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Abstract

Design and Potential Analysis of an Eddy Current Sensor for Inductive Conductivity Measurement in Fluids

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Eddy current inductive sensors have the potential to become a cost-effective alternative to the industrial standard of transformer-type inductive conductivity sensors (TICS). In the scope of this paper, a first exemplary eddy current sensor for sea water conductivity measurement is developed, based on the derived sensor theory of a previous work. The sensor consists of a ferrite rod carrying two solenoids for excitation and sensing. By a high frequency excitation with a small current, eddy currents are induced in the fluid. The counter-fields are measured with the sensing coil. Since the conductivity of sea-water is comparably low, the resonance point of the coil is used to amplify this effect. The developed prototype is analyzed based on a derived transfer function and FEM-Simulations, to characterize the sensor in optimal conditions. The theory is validated using an implementation. With conducted experiments on a sensor test bench, the characteristic could be confirmed and disturbances identified. Changing temperature has a great effect on the resonance damping due to the correlated copper resistance. However, temperature and conductivity changes have slightly different effects on the frequency spectroscopy, which allows to distinguish between both. The authors were able to prove this also by the derived transfer function. As a result, the experiments can confirm the theoretical understanding of the eddy current sensor. This gives a perspective for a novel sensor to allow sea water conductivity measurement. Yet, the current implementation is to unstable for high resolution measurements and needs further improvements.

Figures

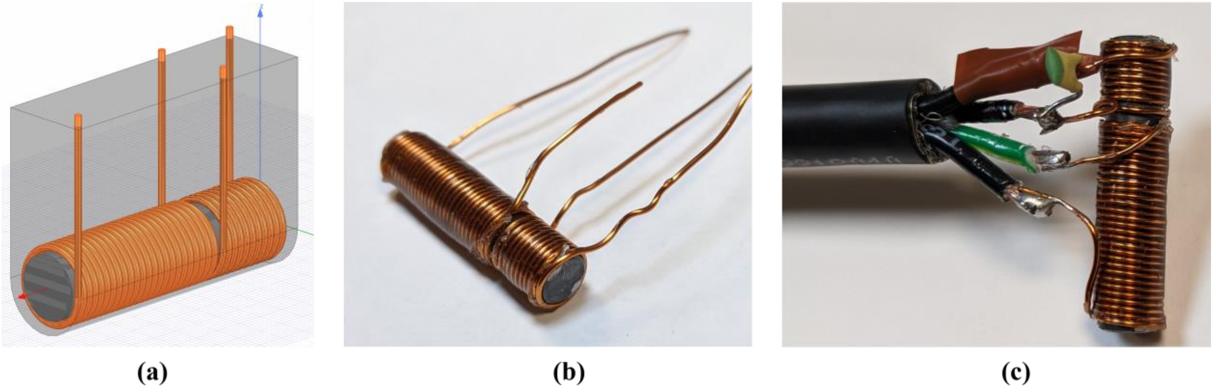

Figure 1: Implementation of the eddy current sensor (a) in the FEM-simulation (b) of the manufactured prototype (c) with soldered capacitor

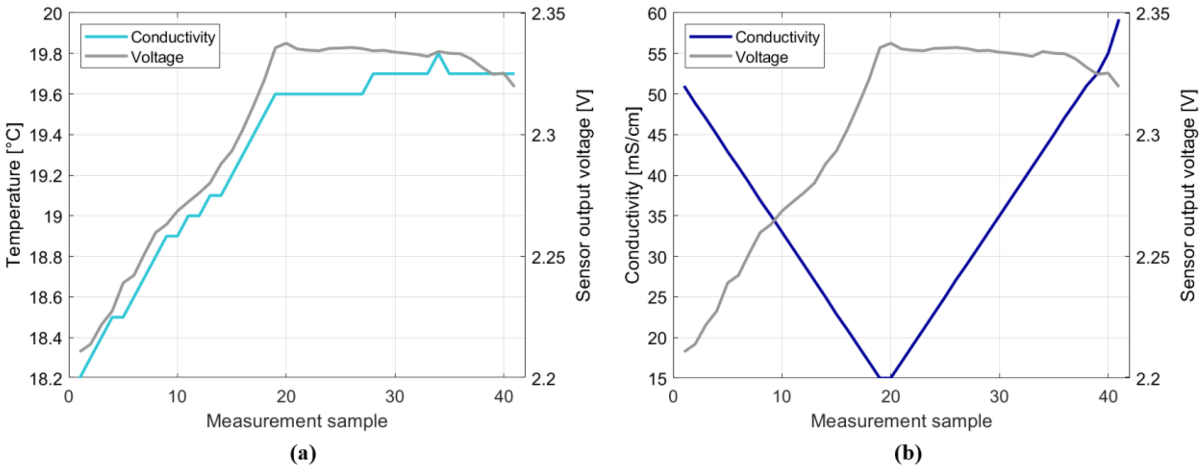

Figure 2: Plot of the maximum voltage output for the characterization test over (a) change in temperature (b) change in conductivity

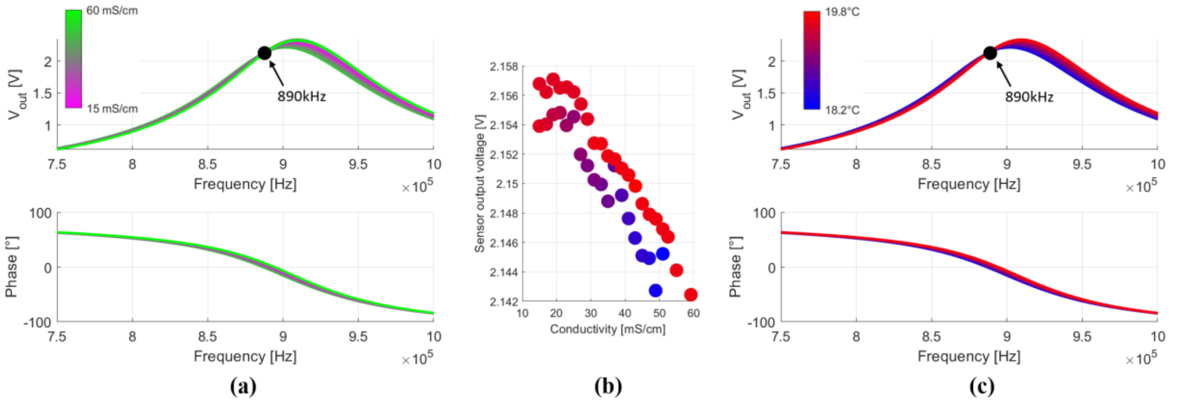

Figure 3: Frequency spectrum for the sensor output voltage coloured for (a) conductivity and (c) temperature. In (b): Output voltage at 890kHz plotted over conductivity with temperature colour grading.

References

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