FEM-Simulation of a Printed Acceleration Sensor with RF Readout Circuit

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Abstract

Printed electronic is a new technology for sensor fabrication. The aim is to develop an acceleration sensor-system which uses the same materials and technologies as printed electronics, so that the sensor can be easily integrated in common RFID-Systems. In this poster presentation we want to figure out the development of a capacitive sensor system, which is in the position to detect accelerations in the range of ± 20 g. Besides the sensor element the system contains a printed RF-inductance, which is used for a contactless data transfer (Figure 1). We use FEM with COMSOL Multiphysics for the development of the sensor-system. On the one hand we simulate the behavior of the L-C-oscillating circuit using the RF Module (Figure 2). On the other hand we simulate the sensor itself. We calculate the deflection of the sensor by acceleration (using the Nonlinear Structural Materials Module) and we evaluate the change in capacitance by this deflection (mechanics and electrostatics are coupled via ALE/Moving Mesh). The changed capacitance of the sensor leads to a change of the resonance frequency of the oscillating circuit. This is detected by the RF Module again. As a result we want to show a plot of the magnetic field lines between the two coupled coils and the magnetic field lines in the sensor-system itself (Figure 3). We want to figure out the eddy currents (Figure 4) in the sensor calculated by COMSOL. Furthermore we want to show the first mechanical design of the sensor and its deflection by acceleration and the influence of acceleration on the resonance frequency of the oscillating circuit. Based on these data we will decide about the design of the acceleration sensor-system. We want to define the system's inductance and capacitance and the sensors mechanical design. Because of the known inductance and capacitance it is possible to build a first concept of an evaluating-circuit before the sensors system's development is finished. Using COMSOL we could reduce the costs of our building prototypes. We could easily develop a first layout of the oscillating circuit and the sensor evaluating many parameters like capacitance and inductance.

Figures used in the abstract

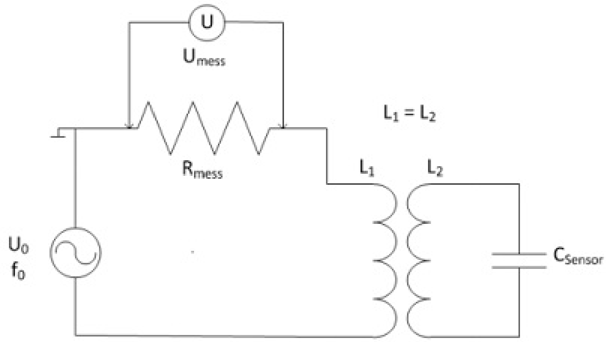

Figure 1: Basic sensor circuit.

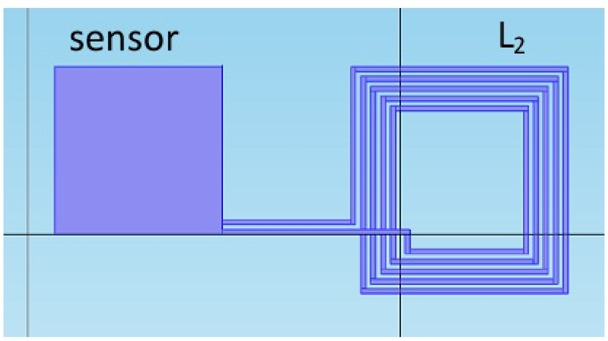

Figure 2: First design approach of the sensor-system.

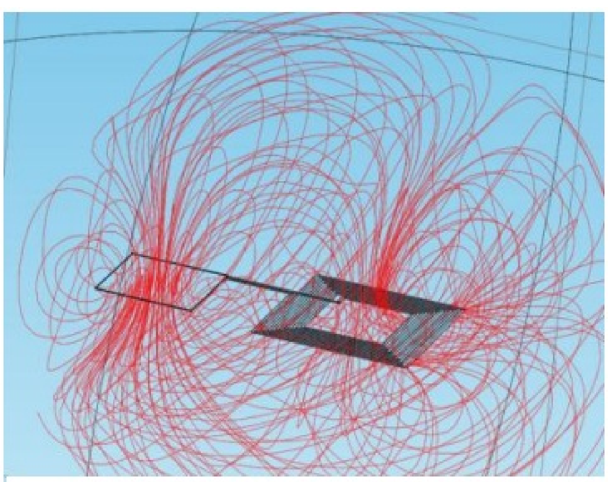

Figure 3: Magnetic field of a sensor-system.

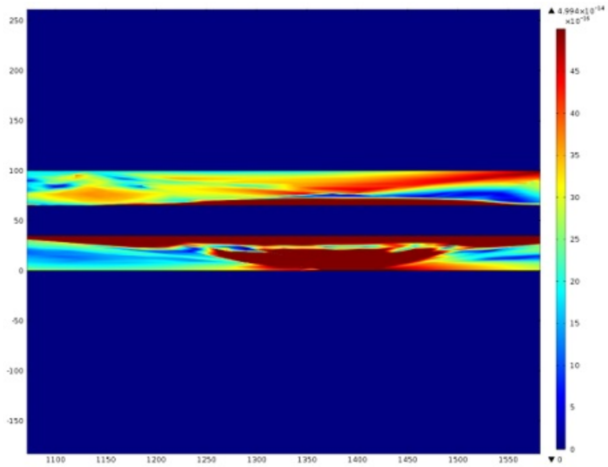

Figure 4: Induced current in the capacitor plates. These currents are responsible for the magnetic field lines (Figure 3) crossing the capacitor plates.