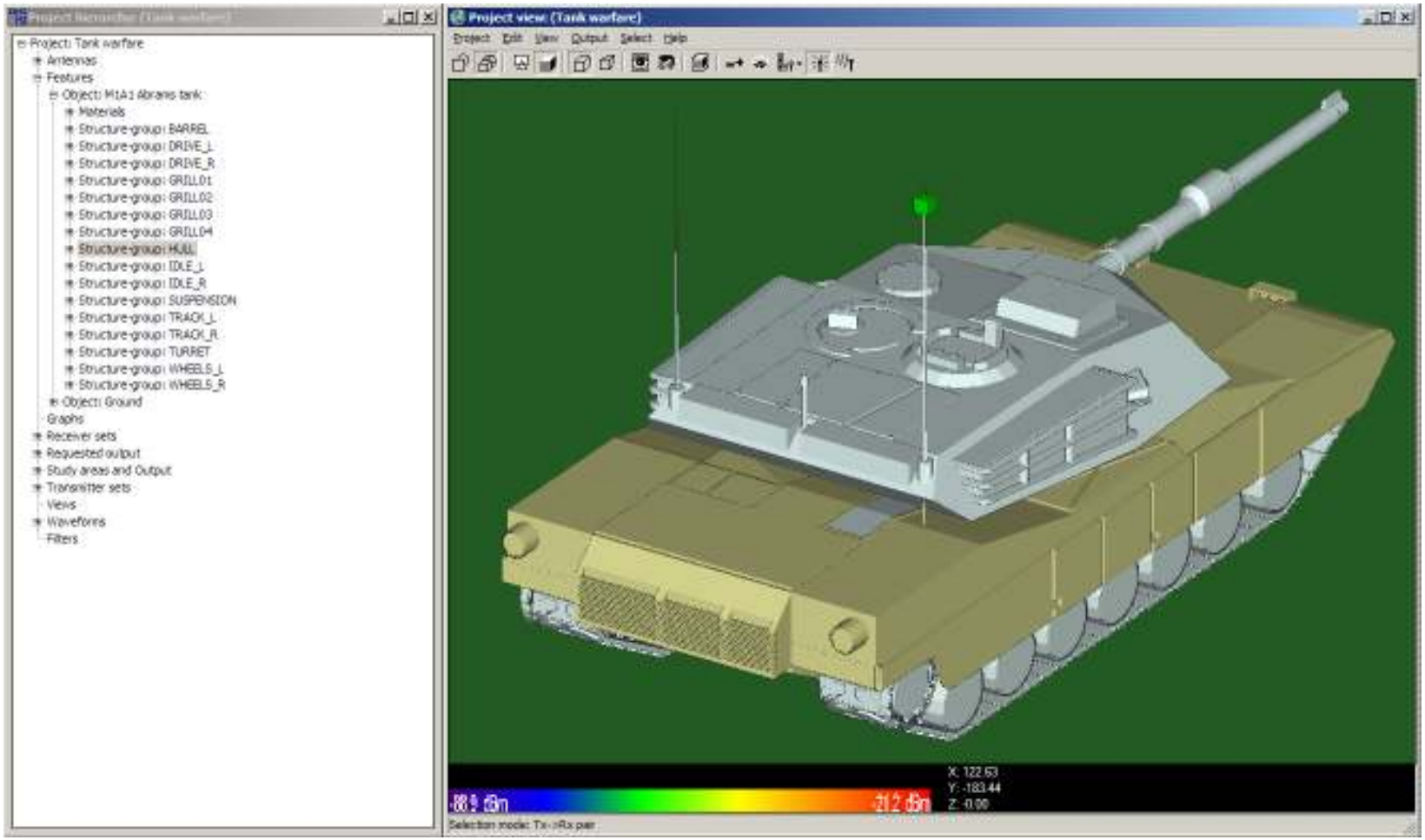
Project Hierarchy Window



Project Hierarchy is Keyed to Graphical Display



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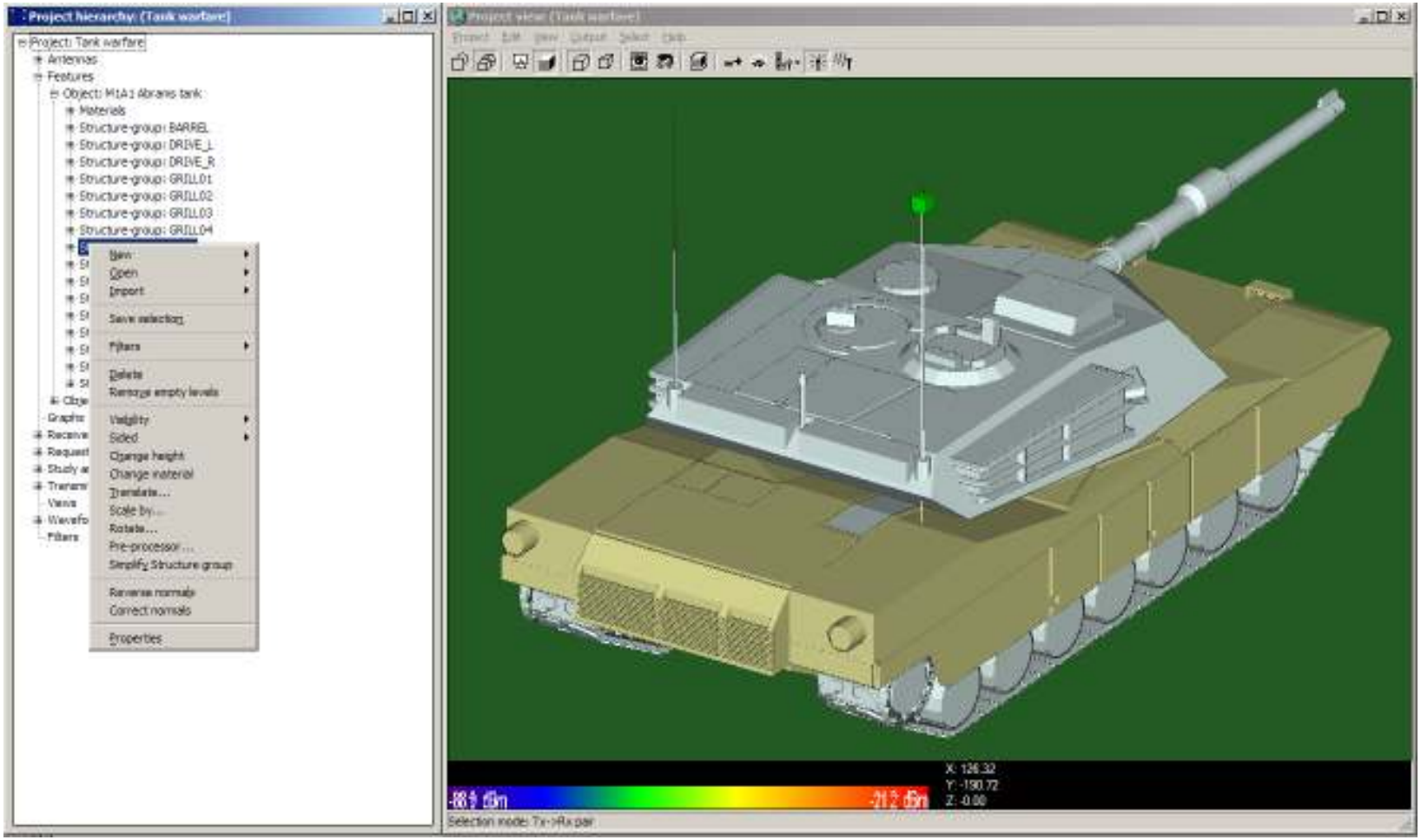
Right-Click to View Context Sensitive Menus



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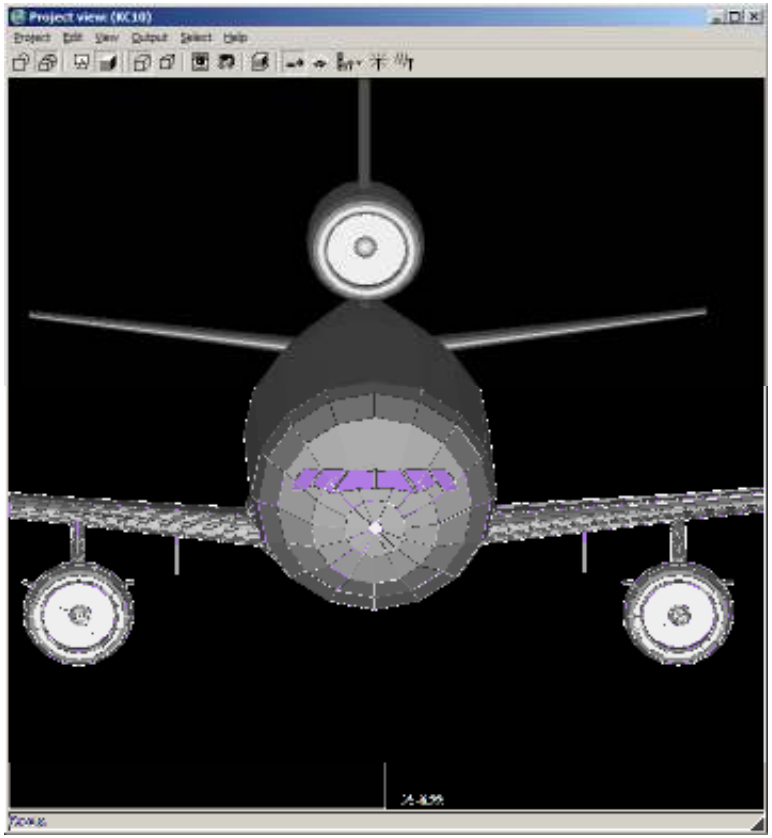
XGTD Feature Data
Geometry and Material Properties

- Feature Types: Objects and Anechoic chambers
- XGTD's hierarchical organization: Feature, Structure group, Structure, Sub-structure, Face
- Vector geometrical data
- Electromagnetic material properties
- Display properties (color)

Material Properties

- Material properties are used to determine reflection, transmission and diffraction coefficients
- Predefined types such as concrete, perfect absorber, metal, glass, etc, are always accessible
- Each face is assigned a material type
- New material types can be stored in a library
- User defined files with angle, frequency and polarization dependent coefficients can also be used



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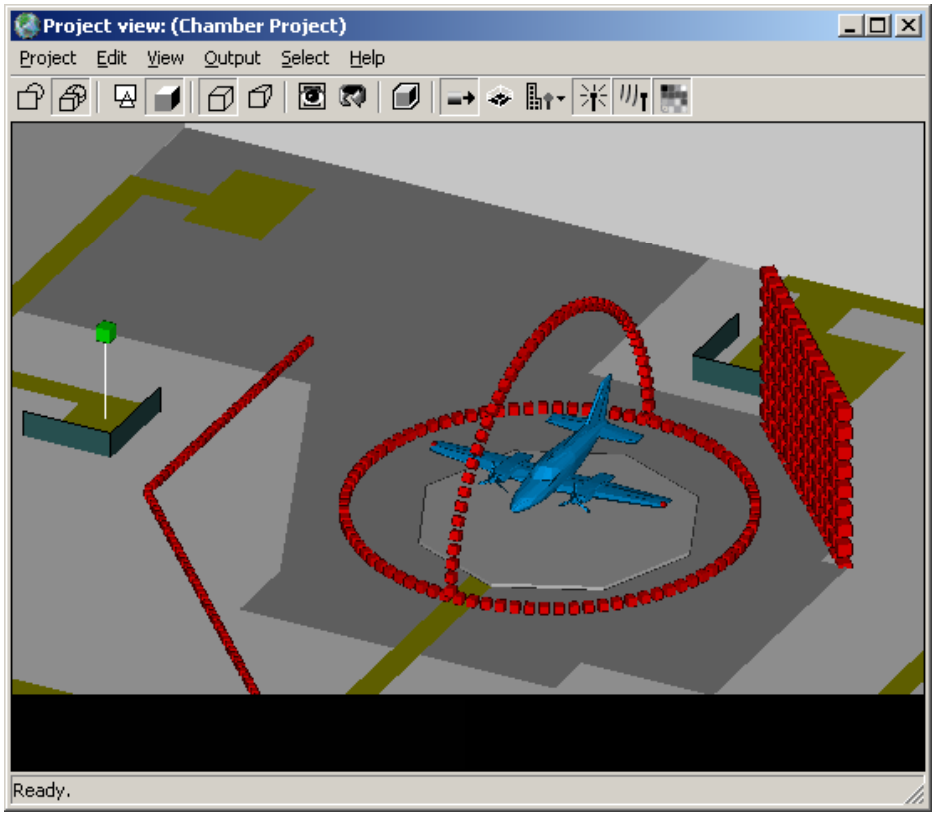
Transmitter and Receiver Sets

- Various ways of placing transmitter and receiver points



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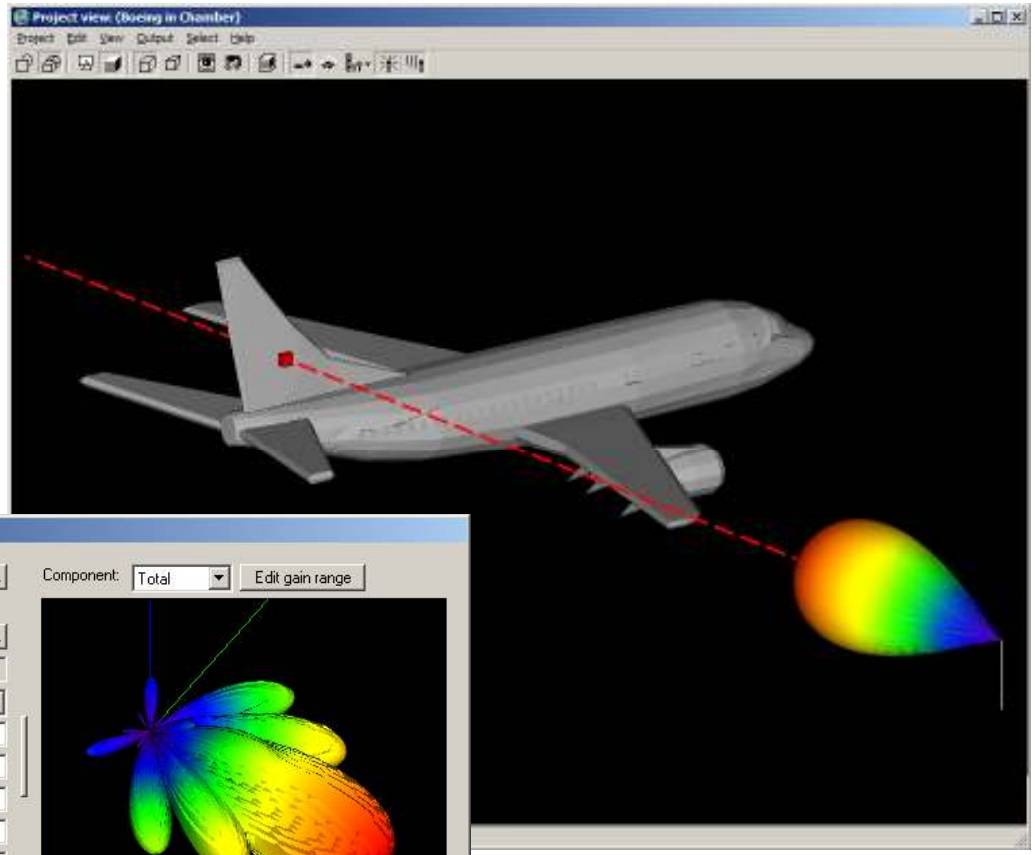
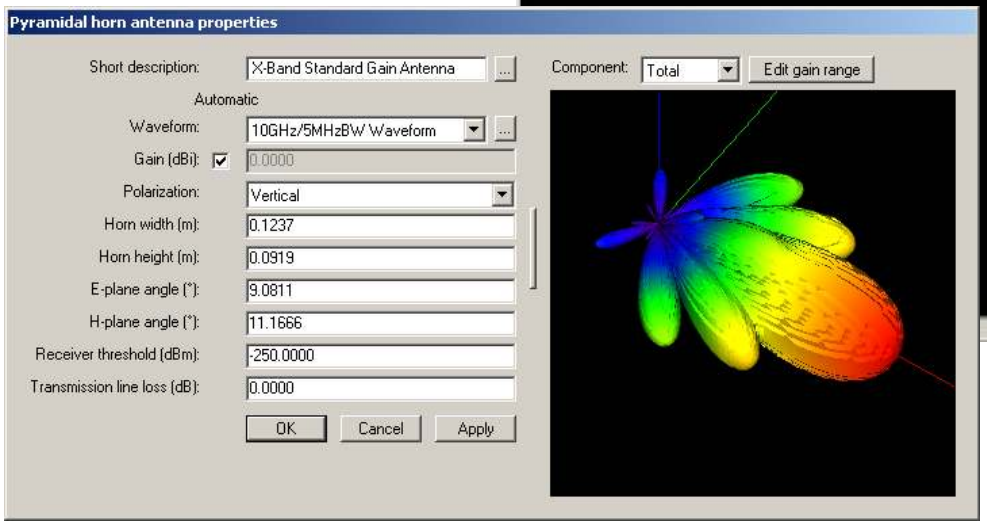
Specifying Antenna Characteristics

- Antennas are assigned to transmitter and receiver points
- XGTD has many generic antenna types with variable parameters
  - Linear dipole, pyramidal horn, patches, apertures, helix, parabolic reflector, directional antennas, and others
- Import far-zone antenna patterns from XFDTD, XGTD, NSMA, Odyssey, and MSI Planet formats
- User defined files for importing full 3-D patterns
- Set the main beam direction and polarization by specifying the orientation of the antenna
- Plot 2-D pattern cuts using the GUI, or view 3-D pattern

Antenna 3-D Pattern and Boresight Display





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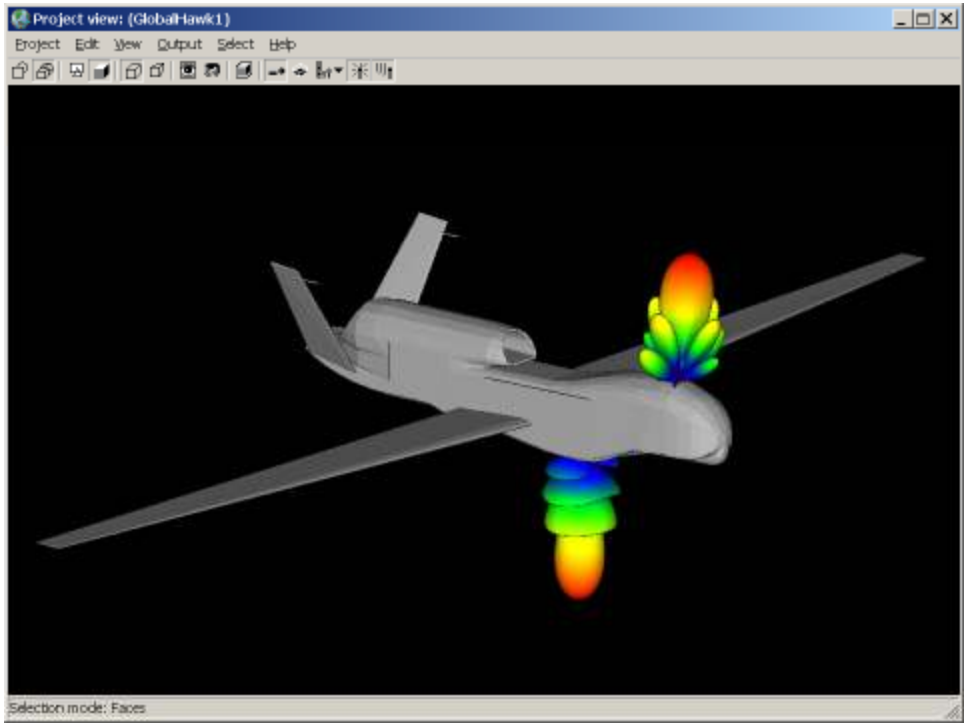
Surface Mounted Antennas

- Automatically acquire orientation from underlying surface
- Optional rotation of antenna about surface normal



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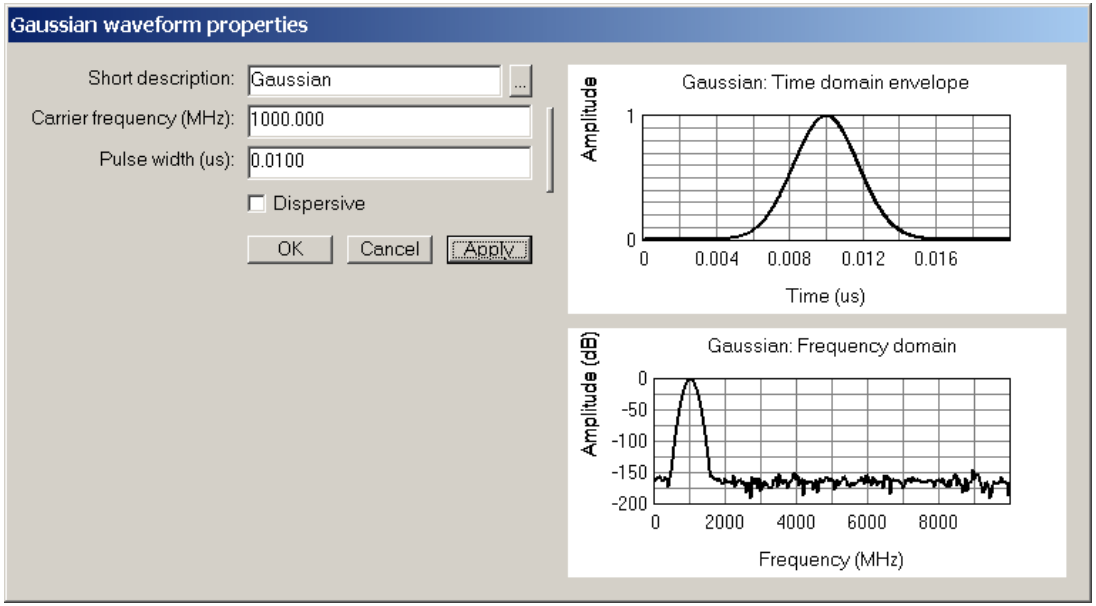
Specifying Waveform Characteristics

- Sinusoid and broadband waveforms
- Various modulations of carrier frequency are available
- Frequency and time domain user-defined files
- Time and frequency domain output



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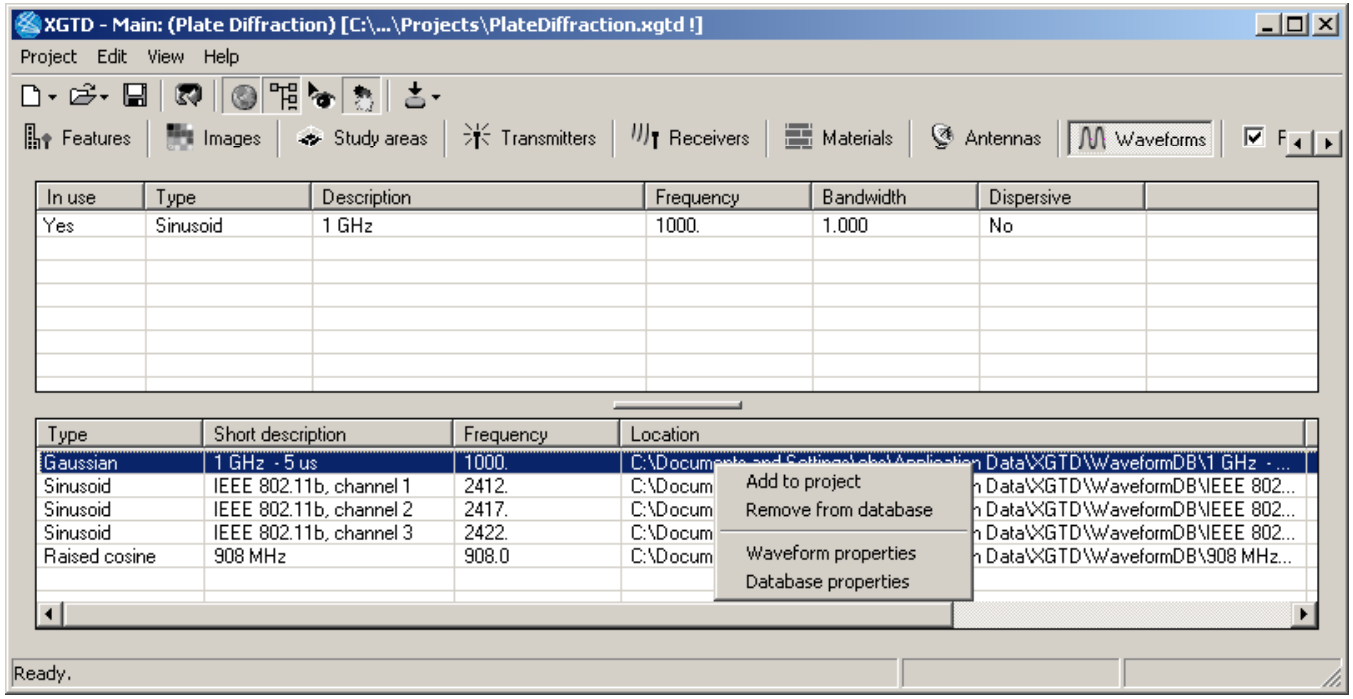
XGTD Databases

- Databases for antennas, materials and waveforms
- Modify existing entries, and add new ones
- Available to all projects



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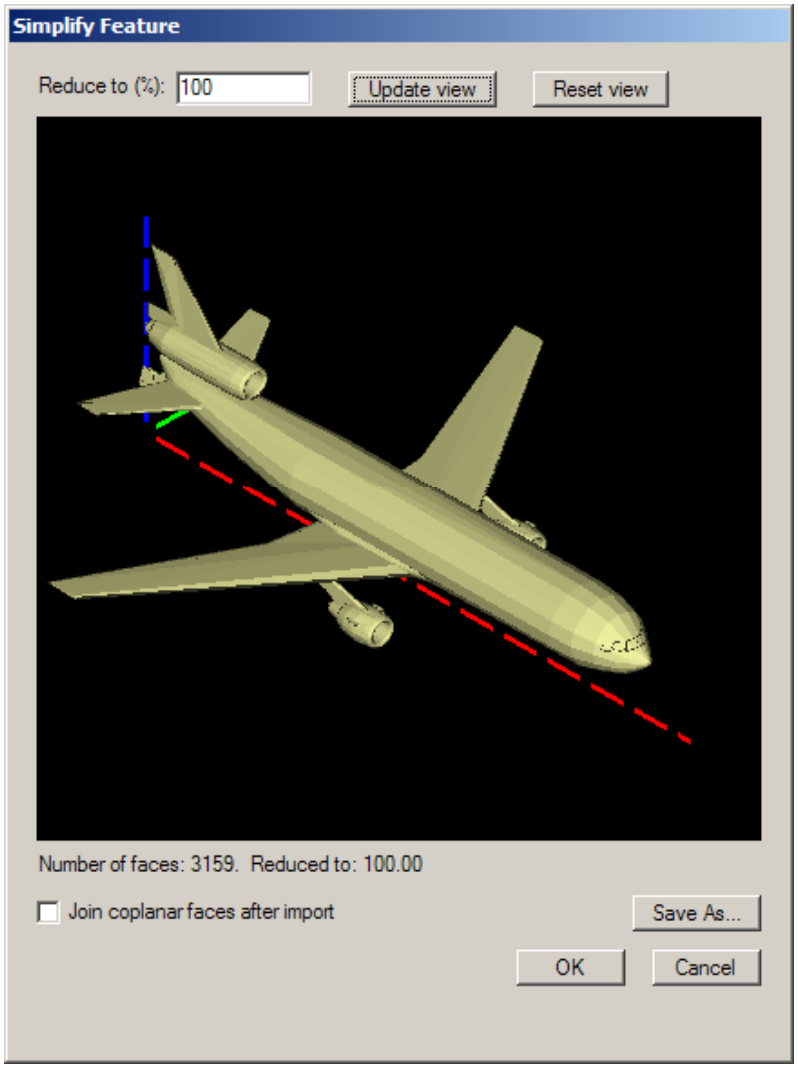
CAD File Importation

- The UTD EM solver requires full three-dimensional models of objects
- All current UTD calculation capabilities require on a faceted geometry
- Data is often available in AutoCAD's DXF, ACIS's SAT, IGES, and STL formats
- During or after import, material properties can be quickly assigned to different parts of an object

Object Simplification Tools

- Semi-automatic geometry simplification to remove unnecessary detail
- Simplification can significantly improve calculation speed
- Removal of very small facets will usually improve accuracy of solutions

Object Simplification Tools (2)



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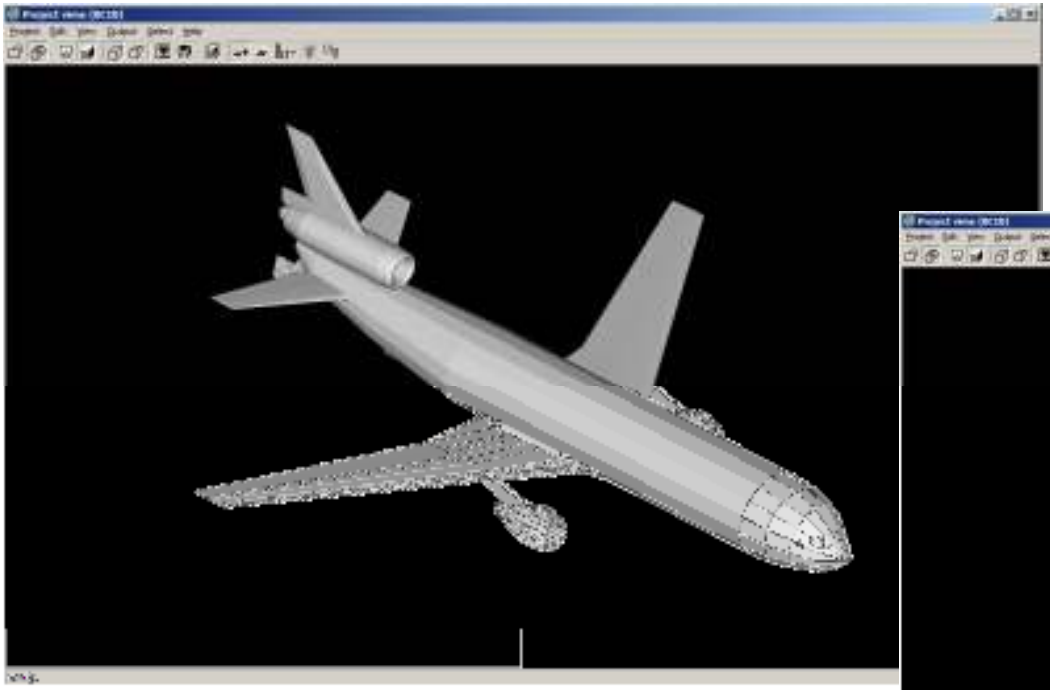
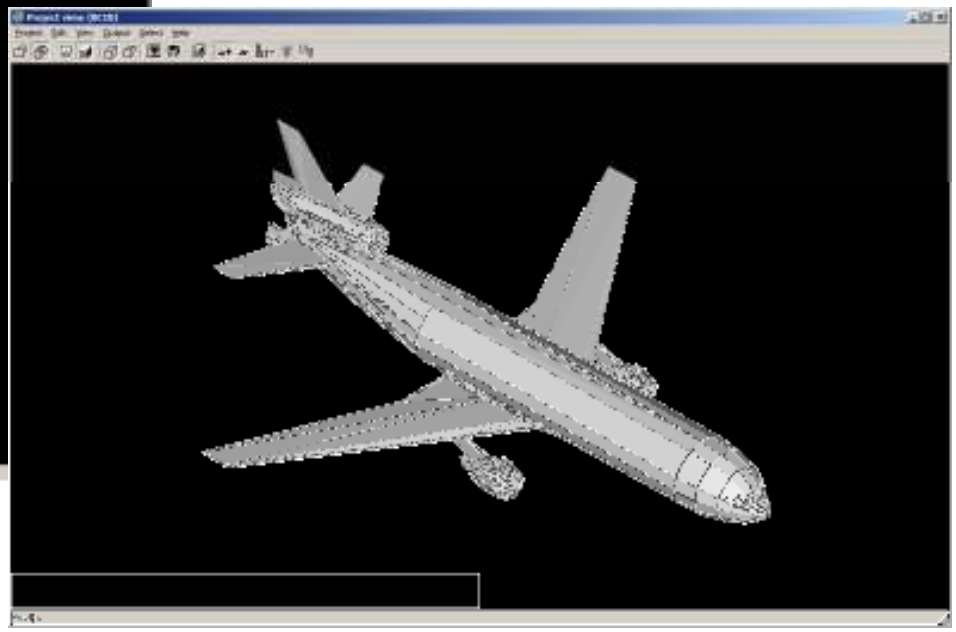
Result of Object Simplification



5900 faces



2500 faces

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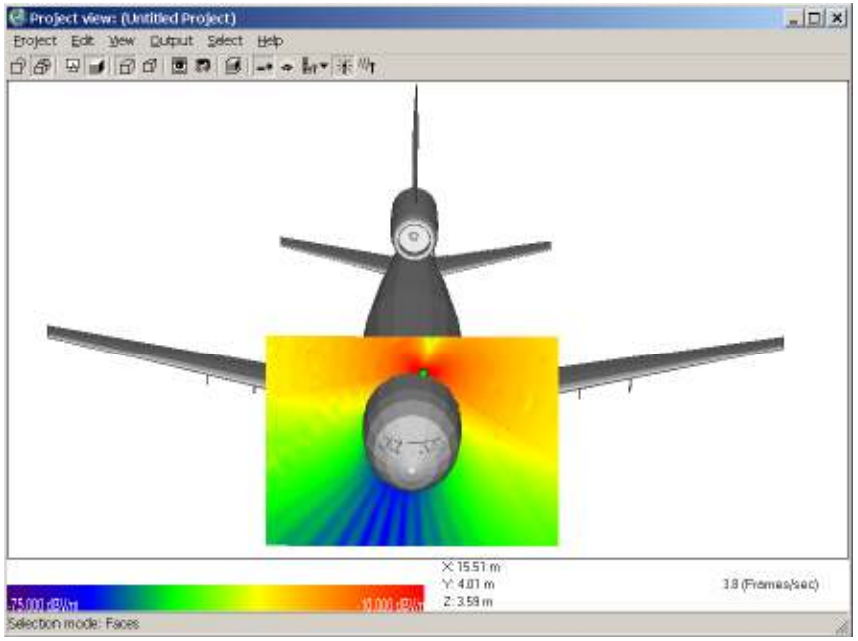
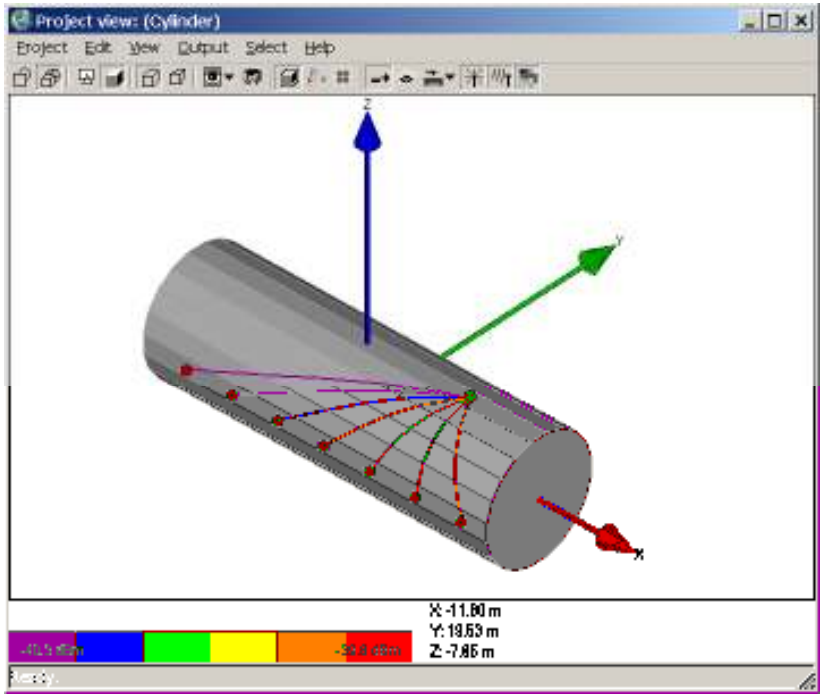
Many Capabilities in XGTD for Displaying Output



Field Strength



Ray Paths

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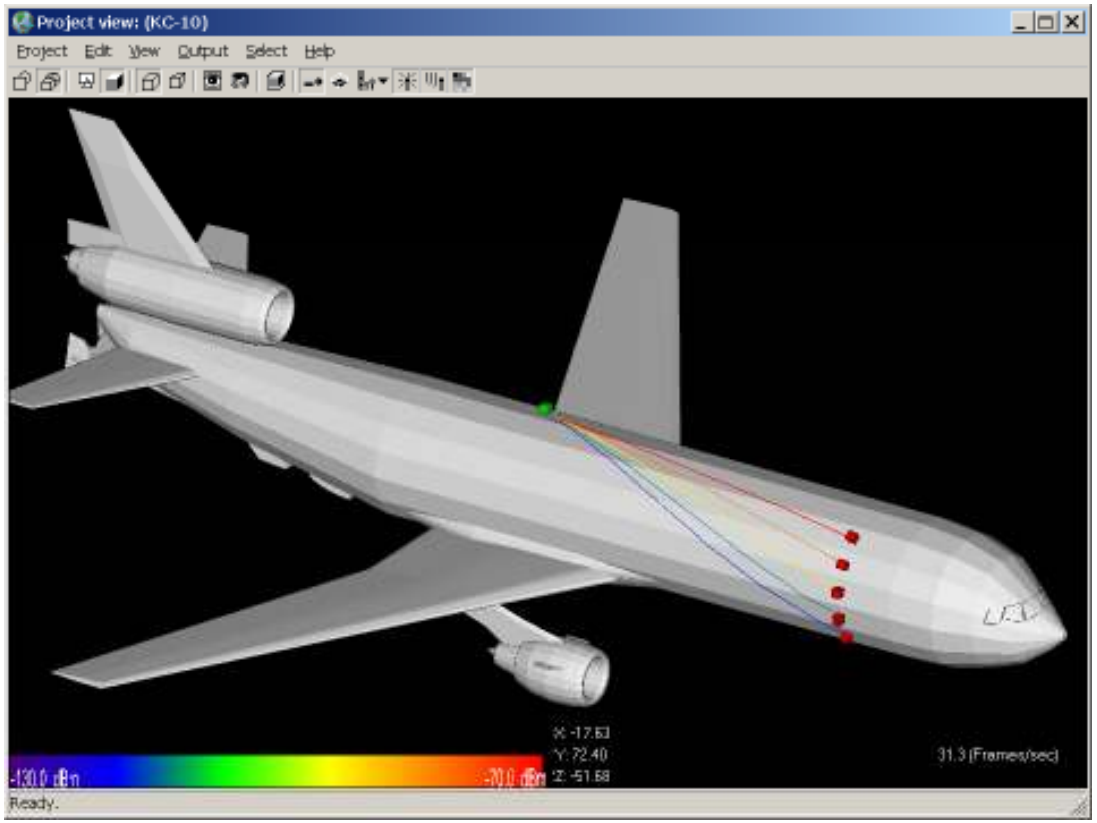
Surface Diffracted Rays "Creeping Waves"

- Construct geodesic rays paths on surfaces and evaluate field strength and polarization



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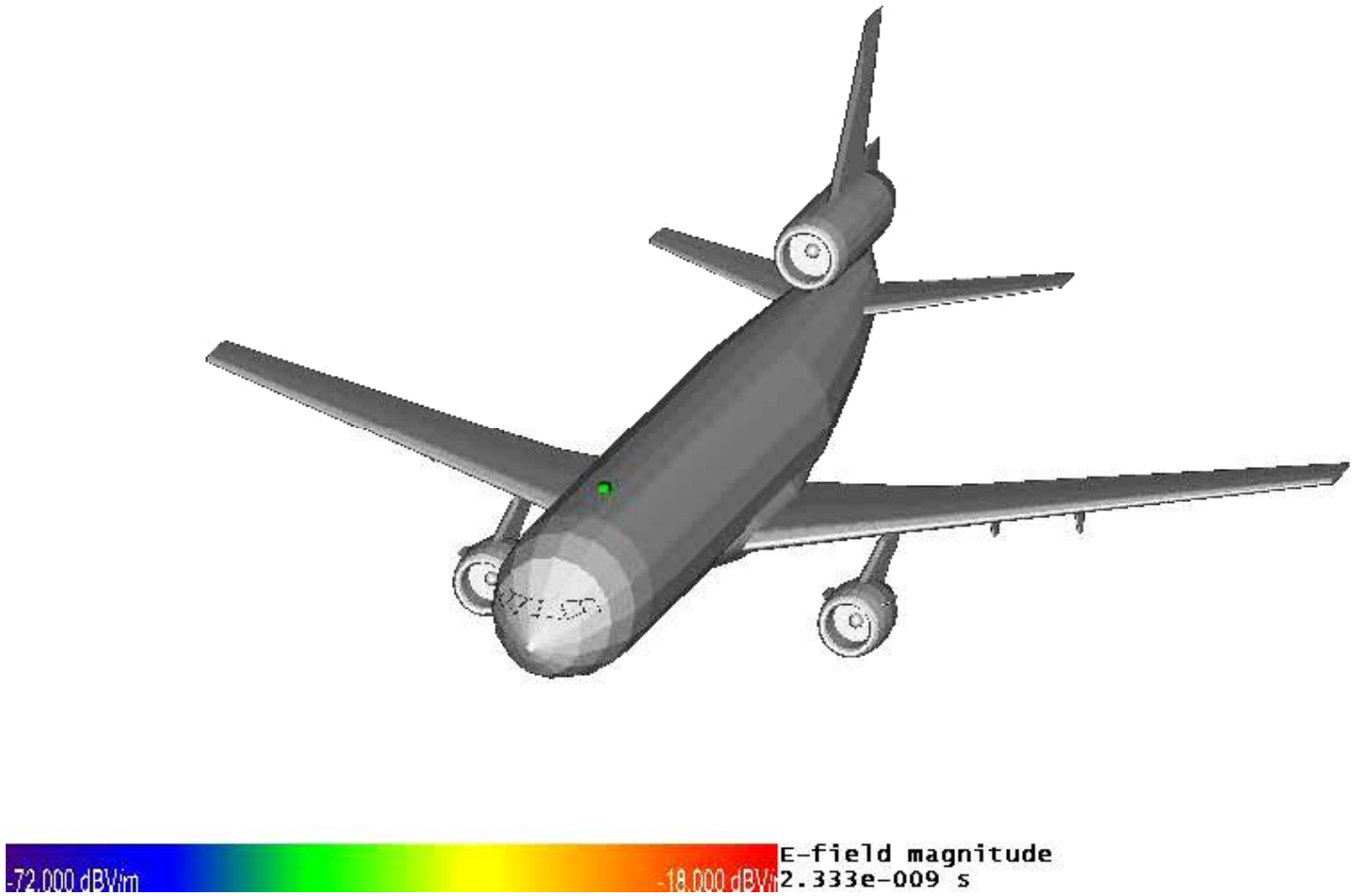
Creeping Waves on a Airplane Fuselage



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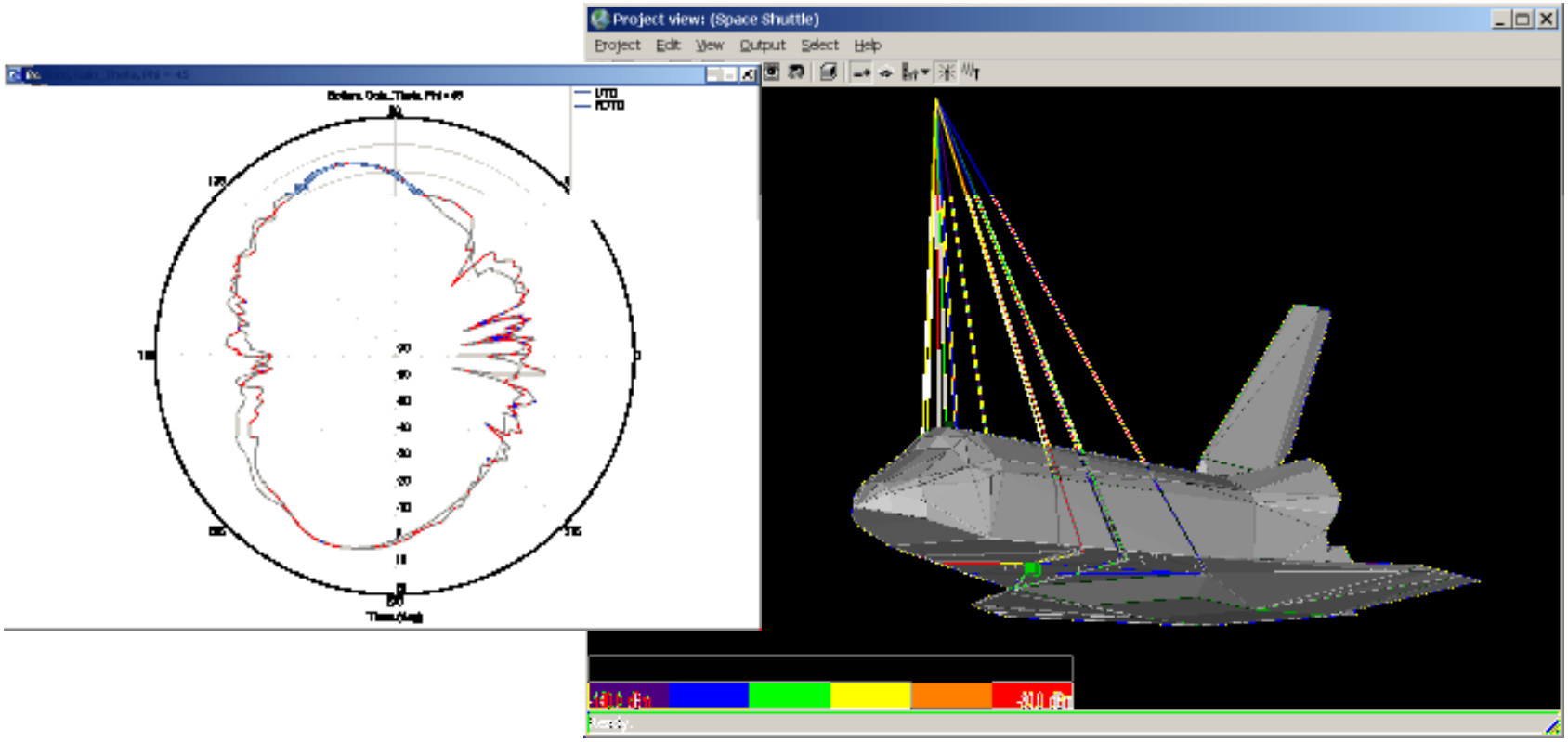
Computing Far Zone Antenna Patterns with XGTD

- XGTD is also capable of computing far zone gain patterns for antennas mounted on or near an aircraft, vehicle or other platform



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XGTD for Anechoic Chamber Analysis (2)

- Specify type of RAM for walls, floor, and objects within the chamber
- Absorber layout editor for placement of regions of different RAM material on desired surfaces
- Simulate propagation inside chamber, including illumination of SUT and effectiveness of absorber to reduce wall reflections

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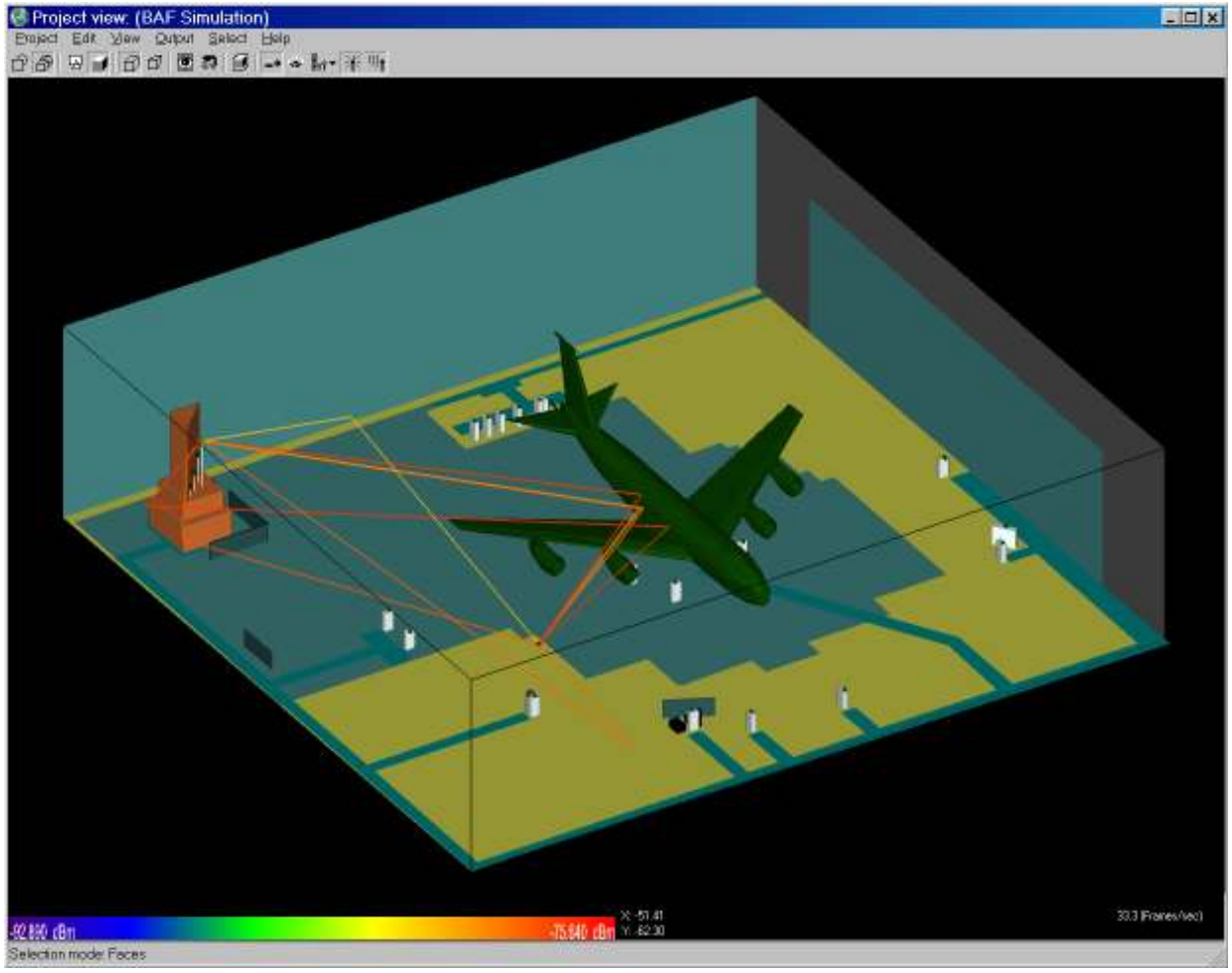
Viewing Ray Paths



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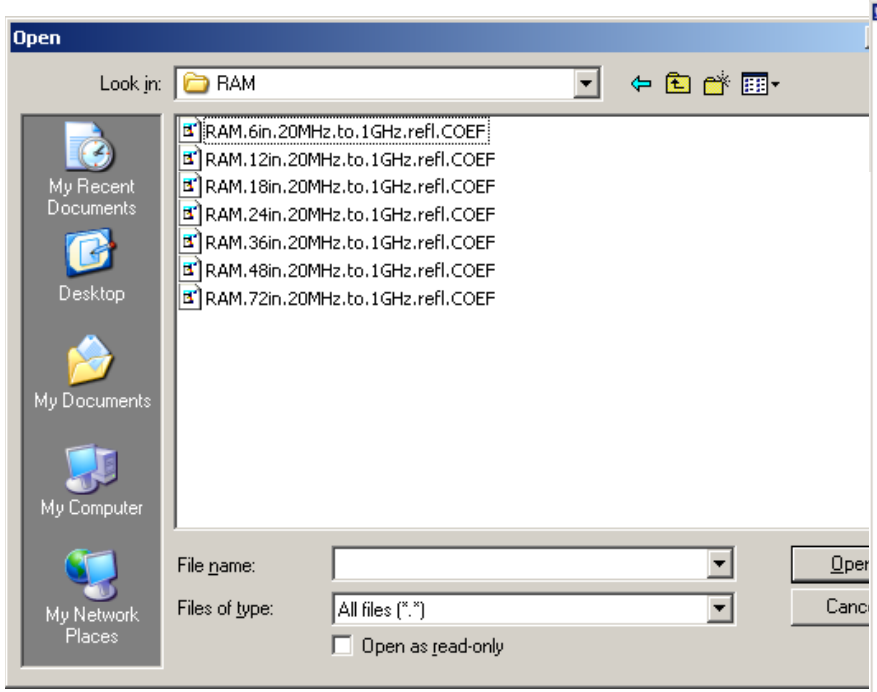
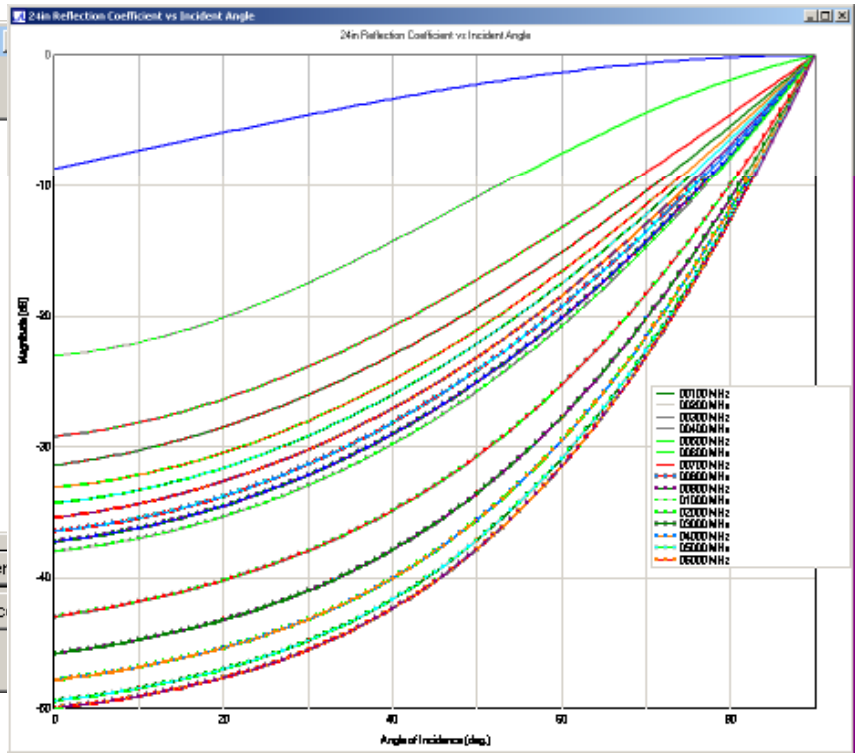
XGTD Absorber Library

- Read complex-valued coefficients files
- Coefficients can depend on polarization, plane of incidence and angle of incidence, and frequency





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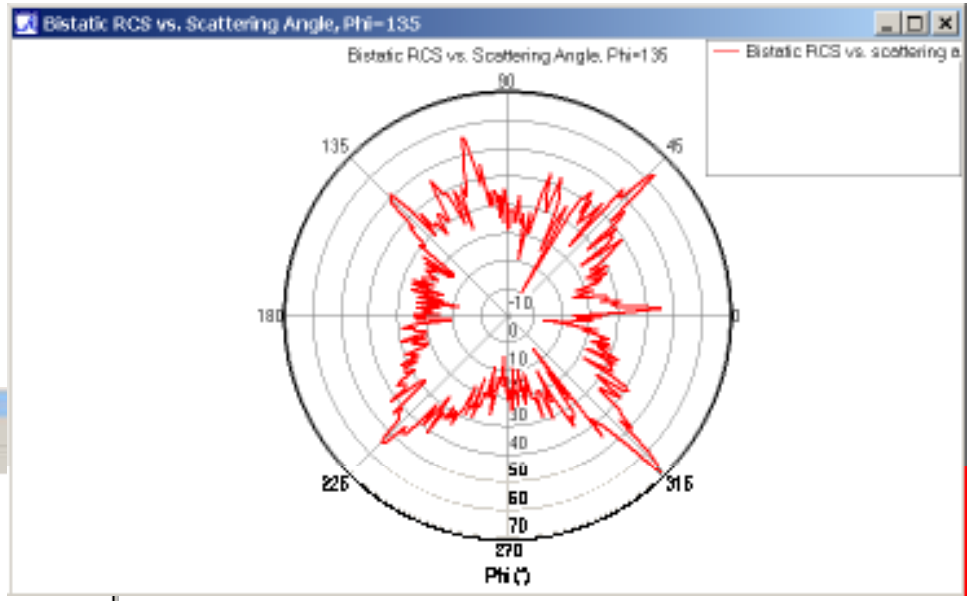
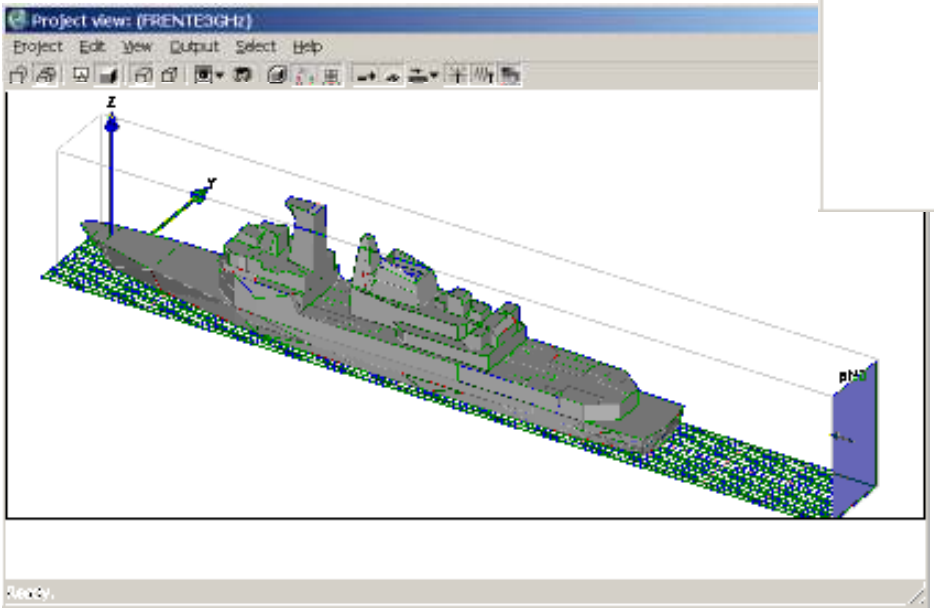
RCS Computations





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Summary of XGTD Capabilities

- XGTD is a general purpose ray-based electromagnetic analysis tool for antenna radiation, antenna coupling, scattering, and EMC applications
- Single and multiple wedge and slope diffraction with modified coefficients for lossy dielectric materials
- Creeping waves on convex PEC surfaces
- Predict far-zone antenna gain patterns and RCS
- Predict interference between antennas
- Geometries may be entered using graphical editors or by importing CAD files
- Runs on Windows 2000/XP operating system

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