

UNIVERSITI TEKNOLOGI MARA

**FAULT CLASSIFICATION IN
POWER TRANSMISSION AND
DISTRIBUTION SYSTEMS USING
CLASS DEPENDENT FEATURE AND
2-TIER MULTILAYER
PERCEPTRON NETWORK**

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Thesis submitted in fulfilment
of the requirements for the degree of
Master of Science

Faculty of Electrical Engineering

February 2017

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Fault frequently occur in transmission lines and become a major issue in power system engineering. It is an unavoidable incident and leads to many problems such as failure of equipment, instability in power flow, and economical losses. Therefore, suitable protection scheme is essential to reduce the misclassification of protection relay. Recent studies on power system engineering utilised fault transient signals using Wavelet Transform (WT) and Artificial Neural Network (ANN) for fault classification in transmission lines. Fault transient signals have been reported to be robust against surroundings inconsistency. However, the presence of ground fault (g) in three-phase faults has caused difficulty in separation of fault types. This is due to the input signals that only contain three phase currents and voltages. Recent studies also show that ANNs are powerful tools for fault classification. However, most studies utilised single ANN structure to classify all the faults, even though not all fault classes are equally difficult to distinguish from the true class label. This approach will result in large size of ANN involved, outputs are difficult to optimise, and their performance is usually lower than that of smaller networks. This thesis proposes a method for fault classification using WT and 2-Tier ANN. In the first stage, six common wavelet features known as energy (E), mean (μ), standard deviation (σ), entropy (H), kurtosis (K), and skewness (γ) are analysed and the best performing features are selected. Then, the selected features are input into the first Multilayer Perceptron (MLP) network to classify phase faults (A, B and C). Next, a new feature that properly describe the presence of ground fault called Class-Dependence Feature (CDF) is proposed. The CDF is determined from the correlation between the output of first ANN and wavelet mean and energy features. Then, the CDF is fed into the second ANN and used to determine the presence of ground fault. Comparison performance with different ANN structures and different types of classifier indicated that the proposed method showed good classification accuracy. The average accuracy of CDF and 2-Tier MLP network for three different datasets, ideal (no noise), 20 dB and 30 dB shows the highest with 99.36% as compared to other structures and classifiers. The presented method have also been implemented in IEEE 9 Bus transmission line system and radial distribution network and produces acceptable classification accuracy of 97.42 % and 97.99% respectively.

ACKNOWLEDGEMENTS

Alhamdulillah, all praises belongs to God, the most merciful, the most beneficent and the most kind for giving me the strengths, courage and opportunity to carry out and complete this thesis.

I would like to express my sincere gratitude to my supervisor, Dr. Mohammad Nizam Ibrahim. I have the great privilege and honour to express to him for his supervision, guidance, constructive criticism, continuous encouragement, and assist throughout the work of this thesis work. In addition, I would like to express my gratitude to thank my co-supervisors Dr Muhammad Khusairi Osman and Prof. Madya Ir. Dr. Zakaria Hussain for their valuable comments and suggestion on improving my research work especially on Artificial Intelligent (AI).

I would like to express my deepest gratitude to my beloved late father and mother, my sisters, Kakak and Kak cik for sharing my pain and pleasure.

Last but not least, I would like to thank the team members of Advance Control Systems and Computing Research Group (ACSCRG) for making the Electrical Engineering Postgraduate Research Laboratory an enjoyable place to work, UiTM Penang electrical technician especially to En. Sobri for providing computers for running simulation experiments and analysis, and everyone that involve in this research.

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