OKTAL-SE
Synthetic Environment

EMF VISUAL

THE REFERENCE SOFTWARE
IN ELECTROMAGNETIC EXPOSURE SIMULATION

mvg
Microwave Vision Group

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.

EMF Visual,
electromagnetic exposure simulation software

+

❶ **Completely redesign interface**

❷ **GPU-accelerated computing for fast exposure evaluation**

❸ **Precise and fast creation of 3D environment**

❹ **Beam Steering function for simulations using 5G Massive MIMO antennas**

❺ **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 Standard (CPU) or Advanced (GPU)
☐ SE-SKP-EMF (plugin for SketchUp[1])
☐ SE-AGETIM-LIGHT-EMF (3D creation)
☐ SE-FFT-EMF (3D Converter)
☐ BSA Synthesis (Custom Antenna creation)

Services
☐ Training
☐ Hotline

■ 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 SE-SKP-EMF:** plugin for SketchUp[1].

[1]https://www.sketchup.com/   [2]https://3dwarehouse.sketchup.com
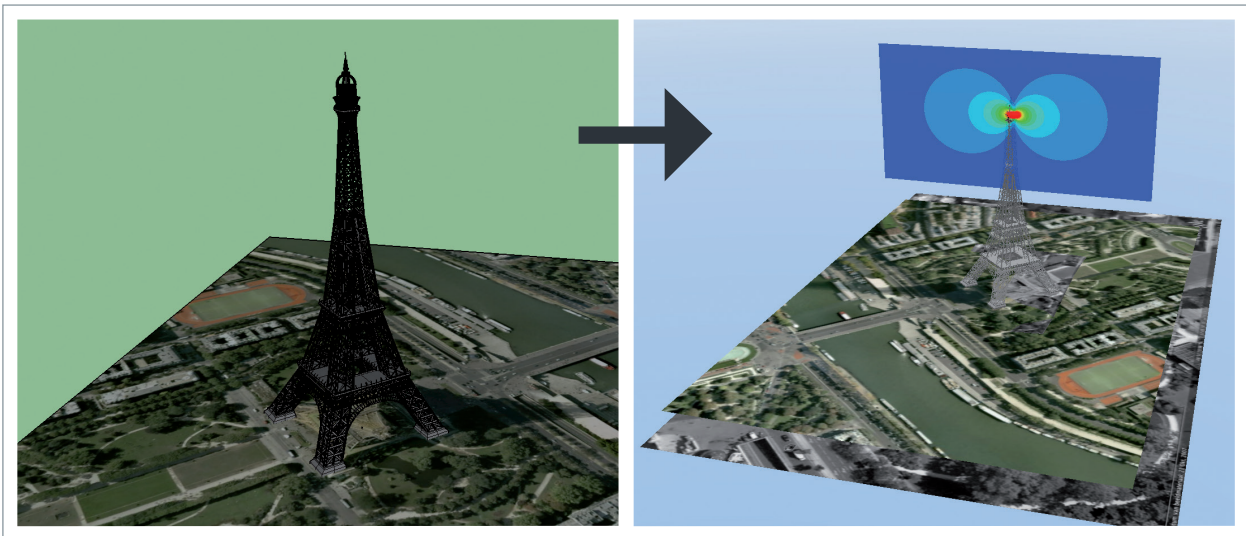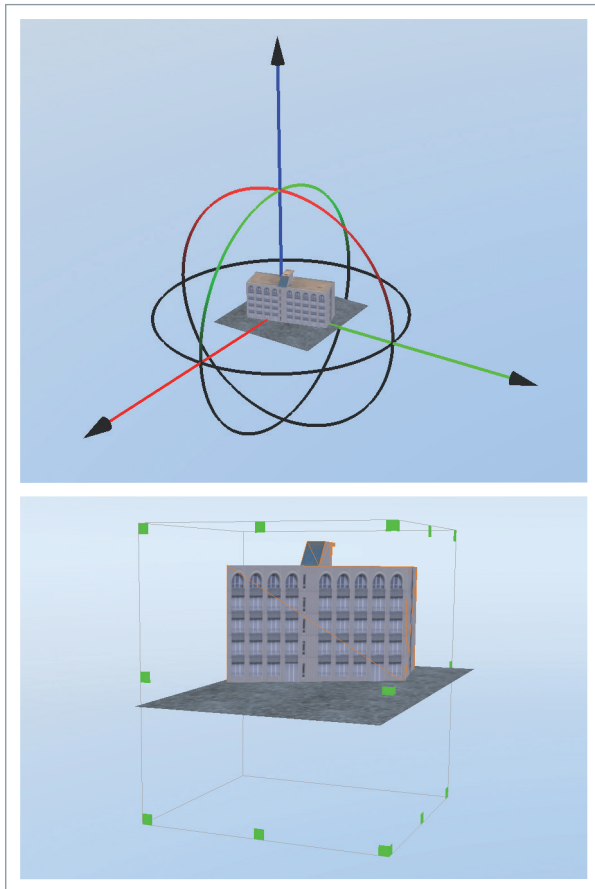
- **By using the Option SE-AGETIM-LIGHT-EMF:** 3D object/scenario creation for EMF Visual from SIG database.
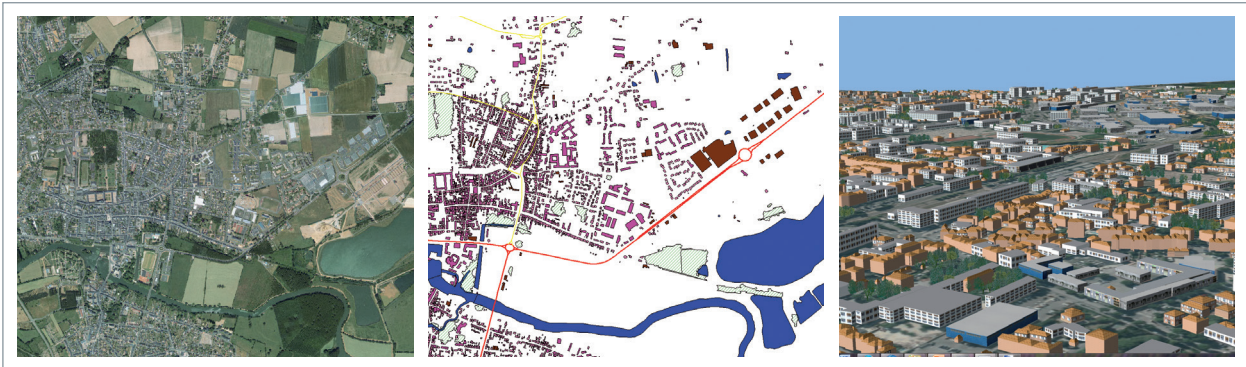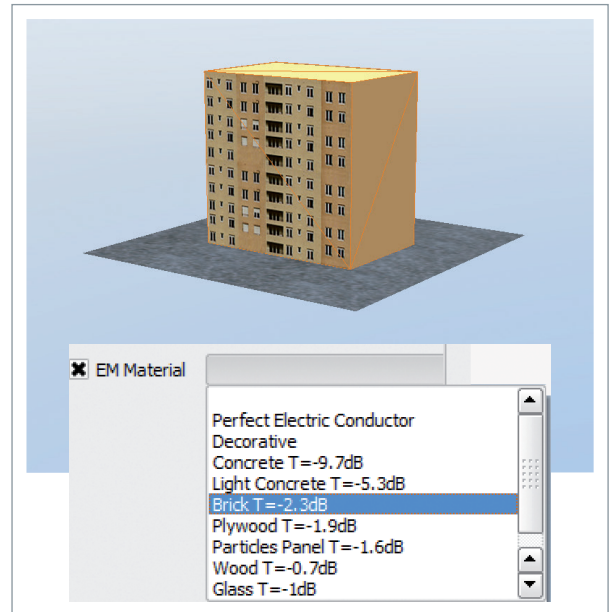

- **By using the Option SE-FFT-EMF (File Format Transfer):** 3D files converter for EMF Visual.

- 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.
- Over 500 KATHREIN antennas for 2G, 3G, 4G 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.
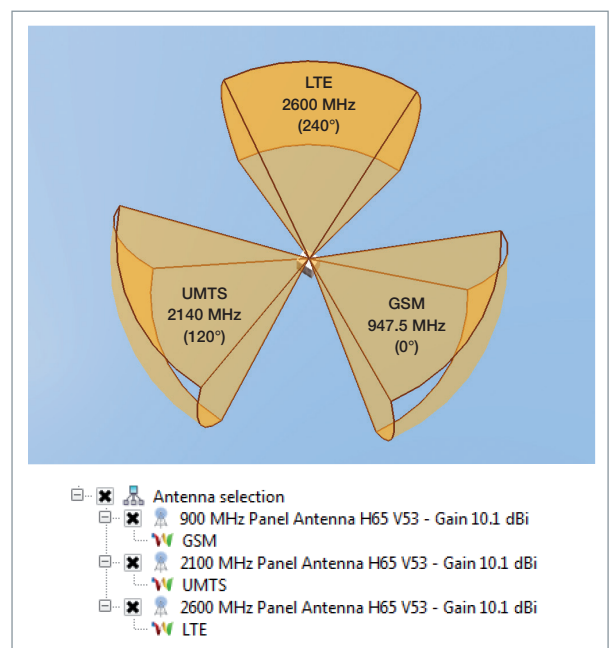
THE 5ᵀᴴ GENERATION OF MOBILE RADIO COMMUNICATION (5G) use Massive MIMO antennas with beam steering capability to control actively the direction of propagation.
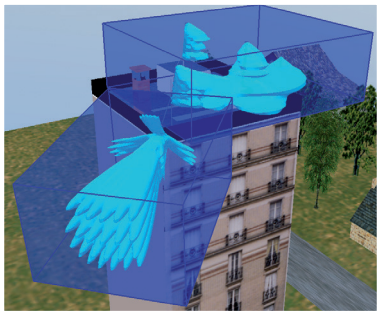

EMF Visual integrates a Massive MIMO antenna database with 2D array antennas working at 3.5GHz, 28GHz, 39GHz together with a dedicated function for adjusting easily the beam steering range in azimuth and elevation.

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.
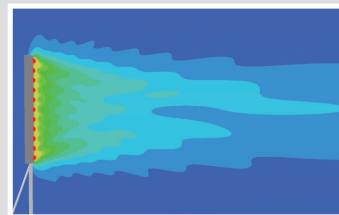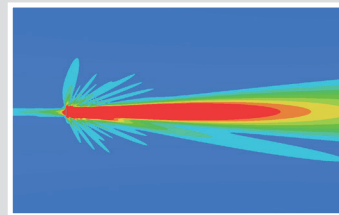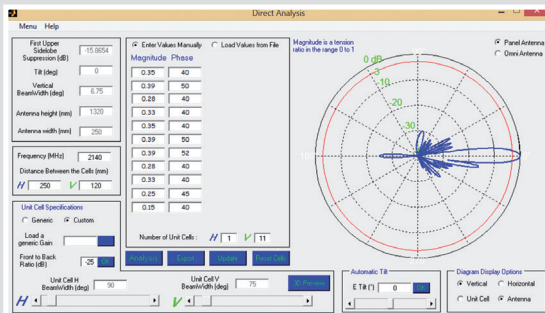
STEP 3: COMPUTATION

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

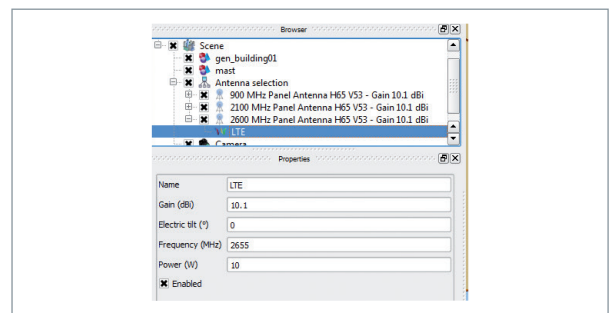|	
Intel Core i7 CPU	3.20 GHz
RAM	8 Go
NVIDIA GeForce GTX 750 Ti	4 Go

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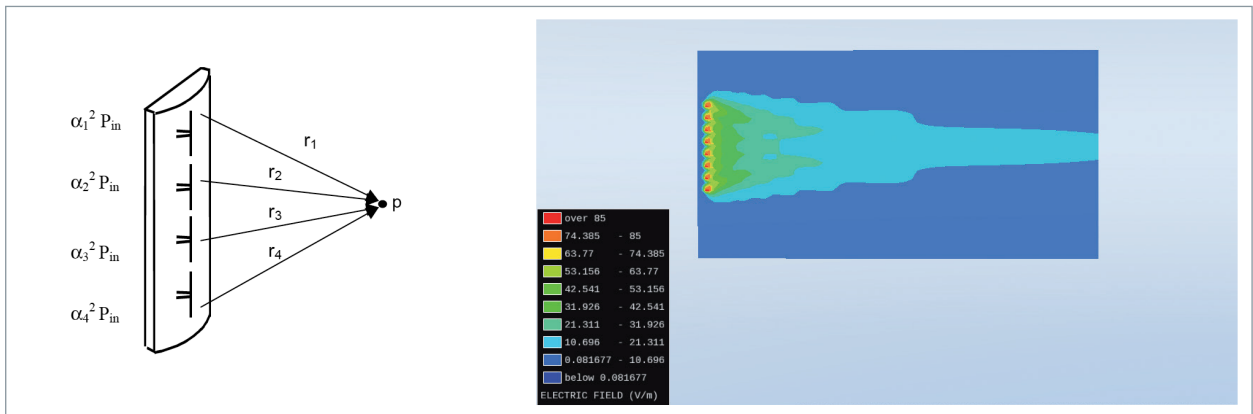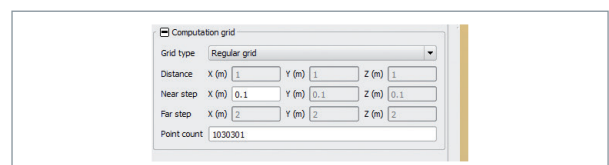

- Definition of a computation volume around the area of interest.
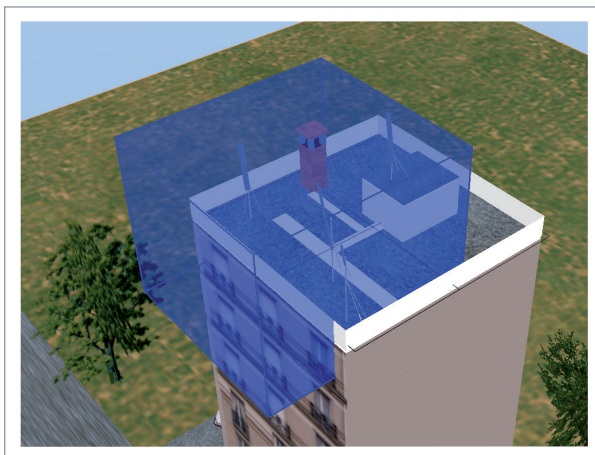
- Selection of the active antenna.

- Adjustment of the mesh step (number of computation points).
- Non-uniform grid to improve resolution around the antennas and to speed up the calculations.
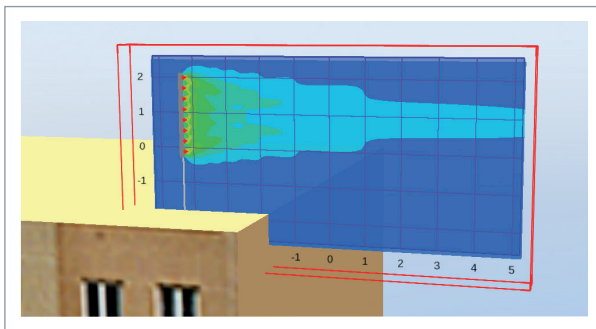
STEP 4: RESULT DISPLAY

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.

Iso-surface	Vertical cut plane	Horizontal cut plane
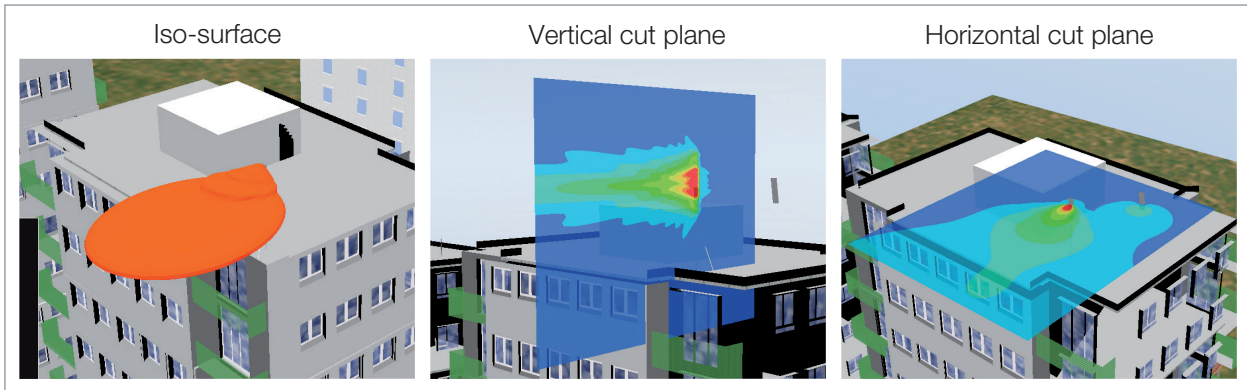
- Multiple cut plane and multiple distance measuring possibilities for security perimeter definition.


- 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.

STEP 5: RESULT EXPORTATION

EMF Visual generates ASCII Txt file (permits result to be loaded in Excel, Matlab…).

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.
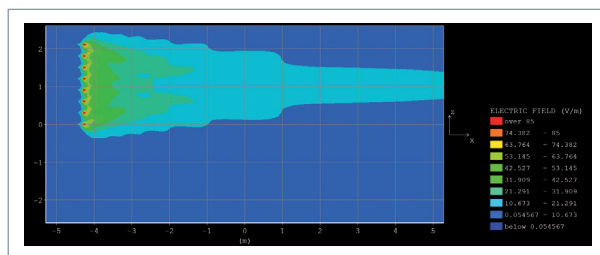
HARDWARE REQUIREMENTS

Processor	PC Pentium > 2 GHz
Graphical Board	NVIDIA using CUDA 5.0 ("Compute Capability" of the card greater than 1.1)
Interface	USB Port
Operating system	WIN7 / WIN8 / WIN10
Memory	> 2 GB RAM
Free space	1 GB free space on hard disc

Did you know?

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.

SE-AGETIM-LIGHT-EMF

SE-AGETIM-LIGHT-EMF is a simple terrain generation tool. Any user should be able to generate a virtual 3D scene for EMF-VISUAL. The user can import existing data (planimetry, altimetry, photography), and slightly modify parts of it. The data are automatically treated (corrected, simplified, kept or ignored in the generation process…), and the result is a 3D scene ready to be imported by EMF-VISUAL.

The GIS (Geographical Information System) user interface of SE-AGETIM-LIGHT-EMF also requires the third party GlobalMapper™ software that is included in the SE-AGETIM-LIGHT-EMF software delivery.

The basic features of SE-AGETIM-LIGHT-EMF are the following:

- Source data acquisition via internet (format : shapefile, dted etc…)
- Terrain generation (minimizing GIS operation)
- Priority to the realism and aesthetic of the generated DB
- Robustness with regard to the quality of source data
- Opportunist approach: if the source data is good, it is used, if not ignored.

SE-AGETIM-LIGHT GUI
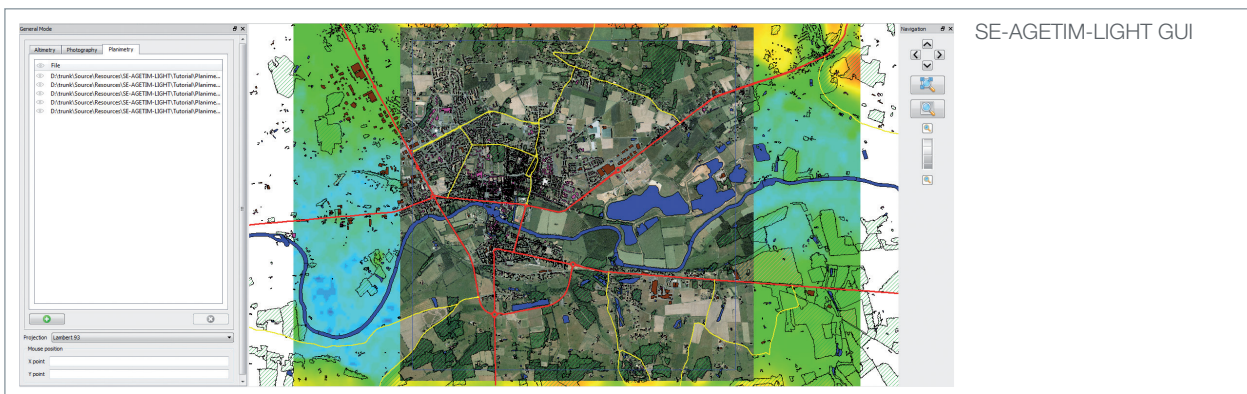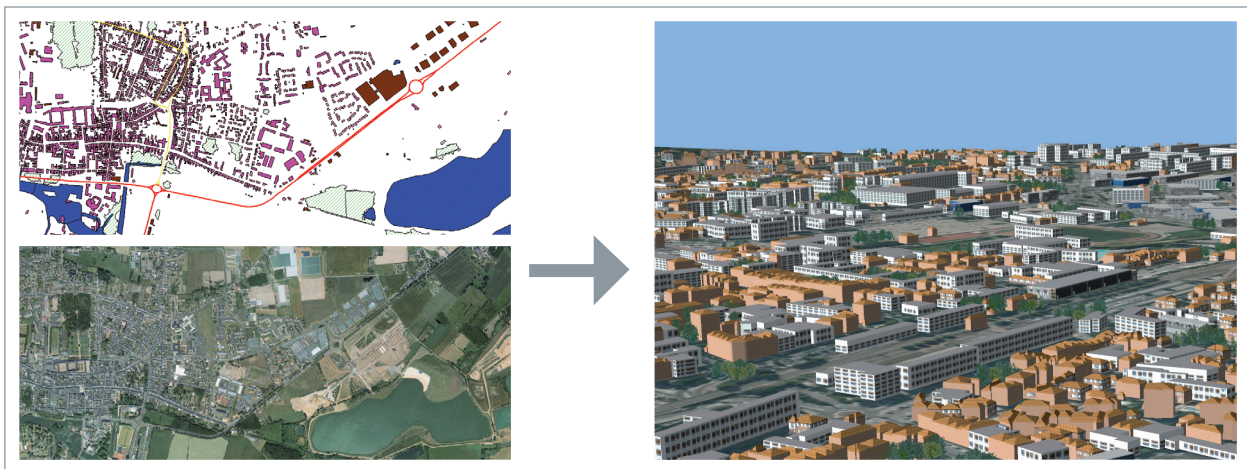
SE-FFT-EMF

SE-FFT-EMF (File Format Transfer) product is a 3D geometric data converter, from and to the EMF-VISUAL format (called SDM format). It handles meshed databases (polygons characterized by textures, colors, etc.) used to describe terrains, objects and targets.

SE-FFT-EMF enables the conversion from OpenFlight, OpenInventor, VRML or TDF formats, towards the SDM format and vice versa (except for the TDF format). It also enables the conversion from the SDM format to the BSG format.

SE-FFT-EMF is made of five groups of software:
- SE-FFT-2FLT, that converts database in the SDM format into OpenFlight files, and SE-FFT-FLT, that does the reverse conversion. The resulting SDM files can be imported by EMF-VISUAL. The resulting FLT files can be imported by the OpenFlight utility programs.
- SE-FFT-2IV, that converts database in the SDM format into OpenInventor or VRML files, and SE-FFT-IV that does the reverse conversion (OpenInventor and VRML files). The resulting SDM files can be imported by EMF-VISUAL. The resulting IV files can be imported by the OpenInventor utility programs.
- SE-FFT-TDF, that converts database in the TDF format into SDM files.
- SE-FFT-2BSG, that converts database in the SDM format into BSG files.
- SE-FFT-2SEDRIS, that converts database in the SDM format into SEDRIS STF files, and SE-FFT-SEDRIS that does the reverse conversion. The resulting SDM files can be imported by EMF-VISUAL. The resulting STF files can be imported by the SEDRIS utility programs.

For the OpenFlight module, the versions of the formats supported by the two software components are:
- FLT to SDM: OpenFlight 14.2 to 16.4 and SDM 3.0 for SE-FFT-FLT
- SDM to FLT: SDM 3.0 and 15.8 for SE-FFT-2FLT

For the OpenInventor/VRML module, the versions of the formats supported by the two software components are:
- IV to SDM: OpenInventor, VRML 1.0 and 2.0 and SDM 3.0 for SE-FFT-IV
- SDM to IV: SDM 3.0 and OpenInventor or VRML 2.0 for SE-FFT-2IV

For the TDF module, the TDF format versions handled are the 10.0 and 11.3 and the format SDM 3.0.

For the BSG module, the BSG format version handled is the 1.0 and the format SDM 3.0.

For the SEDRIS module, the versions of the formats supported by the two software components are:
- SEDRIS to SDM: SEDRIS 4.1 and SDM 3.0 for SE-FFT-SEDRIS
- SDM to SEDRIS: SDM 3.0 and SEDRIS 4.1 for SE-FFT-2SEDRIS

▰ SE-SKP-EMF

A plugin for the tool SketchUp[1] is also available as an option. Thanks to this tool, the user can create, from scratch, a model or download it from the Trimble SketchUp library[2] and convert it into the SDM Format.

All the formats compliant with SketchUp interface can be converted into the SDM format.

SketchUp™ plug-in

[1]https://www.sketchup.com/
[2]https://3dwarehouse.sketchup.com
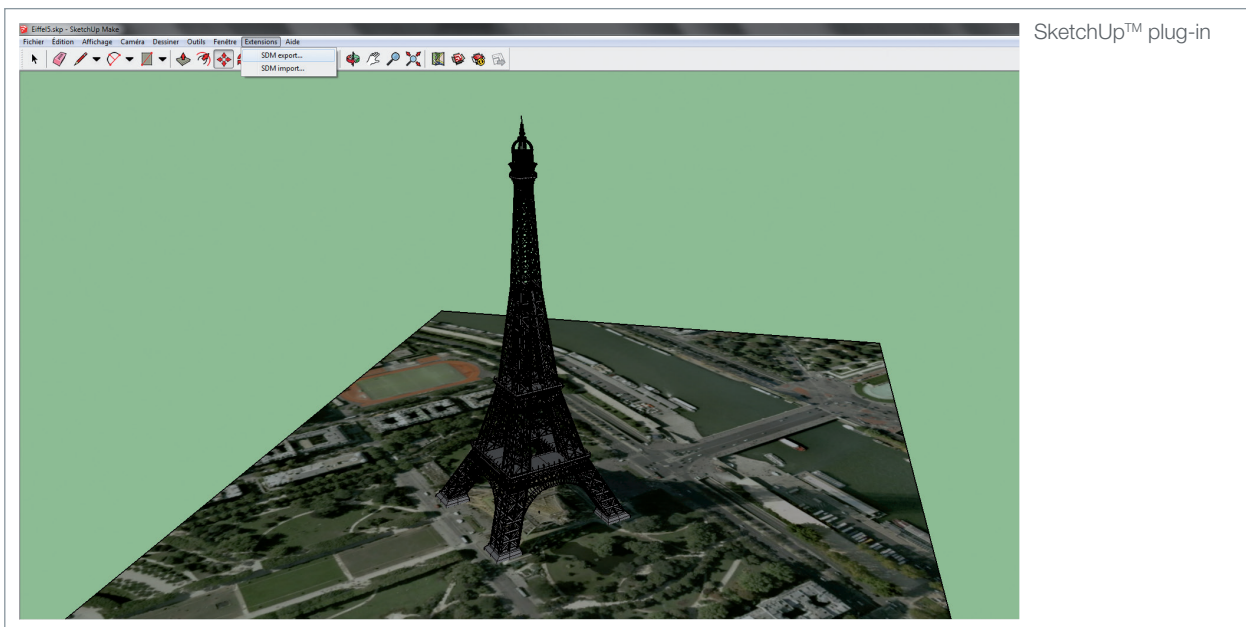
MVG - Testing Connectivity for a Wireless World

The Microwave Vision Group offers cutting-edge technologies for the visualisation 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/contact**

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