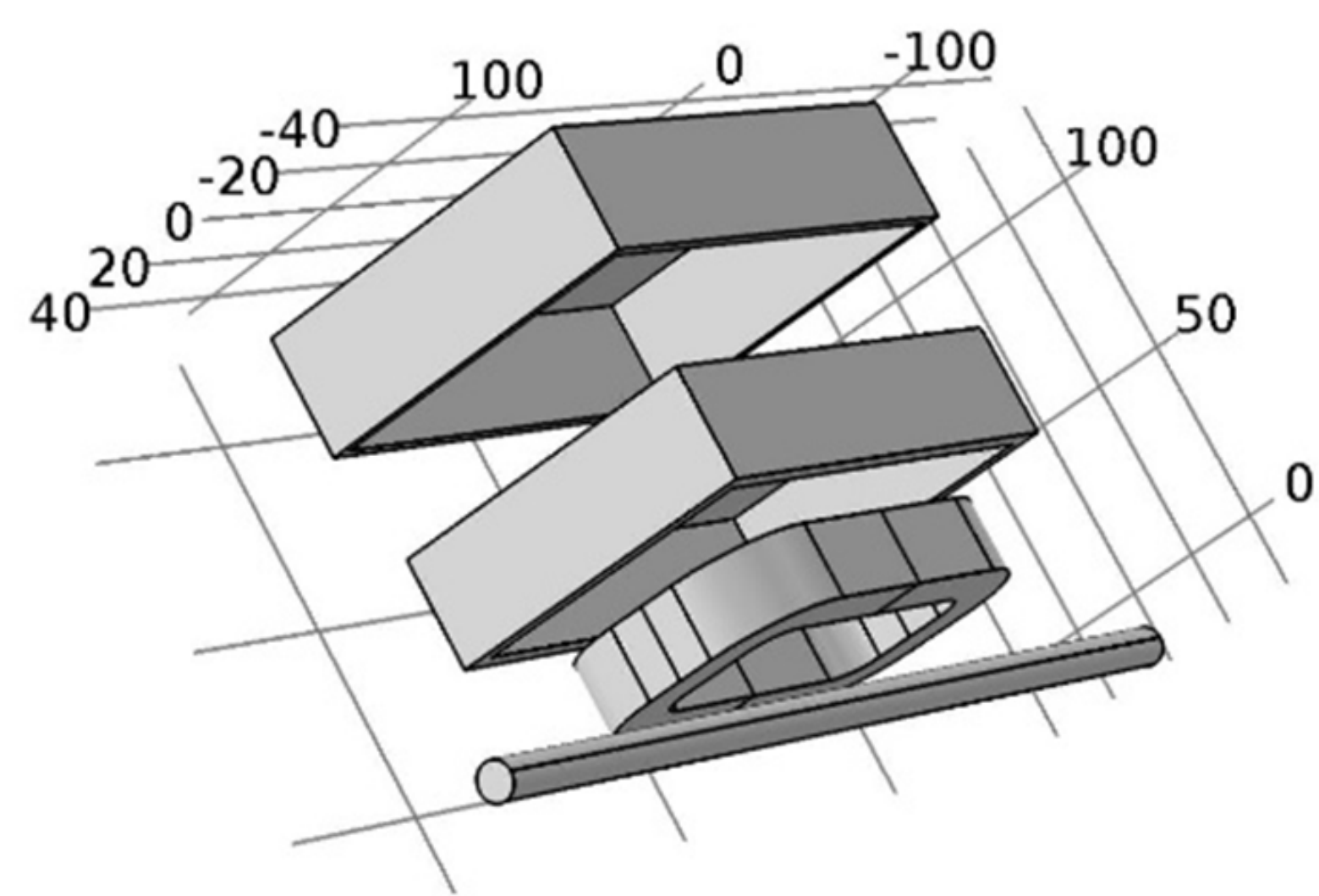# Simulation of an ECT Sensor to Inspect the Reinforcement of Concrete Structures

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Introduction: This paper describes the use of COMSOL Multiphysics® to simulate an ECT (Eddy Current Testing) sensor, designed to inspect the elements of the reinforcement of concrete structures.

Figure 1. The elements of the ECT sensor. From bottom to top: multi-turn coil, ferrite box and aluminum box.
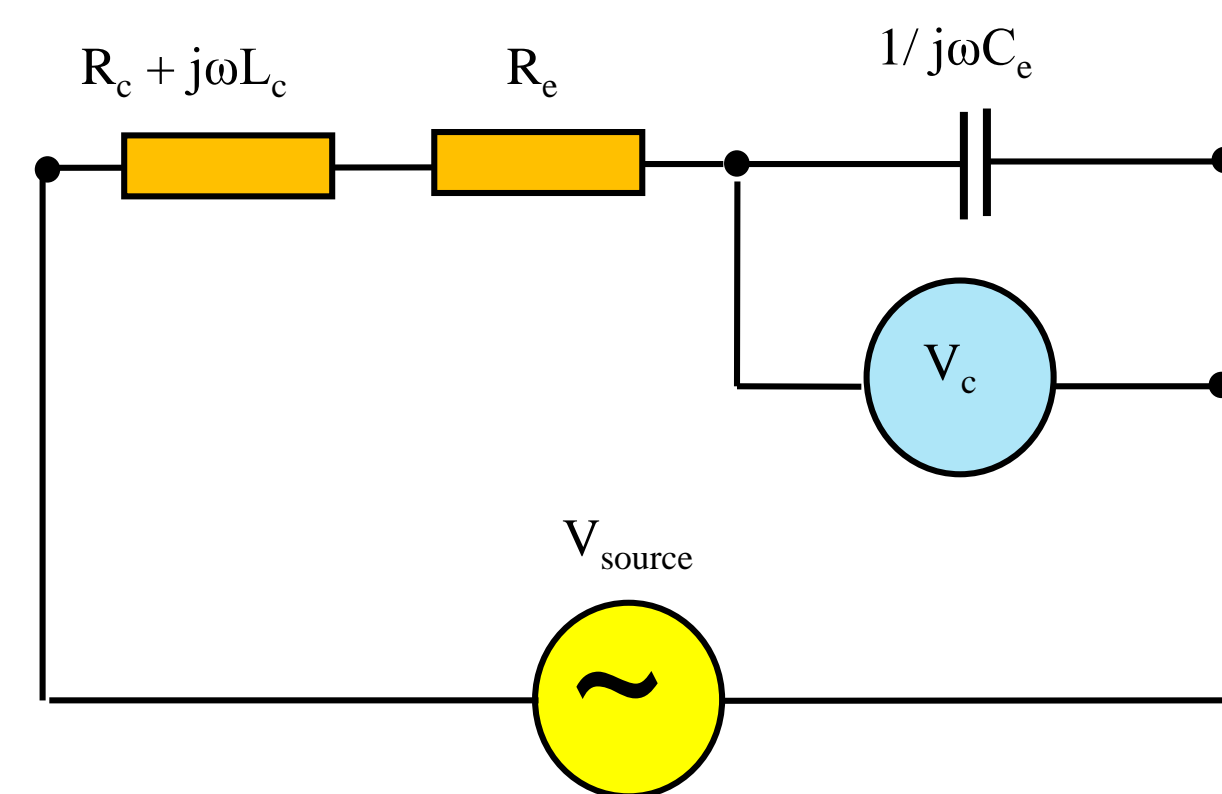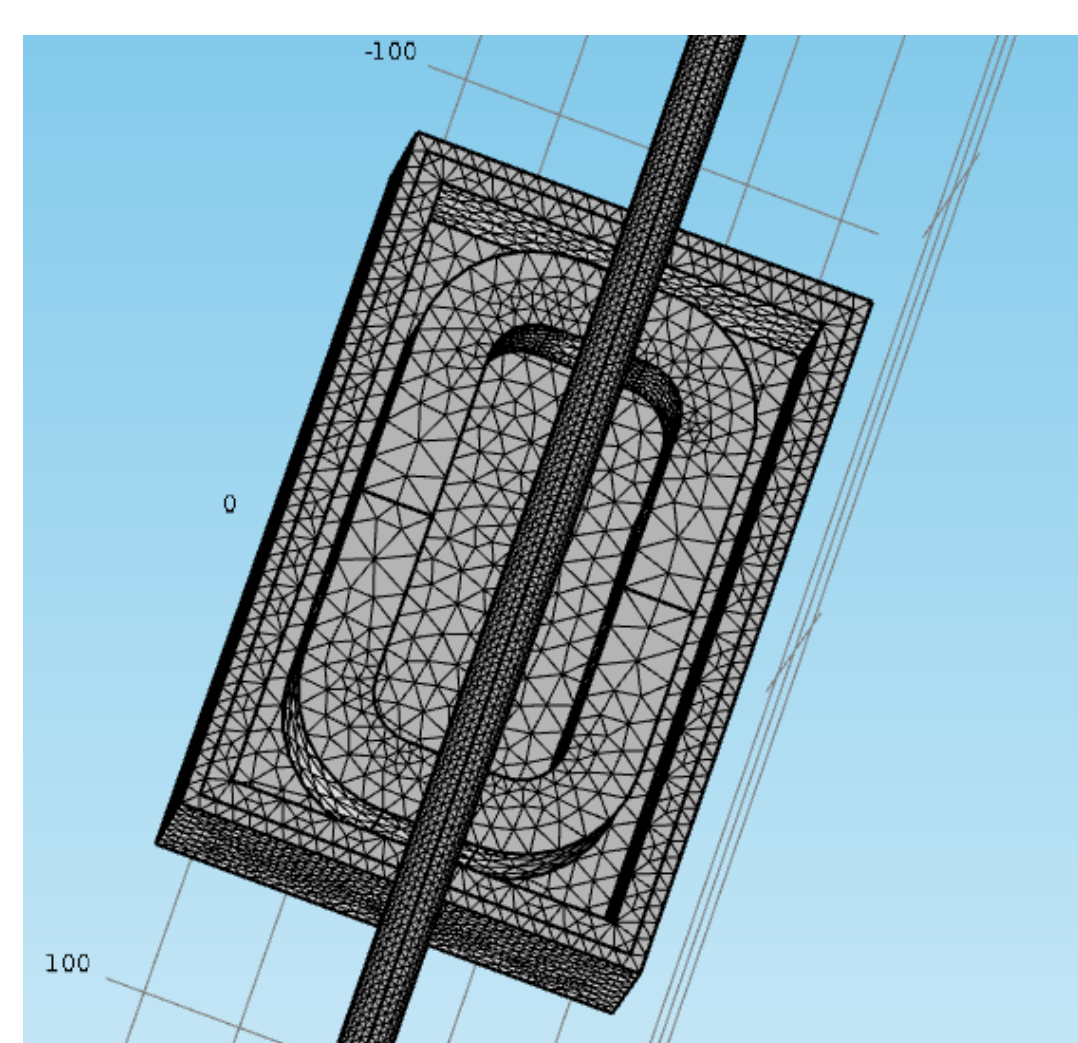
Figure 2. An electrical circuit of the ECT sensor.

Voltage across the capacitor:

$$V_c = -V_{Source}\frac{(\omega^2\,C\,L - 1 + j\,\omega\,C\,R)}{(\omega\,C\,R)^2 + (\omega^2\,C\,L - 1)^2}$$

L is the inductance of the coil, **R** is the total resistance and **C** is an external capacitor .

Use of COMSOL Multiphysics

**Figure 3.** Mesh generated for the model.

Meshing chosen according to the regions of interest, using predefined size options. Free tetrahedral elements were used. Magnetic Fields and Electrical Circuits physics. Solutions in the frequency domain.
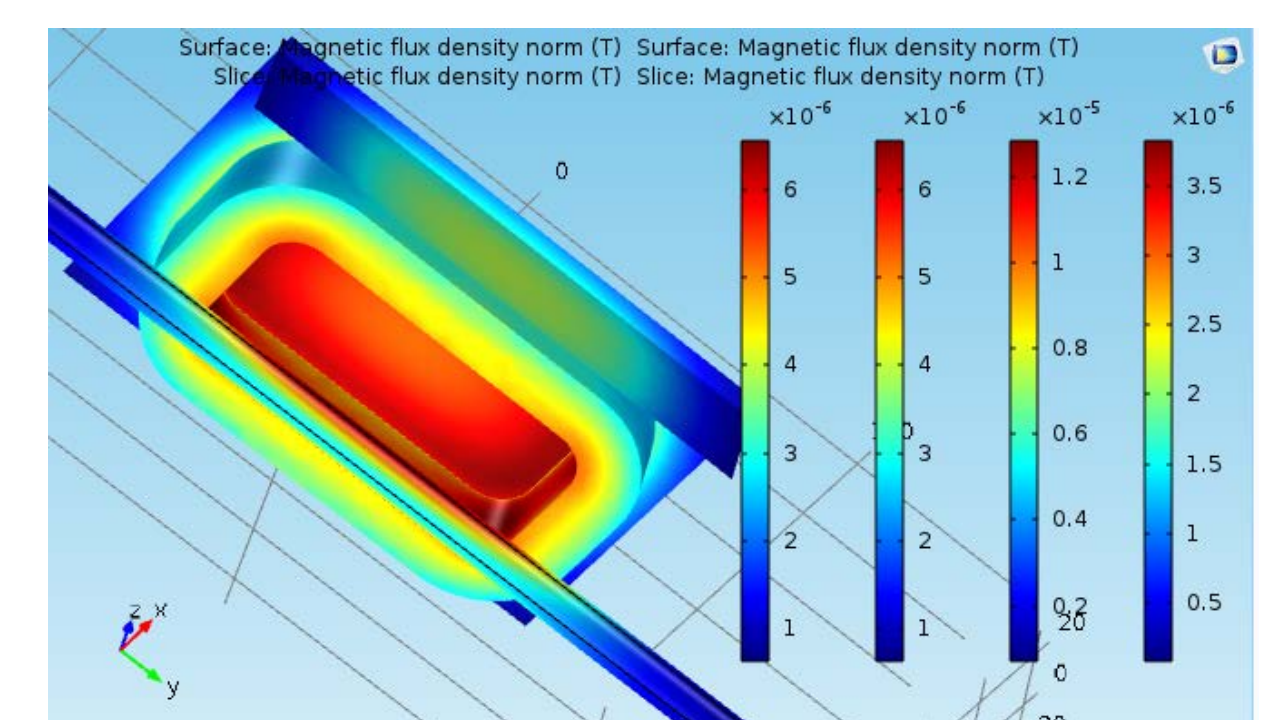
Three configurations were considered:

1) The sensor is built using only the coil.
2) The sensor is built using the coil and the ferrite box.
3) The sensor is built in its complete configuration.
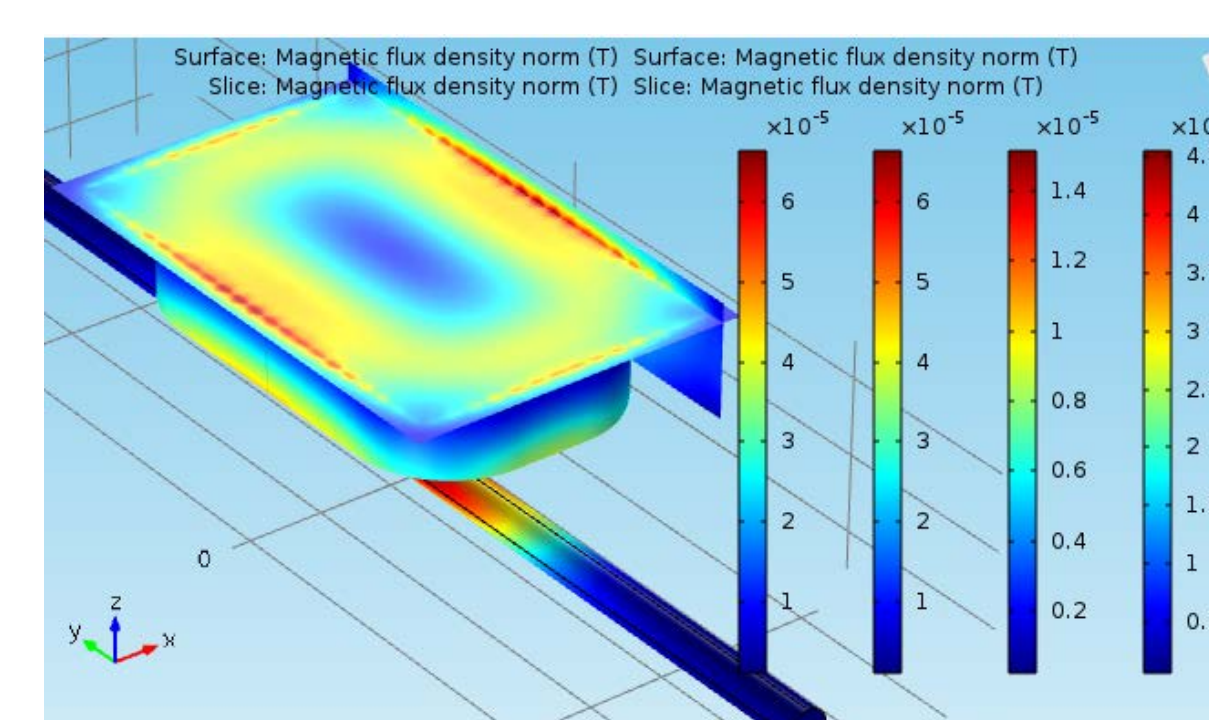
Results

Case 1:
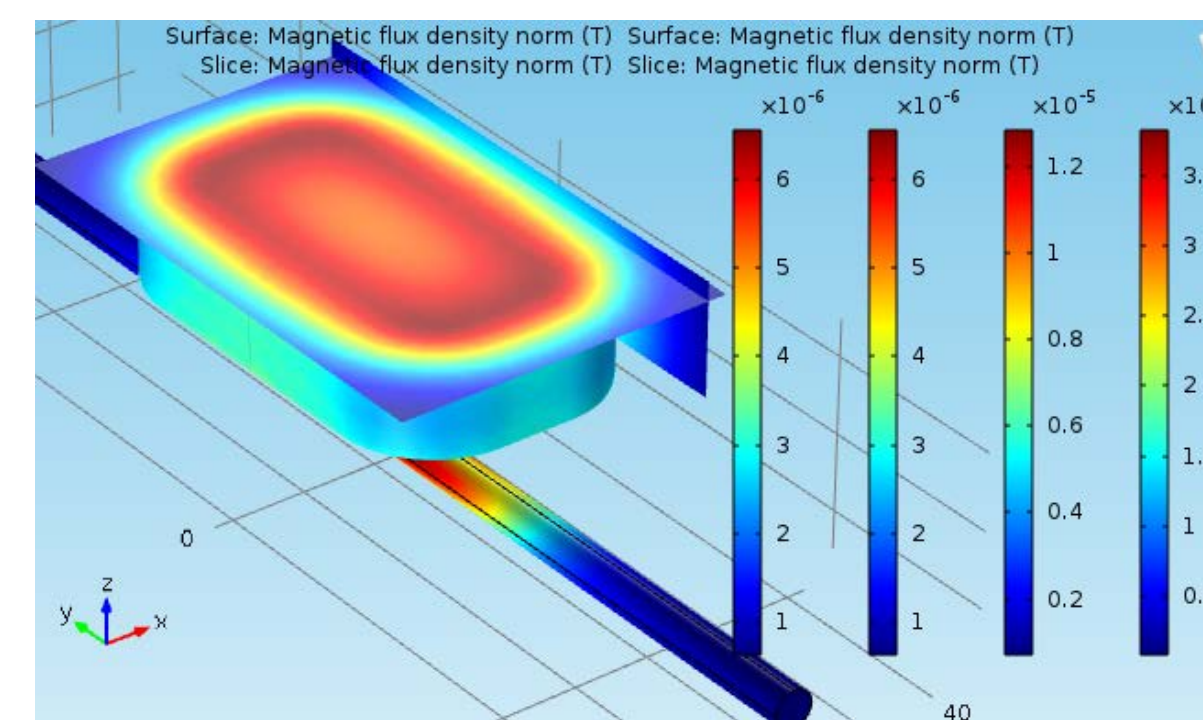
Figure 4. Magnetic flux density for case 1 (top perspective).
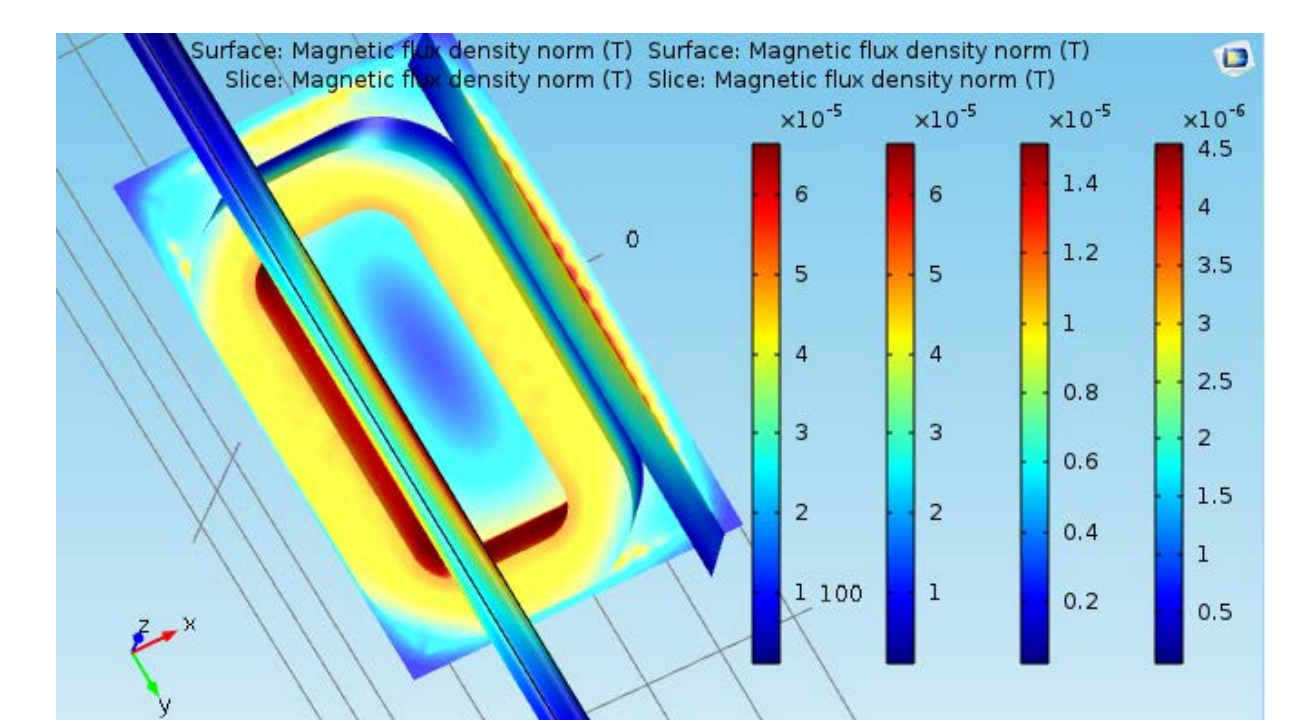

Figure 5. Magnetic flux density for case 1 (bottom perspective).
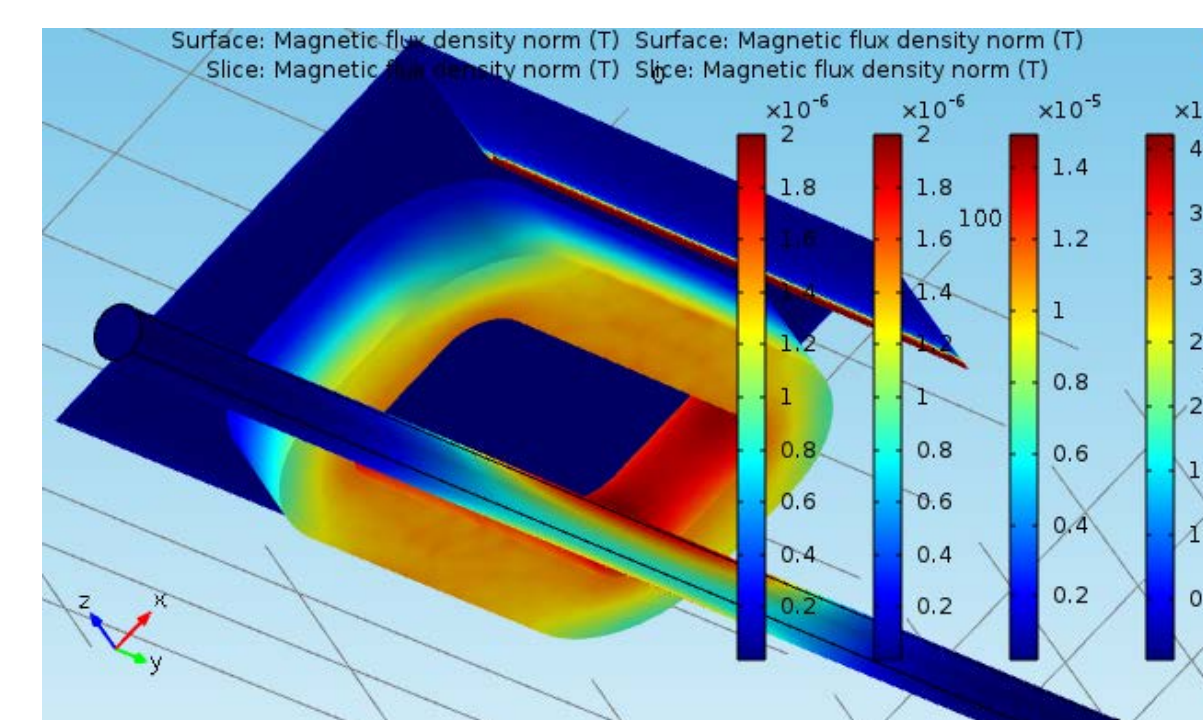
Case 2:

Figure 6. Magnetic flux density for case 2 (top perspective).
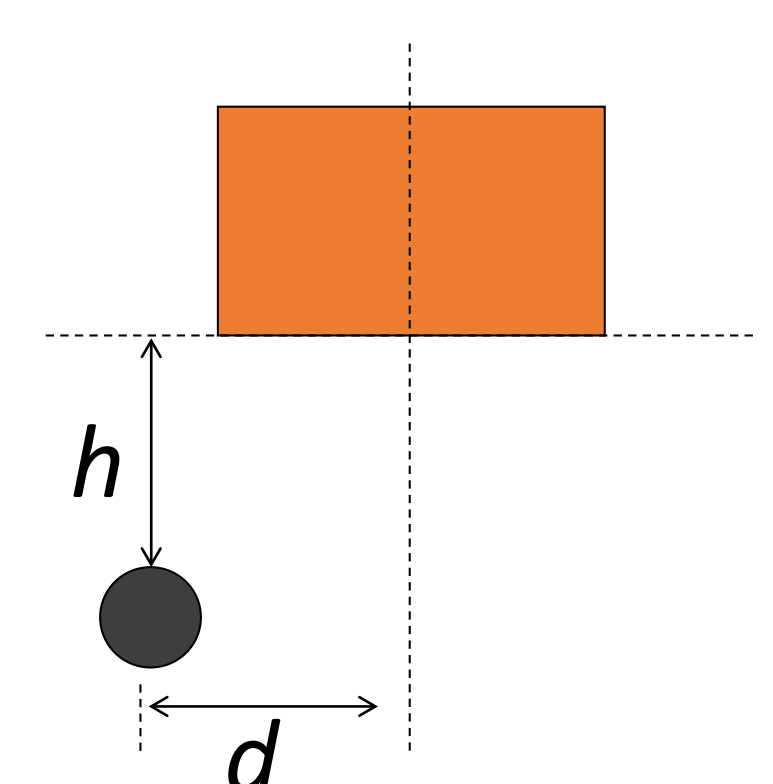

Figure 7. Magnetic flux density for case 2 (bottom perspective).
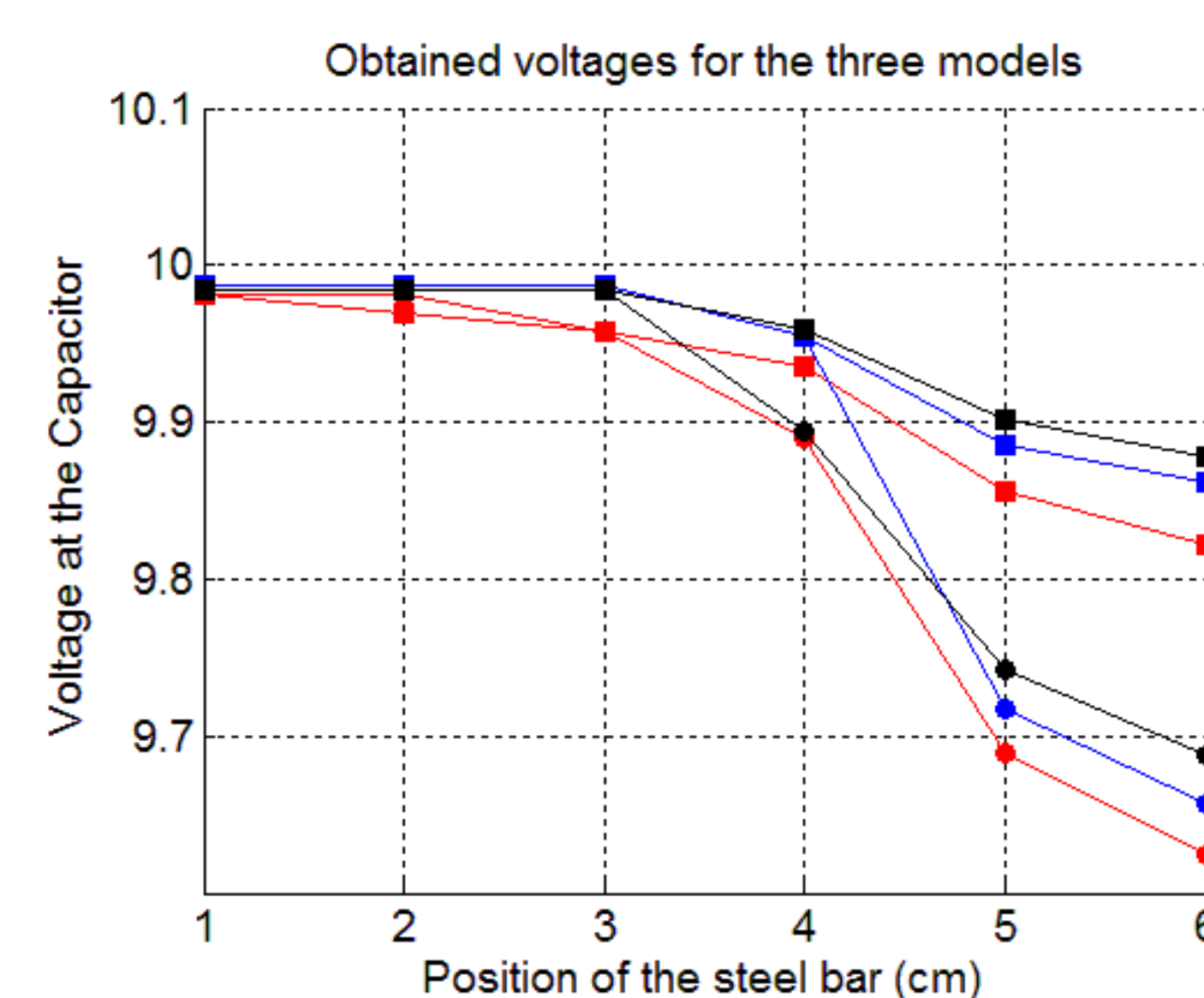
Case 3:

Figure 8. Magnetic flux density for case 3 (bottom perspective).

Sensor movement:

Figure 9. Schematic representation of the sensor position.

Figure 10. Obtained results for the three sensor configurations, in function of the position of the sensor.

Conclusions: COMSOL Multiphysics proved to be very useful in the three-dimensional modeling of electromagnetic components of ECT sensors for reinforcement inspections.

References: References and additional details in the full paper.