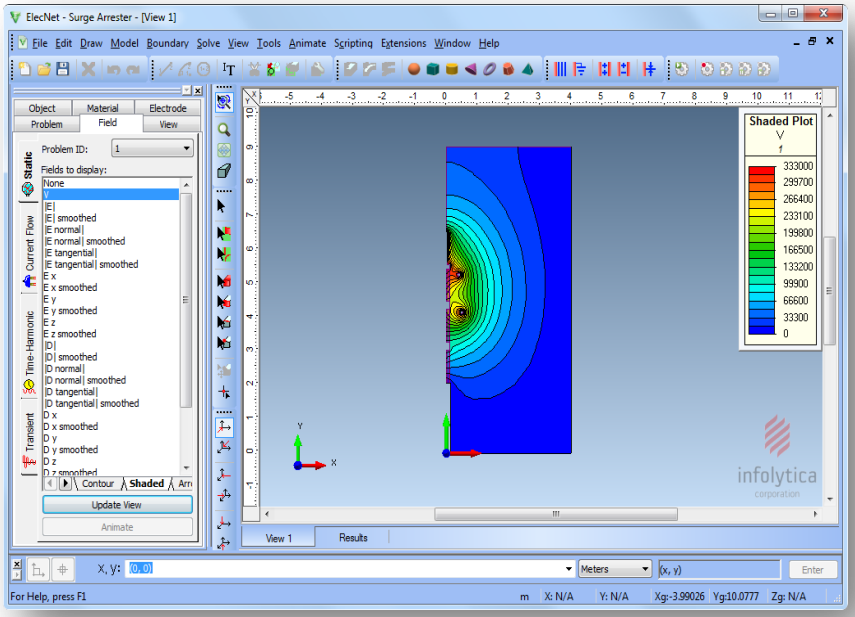
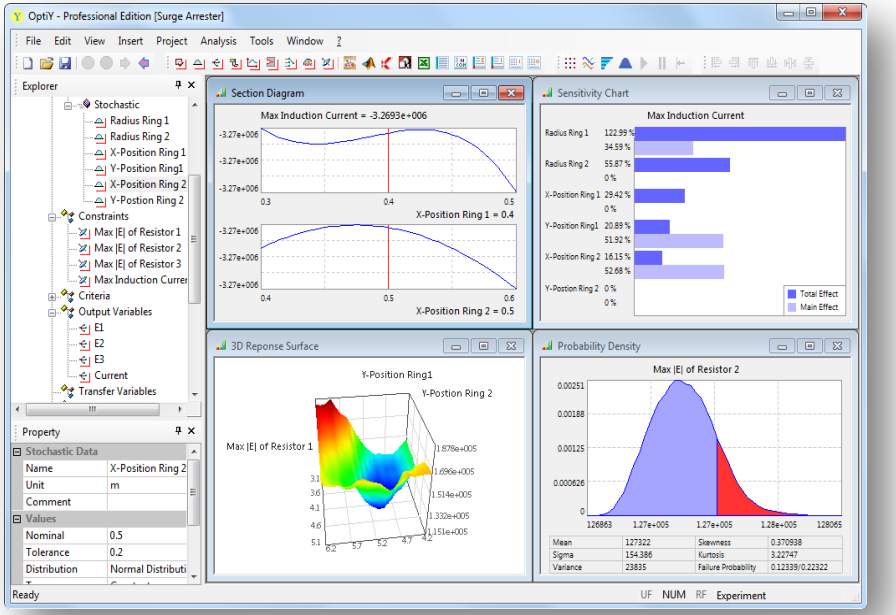
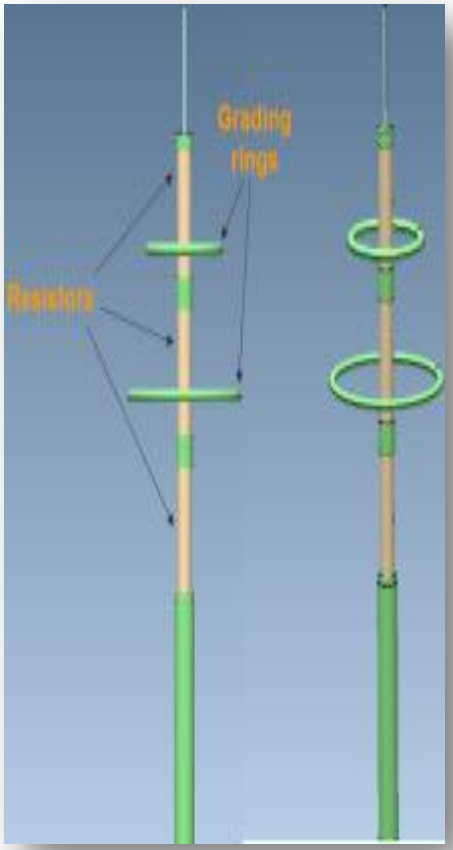
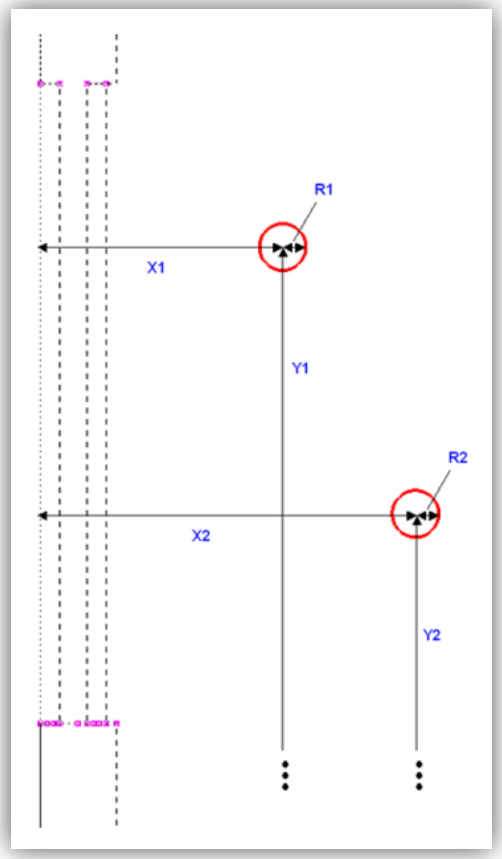
Tolerance Analysis of Surge Arrester





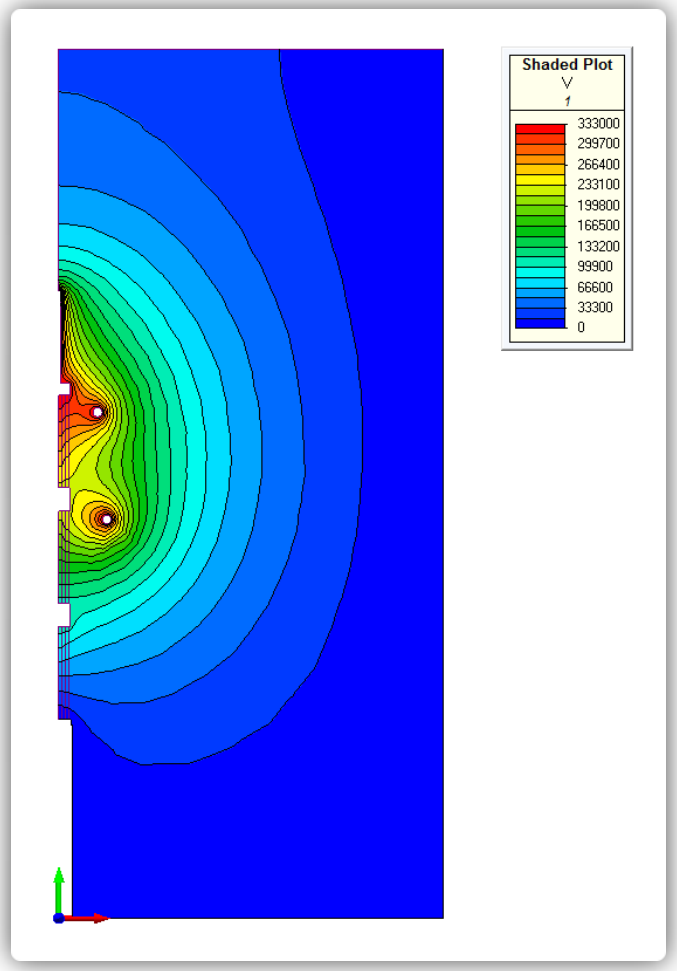
Design of Surge Arrester



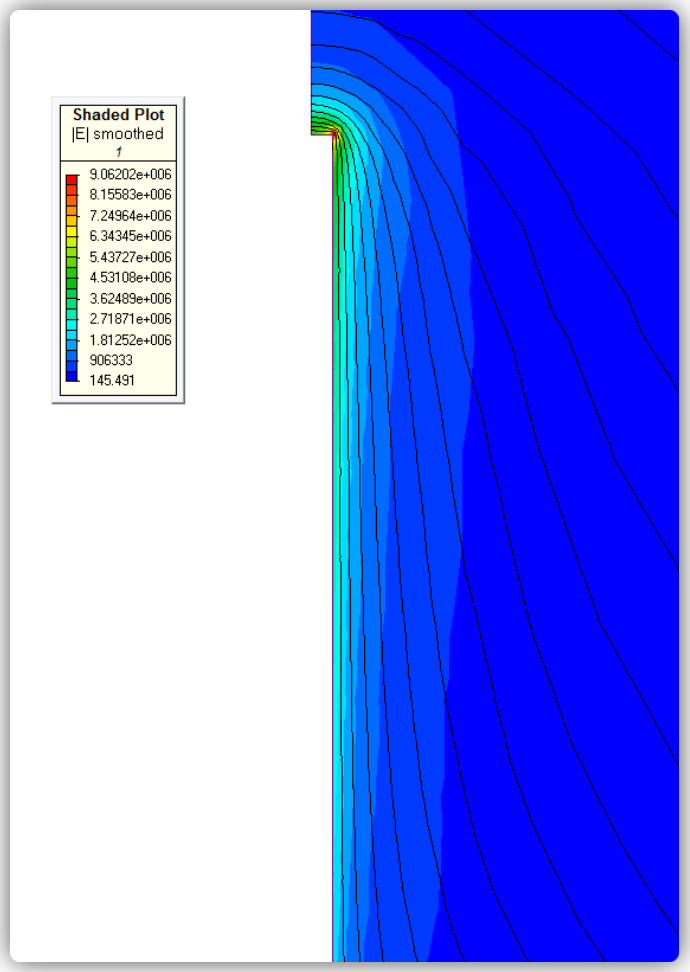


Application from Infolytica Corporation

Field Simulation in Infolytica-ElecNet



V - Field



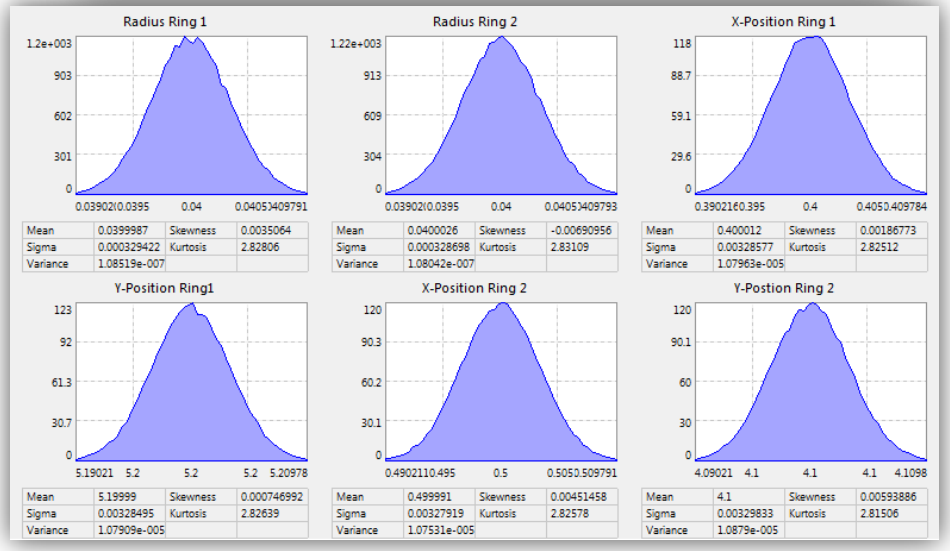
|E| - Field

Design Specifications

Design Parameters and Tolerances

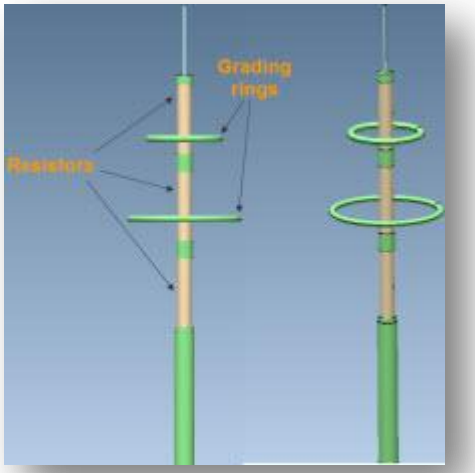
Design Parameters

Name	Nominal	Tolerance	Unit
Radius Ring 1	0.04	0.002	m
Radius Ring 2	0.04	0.002	m
X-Position Ring 1	0.4	0.02	m
Y-Position Ring1	5.2	0.02	m
X-Position Ring 2	0.5	0.02	m
Y-Postion Ring 2	4.1	0.02	m



Design Constraints

- Max. |E| of all Resistors ≤ 127500 V/m
- Max. Induction Current ≥ -3269300 A



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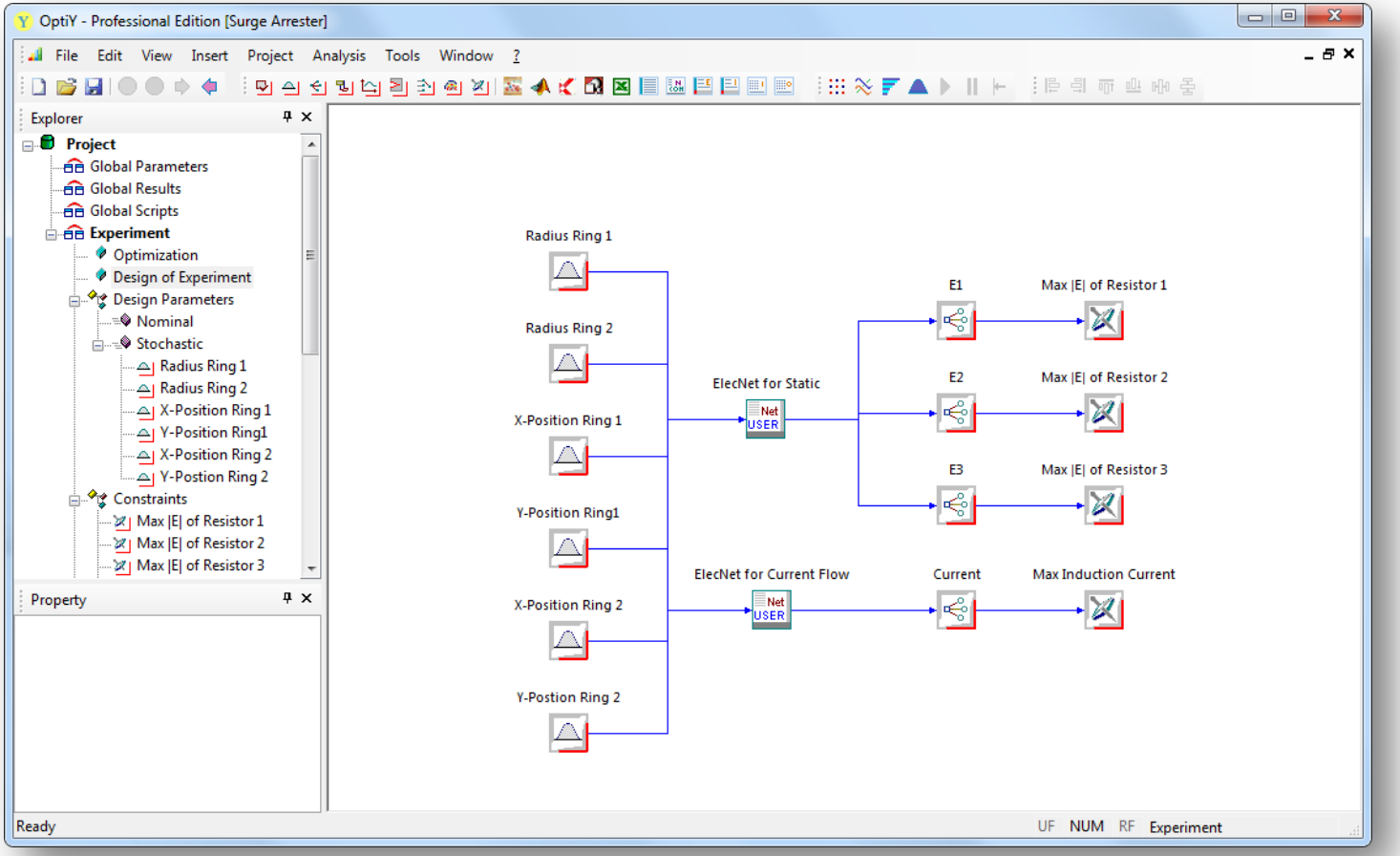
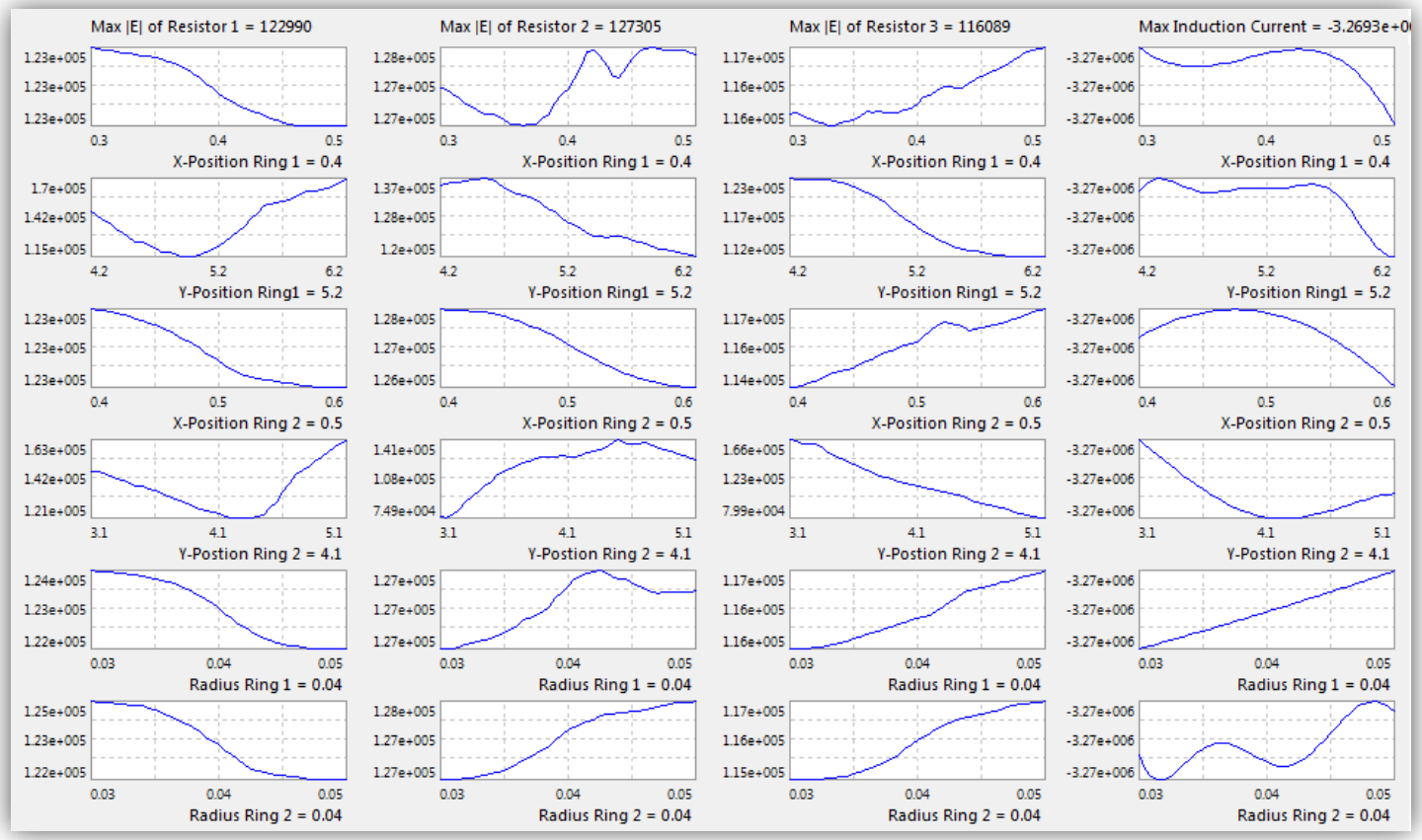
OptiY Process Work Flow



Workflow shows the processing sequences: Static and Current Flow Solver

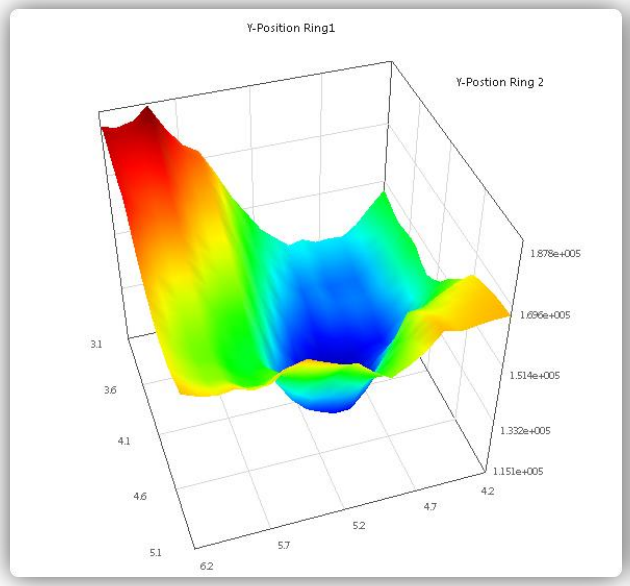
Design of experiment: 100 calculations of original model in ElecNet

2D-Graphics of the Meta Model

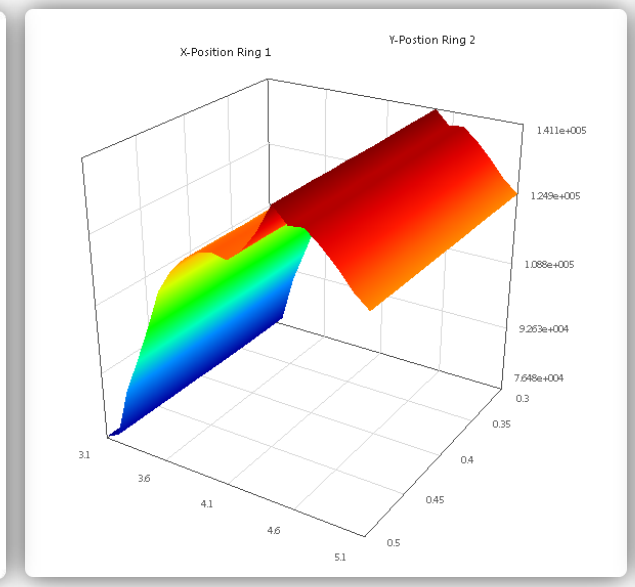


Meta model is the mathematical relationships between input and out put parameters of the original model
It is much more computing-non-intensive compared to the original model

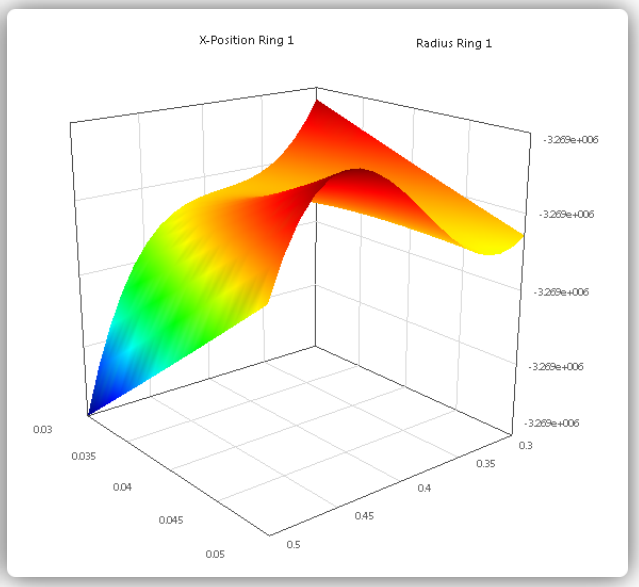
Some 3D-Graphics of the Meta Model



X = Y-Position Ring 1
Y = Y-Position Ring 2
Z = Max |E| of Resistor 1



X = X-Position Ring 1
Y = Y-Position Ring 2
Z = Max |E| of Resistor 2



X = X-Position Ring 1
Y = Radius Ring 1
Z = Max Induction Current

Residual Plots

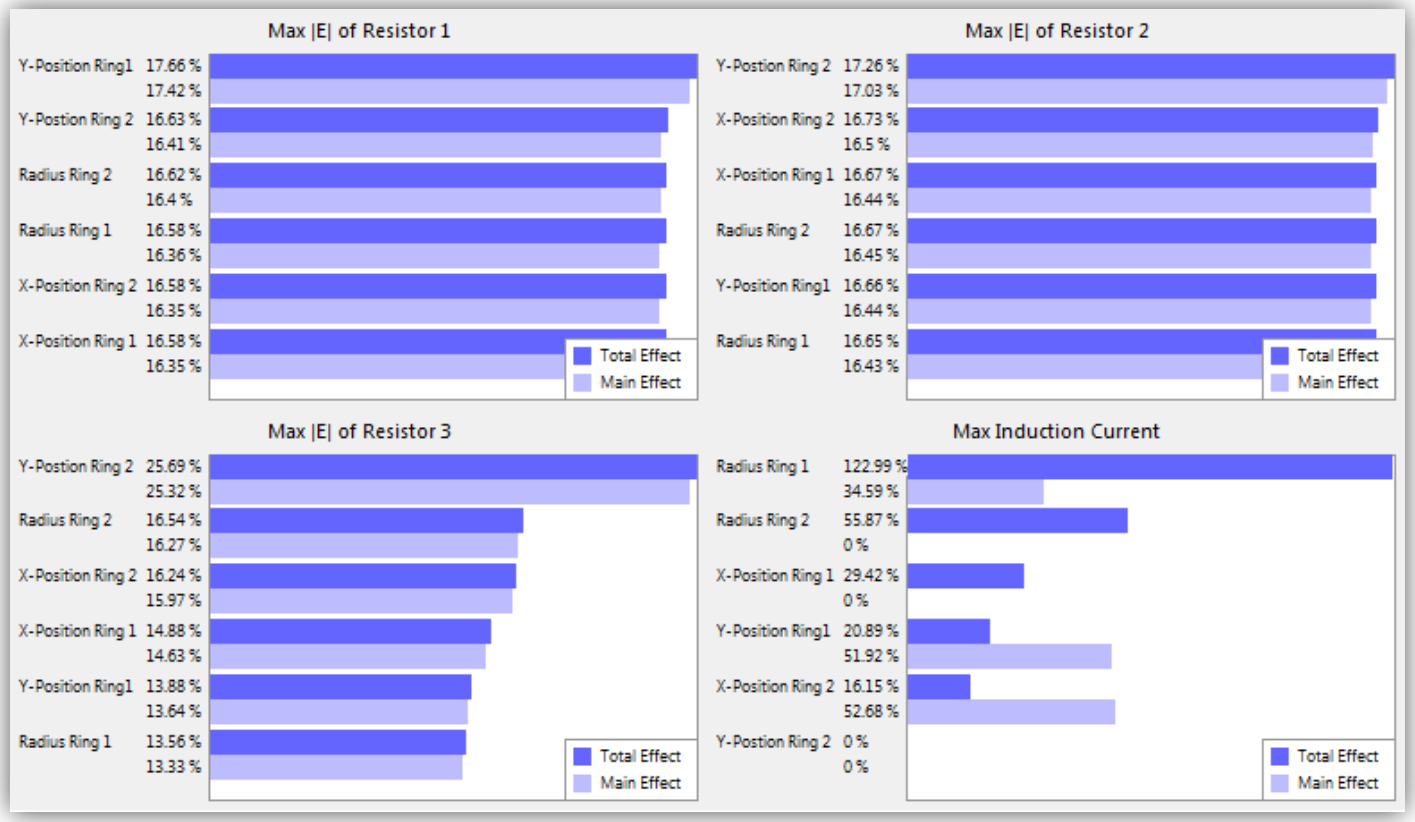
Plots show the absolute differences between original and meta model based on design of experiment
Small values indicate high quality of the approximated meta model

Design Objective Distributions

Total failure probability = 22.32%

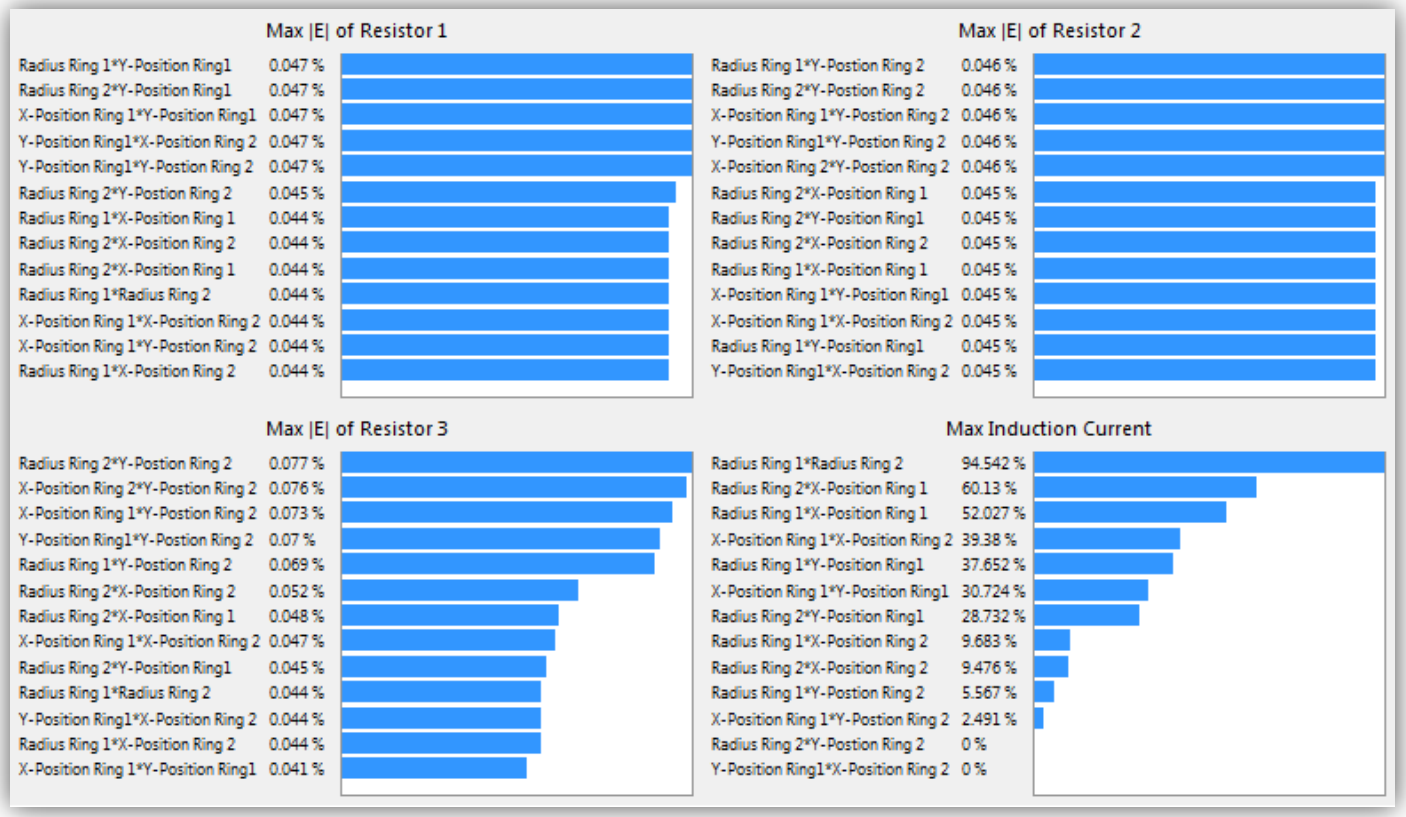
Sample size = 100.000 based on the fast meta model

Sensitivity: Design Parameter Importance



All parameters are equal important for electrical field strength |E|
Radius of both grading rings are most important for induction current

Sensitivity: Design Parameter Interactions



There are only small and negligible interactions for electrical field strength |E|
The interactions of grading ring radius are most significant for induction current

Conclusion

Nominal design using classical nominal simulation cannot warranty the reliability and quality of the products, because the nominal parameters are only one fix value.

Tolerance analysis is a power-full tool for design of reliable and quality product in the early design stage without any cost. It considers the tolerances as stochastic distributions.

In the case of the surge arrester, the design failure probability of **22,32%** can be shown for the mass manufacturing.

OptiY® is the leading software platform for robust design of all engineering fields using different commercial CAD/CAE-software or in-house codes.