Recurrence Analysis of Time Series of Partial Discharge in Optical-UHF Combined Sensing

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Abstract

Partial discharge (PD) is a dynamical system with nonlinear chaotic characteristics. Research on the time series of PD is helpful to extract the discharge mechanism. This paper takes a PD optical-UHF detection platform to detect the PD signals of typical defects. The optical and UHF signal are fused to avoid the insensitivity of single method in specific defects. The phases of PDs are taken as one-dimensional time series. The PD phase series are reconstructed in phase space and the attractors and the recurrence plots are presented. The attractors in phase space characteristic the PD system from predictability, stability, and complexity. The typical recurrence characteristics such as recurrence rate, determinism, laminarity, and entropy are extracted as evaluation parameters. Results show that the PD phase attractors are more random under low voltage and tends to be more ordered, stable, and complex when the applied voltage increases. The order of predictability, stability, and complexity of the four defect types from high to low is: point discharge, surface discharge, suspended discharge, air-gap discharge. The recognition accuracy based on recurrence characteristics achieves 100% with the most basic BPNNs.

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