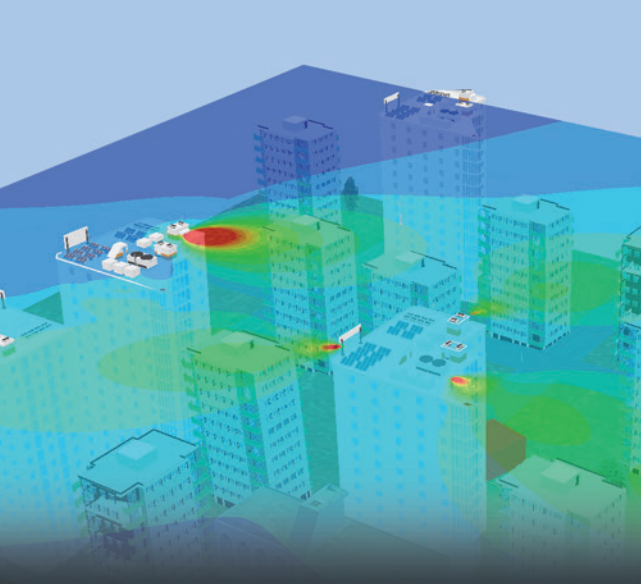


+
EMF VISUAL

**THE REFERENCE
SOFTWARE**
IN ELECTROMAGNETIC
EXPOSURE SIMULATION



EMF Visual,

electromagnetic exposure simulation software

Worldwide, the telecommunication regulatory bodies are paying more and more attention to human exposure to RF emissions. The authorization for installing new antennas is nowadays dependent upon a proof of compliance with local reference levels.

As a result, an accurate simulation of human exposure to electromagnetic fields is essential. This is the only way to calculate and consider the cumulated level of exposure generated by new antennas in their future installation sites together with all those already in place, used for cellular networks (2G, 3G, 4G, Tetra) or radio services (FM, TV, WLAN, ...).

EMF Visual software, reference in the industry, offers reliable and fast calculations. It allows the visualization of electromagnetic fields in a determined zone (near-field/far-field), taking into account the multiple emitters and their interaction with surrounding buildings.

The simulation results can be compared directly with reference levels given by ICNIRP, Safety Code 6, FCC,...etc. thus providing clear and easy-to-understand evaluations of the compliance of a site.

In this new version, EMF Visual is even more powerful thanks to new advanced features. It now uses GPU resources which allow to cover larger areas for exposure evaluation, and enables the use of the GIS database or 3D objects conversion for a direct loading of virtual 3D scenes while interfacing with Sketch Up software.

- 1 **Beam Steering function for simulations using 5G Massive MIMO antennas**
- 2 **GPU-accelerated computing for fast exposure evaluation**
- 3 **Precise and fast creation of 3D environment**
- 4 **The RF exposure results as part of the assessment report for EN 62232**

+ Main features

Product category

- Electromagnetic exposure simulation software

Simulation capabilities

- EMF Visual is a prediction, analysis and communication tool, which can accurately simulate exposure in both near and far field of the antennas while taking into account its environment

User profile

- Cellular network operators/installer, broadcast companies, regulatory bodies, municipalities.

+ System Configuration

Software

- EMF Visual 2023 Standard (CPU) or Advanced (GPU)
- EMF Visual Scene
- BSA Synthesis
- SE-FFT-EMF (Plugin for SketchUp/Blender/3DS Max)

Services

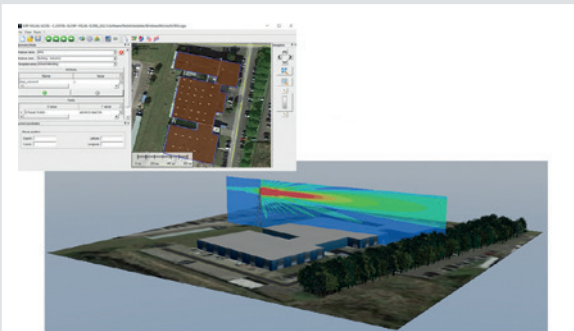
- Hotline
- Training

■ Included □ Optional

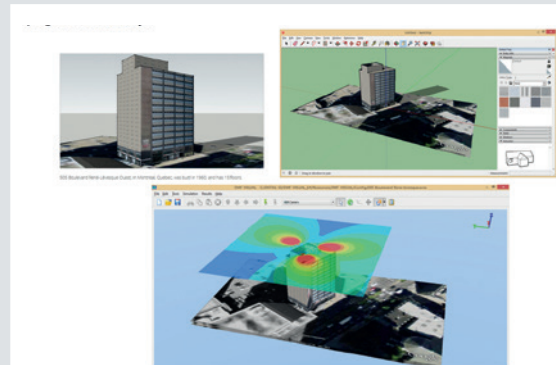
STEP 1: 3D SCENARIO CONSTRUCTION

The creation of 3D scenario for EMF Visual can be done:

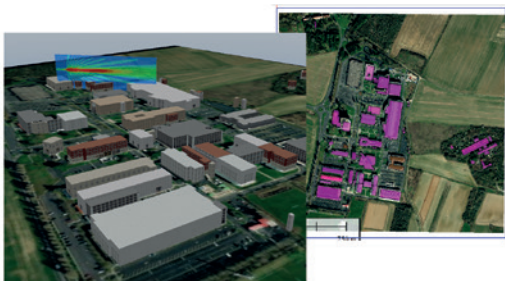
- by importing 3D objects from the EMF Visual generic database. A wide choice of 3D objects to represent ground, buildings, houses, masts, towers, indoor objects, etc... is available in the generic database.
- by using the Option EMF Visual Scene:
- by using the Option SE-FFT-EMF (Plugin for SketchUp/Blender/3DS Max)



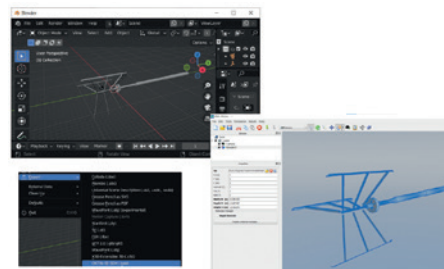
Creating a 3D scene involves using a simple map image and manually defining building outlines.



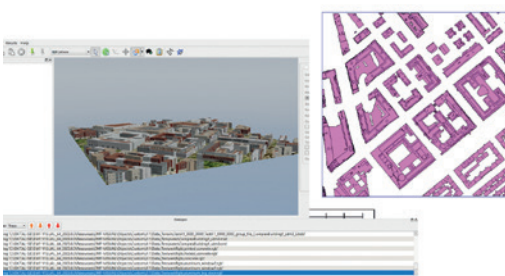
Using Plugin for SketchUp



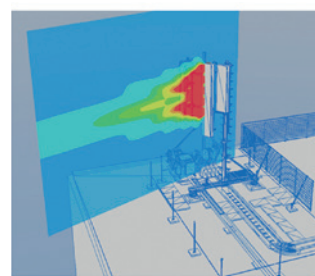
Using Open Street Map (OSM) files



Using Plugin for Blender

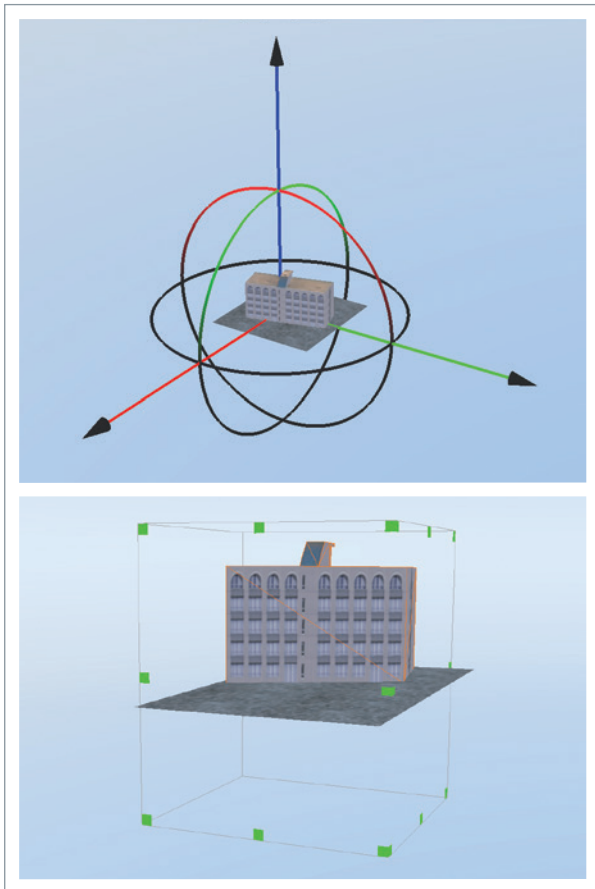


Using Shape (SHP) files

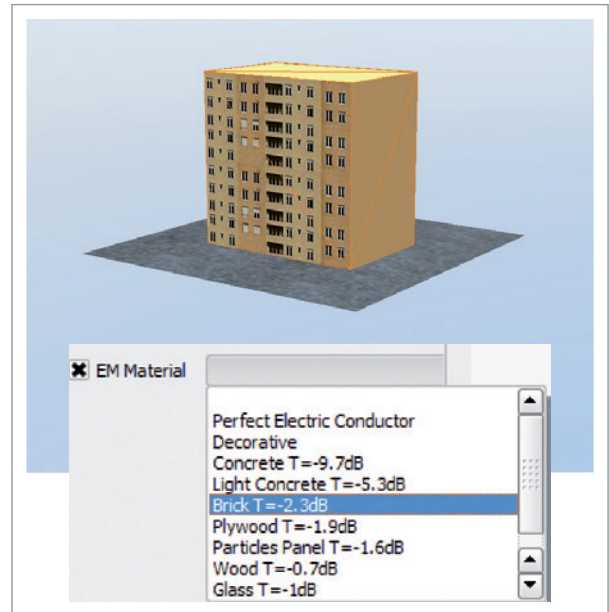


Using Plugin for 3DS Max

- Graphical tools to adjust the 3D object properties.



- Tools for assignment of the electromagnetic properties.



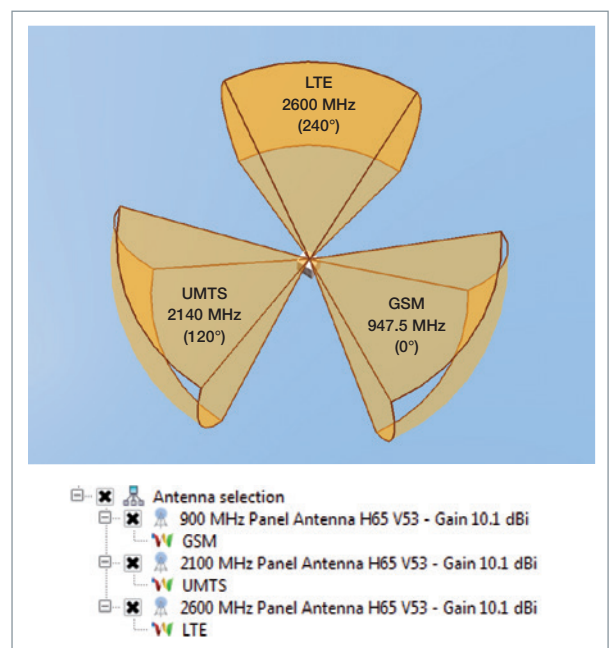
STEP 2: ANTENNA SELECTION AND INSTALLATION

EMF Visual software can use antenna models from the existing database or a custom antennas created by BSA Synthesis Option.

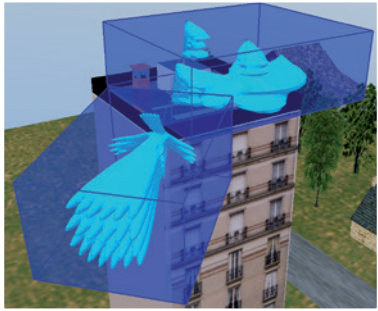
- A complete database of generic models of the most current antennas used in 2G, 3G, 4G (700, 900, 1800, 1900, 2100, 2600 MHz) and 5G (3.5, 28, 39 GHz) cellular networks.
- An additional database of FM and Wifi antennas.

Antenna configuration tools.

- Geometric visualization of the antenna main beam cone in the scene together with graphic tools for adjusting position, tilt, azimuth and power.



THE 5TH GENERATION OF MOBILE RADIO COMMUNICATION (5G) USE MASSIVE MIMO ANTENNAS WITH BEAM STEERING CAPABILITY TO CONTROL ACTIVELY THE DIRECTION OF PROPAGATION



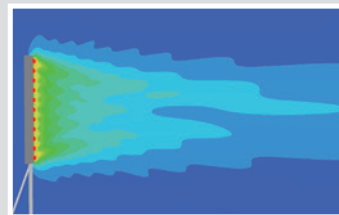
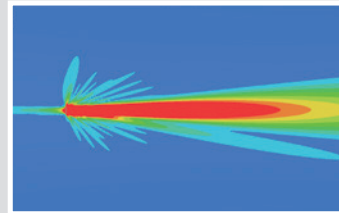
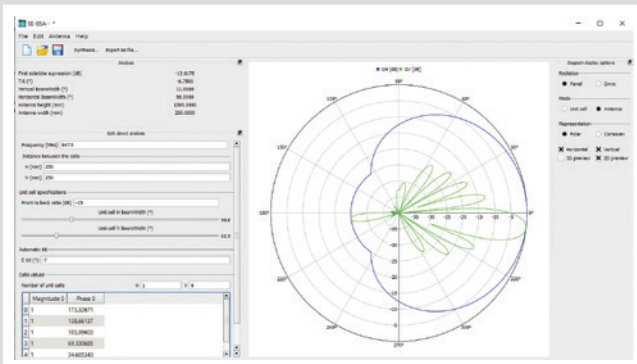
EMF Visual integrates a Massive MIMO antenna database with 2D array antennas working at 3.5GHz, 28GHz, 39GHz together with a dedicated function for adjusting easily the beam steering range in azimuth and elevation.

With Beam Steering function for Massive MIMO antennas, EMF Visual allows to show either a particular orientation of the main lobe or the global envelop with all the possible orientations at the same time for site compliance checking purpose.

In addition to the antennas in the database, the user can also define custom 5G antennas operating over a desired frequency band, with custom beam steering range & resolution, size, and number of elements.

BSA SYNTHESIS OPTION: DEFINE ANTENNA CHARACTERISTICS AND CREATE CUSTOMIZED ANTENNAS

- BSA Synthesis computes magnitude and phase for each unit cell to generate an antenna model that fits with far field radiation pattern:
 - vertical and horizontal -3dB beam width and frequency.
 - side lobe suppression.
 - number of cell units or antenna length.
 - front to back ratio.
- Analysis of antenna model from unit cell magnitude and phase data (1D and 2D array antenna).
- Exportation of the antenna model to the EMF Visual database.



STEP 3: COMPUTATION

After defining the computation volume around the area of interest, the electromagnetic field level calculation is launched. The calculation is based on optical geometry (ray tracing). It allows simulation to be performed over a wide area in terms of wavelength and the interactions with the environment of the radiating sources to be taken into account.

- Two computation modes are available according to the chosen option.
- Standard mode: CPU (Central Processing Unit) calculation
- Advanced mode: GPU (Graphics Processing Unit) calculation

Number of reflecting polygons	1800	2400	3000	3600	4200	4800	6000	7200
GPU Simulation duration	1h19min	1h39min	2h04min	1h56min	2h07min	2h04min	2h08min	2h10min
CPU Simulation duration	1h54min	3h49min	5h32min	8h23min	10h32min	12h52min	18h18min	1d49min

Note: the same calculation made without reflecting polygons (free space propagation) is around 30 seconds.

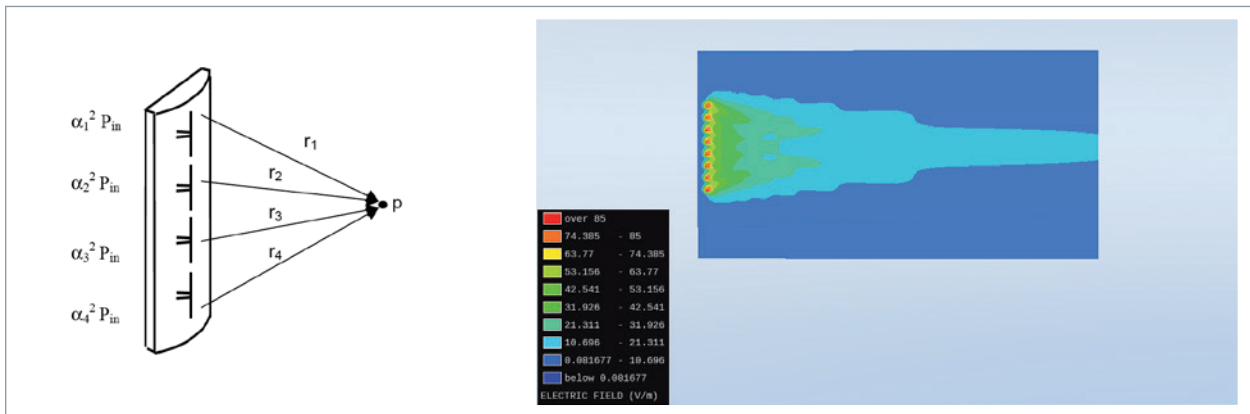
PROPERTIES OF THE VOLUME	
Width/X (m)	14
Depth/Y (m)	14
Height/Z (m)	14
Regular grid	
Near step	0.1 m
Point count	2803221

The simulation contains one antenna 900 MHz Omnidirectional V7 Gain 11.3 dBi

MATERIAL PROPERTIES FOR EACH CUBE	
Concrete T	-9.7 db

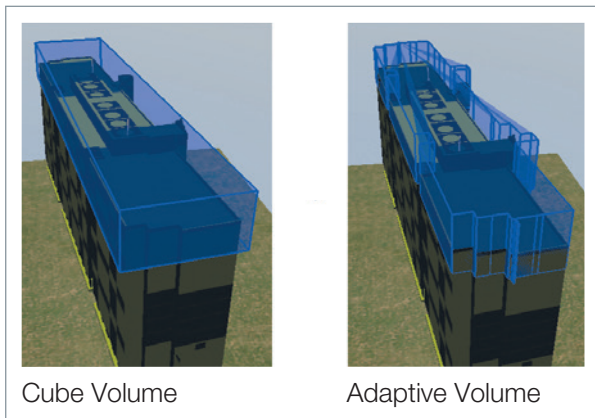
PC CONFIGURATION	
Intel Core i7 CPU	3.20 GHz
RAM	8 Go
NVIDIA GeForce GTX 750 Ti	4 Go

- Accurate representations of the near field by considering the contribution of each sub-cell of the antenna.

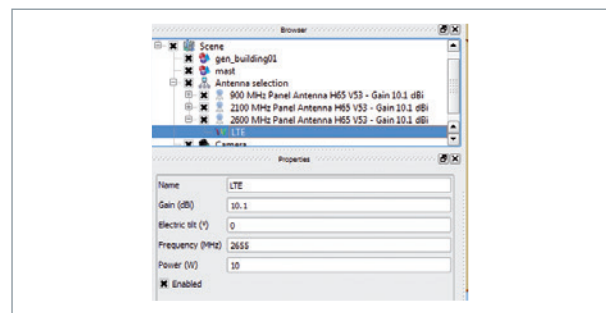


- Definition of a computation volume around the area of interest, two options for the defining the computation volume:

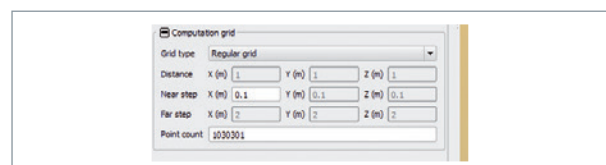
1. Cube volume
2. Adaptive volume



- Selection of the active antenna.

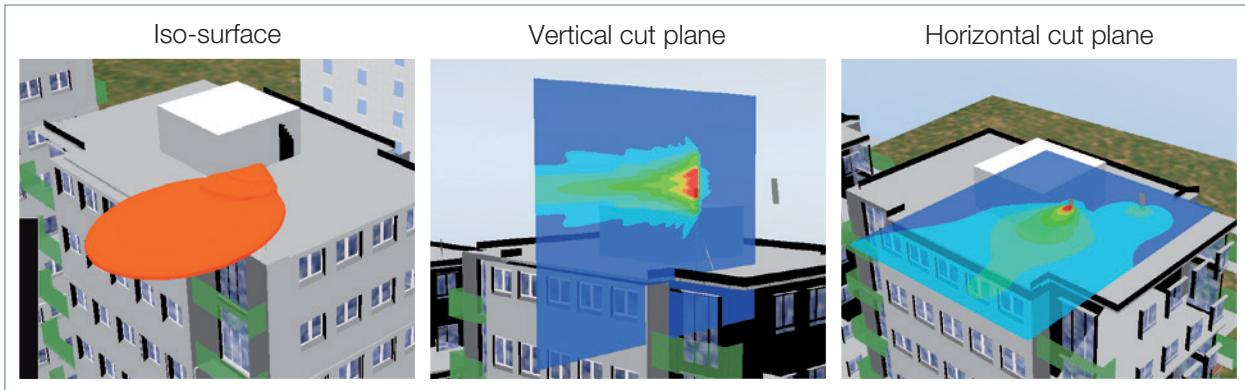


- Adjustment of the mesh step (number of computation points).
- Non-uniform grid to improve resolution around the antennas and to speed up the calculations.

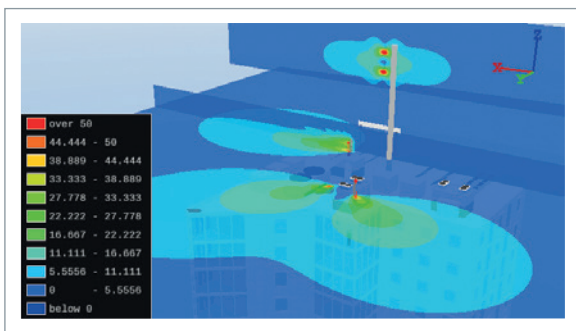


STEP 4: RESULT DISPLAY

Once the computation is finished, the user can use iso- surface or cut plane tools to display the level of exposure in the vicinity of the 3D environment.



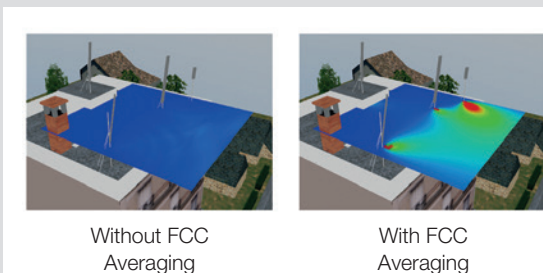
- Multiple cut plane and multiple distance measuring possibilities for security perimeter definition.



- Evaluates the levels of exposure in terms of E-field (V/m), H-field (A/m), Power Density (W/m²), % of the E-field or % of the Power for multi-frequency sources.
- Determines the safety distances with respect to standards or recommendations (EU recommendation, ICNIRP, and so on ...).
- Visual post-processing of the results: choice of colour or transparency.

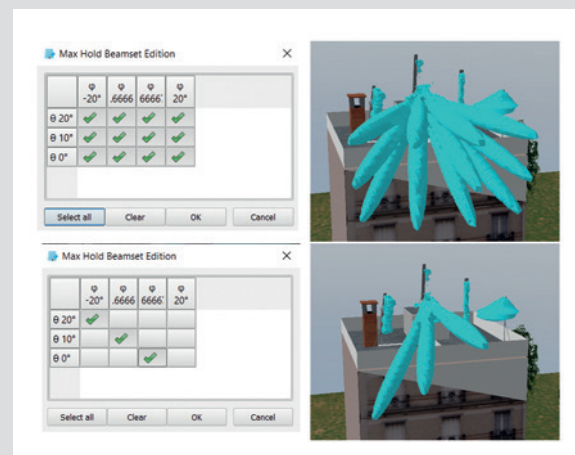
DISPLAY OPTION: FCC AVERAGING

The FCC Averaging feature is now available with the active FCC recommendation. It modifies how the cross section is displayed. Instead of showing the power at a single point, the cross section will now show the power integrated from that point up to a height of 6 feet.



DISPLAY OPTION: BEAMSET EDITION FOR MIMO

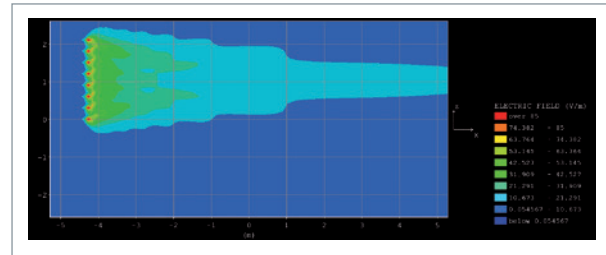
Combined with MAXHold Function, the BeamSet Edition allows to select independently each Beamset to be displayed.



STEP 5: RESULT EXPORTATION

EMF Visual generates XLS file containing the list of used antennas with radio and mechanical settings.

Antenna Label	Band Name	Frequency (MHz)	Power (W)	Gain (dB)	Electric Tilt (°)	Mechanical Tilt (°)	ERP (dBm)
900 MHz Panel Antenna H95 V9 - Gain 17.4 dBi	GSM	947.5	50	17.4	0	22.22	298.3
1800 MHz Panel Antenna H95 V11 - Gain 17.1 dBi	DCS	1842.5	50	17.1	0	22.29	305.41
700 MHz Panel Antenna H95 V9 - Gain 17.9 dBi	LTEP90	700	50	17.9	0	25.27	317.4
900 MHz Panel Antenna H95 V9 - Gain 16.9 dBi	GSM	947.5	20	16.9	0	21.15	268.79
900 MHz Panel Antenna H95 V9 - Gain 17.4 dBi	GSM	947.5	50	17.4	0	22.87	320.05



For each volume and each band, one ASCII Txt file is created:

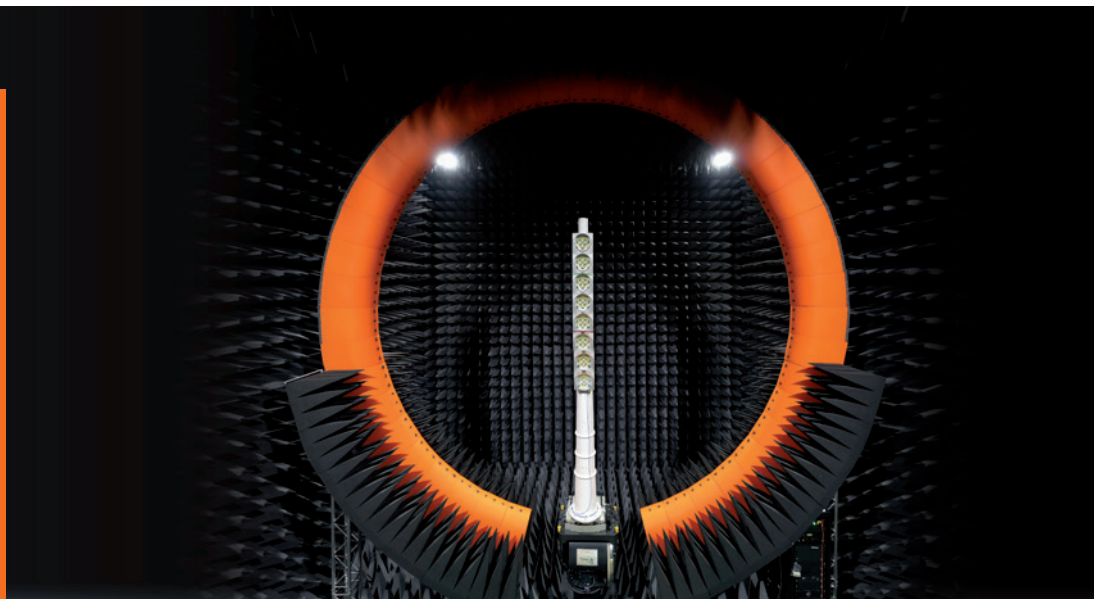
- contains the computed E-field value (V/m) is created.
- displays the E-field values for each antenna with the corresponding Cartesian coordinates.
- It is possible to generate a bitmap file, represented the cut plane.

HARDWARE REQUIREMENTS

Graphical Board (only required for Advanced mode: GPU)	<ul style="list-style-type: none"> • NVIDIA using CUDA 10.2 ("Compute Capability" of the card greater than 3.0) • Minimum driver version: 441.22
Operating system	WIN10 / WIN 11
Memory recommended	16 GB RAM
Free space	10 GB free space on hard disc



Following the standard EN62232, an antenna manufacturer is usually required to provide information on RF exposure, including applicable compliance boundaries (exclusion area) to the end user of the product.



To ensure your base station antenna designs are compliant with the latest RF safety standardization parameters in three simple steps:

- ① Perform the required antenna measurements using your existing MVG SG system
- ② Use MVG's automated software to perform advanced processing and export the data
- ③ Run the exported data through EMF Visual to display and export the electromagnetic exposure simulation result.

MVG - Testing Connectivity for a Wireless World

The Microwave Vision Group offers cutting-edge technologies for the visualization of electromagnetic waves. Enhancing the speed and accuracy of wireless connectivity testing, as well as the performance and reliability of anechoic and EMC technologies, our systems are integral to meeting the testing challenges of a fully connected world.



WORLDWIDE GROUP, LOCAL SUPPORT

Our teams, in offices around the world, guide and support you from purchase, through design, to delivery and installation. Because we are local, we can assure speed and attention in project follow through. This includes customer support and maintenance once the system is in place.

For the exact addresses and up-to-date contact information:

www.mvg-world.com/mvg-offices



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