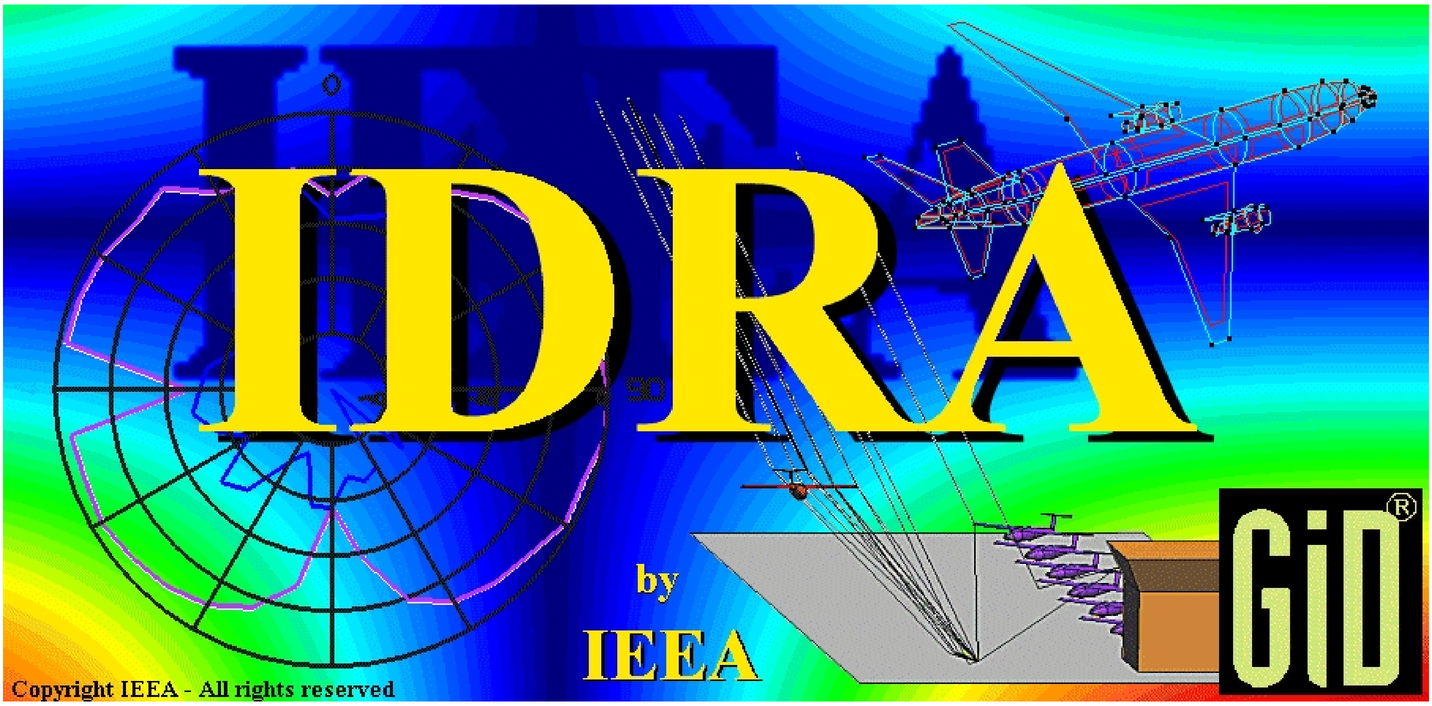
IDRA Help

Content



Introduction

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Installation

System requirements :

IDRA runs only under Windows. It was tested with windows 2000 and windows XP.

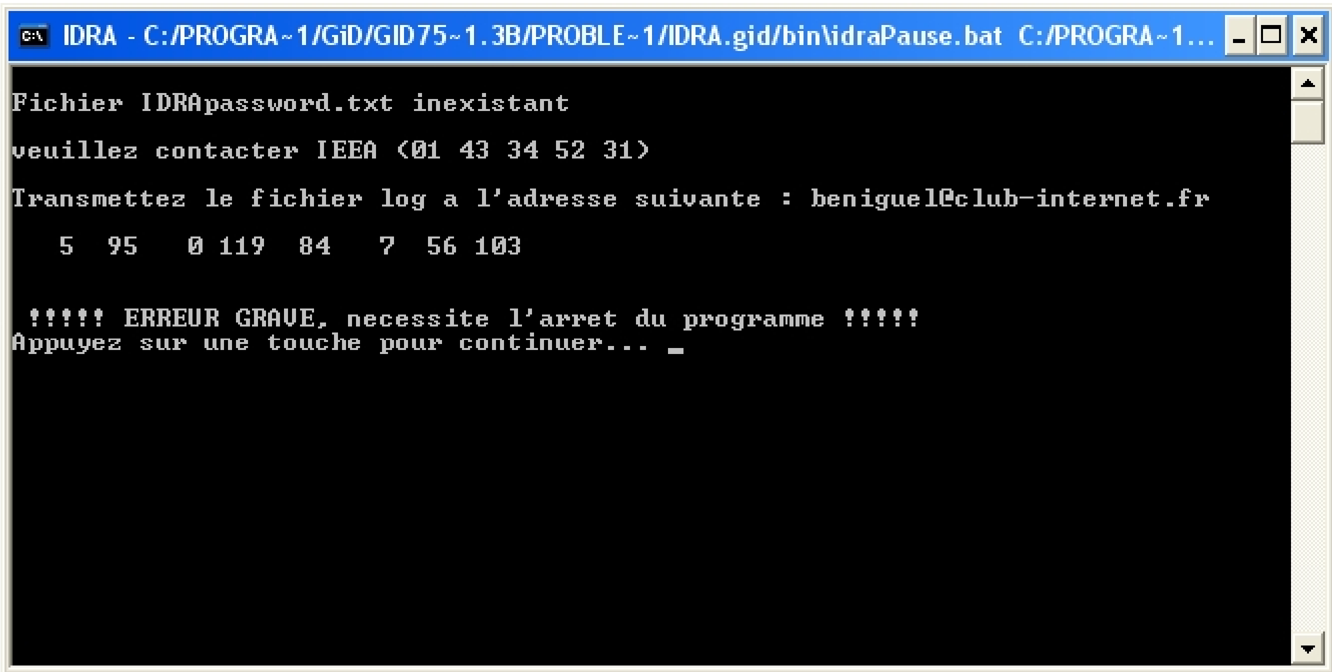
IDRA needs GID 7 or later. It was tested with GID7.5.3b and GID8.0. IDRA may be launch with a unlicensed GID version. However, for visualization purposes, IDRA uses GID mesh capabilities which aren't available in the unlicensed version.

Installation :

The IDRA.gid directory must be placed under the GID problemtypes directory, usually located at :
C:\Program Files\GiD\GiD7.5.3b\problemtypes

Password :

During the first run, IDRA will try to read a file containing a password (IDRApassword.txt). The following message will appear :



To get this file, please [contact IEEA](#). You will have to provide the 8 integers in the error message. They identify your computer. They will be used by IEEA to create the file IDRApassword.txt. This file will only work on the computer which generated the error message.

IDRApassword.txt must be placed in GID working directory (for example : C:\Program Files\GiD\GiD7.5.3b).

UTD Theory

This part will only give basic elements on Uniform Theory of Diffraction (UTD). There is a book found to be particularly useful and comprehensive on the subject of UTD : *Introduction to the Uniform Geometrical Theory of Diffraction*, by McNamara, Pistorius and Malherbe.

Compared with other methods, the UTD has some interesting advantages. It is an efficient tool to understand the phenomenology because the global field results from geometrically localised contributors (rays). In addition, the computational time is reduced. It is frequency independent and enables the method to handle electrically large structures.

IDRA is a electromagnetic computation software based on the UTD. Basically, the software performs a two step steps calculation :

- The first is ray tracing. Most of the computation time is spend during this step. Given a source point S and an observation point P, the software has to find the interaction point Q on the structure element. This step is repeated for each structure element. In addition, a visibility test is performed to exclude rays intercepted by another structure element.

- Once the interaction point is found, information about angles and curvatures are gathered to compute the UTD coefficients and the corresponding electric field. The details of the UTD coefficients will not be explained here. They are directly derived from classical results.

The following simple ray contributions are taken into account in the computation :

- incident ray
- reflected ray
- diffracted from edges or corners
- diffracted from curved surfaces, or also called creeping rays

Higher order contributions are also computed :

- doubly reflected
- doubly diffracted from edges
- reflected and diffracted from edges, or diffracted from edges and then reflected by surfaces, the same with corner diffraction, doubly diffracted
- creeping rays reflected or diffracted

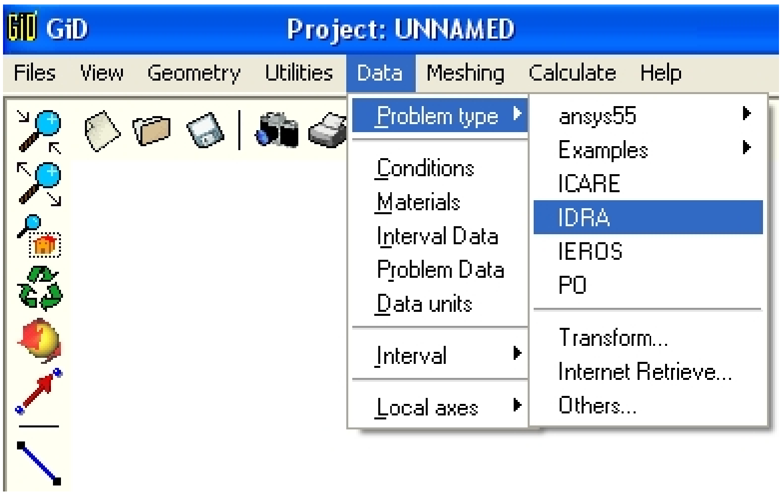
For simple shapes, the ray tracing is straightforward. The Descartes-Snell laws can be directly applied to find the reflection point on a plate surface. The Keller's cone properties are used to compute the position of the diffraction point on a straight edge. The laws are still true for any shape, but they aren't easy to implement on arbitrary geometries. In these cases, a minimization of the ray path is used to satisfy the Fermat's Principle.

In contrary to the integral techniques, UTD is a local method. That's why, the field computation at one point is independent from the other observation points. As a result, the computation time is directly related to the number of observation. In addition, the computation time increases significantly when higher order contributions are taken into account. The computation can be 10 times longer with multiple interactions. Since these rays generally have a lower intensity, it is recommended to launch a first run with only simple contributions.

Getting start

GID must be launched

Select the IDRA problem type as described below :

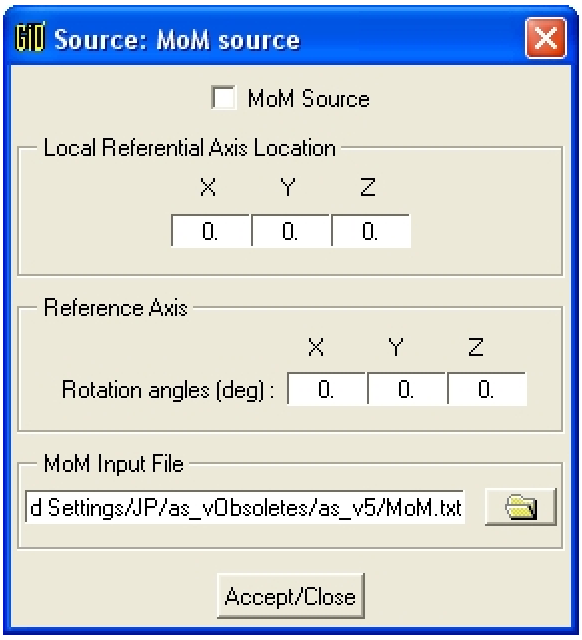


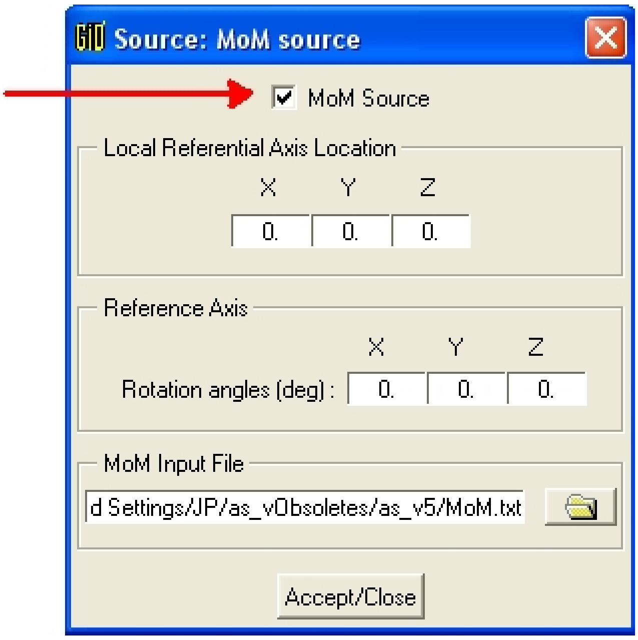
The IDRA tool bar appears :

Each icon in the tool bar will start an IDRA tool or definition window. In the case of a definition window, a check box will be presented on the top of the window. It must be checked to activate the item defined in the window. For example :

NO MoM Source in the computation :

MoM Source in the computation :





If an item is checked, the incompatible items will be unchecked. For example, if the plane wave is activated, the other sources will be unchecked (the source point, the MoM source, the planar array and the conformal array).

What's new

IDRA version 1.6.1 new features :

- Massively icon based user interface
- Creeping/reflected and creeping/diffracted rays added
- UTD coefficients for the radiation from a source on a convex surface
- Source and observation visualisation
- Only one GID project federating the former Calculation and Visualisation projects
- 3D Far field pattern visualisation
- RCS computation (experimental)
- Minor bugs removed

Geometry

[Geometry Creation](#)

[Geometry Selection](#)

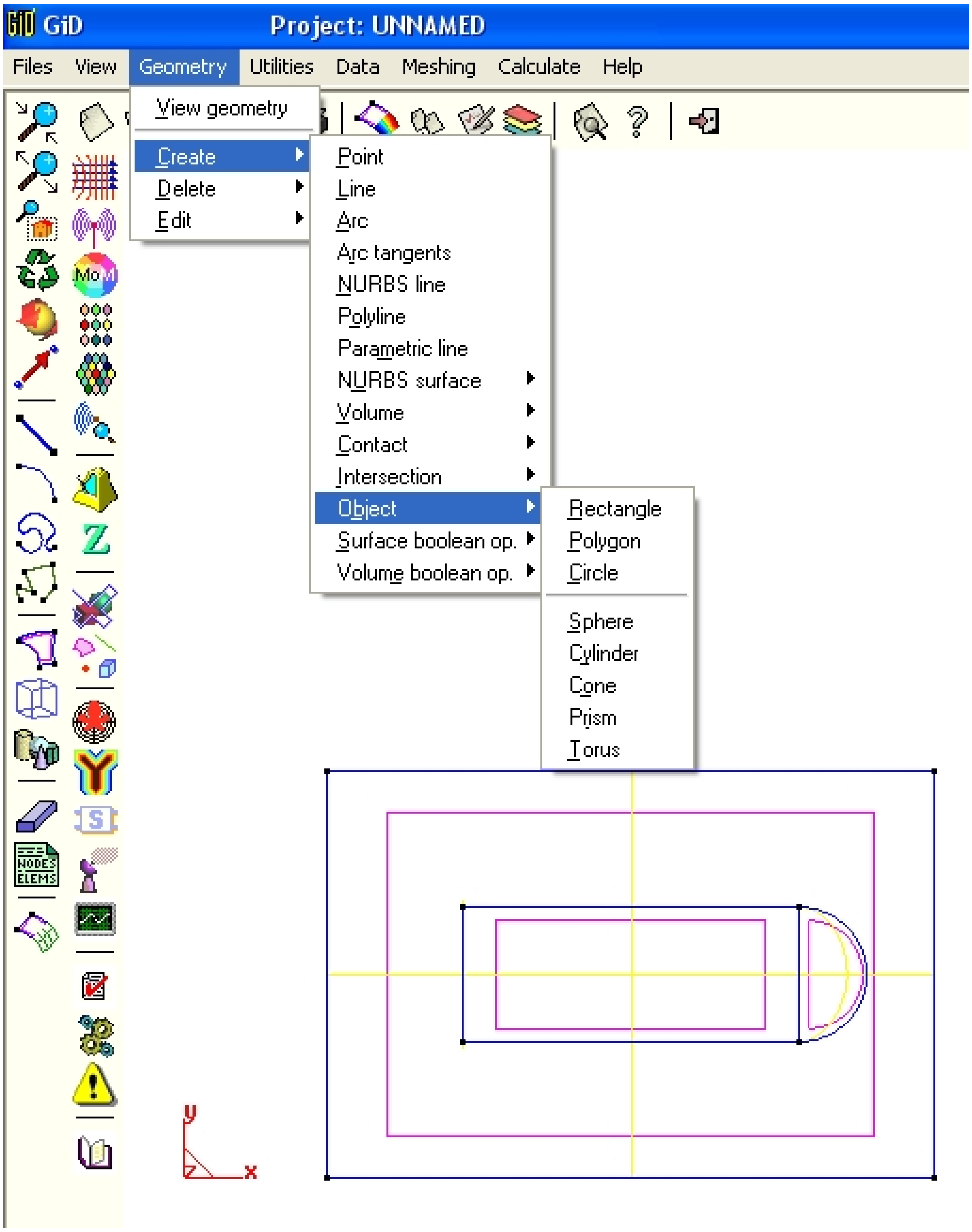
Geometry Creation

GID is a CAD software. It enables the user to create the whole geometry, which will be treated by IDRA.

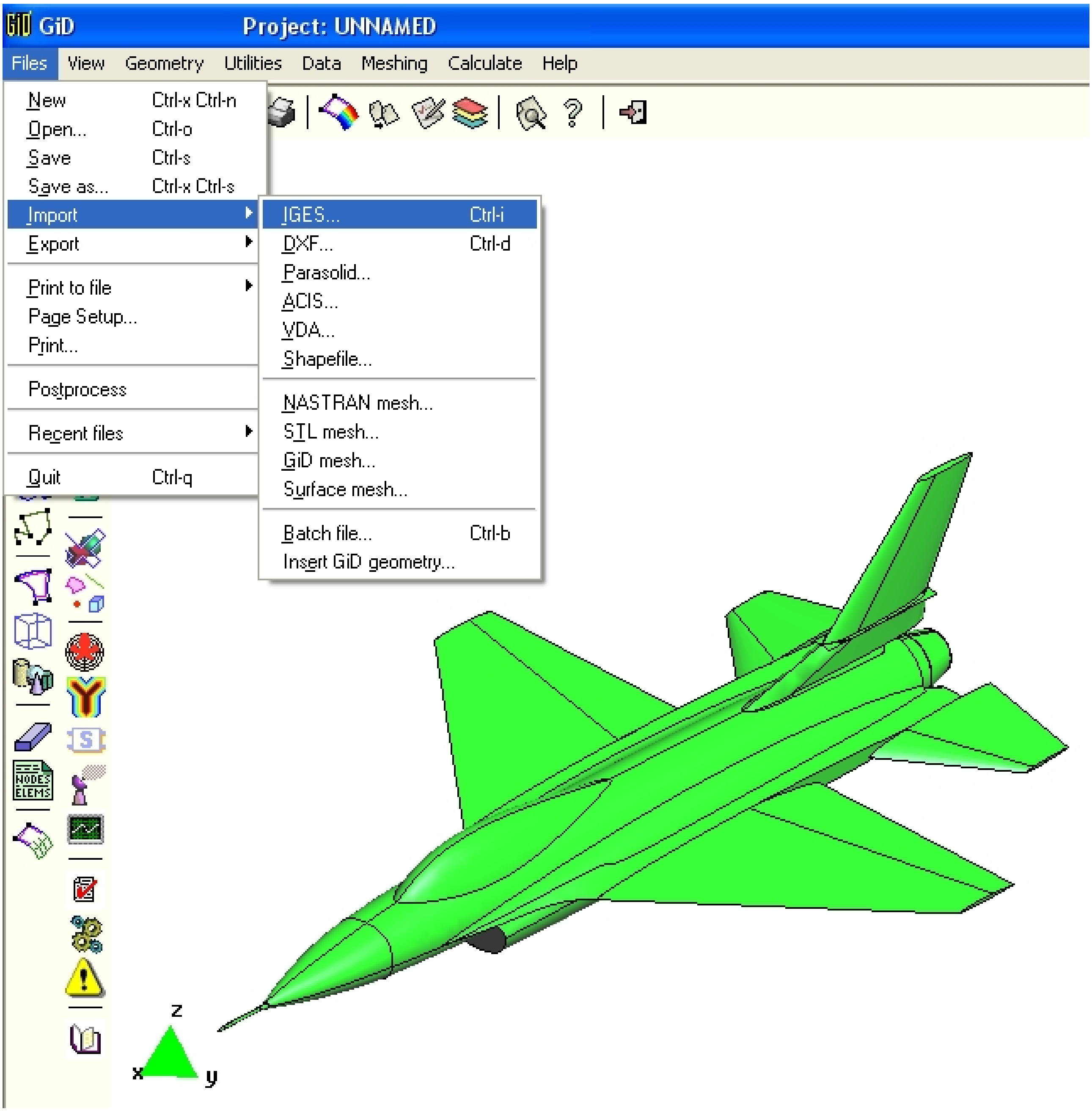
GID can also import most of common CAD formats.

Please use the GID help and examples.

A very simple example of geometry designed directly with GID :



A more complex example imported from the IGES format (GiD render is on) :



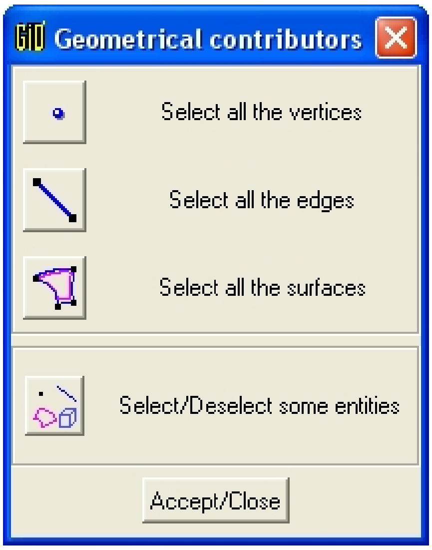
Geometry Selection

 open the geometry selection window

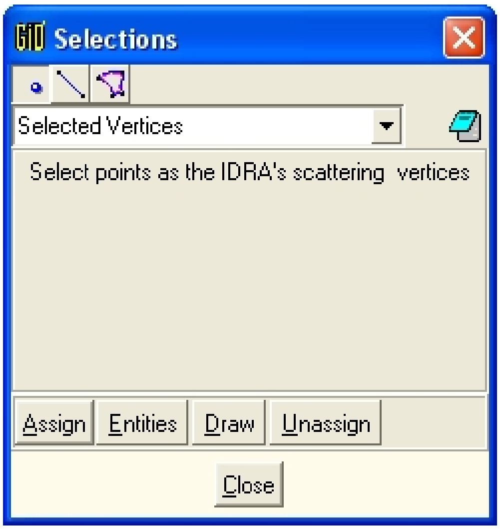
Once the geometry is created or imported, the user must define which parts of the geometry will be taken into account during the computation. This functionality has 2 aims :

- in case of huge geometries, the computation time can be decreased by ignoring parts of the geometry which would probably not interact with the source (inside parts, deep shadow parts,...)
- for physical insight into scattering process.

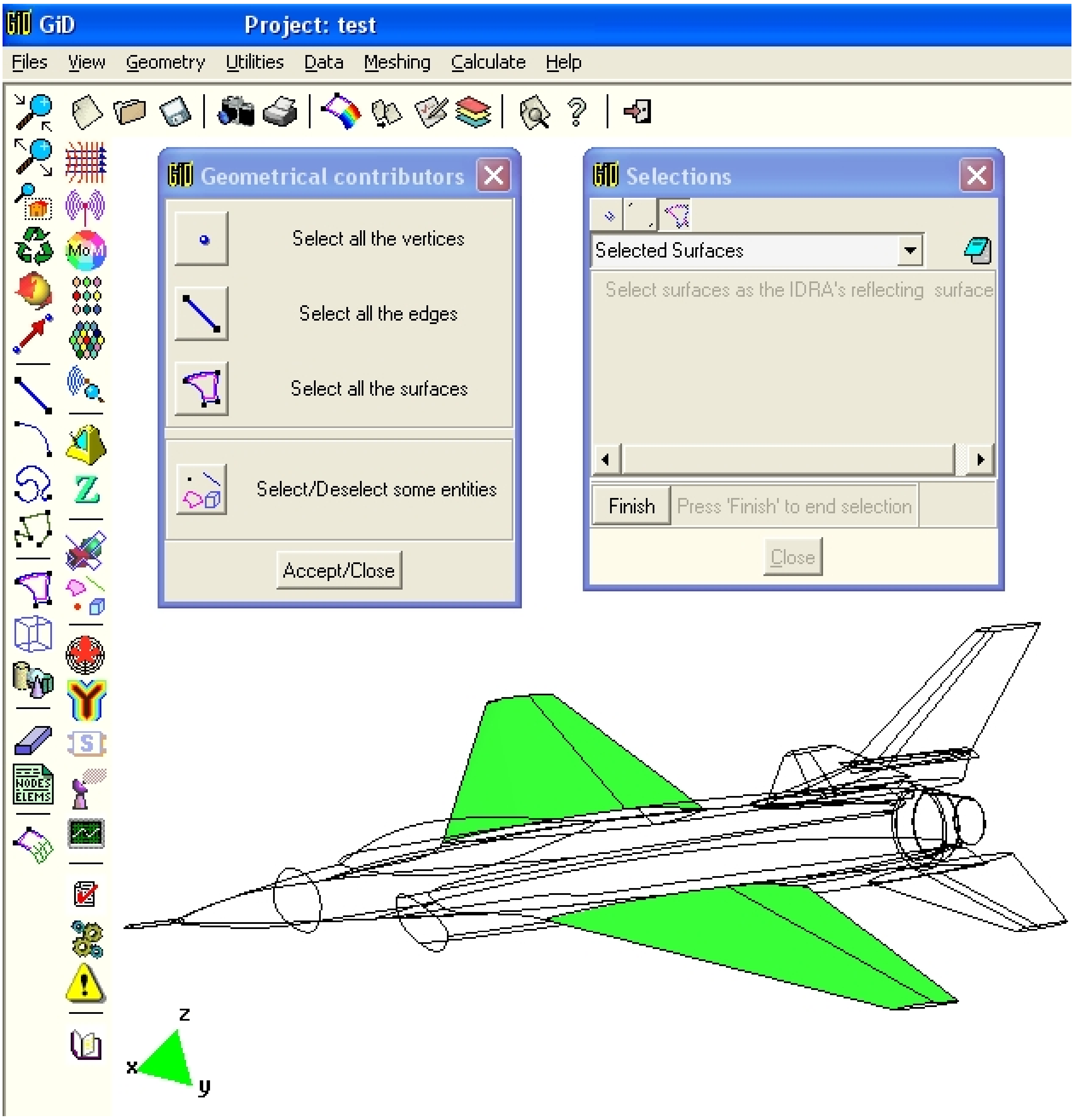
The whole geometry may be selected with the 3 buttons : *Select all the vertices, Select all the edges, Select all the surfaces*



The button *Select/Deselect some entities* open a special window which enables the user to assign/unassign single geometrical parts to the selection.



The *Draw* utility gives an easy graphical check of the selection. In the following example, only the surfaces representing the wings were selected :


GiD Project: test
Files View Geometry Utilities Data Meshing Calculate Help
Geometrical contributors
Select all the vertices
Select all the edges
Select all the surfaces
Select/Deselect some entities
Accept/Close
Selections
Selected Surfaces
Select surfaces as the IDRA's reflecting surface
Finish
Press 'Finish' to end selection
Close
z
x
y

Source Description

[Plane Wave]

[Source Point]

[MoM Source]

[Planar Array]

[Conformal Array]

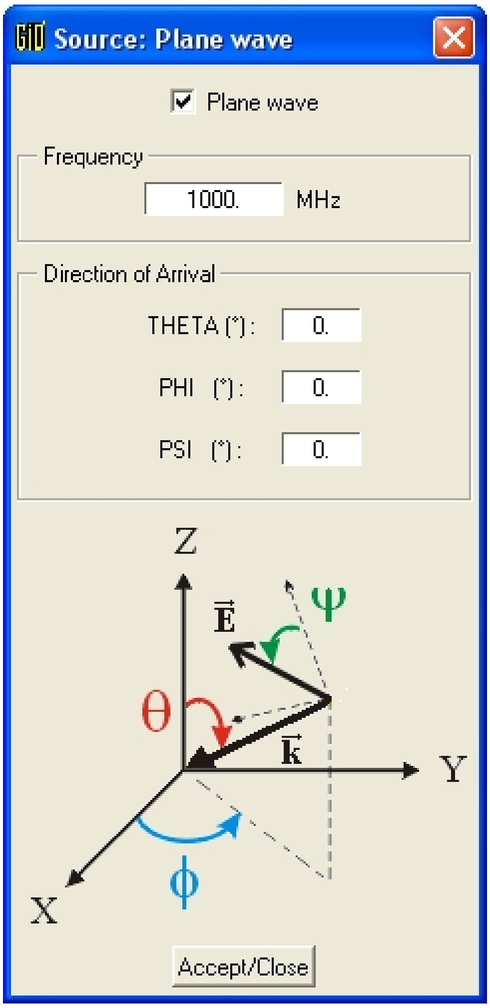
Plane Wave

open the plane wave definition window

4 parameters are required to define a plane wave :

- the frequency of the plane wave
- 2 angles to define the direction of incidence
- 1 angle to define the polarisation of the electric field

A picture is displayed in order to define the angular parameters.



Source Point

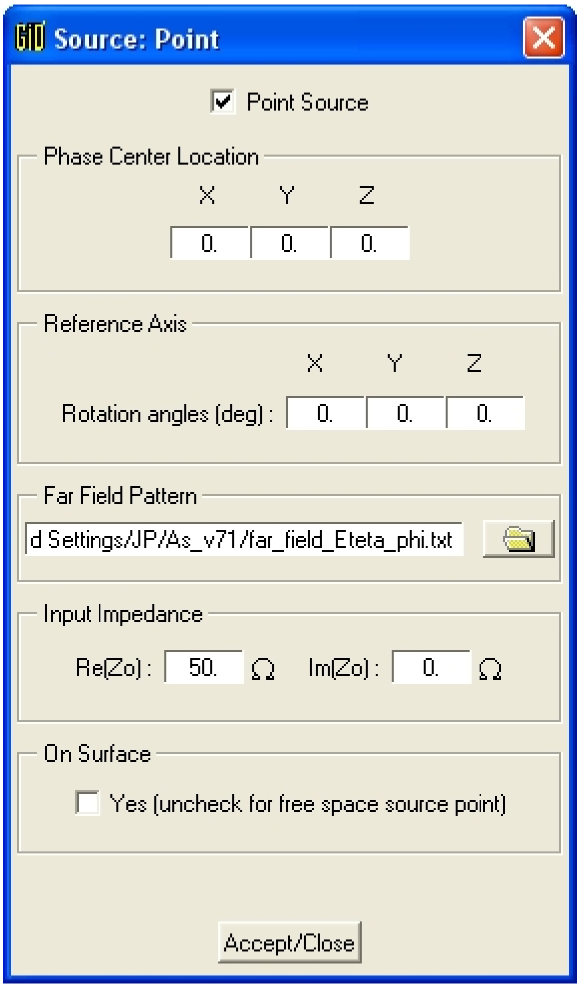
 open the source point definition window

The source point location is defined with its three coordinates (X,Y,Z). For a real antenna, the source point location is the position of the phase center.

This far field pattern may be moved with 3 rotation angles (around axis X, Y and Z).

In the case of coupling computation, the input impedance of the source is required.

If the source must be close to a surface, the *On Surface* button must be checked. In that case, the software will try to find the nearest surface.



The free space far field pattern of the point source is described in a file. The format of this file is the same as the output format of IDRA. This file may be generated by another software, or it may build from measurements.

Example (there is only the beginning of the file) :

```
 1.0300000E+09
-180.0000     180.0000     2.000000
0.0000000E+00   135.0000     45.00000
      LOCATION            ETHETA              EPHI          gain in dB        POLARISATION
   THETA      PHI     magn.     phase      magn.     phase      vert.     horiz.     total   axial r.     angle   direction
-0.1800E+03 0.0000E+00 0.9555E-01 -0.1377E+03 0.0000E+00 0.0000E+00  0.4167E-06 -0.2000E+03  0.0000E+00 0.0000E+00 0.1137E-05   LINEAR
-0.1780E+03 0.0000E+00 0.9549E-01 -0.1377E+03 0.0000E+00 0.0000E+00 -0.5292E-02 -0.2000E+03 -0.5293E-02 0.0000E+00 0.1754E-05   LINEAR
-0.1760E+03 0.0000E+00 0.9531E-01 -0.1377E+03 0.0000E+00 0.0000E+00 -0.2118E-01 -0.2000E+03 -0.2118E-01 0.0000E+00 0.1816E-05   LINEAR
-0.1740E+03 0.0000E+00 0.9502E-01 -0.1377E+03 0.0000E+00 0.0000E+00 -0.4771E-01 -0.2000E+03 -0.4771E-01 0.0000E+00 0.1518E-05   LINEAR
-0.1720E+03 0.0000E+00 0.9462E-01 -0.1377E+03 0.0000E+00 0.0000E+00 -0.8494E-01 -0.2000E+03 -0.8494E-01 0.0000E+00 0.2609E-05   LINEAR
```

In fact, IDRA doesn't read the entire file. The following items are required :

- Operating frequency
- min max step (degrees)
- min max step (degrees)
- 2 lines of comments (may be left blank)
- For each direction of observation present in the file, IDRA will only read the first 6 columns. The amplitude (Volts) and the phase (degrees) are required.

Remarks :

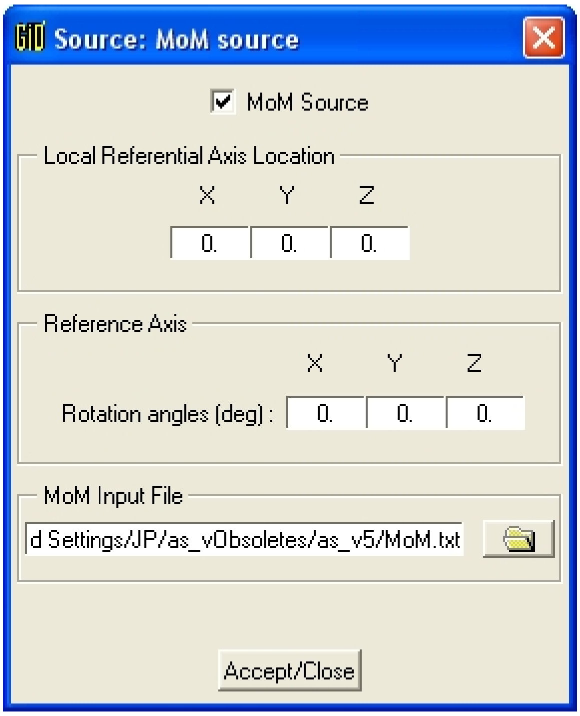
- -180° Ò   Ò 180°
- 0° Ò   Ò 180°
- The theta loop is inside the phi loop
- The phase reference used to compute the input file must be located at the phase center of the antenna.

MoM Source

open the MoM distribution definition window

MoM current distribution is a cloud of dipoles. They are the result of a MoM computation and represent the current distribution on a structure (for example on an antenna). This ability is particularly useful if the phase center can not be defined.

The cloud of dipoles is defined in a local referential. This local referential may be translated in the referential of the geometry. It may also be rotated around the 3 axis.



The format of input file is as following (output format of the MoM software ICARE) :

- 1st line : operating frequency
- 2nd line : number of dipoles
- 1 line for each dipole :
    - column 1 : id of the dipole (isn't used by IDRA)
    - column 2 to 4 : coordinates of the dipole in the local referential
    - column 5 to 10 : complex current vector. Each component of the complex vector is represented by its real part and its imaginary part.

Example of MoM input file simulating a $\lambda/2$ dipole antenna along the x axis :

1.0300000E+09

10

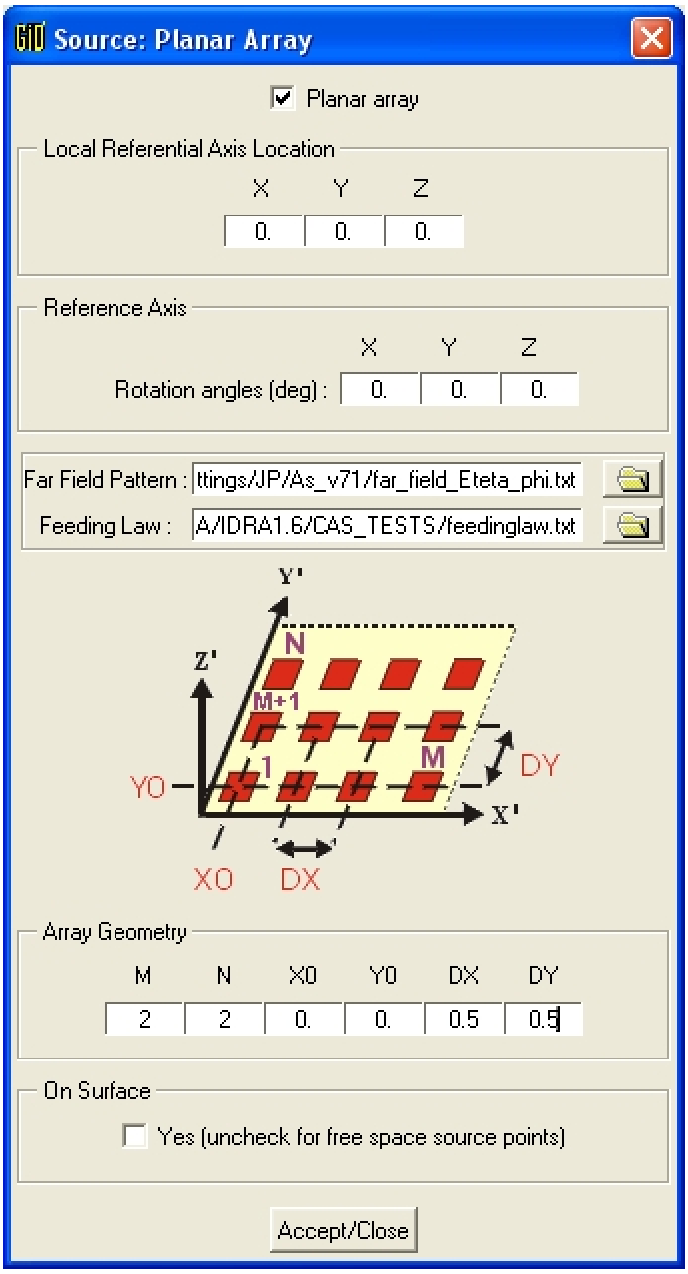
82	-0.675000E-01	0.000000E+00	0.000000E+00	0.178380E-04	-0.197221E-04	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
80	-0.525000E-01	0.000000E+00	0.000000E+00	0.492213E-04	-0.531024E-04	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
78	-0.375000E-01	0.000000E+00	0.000000E+00	0.733138E-04	-0.759158E-04	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
77	-0.225000E-01	0.000000E+00	0.000000E+00	0.905417E-04	-0.871863E-04	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
79	-0.750000E-02	0.000000E+00	0.000000E+00	0.994984E-04	-0.985864E-04	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
81	0.750000E-02	0.000000E+00	0.000000E+00	0.994563E-04	-0.109113E-03	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
83	0.225000E-01	0.000000E+00	0.000000E+00	0.904261E-04	-0.105175E-03	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
85	0.375000E-01	0.000000E+00	0.000000E+00	0.731562E-04	-0.888763E-04	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
86	0.525000E-01	0.000000E+00	0.000000E+00	0.490709E-04	-0.617038E-04	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00
87	0.675000E-01	0.000000E+00	0.000000E+00	0.177718E-04	-0.228252E-04	0.000000E+00	0.000000E+00	0.000000E+00	0.000000E+00

Planar Array

open the planar array definition window

A planar array is a grid of source points. The grid is defined in a local referential. This local referential may be translated in the referential of the geometry. It may also be rotated around the 3 axis.

If the source points must be close to a surface, the *On Surface* button must be checked. In that case, the software will try to find the nearest surface for each source point.



All the source points have the same radiation pattern. The details of the far field description may be found here.

The amplitude and the phase of each source point may be modified. This is done with the feeding law file. This file contains 1 line per source point. Each line contains :

- a number (ignored by IDRA)
- amplitude factor (absolute value, not in dB)
- phase (degrees)

Concerning the order of the source points, the X loop is inside the Y loop. The figure in the definition window shows where is the M+1 point.

There is a very simple example of feeding law file (all the sources are synchronized):

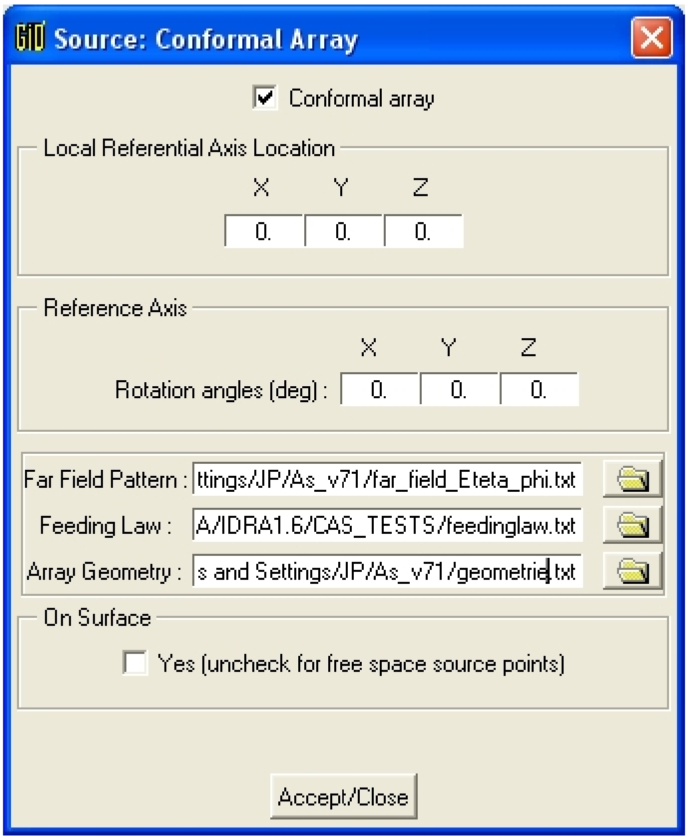
```
1      1.     0.
2      1.     0.
3      1.     0.
4      1.     0.
```

Conformal Array

 open the conformal array definition window

A conformal array is a cloud of source points. The cloud of source points is defined in a local referential. This local referential may be translated in the referential of the geometry. It may also be rotated around the 3 axis.

If the source points must be close to a surface, the *On Surface* button must be checked. In that case, the software will try to find the nearest surface for each source point.



All the source points have the same radiation pattern. The details of the far field description may be found here.

The position and the orientation of the source points are defined in the array geometry file. This file contains 1 line per source point. Each line contains :

- a number (ignored by IDRA)
- 3 coordinates of the source point (X, Y, Z)
- 3 rotation angles (degrees) around the three axis (X, Y, Z)

There is a very simple example of array geometry file (all the sources are aligned along the X axis and there is no rotation) :

```
1      0.     0.     0.     0.     0.     0.
2      1.     0.     0.     0.     0.     0.
3      2.     0.     0.     0.     0.     0.
4      3.     0.     0.     0.     0.     0.
```

The amplitude and the phase of each source point may be modified. This is done with the feeding law file. This file contains 1 line per source point. The order of these lines must be the same than the order in the array geometry file. Each line contains :

- a number (ignored by IDRA)
- amplitude factor (absolute value, not in dB)
- phase (degrees)

There is a very simple example of feeding law file (all the sources are synchronized) :

```
1     1.    0.
2     1.    0.
3     1.    0.
4     1.    0.
```

Electromagnetic Properties

[Frequency Range](#)

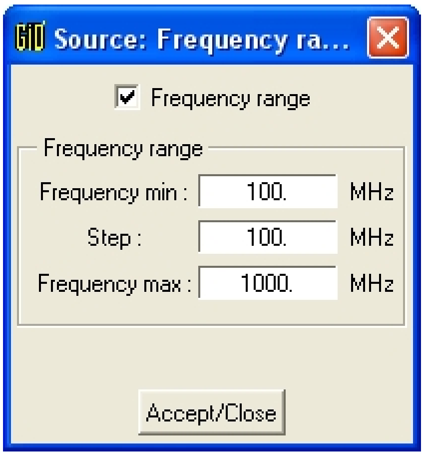
[Dielectric Materials](#)

[Contributions](#)

Frequency Range

open the frequency range definition window

All the IDRA sources (plane wave, source point, MoM source, planar array and conformal array) include a frequency definition (directly in the definition window or in a far field file or a MoM distribution file). That's why, no more information about frequency is required. However, it is possible to launch a computation over a frequency range. In that case, all the frequency information in the source definition will be ignored. This option must be used carefully : the far field pattern and the MoM distribution are assumed frequency independent, but this assumption cannot be true over a wide frequency range.



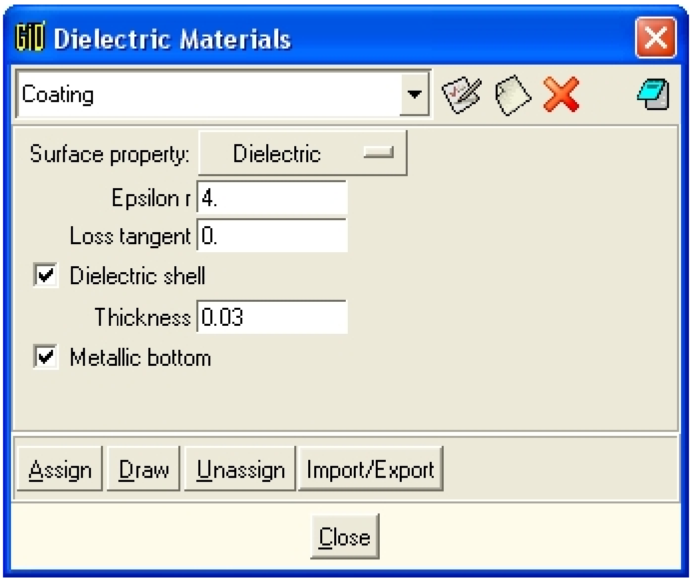
Dielectric Materials

open the dielectric materials definition window

The default material for the whole geometry is a perfect conductor (metal). However, it is possible to assign dielectric properties to surfaces. There are 2 ways to define a dielectric material :

- with a dielectric layer
- with a surface impedance

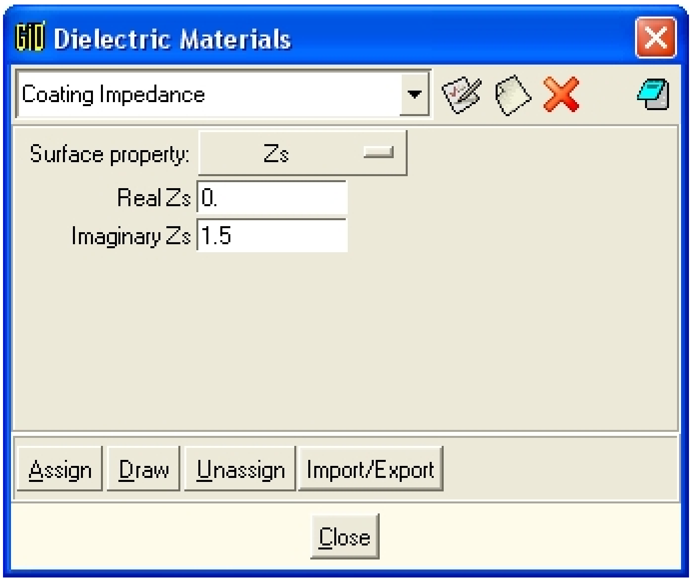
In the case of a dielectric layer, the relative permittivity (εr and loss tangent) is required. If the layer is not infinite, the *Dielectric shell* button must be checked. In that case, the thickness of the layer is required. In addition, the finite layer may have a metallic bottom.



A surface impedance is simply given by its real part and its imaginary part. The normalized surface impedance is required. In other words, the actual surface impedance must be divided by the vacuum impedance (about 377 ohms). The following example is equivalent to the previous one, if the frequency is 1 GHz. In the case of a thin coating over a metallic surface, the surface impedance (not normalized) is given by :

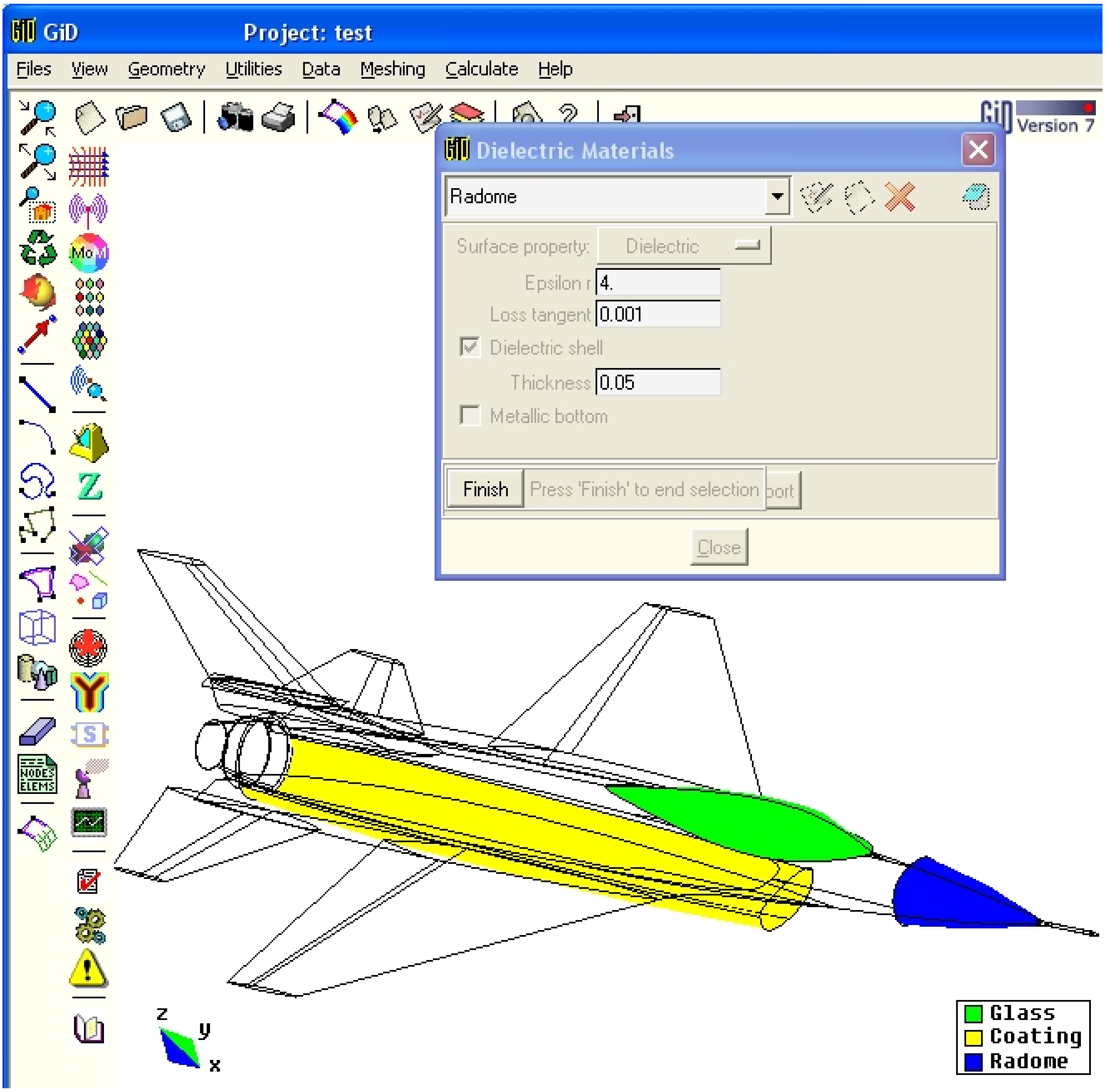
$$Z = j\sqrt{\frac{\mu}{\varepsilon}}\tan(d\omega\sqrt{\mu\varepsilon})$$

where j=sqrt(-1), $\omega=2\pi$*frequency and d is the thickness of the coating.



There are basic materials in the initial list. They contain approximate values. In addition, these values may be frequency dependent. It is possible to add new materials with the function *new dielectric material* . The new material will be only saved in the current project. Similarly, the modification of existing material will be saved only in the current project. It is also possible to import the materials from other projects with the function *Import/Export*. If this function is applied to the IDRA.mat file (default file for new projects) in the IDRA.gid project, it can also export the new materials to the default list.

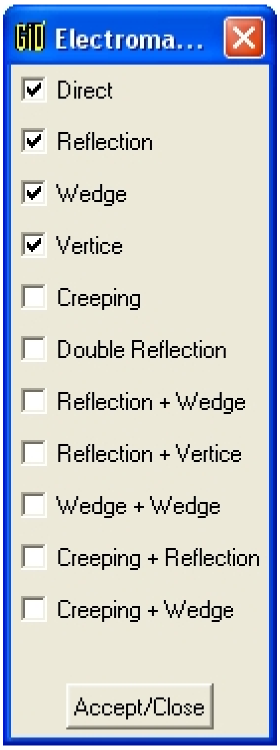
The *Draw* utility gives an easy graphical check of the assigned materials :



Contributions

 open the electromagnetic contributions selection window

As presented in the UTD Theory part, the computed electric field is the summation of elementary contributions. It is possible to select what kind of rays will be taken into account during the computation. The presented list of rays generally corresponds to the following order : from the higher energy to the lowest. However, this hierarchy may depend on the source location, on the geometry and on the observation location.



The computation time increases significantly when higher order contributions are taken into account. The computation can be 10 times longer with multiple interactions. Since these rays generally have a lower intensity, it is recommended to launch a first run with only simple contributions.

In addition, this functionality provides a good physical insight into scattering process.

Observation Description

[Far Field](#)

[Near Field](#)

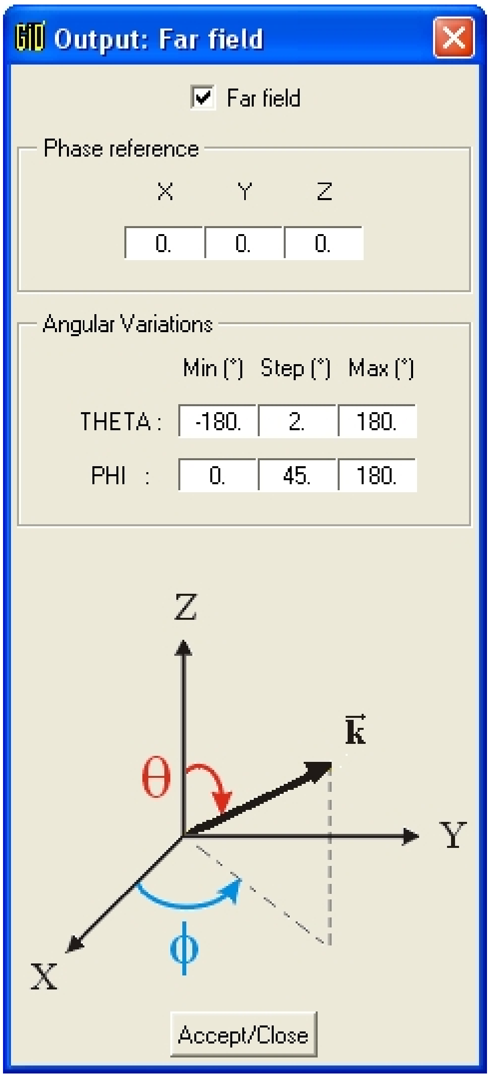
[Coupling](#)

[Radar Cross Section](#)

Far Field

open the far field definition window

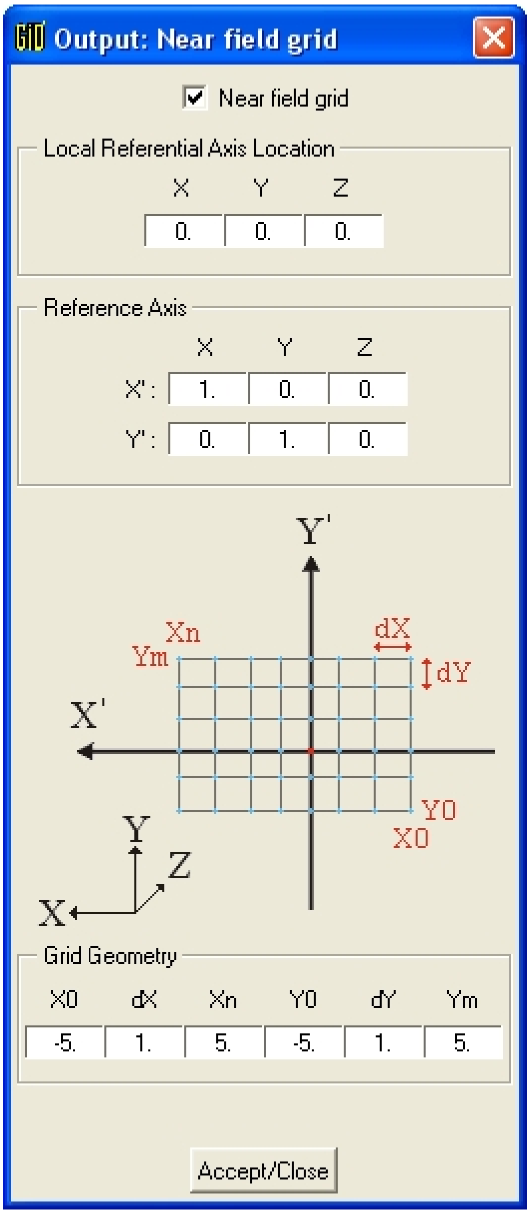
The directions of observation are defined with the angles θ and ϕ. A picture shows the definition of those angles. The phase reference is defined with its coordinates (X, Y, Z). This reference only affects the phase of the far field. The amplitude radiation pattern isn't affected.



Near Field

open the near field definition window

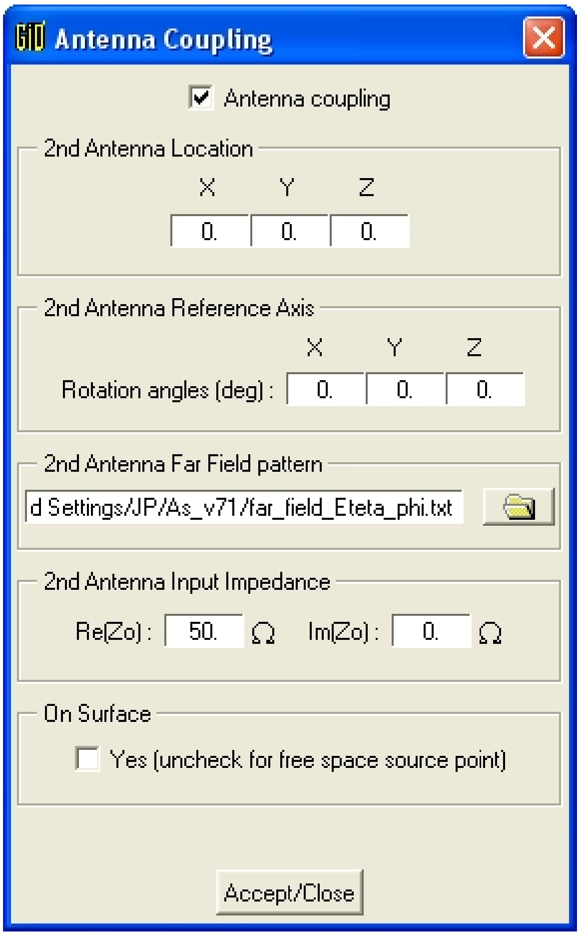
The near field window defines a grid of observation points. This grid may be translated. In addition, the axis of this grid may be modified. These axis don't need to be orthogonal.



Coupling

open the coupling definition window

This window defines a second source point. In that case, the input impedance is required for both source points. The output will be the S parameters between the first and the second source points.

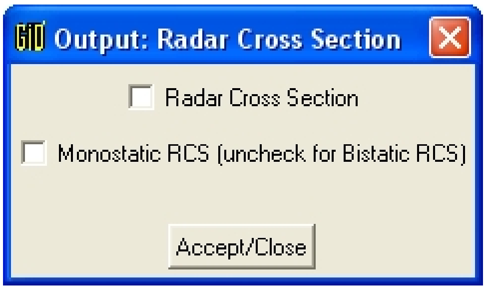


Radar Cross Section

 open the radar cross section definition window

The radar cross section (RCS) computation is still under development in IDRA. Please contact IEEA for more information.

In a RCS computation case, the source is a plane wave and the observation is far field. Many caustics may occur in such a configuration.



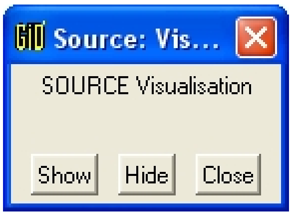
Input Visualisation

 Source Visualisation

 Observation Visualisation

Source Visualisation

 open the source visualisation utility



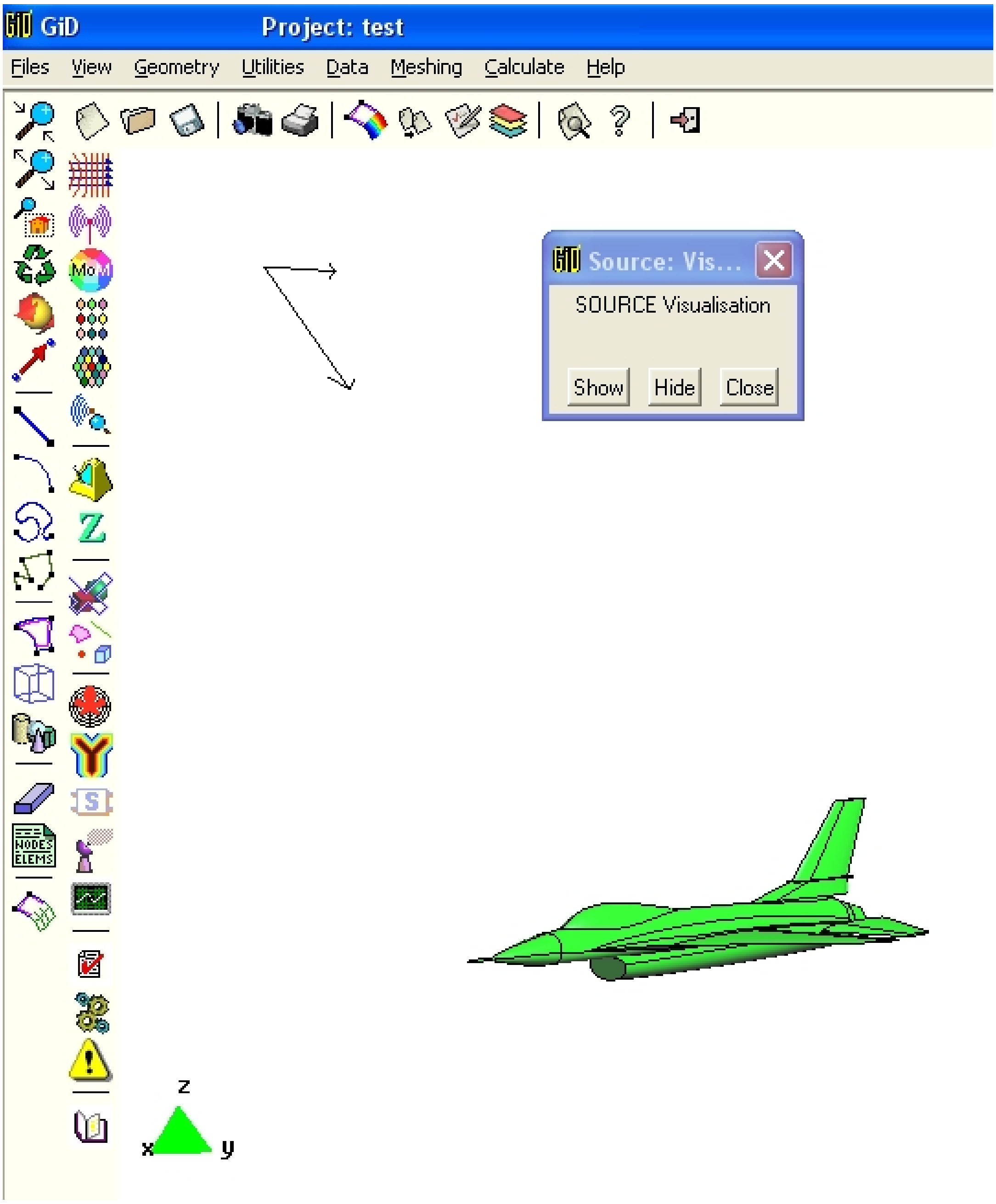
Show : show the source

Hide : hide the source

Close : hide the source and close the utility

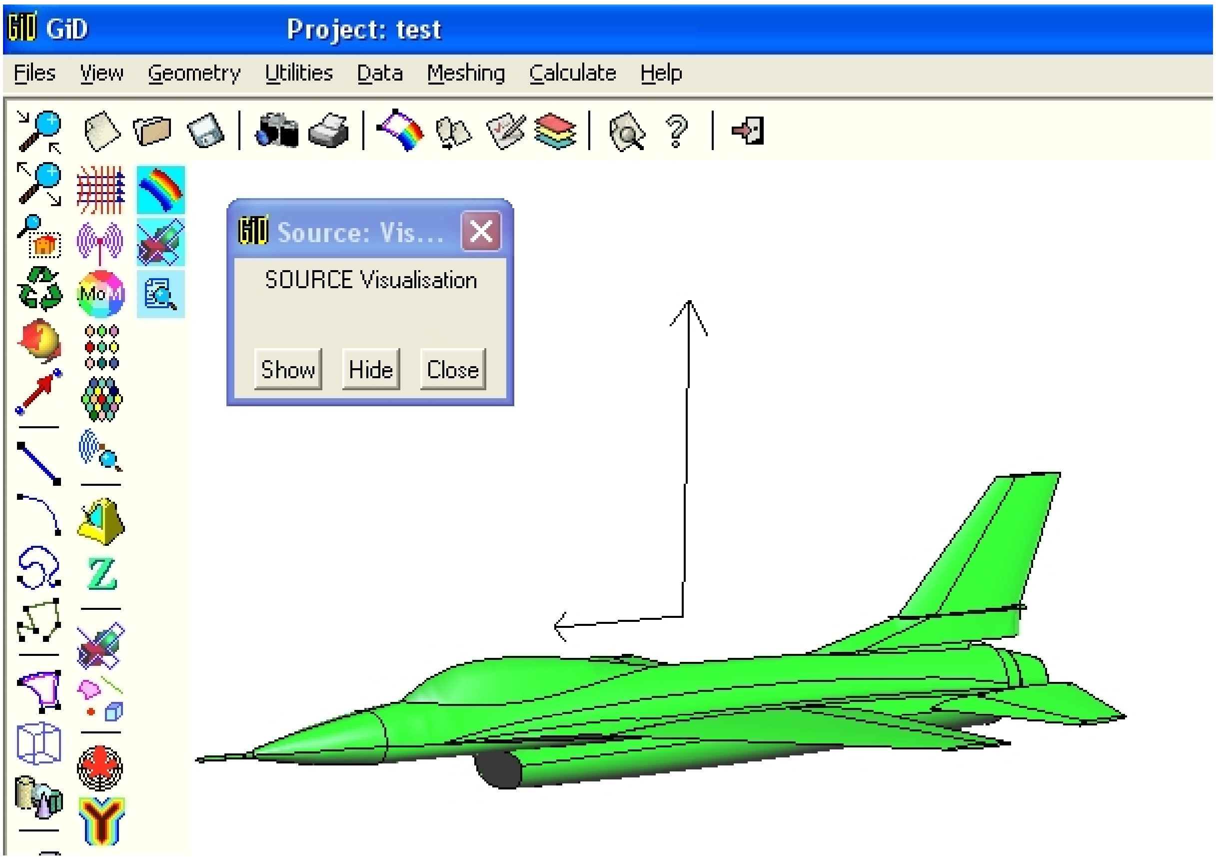
Plane wave :

If the source is a plane wave, it will be represented by 2 arrows. The long one represents the the direction of incidence. The short one represents the polarisation of the electric field.

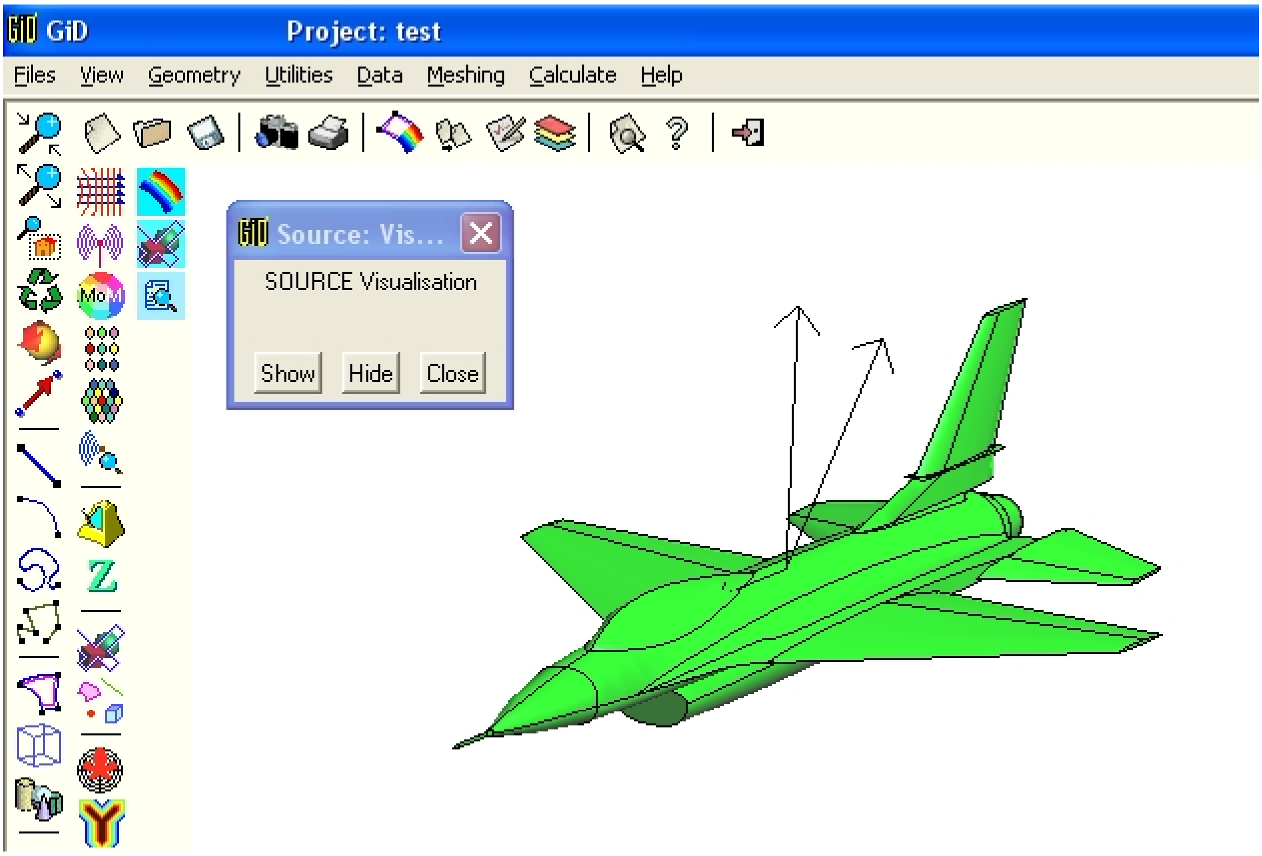


Source point :

If the source is a source point, it will be represented by 2 arrows. If the source is an array of source points, each element will be represented by a couple of arrows. These arrows start at the source point location. The long one represents the initial axis for the theta angle. The short one represents the initial axis for the phi angle. In other words, these arrows show how the radiation pattern is oriented :

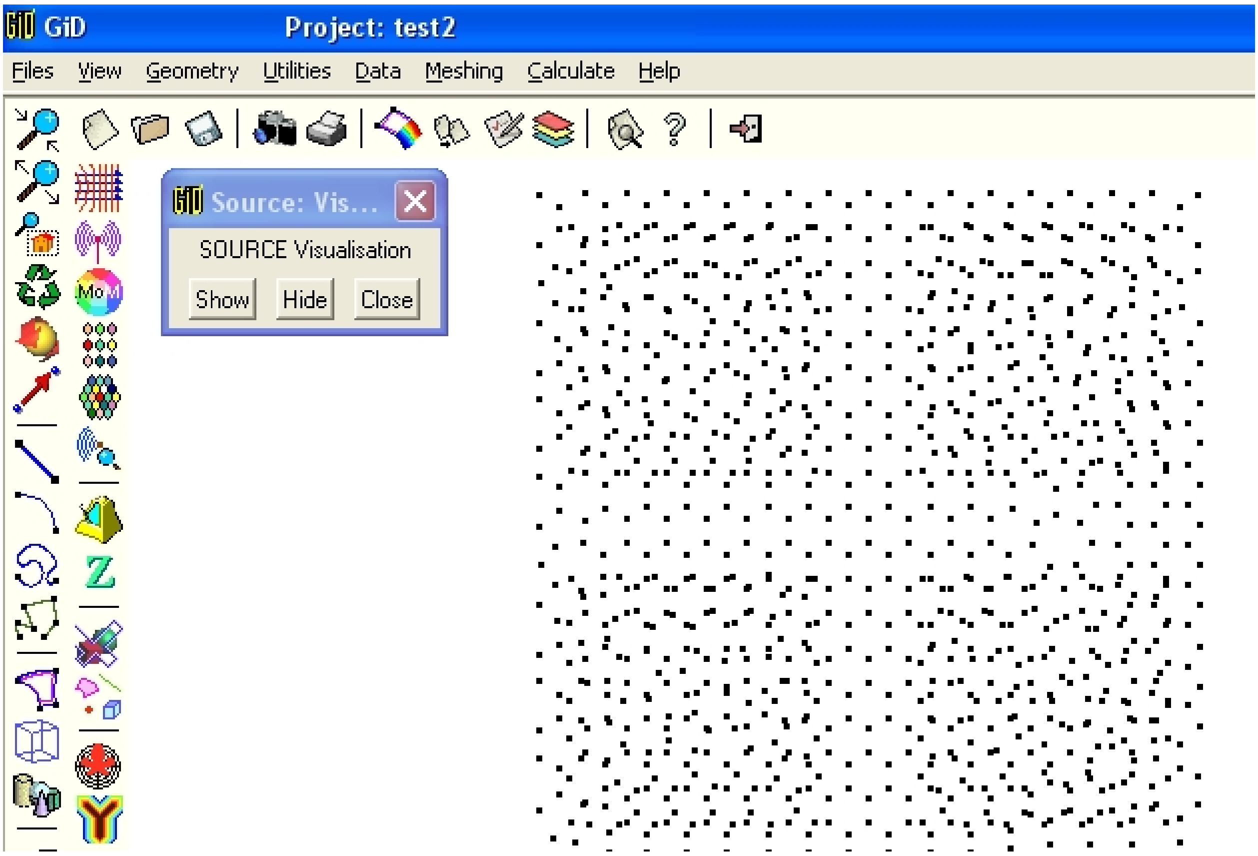


In the case of a source on a surface, a another long arrow will appear to show the normal of the surface :



MoM distribution :

If the source is a MoM distribution, each dipole will be represented by a point (the render must be off) :



Observation Visualisation

 open the observation visualisation utility

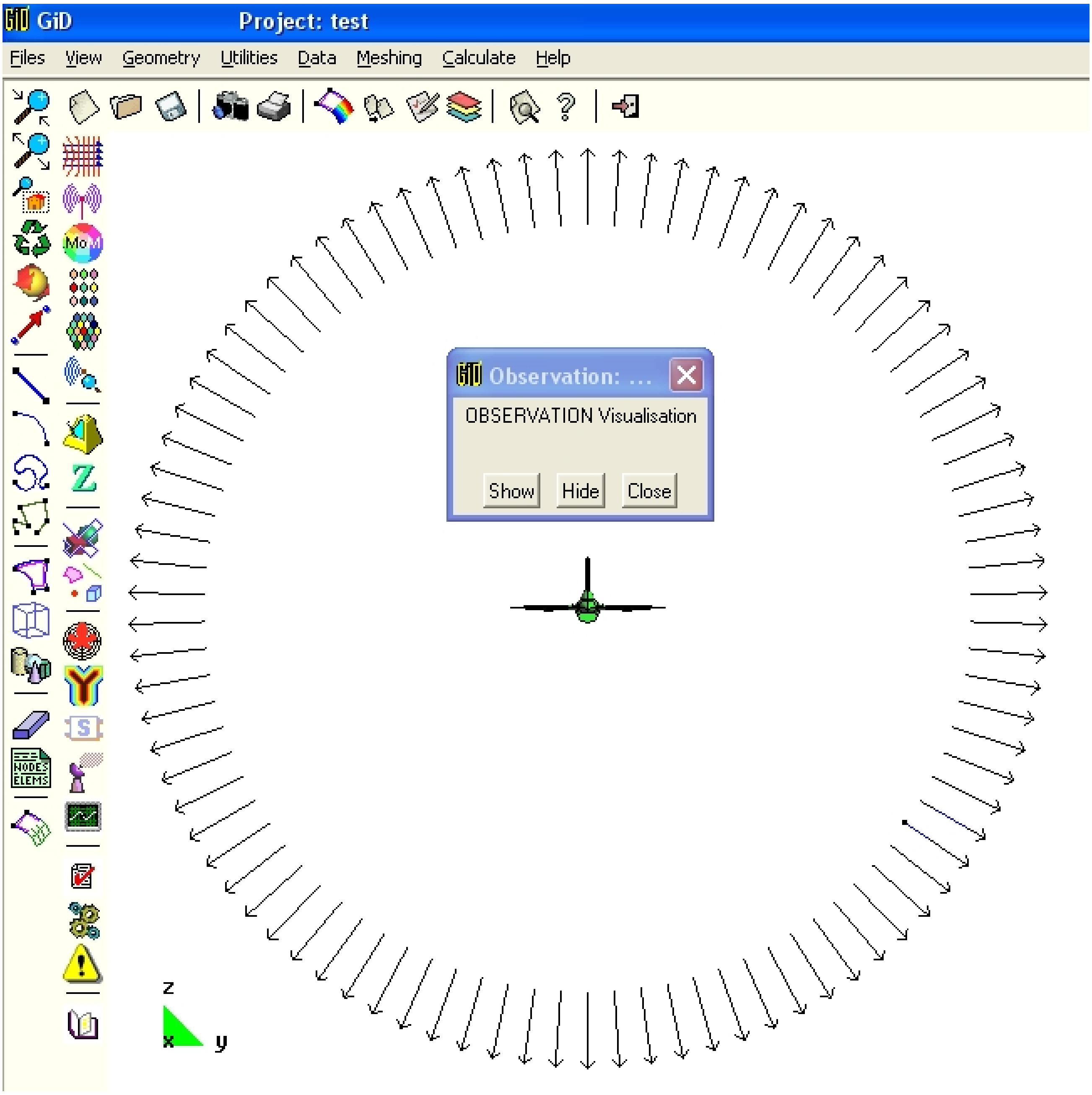
Show : show the observation

Hide : hide the observation

Close : hide the observation and close the utility

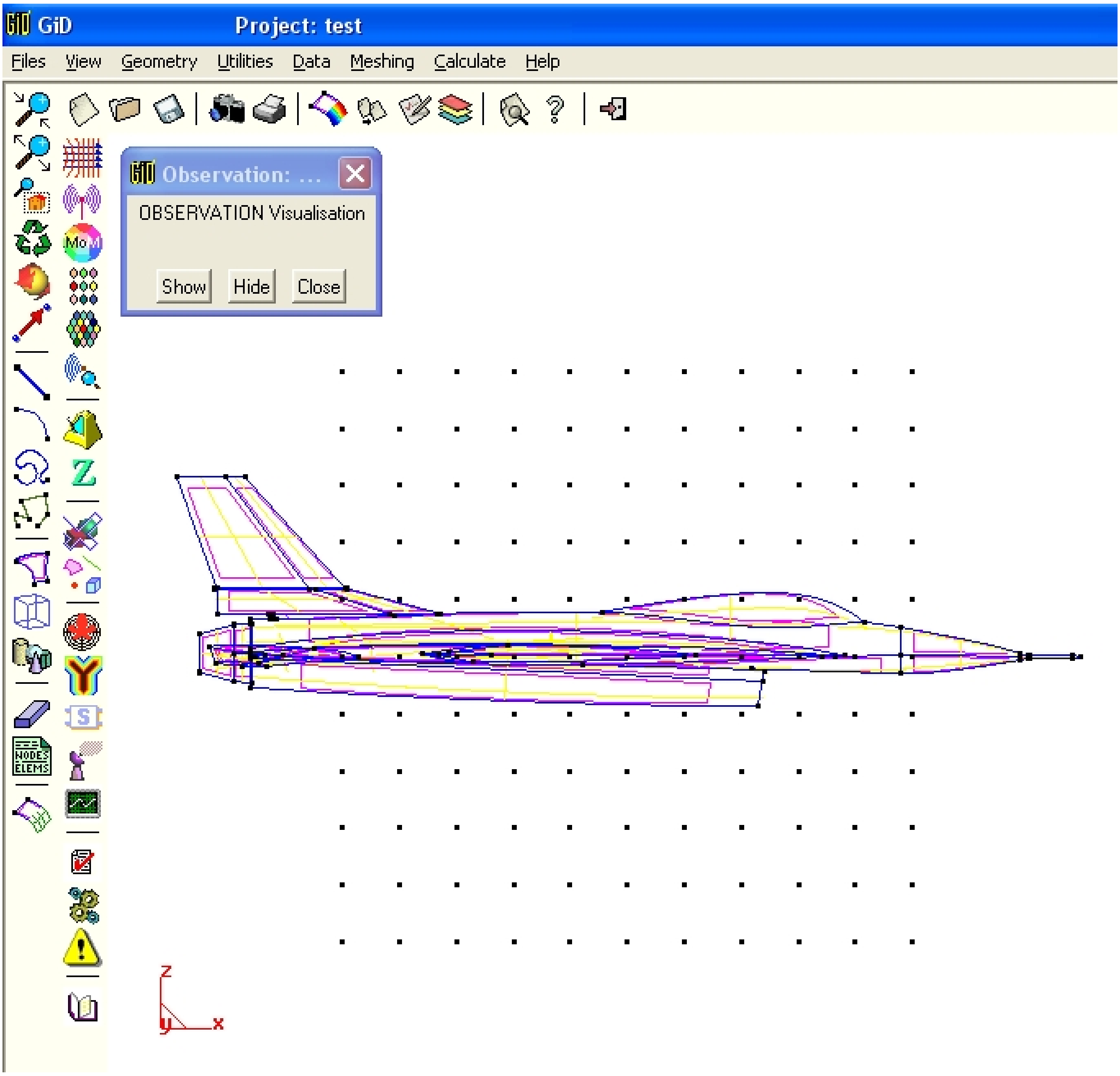
Radiation Pattern :

If the observation is a far field radiation pattern, each direction of observation will be represented by an arrow :



Observation grid :

If the observation is a grid of observation points, each observation point will be represented by a point (the render must be off) :


GiD Project: test
Files View Geometry Utilities Data Meshing Calculate Help
Observation: ...
OBSERVATION Visualisation
Show Hide Close
NODES ELEMS
z
x
y

Computation

[Input File](#)

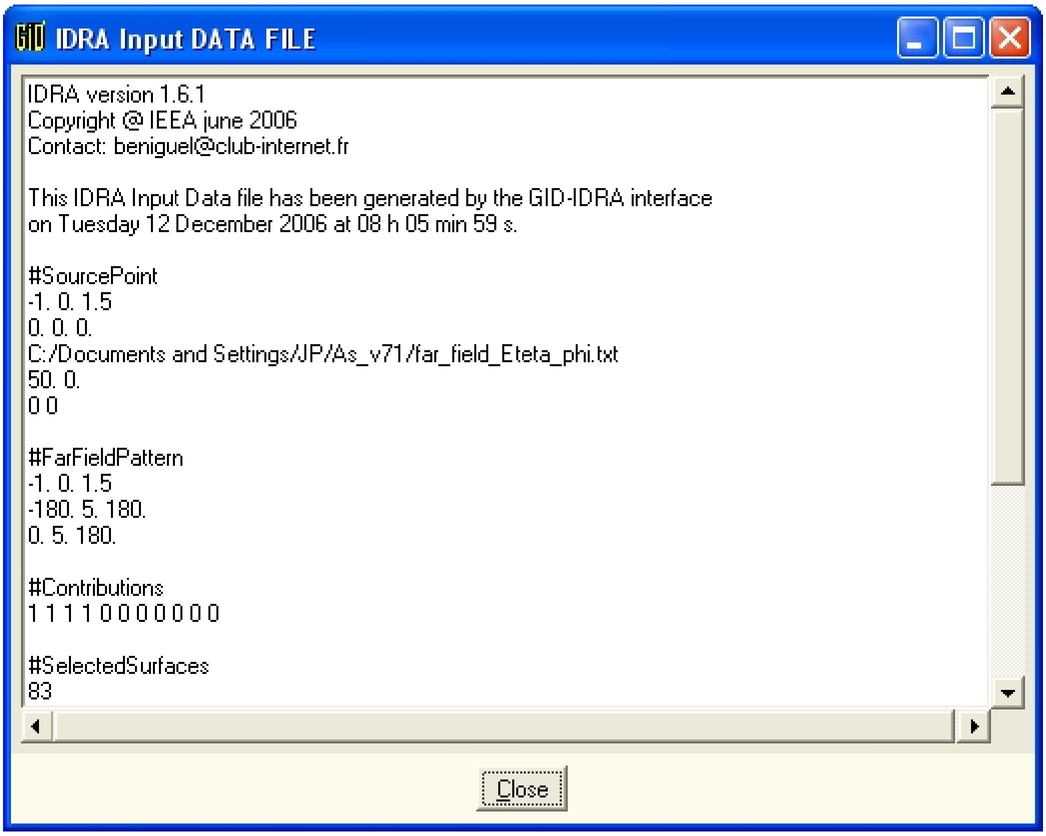
[Run IDRA](#)

[Error File](#)

Input File

check and show the input file

The graphical user interface creates a data file. The UTD software will read this input file. This functionality is generally used for debugging purposes.

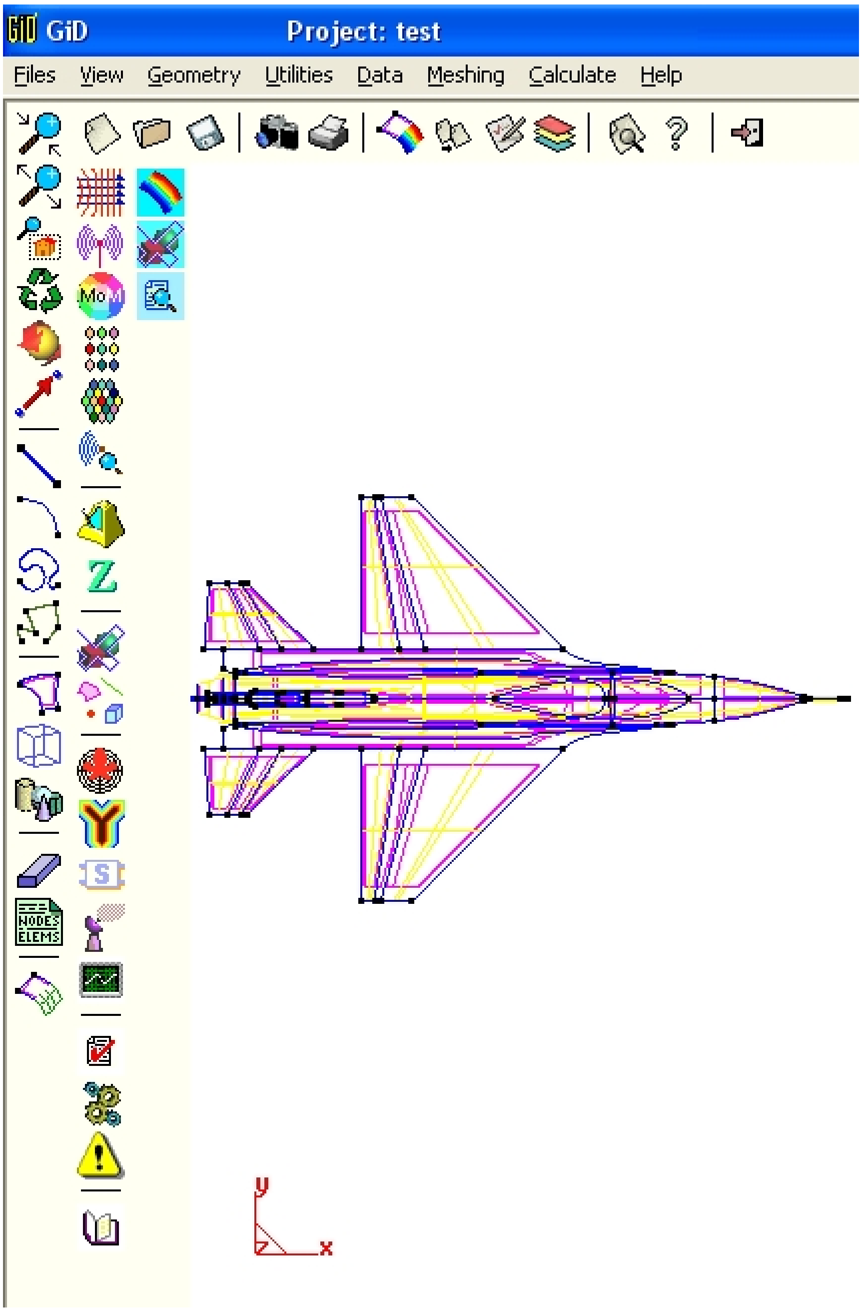


Run IDRA

Launch an IDRA computation

The UTD software appears in a command line window. This window displays the progression of the computation. It may also display warnings or information if an error occurs. The current version is only available in French. The English version is coming soon.

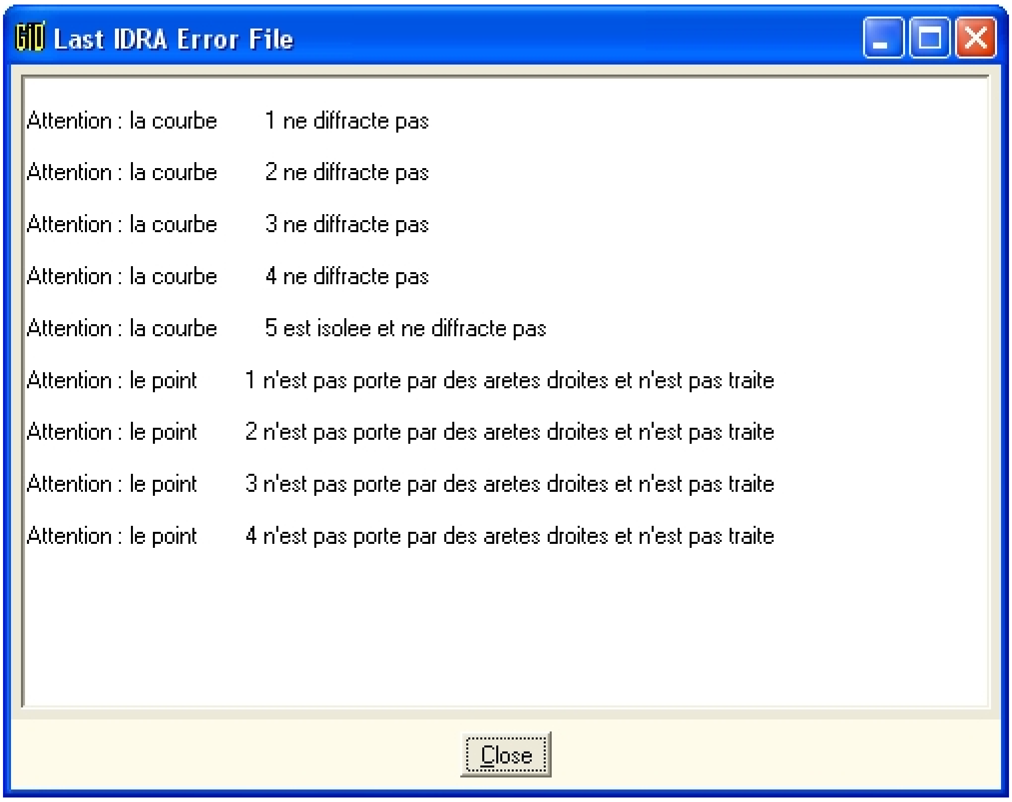
Once a computation was successfully completed, 3 new post-processing icons (blue) appear in the tool bar :



Error File

 Show the warnings and the errors which occurred during the last execution

The error file contains the warnings and the errors displayed in the command line window during the computation. The current version is only available in French. The English version is coming soon.


Last IDRA Error File
Attention : la courbe 1 ne diffracte pas
Attention : la courbe 2 ne diffracte pas
Attention : la courbe 3 ne diffracte pas
Attention : la courbe 4 ne diffracte pas
Attention : la courbe 5 est isolee et ne diffracte pas
Attention : le point 1 n'est pas porte par des aretes droites et n'est pas traite
Attention : le point 2 n'est pas porte par des aretes droites et n'est pas traite
Attention : le point 3 n'est pas porte par des aretes droites et n'est pas traite
Attention : le point 4 n'est pas porte par des aretes droites et n'est pas traite
Close

Outputs

[Results Visualisation]

[Rays Visualisation]

[Output files]

Results Visualisation

open the results visualisation window

The results visualisation window is not the same for the far field and the near field. However, the common points are the following :

- If a frequency range was computed, a frequency must be selected.
- It is possible to modify the geometry selection or the contributions. Only the selected parts of the geometry and the selected contributions will be used to generate the displayed result. If nothing is modified, the selection is supposed to be the same than for the computation (default). If the selection includes parts or contributions that weren't selected for the computation, these parts or contributions will be ignored. This functionality provides a good physical insight into scattering process.
- Once a results visualisation is generated with the button *show*, GID is in post-processing mode. The GID function *toggle pre/postprocess* must be used to come back to the pre-processing mode. This must be done to modify the computation or the visualisation parameters.

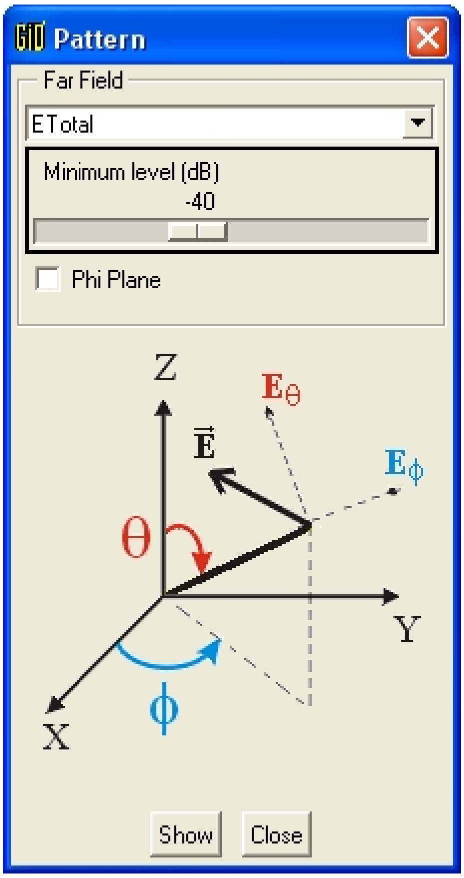
Far Field :

The far field component must be selected (Etotal, ETheta, EPhi or Polarisation).

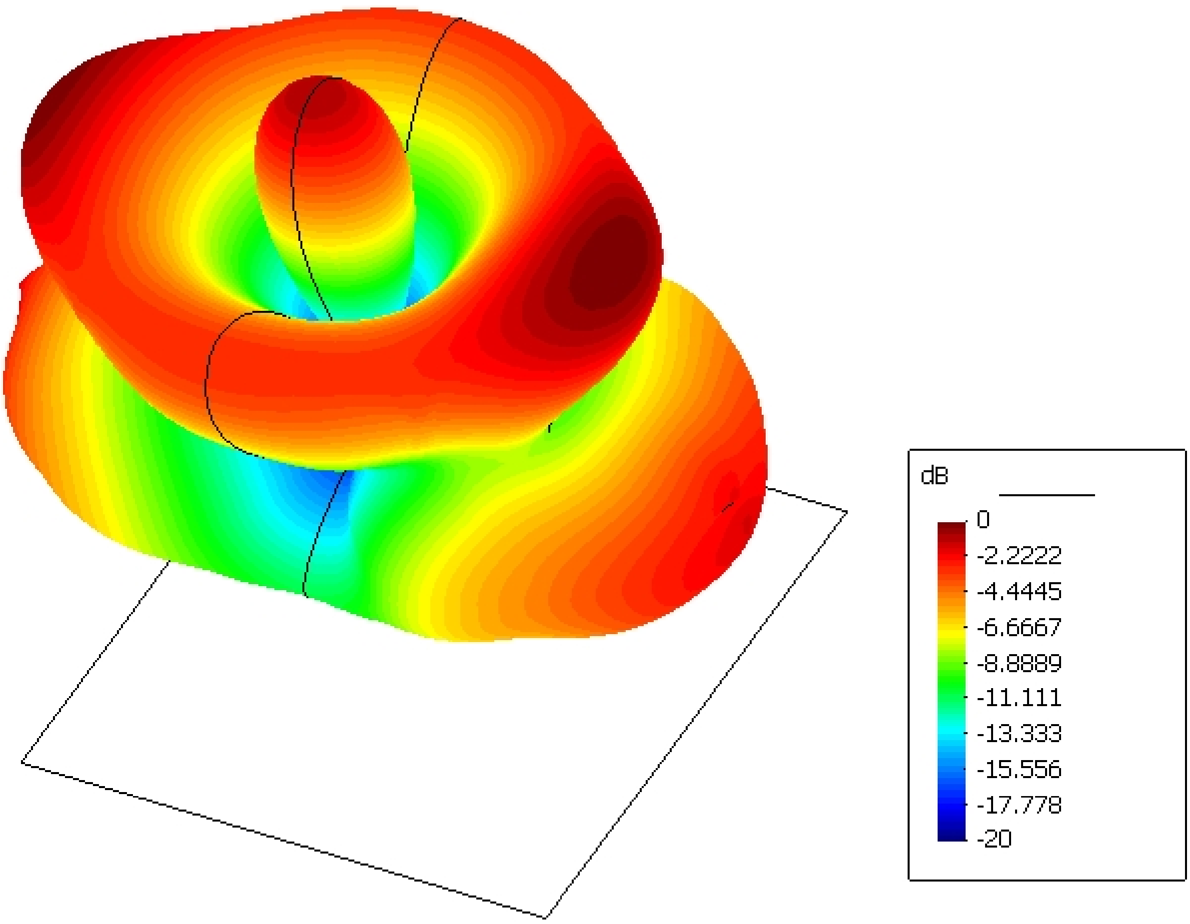
The result is represented in dB scale. It is possible to modify the minimum level, which corresponds to the level at the center of the spherical coordinates.

If Polarisation is selected, 2 additional lines are plotted for each direction of observation. They represent the major and minor axes of the elliptic polarisation.

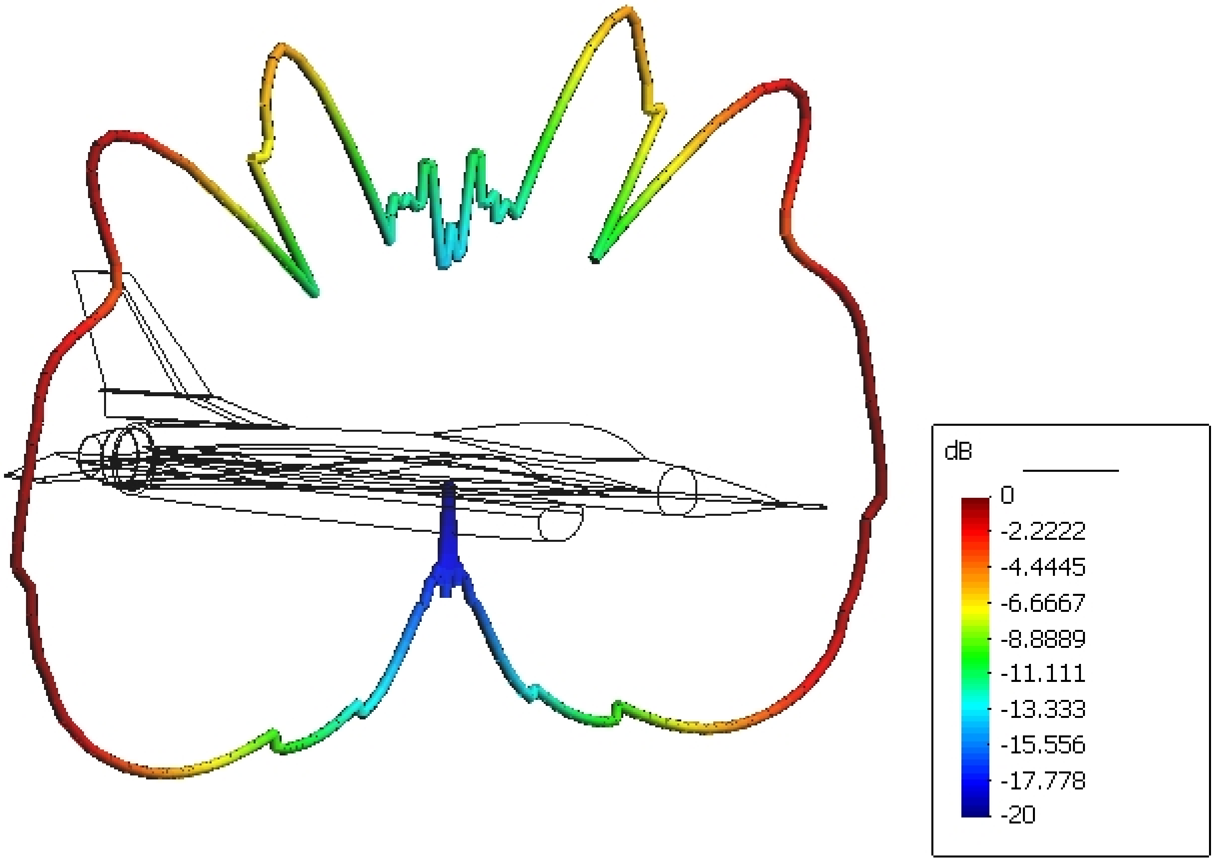
The whole radiation pattern can be displayed in 3D. It is also possible to draw only a radiation pattern for a given phi angle with the check button *Phi Plane.*



Example of full far field pattern visualisation (dipole antenna over a square plate) :

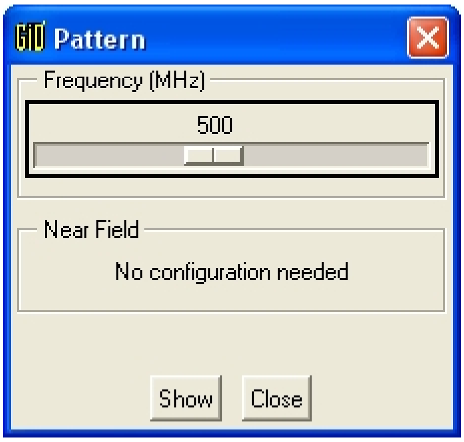


Example of a phi plane far field pattern visualisation :

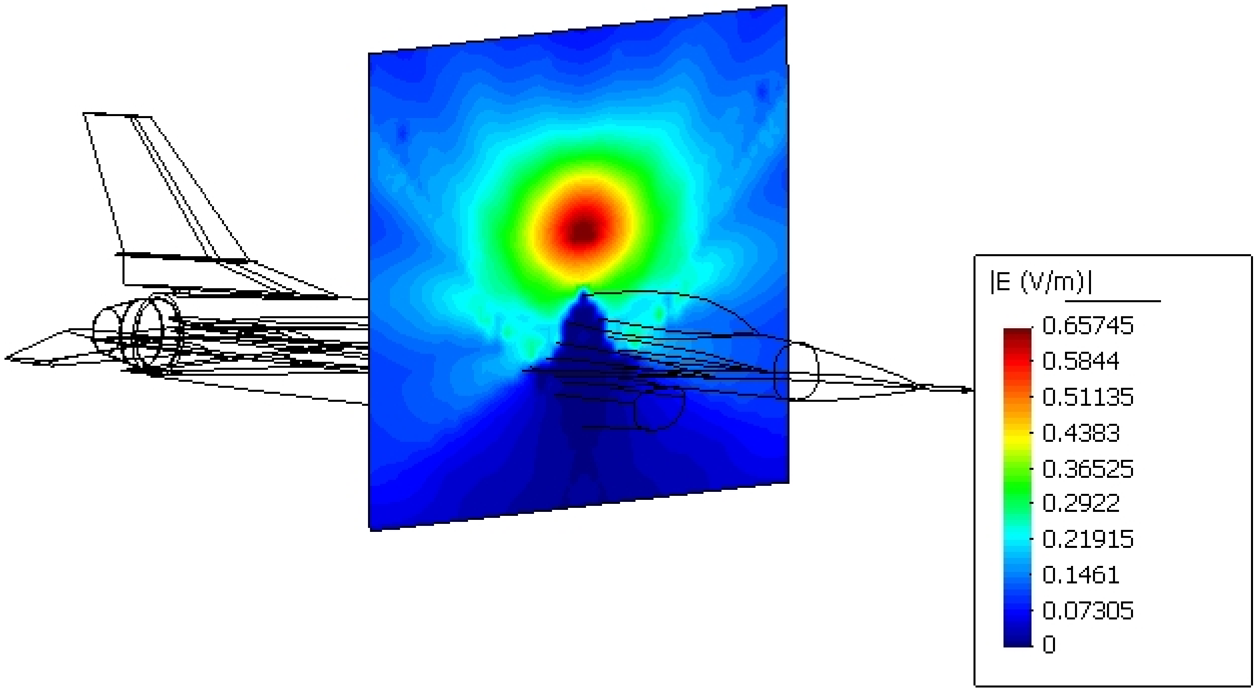


Near Field :

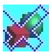
There is nothing to do for the near field results visualisation.

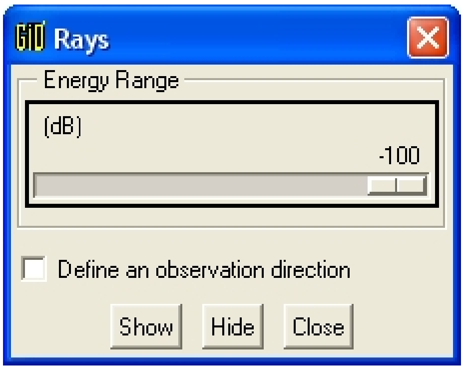


Example of near field results visualisation :



Rays Visualisation

 open the rays visualisation window



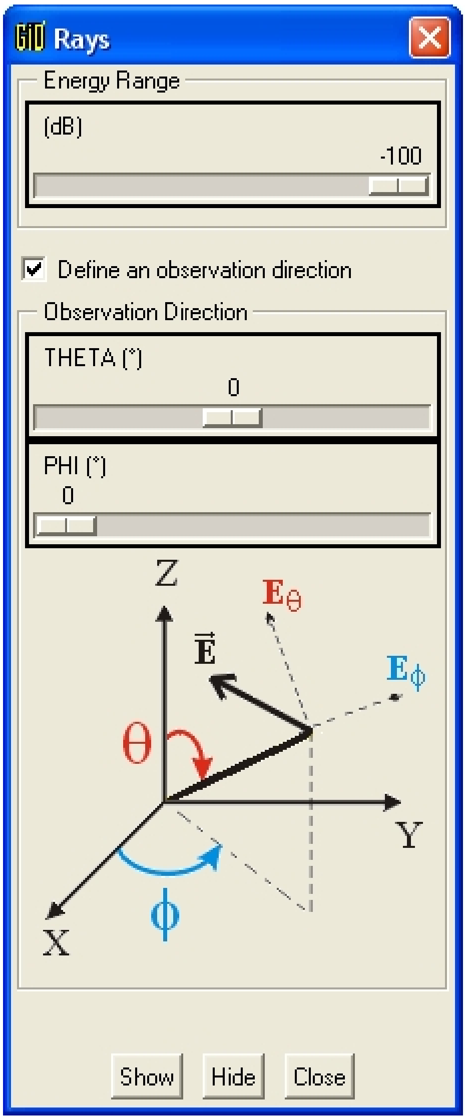
Show : show the rays

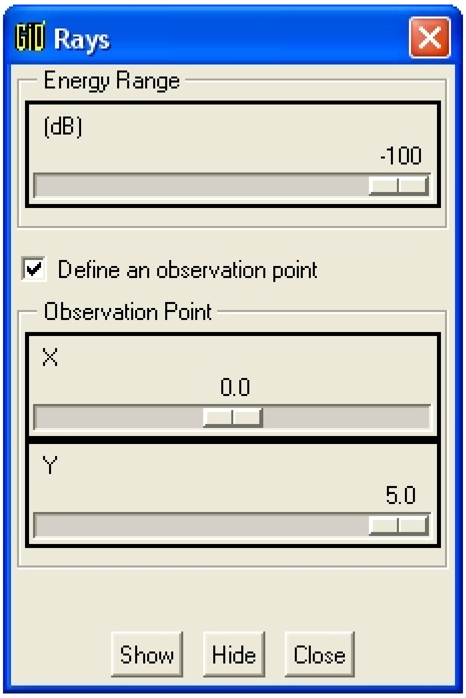
Hide : hide the rays

Close : hide the rays and close the utility

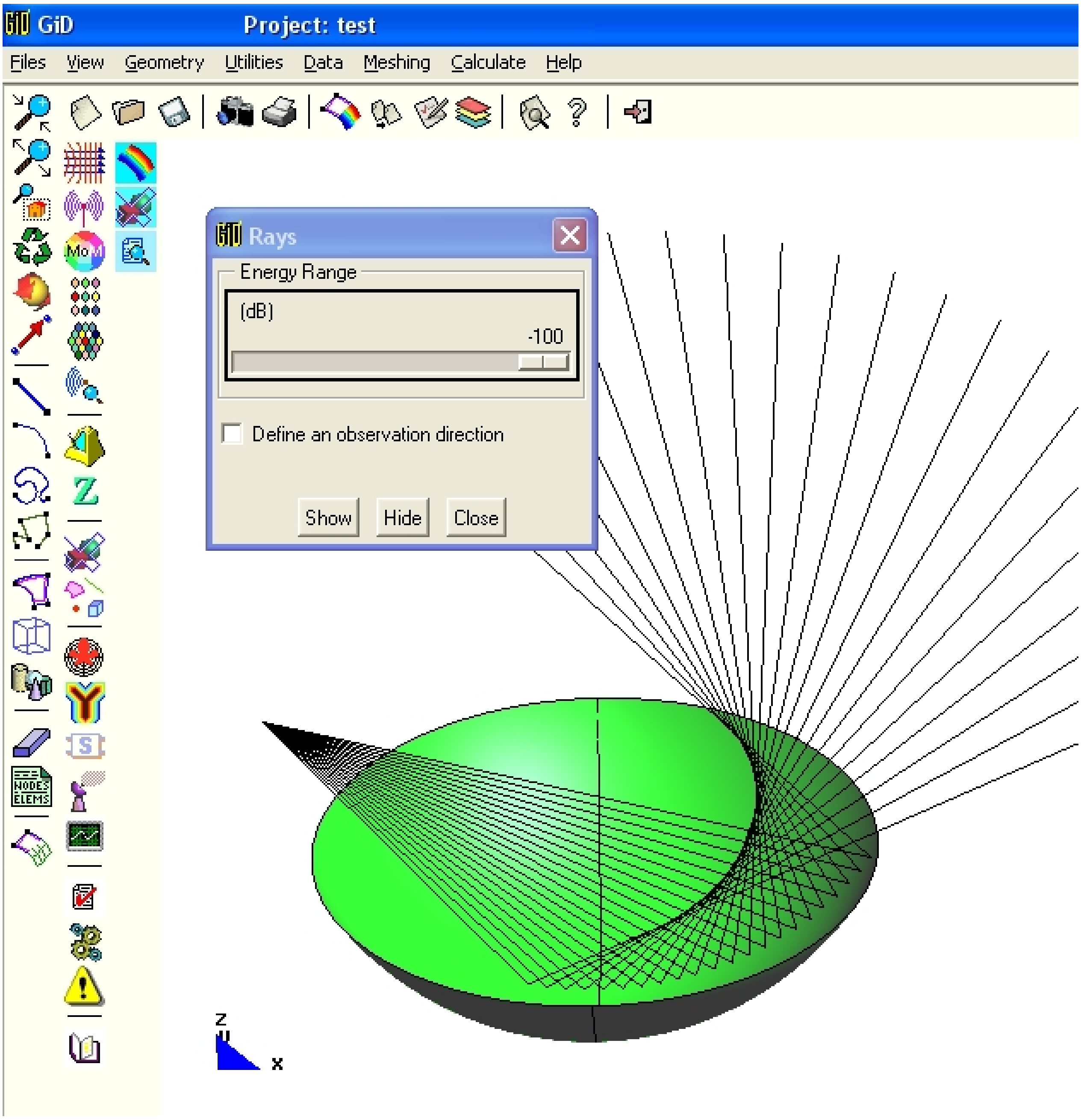
There could be an huge number of rays. Several ways to reduce the number of rays to display :

- If the energy ratio between a ray and the strongest ray is lower than the energy range, then this ray will not be plotted.
- It is possible to modify the contributions. Only the selected contributions will be displayed. If nothing is modified, the selection is supposed to be the same than for the computation (default). If the selection includes contributions that weren't selected for the computation, these contributions will be ignored.
- If the button *Define an observation direction/point* isn't checked, then the rays for all the observations will be plotted. It is also possible to select a particular observation direction or observation point :





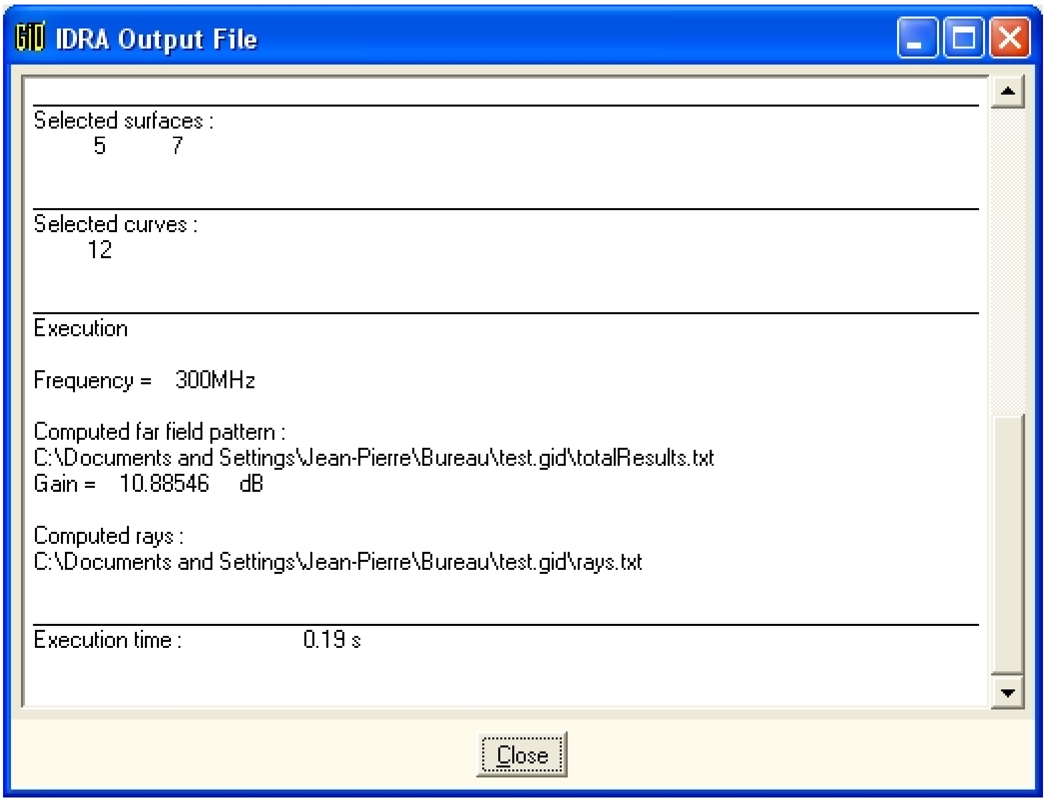
Example of rays visualisation (source point over a spherical reflector) :



Output files

 show the output file

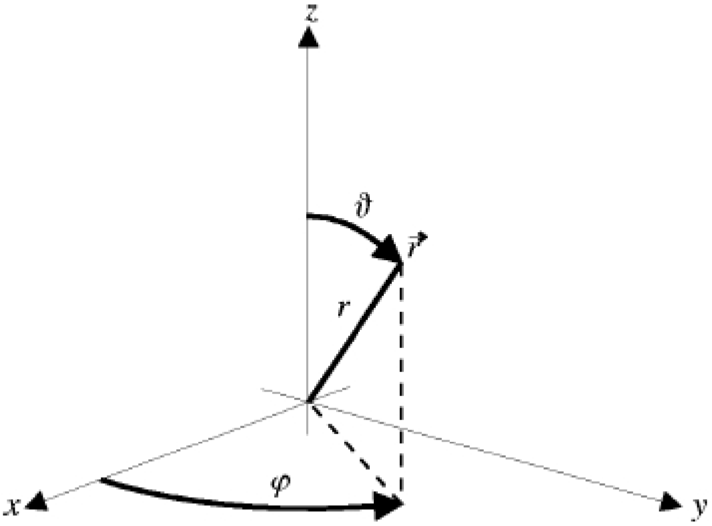
The output file contains information about the computation (input information, generated files, computation time, gain, S parameters, ...).



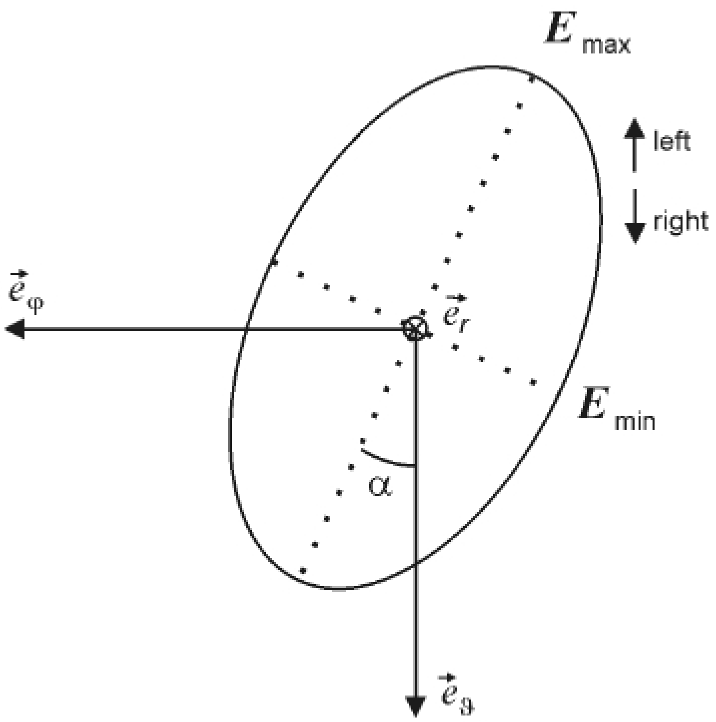
The totalResults.txt file contains all the results, except the frequency range (only the last frequency is stored in that file). The results.txt file is generated during the post-processing. It takes into account the parameters of the [Results Visualisation] (frequency, selected geometry parts, contributions).

If a frequency range is computed, the output far field patterns are stored in spirent format files. The name of these file contains the operating frequency. There is a gain file and a phase file. A right circular polarisation is assumed.

Let us consider the far field pattern. The electric field computed. The 1/r term is omitted. A spherical coordinate system is used to describe the direction of observation :



Coordinate system used to describe the polarisation :



The header contains :

- Operating frequency
- min max step (degrees)
- min max step (degrees)
- 2 lines of comments

For each direction of observation, there are 12 columns :

- 1 - 2 : and (degrees)
- 3 - 4 : amplitude (Volts) and phase (degrees) of the projection of the electric field on the vector e named Etheta
- 5 - 6 : amplitude (Volts) and phase (degrees) of the projection of the electric field on the vector e named Ephi
- 7 : vertical gain (dB), defined as 20 * log10(|Etheta|), normalized by the maximum gain value
- 8 : horizontal gain (dB), defined as 20 * log10(|Ephi|), normalized by the maximum gain value
- 9 : total gain (dB), defined as 20 * log10($|Etheta|^2 + |Ephi|^2$), normalized by the maximum gain value
- 10 : E_{min} / E_{max} ratio (0 for a linear polarisation, 1 for a circular polarisation)
- 11 : α angle
- 12 : polarisation (LINEAR, LEFT or RIGHT)

Example (there is only the beginning of the file) :

```
 1.0300000E+09
-180.0000      180.0000      2.000000
0.0000000E+00   135.0000      45.00000
      LOCATION              ETHETA                EPHI           gain in dB          POLARISATION
   THETA      PHI       magn.      phase       magn.      phase       vert.      horiz.      total    axial r.      angle   direction
-0.1800E+03 0.0000E+00 0.9555E-01 -0.1377E+03 0.0000E+00 0.0000E+00  0.4167E-06 -0.2000E+03  0.0000E+00 0.0000E+00 0.1137E-05   LINEAR
-0.1780E+03 0.0000E+00 0.9549E-01 -0.1377E+03 0.0000E+00 0.0000E+00 -0.5292E-02 -0.2000E+03 -0.5293E-02 0.0000E+00 0.1754E-05   LINEAR
```

-0.1760E+03	0.0000E+00	0.9531E-01	-0.1377E+03	0.0000E+00	0.0000E+00	-0.2118E-01	-0.2000E+03	-0.2118E-01	0.0000E+00	0.1816E-05	LINEAR
-0.1740E+03	0.0000E+00	0.9502E-01	-0.1377E+03	0.0000E+00	0.0000E+00	-0.4771E-01	-0.2000E+03	-0.4771E-01	0.0000E+00	0.1518E-05	LINEAR
-0.1720E+03	0.0000E+00	0.9462E-01	-0.1377E+03	0.0000E+00	0.0000E+00	-0.8494E-01	-0.2000E+03	-0.8494E-01	0.0000E+00	0.2609E-05	LINEAR

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Contact

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