Abstract

Frequency response of critical electrical system is an important measurement to visualize the characteristic of electrical system for condition monitoring purpose. An off-line frequency response analysis method is commonly adopted as a diagnostic technique for transformer's winding deformation and displacement detection. Defects of a transformer can be detected by comparing the impedance frequency response of each phase of the winding of the transformer-under-monitored with respect to the measured impedance frequency response of the same winding of the same transformer during the factory test. Due to off-line nature of frequency response analysis, it does not allow real-time condition monitoring of a transformer under its powered up operating condition. Several methods have been proposed for on-line frequency response analysis but the additional circuitries for injecting and receiving signals require some forms of electrical contacts to the high-voltage transformer, which can pose safety hazards to personnel who installs the instrument on-site. Also, additional circuitry to establish the electrical contact has an effect on the frequency response of the transformer, which can affect the diagnosis accuracy. In this thesis, an on-line frequency response extraction technique which is based on fully two-probe inductive coupling approach is introduced and explored. As opposed to capacitive coupling method, no direct electrical contact with the transformer to be monitored is needed and it eliminates the safety hazards concern. Also, the implementation is relatively easy and does not need to cut-off the power supply to the transformer. Proposed method is demonstrated experimentally for on-line condition monitoring of a transformer and an induction motor for early detection of winding defects.

Publication List

Journal Papers

1. **Sooriya Bandara Rathnayaka**, See Kye Yak and Li Kangrong, "On-line impedance monitoring of transformer based on inductive coupling approach", *IEEE Trans. Dielectr. Electr. Insul.*, vol. 24, no. 2, pp. 1273–1279, 2017, DOI: 10.1109/TDEI.2017.006111.
2. **Sooriya Bandara Rathnayaka**, See Kye Yak and Li Kangrong, "Inductively coupled on-line impedance measurement for condition monitoring of electrical equipment", *IET Science, Measurement & Technology*, 2017 (accepted with major revision).
3. **Sooriya Bandara Rathnayaka**, See Kye Yak, Manish Prajapati, Fei Fan, Kangrong Li, Nishshanka Bandara Narampanawe and Chua Eng Kee, "Non-Intrusive Inductively Coupled Method for Winding Defects Detection of 3-Phase Induction Motor", *IEEE Trans. Ind. Electron.*, 2017 (under review).
4. Li Kangrong, See Kye Yak, and **Sooriya Bandara Rathnayaka**, "Impact analysis of conducted emission measurement without LISN", *IEEE Trans. Electromagn. Compat.*, vol. 58, no. 3, pp. 776–783, 2016, DOI: 10.1109/TEMC.2016.2533539.

Conference Papers

5. **Sooriya Bandara Rathnayaka** and See Kye Yak, "Early detection of induction motor's defects using an inductively coupled impedance extraction method", *IEEE International Electric Machines and Drives Conference (IEMDC) USA*, 2017, pp. 1-6, DOI: 10.1109/IEMDC.2017.8002000.

6. See Kye Yak and **Sooriya Bandara Rathnayaka**, “Early detection of inter-turn stator winding short of an induction motor using an online frequency response method”, in First World Congress on Condition Monitoring (WCCM) UK, 2017 (presented).
7. **Sooriya Bandara Rathnayaka**, See Kye Yak, Manish Prajapati, Kangrong Li, Nishshanka Bandara Narampanawe and Fei Fan “Inductive Coupling Method for On-line Frequency Response Analysis (FRA) for Transformer Winding Diagnostic”, *IEEE premier international technical conference of IEEE Region 10 (TENCON) Malaysia*, 2017 (presented).
8. **Sooriya Bandara Rathnayaka**, See Kye Yak, Manish Prajapati, Kangrong Li and Nishshanka Bandara Narampanawe “Influence of Temperature on Transformer's Winding Defect Analysis Using Inductive Probes”, *Progress in Electromagnetics Research Symposium (PIERS) Singapore*, 2017 (accepted).
9. Nishshanka Bandara Narampanawe, See Kye Yak, **Sooriya Bandara Rathnayaka**, Jie Zhang, Kangrong Li, Eng Kee Chua and Wei Peng Goh “An Empirical Characterization of a Flexible Current Probe for In-Circuit Impedance Measurement”, *Progress in Electromagnetics Research Symposium (PIERS) Singapore*, 2017 (accepted).