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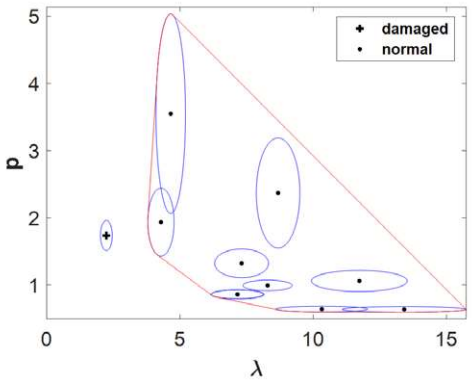
Analysis of the GGD vibroacoustic detector of power transformer core damage

Abstract. *Vibroacoustic diagnostics (VM—Vibroacoustic Method) is one of the methods for diagnosing the active part of power transformers. One of the recently published objective method for the detection of transformer unit core damage was based on the analysis of the statistical properties of the vibration signal registered on the surface of the tank of an unloaded transformer in the steady state of vibrations (VM). The GGD vibroacoustic detector of power transformer core damage is based on the relative changes in vibration power as a function of frequency and the generalized Gaussian distribution (GGD). The article shows how to configure the detector in order to reduce the variance at the detector output and speed up the detection.*

Keywords: vibroacoustic method, transformer core damage, generalized Gaussian distribution, estimation.

Design of the GGD vibroacoustic detector

The procedure for determining the output values of the detector is described in [1]. Firstly, FFT analysis of the vibroacoustic signal is performed with the determination of the relative changes in vibration power as a function of frequency $P_i(f)$ and, finally, the statistical properties of the dataset $P_i(f)$ is calculated. GGD is used to describe the $P_i(f)$ set. The detector output values are the λ and p parameters of the GGD distribution. These two numerical values form the basis for the classification of the technical condition of the transformer unit core.



Rys.1. Area covering correctly operating transformers and damaged one with the standard deviation of the estimated values of λ and p. filter with voltage control in the supply line

Experimental validation

The convex hull of the area containing correctly operating transformers including the standard deviation of the estimated values of λ and p for the sample size of $N=500$ is shown in Fig. 1.

Conclusion

The article has shown the influence of the variance of the maximum likelihood (ML) estimator of the GGD distribution on the pair (λ, p) constituting the output of the detector of power transformer core damage, where the reduction of the variance value is obtained by increasing the number of random samples of the detector. The reduction of the variance of the output values can also be obtained by repeating, for example, three times the calculations and determining the median as the result value.
Speeding up the calculations can be achieved by using the approximated fast estimator [2] of GGD, but it is necessary to repeat the calculations several times and determine the median as the output value in order to reduce the variance of the output values.
An area covering correctly operating transformers has been defined, taking into account the standard deviation of the estimated values of λ and p, which has a clear separation from the area of the damaged transformer.

References

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