MODELLING SWEEP FREQUENCY RESPONSE OF POWER TRANSFORMERS

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(178069V)

Degree of Master of Science

Department of Electrical Engineering

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Dissertation submitted in partial fulfilment of the requirements
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DECLARATION

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Signatures of the supervisors:

Dr.Rasara Samarasinghe Date:

Prof. Rohan lucas Date:

ABSTRACT

Condition monitoring of power system components is crucial in order to supply quality and uninterrupted power supply to its consumers. Among other components, the power transformer is considered to be one of the most expensive and vital components in the power network. Therefore condition assessment and fault diagnosis of power transformers have become main features of the power system's maintenance strategy. Sweep frequency response analysis is a widely used condition monitoring technique to assess mechanical integrity of power transformers. SFRA measures the transformer response to a wide frequency input signal and provides a graphical frequency response of the transformer that needs to be analysed and interpreted afterwards. This thesis presents a novel approach to determine lumped parameter equivalent circuit of transformers using transfer functions estimated from measured SFRA response. Firstly, a novel algorithm based on Levy's and Sanathanan-Koerner method is used to convert the graphical SFRA curves into transfer function in Laplace domain. Once transfer functions estimation is derived, the lumped parameter equivalent circuit model is developed using artificial neural network and genetic algorithm integrated approach. In fact, artificial neural network is used to derive the initial approximation of genetic algorithm where artificial neural network results are optimized by genetic algorithm to find the final estimated parameters. The entire approach has been validated by means of error analysis and actual responses. Furthermore, modelled equivalent circuits by the proposed method have been incorporated to develop reference curves for various power transformer fault types which can be used to assess the severity and fault location of failures. This method can be easily implemented in a digital computer and can be used in on-site fault diagnosis of power transformers.

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DGA	Dissolved gas analysis
DC	Direct current
SFRA	Sweep frequency response analysis
RLC	Resister, inductor and capacitor
ANN	Artificial neural network
GA	Genetic algorithm
Std.	Standard
FRA	Frequency response analysis
R-L-C-M	Resister, inductance, capacitance and mutual inductance
EMTP	Electromagnetic transient program
RMS	Root mean square
H.V	High voltage
L.V	Low voltage
TF	Transfer function
SC	short circuit
freq.	Frequency