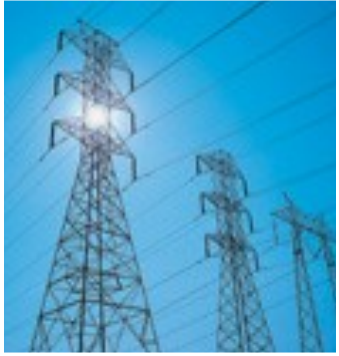# Tools & Utilities

Several tools and utilities are provided with the software packages of SES in order to help you speed up the input tasks, automate repetitive runs and expedite the output processes. SES software package unleashes all of its engineering power through an unprecedented level of data input and results display simplicity, which dramatically increases productivity.

1 *Powerful*

2 *Automated*

3 *Integrated*

4 *Flexible*

World Leader in Grounding & EMI

www.sestech.com
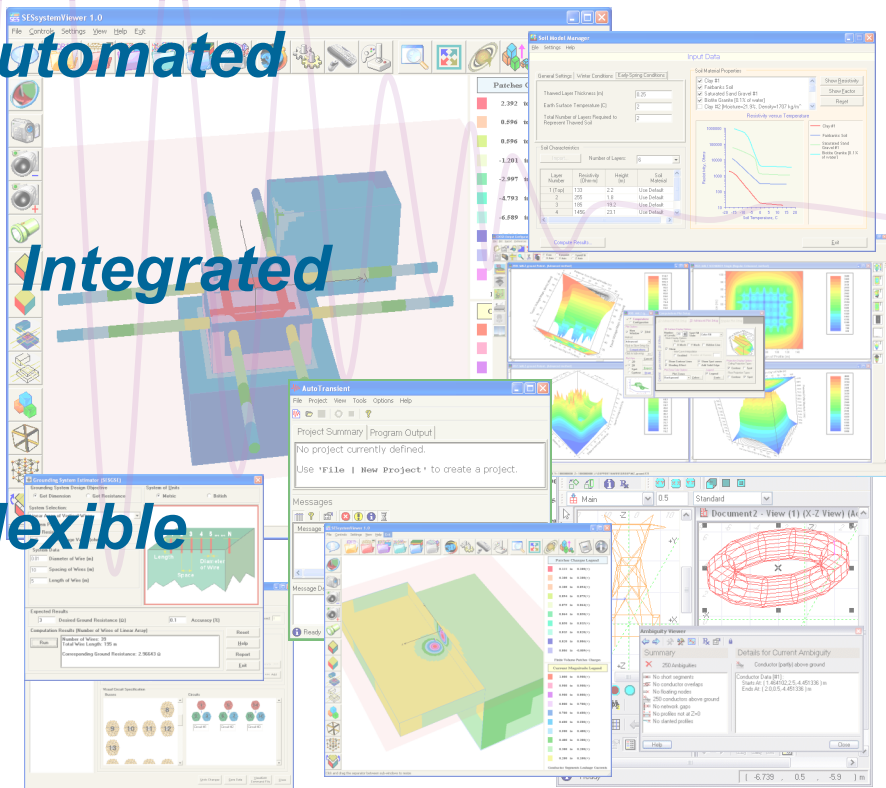
AutoTransient

The AutoTransient tool automates the analysis of transient phenomena carried out with HIFREQ and FFTSES. It runs both programs in turn, using the computation frequencies recommended by FFTSES to run HIFREQ, until user-defined termination criteria are met. It also builds the FFTSES computation databases from the resulting HIFREQ databases (F21 files). Using the FFT21Data tool, it can create 2D and 3D time-domain animation plots.
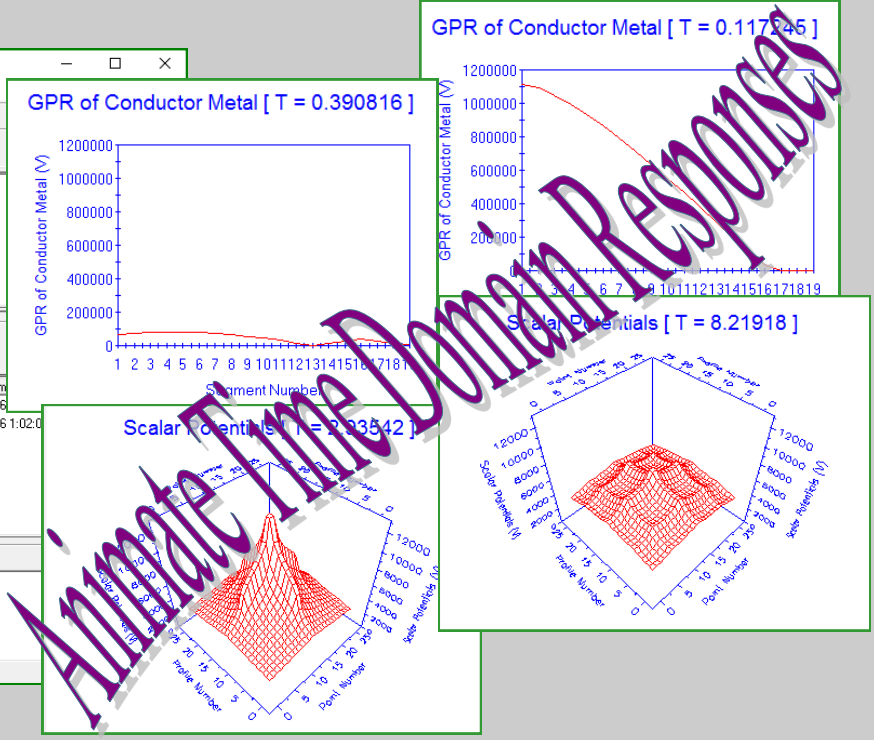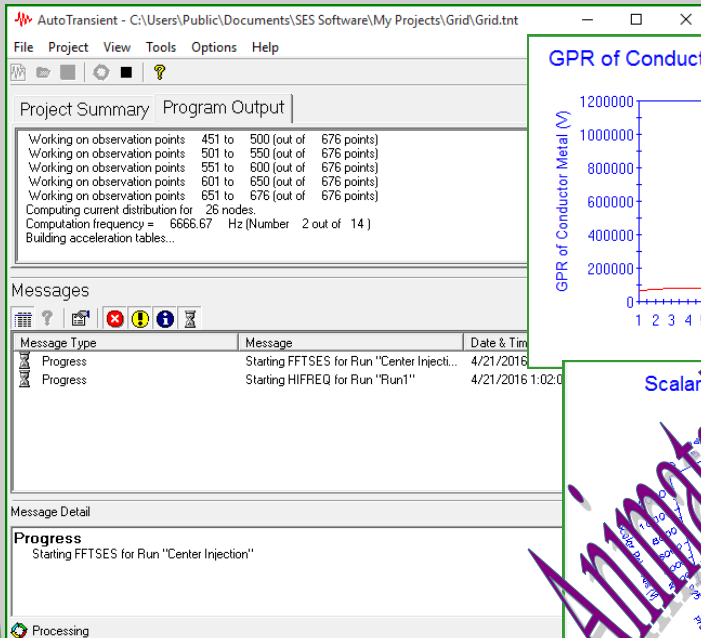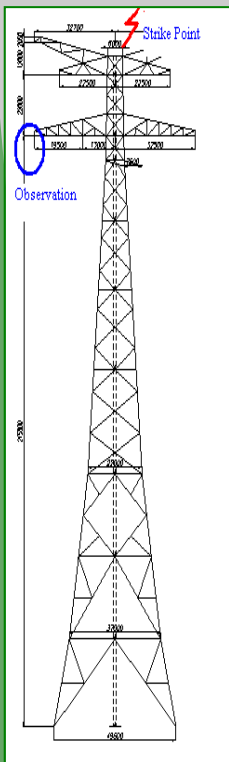
Technical Highlights

♦ The AutoTransient program carries out the standard steps of a HIFREQ-FFTSES transient study automatically. Starting from template FFTSES and HIFREQ files, the program runs the Forward FFTSES and finds the first set of recommended computation frequencies. After running HIFREQ at those frequencies and building the FFTSES Input Databases, the program runs the Inverse FFTSES and deduces the next set of recommended frequencies. This last step is repeated until the termination criteria are met.

♦ You can choose to stop the program once there are no more recommended frequencies, when a specified amount of time has elapsed, or when a specified number of cycles of the above procedure have been carried out.

♦ When running HIFREQ, you can choose to run all recommended frequencies, or to run only one frequency at a time. This last method, which would be very cumbersome to do manually, gives a lot of flexibility since many electrical properties (resistivities, permeabilities, etc.) can be varied as a function of frequency. The program allows you to specify frequency-dependent soil characteristics through a simple dialog. With a little bit of programming effort, you can specify a frequency dependence for any quantity defined in the HIFREQ template file.

♦ The program performs data cross-validation between HIFREQ and FFTSES, to help avoid the most common data entry problems in a transient analysis.

♦ You can interrupt the analysis at any time, then restart it where you left off.

♦ The program includes the EM Calculator tool that can help determine the optimal conductor segmentation to use when performing a transient analysis.

World Leader in Grounding & EMI

A software tool that extracts data directly from the frequency to time domain conversion software database files and displays it in various graphical forms, including 2D and 3D animations

FFT21Data

FFT21Data is a utility that extracts data directly from FFTSES' database files and exports it in a spreadsheet-compatible format. It can also display this data in graphical form, and create animation plots of the data.

FFT21Data extracts (or displays) the data as a function of space (*i.e.*, point number, profile number or conductor segment number). The data can be examined at a specified instant in time; alternatively, the maximum (minimum) value that the data takes at all times can be examined. This functionality complements what is already available in SES software.
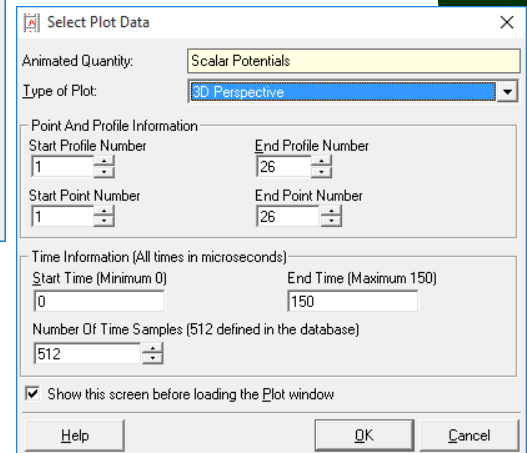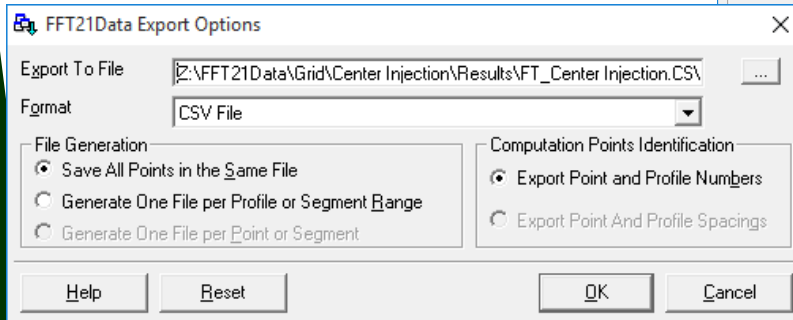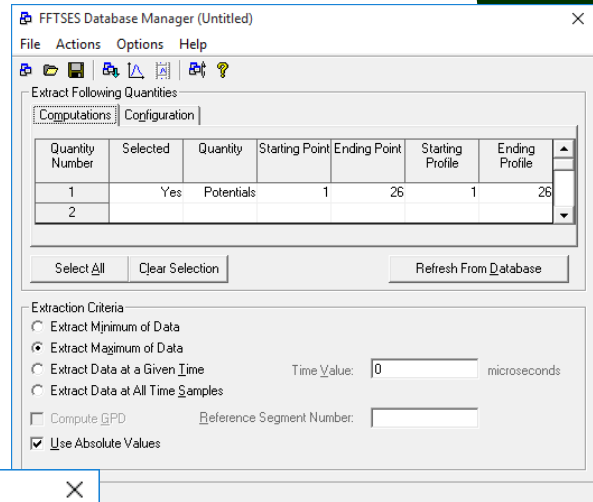
By combining plots taken at several instants of time, the utility can also display animated 2D and 3D plots, showing the time evolution of the computation results along a specified range of computation points or conductor segments.

World Leader in Grounding & EMI
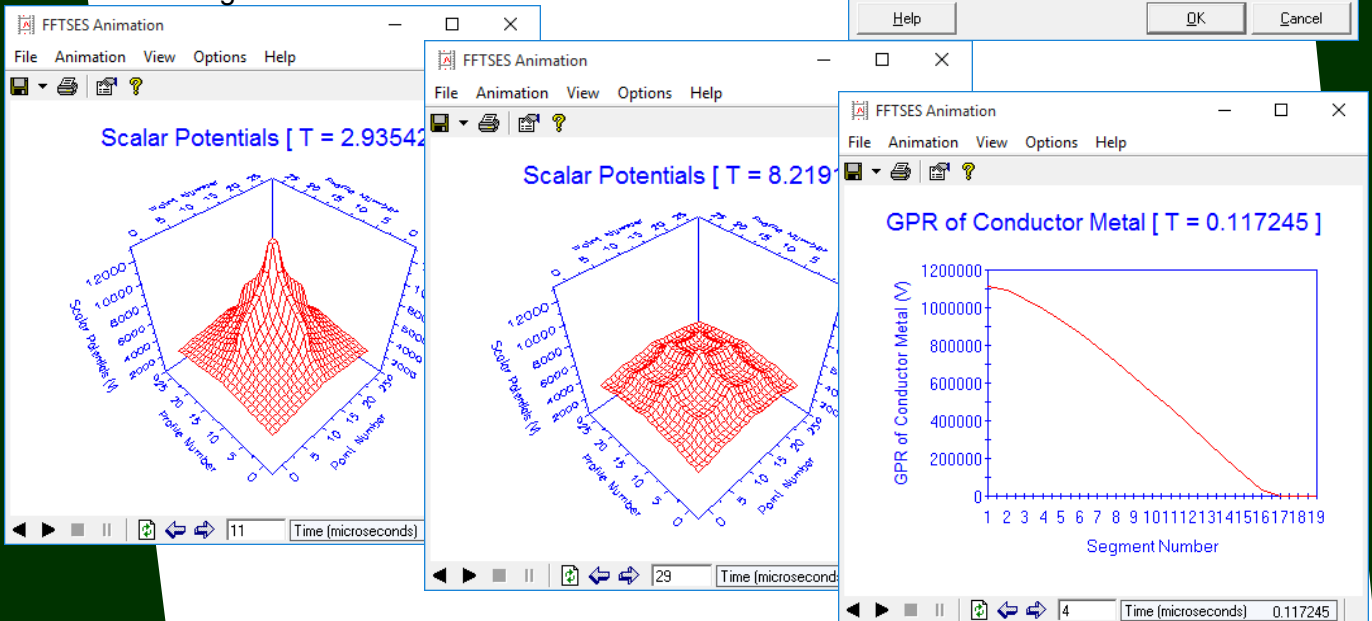
GraRep

GraRep displays and prints graphics, reports or text files from existing files or sent from **Output Toolbox**.

GraRep allows you to zoom in on a selected portion of a picture, scale a picture up or down, view up to ten pictures simultaneously, customize the printing of plots, and view and print reports, messages and text. GraRep is used internally by the Output Toolbox and other SES software to display computation results graphically or in report form. The program can also be used in "standalone" mode, i.e., it can be started as a Windows executable, independently of Toolbox.
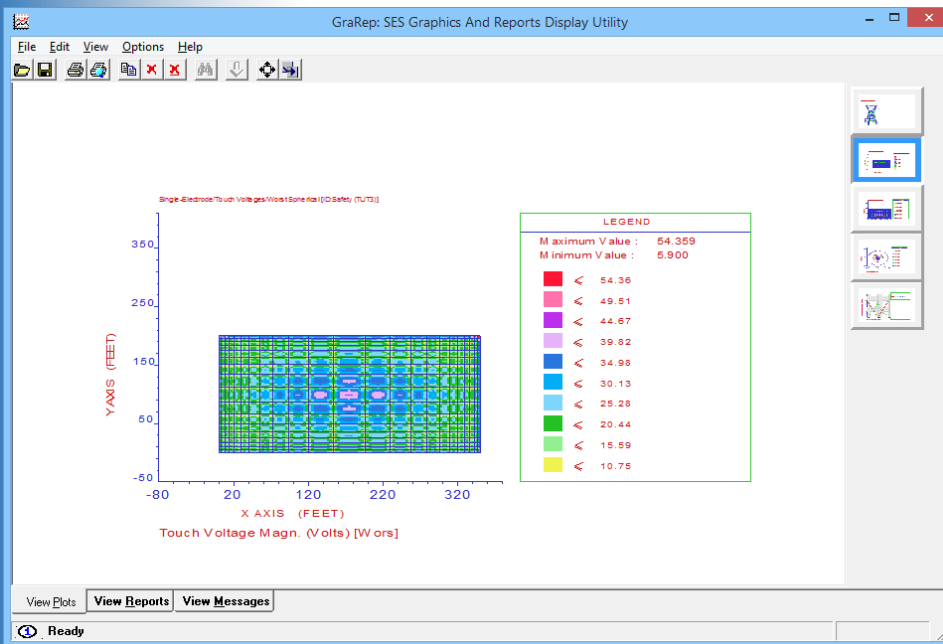
View Plots Tab

In the View Plots Tab, you can display various plots produced by Output Toolbox and others:

- 2D Spot plots that provide color coded results to quickly and clearly detect areas of concern for Touch Voltage, Step Voltage, Soil GPR, Magnetic Field etc.

- These same quantities represented as 3D surfaces.

- Contour plots that display user-defined boundaries. Ideal for displaying Zone of Influence.

- Results for individual conductors displayed on the conductor network, either with text, color or both, for multiple representations of a quantity: magnitude and angle, or real part and imaginary etc...

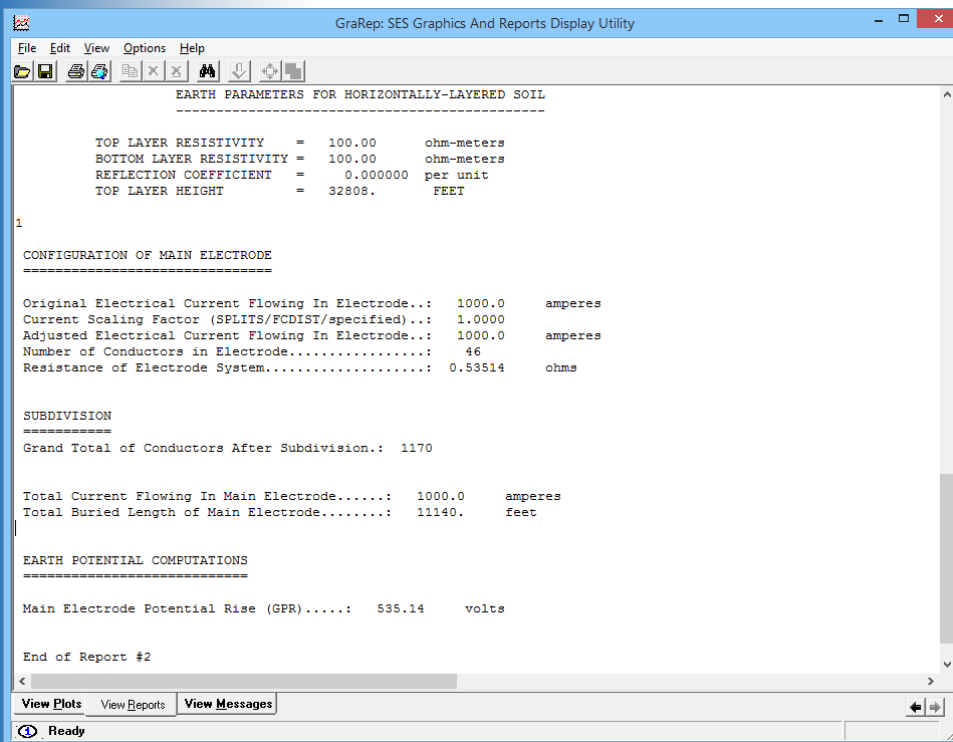- Standard 2D plots for multiple profiles or phases, simultaneously.

www.sestech.com

World Leader in Grounding & EMI
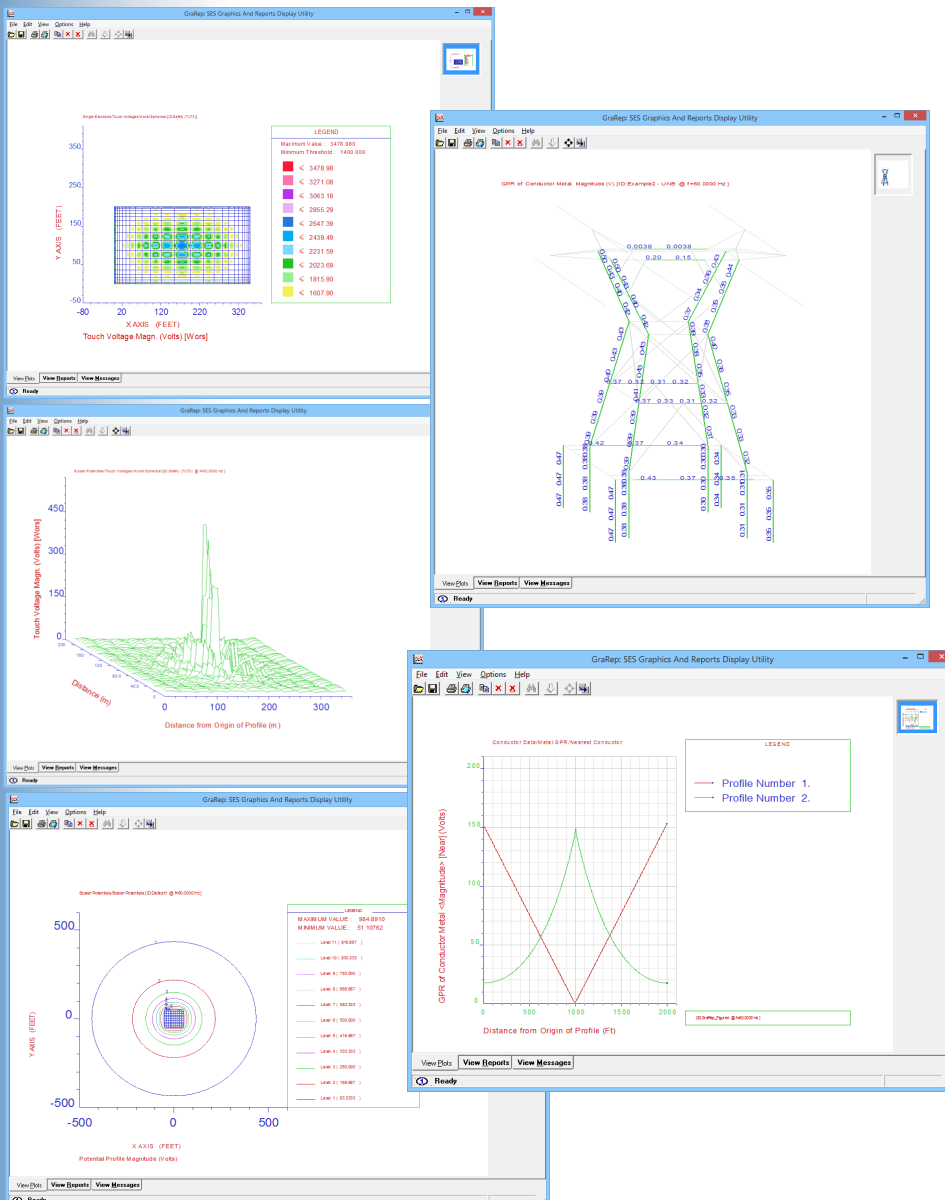
GraRep

View Plots Tab

- The View Plots tab is separated into two major areas: the main viewing area, and the Picture Button queue at the right edge of the window.

- When a picture is first loaded, it is displayed in the main viewing area and a Picture Button showing a thumbnail version of the picture is created and added to the queue.

- Pictures can be deleted, saved or copied at any time. Furthermore, pictures can be moved, scaled or zoomed using simple mouse movements and clicks.

View Reports & View Messages Tabs

- Text reports are displayed in the **View Reports** tab. The text can be highlighted and copied to the clipboard for use elsewhere, or saved as a pdf file.

- Various types of reports are available, from detailed conductor currents for each conductor segment in a large network, to a succinct summary of key results.

- The **View Messages** tab lists the plot commands being executed and displays any relevant error messages.

GRSplits

A Graphics Input / Output Processor to visualize Circuit Models Created by SES Software Packages

GRSPLITS is a graphics input / output processor that displays the circuit model created by SES software packages that use the SPLITS or FCDIST computation engines (such as Right-Of-Way or MultiLines). This tool greatly simplifies the task of manipulating, visualizing and checking the components of a SPLITS or FCDIST circuit or their computation results.

The entire circuit or only the parts of interest can be plotted. This means that it is possible to plot only the central site or one or more terminals or some specified sections (spans) for a given terminal. Up to four terminals can be displayed simultaneously. The numerical values of the longitudinal and shunt impedances can be printed for each section.

The interconnections between the various phases of a given section are also displayed when their impedance is below a specified threshold value. Identical sections are replaced by a single section, followed by dashed lines if desired. Computation results, such as shunt voltages and series or shunt currents can be displayed at the Central Station, at Terminals and for a range of sections as required. Plots can be produced in most popular formats.
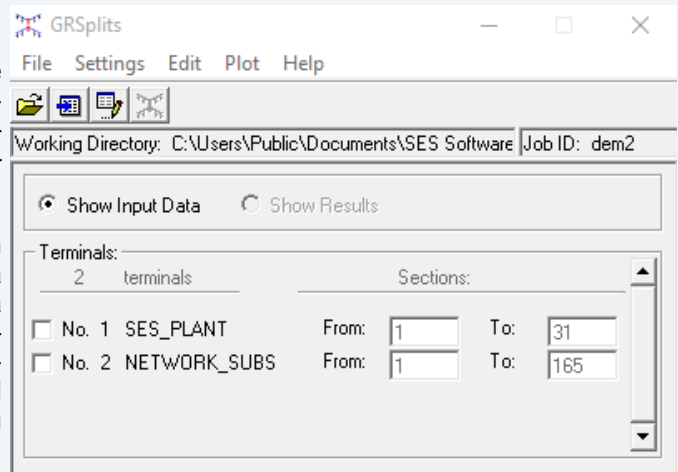
The program analyzes the contents of the input file and displays the results in the **Terminals** frame. The user may select which terminals and sections to display. The **Plot Style** and the **Text** display (**Show Text**) options can be set accordingly. If desired, the graphical settings can be adjusted in the **Settings** menu and the display of interconnections can be turned on or off by choosing an appropriate **Interconnection Threshold**. Once all the options are configured, the circuit plot can be produced by selecting the **Plot Circuit** in the **Plot** menu. The following is a short description of the most interesting options available in the program.

Plot Style Options: This option selects which parts of the circuit are to be displayed. Five options are available: **All**, **Central Site and Terminals Only**, **Central Site Only**, **Sections Only** and **Terminals Only**.

Show Text Options: Selects what kind of circuit data are to be displayed on the plot. Up to five types of data can be simultaneously displayed. **Line Impedances**, **Shunt impedances**, **Source Voltages**, **Connection Impedances** and **Bus Name**.
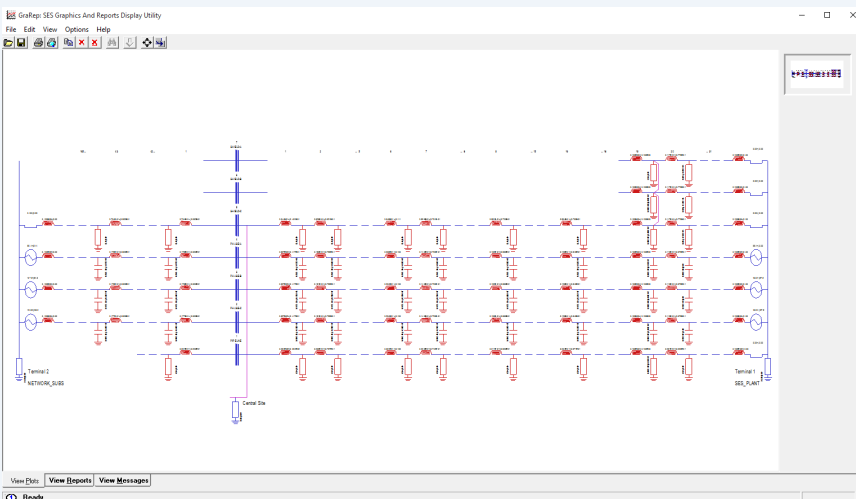
Terminals: Defines which terminals and sections will be displayed. Any combination of up to four terminals can be selected.

Interconnection Threshold: This option on the program's main screen is used to control which mutual connection impedances between the lines of the circuit (interconnections) are shown. The connection impedances below this threshold will be indicated by a line connecting the corresponding wires.

Graphical Settings: The **Graphical Settings** dialog, which can be accessed from the **Set Graphical Factors** item from the **Settings** menu, can be used to control the appearance of the generated plot. The following options are available: **Color**, **Output Device**, **Character Height** and **Rescaling Factor**.

Input File Editor: This item which is invoked by selecting the **Edit Input Data** File item under the **Edit** menu on the program's main screen, can be used to view or modify the currently loaded input file. The editing capabilities of that window are those of a standard, Notepad-like, editor, and are available through the usual keyboard shortcuts.

GRSplits-3D

A 3D circuit visualization tool

GRSPLITS-3D is an input/output processor designed to visualize the circuit model defined in a SPLITS or FCDIST input file. It offers the ability to plot circuit models, and also allows direct interaction with any displayed component. Its 3D engine offers navigation and filtering tools that make circuit visualization and validation an easy task, even for the largest systems.

Intuitive and Visual Data Interaction

GRSPLITS-3D offers many display features and filtering tools that bring circuit inspection to another level.
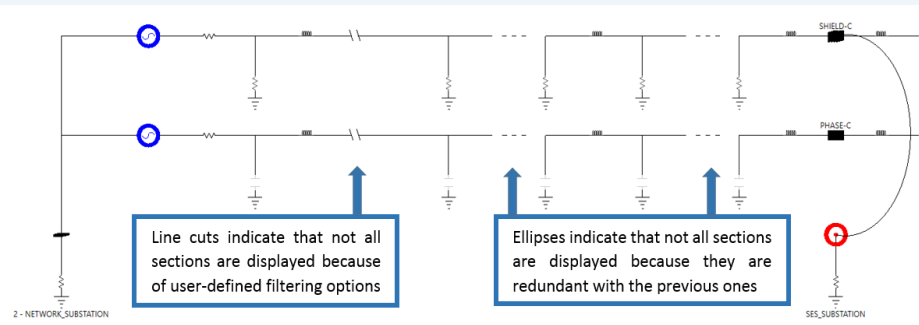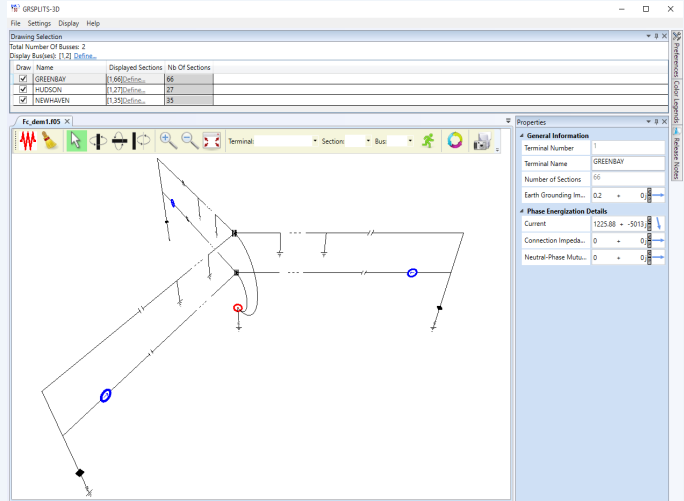
Display Filtering

GRSPLITS-3D offers a wide range of features allowing you to control what is displayed on screen.

The Display Selection panel lets you control which Terminal, which sections, and even which busses should be displayed allowing you to quickly focus on a given area of the circuit that requires a deeper analysis. Many visual cues are present in the drawn circuit to remind the user that only specific areas are currently displayed.

The Display Options panel can also be used to filter the 3D scene output. This panel offers many settings that control what will be displayed and how.

From this panel, you can decide to display the associated results of your circuit, the tooltips when moving in the 3D scene, dynamic text that display the value of each 3D component that are displayed and many more...

Line cuts indicate that not all sections are displayed because of user-defined filtering options

Ellipses indicate that not all sections are displayed because they are redundant with the previous ones

Tooltips

Helpful and concise tooltips appear directly on the circuit viewer showing a summary of relevant circuit parameters.
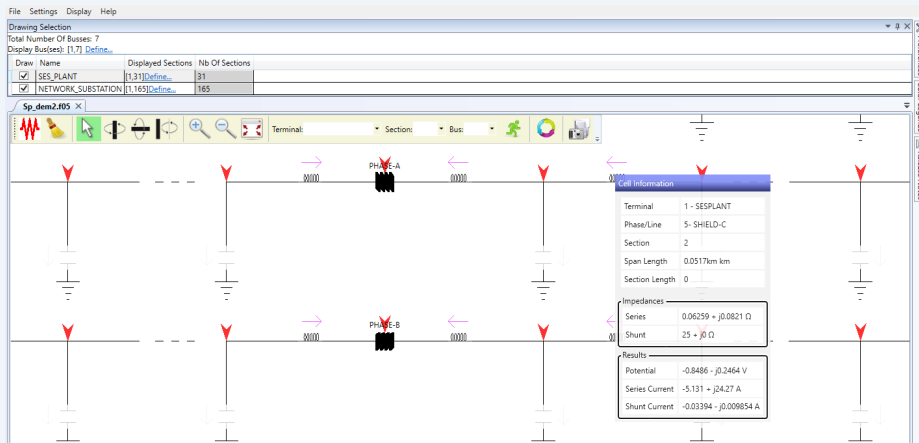
Results Display

Results for section and shunt currents as well as shunt potentials are shown directly on the viewer.

Both the colors and the applicable ranges for the Impedance, Voltage, and Current color legends are fully customizable.
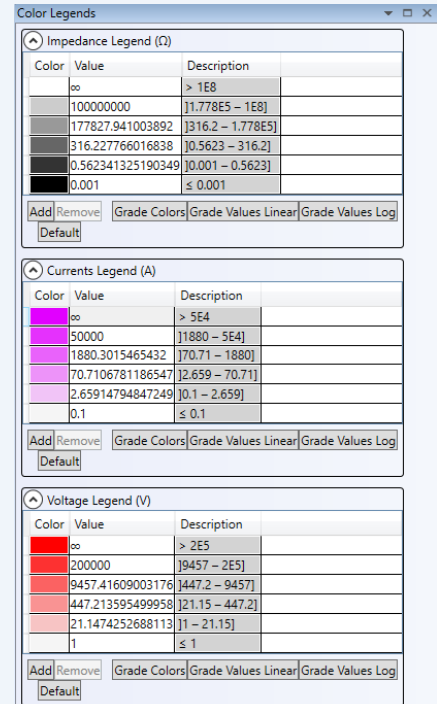
GRServer

An Advanced Graphics and report output processor with input processing capabilities

GRServer can display, plot, and print configuration and computation results obtained using any SES software package. GRServer also has the capability to view the input files, run the engineering modules to populate the computation databases and view output files. In addition, it may be used to view multiple Windows graphics files in its convenient multi-window environment.

GRServer generates reports and plots with ease. The plots which are created in each of the display windows are also created as thumbnails (plot icons) on the sidebar. The thumbnails are used as references to the individual plot windows; clicking on a thumbnail highlights the corresponding plot window. GRServer's multi-window interface allows the creation of as many plots as can be loaded into memory.

The main window allows access to all of the functions which are used for creating reports and plots from the engineering computation database; its multi-document structure makes it an efficient means to compare results and draw conclusions.
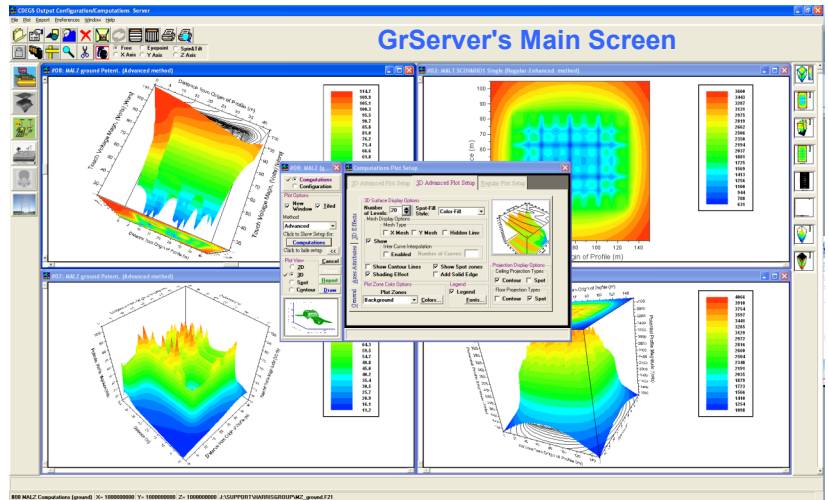
The window menu has six distinct components as shown here. The toolbar provides easy access to the most used features that can also be found in the menu bar. The six program buttons on the left sidebar are for loading the engineering computation databases for the programs other than the currently opened one. Clicking on any of these enabled buttons will automatically load the corresponding database. The plot icons (in the right sidebar) are the thumbnails of the plots created in the plot window space. Since the plot icon sidebar is scrollable, there is no limitation on the number of icons it can contain. Clicking on a plot icon activates the plot window associated with the icon. A popup menu shows up when right-clicking on a plot icon. It allows for the printing, saving, and deleting the plots.

A Few Typical Features
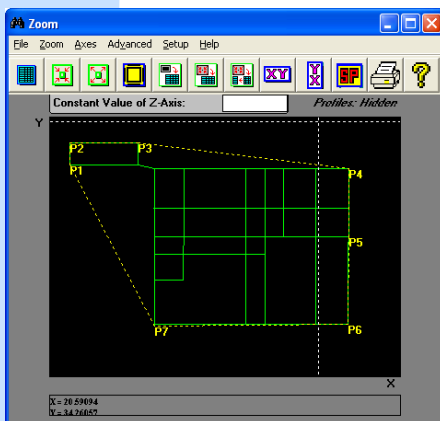
Options Window: The Options window is the entry point for generating configuration and computation plots.

Advanced Features: The 3D computations setup window offers many 3D plots. They include options such as displaying a floor and/or ceiling projection of the graph surface, displaying contour lines and/or spot zones, spot-fill styles, etc.

Zooming In and Out: Zooming to an area is as simple as dragging a mouse over the area boundaries. If necessary a more accurate boundary window can be edited to insure that the required area is defined with great precision.

Previewing and Printing: The Print-Preview window allows the user to move and scale the plot to desired specifications. In addition, it allows the user to import reports generated by the report facilities in GRServer.

3D settings: X/Y-mesh, Colored Spot-Fill, Shading Effect, Legend, Spot Zones and Contour Ceiling Projection.

Saving to a File or Clipboard: Clicking on the Save or Save As menu items from the File menu or from the plot icon sidebar pop-up menu saves the current plot to the designated file. Also, you can copy it to the Windows Clipboard.

Updating the Computation Results: The input file may be modified, printed, and saved from within the built-in editor. The user may rerun the corresponding case immediately to create an updated computation results database.

Using the Zoom Server to Define Zoom Regions: Zoom regions (for the configuration and computation modes) are defined in the Search Zone Vertices grid in the Zoom Options or in the Zoom & Report tab. The zoom coordinates may be entered either manually or by visually selecting a zoom region from the conductor network plot.

www.sestech.com

World Leader in Grounding & EMI

SES-Ampacity

Select the appropriate conductors for grounding or transmission line design applications

SES-Ampacity is a powerful tool that helps selecting appropriate conductors for grounding or transmission line design applications, based on the conductors' thermal characteristics.

The program can compute the minimum conductor size needed to withstand a given current or can determine the conductor ampacity or the conductor temperature rise of bare buried conductors during a fault, or of overhead conductors during a fault or under steady-state conditions.

Bare Buried Conductor

Bare Overhead Conductor

Technical Highlights

Conductor selection is a major factor that must be taken into account during the process of grounding or transmission line design. It is important that the most appropriate conductor type and size be selected for optimum operating efficiency.

The electrical and thermal properties of conductors dictate the choice of conductor type and size for a given design. Factors such as environmental effects, electrical loss, current loading and many others must often be considered in the process.

SES-Ampacity offers two calculation modules that allow you to quickly estimate the required size of buried conductors or to simulate the thermal behavior of above-ground conductors.

A database stores the properties of conductors that are related to their thermal/electrical behavior for a large collection of conductors. This database can be extended with your own conductor data if the predefined ones do not meet your needs.

www.sestech.com

**World Leader in Grounding & EMI**

Bare Buried Conductor

The Bare Buried Conductor module can compute the following quantities:

- Minimum conductor size.
- Ampacity (i.e., maximum fault current rating).
- Temperature rise during a fault and final temperature after the fault.

The assumptions made in the calculations are as follows:

- No heat loss into the surrounding soil (i.e., the heating process is adiabatic).
- The thermal capacity per unit volume (i.e., the product of specific heat and specific weight) of each conductor remains constant during the heating process: this is usually the case for fault durations on the order of a few seconds or less.

The basic equations used in this module are provided in ANSI/IEEE Standard 80 for the calculation of ampacity for symmetrical currents. To account for asymmetrical current characteristics (i.e., dc offset), the symmetrical current is increased in accordance with the decrement factor presented in the same standard.
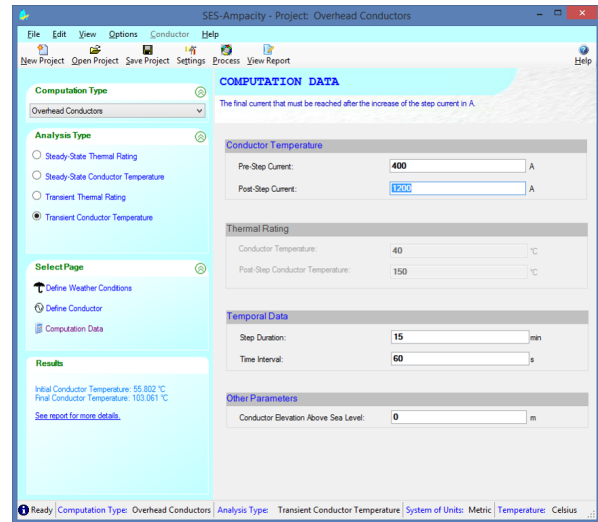
Bare Overhead Conductor

The temperature of an overhead conductor that carries an electrical current is function not only of the magnitude of this current but also of several environmental factors that influence the amount of solar heating and the ability of the conductor to dissipate heat by convection and radiation.
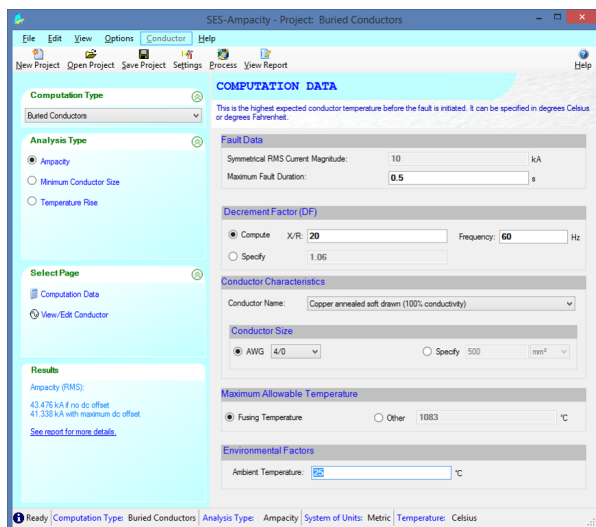
The Bare Overhead Conductor module includes computation methods, based on the procedure described in IEEE Standard 738, relating electrical current to conductor temperature that are used in either of the following two ways:

- To calculate the conductor temperature when the electrical current is known.
- To calculate the current that yields a given maximum allowable conductor temperature.

For those two cases, SES-Ampacity can perform four different computations related to the thermal capacity of bare overhead conductors:

- Steady-State Thermal Rating given conductor temperature.
- Steady-State Conductor Temperature given load current.
- Thermal Rating after a step change in temperature.
- Conductor Temperature after a step change in current.

SES Batch

When performing a study that requires running a large number of files or analysing a multitude of scenarios, it is useful and efficient to be able to prepare many runs, stack them together and let the computer do the work, unattended. That's exactly what SES Batch does: batch processing.

Straightforward Usage
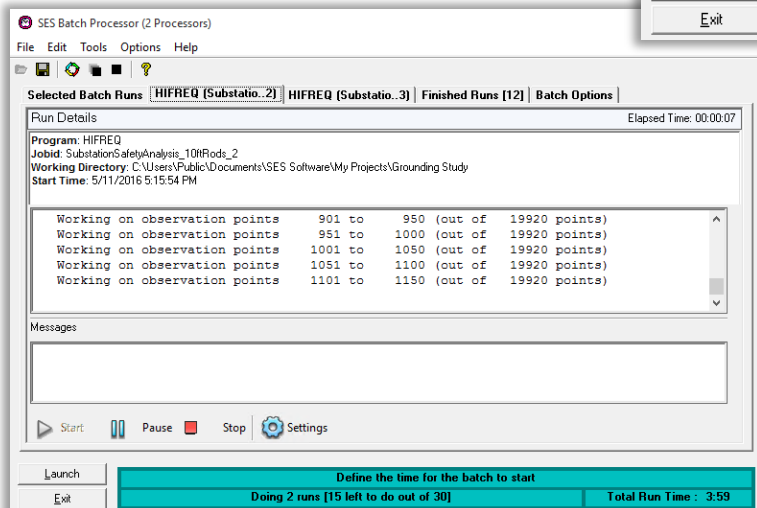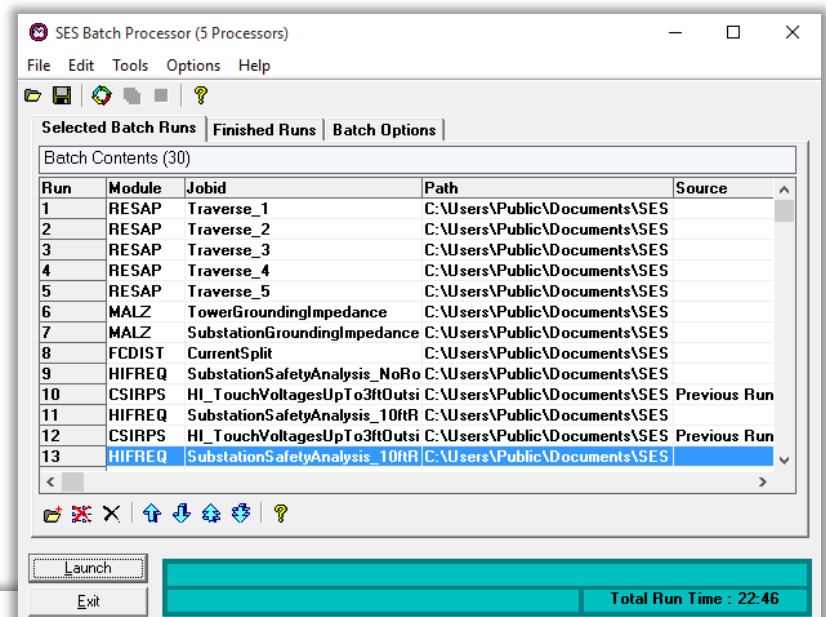
Easily create run lists

- Built-in file browser.
- Drag and drop functionality.
- Order runs by priority.
- Save lists for future use.

Launch runs, continue working

- Subsequent programs start as soon as the previous one terminates.

Monitor progress

- Computation trace of the program that is currently running.
- Status of each completed run.
- Notification when runs done.

Flexibility

Launch

- On demand.
- At a set start time.

While batch processing is in progress

- Add more programs to the list.
- Continue reordering it.
- Pause and resume.

Get the Right Answer

### Automatic multiple run processing opens up possibilities

- Substitute unavailable critical data for a given variable by a parametric analysis of that variable's effect on the results.
- Capture the worst case conditions by running several fault scenarios.
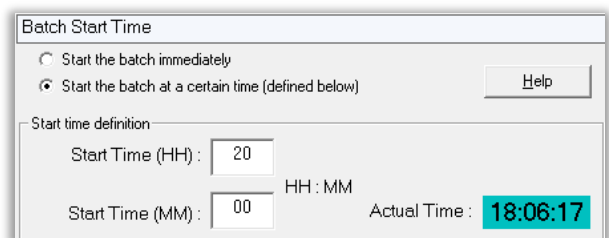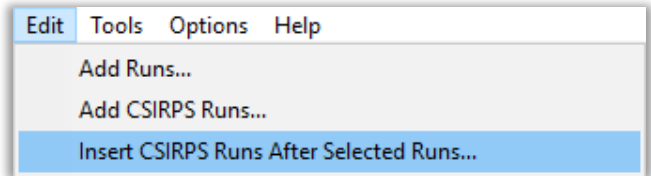
Examine and Process Results

Quick access to outputs

- Log files.
- Output files.
- Plotting packages:
  - Interactive Output Toolbox.
  - GrServer.
  - SESSystemViewer.
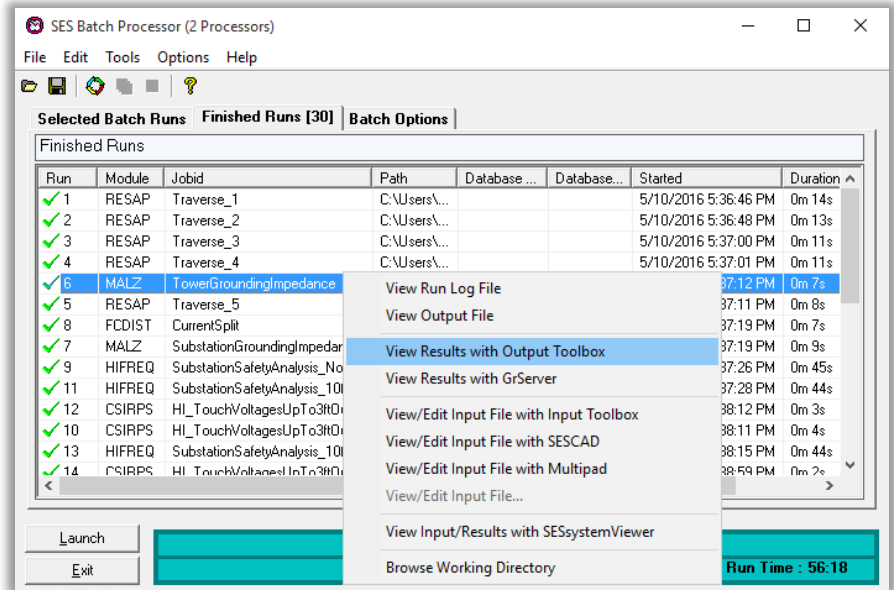
Include plotting and reporting macros in the batch

- For any results database previously computed.
- For results databases yet to be computed by the batch.

Optimize the Use of Your Licenses

Plan runs such as to keep working

- Run a series of cases overnight or over the week-end and have fresh results on which to base your decisions when you come back.

Execution of runs is not just serialized, but parallelized too

- Standard license: up to two runs of different engineering modules.
- Multiprocessor license: several runs of any engineering module (limited by the license type and computer resources).
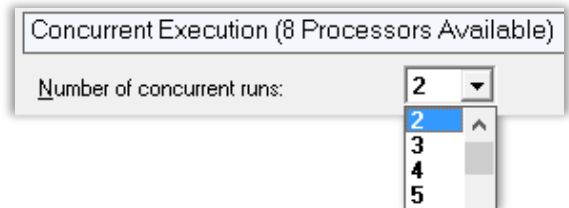
Multiple licenses: Distribute runs efficiently on multiple computers

- Log files list the runs start and end times, helping you determine how to best spread the work.
- Multi-user network licenses make it easy to parallelize work on any computer of your network.

SES Batch maximizes your computer processing time such as to make the best use of your work time!

A Software Tool that Automates the Transfer of Leakage Currents Computed by Right-of-Way or MultiLines to a Conductive Analysis Software Such as MultiGroundZ or MultiFields

SES-CETU

In some specific cases, it is desirable to examine the effects of inductive and conductive interference effects separately. In such cases, SES-CETU becomes the ideal tool to automatically transfer the computed currents discharged by grounded structures to the conductive interference software package.

SES-CETU (Current Energization Transfer Utility) is an interference analysis utility that automates the transfer of leakage currents computed by the SPLITS computation module of Right-of-Way or MultiLines to a conductive analysis software such as MultiGroundZ and MultiFields that use the MALZ or HIFREQ computation modules. This is useful, for example in order to carry out the conductive interference analysis required to obtain the total (i.e., inductive and conductive) interference levels. These leakage currents usually correspond to transmission line tower currents or substation ground currents injected into soil during fault conditions in substations or along the transmission lines.

The induced potentials computed by SPLITS represent the inductive component of the potential impressed on the victim circuits (pipelines, rail tracks, telecommunication lines, etc.) during normal or fault conditions. During normal conditions or In the absence of nearby energized buried metallic structures, the local soil potential will be near that of remote soil (i.e., zero) and the stress voltages of the victim circuits will simply be equal to the induced potentials. In most cases, the victim circuit is near grounding systems such as electric substations, power plants, transmission line structures and distribution poles. Therefore, a conductive component also exists due to the energization of the surrounding soil by the current leaking from these grounding systems. Consequently, it is necessary to calculate the conductive component of the victim circuit. The total interference levels are then determined by combining the inductive component computed by SPLITS with the conductive component obtained from MALZ or HIFREQ.
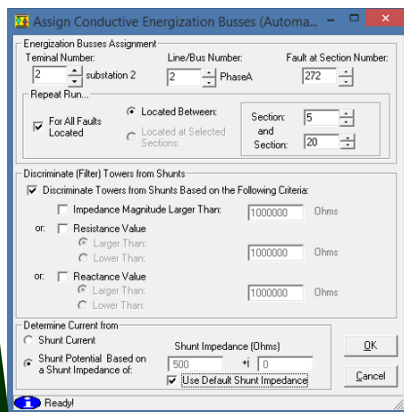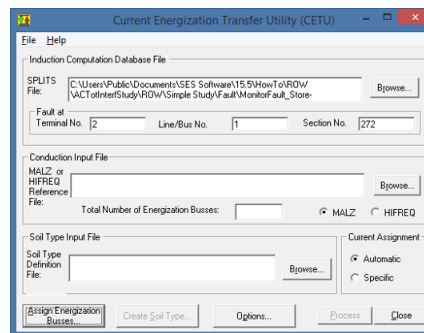
In order to determine the conductive components of the interference, it is necessary to transfer the known fault current distribution from the SPLITS computation results

SESCAD

An Object-Based Graphical Environment CAD System for the Development of Arbitrary Networks of Conductors

View or edit three-dimensional networks of conductors for grounding, AC interference, and lightning or transient studies.

Everything You Need

Specify all objects required for analysis

- Conductors and coaxial cables.
- Multi-core and pipe-type cables.
- GIS, GIL.
- Metallic plates.
- Transformers.

Create high-level objects in simple dialogs

- Detailed grounding grid.
- Transmission tower.
- Complete, multi-circuit transmission line.

Use a wide variety of tools to build more complicated objects from simple ones

- Fill a polygon with a mesh.
- Combine objects into one or several continuous paths.

Data Reuse

Import data from other formats

- Import data from DXF files and from AutoCAD files.
- Exchange data between equipotential grounding studies and high-frequency studies.
- Export data back to DXF or AutoCAD files.

Use data from object database

- Use data from a comprehensive, built-in object database.
- Add your own objects to the database.

www.sestech.com

World Leader in Grounding & EMI

SESCAD

An Object-Based Graphical Environment CAD System for the Development of Arbitrary Networks of Conductors

Visualization and Graphical Editing

### Interact with objects graphically

- Select and move objects graphically.
- Group and replicate objects.
- Rotate and scale objects.
- Use **Auto-Snap** to ensure the accuracy of graphical operations.
- Configurable number of **Undo** levels.

Visualize your data in many different ways

- Zoom on your drawing by a factor of a million or more.
- Maintain several distinct, synchronized views of the same drawing.
- Display conductors in different colors based on their characteristics, to help identify them.
- Add background pictures to help identify elements of the network.
- Get detailed information on selected objects using the **Quick-Info** tool and the **Measurements** tool.
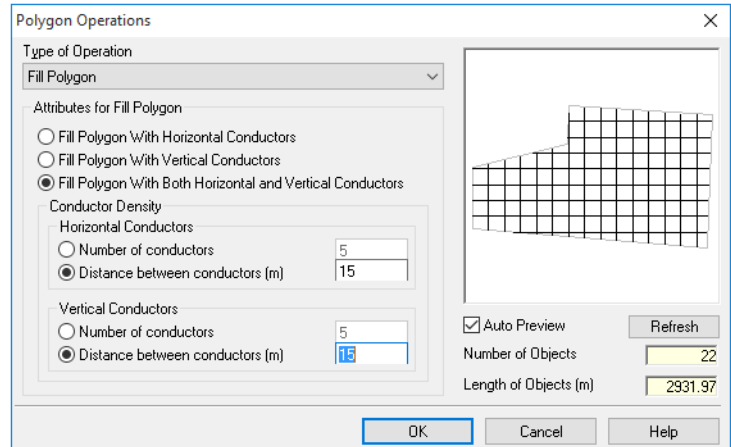
Data Validation and Reports
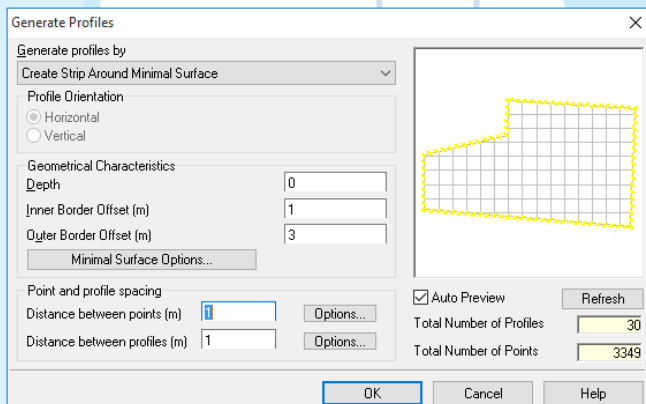
Validate the data as you go

- Consult the **Ambiguity Viewer** to quickly find possible problems with your input data. The **Ambiguity Viewer** is updated in the background and can repair problems automatically.
- Use the **Detect Connected Components** tool to check if the network conductors are properly connected.
- Use the **Power Tools** to repair bad connections or other problems in the network.

Run the case and generate reports

- Create a Bill of Materials report from the data specified in a drawing.
- Run the engineering program directly from within the SESCAD environment.
- Start one of several SES output processing programs to visualize the results directly from within SESCAD.

SES

SESCONVERTER

SESConverter can be used to import and convert CAD files compatible with the DXF or DWG formats to various SES software package compatible input files (*.f05) that use the SES Input Command Language (SICL). SESConverter can also convert SICL input files (*.f05) to the DXF and DWG formats.

IMPORT DXF/DWG TO SES .F05 FORMAT

In SESConverter, import implies that objects are converted from the DXF or DWG formats to the internal SICL format which can be read by all SES software packages. When a DXF file or a DWG file is loaded in SESConverter, the data is displayed in three grids: **Layers**, **Entities** and **Blocks**. By selecting items within the three grids, you can determine if (and which) data is converted to SICL commands. Moreover, the model contained within the DXF or DWG files is displayed graphically based on the items selected within the three grids. Using the **Show** column, you can view or hide the various items in the input file.
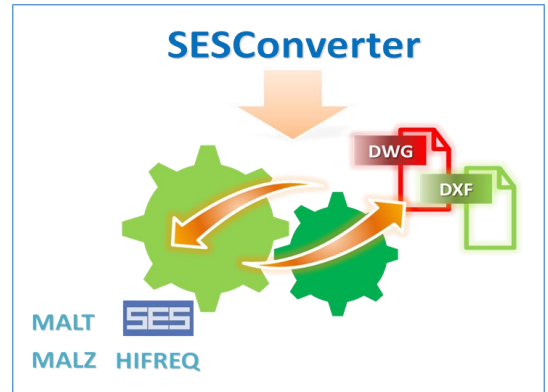
Convert DXF/DWG Entities to SES Objects:
- Convert most DXF/DWG entities to SES conductors.
- Convert DXF/DWG Polyfacemesh and 3Dface entities to SES plates.
- Convert DXF/DWG DXFCircle, DXFLwpolyline and DXFInsert entities to SES rods.

Convert DXFInsert in Different Ways:
- Convert the contents of DXFInsert entities independently from the contents of DXFLayers.
- Convert the contents of DXFInsert entities even when their DXFLayer is hidden or frozen.

Save Selected DXFLayers: Extract and save selected layers to a DXF/DWG file, or save all layers to different files.

EXPORT FROM SES .F05 TO DXF/DWG FORMAT

In SESConverter, export implies that objects are converted from the SICL format to the DXF or DWG format: SES conductors, rods and plates are all converted to DXF lines.

RADIUS MAPPING

The radius of conductors in SICL input files can be associated to various properties of the corresponding DXF entities.

- **Color Radius Mapping:** The value of the color of DXF entities can be mapped with the SES conductor radius.

- **Layer Radius Mapping:** The SES conductor radius to be assigned to all entities in the same DXF layer can be explicitly defined.

A Powerful Script Interpreter that adds Programming Capabilities to SES Input Files

SES-Script

Often it is necessary to examine the effects of one or several parameters of a problem on the computation results. In this case a parametric analysis that relies on the results of a large number of cases is required. The creation of these cases, which have similar input data, can be quite time-consuming and error-prone if carried out manually. It is therefore desirable and efficient to create all these cases using automated procedures. That's exactly what SES-Script does: Create, based on a template file, the appropriate input files for batch processing.

The use of parametric analysis is becoming increasingly frequent in R&D and engineering studies. In such studies, a system is modeled and simulated for several values of one or more parameters, usually to find the optimal combination of those parameters according to some technical or economic criteria.

SES software packages already include some built-in capabilities for parametric analyses but it is difficult to make the software capable of performing parametric analyses for all possible combinations of parameters that could be of interest in practice.

This is where SESScript steps in. This utility is a script interpreter that adds programming capabilities to SES input files. This program can generate hundreds of files from a single input file containing a mixture of the SES SICL command language and scripting code. Using this program requires some computer programming skills and is therefore not entirely straightforward. Nevertheless, those of you who are familiar with programming may find it a useful, time saving tool.

Overview

The main screen of SESScript is the central point of the of the program. You can use it to initiate all of the operations in the program, such as loading a script file or a previously saved session file, defining parameters for the script, setting options for the program or processing the script. The functions available in the program are regrouped in the menu bar and the toolbar. In addition, you can define the values of the parameters that are to be used when processing the script as well as the name of the files that should be generated directly from this screen. The typical use of the SESScript program involves a few steps:
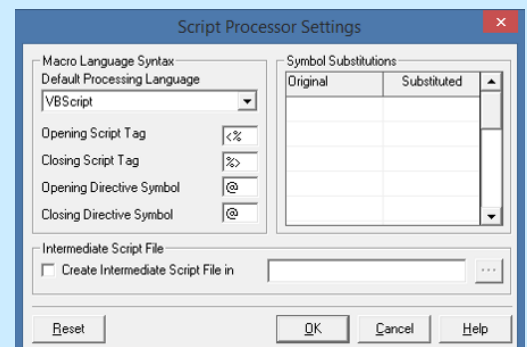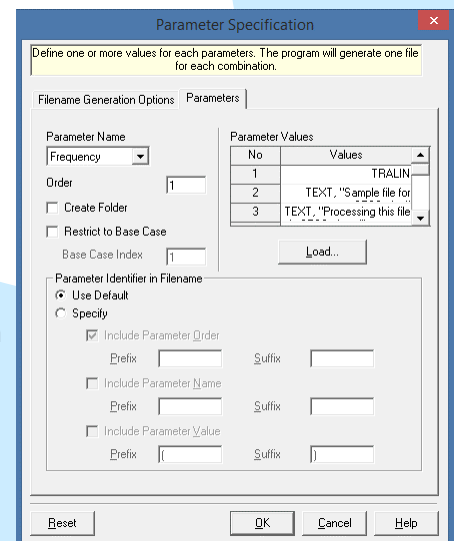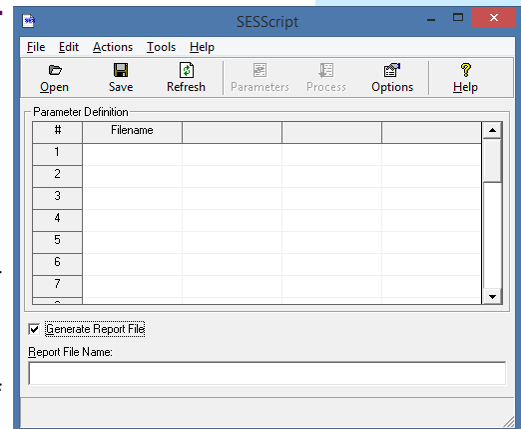
Creating a script file. This file can contain any text, and should normally contain special instructions that are to be interpreted by SESScript.

Loading the file in SESScript. At this point, the program analyzes the file for any instructions it might contain.
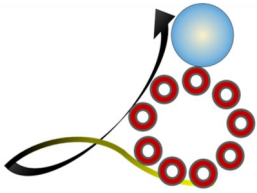
Specifying any relevant parameters. The script file may contain several unspecified parameters. SESScript offers you to replace those parameters with specific values.

Processing the script file. The processing can generate a large number of files, with typically different values of the parameters in each of the files.
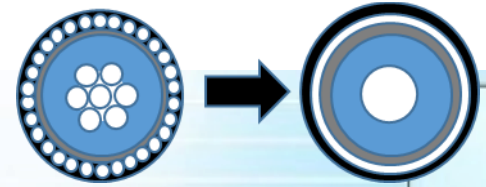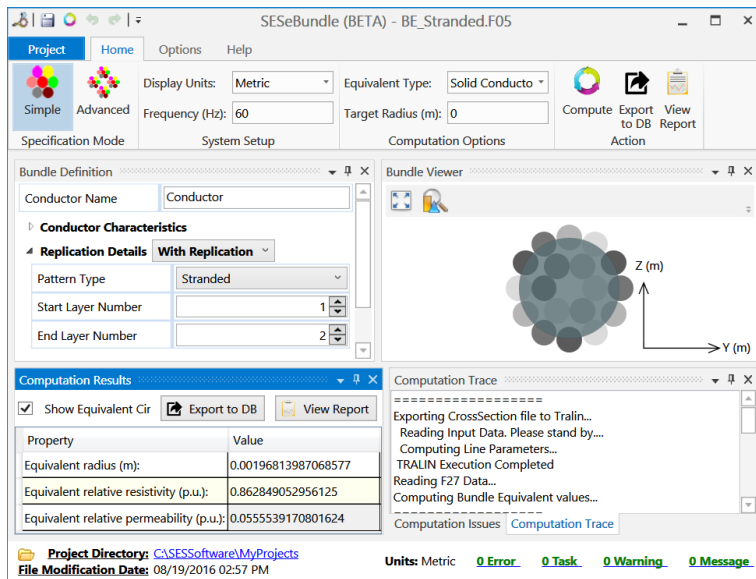
There are options to control the syntax of the script language (Macro Language Syntax), and to control whether or not a debug script file is created whenever a script file is processed. You can also specify symbol substitutions that should be carried out in the original script file before processing it.

tech.com

World Leader in Grounding & EMI

SESeBundle

Reduce Segments Number

The **SESeBundle** tool is useful to find the characteristics of an equivalent single conductor that represents accurately a bundle of conductors.

Produce Solid and Hollow Equivalents

SESeBundle is capable of computing two types of equivalents:

- **Solid:** finds the radius, relative resistivity and relative permeability of an equivalent single conductor which accurately replaces a bundle of conductors in the sense that the equivalent conductor and the actual bundle yield the same series impedance.

- **Hollow:** finds external and internal radii and relative resistivity of an equivalent single hollow conductor that represents accurately a bundle of conductors while preserving the series impedance of the bundled conductors. This is of great help when modeling cables with concentric neutrals.

Increase Speed

To model a bundle of conductors, you could in principle model each conductor independently. However, in many cases, it is possible to use an equivalent, reducing memory usage and increasing computational performance.

Create Equivalents for:

- Bundled phase conductors.

- Regularly interconnected shield wires.

- Rails and their mitigations.

- Pipelines and their mitigations.

- Cables with concentric wires and/or a wire armor composed of several individual conductors.

- ...

SESGSE
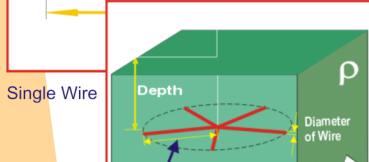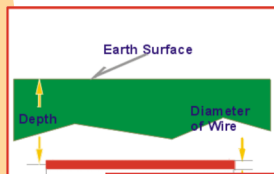
A Grounding System Estimator

The SES Grounding System Estimator (SESGSE) program is a simple tool which allows you to quickly calculate the ground resistance of a given grounding electrode, or determine the type of grounding system required to achieve a specified grounding resistance value. A uniform soil model is assumed; for non-uniform soils, use the Estimator or Predictor mode option of the AutoGroundDesign software package.
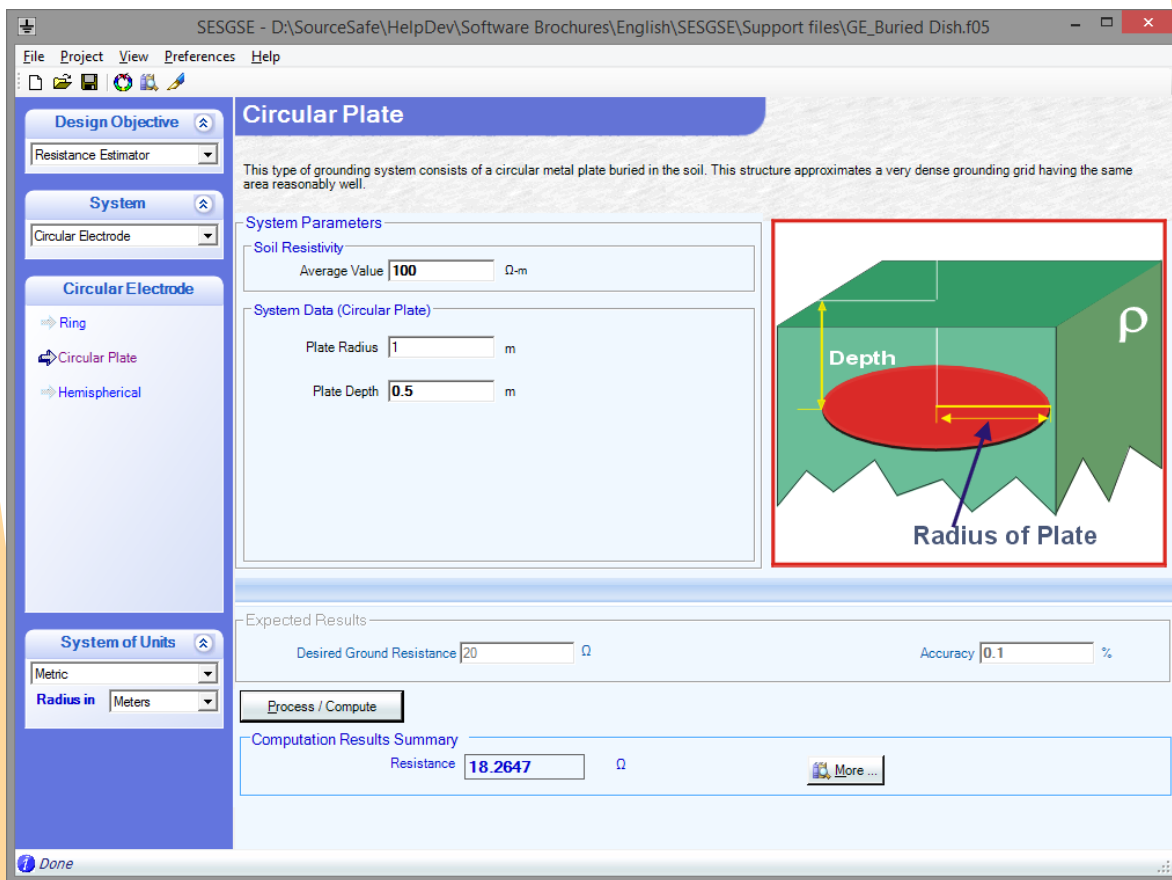
The program can perform these calculations for many types of commonly encountered electrodes, including ground rods (or arrays of ground rods), horizontal ground conductors and plates of various shapes. SESGSE requires a minimal amount of input data. For example, to compute the grounding resistance of a buried metallic dish, only three inputs, i.e. Soil Resistivity, Plate Radius and Plate Depth, are required.
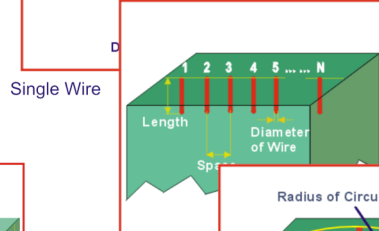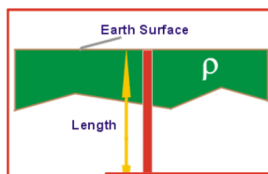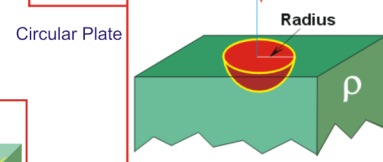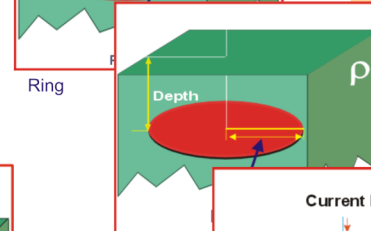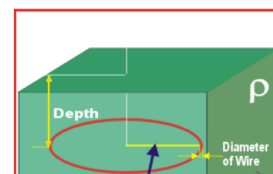
Collected Grounding Electrodes

Horizontal Electrodes

Single Wire

Radial Wires

Linear Wire Array

Dense Grid
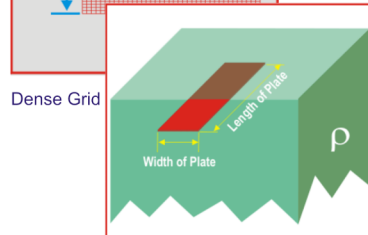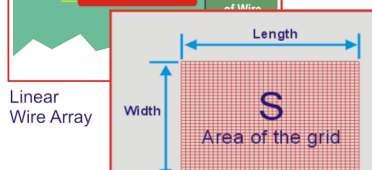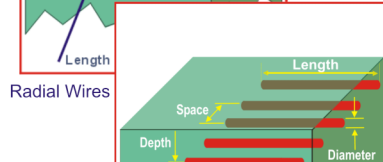
Rectangular Plate

Vertical Electrodes

Single Wire

Linear Wire Array

Circular Wire Array

Rectangular Wire Array
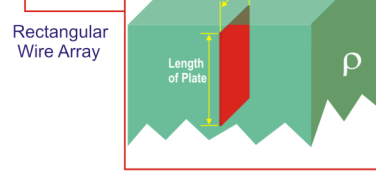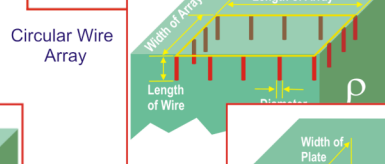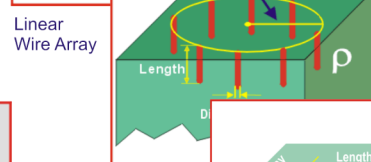
Rectangular Plate

Circular Electrodes

Ring

Circular Plate

Hemispherical

The program interface mainly consists of six groups:

- *Design Objective* defines the types of computations required, *Resistance Estimator/Dimension Predictor*.
- *System* allows you to select the type of grounding electrodes.
- *System Parameters* defines the fundamental parameters of the grounding electrodes.
- *Expected Results* defines the desired grounding resistance and the accuracy to be met.
- *Computation Results Summary* displays the results of the requested computations.
- *System of Units* specifies which system of units to be used for input and output.

SESGSE

A Graphical Tool for Computing the Internal Impedance of Arbitrarily Shaped Conductors
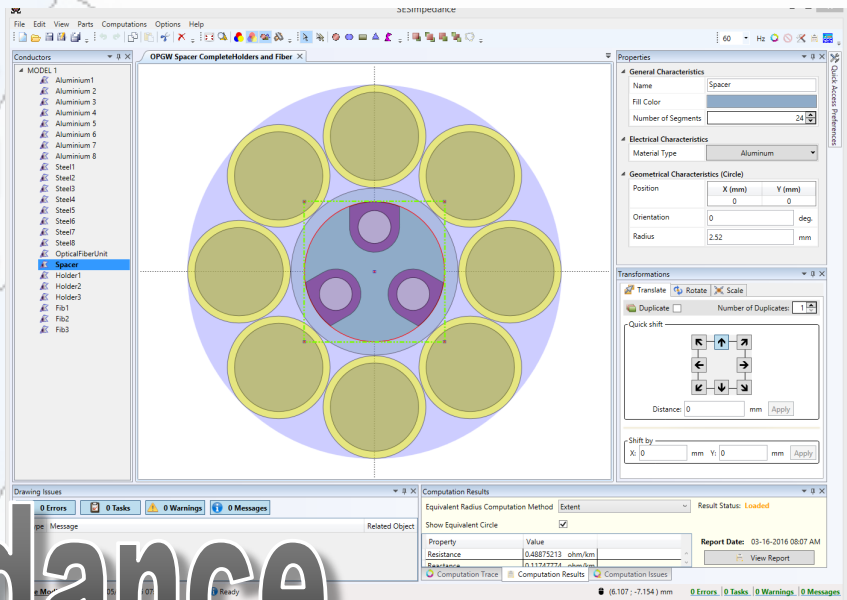
SESImpedance

SESImpedance is a straightforward application combining an intuitive and easy to use drawing interface with a powerful computation engine (based on the Finite Element Method). The program fully accounts for skin effect to calculate the internal impedance per unit length of long conductors of constant cross-section, with arbitrary geometry and composition.
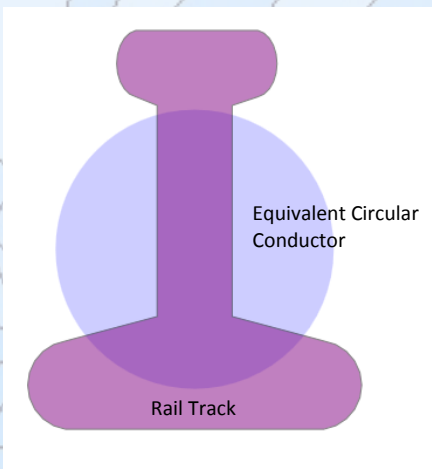
With SESImpedance you can very quickly build your model and obtain the value of the internal resistance and reactance for conductors such as:

- ♦ **OPGW**: with different material types.
- ♦ **Stranded cables**: comprising many sub-conductors.
- ♦ **Rail tracks** or **elliptical cables**: non-circular conductors.

SESImpedance computes the characteristics of an equivalent conductor of circular cross-section, making it possible to use SESImpedance results in applications that are restricted to circular conductors.

Equivalent Circular Conductor

Rail Track

SESImpedance is an object-oriented application that makes the modeling of complex conductors very simple for beginners and advanced users:

- ♦ Import drawings from **SESCAD** or create them directly in SESImpedance.
- ♦ Use the built-in **Material Database** to specify the material type of the various parts of the conductor.
- ♦ Control the **Computation Parameters** such as: frequency or meshing density.
- ♦ Specify data in various systems of units.

www.sestech.com

SES

World Leader in Grounding & EMI
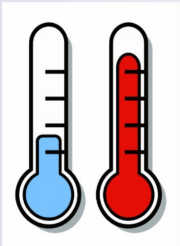
SoilModelManager

A Software Tool that Automates Selection of Soil Structures that Apply During Winter or Early-Spring and Dry Summer Seasons

Introduction

In regions where the top layer soil can freeze during winter or dry out during summer it is necessary to assess the effects of shallow depth resistivity variations on the grounding design. The recent internationally approved *IEC standard 61936-1 entitled Power Installations Exceeding 1 kV ac – Part 1: Common Rules*, states clearly in Section 10.3.1 General Clause b:

> Determine the (grounding) zone of interest. If not a global earthing system (meaning an urban zone), then determine the soil characteristics of the zone of interest, taking into account the **seasonal variation** of the soil parameters.
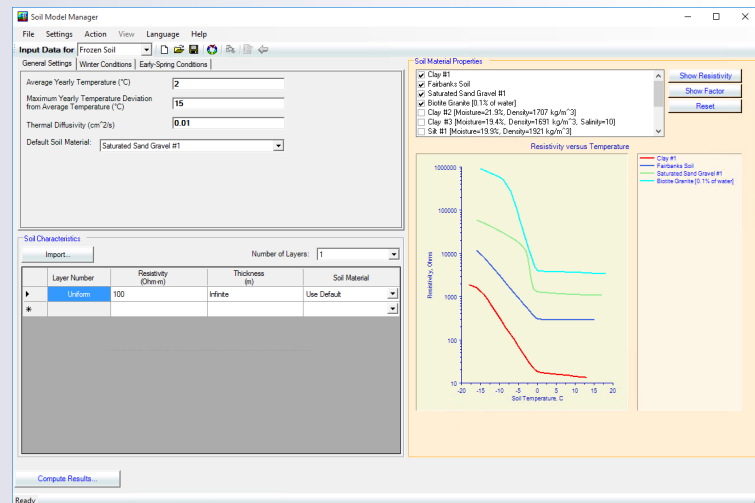
This requirement means that the designer of a grounding system has the obligation to determine if seasonal soil resistivity variations have an impact on the grounding performance. Consequently, consideration of the so-called "winter and early-spring worst-case scenario conditions" or "wet soil surface and shallow depth dry soil summer conditions" must be taken into account when building a realistic soil model that reflects realistic conditions throughout the year. However, there is no established approach on how to model this phenomenon. S**oilModelManag**er is a software tool that automates the selection of soil model structures that apply during various seasons.

Overview of SoilModelManager

It is well known that soil resistivity increases dramatically when the temperature drops below zero degrees Celsius. The resistivity can increase by a factor of 5-1000 times the "summer" value, depending on the temperature, soil material type, moisture content, salinity etc. What resistivity scaling factors should be used for the various top soil layers that are affected by the temperature in a given geographical region when soil freezes? Some have argued that a factor of 5 to 6 would be an adequate average. Others prefer to use a value on the order of 20 or more. The best approach is not to try to use an average value but to emulate the real distribution of resistivity with depth as a function of the temperature at that depth. This is what **SoilModelManager** does, taking into account the unfrozen (summer) soil model and other relevant information such as meteorological data as provided by the user. **SoilModelManager** uses resistivity scaling factor curves corresponding to the soil type under study to automatically generate the appropriate soil models for the winter and early-spring seasons.

SoilModelManager can also be used to estimate soil resistivity variations in warm regions, where soil resistivity may show strong seasonal variations due to changing soil moisture content between the dry and wet seasons.

SES
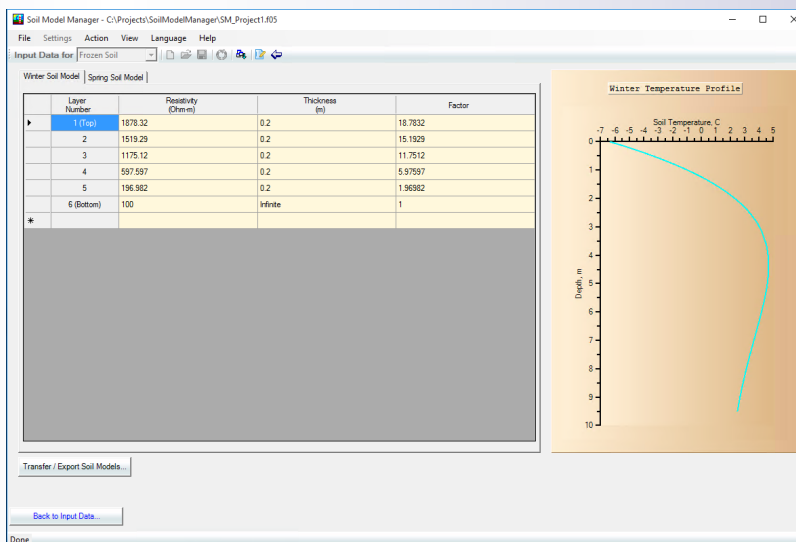
SES-Shield
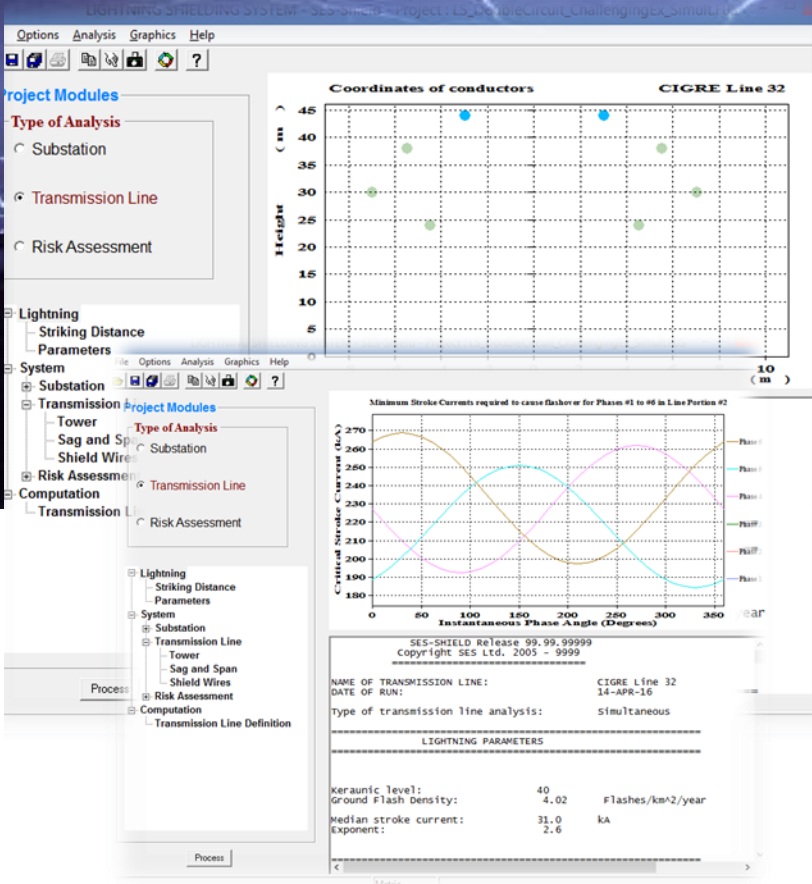
Substation Analysis

Transmission Line Analysis
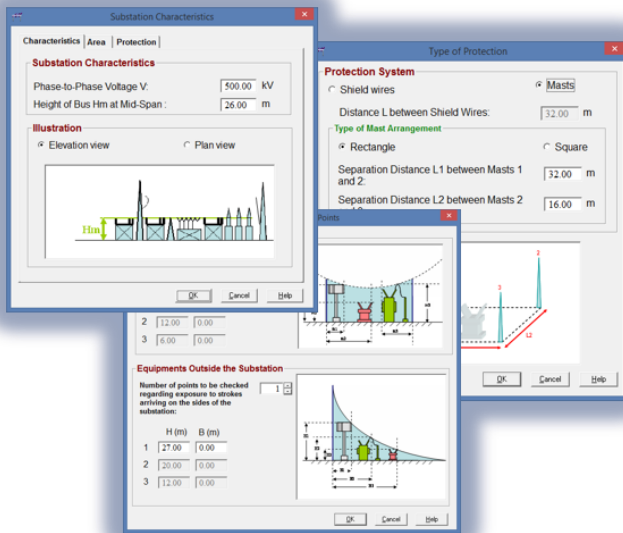
Risk Assessment Analysis

Prevent, Protect and Optimize...

SES-Shield is used to optimize the location and configuration of shield wires and masts in order to prevent the exposure of energized conductors, buses and equipment to direct lightning strikes.

SES-Shield^{TM} is a professional's tool aimed at providing optimum solutions for the protection of transmission lines and substations against direct lightning strikes and can also be used to assess risks that may be hazardous to a structure and to a service .

Most Recent Methodologies...

The analysis methodologies for the substation and transmission lines modules are based on the most recent Electrogeometric / Rolling Sphere theories and methods described in the IEEE Standard, while the risk assessment module is based on the most rigorous method described in the pertinent IEC Standard.

www.sestech.com

World Leader in Grounding & EMI

Substation Analysis Capabilities

♦ Supports shield wires or mats.

♦ Determines the required height of the masts supporting the shield wires for optimal protection.

♦ Examines the conformity of the protection of equipment when lightning strikes above and the sides of the substation.

♦ Computes the shielding failure rate due to lightning strokes to the substation.
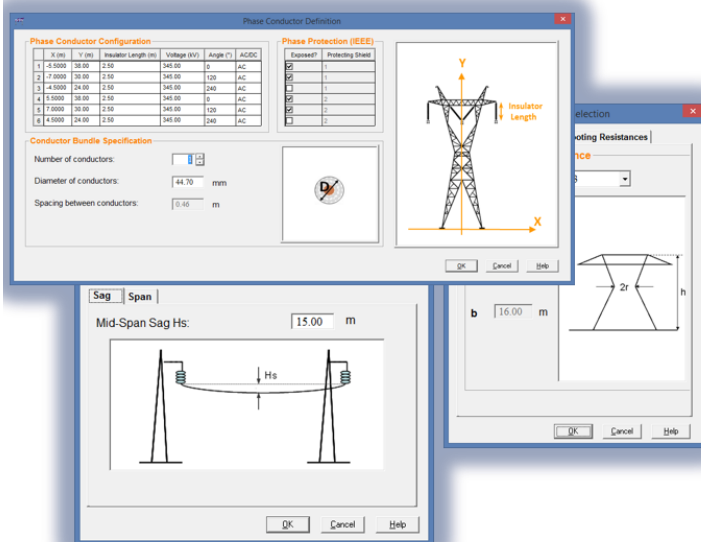
Transmission Line Analysis Capabilities

♦ Determines the Uncovered Width.

♦ Automatically computes the probability of minimum and maximum current occurrences.

♦ Determines the optimal position of the shield wires as well as the optimal shielding angles.

♦ Computes the Shielding Failure Rates.

♦ Computes the back flashover failure rates.
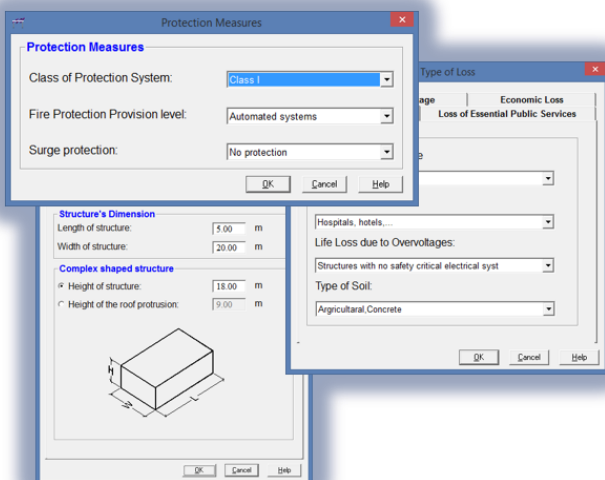
Risk Assessment Analysis Capabilities

♦ Computes the collection areas for direct and indirect strikes to the structure.

♦ Computes the collection areas for direct and indirect strikes near the structure.

♦ Estimates the risk of losses for human life, services, cultural heritage and economic.

♦ Computes the total risk and indicates if protection measures have to be taken.
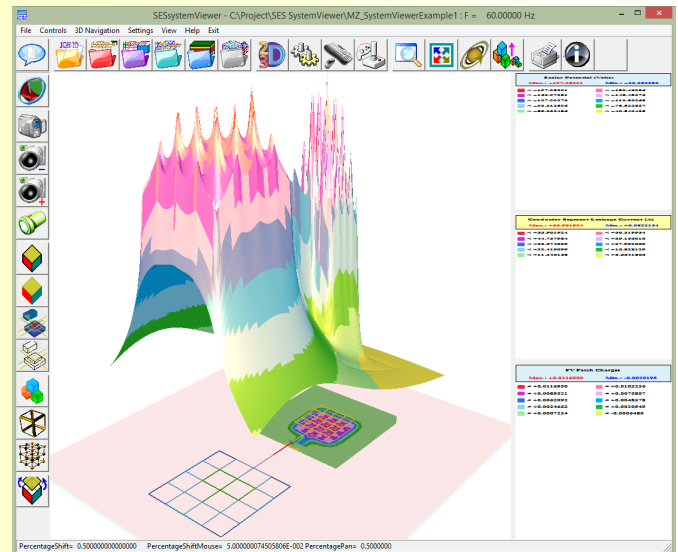
SESSystemViewer

A Powerful Interactive 3D Graphics Rendition Software Tool

This powerful software tool helps you visualize your entire model, including its surrounding soil structure, as a 3D perspective view. Furthermore, computation results are displayed on top of the relevant system components in 3D or 2D-spot fashion.

SESSystemViewer displays the system configuration specified by MultiGround, MultiGroundZ and MultiFields software packages. All computation results pertaining to the system configuration can be displayed right on the system component itself in vivid spot colors that reflect intensity of the displayed quantity such as conductors' leakage currents, longitudinal currents and ground potential rises (GPR). Computation results are displayed above the specified observation points in 3D or 2D spot plots. Soil layers and finite volumes of soils are displayed with their patch charge densities.

The main graphics computation engine of SESSystemViewer is driven by the OpenGL industry standard protocol. The interface consists essentially of a convenient single window environment that is segmented into seven regions, namely:

- A 3D display region.
- Three legend zones associated to the following displayed categories, i.e.:
  - ♦ Computed quantity at observation points.
  - ♦ Specified or computed quantity along conductors.
  - ♦ Charge densities on finite soil volumes patches.
- A menu bar that offers various useful options, features and action shortcuts.
- Vertical and horizontal toolbar regions populated with clearly identifiable buttons that duplicate most of the menu items and provide convenient feature and action shortcuts.

SESSystemViewer loads the information contained in the input file or in the computation database and displays it as any combination of the following items:

- Conductor network.
- Selected computed quantity at specified observation points.
- Soil model structure including finite soil volumes.
- Reference Cartesian axes.

Conductors can be displayed as lines of various thicknesses or cylinders with a radius equal to a multiple of the specified one. Conductors are highlighted in various colors representing a range of values associated with input data information (such as radius, material type, coating type or energization type) or with computed data (such as leakage currents, longitudinal currents, conductor GPR and coating GPR).

Computed quantities such as soil potentials, touch voltages, electric and magnetic fields are displayed above specified observation points in 3D or 2D-spot fashion.

Finite volume patches can be displayed as vertices (points), wire frames or solid surfaces.

Linear or logarithmic scale, color levels and shading styles can be specified by the user.

The location of the observer (camera) as well as the increments of the pan and rotation movements can be specified. The X, Y or Z coordinates can be scaled arbitrarily to help better visualize thin objects. Finally, various 3D navigation controls can be reassigned to the mouse left and right buttons and to the cursors.
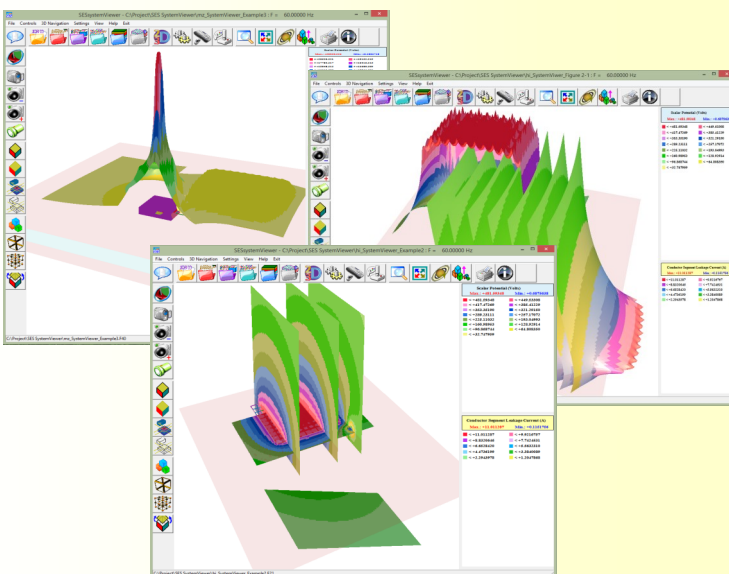
SESThreshold

SESThreshold is an application that computes thresholds for touch and step voltages, as recommended by industry standards.

In a modern grounding study, it is common to encounter a number of areas or zones with thresholds different from those for the rest of the site. SESThreshold allows specifying an arbitrary number of such zones of different thresholds, shapes, and sizes.

With a tabulated list of thresholds, the application is capable of plotting touch and step voltages against these thresholds, showing the color gradation across the zones in one single plot.

Several tools in SESThreshold help specify the parameters of the analysis and visualize its results.

- ♦ Touch and step voltages can be analyzed for multiple zones displayed in a single plot.

- ♦ Each zone can have separate safety threshold specifications.

- ♦ The copy tool easily allows copying of specifications from one zone to another.

- ♦ Each threshold can be computed, user-specified, or ignored.

- ♦ The color gradation in the resulting plot of the selected quantity easily shows the regions that are above and below the thresholds.

- ♦ An integrated report table shows the threshold of each zone.

www.sestech.com　　　　　**World Leader in Grounding & EMI**

SESThreshold Integrated Tools

Zone Editor/Viewer

- ♦ Multifaceted tool — works as an editor and as a viewer.

- ♦ The network grid and profiles provide the backdrop onto which zones can either be created or viewed.

- ♦ Create custom zones.

- ♦ Create zones in accordance to the variations of the surfacing soil.
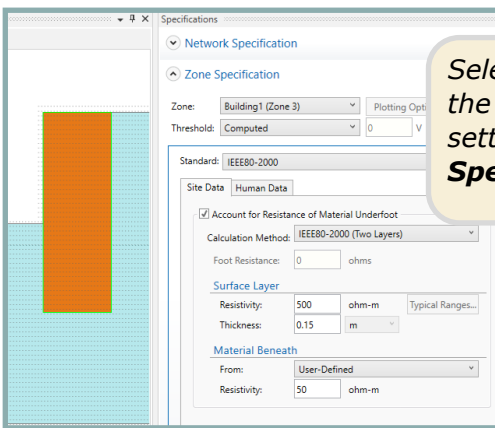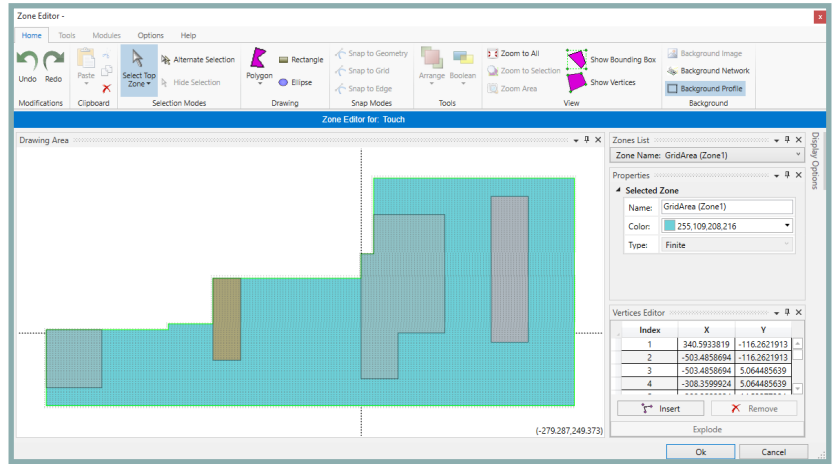
> Selection of a zone from the viewer shows all of its settings and criteria in the **Specifications** panel.

> Once the thresholds have been computed, the viewer allows sorting of the zones by threshold values for better visualization.
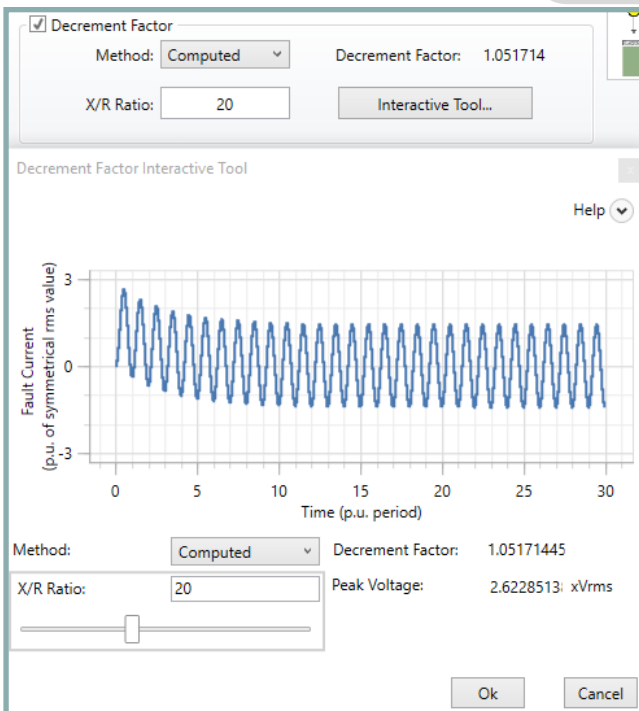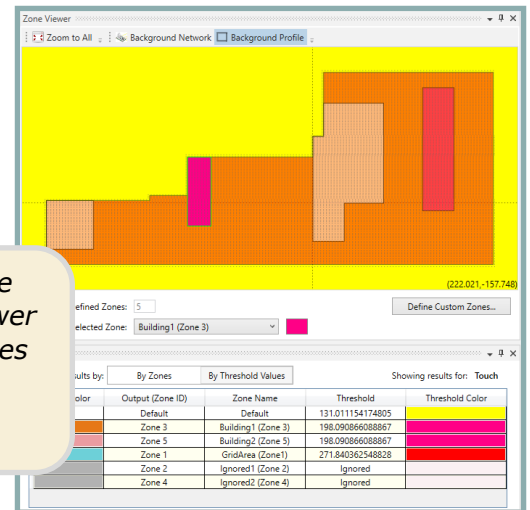
Decrement Factor Interactive Tool

- ♦ Calculation of the decrement factor uses X/R as input.

- ♦ Alternatively, decrement factor can be specified, in which case X/R will be computed.

- ♦ The interactive tool offers sampling of a range of values (X/R or decrement factor), allowing for the visualization of the exponential decay of the sinusoidal fault current over time.

- ♦ Also calculates Peak Voltage which is important in Zone-of-Influence studies of the interference analysis of telecommunication lines and equipment.
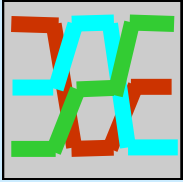
TransposIT

Automated Transposition of Phase Conductors and Cross-bonding of Cable Sheaths for Multi-Phase Circuits

TransposIT is a software utility that automates the analysis of the optimum transposition or cross-bonding scenario on a power system network. Currently, the automation is implemented on the data specification only. Future implementation will provide automation to the algorithm used to determine the optimum transposition based on a set of criteria defined by the user.

This utility, works on a circuit data defined by the SPLITS computation module. Therefore, it is useful to the MultiLines and Right-of-Way software packages.

Overview of TransposIT

It is well known that substantial current unbalance can develop within and between the circuits of a transmission line when the phases are not regularly transposed, even when the loads are balanced. Studying the effects of the characteristics of such transpositions (their location, direction of rotation, etc…) in order to arrive at an optimal configuration is a tedious task, requiring manual modification of the network model at every transposition location. Moreover, a huge number of different transposition scenarios may have to be examined.

The TransposIT utility was created to simplify this task. This utility takes a reference SPLITS file as input and produces on output a different SPLITS file, with transpositions applied at user-defined locations, on user-specified circuits. The program's interface allows you to specify the transpositions either visually through a graphical interface, using windows screens through a tabular approach, or using a command input file. Either way, the transpositions are immediately displayed visually: this makes it easier to confirm that the transpositions really have the desired characteristics. All three modes of input are fully synchronized.

Note that TransposIT can also be used to carry out cross-bonding of cable sheaths as easily as for phase transpositions. In fact, any operations that require changing regularly the physical position of conductors in order to meet certain mutual coupling criteria can be done easily using this software utility.

World Leader in Grounding & EMI