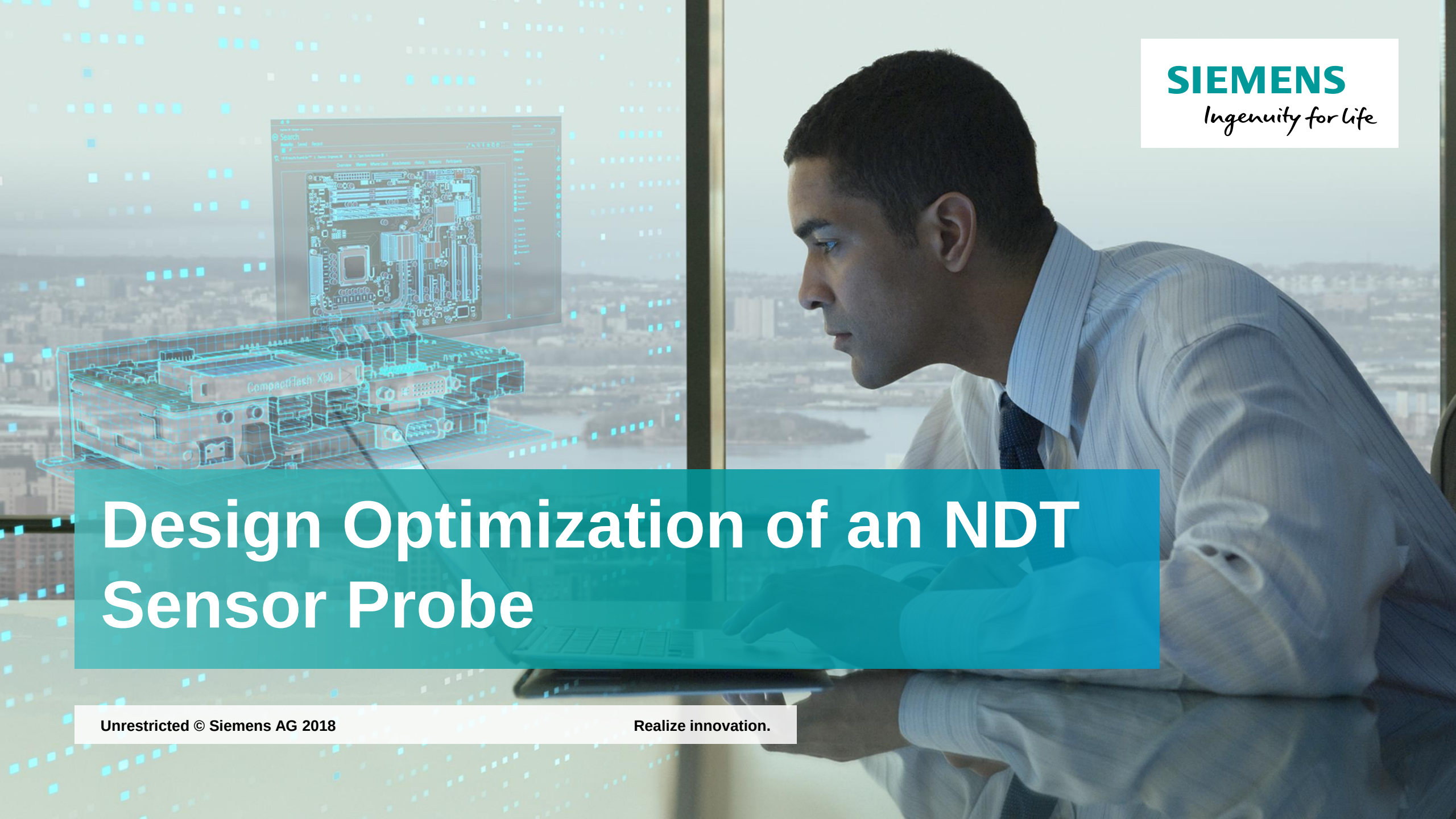

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Design Optimization of an NDT Sensor Probe

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Design Optimization of an NDT Sensor Probe

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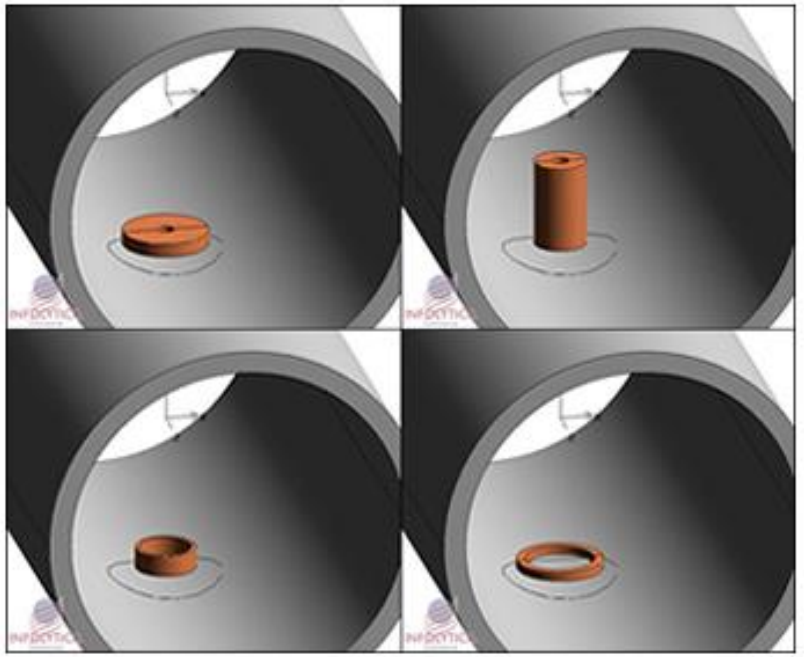
One of the most critical design decisions in any Non-Destructive Testing/Non-Destructive Evaluation (NDT/NDE) problem is the design of the probe and its suitability for detecting particular types of defects. Starting from a model based on the WFNDEC Eddy Current Benchmark Problem 2, OptiNet was used to determine the optimal coil geometry and frequency at which the inspection should be performed.

Given an approximation of the shape and size of flaws that a sensor is designed to detect, a combination of MagNet and OptiNet can be used to generate an optimal design for the probe.



Various Geometrical Modifications

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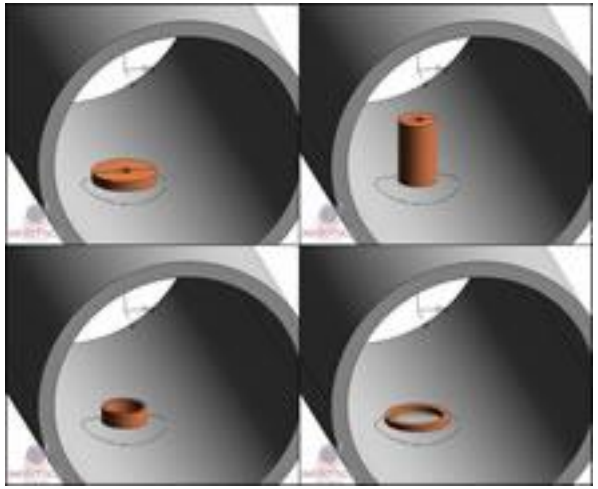
An OptiNet problem is created to determine the optimal coil shape and excitation frequency to scan for the defect. Note that this cannot be computed using a single MagNet solution; the signal level is the difference between two solutions, one with and one without the flaw. Defining an objective function such as this is easily accomplished through the use of scripting. An image shows some of the geometries tried by OptiNet in a search for the optimal sensor.



Coil Diameter Vs Signal Level

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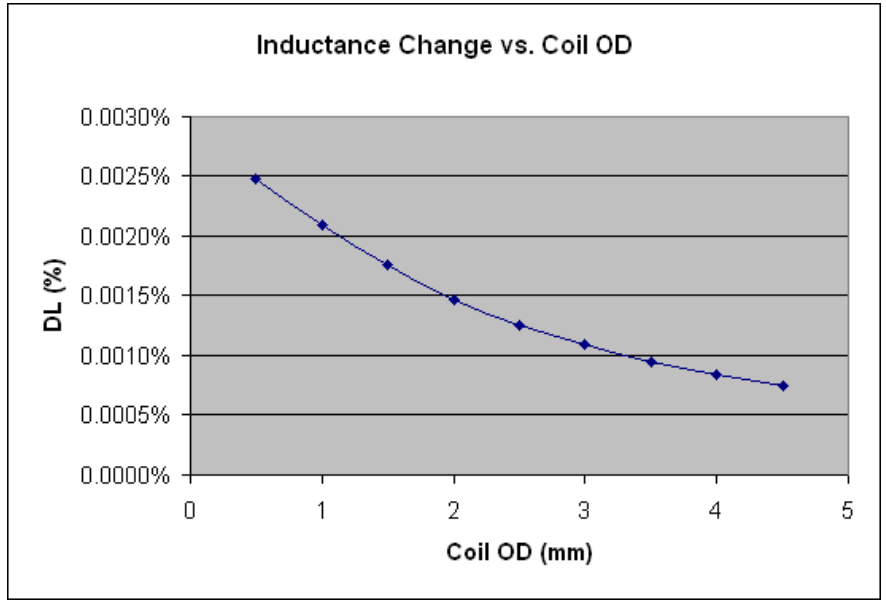
Here, a plot of coil diameter versus signal level (the change in coil impedance) shows that MagNet provides a smooth, noiseless response curve. MagNet's capabilities allow the accurate modelling of difficult NDT phenomena even for very small defects.



Optimizing the Mesh

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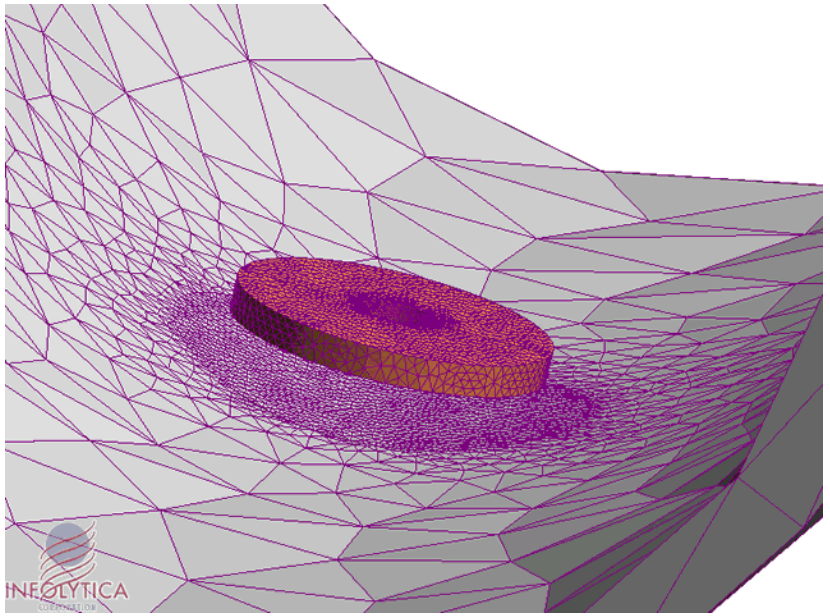
OptiNet is configured to search for the optimal coil diameter, thickness and width, as well as the excitation frequency. Scripting even allows each solution to update the mesh so that for each solution, the mesh is optimized for the coil dimensions under test. The image shows how the region of interest (the space under the coil where the eddy currents will be induced) is meshed finely, whereas the remainder of the problem is coarsely discretized. MagNet's flexible and powerful meshing capabilities produce a huge savings in the solution time.



Response of Initial and Optimized Sensors

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Starting from an arbitrary initial configuration, OptiNet was able to improve the sensitivity of the probe by a factor of 3. After 205 iterations, OptiNet had converged to an improved solution. Here, the difference in the signals, seen by both probes as they approach the defect, is plotted. The increased sensitivity (and the benefits of OptiNet) are clearly demonstrated.