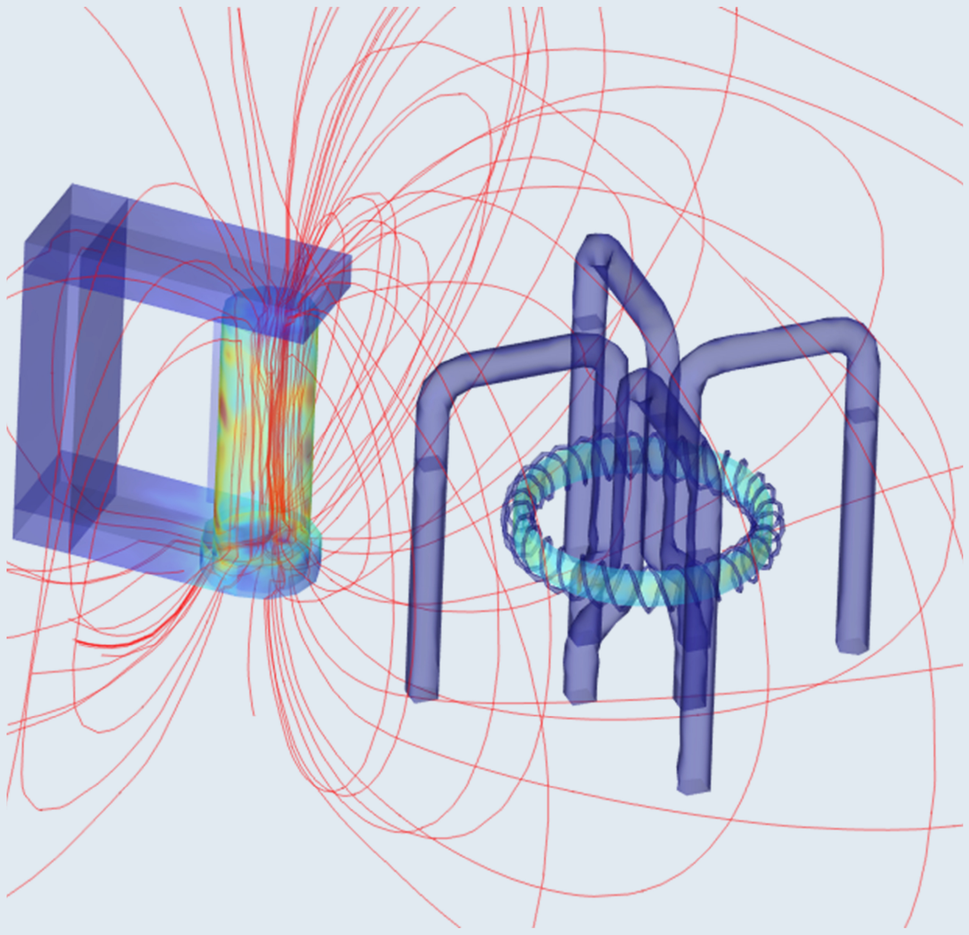

Fluxgate Virtual Current Sensor

The project is about modeling a current sensor based on fluxgate technology. The realized virtual sensor will help engineers in many areas, for example, sensor designing and sensor power module integration.

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Introduction & Goals

The fluxgate sensors are well known for their high accuracy and used today in many areas in the automotive industry especially for battery management systems and for the on-board chargers as residual current detectors. The full vehicle electrification goes through high power density and high compactness systems. Thus, the electrical sensors works under severe operational conditions namely: the frequency, the temperature and the electromagnetic pollution and others ...

It is with a high interest to have a virtual sensor model for early sensor design phase and for system level simulations. Indeed, it allows better integration under customer constraints. The poster describes how the virtual fluxgate sensor is built under the COMSOL® software and gives an example of integration with simulation results.

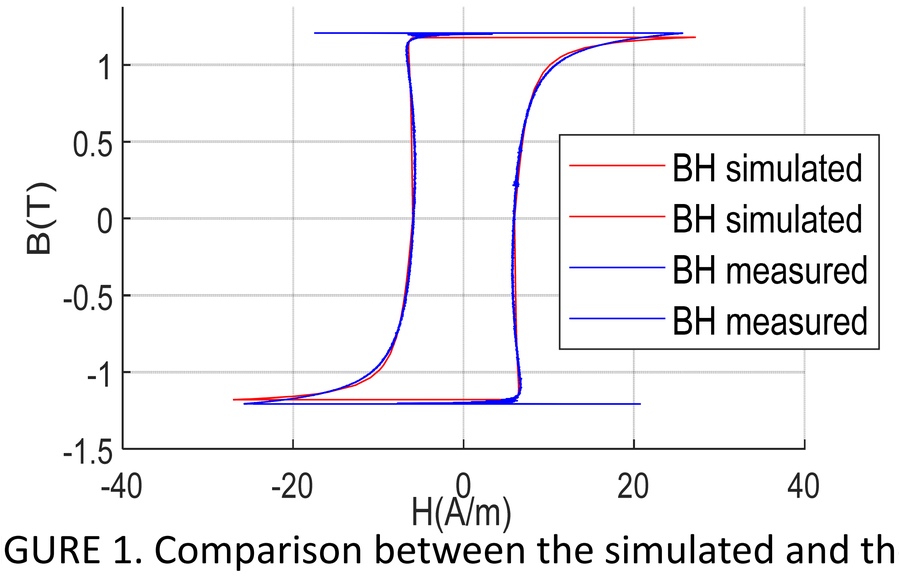

FIGURE 1. Comparison between the simulated and the measured hysteresis loops.

Modeling Methodology

Four COMSOL modules are used: AC/DC Module, Electrical Circuit interface, Events interface and General Form PDE interface.

The “Events” interface is used to replace and to simulate the command algorithm that manages the electronics.

The “General Form PDE” interface is used to implement a magnetic dynamic behaviour to the magnetic core following the equation:

$$H_{\mathrm{dyn}}(B) = H_{stat}(B) + \gamma \times \frac{\mathrm{d}B}{\mathrm{d}t}$$

The realised COMSOL model is piloted using LiveLink™ for MATLAB® to run and post process the signals into current measurements.

Results

The sensor integration under an electromagnetic pollution is studied. A relay is chosen as a source of pollution. Two cases of relay’s emplacement close to the sensor were simulated.

The electromagnetic pollution damage is evaluated with the two sensor measurement channels: digital and analog.

Channels	Ref (relay off)	0° rot.	90° rot.	0° error (%)	90° error(%)
Analog	0.00351	0.00358	0.00356	+1.8	+1.3
Digital	0.00296	0.00263	0.00198	-11	-33.3

The digital channel is highly sensitive to electromagnetic pollutions.

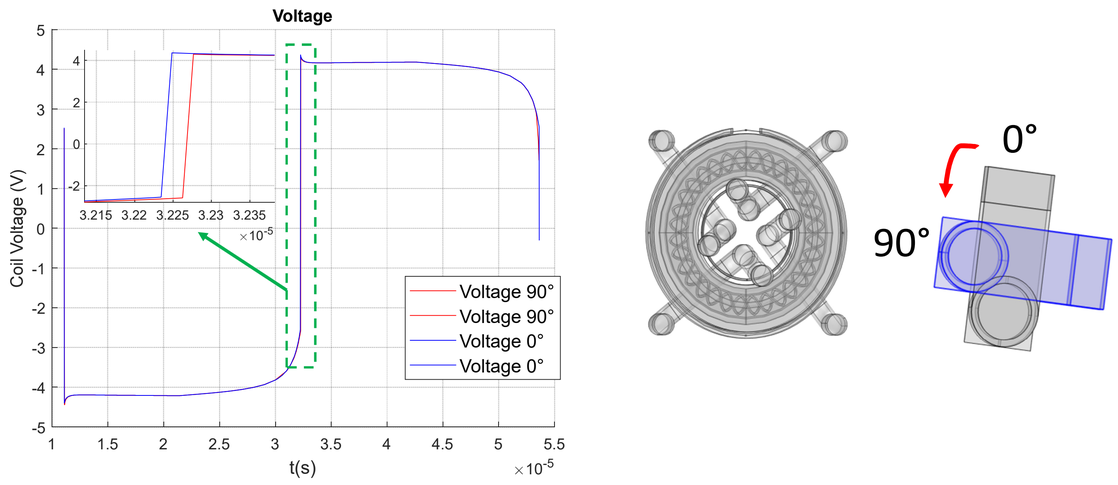

FIGURE 2. Left: Voltage comparison. Right: position of the relay regarding to the sensor.

REFERENCES

1. A. Lekdim, “Open-loop Hall-effect current sensor magnetic model for circuit-type simulation software analyses”, *IEEE Sensors*, Volume: 22, Issue: 11, 01 June 2022.

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