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Ultrasonic Localization Simulation and Experiment of Partial Discharge Based on Double Helix Sensor Array

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Purpose/Aim

Partial discharge (PD) is the main reason for the insulation deterioration inside the electrical equipment. It's necessary and valuable to locate the PD source occurred in electric power system timely and accurately. At present, ultrasonic array location method is an effective way in partial discharge detection. With high signal gain, strong anti-interference ability as well as high resolution, this method has been widely used to locate the partial discharge source. As we all know, the partial discharge ultrasonic array sensor with good acoustic performances is the basis of PD detection and location. And indeed, there is still much room for improvement in array arrangement using the ultrasonic array location method, which needs further exploration.

Experimental/Modeling methods

In this paper, a partial discharge location technique based on double helix ultrasonic sensor array is proposed, and the accuracy of this method has been verified by simulation and lab experiment. Firstly, the static beam-pattern was analyzed for several kinds of arrays to get the acoustic performances, which explains the great acoustic characteristics of double helical array in theory contrasted with other circular array; Secondly, this paper uses MATLAB to establish an acoustic finite element model, which employs the double helix sensor array to simulate the acoustic characteristics of a single narrowband ultrasonic source. Next, this paper uses MUSIC algorithm to draw the corresponding spatial spectrum and locate the PD source. Finally, the lab experiment has been executed to verify the simulation in a similar process.

Conclusions

The results show that the uncertainty of ultrasonic positioning based on double spiral ultrasonic sensor array is less than 7% both in simulation and lab experiment. It means that this array can successfully locate the PD source, and can also meet the requirements of engineering.

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