XGSLab

The development of XGSLab software began in 1990 and the first module was available in 2005. Since then, XGSLab has been continuously improved as much as in performance, ease of use and with its 2D/3D graphical output.

ELECTROMAGNETIC SIMULATION FOR POWER, GROUNDING AND LIGHTNING PROTECTION SYSTEMS XGSLab (or shortly **XGS)** is one of the most powerful software of electromagnetic simulation for power, grounding and lightning protection systems and the only software on the market that considers International (IEC/TS 60479-1:2018), European (EN 50522:2010) and American (IEEE Std 80-2013) Standards in grounding system analysis.

XGS INCLUDES THE MODULES:

➢ GSA (Grounding System Analysis) for basic application with underground systems
➢ GSA_FD (Grounding System Analysis in the Frequency Domain) for general applications with underground systems
➢ XGSA_FD (Over and Underground System Analysis in the Frequency Domain) for general applications with overhead and underground systems
➢ XGSA_TD (Over and Underground System Analysis in the Time Domain) for general applications with overhead and underground systems
➢ NETS (Network Solver) solver for multi-conductor and multi-phase full meshed networks.
➢ SHIELD is a powerful full 3D graphical application for the evaluation of the protection of structures from direct lightning strokes using the Rolling Sphere and the Eriksson methods.

GENERAL:

➢ XGSLab has got a broad field of application because the implemented calculation model is for general use and solves the Maxwell's equations considering the earth effects by Sommerfeld integrals.
➢ Step voltage calculation is now possible from steps 0.25 m (0.82021 ft) long.
➢ Implemented the new Seasonal Analysis that allows to consider the soil model variations depending on the temperature expected for a location.
➢ We have performed Speed Test which has proved fastest response. We found there is fastest Computer Program in built. In XGSLab reached this High Speed in Calculation by following directions:
　　1.Algorithmsoptimization
　　2.Parallel Computing
➢ We have started to implement a new graphic based on OpenGL, the industry standard for high performance 3D vector graphics used in the fields of CAD, virtual reality, scientific visualization, flight simulation.
➢ All modules include a tool for the soil analysis that can calculate a uniform or double layer soil model starting from measured soil resistivity data, with an additional soil covering layer
➢ The software can import from "dxf" file with single or multiple electrodes of any shape. GSA_FD and XGSA_FD need to know also the electrodes topology and then include an algorithm for the automatic recognition of the connection between conductors and the construction of the incidence matrix.
➢ All modules include libraries with typical properties of materials and offer the possibility to choose the language (English, German, Spanish, Italian and French).

XGS ESSENTIALLY CAN BE USED TO THE CALCULATION OF:

➢ GROUNDING SYSTEMS
➢ CATHODIC PROTECTION SYSTEMS
➢ ELECTROMAGNETIC FIELDS
➢ ELECTROMAGNETIC INTERFERENCES
➢ FAULT CURRENTS DISTRIBUTION
➢ LIGHTNING PROTECTION SYSTEMS

XGSLAB REQUIRES THE FOLLOWING SET OF INPUT DATA:

➢ REFERENCE STANDARD (IEC, EN, iEEE-80)
➢ SOIL DATA (soil model an parameters)
➢ LAYOUT DATA (geometry, topology and cross sections)
➢ ELECTRICAL DATA (injected currents or imposed EMF)

Output results depend on the module in use and in any case are available in numerical or graphical format. XGSLab produces professional color graphics based on orthographic or isometric projections ready to be used in engineering reports.

MORE DETAILS ABOUT MODULES

➢ **GSA** is a widely utilized and recognized module for earth grid calculation and design including soil resistivity analysis. GSA is based on a PEEC static numerical model and to the equipotential condition of the electrodes and can analyses the low frequency performance of grounding system composed by many distinct electrodes of any shape but with a limited size into a uniform or multilayer soil model.

➢ **GSA_FD** is a module for earth grid calculation and design in the frequency domain, including soil resistivity analysis and represents the state-of-the-art grounding software. GSA_FD is based on PEEC full wave numerical model and can be applied in general conditions with systems composed by many distinct electrodes of any shape, size and kind of conductor (solid, hollow or stranded and coated or bare) into a uniform, multilayer or multizone soil model in a large frequency range from DC to about 100 MHz. It is moreover important to consider that GSA_FD can consider the frequency dependence of soil parameters according to many models and in the model with a consensus indicates in the CIGRE TB 781 2019

➢ **XGSA_FD** extends the GSA_FD application field to the overhead systems. Also, XGSA_FD is based on a PEEC full wave numerical model and can be applied in general conditions in the same frequency range of GSA_FD. XGSA_FD can also manage catenary conductors and bundle conductors too and can consider sources where potential or leakage current and longitudinal current are forced and independent by other conditions. For these reasons XGSA_FD is probably one of the powerful and multipurpose tool on the market for these kind of calculations.

➢ **XGSA_TD** is a powerful module which extends the XGSA_FD application field to the time domain. In the regard, XGSA_FD uses the as called "frequency domain approach". This approach is rigorous and allows considering the frequency dependence of soil parameters. Kas known, a transient can be considered as the superposition of many single frequency waveform calculated with the forward fast fourier transforms (FFT).

➢ **NETS** is a very flexible tool able to solve full meshed multi-conductor and multi-phase networks taking into account all the neutral conductor's paths as well as the earth path. NETS is based on Kirchhoff laws for multi-conductor and multi-phase systems. This approach is general and overcomes the limits of the classic symmetrical components method and can be used to represent power systems as multi-conductor networks enabling the consideration of asymmetrical and/or unbalanced systems also in presence of grounding circuits or circuits with a different phases number.

➢ **SHIELD** considers International (IEC 62305-3:2012), European (EN 62305-3:2012) and American (IEEE Std 998-2012) Standards. When the Rolling Sphere Method is set, SHIELD first generates a 3D surface corresponding to all possible points that can be touched by the surface of the sphere with a specific radius as it rolls over the air termination system.
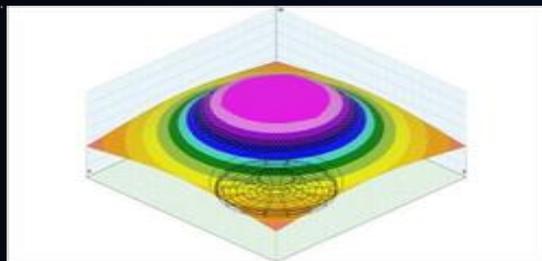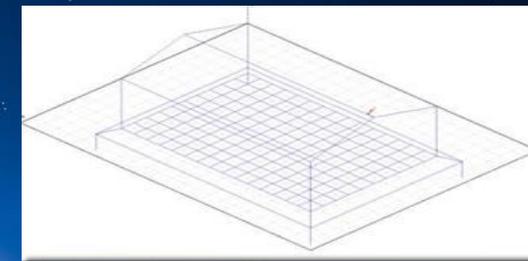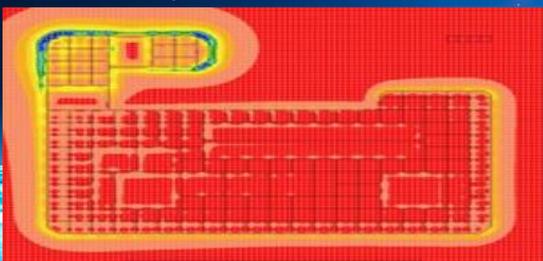
Earth surface potential
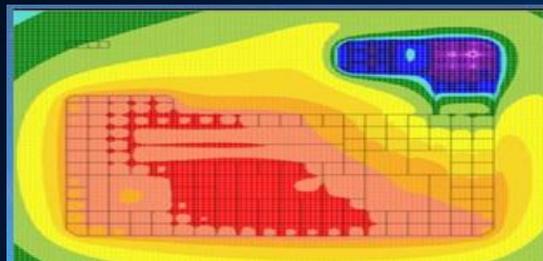
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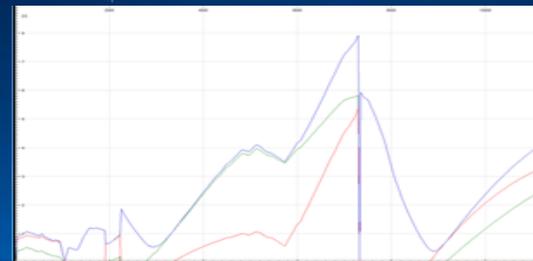
Included potential along the pipeline
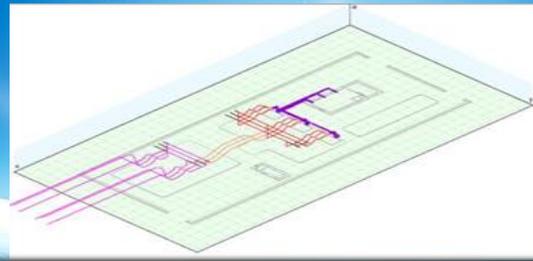(Blue magnitude, green real, red imaginary)
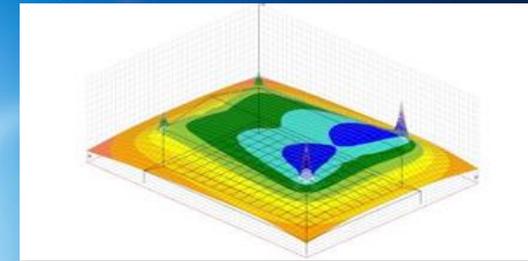

Lightning stroke on a LPS

Earth surface potential with floating electrode
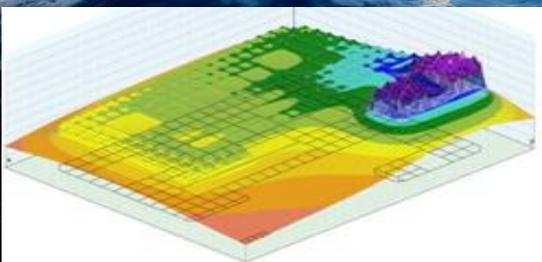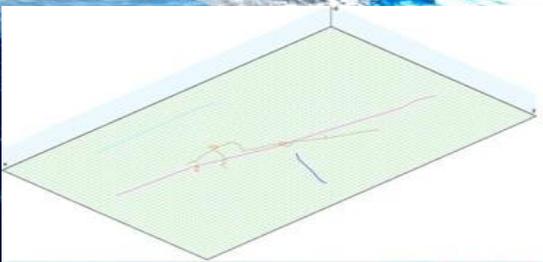

Step voltage

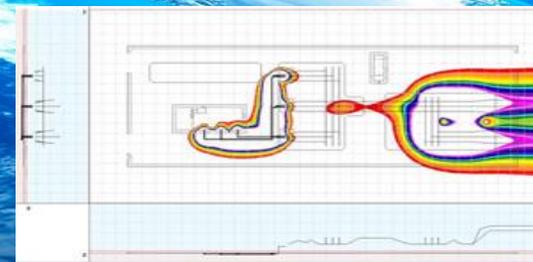Currents along the main conductors in an electrical substation
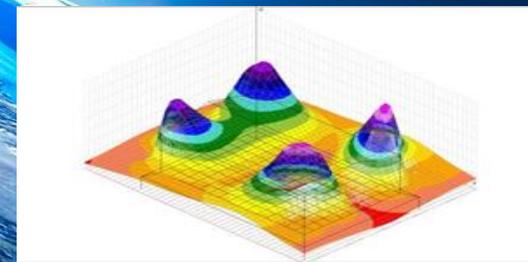

Earth surface potential-1mhz

Earth surface potential

Currents along the main conductors in an electrical substation

Interference layout between overhead power lines and buried pipeline (green)

Magnetic field on an horizontal section (between a given range)

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