Single coil eddy current sensor multi-parameter measurement for NDT

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Most of eddy current sensor are measuring single information such as amplitude, phase or frequency. The test results are easily affected by lift-off. Differential coil defect detection can partially avoid the influence of lift off. However, it is not easy to establish the relationship between differential voltage and physical mechanism of defects. Based on the work of G. Y. Tian in 1998, this paper presents a method to measure the resistance and inductance of the induced eddy current loop. Firstly, this paper studied the method measuring the parameters of the electronic circuit for an eddy-current probe in air. The equivalent conversion relationship between eddy-current probe RLC model and the Butterworth-Van Dyke (BVD) model, which is wildly used in the piezoelectric sensor, is derived. Then, a method measuring the parameters of BVD model though the phase-frequency curve is given. Therefore, the parameters of a eddy-current probe can be calculated from the equivalent conversion formula between RLC model and BVD model. Secondly, we converts the resistance and inductance of the induced eddy current loop to the change of the resistance and inductance of the electronic circuit for an eddy-current probe. Thirdly, measuring the parameters change of eddy-current probe between in air and coupled to the surface of an electrically conducting material. Then, the resistance and inductance of the induced eddy current loop can be solved. This method has been verified by COMSOL simulation and ADS simulation respectively in this paper. Through multi parameter measurement, this method can realize multi physical quantity separation. So it can improve the detection sensitivity and anti-interference ability. Preliminary experiments show that when the lift-off is 7 mm, the lift-off sensitivity of a planar coil is 0.01 mm. When the lifting distance is 15 mm, the artificial crack with a width of 1 mm in cast iron can be distinguished.