SINT Ingegneria

ONE STEP AHEAD

XGSLab

THE STATE OF THE ART
SOFTWARE FOR
GROUNDING SYSTEM
ELECTROMAGNETIC FIELDS
AND INTERFERENCE ANALYSIS

Comparison between XGSLab® and CDEGS®

Introduction

The program XGSLab includes following modules:

- GSA® (Grounding System Analysis)
- GSA_FD® (Grounding System Analysis in the Frequency Domain)
- XGSA_FD® (Over and Under Ground System Analysis in the Frequency Domain)

The program CDEGS® (developed by SES & Technologies ltd. Canada) includes many modules and in particular:

- MALT®
- MALZ®
- HIFREQ®

The different modules are based on different physical assumptions and each of them has a specific application range (detailed description of the different modules are here omitted).
The comparison was made between modules based on similar assumptions.

GSA® has been compared with MALT®.
Both the modules are based on the fundamental assumption that each electrode is equipotential.

GSA_FD® has been compared with MALZ® and HIFREQ®.
GSA_FD® allows the following calculation options:

- (S) takes into account only the self-impedance of conductors
- (S+M) takes into account the effects of both the self and mutual impedances among conductors

The option (S+M) is more accurate than the option (S) but requires more calculation time.
MALZ® takes into account the voltage drop along conductors due to their self-impedance but it does not consider the effects of mutual impedance among conductors.
On the other hand, HIFREQ® is not limited as MALZ® and it is then more general and precise.
For these reasons, GSA_FD® (S) has been compared with MALZ® while GSA_FD® (S+M) has been compared with HIFREQ®.
HIFREQ® can consider different accuracy levels, depending on the parameter settings. The Default setting adopts a low frequency approximation while the Medium and High settings are more precise but require more calculation time. In the following, only High and Default accuracy levels are taken into account.

In all cases the comparison has been make taking into account a large meshed grid (500 m x 500 m) as a case of study.

CDEGS® results are available in the free document “Comparison of Low-Frequency and High-Frequency Grounding Software Package Capabilities”.

Main input data:

- I_E = 1000 A (phase 0 deg) injected in a grid corner
- Frequency = 60 Hz
- Soil resistivity = 1, 2, 5, 10, 20, 50, 100, 500, 1000, 10000 Ωm
- Soil relative permittivity = 1
- Depth of grid burial = 0.5 m
- Wires Cross Section = AWG 4/0 (107.22 mm^2)
- Wires diameter = 13,41 mm
- Wires material: copper (resistivity $1.8*10^{-8}$ Ωm, relative permittivity 1, relative permeability 1)
- Grid dimension: 500 x 500 m
- Grid mesh: 25 x 25 m
- GPR reference point: injection point
- Layout: see Figure 1

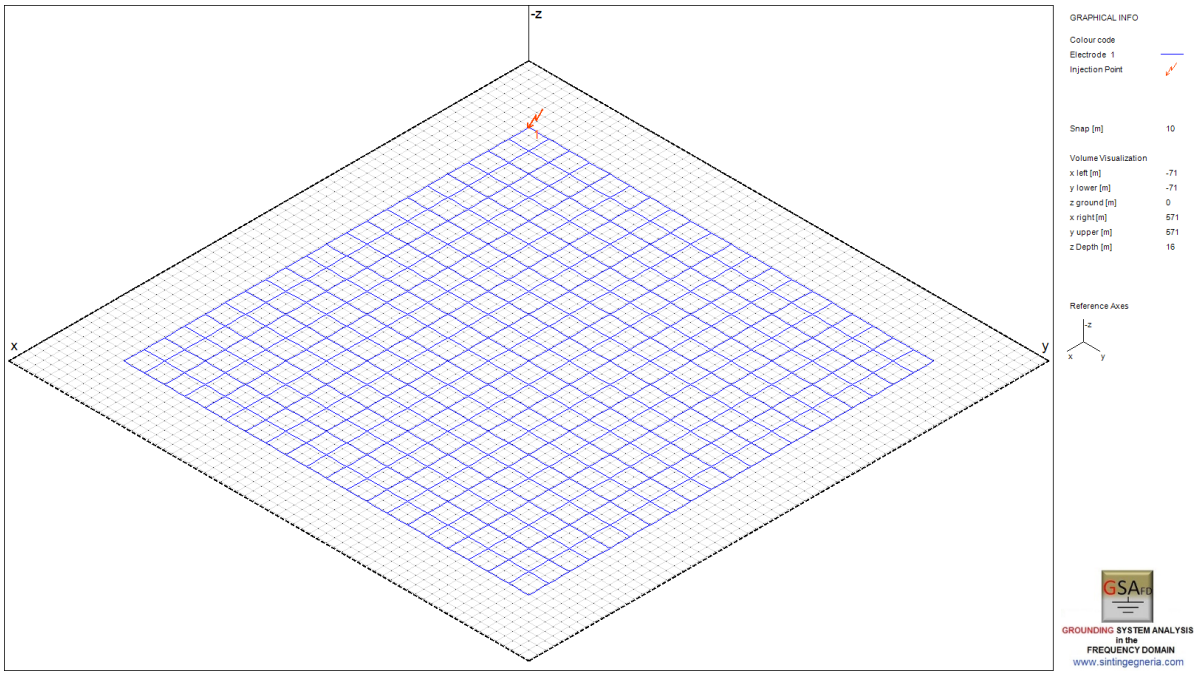

Figure 1: "Grounding System Layout" 3D representation

Comparison between GSA® and MALT®

The comparison between the values of Ground Potential Rise (GPR) obtained using GSA® and MALT® is shown in Figure 2.

The maximum differences between the results obtained with GSA® and MALT® are about 0,3 – 0,5% and for this reason, the results in Figure 2 are overlapped and indistinguishable.

The agreement between the results obtained with XGSLab® and CDEGS® is excellent with any resistivity value.

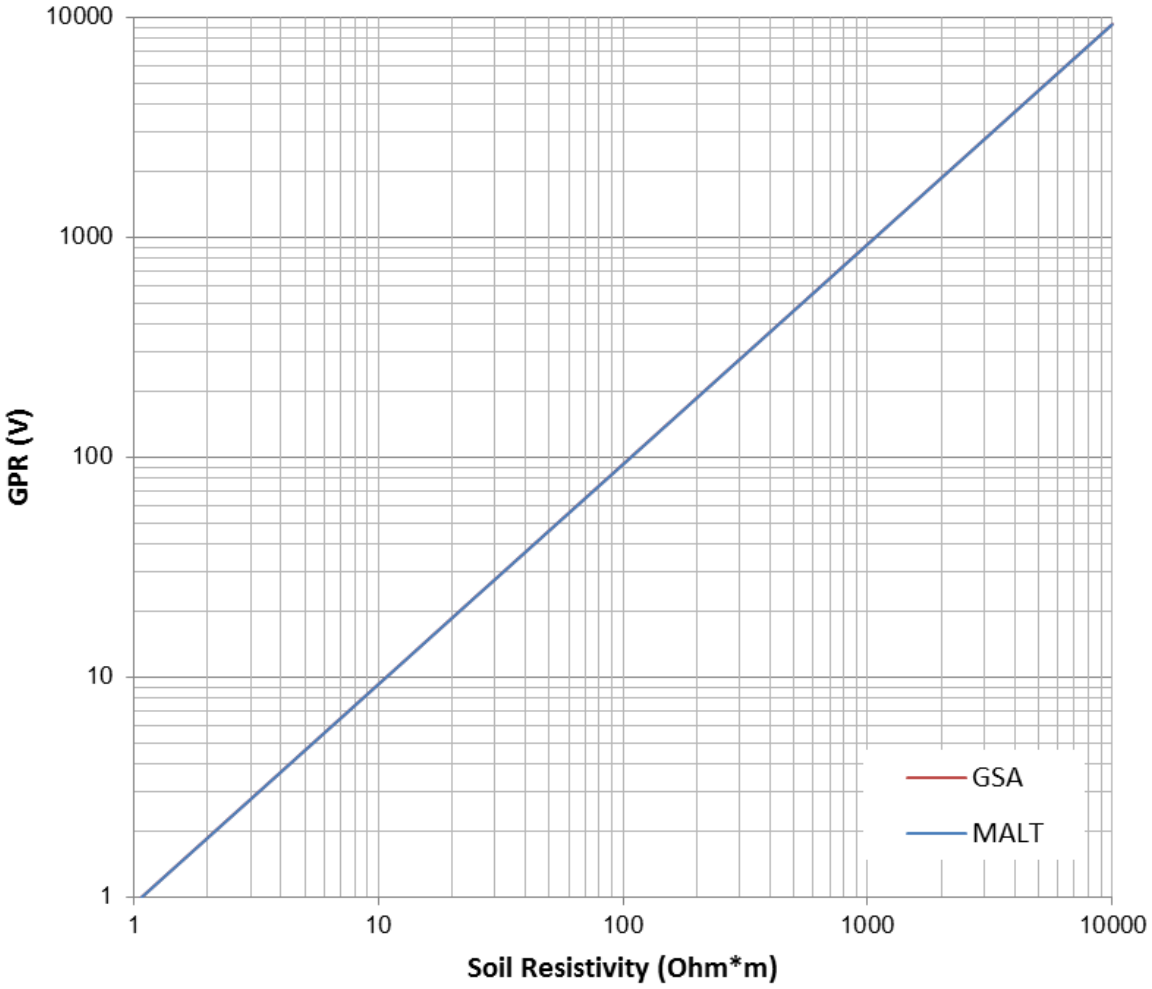

Figure 3: Comparison between GSA® and MALT®

Comparison between GSA_FD® and MALZ® - HIFREQ®

The comparison between the values of Ground Potential Rise (GPR) obtained using GSA_FD® (S) and MALZ® is shown in Figure 3 while the comparison between GPR values obtained using GSA_FD® (S+M) and HIFREQ® (High and Default sets of accuracy settings) is shown in Figure 4.

The maximum differences between the results obtained with GSA_FD® and CDEGS® are as follows:

- GSA_FD® (S) Vs. MALZ®: about 2 -3%
- GSA_FD® (S+M) Vs. HIFREQ® Default version: about 3 - 4 %
- GSA_FD® (S+M) Vs. HIFREQ® High version: 7 - 8 %

The agreement between the results obtained with XGSLab® and CDEGS® is good over the full test range.
But the agreement becomes excellent with resistivity values greater than 10 Ωm.

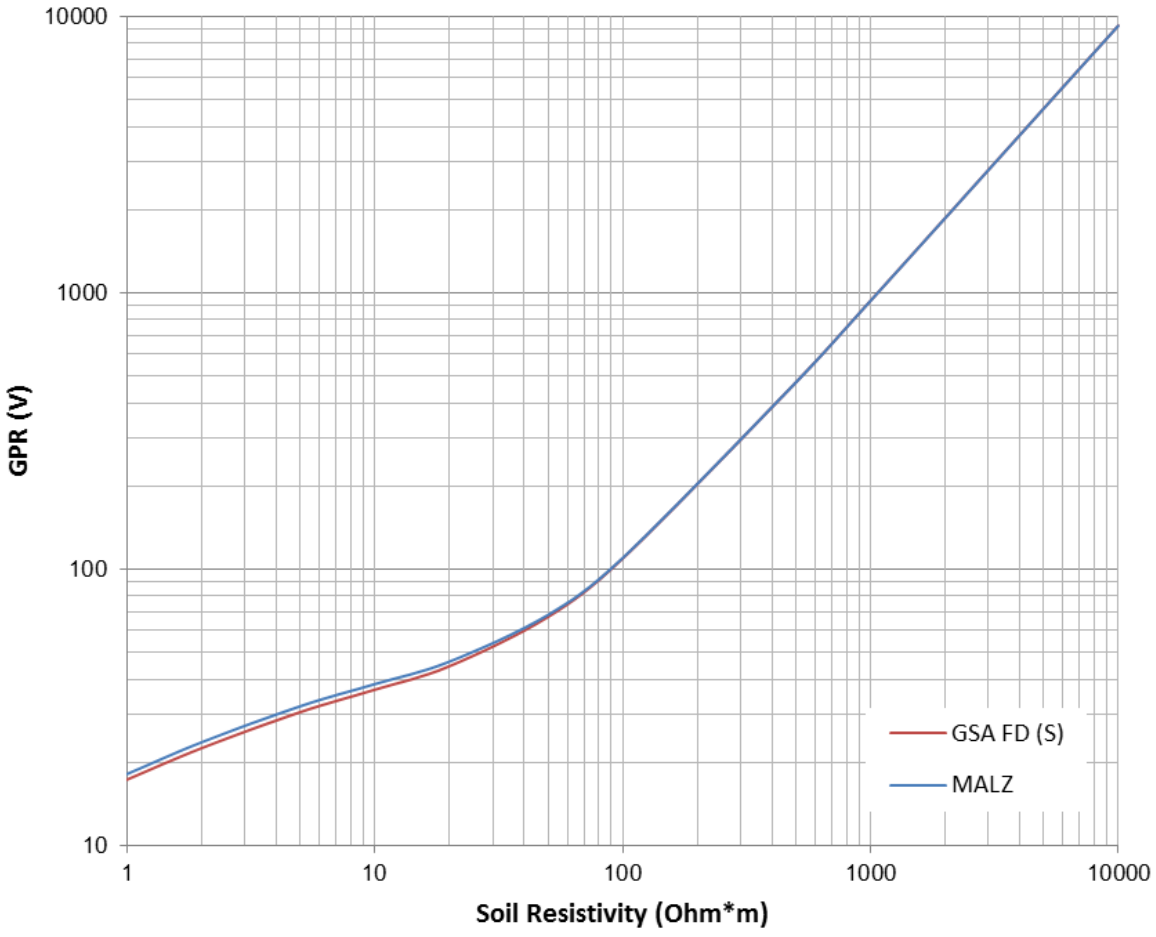

Figure 3: Comparison between GSA_FD® (S) and MALZ®

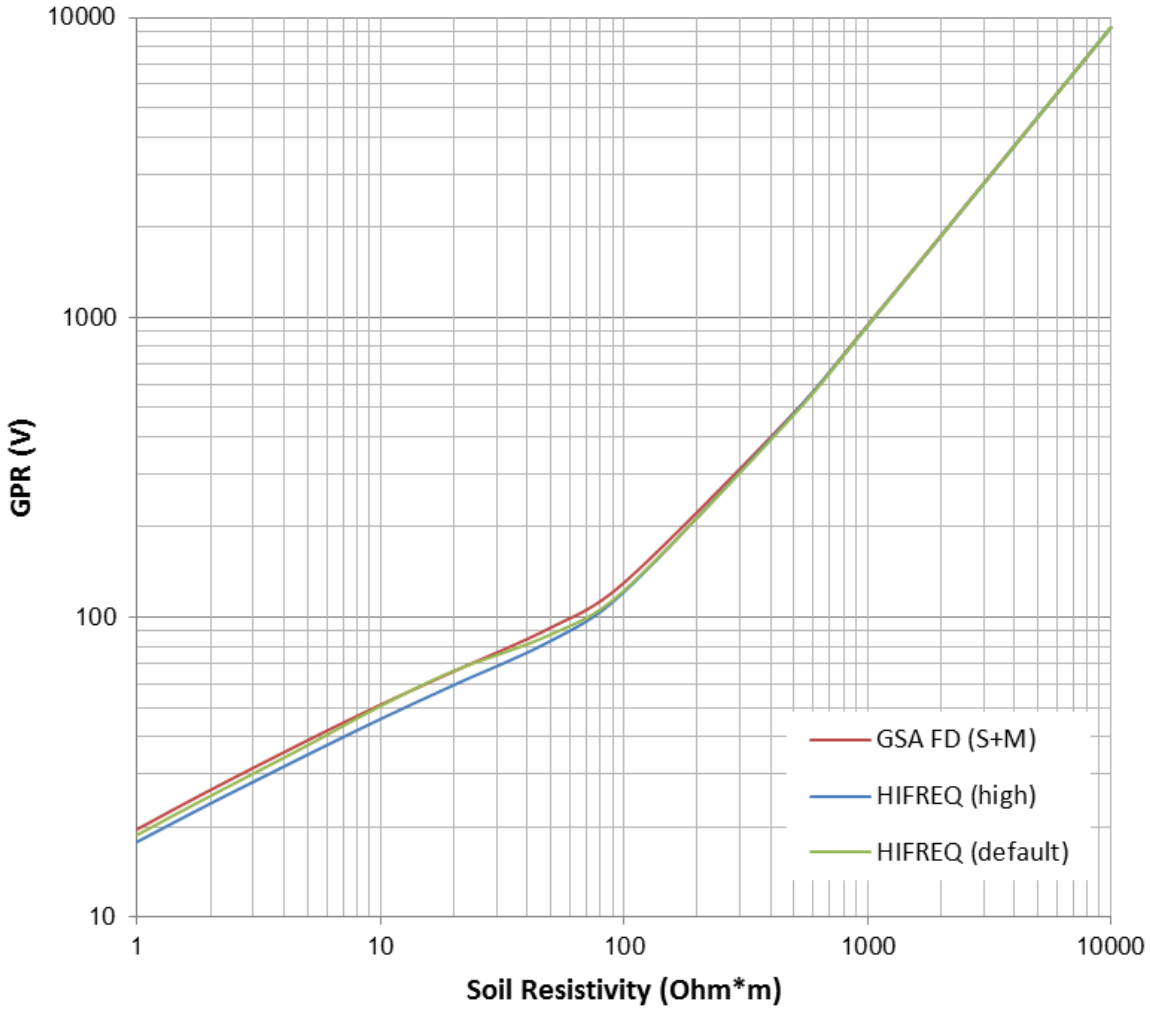

Figure 4: Comparison between GSA_FD® (S+M) and HIFREQ®